Innovent® 3D Printing System User Manual
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WARNING
Use this system, and components within the system only as instructed. Improper use of this system may result in injury, death, or damage to property.

NOTE
The support photos and graphics contained in this manual are for example only and may not exactly match the components and/or software screens of your Innovent® 3D Printing System.

NOTE
This manual is under development. The any and all information contained in this manual may be subject to change. For the most up-to-date documentation, please contact your ExOne® representative.
REACTIVE MATERIAL WARNING

The Innovent® 3D printing system is certified to print a variety of materials and binders. Our customer’s interest and safety is of utmost importance to us. The Innovent® 3D printing system is:

NOT DESIGNED OR CERTIFIED TO PRINT REACTIVE MATERIALS.

Reactive metals include, but are not limited to: titanium, aluminum, and magnesium. Other non-metallic reactive powders may similarly effect the function of the system. Improper use of reactive material in the system could potentially cause a variety of unintended and adverse consequences including, without limitation: damaging the printing system and/or facility, bodily injury, dust explosion and/or combustion possibly leading to property damage or death.

Statement regarding EN 61000-3-2:

The ExOne Innovent Industrial 3D Metal Printer is classified as “Professional Equipment”, and as such, is not intended for sale to the general public. Permission to connect to the supply utility is required in some countries.
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2 Introduction

2.1 Advisories

Advisory symbols have been used to help organize this User Manual and call attention to important information regarding safe operation and maintenance.

![WARNING]

**WARNING**

Warnings are provided when an action or inaction can cause personal injury or death to the user, major damage to the components of the system, and/or damage to the facility.

![NOTE]

**NOTE**

Notes are provided to identify useful information for operating or maintaining the system. This information can include additional explanation, tips, or comments concerning the system.

2.2 Checklists

All checklists are listed using open bullets, all notes and considerations are listed using closed bullets.

2.3 Example Checklist

- This is a checklist item.
  - So is this.
    - And this.
  - This is not.
    - This isn’t either.

2.4 UI Elements

User Interface elements are described using the following shorthand with any number of submenus possible in the chain:

[Main menu (sometimes implied)] → [First submenu] → [Second submenu] → [UI Button]
3 General Safety Precautions

CAUTION

Adherence to the guidelines in this document does not constitute a guarantee of safety. Real world conditions can affect the function of the Innovent® system in ways beyond the scope of this document.

MOVING PARTS

The Innovent® 3D Printing System has many moving parts. Although operation of the Innovent® 3D Printing System is reasonably safe, it is still possible to initiate motion commands or touch components that could result in operator injury or equipment damage. Thorough understanding of component locations, nomenclature, and operating procedures is essential to the safe operation of the Innovent® 3D Printing System.

HEAT SOURCES

The Innovent® 3D Printing System contains heat sources. However, heated parts may remain hot after the printer has stopped operating. Use of an infrared or non-contact thermometer for temperature verification is recommended.

CAUTION

It is the responsibility of any person using this or any other equipment to ensure their own safety. Responsible safety procedures include:

- A thorough review of this document, paying attention to hazard warnings, specifications, and related diagrams.
- A thorough understanding of the components in the Innovent® 3D Printing System, with attention to voltage sources, intended use, heat ranges, and warning labels.
- A thorough review of individual instruction manuals supplied for any component within the Innovent® 3D Printing System.
- Situational awareness of the user’s own surroundings.
- Strict adherence to cleaning and maintenance as detailed in this guide is imperative for maximum safety, productivity, and longevity of the Innovent® 3D Printing System.
Modifying or altering the Innovent® system may cause the system to cause damage to itself, to the facility, or to its operators.

- Do not disconnect any fluid or air hoses while the Innovent® printer is operating.
- Do not attempt to make alterations to the Innovent® 3D Printer.
- Do not disconnect any cables while the printer is running.
- Do not move the printer or adjust leveling feet once installed.
- Do not mix different powders in the Innovent® 3D Printer. Run only one approved powder at a time.
- Loading unapproved powders or fluids into the Innovent® 3D Printer may void warranties on parts and services. For a list of approved supplies, contact an ExOne® sales representative.
4 Facility Requirements

The typical Innovent® 3D Printing System installation must meet the following minimum facility requirements. Note that a separate electrical circuit for each piece of equipment in the Innovent® 3D system is highly recommended.

<table>
<thead>
<tr>
<th>Item</th>
<th>Requirement</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utility outlet, for local use</td>
<td>Electrical</td>
<td>Local regional voltage, for use with floor vacuums, scales, and other ancillary equipment.</td>
</tr>
<tr>
<td>Innovent® Electrical Supply</td>
<td>Electrical</td>
<td>Configurable for 120 V AC 60hz 15A OR 220V 11A on request.</td>
</tr>
<tr>
<td>Curing oven electrical supply</td>
<td>Electrical</td>
<td>120 VAC, 15 A.</td>
</tr>
<tr>
<td>Standard furnace electrical supply</td>
<td>Electrical</td>
<td>240 VAC, single phase, 35A.</td>
</tr>
<tr>
<td>Compressed air</td>
<td>Air</td>
<td>4 - 6.5 bar (60-95 psi) ; 1.7 m3/hr. (1.0 CFM) ISO 8573- 1 Class 2.4.3.</td>
</tr>
<tr>
<td>Compressed air</td>
<td>Connection</td>
<td>¼ inch O.D. push-to-connect with shut-off.</td>
</tr>
<tr>
<td>Lighting</td>
<td>Electrical</td>
<td>Adequate for safe operations and inspections.</td>
</tr>
<tr>
<td>External ventilation</td>
<td>Ventilation</td>
<td>Must conform to local laws and regulations.</td>
</tr>
<tr>
<td>Ethernet</td>
<td>Internet</td>
<td>Local network Ethernet for connection to printer.</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>Controlled</td>
<td>40% - 50% relative humidity.</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>Controlled</td>
<td>Maintain a steady work temperature of ±1.5 °C (±3 °F) within the range of 18 to 27 °C (68 to 77 °F)</td>
</tr>
<tr>
<td>Vibration</td>
<td>Foundation</td>
<td>Stable environment, free of vibration.</td>
</tr>
<tr>
<td>Floor loading</td>
<td>Foundation</td>
<td>Normal load specifications.</td>
</tr>
<tr>
<td>Cabinets</td>
<td>Storage</td>
<td>Approved liquid storage containers for binder, cleaner, waste. Cabinet storage for powders and support media.</td>
</tr>
<tr>
<td>Shelving</td>
<td>Storage</td>
<td>For parts between powder removal and crucible packing.</td>
</tr>
<tr>
<td>Work area</td>
<td>Tables</td>
<td>Areas for powder removal, crucible setup, and furnace-run crucible staging.</td>
</tr>
<tr>
<td>Workflow</td>
<td>Space</td>
<td>Design → Printing → Curing → Powder Removal → Crucible Setup → Furnace Run → Cleaning and Finishing → QA.</td>
</tr>
</tbody>
</table>

Table 1 – Innovent® System Facility Requirements
ExOne Recommended Floor Layout

Check your local ordinances for material storage and disposal.

NOTE: Furnace floor space requirements will vary depending on the dimensions of the furnace option that is chosen as well as the vendor’s recommended safe working area.

*Figure 1 - Example Floorplan and Minimum Working Space*
5 The Innovent® 3D Printer

The Innovent® 3D Printing System selectively binds thin, cross-sectional layers of fine powder. As the printhead passes over the powder bed, binder is deposited into the powder. Heat is then applied to partially set the binder and prepare the powder bed for recoating with powder. With each successive pass of the printhead, more of the object is bound until a near-net shape object is completed.
## Innovent® 3D Printer

<table>
<thead>
<tr>
<th>Type</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working Envelope</td>
<td>160 x 65 x 65 mm (6.3 x 2.5 x 2.5 in).</td>
</tr>
<tr>
<td>Electrical</td>
<td>Configurable for 120 V AC 60hz 15A OR 220V 11A on request. If necessary, ExOne® may assist you with other power localization options. Use of an uninterruptible power supply is recommended to avoid loss of job in case of power loss.</td>
</tr>
<tr>
<td>Utility outlet for computer</td>
<td>120 V AC 60hz.</td>
</tr>
<tr>
<td>Compressed air supply</td>
<td>¼&quot; OD push-to-connect with shut off. 4 - 6.5 bar (60-95 psi). 1.7 m³/hr (1.0 CFM). ISO 8573-1, Class 2.4.3.</td>
</tr>
<tr>
<td>External dimensions</td>
<td>Lid Closed (LxWxH): 1203 x 887 x 1434 mm (47.4 x 35 x 56.5 in). Lid Open (LxWxH): 1203 x 925 x 2180 mm (47.7 x 35 x 86 in).</td>
</tr>
<tr>
<td>Weight</td>
<td>453.59 kg (1000 lb).</td>
</tr>
<tr>
<td>Binder tank</td>
<td>2.5 gallon container (10 liter).</td>
</tr>
<tr>
<td>Cleaner tank</td>
<td>2.5 gallon container (10 liter).</td>
</tr>
<tr>
<td>Waste tank</td>
<td>2.5 gallon container (10 liter).</td>
</tr>
<tr>
<td>Resolution</td>
<td>Process dependent, 64 x 64 x 100 micron typical for 30 micron stainless steel.</td>
</tr>
<tr>
<td>Build speed</td>
<td>30 seconds per layer optimum.</td>
</tr>
<tr>
<td>Network interface</td>
<td>Ethernet.</td>
</tr>
<tr>
<td>Fluid pumps</td>
<td>Peristaltic pump.</td>
</tr>
<tr>
<td>In-pump tubing</td>
<td>3/16&quot; thermo-plastic elastomer.</td>
</tr>
<tr>
<td>Other tubing</td>
<td>1/8&quot; Black EPDM tubing.</td>
</tr>
<tr>
<td>Print head</td>
<td>ExOne® 256 jet drop on demand print head.</td>
</tr>
<tr>
<td>Software</td>
<td>ExOne® Proprietary UI.</td>
</tr>
<tr>
<td>Safety mechanisms</td>
<td>AB safety rated interlocks.</td>
</tr>
<tr>
<td>Drying lamp</td>
<td>Carbon element infrared emitter.</td>
</tr>
</tbody>
</table>

*Table 2 – Innovent® 3D Printer Specifications*
5.1 Major access points for the Innovent® 3D Printer

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Working Area Access Door</td>
<td>Access work area for printing and cleaning.</td>
</tr>
<tr>
<td>2 Electrical Cabinet Access</td>
<td>Allows access to the electrical cabinet.</td>
</tr>
<tr>
<td>3 Fluid Cabinet Access</td>
<td>Access to fluid pumping and vacuum systems.</td>
</tr>
<tr>
<td>4 Pneumatic Cabinet Access</td>
<td>Allows access to the pneumatic cabinet.</td>
</tr>
<tr>
<td>5 Touch Screen Interface</td>
<td>Allows operation of the printer.</td>
</tr>
</tbody>
</table>
5.2 Warning Labels:

The following warning labels are on the exterior of the printer cabinet and must be observed while using the Innovent® 3D Printer.

![Warning Labels](image)

**Figure 5 - Warning Labels**

5.2.1 Material Restriction Warning:

![Material Restriction Warning](image)

**Figure 6 - Material Restriction Warning**

The Innovent® 3D Printer has not been designed or certified for use with reactive metal powders. The use of the Innovent® 3D Printer with reactive metal powders could result in fire or explosion causing loss of property, injury, or death.
5.2.2 Shock Hazard Warning:

The electrical cabinet contains live circuits while the system is on. Use caution when opening the electrical cabinet. Do not attempt to service the electrical cabinet without the direct instruction of an ExOne® Service Technician.

Exercise caution when cleaning enclosures. Failure to comply may result in damage or death to persons or property.

Figure 7 - Electrical Cabinet
5.3 The Work Area and Job Box Accesses

The front panel of the Innovent® 3-D Printer contains the work area and job box access areas, as well as the power and emergency stop controls.

![Figure 8 - Work Area and Job Box Access](image)

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 X 2 Axis</td>
<td>Moves the recoater/heater carriage in the X direction.</td>
</tr>
<tr>
<td>2 Enable Button</td>
<td>Enables motion, heat, pneumatics, fluids, and printhead.</td>
</tr>
<tr>
<td>3 Emergency stop</td>
<td>Cuts power to motion, heat, fluids, printhead, vents and seals pneumatics.</td>
</tr>
<tr>
<td>4 Recoater Assembly</td>
<td>Deposits a precise layer of powder onto the print bed.</td>
</tr>
<tr>
<td>5 Job box</td>
<td>Contains the powder bed and printed parts.</td>
</tr>
<tr>
<td>6 Z Axis</td>
<td>Raises and lowers the print bed.</td>
</tr>
<tr>
<td>7 Print head and Y Axis</td>
<td>Deposits binder onto the powder bed and Moves the printhead in the Y direction.</td>
</tr>
<tr>
<td>8 X 1 Axis</td>
<td>Moves printhead carriage in the X direction.</td>
</tr>
</tbody>
</table>
Moving the job box in or out of the Innovent® 3D Printer can cause pinch points. Use caution when moving the job box in or out of the printer. Failure to comply may result in property damage or injury.
5.4 Fluid Storage Area

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Binder Filter</td>
<td>Filters binder on the way to the printhead.</td>
</tr>
<tr>
<td>2 Binder Reservoir</td>
<td>Contains binder for printing, must be filled before printing.</td>
</tr>
<tr>
<td>3 Waste Reservoir</td>
<td>Contains a mixture of binder and waste for disposal, must be emptied before printing.</td>
</tr>
<tr>
<td>4 Cleaner Reservoir</td>
<td>Contains cleaner for cleaning the print head, must be filled before printing.</td>
</tr>
<tr>
<td>5 Cleaner Filter</td>
<td>Filters cleaner for distribution to wiper trough.</td>
</tr>
<tr>
<td>6 Pump Enclosure Assembly</td>
<td>Houses all pump motors.</td>
</tr>
</tbody>
</table>
5.5 Pneumatic Cabinet Access:

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Compressed air regulator</td>
<td>For maintenance and adjustment off the compressed air feed to the printer.</td>
</tr>
<tr>
<td>2 Actuator valve manifold</td>
<td>Contains control valves for the compressed air systems.</td>
</tr>
<tr>
<td>3 Printhead Valve Manifold</td>
<td>Contain control valves that switch vacuum, pressure and venting for printhead.</td>
</tr>
<tr>
<td>4 Vacuum Ballast</td>
<td>Stores a vacuum for the printhead.</td>
</tr>
<tr>
<td>5 Low pressure regulator</td>
<td>Regulates low-pressure air to the printhead.</td>
</tr>
</tbody>
</table>
5.6 The Recoater Access

The work area access affords easy access to the recoater for cleaning and service.

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Powder Hopper</td>
<td>Contains powder to be deposited into the recoater assembly.</td>
</tr>
<tr>
<td>2 Heating Element</td>
<td>The heating element, attached to the recoater assembly, maintains an acceptable print bed temperature.</td>
</tr>
<tr>
<td>3 Recoater</td>
<td>The recoater assembly spreads precise layers of powder onto the print bed.</td>
</tr>
<tr>
<td>4 X1-Axis Motor</td>
<td>Controls the X1 Axis which moves the print head assembly.</td>
</tr>
</tbody>
</table>
5.7 The Printhead System

The Printhead system has the following subsystems

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Y-Axis motor</td>
<td>Moves the print head in the Y direction.</td>
</tr>
<tr>
<td>2 X2-Axis Motor</td>
<td>Controls the X2 Axis which moves the recoater assembly.</td>
</tr>
<tr>
<td>3 Wiper and wiper trough</td>
<td>Cleans the printhead periodically during a print.</td>
</tr>
<tr>
<td>4 Priming area</td>
<td>Area for priming the printhead, gives access for manual cleaning of the printhead if necessary.</td>
</tr>
<tr>
<td>5 Capping station</td>
<td>Resting area for the printhead when not in use.</td>
</tr>
<tr>
<td>6 Test print area</td>
<td>Holds thermal paper for test prints.</td>
</tr>
<tr>
<td>7 Printhead</td>
<td>Deposits binder onto the print bed to form a print.</td>
</tr>
</tbody>
</table>
5.8 The Printhead
The ExOne® 256 jet drop on demand printhead is attached to the Y-Axis, and is installed and adjusted by an ExOne® service technician.

CAUTION

Do not make adjustments or modifications to the printhead. The printhead should only be serviced by an ExOne® service technician. Failure to comply may cause permanent damage to the printhead or to the Innovent® 3D Printer.

5.9 The Electrical Cabinet Access
The electrical cabinet should only be opened to clean the air filter when it has become dirty. Modification of the setup of the electrical cabinet will void the warranty of the Innovent® 3-D Printer, may cause damage to the system and facility, and may result in injury or death.

Shock Hazard

The electrical cabinet contains live circuits while the system is on. Use caution when opening the electrical cabinet. Do not attempt to service the electrical cabinet without the direct instruction of an ExOne® Service Technician. Exercise caution when cleaning enclosures. Failure to comply may cause permanent damage to the Innovent® 3D Printer, personal injury and/or death.

CAUTION

Do not make adjustments or modifications to the electrical cabinet. The electrical cabinet should only be serviced by an ExOne® service technician. Failure to comply may cause permanent damage to the Innovent® 3D Printer, personal injury and/or death.
5.10 The Touch Screen Interface

The Touch Screen Interface provides control to the Innovent® 3D Printer through the included software package.
6 The Innovent® Software Interface

The Innovent® software interface is included with the Innovent® 3-D Printing System and enables control of the system for printing, cleaning, and maintenance. To start the software interface:

- Turn on the Innovent® 3-D Printer (see 5.2 – The Work Area and Job Box Access.)
- On the touch screen interface, from the desktop, select and open the Innovent® executable to start the interface software.

**NOTE**

Software updates may cause UI elements to appear differently from those pictured in this manual.

6.1 Turning on the printer

- Turn on the main power to the printer via the AC power switch at the back-right side on the Innovent® 3-D printer.
- Set the Emergency Stop switch to the on position.
- Push the power button to initiate power to the Innvoient™ 3-D printer.
6.2 Initialization screen

Before accessing the main menu of the ExOne® Innovent® software it is necessary to initialize the printer. After hitting the [Initialize] button, initialization will run automatically.

A prompt to skip homing may occur. Homing may be skipped if no changes have been made to the axis positions since the previous use of the software. Otherwise, homing will be necessary for the safety of the system.

Do not skip homing if axes have been moved manually, or if any work has been done inside the cabinet of the printer. Failure to do so may cause the axes to have an inaccurate sense of position.
6.3 Main menu

The main menu grants access to the major processes in the Innovent® printer.

![Image of the Innovent® Software Main Menu]

These processes are:

[- **Select Print Files**] – contains controls for the selection and arrangement of parts in the build volume, saving print jobs, and some modification of files.

[- **Setup Powder**] – Contains controls for setting up the print bed for printing as well as loading and unloading the job box.

[- **Startup Printhead**] – Contains controls for preparing the print head for printing, calibrating the print head, and maintaining the print head assemblies.

[- **Print Files**] – This menu button is greyed out until print files have been loaded in the [Select Print Files] menu. The [Print files] menu contains controls used to view the print job and adjust process settings in real-time.

[- **Process Settings**] – Contains controls for process settings for the printer including:

[- **Build Reports**] – Allows viewing of build reports created when a print job is started. Build reports can also be printed from this menu, or from the computer directly.

[- **Maintenance**] – Allows access to maintenance procedures including default process settings and manual control of printer assemblies.

Additionally, the [Minimize] button in the bottom center of the main menu minimizes the ExOne® Innovent® software to the taskbar.
6.4 Select Print Files

The [Select Print Files] screen, accessible from the main menu, has several submenus that occur in the process of loading files to print. Once files are added, individual parts can be duplicated, moved, and build layouts or “build jobs” can be saved.

Figure 17 - The Select Print Files Screen

[Add New Part] - Opens a file selection screen to add individual parts to the layout.

[Duplicate Part] – Makes a copy of the selected part and places it automatically in the build volume.


[Save Layout] – Saves the current layout.

[Delete] – Deletes the selected part or layout.

[Delete All] – Deletes all loaded parts and layouts.

[Print] – Opens a dialogue to print the selected build report to an accessible printer.

[Preview Build] – Opens a simulation of the print environment to be previewed.

[Exit] – Exits to the main menu.
6.4.1 Part Manipulation

The bottom right portion of the [Select Print Files] window contains controls for manipulation of parts within the print volume.

[View] – Views all selectable parts and layouts loaded in the current layout.

[Position] – Contains controls for precise positioning of the selected part or layout.
**[Rotate]** – Contains controls for precise rotation of the selected part or layout.

![Part Rotation Tab](image)

*Figure 20 - The Select Print Files: Part Rotation Tab*

**The view bar**

![View Bar](image)

*Figure 21 - The Select Print Files: View Bar*

The view bar contains one-touch controls for viewing the layout from each side of the build volume, as well as an isometric view. The view bar appears in several different menus in the user interface.
6.4.2 The [Add New Part] Screen

Once [Add New Part] is selected, a part-inspection window will open. In this menu, parts may be selected from the computer, from an attached flash drive, or from an accessible network drive.

![The Add New Part Screen](image)

*Figure 22 - The Add New Part Screen*
6.4.3 The Part Inspection Window

Once selected, the part will be displayed in an inspection window.

![Figure 23 - The Part Inspection Screen](image)

**[Add to Print Bed]** – Adds the part to the print layout.

**[Close]** – Closes the window and returns to the [Select Print Files] menu.

**[Save Part As]** – Saves the selected part. This can be used to save a part after it has been scaled or converted from inches to millimeters.

**[Scale Part]** – Opens a window with controls to scale the part.

![Figure 24 - The Part Inspection: Part Scaling Screen](image)
[MM to Inch] – Converts the part from SAE to metric, or vise-versa. This is useful if a part is designed in inches, as STL files do not have unit data. Some files designed in inches will prompt a dialogue asking if the file should be converted automatically.

[File Information] – Once selected, file information will be displayed in the bottom-right corner of the part selection screen. A file can be analyzed for integrity. STL files with missing triangles will express zero volume, as they are an infinitely thin shell.

![File Information](image)

Figure 25 - The Part Inspection: File Information Field

[Analyze] – Performs an analysis of the STL triangle mesh looking for unshared edges. If any triangle edge is not shared with exactly one other triangle edge in the mesh, the suspect edge is highlighted in yellow.

NOTE

The analyze tool looks for the most common file error, but does not guarantee file integrity. Use CAD software to analyze files for missing or inverted triangles, holes in files, or other defects in models.

The view bar

![View Bar](image)

Figure 26 - The Part Inspection: View Bar

In the [Part Inspection] window, the view bar has additional views to view the model in modes specific to part integrity.
6.4.4 The Preview Build Screen

The [Preview Build] screen, accessible via [Select Print Files] → [Preview Build] contains a simulation of the print environment to be previewed.

In this screen, individual layers or layer ranges can be selected. In the [Recoat & Dry] field process settings can be changed for the current build. These process settings are detailed in Section 6.7 Process Settings.

Figure 27 - The Preview Build Screen
6.5 Set up Powder

The [Powder Setup] screen, accessible from the main menu, contains controls for setting up the print bed for printing as well as loading and unloading the job box. It is broken into five fields: Job Box Load and Unload, Build Platen, Temporary Recoater settings, Recoater, and Powder Supply.

6.5.1 Job Box Load & Unload

Contains controls for locking and unlocking the Innovent® cabinet doors, as well as engaging and disengaging the job box.
[Lock Doors] – Locks all doors on the Innovent® cabinet. Many functions are inaccessible with the doors unlocked. If a door is not properly closed, an error will prompt the user to close doors.


[Engage Job Box] – Raises the platen to the underside of the job box and engages the front and rear platen magnets.

[Release Job Box] – Disengages the front and rear platen magnets, and lowers the platen to allow the job box to be removed.

Additionally, the [Job Box Load & Unload] field contains indicators pertaining to the job box sensors and safety measures.

[Door Locks] – Indicates the locked or unlocked status of the door locks.

[Guarding Circuit] – Indicates the open or closed status of the guarding circuit, which disables functionality when the doors are open or unlocked.

[Job Box Door] – Indicates the open or closed status of the job box door.

[Work Area Door] – Indicates the open or closed status of the work area door.

[Recoater Door] – Indicates the open or closed status of the recoater access door.

[Box Present] – Indicates the on or off status of the sensor detecting the presence of the job box. An on reading corresponds to the presence of a job box.

[Box in position] – Indicates the on or off status of the sensor detecting the alignment of the job box. An on reading corresponds to the correct alignment of a job box.

[Platen Retracted] – Indicates the yes or no status of the platen interface with the build box. If the platen is retracted, the build box is able to be installed or removed.

[Platen Magnets] – Indicates the on or off status of the magnets that engage the build plate to the platen.

[Platen Engaged Front] – Indicates the yes or no status of power to the front platen magnet.

[Platen Engaged Rear] – Indicates the yes or no status of power to the rear platen magnet.

[Z Up Motion OK] – Indicates the yes or no status of upward Z motion capability.

[Z Down Motion OK] – Indicates the yes or no status of downward Z motion capability.

[Heater Enable] – Indicates the on or off status of the build platen heater.

[Heater at Temp] – Indicates the on or off status of the heater temperature sensor.

[Heater Timeout] – Indicates if the heater times out before achieving the desired temperature.
[Print Bed Temp (℃)] – Indicates the last temperature taken by the print bed temperature sensor.

6.5.2 Build Platen

Contains a visualization of the depth of the floor plate in the job box. Contains controls for the print bed which consists of the build platen, the job box floor plate, and the powder print bed.

![Image of Build Platen Manual Control Field]

**Figure 30 - The Powder Setup: Build Platen Manual Control Field**

[SLOW JOG SPEED] – Toggles between normal and slow jog speed.

[TOP] – Moves the print bed to the top of the job box.

---

Before selecting [TOP] it is necessary to verify that the platen magnets are on, that the front and rear platen sensors are engaged, and that the [Z Up Motion OK] and [Z Down Motion OK] fields both indicate YES. Check the interface between the build platen and the build plate by holding [UP] until the build plate moves up, and then [DOWN] until the build plate moves down. This verifies that the build plate is properly engaged before lifting it significantly.

Failure to comply could cause the build plate to be forced upwards while not properly engaged, damaging the build box or the Z Axis shaft.

[UP] – Moves the print bed up as long as the button is pressed.

[LAYER DOWN] – Moves the print bed down one layer.

[DOWN] – Moves the print bed down as long as the button is pressed.

[BOTTOM] – Moves the print bed to the bottom of the job box.
6.5.3 Temporary Recoater Settings

Contains controls for temporary recoater settings that facilitate the setup of the powder print bed. These settings do not apply to the print process settings, and are used for manual control only.

![Temporary Recoater Settings](image)

**Figure 31 - The Powder Setup: Temporary Recoater Settings Field**

- **[Use Process Settings]** – Sets the temporary recoater settings to those in the global process settings.
- **[Recoat Speed]** – Sets the temporary speed of the recoater while it is depositing powder on the print bed.
- **[Oscillator Speed]** – Set the speed of the oscillator which in turn sets the rate of deposition of powder from the recoater.
- **[Roller Speed]** – Sets the rotation speed of the roller as it passes over the print bed.
- **[Drying Speed]** – Sets the speed at which the emitter lamp is moved over the print bed.
- **[Emitter Output]** – Sets the output for the emitter lamp while in the drying cycle.
- **[Roller Traverse Speed]** – Sets the speed at which the roller moves across the print bed.
- **[Job Process Settings]** – Accesses the [Job Process Settings] menu, also accessible via the main menu.

---

**NOTE**

Not all Innovent® systems are equipped with a roller. Leave the [Roller Speed] and [Roller Traverse Speed] fields blank if operating a system without the roller.
6.5.4 Recoater

The Recoater Field contains controls for the recoater X axis.

[Level Recoat] – Applies a layer of powder and levels it without lowering the print bed.

[Normal Reccoat] – Applies a layer of powder and levels it, lowering the print bed one layer.

[Recoat Cycles] – Sets the number of times the recoating procedure is done.

[Dry Before Reccoat] – Executes a Drying cycle before each recoat.

[Drain Recoater] – Runs the recoater while positioned over the left gutter to cycle the recoater powder.

[Fill Recoater] – Fills the recoater hopper with powder.

[Retract Recoater] – Returns the recoater to its fully retracted position at the far-right.
6.6 Startup Printhead

The [Startup Printhead] screen, accessible from the main menu, contains controls for: preparing the print head for printing, calibrating the print head, and maintaining the print head assemblies.

![Figure 33 - The Printhead Startup Screen](image)

6.6.1 Cleaning

[Prime + Wipe + Jet] – Runs a prime cycle, a wipe cycle, and a jetting cycle in order to clear the print head of obstructions.

[Start Printhead] – Runs the print head startup procedure.
[Cap Printhead] – Moves the print head to the capping area to protect the print head jets.

[Printhead to Maintenance Position] – Moves the print head to the maintenance position over the print head drain.

[Flush Wiper (Drain & Fill)] – Drains and then refills the trough of cleaner that the wiper rests in.

[Drain Wiper] – Drains the wiper trough.

[Cancel] – Cancels the currently running operation.

6.6.2 Drop Volume and Saturation

![Image of Drop Volume and Saturation](image-url)

**Figure 35 - The Printhead Startup: Drop Volume and Saturation Field**


[Fix Saturation] – Uses the results of the previous drop volume test to adjust binder saturation.

[Test Pattern] – Prints a test pattern that tests for missing jets.

![Image of Test Pattern Printing](image-url)

**Figure 36 - The Printhead Startup: Test Pattern Printing Field**
**[Perpendicularity]** - Prints a test pattern to check perpendicularity which will provide data for service.

![Figure 37 - The Printhead Startup: Perpendicularity Screen](image)

**[Two Way Offset]** - Prints a test that shows the offset of the printhead which will provide information for service.

![Figure 38 - The Printhead Startup: Two Way Offset Screen](image)

**[Build Zero]** - Prints a test that shows the placement of the jobbox which will provide information for service.

![Figure 39 - The Printhead Startup: Build Zero Screen](image)
6.6.3 Machine Access

Contains controls for locking and unlocking the cabinet doors, as well as status indicators for the door lock system.

![Machine Access](image)

**Figure 40 - The Printhead Startup: Machine Access Field**

- **Lock Doors** – Locks all cabinet doors.
- **Unlock Doors** – Unlocks all cabinet doors.

Additionally, there are indicators for the state of the door locks and guarding circuit in this field.

- **Door Locks** – Indicates the locked or unlocked status of the door locks.
- **Guarding Circuit** – Indicates the open or closed status of the guarding circuit, which disables functionality when the doors are open or unlocked.
- **Job Box Door** – Indicates the open or closed status of the job box door.
- **Work Area Door** – Indicates the open or closed status of the work area door.
- **Recoater Door** – Indicates the open or closed status of the recoater access door.
6.6.4 The Drop Volume Measurement Screen

The [Drop Volume Measurement] field, accessed via [Startup Printhead] → [Measure Drop Volume] contains controls and data for calculating the average drop volume of binder droplets released by the print head.

Figure 41 - The Drop Volume Measurement Screen

Measured Samples

The [Measured Samples] field contains controls and fields for entering measured results of a drop volume sample. Drop volume must be calculated accurately for the Innovent® 3D Printer to print to the desired level of binder saturation in the printed green-body part.

Figure 42 - The Drop Volume Measurement: Measured Samples Field

[Sample Mass] – Entry fields for drop mass calculations.

[Fire Sample] – Fires a test sample into the test print area.

| NOTE | The Test print area must be thoroughly cleaned and a test strip must be placed in the test print area before firing a test sample. Failure to do so will cause inaccuracy in the test sample measurements, decreasing print quality. |

[Cancel Firing] – Cancels firing of the test print.

[Clear Values] – Clears the values in the [Sample Mass] fields.

Binder Saturation

The [Binder Saturation] field contains information on the saturation level of binder. Saturation is expressed as a percentage that represents the percent of the theoretical void space between the particles of powder that is filled with binder.

![Binder Saturation Field](image)

Figure 43 - The Drop Volume Measurement: Binder Saturation Field

[Computed Saturation] – Based on print resolution and drop volume, the saturation value computed to be closest to the desired saturation.


| NOTE | Optimum saturation varies based on particle size and grain geometry of the powder being used. |

[Recorded Drop Volume] – The average drop volume, as calculated by the drop volume test.

[Date Recorded] – The date that the last drop volume test was recorded.

[Time Recorded] – The time that the last drop volume test was recorded.
Safety & Guarding

The [Safety & Guarding] field contains controls for locking and unlocking the cabinet doors, as well as indicators for all of the door locks and guarding circuits.

![Safety & Guarding](image)

*Figure 44 - The Drop Volume Measurement: Safety and Guarding Field*

Drop Volume Measurement History

The [Drop Volume Measurement History] field contains a graphical chart of the history of drop volume tests for the Innovent® 3D Printer.

![Drop Volume Measurement History](image)

*Figure 45 - The Drop Volume Measurement History Field*
6.7 Print Files

The [Print Files] screen, accessible from the main menu, becomes available when a layout has been made for printing. Initially a confirmation screen prompting the user to confirm all necessary machine conditions will appear.

Figure 46 - The Pre-Print Supply Check Screen

Once complete, the [continue] button will be selectable and allow the user to continue to the [Innovent® Print Job] screen.

Figure 47 - The Innovent Print Job Screen
The **Innovent® Print Job** screen contains information on the current print job including a simulation, job status time metrics, the currently printing files, supply level indicators, and process settings.

### 6.7.1 Simulation view

The simulation view contains an interactive visualization of the print job and its current progress, as well as the view manipulation bar for commonly used views.

![Figure 48 - The Print Job: Live Simulation View Field](image)

Parts in simulation view are shaded to represent the current progress of printing.

- Opaque gray represents portions of the job that have been printed.
- Translucent gray represents portions of the job that have yet to print.
- Blue represents the layer currently being printed.

### 6.7.2 Job Status

The **Job Status** field contains information about the current print job.

![Figure 49 - The Print Job: Job Status Field](image)
[Elapsed Run Time] – The amount of time since the start of the print job.

[Est. Time Remaining] – An estimate of the remaining time in the print job based on the average layer time.

[Average Layer Time] – The average amount of time a layer has taken throughout the print.

[Time Paused] – If the printer is paused, the [time paused] field tracks paused time.


[Machine action] – The command currently being carried out by the printer.

[Layer] – Displays the current layer and the total number of layers within a progress bar.

[Pass] – Displays the current pass of the print head over the powder in a progress bar.

6.7.3 Files Printing

The [Files Printing] field displays the files currently being printed individually based on filename. These may be selected to highlight their position in the print job.

Figure 50 - The Print Job: Files Printing Field
6.7.4 Powder & Fluid Levels

The [Powder & Fluid Levels] field displays status for all supply levels. If a level reaches a critical state, the font color of the status will become red, and an error may occur. Errors of this type typically pause the print job and request the machine operator to refill the supply that has run out. The print job can be started afterward to continue the print job.

![Powder & Fluid Levels Field](image)

**Figure 51 - The Print Job: Powder & Fluid Levels Field**

- **[Print Bed Temp]** – Displays the last recorded temperature of the print bed. The ideal temperature is maintained by job box heaters and the drying element.

- **[Binder Supply]** – Displays the status of the 5-gallon supply reservoir of binder.

- **[Cleaner Supply]** – Displays the status of the 5-gallon supply reservoir of Cleaner.

- **[Waste Level]** – Displays the status of the 5-gallon waste reservoir.

- **[Printhead Binder Level]** – Displays the level of binder in the print head module reservoir. This level is automatically maintained by the printer.

- **[Printhead Vacuum]** – Displays the vacuum pressure on the print head. This level is automatically maintained by the printer.

- **[Recoater Powder]** – Displays the level of powder in the recoater hopper. This level is automatically maintained by the printer.
6.7.5 Cleaning

The [Cleaning] field contains controls for cleaning the print head during the printing process. This can be used when a decrease in print head performance is observed during a print.

- [Prime] – Issues a command to prime the print head based on the [Next Layer] toggle setting.

- [Next Layer] – Toggles the option to finish the currently printing layer before priming the print head. If turned on, the print layer will finish, the print head will be primed, and the next layer will start. If turned off, priming will be done immediately.

- [Clean Wiper] – Issues a command to clean the wiper based on the [Next Layer] toggle setting.

- [Next Layer] – Toggles the option to finish the currently printing layer before clean the wiper. If turned on, the print layer will finish, the wiper will be cleaned, and the next layer will start. If turned off, wiper cleaning will be done immediately.

- [Change] – Opens a menu to change the automatic prime, wipe, and wiper clean settings. Priming, wiping, and wiper cleaning are done throughout the print to maintain the print head and keep it free of powder.

6.7.6 Reccoat and Dry

The [Recoat and Dry] field displays current process settings for the recoater and heater X2 axis.
[Recoat] – Executes a print bed recoating cycle.

[Dry] – Executes a print bed dry cycle.

[Change] – Opens the live [Recoating & Drying Profile] screen for modifying the layer-by-layer process settings for recoating and drying the print bed.

The fields in the layer-by-layer [Recoating & Drying Profile] settings tab initially correspond to the initial job process settings values found in:

[Main menu] → [Job Process Settings]

---

NOTE

Unless otherwise defined, the initial values will be used. Once defined, the new settings will be used starting at the layer specified and will be used for all following layers unless otherwise defined. These settings will not be saved in the profile.

---

A profile specific [Recoat and Dry] Settings control also exists in the [Process Settings] screen, and can be saved.

---

Figure 53 - The Print Job: Recoat & Dry settings field

Figure 54 - The Print Job: Recoating and Drying Profile
[Binder Set Time] – The default amount of time the binder is allowed to set before drying.

[Drying Speed] – The default speed at which the heating element is moved over the print bed.


[Recoat Speed] – The default speed of the recoater in the X direction.

[Oscillator speed] – The default oscillation frequency of the recoater oscillator.

[Roller Rotation Speed] – The default rate of rotation of the recoater roller.

---

**NOTE**

Not all Innovent® 3D Printing Systems have roller systems installed. If the roller is not installed, adjusting roller settings will have no effect.

---

[Roller Transverse Speed] – The rate at which the roller is moved over the print bed in the X direction.

---

**Figure 55 Print Job: Additional Buttons**

[Exit] – Exits to the main menu.

[Initialize and Start Printing] – Begins the print job.

6.8 Process Settings

The [Process Settings] screen, accessible from the main menu, contains fields displaying default settings for the loaded print profile. These settings can be loaded, changed, and saved to a file to be used again later.

![Figure 56 - The Job Process Settings Screen](image)

- **Save and Exit** – Saves the current settings to the currently open profile and exits to the main menu.
- **Save** – Saves the currently open profile.
- **Save As** – Saves the current profile as a new profile.
- **Open** – Opens a saved profile.
- **Cancel and Exit** – Cancels all changes and exits to the main menu.

### 6.8.1 Descriptions

![Figure 57 - The Job Process Settings: Descriptions Field](image)

- **General** – The name of the profile, independent of the name of the .ini file.
- **Powder** – The powder that the profile is designed to use.
[Binder] – The binder that the profile is designed to use.

6.8.2 Foundation Layers

Sets the number of layers the printer will deposit and prepare in the starting sequence of printing.

6.8.3 Printing

[Desired Saturation] – The Saturation percentage desired. Saturation is defined as the percentage of theoretical void space between powder particles that is filled with binder.

[Computed Saturation] – A computed nearest-value to desired saturation due to print resolution and finite binder particle size.

[Layer Thickness] – The thickness of each layer of deposited powder.

[Passes Per Jet Spacing] – The number of passes necessary to fully print the layer.

[X Drop Spacing] – Spacing between binder jets in the X direction. This is static based on the printhead configuration.

[Y Drop Spacing] – Spacing between binder jet pulses in the Y direction.

[Y Print Speed] – The speed at which the print head is moved in the Y direction. This is computed based on the Drop Spacing and Computed Drop Frequency.

[Computed Drop Frequency] – The frequency at which the print head jets binder.

[Fix Saturation] – Adjusts the saturation based on changes to Y-Drop Spacing and other changes.
**Bottom Bleed Reduction** – Refers to the adjustment of saturation of the first two bottom boundary layers to preserve the original shape of models. Poor part integrity may occur on the first two layers if bleed reduction is set too high.

[None] – Does not reduce saturation on the first two layers.

[Low (50-75)] – Jets 50% saturation on the first layer, and 75% saturation on the second layer.

[Medium (25-50)] – Jets 25% saturation on the first layer, and 50% saturation on the second layer.

[High (0-25)] – Jets 0% saturation on the first layer, and 25% saturation on the second layer.

### 6.8.4 Recoating and Drying Profile

The Recoating and Drying Profile section contains settings for the application of layers of powder as well as for the drying characteristics during print. The top section contains default information, which may be changed on a layer-by-layer basis in the lower section.

![Recoating & Drying Profile](image)

**Figure 60 - The Job Process Settings: Recoating and Drying Profile Field**

[Binder Set Time] – The default amount of time the binder is allowed to set before drying.

[Drying Speed] – The default speed at which the heating element is moved over the print bed.


[Recoat Speed] – The default speed of the recoater in the X direction.

[Oscillator speed] – The default oscillation frequency of the recoater oscillator.

[Roller Rotation Speed] – The default rate of rotation of the recoater roller.
[Roller Transverse Speed] – The rate at which the roller is moved over the print bed in the X direction.

Layer-by-Layer Recoat and Dry Settings

The fields in the layer-by-layer Recoating and Drying settings tab correspond to the initial values for the Recoating and Drying profile. Unless otherwise defined, the initial values will be used. Once defined, the new settings will be used starting at the layer specified and will be used for all following layers unless otherwise defined. These settings are saved in the job process settings profile. A real-time Layer Recoat and Dry Settings control also exists in the [Print Files] screen, though those settings are not saved.
6.9 Build Reports

The [Build Reports] screen, accessible from the main menu, contains a file browser that enables loading, viewing, and printing of build reports generated when printing.

Figure 61 - The Build Report Selection Screen
6.10 Maintenance

The [Maintenance] screen, accessible from the main menu, contains fields displaying maintenance operations available to the user.

![Maintenance Functions Screen]

- **[Log In]** – Service technician access login.
- **[Log Out]** – Service technician access logout.
- **[Idle Cleaning Status]** – Displays the status of the Idle Cleaning routines.
6.10.1 Manual Control

The [Manual Control] screen contains controls for manual control of the X1, X2, Y, and Z axes, as well as the print head cap and wiper.

**Axes**

Allows the user to enable, disable, reset, or home the X1, X2, Y, and Z axes. Provides status indicators for the X1, X2, Y, and Z axes.

**Manual controls**

Allows manual control of the X1, X2, Y, Z axes as well as capping and wiping stations.
The Innovent® 3D Printing System has many moving parts. Although operation of the Innovent® 3D Printing System is reasonably safe, it is still possible to initiate motion commands or touch components that could result in operator injury or equipment damage. Thorough understanding of component locations, nomenclature, and operating procedures is essential to the safe operation of the Innovent® 3D Printing System.

- **[Printhead Cap]** – Raises and lowers the print head cap.
- **[Printhead Wiper]** – Raises and lowers the print head wiper.
- **[PHC Encoder]** – Allows the user to manually reset the print head control encoder.
**Figure 66 - The Manual Control: Axis Jog Diagram**

[X1] – Controls motion of the X1 axis assembly, which contains the Y axis assembly and print head.

[X2] – Controls motion of the X2 axis assembly, which contains the recoater and heater.

[Y] – Controls motion of the Y axis assembly, which controls the print head.

[Z] – Controls motion of the Z axis assembly, which controls build plate and print bed height.

[Jog Speed] – Allows the user to increase or decrease the jog speed of the axes.

**Idle Cleaning status**

The Idle [Cleaning Status], accessible from the [Maintenance Functions] screen popup window shows the status of the idle cleaning protocol.
[Clean Now] – Performs idle cleaning.

[Reset Idle Timer] – Resets the timer for idle cleaning, resetting the amount of time until the next cleaning.

[Close] – Closes the menu.

---

NOTE

For hardware incompatibility reasons, the idle cleaning feature is disabled on some systems.
7 Maintenance

Maintenance for the Innovent® 3-D Printer can be broken into the following categories:

1. Duties performed per-run, before or after.
2. Duties performed daily.
3. Duties performed periodically: weekly, monthly, bimonthly.
4. Duties performed as-needed.
5. Duties to be performed by an ExOne® service technician during 12 or 24 month maintenance.
6. Faults that require repair by an ExOne® service technician.

Warnings: Persons cleaning and maintaining the Innovent® 3D Printer may subject to the following risks.

---

**ENTRAPMENT**

Never put hands or body parts inside the Innovent® 3D printer cabinet while the printer is operating, or while installing or removing the job box. While the Innovent® 3D Printer has been designed not to function with the guarding doors open, it is possible to create a pinching or crushing hazard resulting in injury.

---

**HOT SURFACE**

The Innovent® 3D Printer contains heaters in the build plate and on the recoater heating lamp. Additionally, electric motors may become hot from continuous use. Always verify safe handling temperatures with a non-contact thermometer. Failure to do so may result in injury.

---

**FINE PARTICLES**

Always wear a filter mask while handling powder. Even a powder with relatively large average particle size contains fine and ultrafine particles. Follow all safe handling requirements specific to any materials being used. Failure to do so may result in injury, health complications, or death.

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**FLAMMABLE**

Dispose of waste fluid in a manner approved for disposal of flammable liquids if applicable. Store binder and cleaner in storage appropriate for flammable materials. Failure to do so may result in property damage, injury or death.
Never move or remove the job box while the job box is engaged in the Innovent® 3D Printer. Failure to comply could result in injury or damage to the Z axis assembly.
### 7.1 Table of Maintenance and Cleaning Duties

<table>
<thead>
<tr>
<th>Daily cleaning and maintenance</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-Print</strong></td>
<td></td>
</tr>
<tr>
<td>☐ Clean Printer Cabinet</td>
<td></td>
</tr>
<tr>
<td>☐ Fill Binder Container</td>
<td></td>
</tr>
<tr>
<td>☐ Fill Cleaner Container</td>
<td></td>
</tr>
<tr>
<td>☐ Empty Waste Container</td>
<td></td>
</tr>
<tr>
<td>☐ Fill Powder Supply</td>
<td></td>
</tr>
<tr>
<td>☐ Clean Job Box Enclosure</td>
<td></td>
</tr>
<tr>
<td>☐ Clean Underside of Job Box</td>
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<tr>
<td>☐ Prime Recoater</td>
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<tr>
<td>☐ Verify Print Head Quality</td>
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<tr>
<td><strong>Post-Print</strong></td>
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<tr>
<td>☐ Clean Work Area</td>
<td></td>
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<tr>
<td>☐ Clean Interior Powder Accumulation</td>
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<tr>
<td>☐ Clean Job Box</td>
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<tr>
<td>☐ Clean Depowdering station</td>
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<tr>
<td>☐ Wipe down Axes</td>
<td></td>
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<tr>
<td><strong>Daily Cleaning and Maintenance</strong></td>
<td></td>
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<tr>
<td>☐ Clean Recoater Blade/Roller</td>
<td></td>
</tr>
<tr>
<td>☐ Verify Capping Sponge Quality</td>
<td></td>
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<tr>
<td><strong>Weekly Cleaning and Maintenance</strong></td>
<td></td>
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<tr>
<td>☐ Clean Wiper Trough</td>
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<tr>
<td>☐ Clean Priming Area</td>
<td></td>
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<tr>
<td><strong>Monthly Cleaning and Maintenance</strong></td>
<td></td>
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<tr>
<td>☐ Conduct Drop Volume Test</td>
<td></td>
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<tr>
<td>☐ Clean Powder Recycling Sieve</td>
<td></td>
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<tr>
<td><strong>As-Needed Cleaning and Maintenance</strong></td>
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<tr>
<td>☐ Replace Job Box Felt</td>
<td></td>
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<tr>
<td>☐ Cup Test and Recoater Adjustment</td>
<td></td>
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<tr>
<td>☐ Clean Cabinet Fan Filters</td>
<td></td>
</tr>
</tbody>
</table>

*Table 3 - Maintenance and Cleaning Duties*
7.2 Pre-Run Cleaning and Maintenance

7.2.1 Maintain supply levels

Prior to printing, a cleaning and setup checklist must be followed to prepare the Innovent® printer. Attention must be paid to any accumulation of powder, as well as any signs of print head drip and fouling. If the two conditions are allowed to interact, the print head can become damaged by scraping of powder across the print head jets.

A table of supplies is available in Section 9.5.

7.2.2 Fill Binder Container

To refill the binder reservoir:

---

**FLAMMABLE**

Binder and waste may be flammable. Keep all open flames and heat sources away from the pumping system. Only store binder and waste in approved safe storage containers. Clean all spills immediately. Failure to observe this warning may result in property damage, injury, or death.

**AVOID DIRECT CONTACT**

Avoid prolonged direct contact with binder or waste. If direct contact occurs, wash contacted area with soap and water. Consult MSDS for cleanup recommendation. Failure to observe this warning may result in injury.

**INHALATION HAZARD**

Binder and waste may cause an inhalation hazard. Avoid prolonged exposure to vapors. If unavoidable, wear a respirator rated for the binder system being used. Consult included MSDS for guidelines on respirator choice. Failure to observe this warning may result in injury or death.

**DO NOT DUMP**

Do not dispose of binder, cleaner, or waste in wastewater systems. Dispose only in approved methods for flammable waste. Consult MSDS for disposal recommendations.
<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Binder Filter</td>
<td>Filters binder on the way to the print head</td>
</tr>
<tr>
<td>2 Binder Reservoir</td>
<td>Contains binder for printing, must be filled before printing</td>
</tr>
<tr>
<td>3 Waste Reservoir</td>
<td>Contains a mixture of binder and waste for disposal, must be emptied before printing</td>
</tr>
<tr>
<td>4 Cleaner Reservoir</td>
<td>Contains cleaner for cleaning the print head, must be filled before printing</td>
</tr>
<tr>
<td>5 Cleaner Filter</td>
<td>Filters cleaner for distribution to wiper trough</td>
</tr>
<tr>
<td>6 Pump Enclosure Assembly</td>
<td>Houses all pump motors</td>
</tr>
</tbody>
</table>

- Open the fluid station access.
- Wearing protective gloves, attach the fill hose adapter to the binder container that will be used to fill the binder reservoir.
- Confirm that the spigot on the fill hose is set to the off position.
Open the fill cap on the binder container.

Place the end of the fill hose into the binder reservoir.

Open the fill hose spigot.

When the binder level has reached the desired level in the fill reservoir, turn off the fill spigot and carefully remove the fill hose.

---

**CAUTION**

Do not overfill the binder reservoir. Do not tamper with reservoir sensors. Clean all spills immediately. Failure to observe this warning may result in injury.

Replace the fill cap on the binder reservoir.

Clean all spills immediately.

---

**7.2.3 Fill Cleaner Container**

To refill the cleaner reservoir:

- Open the fluid and pumping station access.
- Wearing protective gloves, attach the fill hose adapter to the cleaner container that will be used to fill the cleaner reservoir.
- Confirm that the spigot on the fill hose is set to the off position.
- Open the fill cap on the cleaner container.
- Place the end of the fill hose into the cleaner reservoir.
- Open the fill hose spigot.
- When the cleaner level has reached the desired level in the fill reservoir, turn off the fill spigot and carefully remove the fill hose.

---

**CAUTION**

Do not overfill the cleaner reservoir. Do not tamper with reservoir sensors. Clean all spills immediately. Failure to observe this warning may result in injury.

Replace the fill cap on the cleaner reservoir.

Clean all spills immediately.

---

**7.2.4 Empty Waste Container**

To empty the waste reservoir:
Wearing protective gloves, carefully remove the fill tube from the waste reservoir.

Place a drip catch underneath the hose and remove the waste reservoir.

Empty the waste reservoir in an approved fire-resistant container.

Replace the waste reservoir.

Replace the fill tube.

Clean all spills immediately.

Binder and waste may be flammable. Keep all open flames and heat sources away from the pumping system. Only store binder and waste in approved safe storage containers. Clean all spills immediately. Failure to observe this warning may result in property damage, injury, or death.

Avoid prolonged direct contact with binder or waste. If direct contact occurs, wash contacted area with soap and water. Consult MSDS for cleanup recommendation. Failure to observe this warning may result in injury.

Binder and waste may cause an inhalation hazard. Avoid prolonged exposure to vapors. If unavoidable, wear a respirator rated for the binder system being used. Consult included MSDS for guidelines on respirator choice. Failure to observe this warning may result in injury.

Do not dispose of binder, cleaner, or waste in wastewater systems. Dispose only in approved methods for flammable waste. Consult MSDS for disposal recommendations.
7.2.5 Fill Powder supply

- Open the work area access door of the Innovent® 3D Printer to uncover the powder supply hopper.

- Do not fill the hopper above the lip of the hopper. Powder may spill into mechanical systems not intended for direct contact with powder.

---

**CAUTION**

Do not put un-processed powder into the powder supply. Always put powder through the powder recycler sieve before adding to the powder supply. Make sure that all loose hair and dust has been removed or contained before handling processed powder. Failure to adhere to these guidelines may result in contamination of powder systems.

---

**INHALATION HAZARD**

Wear a particulate filter mask rated for the powder being handled. Consult the SDS for the specific material being used for safety recommendations. Failure to observe this warning may result in injury or death.

---

7.2.6 Clean Job Box Enclosure

- Open the work area access door of the Innovent®.
- Vacuum any accumulated powder in the job box seating area.
Accumulation of binder may be cleaned with a moist towel and followed up with a dry towel.

The job box rollers and platen are heated during printing. Use an infrared thermometer or other measuring tool to verify a temperature of no more than 49°C (120°F) before handling. Failure to observe this warning may result in injury.

7.2.7 Clean Underside of Job Box

While the job box is empty and removed from the system, wipe the underside of the job box clean with a dry cloth.

The job box is heated during printing and curing. Use an infrared thermometer or other measuring tool to verify a temperature of no more than 49°C (120°F) before handling. Failure to observe this warning may result in injury.

7.2.8 Prime Recoater

In the [Setup Powder] screen, hit the [Drain Recoater] button.

Repeat 2-3 times to clear any bridged or obstructed powder.

The recoater is in close proximity to the X axis heating element. Use an infrared thermometer or other measuring tool to verify a temperature of no more than 49°C (120°F) before handling. Failure to observe this warning may result in injury.
7.2.9 Verify Printhead Quality

Run a test print, clean print head as necessary.

![Figure 70 - The printhead cleaning and testing area](image)

- Prime the printhead.
  - [Printhead Startup] → [Prime Wipe and Jet]
- Print a test pattern and inspect for accuracy.
  - [Printhead Startup] → [Print Test Pattern]
  - If the test print is not satisfactory, prime the printhead 2-4 times and print the test pattern again.
7.3 Post-Run Cleaning and Maintenance

Regular and thorough cleaning is important to the safe and effective operation of the Innovent® printer. The following cleaning must be done after running every job on the Innovent® printer.

7.3.1 Clean Work Area

□ Open work area access door.
□ Use a small scoop and dry cloth to remove any powder from the work area.
  • Powder accumulated on the print deck is re-useable after sifting through the sieve.
□ Remove any remaining powder from work area and from behind the recoater in a method approved for the materials being used.

NOTE

Powder that has come in contact with the floor is not reusable.

7.3.2 Clean Job box

□ Using a dry cloth, wipe any powder accumulation off of job box print bed area.
□ Clear all remaining powder out of the job box by pouring it carefully though the sieve.
□ If any binder has accumulated on the job box lip or walls, clean using a clean cloth wetted with cleaning fluid.
  • Wipe dry immediately with a lint free dry cloth.

HOT SURFACES

The job box is heated during printing and curing. Use an infrared thermometer or other measuring tool to verify a temperature of no more than 49°C (120 °F) before handling. Failure to observe this warning may result in injury.

7.3.3 Wipe Axes

□ Wipe the X axis slides with an alcohol wipe.
7.4 Daily Cleaning and Maintenance

The following maintenance must be done daily to maintain the Innovent® system at optimum functionality. If not in continuous duty, daily maintenance may be done every three print runs.

7.4.1 Clean Printer Cabinet

- Using a dry cloth, wipe any accumulation of dust or powder from the top and sides of the printer.
- Using warm water, wipe any binder spray from the exterior of the printer and inside the access doors.

7.4.2 Clean the Recoater Blade

- Using a dry cloth or dry synthetic scouring pad, wipe the recoater clean of any debris that has accumulated on the recoater blade.
  - Do not use water or alcohol to clean the recoater blade.
  - If a significant amount of binder-laden powder is on the recoater blade, a small amount of cleaner may be used. Wipe dry immediately.

HOT SURFACES

The recoater is in close proximity to the X2 axis heating element. Use an infrared thermometer or other measuring tool to verify a temperature of no more than 49°C (120 °F) before handling. Failure to observe this warning may result in injury.

7.4.3 Clean the roller (If installed.)

- Remove the job box from the printer.
- In the Innovent® UI, select [Maintenance functions] → [Manual Control] → [X2 (left arrow)] to move the recoater to the center of the job box opening.
- Using a dry cloth or synthetic scouring pad, wipe the roller clean of any debris that has accumulated.
  - Do not use water or alcohol to clean the roller.
  - If a significant amount of binder-laden powder is on the roller, a small amount of cleaner may be used. Wipe dry immediately.
- Clean up any debris that has fallen onto the platen or rollers.

7.4.4 Verify Capping Sponge Quality

Checking the capping sponge must be done frequently to maintain proper capping of the print head. Cleaning the sponge may be done as necessary, but checking the sponge must be done at least three times a week regardless of printer duty.
If the capping sponge is showing signs of wear or degradation, it may be necessary to replace the capping sponge (listed in the table of wear parts and spare parts, Section 9.4).

□ Check the capping sponge for accumulated debris and powder, clean as necessary.
  • Rinse the sponge with ethylene glycol to loosen debris.
  • Replace sponge and saturate thoroughly with ethylene glycol.

□ Check the capping sponge for ethylene glycol saturation.
  • Saturate thoroughly with ethylene glycol.
7.5 Weekly Cleaning and Maintenance

The following maintenance must be done weekly to maintain the Innovent® system at optimum functionality. If not in continuous duty, weekly maintenance may be done every fifteen print runs.

7.5.1 Clean Wiper Trough

- Sweep the trough for powder with a magnet if using ferromagnetic powder.
- Empty the wiper trough via: [Startup Printhead] ➔ [Drain Wiper]
- Wipe additional residue with a dry lint free towel.
  - Be careful not to leave debris in the wiping trough. Remove all torn fibers from the wiper trough.
- Fill the wiper trough via: [Startup Printhead] ➔ [Fill Wiper]

If the wiper blades show signs of wear or cracking, it may be necessary to replace the wiper blades (listed in the table of wear parts and spare parts, Section 9.4)

7.5.2 Clean priming area

- Clean the jetting station with warm water and a cloth or paper towel as needed.

If a solid accumulation of binder has fouled the drain area:

- Place a cloth wetted with warm water on the drain area for 30 minutes and remove the binder plug with a needle nose pliers or hemostat.
  - Accumulation of binder in the jetting station can clog the drain to the station which in turn can cause binder to leak into the pumping station and onto the outside of the cabinet.

If the hose that connects the drain to the waste container is fouled with accumulated binder:

- Carefully remove the hose from inside the fluid access area.
- Soak the hose in warm water to loosen the clog.
- Remove the clog when possible.

Binder and waste may be flammable. Keep all open flames and heat sources away from the pumping system. Only store binder and waste in approved safe storage containers. Clean all spills immediately. Failure to observe this warning may result in property damage, injury, or death.
Avoid prolonged direct contact with binder or waste. If direct contact occurs, wash contacted area with soap and water. Consult MSDS for cleanup recommendation. Failure to observe this warning may result in injury.

Binder and waste may cause an inhalation hazard. Avoid prolonged exposure to vapors. If unavoidable, wear a respirator rated for the binder system being used. Consult included MSDS for guidelines on respirator choice. Failure to observe this warning may result in injury.

Do not dispose of binder, cleaner, or waste in wastewater systems. Dispose only in approved methods for flammable waste. Consult MSDS for disposal recommendations.
7.6 Monthly Cleaning and Maintenance

The following maintenance must be done monthly to maintain the Innovent® system at optimum functionality. If not in continuous duty, monthly maintenance may be done every sixty print runs.

7.6.1 Perform Drop Volume Test

The drop volume test requires a test scale accurate to 0.1 mg.

□ Prepare 3 test pads for measurement.
□ Go to: [Startup Printhead] → [Drop Volume Measurement]
□ Place the first pad on the scale and tare.
□ Position the first test pad in the center of the test print area.
□ Weigh the first test pad.
□ Enter the weight of binder jetted into the [Sample Mass] field.
□ Repeat with the second and third test pads.
□ When the three samples have been recorded, select [Compute Drop Volume] to adjust the drop mass calculation.
□ Select: [Fix Saturation]
□ Note that the drop mass calculation has updated on the graphical chart and exit the screen.

7.6.2 Check Door Lock Functionality

□ Unlock the doors in the UI.
□ Verify that the UI recognizes that the doors are unlocked.
□ Try to execute motion commands in the UI.
□ Verify that a request to lock the doors occurs.
□ Lock the doors in the UI.
□ Try to open machine lid normally while the doors are locked.
□ Verify that the lid does not open.

7.6.3 Check Emergency Stop Functionality

□ Save and close all presets and print layouts.
□ Press the emergency stop button.
- Verify that the motion axis power has been interrupted.
- Exit the ExOne Software User Interface.
- Reset the emergency stop.
- Start the printer as normal.
7.7 As-Needed Cleaning and Maintenance

The following maintenance must be done in accordance with the conditions stated in the maintenance procedure.

7.7.1 Replace Job Box Felt

If the job box is leaking significantly into the printer enclosure, it may be necessary to replace the job box felt (listed in the table of wear parts and spare parts, Section 9.4).

- Place job box on a clean workstation.
- Thoroughly clean all powder from the job box.
- Remove the floor plate of the job box and turn upside down.
- Using a metric Allen wrench, remove the top plate of the job box floor plate by removing the six M4 bolts.
- Remove the bottom plate to a safe location.
- Remove the felt pad from the assembly.
- Vacuum the entire assembly thoroughly, especially threaded insets.
- Clean all flat spaces with a dry cloth.
- Place the new felt pad on the top plate.
- Loosely set all screws.
- Place the floor plate into the job box.
- Tighten the screws.

NOTE

New felt is stiffer than felt that has been used, and can cause the floor plate to disengage from the Z axis. It is possible that a new felt pad will need to be “broken in” by running it through one or more curing cycles.

7.7.2 Clean Cabinet Fan Filters

- Turn off the printer.
- Clean the cabinet exterior and floor area.
- Open the cabinet doors.
- Vacuum both sides of the box filter, as well as any accumulations inside cabinets.
- Close and lock the cabinet.
- Turn printer back on when all filters and cabinets have been cleaned.
Binder and waste may cause an inhalation hazard. Avoid prolonged exposure to vapors. If unavoidable, wear a respirator rated for the binder system being used. Consult included MSDS for guidelines on respirator choice. Failure to observe this warning may result in injury.
7.8 12-Month and 24-month maintenance

In order to maintain optimum performance, the Innovent® printer should receive 12-month and 24-month maintenance by an ExOne® service technician. To schedule a service appointment, contact an ExOne® service representative.
8 Operation Procedure

After all Pre-printing cleaning and maintenance has been performed, printing a part on the Innovent® 3-D printer has three phases. First a layout file must be made by placing and orienting existing 3-D models. Second, the printer must be initialized and prepared for printing. Finally the print must be monitored for consistency throughout its run.

The Innovent® 3D Printing System has many moving parts. Although operation of the Innovent® 3D Printing System is reasonably safe, it is still possible to initiate motion commands or touch components that could result in operator injury or equipment damage. Thorough understanding of component locations, nomenclature, and operating procedures is essential to the safe operation of the Innovent® 3D Printing System.
The Innovent® 3D Printing System contains heat sources. Heated parts may remain hot after the printer has stopped operating. Use of an infrared or non-contact thermometer for temperature verification is recommended. Failure to comply with this warning may result in injury.

It is the responsibility of any person using this or any other equipment to ensure their own safety. Responsible safety procedures include:

- A thorough review of this document, paying attention to hazard warnings, specifications, and related diagrams.
- A thorough understanding of the components in the Innovent® 3D Printing System, with attention to voltage sources, intended use, heat ranges, and warning labels.
- A thorough review of individual instruction manuals supplied for any component within the Innovent® 3D Printing System.
- Situational awareness of the user’s own surroundings.
- Strict adherence to cleaning and maintenance as detailed in this guide is imperative for maximum safety, productivity, and longevity of the Innovent® 3D Printing System.
8.1 Preparing the Job Box for Printing

The job box houses prints as they are printed. It does so by containing a bed of powder which is deposited by the spreader and supported by the build plate. This plate can be raised and lowered, and must be lowered fully in order to remove the job box from the printer.

![Figure 72 - Powder Setup Submenu](image)

Moving the job box from one piece of system equipment to another creates pinch point hazards. Always exercise caution when moving the job box to or from any piece of equipment. Failure to comply with this warning may result in injury.

**PINCH POINTS**

Many features have been programmed for safety reasons not to run while the Innovent® doors are unlocked. If a feature is unresponsive, check to make sure the doors are in their closed and locked positions.

**NOTE**

---

**Checklist**

- Prepare the printer to accept the job box.
  - Move the build plate to the bottom of the job box.
    - [Powder Setup] → [Bottom]
□ Unlock the Innovent® work area access door.
  o [Powder Setup] → [Unlock doors]
□ Load the job box into the printer.
  o Position the job box near Innovent® printer.
  o Open the work area access door.
  o Remove any accumulation of powder inside the Innovent® 3D printer in a method approved for the materials being used.
  o Position the job box within the job box holders on the left side.
  o Once job box is firmly in place, close the job box latch on the right.

□ Lock the Innovent® work area access door.
  o [Powder Setup] → [Lock doors]
Engage job box in the Innovent® console.
- [Main Menu] → [Setup Powder] → [Engage Job Box]

Prepare the job box for printing.
- Move the build plate to the top of the job box.
  - Press and hold the [UP] button until the job box floor plate begins to move.
  - Press and hold the [DOWN] button until the job box floor plate returns to the bottom.
  - Press [Top] to bring the job box floor plate to the top of the job box.
- Prime the recoater.
  - Press [Drain Recoater] for three drain cycles.
  - Using a flashlight, look for any obstructions in the recoater powder vent.
  - Remove obstructions as necessary.
- Fill the print bed.
  - In the [Recoater] → [Recoat Cycles] field set the number to 10.
  - Select [Level Reccoat] to spread powder across the build plate.
  - Repeat [Level Reccoat] as necessary in order to achieve a satisfactory base layer.
    - A satisfactory base layer is free of deformation, even, and has a uniform edge consistency.
Figure 75 - A prepared print bed
8.2 Loading or building a layout

Before starting a print it is necessary to create a layout file, which is an arrangement of the objects as they will print into the job box. Generally it is best to have all parts facing the same direction and, if applicable, for all of their stilts to face in the same direction. This makes later handling and de-powdering easier. Additionally, it is useful to have the parts lay as flat as possible, as it will decrease the total print time.

8.2.1 Checklist

- Add a new part to start a layout.
  - [Select Print Files] → [Add New Part]
- Select the part or layout to be printed and select: [Load File]
- Select [Add to Print Bed] to add an instance of the part to the print bed.
  - Use the [Duplicate Part] button to add additional instances of the part as necessary.
  - Position the additional instances by selecting and dragging them, or by entering positions in the [Position] submenu.
- Select [Add New Part] to add any other parts.
  - Duplicate and position as necessary.
Do not overcrowd the build box. Overcrowding will cause difficulty in de-powdering.

- The amount of handling space needed for a part is related to the delicacy with which it must be handled.
- Parts that can be picked up with thumb and forefinger need space at the edges for a thumb (about 2x2cm) near two handling surfaces.
- Parts that must be supported by the whole hand will need more space (4x10cm) in order to lift the part safely from the print bed.

Orient parts so that they are easy to de-powder and remove from the box.

- Face all stilts in the same direction if possible.
- Orient such that the part has an easy to handle surface accessible, not underneath, the part.
- Orient duplications of parts regularly and facing the same direction.
- Orient fragile stilts away from the front of the box, such that they are subject to less damage in de-powdering.

- Select [Save Layout] to save the layout for later use if necessary.
- Top-justify parts by referencing the height of the tallest part and adjusting all other parts to match its height.
- Hit [Exit] to return to the main menu.
8.3 Starting the Print

The printing process itself consists of a print powder layer applied by the recoater; priming the print head, in which the print head is cleaned and primed in the automatic wiping station; applying binder, in which binder is selectively jetted onto the print bed; heating, in which the heating element dries the binder and heats it to an acceptable temperature; and recoating, in which the recoating assembly deposits and spreads an even coat of powder over the print bed.

![Figure 77 - The Print Monitoring and Settings Screen](image)

8.3.1 Checklist

- Open Printing dialogue and confirm checklist items.
  - [Main Menu] → [Print Files]
- Address any error conditions as detailed in above sections.
- Select: [Continue]
- Select: [Initialize and start printing]
  - The [Innovent® Print Job] screen will appear, which allows the user to monitor the print as it completes.
- Monitor for early-print errors.
  - It is worthwhile to watch the first few layers to make sure initial cleaning and setup resulted in a successful printing system.
8.4 Adjusting Recoat and Dry Settings

The print bed temperature must be between 40°C and 70°C (104°F to 158°F) in order to result in a successful print. In newer models of the Innovent® printer the recoat and dry settings are handled automatically by the printer. However, it may be necessary to adjust the recoat and dry settings during a print in order to achieve a successful print. This can be done from the Innovent® Print Job screen.

8.4.1 Checklist

- Select [Change...] in the [RECOAT AND DRY] field at the bottom right corner of the Print Job screen
- Adjust recoating and drying speed as necessary:
  - Select the layer at which the new settings start.
  - Enter setting for dry speed.
  - Enter setting for Heater output (automatic in most models.)
    - The other fields are powder specific for recoating and do not need to be adjusted to ensure print quality.
- Add additional recoat and dry options for different layer regions as necessary.
- If the temperature of the bed is higher than 70°C during binder jetting, increase the speed by 2mm/s.
- If the temperature of the bed is lower than 50°C during binder jetting, lower the speed by 2mm/s.
- Keep heater output and recoater speed roughly proportional to each other, avoid heating very quickly at low speed, or heating a small amount at high speed if possible.
8.5 Print Quality Check

A print batch can take a significant amount of time, and it would be wasteful to monitor it constantly throughout the print. However, it is important to check the printer throughout a print in order to catch small errors, if they occur, before they become catastrophic. Once or twice an hour, check the following:

---

**NOTE**

If any of the following exhibit signs of worsening or contacting and damaging the print head, cancel the print immediately and service the printer. If problems continue to occur, call an ExOne® service representative.
8.5.1 Checklist

□ Print bed is of good quality, adjust accordingly:
  o Recoater is fully recoating the print bed.
    ▪ Free of short spread (recoater powder is not filling to the corners of the print bed).
      • Print bed may not have been sufficiently filled at setup.
        o Manually recoat the print bed
          ▪ [Innovent Print Files] → [Recoat & Dry] → [Recoat]
        • Recoater output may be set too low.
          ▪ [Innovent Print Files] → [Recoat & Dry] → [Change] → [Recoat speed]
    ▪ Free of spread gaps (horizontal gaps in the print bed spread).
    • Debris may be obstructing recoater assembly.
      o Pause the print job.
      o Manually drain the recoater.
        ▪ [Setup Powder] → [Drain Recoater]
      o Check the recoater vent for obstructions with a flashlight and thin piece of plastic (zip tie).
      o Manually drain the recoater.
        ▪ [Setup Powder] → [Drain Recoater]

Figure 79 - The Print Job Screen
Resume the print job.

- Free of pits in the edges of the job box.
  - There may be a leak in the job box felt.
    - Clean the job box thoroughly and remove any accumulations of powder in the felt.
    - Replace job box felt if necessary.

- Free of smears:
  - Looks like liquid has been wiped across the print bed.
  - The recoating foot is making contact with wet binder.
    - Drying speed may be too fast.
      - [Innovent Print Files] → [Recoat & Dry] → [Change] → [Dry speed]

- Free of drags:
  - Parts have been moved by the recoater.
  - Debris is connecting with print head or sticking to the recoater foot.
    - Drying speed may be too fast.
      - [Innovent Print Files] → [Recoat & Dry] → [Change] → [Dry speed]

- Free of curling parts:
  - Parts lift away from powder bed, curling upwards.
    - Drying speed may be too slow.
      - [Innovent Print Files] → [Recoat & Dry] → [Change] → [Dry speed]

- Free of pushed layers:
  - Top layers have been shorn off of the print and pushed away.
  - Previous layer impacted the recoater and was shorn off.
    - Drying speed may be too slow.
      - [Innovent Print Files] → [Recoat & Dry] → [Change] → [Dry speed]

All supply level indicators are acceptable:
- Binder
- Cleaner
- Waste
- Printhead Binder
- Printhead Vacuum
- Re-coater powder
- Powder supply hopper
- Overflow powder

Overflow powder may be transferred to a clean secondary bucket to be run through the sieve during part cleaning.
8.6 Unloading a Job

In order to transfer parts from the job box to the crucible for infiltration, it is necessary to cure the parts while in the job box. This sets the binder, and makes parts durable enough to handle.

The Innovent® Job Box and Curing Oven contain heated parts.

- Assume objects surrounding the curing oven are hot until proven otherwise.
- Use no-contact methods of determining the temperature of the job box (e.g. infrared thermometer).
- Always place a heat warning sign on job boxes that have recently been removed from the curing oven.
- Never handle hot surfaces without proper thermal gloves.
- Follow all safe handling requirements specific to the printed powder.

Failure to comply with these warnings may result in injury.
Moving the job box from one piece of system equipment to another creates pinch point hazards. Always exercise caution when moving the job box to or from any piece of equipment. Failure to comply with these warnings may result in injury.

8.6.1 Remove the job box from printer

- Unlock and open the work area access door on the Innovent® printer.
- Release the job box latch.
- Using handles, carefully slide the job box out of the job box holders.
- Place job box in the curing oven.

8.6.2 Spot Clean Printer

- Look for any accumulations of metal powder and clean them.
- Look for any accumulations of binder or cleaner on the print deck or wiping/jetting station and clean them out.

**WARNING**

Metal powder in the curing oven may be hot. If the interior of the curing oven is above 50°C (120°F) do not sweep out the curing oven. Wait until a safe temperature has been reached. Failure to comply with these warnings may result in injury.
8.6.3 Load the job box into curing oven

- Turn the curing oven on if it is not already.
- Open the curing oven.
- Clean the inside of the curing oven, if it is at a reasonable temperature to do so.
- Insert the job box into the curing oven.
- Seal curing oven.
- Close the curing oven.

![Figure 82 - Job box on the depowdering station](image)

8.6.4 Depowdering process

- Remove job box from curing oven and allow to cool.
- Once cool, place outside brackets of depowdering station.
- Using a brush, clear off loose powder.
- Use handles to slowly turn job box and lower until job box it sitting on the base of depowdering station.
- Allow loose powder to fall to the side.
- Using a brush, carefully clear off powder being cautious to not disrupt the part.
- Once part is mostly clear of powder, lift it out of the print bed to prepare for infiltration.

![Figure 83 - The depowdering process](image)
9 Appendix

9.1 Troubleshooting and Diagnostics

9.1.1 Print Quality Check

![Figure 84 - An ideal print, free of artifacts](image)

It is important to check the printer periodically throughout a print in order to catch small errors, if they occur, before they become catastrophic. The following checklist will help ensure a reasonable quality of printing.

---

**NOTE**

If any of the following exhibit signs of worsening or contacting and damaging the print head, cancel the print immediately and service the printer. If problems continue to occur, call an ExOne® service representative.
9.1.2 Checklist

- Print bed is of good quality, adjust accordingly:
  - Recoater is fully recoating the print bed:
    - Free of short spread (recoater powder is not filling to the corners of the print bed).
      - Print bed may not have been sufficiently filled at setup.
        - Manually recoat the print bed
          - [Innovent Print Files] → [Recoat & Dry] → [Recoat]
        - Recoater output may be set too low.
          - [Innovent Print Files] → [Recoat & Dry] → [Change] → [Recoat speed]
    - Free of spread gaps (horizontal gaps in the print bed spread).
      - Debris may be obstructing recoater assembly.
        - Pause the print job.
        - Manually drain the recoater.
          - [Setup Powder] → [Drain Recoater]
        - Check the recoater vent for obstructions with a flashlight and thin piece of plastic (zip tie).
        - Manually drain the recoater.
          - [Setup Powder] → [Drain Recoater]
Resume the print job.

- Free of pits in the edges of the job box.
  - There may be a leak in the job box felt.
    - Clean the job box thoroughly and remove any accumulations of powder in the felt.
    - Replace job box felt if necessary.

- Free of smears:
  - Looks like liquid has been wiped across the print bed.
  - The recoating foot is making contact with wet binder.
    - Drying speed may be too fast.
      - [Innovent Print Files] → [Recoat & Dry] → [Change] → [Dry speed]

- Free of drags:
  - Parts have been moved by the recoater.
  - Debris is connecting with print head or sticking to the recoater foot.
    - Drying speed may be too fast.
      - [Innovent Print Files] → [Recoat & Dry] → [Change] → [Dry speed]

- Free of curling parts:
  - Parts lift away from powder bed, curling upwards.
    - Drying speed may be too slow.
      - [Innovent Print Files] → [Recoat & Dry] → [Change] → [Dry speed]

- Free of pushed layers:
  - Top layers have been shorn off of the print and pushed away.
  - Previous layer impacted the recoater and was shorn off.
    - Drying speed may be too slow.
      - [Innovent Print Files] → [Recoat & Dry] → [Change] → [Dry speed]

☐ All supply level indicators are acceptable:
  - Binder
  - Cleaner
  - Waste
  - Printhead Binder
  - Printhead Vacuum
  - Re-coater powder
  - Powder supply hopper
  - Overflow powder
    - Overflow powder may be transferred to a clean secondary bucket to be run through the sieve during part cleaning.
### 9.1.3 Error Codes

Table 4 - M-FLEX(TM) Error Codes

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<th>Error Description (displayed to user)</th>
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<td>MC_ERROR_NONE</td>
<td>0</td>
<td>No Error</td>
</tr>
<tr>
<td>MC_ERROR_LINK_OPEN_FAILED</td>
<td>1</td>
<td>Comm Link Open Failed</td>
</tr>
<tr>
<td>MC_ERROR_LINK_CLOSE_FAILED</td>
<td>2</td>
<td>Comm Link Close Failed</td>
</tr>
<tr>
<td>MC_ERROR_LINK_NOT_OPEN</td>
<td>3</td>
<td>Comm Link Not Open</td>
</tr>
<tr>
<td>MC_ERROR_LINK_TIMEOUT</td>
<td>4</td>
<td>Comm Link Timeout</td>
</tr>
<tr>
<td>MC_ERROR_LINK_COMMAND_ECHO</td>
<td>5</td>
<td>Comm Link Invalid Echo</td>
</tr>
<tr>
<td>MC_ERROR_LINK_WRITE_FAILED</td>
<td>6</td>
<td>Comm Link Write Failed</td>
</tr>
<tr>
<td>MC_ERROR_LINK_READ_FAILED</td>
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<td>Comm Link Read Failed</td>
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<td>8</td>
<td>Comm Link Invalid Response</td>
</tr>
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<td>9</td>
<td>Operation Cancelled</td>
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<td>MC_ERROR_CONTROL_POWER</td>
<td>10</td>
<td>Control Power OFF</td>
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<tr>
<td>MC_ERROR_GUARDING</td>
<td>11</td>
<td>Guarding OPEN</td>
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<tr>
<td>MC_ERROR_AXIS_DISABLED</td>
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<td>Axis Is Disabled</td>
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<td>13</td>
<td>Wiper Interference Detected</td>
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<tr>
<td>MC_ERROR_AXIS_CAP_INTERERENCE</td>
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<td>Cap Interference Detected</td>
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<td>Platen Not Engaged</td>
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<td>MC_ERROR_AXIS_POSITIVE_SOFT_LIMIT</td>
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<td>Positive Soft Limit Exceeded</td>
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<td>MC_ERROR_AXIS_NEGATIVE_SOFT_LIMIT</td>
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<td>Negative Soft Limit Exceeded</td>
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<td>MC_ERROR_AXIS_POSITIVE_HARD_LIMIT</td>
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<td>Positive Hard Limit Switch Activated</td>
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<td>MC_ERROR_AXIS_NEGATIVE_HARD_LIMIT</td>
<td>19</td>
<td>Negative Hard Limit Switch Activated</td>
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<td>MC_ERROR_AXIS_TIMEOUT</td>
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<td>Move Timed Out</td>
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<td>Destination Position Not Reached</td>
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<td>IO Point Undefined</td>
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<td>Recoater Routine Timed Out</td>
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<td>MC_ERROR_CLEANER_PROGRAM</td>
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<td>Description</td>
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<td>39</td>
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<td>40</td>
<td>Printhead - Command Port Timeout</td>
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<td>41</td>
<td>Printhead - Command Port Echo Error</td>
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<td>42</td>
<td>Printhead - Command Port Write Failed</td>
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<td>43</td>
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<td>44</td>
<td>Printhead - Command Port Invalid Response</td>
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<td>45</td>
<td>Printhead - Data Port Open Failed</td>
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<td>46</td>
<td>Printhead - Data Port Close Failed</td>
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<td>Printhead - Data Port Not Open</td>
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<td>Printhead - Data Port Timeout</td>
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<td>Printhead - Data Port Write Failed</td>
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<td>50</td>
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**PRINT FILE ERRORS**

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<td>1</td>
<td>Droplet Layer Generation Failed</td>
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<td>2</td>
<td>Invalid Print Pass Data</td>
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**FLUID ERRORS**

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<td>0</td>
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<tr>
<td>1</td>
<td>Binder Reservoir Refill Timeout</td>
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<tr>
<td>2</td>
<td>Meniscus Vacuum Regulation Timeout</td>
</tr>
<tr>
<td>3</td>
<td>Binder Fluid Container Empty</td>
</tr>
<tr>
<td>4</td>
<td>Cleaner Fluid Container Empty</td>
</tr>
<tr>
<td>5</td>
<td>Waste Fluid Container Full</td>
</tr>
<tr>
<td>6</td>
<td>System Air Pressure Low</td>
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9.2 Maintenance and Cleaning Schedule

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<th>Daily cleaning and maintenance</th>
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<tr>
<td><strong>Pre-Print</strong></td>
<td></td>
</tr>
<tr>
<td>☐ Clean Printer Cabinet</td>
<td></td>
</tr>
<tr>
<td>☐ Fill Binder Container</td>
<td></td>
</tr>
<tr>
<td>☐ Fill Cleaner Container</td>
<td></td>
</tr>
<tr>
<td>☐ Empty Waste Container</td>
<td></td>
</tr>
<tr>
<td>☐ Fill Powder Supply</td>
<td></td>
</tr>
<tr>
<td>☐ Clean Job Box Enclosure</td>
<td></td>
</tr>
<tr>
<td>☐ Clean Underside of Job Box</td>
<td></td>
</tr>
<tr>
<td>☐ Prime Recoater</td>
<td></td>
</tr>
<tr>
<td>☐ Verify Print Head Quality</td>
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</tr>
<tr>
<td><strong>Post-Print</strong></td>
<td></td>
</tr>
<tr>
<td>☐ Clean Work Area</td>
<td></td>
</tr>
<tr>
<td>☐ Clean Interior Powder Accumulation</td>
<td></td>
</tr>
<tr>
<td>☐ Clean Job Box</td>
<td></td>
</tr>
<tr>
<td>☐ Clean Depowdering station</td>
<td></td>
</tr>
<tr>
<td>☐ Wipe down Axes</td>
<td></td>
</tr>
</tbody>
</table>

**Daily Cleaning and Maintenance**

☐ Clean Recoater Blade/Roller
☐ Verify Capping Sponge Quality

**Weekly Cleaning and Maintenance**

☐ Clean Wiper Trough
☐ Clean Priming Area

**Monthly Cleaning and Maintenance**

☐ Conduct Drop Volume Test
☐ Clean Powder Recycler Sieve

**As-Needed Cleaning and Maintenance**

☐ Replace Job Box Felt
☐ Cup Test and Recoater Adjustment
☐ Clean Cabinet Fan Filters
9.3 Table of Spare Parts and Wear Parts

A table of spare parts and wear parts is available through The ExOne Company. Contact your service representative for an up-to-date table of spare parts and wear parts.
9.4 MSDS

MSDS corresponding to the materials provided with the Innovent® 3D Printing System are attached in the initial documentation package. Additional copies will be provided on request.

Use of materials other than those listed with the Innovent® 3D Printer may cause the Innovent® 3D Printing System to behave differently. Always follow safe material handling guidelines as stated by MSDS for the materials used. If in doubt about the safety of a material in the Innovent® 3D Printer, contact an ExOne® representative.
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