# USER MANUAL
# HTX TM-Sprayer™

Model: TMSP-M3 Rev. 19 - 2/2019

HTXImaging
by HTX Technologies, LLC

Note: For your own safety, read the manual and always observe the warnings and safety information on the device and in the manual.

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MANUFACTURER WARRANTY

HTXImaging
by HTX Technologies, LLC

Dear customer: Lab Name: HTX Invoice #

Thank you for your acquisition of an HTX Technologies instrument. This instrument was carefully designed and manufactured to perform advanced research work. We hope that you find it to be of value for your lab and we look forward to working with you again in the future.

Instrument type: HTX TM-Sprayer™ Model TMSP-M3 24V SNo._____

_____

_____

Installation date: _____

Training date: _____

Trainees: _____

Warranty end date: _____

Service Contract(*) Number:

(*) If you wish to protect this instrument beyond the initial warranty terms please send an e-mail to info@htximaging.com and request a quote.

To obtain tech support, please contact your local reseller or contact HTX Technologies directly at support@htximaging.com

| HTX Representative | Lab Representative |
|---|---|
| Name: | Name: |
| Signature: | Signature: |
| Date: | Date |

# INTENDED USE

Note: Only use the device for applications that fall within the range of the intended use. Otherwise, the protective and safety equipment of the device could fail.

## DEVICE OVERVIEW

Figure 1 Legend:

| | |
|---|---|
| 1 | Temperature Controller |
| 2 | Pressure Gauge |
| 3 | Low Pressure Warning |
| 4 | Switching Valve |
| 5 | Cartesian XY Stage |
| 6 | Spray Nozzle Head |
| 7 | Sample Tray Holder |

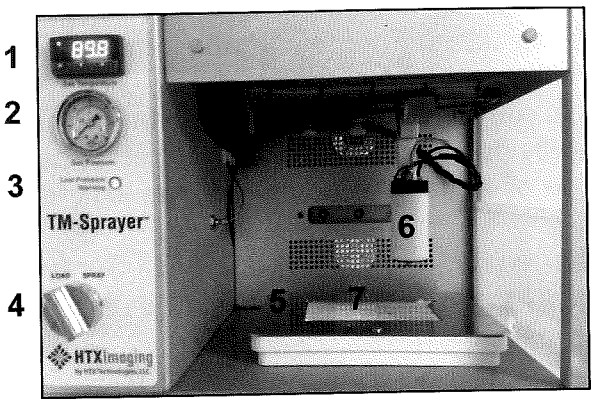



*Figure 1. Overview of TM-Sprayer*

## INTENDED USE

Note: Not for diagnostic use. This device is to be used for Research and Development (R&D) purposes only.

In R&D laboratories the device can be used in conjunction with a mass spectrometer in the following areas:

- Proteomics & Lipidomics
- Polymers and Additives Analysis
- Pharmacokinetics & Drug Discovery
- Forensic Science
- Food Analysis

## FEATURES

- Heated and pressurized spray nozzle head with a flow rate ranging from 0.005-0.500 mL/min, temperature up to 130°C, and pressure up to 2 bars (30 PSI)
- Auto-tuning PID Temperature controller with RTD temperature sensor
- Stainless steel valve and matrix loop; In-line 2-micron filter
- High precision Cartesian stage with movement velocity up to 1,350 mm/min
- Alternating vertical and horizontal spray patterns with adjustable offsets for optimum coverage
- Integrated enclosed chamber with exhaust fan and lights
- Open stage with removable sample tray holder for easy cleanup
- Low-pressure alarm and safety cut-off; High temperature safety cut-off
- Windows PC control with intuitive graphical user interface
- Ability to edit and save methods
- Highly reproducible and uniform deposition
- Small (<5 microns) and uniform spray droplets size

- Quantitative control of matrix amount per unit of surface
- Very fast sample preparation; Less than 12 minutes per slide
- High capacity; 5 glass slides (25 x 75mm) or 1 Micro Titer Plates (MTP)
- Easy spray nozzle head exchange
- Wet, dry and super-dry modes for extraction and delocalization control

Options: Connects to any isocratic or syringe pump via standard VICI 1/16" tubing connectors.

### ELUENTS

Only non-toxic and non-flammable solvent mixtures should be used in the instrument. All solvents should be degassed for 15 minutes prior to use. Check product MSDS and flammability before setting process temperature. Always use at least 30% water in solution to be sprayed. Matrix should be fully dissolved (sonication is recommended). Even small quantities of other substances, such as additives, modifiers, or salts can influence the durability of the materials.

## SCOPE OF DELIVERY

Note: Only use original parts and accessories made by HTX Technologies or a company authorized by HTX Technologies.

| Container | Part Description | Check |
|---|---|---|
| HTX Sprayer Box | TM-Sprayer Main Unit | ☐ |
| | Front Glass Panel | ☐ |
| Accessories Box | User Manual (English) | ☐ |
| Sub-Accessories Box # 1 | Spray Nozzle Head | ☐ |
| | 24V Power Supply | ☐ |
| | Power Cord | ☐ |
| | USB 2.0 Cords | ☐ |
| | Sample Tray Holder and Positioning Plate | ☐ |
| | Tubing kit and consumables | ☐ |
| | NE-300 Syringe Pump w/ Power Supply + 1mL SGE glass syringe (Optional) | ☐ |
| Sub-Accessories Box # 2 | Knauer P 4.1S Piston Pump | ☐ |
| Sub-Accessories Box # 3 | Windows PC | ☐ |

## SAFETY

Intended Users: This user manual is addressed to persons that have qualification as chemical-laboratory technicians or comparable vocational training.

The following knowledge is required:

- Knowledge of laboratory robotics and liquid handling

- Knowledge regarding substances that are suitable for use in sample preparation
- Knowledge regarding the health risks of chemicals

Note: If you do not meet these requirments, under no circumstances may you perform the work described in this user manual.

What must be taken into account?

- All safety instructions in the user manual
- The environmental, installation and connection specifications in the user manual
- National and international regulations pertaining to laboratory work
- Original spare parts, tools, and eluents made or recommended by HTX Technologies
- Good Laboratory Practice (GLP)
- Accident prevention regulations published by local governing bodies for laboratory work

Note: More safety-relevant information is listed in alphabetical order in the following table:

| Topic | Explanation |
|---|---|
| Decontamination | • Contamination of devices with toxic, infectious or radioactive substances poses a hazard for all persons during operation, repair, sale, and disposal of a device.<br>• All contaminated devices must be properly decontaminated.<br>• All materials or fluids used for decontamination must be collected separately and disposed of properly. |
| Flammability | • Organic eluents are highly flammable.<br>• Tubing and capillaries can detach from their screw fittings and allow eluent to escape.<br>• It is prohibited to have any open flames near the analytical system. |
| Lower Pressure and High Temperature Safety Alarm | • Pay attention to messages from the device or the control software. |
| Solvent Tray | • There is a risk of electrical shock or short circuit if liquids contact the power supply or the instrument's interior.<br>• For this reason, place all bottles in a solvent tray. |
| Eluent Lines | • In case of a leak, install tubing and hoses so that liquids cannot get into the interior of the instrument. |
| Power Strip | • If several devices are connected to one power strip, always consider the maximum power consumption of each device. |
| Power Cable | • Defective power cables should not to be used to connect the device to the main power supply. |
| Self-Ignition Point | • Only use eluents that have a self-ignition point higher than 300°C under normal ambient conditions. |
| Power Supply | • Only connect devices to voltage sources whose voltage equals the device's voltage. |
| Toxicity | • Organic solvents are toxic above a certain concentration.<br>• Ensure that work areas are always well ventilated.<br>• Wear protective gloves and safety glasses when working with the device. |

Where is use of the device prohibited?

- Never use the system in potentially explosive atmospheres without appropriate protective equipment.
- For further information, contact HTX Technologies, LLC.

Opening the device

- The device may only be opened by an engineer of HTX Technologies, LLC or of an authorized HTX Technologies, LLC distributor.

## DEFINITION OF PERSONAL AND MATERIAL DAMAGES

Possible dangers related to the device are distinguished as personal and material damages in this user manual.

| Type of Damage | Category | Explanation |
|---|---|---|
| Personal and Material Damages | DANGER! | Lethal or very serious injuries can occur. |
| | WARNING! | Serious injuries can occur. |
| | CAUTION! | Device defect can occur. |

## SYMBOLS AND SIGNS

| Type | Symbol | Meaning |
|---|---|---|
| CE Mark | CE | Device fulfills the requirements of the Conformité Européenne, which is confirmed by the Declaration of Conformity. |
| Warning Signs |  | Reader User Manual before using |
| |  | Caution: Hot! |
| |  | Wear protective gloves |

## HOT SURFACES

- Temperature controller indicates temperature of spray nozzle body (72.5°C as displayed in Figure 2a).
- CAUTION: It is unsafe to touch the spray nozzle body during movement or when temperature is above **40°C**.

- Both the spray nozzle body (anodized aluminum, red or clear) and the insulation sleeve (white Teflon) can become very hot during operation (see Figure 2b).

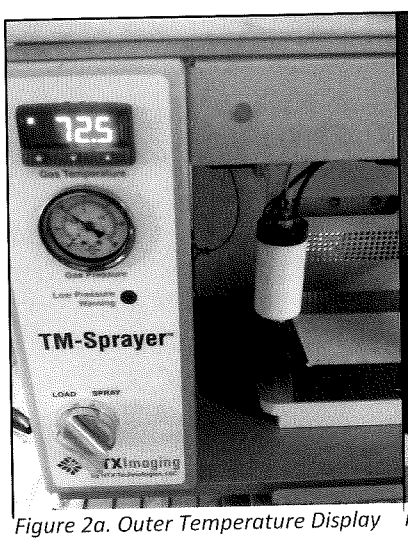



*Figure 2a. Outer Temperature Display*

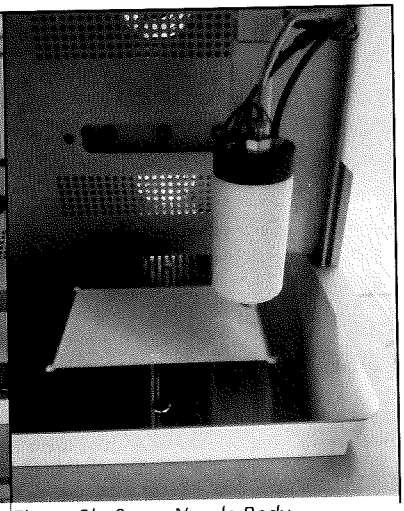


*Figure 2b. Spray Nozzle Body*

# UNPACKING AND SETUP

## CONTACTING THE TECHNICAL SUPPORT

You have various options to contact the technical support:

- Phone: +1-919-928-5688
- Fax: +1-919-928-5153
- Email: support@htximaging.com

## LOCATION REQUIREMENTS

Power supply:

- The device is only suitable for 24 V direct current.
- Only connect to the HTX supplied switching power supply.
- Keep power supply away from liquids.

Ventilation:

- The device should be installed inside a laboratory vented hood with proper ventilation and sufficient solvent extraction capability.
- If a laboratory vented hood is not available, an exhaust kit supplied by HTX can be ordered.

Specifications: The location for the device must meet the following requirements:

| Parameter | Measurement |
|---|---|
| Weight | 18 kg (40 lbs.) |
| Dimensions | 41 × 38 × 33 cm (16 x 15 x 13 inches)<br>(Width × Height × Depth) |
| Power Supply | 24 V DC. Only use with P/N SP131P924HR |
| USB Port | Safety Extra Low Voltage (SELV) |

| | |
|---|---|
| Air Humidity | < 60% |
| Temperature | 15-40°C (59-104°F) |
| Space | Side clearance to other devices: 10 cm (4 inches)<br>At least a 30 cm (12 inches) gap to the fan on the rear of the device |

## COMPONENTS

### Front and Rear Panel Components

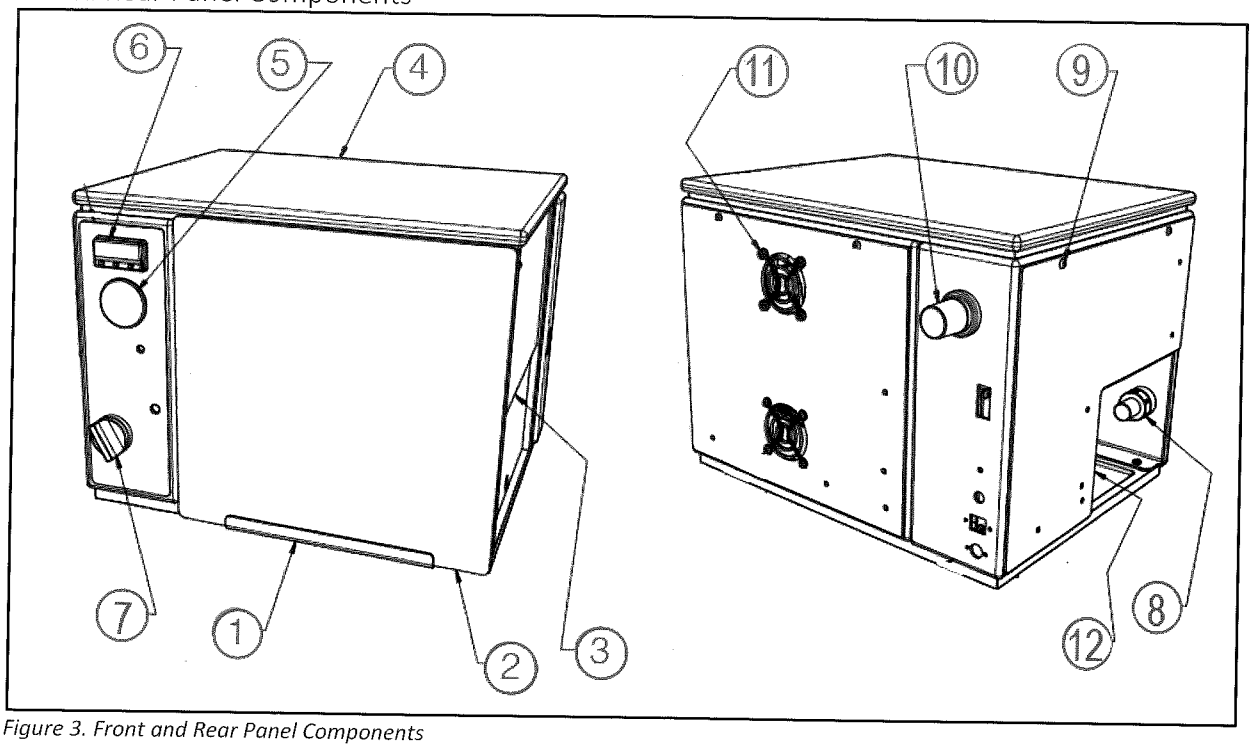



*Figure 3. Front and Rear Panel Components*

Figure 3 Legend:

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Glass shield bracket | 7 | Valve Knob |
| 2 | Glass Shield | 8 | Valve Body |
| 3 | PP shield sub-assembly | 9 | Side panel set screw |
| 4 | Top – Corian® synthetic marble | 10 | Air pressure regulator |
| 5 | Air pressure gauge | 11 | Vent Fan |
| 6 | Temperature Controller | 12 | Left panel insert for 6-port valve |

## INSTALLING THE SPRAY NOZZLE

Safety: Device should be turned off or disconnected before installing spray nozzle. Wear appropriate safety gear including safety glasses and gloves.

## Spray Nozzle Overview

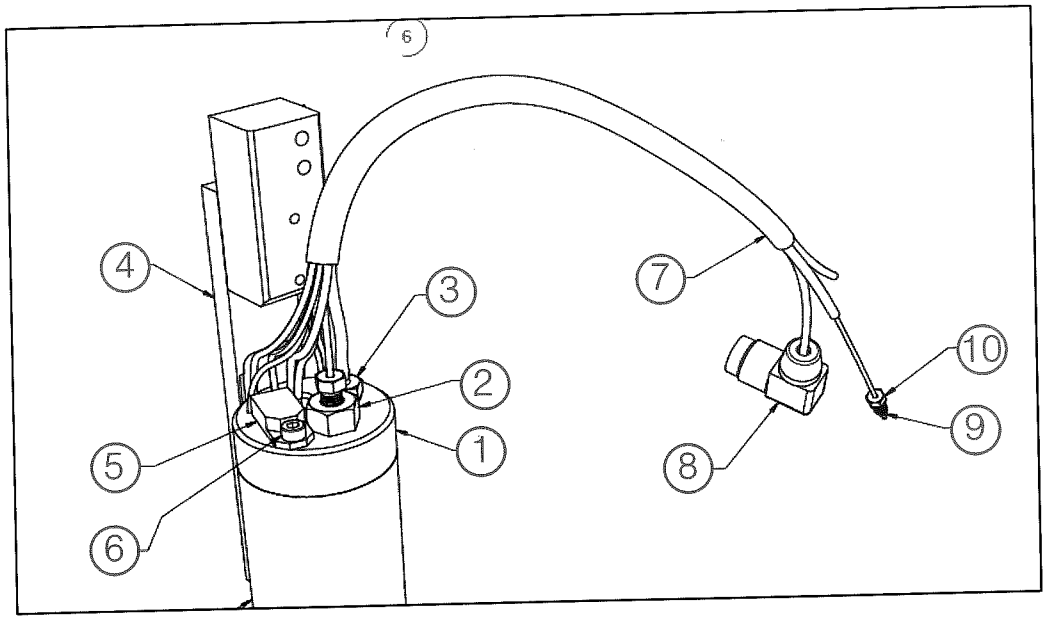



*Figure 4. Spray Nozzle Components*

Figure 4 Legend:

| Item | Description |
|---|---|
| 1 | Heated, red anodized core |
| 2 | Valco Bulkhead |
| 3 | Gas line |
| 4 | Teflon Bracket |
| 5 | Thermal Cutoff |
| 6 | Set screw for thermal cutoff |
| 7 | Spiral Wrap tubing |
| 8 | 5-pin electrical connection |
| 9 | Blue Peek tubing (fluid line) |
| 10 | Valco ferrule |

## Connecting the Spray Nozzle

1. Attach nozzle to bracket: Use the **2 knob screws** to secure **spray nozzle** to **Teflon bracket (4)**.
2. Connect power line: Connect **elbow connector (8)** to **5-pin connector** on left wall of spray chamber.
3. Connect liquid line: Connect **VALCO connector (10)** to bulkhead on partition wall.
4. Connect nitrogen line: Connect **1/8" (black) PUR tubing** to **quick connect fitting** on left wall of spray chamber.
5. Secure clips: Manually position nozzle in front/right corner of stage (device must be turned off). Secure **nozzle harness (7)** in place with **clips** mounted on back wall of spray chamber.

## INSTALLING THE SAMPLE HOLDER AND GLASS PANEL

- Sample Holder: Position sample holder in chamber. Use dowel pin to properly locate the holder. Place the positioning frame on top of sample holder.
- Glass Panel: Position the glass panel to close spray chamber. The bottom of the glass panel should be secured in bracket and at the top with magnets.

## CONNECTING THE DEVICE (REAR PANEL)

Power Supply:

- Position the 24V Power Supply on a dry surface and protected from liquid spills.
- Connect the power cord to 100V to 240V AC 47-63 Hz.
- The power cord should be inspected yearly for wear and replaced if necessary.
- Current draw 1.58-0.64A
- Connect 24V line to 5-pin connector on back of device.

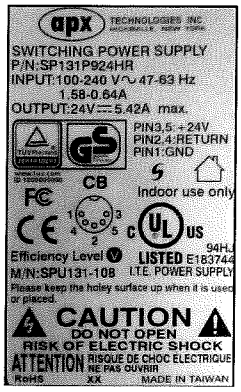



*Figure 5. Power Supply Specifications*

Nitrogen Line:

- Use provided 1/8 inch OD tubing to connect nitrogen gas line with stable pressure of 2 Bars (30 PSI) to quick connect on back of device.
- Alternatively, use the 6 mm to 1/8 inch connector if the user has a 6 mm connection to the N2 tank.
- One of these connections should have been prepared according to the site preparation documentation.

USB connection:

- Use either 1m (~3 feet) or 2 m (~6 feet) provided USB 2.0 cables.
- Only use with USB cable less than 3 meters (~9 feet) in length.
- Connect Windows PC USB port to device USB (SELV) port.

## CONNECTING THE VALVE

The device is equipped with a manual 2-position, 6-port VALCO valve.

- In the **LOAD** position flow from the pump will be conducted directly to the spray nozzle.
- In the **SPRAY** position, the flow from the pump will push the content of the matrix loop to the spray nozzle.
- Only use **VALCO connectors** suitable for **1/16" OD tubing** and HPLC applications.
- All tubing is **1/16" OD** unless specified otherwise.

Spray Nozzle Line:

- Connect **Port 5** of the valve to the bulkhead union on partition wall of device.
- 9 inch recommended length.
- ID 0.010" (Blue) or ID 0.020" (Orange) PEEK tubing.

Matrix Loop:

- Connect the matrix loop (available in 5mL, 10mL and 30mL) to **Port 3** and **Port 6**.

Waste Line:

- Connect waste line PFE tubing (Clear) from **Port 2** to **waste container**.
- Open end of waste line should be located above valve level to avoid syphoning.

Matrix line:

- Connect matrix line PFE tubing to **Port 1**.
- Connect **PEEK LUER lock fitting (Beige)** to open end to provide easy connection to matrix syringe.

Pump line:

- Connect the pump feed line tubing to **Port 4**.

Note: To provide proper pump function, a **500 PSI Back Pressure Regulator** is recommended on the pump line PEEK tubing between the **pump outlet** and **Port 4**.

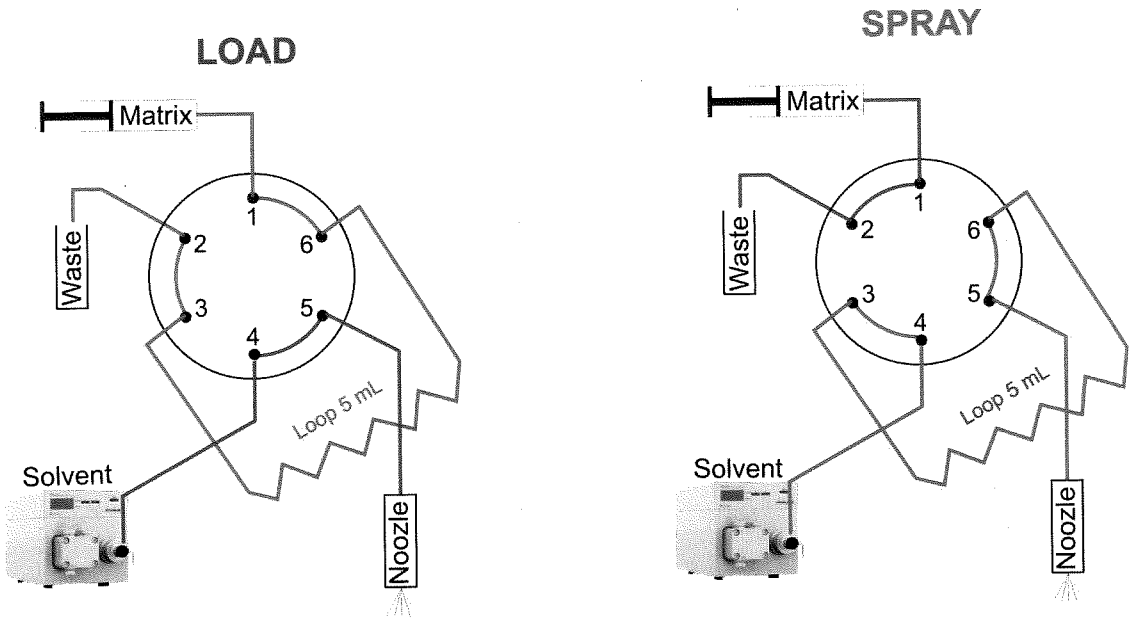



*Figure 6. 6-Port Valve Configuration*

# DAILY WORKFLOW OVERVIEW

Note: The following instructions apply to an installed system that has been recently used, where the solvent pump does not need priming and the loop is already filled with clean solvent.

START-UP

- Turn on the Knauer Pump. Turn on TM-Sprayer unit. Set valve to LOAD position.
- Launch TM-Sprayer Software.
- **IMPORTANT: Check that exhaust fan is operational. Do not start solvent pump if proper active venting is not functioning.**
- Start solvent pump at 0.100mL/min. Backpressure should be normal. ~ 500 psi (3.4 MPa).
- Start compressed air flow to TM-Sprayer. Set at 10 psi (70kPa).
- Adjust operating temperature per solvent mixture. Follow safety instructions.
- **SOLVENT MIXTURE SHOULD CONTAIN 30% WATER MINIMUM**
- Prepare Matrix solution. Typical concentration is 5mg/ml.
- With valve in LOAD position, use a syringe to fill loop with matrix. 20% overfill is recommended. E.g. Use the provided 6mL syringe to fill 5mL loop.

SAMPLE PREPARATION

- Bring MALDI plate with affixed sample(s) from storage.
- Check that flow rate and temperature are correct and stable.
- Review sample position and define spraying area in TM-Sprayer software.
- Select Method by clicking on left column. Current Method field will confirm selection.
- Press START. Option changes to CONTINUE. Follow STATUS tab for prompts.
- When prompted, switch valve to Spray and confirm by clicking Continue.
- Software will automatically delay start to allow purging of liquid lines.
- At end of run spray nozzle goes to Waste position.
- Follow end of run prompts. Software will keep track of usage and remaining matrix volume.

PAUSE MODE

- At end of sample prep sequence with valve switched back to LOAD.
- IMPORTANT: Keep pump flow on so that clean solvent flows to nozzle and prevents matrix residues from crystallizing and clogging the capillary and spray nozzle.
- Spray at 0.200mL/min for 10 minutes, then at 0.010mL/min until ready to resume.
- To resume, start from SAMPLE PREPARATION sequence above.

SHUT DOWN

- Switch valve back to LOAD position. Set pump flow rate at 0.500mL/min.
- Set Temperature to 30°C to start cool down.
- Fill syringe with 5-6 mL of clean solvent and flush loop completely. Repeat 3 times.
- Toggle valve to wash matrix residue. Leave valve in Load position.
- **Keep airflow and pump flow on until temperature is below 50°C. This is important to prevent clogging.**
- Turn N2 flow off (droplet will form at nozzle tip).
- Stop Pump flow or leave at very low flow rate (e.g.: 0.010ml/min).
- Exit TMSP Software.
- Power OFF TM-Sprayer. Power OFF Pump (or leave running at very low flow rate).

# SOFTWARE CONTROL

## TM SPRAYER CONTROL SOFTWARE 4.1

### STARTUP SCREEN

- Double click on TMSP icon to launch application.
- Screen loads and displays available spray area in center, process controls on right and left side, and method list at the bottom of the screen.

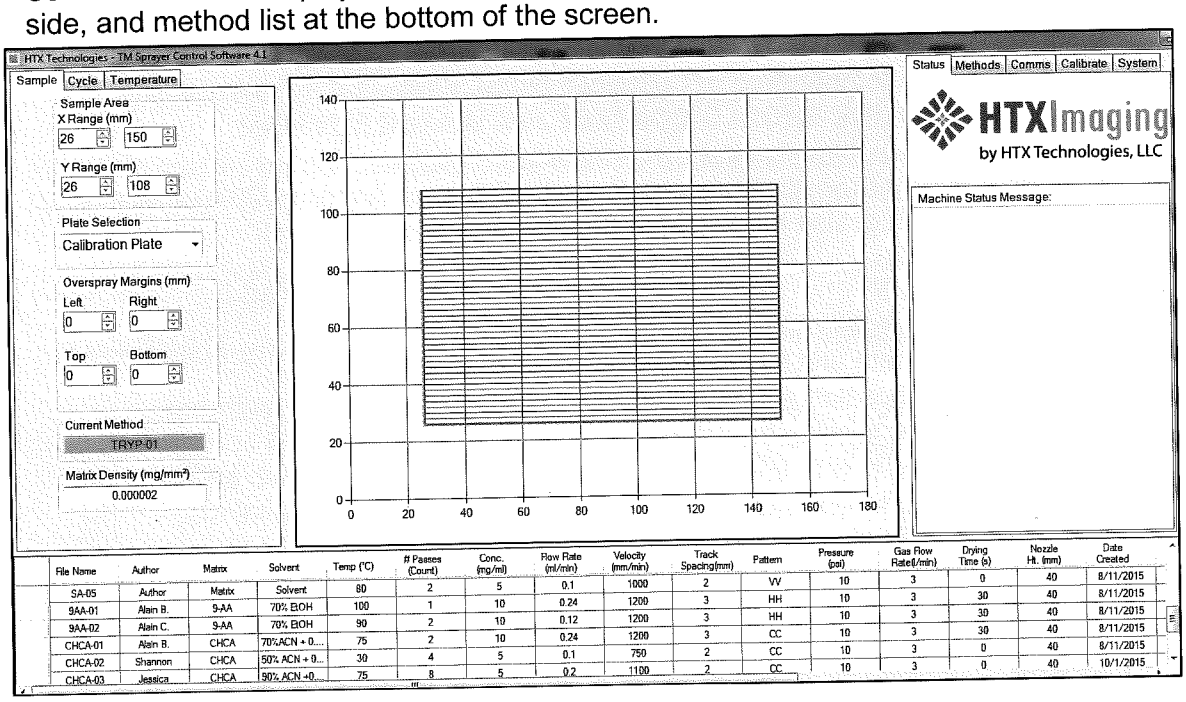



*Figure 7. Sample tab in TM-Sprayer software interface*

## DEFINITIONS

*Cycle*

- A Cycle represents the combination of a **Sample Area**, augmented by the **Overspray Margins**, and a **Method**.

*Sample Area*

- The Sample Area is defined in the SAMPLE TAB by the **X Range** and **Y Range** of the sample. Set the lower and upper value of the X and Y ranges to match the coordinates of the edges of the sample.

*Plate*

- When choosing a predefined Plate (Plate Selection drop down menu) the X Range and Y Range default to the full Plate coordinates. The expected location of the plate is displayed on the desktop.

### *Overspray Margins*

- The average spray diameter is 8mm and a default overspray of 10mm in all four directions is applied to all plates except for the MTP format and the Entire Surface. Overspray Margins can be adjusted from 0 to 10mm.

### *Sample Area Adjustments*

- If the physical sample is a lot smaller than the sample plate, it makes sense to adjust down the Sample Area. This is done by modifying the X and Y value of the Sample Area range.

  Example: In Figure 3, the user has selected the "Std Glass Slide" from the plate selection menu, adjusted the X Range upper value down from 150mm (right edge of Std Glass Slide) to 100mm, and reduced the Top and Bottom Overspray Margins from the default 10mm to 5mm.

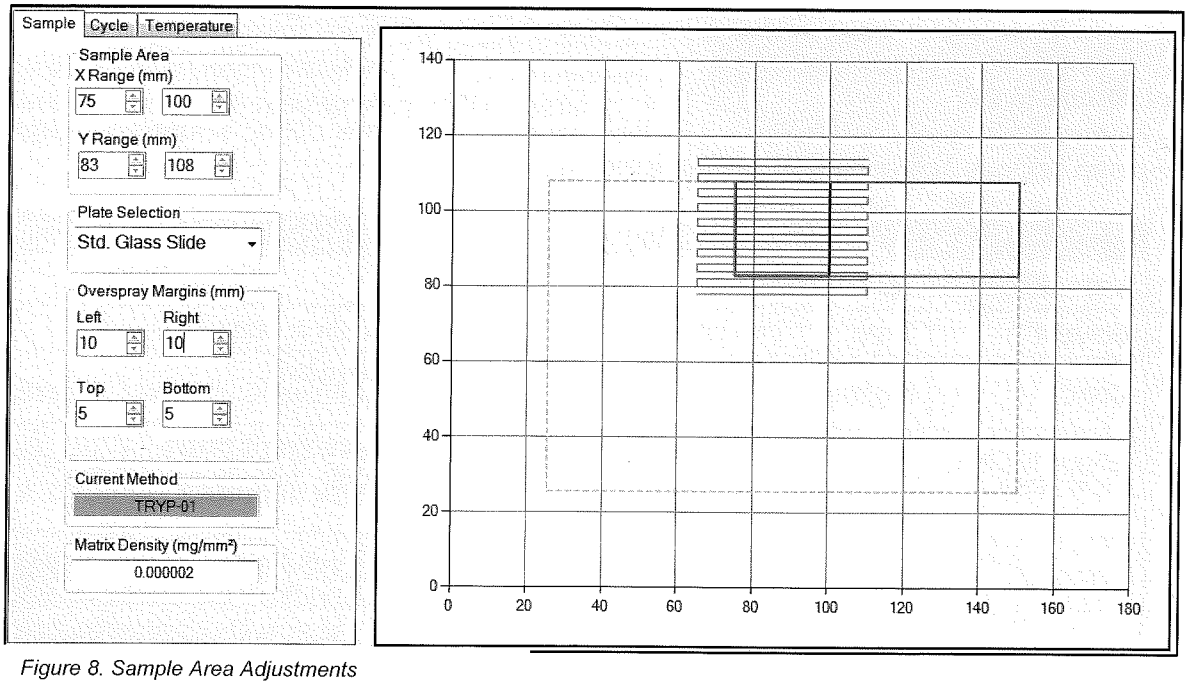



*Figure 8. Sample Area Adjustments*

### *Method*

- A Method contains all the parameters related to spray conditions, as well as extra fields for author, date created, and user comments.
- Some parameters are communicated automatically to the system via software control while others must be set manually by the user.
- Methods can be adjusted, duplicated or deleted via the options of the "Method" tab.
- The Methods.xml file (located at C:\TMSprayer\Data) can also be modified in Notepad or Excel.
  - This is an advanced setting, which is not needed during normal operation.

### *Track*

- A Track represents a straight-line segment covered by the spray nozzle.
- Tracks can be either vertical or horizontal.

### *Pass*

- A Pass represents one complete layer and is comprised of a series of parallel tracks, spaced evenly.
- The distance between two consecutive parallel tracks is called Track Spacing.

*Automatic Parameters*

- Automatic Parameters are communicated by the software to the TM-Sprayer unit when a method is selected.

| Parameter | Unit | Description |
|---|---|---|
| Temperature | °C | Sets the temperature of the spray nozzle heater |
| # Passes | Count | Sets the number of passes (i.e. layers of matrix) |
| Velocity | mm/min | Sets the linear speed of the nozzle while spraying |
| Track Spacing | mm | Sets the distance between tracks within a pass |
| Pattern | Type | Sets the rotation and offset pattern between passes |
| Drying Time | seconds | Sets the wait time at the home position between passes |

*Manual Parameters*

- Manual Parameters need to be set by the user manually, either during solution preparation, pump settings or mechanical setting of the instrument.

| Parameter | Unit | Description |
|---|---|---|
| Matrix | Type | Indicates the matrix type |
| Solvent | Type | Indicates the solvent in which matrix is dissolved |
| Conc. | mg/mL | Indicates the concentration of the matrix.<br>Used to calculate matrix density |
| Flow Rate | mL/min | Indicates the flow rate of the push solvent pump<br>User needs to set flow rate manually from pump control panel |
| Pressure | psi | Indicates the flow rate as measured by front pressure gauge |
| Nozzle Height | mm | Indicates the distance from the tip of the nozzle to the surface of the sample. By default, nozzle height is set to 40 mm when using standard polypro riser.<br>Can be adjusted to 65 mm by removing the polypro riser. |

*Informational Parameters*

- These parameters have no effect on the method but provide a helpful record locator.

| Parameter | Type | Description |
|---|---|---|
| File Name | Text | If name contains "HTX," the method cannot be edited.<br>Make a copy to duplicate and modify |
| Author | Text | User name or original author |
| Date Created | Date | Date when method was created |
| Comment 1 | Text | Free format |
| Comment 2 | Text | Free format |
| Comment 3 | Text | Free format |

Follow these simple steps to start a method, then follow the prompts on the status tab for further guidance.

**Step 1.** Select plate, adjust spray area.

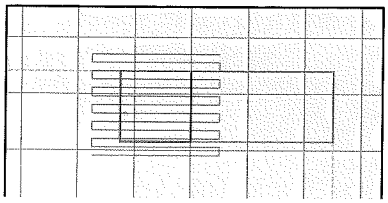


*Figure 9. Step 1*

**Step 2**. Select a Method by clicking on column to the left of that method. An arrow (triangle shape pointing right) confirms which method is selected and its File Name now appears in the Current Method field.

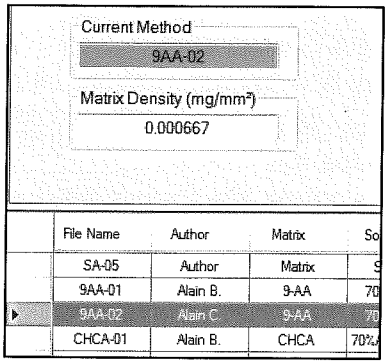



*Figure 10. Step 2*

**Step 3**. Manually adjust flow rate on pump per Method parameters.

**Step 4**. Switch valve to LOAD position. Load matrix in loop with syringe. Adjust Matrix Volume in Cycle tab if different than the full loop volume value.

**Step 5**. In the Cycle tab, click START. This will communicate the method temperature to the unit, and activate the Status tab dialog prompts.

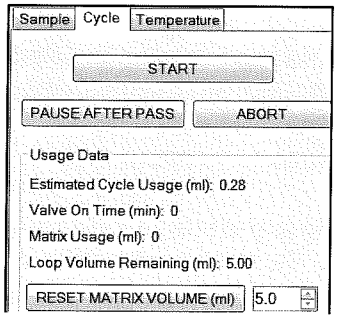



*Figure 11. Step 5*

**Step 6**. When prompted, switch the valve to SPRAY and click CONTINUE. Unit will delay start to allow full purge of the delay volume between valve and nozzle tip.

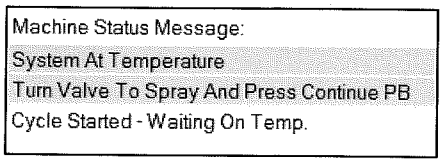



*Figure 12. Step 6*

## END OF CYCLE

- At the end of the Cycle the spray nozzle will park to the Waste Position. Interface will prompt user to switch valve to LOAD. This action stops the matrix usage, preserved the unused matrix inside the loop and lets clean solvent flow to the nozzle.

- Once user acknowledges switching the valve back to LOAD, the unit is ready for the next cycle.

Note: The interface (Cycle Tab) keeps track of matrix usage and volume left in the loop. If the volume remaining is insufficient for the next Cycle, and error prompt will be displayed.

## PAUSE AFTER PASS AND ABORT

### *Pause After Pass*

- **Pause** lets the user interrupt a run at the end of a completed pass, and provides the option to resume the run.
- During a pause, the spray nozzle waits at the Home position.

### *Abort*

- The **Abort** button is available when the instrument is running a method. It can be pressed when the system is running normally or when in a **Paused** state.
- When aborting a method, the spray nozzle will move to the Waste position

## TABS, SCREEN ELEMENTS AND CALCULATIONS

### *Sample Tab*

- The sample tab contains the Plate selection tool, and the dimension adjustment options.
- The sample tab also displays the Current Method and the Matrix Density.

$$Matrix\ Density = \frac{\#\ of\ Passes\ .Flow\ Rate\ .Conc.}{Velocity\ .Track\ Spacing}$$

### *Cycle Tab*

- The Cycle Tab is where the user starts, pauses, aborts and confirms completion of a Cycle.
- It also provides usage data, timers and reading of the actual temperature of the spray nozzle.

### *Usage Data*

- Usage data estimates the matrix needed to complete a given cycle. If the matrix in the loop is not sufficient a message will prompt the user to address the situation

### *Valve On Time*

- Valve On Time tracks the time the valve is in the SPRAY position.
- The time counter starts when the user clicks "Continue" after switching the valve, and strops when the user clicks "Confirm Valve Switch back to LOAD"

*Matrix Usage*

- Matrix Usage represents the volume of matrix pushed out of the loop since the beginning of the cycle.

$$Matrix\ Usage = Valve\ On\ Time\ .\ Flow\ Rate$$

*Loop Volume Remaining*

$$Loop\ Volume\ Remaining = Loop\ Volume - Matrix\ Usage$$

*Delay Timer*

- The delay timer allows for the wash solvent present in the liquid line from the valve to the tip of the nozzle to be purged to Waste before the spray nozzles moves over the sample area.

$$Delay\ Time = \frac{Delay\ Volume}{Flow\ Rate}$$

  - The Delay Volume is set to 0.047ml in the system tab. It is calculated based on 24 inch of 0.010" ID (Blue) PEEK tubing connected between the valve and the nozzle.
  - If using different length or ID of tubing, one needs to adjust the value in System.xml located at C:\TMSprayer\Data.

*Wait Time*

- The Wait Time is set as a method parameter and the counter starts when the spray nozzle returns to the home position at the end of each pass.

*Temperature Tab*

- The Temperature Set Point Adjustment lets the user overwrite the temperature set point before or during a cycle.
- This is useful to let the spray nozzle warm up before starting a cycle, or to correct the temperature during a cycle without aborting that cycle.
- **IMPORTANT NOTE**: Changing the Temperature Set Point prior to starting a cycle will NOT change the method. Upon starting the cycle method, the method set point will be used. HOWEVER, if the user changes the set point during a pass, the set point for the remainder of that cycle will be changed.

*Status Tab*

- Status prompts help guide the user through the manual steps of a cycle (no text highlight), as well as provide notices (yellow text highlight) or warnings (red text highlight).
- The latest prompt is at the top of the message window.

*Methods*

- Save Methods will save all the methods in the methods.xml table.
- This action will overwrite previously saved method parameters unless the method name contains the text "HTX".
- Add Method will add a new method to the methods.xml table.

*Comm*

- Communication ports are set during installation and memorized.
- The default ports are HEATER CONTROL = COM 5, STEPPER CONTROL = COM 6.
- If default values are not accepted, check Device Manager/Ports (COM and LPT) to identify correct port allocation.

*Calibrate*

- Calibration is recommended at installation and each time the nozzle is exchanged.
- Calibration password is "HTX2015".
- Calibration adjustments are usually between 0 and 3 mm and allow the exact alignment of the spray nozzle with a reference home position on the plate holder.
- On earlier models, users will need to mark the home reference position which is located 25mm to the right and 25 mm above the edges of the stainless-steel frame in the lower left hand corner of the frame.

*System*

- The system values are meant to be permanent and can only be adjusted by modifying the file system.xml in a text editor.

## SPRAY PATTERN DESIGN

Spray Patterns describe how the spray nozzle travels over the sample and can have an important effect on the uniformity of the matrix layer. The spray pattern can also influence the speed of drying of the solution if the spray nozzles is allowed to come back on a previously sprayed area sooner (wetter deposition) or later (drier deposition).

Patterns are preprogrammed and during a cycle a unit will automatically rotate and off-set the spray based on the value set for the **Pattern** and **Track Spacing** parameters.

### *Available Patterns*

1. Criss-Cross (CC)
    a. Spray will alternate between Vertical and Horizontal tracks, with offsets equal to ½ track spacing
    b. CC sequence = Pass 1, Pass 2, Pass 3, Pass 4, Pass 1, etc…

2. Vertical/Vertical (VV)
    a. Spray will only follow vertical tracks, and offset every other track by ½ track spacing
    b. VV sequence = Pass 1, Pass 3, Pass 1, etc…

3. Horizontal/Horizontal (HH)
    a. Spray will only follow horizontal tracks, and offset every other track by ½ track spacing
    b. HH sequence = Pass 2, Pass 4, Pass 2, etc…

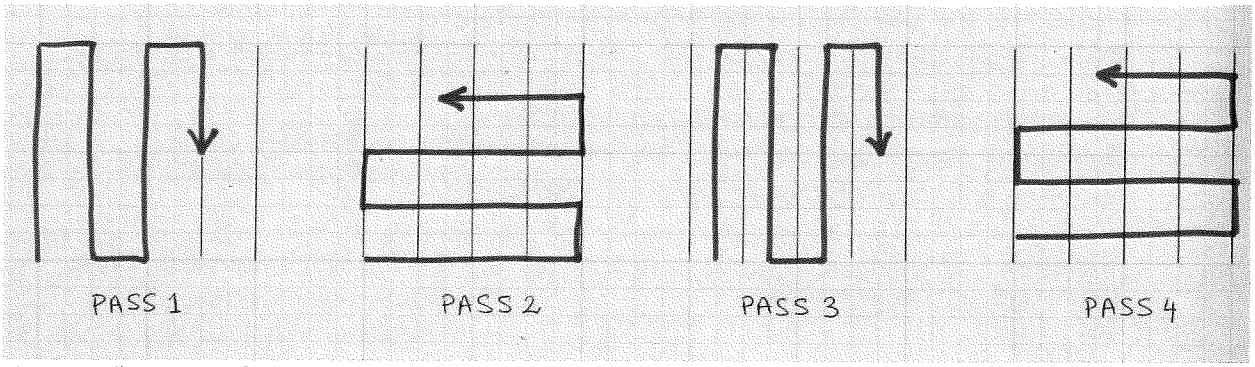



*Figure 13. Illustrations of Passes*

# MAINTENANCE AND CARE

Proper maintenance of your HTX device will ensure successful sample preparation and reproducible results.

## CONTACTING TECHNICAL SUPPORT

If you have any technical questions regarding the hardware or software of the manufacturer, please use one of the contact options below:

1. Technical Support Hotline:
    a. Phone: +1 919-928-5688 (Available by telephone: 9 am-5 pm EST)
    b. Fax: + 1 919-928-5153□
2. E-mail contact: support@htximaging.com

Note: Technical Support is only provided in English.

## MAINTENANCE CONTRACT

The following maintenance work on the device may only be performed by HTX Technologies, LLC or a company authorized by HTX Technologies, LLC and is covered by a separate maintenance contract:

- Opening the device or removing housing parts.

Users may perform the following maintenance tasks themselves:

- Replacing the spray nozzle head with new or refurbished spray nozzle supplied by HTX
- Replacing the filter in VALCO bulkhead
- Replacing solvent lines
- Removing and cleaning the sample tray holder

WARNING: Aggressive or toxic solvent residue can irritate skin! Wear protective gloves.

## RELEVANT SERVICE NOTES FOR TM-SPRAYER MAINTENANCE

1. HTX SN-005: Changing the HTX Spray Nozzle
2. HTX SN-006: Changing the HTX Interface Board
3. HTX SN-008: Changing the Filter in the VALCO Bulkhead
4. HTX SN-010: Cleaning and Replacing the C6W Valve Rotor
5. HTX SN-011: Configuring the Solvent Line for the TM and M5 Sprayer

# TROUBLESHOOTING

## QUICK FIXES

- Check all screw fittings
- Check whether air has gotten into the supply lines
- Check device for leaks

## PERSISTENT PROBLEM

- Check errors against error list
- Contact the technical support of HTX Technologies

## Error List and Solutions

| Problem | Solution/Relevant HTX Service Notes |
|---|---|
| Device will not turn on | Power cable needs to be connected to power supply and power adapter has to be turned on.<br><br>Inspect the power cable to ensure that it is plugged into the power supply. |
| Device not communication with nozzle, pump, or tray | HTX SN-009: Communication Port Troubleshooting |
| Pump does not transport solvent | HTX SN-001: Connecting the Knauer Pump<br>HTX SN-008: Changing the Filter on the VALCO Bulkhead |
| Knauer Pump pressure or flow rate fluctuations | HTX SN-002: High Pressure Reading Troubleshooting<br>HTX SN-004: Low (or Oscillating) Pressure Reading Troubleshooting |
| Nozzle or Tray Temperature is oscillating/not accurate | HTX SN-013: CAL3300 Controller Tuning |

## TECHNICAL DATA

| Component | Details |
|---|---|
| System | • Heated / Pressurized Spray Nozzle<br>• Linear actuator on XY Stage |
| Solvent Flow | • Flow Rate Range: 0.005-0.500 mL/min<br>• Back Pressure: 500 psi |
| Nitrogen Gas Inlet Pressure | • 8-30 psi |
| Operation | • PC Control via USB<br>• Manual valve on the device |
| Power Supply | • 24V, 3.14 VA |
| Active Power Consumption | • Maximum 75 W |
| Weight | • 18 Kg (40 lbs.) |
| Dimensions (Width x Height x Depth) | • 41 x 38 x 33 cm (16 x 15 x 13 inches) |

## ACCESSORIES AND SPARE PARTS

| Part Name | Supplier | Part Number |
|---|---|---|
| Spray Nozzle Head (24V) | HTX | HTX.TMSP.MT50xx |
| Annual PM kit | HTX | HTX.TMSP.PMKit1 |
| Tubing replacement kit | HTX | HTX.TMSP.PMKit2 |
| Tray holder w/ pos. frame | HTX | HTX.TMSP.TH01 |
| 6 Port valve | VICI | C6W |
| 5 ml loop | VICI | SL5KCW |
| 10 ml loop | VICI | SL10KCW |
| 30 ml loop | HTX | VICI.SL30KCW |
| 2 micron filters (bag of 10) | VICI | 2SR2-10 |
| Luer lock assembly (male and female) | IDEX | F-120 and P-659 |
| 500 PSI Back Pressure Regulator | IDEX | P-789 |
| 5ML Norm-Ject® Syringe (HSW) | SIGMA-ALDRICHT | Z248010-1PAK |

# LEGAL INFORMATION

## WARRANTY CONDITIONS

The factory warranty for the device is valid for 12 months after the date of dispatch. All warranty claims shall expire in the event that any unauthorized changes are made to the device.

During the warranty period, any components with material or design-related defects will be replaced or repaired by the manufacturer free of charge.

This warranty excludes the following:

1. Accidental or willful damage
2. Damage or errors caused by third parties that are not contractually related to the manufacturer at the time the damage occurs
3. Wear on parts including tubing, fittings and filters
4. Damage caused by negligence or improper operation of the device and damage caused by clogged capillaries
5. Packaging and transport damage

In the event of device malfunctions, directly contact the manufacturer.

## MANUFACTURER

HTX Technologies, LLC
PO Box 16007
Chapel Hill, North Carolina 27516
USA
Phone: +1-919-928-5688
Fax: +1-919-928-5153
E-Mail: info@htximaging.com
Internet: www.htximaging.com

## TRANSPORTATION DAMAGES

The packaging of our devices provides the best possible protection against transportation damage. Check the devices for signs of transportation damages. In case you notice any damage, contact the technical support and the forwarder company within three workdays.

# DISPOSAL

Drop-off old devices only at certified waste facilities, where they will be disposed of properly.

Last Revised January 2019.

# APPENDIX

## TM-SPRAYER CONTROL SOFTWARE 4.1 INSTALLATION STEPS

### For Current TMSP CS 3.1 Users

If you have been using version 3.1, you do not need to un-install it. Both versions can co-exist on the same Windows PC.

Instructions:

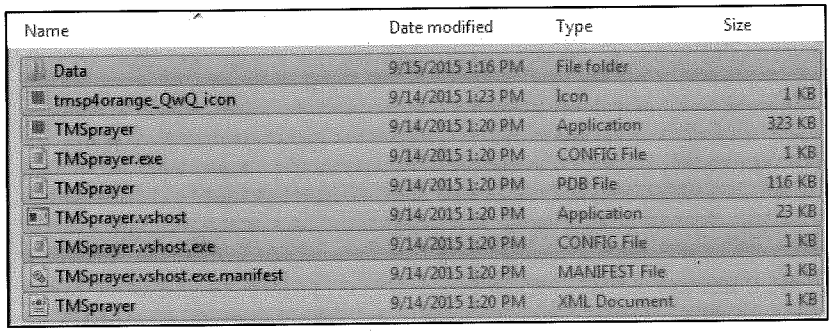
1. Close version 3.1.
2. Power OFF TM-Sprayer.
3. POWER ON TM-Sprayer (needed to free-up the COM ports).
4. Proceed with 4.0 installation

### For New TM Sprayer Users

Instructions:

1. Install the software files:
   a. Locate on install medium the folder named "TMSprayer".
   b. Copy the complete folder and paste directly onto the C: drive.
   c. Check that the location of the Data folder is exactly C:\TMSprayer\Data as pictured in Figure 13.
   d. Check that within the TMSprayer folder the files are as pictured in Figure 14.

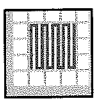

*Figure 14. Software Folder Location*



| Name | Date modified | Type | Size |
|---|---|---|---|
| Data | 9/15/2015 1:16 PM | File folder | |
| tmsp4orange_QwQ_icon | 9/14/2015 1:23 PM | Icon | 1 KB |
| TMSprayer | 9/14/2015 1:20 PM | Application | 323 KB |
| TMSprayer.exe | 9/14/2015 1:20 PM | CONFIG File | 1 KB |
| TMSprayer | 9/14/2015 1:20 PM | PDB File | 116 KB |
| TMSprayer.vshost | 9/14/2015 1:20 PM | Application | 23 KB |
| TMSprayer.vshost.exe | 9/14/2015 1:20 PM | CONFIG File | 1 KB |
| TMSprayer.vshost.exe.manifest | 9/14/2015 1:20 PM | MANIFEST File | 1 KB |
| TMSprayer | 9/14/2015 1:20 PM | XML Document | 1 KB |

*Figure 15. Content of TMSprayer Folder*

2. Launch the Application:
   a. Select the Application TMSprayer
   b. Create a shortcut of that file onto the desktop.
   c. This will be the icon you click to launch the application:



3. Configure the software:
   a. Double click on the application icon and launch the software.
   b. If a communication error pops you will need to configure the COM ports. The TM-Sprayer unit creates two virtual serial ports on the PC. The first one

enables Heater Control Communication and is by default configured, and the other is Stepper Motor Communication.

c. Note: On a brand new Windows PC the ports created are numbered 3 and 4, and correspond respectively to Heater Control (COM3) and Stepper Motor (COM4).
d. If 3 and 4 are not the correct ports, open the Device Manager under My Computer/Properties and check what Ports have been created under Ports. The first one will be the Heater Control, the second one the Stepper Motor (Figure 15).
e. If the port #s are correct but connection still fails, close the software, turn the TM-Sprayer OFF and then back ON to free-up the ports. Launch software again.
f. When you successfully attempt connection the button will turn green, confirming that communication is established.

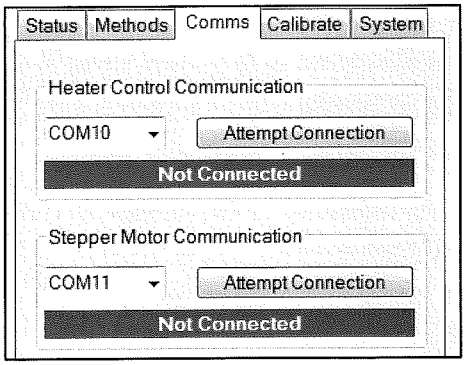



*Figure 16. Communication Ports for TM Sprayer*

## Quick Start Instructions

A. Turn on Pump
   1. Plug in the pump.
   2. Press the power switch to turn on power.
   3. Press any key to stop the display from blinking.

B. Setup Pumping Parameters
   1. To Change Numbers:
      i. Press the up-arrow keys ↑ to increment the digit above each key.
      ii. Move the decimal point: Simultaneously press the 2 up-arrow keys under the 2 digits next to the decimal point position to set or clear it. Or, press and hold the left-most up-arrow key for at least 1 second. When the digit increments from 9 to 0, the decimal point will begin to shift. Release the key when the decimal point is correct.
      iii. Press any non-arrow key, or wait 2 seconds, to enter the new setting. The display will blink when a valid new value is entered and stored in memory.

   2. Set the Syringe Inside Diameter:
      i. Momentarily press the [Diameter] key.
      ii. Set the inside diameter of the syringe in millimeters (mm). See syringe inside diameter reference chart on page 35.

   3. Set the Pumping Rate:
      i. Momentarily press the [Rate] key.
      ii. To change the pumping rate units:
         1. Momentarily press the [Rate] key again. The display will show: [UnIt S]
         2. While the units are blinking, press any up-arrow key to select the next available rate units.
         3. Press any non-arrow key, or wait 2 seconds, to set the rate units.
      iii. Set the pumping rate. If the pumping rate is out of range, the display will show: [□□r]

   4. Load the Syringe
      i. Press in the white drive-nut button to move the pusher block.
      ii. Lift and turn the syringe clamp away from the syringe holder block.
      iii. Position the syringe on the pump with the flange to the left of the syringe holder block.
      iv. Lift and turn the syringe clamp onto the syringe barrel.
      v. Move the pusher block next to the syringe plunger.

   5. Syringe Purge / Priming
      i. Press and hold the [Start/Stop] key for one second. Release the key to stop. The display will show [PUr G] while infusing at the top speed.
      ii. Press and hold the [→←] key to reverse the pump and release the pusher block if jammed.

   6. Start the Pump
      i. Momentarily press the [Start/Stop] key to start or stop the pump.

   7. While Pumping
      i. The pumping rate can be changed.

C. Pump Reset:
   1. Press and hold the right-most up-arrow key while turning on power to the pump.

## NE-300 Pump Specifications

| **Mechanical & Electrical** | |
|---|---|
| Syringe sizes: | Up to 60 mL. 140 mL partially filled. |
| Number of syringes: | 1 |
| Motor type: | Step motor |
| Motor steps per revolution: | 400 |
| Micro-stepping: | 1/8 to 1/2 depending on motor speed |
| Advance per step: | 0.2126 µm to 0.8504 µm depending on motor speed |
| Motor to drive screw ratio: | 15/28 |
| Drive screw pitch: | 20 revolutions/" |
| Power connector: | 2.1 mm, center positive, DC |
| Voltage at power connector: | 12V DC |
| Amperage: | 750 mA maximum |
| Power supply type: | External wall adapter, country and power source specific |
| Power supply output rating: | 12V DC, 1000 mA regulated |
| Dimensions: | 8 3/4" x 5 3/4" x 4 1/2"<br>(22.86 cm x 14.605 cm x 11.43 cm) (L x W x H) |
| **Operational** | |
| Accuracy | Within +/- 1% over length of syringe, exclusive of syringe variations. |
| Reproducibility | +/- 0.1% |
| Maximum speed: | 3.7742 cm/min |
| Minimum speed: | 0.004205 cm/hr |
| Maximum pumping rate: | 1257 mL/hr with a B-D 60 mL |
| Minimum pumping rate: | 0.73 µL /hr with a B-D 1 mL syringe |
| Maximum force: | 35 lbs. at minimum speed, 18 lbs. at maximum speed |
| Syringe inside diameter range: | 0.100 50.00 mm |

### HSW Norm-Ject Syringe Diameters and Rate Limits

| Syringe (mL) | Inside Diameter (mm) | Max Rate (mL/hr) | Min Rate (µL/hr) | Max Rate (mL/min) |
|---|---|---|---|---|
| 5 | 12.45 | 275.6 | 5.119 | 4.594 |

### SGE (gas tight) Syringe Diameters and Rate Limits

| Syringe (µL) | Inside Diameter (mm) | Maximum Rate (µL/hr) | Minmum Rate (µL/hr) |
|---|---|---|---|
| 5 | 0.343 | 209.2 | 0.004 |
| 10 | 0.485 | 418.3 | 0.008 |
| 25 | 0.728 | 942.5 | 0.018 |
| 50 | 1.03 | 1886 | 0.036 |
| 100 | 1.457 | 3775 | 0.071 |
| **Syringe (mL)** | **Inside Diameter (mm)** | **Maximum Rate (mL/hr)** | **Minimum Rate (µL/hr)** |
| 0.25 | 2.303 | 9.432 | 0.176 |
| 0.5 | 3.257 | 18.86 | 0.351 |
| 1 | 4.606 | 37.73 | 0.701 |
| 2.5 | 7.284 | 94.36 | 1.752 |
| 5 | 10.3 | 188.6 | 3.504 |
| 10 | 14.57 | 377.5 | 7.01 |

*Note to installer:*

Trypsin Digest Kit is typically supplied with an SGE 1mL Syringe, ID = 4.606 mm
The SGE 10mL Syringe, ID = 14.570 mm, is typically used when the NE-300 pump is set-up as a back-up solvent pump.

# DECLARATION OF CONFORMITY

**Manufacturer name and address**

HTX Technologies, LLC
PO Box 16007
Chapel Hill, North Carolina 27516
USA

**Type of Equipment**
Laboratory Equipment

**Product Description**
HTX TM-Sprayer

**Model No.**
Model TMSP-M3

The device complies with the following requirements and product specifications:

Low Voltage Directive (LVD) 2014/35/EU

- **EN61010-1 (2010)**: Safety requirements for electrical equipment for measurement, control and laboratory use.

Electromagnetic Compatibility & Immunity (EMC) Directive 2014/30/EU

- Emissions: **EN 61326-1:2006, FCC Part 15C and ICES-003**; EN 55011:1997 + A1:1999 + A2:2002, FCC Part 15.109(g), ICES-003 EN 55011:1997 + A1:1999 + A2:2002, FCC Part 15.107(b), ICES-003 EN61000-3-2:2006 +A1:2009 +A2:2009, EN61000-3-3:1995 + A1:2001
- Immunity: **EN 61326-1:2006**; EN 61000-4-2:1995 + A1:1998 + A2:2001, EN61000-4-3:2002, EN 61000-4-4:2004, EN61000-4-5:1995 + A1:2001, EN61000-4-6:1996 + A1:2001, EN61000-4-8:1993 + A1:2001

The product was tested with a typical configuration.
Chapel Hill, 2017/07/28

Mr. Alain J. Creissen (Company Officer)

The mark of conformity has been applied to the rear panel of the device.

CE