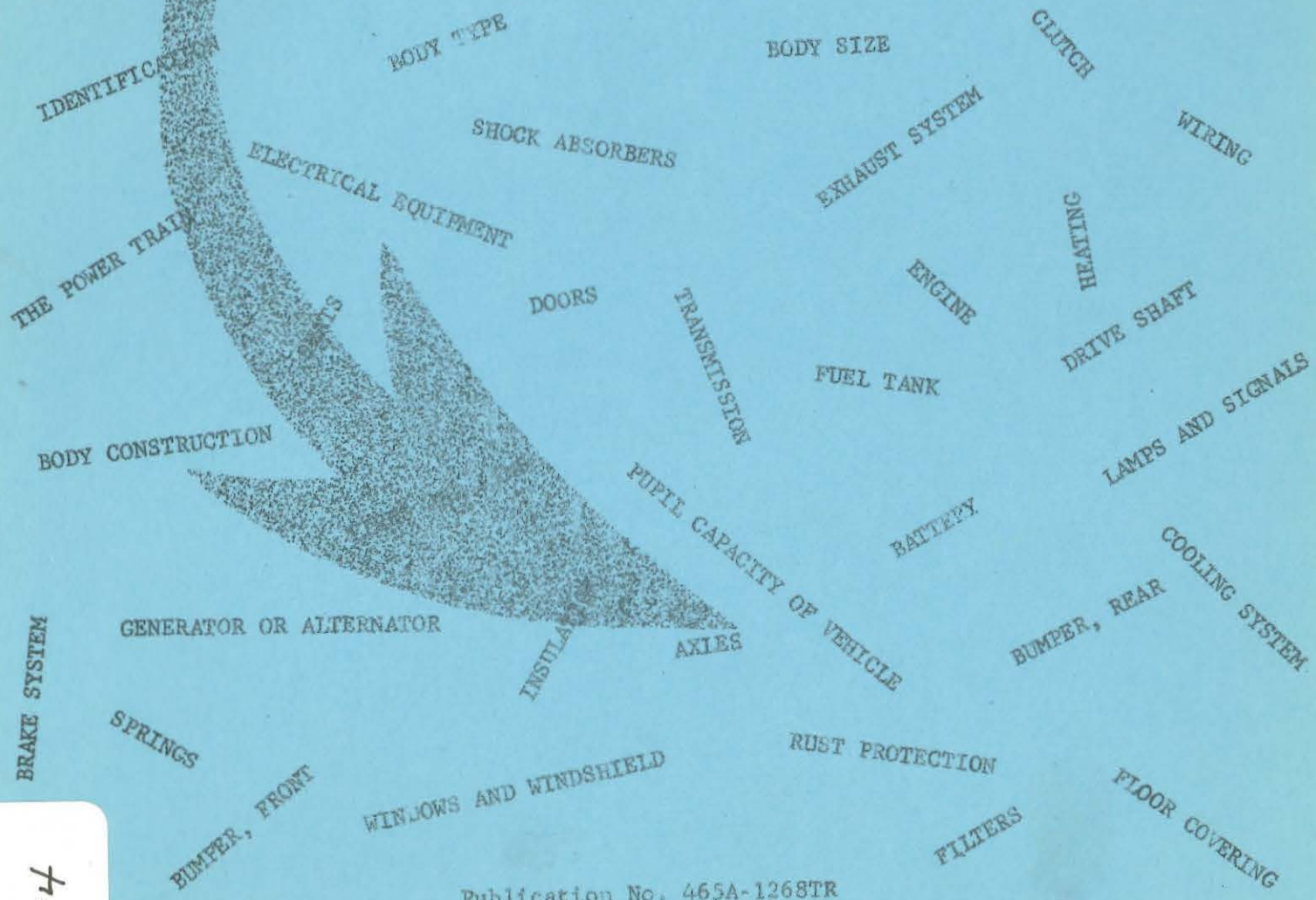
A Guide for

DEVELOPING SCHOOL BUS PURCHASING SPECIFICATIONS



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FOREWORD

Since school buses represent a large investment, it becomes necessary for local district officials to make certain that their money is expended in a prudent manner. Purchasing the "right" bus is not an easy task, especially if the superintendent has no one to assist him in the operation of the transportation program.

We have known of many instances whereby a school district has merely notified chassis and body dealers that bids were being requested on a certain capacity bus. The only specification mentioned in the notice, except for the capacity, was the requirement that the bus meet Iowa Standards.

Under these conditions, not only is it difficult for a seller to prepare a bid proposal which is comparable to a competitor's, but in all probability each bid will contain a difference in some of the items included in the bid proposal. This also makes it more difficult for the board to compare the bids and make a sound decision.

For example, one chassis dealer's bid may be on the basis of a 60-amp alternator and another dealer might be bidding in terms of a 100-amp alternator. This one item alone could show enough difference in the amount of the bid to cause the former to be awarded the contract. If both dealers had been bidding on the same capacity alternator, it is quite possible that the latter dealer would have received the contract.

This guide has been prepared in terms of the recommendations of the 1964 National Conference on School Transportation. It must be emphasized that these are only suggestions and must be adjusted on the basis of local needs.

Paul F. Johnston

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Superintendent of Public Instruction

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Using this Guide. An effort was made in developing this guide to fulfill a twofold purpose: (1) to set forth those major considerations in which decisions are required in selecting school buses, and (2) 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 the Minimum Standards for School Buses, but rather merely attempt to support and supplement the standards;

(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 solely with the conventional type school bus body and chassis. 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.

Introduction

School bus equipment 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 vehicle will be operating, traffic conditions, probable operating speeds, and the chassis ratings required to provide the capacity necessary in given route situations.

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

PART I -- SELECTING THE CONVENTIONAL 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 the (1) length of frame cowl to axle, (2) gross vehicle weight, and (3) the capacity of various chassis components, such as axles, springs, and engine sizes.

Computing the gross vehicle weight C1*

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.

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*This coding system (C1, C2, etc.) refers to the chassis specifications checklist on pages 28 to 32.

To determine the gross vehicle weight, add the weight of the chassis wet (with oil, water, and a full tank of fuel) with specified tires, plus the weight of the bus body, plus the weight of the pupil passengers, plus the driver's weight, plus an extra overload weight allowance for standees if permitted by State law. (not permitted in Iowa)
For purposes of illustration, the actual average gross vehicle weight of a 60-capacity bus might be computed as follows:

Weight of chassis (wet)*.....	6,000 lbs.
Total weight, bus body.....	6,000 lbs.
Total weight, pupils.....	6,900 lbs.**
Drivers weight.....	150 lbs.
Extra weight allowance.....	200 lbs.***
Total actual average gross vehicle weight.....	19,250 lbs.

Thus, in this particular case the purchaser should indicate in his specifications the need for a conventional chassis having a gross vehicle weight rating of at least 19,250 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:****

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*Weight of the chassis with oil, water, and full tank of fuel.

**60 pupils x 115 lbs. per pupil.

***For illustrative purposes this figure could represent an additional weight allowance for certain optional items of equipment such as tires, axles, and springs.

****It should be noted that the manufacturers' recommended minimum G.V.W. ratings exceed the average actual G.V.W. ratings listed in the table. This indicates that these minimum 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 cautioned, therefore, that just as it is important to select adequate equipment for the job to be done, it is equally important not to "over buy" in terms of performance.

Chassis size or capacity	Average actual G.V.W.*	Manufacturer's recommended minimum rated G.V.W.*
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

The gross vehicle weight rating for a given chassis as published will change when options for tires, axles, springs, shock absorbers, vacuum tanks, and 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 power train C2

The following chassis components are generally considered to be an integral part of the power train: engine, clutch, transmission, drive shaft, and axles.

*Based on data contained in chassis manufacturers' new proposed power and grade ability formula.

The engine C3 (Power or grade ability--Minimum standard, page 13.)*

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, and a 7.17 to 7.2 rear axle ratio, should meet the following minimum net H.P. ratings for the various chassis sizes or capacities:**

Chassis size or capacity	Manufacturer's recommended minimum rated G.V.W.	Recommended tire sizes				Required minimum net horsepower rating
		Tube type tires		Tubeless tires***		
		Size	Ply	Size	Ply	
36	14,000	7.00-20	8	7-22.5	8	40.7 at 1390 rpm.
42	16,000	7.50-20	10	8-22.5	10	45.4 at 1368 rpm.
48	17,000	7.50-20	10	8-22.5	10	49.5 at 1368 rpm.
54	18,000	8.25-20	10	9-22.5	10	53.9 at 1325 rpm.
60	20,000	8.25-20	10	9-22.5	10	57.9 at 1325 rpm.
66	22,000	9.00-20	10	10-22.5	10	62.2 at 1267 rpm.

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 its normal operating speed from a standing start; in other words, its acceleration. Even the lowest powered bus will operate at a top speed equivalent to the safe speed limit for buses, but good acceleration may require additional horsepower or shifting into a lower gear. In

*This and subsequent similar notations refer to the page on which the minimum standard appears in our Bulletin TR-B-3R (Revised).

**Based on data contained in chassis manufacturers' new proposed power and grade ability formula.

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

other words, the size and weight of the vehicle and geographic terrain in which the vehicle 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 local school bus route in light of whether or not the route consists of level hard-surfaced roads over which traffic is light, hills, 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 places demands on the engine power supply which can reduce the amount of acceleration potential of a given engine and thus represents an important factor to be considered.

The clutch C4 (Minimum standard, page 8.)

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	11
54	11
60	12
66	13 or of equal performance

Transmission C5 (Minimum standard, page 15.)

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 conditions over which the vehicle will operate. The transmission should provide for a minimum of four (4) forward speeds, and some situations will require a five (5) forward speed transmission 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 ration, 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 distance between stops.

Automatic transmissions may pay for themselves over the life of the vehicle in terms of fewer needed repairs. 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 48 passenger chassis and up.

Drive shaft C6 (Minimum standard, page 9.)

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

Axles C7 (Minimum standards: Axles, page 6; Weight distribution, page 15.)

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 axles

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 minimum capacities for the various chassis sizes:*

(see table on next page)

*The required minimum 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 minimum front axle capacity required for a given school bus.

Chassis size or capacity	Average actual G.V.W.	Required minimum front axle capacities (in lbs.)*	
		A**	B***
36	13,200	3,630	5,082
42	14,700	4,043	5,660
48	16,100	4,428	6,199
54	17,500	4,813	6,738
60	18,800	5,170	7,238
66	20,200	5,555	7,777

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 minimum capacities for the various chassis sizes:****

(see table on next page)

*The required 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. Normally 25% to 35% of the average actual gross vehicle weight is supported at the ground by the front tires.

**Capacities listed in Column A were computed in the following manner: 25% of the average actual gross vehicle weight supported at ground by the front tire plus an additional allowance of 10% in excess of the actual weight.

***Capacities in Column B were computed in the following manner: 35% of the average acutal gross vehicle weight supported at ground by the front tire plus an additional allowance of 10% in excess of the actual weight.

****The required minimum 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 minimum rear axle capacity required for a given school bus.

Chassis size or capacity	Average actual G.V.W.	Required minimum rear axle capacities (in lbs.)*	
		A**	B***
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

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 distance between

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*The required 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. Normally 65% to 75% of the average actual gross vehicle weight is supported at ground by the rear tires.

**Capacities listed in Column A were computed in the following manner: 65% of the average actual gross vehicle weight supported at ground by the rear tires.

***Capacities in Column B were computed in the following manner: 75% of the average actual gross vehicle weight support at ground by the rear tires.

stops is 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 C8 (Minimum standard, page 7.)

Adequate brakes are an especially important consideration in selecting a school bus chassis.* Brakes normally available for school buses are of three types: (1) hydraulic with vacuum booster, (2) air over hydraulic, and (3) full compressed air. The line pressures of vacuum-assisted hydraulic 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.

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*Proper maintenance and adjustment of brakes is essential. The most satisfactory brake without proper maintenance and adjustment may prove to be unsatisfactory in an emergency if it has not received regular maintenance to meet a performance standard.

Actually, 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 the square inch of brake lining area in the opinion of a number of automotive engineers.

Bumper, front C9 (Minimum standard, page 8.)

Cooling system C10

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

Electrical equipment C11

The electrical equipment and wiring on most school bus chassis should be sufficient for normal operating requirements with the possible exception of two items: (1) the battery, and (2) the generator or alternator.

The additional lights and signals required on the modern school bus provide more and more of a tax on the generator and the battery. For this reason care should be exercised in choosing these two items.

a. Battery C12 (Minimum standard, page 7.)

With the increase of demand for sufficient current to care adequately for 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 the battery and its location with reference to ease of servicing and the shielding of the battery from excessive heat.

b. Generator or alternator C13 (Minimum standard, page 11.)

For guidance in selecting a generator or alternator of adequate capacity, see suggested method for estimating Generator or Alternator Capacity, page 11.

Exhaust system C14 (Minimum standard, page 9.)

Filters C15 (Minimum standards: Air cleaner, page 6; Oil filter, page 13.)

Air filters may be one of these types: (1) oil bath, (2) dry element type.

Chassis are normally equipped with one of two types of oil filters: (1) the renewable cartridge, or (2) the sealed unit. The sealed unit can be of the by-pass or full-flow type.

Fuel tank C16 (Minimum standard, page 10.)

Shock absorbers C17 (Minimum standard, page 14.)

Springs C18 (Minimum standards: Power and grade ability, page 13; Springs, page 14; Weight distribution, page 15.)

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

Tires and rims C19 (Minimum standard, page 14.)

The tires specified should be adequate to support the gross weight of the vehicle loaded. The tire capacity, size, and ply as rated according to the Tire and Rim Association, plus a 10 percent margin for each tire, is recommended in selecting tires for school buses. All tires on a school bus should be of the same size and capacity. Some authorities feel that vehicles carrying more than 24 passengers should be provided with dual rear wheels when conditions warrant.

Tires and wheels must be selected with safety and longevity in mind. Tires and wheel sizes should be adequate to support the load with margin to spare. Properly selected, today's tires minimize dangers.

Four considerations will determine the size and type of tires. These are (1) gross vehicle weight, (2) type of road surface in the operational area, (3) type of operation, i.e., long runs with a few stops or many starts and stops, and (4) size, type, and number of wheels. The various tire companies can advise on the type of tread and the construction for variations in operation.

Special tire treads may be specified when so desired, i.e., snow tread, mud grip, etc.

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

*Based on data contained in chassis manufacturers' new proposed power and grade ability formula, with additional figures for tubeless tires obtained from the Tire and Rim Association.

Chassis size or capacity	Tube type		Tubeless		Rim sizes			
					Tube type tires		Tubeless tires	
	Tire size	Ply	Tire size	Ply	Pre-ferred	Alter-nate	Pre-ferred	Alter-nate
36	7.00-20	8	7-22.5	8	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*

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.....	8	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	6.0	6.0	6.75	6.75	7.5
alternate.....	None	5.25	5.25	6.00	6.0	6.75
Min. net H.P. required	40.7	45.4	49.5	53.9	57.9	62.2
at engine R.P.M....	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%±10%)-75% weight distribution/						
front axle.....	3,630	4,043	4,428	4,813	5,170	5,555
rear axle.....	9,900	11,025	12,075	13,125	14,100	15,150
/(35%±10%)-65% weight distribution/						
front axle.....	5,082	5,660	6,199	6,738	7,238	7,777
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

*Based on data contained in chassis manufacturer's new proposed power and grade ability formula. (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 7.17:7.2 rear axle ratio.)

**or higher

***or of equal performance

PART II -- 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: (1) length and type of chassis, (2) chassis components, and (3) seating arrangements.

The purchaser must consider his school bus body needs in terms of capacity and certain other related factors such as: (1) safety and comfort, (2) ease of maintenance, (3) type of terrain and local road conditions, (4) availability of parts and services, (5) maneuverability in traffic, (6) driver visibility, (7) quality of construction, and (8) reasonableness of cost. He must examine the various types of bus bodies and select the most suitable one in terms of his needs.

Various types of school bus bodies

The different types of school bus bodies available are as follows: Conventional, Transit, and Suburban. Other miscellaneous types of vehicles such as sedans, station wagons, and carry-alls are often used for pupil transportation purposes. As has been previously indicated, however, this guide will deal only with the conventional type school bus body.

The conventional school bus body B1*

The conventional type bus body is built on a truck 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

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*This coding system (B1, B2, etc.) refers to the body specifications checklist, pages 33 to 38.

a conventional body can be used to advantage in rural areas. In general, local mechanics will be capable of caring for and repairing the engine. Any parts that must be replaced are relatively easy to obtain. The price for a bus with a conventional body is usually less than that for the transit type. It is normally available in the following pupil seating capacities: 24, 30, 36, 42, 48, 54, 60 and 66.

Body sizes B2

Body construction B3 (Minimum standard: Construction, page 17.)

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 their 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, you will notice that the overall weight and the gauge of the steel components may not be an accurate measure 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 weight, a bus will offer better gas mileage, better road handling, and more efficient braking.

Here are some of the 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 steel, used in the body, of commercial quality that conforms to the specifications as set forth in the Minimum Standards for School Buses? Does the bus body meet the School Bus Body Manufacturers' Association "Static Load Test Code for School Bus Body Structure?"

Before purchasing a school bus, it may be profitable to determine for comparative purposes the structural components of available conventional bus 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, the main and intermediate floor beams, as well as the distance 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 of both penetration of outside objects and/or 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 if 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 (body posts, strainers, and stringers) across the rear and at the rear corners.

Rub rails (Minimum standard, page 28.)

Insulation (Minimum standard, page 23.)

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 31.)

Bumper, rear B6 (Minimum standard, page 16.)

Doors B7 (Minimum standard, page 18.)

There are three types of school bus entrance doors: (1) split leaf (center split), (2) folding jack-knife (center hinged), and (3) sedan (solid one-piece door). These doors can normally be

operated or controlled in three different ways: (1) manually, (2) by air, and (3) by vacuum. Each type of control may have certain advantages when teamed with one or more of the aforementioned types of doors.

Buses of the conventional type usually have doors that are either manually operated or air operated.

Floor covering B8 (Minimum standard, page 21.)

Heating, defrosting, and ventilation B9 (Minimum standards: Defrosters, page 18; Heaters, page 22; Ventilation, page 31.).

The question of heaters and defrosters is closely related to the climatic conditions of a given locality. In some of our 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, heating and defrosting may present no particular problem.

BTU heater ratings are not always reliable guides to heating efficiency. It is the chassis engine that produces the heat, and this production of heat will be essentially the same for different bus bodies. 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.

Relative to effective defrosting, fans or blowers should have enough power to defrost the entire front windshield. This is essential to provide good driver vision at all times. A fogged windshield is a definite safety 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 22.)

Lamps and signals B11 (Minimum standard, page 23.)

Seats B12 (Minimum standard, page 28.)

Seats are one of the larger cost items in the school bus, not only in the initial cost of the vehicle but also in its 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 material 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.

--the seating space specified may be more where high school students are to be transported exclusively.

--driver's seat--in planning the seating on a school bus, 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 29.)

Windshield and windows B14 (Minimum standard, page 31.)

Wiring B15 (Minimum standard, page 32.)

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

Almost all the wiring in any bus runs behind the interior paneling or is concealed behind interior molding. Thus the wiring cannot normally be seen unless the paneling or molding is removed. This is all the more reason 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 such questions as follows: 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? And most important, is the gauge of the wire such that it will be able to adequately carry the required electrical load without loss of voltage? Is a central fuse or circuit block 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 20; First-aid kit, page 21; Sun shield, page 31; Windshield washers, page 32; Windshield wipers, page 32.)

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

PART III -- DEVELOPING SCHOOL BUS SPECIFICATIONS INFORMATION FOR BID PROPOSALS

The following suggested checklists, one for school bus chassis and one for school bus bodies, may be used in developing purchasing specifications.

These checklists should serve, however, only as suggestions. The individual items and areas listed should be carefully reviewed for possible additions, deletions, and/or modifications in terms of local requirements. Normally if school bus bids are secured through the use of some type of prescribed form or format which clearly indicates specific local requirements, the following is usually accomplished: (1) 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 (2) the potential purchaser can, as a result of use of concisely prescribed specifications, 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 Association of School Business Officials' Bulletin No. 22.*

It is essential that the potential purchaser be thoroughly familiar with the equipment that is available from the various school bus chassis and body manufacturers. Acquiring a familiarity with the

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*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, Illinois: 1962).

equipment available can be accomplished in a number of ways: (1) through a study of the manufacturers' sales literature, specifications lists, catalogues, and data books, (2) through discussion and/or conferences with the manufacturers' sales representatives, and (3) through colleagues 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, unknowningly eliminate potential bidders and thus destroy any advantage to be derived from the preparation of specifications information in purchasing school bus equipment.

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.

SCHOOL BUS SPECIFICATIONS INFORMATION

FOR BID PROPOSALS

Name of Purchaser_____

Address_____

_____

Date_____

General Instructions

1. Bids to be opened at_____(hour) on_____(date), 19____(year) at the following location_____.

2. The school bus body and/or chassis shall comply with all State and local specifications requirements, rules, regulations, and standards.

3. The purchaser may enumerate in the General Instructions for bids any special provisions for inspecting equipment prior to or after delivery and/or purchase.

4. The purchaser may enumerate in the General Instructions for bids any warranty requirements.

5. The purchaser may enumerate in the General Instructions for bids any specific delivery requirements.

6. The purchaser may enumerate in the General Instructions for bids any desired payment arrangements.

7. The purchaser should normally reserve the right, subject to State and local provisions, to reject any and all bids for adequate cause.

SCHOOL BUS CHASSIS INFORMATION

(A suggested checklist for preparing specifications information for bid proposals on the conventional type school bus chassis)

PLEASE NOTE:

Using a 60-passenger conventional school bus as an example, the following checklist has been completed for purposes of illustration only.

Chassis checklist	Specifications information
C1 Pupil capacity of vehicle	60 passenger
Average actual G.V.W.	19,250
Manufacturer's recommended minimum rated G.V.W.	20,000
C2 The power train	
C3 Engine	
1. Number of cylinders	8
2. Required minimum net rating (as computed in accordance with grade ability formula)	57.9 net H.P. @1,325 R.P.M.
C4 Clutch	
1. Diameter of clutch	
a. 11 inch	
b. 12 inch	X
c. 13 inch or of equal performance	

Chassis checklist	Specifications information
C5 Transmission	
1. Type	
a. standard	
b. standard--synchronized	X
c. automatic	
2. Number of speed forward	5
C6 Drive shaft	
1. Number of sections	3
2. Number of protective guards	3
C7 Axles	
1. Manufacturer's front axle rating (in lbs.)	5,170
2. Manufacturer's rear axle rating (in lbs.)	14,100
3. Rear axle ratio	7.2 to 1
C8 Brake system	
1. Hydraulic with vacuum booster	
2. Air over hydraulic	X
3. Full compressed air	
C9 Bumper, front	
C10 Cooling system	
Radiator capacity	minimum 14 quarts
C11 Electrical equipment	
C12 Battery	
Required ampere hrs. at 12 volts measured at 20 hr. rate	70 amperes

Chassis checklist	Specifications information
C13 Generator or alternator	
1. Generator	_____
2. Alternator	X
rated capacity	100 amperes
charging rate at idle	10 amperes
voltage controlled	X
current controlled	X
C14 Exhaust system	
C15 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) renewable cartridge	X
(2) sealed unit	_____
(a) by-pass type	_____
(b) full-flow type	X
b. size or capacity	minimum 1 quart
C16 Fuel tank	
1. Capacity (in gallons)	minimum 30 gallons

Chassis checklist	Specifications information
C17 Shock absorbers	
1. Front	
a. size or capacity	shall be designed to carry their proportional share of the G.V.W. without evidence of overload
2. Rear	
a. size or capacity	shall be designed to carry their proportional share of the G.V.W. without evidence of overload
C18 Springs	
1. Front	
a. rating at ground (in lbs.)	2,844
2. Rear	
a. rating at ground (in lbs.)	7,755
C19 Tires and rims	
1. Wheelbase	220 inches
2. Tires	
a. number	7
b. tube type	X
c. tubeless	
d. size	8.25-20
e. ply rating	10 PR.
f. type tread	
(1) snowtread	
(2) regular	X

Chassis checklist	Specifications information
Tires and rims--cont'd.	
3. 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

SCHOOL BUS BODY INFORMATION
(A suggested checklist for preparing specifications information for bid proposals on the conventional type school bus body)

PLEASE NOTE:

Using a 60 passenger conventional school bus as an example, the following checklist has been completed for purposes of illustration only.

Body checklist	Specifications information
B1 Body type	conventional
B2 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)	330 inches
B3 Body construction	
B4 Insulation (body)	
B5 Rust protection (body)	
1. Undercoating required	
a. yes	X
b. no	

Body checklist	Specifications information
Rust protection--cont'd.	
2. Painting	
a. exterior color (entire body including hood, cowl, and roof)	National school bus chrome
b. Bumpers, fenders and Lettering	black
c. interior color	tan
B6 Bumper, rear	
B7 Doors	
1. Entrance door	
a. type	
(1) split leaf	
(2) folding jack-knife	X
(3) sedan	
b. method of operation	
(1) manual	X
(2) air	
(3) vacuum	
2. Emergency door	
a. location	
(1) center rear	X
(2) left side rear	
B8 Floor covering	
1. Stepwell	
a. ribbed rubber	X
b. nonribbed rubber	

Body checklist	Specifications information
B9 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	ahead of rear wheel housing
c. Heater No. 3	in driver's compartment
4. Capacity	capable of providing for an even and adequate distribution of heat throughout the bus
B10 Identification (required lettering)	
1. Words "school bus" in 8 inch letters front and rear	X
2. Words "stop on signal" in 5 inch letters rear	X
3. Bus number "32", 5 inches high on right side of bus below name of school district.	X
4. Name of school district in 5 inch letters on sides of bus	X
B11 Lamps and signals	
B12 Seats	
1. Upholstery (seat and back cushion)	

Body checklist	Specifications information
Seats--cont'd.	
a. type	
(1) artificial leather	X
(2) other	
b. color	to be specified
2. Type of seat cushion construction	
a. springs	X
(1) cotton padding	2 inches thick
(2) rubberized hair	
(3) foam or polyfoam rubber	
(4) other	
b. foam rubber	
c. polyurethene	
d. other	
3. Driver's seat	
a. Type	
(1) adjustable	X
(2) equipped with seat belt	X
(3) other	
b. upholstery (seat and back cushion)	
(1) type	
(a) artificial leather	X
(b) other	
(2) color	to be specified

Body checklist	Specifications information
Seats--cont'd.	
c. type of seat cushion construction	
(1) springs	X
(a) cotton padding	3 inches thick
(b) rubberized hair	
(c) foam or polyfoam rubber	
(d) other	
(2) foam rubber	
(3) polyurethene	
(4) other	
B13 Stanchions and guard rails	
B14 Windows and windshield	
1. Type glass in side windows	
a. laminated	X
b. tempered	
2. Type windshield	
a. flat	X
b. curved	
c. glare and heat resistant	X
B15 Wiring	
1. Central fuse or circuit block	
a. required	X
b. not required	

Body checklist	Specifications information
Wiring--cont'd.	
2. Diagram of electrical system	
a. required	X
b. not required	
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, windshield washers, windshield wipers, sunshield(s), rear view mirrors, a 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 METHOD FOR ESTIMATING GENERATOR OR ALTERNATOR CAPACITY

Constant Load

Equipment	Current Draw (Amperes)
Ignition	2.50 (average)
Head lamps (Type 2 dual lower beam)	8.40
Tail lights	1.18
Clearance lights	2.36
Cluster lights	3.54
Body instrument panel	.80
Primary front heater motors	24.00
Primary defroster motor	12.00
Supplementary front heater motor	12.00
Supplementary defroster motor	12.00
Underseat heater motors	10.50
Underseat heater motor	8.50
Defroster fan motor	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	11.60
Step-well and 6 interior dome lights	5.64
Individual additional dome lights	0.94
Stop (brake) lights	6.60
Turn Signals	2.36

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

Constant load + 35% of intermittent load = total load.

SUGGESTED BID FORM

Gentlemen:

Pursuant to your call for bids on _____ (date), 19____ (year), the undersigned hereby proposes and agrees to furnish and deliver to _____ (name of purchaser)

_____ (address)

the following items of school bus equipment:

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

The above School Body and/or Chassis 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 (list equipment traded in)

_____

_____ $_____

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 _____