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Minimum

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for

School Buses

1964 REVISED EDITION

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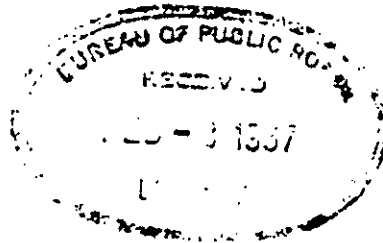
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**MINIMUM STANDARDS FOR
SCHOOL BUSES, 1964,**

1964 REVISED EDITION



Recommendations of

NATIONAL CONFERENCE ON SCHOOL TRANSPORTATION

Sponsored by

American Association of School Administrators, NEA
Council of Chief State School Officers
Department of Rural Education, NEA
National Commission on Safety Education, NEA
U. S. Office of Education

Administered by

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The 1964 National Conference on School Transportation also adopted recommendations published under the title *Selection, Instruction, and Supervision of School Bus Drivers: Recommended Policies and Practices*. Copies of this publication are available from the National Education Association for \$.50 each, subject to the same conditions as noted above for *Minimum Standards for School Buses*.

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FOREWORD

The 1964 National Conference on School Transportation was the latest in a series beginning in 1939 and continuing in 1945, 1948, 1951, 1954, and 1959. All Conferences have been made up of official representatives of state departments of education and advisors from industry and from other interested professional organizations and groups. Each Conference has resulted in one or more publications containing the recommendations of that particular Conference.

The recommendation of standards for school buses has been a major purpose of all of these Conferences. The 1939 Conference was called for this sole purpose and formulated a set of recommended standards for school buses of 20 or more passengers. The 1945 Conference revised these standards and added standards for small vehicles of 10 to 18 passengers, both of which were further revised by the 1948 Conference. In 1951, an Interim Conference formulated tentative standards for transit and metropolitan types of school buses, and these were incorporated in the revised standards that came out of the 1954 Conference. There were further revisions in 1959, and the 1964 Conference added standards for school buses to be used in transporting handicapped children.

Other major problems in pupil transportation have received attention at these National Conferences. The 1945, 1948, and 1959 Conferences all made recommendations to be transmitted to the National Committee on Uniform Traffic Laws and Ordinances. These recommendations were concerned primarily with the passing of school buses on the highway. The 1948 Conference made recommendations on uniform records and reports for pupil transportation. The major purpose of the 1948 Conference was the formulation of recommendations related to standards and training programs for school bus drivers. These recommendations were revised by the 1959 Conference, and a new publication on this topic was issued. The 1954 Conference gave considerable time to the discussion of the extended use of school buses in the school program.

One of the major problems of the 1964 Conference was related to the use of proper specifications in the purchase of school buses. It has long been recognized that the National Standards or any other set of standards do not constitute adequate purchase specifications because under any set of minimum standards there are certain options that must be exercised. Therefore, the 1964 Conference approved certain materials related to the development of purchase specifications which are designed to serve two purposes. The first purpose is to impress on the purchaser that these options should be exercised and that, unless he specifies exactly what he wants, he may purchase a vehicle that is dif-

ferent from what he intended in performance, in quality, or in arrangement. The second purpose is to point out for purposes of illustration the possible choices under certain standards and to emphasize the necessity for exercising these choices according to need. These materials related to the development of specifications do not alter in any way the substance of the recommended National Standards.

It is obvious that the recommendations of these National Conferences will be effective only insofar as they are implemented by the states, since laws and regulations related to standards for school buses and school bus drivers and operational procedures for school buses are enforced by the states.

Funds granted to the Commission from the Automotive Safety Foundation have provided a partial subsidy for the 1964 Conference and have made possible the publication of this report.

E. GLENN FEATHERSTON, *Conference Chairman*,
and Deputy Associate Commissioner for Educational Research and Development, U. S. Office of Education, Washington, D. C.

OBJECTIVES AND GUIDING PRINCIPLES

Since the first National Conference on school bus standards in 1939, certain objectives and guiding principles have had a vital role in the development of the minimum standards for school buses. These objectives and guiding principles have been reaffirmed and emphasized at the subsequent National Conferences. The two major objectives, *safety* and *economy*, along with the following principles, have served as guideposts for making decisions on the minimum standards and in arriving at sound and common agreement.

Objectives

The transportation of pupils in safety and comfort on *safe, economical* vehicles can be assured through adequate state regulations governing school bus construction.

Safety includes all those factors relating to school bus construction which may directly or indirectly affect the safety and welfare of pupils transported.

Economy includes the construction, procurement, operation, and maintenance of school buses at the lowest cost consistent with the safety and welfare of pupils.

Guiding Principles

1. Uniform state school bus standards should
 - a. be consistent with the objectives of safety and economy
 - b. eliminate the construction of unsafe buses
 - c. reduce conflicting standards wherever possible among states in the interest of production efficiency and lower costs
 - d. specify exact dimensions where necessary to increase the efficiency of volume production
 - e. eliminate unnecessary luxury consistent with the safety and welfare of pupils transported.
2. Any adaptation of the nationally recommended minimum standards should be made by the states only in order to permit desirable adjustments to local needs and only when such adaptations do not
 - a. basically conflict with the recommended national minimum standards
 - b. otherwise unduly increase production costs.
3. Uniform state standards for school buses should specify results desired in terms of safety and economy, and these performance specifications must be defined when this is necessary to make the regulations enforceable.

4. Provisions should be made for periodic review and revision of uniform state standards for school buses through cooperation of the states.
5. Uniform state standards for school buses should permit opportunities to make use of new inventions and improvements which are consistent with safety and economy.
6. Uniform state standards for school bus construction should provide for a degree of flexibility within which sound construction is possible (consistent with safety and economy) to accommodate the various manufacturers.
7. Uniform state standards for school bus construction should recognize that the actual designing of school buses is a responsibility of the manufacturers.
8. The current national minimum standards for school buses are considered in full force and effect as recommendations to the states. Revisions of these standards are made only when evidence indicates that such revisions are needed.

USING THESE MINIMUM STANDARDS FOR SCHOOL BUSES

In order that these minimum standards for school buses may be put into effect, each state legislature which has not already done so should confer upon the state department of education the general responsibility for setting up statewide rules and regulations regarding the construction of school bus chassis, bodies, and equipment. In *no* instance, however, should the detailed standards for school buses be written into the state law.

The minimum standards for school buses appearing in this report must be officially adopted by a state to become legally effective within that state.

These minimum standards for school buses are intended to apply primarily to new vehicles purchased after adoption of the standards. Any state considering making the standards applicable to vehicles purchased previously must consider carefully the economic effects of such retroactive action.

These minimum standards are intended to apply to all types of school buses: (a) conventional type body-on-chassis vehicles having a seating capacity of 24 or more pupils; (b) transit and metropolitan types of vehicles having a seating capacity of 24 or more pupils; and (c) small vehicles (including station wagons, suburbans, and converted panel trucks) having a seating capacity up to and including 23 pupils.

These minimum standards are not intended to apply to buses used primarily as public carriers rather than to transport pupils to and from school.

These revised minimum standards should be put into effect and enforced by states beginning with those new school bus models which appear after January 1, 1966.

MINIMUM STANDARDS FOR SCHOOL BUSES

The Bus Chassis

Air cleaner —

Bus shall be equipped with adequate oil-bath or dry-element type air cleaner mounted outside passenger compartment.

Axles —

1. Front axle or other type of suspension assembly shall be of sufficient capacity at ground to support such load on front axle as would be imposed by actual average gross vehicle weight plus 10 percent.
2. Rear axle shall be full-floating type. Rear axle or other type of suspension assembly shall have gross weight rating at ground equal to or exceeding that portion of total load which is supported by rear suspension assembly.

Exception—transit and metropolitan vehicles

1. Front axle shall be wide-track, heavy-duty bus type and shall have gross weight rating at ground equal to or exceeding that portion of total load which is supported by front axle.
2. Rear axle shall be full-floating, heavy-duty bus type and shall have gross weight rating at ground equal to or exceeding that portion of total load which is supported by rear axle.

Battery —

1. Storage battery, as established by manufacturer's rating, shall be of sufficient capacity to care for starting, lighting, signal devices, heating, and other electrical equipment.
2. No bus shall be equipped with battery of less than 70 ampere-hours at 12 volts, measured at 20-hour rate.
3. When battery is to be mounted outside of engine compartment, it may be temporarily mounted to chassis. Body company will permanently mount battery on sliding tray located so that center line of battery is 52 inches back of cowl. One-piece battery cables shall be provided by chassis manufacturer, such cables to be at least 36 inches longer than normally required, to accommodate battery when located 52 inches to rear of cowl.

Exception—small vehicles

1. Same as Item 1 above.
2. No small vehicle shall be equipped with battery of less than 50 ampere hours at 12 volts, measured at 20-hour rate.
3. Item 3 does not apply.

See also page 29.

Brakes —

1. Four-wheel brakes, adequate at all times to control bus when fully loaded, shall be provided.
2. Foot or service brakes shall, at all times, be capable of stopping complete unit (*i.e.*, wet chassis weight,¹ plus body weight, plus driver's weight, without pupils) from speed of 20 miles per hour in not more than 30 feet, such distance to be measured from point at which movement of service brake pedal or control begins. Tests for stopping distance shall be made on substantially level (not to exceed plus or minus 1-percent grade), dry, smooth, hard surface that is free from loose material.
3.
 - a. Chassis shall be equipped with auxiliary brake capable of locking rear wheels and capable of holding vehicle on any grade on which it is operated under any conditions of loading on a surface free from snow or ice. Operating controls of such auxiliary brake shall be independent of operating controls of service brakes.
 - b. Under test conditions outlined in Item 2 above, auxiliary brake shall be capable of stopping vehicle from speed of 20 miles per hour in measured distance of 50 feet.
4. Chassis carrying body of 36 or greater basic pupil capacity shall be equipped with full compressed-air brakes, vacuum-actuated power or assistor-type brakes, or compressed-air-over-hydraulic brakes. (See table under *Body sizes*, page 29.)
 - a. Such installation shall be made by authorized representative of chassis or brake manufacturer and shall conform to recommendation of that manufacturer.
 - b. Hydraulic line pressure shall not exceed recommendation of chassis or brake manufacturer.
 - c. Total reservoir capacity (see Item d(1) below) shall be at least 1,650 cubic inches for full compressed-air systems, and at least 1,000 cubic inches for vacuum-actuated systems and for compressed-air-over-hydraulic systems.
 - d. Buses having full compressed-air systems shall be equipped with:
 - (1) at least two reservoirs (or one vessel divided into two compartments) connected in series
 - (2) safety valve mounted on first reservoir to protect air-brake system against excessive air pressure and check valve mounted in optional location
 - (3) air gauge mounted on instrument panel to register air pressure in air-brake system (see *Instruments and instrument panel*, page 24.)
 - (4) audible low-pressure indicator to warn driver if air pressure in air-brake system falls below 60 pounds per square inch.

¹ With oil, water, and full tank of fuel.

- e. Buses having vacuum-actuated or compressed-air-over-hydraulic systems shall be equipped with check valve located between source of supply and reservoir.
5. Brake system vacuum tank installed by chassis manufacturer shall be used exclusively for operation of brakes. System shall include suitable and convenient connection for installation of separate vacuum reservoir with capacity of not less than 1,000 cubic inches, furnished and installed by body manufacturer and protected by check valve, for actuation of other vacuum-powered accessories. Engine shall be protected by proper filters.

Following provisions for brakes shall supersede those shown above on all school bus chassis manufactured after January 1, 1967:

1. Service brakes:

- a. Stopping ability of service brake system. Service brake system shall be designed and constructed so that by application of single control unit vehicle can be stopped within distances specified in (1) and (2), below. Stopping distance requirement tests shall be conducted in accordance with SAE J658² and with vehicle loaded (MGVW—manufacturer's gross vehicle weight).

(1) Brakes shall be designed to have capability of developing deceleration of 14 fpsps (feet per second per second) from speed of 20 mph at pedal effort of not more than 75 pounds.

(2) Stopping distance test with brakes cold shall be conducted after proper conditioning according to SAE J880³ and vehicle shall stop, from speed of 20 mph, within following distances at pedal effort of not more than 200 pounds:

(a) 10,000 pounds GWV and under _____ 25 feet

(b) Over 10,000 pounds GVW _____ 35 feet

(3) Brake balance shall be such that, when tested at speed of 20 mph under any normal condition of loading within MGVW (manufacturer's gross vehicle weight), deceleration of 12 fpsps (feet per second per second) can be achieved without locking wheels on any axle.

- b. Energy absorption—horsepower rating. Energy absorption capability of brakes, when tested in accordance with procedure established by SAE J880³ or

equivalent, shall be not less than $12 + \frac{1.4 \text{ GVW}}{1000}$.

² Service Brake Performance, recommended practice of Society of Automotive Engineers.

³ Brake Rating System Test Code—Commercial Vehicles, recommended practice of Society of Automotive Engineers.

- c. Travel reserve of air brake actuator or hydraulic brake pedal. Brake actuator travel, when measured statically at actuating force required for compliance with Item 1a(2) above, shall be not more than 60 percent of available travel.
- d. Reservoirs required. Every brake system which employs air or vacuum shall include following reservoir capacity:
 - (1) Air brake system shall have reservoir capacity which is equal to or greater than 12 times total volume of all brake actuators at full travel.
 - (2) Vacuum brake system shall have reservoir used exclusively for brakes, with capacity of not less than 1,000 cubic inches, and shall be adequate to insure loss in pressure at full stroke application of not more than 30 percent.
 - (3) Brake system shall include suitable and convenient connection for installation of separate vacuum reservoir with capacity of not less than 1,000 cubic inches, furnished and installed by body manufacturer and protected by check valve, for actuation of other vacuum-powered accessories. Engine shall be protected by proper filters.
- e. Safeguarding of air or vacuum system reservoir. Brake system reservoir shall be "so safeguarded by a check valve or equivalent device that in the event of failure or leakage in its connection to the source of compressed air or vacuum, the stored air or vacuum shall not be depleted by the leak or failure."⁴ Means shall be provided to establish air check valve to be in working order.⁵
- f. Gauges. A vehicle using air or vacuum in operation of brake system shall be equipped with illuminated gauge, accurate to within 10 percent of actual reservoir pressure, which will indicate to driver, in case of
 - (1) air brakes: pressure in psi (pounds per square inch) which is available for operation of brakes; or
 - (2) vacuum brakes: vacuum in inches of mercury which is available for operation of brakes.
- g. Warning devices. In addition to gauges required in f above, vehicle shall be equipped with warning signal,

⁴ *Uniform Vehicle Code*, 1962 revision, Section 12-301, (i), 3.

⁵ Interstate Commerce Commission, *Motor Carrier Safety Regulations*, Paragraph 193.50, (b), as amended (effective date December 31, 1962).

readily audible or visible to driver, which will give continuous warning to driver when, in case of

- (1) air brakes: air pressure in system available for braking is 60 psi (pounds per square inch) and less; or
- (2) vacuum brakes: vacuum in system available for braking is 8 inches of mercury and less.

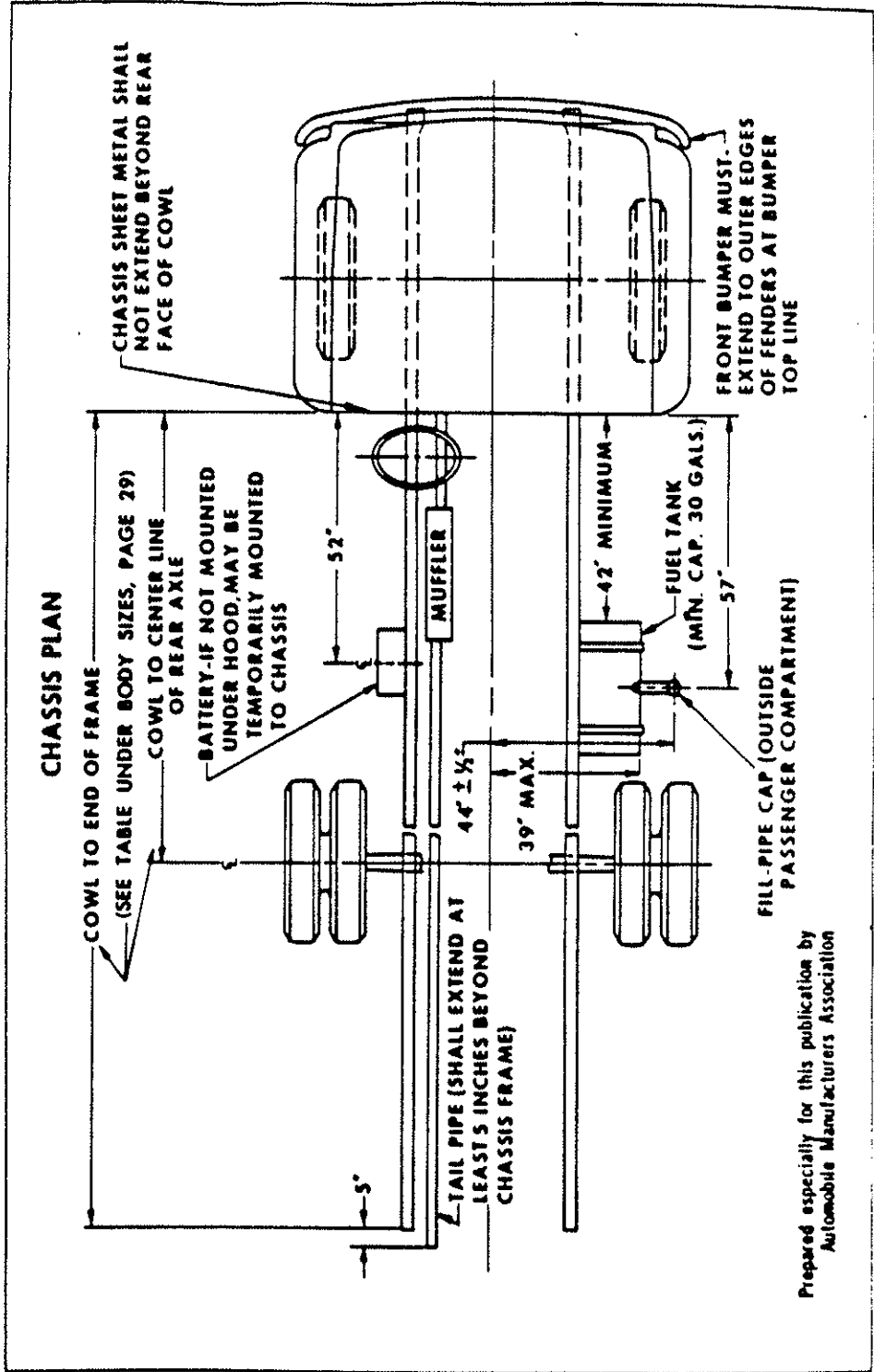
2. Emergency stopping system:

- a. General. Brake system(s) shall perform emergency stopping function and be so designed and constructed that single failure anywhere in brake system which performs service brake function, excepting mechanical parts of wheel brake assemblies and brake pedal and brake pedal attachment to brake valve(s) or master cylinder(s), will not leave vehicle without operative brakes capable of stopping vehicle when loaded up to and including manufacturer's rated GVW (gross vehicle weight) at any legal speed and in accordance with requirements of b and c, below.
- b. Emergency stopping performance requirements. Following performance shall be obtained under road and test conditions outlined in 1a above:
 - (1) Vehicle, when loaded to manufacturer's GVW (gross vehicle weight) capacity, shall be brought to stop from speed of 20 mph in measured distance of 85 feet.
 - (2) Deceleration of not less than 6 fpsps (feet per second per second) shall be maintained throughout stop from 20 mph.
- c. Control requirements of emergency stopping system. Control of emergency stopping system shall be designed and constructed:
 - (1) to permit modulated control by driver of brake application and release; and
 - (2) to prevent release of brakes by driver unless energy is available for re-application.

3. Parking brakes:

Parking brake system shall be designed and constructed to meet following requirements:

- a. Parking brake shall hold vehicle stationary, or to limit of traction of braked wheels, on 20-percent grade under any condition of legal loading and on surface free from snow, ice, and loose material.
- b. When applied, parking brake shall remain in applied position with capability set forth in 3a above, despite exhaustion of source of energy used for application or despite leakage of any kind.



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Bumper, front —

1. Front bumper shall be furnished by chassis manufacturer as part of chassis.
2. Front bumper must extend to outer edges of fenders at bumper top line (to assure maximum fender protection) and be of sufficient strength to permit pushing vehicle of equal gross weight without permanent distortion to bumper, chassis, or body.

Exception—transit and metropolitan vehicles

Same as above except that front bumper shall be furnished by body manufacturer.

Bumper, rear — see page 30.

Certification —

Chassis manufacturers will, upon request, certify to state departments of education that their product meets minimum standards on following items:

- a. axles
- b. brakes
- c. exhaust system noise level
- d. horn
- e. power and gradeability
- f. springs.

Clutch —

All chassis of 48- through 60-pupil capacity having mechanical type transmission shall be equipped with clutch of 12-inch minimum diameter. Chassis of 66 and greater pupil capacity having mechanical type transmission shall be equipped with clutch of 13-inch minimum diameter or clutch of equivalent performance.

Color —

Chassis, including wheels and front bumper, shall be black;⁶ hood, cowl, and fenders shall be in national school bus chrome.⁷ (See page 82).

Drive shaft —

Drive shaft shall be protected by metal guard or guards to prevent it from whipping through floor or dropping to ground if broken.

Exception—small vehicles

Standard does not apply to vehicles with torque-tube drive shaft.

⁶ Federal Standard No. 595, black enamel #17038. Color chips are available from General Services Administration, Business Service Center, Region 3, 7th and D Streets, S. W., Washington, D. C. 20407.

⁷ Federal Standard No. 595, chrome yellow enamel #13432. Color chips are available from source given in footnote 6.

Electrical system —

1. *Battery*—see pages 13, 29.
2. *Generator or alternator*—see page 23.
3. *Lamps and signals*—see page 43.
4. *Wiring*—see page 53.
5. Chassis manufacturer shall install readily accessible electrical terminal so that body and chassis electrical load can be recorded through chassis ammeter without dismantling or disassembling chassis component. Chassis wiring system to terminal shall have minimum 100-ampere capacity. Chassis ammeter and wiring shall be compatible with generating capacity, and ammeter shall be capable of recording continuous draw of 100 amperes.

Exhaust system —

1. Exhaust pipe, muffler, and tailpipe shall be outside bus body and attached to chassis.
2. Tailpipe shall be constructed of seamless or electrically welded tubing of 16-gauge steel or equivalent and shall extend at least 5 inches beyond chassis frame. (See *Tailpipe*, page 51.)
3. Size of tailpipe shall not be reduced after it leaves muffler.
4. Exhaust system shall be properly insulated from fuel tank and tank connections by securely attached metal shield at any point where it is 12 inches or less from tank or tank connections.
5. Noise level shall not exceed 125 sones as measured by Beranek-Armour-ATA Equivalent Tone Method.^a
6. Muffler shall be constructed of corrosion-resistant material.

Fenders, front —

1. Total spread of outer edges of front fenders, measured at fender line, shall exceed total spread of front tires when front wheels are in straight-ahead position.
2. Front fenders shall be properly braced and free from any body attachment.
3. Chassis sheet metal shall not extend beyond rear face of cowl.

Exception—transit and metropolitan vehicles
Standard does not apply.

Frame —

1. Frame or equivalent shall be of such design as to correspond at least to standard practice for trucks of same general load characteristics which are used for severe service.

^a Automobile Manufacturers Association, 320 New Center Building, Detroit, Michigan 48202.

2. When frame side members are used they shall be of one-piece construction. If frame side members are extended, such extension shall be designed and furnished by chassis or body manufacturer with his guarantee, and installation shall be made by either chassis or body manufacturer and guaranteed by company making installation. Extensions of frame lengths are permissible only when such alterations are behind rear hanger of rear spring and shall not be for purpose of extending wheelbase.
3. Holes in top or bottom flanges of frame side rail shall not be permitted except as provided in original chassis frame. There shall be no welding to frame side rails except by chassis or body manufacturer.

Frame lengths — see table under *Body sizes* on page 29.

Fuel tank —

1. Fuel tank shall have minimum capacity of 30 gallons, be made of 16-gauge terneplate or equivalent, and be mounted directly on right side of chassis frame entirely outside body.
2. Flexible gasoline- and oil-proof connection shall be provided at engine end of fuel feed line.
3. Tank shall be equipped with adequate baffles.
4. Engine supply line shall be taken from top of tank.
5. Drain plug of at least ¼-inch diameter shall be located in center of bottom of tank.
6. Fill-pipe cap shall be of such design as to minimize spillage of fuel when bus turns corners in either direction. If venting of fuel tank is done other than through fill-pipe cap, cap shall be of nonvented type.⁹
7. Fuel filter with replaceable element shall be installed between fuel tank and carburetor.
8. Fuel tank, fittings, or lines shall not extend above top of chassis frame rail.
9. If tank sizes other than 30 gallons are supplied, location of front of tank and filler spout must remain as specified below.

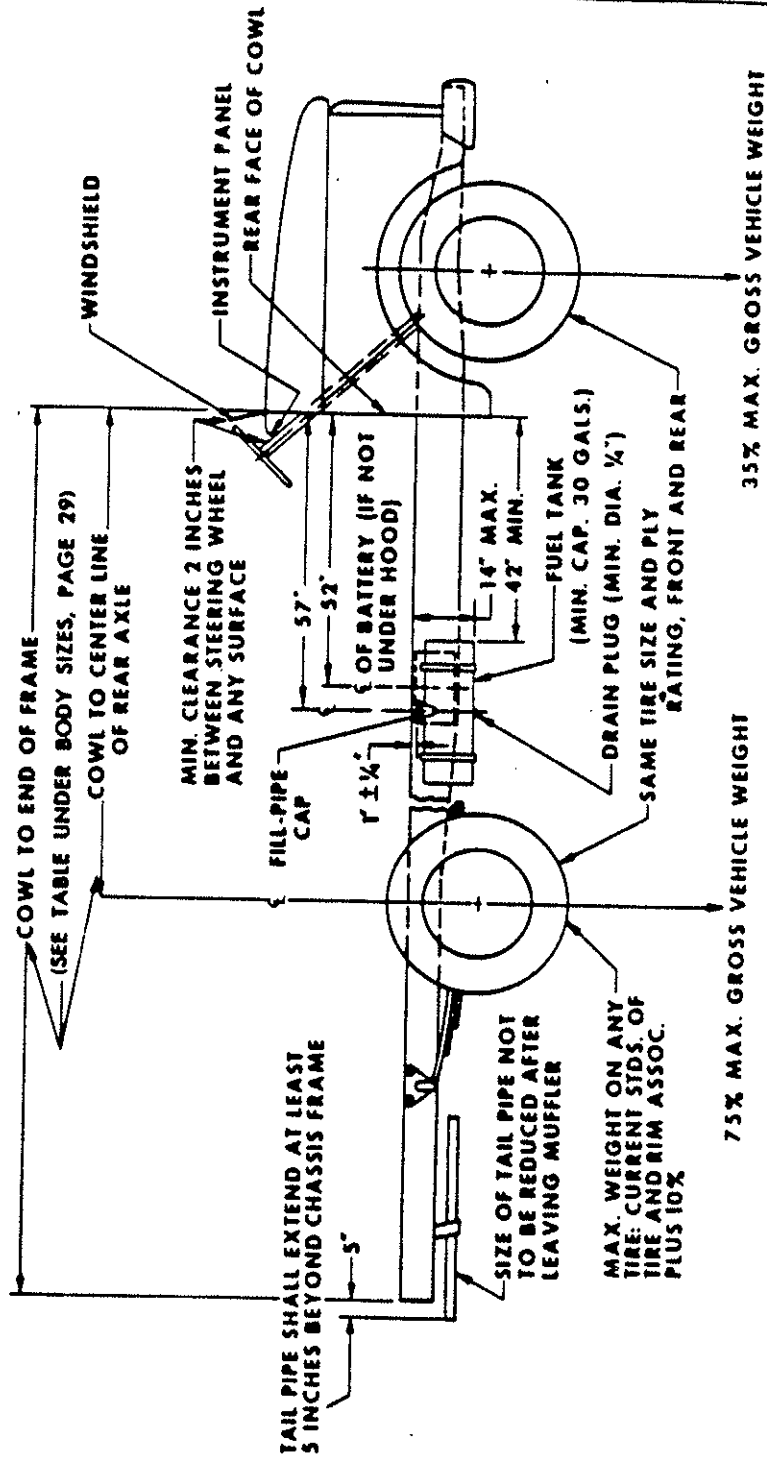
Note: Measurements shown below are for guidance of chassis manufacturers and serve only to prevent need for replacement of original tank. Inspectors concerned with state or local approval of vehicle need not consider them unless tank does not fit.

- a. Tank shall not extend in height above side member of chassis.

⁹ See provisions for fuel systems in current *Motor Carrier Safety Regulations* of Interstate Commerce Commission, obtainable from Superintendent of Documents, Washington, D. C. 20401. Price, 30 cents.

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CHASSIS ELEVATION



- b. Distance from center line of chassis to outside of tank shall not be more than 39 inches.
- c. Bottom of tank shall not be more than 14 inches below top of frame.
- d. Distance from cowl to front of tank shall be 42 inches minimum.
- e. Distance from cowl to center of fill-pipe cap shall be 57 inches.
- f. Distance from center line of chassis to center of fill-pipe cap shall be 44 inches with plus or minus tolerance of $\frac{1}{2}$ inch permitted.
- g. Center of fill-pipe cap shall be 1 inch below top of frame with plus or minus tolerance of $\frac{1}{4}$ inch permitted.

Exception—small vehicles

Fuel tank shall be mounted, filled, and vented outside body.

Exception—transit and metropolitan vehicles

- 1. Fuel tank shall have minimum capacity of 30 gallons, be made of 16-gauge terneplate or equivalent, and be mounted away from left side of bus entirely outside passenger compartment.
- 2. Bottom of tank shall not be exposed below skirt of body side paneling. (See Item 5 under *Construction*, page 31.)
- 3. Engine supply line shall be taken from upper portion of tank and shall be adequately protected.
- 4. Drain plug of at least $\frac{1}{4}$ -inch diameter shall be located in bottom of tank.
- 5. Fill-pipe cap shall be entirely outside passenger compartment.

Exception—vehicles of less than 54-passenger capacity constructed for transporting handicapped children

Fuel tank may be located behind rear wheels, inside or outside chassis frame, with fill-pipe located on right side of body.

Generator or alternator —

Generator or alternator with rectifier shall have maximum output of at least 60 amperes (in accordance with Society of Automotive Engineers rating) with a minimum charging of 15 amperes at manufacturer's recommended engine idle speed (12-volt system), and shall be ventilated and voltage-controlled and, if necessary, current-controlled. Dual belt drive shall be used with generator or alternator.

Note: If electrical load is increased through addition of heater motors, electric windshield wipers, defrosters, etc., refer to Appendix for guidance in selecting generator or alternator of adequate capacity.

Exception—small vehicles

Generator or alternator with rectifier shall have maximum output of at least 40 amperes with 12-volt system, and shall be ventilated and voltage-controlled and, if necessary, current-controlled.

Governor —

Engine governor is permissible and where used shall be set at manufacturer's recommended maximum engine speed. When it is desired to limit road speed, road-speed governor should be installed.

Exception—transit and metropolitan vehicles

When engine is remotely located from driver, governor shall be installed to limit engine speed to maximum revolutions per minute recommended by engine manufacturer, or tachometer shall be installed so engine speed may be known to driver.

Heating system, provision for —

Chassis engine shall provide inlet and outlet holes in accessible locations for attachment of bus heating system water lines.

Also see *Heaters*, page 39.

Horn —

1. Bus shall be equipped with horn or horns of standard make, each horn capable of producing complex sound in band of audiofrequencies between approximately 250 and 2,000 cycles per second and having total sound level of 110 decibels within these frequency limits when measured at point on axis of horn 3 feet from exit of horn.
2. Sound-level measurements shall be made with meter that complies with American Standard Z24.3-1944, or current revision thereof, as promulgated by American Standards Association, Inc.¹⁰ Measurement shall be made with meter set to flat response (C weighting network).
3. Sound-level measurements shall be made with horn or horns installed on bus. There shall be no reflecting walls or obstacles other than ground and vehicle closer than 100 feet from horn during sound-level measurements.
4. If louder horn is desired, it shall be capable of producing sound level of 120 decibels under conditions specified above.

Instruments and instrument panel —

1. Chassis shall be equipped with following instruments and gauges (lights in lieu of gauges are not acceptable):
 - a. Speedometer.
 - b. Odometer which will give accrued mileage including tenths of miles.
 - c. Ammeter with graduated charge and discharge, both ammeter and its wiring to be compatible with generating capacities and capable of handling continuous current draw of 100 amperes.

¹⁰ 10 East Fortieth Street, New York, New York 10016.

- d. Voltmeter with graduated scale (optional item)
 - e. Oil-pressure gauge
 - f. Water-temperature gauge
 - g. Fuel gauge
 - h. Upper-beam headlamp indicator
 - i. Air-pressure or vacuum gauge, where air or vacuum brakes are used, and audible low-pressure indicator to warn driver if air pressure in air-brake system falls below 60 pounds per square inch. See *Brakes*, page 14.)
2. All instruments shall be easily accessible for maintenance and repair.
 3. Above instruments and gauges shall be mounted on instrument panel in such manner that each is clearly visible to driver in normal seated position.
 4. Instrument panel shall have lamps of sufficient candlepower to illuminate all instruments and gauges.

Oil filter —

Oil filter of replaceable element or cartridge type shall be provided and shall be connected by flexible oil lines if it is not of built-in or engine-mounted design. Oil filter shall have oil capacity of at least 1 quart.

Openings —

All openings in floorboard or firewall between chassis and passenger-carrying compartment, such as for gearshift lever and auxiliary brake lever, shall be sealed unless altered by body manufacturer. (See Item 9 under *Construction*, page 34.)

Passenger load —

1. Average actual GVW (gross vehicle weight) is sum of average chassis weight, plus average body weight, plus 150 pounds for driver's weight, plus total seated pupil weight (based on 115 pounds per pupil).
2. Recommended chassis manufacturer's rated GVW (gross vehicle weight) is weight assigned to complete vehicle. (Weights assigned for each pupil capacity classification are shown in table for next topic, *Power and gradeability*.)
3. Manufacturer's gross vehicle weight rating shall be furnished in duplicate (unless more are requested by state department of education) by manufacturer to each state department of education. State department of education shall, in turn, transmit such rating to each other state agency responsible for development or enforcement of state standards for school buses. (See pages 86-7.)

Power and gradeability — (see Appendix for formula)

1. Chassis must be so geared and powered as to be capable of surmounting 3.7-percent grade at speed of 20 miles per hour with full load (see *Passenger load*, page 25) on continuous pull in direct drive.
2. Following figures are based on achieving 3.7-percent grade at 20 mph in direct drive using 1.5 rolling resistance, 150-pound driver, 115-pound pupil, and 7.17:1 to 7.2:1 rear axle ratio.¹¹ For 36-pupil capacity, rear axle ratio is 6.16:1 or higher.

Chassis size/capacity	36	42	48	54	60	66
a. Recommended manufacturer's rated GVW	14,000	16,000	17,000	18,000	20,000	22,000
b. Actual average GVW (calculated)*	13,200	14,700	16,100	17,500	18,800	20,200
c. Recommended tire size (with tube)						
Size	7.00-20	7.50-20	7.50-20	8.25-20	8.25-20	9.00-20
Ply	8	10	10	10	10	10
d. Rim size (with tube)						
Preferred	5.5	6.0	6.0	6.5	6.5	7.0
Alternate	5.0	5.5	5.5	6.0	6.0	6.5
e. Recommended tire size (tubeless)						
Size	7-22.5	8-22.5	8-22.5	9-22.5	9-22.5	10-22.5
Ply	6	10	10	10	10	10
f. Rim size (tubeless)						
Preferred	5.25	6.00	6.00	6.75	6.75	7.50
Alternate	—	5.25	5.25	6.00	6.00	6.75
g. Minimum net h.p. required at engine r.p.m.						
40.7	40.7	45.4	49.5	53.9	57.9	62.2
1390	1390	1368	1368	1325	1325	1267

* Sum of average chassis weight, plus average body weight, plus 150 pounds for driver weight, plus total seated pupil weight.

Shock absorbers —

Bus shall be equipped with front and rear double-acting shock absorbers compatible with manufacturer's rated axle capacity.

¹¹ Best performance level will be obtained with slowest available axle ratio (for instance, 7.17:1 or 7.2:1). If conditions permit higher-geared top road speed, changing to faster axle ratio (for instance, 6.2:1) will reduce engine r.p.m. and therefore reduce available h.p. at any given road speed. Result will be reduced level of performance.

Exception—small vehicles

Standard does not apply to small vehicles not specifically manufactured as school buses.

Springs —

1. Springs or suspension assemblies shall be of ample resiliency under all load conditions and of adequate strength to sustain loaded bus without evidence of overload.
2. Springs or suspension assemblies shall be designed to carry their proportional share of gross vehicle weight in accordance with requirement for *Weight distribution* as shown on page 28.
3. If rear springs are used, they shall be of progressive type.
4. If leaf-type front springs are used, stationary eyes shall be protected by full wrapper leaf in addition to main leaf.

Exception—small vehicles

Springs that are regular equipment on vehicle to be purchased may be used.

Steering gear —

1. Steering gear shall be approved by chassis manufacturer and designed to assure safe and accurate performance when vehicle is operated with maximum load and at maximum speed.
2. Steering mechanism shall provide for easy adjustment for lost motion.
3. No changes shall be made in steering apparatus which are not approved by chassis manufacturer.
4. There shall be clearance of at least 2 inches between steering wheel and cowl instrument panel, windshield, or any other surface.
5. Power steering is permissible if approved by chassis manufacturer.

Tires and rims —

1. Tire sizes shall be as shown in table for *Power and gradeability*, page 26.
2. Rim sizes shall be based upon current standards of Tire and Rim Association.¹²
3. In order to allow for reasonable tolerance, total weight imposed on any tire shall not be greater than 10 percent above current standard of Tire and Rim Association.¹²
4. Dual rear tires or wide single equivalents shall be provided on all vehicles.

¹² Current standards may be obtained from Tire and Rim Association, Comand Building, 34 North Hawkins Avenue, Akron, Ohio 44313, or from tire manufacturers.

5. All tires on given vehicle shall be of same size and ply rating except where wide single equivalents are used.
6. Spare tire, if required, shall be suitably mounted in accessible location outside passenger compartment.

Exception—small vehicles

Same as above, except that dual rear tires are not required.

Transmission —

1. Mechanical type transmission shall be synchromesh except first and reverse gears. Its design shall provide not less than four forward and one reverse speeds.
2. Automatic transmissions are permissible.

Exception—small vehicles

Three-speed transmissions are acceptable.

Undercoating —

Chassis manufacturer shall coat undersides of front fenders with fire-resistant, asphalt base, rubber base, or other undercoating material, applied by spray method, in order to seal, to deaden sound, to insulate, and to prevent oxidation.

Also see *Undercoating* on page 51.

Weight distribution —

Weight distribution of fully loaded bus on level surface shall be such that not more than 75 percent of gross vehicle weight is on rear tires and not more than 35 percent is on front tires.

Exception—transit and metropolitan vehicles

With engine inside front of body: If entrance door is ahead of front wheels, not more than 75 percent of gross vehicle weight shall be on rear tires nor more than 50 percent on front tires. If entrance door is behind front wheels, not more than 75 percent of gross vehicle weight shall be on rear tires nor more than 40 percent on front tires. With engine in rear: Not more than 75 percent of gross vehicle weight shall be on rear tires nor more than 40 percent on front tires.

The Bus Body

Aisle —

1. Minimum clearance of all aisles, including aisle (or passageway between seats) leading to emergency door, shall be 12 inches. (See Item 2f under *Doors*, page 35.)
2. Aisle supports of seat backs shall be slanted away from aisle sufficiently to give aisle clearance of 15 inches at tops of seat backs.

Exception—transit and metropolitan vehicles

With engine inside front of body: Minimum distance between stanchion at rear of entrance step-well and engine cover shall be 14 inches measured at floor level.

Battery —

1. Battery is to be furnished by chassis manufacturer.
2. When battery is mounted outside of engine compartment by chassis manufacturer, body manufacturer shall securely attach battery on slide-out tray in closed, vented compartment in body skirt whereby battery may be exposed to outside for convenient servicing. Battery compartment door or cover shall be secured by adequate and conveniently operated latch or other type fastener.
(See also page 13.)

Body sizes —

Bodies for conventional body-on-chassis type vehicles shall be limited to lengths shown in table below. Sizes are based on 27-inch center-to-center spacing between rows of forward-facing seats, over-all width of 96 inches, center aisle width of 12 inches, and average rump width of (a) 13 inches for 3-3 seating plan and (b) 15 inches for 3-2 seating plan. Body lengths are measured from back of cowl to rear of body at floor level.

Number of rows of seats	Pupil Capacity		Maximum body length (in inches)	Minimum measurement, cowl to center line of rear axle (in inches)	Minimum measurement, cowl to end of frame (in inches)
	3-3 plan; rump width of 13 inches	3-2 plan; rump width of 15 inches			
4	24	20	178	102	173
5	30	25	196	123	187
6	36	30	222	125	210
7	42	35	250	142	241
8	48	40	277	160	268
9	54	45	304	192	295
10	60	50	332	211	323
11	66	55	355	229	349

Exception—small vehicles

Small vehicle may vary in capacity up to 23 pupils, may be narrower than large vehicle, and body may have been converted from one originally manufactured for other purposes.

Exception—transit and metropolitan vehicles

Measurements in preceding table do not apply.

Bumper, front — see page 19.

Bumper, rear —

1. Rear bumper shall be of pressed steel channel at least 3/16-inch thick and 8 inches wide (high).
2. It shall be wrapped around back corners of bus. It shall extend forward at least 12 inches, measured from rear-most point of body at floor line.
3. Bumper shall be attached to chassis frame in such manner that it may be easily removed, shall be so braced as to develop full strength of bumper section from rear or side impact, and shall be so attached as to prevent hitching of rides.
4. Rear bumper shall extend beyond rear-most part of body surface at least 1 inch, measured at floor line.

Exception—small vehicles

Standard does not apply.

Ceiling — see *Insulation* on page 41, and *Interior* on page 43.

Chains — see Item 4 under *Wheel housings* on page 51.

Color —

1. School bus body including hood, cowl, and fenders shall be painted uniform color, national school bus chrome,¹³ according to specifications available from General Services Administration. (See page 82.)
2. Rear bumper and lettering shall be black.¹⁴
3. Body trim, if used, shall be black.¹⁴

Construction —

1. Construction shall be of prime commercial quality steel or other metal or other material with strength at least equivalent to all-steel as certified by bus body manufacturer. All such construction materials shall be fire-resistant.

¹³ See footnote 7.

¹⁴ See footnote 6.

2. Construction shall provide reasonably dustproof and watertight unit.
3. Bus body (including roof bows, body posts, strainers, stringers, floor, inner and outer linings, rub rails, and other reinforcements) shall be of sufficient strength to support entire weight of fully loaded vehicle on its top or side if overturned. Bus body, as unit, shall be designed and built to provide impact and penetration resistance.

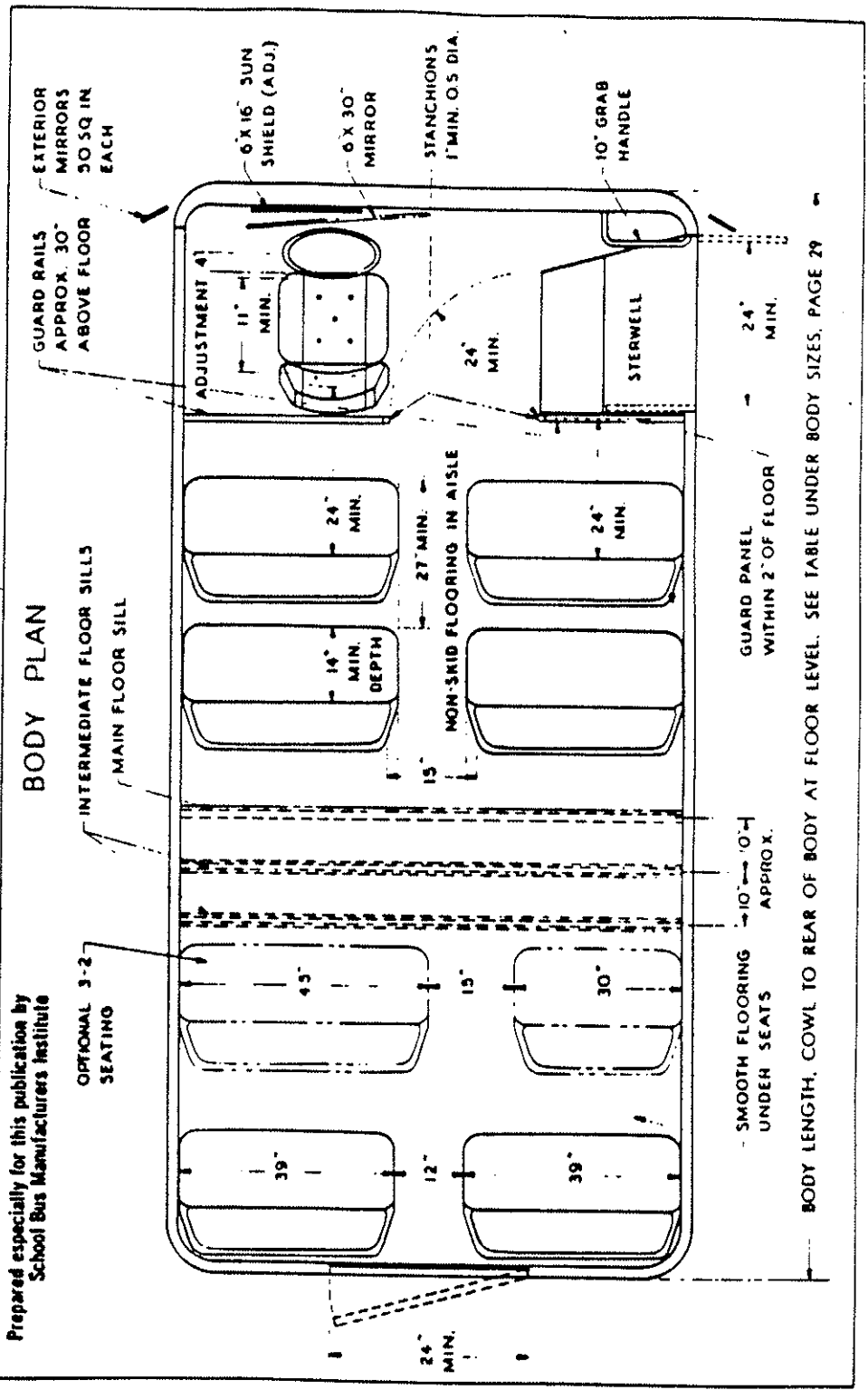
As evidence that bus body meets this standard, all body manufacturers shall furnish, for each current body model, certification in duplicate (unless more are requested by state department of education) that bus body meets *Static Load Test Code for School Bus Body Structure*.¹⁵ Copies of *Code* will be furnished by School Bus Manufacturers Institute to each state department of education. State department of education will in turn transmit copies of *Code* and individual model certificates to individual state agencies responsible for development and/or enforcement of state standards for school buses.

Details involved in testing bus body structure will remain as shown in *Code*; to qualify under *Code*, however, deflections of body structure must not exceed following measurements:

- a. deflection at center of roof bow..... 3.00 inches
 - b. deflection of each side pillar at window sill level.... 1.00 inch
 - c. deflection at center of floor..... .40 inch.
4. Floor shall be of prime commercial quality steel of at least 14-gauge or other metal or other material at least equal in strength to 14-gauge steel. If plywood is used, it shall be 5-ply, at least 5/8-inch thick and it shall equal or exceed properties of exterior-type Douglas fir plywood, B-B Grade, as specified in standard issued by U. S. Department of Commerce.¹⁶ Floor shall be level from front to back and from side to side except in wheel housing, toeboard, and driver's seat platform areas.
 5. Roof strainers: Two or more roof strainers or longitudinal members shall be provided to connect roof bows, to reinforce flattest portion of roof skin, and to space roof bows. These strainers may be installed between roof bows or applied externally. They shall extend from windshield header and, when combined with rear emergency door post, are to function as longitudinal members extending from windshield header to rear floor body cross member. At all points of contact between strainers or longitudinal members and other struc-

¹⁵ Obtainable from School Bus Manufacturers Institute, an Industry Division of Truck Body and Equipment Association, Inc., 1012 Fourteenth Street, N. W., Washington, D. C. 20005.

¹⁶ Commercial Standard CS45-60, *Douglas Fir Plywood: A Recorded Voluntary Standard of the Trade* (as amended). Obtainable from Superintendent of Documents, Washington, D. C. 20401. Price, 15 cents.



BODY LENGTH, COWL TO REAR OF BODY AT FLOOR LEVEL. SEE TABLE UNDER BODY SIZES, PAGE 29

tural material, attachment shall be made by means of welding, riveting, or bolting.

After load as called for in *Static Load Test Code* has been removed, none of following defects shall be evident:

- a. Failure or separation at joints where strainers are fastened to roof bows.
 - b. Appreciable difference in deflection between adjacent strainers and roof bows.
 - c. Twisting, buckling, or deformation of strainer cross section.
6. Side strainer(s): There shall be one or more side strainers or longitudinal members to connect vertical structural members and to provide impact and penetration resistance in event of contact with other vehicles or objects. Such strainer(s) shall be formed (not in flat strip) from metal of at least 16-gauge and 3 inches wide.

Side strainer(s) shall be installed in area between bottom of window and bottom of seat frame and shall extend completely around bus body except for door openings and body cowl panel. Side strainer(s) shall be fastened to each vertical structural member in any one or any combination of following methods as long as stress continuity of member(s) is maintained:

- a. Installed between vertical members.
- b. Installed behind panels but attached to vertical members.
- c. Installed outside external panels.

Fastening method employed shall be such that strength of strainer(s) is fully utilized.

Side strainer(s) or longitudinal member(s) may be combined with one of required rub rails (see page 46), or be in form of additional rub rail, as long as separate conditions and physical requirements for rub rails are met. No portion of side strainer or longitudinal member is to occupy same vertical position as either rub rail.

7. Rear corner reinforcements: Rear corner framing of bus body between floor and window sill and between emergency door posts and last side posts shall consist of at least three structural members applied horizontally or vertically or in another combination to provide additional impact and penetration resistance equal to that provided by frame members in areas of sides of body. Such structural members shall be securely attached at each end.
8. a. Floor sills: There shall be one main body sill at each side post and two intermediate body sills on approximately 10-inch centers. All sills shall be of equal height not to exceed 3 inches. All sills shall extend width of body floor except where structural members or features restrict area.

Main body sill shall be equivalent to or heavier than 10 gauge and each intermediate body sill shall be equivalent to or heavier than 16 gauge, or each of all body sills shall be equivalent to or

greater than 14 gauge. All sills shall be permanently attached to floor.

- b. Connections between sides and floor system shall be capable of distributing loads from vertical posts to all floor sills. As evidence that this requirement is fulfilled, none of following conditions shall occur during or after application of load, as called for in *Static Load Test Code*:

- (1) Appreciable difference in deflection between adjacent sills.
- (2) Failure or separation in joints where floor, floor sills, and sides connect.
- (3) Twisting, buckling, or deformation of floor sill cross sections.

9. All openings between chassis and passenger-carrying compartment made due to alterations by body manufacturer must be sealed. (See *Openings*, page 25.)

Exception—small vehicles

Items 1 through 9 do not apply to small vehicles not manufactured specifically as school buses.

Exception—transit type vehicles

Item 8a does not apply.

Defrosters —

Defrosters, if required, shall be of sufficient capacity to keep windshield, window to left of driver, and glass in entrance door clear of fog, frost, and snow. This may be done by using fans or by taking heat directly from approved heater or auxiliary heaters.

Doors —

1. Service door:

- a. Service door shall be power or manually operated, under control of driver, and so designed as to afford easy release and prevent accidental opening. When hand lever is used, no parts shall come together so as to shear or crush fingers.
- b. Service door shall be located on right side of bus opposite driver and within his direct view.
- c. Service door shall have minimum horizontal opening of 24 inches and minimum vertical opening of 68 inches.
- d. Service door shall be of split type, sedan type, or jackknife type. (Split-type door includes any sectioned door which divides and opens inward or outward.) If one section of split-type door opens inward and other opens outward, front section shall open outward.
- e. Lower as well as upper panels shall be of approved safety glass. (See Item 1 under *Windshield and windows*, page 52.) Bottom of lower glass panel shall not be more than 35 inches from

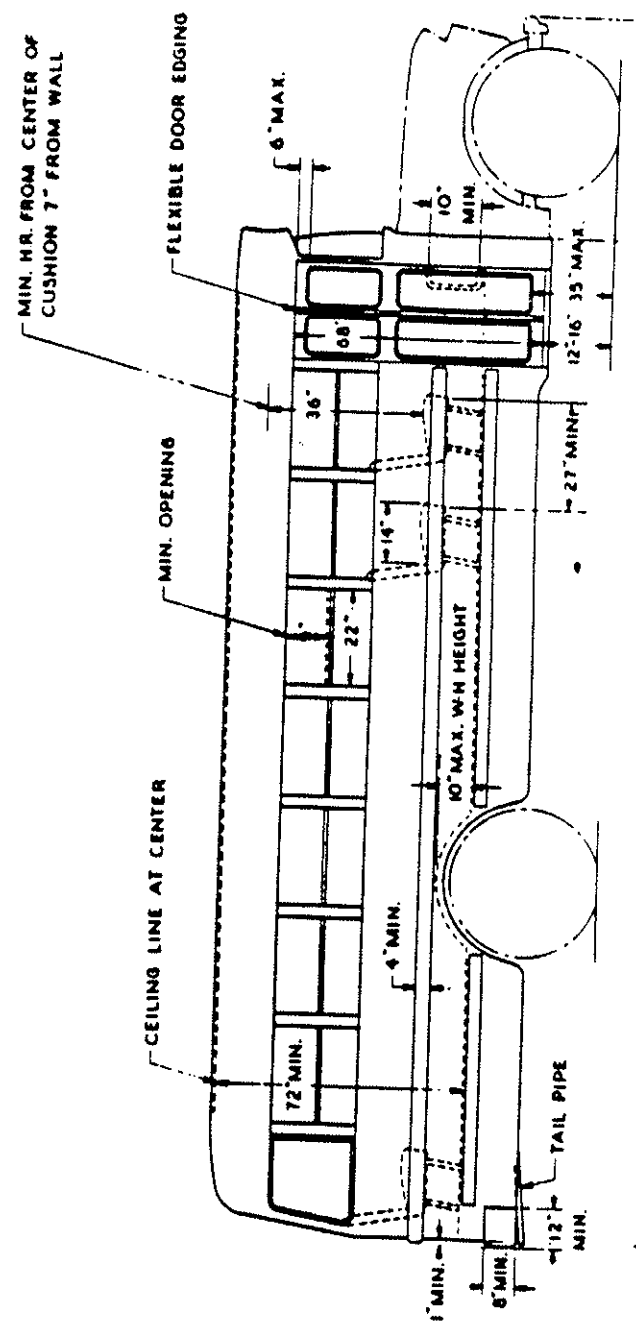
ground when bus is unloaded. Top of upper glass panel shall not be more than 6 inches from top of door.

- f. Vertical closing edges shall be equipped with flexible material to protect children's fingers.
- g. There shall be no door to left of driver. (This shall not be interpreted to conflict with Item 2a below.)

2. Emergency door and emergency window:

- a. Emergency door shall be located in center of rear end of bus or in rear half of left side of bus if engine is so located as to make it impossible to place door in center of rear end.
- b. Emergency door shall have minimum horizontal opening of 24 inches and minimum vertical opening of 48 inches measured from floor level.
- c. Emergency door shall be hinged on right side if in rear end of bus and on front side if on left side of bus. It shall open outward and shall be labeled inside to indicate how it operates.
- d. Upper portion of emergency door shall be equipped with approved safety glass, exposed area of which shall be not less than 400 square inches. (See Item 1 under *Windshield and windows*, page 52.)
- e. There shall be no steps leading to emergency door.
- f. No seat or other object shall be so placed in bus as to restrict any part of passageway leading to either rear or left-side emergency door to opening smaller than rectangle of 12 inches in width and 48 inches in height, measured from floor level.
- g. Words "EMERGENCY DOOR," both inside and outside in letters at least 2 inches high, shall be placed directly above emergency door.
- h. If emergency door is located on left side of bus:
 - (1) Window at rear shall be designed as emergency exit and shall be no smaller than 16 inches in height and 54 inches in width on buses 80 inches or more in width; it shall be no smaller than 16 inches in height and 48 inches in width on buses less than 80 inches in width. Window shall be hinged from top and devised and operated to insure against accidental closing in emergency.
 - (2) Paneling is required to cover space between top of rear divan seat and inside surface of emergency window at rear.
- i. Words "EMERGENCY EXIT," in letters at least 2 inches high, shall be placed directly above emergency window on inside and directly below it on outside.
- j. (1) Emergency door and emergency window shall be designed to be opened from inside and outside of bus and shall be equipped with fastening device which may be quickly released but is designed to offer protection against accidental

BODY ELEVATION



BODY LENGTH, COWL TO REAR OF BODY AT FLOOR LEVEL

MAXIMUM OVER-ALL LENGTH 35'

Prepared especially for this publication by
School Bus Manufacturers Institute

release. Control from driver's seat shall not be permitted. Provision for opening from outside shall consist of non-detachable device so designed as to prevent hitching-to, but to permit opening when necessary.

Emergency door shall be equipped with slide-bar, cam-operated lock. Slide bar shall have minimum stroke of 1 inch. Emergency door lock shall be equipped with suitable electric plunger-type switch connected with buzzer located in driver's compartment. Switch shall be enclosed in metal case, and wires leading from switch shall be concealed in bus body. Switch shall be so installed that plunger contacts farthest edge of slide bar in such manner that any movement of slide bar will immediately close circuit on switch and activate buzzer.

Door lock shall be equipped with interior handle that extends approximately to center of emergency door. It shall lift up to release lock.

- (2) Emergency window in rear shall be equipped with latch (or latches) on inside, connected with electrical buzzer that will actuate when latch is being released.

It shall also be equipped on outside with nondetachable fastening device so designed as to prevent hitching-to, but to permit opening from the outside.

Exception—small vehicles

Substitute following standards for those above:

1. Service door shall be located to right of driver and shall be manually controlled from driver's seat by over-center control for bus-type conveyance.
2. Emergency door:
 - a. Emergency door shall be located in center of rear end of bus and shall be equipped with fastening device for opening from inside and outside body, which may be quickly released but is designed to offer protection against accidental release. Metal guard shall be placed over door control on inside. Control from driver's seat shall not be permitted. Provision for opening from outside shall consist of device designed to prevent hitching-to, but to permit opening when necessary.
 - b. Door shall open either vertically or horizontally. When vertical-type door is used, there shall be unobstructed aisle at least 12 inches wide.
 - c. Emergency door shall be marked "EMERGENCY DOOR" on inside.
 - d. There shall be no steps leading to emergency door.
 - e. No seat or other object shall be placed in bus which restricts passageway to emergency door to less than 12 inches.

Electrical system —

1. *Battery*—see pages 13, 29.
2. *Generator or alternator*—see page 23.
3. *Lamps and signals*—see page 43.
4. *Wiring*—see page 53.
5. See also Item 5 under *Electrical System*, page 20.

Emergency window — see Item 2 under *Doors*, page 35.

Fire extinguisher —

1. Bus shall be equipped with at least one dry-chemical type fire extinguisher of at least 2½-pound capacity, mounted in extinguisher manufacturer's bracket of automotive type, and located in driver's compartment in full view of and readily accessible to driver.
2. Fire extinguisher shall bear label of Underwriters' Laboratories, Inc.,¹⁷ showing rating of not less than 8-B:C.¹⁸

First-aid kit —

1. Bus shall carry Grade A metal first-aid kit, mounted in full view and in accessible place in driver's compartment.
2. Number of units and contents shall be designated by proper state authorities from following unit-type kit as set forth in current Interstate Commerce Commission *Motor Carrier Safety Regulations*:¹⁹

4-inch bandage compress	1 pkg.
2-inch bandage compress	1 pkg.
1-inch adhesive compress	2 pkgs.
40-inch triangular bandage with two safety pins	1 pkg.
Burn ointment	1 pkg.
Iodine applicator or applicator of other antiseptic solutions of, at least, equivalent bacteriological properties	1 pkg.
Wire splint	1 pkg.
Tourniquet	1 pkg.

Floor — see *Construction* on page 30.

Floor covering —

1. Floor in underseat area, including tops of wheel housings, driver's compartment, and toeboard, shall be covered with fire-resistant rub-

¹⁷ 207 East Ohio Street, Chicago, Illinois 60611.

¹⁸ 8-B:C denotes amount of chemical needed to extinguish 8-square-foot type B fire (flammable liquid) or type C fire (electrical).

¹⁹ Obtainable from Superintendent of Documents, Washington, D. C. 20401. Price, 30 cents.

- ber floor covering or equivalent having minimum over-all thickness of .125 inch.
2. Floor covering in aisle shall be of aisle-type fire-resistant rubber or equivalent, non-skid, wear-resistant, and ribbed. Minimum over-all thickness shall be .1875 inch measured from tops of ribs. Rubber floor covering shall meet Federal Specification ZZ-M-71b.²⁰
 3. Floor covering must be permanently bonded to floor and must not crack when subjected to sudden changes in temperature. Bonding or adhesive material shall be waterproof and shall be of type recommended by manufacturer of floor-covering material. All seams must be sealed with waterproof sealer.

Exception—small vehicles

Floor covering on small vehicles not manufactured specifically as school buses shall be manufacturer's standard.

Heaters —

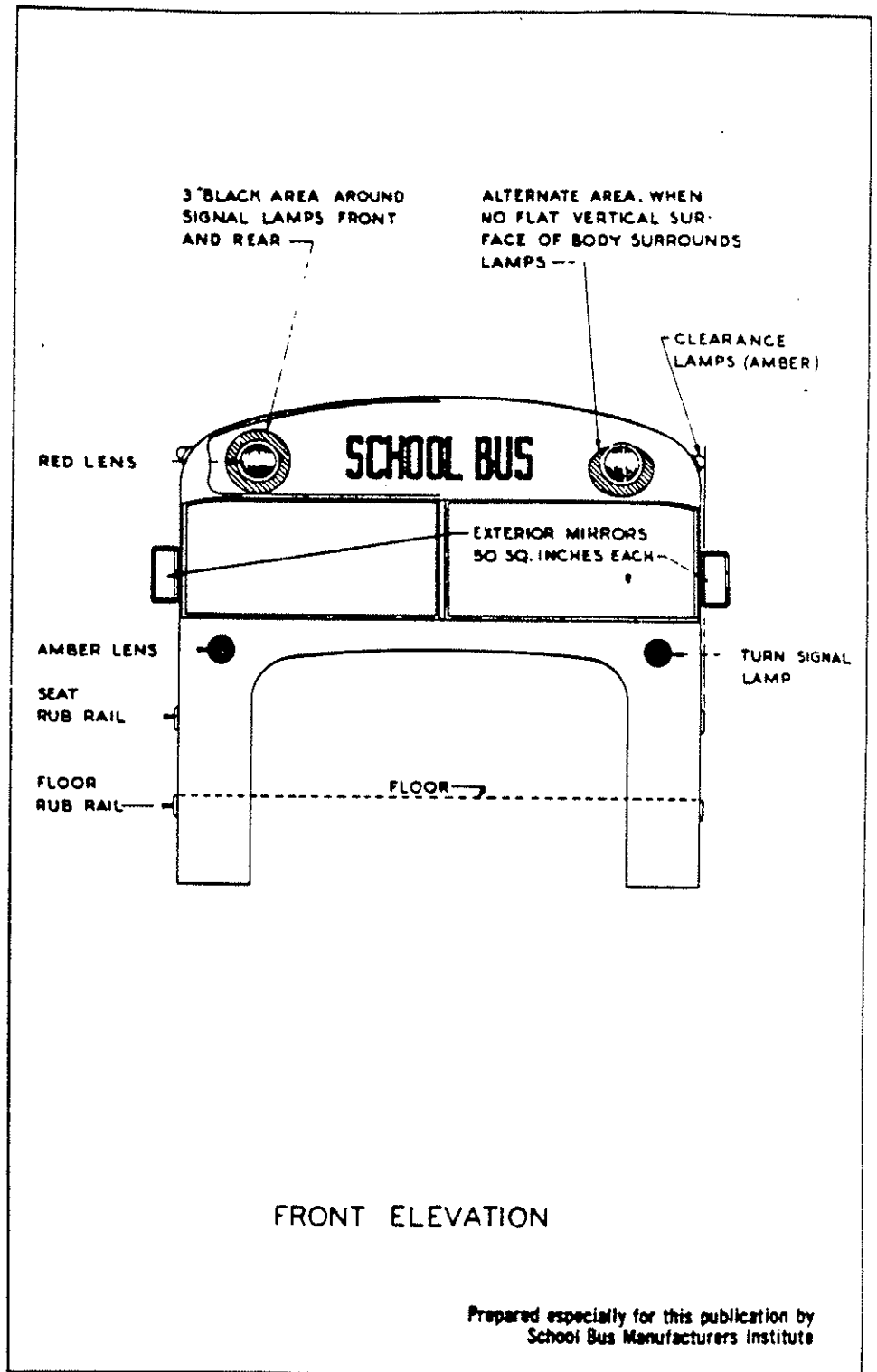
1. Where heaters are required, they shall be of hot-water or combustion type.
2. If only one heater is used, it shall be of fresh-air or combination fresh-air and recirculating type.
3. If more than one heater is used, additional heaters may be of circulating type.
4. Where hot-water heaters are used, they shall bear name plate rating in accordance with *Standard Code for Testing and Rating Automotive Bus Hot Water Heating and Ventilating Equipment*,²¹ plate to be affixed by heater manufacturer. Copies of the *Code* shall be furnished in duplicate (unless more are requested by state department of education) by School Bus Manufacturers Institute-to each state department of education. State department of education shall, in turn, transmit such *Code* to each other state agency responsible for development or enforcement of state standards for school buses.
5. All combustion-type heaters shall be approved by Underwriters' Laboratories, Inc.²²
6. If combustion-type heaters are used, they shall be installed on new buses by body manufacturers and on buses now in operation by authorized dealers or by authorized garages.²³

²⁰ Obtainable from Superintendent of Documents, Washington, D. C. 20401.

²¹ Obtainable from School Bus Manufacturers Institute, an Industry Division of Truck Body and Equipment Association, Inc., 1012 Fourteenth Street, N. W., Washington, D. C. 20005.

²² 207 East Ohio Street, Chicago, Illinois 60611.

²³ See requirements for combustion-type heaters in current *Motor Carrier Safety Regulations* of Interstate Commerce Commission, obtainable from Superintendent of Documents, Washington, D. C. 20401. Price, 30 cents.



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7. Heaters shall be capable of maintaining inside temperature of 50 degrees Fahrenheit at average minimum January temperatures as established by U. S. Department of Commerce, Weather Bureau,²⁴ for area in which heater is required.

Exception—small vehicles

Item 4 does not apply to vehicles not specifically manufactured as school buses.

Also see *Heating system, provision for*, page 24.

Identification —

1. Body shall bear words "SCHOOL BUS" in black letters at least 8 inches high on both front and rear of body or on signs attached thereto. Lettering shall be placed as high as possible without impairment of its visibility. Lettering shall conform to "Series B" of Standard Alphabets for Highway Signs.²⁵
2. Words "STOP ON SIGNAL" may be painted on rear of bus. Word "STOP" by itself shall not be used. Height of letters may not exceed 5 inches.
3. Only signs and lettering approved by state law or regulation, limited to name of owner or operator and any number necessary for identification, shall appear on sides of bus.

Inside height —

Inside body height shall be nominal 72 inches or more, measured metal to metal, at any point on longitudinal center line from front vertical bow to rear vertical bow.

Exception—small vehicles

Standard does not apply.

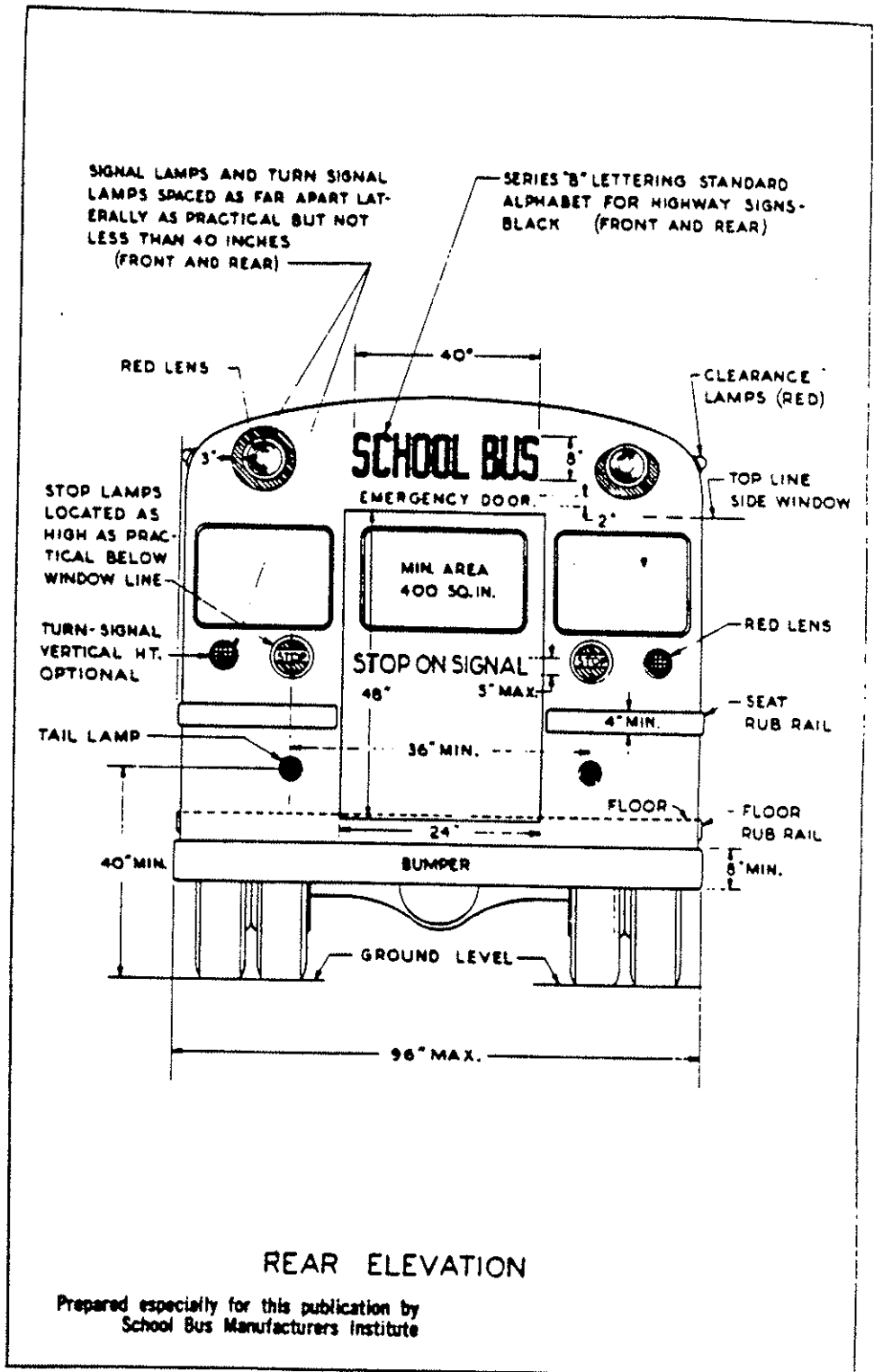
Insulation —

Ceiling and walls shall be insulated with proper material to deaden sound and to reduce vibrations to a minimum. If thermal insulation is specified also, it shall be of fire-resistant material of type approved by Underwriters' Laboratories, Inc.²⁶

²⁴ Washington, D. C. 20235.

²⁵ Designed by U. S. Bureau of Public Roads for Joint Committee on Uniform Traffic Control Devices. A full-scale layout (40 inches over-all length) of words "SCHOOL BUS" as here specified, with suggestions for application, is available from National Commission on Safety Education, 1201 Sixteenth Street, N. W., Washington, D. C. 20036. Price, 50 cents. One copy of this layout may be used repeatedly as guide for placing specified lettering on buses.

²⁶ 207 East Ohio Street, Chicago, Illinois 60611.



REAR ELEVATION

Prepared especially for this publication by
 School Bus Manufacturers Institute

Interior —

1. Interior of bus shall be free of all unnecessary projections likely to cause injury. This standard requires inner lining on ceilings and walls.
2. Ceilings over aisles shall be free of all projections.

Lamps and signals —

1. All lamps and their installation shall conform to current standards and recommended practices of Society of Automotive Engineers.²⁷
2. Head lamps: Bus shall be equipped with head lamps.
3. Clearance and side-marker lamps: Clearance and side-marker lamps (amber at front, red at rear) shall be mounted as high as possible on permanent structure of bus and in such manner as to indicate extreme width of body. Clearance lamps and side-marker lamps may be in combination.
4. Tail and stop (brake) lamps:
 - a. Bus shall be equipped with two tail lamps and two stop (brake) lamps not in combination, emitting red light plainly visible for distance of 500 feet to rear. Stop (brake) lamps shall have light intensity at least equal to that of Class A turn signal lamps as established by Society of Automotive Engineers.
 - b. Tail lamps shall be mounted not less than 40 inches from surface on which vehicle stands. Stop (brake) lamps shall be as high as practicable but below window line, and spaced as far apart laterally as practicable but not less than 3 feet. Measurements shall be taken from lamp centers.
5. License-plate lamp: Bus shall be equipped with rear license-plate illuminator. This lamp may be combined with one of tail lamps.
6. Interior lamps: Interior lamps shall be provided which adequately illuminate aisle and step-well.
7. School bus alternately flashing red signal lamps:

Definition: School bus alternately flashing red signal lamps are lamps mounted at same horizontal level, intended to identify vehicle as school bus and to inform other users of highway that such vehicle is stopped or about to stop on roadway to take on or discharge school children.

 - a. Bus shall be equipped with two red lamps at rear of vehicle and two red lamps at front of vehicle, which shall be controlled by manually actuated switch and when actuated shall flash alter-

²⁷ 485 Lexington Avenue, New York, New York 10017.

nately at rate of 60 to 120 cycles per minute. "On" period shall be long enough to permit bulb filament to come up to full brightness. No brake-operated switch shall be permitted.

b. There shall be visible or audible means of giving clear and unmistakable indication to driver when signaling system is turned on.

c. Installation recommendations:

(1) Each signal lamp shall be mounted with its axis substantially parallel to longitudinal axis of vehicle.

(2) Front and rear signal lamps shall be spaced as far apart laterally at practicable, but in no case shall spacing between lamp centers be less than 40 inches.

(3) Signal lamps shall be mounted at front on same horizontal center line and above windshield, and at rear on same horizontal center line so that lower edge of lens is not lower than top line of side window opening.

(4) Vision of front signal lamps to front and rear signal lamps to rear shall be unobstructed by any part of vehicle from 5 degrees above to 10 degrees below horizontal and from 30 degrees to right and 30 degrees to left of center line of vehicle.

(5) Area around lens of each alternately flashing red signal lamp and extending outward approximately 3 inches shall be painted black.²⁸ In installations where there is no flat vertical portion of body immediately surrounding entire lens of lamp, circular or square band of black ²⁸ approximately 3 inches wide, immediately below and to both sides of lens, shall be painted on body or roof area against which signal lamp is seen (from distance of 500 feet along axis of vehicle).

(6) Each lamp shall be mounted with its aiming plane vertical and normal to the vehicle axis.

8. Turn signal lamps: Bus shall be equipped with Class A turn signal lamps that meet specifications of Society of Automotive Engineers.²⁹ These signals must be independent units and may be equipped with four-way hazard warning switch to cause simultaneous flashing of turn signal lamps when needed as vehicular traffic hazard warning.

9. Flags and flares:

a. School bus shall carry at all times at least two red cloth flags not less than 12 inches square and means for mounting for use in warning traffic in event of prolonged stops on highway.

b. Bus shall carry at least three liquid-burning flares or red electric

²⁸ See footnote 6.

²⁹ 485 Lexington Avenue, New York, New York 10017.

lanterns, or at least three red emergency reflectors, to be displayed according to state law in event of prolonged stops on highway. Liquid-burning flares must be carried in leakproof metal box or carried outside body compartment.

Metal treatment —

All metal used in construction of bus body shall be zinc- or aluminum-coated or treated by equivalent process before bus is constructed. (Included are such items as structural members, inside and outside panels, floor panels and floor sills; excluded are door handles, grab handles, stanchions, interior decorative parts, and other interior plated parts.)

All metal parts that will be painted shall be (in addition to above requirements) chemically cleaned, etched, zinc-phosphate-coated, and zinc-chromate or epoxy-primed or conditioned by equivalent process.

In providing for these requirements, particular attention shall be given to lapped surfaces, welded connections of structural members, cut edges, punched or drilled hole areas in sheet metal, closed or box sections, unvented or undrained areas, and surfaces subjected to abrasion during vehicle operation.

As evidence that above requirements have been met, samples of materials and sections used in construction of bus body, when subjected to 1,000-hour salt spray test as provided for in latest revision of ASTM Designation: B 117, "Standard Method of Salt Spray (Fog) Testing,"³⁰ shall not lose more than 10 percent of material by weight.

Exception—small vehicles

Standard does not apply to small vehicles not specifically manufactured as school buses.

Mirrors —

1. Interior clear-view mirror shall be at least 6 by 30 inches over-all, to afford good view of pupils and roadway to rear. If not metal-backed and framed, mirror shall be of laminated plate safety glass.³¹ It shall have rounded corners and protected edges.
2. Two exterior clear-view, rearview mirrors shall be provided, one to left and one to right of driver. Area of each mirror shall be not less than 50 square inches over-all. Each mirror shall be firmly supported and adjustable to give driver clear views past left rear and right rear of bus.

³⁰ American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

³¹ Current *Safety Code for Safety Glazing Materials for Glazing Motor Vehicles Operating on Land Highways* (Z26.1), obtainable from American Standards Association, Inc., 10 East Fortieth Street, New York, New York 10016.

3. Exterior convex mirror at least 7½ inches in diameter may be located either on left or right side of bus in such manner that seated driver may observe, through its use, areas to front or side of bus where direct observation is not possible.

Mounting —

1. Chassis frame shall extend to rear edge of rear body cross member. Bus body shall be attached to chassis frame in such manner as to prevent shifting or separation of body from chassis under severe operating conditions.
2. Body front shall be attached and sealed to chassis cowl in such manner as to prevent entry of water, dust, and fumes through joint between chassis cowl and body.
3. Insulating material shall be placed at all contact points between body and chassis frame. Insulating material shall be approximately ¼-inch thick, shall have quality of sidewall of automobile tire, and shall be so attached to chassis frame or body member that it will not move under severe operating conditions.

Exception—small vehicles

Standard does not apply to vehicles not specifically manufactured as school buses.

Over-all length —

Over-all length of bus shall not exceed 35 feet.

Over-all width —

Over-all width of bus shall not exceed 96 inches.

Posts — see *Construction* on page 30 and Item 2 under *Windshield and windows* on page 52.

Rub rails —

1. There shall be one rub rail located on each side of bus approximately at seat level which shall extend from rear side of entrance door completely around bus body (except for emergency door) to point of curvature near outside cowl on left side.
2. There shall be one rub rail located approximately at floor line which shall cover same longitudinal area as upper rub rail, except at wheel housings, and shall extend only to radii of right and left rear corners.
3. Both rub rails shall be attached at each body post and all other upright structural members.
4. Both rub rails shall be 4 inches or more in width, shall be of 16-gauge steel, and shall be constructed in corrugated or ribbed fashion.
5. Both rub rails shall be applied outside body or outside body posts. Pressed-in or snap-on rub rails do not satisfy this requirement.

Exception—small vehicles

Standard does not apply to small vehicles not manufactured specifically as school buses.

Sanders —

Where required or used, sanders shall:

1. Be of hopper cartridge-valve type.
2. Have metal hopper with all interior surfaces treated to prevent condensation of moisture.
3. Be of at least 100-pound (grit) capacity.
4. Have cover on filler opening of hopper, which screws into place, sealing unit airtight.
5. Have discharge tubes extending to front of each rear wheel under fender.
6. Have no-clogging discharge tubes with slush-proof, non-freezing rubber nozzles.
7. Be operated by electric switch with telltale light mounted on instrument panel.
8. Be exclusively driver-controlled.
9. Have gauge to indicate hoppers need refilling when they are down to one-quarter full.

Seat belt for driver —

Seat belt for driver shall be provided, belt to comply with current specifications and recommended practices of Society of Automotive Engineers³² except that belt shall be fastened to bus floor immediately behind driver's seat when adjusted to its rear-most position.

Seats —

1. All seats shall have minimum depth of 14 inches.
2. In determining seating capacity of bus, allowable average rump width shall be:
 - a. 13 inches where 3-3 seating plan is used
 - b. 15 inches where 3-2 seating plan is used.
(See table under *Body sizes*, page 29.)
3. All seats shall be forward-facing and shall be securely fastened to that part or parts of bus which support them. (See Item 2 under *Aisle*, page 29.)
4. No bus shall be equipped with jump seats or portable seats.
5. Forward-most pupil seat on right side of bus shall be located so as not to interfere with driver's vision, not farther forward than guard

³² 485 Lexington Avenue, New York, New York 10017.

rail behind driver or rear of driver's seat when adjusted to its rear-most position.

6. Minimum center-to-center seat spacing shall be 27 inches. Distance between driver's seat when adjusted to its rear-most position and front face of seat-back of forward-most pupil seat on left side of bus shall not be less than 24 inches measured at cushion height.
7. Seat cushion shall be constructed with springs, foam rubber, polyurethane foam, or other equivalent material. If springs are used, there shall be at least 21 springs per cushion. Padding used to cover springs may be cotton, rubberized hair, foam rubber, or other equivalent material. If cotton or similar material is used, padding for cushions shall be at least 2 inches thick, except for reasonable distance from edge of cushion to allow for curve of edges. If sponge rubber, rubberized hair, or similar material is used, its thickness shall be at least 1 inch, except for edges of cushion. If foam rubber or polyurethane foam is used without springs, its thickness in cushion shall be approximately 5 inches and it shall be depressed not more than 80 percent when distributed weight of 345 pounds is applied to it. If cotton or similar material, rubberized hair, foam rubber, or polyurethane form is used in seat back rests, it shall be approximately 2 inches thick and shall not be depressed more than 80 percent when distributed weight of 300 pounds is applied to it. Seat covering shall be artificial leather equal to coated fabrics, 42-ounce finished weight, 54 inches wide, reinforced backing of 1.06 broken twill. Padding and covering on all seats shall be of material that will not flash or explode upon contact with spark or open fire. Seams of seat cushions shall be made of good quality welt.
8. Minimum distance between steering wheel and back rest of driver's seat shall be 11 inches. Driver's seat shall be strongly attached, shall have vertical adjustment, and shall have fore-and-aft adjustment of not less than 4 inches.
9. Minimum of 36-inch headroom for sitting position above top of undepressed cushion line of all seats shall be provided. Measurement shall be made vertically not more than 7 inches from side wall at cushion height and at fore-and-aft center of cushion.
10. Backs of all seats of similar size shall be of same width at top and of same height from floor and shall slant at same angle with floor.
11. Where grab handles on seats are used, they shall be enclosed.
12. Fibre-glass seats may be used provided they meet the following standards:
 - a. Fiber-glass seats must meet all foregoing provisions for seats except those concerning construction of seat cushions and seat backs.
 - b. Fiber-glass seats shall combine rigid construction of welded tubular steel with contoured matched die-formed or hand-sprayed

molded plastic shell. Exposed steel shall be stainless steel or shall be finished with baked enamel.

- c. Plastic shells shall consist of good commercial grade, fire-resistant, color-pigmented resin reinforced with glass fibers in such manner as to avoid resin-rich sections. Shells shall be shaped to provide maximum comfort.
- d. Both metal frames and plastic shells shall have rounded corners and be free from sharp edges.

Exception—small vehicles

Substitute following standards for those above:

1. All seats shall be securely fastened to body of vehicle.
2. Seats shall be covered with fire-resistant padding material and comfortably upholstered with adequate padding. (Not applicable to fibre-glass seats.)
3. Jump seats or portable seats shall not be used.
4. Seat beside driver, if regular equipment or installed by vehicle manufacturer, may be used for pupil seating. It shall be securely fastened to body and shall be so constructed as not to interfere with pupils entering or leaving vehicle.
5. Allowable average rump width in determining seating capacity of bus shall be 13 inches.
6. All seats shall be at least 14 inches in over-all depth.
7. If forward-facing seats are used, they shall be so placed that distance from center to center measured at top center of backs shall be not less than 27 inches.
8. If longitudinal seats are used, only two shall be installed and distance between front edges of seat cushions shall be at least 20 inches.
9. Back rest for each longitudinal seat shall measure at least 8 inches vertically and shall be so mounted that its top edge is at least 12 inches above seat.

Stanchions and guard rails —

1. Vertical stanchion shall be installed at right rear corner of driver's seat in such position as neither to interfere with adjustment of driver's seat nor to obstruct 12-inch aisle. Guard rail, approximately 30 inches above floor, and so placed as not to interfere with fore-and-aft adjustment of driver's seat, shall extend from vertical stanchion to left-hand wall behind driver's seat.
2. Vertical stanchion shall be installed at rear of entrance step-well from roof to floor. Placement shall not restrict passageway at any level to less than 24 inches nor aisle to less than 12 inches.
3. Guard rail and step-well guard panel shall be installed from step-well stanchion to right-hand wall to prevent children in front seat from being thrown into step-well in case of sudden stop. Guard rail shall

be approximately 30 inches above floor and its guard panel shall not restrict entrance passageway to less than 24 inches at any level. Panel shall extend from guard rail to within 2 inches of floor. If panel extends over or into step-well opening, it must be flanged at floor line so as to close any opening between panel and floor.

4. Clearance between step-well guard panel and first pupil seat shall be at least 24 inches measured from panel to front face of seat back at cushion height.
5. All stanchions and guard rails shall be minimum of 1-inch outside diameter and stainless steel clad.

Exception—small vehicles

Standard does not apply to vehicles not specifically manufactured as school buses.

Steering wheel — see Item 4 under *Steering gear* on page 27.

Steps —

1. First step at service door shall be not less than 12 inches and not more than 16 inches from ground, based on standard chassis specifications.
2. Service door entrance may be equipped with two-step or three-step step-well. Risers in each case shall be approximately equal. When plywood floor is used on steel, differential may be increased by thickness of plywood used.
3. Steps shall be enclosed to prevent accumulation of ice and snow.
4. Steps shall not protrude beyond side body line.
5. Grab handle not less than 10 inches in length shall be provided in unobstructed location inside doorway.
6. Surface of steps shall be of non-skid material.

Exception—small vehicles

Steps (if any) on small vehicles not manufactured specifically as school buses shall be manufacturer's standard.

Stirrup steps —

There shall be one stirrup step and suitably located handle on each side of front of body for easy accessibility for cleaning windshield and lamps.

Exception—small vehicles

Standard does not apply to vehicles not specifically manufactured as school buses.

Stop signal arm —

Stop signal arm may be installed on left side of bus.

Storage compartment —

Metal container of adequate strength and capacity for storage of tire chains and/or tow chains and such tools as may be necessary for minor emergency repairs while bus is enroute shall be provided. Such storage container may be located either inside or outside passenger compartment but, if inside, it shall have cover (seat cushion may serve for this purpose) and be fastened to floor in right rear portion of bus.

Sun shield —

Interior adjustable sun shield not less than 6 by 16 inches in size shall be installed above windshield.

Tailpipe —

Tailpipe shall not extend beyond rear bumper. (See Item 2 under *Exhaust system*, page 20.)

Undercoating —

Entire underside of body, including floor members and side panels below floor level shall be coated with fire-resistant, asphalt base, rubber base, or other undercoating material, applied by spray method, in order to seal, to deaden sound, to insulate, and to prevent oxidation.

Also see *Undercoating* on page 28.

Ventilation —

1. Body shall be equipped with suitable, controlled ventilating system of sufficient capacity to maintain proper quantity of air under operating conditions without opening of windows except in extremely warm weather.
2. If static-type exhaust roof ventilators are desired, they shall be installed in low-pressure area of roof panel.

Exception—small vehicles

Standard does not apply to small vehicles not manufactured specifically as school buses.

Wheel housings —

1. Wheel house openings shall allow for easy tire removal and service.
2. Wheel housings shall be designed to support seat and passenger loads and shall be attached to floor sheets in such manner as to prevent any dust or water from entering the body.
3. Inside height of wheel housings above floor line shall not exceed 10 inches.

4. Wheel housings shall provide clearance for dual wheels as established by National Association of Chain Manufacturers.³³

Exception—small vehicles

Standard does not apply to small vehicles not manufactured specifically as school buses.

Width — see *Over-all width* on page 46.

Windshield and windows —

1. All glass in windshield, windows, and doors shall be of approved safety glass,³⁴ so mounted that permanent mark is visible, and of sufficient quality to prevent distortion of view in any direction.
2. Glass in windshield shall be heat-absorbent, laminated plate. Windshield shall be large enough to permit driver to see roadway clearly, shall be slanted to reduce glare, and shall be installed between front corner posts that are so designed and placed as to afford minimum obstruction to driver's view of roadway.
3. Windshield shall have horizontal gradient band³⁵ starting slightly above line of driver's vision and gradually decreasing in light transmission to 20 percent or less at top of windshield.
4. Glass in all side and rear windows shall be of AS-2 or better grade, as specified in American Standards Association code Z26.1.³²
5. Each full side window shall provide unobstructed emergency opening at least 9 inches high and 22 inches wide, obtained by lowering of window.
6. Knockout-type, split-sash windows may be used.
7. All exposed edges of glass shall be banded.

Windshield washers —

Windshield washers shall be optional but, where required, they shall conform to body manufacturer's recommendations as to type and size for bus on which they are to be used.

Windshield wipers —

Bus shall be equipped with two positive-action variable-speed windshield wipers of vacuum, air, or electric type. (See Item 5 under *Brakes* for provision on second vacuum reservoir for actuation of vacuum-powered accessories, page 15.)

³³ 111 West Washington Street, Chicago, Illinois 60602.

³⁴ See footnote 31.

³⁵ See footnote 31.

Wiring —

1. All wiring shall conform to current standards of Society of Automotive Engineers.³⁰
2. Circuits:
 - a. Wiring shall be arranged in at least eight regular circuits, as follows:
 - (1) head, tail, stop (brake), and instrument panel lamps
 - (2) clearance lamps
 - (3) dome and step-well lamps
 - (4) starter motor
 - (5) ignition and emergency door signal
 - (6) turn signal lamps
 - (7) alternately flashing red signal lamps
 - (8) horn.
 - b. Any of above combination circuits may be subdivided into additional independent circuits.
 - c. Whenever heaters and defrosters are used, at least one additional circuit shall be installed.
 - d. Whenever possible, all other electrical functions (such as Sanders and electric-type windshield wipers) shall be provided with independent and properly protected circuits.
 - e. Each body circuit shall be color coded and a diagram of the circuits shall be attached to the body in a readily accessible location.
3. A separate fuse or circuit breaker shall be provided for each circuit except starter motor and ignition circuits.
4. All wires within body shall be insulated and protected by covering of fibrous loom (or equivalent) which will protect them from external damage and minimize dangers from short circuits. Whenever wires pass through body member, additional protection in form of appropriate type of insert shall be provided.
5. Wires not enclosed within body shell shall be fastened securely at intervals of not more than 24 inches. All joints shall be soldered or joined by equally effective connectors.

Exception—small vehicles

Wiring shall be manufacturer's standard.

³⁰ 485 Lexington Avenue, New York, New York 10017.

VEHICLES FOR TRANSPORTING HANDICAPPED CHILDREN

General Requirements

Vehicles constructed for transporting handicapped children shall comply generally with minimum standards for school buses but, because of use of special equipment, certain modifications in these minimum standards must be made. This section lists, with respect to vehicles constructed or modified for transportation of handicapped children, (a) standards for special equipment, and (b) exceptions required in minimum standards for school buses.

Special Equipment

1. *Special service door:*

- a. Special door opening shall be located on right side of bus and far enough to rear to prevent door, when open, from obstructing front right service door. Door opening shall be not less than 48 inches in width.
- b. Door shall be made of two panels of approximately equal width, equipped with hinges and hinged to side of bus, and each panel shall open outward. Forward panel shall be provided with overlapping flange to close space where door panels meet and weather seal shall be provided to close all door edges.
- c. Door shall be equipped with at least one-point fastening device on rear panel to floor or header and at least two-point fastening device to floor and header on forward door panel, both manually operated.
- d. Door shall be equipped with device that will actuate audible or visible signal located in driver's compartment when doors are not securely closed.
- e. Each door shall contain fixed or movable window aligned with lower line of other windows of bus and as nearly as practical of same size as other bus windows.
- f. Each door panel shall open outward and positive fastening device shall be installed to hold door in open position.
- g. Door panels shall be constructed to be equivalent in strength and materials to other school bus doors.
- h. When ramps are used, door panels shall extend below floor line to cover ramp container opening. When power lifts are used, door panels shall extend below to full length of skirt.
- i. Door posts and headers shall be reinforced sufficiently to provide support and strength equivalent to areas of side of bus not used for service doors. Outriggers from chassis shall be in-

stalled at front and rear of door opening to support floor with same strength as other floor portions.

2. *Ramp:*

- a. If ramp is used, it shall be of sufficient strength and rigidity to support wheel chair, occupant, and attendant. It shall be equipped with protective flange on each longitudinal side to keep wheel chair on ramp.
- b. Floor of ramp shall be covered with non-skid material.
- c. Ramp shall be of weight, and equipped with handle or handles, to permit one person to put ramp in place and to return it to storage place.
- d. Provisions shall be made to secure ramp to side of bus for use without danger of detachment, and ramp shall be connected to bus at floor level in such manner as to permit easy access of wheels of wheel chair to floor of bus.
- e. Ramp shall be at least 88 inches in length and width of ramp shall conform generally to width of door opening.
- f. Dustproof and waterproof enclosed container shall be provided if ramp is stored under floor.

3. *Power lift:*

- a. If power lift is used, it shall be of sufficient capacity to lift wheel chair, occupant, and attendant.
- b. Power lift shall be mounted to chassis frame.
- c. Power lift platform shall be not less than 26 inches in width nor less than 45 inches long, including guard panels or rails.
- d. Power lift platform shall be covered with non-skid material.
- e. Self-adjusting steel or equivalent ramp of sufficient width to minimize incline to lift platform shall be attached to lift platform. Ramp shall be equipped with skid-resistant surface.
- f. Power lift unit shall be controlled from panel within bus and adjacent to lift and be capable of operation by attendant standing upon lift when lift is in any position.
- g. Device shall be installed which will be used to prevent operation of lift until doors are opened.

4. *Stanchions:*

Stanchion, guard rail, and guard panel shall be installed at both rear and front edges of special service door opening extending into bus. If power lift is used, chain shall be installed between stanchion posts to enclose area of power lift.

5. *Fastening devices for wheel chairs:*

Positive fastening devices shall be provided, attached to floor or walls or both, that will securely hold wheel chairs in position when in bus.

6. *Seat restraining devices:*

Seat frames shall be equipped with rings or other devices to which belts or restraining harnesses may be attached.

7. *Aisles:*

All aisles, including aisles leading to emergency door, shall be wide enough to permit passage of wheel chair.

8. *Special light:*

Light shall be placed inside bus, over special service door, and shall be operated from door area.

9. *Grab handles:*

Grab handles shall be provided on each side of front right service door on buses constructed for transportation of handicapped children.

10. *Fuel tank:*

See *Exception*—vehicles of less than 54-passenger capacity constructed for transporting handicapped children, under *Fuel tank*, page 23.

SUGGESTIONS FOR DEVELOPING SCHOOL BUS PURCHASING SPECIFICATIONS

Introduction

In developing these suggestions, an effort was made to fulfill a twofold purpose: (a) to set forth those major considerations in which decisions are required in selecting school buses, and (b) to provide suggestions for developing school bus specifications to be used in securing bid proposals.

Certain cautions should be kept in mind:

- (1) These suggestions in no way replace or supplant, but rather are intended to support and supplement, the *Minimum Standards for School Buses*.
- (2) These suggestions do not cover all possible considerations in the selection of school buses. Prior to its use, therefore, it is essential that this material be carefully reviewed in terms of state and local needs and/or requirements.
- (3) *These suggestions deal specifically with the conventional type body-on-chassis vehicle.* Although transit and metropolitan vehicles as well as the various types of small vehicles present certain special problems which are not covered here, some of the major considerations set forth would apply also in developing specifications for these other types of vehicles.

School buses should be selected to meet the particular needs of the purchaser. Consequently, the purchaser should appraise local needs in terms of the operating area terrain, prevailing weather conditions, types of roads over which vehicles will be operating, traffic conditions, probable operating speeds, and the chassis ratings required to provide the capacities necessary in given route situations.

The purchaser must make decisions in at least the following areas in preparing school bus specifications.

Selecting the School Bus Chassis

In selecting the chassis, it is first necessary to specify the type and capacity of the school bus body desired inasmuch as this decision will affect (a) the length of frame (cowl to axle), (b) gross vehicle weight, and (c) the capacity of such chassis components as axles, springs, and engine size.

Computing gross vehicle weight C1³⁷

The chassis selected will be required to carry a given weight: the school bus body, the transported pupils, etc.; therefore, it is necessary to relate the gross weight of the vehicle to be purchased to the manufacturer's G.V.W. rating of the chassis.

To determine the gross vehicle weight, add the weights of the chassis wet (with oil, water, and full tank of fuel) with specified tires, the bus body, plus the weight of the pupil passengers (115 lbs. each), the driver (150 lbs.), and an extra allowance for standees if permitted by state law. Thus, the actual average gross vehicle weight of a 60-passenger bus might be computed as follows:

Weight of chassis (wet)	6,000 lbs.
Weight of body	6,000 lbs.
Weight of pupils	6,900 lbs.
Driver's weight	150 lbs.
Extra weight allowance	XXX lbs.*
Total actual average gross vehicle weight	19,050 lbs.

* This figure could represent an additional weight allowance for certain optional items of equipment such as tires, axles, sanders, springs, and also for standees.

In this particular case the purchaser should indicate in his specifications the need for a chassis having a gross vehicle weight rating of at least 19,050 lbs.

Generally, the school bus chassis should meet or exceed the following minimum gross vehicle weight ratings without major chassis modification for the various chassis sizes or capacities:³⁸

Chassis size or capacity	Average actual G.V.W. ^a (calculated)	Manufacturer's recommended rated G.V.W. ^a
36-passenger chassis	13,200	14,000
42-passenger chassis	14,700	16,000
48-passenger chassis	16,100	17,000
54-passenger chassis	17,500	18,000
60-passenger chassis	18,800	20,000
66-passenger chassis	20,200	22,000

^a Based on data contained in the new power and gradeability formula.

³⁷ This coding system (C1, C2, etc.) refers to the checklist of chassis information on pages 73 to 76.

³⁸ It should be noted that the recommended G.V.W. ratings exceed the average actual G.V.W. ratings listed in the table. This indicates that these recommended G.V.W. ratings often provide for an additional margin of performance beyond that which may be actually needed in a given situation. The potential purchaser is therefore cautioned that, just as it is important to select adequate equipment for the job to be done, it is equally important not to 'over buy.'

The gross vehicle weight rating for a given chassis as published will change when options for tires, axles, springs, shock absorbers, vacuum tanks, engines, etc., are specified.

Chassis Components

Each chassis component should be specified in terms of the job to be required of it. By specifying the proper chassis components, the purchaser will insure the greater longevity of each component. A school bus chassis is no stronger than its weakest component. Long-range and true economy requires that proper equipment be specified. The following chassis components are generally considered to be integral parts of the power train: engine, clutch, transmission, drive shaft, and axles.

The engine C2 (Power and gradeability—Minimum standard page 26.)³⁹

When computing engine power, the minimum net horsepower needed is that which will move a given G.V.W. up a 3.7-percent grade at 20 mph in direct drive, using a 1.5 rolling resistance, 150-pound driver, 115-pound pupil, and a 7.17:1 to 7.2:1 rear axle ratio. The engine should meet the following minimum net horsepower ratings for the various chassis sizes or capacities:⁴⁰

Chassis size or capacity	Gross vehicle weight		Recommended tire size *				Required minimum net horsepower rating
	Average actual G.V.W. (Calculated)	Manufacturer's rated G.V.W.	Tube type		Tubeless		
			Size	Ply	Size	Ply	
36	13,200	14,000	7.00-20	8	7-22.5	6	40.7 at 1390 rpm
42	14,700	16,000	7.50-20	10	8-22.5	10	45.4 at 1368 rpm
48	16,100	17,000	7.50-20	10	8-22.5	10	49.5 at 1368 rpm
54	17,500	18,000	8.25-20	10	9-22.5	10	53.9 at 1325 rpm
60	18,800	20,000	8.25-20	10	9-22.5	10	57.9 at 1325 rpm
66	20,200	22,000	9.00-20	10	10-22.5	10	62.2 at 1267 rpm

* Data obtained from the Tire and Rim Association, Akron, Ohio.

Acceleration is a factor which is normally given too little consideration in analyzing the requirements for a school bus. The time required to operate over a given route is not normally determined by the top speed of the vehicle but by its ability to reach road speed from a standing start; in other words, its acceleration. Even the lowest-powered bus will operate at a speed equivalent to the safe speed limit for buses, but good acceleration may require additional horsepower or shifting into a lower gear.

³⁹ This and subsequent similar notations refer to the page on which the minimum standard appears.

⁴⁰ Based on data contained in the new power and gradeability formula.

Therefore, the size and weight of the vehicle and geographic terrain in which it is to operate will figure heavily in developing the specifications for the engine.

The engine should have the horsepower required to pull the fully loaded vehicle over the school bus route, taking into account whether or not the route consists of level hard-surfaced roads over which traffic is light, rolling terrain, or steep grades with varying types of surfaces. A bus to be operated on the level will not need the same horsepower requirements as a bus operated on hills or steep grades. The acceleration requirements for vehicles that will be entering and/or transporting pupils on high-speed highways or in areas of heavy traffic must also be given careful consideration. The use of governors, power steering, air brakes, and automatic transmissions must be considered because these devices place demands on the engine power supply which can reduce the acceleration potential of a given engine.

The clutch C3 (Minimum standard, page 19.)

The life of the clutch on a school bus depends in large part upon the skill, training, attitude, and experience of the school bus driver. Most authorities agree that the chassis should be equipped with a clutch having a diameter not less than the minimum dimensions indicated in the following table:

Chassis size or capacity	Recommended minimum diameter of clutch (in inches)
36	—
42	—
48	12
54	12
60	12
66	13 or of equivalent performance

Transmission C4 (Minimum standard, page 28.)

The operating conditions again enter into the selection of this important chassis component. The chassis manufacturer's recommendation should be considered in selecting this component in terms of local terrain and other road and traffic conditions. The transmission should provide for a minimum of four (4) forward speeds, and some situations will require five (5) forward speeds, depending upon the chassis or capacity of the vehicle. The five-forward-speed transmission is available normally in these types: (a) direct wide ratio, (b) direct close ratio, and (c) overdrive in fifth. Factors to be seriously considered before specifying an overdrive for a school bus are the speed at which the vehicle is required to operate and the distances between stops.

Automatic transmissions are a convenience for all drivers, especially for those who may not be adept at shifting a manual transmission.

Automatic transmissions also can result in extended life of motors, drive lines, and differentials, but consideration must be given to facilities needed to service automatic transmissions.

Selection of the proper transmission goes hand-in-hand with the selection of the engine of the vehicle. The number of forward speeds available in transmissions varies from 4 to 5 in chassis for buses of 48-passenger capacity and above.

Drive shaft C5 (Minimum standard, page 19.)

The torque capacity of the drive shaft assembly should equal the maximum engine torque as developed through the lower transmission gear ratio. Drive shafts should be equipped with protective metal guards to prevent their whipping through the floor or dropping to the ground if broken.

Axles C6 (Minimum standards: Axles, page 13; Passenger load, page 25; Weight distribution, page 28.)

The selection of front and rear axles involves consideration of a number of factors such as local road conditions and the size and weight of the vehicle in question. Front and rear axles or other types of suspension assemblies should be of sufficient capacity at ground to support such load as would be imposed by gross vehicle weight as defined under passenger load and the average actual G.V.W.

- a. Front axle. For buses that operate over paved roads and city streets with light to medium loads, the standard front axle may be adequate. It is quite generally agreed that the manufacturer's front axle ratings (in lbs.) should meet or exceed the following capacities for the various chassis sizes:⁴¹

Chassis size or capacity	Average actual G.V.W. (calculated)	Front axle capacities (in lbs.) [*]	
		A ^{**} (25%)	B ^{**} (35%)
36	13,200	3,300	4,620
42	14,700	3,675	5,145
48	16,100	4,025	5,635
54	17,500	4,375	6,125
60	18,800	4,700	6,580
66	20,200	5,050	7,070

^{*} The capacity of the front axle will vary in terms of the actual G.V.W., the actual weight distribution, and the local operating conditions and terrain. From 25 to 35 percent of the average actual gross vehicle weight is supported at the ground by the front tires.

^{**} For purposes of illustration only, the capacities in Columns A and B were computed on the basis of 25 percent and 35 percent, respectively, of the average actual gross vehicle weight being supported at ground by the front tires.

⁴¹ The front axle capacities listed in Columns A and B do not necessarily correspond with the manufacturer's front axle ratings. The purchaser will need, therefore, to match the proper manufacturer's front axle rating with the front axle capacity required for a given school bus.

If, on the other hand, the vehicle is to be operated over unimproved roads, optional equipment or heavy duty front axles with greater capacity should be specified.

- b. Rear axle. General consensus holds that the manufacturer's rear axle ratings (in lbs.) should normally meet or exceed the following capacities for the various chassis sizes:⁴²

Chassis size or capacity	Average actual G.V.W. (calculated)	Rear axle capacities (in lbs.)*	
		A** (65%)	B** (75%)
36	13,200	8,580	9,900
42	14,700	9,555	11,025
48	16,100	10,465	12,075
54	17,500	11,375	13,125
60	18,800	12,220	14,100
66	20,200	13,130	15,150

* The capacity of the rear axle will vary in terms of the actual G.V.W., the actual weight distribution, and the local operating conditions and terrain. From 65 to 75 percent of the average actual gross vehicle weight is supported at ground by the rear tires.

** For purposes of illustration only, the capacities in Columns A and B were computed on the basis of 65 and 75 percent, respectively, of the average actual gross vehicle weight being supported at ground by the rear tires.

Only the full-floating type rear axles meet the current standards. A single-speed rear axle with a ratio of about 7.2:1 is adequate under normal operating conditions.

A single-speed rear axle with sufficient capacity to carry the load of any school bus is available from all the various chassis manufacturers. A two-speed axle should only be specified for vehicles that operate on the open highway where the distances between stops are great. Ordinarily, by the time the school bus driver can gain speed enough to make a shift into a ratio permitting the bus engine to operate at a slower speed, another pupil stop is reached. Little may be gained by installation of a two-speed axle if its primary use is on a route that requires a large number of stops. In such cases, a larger engine may be a better investment than a two-speed axle.

Other Important Chassis Considerations

Brakes C7 (Minimum standard, page 14.)

Adequate brakes are an especially important consideration in selecting a school bus chassis.⁴³ Brakes normally available for school buses are

⁴² The rear axle capacities listed in Columns A and B do not necessarily correspond with the manufacturer's rear axle ratings. The purchaser will need, therefore, to match the proper manufacturer's rear axle rating with the rear axle capacity required for a given school bus.

⁴³ Proper maintenance and adjustment of brakes is essential. The most satisfactory brake may prove unsatisfactory in an emergency if it has not received regular maintenance to meet a performance standard.

of three types: (a) full compressed-air brakes, (b) vacuum-actuated power or assistor-type brakes, and (c) compressed-air-over-hydraulic brakes. The line pressures of vacuum-actuated power brakes will often go as high as 2,000 pounds per square inch, whereas 'sudden' stops with full compressed-air brakes rarely require more than 115 pounds per square inch line pressure. Full compressed-air brakes require less energy on the part of the driver for maximum application and may provide, when kept properly adjusted, greater stopping ability.

Heavy duty brakes of larger capacity are desirable for hilly or mountainous country as well as for those vehicles which are to be operated in heavy traffic where a great deal of stopping is required.

In the opinion of many automotive engineers, a performance standard (the capability of the braking system to stop the complete unit at a given speed within a given distance) represents a more satisfactory guideline for brake performance than does the number of square inches of brake lining area.

Bumper, front C8 (Minimum standard, page 19.)

Cooling system C9

The cooling system usually provided in a school bus chassis is sufficient for normal operation. Where engine cooling is a problem, however, a more effective cooling system is normally available as an optional item for almost every chassis.

Electrical equipment C10

The electrical equipment and wiring on most school bus chassis should be sufficient for normal operating requirements with the possible exception of two items: (a) the battery, and (b) the generator.

The additional lights and signals required on the modern school bus increase the burden on the generator and the battery. For this reason, care should be exercised in choosing these two items.

a. *Battery C11* (Minimum standard, page 13.)

With the increased demand for sufficient current to operate larger windshield wiper motors, more effective heater fan motors, more powerful signal lamps and other lamps, as well as to meet the needs for such optional items as two-way radios and (in larger buses) intercom amplifiers, batteries of greater capacity are essential. Other considerations relate to location of the battery with reference to ease of servicing and to shielding it from excessive heat.

b. *Generator or alternator C12* (Minimum standard, page 23.)

For guidance in selecting a generator or alternator of adequate capacity, see Suggested Method for Estimating Generator or Alternator Capacity, in Appendix.

Exhaust system C13 (Minimum standard, page 20.)

Filters C14 (Minimum standards: Air cleaner, page 13; Oil filter, page 25.)

Air filters may be of the oil-bath type or the dry-element type.

Chassis are normally equipped with one of two types of oil filters: (a) replaceable element, or (b) built-in unit (which can be of the bypass or full-flow type).

Fuel tank C15 (Minimum standard, page 21.)

Shock absorbers C16 (Minimum standard, page 26.)

Springs C17 (Minimum standards: Power and gradeability, page 26; Springs, page 27; Weight distribution, page 28.)

Proper springs and/or suspension assemblies on a chassis are extremely important both for safe operation of the vehicle and for its operating life. Progressive type rear springs are required in all cases. Springs or suspension assemblies should be of ample resiliency under all load conditions and of adequate strength to sustain the loaded bus without evidence of overload. Springs or suspension assemblies should be designed to carry their proportional share of the gross vehicle weight.

In computing the capacity of springs or suspension assemblies, normally divide the weight to be supported by the front (or rear) tires by 2.

Tires and Rims C18 (Minimum standard, page 27.)

The tires specified should be adequate to support the gross weight of the loaded vehicle. In selecting tires for school buses, the tire sizes and ply ratings as well as rim sizes should conform to the current standards of the Tire and Rim Association. A weight up to 10 percent greater than the current Tire and Rim Association standard may be considered a reasonable tolerance.

All tires on a school bus should be of the same size and ply rating, except where wide single equivalents are used in place of the otherwise required dual tires on rear wheels.

Among the factors that need to be considered in selecting school bus tires and rims are these: (a) gross vehicle weight, (b) type of road surface in the operational area, (c) type of operation (i.e., long runs at open road speeds with few stops or runs with many starts and stops), and (d) size, type, and number of wheels. Tire companies can advise on the size and construction of various tires for different kinds of school bus service. Special tire treads (i.e., snow tread, mud grip, etc.) may be specified when so desired.

Tires and rims should normally meet or exceed the following minimum requirements for the various chassis sizes or capacities:⁴⁴

⁴⁴ Based on data contained under Power and gradeability, page 26.

Chassis size or capacity	Tube type tires		Tubeless tires		Rim size			
	Size	Ply	Size	Ply	Tube type tires		Tubeless tires	
					Pre-ferred	Alter-nate	Pre-ferred	Alter-nate
36	7.00-20	8	7-22.5	6	5.5	5.0	5.25	—
42	7.50-20	10	8-22.5	10	6.0	5.5	6.00	5.25
48	7.50-20	10	8-22.5	10	6.0	5.5	6.00	5.25
54	8.25-20	10	9-22.5	10	6.5	6.0	6.75	6.00
60	8.25-20	10	9-22.5	10	6.5	6.0	6.75	6.00
66	9.00-20	10	10-22.5	10	7.0	6.5	7.50	6.75

A composite table of minimum chassis requirements ⁴⁵

Chassis size/capacity	36	42	48	54	60	66
Manufacturer's recommended G.V.W. _____	14,000	16,000	17,000	18,000	20,000	22,000
Actual average G.V.W. _____	13,200	14,700	16,100	17,500	18,800	20,200
Tire sizes (w/tube)						
size _____	7.00-20	7.50-20	7.50-20	8.25-20	8.25-20	9.00-20
ply rating _____	8	10	10	10	10	10
Tire sizes (tubeless)						
size _____	7-22.5	8-22.5	8-22.5	9-22.5	9-22.5	10-22.5
ply rating _____	6	10	10	10	10	10
Rim sizes (w/tube)						
preferred _____	5.5	6.0	6.0	6.5	6.5	7.0
alternate _____	5.0	5.5	5.5	6.0	6.0	6.5
Rim sizes (tubeless)						
preferred _____	5.25	6.00	6.00	6.75	6.75	7.50
alternate _____	—	5.25	5.25	6.00	6.00	6.75
Min. net H.P. required at engine R.P.M. _____	40.7	45.4	49.5	53.9	57.9	62.2
	1,390	1,368	1,368	1,325	1,325	1,267
Rear axle ratio _____	6.16*	7.17:7.2	7.17:7.2	7.17:7.2	7.17:7.2	7.17:7.2
Recommended clutch diameter (in inches) _____	11	11	12	12	12	13**
Axle capacities:						
(25%-75% weight distribution)						
front axle _____	3,300	3,675	4,025	4,375	4,700	5,050
rear axle _____	9,900	11,025	12,075	13,125	14,100	15,150
(35%-65% weight distribution)						
front axle _____	4,620	5,145	5,635	6,125	6,580	7,070
rear axle _____	8,580	9,555	10,465	11,375	12,220	13,130
Cowl to rear axle (in inches) _____	125	142	160	192	211	229

* Or higher.

** Or of equivalent performance

⁴⁵ Based on data contained under Power and gradeability, page 26. (Minimum net horsepower needed to move a given G.V.W. up a 3.7-percent grade at 20 mph. in direct drive, using a 1.5 rolling resistance, 150-pound driver, and a 7.17:1 to 7.2:1 rear axle ratio.)

Selecting the School Bus Body

In selecting the school bus body, it is first necessary to specify the type and capacity desired inasmuch as this decision will affect a number of the other body and/or chassis characteristics such as: (a) length and type of chassis, (b) chassis components, and (c) seating arrangements.

The purchaser must consider his school bus body needs in terms of capacity and such other related factors as: (a) safety and comfort, (b) ease of maintenance, (c) type of terrain and local road conditions, (d) availability of parts and service, (e) maneuverability in traffic, (f) driver visibility, (g) quality of construction, and (h) reasonableness of cost. He must examine the various types of bus bodies and select the most suitable one in terms of his needs.

The conventional school bus body B1⁴⁶

The conventional type school bus body is built on a chassis with the engine under a hood located ahead of the driver's seat and windshield. If equipped with a standard truck engine, a school bus with a conventional body can be used to advantage in rural areas where local mechanics generally will be capable of caring for and repairing the engine. Replacement parts are relatively easy to obtain. The cost of a conventional type bus is usually less than that of a transit or metropolitan type vehicle. The conventional type bus is normally available in the following pupil seating capacities: 24, 30, 36, 42, 48, 54, 60, and 66.

Body sizes

B2 (Minimum standard, page 29.)

Body construction

B3 (Minimum standard: Construction, page 30.)

A school bus carries its passengers over dangerous highways, over railway crossings, through busy intersections, and often over unimproved roads and lanes. It must, therefore, be structurally safe to offer adequate protection to children.

The bus must be able to stand the rock and sway such vehicles undergo during thousands of miles of travel. Buses receive hard usage during their operating life, and good structural support means less maintenance and repair cost as the bus gets older.

In comparing bus construction, the purchaser will notice that the over-all weight and the gauge of the steel components may not be accurate measures of the strength, durability, and resilience built into the bus. The reason is that modern engineering techniques have made it possible to use steel with utmost efficiency. Without unnecessary dead

⁴⁶ This coding system (B1, B2, etc.) refers to the checklist of body information on pages 77 to 79.

weight, a vehicle will offer better gas mileage, better road handling, and more efficient braking.

Here are some questions to ask about the construction of bus bodies. Are structural members die-formed for maximum strength? Are reinforcing members used at stress points to increase strength still further? Are the frame members joined together in such a way as to help reduce stress points? Is the body steel of prime commercial quality? Does the bus body meet the School Bus Body Manufacturers Association *Static Load Test Code for School Bus Body Structure*?

Before purchasing a conventional type school bus, it may be profitable to determine the structural components of available bodies, making comparisons in the following areas:

Floor system—Most manufacturers use comparable gauges of steel, or plywood of equal strength, in the construction of the floor. The depth, width, length, shape, and gauge of the floor supports and the main and intermediate floor beams, as well as the distances between them, can in some cases disclose major structural differences.

Sides and roof of the vehicle—It is important to determine the kind of structural support (body posts, roof bows, strainers, and stringers) provided behind the side panels and under the skin of the roof. If the bus should overturn, the roof and sides would have to support the entire weight of the vehicle. Adequate structural support in these two areas reduces the likelihood both of penetration by outside objects and collapse.

Rear of the vehicle—Statistics indicate that a large percentage of accidents involving school bus collisions occur at the rear of the vehicle. A careful check of this area of a school bus is extremely important in order to determine whether adequate collision protection is built into the vehicle. It is important to find out, for example, what the body offers in the way of internal structural members (posts, strainers, stringers) across the rear and at the rear corners.

Rub rails (Minimum standard, page 46.)

Insulation (Minimum standard, page 41.)

Rust protection (body) B5—In recent years, advances have been made in steel manufacturing and coatings to give protection against rust. It has been estimated that adequate rust prevention can save a school district a considerable amount of money over the life of the vehicle in eliminating the replacement of rust-damaged panels and in painting maintenance. Rust protection also may be a safety factor, for an unprotected structural member can be weakened by corrosion.

Undercoating (Minimum standard, page 51.)

Bumper, rear B6 (Minimum standard, page 30.)

Doors B7 (Minimum standard, page 34.)

There are three types of school bus entrance doors: (a) split-leaf (center split), (b) folding jackknife (center hinged), and (c) sedan

(one-piece). These doors can normally be operated or controlled manually, by air, or by vacuum. Each kind of control may have certain advantages when teamed with one or more of the aforementioned types of doors. Conventional type school buses usually have doors that are operated manually or by air. Increasing numbers of conventional type buses are being purchased with the air-operated door.

Floor covering B8 (Minimum standard, page 38.)

Heating, defrosting, and ventilation B9 (Minimum standards: Defrosters, page 34; Heaters, page 39; Ventilation, page 51.)

Questions about heaters and defrosters are closely related to the climatic conditions of a given locality. In some northern states, heating and defrosting with today's more efficient and cooler operating engines presents a real problem. In areas of more moderate year-round temperature, adequate heating and defrosting may be achieved with no difficulty.

BTU heater ratings are not always reliable guides to heating efficiency. It is the chassis engine that produces the heat, and a given engine will produce the same amount of heat regardless of body capacity. A more important consideration is the circulation of warmed air.

The bus should have an adequate number of heaters. Rear underseat heaters are recommended in those areas where the cold is intense during the winter months. A right-hand front heater is needed to melt tracked-in ice and snow in the step-well area and to assure good defrosting of the entrance door windows and right front windshield. For effective defrosting, fans or blowers should have enough power to defrost the entire front windshield. This is essential for good driver vision at all times. A fogged or frosted windshield is a serious hazard.

In evaluating a school bus heating and defrosting system, answers are needed to such questions as: Will heat be effectively delivered to all passengers in the bus, including those at the rear? Are heater motors easily accessible for maintenance checks? Are heater controls conveniently located and easy for the driver to operate? What type of blowers circulate the warmed air?

Identification B10 (Minimum standard, page 41.)

Lamps and signals B11 (Minimum standard, page 43.)

Seats B12 (Minimum standard, page 47.)

Seats are one of the more expensive items in the school bus, not only in terms of initial vehicle cost but also from the standpoint of maintenance. A school bus seat is no stronger than its weakest component, be it the frame, upholstery, or back. Particular preferences in the following areas should be specified in selecting the seating:

- the seat frame: will it resist bending and breaking? does it make use of rust-resistant materials? has it been engineered for the hardest kind of use? what method is employed to attach the seat frame to the floor?
- the type, weight, and thickness of the cushion-filler padding mate-

rial may be specified as well as the type, thickness, and weight of upholstery covering material; if springs are used in the seat cushions, the number, free height, and the gauge of the springs may be specified.

- the backs of the seats may be protected with various types of material such as specially coated steel or aluminum.
- increased center-to-center seat spacing may be specified where high school and junior college students are to be transported exclusively.
- driver's seat: special consideration should be given to the driver's seat; is it adjustable both vertically and horizontally? can the seat be readily equipped with a seat belt? is the driver's view when seated unobstructed? is the seat comfortable?

Stanchions and guard rails B13 (Minimum standard, page 49.)

Windshield and windows B14 (Minimum standard, page 52.)

Wiring B15 (Minimum standard, page 53.)

The wiring of the bus carries electrical power to operate the heater, the defroster, and all lights and signals. Failure can be dangerous. It should be designed to provide a lifetime of service without costly replacement. If the system fails for any reason, it should be easy to check and pinpoint the trouble.

In any bus, most of the wiring runs behind the interior paneling or is concealed behind interior molding and thus cannot normally be seen unless the paneling or molding is removed. It is, therefore, important to inquire about the wiring. The wiring should be well insulated and adequately protected against chafing and wear.

It is a good idea to inspect a sample of the wiring used in every bus under consideration and to obtain the answers to these questions: Is all wiring adequately insulated and well protected? Does all wiring run inside the bus to avoid exposure to the corrosive effects of dust, road salts, and moisture? Is the gauge of the wire such that it will be able to carry the required electrical load without loss of voltage? Is a separate fuse or circuit breaker provided? Is it easy to get at? Is a diagram of the entire wiring system provided? Is wiring color-coded and easy to trace? Are wiring circuits protected by circuit breakers or fuses? Are switches and electrical controls within easy reach of the driver? Is the electrical control panel illuminated?

Other items (Minimum standards: Fire extinguisher, page 38; First-aid kit, page 38; Sun shield, page 51; Windshield washers, page 52; Windshield wipers, page 52.)

A number of auxiliary items of equipment will require special attention in purchasing the school bus.

Information for Bid Proposals

The following forms and checklists are intended to serve only as suggestions. They should be carefully reviewed for possible additions, deletions, and/or modifications in terms of local requirements. Securing school bus bids through the use of a format which clearly indicates specific local requirements has the following advantages: (a) vendors' and manufacturers' representatives, because they have available a clear and concise statement of local requirements, can often provide the potential purchaser with a firm and more realistic bid, and (b) the potential purchaser, as a result of use of concisely prescribed specifications, can more easily compare and evaluate each bid submitted in terms of specific and comparable items. Valuable information and guidance relative to sound school purchasing practices and procedures is available in Bulletin No. 22 of the Association of School Business Officials.⁴⁷

It is essential that the potential purchaser be thoroughly familiar with the school bus chassis and bodies that are available from the various manufacturers. Acquiring a familiarity with the equipment available can be accomplished in a number of ways: (a) through a study of the manufacturers' sales literature, specifications lists, catalogs, and data books, (b) through discussion and/or conferences with the manufacturers' sales representatives, and (c) through conferring with colleagues who are also working in this area.

The purchaser should analyze the specific characteristics of the various manufacturers' products before preparing school bus specifications information for bid proposals. Otherwise, the purchaser will, in all probability, unknowingly eliminate potential bidders and thus destroy any advantage to be derived from the preparation of specifications information in purchasing school buses.

The preparation and use of a master table whereby the purchaser can list and compare, item by item, the characteristics of various products represents one of the methods or techniques commonly used to make a comparative analysis of a number of similar items.

⁴⁷ *Purchasing and Supply Management Manual for School Business Officials*, Bulletin No. 22, by H. Spilman Burns, Chairman. A special report prepared by the ASBO Research Committee in Purchasing and Supply Management (Association of School Business Officials, Evanston, Illinois: 1962).

Checklist of Chassis Information

This checklist is intended to suggest the kinds of items that need to be considered in developing purchasing specifications for the chassis of a conventional type school bus. For illustrative purposes, the specifications information shown is for the chassis of a vehicle having a 60-passenger capacity.

Item	Specifications Information
C 1 Pupil capacity of vehicle.....	60 passenger
Average actual G.V.W.....	18,800 lbs.
Manufacturer's recommended G.V.W.....	20,000 lbs.
C 2 Engine	
1. Number of cylinders.....	8
2. Required minimum net rating (as computed in accordance with power and gradeability formula).....	57.9 net H.P. @ 1,325 R.P.M.
C 3 Clutch	
1. Diameter of clutch	
a. 11-inch	_____
b. 12-inch	x
c. 13-inch or of equivalent performance	_____
C 4 Transmission	
1. Type	
a. mechanical	_____
b. mechanical-synchronized	x
c. automatic	_____
2. Number of forward speeds.....	5
C 5 Drive shaft	
1. Number of sections.....	3
2. Number of protective guards.....	3

Item	Specifications Information
C 6 Axles (based on weight distribution of 25%-75%)	
1. Front axle capacity minimum (in lbs.)	4,700
2. Rear axle capacity minimum (in lbs.)	14,100
3. Rear axle ratio.....	7.2:1
C 7 Brake system	
1. Vacuum-actuated	_____
2. Compressed-air-over-hydraulic	x
3. Full compressed-air	_____
C 8 Bumper, front	
C 9 Cooling system	
Radiator capacity.....	minimum 14 quarts
C 10 Electrical equipment	
C 11 Battery	
Required ampere hrs. at 12 volts measured at 20-hour rate.....	70 amperes
C 12 Generator or alternator	
1. Generator	_____
2. Alternator	x
rated capacity	60 amperes
charging rate at idle	15 amperes
voltage-controlled	x
current-controlled	x
C 13 Exhaust system	

Item	Specifications Information
C 14 Filters	
1. Air cleaner	
a. type	
(1) oil bath	x
(2) dry-element	-----
b. size or capacity	minimum 2 pints
2. Oil filter	
a. type	
(1) replaceable element	x
(2) built-in	-----
(a) by-pass type	-----
(b) full-flow type	x
b. size or capacity	minimum 1 quart
 C 15 Fuel tank	
Capacity (in gallons)	minimum 30 gallons
 C 16 Shock absorbers	
1. Front	
a. size or capacity.....	shall be of adequate size for axle load
2. Rear	
a. size or capacity.....	shall be of adequate size for axle load
 C 17 Springs	
1. Front	
a. minimum required capacity (in lbs.)	2,350
2. Rear	
a. minimum required capacity (in lbs.)	7,050

Item	Specifications Information
C 18 Tires and rims	
1. Tires	
a. number	7
b. tube type	x
c. tubeless	_____
d. size	8.25-20
e. ply rating	10
f. type tread	
(1) snow tread	_____
(2) regular	x
2. Rims	
a. number	7
b. type	.
(1) preferred	_____
(2) alternate	x
c. size (in inches)	6.0
Miscellaneous	
1. Tow hooks are to be provided	
a. Front	x
b. Rear	_____
2. Serial number plate is to be provided	
a. yes	x
b. no	_____
c. information required on the serial plate	
(1) serial number	x
(2) maximum G.V.W. rating	x
(3) wheelbase length	x
(4) rear axle ratio	x
d. parts and service manual required	
(1) yes	_____
(2) no	x

Checklist of Body Information

This checklist is intended to suggest the kinds of items that need to be considered in developing purchasing specifications for the body of a conventional type school bus. For illustrative purposes, the specifications information shown is for the body of a vehicle having a 60-passenger capacity.

Item	Specifications Information
B 1 Body type	conventional
B 2 Body size	
1. Pupil capacity	60-passenger
2. Seating plan:	
a. 3-3 plan	x
b. 3-2 plan	_____
c. other	_____
3. Maximum body length (in inches).....	332 inches
B 3 Body construction	
B 4 Insulation (body)	
B 5 Rust protection (body)	
1. Undercoating required	
a. yes	x
b. no	_____
2. Painting	
a. exterior color (entire body including hood, cowl, and fenders)	National school bus chrome
b. rear bumper and lettering.....	black
c. interior color	tan
B 6 Bumper, rear	
B 7 Doors, entrance	
1. Type	
a. split-leaf	_____
b. sedan	x
c. jackknife	_____
2. Method of operation	
a. manual	x
b. power	
(1) air	_____
(2) vacuum	_____
B 8 Floor covering	

Item	Specifications Information
B 9 Heating	
1. Type heater	
a. hot water	x
b. combustion	_____
2. Number	3
3. Location	
a. Heater No. 1	back of rear wheel housing
b. Heater No. 2	near service door
c. Heater No. 3	in driver's compartment
4. Capacity	capable of providing for an even and ade- quate distribution of heat throughout the bus
B 10 Identification (required lettering)	
1. Words "SCHOOL BUS" in 8-inch let- ters, front and rear	x
2. Words "STOP ON SIGNAL" in 5-inch letters, rear	x
3. Bus number "32" on four corners of bus roof	6" numbers
4. Name of school district on sides of bus	4½" letters
B 11 Lamps and signals	
B 12 Seats	
1. Upholstery (seat cushion and back rest)	
a. type	
(1) artificial leather	x
(2) other	_____
b. color	to be specified
2. Type of seat cushion construction	
a. springs padded	x
(1) cotton	2 inches thick
(2) rubberized hair	_____
(3) foam rubber	_____
(4) other	_____
b. foam rubber	_____

Item	Specifications Information
c. polyurethane foam	_____
d. other	_____
3. Fiber-glass	_____
4. Driver's seat	
a. type	
(1) adjustable	x
(2) equipped with seat belt.....	x
(3) other	_____
b. upholstery (seat cushion and back rest)	
(1) type	
(a) artificial leather	x
(b) other	_____
(2) color	to be specified
c. type of seat cushion construction	
(1) springs padded	x
(a) cotton	3 inches thick
(b) rubberized hair	_____
(c) foam rubber	_____
(d) other	_____
(2) foam rubber	_____
(3) polyurethane foam	_____
(4) other	_____

B 13 Stanchions and guard rails

B 14 Windows and windshield

1. Type glass in side windows	
a. laminated	x
b. tempered	_____
2. Type windshield	
a. flat	x
b. curved	_____
c. heat-absorbent	x

Other items

A number of other items of equipment will require special attention in purchasing the school bus. For example, such items as the fire extinguisher(s), first-aid kit, wiring, windshield washers, windshield wipers, sun shield(s), rear view mirrors, governor, horns, and tools will require special consideration in preparing the purchasing specifications. A number of these items may be purchased either separately or with the vehicle itself.

Suggested Bid Form*

Gentlemen:

Pursuant to your call for bids on, 19....., the undersigned hereby proposes and agrees to furnish and deliver to

.....
name

.....
address of purchaser

the following:

No. of units	Chassis			Body			Pupil capacity (seated)
	Make	Model No.	Year	Make	Model No.	Year	

The above items, which comply with all state and/or local requirements, regulations, and standards, will be furnished and delivered to the above purchaser for total sum of:..... \$_____

Trade-in allowance

..... \$_____

Bid less trade-in allowance

All prices on equipment are (a) f.o.b. at plant.. \$_____

(b) delivered \$_____

Approximate or suggested delivery date.....

The bidder certifies that he has read, understands, and will comply with all specifications and conditions as set forth in the attached documents.

Respectfully submitted,

Bidder.....

By

* It is recommended that legal advice be obtained relative to the development of the bid form for submitting bids in terms of specific state laws and administrative rules and regulations.

APPENDIX

Summary of Past National Conferences

The National Conference on School Bus Standards, sponsored by the National Council of Chief State School Officers and held at Columbia University in 1939, pioneered in the development of nationally recommended standards for the construction of school buses.

In 1945, a National Conference on School Bus Standards, sponsored by the National Council of Chief State School Officers and administered by the NEA National Commission on Safety Education, was held at Jackson's Mill, West Virginia, to revise certain existing standards and develop others which were felt to be essential. In addition, the Conference set up standards for small vehicles to meet the needs of schools in sparsely settled areas.

The primary purpose of the 1948 Conference, also held at Jackson's Mill, West Virginia, was to develop standards for the selection and training of school bus drivers. On the advice of state transportation officials and school bus manufacturers, however, it was decided that one day be devoted to revising certain sections of the existing school bus standards. A significant step at this Conference was the adoption of flashing lights in preference to the stop signal arm. A special committee of transportation officials worked jointly with the Society of Automotive Engineers on the specifications for the flashing lights. The two publications resulting from the Conference were: *Minimum Standards for School Buses* (1948 revised edition) and *Standards and Training Programs for School Bus Drivers*.

In 1951, at the request of the National Council of Chief State School Officers, an Interim National Conference on School Transportation, administered by the NEA National Commission on Safety Education, was held in Washington, D. C. The recommendations of this Interim Conference were published as *Tentative Minimum Standards for Transit and Metropolitan Types of School Buses*.

At the request of the National Council of Chief State School Officers, the NEA National Commission on Safety Education administered the 1954 Conference which was held at Michigan State University in East Lansing. Among the purposes of the 1954 Conference were: revision of the 1948 *Minimum Standards for School Buses*; revision of the 1951 *Tentative Minimum Standards for Transit and Metropolitan Types of School Buses*; development of recommendations for extended educational uses of school buses; consideration of the so-called 'school bus stop law' and other laws and regulations on which national uniformity is desirable; and development of recommendations to further the training of school bus drivers. The published report of this Conference was titled *Minimum Standards for School Buses* (1954 revised edition).

Following a request in 1957 of the Council of Chief State School Officers that another national conference on school transportation be held, the NEA National Commission on Safety Education held four regional conferences during 1958 to identify problems in need of national conference consideration. Representatives of 39 state education departments, together with staff of the U. S. Office of Education and of the Commission, attended these regional meetings.

At its meeting early in 1959, the Conference steering committee authorized six study committees which met later that year to consider problems suggested in the regional meetings and to develop proposals for consideration at the national level. These study committees were ably assisted by technical consultants from the School Bus Body Manufacturers' Association (an Industry Division of the Truck Body and Equipment Association); Automobile Manufacturers Association; Society of Automotive Engineers; Underwriters' Laboratories, Inc.; Tire and Rim Associa-

tion; American Association of Motor Vehicle Administrators; National Committee on Uniform Traffic Laws and Ordinances; and National Bureau of Standards of the U. S. Department of Commerce.

Technical consultants from the above groups and representatives of many other national organizations participated in the 1959 Conference held at the University of Kansas in Lawrence. For the first time at any such national conference an exhibit of school bus components and related equipment was held in which nearly 20 companies took part.

The Conference revised the *Minimum Standards for School Buses*; revised the earlier publication on school bus drivers and gave it a new title—*Selection, Instruction, and Supervision of School Bus Drivers: Recommended Policies and Practices*; and recommended changes in and additions to the *Uniform Vehicle Code*.

Again at the request of the Council of Chief State School Officers, the NEA National Commission on Safety Education organized and administered the 1964 National Conference on School Transportation at the NEA Education Center in Washington, D. C. The Conference steering committee authorized four study committees which met in advance and formulated proposals for Conference consideration on matters concerning school bus bodies and chassis, drivers, and traffic regulations.

More than 300 persons from 47 states attended the 1964 Conference, representing: state and local school systems; other state agencies; school bus chassis, body, and equipment manufacturers; national organizations; federal government agencies; and colleges and universities.

In addition to revising reports of earlier Conferences on school bus standards and school bus drivers, the 1964 Conference developed recommended standards for vehicles used to transport handicapped children and worked out suggestions for developing purchasing specifications for school buses. The material on these new subjects is included in this report. A companion report presents revised recommendations on school bus drivers and includes new material on school bus accident reports and their use. It is published under the same title used earlier—*Selection, Instruction, and Supervision of School Bus Drivers: Recommended Policies and Practices*.

National School Bus Chrome

The color known as National School Bus Chrome was designated as such by the 1939 National Conference on School Bus Standards. The National Bureau of Standards of the U. S. Department of Commerce assisted in developing this color and its colorimetric specifications, as follows:

C. I. E. Chromaticity coordinates		Daylight reflectance Y (%)			Dominant wavelength (in millmicrons)			Excitation purity p (%)		
x	y	max.	std. min.	max.	std. min.	max.	std. min.	max.	std. min.	
.5211	.4549	—	41. 40.	584.5	583.5	582.5	—	93.7	89.0	

Available from the General Services Administration, Business Service Center, Region 3, Seventh and D Streets, S.W., Washington, D. C. 20407, are copies of Federal Specification TT-E-489c entitled *Enamel, Alkyd, Gloss, (for Exterior and Interior Surfaces)*. This document gives technical requirements; sampling, inspection, and test procedures; preparation for delivery instructions; and other information needed by paint manufacturers supplying specific colors of paint.

Statutory Provisions for School Transportation

The function of a legislative statute concerning school transportation should be to authorize the state education department or some other state agency to make necessary regulations governing school bus construction, equipment, and operation. Such regulations should not be incorporated in the statute itself. States in which proper statutory provision does not exist should give careful consideration to the following statements:

1. The increasing number of pupils being transported is adequate evidence of the need for state regulations governing the construction, equipment, and operation of school buses. Such state regulations constitute the best assurance that pupils will be transported in safety and with reasonable economy.

2. Both educational theory and the experience of a majority of the states indicate that the agency best qualified to establish such regulations is the state department of education or a committee of the state authorities directly concerned with safe school transportation, with the chief state school officer as executive officer.

3. The responsibility of the state department of education to establish rules and regulations governing school bus construction, equipment, and operation should be fixed through a single statutory provision which confers broad powers upon the department. Following are two examples of desirable types of laws which are reproduced as suggestions to states desiring to enact an effective statute:

The State Board of Education may adopt reasonable regulations relating to the construction, design, operation, equipment, and color of school busses. No regulation relating to the construction, design, or color of school busses shall apply to busses purchased prior to September 15, 1935. Any school bus repainted after September 15, 1935, shall be painted to conform to all the regulations relating to the color of school busses. The regulations, if approved by the Commissioner of the California Highway Patrol, shall be enforced by the California Highway Patrol. The State Board of Education may issue an order prohibiting the operation on public streets, highways and elsewhere of any school bus which does not comply with the regulations. The order shall be enforced by the California Highway Patrol. (California Education Code, Section 16852.)

All vehicles hereafter purchased or placed in use for the transportation of pupils, whether owned or hired by the school district, shall conform to standards prescribed by the State Council of Education. Such standards, when promulgated by the State Council of Education, may be revised not oftener than once each year, and whenever new requirements are made, they shall be published at least six months before they shall become effective, and shall apply only to vehicles thereafter purchased or put in use. (School Laws of Pennsylvania, Article XIII, Section 1363.)

4. State departments of education, in those states which have not already placed upon some state department the responsibility of setting up state rules and regulations for school buses, should use the first opportunity to request their legislatures to place this responsibility upon the state department of education.

Uniform Vehicle and Traffic Regulations

The need for uniform state legislation on a nationwide basis concerning vehicles and traffic was formally recognized in 1924 when the Secretary of Commerce called the first National Conference on Street and Highway Safety. During the following two years a committee appointed by that Conference drafted the *Uniform Vehicle Code*.^{*} This *Code* represented a compromise reached after a study of all state statutes on vehicles and traffic and became a distillation of the best thought and practice in the field. Judges, prosecutors, lawyers, police, motor vehicle administrators, educators, traffic engineers, safety specialists, business people, and others have taken part in developing successive revisions of the *Uniform Vehicle Code*.

Numerous professional and other groups, both official and non-official, recommend adoption of the *Uniform Vehicle Code* by all states. Although much progress has been made, a great deal more is needed to assure reasonable uniformity of the vehicle and traffic laws among all the states. For a number of years the National Committee on Uniform Traffic Laws and Ordinances has carried forward the work of revising the *Code* to keep it up to date. As a result it meets changing conditions, improved techniques, and advances in the design of highways and vehicles.

The 1945 National Conference on School Transportation recommended uniform traffic regulations regarding school transportation and proposed a change in the *Uniform Vehicle Code* regarding overtaking and passing school buses. The National Committee on Uniform Traffic Laws and Ordinances reviewed the proposed change and suggested a further revision of the pertinent section of the *Code*. After studying the suggested revision, the 1948 National Conference on School Transportation approved it and, in addition, recommended that flashing lights be used on school buses. The *Code* was subsequently revised to include provisions both on overtaking and passing school buses and on special lighting equipment on school buses. Thus, efforts of both national groups were combined in support of agreed-upon objectives.

Since 1948, the National Conferences on School Transportation have studied problems of uniform traffic laws affecting school buses and have occasionally recommended changes in or additions to the *Uniform Vehicle Code*. As revised in 1962, the *Code* defines a school bus and includes provisions relating to the minimum age of school bus drivers, overtaking and passing school buses, special lighting equipment on school buses, and the authority of state boards of education to regulate the design and operation of school buses.

The continued efforts of state education departments and the National Committee on Uniform Traffic Laws and Ordinances can bring about more uniform state laws that will greatly enhance the safety of the millions of children who ride to and from school every day in school buses.

^{*} Most recent revision obtainable from National Committee on Uniform Traffic Laws and Ordinances, 1319 Eighteenth Street, N.W., Washington, D. C. 20036. Price, \$2.

Suggested Method for Estimating Generator or Alternator Capacity

Constant Load

Equipment	Number of Units	Current Draw (Amperes)
Ignition		2.50 (average)
Head lamps (Type 2 dual lower beam).....	2	8.40
Tail lights	2	1.18
Clearance lights	4	2.36
Cluster lights	6	3.54
Body instrument panel		0.80
Primary front heater motors.....	2	24.00
Primary defroster motor.....	1	12.00
Supplementary front heater motor.....	1	12.00
Supplementary defroster motor.....	1	12.00
Underseat heater motors.....	2	10.50
Underseat heater motor.....	1	8.50
Defroster fan motor.....	1	3.50
Windshield wipers		14.00
Fuel pump		3.00
Emergency door buzzer.....		1.00

Intermittent Load

Flasher motor		2.90
Alternately flashing signal lamps.....	2	11.60
Step-well and 6 interior dome lights.....		5.64
Individual additional dome lights.....		0.94
Stop (brake) lights.....	4	6.60
Turn signals	2	2.36

To determine the electrical load (in amperes) for a typical school bus, the following formula is recommended:

$$\text{Constant load} + 35\% \text{ of intermittent load} = \text{total load.}$$

Formula for Calculating Power and Gradeability

$$G = \frac{33750 \times \text{H.P.}}{\text{G.V.W.} \times \text{M.P.H.}} - 1.5 \quad \begin{array}{l} \text{(for buses having seating capacity} \\ \text{up to and including 67 pupils)} \end{array}$$

or

$$- 1.2 \quad \begin{array}{l} \text{(for buses having seating capacity} \\ \text{of 68 or more pupils)} \end{array}$$

Where G = Grade in percent

H.P. = Certified net horsepower delivered at road speed
(M.P.H.)

G.V.W. = Gross vehicle weight (see table on page 26)

M.P.H. = Miles per hour vehicle is driven

Rolling Resistance = 1.5 or 1.2 (depending on seating capacity of bus)

TITLES AND ADDRESSES OF PRINCIPAL STATE SCHOOL OFFICERS

(for use by manufacturers in furnishing information
to state departments of education)

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