Diesel Engine Basics
4 Stroke Cycle Engine

Intake  Compression  Combustion  Exhaust
AIR HEATS WHEN COMPRESSED
Compression Temperature & Auto Ignition Temperature

A: Diesel Fuel Auto Ignition Temperature
B: Air Temperature Initial 32 F
C: Air Temperature Initial 100 F
Combustion Pressures

A: Fuel Injection Timing  1: Ignition Delay Period  3: Diffuse Combustion
B: End of Injection  2: Pre-flame  4: After Burning
Kubota Engine Review
ENGINE MODEL IDENTIFICATION

How to read the model name

- Ex.: V1505-E

- V=Number of Cylinders
  
  E= Eine; 1 cylinder engine
  Z= Zwei; 2 cylinder engine
  D= Drei; 3 cylinder engine
  V= Vier; 4 cylinder engine
  F= Funf; 5 cylinder engine
  S= Sechs; 6 cylinder engine
ENGINE MODEL IDENTIFICATION

- How to read the model number
- Ex: V1505-E
  - 1505=Approximate Displacement (cc.)
    - 662= 656 cc
    - 722= 719 cc
    - 1105= 1123 cc
    - 1505= 1498 cc
    - 1903= 1857 cc
    - 2203= 2197 cc
    - 3300= 3318 cc
ENGINE MODEL IDENTIFICATION

How to read the model number

Series of engines:
- NSM: Z482, D662, D722 (68 mm stroke)
- 03 Series: D1703, V2203 (92.4 mm stroke)
- 05 Series: D905, V1205 (73.6 mm stroke)
- 05 Series: D1105, V1505 (78.4 mm stroke)
ENGINE MODEL IDENTIFICATION

- How to read the model number
  - Ex: V1505-E

  - **E**=for Environmental / Ecological [Clean Engine]
    - Being Regulated
      - U.S.A.: CARB; ULGE Reg. Below 25HP
      - EPA; SI Reg. Below 25HP
      - EPA; Non-road CI Reg. 19 to 37kW
      - EPA; Non-road CI Reg. 37 to 75kW
      - JAPAN: MOC; Tunnel Construction 7.5 to 260kW
      - EU: Non-road CI Reg. Exc. Ag.Tractor 37 to 75kW
    - Under Consideration
      - JAPAN: EA; Special Vehicles 19 kW & Above
**INTERCHANGEABILITY**

- New Super Mini Series (68 mm stroke)
  - Z482/D662/D722
- 05 Series (73.6/78.4 mm stroke)
  - D905/D1005/V1205/V1305. D1105/V1505
- 03 Series (92.4 mm stroke)
  - D1403/D1703/V1903/V2003-T/V2203
- **Note:** All engine parts will not be interchangeable within an engine stroke family, but approximately 88% will be interchangeable. This benefit allows for parts to be stocked for many popular engines, with lower investment expense.
HOW to Read Serial Number

The SERIAL NUMBER is an identified number for the engine. It is marked after the model number. New Serial No. has been applied since January, 1998. It indicates month & year of manufacture as follows.

<table>
<thead>
<tr>
<th>Year</th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>W</td>
<td>X</td>
<td>Y</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

month of manufacture

<table>
<thead>
<tr>
<th>Serial No.</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>0001~9999</td>
<td>A</td>
<td>C</td>
<td>E</td>
<td>G</td>
<td>J</td>
<td>L</td>
<td>N</td>
<td>Q</td>
<td>S</td>
<td>U</td>
<td>W</td>
<td>Y</td>
</tr>
<tr>
<td>(actually 10000~19998)</td>
<td>B</td>
<td>D</td>
<td>F</td>
<td>H</td>
<td>K</td>
<td>M</td>
<td>P</td>
<td>R</td>
<td>T</td>
<td>V</td>
<td>X</td>
<td>Z</td>
</tr>
</tbody>
</table>

e.g. D722-WA0001  “W” indicates 1998 and “A” indicates January. So, WA indicates that the engine was manufactured on January, 1998.
Power Curves

- Torque backup
- Rated output
- Rated speed
- Engine speed
- Output Ne
- Torque T
Power Curves

\[ Hp = \frac{t \times \text{rpm}}{5252} \]
\[ \text{Torque} = \frac{(hp \times 5252)}{\text{rpm}} \]
Typical Kubota Engine

- Injection Pump In Block
- High Mounted Camshaft
- Two Types of Oil Pump Mounting for Kubota Engines
- Large Main Bearing Cases for Tunnel Block Design
“Tunnel” type Crankcase

- Cylinder Liner
- Water Jacket
- Main Journal
V3300 - Split Crankcase

1) Crankcase 1
2) Crankcase 2
3) Oil Pan
Crankshaft

Main Bearing solid type

Main Bearing split type

Crankshaft Sleeve

Thrust Bearing
Cylinder Head

- Valve Guide
- Nozzle
- Head Gasket
- Intake
- Exhaust
DI and IDI combustion types
IDI
70mm and 82mm families
E-TVCS

Combustion Chamber
Nozzle
Glow Plug

Three Vortex
Fan-shaped Concave
Valve Recess
V3300 - 3 Valves per Cylinder

- 2 Intake Valves per Cylinder
- 2 Intake Ports per Cylinder for reduced turbulence in ports
- Significant increase in combustion efficiency
4 small holes

Extra 4 small holes type

3 holes type
I.D.I. (Indirect Injection - swirl chamber)

T.V.C.S. (Three Vortex Combustion System)
- Introduced a combustion chamber with Three intense air flow swirls (Vortices)

D.I. (Direct Injection)

N.T.V.C.S. (New Three Vortex Combustion System)
- Added to the T.V.C.S. special concave recess on the piston crown.

E.T.V.C.S. (Environment Three Vortex Combustion System)
- Modification of the N.T.V.C.S. to drastically reduce exhaust emissions.

E-Series E.T.V.C.S. engines will be identified with a new label on the cylinder head cover with the "E" character (eg. D1105-E).
Valve Mechanism

Valve Spring

Rocker Arm

In/Ex Valve

Push Rod

Tappet

Camshaft
Replacement caps
70mm stroke series
15261-03142  
(D650 15281-03142)
82mm stroke series
15521-03143
D1402, V1902, S2800

15291-03143
Z751, Z851, D1101, D1301, D1102, D1302, V1502, V1702, S2200, S2600
Engine Overhaul Marks

Main Bearing Cases:
Marked “Flywheel” on flywheel side of case

Connecting Rod:
Numbers must line up, and must be installed toward injection pump side

Pistons: Indentation on piston must be toward injection pump side of engine.