Preamble

3D Industries was created in 2012 during which time a series of open source printers were produced similar to open-source versions at the time, but featuring more heavy duty components.

Three printers' were produced Wombat 1 Wombat 2 Wombat 3. Each of these used the extruder and the bed mechanism to move the object on the Y axis and the print head on the X axis.

A completely new version of the printer was introduced with Wombat 4 featuring a welded frame design and a CoreXY mechanism meaning that the extrusion head moved in both the X and Y axis and the Object movement was only a slow descent as each layer was printed.

Significant feedback was received from users of the printers and the Series 5 range was produced. These were enhanced in October 2015 essentially these were all the same style of printers but the design enabled scalability in any direction. (footprint or height). Two printers' were released to demonstrate this scalability with a bespoke option for customers requiring a different build footprint or object height.

3D Printers

- Model W (largest 700 mm wide X 500 mm deep & 500 mm tall)
- Model J (Standard size 500 mm wide X 500 mm deep & 500 mm tall))
- Bespoke model. Customers can advise their object build size requirements.

These printers underwent significant internal and external testing and the feedback received incorporated onto the printers which were then made available for general sale.

Printer features

Feature	Details	Model W	Model J	Bespoke
Model Description	This is reflected by the size	Bench / desk top	Desk top	As designed
Frame	Steel frame of 250 mm RHS steel, powder coated	same	same	same
Printer size	Depends on model (size in mm)	700 x 500	500 X 500	As designed
Printer height	Nominally all the same (size in mm)	500	500	As designed
Build platform	Size in mm	400 x 250	320 x 320	As designed
Print build area	Size in mm	380 x 230	280 x 300	As designed
Print build height	Size in mm	265 mm	265 mm	As designed
Bed heater	Bonded Kapton heater	same	same	same
Bed leveling	Initially manually, then printing of calibration objects	same	same	same
Z Gap setting	Thumbscrew adjustment to inductive sensor	same	same	same
Power supplies	Self contained and sealed, no fan, auto cut out	same	same	same
Electronics	Rumba board with LCD controller housed in a cooled enclosure operable from the front of the printer	same	same	same
Print head	Aluhotend V7 latest version produced by 3D Industries	same	same	same
Extruder	3D Industries modified design of JGR	same	same	same

Notes:

Box Steel frame

The steel frame ensures the stability, rigidity and therefore the accuracy and output print quality. The steel frame means that the X Y and Z axis movements can take place to greater tolerances.

The steel frame has adjustable feet attached or it can be placed on a desk or bench or bolted down to a suitable flat surface. The frame is powder coated. Some items are attached to the frame directly others by proprietary brackets.

For export purposes there will be a knock down version of the printers. The top bottom and sides of the frames are assembled using proprietary plastic/steel brackets and bolts; assembly taking only a short time.
For export purposes the printer is assembled aligned and tested and then knocked down and flat packed for transport. This means that when reassembled the printer should work with no other set up required.

CoreXY mechanisms

The extruder with the hot end is moved on rails in both the X and Y directions by timing belts driven by stepper motors, controlled by the Rumba board according the print object Gcode.

The object being printed is stationary in the horizontal directions and slowly descends as each layer is printed.

This method of printing has many advantages over systems where the object is physically moved in the horizontal directions as the problems of accuracy arise with larger and or more complex objects are produced in this manner.

Bed leveling and sensing

The gap between the hot end nozzle and the bed is typically around 0.2 mm. This has to be constant over the printing area for each successive layer of plastic to be properly laid down to form part of the object.

The print bed is an aluminum plate support by three adjustable bolts connected to a Z Axis gantry that is controlled by a stepper motor and moves up and down on steel rails.

Bed leveling is initially set by physical measures. A series of test objects specifically designed to show the correct levelness of the bed and also test the Z axis gap setting is used to ascertain if the bed is level and the gap setting correct. This provides greater feedback in regard to the settings than direct measurement and also indicates, if any adjustment is required, which adjustable settings bolts have to be used.

The bed sensing in terms of the Z-Axis position and also the extruder head setting in terms of the X and Y axis (homing) is set by the use of inductive sensors. There is no physical switch so that the settings are always correct regardless of environmental conditions that could affect a physical contact system.

The bed leveling is adjusted by means of the three bolts, the final Z gap setting is adjusted by an adjuster fitted to the Z Gantry that activates the Z Axis sensor. A large knob enables very fine adjustments to be made.

Bed heating

The bed heating is achieved by means of a kapton heater bonded to the aluminum base. This enables the plate and therefore the glass resting on it, to be heated to the required temperature and held there according to the requirements of the printing medium.

Integrated Power unit

The power supply is a sealed unit that does not use a fan but has an automatic cut out if required.

Integrated spool holder

One or more spool holders can be bolted directly to the printer frame and the position can be changed. The spool holders enables fast changing of filament spools and any sized spool to be handled.

Electronics and stand alone operation

The printer is controlled by the Rumba board. Specifically on a PC or some other transfer mechanism a ".gcode file" representing the object to be printed is put onto the SD card and this card is inserted into the LCD controller. The printer does not need any connections externally in order to print.

Maintenance

Little maintenance is required and this is detailed in the manual provided.

Production testing has seen multiple units working 24 X 7 for several months at a time with no issues. Specific extreme and destruction test procedures are followed on selected units.

Operation

The print filament used to produce the objects is drawn from the printer spool to the extruder where it is pushed into the nozzle reservoir of melted plastic as required under the control of the electronics board according to the Gcode instructions.

The molten plastic is extruded through the 0.4 mm hole at the end of the nozzle according to the Gcode file instructions. Care must be taken to ensure no dirt or dust is carried through to the extruder on the outside of the filament and a high quality of the filament should be used to ensure that no internal contaminants that could block the 0.4 mm nozzle hole are used. In addition a quality filament cleaner should be in place. Generally purchasing the filament from a reputable source ensures that these problems do not occur. However cheaper filament can have the following problems:

Trouble shooting

Issue	Result	Other damage/ results /Action
Filament broken	Extrusion stops.	The object is not finished and the filament used is wasted. *Re feed the filament and retry. Note that cheaper filament can sometimes not be continuous.*
Filament too thin	The extrusion can stop because the mechanism to push the filament can no longer work. The extrusion of the plastic is uneven resulting in poor quality of printed object.	The object is not finished and the filament used is wasted. *Re feed the filament and retry. Note that cheaper filament can sometimes not be continuous.*
Filament too thick	The extrusion can stop because the mechanism to push the filament through can no longer work. The extrusion is likely to be uneven and can be messy and poor quality because the wrong amount of filament is being ejected.	The object is not finished and the filament used is wasted *Re feed the filament and retry. Note that cheaper filament can sometimes not be continuous.*
Filament exterior dirty	The nozzle can be blocked and extrusion of the plastic cease. The nozzle can be partially blocked meaning that the plastic extruded is not the correct amount or can vary as the blockage changes.	The object is not finished and the filament used is wasted. *Precautions should be taken to ensure the printer is not in a dusty environment (Use a cover when not in use etc)* *A filament cleaner should be attached to the printer so that no dust on the outside of the filament can enter the extruder / hot end.*
Filament internally contaminated	The nozzle can be blocked and extrusion of the plastic cease. The nozzle can be partially blocked meaning that the plastic extruded is not the correct amount or can vary as the blockage changes.	The object is not finished and the filament used is wasted. *Quality filament should only be used. 3D industries can supply or advise.*

The above table indicates that the use of cheaper and lower quality filament can actually result in a higher cost per completed object and lost time.

Filament cleaning

As the filament on the spool can be exposed to the air and the plastic can attract dust, it is important that the filament is properly cleaned before the filament enters the extruder / hot end. In the 3D Industries printers an efficient filament cleaner is attached to the frame and also used as an anchor point for the PTFE tube guiding the filament to the moving extruder. Once it has passed through the cleaner the filament is protected from any further contamination.
The filament cleaner has a cap that can be lifted away from the body to enable replacement / cleaning of the cleaning material. By default “magic sponge” segments are used for this.

Blocked nozzles

The brass nozzles are not intended to be removed and replaced as they can break on subsequent installation and render the entire hot end unusable. The entire hot end should be replaced and the blocked unit returned to 3D Industries. 3D Industries have a free service - a spare hot end is provided with the printer, any blocked hot ends are returned to 3D Industries and a new spare will be dispatched.

Service and Support

The printers are delivered together with essential tools and spare parts:

- Driver with relevant sockets and screw heads.
- Heavy duty spatula
- Pliers and cutters
- Spare Aluhotend
- Miscellaneous spares, cable ties etc
- SD card with objects for sample printing and alignment
- Instruction manual
