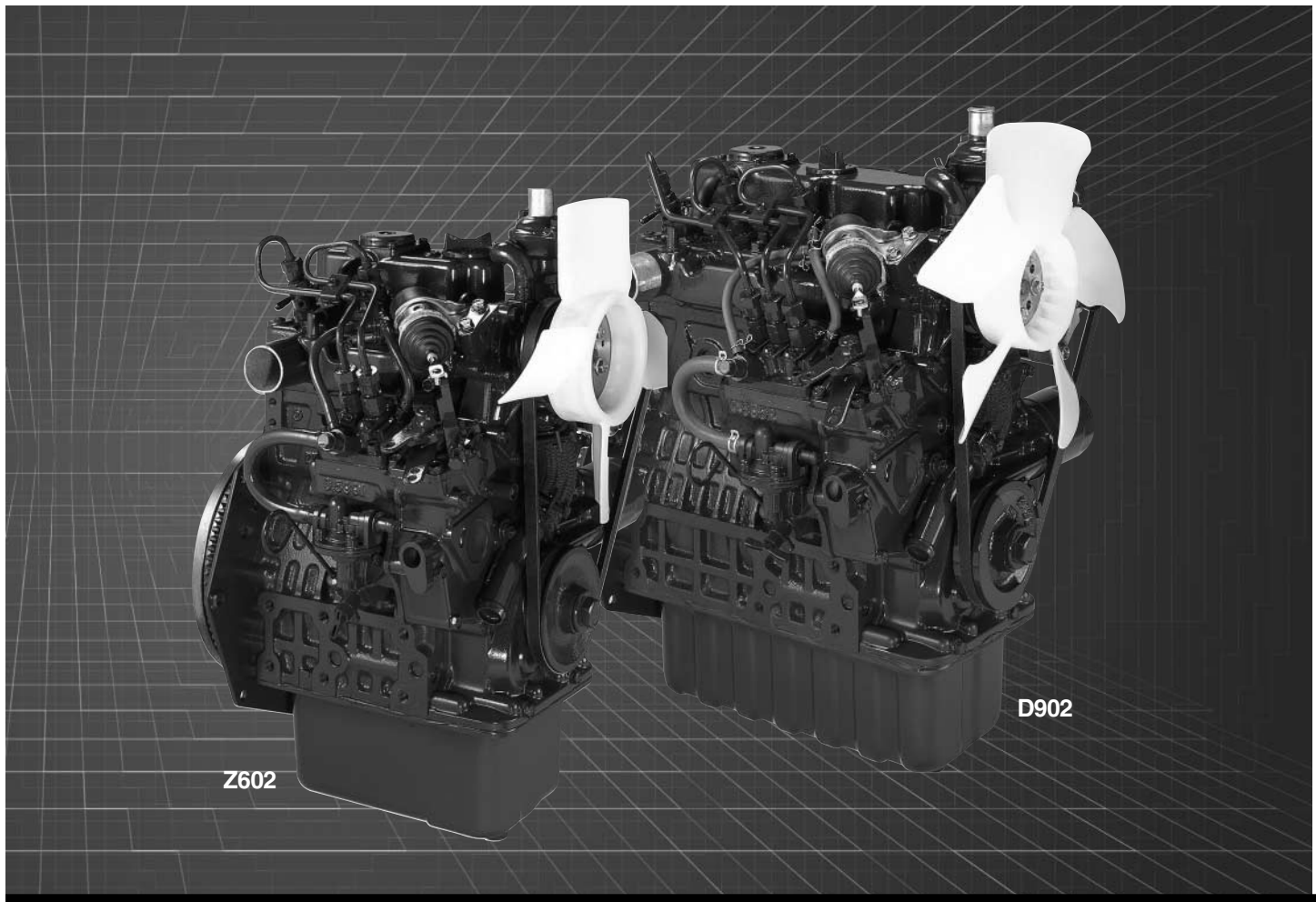




New Super Mini

Environmentally-Friendly Compact Engines Featuring High-Power



Kubota Diesel Engines in the New Super Mini Series have achieved global renown for their durability, reliability, and exceptionally compact size. The lineup of this outstanding series has recently been further upgraded with the addition of models D902 and Z602 that incorporate the innovative and original technology that has been a principal reason for Kubota becoming a leader in the world market for industrial-use diesel engines of 100 HP or less.

Featuring significantly increased power along with low noise and vibration, these two environmentally-friendly additions perfectly clear the EPA Tier-2 Emission Gas Regulations even while retaining approximately the same configurations as the extremely popular models D722 and Z482 that preceded them. To learn more about models D902 and Z602, the Kubota Times interviewed two of the engineers responsible for their development.

Enhanced Power with No Sacrifice to Size

► When was the New Super Mini Series first introduced to the market?

SF: The first model in the New Super Mini Series — featuring a larger displacement than models in the Super Mini Series that preceded it — was launched in 1988. Prior to the introduction of models D902 and Z602, the series numbered five basic models — with the D722 as the most popular — enjoying such high acclaim that they have been fitted to a significant number of OEM products in all parts of the globe.

► What led to the development of models D902 and Z602?

SF: In today's competitive and technologically advancing world, customers for Kubota Diesel Engines are constantly striving to be able to offer OEM products that are ever more compact and functional while remaining reasonably-priced. This requires Kubota to pursue a program of positive and forward-looking research and development to keep pace. Towards achieving this, we use the term Power Density as an index for the requisite factors; a term that incorporates (1) the Engine Power to Size Ratio, (2) the Engine Power to Mass Ratio, and (3) the Engine Power to Cost Ratio. The higher the overall value of "Power Density," the more an engine is able to match an individual customer's needs.

Previously available models D722 (719 cc) and Z482 (479 cc) have already been on the market for 15

years. During that time, competitors have been bringing out newer engines with progressively higher Power Densities; engines that could eventually threaten Kubota's superiority in the marketplace. Therefore, starting with a request from the Tractor Division to develop engines to fit the changes being made to sub-compact tractor model BX2200 as well as smaller models, we undertook being able to offer new engines superior in all ways to those available from any other manufacturer. This has led so far to models D902 (898cc) and Z602 (599cc) that feature larger displacements while retaining approximately the same basic configurations as models D722 and D482.

► It is amazing that both the newer and the older models have the same basic configurations.

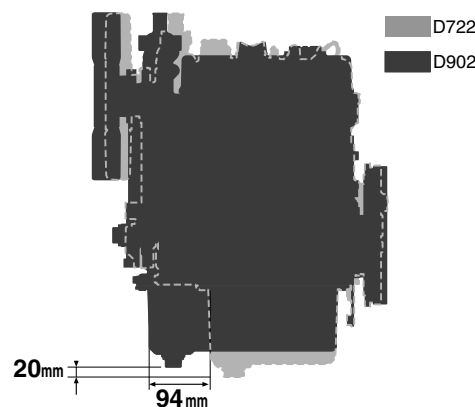
YK: That is a major feature as a matter of fact! The engine configurations remain basically unchanged while both Bore and Stroke have been increased; models D722 and Z482 have a 67mm Bore and a 68mm Stroke while those for models D902 and Z602 are 72mm and 73.6mm respectively.

► Any other changes in configuration?

YK: While overall width of the engine remains unchanged,

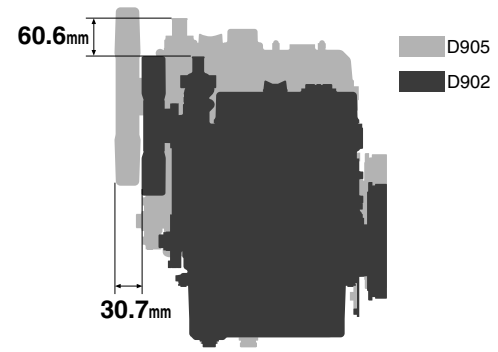
Oil Pan Comparison

The Oil Pan in D902 and Z602 is longer and shallower to reduce engine size.



Height Comparison

Model D902 has the same output power as the D905 (15.1kW[20.2HP/3200rpm]), yet the D902 is 60.6mm shorter in height and 30.7mm shorter in length than the D905.



Satoshi FUJII (SF), Deputy Manager, Engine Engineering Department

Mr. Fujii has been a primary figure in the development of the New Super Mini Series for nearly seven years. Currently responsible for small engine design in the range from 400 to 900cc, he was in charge of design for models D902 and Z602.



Yukimasa KABE (YK): Engineer, Engine Engineering Department

Mr. Kabe has been a research leader for the New Super Mini Series ever since being involved with the development of model D782 seven years ago. He was also responsible for research on models D902 and Z602.

the length of model D902 is 22mm longer to accommodate the enlarged Bores. The dimensions of the Oil Pan have been extended beneath the Gear Casing, but its height is 20mm lower than that for existing models so that the overall configuration remains quite similar. And to compensate for the increase in Engine Power, a Cooling Water Channel has been incorporated between Bores on models D902 and Z602 to regulate temperatures around the Pistons so that engine cooling performance is improved.

SF: In addition, the Water Pump Capacity is nearly 25% greater to further enhance temperature regulation around the Pistons.

► The Cooling Water Channel between the Bores is a new development?

SF: Yes, because the design and power levels of preceding models did not require a Cooling Water Channel between the bores to ensure durability. Design modifications on models D902 and Z602, on the other hand, resulted in the space between the Bores being expanded to 8mm so that a 2.5mm-wide Cooling Water Channel became possible and could be cast by applying Kubota's famed casting technology.

► Is there any possible impact from the greater length?

YK: The impact of increasing length is relatively minor compared to what would have resulted if there was an increase in height. Changing the height would have required the Hood to be higher with the result that the view from the

operator's seat would have been negatively affected. For that reason, we concentrated on maintaining height rather than length.

► Is there any particular advantage in maintaining width?

SF: A very strong advantage, as a matter of fact. By maintaining the same width, it is possible — with only minimal design adjustments being required — to mount models D902 and Z602 in OEM equipment that was previously fitted with models D722 or Z482 respectively.

► What are currently the main applications for these quality Kubota Diesel Engines?

SF: For the most part, they are currently a primary choice for such agricultural equipment as tractors and combine harvesters as well as for construction equipment and generators.

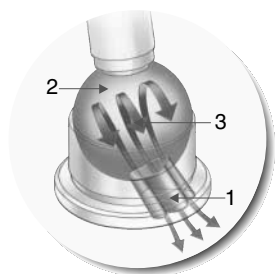
Complying with Ever-Stringent Emission Gas Regulations

► Do these models clear regulations concerning emissions?

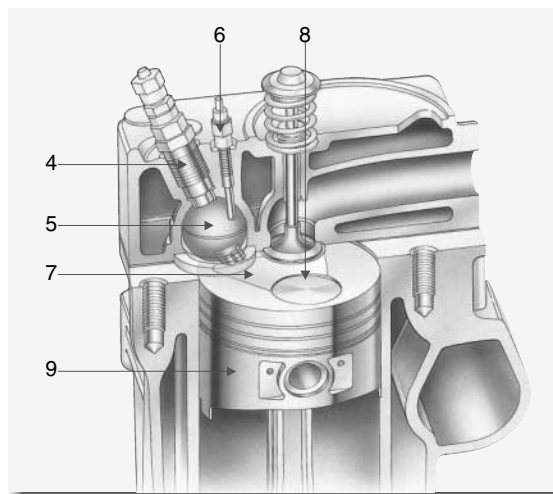
YK: That is always a primary consideration in the development of Kubota engines. By keeping sight of this objective and incorporating Kubota innovation at every step from design through production, both models D902 and Z602 are even capable of clearing the EPA Tier-3 regulations that

E-TVCS (IDI)

The innovative Kubota E-TVCS feature produces far less soot, HC and CO thanks to a better match between the Injection Nozzle and the Concave Recess on the Piston Head. In addition, the Injection Pump and Nozzle are better matched with the Combustion Chamber to reduce NOx emissions.



1. Throat of Combustion Chamber
2. Swirl Chamber
3. Three Vortex
4. Injection Nozzle
5. Swirl Chamber
6. Glow Plug
7. Concave Recess
8. Valve Recess
9. Piston



will be applied to this class starting in 2005.

► It seems to be a contradiction to be able to enhance power performance and fuel efficiency while minimizing emissions.

YK: Though the IDI-Type Combustion Chambers in the D902 and the Z602 are similar to those found on preceding models in New Super Mini Series, improvements include making the Chamber Form more streamlined, raising the Compression Ratio, optimizing Injection Timing, and making positive alterations to the form and angle of the Injection Port.

Reducing Noise Level

► Isn't the level of noise a primary customer consideration?

YK: Yes, it can be. While combustion makes a significant contribution to the overall level of noise, R&D for models D902 and Z602 found ways to avoid any sudden combustion so that the noise level remains at approximately the same level as with models D722 and Z482 in spite of the fact that comparative power was raised by approximately 25%.

SF: Other noise reduction steps include the introduction of the Half-Float Structure Head Cover to reflect noise from the upper portion of the engine, applying MoS₂ Coating, and adding Piston Struts to reduce Piston slapping noise.

YK: Other steps taken to reduce the overall noise level

include adding ribs to both the external and internal surfaces of the Crankcase to reduce strain by increasing rigidity and to increase the diameter of the Crankshaft Journal.

A Look to the Future

► What do you foresee regarding future engine development?

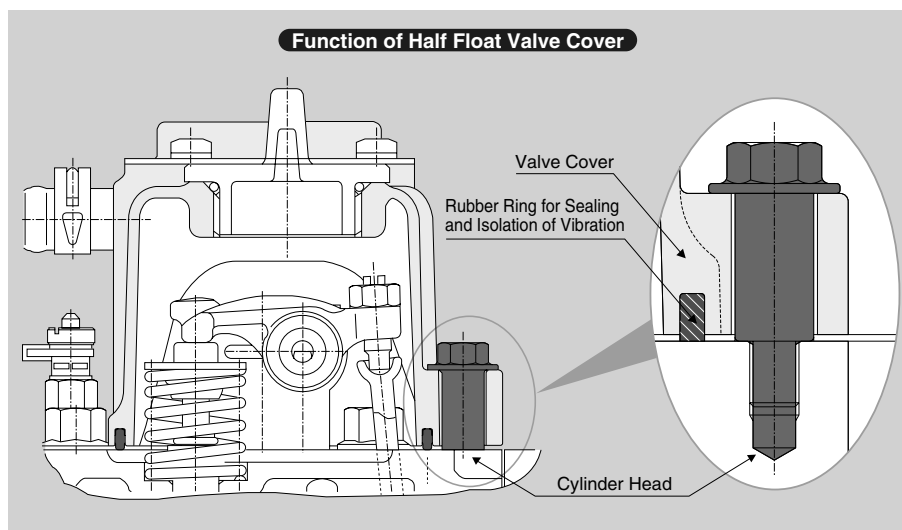
YK: A primary consideration is to continue to be able to clear the ever-stringent regulations on emissions. While both D902 and D602 already have the potential to clear the Tier-4 Regulations that will come into effect in 2008, ongoing joint efforts between the Engineering and Manufacturing Section are being made to further lower emissions as well as to keep fluctuations among mass-produced engines to a minimum.

SF: In addition to focusing on how to reduce emissions, ways are being sought to further lower the levels of noise and vibration and to make the interval between required maintenance longer while keeping unit prices as reasonable as possible. More than any other manufacturer in this field, Kubota is determined to fulfill the emerging needs of customers while meeting the demands of increasingly stringent regulations. Only in this way can Kubota maintain its position as a leading provider of general-purpose diesel engines of less than 100HP.

► Thank you very much for joining us today.

Half Float Valve Cover

The Rubber Ring not only seals out and isolates vibration, but also reduces Crankcase noise.



MoS₂ Coated Piston

Sulfurated Molybdenum Coating results in a reduction of the clearance between the Piston and the Cylinder Liner to optimize the oval ratio and decreased the slapping noise.

