

## Introduction of Products

# Introduction of Small-Size Wheel Loaders WA270-7 and WA320-7

Motoki Oba

Two small-size wheel loader models, WA270-7 and WA320-7, were developed and launched. These new models feature an engine that meets the Tier 4 Interim emissions standards currently in place in Japan, the United States and Europe, and offer higher levels of “environmental,” “safety” and “ICT” performances built on Komatsu “quality and reliability.” Some of the key features of these models are explained below along with the objectives of their development.

**Key Words:** WA270-7, WA320-7, Wheel loader, Tier 4 Interim emissions standards, Komatsu SmartLoader Logic, New electronically controlled HST, Variable displacement piston pump + Load sensing hydraulic system, Low fuel consumption, PZ linkage, Environment, Safety, ICT

## 1. Introduction

The previous models, WA270-6 and WA320-6, both launched in 2007, were favorably accepted in markets around the world with their Tier 3-compliant engine and highly efficient electronically-controlled HST (hydrostatic transmission).

The new models, WA270-7 and WA320-7, now have much better fuel economy thanks to a range of new technologies including the engine that meets the Tier 4 Interim emissions standards currently in place in Japan, the United States and Europe, an improved version of the electronically-controlled HST and the Komatsu SmartLoader Logic for optimum engine control.



Fig. 1 WA320-7

## 2. Objectives of the Development Project

The new models were envisioned as something that would meet the Tier 4 Interim emissions standards, have much higher fuel efficiency and help ensure customers highest possible profitability while being friendly to the environment. Building upon the expertise for “quality and reliability” that has been nurtured in the previous product development efforts, higher levels of “environmental,” “safety” and “ICT (Information & Communication Technology)” performances were sought. These elements were envisaged as key selling points.

Specifically, the selling points of the WA270-7 and WA320-7 include the following:

- (1) Environmental performance and economy
  - 1) EPA (North America), Tier 4 Interim-compliant engine
  - 2) Variable-displacement piston pump for the loader and steering hydraulic circuits, and coordinated control (Komatsu SmartLoader Logic) of the engine, hydraulic system and powertrain (HST) for significant reduction in fuel consumption
- (2) Safety and operator comfort
  - 1) Rear-view camera
  - 2) Seat belt caution
  - 3) New design cab and lower in-cab noise
  - 4) New multifunction mono-lever

- (3) ICT
  - 1) Multi-monitor
  - 2) ECO Guidance to assist fuel efficiency
  - 3) Fuel consumption management by KOMTRAX (remote vehicle data management system)

### 3. Key Product Features

#### 3.1 Tier 4 Interim-compliant engine

Both WA270-7 and WA320-7 are equipped with the Komatsu SAA6D107E-2 engine, which meets EPA Tier 4 Interim regulation, EU Stage IIIB regulation, and the Japanese 2011 emissions regulation. This new engine, based on the Komatsu SAA6D107E engine used on the previous wheel loader models, offers the following new technologies that are similar to WA380-7 engine launched earlier

- (1) Komatsu Diesel Particulate Filter (KDPF)
 

This is an aftertreatment system designed to trap PM (particulate matter) in exhaust gas. The KDPF consists of an oxidation catalyst and a ceramic soot filter with a catalyst. PM is trapped by the soot filter and only filtered gas is allowed to flow out into the atmosphere. When the trapped PM reaches a certain amount, fuel is automatically injected into the exhaust gas and then the oxidation catalyst intervenes to increase the temperature inside the KDPF so that the trapped PM can burn away.
- (2) Cooled EGR system
 

This system brings part of the exhaust gas through an EGR cooler and back into the combustion chambers to help remove NOx from the exhaust gas.
- (3) Komatsu Variable Geometry Turbocharger (KVGT)
 

The opening of the turbine blades is variable depending on engine load, thereby regulating the flow rate and pressure of intake air. This ensures high EGR rates even at low engine speeds.
- (4) Komatsu Closed Crankcase Ventilation (KCCV)
 

Blowby gases (incompletely burned air-fuel mixture) that have leaked into the crankcase are fed through the ACCV filter to remove oil before being sent back to the air intake system where the gases are mixed with fresh air-fuel mixture. The mixture is then burned to remove PM. The oil that has been separated from the blowby gases is sent back into the crankcase.

- (5) New combustion chamber
 

A new, redesigned piston has been introduced to optimize air-fuel mixture and subsequent combustion to help reduce NOx and PM. It has been shown that optimum combustion leads to improved fuel economy and lower noise levels.

#### 3.2 Improved fuel economy and operating efficiency

Maximum performance with substantially lower fuel consumption has been achieved with the introduction of the variable-displacement piston pump for the loader and steering hydraulic circuits which minimizes unnecessary oil supply in neutral, the improved version of the 1 pump + 2 motors new electronically controlled HST system, and the Komatsu SmartLoader Logic, an advanced coordinated optimum control of the engine, hydraulic system and powertrain based on the current working condition of the wheel loader.

Komatsu's internal test has shown that WA320-7 consumes 10% less fuel than WA320-6 per hour during V-shape digging/loading operations.

- (1) Komatsu SmartLoader Logic
 

This engine control system, already used on WA380-7 and other medium-size models, is introduced to improve fuel economy. Based on the inputs from multiple sensors, it grasps the vehicle's working condition, and performs combined control to optimize the engine torque and engine speed in accordance with the loads on hydraulic system and driving system; thus operating the engine in the efficient driving range for better fuel economy.
- (2) New electronically-controlled HST
 

As compared with the one-pump and two-motor type electronically-controlled HST system of the previous WA270-6 and WA320-6 models which used the hydraulically-controlled HST pump, the new WA270-7 and WA320-7 models feature a new electronically-controlled HST pump. The variable torque HST pump offers optimum engine speed under the current working conditions to improve fuel economy.
- (3) Variable-displacement piston pump + Load sensing hydraulic system
 

A newly designed load-sensing hydraulic system with a variable-displacement piston pump has been introduced for the loader and steering systems. Only the volume of oil currently needed is pumped out to the loader and steering systems, with the result that unnecessary oil supply in neutral condition is minimized.

## (4) ECO Guidance

Messages are displayed on the main monitor to recommend fuel-efficient operations to the operator. While operating, messages to advise operating method to improve fuel economy for the current condition are displayed on the monitor screen. When the key is turned to OFF, a useful advice is displayed on the termination screen.

Recommendation for fuel-efficient operation



Termination screen



Menu

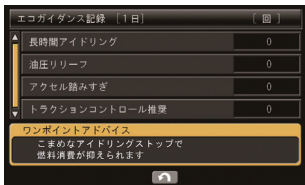


Fig. 2 ECO Guidance

## (5) Auto Idle Shutdown (only for North America and Europe)

This feature is designed to minimize engine idling time. The engine automatically stops to save fuel when it is left idling for more than a certain period of time. When the Auto Idle Shutdown activates, the parking brake and the loader lock are also engaged for safety.

## (6) Fuel consumption management by KOMTRAX

This feature helps support fuel efficient operations by sending a range of related vehicle information to the server such as the amount of fuel consumed and the time the engine has idled, and based on the data thus accumulated, a report with fuel saving recommendations can be presented to the customer.

## (7) New PZ loader linkage

With the previous loader models, two types of linkages were used -- the conventional Z-bar linkage for Japan and the PZ (Parallel Z-bar) linkage for overseas markets. With the new loader models, only the PZ linkage is used for all markets. Unlike the Z-bar linkage, the PZ linkage keeps the bucket parallel during the boom raising and lowering processes and has a greater dumping clearance and reach. Combined with the introduction of the new loader hydraulics, the PZ linkage

offers much greater lift and break-out forces, making digging and loading operations easier. In addition, the Auto Tilt-In feature automatically corrects the tilt angle of the bucket while it is being raised in loading operation, thus preventing spillage of the load carried in the bucket. Because the type of the linkage is unified to the PZ linkage, the "PZ" designation in the model name has been deleted.

## (8) Bucket Auto Tilt-In

The "PZ Auto Tilt-In" function automatically tilts the bucket back while it is being raised to prevent spillage of the load in the bucket. Spill-free operation is made possible by automatically maintaining the angle of the bucket almost the same as that achieved by the conventional Z-bar linkage. The tilt-back correction can be set to three different levels according to the type of operation being carried out.

When forks are used for operation, the Auto Tilt-In can be switched OFF, which then keeps the forks almost parallel during the boom raising and lowering processes, a benefit of the PZ linkage.

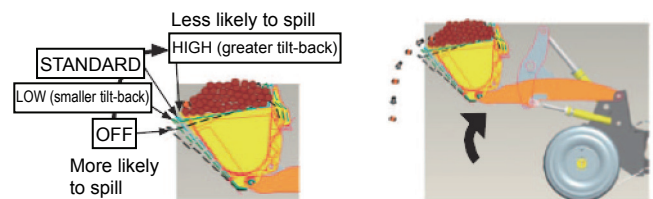


Fig. 3 Auto Tilt-In

## 3.3 Enhanced operator comfort

## (1) Newly-designed cab

The new airtight, pressurized and pillar-less cabs offer unobstructed visibility and a quiet working environment. The enlarged glass area at front corners offers improved visibility of the front wheels and the areas immediately around them. Operator tilt comfort has been substantially enhanced with the ergonomic layout of the controls, the large storage spaces and the auto air conditioner, to name a few. Improved airtightness, the optimum layout of sound absorbing material and other measures have led to a noise level of 69 dB (A) at operator ear on the EU models (which was 72 dB (A) on the conventional WA250PZ-6/WA320PZ-6).



Fig. 4 Newly-designed Cab

(2) 7-inch color multi-monitor

The main monitor is a 7-inch high-resolution TFT LCD color panel, same as the ones used on the medium-size wheel loader models. Compared with the monitors on the previous WA270-6 and WA320-6 models, the new multi-monitor, with its substantially improved screen visibility, assists the operator with ECO Guidance messages and other real-time display of loader conditions during operation. And between operations, the operator can also access a range of information about the loader on various pages of the monitor, such as operational performance, fuel saving data, diagnostics and maintenance. The monitor display is supported by 25 languages.



Fig. 5 7-inch color multi-monitor

(3) Loader lever

The new loader models are equipped with a new multifunction mono-lever to operate the loader functions (standard for overseas markets, optional for Japan). The mono-lever has the forward-reverse changeover switch on top of it. The operator can make forward-reverse directional changes with his/her right hand on the mono-lever while using his/her left hand only to steer the loader, which helps to minimize operator fatigue. The lever also has other switches on top to operate all of the loader functions. For the Japan

market, the conventional two-lever configuration has been maintained as the standard equipment, which features short lever travels and easy dual lever operation.



Fig. 6 Multifunction mono-lever

### 3.4 Other features that enhance operating efficiency

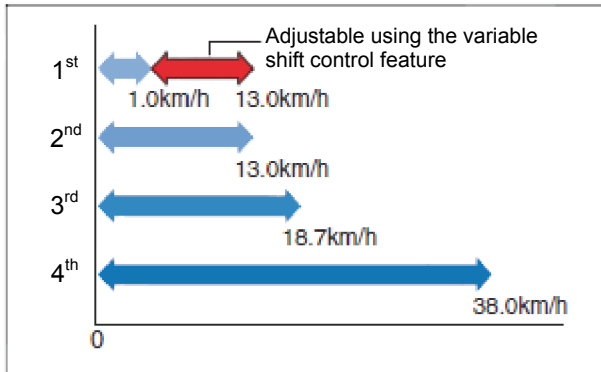
(1) Shift control system

Using the speed range selection switch, four different maximum ground speeds can be selected. The operator can choose the most suitable ground speed for the current operation to maximize operating efficiency. While it used to be located on the right console on the previous loader models, the switch is now incorporated on the forward-reverse change lever next to the steering column for ease of operation.

(2) Variable shift control system

With the speed range set to the 1<sup>st</sup> speed, turning the speed adjustment knob changes the maximum speed between 1 and 13 km/h. This is especially useful and enhances efficiency for operations that require traveling at low speeds with high engine speeds using a constant flow of hydraulic oil, such as loading operation in confined spaces and cleaning operation using a rotating broom. On the previous loader models, the speed was changeable only between 4 and 13 km/h, which has now been expanded down to 1 km/h for higher convenience on the new loader models.





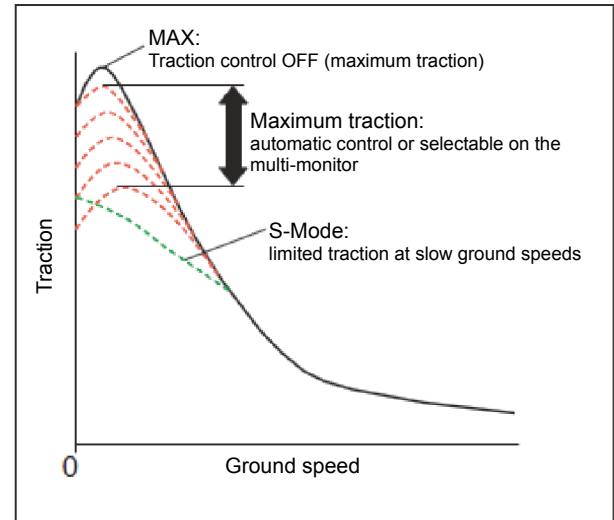
**Fig. 7** Variable shift control

### (3) Variable traction control system

The variable traction control system (K-TCS), which automatically optimizes traction and engine speed according to the operating load being applied on the loader, has further been improved on the new loader models. Combined with the torque proportioning differential, the variable traction control offers the following benefits.

- 1) Easier to cope with slippery, soft terrain
- 2) Prevents the bucket from being pushed too hard in loading operation and minimizes tire slippage, resulting in higher operating efficiency and longer tire life

While only three levels of traction were available on the previous loader models, the new models offer five selectable levels of traction. The system also features the auto traction mode, which automatically adjusts traction according to the accelerator pedal position and other parameters, and the well-proven conventional S-Mode for operations on snowy and otherwise slippery terrain. In the S-Mode, engine speed and HST motor displacement are regulated while the loader is traveling at slow speeds to achieve the optimum driving force and thereby prevent sudden tire slippage.



**Fig. 8** Variable traction control

### (4) One-push traction control switch

If strong tractive force is needed temporarily while the traction control is active, the traction control can be deactivated temporarily to obtain 100% traction by pushing the one-push traction control switch on the mono-lever. The traction control is reactivated when the switch is pressed again or the travel direction is changed from forward to reverse or vice versa.



**One-push traction switch**

**Fig. 9** One-push traction switch

### 3.5 For enhanced safety

(1) Rear-view camera

The rear-view camera, installed at the center of the rear grille, provides the operator with a view at the rear of the wheel loader to help ensure safety. Images from the camera can be shown on the 7-inch LCD display at the right front of the cab.



**Fig. 10** Rear-view camera system

(2) 3-point seat belt and warning

A 3-point seat belt is available as an optional item, which securely holds the operator for improved protection. If the seat belt is not worn, a warning lamp on the multi-monitor comes on to instruct the operator to wear the seat belt.

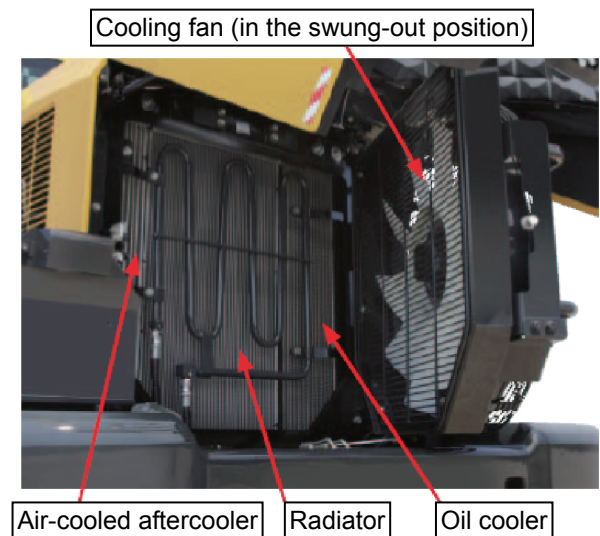
### 3.6 Serviceability

(1) Gullwing-type engine side door

The engine side door can be opened easily with the help of gas springs. The door can be opened and held in two different positions: the partially opened position for daily inspection and maintenance, and the fully opened position for scheduled inspection and maintenance. For ease of maintenance, the engine oil inspection tube, oil filler port and the fuel filter are all located on the same side of the engine.

(2) Cleaning of the cooling cores

The cooling cores feature rectangular fins that are spaced relatively widely to help prevent clogging and overheating as well as extend cleaning intervals of the cores. The hydraulically driven cooling fan is, like on the conventional wheel loader models, mounted on a hinged bracket and therefore can be swung out for ease of access and cleaning. The radiator, the air-cooled aftercooler and the oil cooler are positioned next to each other in a linear configuration, making it easy to access and clean once the cooling fan is swung out. Each of the cooling cores can be replaced individually without the need to remove the entire engine hood.



**Fig. 11** Cleaning of the Cooling Cores

(3) Hydraulically driven fan with the auto-reversing mode

The cooling fan features the auto-reversing mode, in which the fan is automatically rotate in the reverse direction at regular intervals. The setting can be made while observing the monitor screen in the cab. The fan rotates in reverse at regular intervals while the wheel loader is in operation, blowing dirt off the coolers and radiator and substantially reducing the need for manual cleaning by the user. Reversing patterns can be selected by the user.

#### 4. Conclusion

As described above, WA270-7 and WA320-7 meet the Tier 4 Interim emissions regulations and feature a range of new technologies including the HST system and the loader and steering hydraulic systems, making these models clean emission, fuel efficient and attractive in many other respects.

Following the launch in North America, the new models will debut in Europe and Japan. We are confident that these models will be highly acclaimed for the performance they deliver to the customer.

#### Introduction of the writers



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#### [A few words from writers]

For those engineers including me who are involved in the development of machines including construction equipment that are driven by internal combustion engines, offering leaner burning and more fuel efficient solutions is a social commitment and responsibility. I am proud of being part of the team that developed the new wheel loader models and of making a little contribution to society.

I hope that WA270-7 and WA320-7 will be well accepted on the market.