Fuel Economy Driving Techniques 5

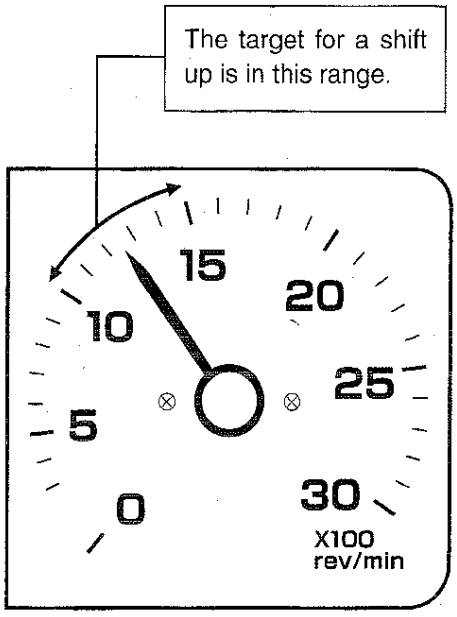
1) Standing start

- Fuel consumption is high for standing starts because of a consecutive full engine load state.
- The impact is even larger when traveling in crowded city streets.
- The lowest level of fuel consumption is when the engine is run at around 1,000 engine rpm.
- A maximum-minimum rotation control type governor also affects the fuel economy in accordance with the gas pedal depression amount. (All-speed rotation control type governors are relatively insensitive to this.)

A transmission shift up (acceleration) is in the range of 1,000 to 1,500 rpm.*

* For most diesel engines

The accelerator pedal depression is $\frac{1}{2}$ to $\frac{2}{3}$.



Tachometer (engine rotation)

Reference

All-speed rotation control governor	The injection amount is closely regulated in accordance with the accelerator pedal depression amount.
Maximum-minimum rotation control governor	When the pedal is depressed to a certain position, the injection amount suddenly increases to a certain level.

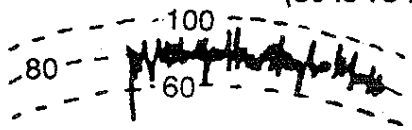
2) Steady-speed driving

- Fuel economy is greatest when the engine revolutions are kept just above the point where the engine stalls.
- Varying speed driving with repeated acceleration and deceleration significantly diminishes fuel economy.
- Even if the vehicle speed does not change often, fluttering of the accelerator pedal leads to significant reductions in fuel economy.
- Using cruise control improves fuel economy because varying speed driving patterns are eliminated.

Changes in vehicle speed (speed variation) kept to no more than 5 km/hr
Generally when driving over 45 km/hr, drive in the highest gear possible.

※Varying speed driving example (tachograph)

(60 to 95 km/hr)



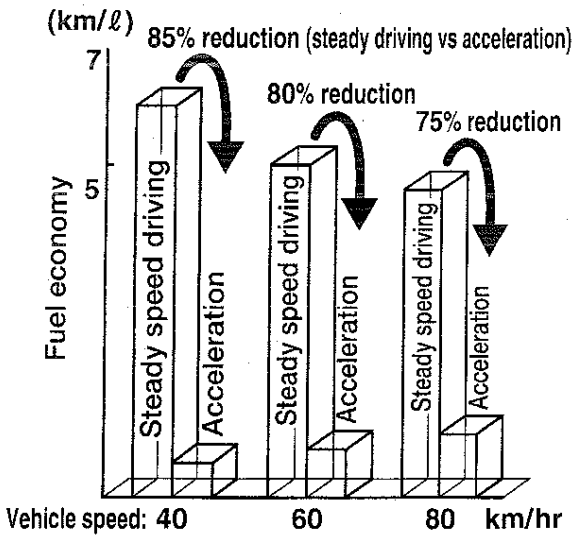
Range of speed changes: 35 km/hr

(40 to 120 km/hr)

Range of speed changes: 80 km/hr

Fuel economy comparison test for steady-speed driving and acceleration

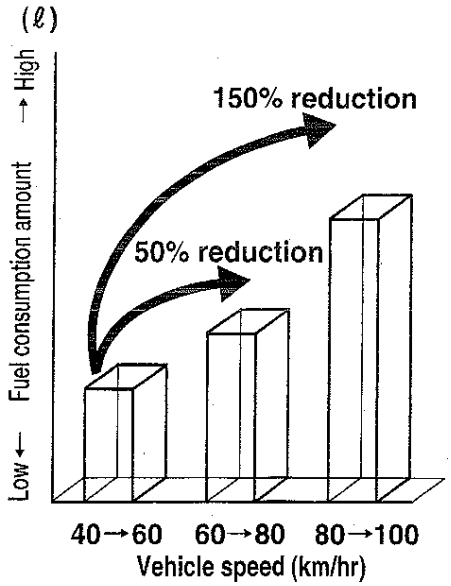
The fuel economy is measured using a heavy-duty vehicle for steady speed driving at speeds of 40, 60 and 80 km/hr and for acceleration from each of these vehicle speeds.



Acceleration- the fuel consumption rating when accelerating at 40, 60, 80 km/hr.

Test of acceleration fuel economy for different vehicle speeds

The fuel economy was measured using a heavy-duty vehicle for acceleration from 40 to 60 km/hr, 60 to 80 km/hr and 80 to 100 km/hr.



3) High speed driving

- As much as possible, high speed driving should be in high gears to limit the number of engine rotations. Higher engine rotations increase the amount of fuel consumed.
- In the following diagram, the number of engine rotations when traveling at 60 km/hr is:

  Using 7th speed → 1,450 rpm

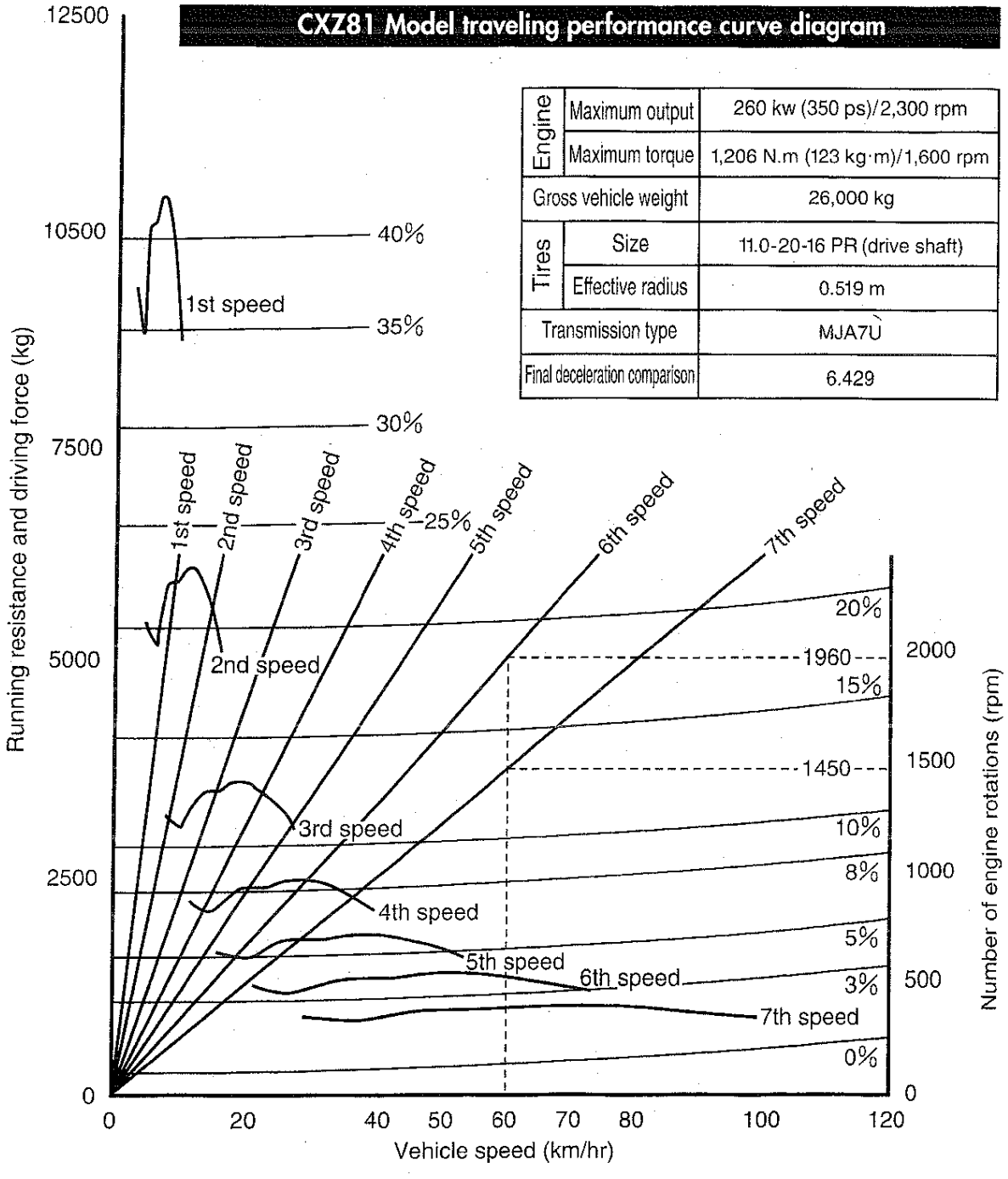
  Using 6th speed → 1,960 rpm

  Therefore, when traveling for a period of 10 minutes, the engine is rotated an extra 5,100 times.

(rpm = number of engine rotations in one minute)

CXZ81 Model traveling performance curve diagram

Engine	Maximum output	260 kw (350 ps)/2,300 rpm
	Maximum torque	1,206 N.m (123 kg·m)/1,600 rpm
Gross vehicle weight		26,000 kg
Tires	Size	11.0-20-16 PR (drive shaft)
	Effective radius	0.519 m
Transmission type		MJA7U
Final deceleration comparison		6.429



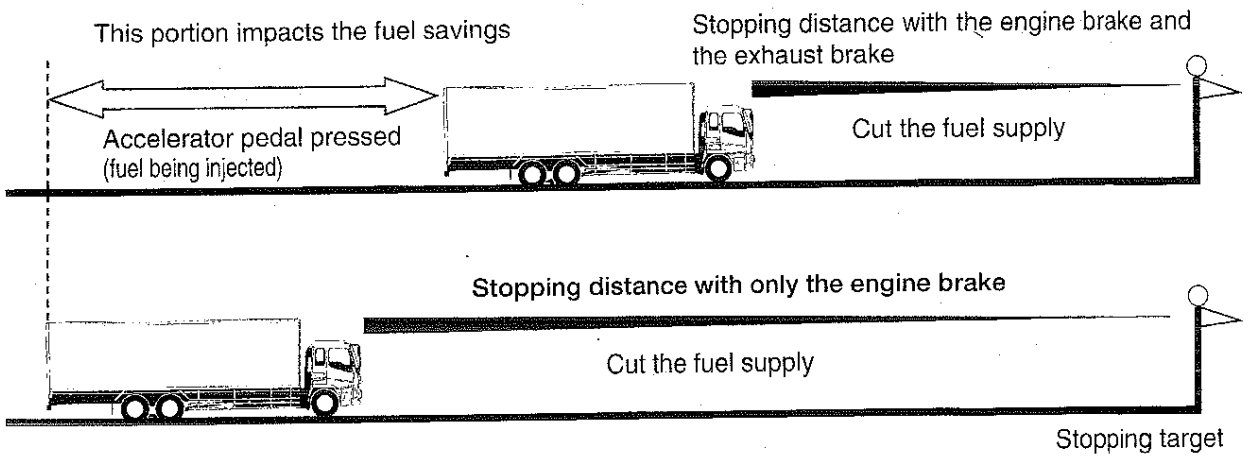
4) Using the engine brake

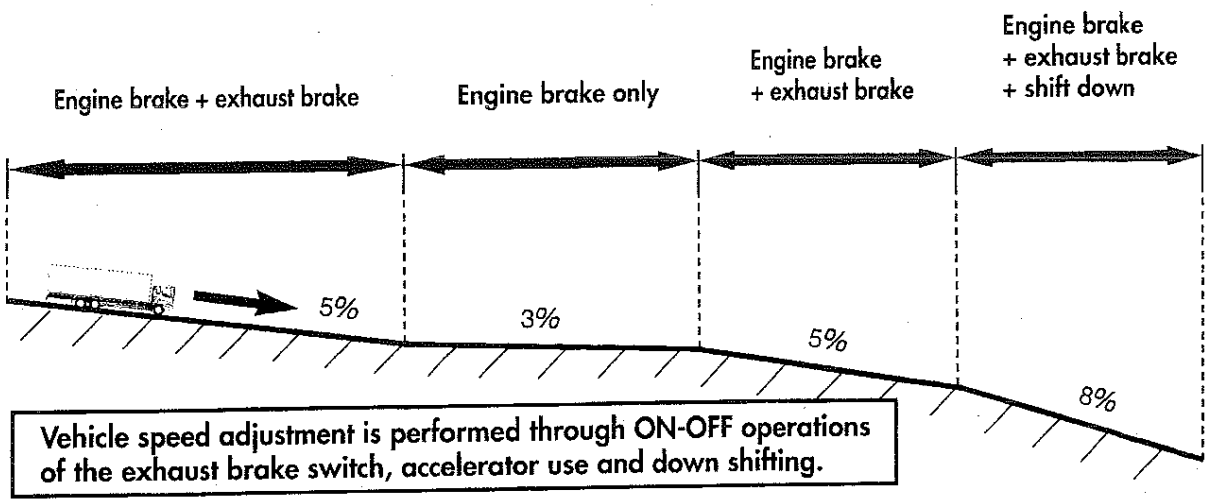
- Fuel supply is cut off when the driver's foot is removed from the accelerator pedal.
- Braking with the exhaust brake is 1.6 times stronger than when only using the engine brake.
- There is a tendency of varying vehicle speeds when the exhaust brake is left deployed.

The exhaust brake is not turned off by foot (accelerator pedal, clutch) and requires to be manually switched off.

While coasting, use the engine brake rather than the exhaust brake.

Comparison of stopping distance

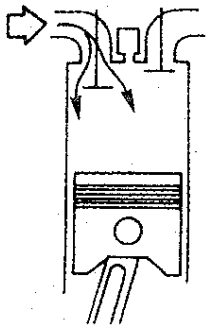
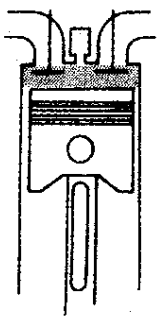
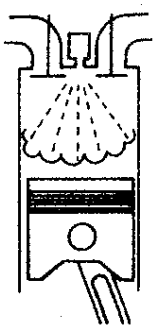
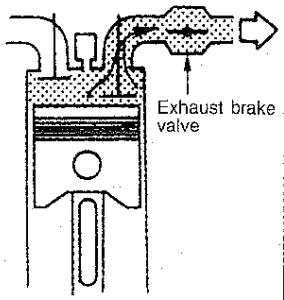




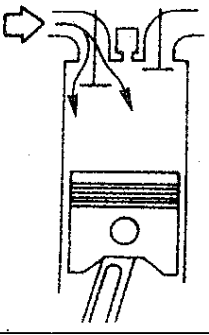
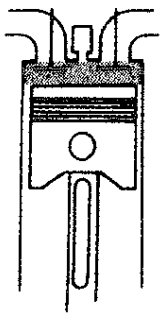
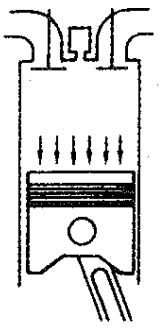
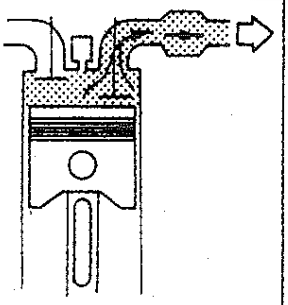
Vehicle speed adjustment is performed through ON-OFF operations of the exhaust brake switch, accelerator use and down shifting.

Reference Operations and principle of the exhaust brake

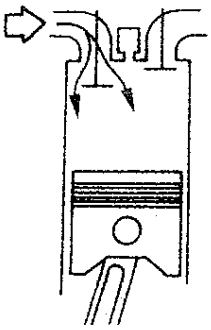
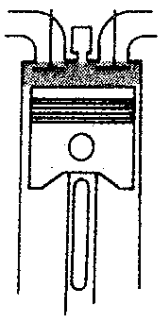
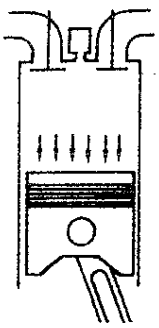
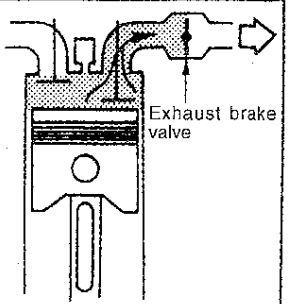
(1) During normal operation ··· The engine continues rotating so that enough rotating power is transferred to the crankshaft through combustion to overcome running resistance.

Process	Air intake	Compression	Combustion	Air exhaust
				
Resistance	△	◎	×××	△

(2) During engine brake deployment ··· Braking power is achieved since the combustion process changes to air expansion only on the combustion stroke when the fuel supply is cut off.

Process	Air intake	Compression	Combustion	Air exhaust
				
Resistance	△	◎	×	△

(3) During exhaust brake deployment ··· By closing the exhaust brake valve, the exhaust process changes to air compression and creates braking power that is 1.6 times stronger than the engine brake.

Process	Air intake	Compression	Combustion	Air exhaust
				
Resistance	△	◎	×	○

Explanation of symbols ◎: Large braking power ○: Medium braking power △: Small braking power ×: No braking power

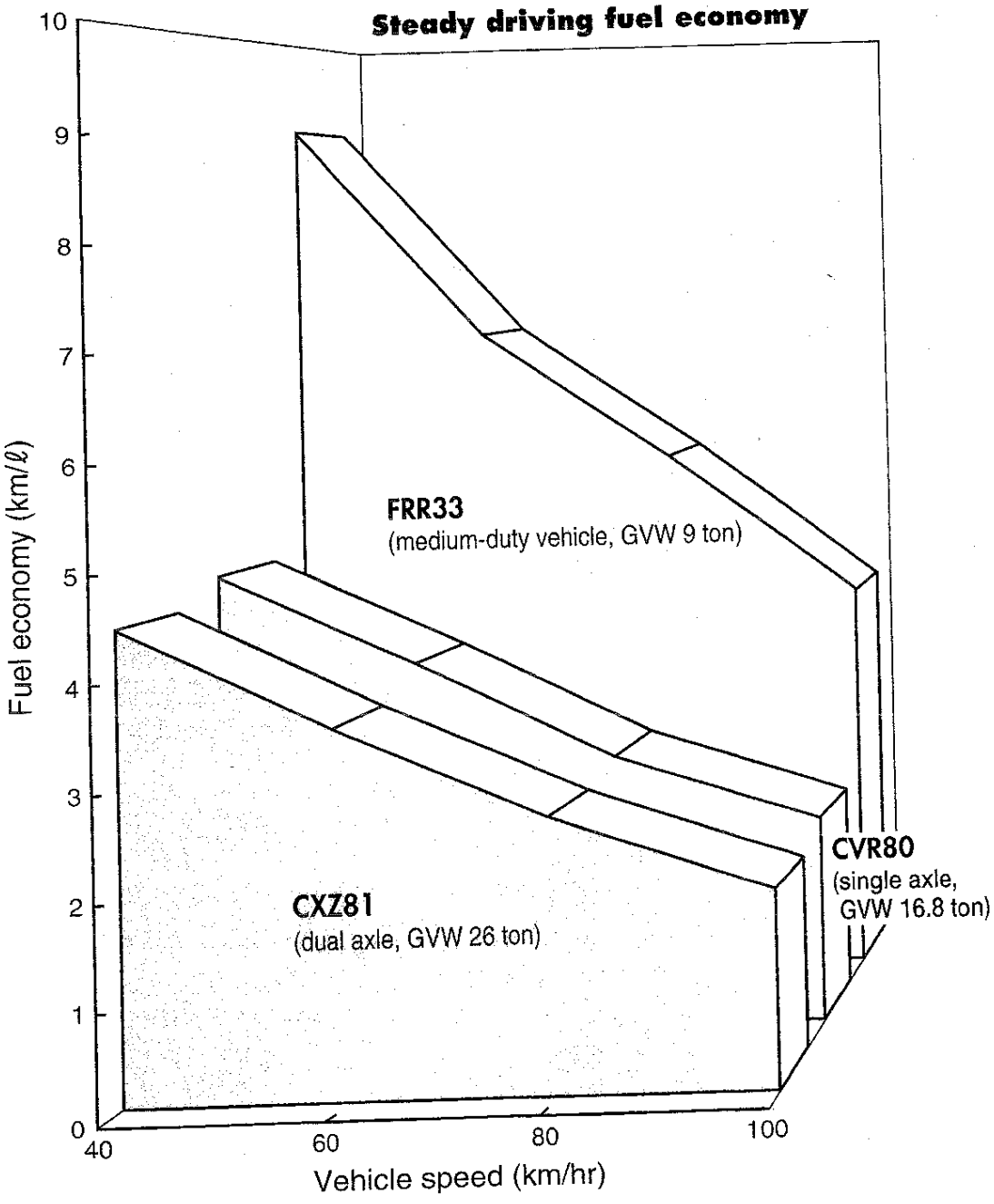
5) Maximum speed

Vehicle speed should be kept at reasonable levels since fuel economy diminishes as speeds increase.

100 km/hr ➡ 80 km/hr

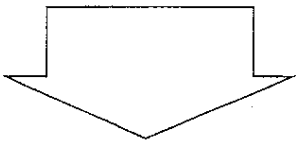
Fuel economy increases approximately 20% by reducing vehicle speed 20 km/hr from 100 km/hr to 80 km/hr.*

(* Varies by model, load and driving condition)



6) Number of stops

- The amount of fuel consumed for standing starts is equivalent to driving up an incline at full power.
- Much fuel is necessary to activate the tires from a standing position.
- Even when encountering red lights, it is possible to adjust the time of arrival in advance so that the light has already changed to green.



Reduce the number of stops through thoughtful driving

Strive as much as possible to keep tire rotation from stopping

Avoid congested streets by checking traffic information.

7) Idling

- Keep idling to the minimum necessary.

The amount of fuel consumed (liters) from one hour of idling is:

10PE1(10 cyl. diesel)·····1.6～1.7
8PE1(8 cyl. diesel)·····1.3～1.4
6WA1(Large 6 cyl. diesel)·····1.1～1.5
6HH1(Medium 6 cyl. diesel)·····0.7～0.8
(These figures are about 20% worse when the air conditioning is on.)

- Temporary engine stops should be used only when the stop is expected to be at least 30 seconds to prevent placing additional burden on the battery starter.
- Warm-up driving can be completed in about 10 minutes even in the winter season. (The indicator for completion of warm-up driving is when the water temperature gauge needle moves slightly.) The amount of fuel consumed until warming up completion is about the same whether it is done at idle or at an engine rotation of 700 rpm, the amount of time required can be cut in half at 700 rpm.

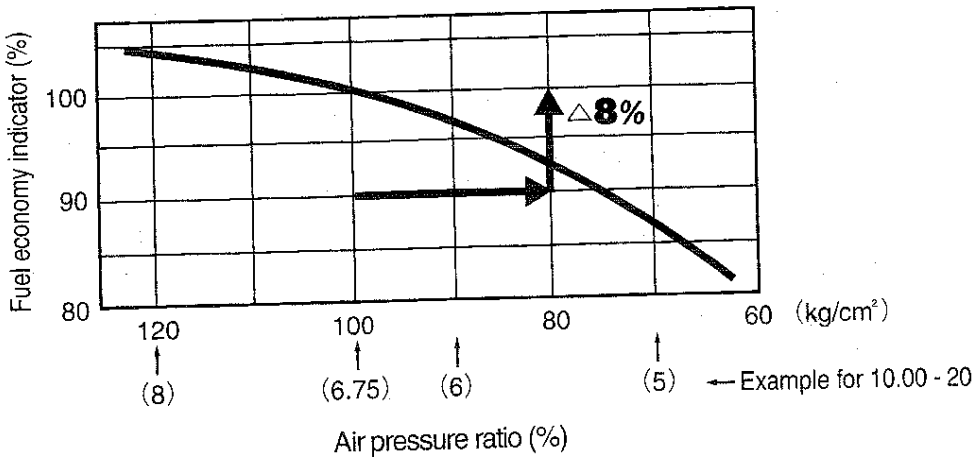
6 Vehicle Maintenance and Upkeep

1) Tires

(1) Air pressure

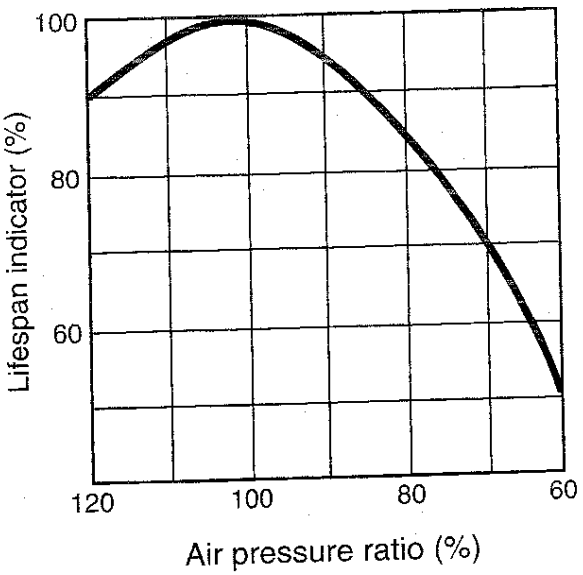
When the tire air pressure is 20% lower, fuel economy is reduced by nearly 8%. Even though fuel efficiency improves when air pressure is high, since this state also leads to shorter tire lifespans, it is important to maintain the specified air pressure level.

Air pressure and fuel economy

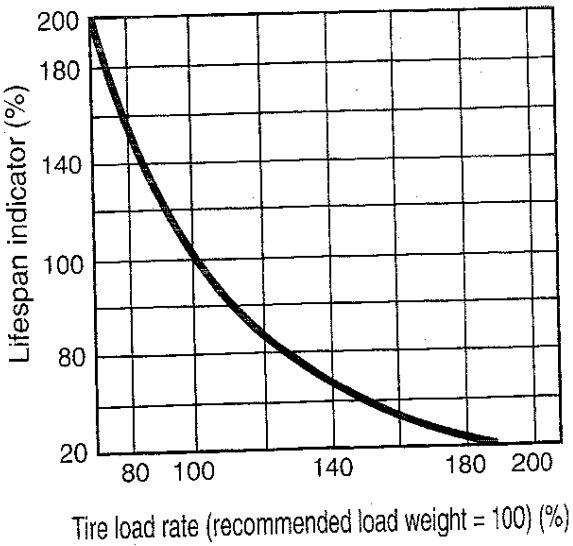


Reference

Air pressure and friction lifespan



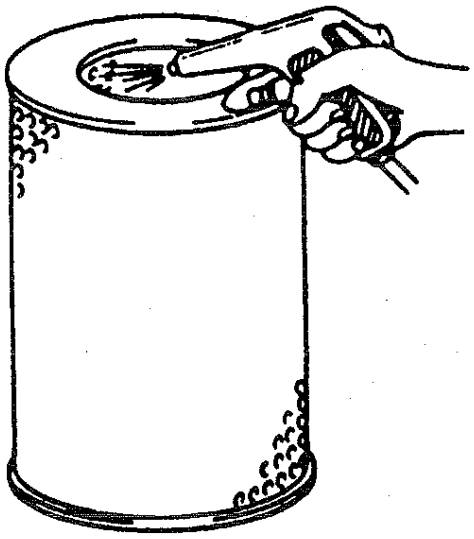
Friction lifespan and load weight



2) Air cleaner clogging

When the air cleaner is heavily clogged with dirt, air intake amounts drop, lowering fuel economy and output.

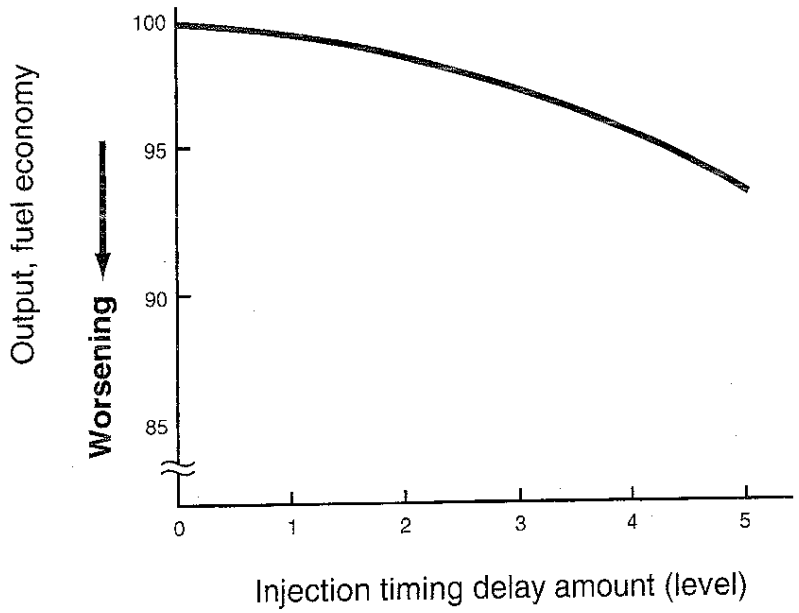
Fuel economy reduction: 3 ~ 5%



3) Fuel injection timing

When the fuel injection timing is late, fuel economy and output both decline. Confirm that the injection timing is normal because if it is faster than normal, exhaust gas concentrations worsen, increasing the heat load and lowering the engine reliability.

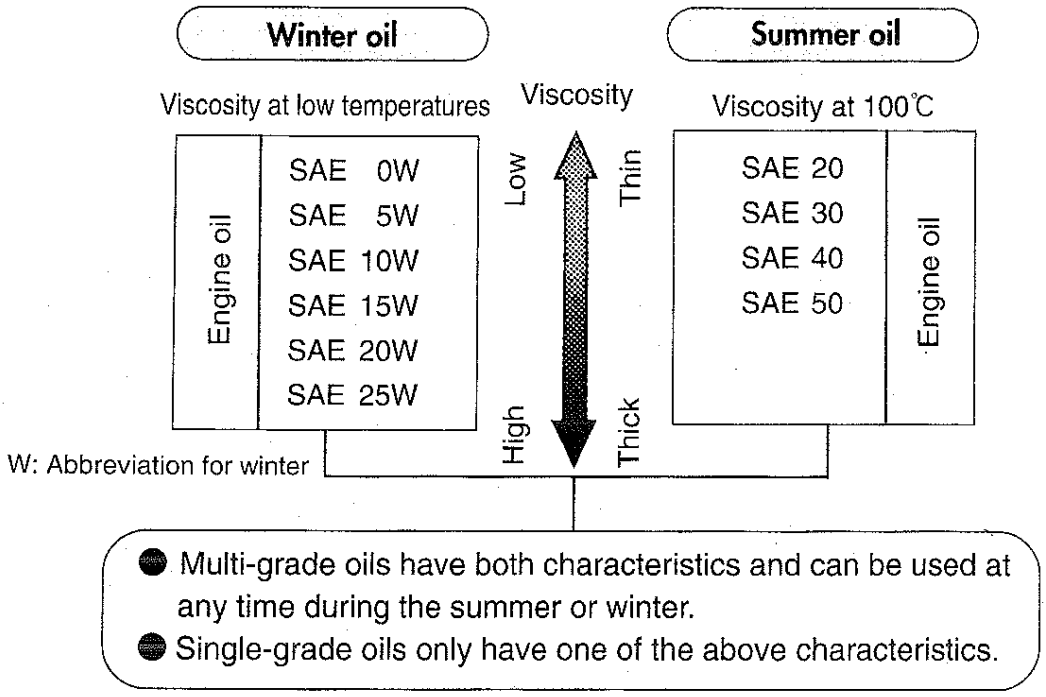
Rate of output and fuel economy worsening



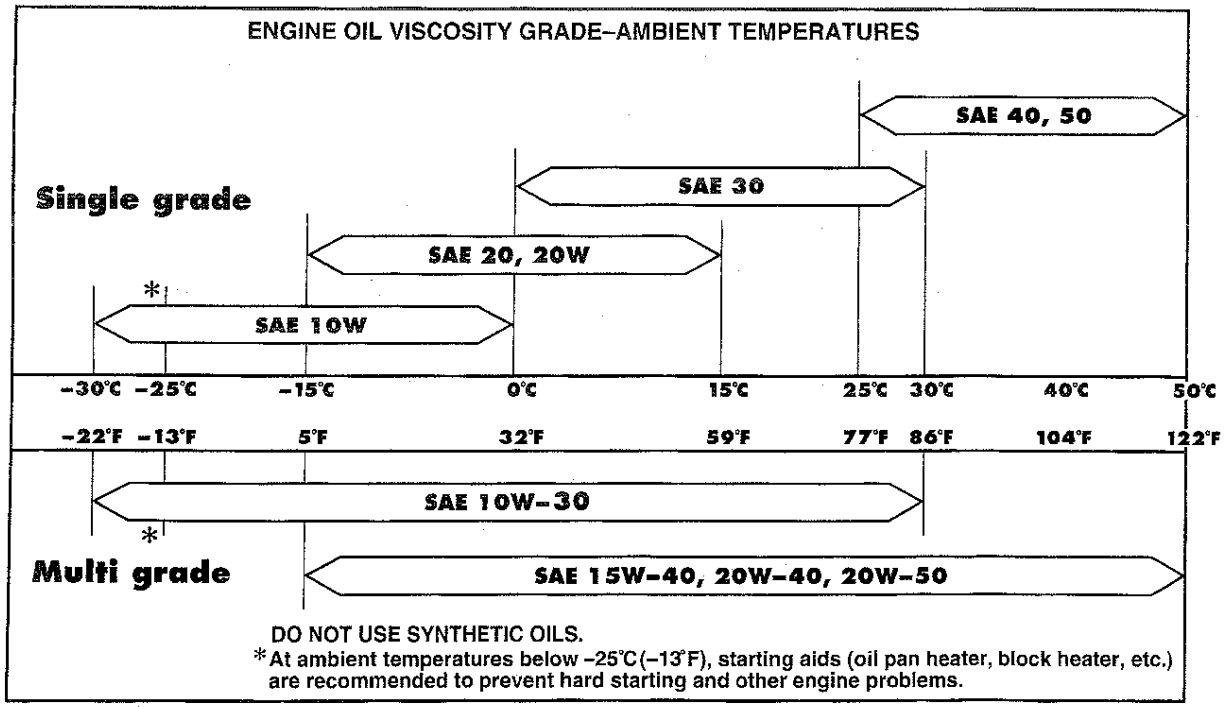
4) Engine oil

Since there are different types of engine oils, some of which undergo considerable changes in viscosity with variations in temperature, it is necessary to change to an appropriate oil for the particular season.
If the oil viscosity is too high, loss from friction rises and fuel economy worsens.

Engine oil types



ENGINE OIL VISCOSITY CHART

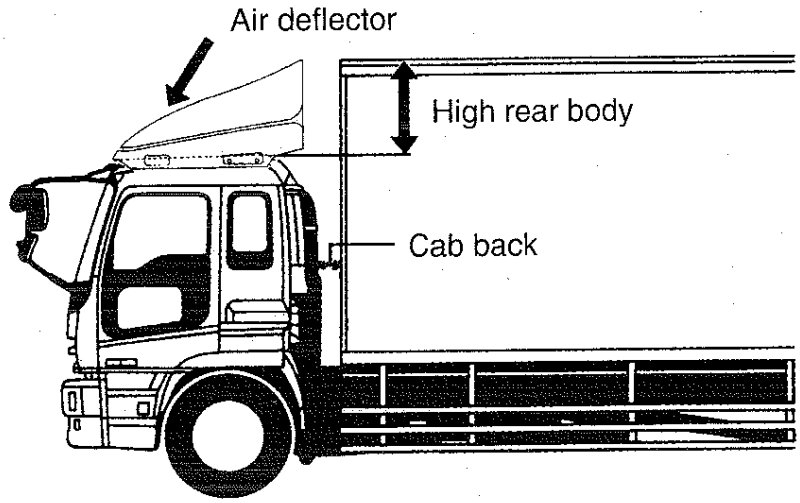


5) Aerodynamic components

These are components which lower the air resistance. Effective for vehicles with a large share of high-speed traveling and vehicles traveling at high cruising speeds.

(1) Air deflector

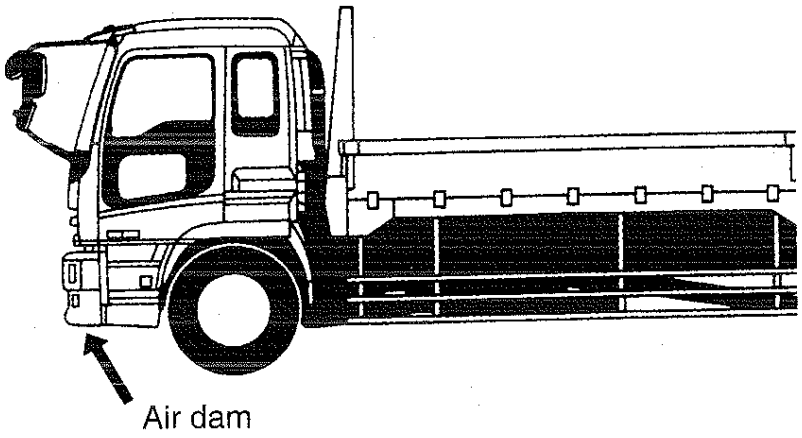
Only effective for vehicles with a cargo bed which is higher than the cab and vehicles with a broad cab back.



Fuel savings effect
5 ~ 10%

(2) Air dam

Unlike the air deflector, the air dam can also be used for flat body vehicles and special body vehicles.



Fuel savings effect
2 ~ 4%

Factors' Impact on Fuel Consumption

Difference between varying speed driving and steady-speed driving	27%
Difference in maximum vehicle speeds (70 km/hr and 80 km/hr)	14%
1 km/hr difference in maximum vehicle speed (at 80 km/hr and higher)	1%
Gear changes at under 1,500 rpm	15%
Difference between sharp acceleration and steady acceleration	14%
Regular use of higher gears (difference between 7th speed and 6th speed and 6th speed and 5th speed)	8%
Difference between bias tires and radial tires	13%
Difference in tire air pressure (6.75 kg/cm^2 and 5 kg/cm^2)	13%
Shorter idling time	2~11%
Air cleaner clog	3~5%
Engine racing	10 cc each time
Air deflector deployment (high speed)	5~10%
Air dam deployment (high speed)	2~4%
Difference between a total vehicle weight of 26 tons and 30 tons	5~10%

(For a heavy duty (H/D) truck)