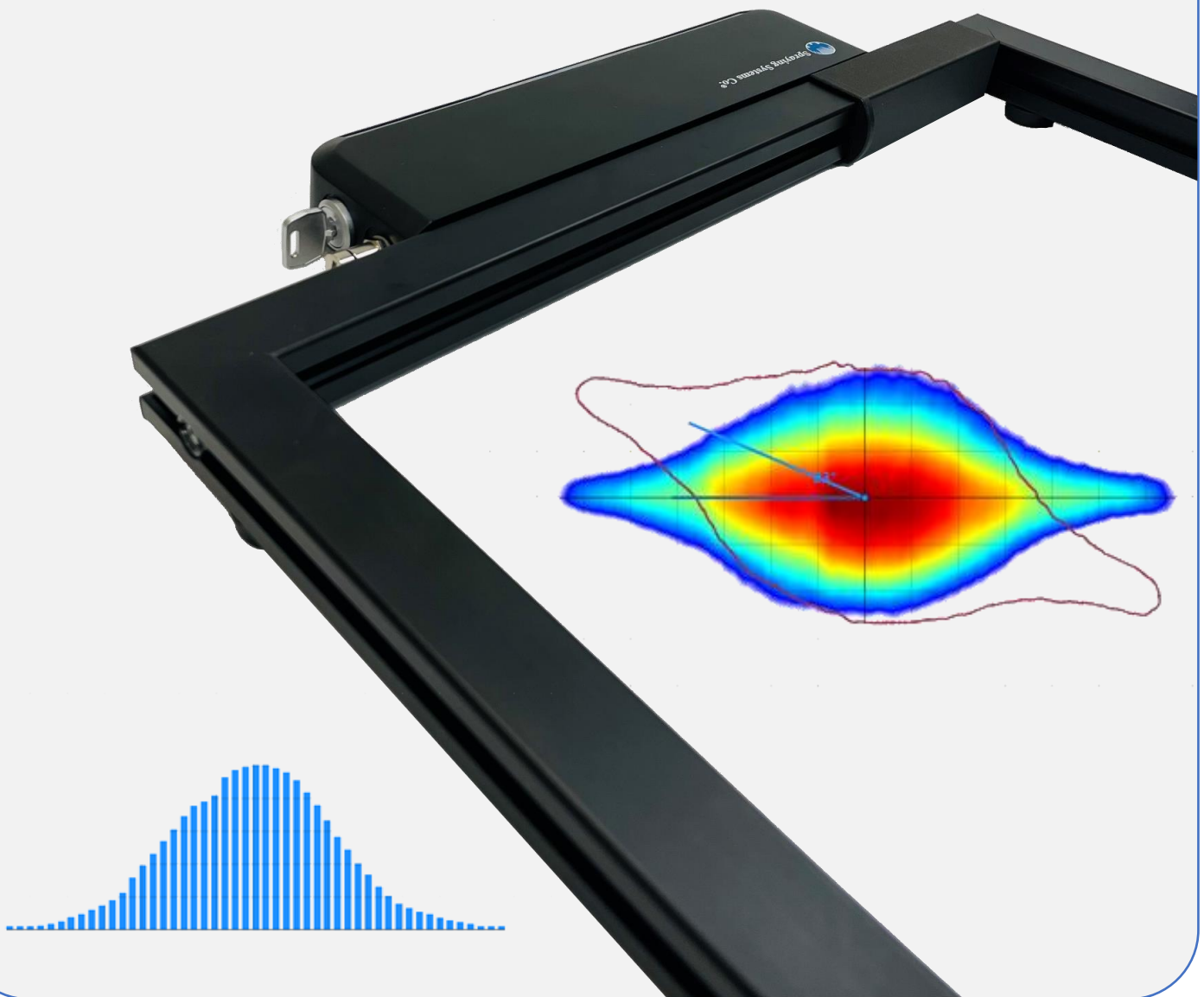


SPRAYSCANTM mPT

Mobile Patternator **User Manual**



Version 2.0



Spraying Systems Co.[®]
Experts in Spray Technology

Software Instructions

The **SprayScan mPT** mobile patternator is a portable spray characterization instrument that allows a user to receive information quickly and easily on the coverage, pattern, and distribution of a spray.

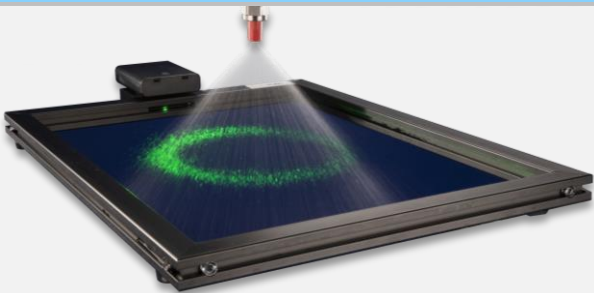


Table of Contents

Data Collection.....	2
Data Import.....	2
Locating the Frame and Spray	3
Spray Contour Settings	4
Data Export	5
Spray Comparison Tool	6
Software Preferences.....	7
Example Data	7
Software Directions	7
Safety Information and Conventions	8
Maintenance Instructions.....	13
Additional Hardware Information.....	14
Warranty Information.....	15

1

Data Collection



1.1 Best Practices

When recording the spray, there are a few things to keep in mind:

- Use a black background behind the spray to reduce noise and other features in the data image.
- A dense spray plume above or below the laser plane may obscure spray area. Therefore, try to acquire the image from a camera position that minimizes this effect.
- Capture the video from either directly in **front of, or behind**, the laser. This will result in the brightest spray pattern being recorded, which leads to a more accurate analysis. However, over-saturating the image intensity is also bad and therefore the camera may need to be raised or lowered.
- Use a tripod, or another other way to mount/stabilize the frame. The bottom of the frame has 4 removable rubber feet that are compatible with standard mounting hardware (tripods, etc.).

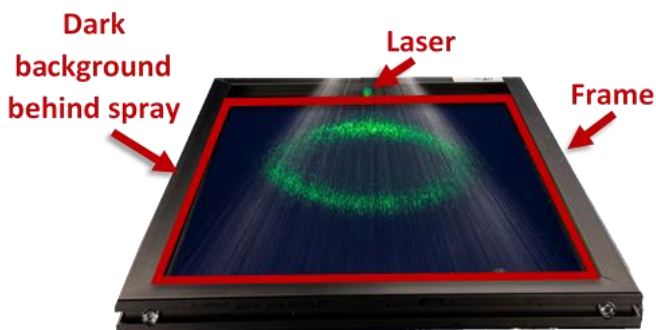


Figure 1: Data Collection

2

Data Import



2.1 Load Data

Video and image files can be imported into the SprayScan mPT software.

Compatible video files: *.mp4, .mpeg, .flv, .wmv, .mov*

Compatible image files: *.jpg, .jpeg, .png*

2.2 Video Processing Options

The video processing method can be specified in the software preferences window ([section 7](#)). The two options in the preferences window are intensity averaging ([section 2.21](#)) and intensity summation ([section 2.2.2](#)).

2.2.1 Averaging

By default, the video processing option is set to “Averaging”. This method averages together the intensity values for the first 100 (or fewer) frames of the video. Averaging the video frames together results in a more accurate representation of the spray plume.

2.2.2 Summation

The “Summation” method adds the intensity values from each frame in the video together. This can be used for displaying all of the particles observed in a video. This option works well when a particularly sparse spray is imported.



3

Locating the Frame and Spray



3.1 Frame Selection

The software will attempt to auto-detect the frame of the SprayScan mPT, which is represented by a blue polygon. Some user adjustment may be required to position the polygon directly overtop the frame. To perform this adjustment, simply click and drag the inner corners of the frame until the blue polygon and the **inside of the frame** are aligned, see Figure 2. In this window, when clicking onscreen, the nearest point (of 4) is activated and transferred directly to the cursor's position.

Verify the length and width of the SprayScan mPT frame being used. The standard inner frame dimensions are 11"x 15". If necessary, these values can be changed by typing new values into the X & Y dimension boxes.

Press once the frame is fully defined.

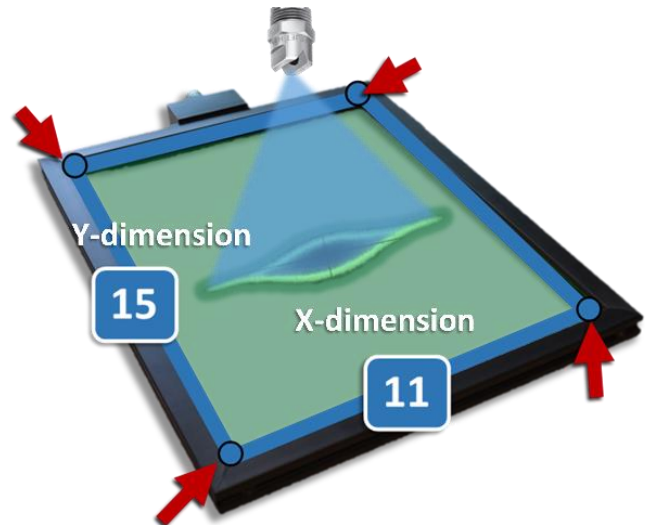


Figure 2: Frame Selection

3.1.1 Frame Calibration

The frame calibration feature can be used to save the position points of the frame within the figure window. When loaded, a frame calibration file can be used to replace the Frame Selection step ([section 3.1](#)). When this feature is used, the physical positioning of both the laser and camera cannot be changed. If either of these items is changed, a new calibration file must be used.

When is selected:

The user will be asked to save a frame calibration file (.fmpt file extension) after the Frame Selection ([section 3.1](#)) step is complete. The .fmpt file contains information on the location of the frame points and the size of the frame.

When is selected:

The user will choose a previously created frame calibration file to load into the software. Once the file is loaded, the software can run without any user input on the frame size or location.

3.2 Spray Selection

Once the frame is characterized, an image of the illuminated spray plume will load onto the screen. Similar to the Frame Selection step ([section 3.1](#)), a blue rectangle will encompass the target area, for this spray. If necessary, click and drag to adjust this rectangle until it fully contains the spray area.

Press once the spray is fully defined to continue.

4

Spray Contour Settings



After the spray is fully defined, the distribution result will automatically load. The **Figure Display Settings** window allows for customization of the spray distribution display.

4.1 Grid Toggle



This toggle adds and removes the X and Y grid lines from the plot window.

4.2 1D Distribution



This toggle generates a 1D plot of the data. This plot is a 1-dimensional representation of the 2-dimensional data. It is how the spray would look in a mechanical patterning system.

4.3 Spray Smoothing



This toggle adds and removes a smoothing factor to the spray contours.

4.4 Spray Rotation



This button allows users to rotate the spray area about its center point. The area can be rotated a full 360°.

4.5 Spray Outline



This button shows and removes a red outline, which indicates the effective spray area. This button toggles on with the spray rotation (section 4.4).

4.6 Colormap Selection



This button allows the user to choose between five different, predefined colormaps.

4.7 Refresh Plot



This button reset the layout of the plot to its default settings.

4.8 Threshold Adjustment

The threshold value can be directly adjusted by dragging the marker, located on the colorbar.

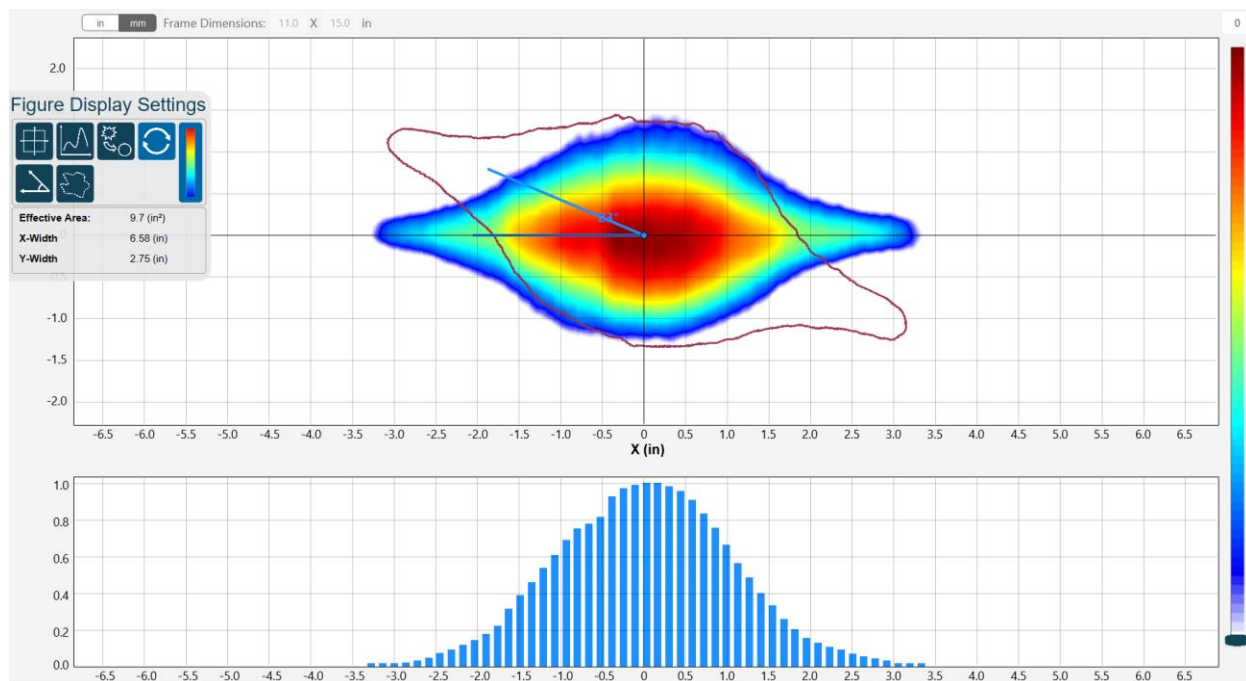


Figure 3: Spray Contour with Figure Display Settings window



5

Data Export



5.1 Export Options

There are four different ways to save the data:

- An image of the Spray Contour plot (.png)
- An image of the Spray Area (.png)
- A 2D dataset of the Spray Distribution matrix (.txt)
 - These text files can be loaded directly into the Spray Comparison Tool ([section 6](#))
- A PDF containing information on the spray (.pdf)
 - The PDF can have a header with user defined project information such as the: nozzle ID, liquid pressure, spray angle, and spray height

File Name: Test

Location: ex:\FileLocation\

☒ Spray Contour Image
 ☒ Spray Area Image
 ☒ TXT File

☒ PDF Datasheet

Datasheet Header Information

Nozzle ID: (Optional)

Liquid Pressure: (Optional)

Spray Angle: (Optional)

Spray Height: (Optional)

Figure 4: Data Export Menu

6

Spray Comparison Tool

6.1 Import Files

Text files exported from the SprayScan mPT software can be directly loaded into the Spray Comparison Tool. Two separate must be imported into the tool before the comparison can begin.

6.2 Comparison Window

The comparison window displays the correlation coefficient, X-width, Y-width, and area values for the two loaded sprays. If the percent difference between the two values is greater than the acceptable difference, the values will be red. The acceptable difference can be adjusted in the preferences window ([section 7](#)).

6.3 Plot Window

The Spray Comparison Tool allows for a quick comparison of spray patterns. Simple comparisons will help reveal problems and if necessary, indicate if a different nozzle is required to achieve the desired coverage. Comparisons are shown through five different plot options.

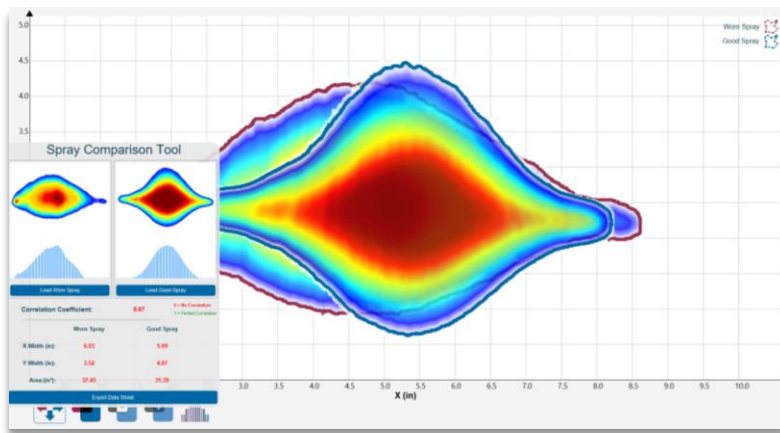


Figure 5: Spray Comparison Tool Window

6.3.1 Traditional Overlay Plot

The traditional overlay plot allows users to view both spray plumes, each with a semitransparent colormap. In this view, users can click & drag to move the spray contours independent of one another.

6.3.2 Overlay Plot

The overlay plot shows a binary overlay of the two spray plumes. Spray 1 is designated by a solid **maroon color**, spray 2 is designated by a solid **blue color**, and the overlaid portions of the sprays are designated by a solid **black color**.

6.3.3 Addition Plot

This plot window shows the result of the adding the intensities of the two plots together.

6.3.4 Subtraction Plot

This plot window shows the result of subtracting the intensities of the two plots from one another.

6.3.5 1D Plot

This plot window shows the 1- dimensional plots for the two sprays. In this view, users can click & drag to move the 1D plots independent of one another, along the x-axis. The percent overlap is shown in the black bar on above the two plots; the percent overlap value changes in real-time, as the plots are moved.

6.4 Data Export

Users are able to save the data from the Comparison Tool to a PDF Datasheet, see Figure 6. This datasheet contains:

- A figure of the overlaid plots ([section 6.3.2](#))
- Information from the Comparison Window ([section 6.2](#))
- A plot of each individual spray plume
- Information for each plot:
 - Filename (data source)
 - X-Width
 - Y-Width
 - Effective Radius
 - Effective Area
 - Circularity

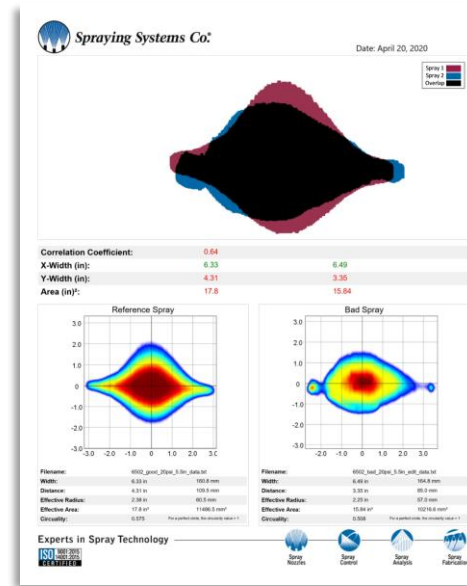


Figure 6: Spray Comparison PDF Export

7

Software Preferences

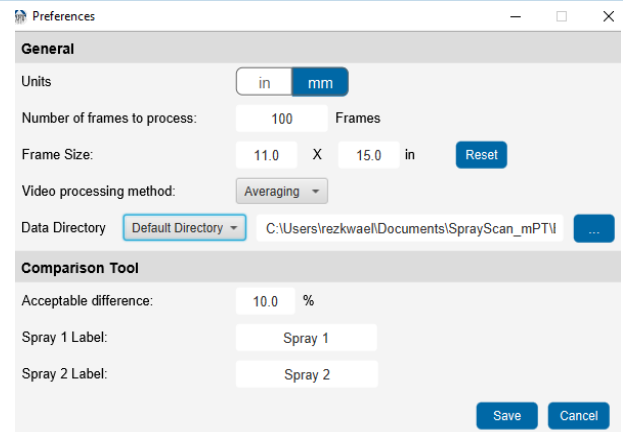
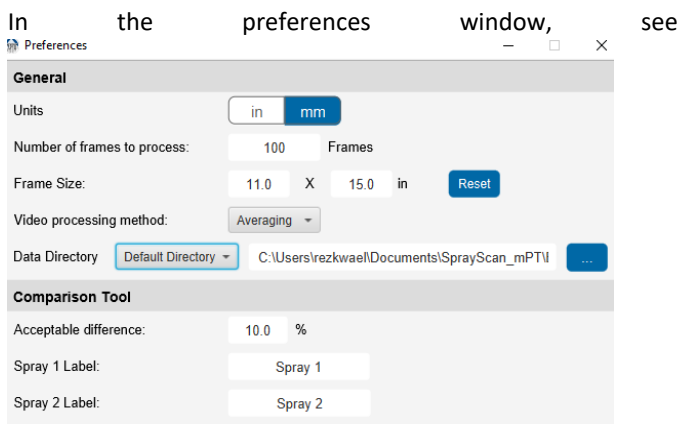


Figure 7: Software preferences window

8

Example Data

Example images and text files can be found in the folder:

C:\Users\{User Account}\Documents\SprayScan_mPT\Examples

9

Software Directions

The software directions can be opened directly in the software by clicking the icon in the bottom left corner of the screen.



To ensure the safe operation and optimal performance of the product, follow all warnings in this guide. Safety precautions must be observed during all phases of operation, maintenance, and service.

Operators must adhere to these recommendations, and to always apply sound laser safety practices. Never open the enclosure. There are no user serviceable components associated with this product. All internal service and maintenance should only be performed by qualified Spraying Systems Co. personnel.

Table 1-1 lists safety conventions and their meanings; these conventions are used throughout this guide.

Table 1: Safety Symbols

Symbol	Description
 Laser	Text marked with a Laser Warning symbol refers to a potential safety hazard. It requires a procedure that, if not followed correctly, can result in bodily harm to you or others. Do not proceed beyond the Laser Warning symbol until you completely understand and meet the required conditions.
 Caution	Text marked with a Caution symbol refers to a potential product hazard. It requires a procedure that, if not followed correctly, can result in damage or destruction to the product or components. Do not proceed beyond the Caution symbol until you completely understand and meet the required conditions.
No symbol	Text marked with Important refers to pertinent information regarding the operation of this product.

10.1 Safety Features and Compliance to Government Requirements

Laser Safety:

CDRH 21 CFR 1040.10

IEC 60825-1:2014



10.2 Laser Classification

The governmental standards and requirements specify that lasers must be classified according to their output power or energy and laser wavelength. The laser used in the SprayScan mPT is classified as a Class 3B laser product under 21 CFR, subchapter J, part II, 1040.10(d). This product emits visible laser radiation at or around a wavelength of 532 nm. The total light power radiated from the optical output is between 5 mW and 500 mW.

Class 3B laser systems may be hazardous under direct and specular reflection viewing conditions, but do not normally constitute a fire hazard, diffuse reflection hazard, nor a laser generated air contaminant (LGAC) production hazard.

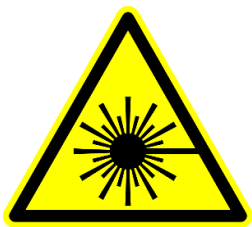
For more information on this laser classification, scan the QR code on the right or visit <https://www.lasersafetyfacts.com/3B>



10.3 User Standards

The user of this product must ensure that appropriate control measures are observed when operating this product in their facility, including engineering control measures, as per Sections 3 and 9 of ANSI Z136.4. Users must be trained in how to safely operate laser systems, and a Laser Safety Officer must be on site when the product is in use.

Important: The user should not open the SprayScan mPT enclosure for any reason during operation or maintenance. No internal servicing should be performed by the user.



WARNING: You must use appropriate laser safety eyewear when operating this device and, ensure that the laser safety eyewear used protects against light emitted at a wavelength of 532 nm. Review the safety labeling on the product and verify that the personal protective equipment being used is adequate for the output power and wavelength listed on the product. Protective eyewear should be rated at OD 2 or higher.

The end user is solely responsible for determining the suitability of all personal protective equipment.



CAUTION: Use of this product in a manner other than that described herein can impair the protection provided by the device.

10.4 Beam Attenuator

This device features a beam attenuator in the form of an aperture cover. This cover slides manually along the included frame and can be positioned to completely block laser emission when the product is not in use. An image depicting the aperture cover can be seen in Figure 8 on the following page. Note that while the aperture cover is highlighted in blue in this figure, the cover on the actual unit is black.

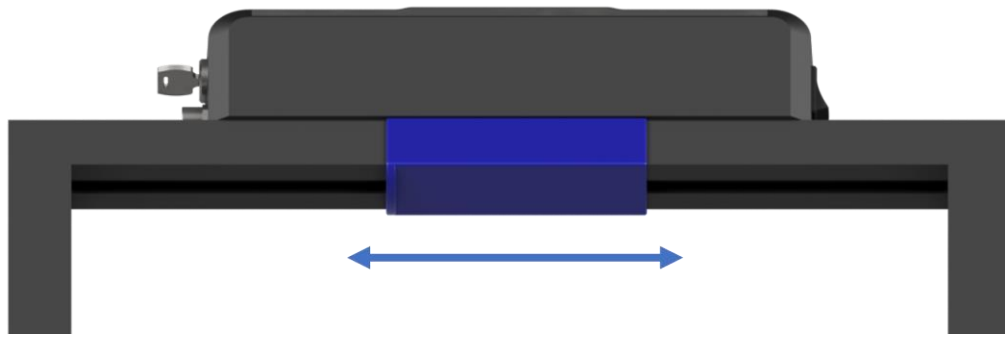


Figure 8: Aperture Cover Location

10.5 Key Control

The device is not operable until the key switch is in the ON position (horizontal orientation). If the key is turned to the OFF position during operation, the laser will not remain on. The key cannot be removed from the unit while in the ON position. The location of the key control can be seen in Figure 9 below.

10.6 Remote Interlock

The SprayScan mPT device features a remote interlock connector as per the requirements established in 21CFR1040.10. When the terminals of the connector are not electrically joined, it prevents the device from emitting any laser radiation. The user can connect the device to a door remote system via the M8 connector port and an M8 cable (not included). The SprayScan mPT comes shipped with a connector wire inside a protective cap on the M8 connector that joins the terminals. This is so that the user can operate the unit without using a remote interlock. Without this connector wire, the device will not emit laser radiation unless a door switch is connected, so make sure that this component does not become lost. It is recommended that if a door switch is not going to be used with this device, then the user should leave the M8 protective cap in place so as not to risk losing the connector wire. The location of this M8 connector can be seen in Figure 9 below. More information on this component can be found in the hardware section of this manual. For specific instructions regarding how to integrate the remote interlock into an existing system, reach out to Spraying Systems Co. at Spray.Analysis@spray.com.

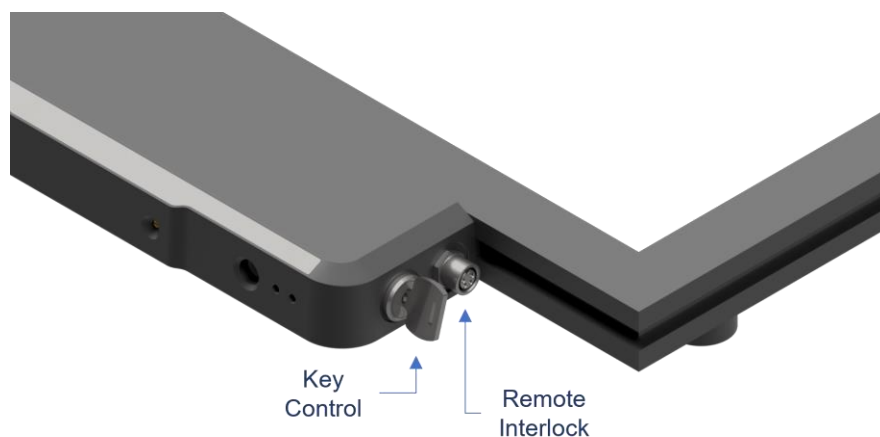


Figure 9: Location of Key Control and M8 Connector Port

10.7 Emission Indicator

The mPT unit features a visible warning prior to emission of laser radiation via a blue LED light. This LED is located on the unit's power switch. When the unit is powered on, the indicator lights up immediately, but there is a short delay before the laser is activated; the duration of this delay is approximately 1.5 seconds.

10.8 Safety Labels and Locations

The SprayScan mPT features laser safety warning labels as required by the standards set forth in 21CFR1040.10 and IEC-60825. A label indicating the position of the aperture can be found on the underside of the mPT laser enclosure. An additional label featuring warning logotype, as well as certification and identification information, is located on the outside of the included carrying case and inside this user manual. The aperture label location and detail are depicted in Figures 10 and 11 below, while the additional safety warning label is depicted in Figure 12 below.



Figure 10: Aperture Label Location

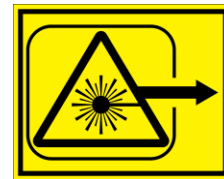


Figure 11: Aperture Label Detail

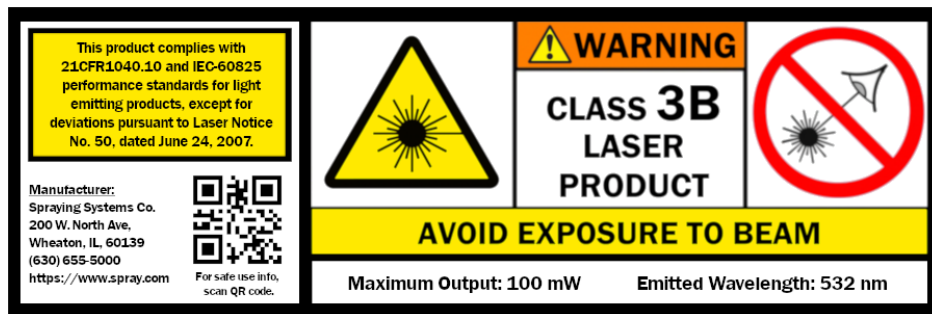


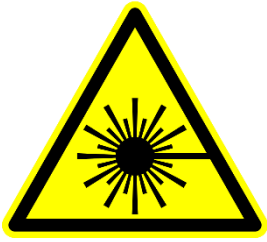
Figure 12: Laser Safety Warning Label

10.9 General Safety Recommendations

Spraying Systems Co. recommends that you follow these procedures to operate the device safely:

- Never look directly into the laser output aperture while power is supplied to the laser.
- Avoid positioning the laser at eye level.
- Ensure that all personal protective equipment (PPE) is suitable for the output power and wavelength listed on the laser safety label affixed to this product.
- Always turn the key to the OFF position when the device is not in use.
- Use the laser in a room with access controlled by door interlocks. Post warning signs. Limit access to the area to individuals who are trained in laser safety while operating the laser.
- If this instrument is used in a manner not specified in this document, the protection provided by the instrument may be impaired and the warranty will be voided.

10.9.1 Optical Safety



WARNING: Never look directly into the laser aperture when the key or power switch are in the ON position. Ensure that you always wear appropriate laser safety eyewear while operating this product.

Proper enclosures must be used to secure a laser safe work area. This includes but is not limited to laser safety signs, interlocks, appropriate warning devices, and training/safety procedures. In addition, it is important to install the laser system away from eye level.

10.9.2 Additional Safety Resources

For additional information regarding laser safety, refer to the following list:

Laser Institute of America (LIA)

13501 Ingenuity Drive, Suite 128

Orlando, Florida 32826

Phone: 407.380.1553

Toll Free: 1.800.34.LASER

American National Standards Institute

ANSI Z136.1, American National Standards for the Safe Use of Lasers

(Available through LIA)

Center for Devices and Radiological Health

21 CFR 1040.10 – Performance Standards for Light-Emitting Products

US Department of Labor - OSHA

Publication 8-1.7 – Guidelines for Laser Safety and Hazard Assessment

International Electrotechnical Commission

IEC 60825-1 – Safety of Laser Products – Part 1: Equipment Classification, Requirements and User's Guide



Important: The user must not open the SprayScan mPT enclosure during maintenance or operation. There is never a need for the user to open this enclosure. If the device is not working properly, and this problem cannot be fixed using the maintenance procedure described below, the user should contact the manufacturer and have the device sent back for servicing by qualified personnel. Opening the laser enclosure or void any product warranty, unless explicitly instructed to do so by a Spraying Systems Co. representative.

The only necessary maintenance which should be performed by the user involves cleaning the aperture lens. The lens should be cleaned after any time the device is used to collect data while spraying a substance other than water, when the lens appears cloudy or obscured, or when the intensity of the laser light appears to be diminished.

Important: It is neither necessary nor recommended to remove the enclosure from the frame to perform this maintenance, as that would require opening the enclosure. There is no reason for the user to ever remove the enclosure from the rectangular frame.

The procedure for cleaning the aperture lens is described below:

1. Soak the end of a cotton swab in a small amount of lens cleaning fluid. Keep in mind that some chemicals, such as isopropyl alcohol, can cause discoloration of the plastic enclosure. Note that only high quality cotton swabs should be used in order to avoid transferring loose cotton fibers onto the lens.
2. Put the cotton swab through the slot in the frame near the aperture, see Figure 13.
3. Use the swab to clear away any contaminants or smudges which could obscure the lens, wiping in a circular motion.
4. Allow any excess cleaning fluid to evaporate before using the device.
5. If the lens has not been completely cleaned, or if there are cotton fibers left on the lens, repeat this procedure.

Important: Never attempt to remove debris from the aperture lens with a hard or sharp tipped utensil, as doing so would risk scratching the lens. A scratched lens is likely to have a negative impact on device performance.

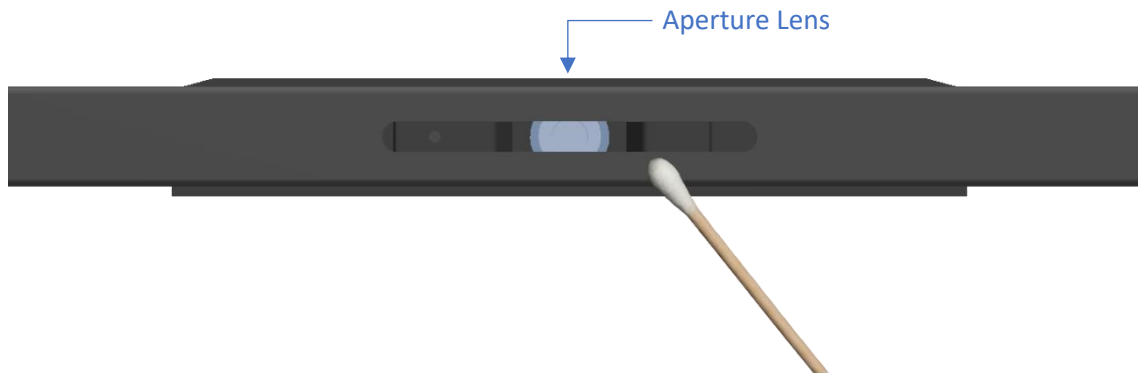


Figure 13: Location of Aperture Lens for Maintenance

12

Additional Hardware Information

12.1 Charging the Unit

The SprayScan mPT includes a rechargeable lithium-ion battery. The battery takes approximately three hours to fully charge using the included 5V power cord. With a full charge, the unit can run for approximately 5.5 hours (at full laser intensity). This device can also be run with the power cord plugged in.

The SprayScan mPT features LED indicators that signify when the unit is charging, and when the charging is complete. The location of these indicator lights is depicted in Figure 14 below.

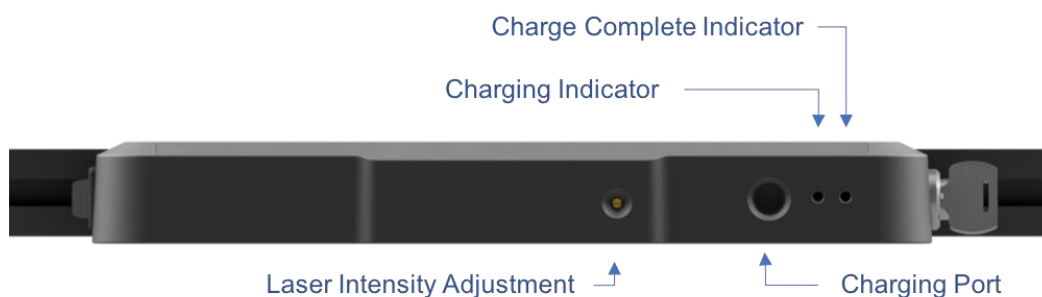


Figure 14: Charging Indicators and Laser Intensity Adjustment

12.2 Adjusting the Laser Intensity

The optical intensity of the laser can be adjusted with the laser tuning screw, which can be seen in Figure 14 above. A small screwdriver is provided for adjusting the laser power. Turning the screw counter-clockwise increases the laser intensity, while turning clockwise decreases the intensity. The unit is set to maximum intensity by default. In some situations, such as when using the SprayScan mPT in an area with low light conditions, it may be necessary to decrease the laser intensity in order to collect quality data. If the light conditions are too dark relative to the laser intensity, the spray pattern will become saturated in the SprayScan software and the user may not be able to distinguish between areas of the spray that are more or less sparse. However, it is recommended that the user leave the intensity setting at maximum unless the room conditions and data quality necessitate an adjustment. Keep in mind that the laser intensity adjustment screw takes 25 turns to adjust from maximum to minimum settings, so the user may not immediately notice a difference in laser power when making an adjustment.

12.3 Remote Interlock Connector

As mentioned on page 10 of this manual, the SprayScan mPT comes equipped with remote interlock capability using the M8 connector on the side of the unit. As previously stated, if the user does not intend to use a remote interlock, it is recommended that the M8 protective cap be left untouched. Inside this protective cap there is a connector wire that completes the circuit if a door switch is not attached; this component is easily misplaced if the cap is removed, and the unit requires either the connector wire or a door switch to function.

12.4 Hardware Troubleshooting

If the SprayScan mPT does not turn on when the power switch is activated:

- Make sure that the key control is inserted into the device and is turned to the correct position.
- Check that the unit is charged or is plugged into a wall outlet.
- Check that the connector wire has not been removed from the M8 connector if a remote interlock is not being used.

If the laser intensity is very low.

- Make sure that the device has an adequate charge or is plugged into a wall outlet.
- Make sure that the laser intensity has not been adjusted to a lower setting.

If the laser line appears inconsistent, broken, or otherwise unclear.

- Clean the aperture using the procedure described on page 13 of this manual.
- Keep in mind that it is normal for there to be a small degree of vertical light bleed from the laser line, this is more noticeable when the laser intensity is at maximum. In most instances this will not cause a problem with data collection, but in certain light conditions it may be necessary to decrease the laser intensity to minimize this effect. It is also normal for the laser power to be slightly greater at the center of the frame compared to the edges.

Opening the SprayScan mPT enclosure or modifying the device in any way will void the product warranty, unless explicitly instructed to do so by a Spraying Systems Co. representative.

13

Warranty Information

The Limited Warranty covers any defects in material or workmanship under normal use during the Warranty Period of 1 year from the date of purchase. During the Warranty Period, Spraying Systems Co. will repair or replace, at no charge, products or parts of a product that prove defective because of improper material or workmanship, under normal use and maintenance. This Limited Warranty does not cover any problem that is caused by conditions, malfunctions, or damage not resulting from defects in material or workmanship. To obtain warranty service, you must first contact a Spraying Systems Co. representative to determine the problem and the most appropriate solution for you. Opening the SprayScan mPT enclosure or modifying the unit in any way will void the Limited Warranty unless the user is explicitly instructed to do so by a Spraying Systems Co. representative. Please note that the Limited Warranty does not apply to the Surface Pro tablet that is included with the SprayScan mPT unit.