UNDERSTANDING COACH / RV PERFORMANCE

CATERPILLAR®

This document is written for educational purposes only. The coaches, power trains, accessories, performance and fuel economy depicted are for illustration only and do not reflect the actual performance of any particular coach, power train, and accessories.

Understanding vehicle performance and fuel economy requires a basic knowledge of the many variables that affect the operation of a motor home. Some of the most significant factors affecting fuel economy and performance are:

- Driver
- Route selection
- Vehicle speed
- Frontal area and Aerodynamic properties
- Grade (Hill)
- Engine Cooling requirements
- Climate / Ambient Conditions
- Fuel
- GVW (Gross Vehicle Weight) or GCW (Gross Combination Weight / Towing)
- Idle time
- Generator usage
- Tires

DRIVER

The most significant variable affecting fuel economy is the driver. The driver controls the vehicle speed, acceleration rate, brake usage (service, compression, or exhaust), cruise control usage, automatic transmission shifting override and "mode" selection, tire inflation pressure, and more. It is not uncommon, for identically spec'ed coaches to experience as much as a 20% (6.0 vs. 7.5 MPG) difference in fuel consumption between the best and the worst drivers.

ROUTE SELECTION

Driving in congested areas increases fuel consumption. Traveling 15% of the total miles on congested roads results in approximately an 8% increase in fuel consumption. Traveling 25% of the total miles on congested roads results in approximately a 15% increase in fuel consumption.

Anticipate stops. A heavy vehicle like a motor home can coast a long distance without throttle application. A diesel engine, mechanically or electronically controlled, does not consume fuel when coasting since fuel is not injected into the cylinders. Minimize vehicle speed fluctuation. Use the cruise control, when safe to do so, to maintain a steady vehicle speed.

In the following discussion we will compare the four (4) vehicles described in *Figure 1*.

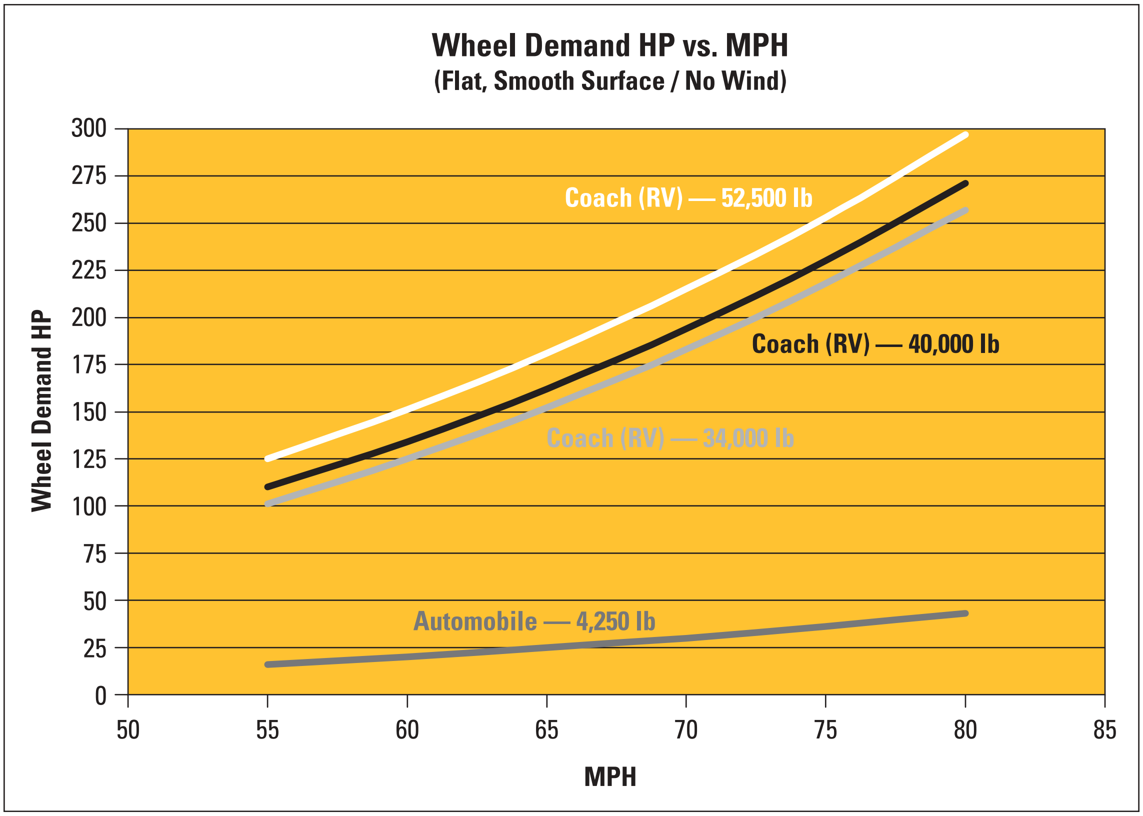
Figure 1. Vehicle Description

Vehicle	GVW / GCW (lb)	Engine Model	HP / Torque (lb-ft)	Frontal Area (ft²)	Coefficient of Drag (Cd)
Automobile	4,250	Gas	250 / 250	30	0.32
Coach	34,000	C7	350 / 860	90	0.60
Coach	40,000	C9	400 / 1,100	90	0.60
Coach	52,500	C13	525 / 1,650	90	0.60

VEHICLE SPEED

Figure 2 shows Wheel Demand Horsepower vs. Speed, on a flat, smooth surface and on a calm day (no wind) for an automobile and three coaches of different weights (34,000 / 40,000 / and 52,500 pounds).

Figure 2. Wheel Demand HP vs. Vehicle Speed – Flat, Smooth Surface / No Wind



Increasing vehicle speed and / or gross vehicle weight places a higher horsepower demand on the engine. When horsepower demand increases, fuel consumption increases.

Figure 2 represents a coach without a trailer. Coaches frequently have a vehicle or trailer in tow. The trailer or towed vehicle weight and aerodynamic properties can substantially increase the coach wheel demand horsepower and therefore fuel consumption.

FRONTAL AREA AND AERODYNAMIC PROPERTIES

Figure 3. Wheel Demand HP vs. Vehicle Speed – Flat, Smooth Surface / No Wind

MPH	Vehicle Description GVW (lb)	Aerodynamic / Air Resistance HP	Rolling Resistance HP	Total Wheel Demand HP
55	Automobile	11	5	16
	Coach – 34,000	62	41	103
	Coach – 40,000		48	110
	Coach – 52,500		63	125
60	Automobile	14	5.7	20
	Coach – 34,000	80	46	126
	Coach – 40,000		54	134
	Coach – 52,500		71	151
65	Automobile	18	6.4	25
	Coach – 34,000	102	51	153
	Coach – 40,000		60	162
	Coach – 52,500		79	181
70	Automobile	23	7	30
	Coach – 34,000	127	57	184
	Coach – 40,000		67	194
	Coach – 52,500		88	215
75	Automobile	28	7.9	36
	Coach – 34,000	156	63	219
	Coach – 40,000		74	230
	Coach – 52,500		97	253
80	Automobile	34	9	43
	Coach – 34,000	190	69	259
	Coach – 40,000		81	271
	Coach – 52,500		107	297

Figure 3 provides a breakdown of Aerodynamic Resistance horsepower and Rolling Resistance horsepower. Combined, they represent the Wheel Demand horsepower needed to drive a vehicle at a given speed, on a flat, smooth surface on a calm day (no wind). Data is given for the automobile and three coaches of different weights (34,000 / 40,000 / and 52,500 pounds).

Note that above 55 MPH, the Aerodynamic Resistance horsepower becomes more significant than the Rolling Resistance horsepower.

The aerodynamic properties (Coefficient of drag) of a motor home without tow vehicle are similar to some of the most aerodynamic tractor-trailers (Cd = 0.60) but considerably higher than those of the modern automobile (Cd = 0.32).

The motor home has a frontal area that is approximately three times larger than an automobile. The larger frontal area combined with a greater Coefficient of drag creates an aerodynamic drag that is approximately six (6) times greater than that of an automobile, and places a much higher horsepower demand on the engine to overcome air resistance.

The horsepower needed to overcome Air Resistance increases as a cubic function of vehicle speed. This means that when vehicle speed doubles, horsepower requirement is eight (8) times greater.

Looking at the 34,000 pound coach, when speed increases from 65 to 70 MPH, the engine must develop an additional 31 horsepower (184 – 153) to meet the Total Wheel Demand horsepower. This is a significant 20% increase! Aerodynamic Resistance horsepower accounts for 25 horsepower (127 – 102) and represents 80% of the increase.

As a rule of thumb, fuel consumption increases approximately 0.08 MPG for every 1 MPH above 55 MPH, assuming that the transmission is in top gear. In other words, increasing vehicle speed from 65 MPH to 70 MPH will increase fuel consumption by 0.4 MPG.

The coach horsepower demand on level ground (*Figure 3.* 52,500 pound coach) is approximately 7.3 times greater than that of the full size automobile. If the automobile gasoline engine were as efficient as the coach diesel engine, the automobile fuel economy would be 45 – 50 MPG (7.3 × 6.5 MPG = 47.5 MPG), not 25 MPG.

GRADE (HILL)

Figure 4 shows the Wheel Demand horsepower at various speeds, on a 6% grade on a calm day (no wind), of the automobile and for three coaches of different weights (34,000 / 40,000 / and 52,500 pounds).

On a grade, the Wheel Demand horsepower increases significantly as vehicle weight increases.

Figure 4. Wheel Demand HP vs. Vehicle Speed – 6% Grade / No Wind

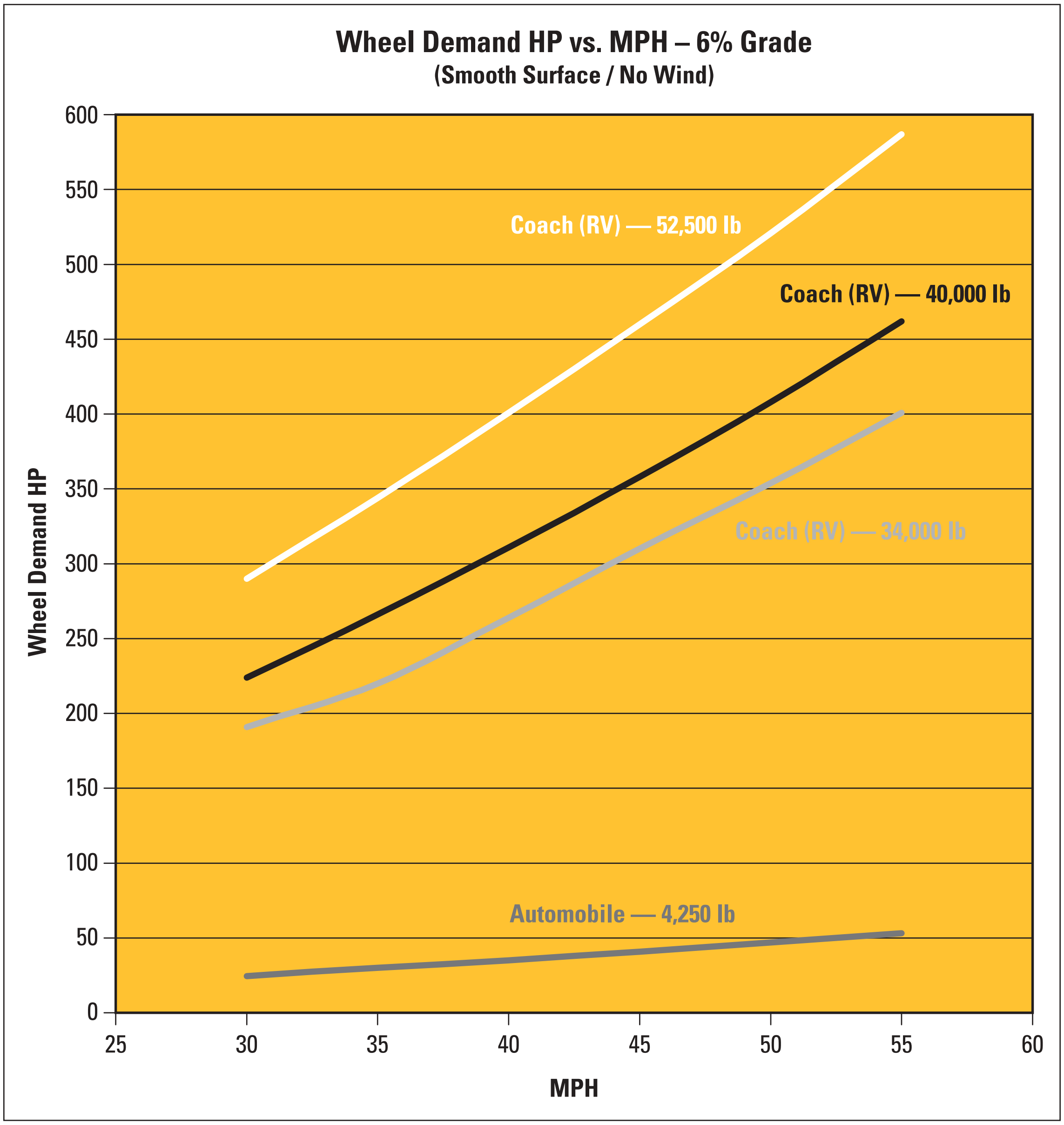


Figure 5 compares the Wheel Demand horsepower at various speeds, on a 6% grade on a calm day (no wind), of the automobile and for three coaches of different weights (34,000 / 40,000 / and 52,500 pounds).

Grade

Figure 5. Wheel Horsepower Demand on 6% Grade / No Wind

MPH	Vehicle Description GVW (lb)	Aerodynamic / Air Resistance HP	Rolling Resistance HP	Grade Resistance HP	Total Wheel Demand HP
30	Automobile	2	2.5	20	24.5
	Coach – 34,000	10	18	163	191
	Coach – 40,000		22	192	224
	Coach – 52,500		28	252	290
35	Automobile	3	3	24	30
	Coach – 34,000	16	22	190	218
	Coach – 40,000		26	224	266
	Coach – 52,500		34	294	344
40	Automobile	4.5	3.5	27	35
	Coach – 34,000	24	26	218	268
	Coach – 40,000		31	256	311
	Coach – 52,500		41	336	401
45	Automobile	6	4	31	41
	Coach – 34,000	34	31	245	310
	Coach – 40,000		36	288	358
	Coach – 52,500		48	378	460
50	Automobile	8.5	4.5	34	47
	Coach – 34,000	46	36	272	354
	Coach – 40,000		42	320	408
	Coach – 52,500		55	420	521
55	Automobile	11	5	37	53
	Coach – 34,000	62	41	299	402
	Coach – 40,000		48	352	462
	Coach – 52,500		63	462	587

On a grade, the sum of the horsepower required to overcome Air Resistance, Rolling Resistance, and Grade Resistance constitute the Wheel Demand horsepower. This horsepower demand increases dramatically with vehicle speed and weight.

Grade Resistance horsepower is by far the most significant contributor to the Wheel Demand horsepower.

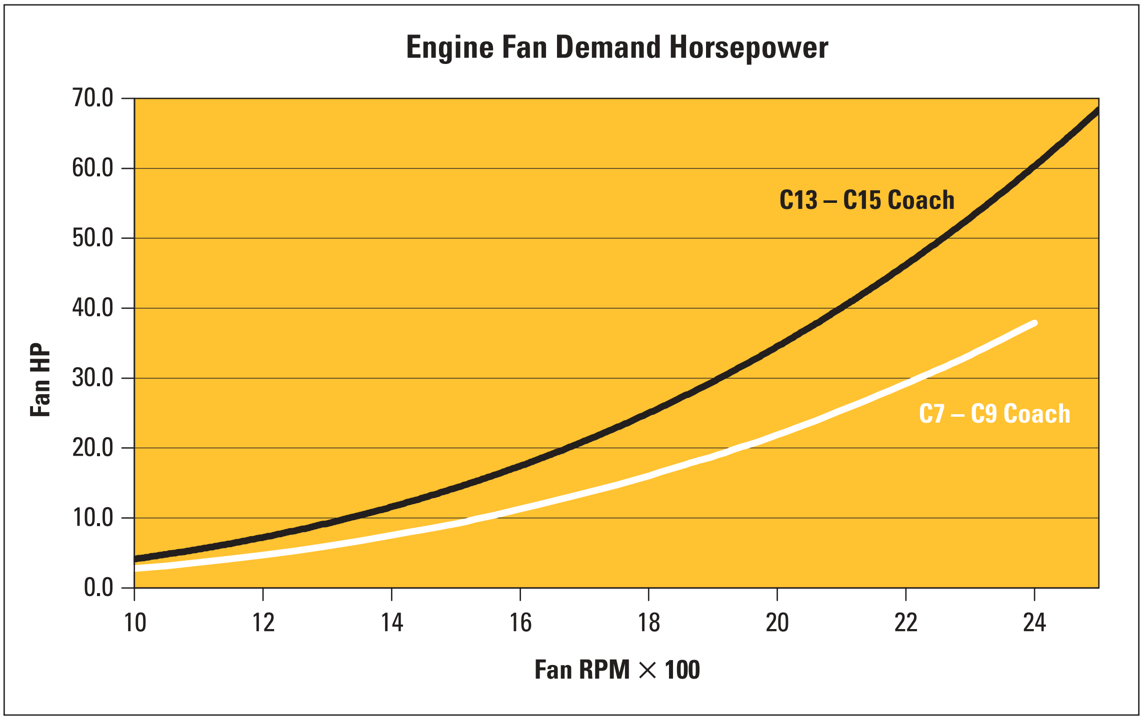
ENGINE COOLING REQUIREMENTS

Diesel powered Class A coaches are generally configured with a rear-mounted engine. There are several advantages to this configuration: Coach interior layout, short drive shaft to the rear wheels, improved visibility and a quieter driver station to name a few. On the downside, the power train (engine and transmission) and chassis accessories (air conditioner, hydraulic oil cooler) heat rejection become more challenging since the heat exchangers (radiator, condenser core, etc…) do not benefit from the Ram Air (front engine configuration) while the coach is underway. With a rear-mounted engine, the power train and accessories cooling is accomplished with a fan that is "ON" a greater percentage of the time. The cooling fan requires a sizeable amount of horsepower to perform its intended function. The additional parasitic demand horsepower not only consumes fuel, it also reduces the reserve horsepower available at the drive wheels to accelerate the coach or maintain cruise speed on an uphill climb.

Two engine cooling system configurations are used in motor homes. The smaller coaches powered by C7 generally have a belt driven cooling fan that is "ON" whenever the engine is running. The faster the engine runs, the faster the fan turns, increasing the horsepower demand on the engine. The larger coaches powered by C9, C13, and C15 engines are generally equipped with a side-mounted radiator using a thermostatically controlled and hydraulically driven cooling fan. These larger cooling fans, when operational, require more horsepower from the engine to handle the greater cooling requirements of the larger coaches. When the fan is not running, a minimum amount of horsepower is required from the engine. The smaller coaches equipped with rear-mounted radiators can also be configured with a thermostatically controlled cooling fan.

Figure 6 shows a typical engine cooling fan demand horsepower for a C7 or C9 powered coach and a C13 or C15 powered coach with the radiator cooling fan "ON".

Figure 6. Engine Cooling Fan Demand Horsepower vs. Fan RPM



NOTE: Fan RPM and Engine RPM are often different. The coach manufacturer designs the cooling system configuration. *Figure 6 and 7* depict an engine cooling fan turning 25% faster than the engine (**Example:** 1800 Engine RPM = 2250 Fan RPM).

Figure 7 shows the horsepower and torque at different RPM for the C13 Caterpillar diesel engine rated at 525 horsepower and 1,650 lb-ft of torque. The table also provides the horsepower demand of the cooling fan and the available wheel horsepower at different RPM.

Figure 7. Available Wheel Horsepower vs. Engine RPM (52,500 Pound Coach)

Engine RPM	Engine HP	Engine Torque (lb-ft)	Fan demand HP	Available Wheel HP C13 525 / 1650	
				Fan OFF	Fan ON
1900	517	1,429	62	455	393
1800	525	1,532	50	462	412
1700	520	1,607	42	458	416
1600	503	1,650	35	443	408
1500	471	1,650	29	414	385
1400	440	1,650	23	387	364
1300	408	1,650	18	359	341
1200	377	1,650	14	322	318

While the 52,500 pound coach engine delivers 525 horsepower at 1800 RPM, the available wheel horsepower is reduced to 462 horsepower (engine cooling fan OFF) due to the total power train parasitic losses. Therefore, approximately 88% of the engine horsepower is available to do work at the drive tires (*Figure 7*, cooling fan OFF).

At 1800 engine RPM, with the engine cooling fan "ON", the fan demands 50 horsepower from the engine and reduces the available horsepower at the drive wheels by the same amount. Nothing is gained by operating the engine above 1800 RPM since both horsepower and torque available are lower than at 1800 RPM. Fan demand horsepower is a major factor in the reduction of available wheel horsepower.

Based on the data from *Figure 5*, the 52,500 pound coach with C13 requires 460 Drive Wheel horsepower to climb a 6% grade at 45 MPH. This is roughly equivalent to the 462 horsepower that is available at the drive wheels at 1800 RPM with the engine cooling fan “OFF”. With the cooling fan “ON”, wheel horsepower at 1800 RPM is reduced to 412 horsepower capable of maintaining a vehicle speed close to 40 MPH on a 6% grade.

Referring to *Figure 5*, the 40,000 pound coach powered with a C9 engine requires 358 horsepower to climb a 6% grade at 45 MPH. This is approximately equivalent to the 352 horsepower (400 × 88% = 352 HP) available at the drive wheels at 2100 RPM, providing that the engine cooling fan is “OFF”. With the engine cooling fan “ON”, 40 MPH is a reasonable expectation.

The 34,000 pound coach powered with a C7 engine provides a similar scenario. 310 horsepower are required to climb a 6% grade at 45 MPH. This is approximately equivalent to the 308 horsepower (350 × 88% = 308 HP) available at the drive wheels at 2400 RPM with the engine cooling fan “OFF”. With the engine cooling fan “ON”, 40 MPH is a reasonable expectation.

The calculations show that all three coaches can climb the 6% grade at approximately the same speed. With increases in GVW or GCW, the Wheel Demand horsepower increases by 8 HP per 1,000 lb @ 45 MPH on a 6% grade. The Wheel Demand horsepower increases to 12 HP per 1,000 lb @ 65 MPH on a 6% grade.

The horsepower requirement of the 52,500 pound coach on a 6% grade is approximately 11.4 times greater than that of the full size automobile. For this reason, the coach speed drops-off at a faster rate and climbs grades at a much slower pace than the automobile.

One additional comment regarding performance: a full size automobile accelerates from Zero to 60 MPH in 7 – 9 seconds. For the coach, a reasonable expectation is 35 – 40 seconds.

CLIMATE / AMBIENT CONDITIONS

Cold air is denser than warm air and increases the aerodynamic drag on the coach. Compared to 70° F ambient temperature, the increased drag caused by denser air at 50° F ambient temperature represents a 5% (0.3 MPG) fuel mileage penalty. At 30° F, the penalty increases to 9% (0.6 MPG).

Wind is a very important variable affecting fuel economy (MPG). *Figure 8* shows the effect of wind condition on the Wheel Demand horsepower of the automobile and for three coaches of different weights (34,000 / 40,000 / and 52,500 pounds).

Figure 8. Wind Condition vs. Wheel Demand HP – Flat, Smooth Surface at 65 MPH

Wind Condition	Vehicle	Aerodynamic / Air Resistance HP	Rolling Resistance HP	Total Wheel Demand HP
No Wind	Auto	18	6.4	25
	34,000	102	51	153
	40,000		60	162
	52,500		79	181
Head Wind 15 MPH	Auto	34	6.4	41
	34,000	190	51	241
	40,000		60	250
	52,500		79	269
Tail Wind 15 MPH	Auto	8.3	6.4	15
	34,000	46	51	97
	40,000		60	106
	52,500		79	125

Figure 8 shows that a 34,000 pound coach requires 153 horsepower at the drive wheels to maintain 65 MPH on a flat, smooth surface on a calm day (no wind). When faced with a 15 MPH head wind, 241 wheel horsepower are required to maintain 65 MPH, a 57.5% increase (88 HP) all attributable to the greater air resistance. A 15 MPH tail wind does not directly offset the 15 MPH head wind penalty. With a 15 MPH tail wind, 97 wheel horsepower are required to maintain 65 MPH, representing a 36.6% (56 HP) reduction in wheel demand horsepower.

Rough roads, rain, slough and snow increase the vehicle rolling resistance and contribute to lower fuel economy. On a cool rainy day, observe the steam (water vapor) surrounding the tires shortly after coming to a stop. Tires act as a pump to displace water from the roadbed. Pumping water requires horsepower and the energy turns to heat contributing to water evaporation and lower fuel economy.

FUEL

Summer blend #2 diesel fuel (API 35 gravity) has a higher BTU (higher heat value) content than #1 winter blend (API 38) and contributes to better fuel economy. Depending on the geographic location, winter blend fuel can make its appearance during the later part of August. Winter blend is responsible for a 2.5% penalty (0.15 MPG).

Combined effects of cooler ambient temperature and winter blend fuel on fuel economy:

(50° F = 0.3 MPG) + (API 38 = 0.15 MPG) = 0.45 MPG penalty (7% worse than summer)

(30° F = 0.6 MPG) + (API 38 = 0.15 MPG) = 0.75 MPG penalty (12% worse than summer)

GVW (Gross Vehicle Weight) or GCW (Gross Combination Weight / Towing)

During the last decade, coach weights have increased substantially to satisfy owner's appetite for more and more amenities. The coaches have gone from no slide to four slides, heavier granite counter tops and ceramic tiles have replaced laminate counter tops and linoleum or carpet floor coverings. Coaches are longer with larger storage compartments. Two air conditioners are commonplace. Larger generators are spec'ed to satisfy the increased electrical demand. Larger power train and drive line are commonly spec'ed to at least maintain an acceptable level of performance with the heavier coaches.

Increasing the GVW (Gross Vehicle Weight) or the GCW (Gross Combination Weight / Towing) increases the engine demand horsepower and increases fuel consumption. The corollary is also true, decreasing the GVW or GCW reduces fuel consumption and improves performance.

A 10,000-pound increase in GVW or GCW will increase fuel consumption by about 8.5% (0.55 MPG) and is equivalent to a loss of 80 engine horsepower at 45 MPH (8 HP / 1,000 lb @ 45 MPH) on a 6% grade.

IDLE TIME

A diesel engine consumes approximately 1 gallon of fuel per hour at a fast idle (900 – 1000 RPM). Idling consumes valuable resources (fuel) and for the most part is unnecessary. Excessive idling can contribute to carbon build-up and / or engine slobber and is detrimental to the engine.

Engine "Warm-up" – The best and fastest way to warm-up an engine is to begin driving at part load and part throttle shortly after start-up, following a brief inspection of the coach.

Engine "Shut-down" – Before exiting the highway, take your foot off the throttle and coast long enough to decelerate the coach to the point where a minimum amount of braking is required to exit the main roadway. A heavy coach can coast a long distance with the driver's foot off the throttle. During the coasting period the engine is not consuming any fuel. With a light load on the engine for a period of two to three minutes, the engine has cooled sufficiently and can be shutdown.

GENERATOR

The typical 8 kW RV diesel generator consumes approximately 0.5 gallon of diesel fuel per hour when operating at 50% load factor.

CALCULATING FUEL MILEAGE (MPG)

When calculating fuel economy, fill the tank on a level surface before departing. Fill it to the same level upon arrival. Do not include the initial fill in the fuel mileage calculations. In the real world, because the pavement at most fuel islands is not level, calculating fuel mileage based on only one tank can be misleading as a few degrees difference in slope at the fuel island can make several gallons difference in amount of fuel pumped to achieve the same level in the tank.

Use the following formula:

MPG = Miles Traveled / [*Gallons Purchased – (Generator Hrs × 0.5 Gal / Hr)]

* Do not include the initial fill.

Example: The coach traveled 7,500 miles and 1,225 gallons of diesel fuel were purchased. During that period, the Generator operated 154 hours.

7,500 Miles Traveled / [1,225 Gallons Purchased – (154 Hrs × 0.5 Gal / Hr)] =
7,500 Miles Traveled / 1,148 Gallons (Adjusted for Generator usage) = 6.53 MPG

If the fuel consumed by the Generator is not subtracted from the total fuel purchased, the fuel economy is incorrectly calculated as 6.12 MPG (7,500 Miles / 1,225 Gallons) equivalent to a 6% error.

ENGINE ELECTRONIC CONTROL MODULE (ECM)

The engine ECM (Electronic Control Module) also calculates fuel economy (MPG). When comparing the ECM calculated fuel mileage to the Actual fuel mileage (tank mileage), make sure the vehicle odometer and speedometer displays are accurate. If the mileage recorded is inaccurate, the fuel mileage (MPG) calculations will also be incorrect.

The speedometer accuracy can be verified using the interstate mile markers as a reference. At a constant 60 MPH, it takes 60 seconds to travel one mile. For every second less than 60 seconds required to travel one mile, the actual coach speed is approximately one MPH faster. For every second exceeding 60 seconds required to travel one mile, the actual coach speed is approximately one MPH slower.

Example: The cruise speed is set at 60 MPH and the coach travels one mile between mile markers in 58 seconds. The actual coach speed is approximately 62 MPH.

Speedometer accuracy can also be confirmed with a Global Positioning System (GPS).

If the speedometer is inaccurate, the odometer may require calibration. A dealer authorized to service Caterpillar engines can verify that the transmission output shaft Revolutions Per Mile (RPM) is programmed correctly in the ECM.

TIRES

Some facts to consider:

- Proper tire inflation pressure is important for your safety and that of others. Maintaining correct inflation pressure based on the actual tire load will also optimize tire life, vehicle ride quality, and fuel economy. With a tire pressure 10 psi lower than the manufacturer's recommendation for the weight, fuel economy will drop 0.5%.
- All tires are least fuel-efficient when new. As the new tire wears, the rolling resistance decreases and fuel economy improves.
- Most of the fuel economy advantage is obtained when the tread is 50% worn.
- Regular radial tires and fuel economy labeled tires provide nearly the same fuel economy as they approach wear out.
- Above 55 MPH, air resistance / aerodynamics is a more important consideration than tire rolling resistance.
- Fuel-efficient tires lose half of their fuel efficiency benefit when vehicle speed increases from 60 to 75 MPH.

OTHER FACTORS

There are several other factors that negatively affect the coach fuel economy. Rough road surface, axle and front end misalignment, etc.

Roof-mounted accessories (air conditioners, cargo carrier, and satellite dish, etc.) or driving with the side window(s) opened adversely affect the aerodynamic drag and negatively impact fuel economy.

All new vehicle components (engine, transmission, drive axle, drive line U-joints, wheel bearings) require a "break-in" period. During the initial 30,000-mile "break-in" period, fuel economy continues to improve. The cumulative effect of small factors becomes significant.

AUTOMATIC TRANSMISSION “MODE” BUTTON

There are two different modes programmed into the automatic transmission Electronic Control Unit (ECU) – “Regular mode” and “Economy mode.” Select “Regular mode” for faster acceleration and faster hill climbing. To optimize fuel economy, select “Economy mode”.

Every time the engine starts, the transmission defaults to the “Regular mode”. When the “mode” button is depressed, the transmission toggles to the “Economy mode” and the “mode ON” light illuminates. The transmission can be shifted between regular and economy mode at anytime and as often as desired with the transmission in any gear.

The “Regular” and “Economy” mode differ in the engine RPM when the transmission up-shifts / downshifts from one gear to another at high throttle position.

In “Economy mode”, the transmission up-shifts as soon as feasible to the next higher gear. The transmission downshifts when the engine RPM falls to slightly above the engine peak torque RPM.

In “Regular mode”, the transmission up-shifts at higher RPM and downshifts earlier to maintain higher engine RPM. Generally speaking, engine horsepower and fuel consumption increase as engine RPM increases.

A large engine RPM difference can be observed between the two operation modes at higher throttle position and engine load. On level ground, there is practically no difference between “Regular” and “Economy” mode because at cruise speed the transmission is in top gear (6th gear) in either mode most of the time. The difference between the two modes is readily observed at high throttle position in rolling hills. In “Regular mode” in rolling hills, particularly with the cruise control on, it is common for the transmission to downshift to 5th gear on each uphill and up-shift to 6th gear on each downhill. In “Economy mode”, the transmission is more likely to remain in 6th gear unless the hill is so steep and / or so long that the engine RPM drops to slightly above peak torque RPM. Modern diesel engines operate efficiently at lower engine RPM and this is the preferred and most economical way to climb mountain grades as long as the engine coolant temperature does not rise excessively. The “Regular mode” may be preferred to maintain vehicle speed and lower engine coolant temperature on steep grades in high ambient temperature.

Fuel economy is generally optimized in the “Economy mode”, at the lowest vehicle speed with the transmission operating in top gear.

In either mode, the up and down (up-shift and downshift) arrows can be selected proactively at any time, without harming the transmission, to place the engine in the desired RPM range to optimize performance and minimize transmission shifting (hunting) between gears on a grade.

The transmission ratios between 6th and 5th gear are close together (small step). Knowing that a hill climb will force the transmission into 4th gear or lower, the driver can anticipate and manually downshift early to 5th gear raising the engine RPM for improved performance. Since the 5th to 4th gear ratios are wider (larger step), allow the transmission to lug back the engine to just above the peak torque RPM in 5th gear. When the transmission downshifts to 4th gear, the engine RPM will rise noticeably to increase the available engine horsepower at the drive wheels.

EXHAUST BRAKE (C7, C9) and COMPRESSION BRAKE (C13, C15)

Brakes have one purpose in life, to convert kinetic energy – that is the energy of a moving vehicle into HEAT. Heavier vehicles, particularly at high speed, have a large amount of kinetic energy. For this reason, service brakes of large vehicles are more susceptible to overheating and fade on a long downgrade. An exhaust or compression brake (engine model dependent) can be used to assist with the motor coach deceleration and to control speed on a steep grade.

When descending a steep grade, it may be appropriate to select a lower transmission gear to maintain higher engine RPM to increase the exhaust or compression brake performance. When the speed of descent is still too fast, use the service brakes to slow down enough to select a lower gear. To increase speed, release the service brakes, use the "up arrow" and momentarily apply throttle to allow the transmission to up-shift to a higher gear, and finally turn "OFF" the exhaust or compression brake. The compression brake has a three-position (LOW, MED, HIGH) switch to modulate braking under a wide variety of road conditions.

Exhaust and Compression brakes provide greater braking performance (retarding HP) at higher engine RPM. Generally speaking, descend a steep grade in the next lower gear than would be required to climb the same grade.

DO NOT use the exhaust brake, compression brake, or cruise control on a slippery road.

An exhaust or compression brake does not lower the fuel mileage (MPG) when used for controlling vehicle speed on steep grades or to assist in stopping the coach. Keep in mind that best fuel mileage is achieved when "coasting" as much as possible before using any type of brake to bring the vehicle to a stop.

In moderate rolling hills, brake usage can materially reduce fuel economy (MPG). In rolling hills, best fuel economy is achieved by turning the exhaust or compression brake "OFF". The vehicle accelerates on descent and decelerates on the climb, but will not downshift as often or spend as much time at wide open throttle to maintain the desired cruise speed. On a downhill, let the mass of the heavy vehicle provide most of the acceleration horsepower and crest the next hill with minimum throttle. Most drivers can achieve better fuel economy by using the cruise control rather than taking over the throttle position management task.

A "Pre-select" gear is programmed from the factory. The "pre-select" gear is the target gear for slowing the coach when the exhaust or compression brake is turned "ON". Most coaches have either a 2nd or 4th gear "pre-select." When the coach is at cruise speed, and the exhaust or compression brake is engaged, the transmission shifts from 6th to 5th gear, and when the vehicle speed drops sufficiently, from 5th to 4th, and so on until the pre-select gear is reached.

SUMMARY OF SIGNIFICANT FACTORS INFLUENCING COACH MPG

FACTORS	% PENALTY
DRIVER • Worst to Best Drivers – (6.0 – 7.5 MPG)	20%
ROUTE • Interstate vs. Congested Road – (up to 1.3 MPG)	20%
VEHICLE SPEED • 60 vs. 70 MPH – (0.8 MPG / Aero dependent)	12%
CLIMATE • Summer (70° F or higher) vs. Winter (30° F) – (0.75 MPG) • Wind / Terrain – (0.75 MPG)	12% 12%
FUEL • #2D (API 35) vs. Winter Blend (API 38) – (0.15 MPG) • #2D (API 35) vs. Kerosene (API 48) – (0.9 MPG)	2.5% 14%
GCW • 55,000 lb vs. 45,000 lb @ 65 MPH – (0.55 MPG)	8.5%
TIRES • New vs. Worn low profile radial tires – (0.15 MPG)	2.5%
IDLE TIME • 20% vs. 10% idle time – (0.09 MPG)	1.5%

NOTE: 10% = $350. / Year (Assuming 7,500 miles / 6.5 MPG / $3.00 per gallon)

TO LOCATE A DEALER
Toll-free: (877) 777-3126
Web: rv.cat.com

RELATED LITERATURE
Caterpillar RV Center Directory – **LEGT5257-01**
Caterpillar RV Center Capability – **LEDT5259**

CATERPILLAR®

LEGT5364-01