

Introduction of Products

Bulldozer D475A-8/-8E0

Takuya Uemura

Akinobu Takada

Taira Ozaki

Regarding D475, the largest bulldozer in the Komatsu large size bulldozer line-up, D475A-8/-8E0 have been developed under the concept of “production increase”, “safety improvement”, “reliability improvement”, “ride comfort improvement”, “expansion of Information and Communication Technology (ICT)”, basically optimizing structure, mechanism, system, layout, and adopting the newest technologies. This report introduces the main features of the new model.

Key Words: bulldozer, mining, emission regulations, EPA Tier4 Final, EU Stage V, automatic transmission, lock up, enhanced backward traveling power, hydraulic ladder, fan swing, one-link, ride comfort, CDM, shoulder pad, auto pitch

1. Introduction

We developed the D475A-8 (D475A-8E0 for EU), the full-model change of the D475A-5E0, which had no additional development since merchandised in 2005. We would like to introduce its outline.

2. Aims of Development

We developed the vehicle with the themes of “production increase”, “safety improvement”, “reliability improvement”, “ride comfort improvement”, “expansion of ICT” to have remarkably increased product appeal to recapture the market share. At the same time, the engine compliant to EPA Tier4Final in the U.S. and EU Stage V in Europe is installed to enable its market introduction to the areas having these regulations.

Table 1 Komatsu D475A-8 main specification

Item	Unit	Value
Weight	ton	115.3
Piston displacement	L	30.48
Horse power (Gross)	kw / rpm	777 / 2000
Track length on ground	mm	4525
Gauge width	mm	2770
Blade Capacity	m ³	34.4



Fig. 1 Komatsu D475A-8 general view

3. Main implemented items

Here are the main items newly adopted for the D475A-8 which remarkably increased its product appeal.

- (1) Environment, productivity, economic efficiency
 - 1) Engine compliant with EPA Tier4Final / EU Stage V
 - 2) Automatic transmission powertrain with lock up
 - 3) Improvement of downhill dozing efficiency with enhanced backward traveling horse power
 - 4) Output switching with Power mode / Economy mode
- (2) Safety and Maintainability
 - 1) Platform for maintenance and retractable hydraulic ladder
 - 2) A large handrail and 2-step access
 - 3) Enhanced accident prevention with the Operator Presence Sensing System
 - 4) Installation of anchor point for tie off
 - 5) Installation of rear view camera
 - 6) A larger engine side cover / horizontal opening
 - 7) Improvement of maintainability and repairability with the improvement of the radiator structure
- (3) Reliability
 - 1) A twofold increase of main frame durability life
 - 2) Reduction of blade sway by improving the link structure of the blade
- (4) Comfortable workspace and ride comfort
 - 1) New, large monocoque cab for mining
 - 2) High definition 7-inch LCD monitor
 - 3) Improvement of ride comfort (CDM, seat and minor bogie)
 - 4) Improvement of ride comfort (suspension)
 - 5) Improvement of visibility of the ripper point by changing the ripper shape
 - 6) Adoption of fixed type steering lever
- (5) ICT, extensibility
 - 1) Electric control of hydraulic system of work equipment
 - 2) Enhanced machine management by KOMTRAX Plus
 - 3) Blade auto pitch / ripper auto return
 - 4) Expansion to ICT, remote control and automation

4. Major features

4.1 Engine compliant with EPA Tier4Final / EU Stage V

New engine Komatsu SAA12V140E-7 on which Komatsu's technologies are concentrated, substantially reduced the emission of NOx (nitrogen oxides) and PM (particulate matter).

(1) Combustion system

Cooled EGR system with high-EGR ratio (**Fig. 2**) as well as high-pressurization of injection for electronic-control common rail and variable geometry turbo (VGT) (**Fig. 3**) achieved both substantial reduction of NOx and high transient responsiveness.

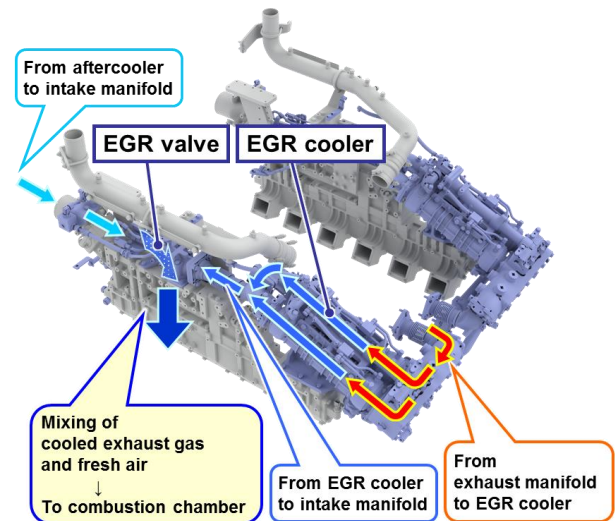


Fig. 2 Cooled EGR system

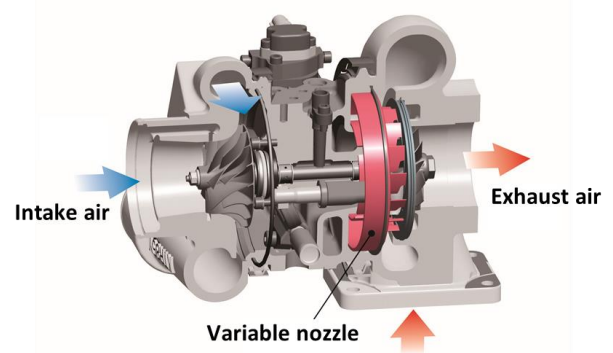


Fig. 3 Variable turbocharger (VGT)

(2) Aftertreatment device

Regarding PM reduction, Komatsu Diesel Particulate Filter is adopted to catch soot in exhaust gas and purify it. (**Fig. 4**)

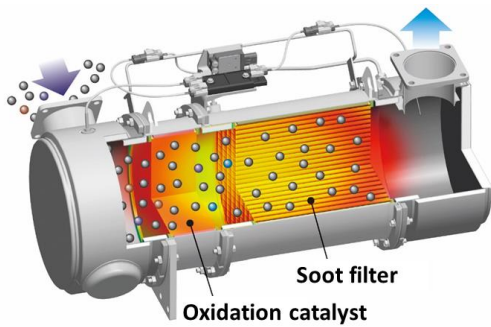


Fig. 4 Komatsu Diesel Particulate Filter

4.2 Automatic transmission powertrain with lock up

Automatic transmission is adopted into the conventional high-efficient powertrain and switching gear shift and lock up / torque converter is automated. This realized both the reduction of operator’s load and the improvement of work efficiency.

Regarding the clutch engagement, an optimal engagement pattern should be selected based on various information such as the travel speed, the acceleration, the tilt of the vehicle, and the operation condition to minimize the gear shift shock.

In addition, optimizing the engine power pattern and engine control to keep constant net power realized the ideal traction performance which matches in both the torque converter high-efficiency range and the engine high-power range regardless of fan rotation. (Fig. 5)

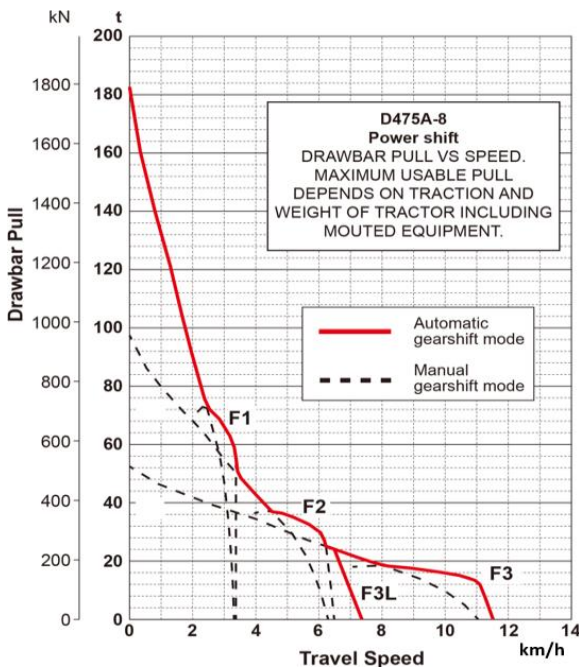


Fig. 5 Automatic transmission with lock up, traction performance

4.3 Improvement of downhill dozing efficiency with enhanced backward traveling horse power

The backward traveling horse power has been increased to improve the efficiency in downhill dozing, which accounts for majority in mines (by 12% compared to the current machine).

This expands the effective range of lock up while backward uphill traveling and improves the production and the fuel consumption efficiency. (Fig. 6)

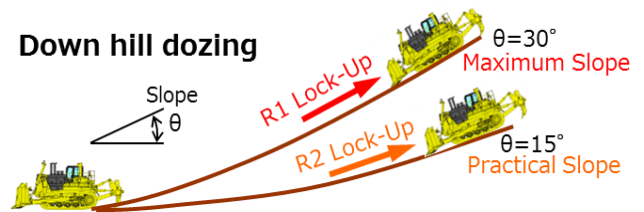


Fig. 6 Image of improvement in backward uphill traveling

4.4 Platform for maintenance, retractable hydraulic ladder

To ensure safe maintenance space on the larger machine which may cause fatal injury if a fall should happen, the platform with a guard rail is laid out at the access areas consolidated on the two surfaces of the machine. (Fig. 7)



Fig. 7 Platform for maintenance facing two surfaces

As the front work equipment of bulldozers which is specially used as an elevating path often may have mud on it during operation, the model is equipped with the retractable hydraulic ladder to ensure safe ascending and descending.

Retraction/extension of the ladder can be shifted easily and safely by pushing a switch on gland and on the vehicle. (Fig. 8)



Fig. 8 Retractable hydraulic ladder

4.5 Enhanced maintainability and reparability with improvement of radiator structure

The swing fan enables a direct access to the radiator core, which was difficult with the conventional structure.

By opening and closing the mask and the fan support, you easily have a direct access to the radiator core without removing the hydraulic piping, which remarkably improves the cleaning performance. (Fig. 9)

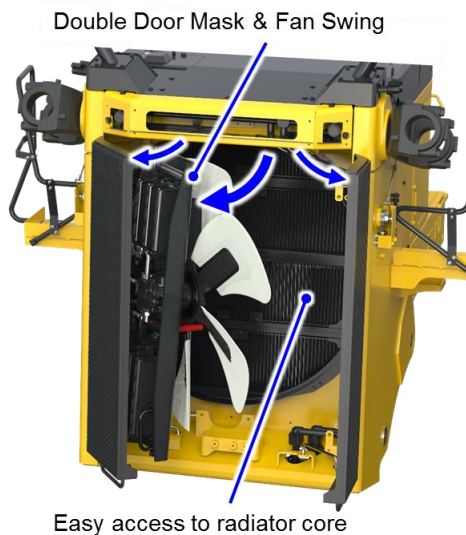


Fig. 9 Fan swing mechanism

In addition, for the improvement of the downtime and repair cost when the radiator core is damaged, the independent tube system is adopted for the radiator core so that the radiator can be repaired by replacing the damaged part only.

The repair cost is reduced by 90% compared to the current machine. At the same time, the loss time for parts supply and replacement work is eliminated. (Fig. 10)



Fig. 10 Radiator core with independent tube system

4.6 Twofold increased main frame durability life

For realizing the improved durability of the main frame which has many requests from the market, the main cross section and the structure of the welded joint have been changed from the conventional structure.

The twofold increased durability life is achieved by increasing the area of the main cross section and improving the welded structure of the beam connecting the right and left main girders with the embedded structure instead of the conventional put-on structure. (Fig. 11)

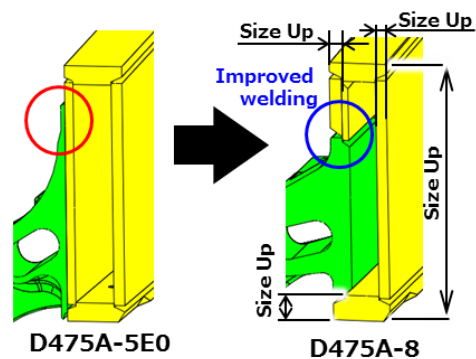


Fig. 11 Improvement of main cross section of main frame

4.7 Reduction of blade sway by improving the link structure of the blade

The conventional link system which receives a load with its symmetrical frames is changed to the one-link system which receives a load with the frame on one side, reducing blade sway by 70% with the effect of the node reduction. (Fig. 12)

The frame on the load receiving side is strengthened and secures the durability equivalent to the conventional link system.



Fig. 12 One-link system of blade

4.8 New, large monocoque cab for mining

To realize a substantial improvement for a comfortable workspace required for hard, long-time operation, the seat and the operation equipment are optimally laid out with the special design for mining bulldozer operations. (Fig. 13 and Fig. 14)

By the adoption of the monocoque structure, double sashes and a large capacity auto air conditioner, air tightness and comfortability are improved.

In addition, with the suspended pedal, flat floor mat and complete electric control system, the cleaning performance and the repairability are improved.

Moreover, this cab can meet the expansion to ICT, remote control and automation.

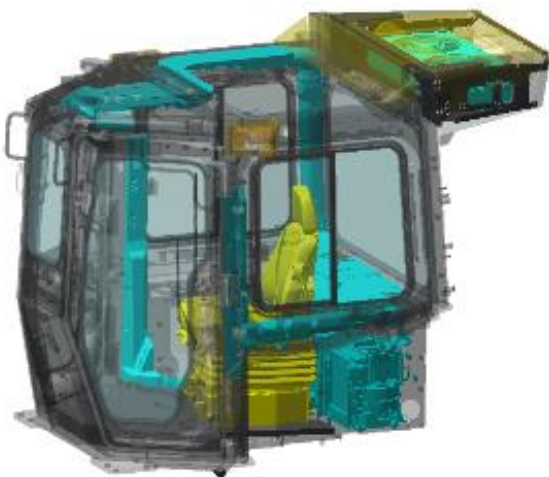


Fig. 13 New large monocoque cab for mining



Fig. 14 Operation space

4.9 Improvement of ride comfort (CDM, seat and minor bogie)

The CDM (cab damper mount) is improved to dramatically ease the input shock transmitted to the cab.

The stroke amount of the CDM is increased by 2.5 times from the conventional type, which substantially reduced the falling shock. (Fig. 15)

In addition, the characteristics of the front CDMs and the rear CDMs are separately optimized to set for suppressing unpleasant slight vibration when traveling on hard road surface.

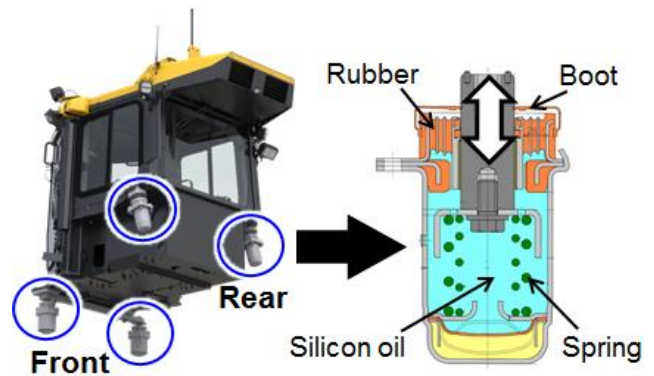


Fig. 15 New CDMs with a large stroke

The air suspension seat made by SEARS with the cushion thickness increased by 70% from the conventional type substantially improves the workspace and comfort as well as the shock reduction. (Fig. 16)

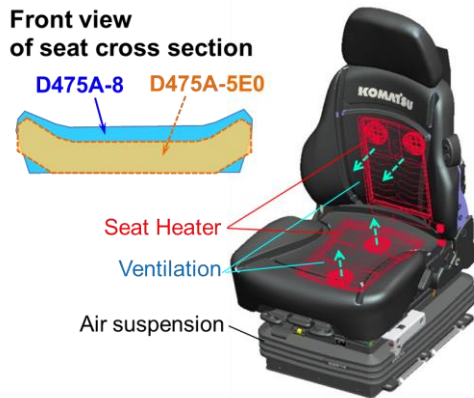
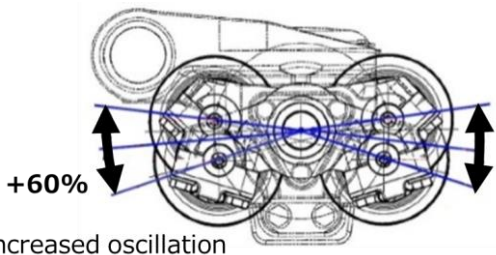


Fig. 16 New air suspension seat

As a measure to reduce the input shock transmitted from the undercarriage, the oscillation angle of the minor bogie is increased by 60% to ease the impact due to the stopper contact in the event of minor bogie oscillation. (Fig. 17)



Increased oscillation

Fig. 17 Increasing oscillation angle of minor bogie

4.10 Improvement of ride comfort (suspension)

Shock while riding and falling at the one-side ride over has been minimized with the adjustment of the oscillating amount by analyzing vehicle behavior.

In addition the shoulder pad has been adopted to absorb the riding shock at the one-side ride over. (Fig. 18)

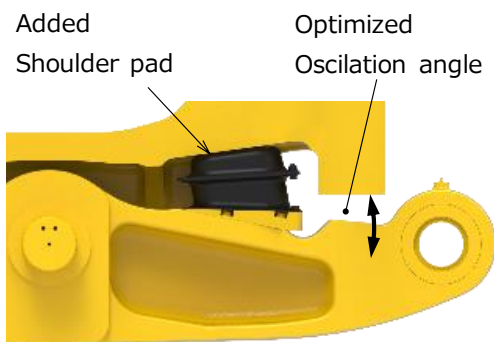


Fig. 18 Improvement of suspension

With these improvements of the suspension as well as the improvement of the CDM, the seat and the minor bogie, the falling shock has been reduced by over 60%. (Fig. 19)

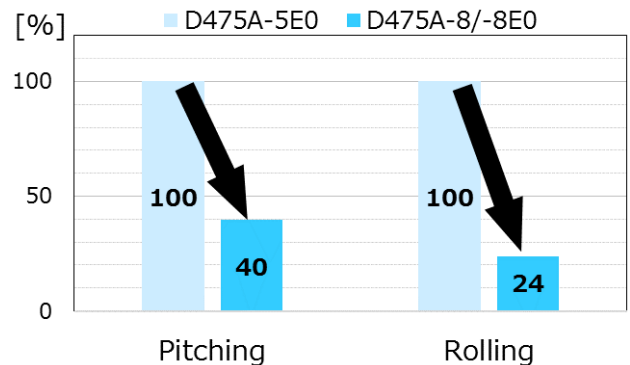


Fig. 19 Improvement of falling shock (one-side ride over)

4.11 Blade auto pitch

The blade auto pitch which automatically performs the patterned blade pitch operation has newly been developed for the D475 to meet the mining use.

The full-pitch dumping while forward traveling and the digging position at the middle stroke of the cylinder while backward traveling can be set by one-touch operation.

This actually eliminates the blade pitch operation while dozing to reduce operator's load. (Fig. 20)

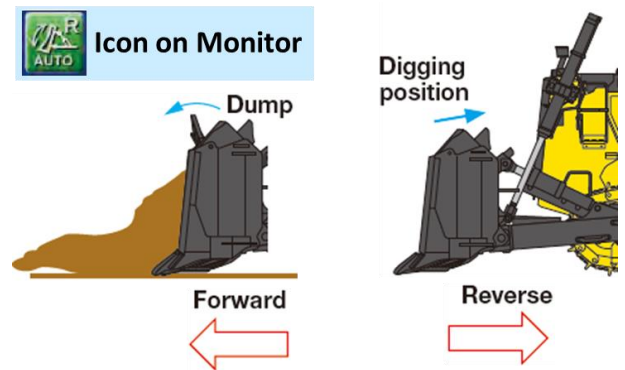


Fig. 20 Blade auto pitch

5. TCO Reduction Effect

With the effects of various quality improvements including increased main frame durability life and improved maintainability and reparability, TCO (total cost of ownership), which indicates the cost the owner bears per hour, is reduced by 7%.

On the other hand, the performance improvements including the adoption of automatic transmission, the optimization of engine power pattern, and the enhancement of the backward traveling horse power increased the amount of

production by 8%.

As a result, TCO per production amount is reduced by 13%. Thus this model should be an attractive product not only for operators but also owners. (Fig. 21)

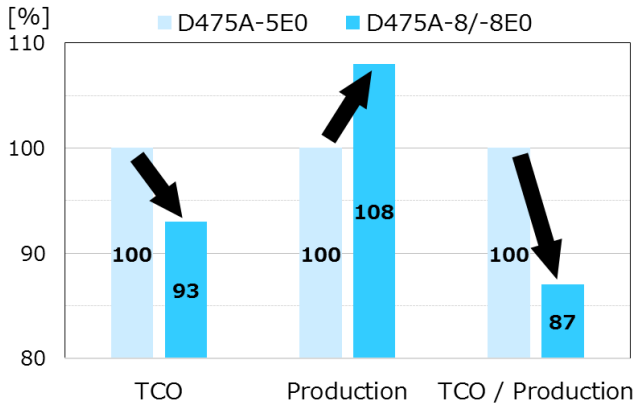


Fig. 21 TCO Reduction Effect

6. Conclusion

With the themes of “production increase”, “safety improvement”, “reliability improvement”, “ride comfort improvement”, “expansion of ICT” having strong demands from the mining market, we have achieved the high goal without compromising. We successfully developed the product which we can offer to the customers with confidence.

Due to the characteristics of the largest vehicle classification, we had many difficulties unable to achieve the same targets as other models by the principle of law of similitude, but we overcame these problems with more ideas and improvements.

We would like to watch the evaluation of the product from the market and follow it up. Also, we would like to continue to work hard to offer irreplaceable products for customers, putting customers’ demands first.

Introduction of the authors



Takuya Uemura
 Joined Komatsu Ltd. in 1998.
 Vehicle Development Center 2,
 Development Division



Akinobu Takada
 Joined Komatsu Ltd. in 1987.
 Vehicle Development Center 2,
 Development Division



Taira Ozaki
 Joined Komatsu Ltd. in 1996.
 Product Planning Department,
 Product Marketing Division

[A comment from the authors]

In this unusual large-scale full model change for D475 in the over-100 tons class, we needed many staff and a long time of period for the development. Thanks to the efforts by the staff of the development center for each component, the evaluation division, production division, procurement division, the subcontractors, the vehicle with the high product appeal combining high performance and reliability has successfully been developed.

We thank you all the people involved in this project.