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

SURFACE VEHICLE INFORMATION REPORT

SAE J1343

REV. AUG2000

Issued 1981-07
Revised 2000-08

Superseding J1343 OCT1988

Submitted for recognition as an American National Standard

(R) Information Relating to Duty Cycles and Average Power Requirements of Truck and Bus Engine Accessories

***Foreword*—**The objective of this report is to estimate a typical accessory drive load for heavy truck and bus applications. The accessory drive load is defined as the power needed for non-propulsion and non-required engine systems.

***1. Scope*—**This report is intended to provide the information to estimate the accessory load of a typical heavy truck or bus. The components covered include: air compressors, alternators, refrigerant compressors, engine cooling fans and power steering pumps. The values show an estimate of the average power requirements and duty cycles for these accessories.

This report does not address loads required for engine operation. Required systems include those needed for engine performance such as fuel pumps and electronic control modules (ECM).

2. References

2.1 Applicable Publications—The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest version of SAE publications shall apply.

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

SAE J1339—Test Method for Measuring Power Consumption of Truck and Bus Engine Fans
SAE J1341—Test Method for Measuring Power Consumption of Hydraulic Pumps for Trucks and Buses

***3. Total Power Consumption*—**The total power consumption of engine driven accessories is the sum of the individual loads. A maximum possible load can be determined by totaling the maximum loads of each accessory. The typical, or average, load for a single accessory can be estimated by multiplying its maximum load by a duty cycle representing the percentage of time it is used. The duty cycle will also represent the average power requirement of the accessory if it has a variable load potential. For example, a light may be on 35% of the time resulting in a 0.35 duty cycle multiplier. A hydraulic pump may be used 20% of the time and average 50% of its maximum load, resulting in a 0.10 duty cycle multiplier. The duty cycle of many accessories will vary with operating conditions such as day or night (e.g., head lights) and warm or cold ambient temperatures (e.g., refrigerant compressors). The total, typical accessory load for a vehicle is the sum of the typical loads for the individual accessories in a particular operating condition. This report lists estimates and duty cycles considered representative for the heavy truck and bus industry.

TO PLACE A DOCUMENT ORDER; (724) 776-4970 FAX: (724) 776-0790
SAE WEB ADDRESS http://www.sae.org

4. ***Individual Components*—**The typical accessories common to heavy trucks and busses are listed below. Estimated loads and duty cycles are given.

4.1 **Air Brake Compressors—**The loads and duty cycles for air compressors for the applications are defined on Figure 1.

Type of Operation	Engine Type	Compressor Intake	Duty Cycle	Pumping Power		Unloaded Power		Average Power	
			(% On)	kW	HP	kW	HP	kW	HP
Line Haul:	Gasoline	NA	10	3.0	4.0	1.1	1.5	1.3	1.8
	Diesel	Turbocharged	5	6.0	8.0	2.4	3.2	2.3	3.0
Short Haul	Gasoline	NA	20	3.0	4.0	1.1	1.5	1.5	2.0
	Diesel	Turbocharged	10	6.0	8.0	2.4	3.2	2.8	3.8
Local Haul	Gasoline	NA	60	3.0	4.0	1.1	1.5	2.2	3.0
	Diesel	Turbocharged	30	6.0	8.0	2.4	3.2	3.5	4.6

Notes:
1. NA: Naturally Aspirated
2. Gasoline Engines using compressor with approx. 10 C.I.D. Diesel Engines using 17 C.I.D.
3. Average power = % duty x pumping power + (100-% duty) x unloaded power

FIGURE 1—COMPRESSOR LOAD AND DUTY CYCLES

4.2 **Alternators—**The power demand to the alternator(s) can be determined by estimating the average amperage draw from the electrical accessories installed on the trucks and multiplying it by the voltage of the system. Most trucks in the USA use 12 V systems while European systems tend to be 24 V. Figure 2 shows the typical current demand for 12 V electrical components. All required loads (e.g., ignition and/or ECMs) are included in the engine net power definition and should not be included as accessories.

Components	Typical Draw	Load	
	Amps	kW	HP
Headlights: Highbeam - pair	10.0	0.120	0.161
Lowbeam - pair	8.2	0.098	0.132
Dash Mounted Indicator Lamp	0.12	0.0014	0.0019
Stoplights – pair[1]	4.3	0.052	0.069
Taillights – pair	1.2	0.014	0.019
Turn Signal Lights[1] 2 lights	4.4	0.053	0.071
3 lights	6.6	0.079	0.106
Hazard Signal Lights - pair[1]	8.4	0.100	0.130
Clearance Lights - set of 4	1.2	0.014	0.019
Identification Lights - set of 3	1.8	0.022	0.029
Marker Lights – set of 8	0.54	0.0065	0.0087
License Plate Light	0.59	0.0071	0.0095
Dome Light[1] 1 light	1.5	0.018	0.024
4 lights	5.9	0.071	0.095
Parking Lights – pair	1.3	0.016	0.021
Backup Lights – pair[1]	4.3	0.052	0.069
Instrument Lights	1.0	0.012	0.016
Instruments – analog gages	1.0	0.012	0.016
Electric Wipers LO	2.0	0.024	0.032
HI	3.4	0.041	0.055
Field Current Alternators: light duty	2.0	0.024	0.032
heavy duty	3.5	0.042	0.056
Electric Fuel Pump	2.6	0.031	0.042
Electric Windows Run	7.0	0.084	0.110
Stall	18.5	0.222	0.298
Electromagnetic Fan Clutch	5.0	0.060	0.080
Radio	4.4	0.053	0.071
Heater/Defroster Fan – 1 Motor Truck LO	11.4	0.137	0.183
HI	16.5	0.198	0.265
Heater/Defroster Fan with air conditioner- Truck	30.0	0.360	0.480
Bunk Heater-Truck LO	4.2	0.050	0.068
MED	7.9	0.095	0.127
HI	11.4	0.137	0.183
Condenser Fans-Bus	70.0	0.840	1.100
Air Circulation Fan-Bus	65.0	0.780	1.000

Notes:
1. Normally intermittent load
2. All loads are constant loads unless otherwise noted
3. Load (kW) = amperage draw x 12 V / 1000 (HP = amps x 12V / 746)

FIGURE 2—TYPICAL DRAW OF ELECTRICAL ACCESSORIES (WHEN SWITCHED ON)

The total loads can be calculated using the previous loads and equations. Total maximum load and total average load can be calculated using Equations 1 and 2, respectively.

$$\text{Total Maximum Load} = \sum(\text{Constant Loads} + \text{Intermittent Loads}) \quad \text{(Eq. 1)}$$

$$\text{Total Average Load} = \sum \text{Constant Loads} + 0.35\left(\sum \text{Intermittent Loads}\right) \quad \text{(Eq. 2)}$$

4.3 Air Conditioning Compressor—The duty cycle and horsepower for the air conditioning compressor, after initial cool-down, is shown in Figure 3. The Average Load column is equal to a typical compressor load times the duty cycle.

Type of Operation	Duty Cycle	Maximum Load		Average Load	
	(% on)	kW	HP	kW	HP
Line Haul Tractors and Trucks-Day	50	4.5	6.0	2.2	3.0
Line Haul Tractors and Trucks-Night	33	4.5	6.0	1.5	2.0
Short Haul Tractors and Trucks-Day	50	4.5	6.0	2.2	3.0
Short Haul Tractors and Trucks-Night	30	4.5	6.0	1.5	2.0
Local Haul Tractors and Trucks-Day	50	4.5	6.0	2.2	3.0
Local Haul Tractors and Trucks-Night	30	4.5	6.0	1.5	2.0
Long Haul Buses-Day	50	22	30	11	15
Long Haul Buses-Night	30	22	30	6.7	9.0
Short Haul Buses-Day	80	22	30	18	24
Short Haul Buses-Night	50	22	30	11	15
Local Haul Buses-Day	80	22	30	18	24
Local Haul Buses-Night	50	22	30	11	15

FIGURE 3—AIR CONDITIONING COMPRESSOR LOADS AND DUTY CYCLES BASED ON 30 °C (86 °F) AMBIENT CONDITIONS

4.4 Engine Cooling Fans and Drives—The power requirements of the engine cooling fan and drive are closely related to the engine heat rejection along with radiator, shroud and chassis configuration. The power needed to drive a cooling fan at rated engine speed may be 15 to 30 kW (20 to 40 HP) or more. Since fan power varies with the fan rpm and design, it is necessary to provide a common method for evaluating the fans. The procedure presented in SAE J1339, is of sufficient accuracy to give comparative results. For a typical class 8 line haul tractor trailer or truck the engine cooling fan is only needed approximately 5 to 10% of the time when supplemented with an adequate volume of ram air. Local delivery trucks and busses may have significantly higher fan-on percentages, possibly in the 10 to 20% range or higher. Some busses also use multiple fans for separate radiator and charge air coolers. The fan-on time may also vary substantially depending on air conditioning compressor input to the fan clutch and the vehicle's duty cycle. Figure 4 shows typical values for several applications. It should be noted that these values are rough estimates and may dramatically impact average accessory loads. The significant distinction between average fan load and maximum fan load should also be considered.

Application	Typical Fan Use (% On)	Typical Max. Fan Load		Av. Fan Load	
		KW	HP	kW	HP
Line Haul Truck	5	15-30	20-40	0.8-1.5	1.0-2.0
Local Delivery Truck	10	15-30	20-40	1.5-3.0	2.0-4.0
Transit Bus	20	15-30	20-40	3.0-6.0	4.0-8.0
Coach Bus	10	15-30	20-40	1.5-3.0	2.0-4.0

FIGURE 4—TYPICAL FAN LOADS AND DUTY CYCLES—
BASED ON 30 °C (86 °F) AMBIENT CONDITIONS

4.5 Power Steering Pumps—Due to the large variations in power steering pumps, it is recommended that the power requirement be obtained from the performance data for the pump in question. See SAE J1341. Duty cycles for the various types of operation are defined in Figure 5. For the purposes of estimating average load, the maximum loads are typically in the 5-15 HP range.

Application	Duty Cycle (% On)	Maximum Load		Average Load	
		kW	HP	kW	HP
Line Haul Tractors, trucks and buses	10	4.0-11	5-15	0.40-1.1	0.50-1.5
Short Haul Tractors, trucks and buses	20	4.0-11	5-15	0.80-2.2	1.0-3.0
Local Haul Tractors, trucks and buses	60	4.0-11	5-15	2.4-6.6	3.0-9.0

Notes: 1. Average Power Steering Pump load = Max. HP x Duty Cycle

FIGURE 5—POWER STEERING DUTY CYCLE BY APPLICATION

5. Example of Accessory Load Calculation—The following example demonstrates the use of the above data and equations to determine the maximum and average accessory loads of a sleeper-type, line-haul tractor-trailer. Figure 6 lists the typical, alternator-driven electrical loads. The maximum and average loads are listed and totaled.

Components	Typical Load	Qty	Load Type	Maximum Load		Average Load	
	KW		(C or I)	kW	HP	KW	HP
Instrument – analog gages	0.012	1	C	0.012	0.016	0.012	0.016
Stoplights – pair	0.052	2 pair	I	0.104	0.139	0.036	0.048
Turn Signal Lights - 3 lights	0.079	3 lights	I	0.079	0.106	0.028	0.038
Backup Lights – pair	0.052	2 pair	I	0.104	0.139	0.036	0.048
Field Current Alternators: heavy duty	0.042	1	C	0.042	0.056	0.042	0.056
Electric Windows run	0.084	2	I	0.168	0.225	0.059	0.079
Radio	0.053	1	C	0.053	0.071	0.053	0.071
Heater/Defroster Fan with air conditioner - Truck	0.360	1	C	0.360	0.480	0.360	0.480
Bunk Heater-Truck MED	0.095	1	C	0.095	0.127	0.095	0.127
Total				1.017	1.363	0.721	0.966

FIGURE 6—EXAMPLE—ELECTRICAL ACCESSORIES