

Introduction of Products

Motor Grader GD405-7

Noritoshi Takekuma

We developed the GD405-7 to meet the 2014 standard in Japan as the motor grader for exclusive use in Japan and started its sales.

With the revival after 11 years since the end of the sales of the GD405A-3, the full-model change incorporating the latest technologies in a compact body has been implemented with the new model.

Here we would like to introduce the outline of this vehicle.

Key Words: motor grader, emission regulations, snow removal, hydrostatic transmission (HST), visibility, ICT-aided construction

1. Introduction

The company could not respond to the emission regulations in Japan in 2008 and stopped the production of the GD405A-3 (hereinafter the Model 3). The GD405 class (blade width 3.1 m class grader) is suitable for small worksites (road construction, snow removal) in Japan and the demand for the revival of graders of this class increased in the market.

In such circumstances, meeting these demands, we newly developed the 3.1 m class grader the GD405-7 (hereinafter the Model 7) with a compact body incorporating high operability, latest environmental measures, safety and high extensibility for ICT-aided construction. Here we describe the outline of the product.



Fig. 1 GD405-7

2. Aims of Development and Measures for Achievement

The Model 7 was developed for exclusive use in Japan. Prior to the development, we visited some worksites and users in Japan to collect customer needs, and proceeded the development with the aims and means for achievement as below.

- (1) Safety and comfort
 - Adoption of the hexagonal cab securing excellent working view
 - Light-touch work equipment lever enabling easy operation
- (2) Productivity
 - Compact body meeting roads in Japan
 - Adoption of HST enabling operation at a creeping speed in small worksites
 - High-speed travel enabling easy move between worksites
- (3) Reliability
 - Wet type multiple disc brake with smooth control
- (4) Environment and economic efficiency
 - Installation of the engine compliant with the 2014 emission standard for non-road vehicle
- (5) Extensibility
 - ICT-based vehicle for easy installation of equipment for ICT-aided construction

3. Major features

3.1 Hexagonal cab with improved visibility

The Model 7 adopted the hexagonal cab with improved visibility, changing from the Model 3's square cab. With the square cab, the working view was obstructed by the A pillars and the front corners of the floor. With the Model 7, excellent working view is secured by the adoption of the hexagonal cab.

Thanks to the excellent working view, the operator can work with safety and less stress in small worksites with many obstacles common in Japan.

In the cab, the telescopic mechanism of the steering wheel and the up/down, back/forth adjustment mechanism of the work equipment lever console are provided so that any operators of various body types can work comfortably.



GD405A-3 (square cab)



Working view with GD405A-3

The view is obstructed

Fig. 2 Working view with GD405A-3 cab



GD405A-7

(Hexagonal cab with improved visibility)



Working view with GD405A-7

The working view is not obstructed by the A pillars and the front corners of the floor.

Fig. 3 Working view with GD405-7 cab

3.2 Layout of work equipment lever

With the Model 3, the control valve and the work equipment lever were mechanically connected. The mechanical connection caused a limitation for the freedom in the layout of the work equipment lever. With the Model 7, the control valve and the work equipment lever are electrically connected to eliminate this limitation.

The improved freedom enabled the work equipment lever laid out close at the operator's hand. The operator's hand operating the work equipment lever does not obstruct the working view, making it even better. In addition, the operator can operate the machine in a relaxed posture with his arms on the arm rests, which can reduce operator fatigue.

The control pattern of the work equipment lever is the same "domestic pattern" as the Model 3. Users transferring from the Model 3 can use it without feeling strange. The "global pattern" same as the GD675-6 which was introduced in Japan earlier can also be selected as an option.



Fig. 4 Layout of the GD405A-3 work equipment lever



Fig. 5 Layout of the GD405-7 work equipment lever

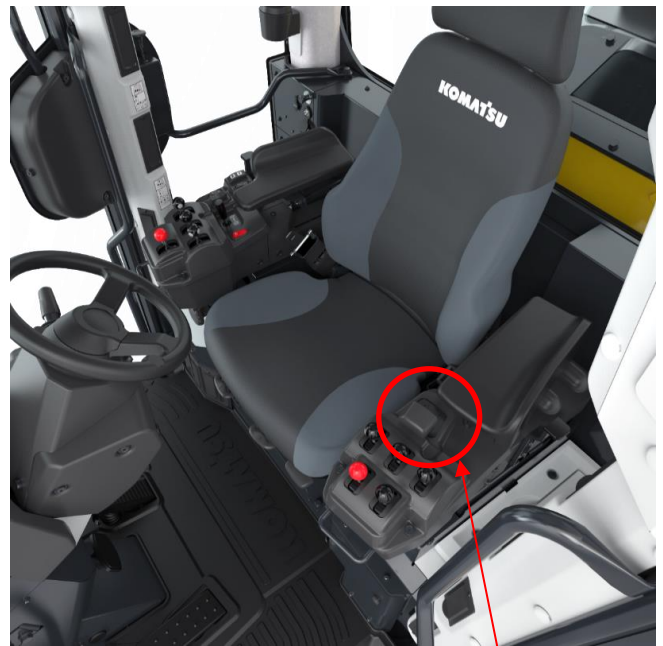
3.3 Steering lever

During the operation, the operator is operating both of the work equipment lever and the steering at the same time. With the Model 7, the electric steering lever is newly located close at the operator's hand in addition to the conventional steering wheel to realize simultaneous operation of the work equipment lever and the steering.

By simultaneously using the steering lever during the operation, the operator can concentrate on his operation keeping his hand on the work equipment lever. As the safety measures, the steering wheel operation is always in priority and the function of the steering lever can be locked with the lock switch to prevent unintended wrong operations.

With the steering lever laid out close at the operator's hand, the number of times of switching to hold between the work equipment lever and the steering wheel is reduced, resulting in a reduction of the amount of operator's hands movements during operation by 92% at maximum.

The operating effort for the work equipment lever and the steering lever is kept small, which contributes to the improved comfortableness and operator fatigue reduction in the operation.



Steering lever

Fig. 6 Steering lever

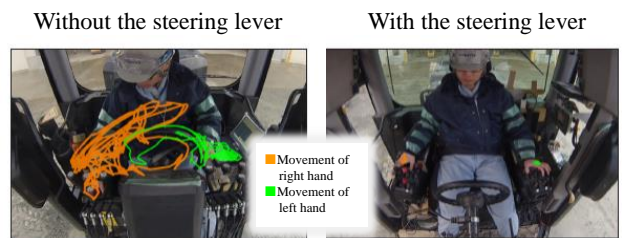


Fig. 7 Comparison of movements of operator's hands

3.4 Seat with seating sensor

For safety improvement, the seat with the seating sensor is adopted. The seating sensor detects the operator's seating condition. Only when it determines that "The operator is sitting", the work equipment and the steering can be operated and the parking brake can be released.

3.5 Size of the vehicle

Although the enlargement of the engine hood and the tread was inevitable with the addition of the exhaust gas aftertreatment device for meeting the emission regulations and the adoption of the wet type multiple disc brake for safety improvement, a compact body required for the 3.1 m class grader has been realized.

Especially, the layout from the vehicle front end to the operator's cab adheres to the reputable layout of the Model 3.

The turning radius of the vehicle is 6.0 m equivalent to that of the Model 3 (with the rear axle with differential gear installed (option)).

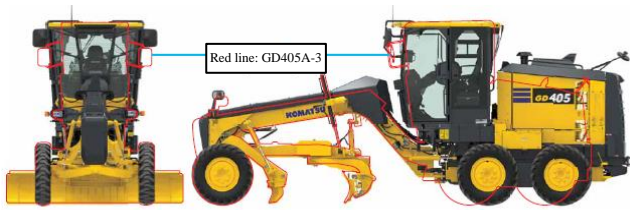


Fig. 8 Size of the vehicle

3.6 Variable displacement pump type Closed-center Load Sensing System (CLSS)

In addition to CLSS adopted since the Model 3, the work equipment hydraulic pump is changed from the fixed capacity gear pump to the variable displacement piston pump. This enables to supply constant amount of oil to the work equipment cylinder regardless of the engine speed.

3.7 HST

The HST system has been adopted for the powertrain for the first time in the motor grader for domestic use. By the adoption of the HST system, “travel speed controllability at a very low speed of 2 km/h or lower”, that is important in leveling finishing work, is substantially improved compared to the Model 3. In addition, it enables easy control of acceleration and deceleration with the accelerator operation only, which reduces the number of times of pedal switching in operation by 65% (compared to the Model 3). The adoption of the HST system also contributes to the reduction of operator fatigue.

Moreover, by combining it with the variable displacement pump type CLSS, the inching pedal has been eliminated.

In spite of being a HST vehicle, this model realizes a maximum speed of 44.3 km/h equivalent to that of the Model 3.

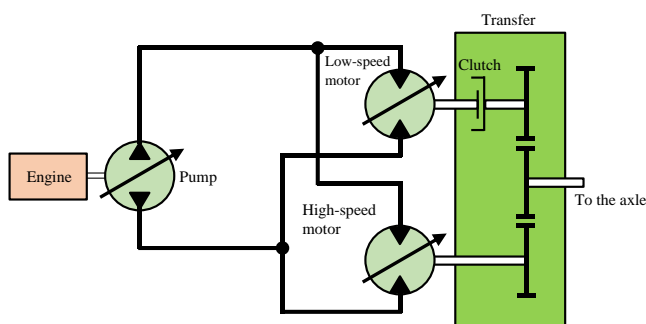


Fig. 9 HST

3.8 Wet type multiple disc brake

The all-hydraulic, wet type multiple disc brake with the same structure as that in the upper model (GD675-6) introduced earlier in Japan has been adopted. With its completely sealed structure, water nor mud does not enter inside even in a tough working environment, periodic adjustment that is required with the conventional dry-type drum brake is not necessary, and smooth, steady braking force can be obtained.

Also, the brake piping was reviewed with its route. With the Model 3, the brake piping passes outside of the rear frame. With the Model 7, the brake piping is laid out inside of the rear frame with the consideration for more reliability.

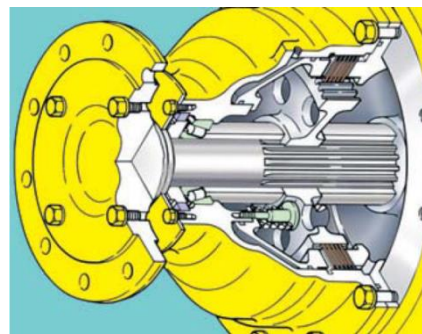


Fig. 10 Wet type multiple disc brake

3.9 Two steering cylinders

The steering cylinder has been increased to two while it is one with the Model 3. This realizes an even steering speed between right and left to provide natural steering and increased reliability.

The route of the steering cylinder piping was reviewed as well as the brake piping. With the Model 7, the piping is partly changed to a tube to enhance the reliability.

3.10 Engine compliant with Tier4Final

The SAA4D107E-3 engine has been adopted. While the piston displacement is reduced to 4460 cc from 5883 cc of the Model 3 to realize the downsizing, the engine horsepower is increased to 107 kW from 92 kW. Komatsu Diesel Oxidation Catalyst (KDOC) and Selective Catalytic Reduction (SCR) are installed in the exhaust gas aftertreatment device, which realizes clean exhaust gas that satisfies the 2014 emission standard for non-road vehicles.

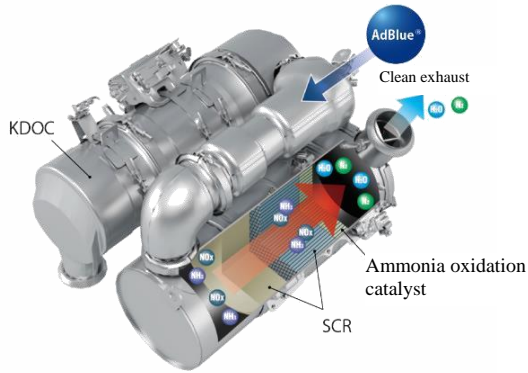


Fig. 11 Exhaust gas aftertreatment device

3.11 Measures for ICT-aided construction

In Japan, with the policy of “i-Construction” presented by the Ministry of Land, Infrastructure, Transport and Tourism in 2015, streamlining in construction sites utilizing technologies for ICT-aided construction is in progress. With the Model 3, users can acquire the ICT-aided construction by installing the machine control system, but it requires a large modification adding the hydraulic valve for the machine control. The Model 7 improves it.

The Model 7 does not require the addition of the hydraulic valve, and the harness and the operation switch for machine control are provided in the cab of the ICT-aided construction equipment plug & play specification (option). Users can have the motor grader for ICT-aided construction by only attaching sensors and harnesses with bolts. TOPCON’s kit is assumed to be installed as the machine control device.

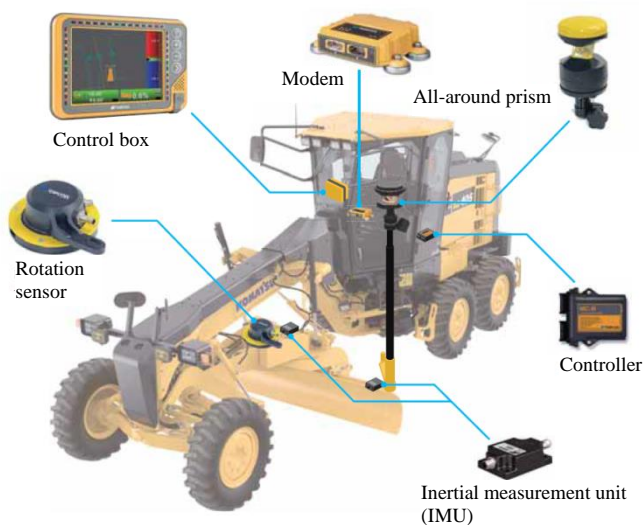


Fig. 12 Measures for plug & play of ICT-aided construction equipment

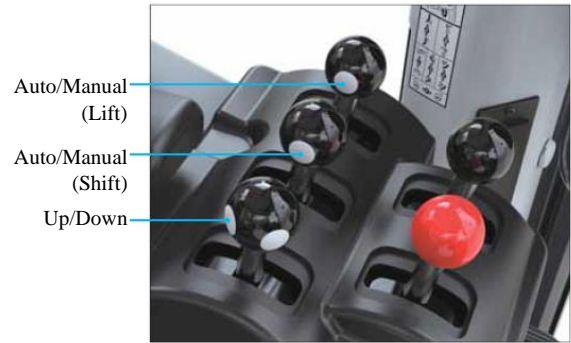


Fig. 13 Operation switch for machine control

4. Snow removal grader

The 3.1 m class graders are assumed to be used for “earthmoving work in summer, snow removal work in winter” with the same machine in the market. Therefore, the Model 7 provides the optional devices for snow removal as well as the Model 3.

As the optional devices for snow removal, hot wires for the front window, the snow wiper, a light-diffusing warning light, the revolution tachograph, the precleaner preventing snow intake to the engine, etc. are provided.



Fig. 14 Test in cold regions

5. Conclusion

As this vehicle is for exclusive use in Japan, we developed it aiming at a vehicle easy to use in “small worksites” common in Japan. Adopting the cab with good visibility, the electric work equipment lever with good operability and HST with excellent operability at a creeping speed, we are sure that this vehicle will satisfy the users’ needs.

We would like to expand the lineup of the motor graders.

Introduction of the author**Noritoshi Takekuma**

Joined Komatsu Ltd. in 2007.
Vehicle Development Center 3,
Development Division

[A comment from the author]

In this development, we made a significant change including the adoption of HST first in the motor graders and the electric work equipment lever. We had many troubles through the implementation of the significant change during the development, but I cannot forget the emotion I got when the vehicle for mass production was completed in the factory line. We successfully finished the difficult development and introduced the product into the market with the cooperation of the staff members involved. Here we would like to thank them with our gratitude.