Prestolite electric
HEAVY DUTY SYSTEMS

Leece·Neville
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Technical Service Bulletin

We all know the first and most important thing to consider when it comes to a school bus is 'Safety'. The second most important item would be 'reliability' with minimal long term financial liability to its owner or operators.

Below, one will find some helpful tips to ensure that your 'School Bus' has the correct 'ALTERNATOR' and how to determine if appropriate 'CABLING' is in place that will connect the required alternator to the electrical system, ensuring 'Safety' and 'Reliability'.

Today's school buses have a very high amperage demand. The amperage requirements for the engine, transmission, high intensity lights, radios, door controls, wheel chair lifts, heaters, air conditioning, monitoring devices, drive line retarders, etc. are increasing year by year. Chances are a 160 amp alternator that performed well in 2000 will not be appropriate in 2005 due to increased amperage demands. ***Note all of the electrical accessories which require additional amperage are not always installed by the manufacture of the bus.*** If the 'ALTERNATOR' and 'CABLING' is not appropriately specified or upgraded to manage the additional amperage requirements this will require the batteries be utilized for purposes which they were not intended, contributing to progressive damage of the batteries and other components in the electrical system.

The Battery: A reservoir of chemical electrical power. Its primary purpose is to provide the electrical energy needed for engine cranking.

Once the engine has been started, the purpose of the battery is complete. After the engine has been started the school bus amperage requirements should be managed by the alternator. This ensures batteries are charged properly and are healthy for the next time they are needed for engine cranking.

Many of today's school buses have an alternator which is not appropriate. The result; amperage required to manage the vast electrical accessories is consumed from the batteries depleting the batteries state of charge.

Did you know that a common flooded lead acid battery can absorb as much as 10 to 20% of its CCA rating in amperage at 75% state of capacity or below? True. If the incorrect alternator is utilized, although the batteries will have enough energy to start the engine and assist in maintaining the needed amperage of the school bus, they actually contribute to an even greater amperage requirement.

A school bus spends most of its operational time with either the engine idling or at very slow ground speeds. Knowing this; if your school bus has the incorrect alternator and amperage is being consumed from the batteries during operation. Chances are at the end of the day the batteries have not been charged appropriately. This contributes to premature alternator, starter and battery failures.

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The Alternator: The total output rating of the alternator normally leads one to inappropriately choose the correct alternator for its application. It's not the 'total' amperage output capability that is important when choosing the correct alternator. ***It is the amount of amperage the alternator can produce at its nominal speed of operation for a school bus that is important.***

Since we have stated a school bus spends most of its time idling or at slow operational speeds lets take a closer look. A typical school bus equipped with standard D.O.T. requirements has the minimal need of 65 amps and a maximum need of 115 amps depending on accessories each individual operator may choose. However a typical school bus with basic Air Conditioning or 4 under seat Heaters has an average amperage requirement of 136 amps and a maximum need of 165 amps depending on accessories each individual operator may choose. Some have minimal requirements of 174 amps and maximum amperage requirements as high as 225 amps.

Performance by application: When recommending an alternator for a specific application, a base line criterion is established by never allowing the required amperage demand of the vehicle to exceed 80% of the alternators output ability. Why? Thermal degradation "heat" is known to contribute to the loss of alternator output efficiency by as much as 15%. The margin of efficiency remaining of 5% is utilized to maintain the batteries state of charge; if and when load demands at idle, intermittently exceed that of the alternators output ability at a set rotor speed.

Such as; when the engine is idling and a wheel chair lift is in operation for passenger loading or off loading. During this time of operation amperage is being consumed from the batteries by the lift and the batteries state of charge is reduced. When lift operation is complete, the alternator will have the ability to replenish the batteries state of charge enabling long battery life and maximum state of charge in the battery without increasing the engine speed. The battery is to be utilized when the highest amperage demand is required for engine startup and only to be utilized intermittently in its application when optional loads exceed that of the alternator for a short period of time. By default the nominal or constants speed of the alternator in the school bus vocation is considered to range from 1850 to 2400 RPM.

Determine the amperage requirement: It is very important that you determine your nominal required amperage before choosing the alternator for your bus.

To determine this, utilize a DC Clamp on amperage instrument and follow the steps below.

** Always ensure that the batteries state of charge is greater than 12.45 volts with a volt meter. If the batteries have been charged with a battery charger or the alternator within 24 hours of this test the batteries surface charge must be removed before proceeding with this test as it will be inaccurate. To remove the surface charge, simply turn the headlamps of the bus on and select "high beam" for 5 minutes. After 5 minutes turn the head lamps off, allow the batteries to recover for 1 minute and measure the true state of battery charge with a voltmeter. Remember the battery voltage must be greater than 12.45 volts for this test to be accurate. If it is necessary recharge the batteries with a battery charger before proceeding with this test.*

A. Start the engine of the bus and operate it at idle speed.
B. Simulate the operation. Turn on electrical accessories that would normally be operated when the bus is en-route off loading or on loading passengers. (If equipped with a wheel chair lift, do not take it into consideration at this point.)

C. Attach DC Amperage Clamp onto Positive alternator output cable and record the total amperage output. Ensure that the arrow of the DC Amperage clamp is facing away from the alternator. Record Amperage output _____.

D. At the battery location of the bus. Locate all cables / wires attached to the **(+) battery terminals.**

1. Clamp each **positive cable/wires** individually ensuring the arrow of the DC Amperage Clamp is pointing to the (+) battery post. If any cable/wire clamped indicates a positive amperage reading, record each positive number. Total and Record all positive amperage readings. Total positive amperage recorded____.
2. If any of the **positive cable/wires** has negative amperage reading with the arrow of the DC amperage clamp pointing toward the positive battery post. Record the negative amperage reading. Total of negative amperage readings_____
3. Subtract the total negative amperage reading of all cables recorded at the batteries from the total positive amperage reading of all cables recorded at the battery. Negative amperage total _____ (-) Positive amperage total _____ = (___).

Example: Negative amperage total = <u>- 47</u> (subtract) Positive amperage total <u>31</u> = (-16)

- *If the total is a negative amperage reading this sum will be utilized in step F. If the total is a positive amperage reading or zero the equipped alternator is sufficient for your bus.*

E. Add values recorded in Step D ___ + Sum of Step E.3. ___ = Total Amperage requirement _____. **See step G if your bus is equipped with an electric drive line retarder.*

F. Turn off all electrical accessories and stop engine. You have now determined the nominal amperage requirement of the School Bus. Below in this document one will find how to appropriately determine the needed alternator for you amperage requirement.

G. If your bus is equipped with an electric drive line retarder you will need to measure the maximum amperage requirement of the drive line retarder while operating it in the highest applied brake position and record the amperage requirement. 25% of this maximum amperage value will then have to be added to the above determined total amperage value. This value will then be utilized in the following step.

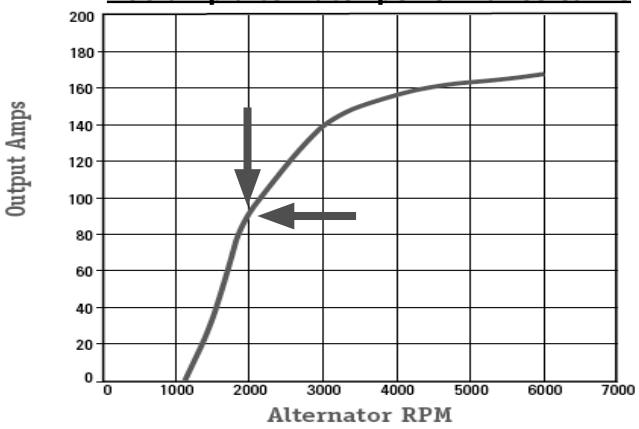
H. ****The above total amperage should not exceed the alternators output capability at 2000 RPM of the alternator.***

****** Repeat the above procedure simulating 'winter' operation and 'summer' operation. The value recorded for summer or winter operation will be different. The largest number should be utilized when sizing the appropriate alternator for your School Bus.***

Now let's look at the typical 160 amp alternator amperage output capability. As we stated the nominal or constants speed of the alternator in the school bus application would be within a range of 1850 to 2400 RPM.

One can see that the 160 amp alternator in hot run conditions can produce an average of 95 amps in this range of operation. Well below what would be required for the average school bus today "if" equipped with Air Conditioning or with three or four under-seat Heaters.

160 amp alternator performance curve



The typical School Bus today would require a 185 amp alternator to ensure that basic amperage requirements are exceeded and healthy batteries are maintained and would not be adequate if air conditioning were installed in all cases.

If you intend to install air-conditioning or under seat heaters in excess of two, a minimum a 200 amp alternator would be required; however in most cases a 270 amp alternator would be required due to the needed amperage at engine idle conditions. Actual alternator output performance charts can be obtained through your local distributor or directly from Leece Neville. (see chart on last page)

Alternator Output cable size: The standard output cabling and circuits installed on most standard school bus chassis if not originally equipped with a 200 amp alternator or larger at the factory would be inappropriate for any alternator larger than 175 amps that would be installed after production. Why? The most important item to be considered for an alternator to have a long reliable life is not to exceed .25 volts of resistance in each output circuit individually when applying a load to the circuit equal to 75% of the alternators rated output capacity. If equipped with inappropriate cabling "to small in size" this would render the same results of an inadequately sized alternator resulting in short or less than expected reliability.

Below one will find an appropriate cable sizing worksheet. However some quick tips that may save you time when accessing the existing cabling on your school bus chassis.

Negative Circuit: alternators 200 amps or larger in total output rating are designed with Case ground. Due to this, to circumvent oversights and issues associated to electrolysis and save time, one can simply utilize the existing ground cable attached to the existing alternator. However one would need to locate - remove - and replace the existing ground/earth cable which leads from the starter/ cranking motor or the chassis frame rail to the engine block. This cable should be replaced with a minimum 1/0 or 1 gauge cable.

Positive Circuit: In many cases the existing positive cable and circuits of a School Bus chassis as built by the manufacture is also inappropriate for alternators larger than 175 amps. This is due to the actual cable size being inadequate and some also incorporate protective fusible devices that will have to be upgraded to a larger amperage requirement. Examples of these fusible devices are fusible wire/cable links, mega fuses and circuit breakers both thermal type and reset type. The entire circuit must be upgraded. When upgrading/replacing this circuit a fusible device such as a mega-fuse should be incorporated into the new circuit if it was originally equipped with one. At minimum a 1/0 or 1 gauge cable should be utilized and the fused device selected should exceed 5% but not exceed 25% of the total rated output capacity of the alternator. In all applications the fused device must be mounted and incorporate a protective coating of all connection points. One should also consider obtaining the appropriate "complete circuit components" from the original manufacture of the applicable bus chassis which would incorporate the appropriate fusible device sized for the alternator you have determined appropriate for the application.

Recommend Cable sizing guide:

Amperage	Cable Length	Cable Size
60-75 Amps	15 Feet or Less 16-25 Feet 26-40 Feet	#6 #4 #2
80-125 Amps	15 Feet or Less 16-25 Feet 26-40 Feet	#4 #2 #0
130-250 Amps	15 Feet or Less 16-25 Feet 26-40 Feet	#0 #2/0 #4/0
250-325 Amps	12 Feet or Less 13-20 Feet	#2/0 #4/0

** Some chassis manufactures utilize cabling of different type and/or size. However due to the construction of the cable and the type of wire, a smaller outside wire diameter or size may be applicable. Refer to our technical training manual Section 3 Article 4 "Cable Test" on our web site* www.prestolite.com *for proper testing instructions to validate existing or recommended circuit or cable/wire type.*

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Operational tip: When appropriate "if" the school bus may be required to operate long periods of time with the engine idling. The operator of the bus should always utilize a high idle device to increase the engine speed to approximately 1100 RPM. This would be periods of time when pre-delivery inspection is taking place, wheel chair lift operation is required or pre-heating / cooling the interior of bus with the heaters or air conditioning. This will ensure long reliable life of the alternator and electrical components of your school bus.

Specification tip: When considering the purchase of a new school bus, it is important to write into the specification, the effects added electrical accessories by a third party installers, add to the amperage demands of the charging circuit and require improvements associated.

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Below is a guide that will assist in choosing the appropriate alternator for common optional equipment utilized in the school bus industry.

Minimum Amperage	Application	Part Number	Type of Excitation	Notes
185	Any school bus with NO A/C. Can be with or without a wheelchair lift.	4833LGH	Self Excite	J-180 MOUNT
		4836LGH	Self Excite	Same as 4833LGH but with reverse POS and NEG terminals (Cummins B and C engines)
		4939PGH	Self Excite	PAD MOUNT
200	Any school bus with ONE A/C. Can be with or without a wheelchair lift. Any school bus without A/C but that does have an electromagnetic brake retarder.	4860JB	Ignition Excite	J-180 MOUNT
		4863JB	Self Excite	J-180 MOUNT
		4940PA	Ignition Excite	PAD MOUNT
		4951PA	Self Excite	PAD MOUNT
270	Any school bus with TWO A/C. Can be with or without a wheelchair lift. Any school bus with ONE A/C AND an electromagnetic brake retarder.	4867JB	Self Excite	J-180 MOUNT
		4870JB	Ignition Excite	J-180 MOUNT
		4942PA	Ignition Excite	PAD MOUNT
		4944PA	Self Excite	PAD MOUNT
		4947PA	Ignition Excite	PAD MOUNT
		4949PA	Self Excite	PAD MOUNT
320	Any school bus with TWO A/C units and either a DASH A/C unit or a THIRD A/C unit. Can be with or without a wheelchair lift. Any school bus with TWO A/C units AND an electromagnetic brake retarder.	4890JB	Self Excite	J-180 MOUNT
		4962PA	Self Excite	PAD MOUNT

These are our minimum recommendations for amperage outputs. This will eliminate all of the guess work associated with trying to match up specific pulley to engine ratios.

Please keep in mind that when specifying alternators for school buses with CNG (compressed natural gas) or LNG (liquid natural gas) engines, either forward engine or rear engine, we recommend using REMOTE MOUNTED REGULATORS. It is recommended that all forward engine transit busses be equipped with REMOTE MOUNTED REGULATORS. Although recommended by Leece-Neville, it is at the discretion of the Original Equipment Bus manufacture to make this option available. If you choose to purchase these parts, contact Leece-Neville at 866-288-9853 for applicable part numbers to make this change by alternator product model

We define A/C as a unit having one evaporator and one condenser. If the bus is equipped with a main rear evaporator system and a slave dash A/C, we would consider that a TWO A/C system, even though they share the same condenser.

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