BIODOT

# RR4500 Reel-to-Reel Web Handling System Reference Manual

# RR4500 Reel-to-Reel Web Handling System Reference Manual

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RM-RR4500



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# PREFACE

## About this Manual

This manual serves as the reference manual for the BioDot RR4500™ Reel-to-Reel Web Handling System. It is organized in the logical sequence for a new user, so that you can search the manual intuitively to locate specific information; however, simply referencing the manual on occasion will not provide you with the instruction you will need to operate the unit. You should read through this manual at least once from beginning to end in order to learn how to set up, operate, and maintain the unit in a safe and efficient manner. This manual also includes information on your system's optional components.

## How this Manual is Organized

This reference manual is divided into chapters that describe setup, operation, and maintenance. The order of these chapters correspond to the steps in the basic sequence for setup, operation, and maintenance of the RR4500. The manual also includes chapters and sections on optional components for the RR4500.

At the end of the manual is additional reference information including troubleshooting tips, specifications, and a glossary.

## Conventions in this Manual

Throughout the manual, you'll find icons or emphasized sections of text designed to draw your attention to key information. This section describes these types of icons and text.

### Notes

Notes offer additional information about certain features of the instrument, or inform you of things to watch out for in performing a step in a procedure. They are identified with a blue icon, as shown in the following example:

> This is an example of a note, which offers additional information and tips about the instrument or setting up the instrument.

### Warnings

Warnings point out information that is critical for you to know and are identified with a red icon, as shown in the following example:

> This is an example of a warning, which draws attention to critical information that you must know.

### Hand-Held Terminal Menus

Items related to the hand-held terminal (HHT) interface or keyboard use the following conventions:

- HHT MENU NAMES and HHT KEYBOARD KEYS use small capitalization, as shown in the examples at the beginning of this sentence.
- HHT menus and submenus used in an operational flow have arrows to demonstrate that flow, as shown in the following examples:

➔ **HHT MAIN MENU**

⇨ HHT SECONDARY SUBMENU

⇒ HHT TERTIARY SUBMENU

→ HHT QUATERNARY SUBMENU

### Procedures

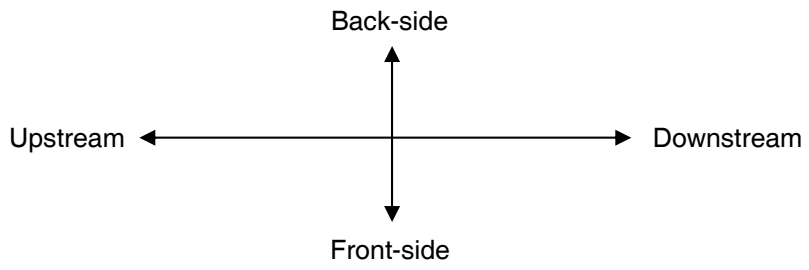
Step-by-step procedures are introduced blue font as shown in the following example:

This introduces a step-by-step procedure.

## Orienting Terminology

Directional terminology is used throughout the manual to illustrate the relative positions of the RR4500 system components. We have defined the set of terminology in Figure 1 to ensure that these terms are clear to you when you encounter them in your reading.

**Figure 1**




The figure above shows the orientation of the following terms, when looking down on the unit:

- **Upstream** refers to elements on the left-hand side, or to the left relative to other elements.
- **Downstream** refers to elements on the right-hand side, or to the right relative to other elements.
- **Back-side** refers to elements towards the back of the machine, or away from the operator.
- **Front-side** refers to elements towards the front of the machine, or nearer the operator.

Except where indicated, directions are given from the point-of-view of a machine operator who is a) facing the front of the machine and b) running web material in the standard direction (from left to right).

## General Safety Precautions

You should note the following safety precautions while working with the RR4500:

- **Avoid Spills:** Do not allow fluids to spill on top of the dispenser/control box, material pay-out or take-up reels, and the Dry Tower base control unit(s). Clean up spills on or around the unit immediately: soak up the spill with a lint-free sponge or cloth, and then carefully (adding solution to your cleaning cloth and not the spill area) clean the area with a 70% IPA solution to remove residue and aid in liquid evaporation.
- **Use Proper Power Cord:** To avoid fire hazard, use only the power cord supplied with the unit.
- **Avoid Electric Overload:** To avoid electric shock or fire hazard, do not run this machine on a circuit with a lesser amperage rating.

- **Ground the Machine:** This machine is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding connector must be connected to earth ground.
- **Do Not Operate Without Covers:** To avoid injury or electric shock, do not operate this machine with covers of panels removed.
- **Use Proper Fuse:** To avoid fire hazard, use only fuses that are of the type and rating specified for this machine.
- **Do Not Operate in Wet/Damp Conditions:** To avoid electrical shock, do not operate this machine in wet or damp conditions.
- **Do Not Operate in an Explosive Atmosphere:** To avoid injury or fire hazard, do not operate this machine near combustible or explosive chemicals.

## Precautions for Optional Dip Tank

If you are using an optional Dip Tank, you should also note the following safety precautions:

- Do not drop or expose the Dip Tank to severe mechanical shock. This could permanently damage the equipment.
- Do not attempt to disassemble defective BioDot Dip Tank components beyond that described in this manual. This will void all warranty obligations, and may render the BioDot Dip Tank unserviceable.
- Operation of the BioDot Dip Tank with the plexiglass cover in place is strongly recommended. All persons in the vicinity of the BioDot Dip Tank should take precautions to protect themselves from any aerosol-borne particles. Operating with the use of a surgical mask and protective eyeglasses is strongly recommended.
- Do not store strong acids or bases in the BioDot Dip Tank for extensive periods of time.
- When not using the BioDot Dip Tank, flush out all remaining fluids.

## Precautions for Optional Dry Tower

If you are using an optional Dry Tower, you should also note the following safety precautions:

- When installing the Dry Tower system, check the size of the electrical service. Make sure it is to the maximum Dry Tower configuration anticipated. This is particularly important if, for example, a RR3110 was purchased and was upgraded with additional drying modules to form a RR3130 Dry Tower system.
- It is strongly recommended that an exhaust duct be connected to collect and remove the air used in the drying process. This air may contain harmful chemicals extracted from membrane or absorbent materials.
- Do not attempt to dry materials containing highly volatile solvents. An **EXPLOSION** hazard may exist. Many surfaces within this product can be in excess of 500°F (260°C) when the heaters are continuously energized and may serve as a source of ignition. This Dry Tower System has not been constructed to meet explosion proof requirements, nor have anti-sparking construction materials been specifically used.
- Clean the roller assemblies on the control and drying modules, and replaceable tubes in the drying module periodically to remove any chemical build-up transferred during operation. A lint-free cloth -

moistened with alcohol- may be rubbed against the Teflon surface to clean and remove staining. Do not clean with abrasive materials as this will damage the surface finish.

- Do not operate the drying modules without airflow, as excessive temperatures can be reached and part failure can occur.
- The platform upon which the Dry Tower system sits must be sufficiently rigid to support the system weight while remaining flat. Any significant warp or sag in the mounting surface will cause membrane-tracking problems throughout the system.

## Contact Information

If you encounter difficulty with the installation or of your unit, or if you are missing any component from your order, please contact Support at +1 949-440-3685 or email us at support@biodot.com.

PART I

# Overview

CHAPTER 1

# RR4500 Overview

## Introduction

The RR4500 Reel-to-Reel Web Handling System provides reagent application and drying capabilities for web processing.

This chapter provides a general overview of the RR4500 system, including figures to show the system's components.

## The RR4500 Illustrated

Figure 2 shows the RR4500 system.

**Figure 2**

Pictured above is a Reel-to-Reel Web Handling System configured with (from left to right) a Payout Module, Capstan Module, Dispenser Module, Vision System, Dip Tank Module, Dry Towers, and Take-up Module with Environmental Enclosure. Each of these components will be reviewed individually below.

Take a moment to familiarize yourself with the basic layout of the instrument, before proceeding with installation. The basic (standard) system is composed of four modules:

- Pay-out module
- Drive capstan module
- Dispensing module
- Take-up module

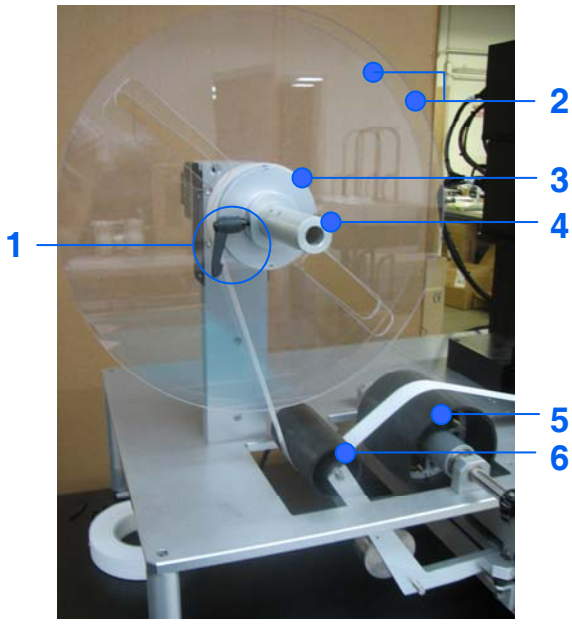
## Pay-Out Module

The pay-out module includes the pay-out reel, Tension Control Module 1 (TCM 1), and associated rollers; also called the “supply end” of the system. TCM 1) is part of the payout module, and consists of a rotational position sensor and a Dancer Arm. TCM 1 modulates web tension on the payout end of the system. Refer to Figure 3 for an image of the pay-out module.

## Drive Capstan Module

The drive capstan module consists of pneumatically operated pinch rollers, and a drive motor. The drive capstan drives the web and controls web speed. Refer to Figure 4 for an image of the drive capstan module.

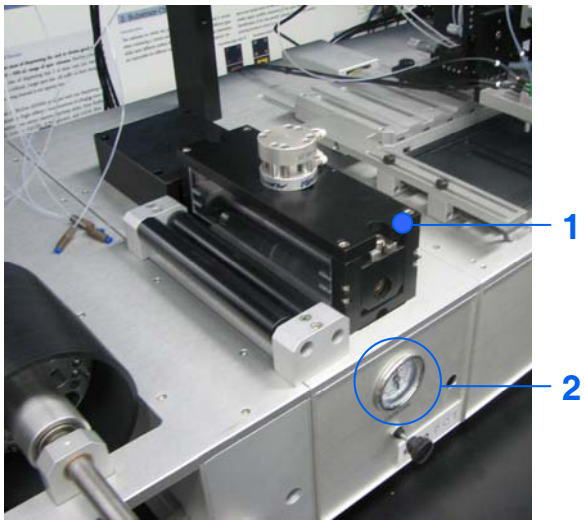
**Figure 3**




The figure above includes:

1. Flange Lever
2. Pay-Out Reel Flanges
3. Hub
4. Drive Shaft with Sleeve
5. Crowned Roller

**Figure 4**




The figure above includes:

1. Drive Capstan
2. Drive Capstan Air Pressure Gauge

## Dispensing Module

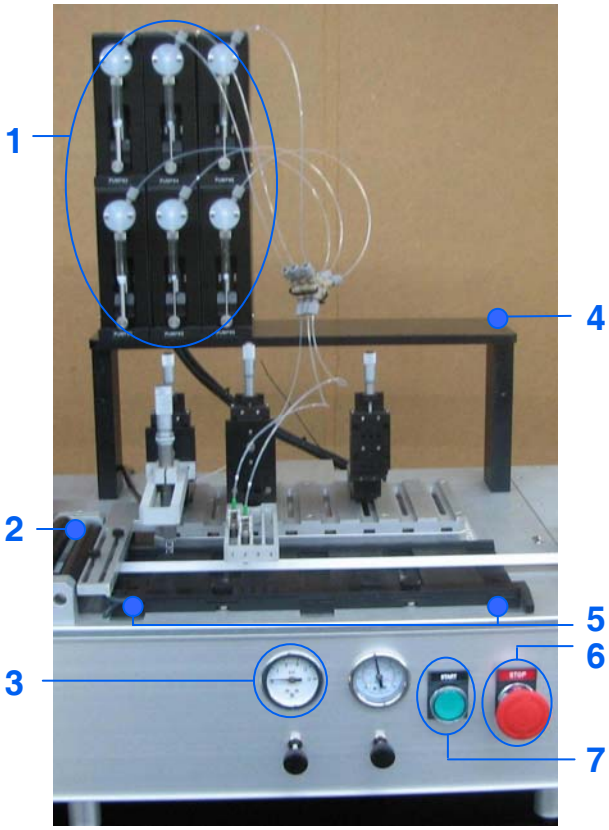
The dispensing module includes the dispensing platform and the dispensing nest. The dispensing platform is the mounting surface for the attachment of dispensers. The dispensing platform adjusts position automatically in response to a signal from a pair of edge sensors on the upstream side of the dispensing nest (the Dispense Auto-Tracking System).

The dispensing nest is the portion of the dispensing module over which the web travels. It contains a front and rear web edge guide. Refer to Figure 5 for an image of the dispensing module.

## Take-up Module

The take-up module includes the take-up reel, the take-up auto-tracking system (consisting of a pair of sensors just upstream of the take-up reel), Tension Control Module 2 (TCM 2), and associated rollers. TCM 2) is part of the take-up module, and consists of a rotational position sensor and dancer arm. TCM 2 modulates web tension on the take-up end of the system. Refer to Figure 6 for an image of the take-up module.

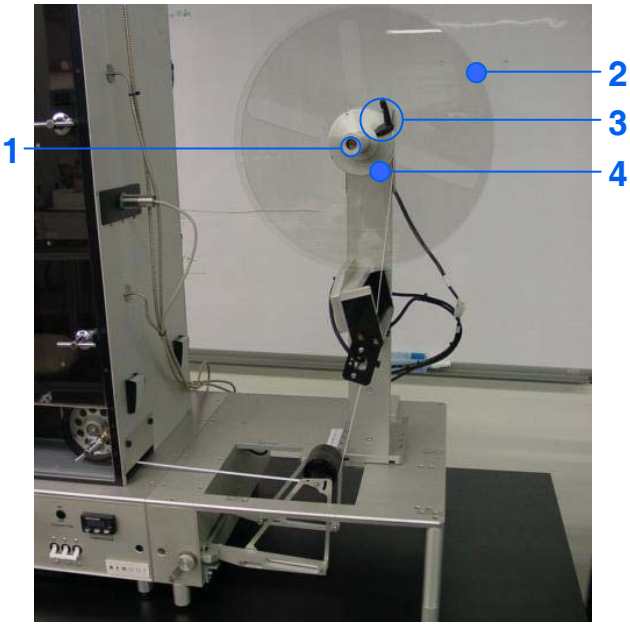
**Figure 5**




The figure above includes:

1. Syringe Pumps
2. Guidance Rollers
3. Air Pressure Gauge
4. Pump Platform
5. Dispensing Nest
6. Start Button
7. Stop Button

**Figure 6**




The figure above includes:

1. Drive Shaft with Sleeve
2. Take-Up Reel Flanges
3. Flange Lever
4. Hub

CHAPTER 2

# DISPENSER OVERVIEW

## Introduction

The RR4500 system works with dispenser kits that are made up of the following:

- Syringe pump, from a third-party vendor
- Up to eight of the following dispensers, in any combination:
  - BioDot BioJet Quanti™ (models 3000 and 4000) dispenser
  - BioDot AirJet Quanti™ (models 3000, 2300, and 2400) dispenser
  - BioDot Frontline Quanti™ 1000 dispenser
  - Other commercially available dispensers (compatibility varies)

## Syringe Pump

The syringe pump drives the fluid through the dispensers, though it may be used on its own to dispense precise amounts of fluid. The syringe pump utilizes a positive displacement pump, a programmable stepper motor and a syringe. Figure 7 shows the Syringe Pumps.

The syringe pump is a third-party product. For information on the syringe pump, refer to the documentation that accompanied that product.

## Dispensers

The following sections describe the different BioDot dispensers that work with the syringe pump to make up the complete dispenser kit. You should familiarize yourself with the basic layout of your dispenser before proceeding with installation.

## BioJet Quanti Dispensers

This series of quantitative dispensers couples BioDot's drop-on-demand valve with one or two high-resolution syringe pumps to meter precise amounts of reagent. The following syringe pump sizes are available with each of these dispensers: 50 µl, 100 µl, 250 µl, 500 µl, and 1.0 ml.

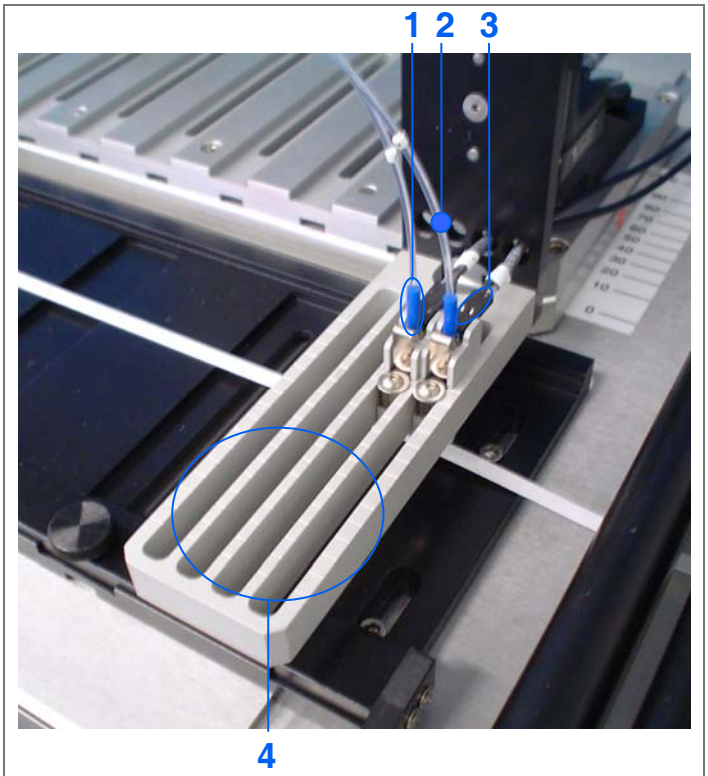
Refer to Figure 8 for an image of two BioJet Quanti dispensers. The figure is representative of the 3000 model, and is shown in the context of a BioDot system platform with vertical and horizontal positioning stages.

**Figure 7**


The figure above includes:

1. Standard Pump
2. BioJet Plus Pump

**Figure 8**




The figure above includes:

1. BioJet Barbed Inlet Port with (blue) Locking Sleeve
2. Supply Line
3. BioJet Power Cable Connection Point
4. Support Arm with Adjustable Slide Positions

The barbed inlet port may have a BioJet Plus™ fitting instead. The supply line will have to have a matching fitting.

## AirJet Quanti Dispensers

This series of dispensers couples aerosol spray airstream technology with one or two syringe pumps to meter precise amounts of reagent. The following syringe pump sizes are available: 50 µl, 100 µl, 250 µl, 500 µl, and 1.0 ml.

The AirJet Quanti dispenser comes in the following models:

- **AirJet Quanti 3000** is the smallest aerosol dispenser in this series, with a nozzle/needle size of 0.30 mm.
- **AirJet Quanti 2300** is the second largest aerosol dispenser in this series, with a nozzle/needle size of 0.60 mm.
- **AirJet Quanti 2400** is the largest aerosol dispenser in this series, with a nozzle/needle size of 0.80 mm.

> A crown tip is supplied in the toolkit that comes with each AirJet™ dispenser. The crown tip is an alternative tip that should be used when dispensing very close to the web material (when a finer line is required). Refer to the following image.

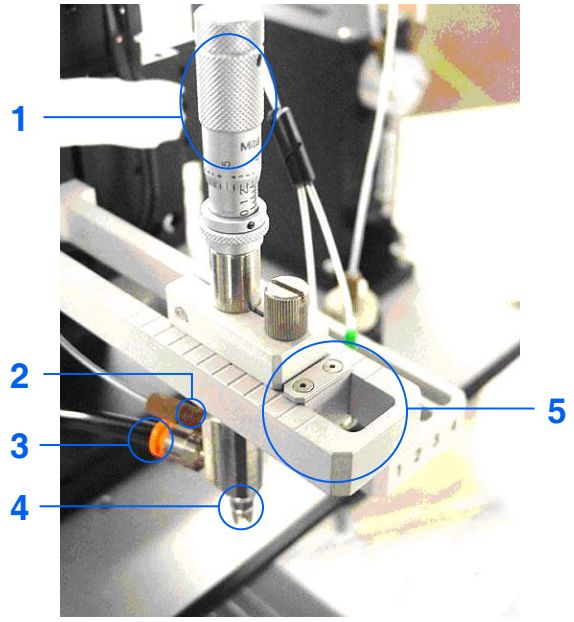
Figure 9 shows an AirJet Quanti dispenser, with associated components. The figure is representative of the 3000, 2300, and 2400 models. The AirJet is shown in the context of a BioDot system platform with vertical and horizontal positioning stages.

## Frontline Quanti 1000 Dispenser

This dispenser couples a micro-tube dispenser with one or two syringe pumps (based on dispensing rate) to meter precise amounts of reagent or ink. The following syringe sizes are available: 50 µl, 100 µl, 250 µl, 500 µl, and 1.0 ml.

Figure 10 shows the Frontline Quanti dispenser.

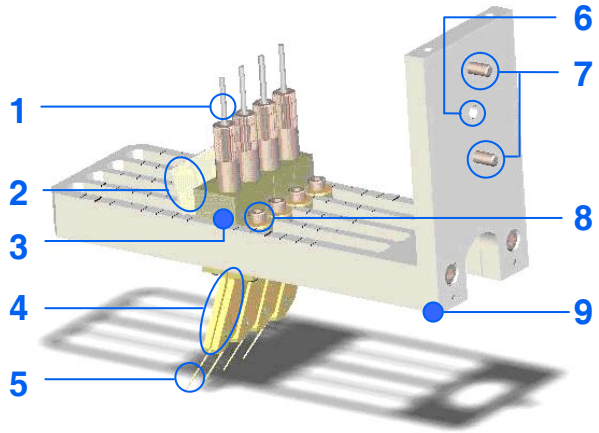
**Figure 9**




The figure above includes:

1. Needle Micrometer Barrel
2. Reagent Inlet
3. Air Inlet
4. Crown Tip
5. AirJet Adjustable Mounting Bracket

**Figure 10**




The figure above includes:

1. Reagent Line
2. Spring Release
3. Slide Block
4. Tip Support
5. Dispense Tip
6. Fixture Screw Mounting Hole
7. Fixture Locating Pins
8. Locking Screw
9. Adjustable Mounting Bracket

## In-Line Degasser

Non-contact dispensing technology exhibits a high level of reliability for small volume dispensing under the proper experimental conditions. The accuracy and the precision of the drop volume are ensured by a continuous column of fluid inside the dispensing channel—meaning in the absence of any air bubbles. De-aeration of all fluid is thus critical to maintain the fluid path of non-contact dispensers free of any air bubble. The presence of any air bubble would lead to inaccurate dispensed volumes.

The BioDot ILD4000 In-Line Degasser, which comes standard with all Dispenser Kits, provides an innovative method to achieve efficient degassing is offered by a flow-thru vacuum degassing chamber. This chamber contains a single amorphous perfluorinated copolymer (Teflon® AF) degassing membrane. It comprises a continuously vented mini-vacuum pump with a unitary PTFE diaphragm. This efficient degassing method reduces the dissolved oxygen inside fresh water from 8 ppm for a fully aerated solution to 1 ppm after passing through the

degassing chamber. Several vacuum degassing modules may be mounted in parallel on one arrayer. This degassing method eliminates any set-up time required for degassing prior to any dispensing experiment.

**Figure 11**


Pictured above is an In-Line Degasser

CHAPTER 3

# OPTIONAL COMPONENTS OVERVIEW

## Introduction

You can also include the following optional components with your RR4500 system:

- BioDot Dip Tank
- BioDot RR3130™ Dry Tower
- Antistatic system
- Environmental chamber (surrounds take-up module)
- Delay tower module
- Line presence inspection system

## Dip Tank

The BioDot Dip Tank provides coating or washing via full-liquid submersion of reeled material. The unit contains three rollers to guide membrane or other reeled substrates through the tank containing liquid solutions. The powered squeegee has a micrometer adjustable roller to control retained liquid in the membrane after it has passed through the reagent tank. Liquid reagent can be added using the fluid pump or manually. The BioDot Dip Tank is easily removed from its support platform for emptying and cleaning. A fluid-level sensor can automatically check the liquid-level height. The unit is constructed of durable Teflon coated aluminum.

The Dip Tank is a versatile system for R&D and production applications. All that is required to operate the pump box is a 110/230VAC-power source when the optional fluid pump is included. The BioDot Dip Tank uses the reel-to-reel dispense system for power.

## RR3100 Dry Tower

The BioDot RR3130 Dry Tower allows previously dispensed upon webs of material to be continuously dried. You can combine up to three Dry Towers, in order to achieve specific material drying needs. At the same time, this

minimizes the workspace required. Each drying module provides a two-foot (61cm) drying zone that is temperature and air velocity-controlled.

The RR3130 Dry Tower is made up of the following modules:

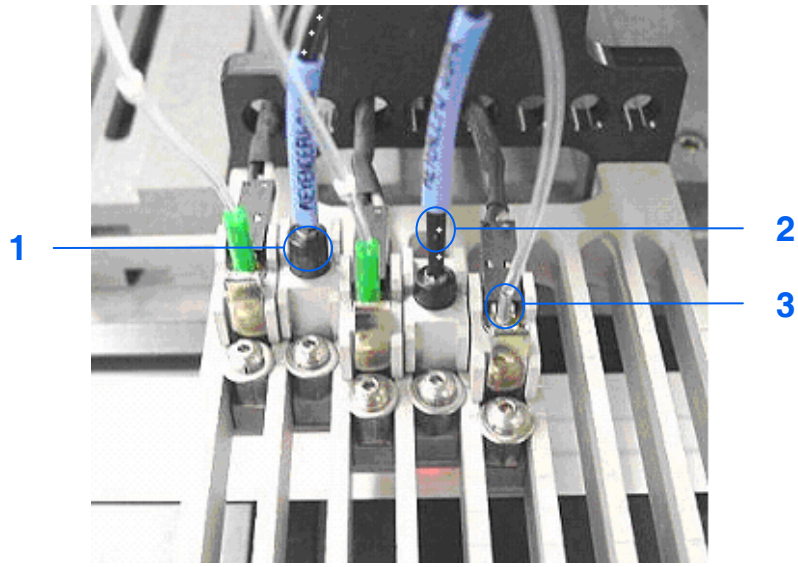
- **Exhaust module** reverses the membrane direction and removes dry air through an exhaust fan to an exhaust duct.
- **Drying modules** provide a directed source of heated dry air along two separate one foot (30cm) vertical pathways vertical. Three drying modules are stacked in a Dry Tower.
- **Control module** is the base unit-providing heater and air flow control as well as positioning, to accommodate various width membranes.

## Line Presence Inspection System

The Line Presence Inspection (LPI) system is an option available for BioDot dispensing systems to detect the presence or absence of a dispensed line. An overview of dispensing systems is provided in the chapter "Dispenser Overview" which begins on page 7.

The LPI system utilizes fiber-optic technology that includes a reflectance sensor, fiber optic amplifier, and ink jet marker. The sensor inspects for absence of the dispensed line and marks the web material when the line/dot is missing. Figure 12 provides a very basic description of the system. The LPI installation process is discussed in the section "Line Presence Inspection System Installation" on page 50.

**Figure 12**




The figure above includes:

1. LPIS* Sensor
2. LPIS* Fiber Optic Cable
3. Inkjet Marker

PART II

# Installation

CHAPTER 4

# RR4500 INSTALLATION

## Introduction

This chapter discusses the steps for installing the RR4500 system, including unpacking, assembly, and connection of system components. A BioDot technician will perform most of these tasks for you on site; however, it is important that you as the user become familiar with the basic installation procedure.

> The following installation instructions apply to the RR4500 system supplied without other components (i.e., dispensers, optional Dip Tank, and optional Dry Tower,). Later chapters explain the installation of these other components.

### Tools/Equipment

You will need the following tools and equipment to install your system:

- Set of Allen wrenches (provided with the unit)
- Tweezers (provided with the unit)
- BioDot Chassis, or other flat surface capable of supporting the dimensions and weight of the instrument (refer to “RR4500” on page 111)

## Unpacking

> When removing the RR4500 from its shipping container, lift each component from the bottom. Attempting to lift the components by the reel hubs, dispenser platform, etc., may misalign or permanently damage the unit.

To unpack the system:

1. Remove all system components and position them on the support chassis.

2. Locate the packing checklist that is provided with the instrument. Review this list to confirm that all ordered parts, tools, and accessories are accounted for. If an item is missing, contact us using the information in “Contact Information” on page ix.

## Assembly

BioDot Technicians will assemble your system for you; however, as it may be necessary for you to disassemble the unit in the future, we strongly advise that you familiarize yourself with the assembly process.

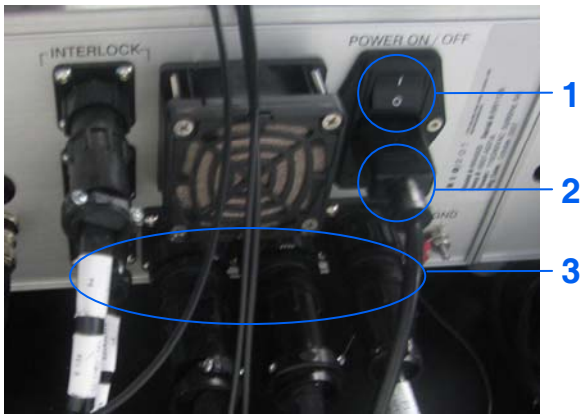
The modular nature of the reel-to-reel simplifies assembly. you have only to connect the factory-labeled component cables to the corresponding “Molex” connectors and/or jacks. The exact order of assembly will vary with the specific design of your web handling process (position of optional components such as Dry Tower, etc.). The Technicians performing your installation will explain such variations, if necessary.

The unit must be assembled on the workbench or table where it will be operated, and the supporting surface must be level and flat. The BioDot support chassis is a strongly recommended option.

### To assemble the system:

1. Verify that the main power switch, located on the back of the unit, is in the OFF position (see Figure 13).
2. Assemble the unit and optional components in the order dictated by the design of your web handling process.
3. Connect all AMP connectors (“plugs” - labeled P1, P2, etc.) to the corresponding jack (J1, J2, etc.) on the back-side of the unit (see Figure 14).
4. Connect all Molex connectors to their matching mate (e.g., A to A, B to B, etc.).
5. Connect the BNC connectors for the BioJet™ dispensers. Dispensers must be connected in the proper order, so that they will be in sync with the Syringe pumps. The BioJets are numbered from left to right, facing the unit, and their connector jacks are numbered 1 through 8 from left to right and bottom to top (see Figure 14).
6. Connect the power cord to the receptacle on the rear of the unit and plug into suitable power mains.
7. Connect 40 to 80 PSI of filtered air (no lubricants) to the input of the mist separator on the back side of the unit (see Figure 15).
   - Insert the ¼ inch air tubing into the quick connect fitting.
   - To remove the airline, push in on the tubing with one hand while pushing in the fitting itself with the other hand.
8. If Line Presence Inspection System is installed, install connections (see Figure 16).
   a. Connect the air line labeled “Mark” or “Inspection” to the corresponding pneumatic connection on the back of the unit.
   b. Connect the other end of the air line to the reservoir bottle for the inspection marking system ink.

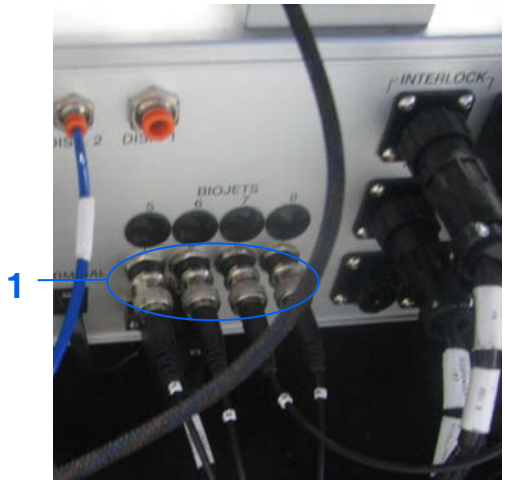
**Figure 13**




The figure above includes:

1. Power Cord
2. Power Switch
3. AMP Plugs

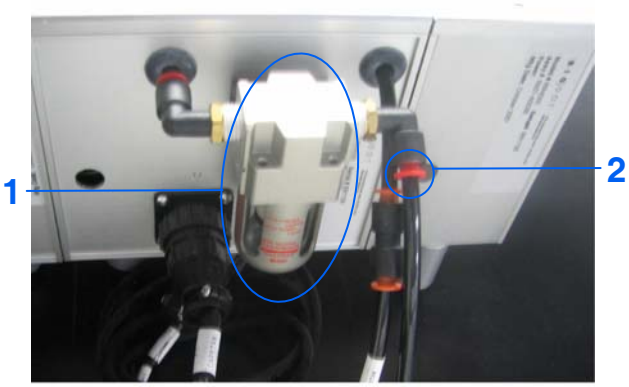
**Figure 14**




The figure above includes:

1. BioJet Jacks

**Figure 15**




The figure above includes:

1. Mist Separator
2. Air Input Quick Connect

**Figure 16**


The figure above includes:

1. Line Presence Inspection System Pneumatic Connection

9. Refer to the following chapters, as needed:
   - The chapter “Dispenser Installation” on page 33 provides information to install Dispensers
   - The chapter “Optional Components Installation” on page 45 provides information to install any optional components.

## RR4500 Alignment

This section outlines the process by which you will physically align the RR4500 system components in preparation for running web material. Your instrument has been factory-configured to accommodate the particular web material that you will be running on the machine; thus the major alignment steps have been completed for you. However, each time you place a material of different width or thickness on the reel-to-reel, adjustments to the alignment may be necessary to assure that your web material runs smoothly and efficiently through the machine.

To align the unit, you will need the following tools and equipment:

- Set of Allen wrenches (provided with the unit)
- Tape measure (or yard stick)
- Web material

There are two parts to alignment, discussed in the following sections:

- Part 1: Physical alignment
- Part 2: Running the web

### Part 1: Physical Alignment

This section explains how to set up the unit so that web may be properly centered in the reel-to-reel.

> If your web material is wound with an interlayer (liner), refer to the liner pay-out/take-up module documentation after reading this procedure. The following procedure applies to all reel-to-reel systems, but requires supplemental information if a liner take-up option has been added to your unit.

The process to physically align the unit includes the following tasks:

1. Perform the initial setup.
2. Position and thread the web material.
3. Align the mechanical system components and crowned rollers.

To perform the initial setup:

1. Energize the system electrical and pneumatic systems.
2. Position the pay-out reel at its most inside position:

a. Remove the outer reel flange by releasing the flange lever and sliding the flange towards you.

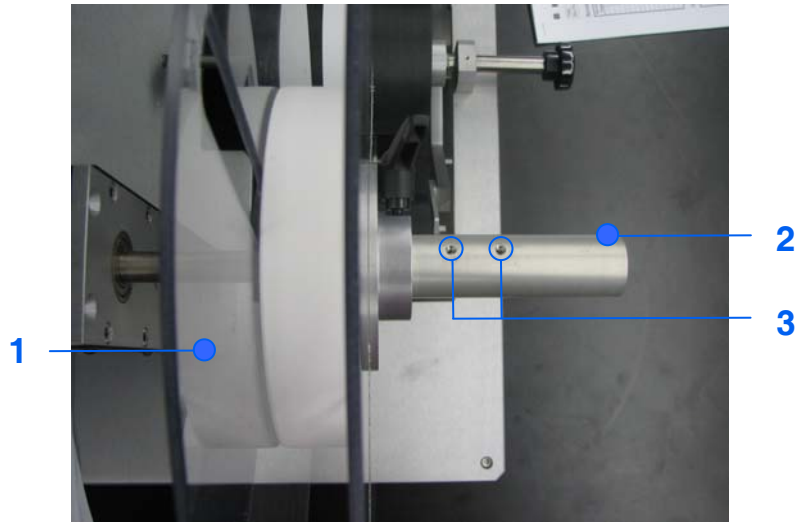
b. Using a 3/32” Allen wrench, loosen the two set screws on the reel shaft.

c. Push the inner flange back to its most back-side position, and re-tighten the set screws.

> In most cases, the pay-out reel is pre-set at the most inside position, but you should confirm this by loosening the set screws and gently pushing the reel in the inside direction.

See Figure 17.

**Figure 17**




The figure above includes:

1. Back-Side Flange
2. Payout Reel Sleeve
3. Payout Reel Set Screws

3. Position the dispensing nest at its most inside position:

a. Using a 9/64” Allen wrench, loosen the four socket head cap screws that secure the dispensing nest.

b. Loosen the two thumbscrews that secure the dispensing nest front edge guide.

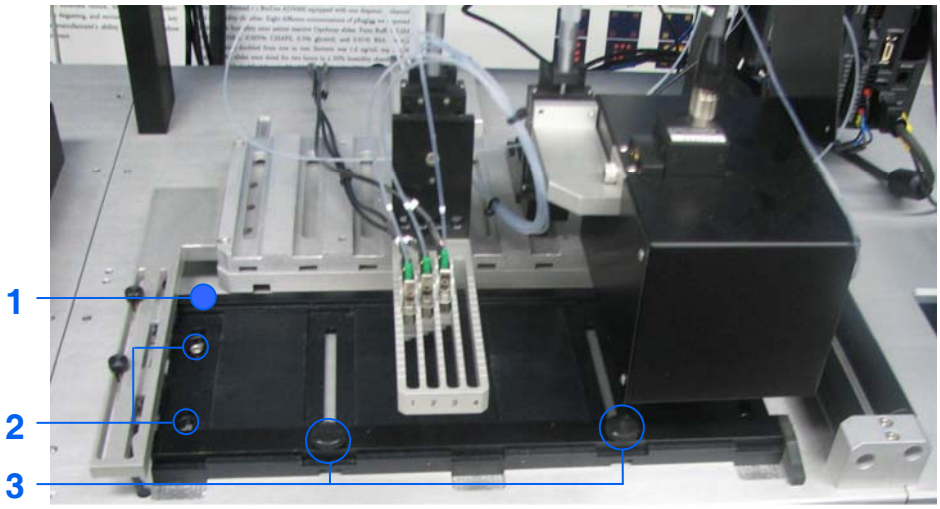
c. Gently slide the unit to its most inside position.

d. Slide the front edge guide to its most outside position.

e. Do not re-tighten screws at this point.

See Figure 18.

**Figure 18**




The figure above includes:

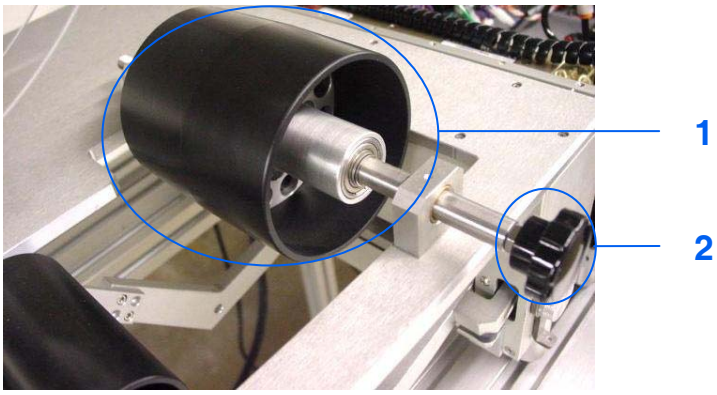
1. Dispensing Nest
2. Cap Screws
3. Thumb Screws

4. Position each crowned roller in the pay-out and take-up modules at the approximate center of its range.

   Turn the adjustment knob on the near end of the crowned roller shaft clockwise (to move roller outside) or counterclockwise (to move roller inside) until the roller is positioned (by eye) in the approximate center of its range.

   See Figure 19.

**Figure 19**




The figure above includes:

1. Crowned Roller
2. Crowned Roller Adjustment Knob

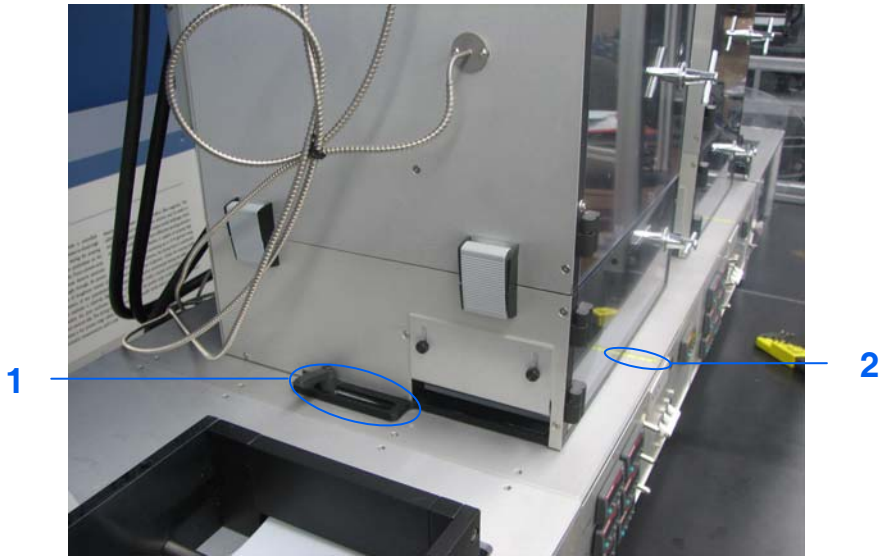
5. If an optional Dry Tower is installed, position each Dry Tower approximately in line with the pay-out/take-up crowned rollers:

   a. Locate the Dry Tower positioning knob on the front face of the Dry Tower module base.

   b. Turn the positioning knob clockwise (to move Dry Tower outside) or counterclockwise (to move Dry Tower inside) to reposition each tower.

   See Figure 20.

**Figure 20**




The figure above includes:

1. Locking Mechanism
2. Position Scale

6. Position the dispense and take-up tracking sensors so that they will not contact web material during the alignment procedure:

   a. Loosen the black thumbscrews securing the positions of each set of tracking sensors (pay-out and take-up).

   b. Slide each sensor away from the material, and reposition at the farthest extent of its range.

> If you have an optional Dip Tank, it is not adjustable in the y-axis.

See Figure 21.

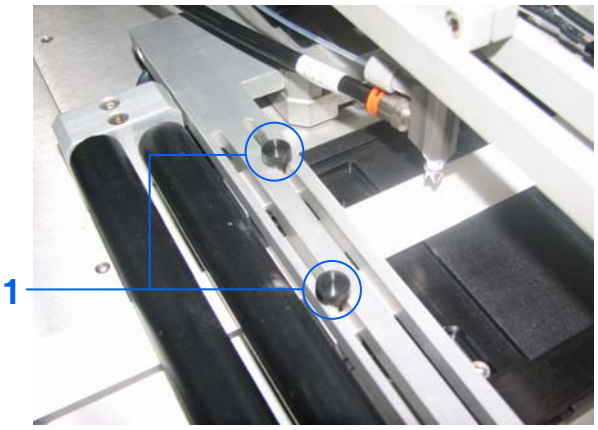
## To position and thread the web material:

1. Obtain a roll of material (wound onto a core of appropriate inside diameter). Locate the spray side of the material, and determine whether the roll has an interior or an exterior wind:

   a. If interior wind, you will position the roll so that the material will pay out in a counterclockwise direction (or, from the left side of the roll).

   b. If exterior wind, you will position the roll so that the material will pay out in a clockwise direction (or, from the right side of the roll).

**Figure 21**




The figure above includes:

1. Dispense Tracking Sensors

**Figure 22**

The figure above pictures material on a pay-out reel with an interior wind.

> The reel-to-reel standard hub size is for a 3-inch diameter (75 mm) roll core; you will need material with a roll core of this size unless your unit is equipped with custom hubs.

See Figure 22.

2. Remove the payout reel outside flange. Pull up on the flange lever to release flange, and remove.
3. Position the roll on the payout reel flange in the appropriate orientation (for an interior or exterior wind).
4. Replace the payout reel outside flange on the reel shaft without retightening the flange lever.

> Tightening the flange lever before attempting to pull material from the roll will require you to place a detrimental force on the drive motor. At this stage, the roll of material should be allowed to “slip” on the reel for the purposes of threading the machine.

5. Place an empty roll core, whose width is greater than that of the web material, onto the take-up reel.

> The roll core on the take-up reel must have a width that is greater than the material itself (.5 inches or more is recommended), to prevent damage to the edge of the material.

6. Route the web material through the reel-to-reel:

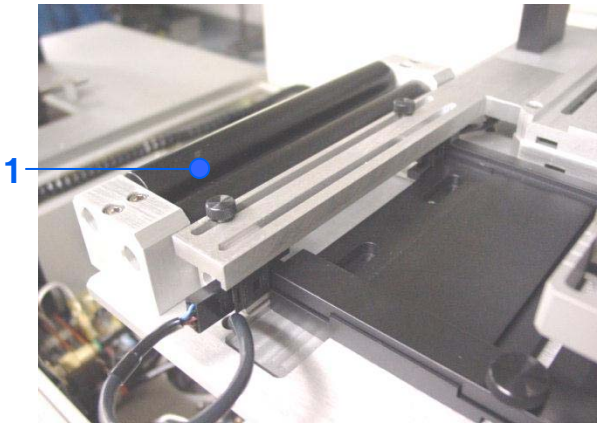
> If for some reason the pinch rollers of the drive capstan are closed, check first to ensure that the air hoses are connected and a minimum pressure of 20 PSI has been attained. If air pressure is correct and drive capstan rollers are engaged, refer to the section “Part 2: Running the Web” on page 29.

a. Pull a length of web material from the roll, and loop it under the first (crowned) roller (left to right).

b. Thread the web through the remaining rollers (if applicapble) on the payout side by looping it over or under the rollers in an alternating fashion.

c. Thread the web beneath the first set of guidance rollers (and between dispense tracking sensors, if installed) and through the dispensing nest. See Figure 23.

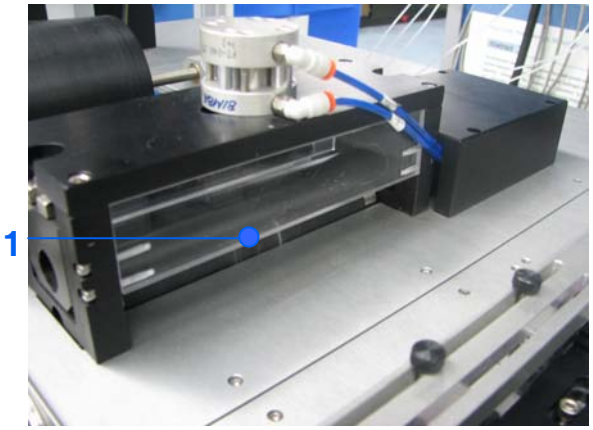
**Figure 23**




The figure above includes:

1. Guide Rollers

**Figure 24**




The figure above includes:

1. Pinch Rollers

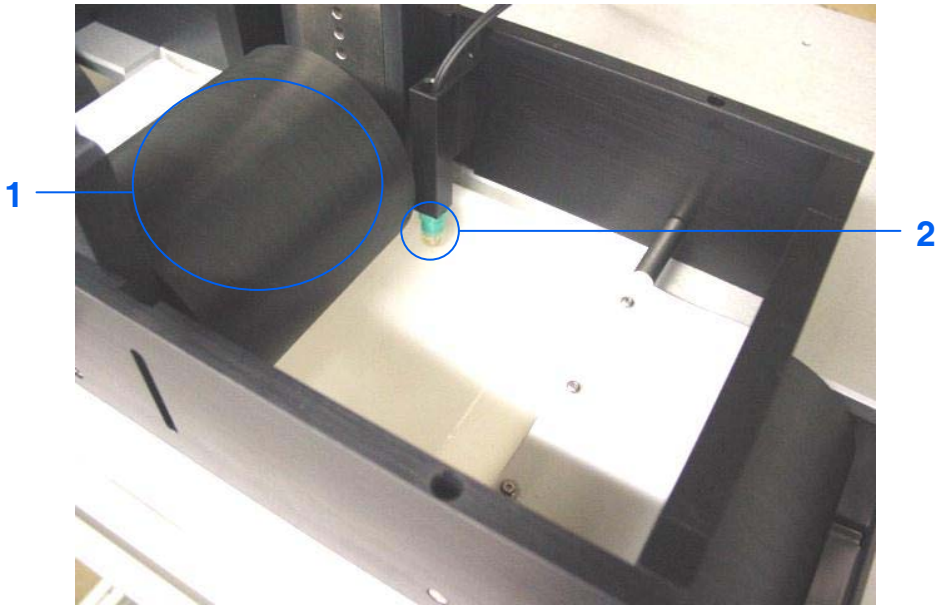
d. Thread the web between the pinch rollers of the drive capstan. See **Error! Reference source not found.**.

e. If an optional Dip Tank is installed, lift the Dip Tank immersion roller to allow routing of web material:

- Pull each locking bolt out and away from the Dip Tank assembly.
- Lock each bolt in the open position by rotating ¼ turn while holding out.
- With bolts locked open, lift roller out of Dip Tank to the desired height.
- While holding roller at desired height, release bolts one at a time.

  See Figure 25.

**Figure 25**




The figure above includes:

2. Immersion Roller
3. Fill Sensor

f. If an optional Dry Tower is installed, route the web through the Dry Tower: See Figure 26 and Figure 27.

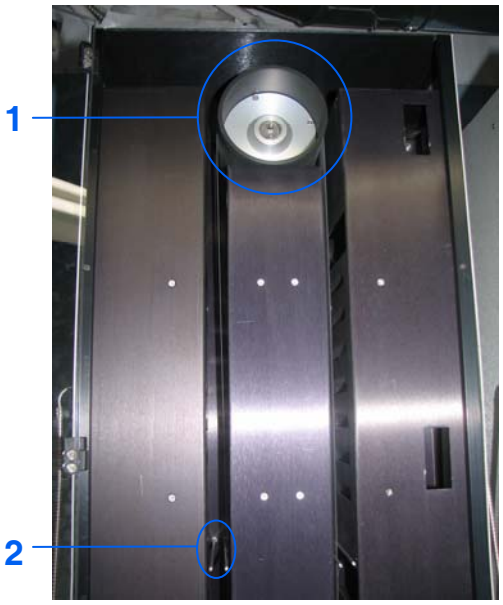
- Route the web beneath the entrance crowned roller at the base of the Dry Tower.
- Route the web vertically through the Teflon guide pins on the upstream side of the Dry Tower, and over the crowned roller at the top.
- Route the web down through the Teflon guide pins on the downstream side, and beneath the exit crowned roller.

**Figure 26**


The figure above includes:

1. Web
2. Dry Tower Entrance Guidance Roller
3. Dry Tower Exit Guidance Roller

**Figure 27**




The figure above includes:

1. Dry Tower Top Roller
2. Teflon Guides

g. Route the web beneath the guidance roller on the entrance side of the environmental chamber (if installed) and over the top of the first crowned roller in the take-up module.

h. Thread the web through the remaining rollers on the take-up side (if applicable) by looping it over or under the rollers in an alternating fashion.

i. Thread the web between the last set of guidance rollers. See Figure 26.

7. Tape the free end of the web material to the center of the take-up roll core.

8. Tighten the payout reel flange lever.

To align the mechanical system components and crowned rollers:

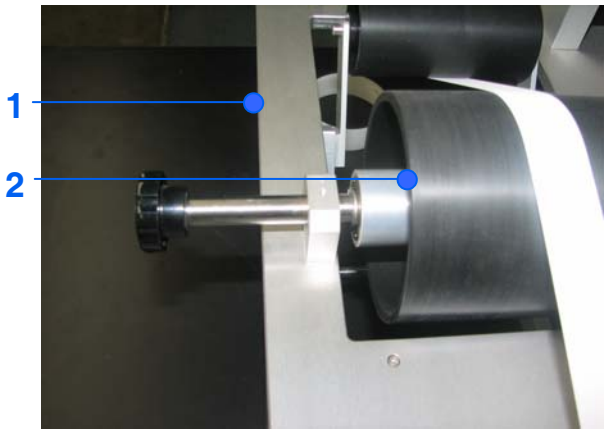
> In order to assure that the web material will run smoothly through the system and spool cleanly onto the take-up reel, the mechanical system components must be centered relative to the web, and the web must be properly centered on the crowned rollers.

1. Position the crowned rollers:

a. Position the first crowned roller (pay-out side) so the highest point of the crown is located in the center of the web material.

b. Measure the distance from the outside edge of the first crowned roller to the outer edge of the machine base. See Figure 28.

**Figure 28**




The figure above includes:

1. Chassis Edge
2. Roller Edge

c. Transfer this measurement to the remaining crowned roller on the payout side, and to those in the take-up module.

d. If an optional Dry Tower module is installed, transfer this same measurement to the crowned rollers in the Dry Tower: use the Dry Tower positioning knob to align each tower.

2. Center the dispensing nest:

a. Move the entire nest forward, if necessary, so that the web is not dragging against the back edge guide and clears the nest without risk of damage. The web does not need to be centered in the nest.

b. Optionally, move the front edge guide of the dispensing nest into the web, to provide a datum edge for the web to track against.

See Figure 18 (on page 22).

> It is not necessary for the web to contact the edge guide, as the dispense and take-up tracking will stabilize web position after alignment. Through experimentation, you may choose to use the edge guide if you find that your material requires extra stabilization (depending on texture, weight, etc.).

## Part 2: Running the Web

At this point your machine should be ready to begin running web material. This section first explains the basic aspects of the hand-held terminal (HHT) that will allow you to operate the reel-to-reel unit. It then explains how to run web material in the unit for the first time.

The process to run the web includes the following tasks:

1. Understand how to operate the HHT.
2. Run your material to find the crowns.

> This section explains how to operate the HHT by use of a short tutorial, which is designed to familiarize you with the keypad and menu structure of the HHT. Refer to the chapter "RR4500 Operation," which begins on page 55, for a detailed description of menu hierarchies and programming instructions.

Use the following tutorial to help understand how to operate the HHT:

1. Confirm that system electrical and pneumatic systems are energized.
2. Confirm that the HHT is properly connected to the reel-to-reel; the coiled cord for the terminal should be plugged in to the outlet labeled "terminal," located on the back of the reel-to-reel dispensing module.
3. Each time power is restored to the unit, the terminal will display a start-up screen with the software version number. Press ENTER to go to the terminal main menu.

> If the terminal displays the words "Factory Mode" upon start-up (start-up screen only), contact us immediately using the information in "Contact Information" on page ix.

4. In the remaining steps, you will simply navigate the relevant sections of the HHT menu set. From the terminal main menu, locate the menu options listed below (two of six options listed on the terminal main menu):

   ➔ **PROGRAM**

   ➔ **SYSTEM UTILITIES**

   During this procedure, you will use only these two menus.

5. To select an option, use the up and down arrow keys to bring the pointer to the desired option, and then press ENTER. Select the SYSTEM UTILITIES option now. This will bring up the system utilities menu:

   ⇨ CAPSTAN/TRACKING

   ⇨ MARKER

   ⇨ STATISTICS

   ⇨ WATCH INPUTS

   Again, by using the up/down arrow keys, select CAPSTAN/TRACKING and press ENTER.

6. The following menu options, each representing a system utility, will be displayed:

   ⇨ TCM (ON/OFF)

   ⇨ DRIVE CAPSTAN (ON/OFF)

   ⇨ DIP TANK (ON/OFF)

- ⇨ DISP TRACK (ON/OFF)
- ⇨ TAKEUP TRACK (ON/OFF)

These are toggle menus; each of the utility options shown (i.e., On versus Off) may be selected by pressing the ENTER key to toggle between the two (it is not necessary to change any of the current settings at this point).

7. Press the ESC key several times until you return to the main menu.
8. From the main menu, select the PROGRAM menu, which will bring up the following options:
   - ⇨ SELECT (NAMES OF CREATED PROGRAMS; THIS OPTION WILL ONLY BE DISPLAYED IF > 1 PROGRAM HAS BEEN INPUT)
   - ⇨ EDIT
   - ⇨ CREATE (PROGRAM NAME)
   - ⇨ DELETE (NAMES OF CREATED PROGRAMS)

   Refer to Refer to the chapter "RR4500 Operation," which begins on page 55, for a detailed explanation of the PROGRAM menu options.

> There is most likely a single program option currently stored in the terminal database. Therefore, the SELECT option will probably not be offered, unless you have arranged for special, preinstalled programs.

9. Select the EDIT option, which will display the program parameters of the only program available (in most instances); SAMPLE ONE:
   - ⇨ NAME: SAMPLE ONE
   - ⇨ FEED: CONTINUOUS (FACTORY SET – NO OTHER OPTION AVAILABLE)
   - ⇨ LENGTH (M): (PARAMETERS WILL VARY, DEPENDING ON YOUR SYSTEM)
   - ⇨ SPEED (MM/S): (PARAMETERS WILL VARY, DEPENDING ON YOUR SYSTEM)
   - ⇨ ACC (MM/S2): (PARAMETERS WILL VARY, DEPENDING ON YOUR SYSTEM)
   - ⇨ DRIVE CAPSTAN: YES (TOGGLE MENU - YES/NO)
   - ⇨ DIP TANK: YES (TOGGLE MENU -YES/NO)
   - ⇨ DISP TRACK: YES (TOGGLE MENU -YES/NO)
   - ⇨ TAKEUP TRACK: YES (TOGGLE MENU -YES/NO)
   - ⇨ TCMS: YES (TOGGLE MENU -YES/NO)
   - ⇨ TANDEM N: (CHECKMARK IF ENABLED)
10. If there is >1 program option, listed under the SELECT menu, select program SAMPLE ONE now.

### To run your material to find the crowns:

1. You will now run a few meters of material and observe the way it is tracking through the system. Return to the main menu by pressing the ESC key on your keypad until the main menu appears.

   This step is optional; you can run a program from any screen. However, please note that certain screens will not allow system status information (data given while the unit is running) to be displayed.

2. Run the program SAMPLE ONE: press the GO key on your keypad. To stop the reel-to-reel, press the ABORT key.

3. Allow the material to run for several meters as you observe the tracking behavior.

4. Make any necessary adjustments to the crowned rollers, so that the web is tracking in a straight line, over the center of each roller, and is being taken up on the take-up reel without damage to the material edges.

5. If adjustments to the positions of the pay-out/take-up reels are necessary, press the ABORT key to stop the machine before making adjustments.

6. When you are satisfied that the web is tracking correctly, position the take-up tracking sensors so that they are able to monitor the tracking of the web (the dispense tracking will come into play in the next chapter). While the unit is running, move each take-up tracking sensor (one at a time) until it just “sees” the web material. You will hear the sound of the take-up reel adjusting position when the sensor sees the edge of the material. Now, very slowly, back the sensor away from the web until you hear the movement of the take-up reel stop.

There may be additional alignment steps that are necessary for your particular material or procedure (i.e., the addition of extra weight to the dancer arms). In most cases, all necessary measures for alignment of your material will have been determined during the assembly and testing of your instrument. However, additional alignment techniques may be employed (and recorded) during set-up. If you encounter difficulties with the alignment of you material after set-up is complete, contact us using the information in “Contact Information” on page ix.

You are now ready to begin inputting your own programs. If you will be dispensing onto your material, read through the chapter “Dispenser Installation,” which begins on page 33.

CHAPTER 5

# DISPENSER INSTALLATION

## Introduction

This chapter discusses the steps for installing dispenser kits with the RR4500 system. BioDot dispensers are designed to install quickly and easily, and with few tools required. A BioDot technician will perform most of these tasks for you on site; however, it is important that you as the user become familiar with the basic installation procedure.

Installing a dispenser kit consists of the following tasks:

1. Install the Syringe Pump.
2. Install the BioDot dispenser.
3. Install the In-Line Degasser.

This chapter explains how to perform all of these installation tasks. If you find that the information here is insufficient or not applicable to your particular dispensing application, contact us using the information in “Contact Information” on page ix.

The instructions in this chapter assume that you have already installed the RR4500 system, discussed in the chapter “RR4500 Installation” on page 17.

### Tools/Equipment

You will need the set of Allen wrenches that is provided with the RR4500 system.

## Syringe Pump Installation

The Syringe Pumps require proper connection to the system platform central processing unit (CPU), via the cable assembly “COM” line or harness; proper connection to system platform power via the cable assembly AMP connector; and proper connection to each other via the cable assembly connectors (one for each standard pump). Refer to Figure 29 and Figure 30 while performing the installation procedure.

> If you are installing BioJet Plus™ pumps, refer to the BioDot OEM pump manual for details.

### To unpack the Syringe Pumps:

1. Remove the syringe pump(s) from the packing container, and carefully remove from the plastic wrapping.
2. Locate the packing checklist that is provided with the instrument. Review this list to confirm that all ordered parts, tools and accessories are accounted for. If an item is missing, contact us using the information in “Contact Information” on page ix.

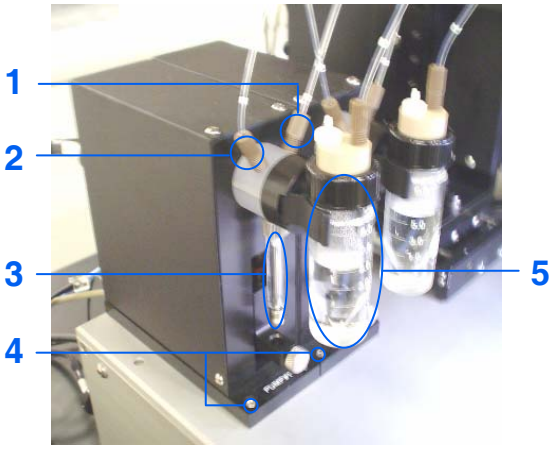
> Syringe Pumps are fully assembled on arrival and may already be attached to the platform depending on the unit. You may need to remove the blue pump valve cover and attach the bottle clip with the supplied hardware.

> **DO NOT** attempt to take a Syringe Pump apart without first contacting BioDot Support Service. Attempting to disassemble a dispenser could damage the instrument and will void your product warranty.
>
> **DO NOT** remove any cable with the power on.

### To install the Syringe Pumps:

1. If pumps require mounting:
   a. Locate the two pre-drilled attach points for the syringe pump(s) on reel-to-reel platform.
   b. Attach the syringe pump(s) to the reel-to-reel platform using the two No. 6-32 x ½ inch long socket head cap screws provided.
   c. Once the pumps are mounted to the platform, connect the cable assembly connector to the syringe pumps rear 15-pin connector (standard pump). Secure the connector with the screws in the connector housing. Repeat this process for all of the syringe pumps.
   d. Connect the 9-pin serial interface cable labeled “COM” from the cable assembly to the platform connector labeled “COM”.
   e. Locate the AMP connector for the syringe pump(s). Insert the connector into the corresponding connection on the rear of the module. J1 – J1, etc.

**Figure 29**




The figure above includes:

1. Reagent Feed Line Connection
2. Bottle-to-Syringe Connection
3. Syringe
4. Cap Screws
5. Supply Bottle

**Figure 30**


The figure above includes:

1. Harness Connection – Pump
2. Power Cord Receptacle
3. Harness Connection – Back of Platform
4. COM Connection

There may be some variation in labeling of plugs and jacks.

2. Fit a syringe of appropriate size to the pump:
   a. Insert plunger all the way inside the syringe barrel prior to installation.
   b. Screw the syringe barrel into the receptacle in the pump valve assembly.
   c. Loosen the plunger thumbscrew on the base of the syringe plunger arm. Slide the syringe plunger out of the syringe barrel by pushing gently downwards on the plunger arm, and position the bottom end of the plunger in the plunger arm receptacle.
   d. Re-tighten the plunger arm thumbscrew to secure syringe.
3. Attach supply line tubing to the syringe pump:
   a. Feed supply line tubing into the supply reagent bottle via the HPLC connector provided, and secure the lid in place; attach the other end of the supply line to the left-hand port of the 3 port valve on the syringe pump via the HPLC connector provided. Screw the BioJet Plus

dispense line into the output (dispense) side of the syringe pump 3 port valve assembly. Right hand port.

b. If using Quanti™ dispensers, attach the other end of the dispenser line to the dispenser as discussed in the appropriate Dispenser installation section.

c. If dispensing with the Syringe Pump only, attach an appropriate tip to the end of the supply line for direct dispensing per your application.

4. Restore power and test the Syringe Pump (refer to the section “Syringe Pump Operation” on page 73).

> We have not included specific testing protocols for the Syringe Pump, as it is (compared to the BioJet™ dispenser) a far less complex dispenser to set up and use. If problems arise, refer to the product documentation for your Syringe Pumps or contact BioDot Support Service.

## BioDot Dispenser Installation

The following sections are based on specific types of dispensers. Use the installation instructions in the section(s) appropriate for your configuration.

### BioJet Quanti

The instructions in this section apply to the 3000 and 4000 models of the BioJet Quanti™ dispenser.

To unpack the BioJet Quanti dispenser:

1. Remove the BioJet(s), support arm, and reagent supply lines from the packing container; carefully remove from inner wrapping material.

2. Locate the packing checklist that is provided with the instrument. Review this list to confirm that all ordered parts, tools and accessories are accounted for. If an item is missing, contact us using the information in “Contact Information” on page ix.

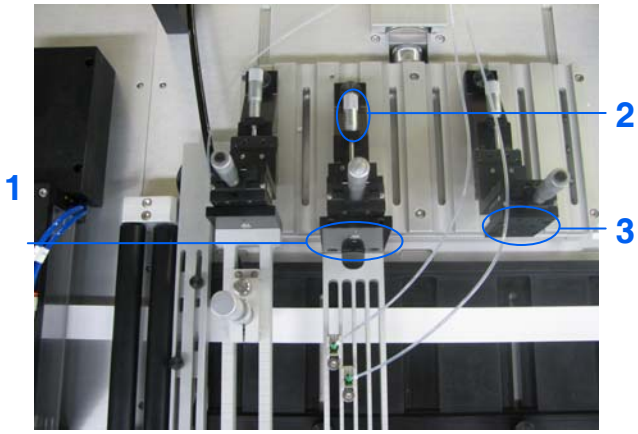
> BioJet dispensers are fully assembled on arrival and attached to a small mounting bracket by which it is mounted to the support arm.
>
> Refer to “BioJet Quanti 3000 Dispenser” on page 111 if you would like information on the basic construction of the BioJet Quanti.

> **DO NOT** attempt to take a dispenser apart without first contacting BioDot Support Service. Attempting to disassemble a dispenser could damage the instrument and will void your product warranty.

To install the BioJet Quanti dispenser:

1. Ensure platform power is off.
2. Ensure the Syringe Pump is installed (refer to “Syringe Pump Installation” on page 33).
3. Attach the BioJet support arm to the Vertical Positioning Platform (in some systems the support arm will be attached to the system platform at the factory and may attach and look differently) using the supplied hardware (see Figure 31)

**Figure 31**




The figure above includes:

1. Vertical (z-axis) Positioning Stage with Micrometer
2. Horizontal (y-axis) Positioning Stage with Micrometer
3. Support Arm (shown without dispenser)

4. Mount the BioJet Quanti Dispenser(s) (via the small mounting bracket) to the support arm using the supplied hardware (see Figure 31).
5. Obtain the coaxial cable(s) provided for dispenser hook-up (standard pumps).
6. Connect the coaxial cable to the BNC connector marked BioJet #1, as shown in Figure 33.
   a. Push the cable connector onto the BNC connector to engage.
   b. Turn the cable connector ¼ turn clockwise to lock the connection in place.
   c. Repeat for additional BioJets.

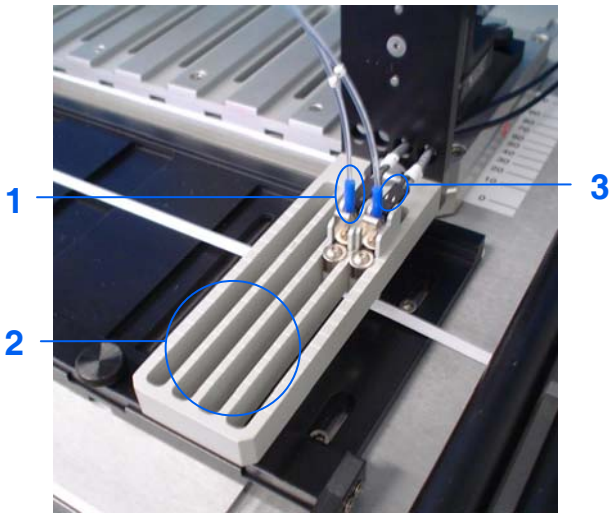
> Where multiple dispensers are installed, the first dispenser must be connected to the connector labeled BioJet #1, the second one to BioJet #2, etc. Their order (BioJet #1, BioJet #2, etc.) corresponds to their position on the platform from left to right (where the user is facing the front side of the unit). Do not skip any connectors.

7. Connect the opposite end of the cable to the BioJet by pushing the cable connector onto the exposed pins on the back of the dispenser (without regard to connector orientation).
8. Connect the free end of the reagent supply line from the syringe pump to the BioJet inlet port. This may be a bore end or a BioJet Plus end (refer to **Error! Reference source not found.**, on page **Error! Bookmark not defined.**). Insert the bore end over the barbed fitting and slide the green locking sleeve over the connection. If it is a BioJet Plus fitting screw the fitting into the top of the BioJet valve and tighten.

9. Restore power and test the dispenser (refer to the section “BioJet Quanti 3000 Operation” on page 70).

> If your system includes a Line Presence Inspection System, you will need to install the fiber optic wires for this system. Refer to the section “Line Presence Inspection System Installation” on page 50 for information on installation of this optional system.

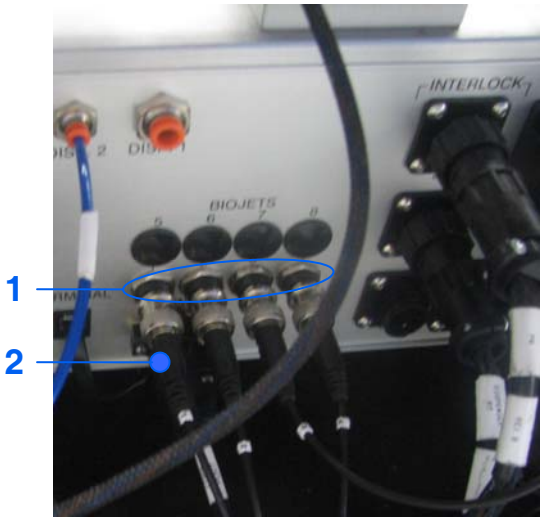
**Figure 32**




The figure above includes:

1. Barbed Fittings with Locking Sleeves
2. Adjustable Slide Bracket
3. Dispenser End of BioJet Power Cable

**Figure 33**




The figure above includes:

1. BCN Connectors
2. BioJet Power (Coaxial) Cable

## AirJet Quanti

The instructions in this section apply to the 3000, 2300, and 2400 models of the AirJet Quanti™ dispenser.

To unpack the AirJet Quanti dispenser:

1. Remove the AirJet™ dispenser(s) and air and reagent supply lines from the packing container; carefully remove all components from inner wrapping material.
2. Locate the packing checklist that is provided with the instrument. Review this list to confirm that all ordered parts, tools and accessories are accounted for. If an item is missing, contact us using the information in “Contact Information” on page ix.

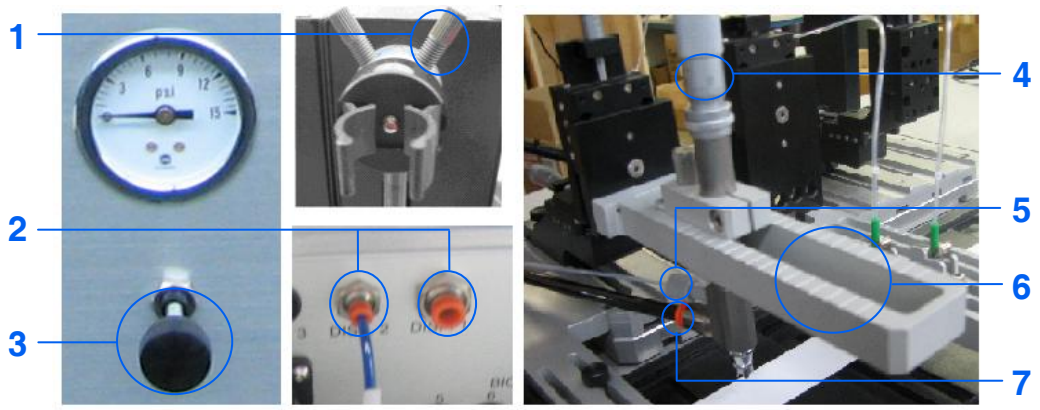
AirJet dispensers are fully assembled on arrival. Refer to “AirJet Quanti Dispenser” on page 112 if you would like information on the basic construction of AirJet dispensers.

**DO NOT** attempt to take an AirJet apart without first contacting BioDot Support Service. Attempting to disassemble a dispenser could damage the instrument and will void your product warranty.

### To install the AirJet Quanti dispenser:

1. Ensure platform power and air pressure are off.
2. Ensure the Syringe Pump is installed (refer to “Syringe Pump Installation” on page 33).
3. Attach the support arm assembly (AirJet mounting bracket attached) to the dispensing platform using the four No. 6-32 x ½ inch long socket head cap screws provided, if necessary (it is usually already mounted on the platform).
4. Secure the AirJet inside the mounting bracket:
   a. Position the AirJet inside the split-clamp, with the air and reagent line inlet ports facing back.
   b. Tighten the split-clamp knob to secure the AirJet.
5. Attach the supplied air line to the air inlet port (lowermost port) in the lower back portion of the AirJet by screwing the ¼ inch quick connect fitting to the AirJet air inlet port (see Figure 34).

**Figure 34**




The figure above includes:

1. Reagent Feed Line Connection
2. Airline Quick Connect Fittings (On Instrument's Back Panel)
3. AirJet Regulator
4. Needle Micrometer Barrel
5. Reagent Feed Line Connection to AirJet
6. Adjustable Mounting Bracket
7. Airline Quick Connect Fitting (On Back of AirJet)

6. Attach the other end of the airline to the mating receptacle labeled AIRJET or DISP *n* (where *n* is the AirJet number from left to right where 1 or more AirJet dispensers are installed) on the system platform rear panel. Insert the fitting into the air outlet receptacle and twist clockwise to lock in place (see Figure 34).

> There may be slight differences between system platforms in the label assigned to the AirJet air outlet receptacle.

7. Attach the reagent supply line, via the ¼-28 HPLC fitting provided, to the supply line inlet port (uppermost port) in the lower back portion of the AirJet (see Figure 34).

8. Locate the AirJet air pressure gauge on the front of the system platform-dispensing module. Lower AirJet air pressure gauge to a minimal pressure before AirJet operation. Turn the knob counter-clockwise to lower the pressure to an appropriate operation level (per your dispensing application).

> The adjustment knobs of the front panel air regulators are fully inserted, at the maximum pressure setting, prior to shipment to prevent damage to the knobs. The gauge pressure should be lowered to a minimal pressure before air pressure is applied to the unit.

9. Restore power and air pressure and test the AirJet (refer to the chapter “Dispenser Operation,” which begins on page 63.

> We have not included specific testing protocols for the AirJet dispenser, as it is (compared to the BioJet) a far less complex dispenser to set up and use. Refer to the section “AirJet Dispenser Troubleshooting” on page 104 if problems arise.

## Frontline Quanti 1000

The Frontline Quanti™ dispenser is very easy to set up and use. The dispenser simply attaches to the vertical positioning stage, and is secured by a screw. Adjust the position of the dispenser, as described in the following instructions.

> The Frontline dispenser may be facing in either direction depending on the application and platform on which it is being used.

### To unpack the Frontline Quanti 1000 dispenser:

1. Remove the dispenser(s) from the packing container, and carefully remove the dispenser from its plastic wrapping.

> The dispensers may already be attached to the head assembly.

2. Remove the head assembly from the protective box and install on the platform with the supplied hardware.

> Frontline Dispenser tips are fragile and should be handled with care.

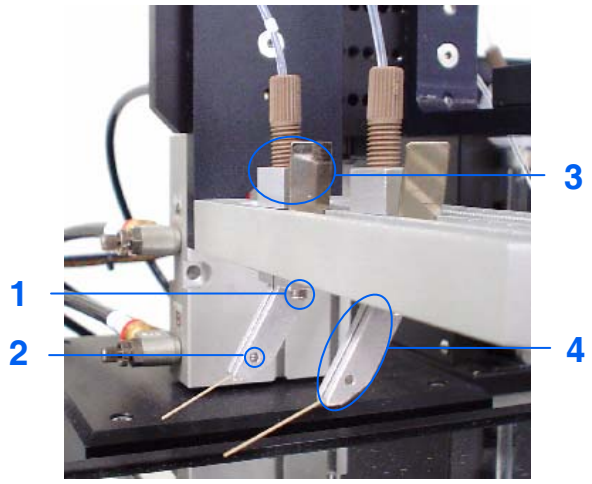
3. Locate the packing checklist that is provided with the instrument. Review this list to confirm that all ordered parts, tools and accessories are accounted for. If an item is missing, contact us using the information in “Contact Information” on page ix.

### To install the Frontline Quanti 1000 dispenser:

1. Ensure the system power is off.
2. Ensure the Syringe Pump is installed (refer to “Syringe Pump Installation” on page 33).
3. Secure support arm attach plate to vertical positioning stage using the supplied hardware (see Figure 35).
4. Loosen the locking screw, depress the spring lock and slide the dispenser to the desired location. Release the spring lock and secure the position with the locking screw.

5. Screw the supply line tubing assembly(s) from the syringe pump into inlet ports on the downstream side of the dispenser.

**Figure 35**




The figure above includes:

1. Locking Screw
2. Dowel Pin
3. Frontline Body
4. Frontline Tip Support

6. Restore power and test dispenser (refer to the chapter “Dispenser Operation,” which begins on page 63, for dispensing instructions).

We have not included specific testing protocols for the Frontline dispenser, as it is (compared to the BioJet) a far less complex dispenser to set up and use. If problems arise, perform the appropriate weekly cleaning and decontamination procedures in the chapter “Dispenser Cleaning and Maintenance,” which begins on page 87, or contact BioDot Support Service.

## In-Line Degasser Installation

### To unpack the ILD4000 In-Line Degasser:

1. Remove all parts from the packing container.
2. Set the parts on a surface near the instrument to which the Degasser will be attached.

### To install the ILD4000 In-Line Degasser:

1. Disconnect the source bottles/vials from the Syringe Pumps and set the bottles/vials aside.
2. Locate the tubing that came with your In-Line Degasser.

3. Screw one end of this tubing in to the front of the In-Line Degasser, in the connections labeled Pump 1-4.

4. Screw the other end of each tubing into the appropriate syringe pump by matching the pump number located on the front of each pump with the corresponding number on the front of the In-Line Degasser:

   a. Before you connect your tubing, locate the tubing filters.

   b. Attach filter to HPLC fitting (Delrin/Blue ferrule) on the tubing that is placed inside the source bottle.

CHAPTER 6

# OPTIONAL COMPONENTS INSTALLATION

## Introduction

This chapter explains how to install the following optional components with your RR4050 system:

- Dip Tank
- RR3130 Dry Tower

### Tools/Equipment

You will need the set of Allen wrenches that is provided with the RR4500 system.

## Dip Tank Installation

This section describes the actions necessary to prepare the Dip Tank for operation. After completing this section, the unit will be ready for reeled material coating or washing.

### To unpack the Dip Tank:

1. Remove the Dip Tank from the shipping container by lifting it from the bottom of the unit.

> When removing the Dip Tank from its shipping container, pick it up from the bottom of the unit. If you pick the unit up by the micrometer or by the rollers, you may misalign or permanently damage the unit.

2. Locate the packing list that is provided with the instrument. Review this list to confirm that all ordered parts, tools and accessories are accounted for. If an item is missing, contact us using the information in “Contact Information” on page ix.

   The Dip Tank comes with a variety of options. You can match the list of options on the packing list to the options physically present on the unit.

To install the Dip Tank:

1. Place the unit in the reel-to-reel sequence where it will be operated. Leave enough room around the unit to allow access to power cords. See Figure 36.

**Figure 36**

Pictured above is the Dip Tank module.

2. Place the BioDot Dip Tank into the support platform. Mount the unit in the reel-to-reel platform line with the vertical micrometer facing toward the Dry Tower. The power squeegee will remove retained liquid in the reeled material before it enters the Dry Tower. See Figure 36.

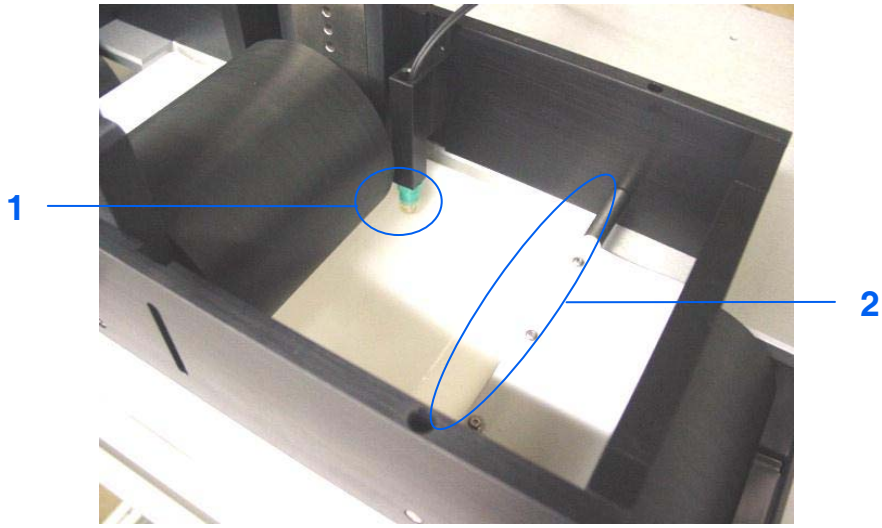
3. Verify that the main power switch located on the back of the pump box is in the off position. (When the fluid pump option has been installed.)

4. Verify that the main power switch located on the back of the reel-to-reel unit is in the off position.

5. Connect the 4-pin Molex power connector from the power squeegee to the master power source on the reel-to-reel. These connectors will have matching labels.

6. Adjust the height of the fluid-leveling sensor as necessary. Connect the 3-pin amp connector to the connection located on the back of the pump box. See Figure 37.

**Figure 37**




The figure above includes:

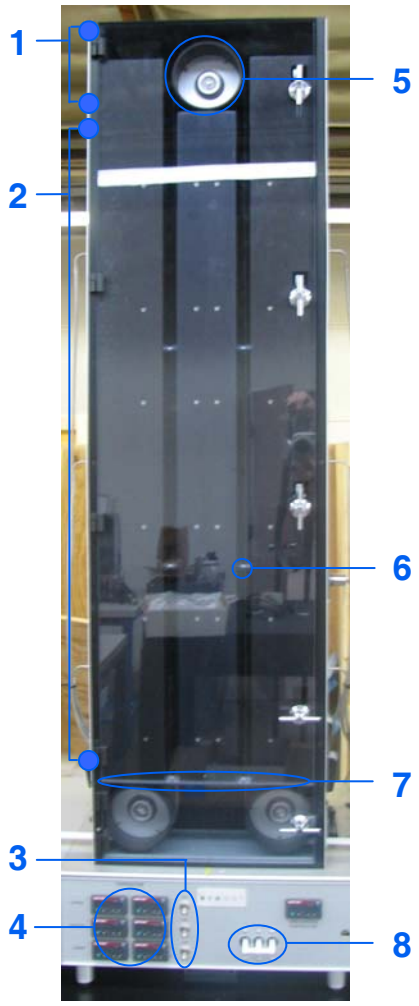
1. Fluid Sensor
2. Squeegee

7. Install the pump on the front side of the pump box. First locate the metal mounting tab on the rear surface of the pump. Then rotate the pump body clockwise until an audible click is heard.
8. Attach the refill tubing to the inlet on the BioDot Dip Tank. Select the appropriate tubing for the reagent that will be used in the Dip Tank.
9. Route the tubing through the fluid pump and close the pump top by rotating downward. The pump tubing should exit the pump on either side and be held firmly in place.
10. Connect the remaining end to the solution reservoir.
11. Place the submersion roller into the Dip Tank. Note there are several height settings for the placement of the submersion roller.
12. Set up the optical liquid leveling sensor. The tip of the fiber will just touch the liquid at the level desired. Adjust the mount up and down as necessary. The BioDot Dip Tank is now ready for operation.

Do not pull the fiber-optic cable on the level sensor, as this will permanently damage the sensor.

## RR3130 Dry Tower Installation

**Figure 38**




The figure above includes:

1. Exhaust Module
2. Drying Modules
3. On/Off Switches for Drying Modules
4. Temperature Controls
5. Roller Assembly
6. Support Rod and Teflon Guide
7. Drip Tray
8. Main Circuit Breaker

The information in this section assumes that a complete Dry Tower System is being installed rather than individual modules. Refer to Figure 38 for interconnections and how to route membrane.

### To unpack the Dry Tower:

1. Remove the Dry Tower from the shipping container.
2. Locate the packing list that is provided with the instrument. Review this list to confirm that all ordered parts, tools and accessories are accounted for. If an item is missing, contact us using the information in “Contact Information” on page vii.

### To install the Dry Tower:

1. Set the control module on a work platform situated between both the Dip Tank and reel-to-reel dispenser platform and the take-up reel or cutter. All modules contain alignment pins and holes (for positioning each to its adjacent module). Engage the appropriate modules to the corresponding pins and holes on the control module.
2. Assemble the two roller assemblies to the projecting shafts, located on the front of the control module. These are attached using the bearing washer and quarter-turn fastener supplied. There is no orientation to observe when assembling these roller assemblies because they are symmetrical.
3. Position the corresponding hinge pegs with those on the control module. Using the latch, the door should freely hinge, shut, and latch.
4. Assemble the drying module on top of the control module. This is completed by engaging the four projecting pins on top of the control module with the matching holes on the bottom of the drying module. Secure the four-draw down latches at the interface between modules by first engaging, then snapping shut the

four draw down latches.

**Figure 39**


The figure above includes:

1. On/Off Switches for Drying Modules
2. Temperature Controls
3. Main Circuit Breaker

**Figure 40**


The figure above includes:

1. Thermo Couple Connectors (6)
2. AMP Connectors

5. Install the four stainless steel rods into the mounting holes, located near the bottom of the front bulkhead on the drying module. These project forward and are used to centralize the membrane within the drying passageway. Assemble the replaceable Teflon® guides by sliding over the rods.

6. Assemble the door assembly to the drying module by using step 3 above. When closing, make sure the stainless steel rod ends nest in the pocketed recesses in the door. Adjustments can be made by slightly bending the rods (if necessary) to insure proper fit.

7. Attach the power and the thermocouple connectors with appropriate matching connectors, which are located at the rear panel of the control module. See Figure 40 for interconnection information.

8. For each additional drying module used, repeat steps 4 through 7.

9. Install the exhaust module to the top of the drying module by attaching the four projecting pins on top of the drying module with the matching holes on the bottom of the exhaust module. Secure in place as in step 4.

10. Assemble the single roller assembly to the projecting shaft, located on the front of the exhaust module as in step 2.

11. Connect the door assembly to the exhaust module as described in step 3.

12. Connect the exhaust module power plug to the receptacle on the control module. See Figure 40 for interconnection information.

13. A 4” (10cm)-diameter exhaust ducting can be attached to the duct on the top of the exhaust module to remove air, which may contain chemical components released during the drying of membrane or the absorbent media.

14. Supply electrical power to the control module from an appropriate power source.

> The incoming power cord must be terminated to a NEMA L21-20S receptacle.

15. Place the drip tray beneath the two roller assemblies in the control module. This is used to collect any liquid, which may fall from saturated materials prior to the drying process, and may not be necessary in all applications.

## Line Presence Inspection System Installation

This section describes the installation process for the Line Presence Inspection (LPI) system, which is an option available for BioDot dispensing systems to detect the presence or absence of a dispensed line. The LPI system components should be installed with the help of a BioDot technician; proper placement of the fiber optic cables and accurate system calibration is required for the system to perform correctly. Contact BioDot Support Service with questions or to make adjustments to the LPI system.

> Do not attempt to disassemble factory-assembled instruments or components without first speaking with a Support Service representative. Doing so may void your warranty.
>
> A decontamination form must be filled out prior to the return of any dispenser or system. Contact Support Service for the correct form.

### To install the LPI system:

1. Ensure platform power is off.

2. Ensure your BioJet™ dispensers are installed, as discussed in the chapter “Dispenser Installation,” which begins on page 33.

> If an LPI system is included in your dispensing system, your BioJet(s) will have been modified to accommodate the LPI system. A housing for the reflectance sensor and fiber optic wires should be located on the right side of each BioJet dispenser.

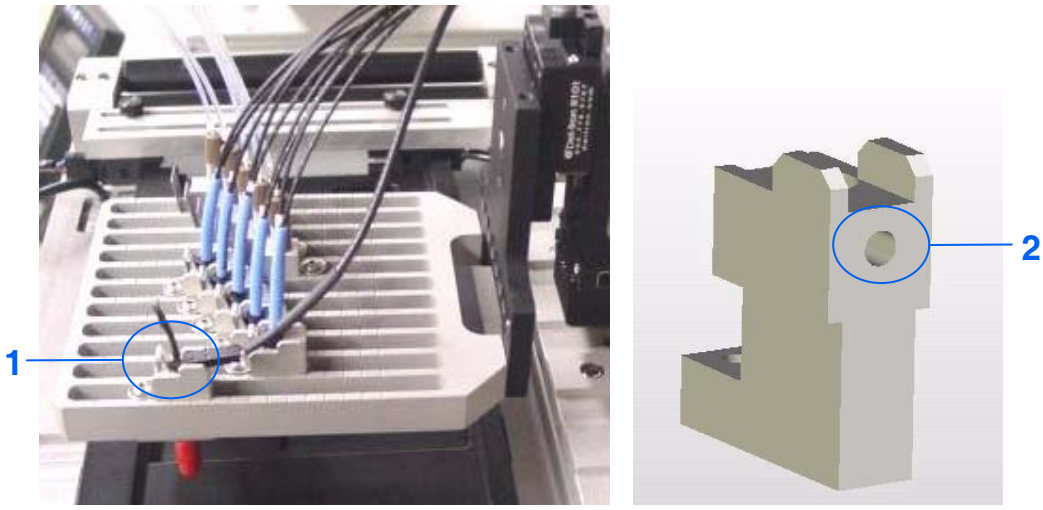
3. Adjust the height of each BioJet to its production height (dispensing height determined by your specific process specifications).

> The LPI system must be recalibrated whenever dispensing height is adjusted to account for changes in the reflectance sensor depth of field.

4. Insert the fiber optic sensor on the right-hand side of each BioJet.

5. Ensure the observed dot of light is in sharp focus on the substrate (web). If the dot of light appears diffuse, adjust the height of the sensor within the slide housing using the small screw on the rear of the dispenser to loosen and then re-secure the sensor (see Figure 41).

**Figure 41**




The figure above includes:

1. Sensor
2. Set Screw

6. Orient the sensor so that the “receive side” (solid black) fiber optic wire is located downstream from the “transmit side” (dotted) fiber optic wire. The receive side of the sensor should be located on the inspection sensor side of each dispenser.

7. Calibrate the reflectance sensor. As calibration requires the exposure of the sensor to the same membrane when wet and when dry (membrane with a dispensed line vs. membrane with no dispensed line). This is most easily accomplished while the system is running:

   a. While the dispenser is running (a light can be observed on the front of the LPI system amplifier), press the SET button on the LPI system amplifier.

   b. Cover/catch the dispensed stream of fluid from the dispenser (so that fluid is no longer dispensed onto the web material) and press the SET button again.

Refer to the Keyence Corporation product information for complete calibration instructions.

PART III

# Operation

CHAPTER 7

# RR4500 OPERATION

## Introduction

This chapter explains how to design, input, and store reel-to-reel web-handling programs using the hand-held terminal (HHT). The chapter focuses primarily on the programming capabilities of the HHT relevant to the reel-to-reel itself. For a more in-depth discussion of dispenser configuration with the HHT, refer to the chapter “Dispenser Operation,” which begins on page 63.

### Tools/Equipment

No additional tools or equipment are required. You will need only the reel-to-reel unit and the HHT.

## Hand-Held Terminal Menu Overview

This section provides a representation of the tree structure of the software menu setup, which is referenced throughout the chapter. The menu hierarchy provided is not an exact replication of the HHT display. The arrows to the left of each entry represent the level (hierarchy) of the given field in the menu structure. For more information on the conventions, refer to the section “Hand-Held Terminal Menus” on page vi.

Reel-to-reel programming primarily involves only four of the five options shown on the main menu:

- PROGRAM
- SYSTEM UTILS
- CONFIGURATION
- DATA STORAGE

The next section shows the hierarchy of these menus, along with their submenus.

### Hand-Held Terminal Menu Hierarchy

➔ **PROGRAM**

⇨ SELECT (NAMES OF CREATED PROGRAMS)

> The SELECT submenu is only available when more than one program has been saved into memory.

- ⇨ EDIT
  - ⇒ NAME: (PROGRAM NAME)
  - ⇒ FEED: CONTINUOUS (FACTORY SET – NO OTHER OPTION)
  - ⇒ LENGTH (M):
  - ⇒ SPEED (MM/S):
  - ⇒ ACC (MM/S$^2$):
  - ⇒ DRIVE CAPSTAN: YES/NO
  - ⇒ DIP TANK: YES/NO
  - ⇒ DISP TRACK: YES/NO
  - ⇒ TAKEUP TRACK: YES/NO
  - ⇒ TCMS: YES/NO
  - ⇒ TANDEM *N*: (CHECKMARK IF ENABLED)
    - → ACTIVE: YES/NO
    - → RATE (UL/CM):
    - → VOL (NL):
    - → PITCH (HZ):
    - → ON TIME (MS):
    - → TRANS N (MS): (TRANSITION PERIOD)
- ⇨ CREATE (PROGRAM NAME)
- ⇨ DELETE (NAMES OF CREATED PROGRAMS)

➔ **PRIME DISPENSER**

- ⇨ TANDEM
- ⇨ DEVICE
- ⇨ ACTIVATE

➔ **SYSTEM UTILITIES**

- ⇨ CAPSTAN/TRACKING

- ⇒ TCM (ON/OFF)
- ⇒ DRIVE CAPSTAN (ON/OFF)
- ⇒ DIP TANK (ON/OFF)
- ⇒ DISP TRACK (ON/OFF)
- ⇒ TAKEUP TRACK (ON/OFF)

⇨ MARKER

- ⇒ PRIME MARKER
  - → PRIMING MARKER

    PRESS ESC TO ABORT

⇨ STATISTICS

⇨ WATCH INPUTS

- ⇒ INPUTS (1 = ACTIVE):

  012345678

  000000001

  HIT ESC TO EXIT

➔ **CONFIGURATION**

⇨ DIR: FORWARD/REVERSE

⇨ LOW ERROR: ON/OFF (OPTIONAL)

⇨ EDIT DISPENSER

- ⇒ EDIT TANDEM BJQ
  - → TANDEM BJQ N
  - → CHANNEL INFO

    CHANNEL 1
  - → SYRINGE (UL): 250
  - → TYPE: XP3000
  - → MODE: HIGH RES/LOW RES
  - → FORCE: QUARTER/HALF/FULL
  - → COM: BIOS/COM1/COM2
- ⇒ EDIT TCMS (TENSION CONTROL MODULE)

- ⇒ TCM 1 (PAYOUT)
  - → ROTATION: INTERIOR/EXTERIOR
  - → ENCODER: (CURRENT ENCODER VALUE)
  - → CENTER: (PRE-SET CENTER VALUE)
  - → HOME STATE: ON/OFF (STATUS)
- ⇒ TCM 2 (TAKEUP)
  - → ROTATION: INTERIOR/EXTERIOR
  - → ENCODER: (CURRENT ENCODER VALUE)
  - → CENTER: (PRE-SET CENTER VALUE)
  - → HOME STATE: ON/OFF (STATUS)

⇨ PRIME (μL/S):

⇨ FILL (μL/S):

⇨ - BAD MARKER -

⇨ FREQ (HZ):

⇨ ON TIME (%):

⇨ HOME (MM/SEC):

⇨ TIMEOUT (MS):

⇨ INDEX (MM/SEC):

➔ **DATA STORAGE**

⇨ SAVE DATA

⇨ LOAD DATA

➔ **SYSTEM INFO**

⇨ SERIAL #

⇨ BIOS

⇨ FIRMWARE

⇨ BDLIB

⇨ KERNEL

⇨ AXIS LIB

⇨ DISP LIB

### Navigating the Menus

The following four keys are used to move through the menu hierarchy:

- The up and down arrow keys move the menu selector up or down one line. The entire menu will scroll upward or downward if the selector is already at its top or bottom position and there are additional menu items above or below the currently selected one.

> The right and left arrow keys are not used.

- The ENTER key will activate the currently selected menu item and either bring up a sub-menu or toggle between fields in a toggle field.
- The ESC key displays the menu above the current one in the hierarchical structure. Continuously pressing ESC will ultimately bring you to the main menu.

## Entering and Saving Data on the Hand-Held Terminal

The three basic options when entering data are to create a new program, edit an existing program, and delete an existing program. When entering data you must immediately save any new program data, or changes you make to existing programs, by selecting SAVE DATA under the DATA STORAGE menu. All data will remain in working memory until it is formally saved in this manner.

### Creating and Deleting Programs

To create a new program, you must first enter a name for the program. After the name is saved into memory, you will then enter the desired web handling parameters for that program under the EDIT submenu.

To create a new program name:

1. Select CREATE under the PROGRAM menu.
2. Type in a program name using the terminal keypad, and press the ENTER key when finished.
3. Immediately save the name:
   a. Use the ESC key to return to the main menu.
   b. Select SAVE DATA under the DATA STORAGE menu.

To enter the program parameters for the new program:

1. Return to the PROGRAM and select EDIT. The EDIT menu, with associated submenus, are shown in the section “Hand-Held Terminal Menu Hierarchy” on page 55. The following is a description of each of the EDIT submenu options:
   - NAME: The name of the current program. To change the name, simply enter a new name and press ENTER.
   - FEED: This is a factory set option, and cannot be changed.

- LENGTH (M): This signifies the total length of material on which dispensing is desired.
- SPEED (MM/S): The rate at which the web will move during the line dispense. Typical values are 50 and 100 mm/sec. (refer to the dispenser rate information on page 107 for information on selecting speed).
- ACC (MM/S): The Acceleration (ACC) is the rate at which the web will accelerate up to the desired speed. Acceptable values range from 12 mm/sec 2 to over 96,000 mm/ sec 2 . You can adjust this rate as necessary. At some web speeds a high acceleration value may stall the motors. Typical acceleration values are around 1,000mm/ sec 2.
- DRIVE CAPSTAN: A toggle field that specifies whether the drive capstan is on or off during the dispense cycle.
- DIP TANK: A toggle field that specifies whether the Dip Tank is being utilized during the dispense cycle. When dipping, this field should be toggled to Yes.
- DISP TRACK: A toggle field which, when toggled to Yes, activates the alignment tracking system for the dispense platform.
- TAKEUP TRACK: A toggle field which, when toggled to Yes, activates the alignment tracking system for the take-up reel.
- TCMS: A toggle field which, when toggled to Yes, activates the tension control system (tension control modules 1 and 2).
- TANDEM *n*: There are *n* of these menu items, one for each dispenser for which the unit is configured. In the menus to which they refer, you enter the dispense cycle parameters for each dispenser. This field is discussed in-depth in the section “EDIT Submenu” on page 68.

2. Use the arrow keys to select menu options where you want to enter data.
3. Enter new data in each menu option field. Press the ENTER key after each completed entry.
4. Save the program:
   a. Use the ESC key to return to the main menu.
   b. Select SAVE DATA under the DATA STORAGE menu. Your new program is now saved (in non-volatile memory).

## Editing an Existing Program

To edit a program, you simply modify the web handling parameters for that program under the EDIT submenu.

To edit a program:

1. Select EDIT under the PROGRAM menu.
2. Select the program to be edited using the arrow keys on the terminal keypad, and press the ENTER key.
3. Make necessary changes, using the arrow keys to select the menu options to be edited, and entering new data on the terminal keypad. Press the ENTER key after each new entry.
4. Save the new data:

a. Use the ESC key to return to the main menu.

b. Select SAVE DATA under the DATA STORAGE menu. Your new program is now saved (in non-volatile memory).

## Running a Program

To run a program:

1. Select a program and press the GO key to run the system. Under continuous mode the screen displays the following:

| | |
|---|---|
| Remain (M): xx.xx | [this is the number of programmed Meters remaining] |
| <GO> Continue | [press the GO key to continue] |
| <ABORT> Abort | [press the ABORT key to abort/stop] |
| <ESC> Reset Length | [press the ESC key to reset the odometer length (and DispVol *)] |

- Once ESC is pressed, the Odometer Length (and DispVol *) is reset and you are asked to GO or ABORT.
- During the run, the display shows the running Odometer (and DispVol *).
- At the end of a run (or if ABORT is pressed), the Odometer (and DispVol *) is displayed again. Press ENTER to return to the Menu.

> Not all systems may have this feature. This only pertains to the first active dispenser due to the screen limitation.

2. Press the ABORT key to stop the system.

CHAPTER 8

# DISPENSER OPERATION

## Introduction

This chapter explains how to design, input, and store dispensing programs for BioDot system platforms using the hand-held terminal (HHT). The chapter focuses on the programming capabilities of the HHT relevant to the dispensers.

You should review this chapter with the HHT in hand. Doing so will help you become familiar and comfortable with the terminal itself. Also, as there are some differences in the menu structure between platforms, you might find it useful to note specifics of your menu programming in the manual as you go along.

## Running a Dispense Cycle with the HHT

The dispense cycle begins and ends with the HHT. Data is entered via the keypad, and the menu structure, stored data, and unit status are displayed on the LCD.

### Navigating the Menus

Four keys are used to move through the menu hierarchy:

- The Up ↑ and Down ↓arrow keys move the menu selector up or down one line. The entire menu will scroll upward or downward if the selector is already at its top or bottom position and there are additional menu items above or below the currently selected one.

> The Right → and Left ← arrow keys are not used.

- The ENTER key activates the currently selected menu item, and either bring up a submenu, or toggle between fields in a toggle field.
- The ESC key displays the menu above the current one in the hierarchical structure. Pressing ESC will ultimately bring you to the Main Menu.

### Starting a Cycle

The dispense cycle, once programmed into working memory, is executed by pressing the GO key on the HHT. The platform will sequentially scan each of the patterns in working memory in order and dispense each selected pattern. If pattern repeat is in use, the platform will move to each grid element and dispense all enabled tasks.

### Aborting a Cycle

A dispense cycle may be interrupted at any point by pressing the ABORT key on the HHT. Any dispensing activity will immediately cease and the slides will be returned to the park position.

Alternatively, the operator may use the Pause Mode key, which allows the operator to pause the platform either before or right after the dispense sequence. The operator can then press GO to resume or ABORT to stop.

> Using the Pause key to pause the platform is useful in confirming dispenser positioning after programming.

### Dispenser Errors

When the platform detects an error condition, it will pause to display the errors to the operator for corrective action. You must acknowledge the error by pressing the Enter key. If the error occurred during a dispense cycle, the cycle will be aborted and the slides retracted to the park position.

## Inputting HHT Programs

### Menu Hierarchies

This section contains a representation of the menu hierarchies within the HHT software menus that pertain specifically to the dispensers. To keep the section concise, fields that do not pertain to the dispensing cycle are omitted. Refer to the chapter “RR4500 Operation,” which begins on page 55, for information on RR4500 system fields.

There are a total of six levels in the hierarchy (the main menu and five submenus). The top level represents the HHT main menu:

- HHT main menu
  - PROGRAM
  - PRIME DISPENSER
  - SYSTEM UTILITIES (system statistics, operation of system components, tracking, line inspection marking, etc.)
  - CONFIGURATION
  - DATA STORAGE
  - SYSTEM INFO (all platforms; deals with HHT software information)

> There are slight menu variations between platforms. The menu trees above are in **FACTORY MODE**. Some of the selections will not be available when you are in non-factory mode.

## Entering and Saving Data on the HHT

The three basic options when entering data are to create a new program, edit an existing program, and delete an existing program. When entering data you must immediately save any new program data, or changes you make to existing programs, by selecting SAVE DATA under the DATA STORAGE menu. All data will remain in working memory until it is formally saved in this manner.

> If the unit loses power, any new programs will be lost if not saved.

### Creating and Deleting Programs

To create a new program, you must first enter a name for the program. After the name is saved into memory, you will then enter the desired web handling parameters for that program under the EDIT submenu.

> Creating the first program on a system platform where there are no programs in memory (i.e., when you first receive from the factory a system platform that has no “sample” programs entered for you) requires a different procedure than that for the creation of subsequent programs.

#### To create the first program name on a system platform:

1. Select DATA STORAGE, PROGRAM, and then CREATE.
2. Type in a program name using the terminal keypad, and press the ENTER key when finished.

#### To create a new program name:

1. Select CREATE under the PROGRAM menu.
2. Type in a program name using the terminal keypad, and press the ENTER key when finished.
3. Immediately save the program name:
   a. Use the ESC key to return to the main menu.
   b. Select SAVE DATA under the DATA STORAGE menu.

#### To enter the program parameters for the new program:

1. Return to the PROGRAM menu and select EDIT.

2. Review the EDIT submenu in the previous menu trees.
3. Use the arrow keys to select menu options where you want to enter data.
4. Enter new data in each menu option field. Press the ENTER key after each completed entry.
5. Save the program:
   a. Use the ESC key to return to the main menu.
   b. Select SAVE DATA under the DATA STORAGE menu. Your new program is now saved (in non-volatile memory).

To delete a program:

1. Select DELETE under the PROGRAM menu.
2. Select the program name using arrow keys, and press the ENTER key. The program in now deleted.

## Program and Configuration: The HHT Dispenser Programming Menus

### PROGRAM Menu

The PROGRAM menu is the primary menu for dispenser programming. It allows you to create, select, delete and edit programs. The PROGRAM menu, including the EDIT submenu where most of the dispenser programming fields are located, is discussed the section “Editing an Existing Program” on page 68.

### CONFIGURATION Menu

The information in the CONFIGURATION menu controls the platform speed, Z-axis (Z slide) movement, BioJet™ dispenser PRIME speed, and Syringe Pump speeds.

The following tables describe the submenus for the CONFIGURATION menu:

| **EDIT DISPENSER Submenu** | |
|---|---|
| EDIT “DEVICE NAME”<br>(BioJet or AirJet) | **OR**, EDIT “TANDEM BJQ/AJQ”, for the RR4500 system.<br>This field selects the dispenser to be configured.<br>A “device name” will not appear in the field if dispensing with a Frontline dispenser or Syringe Pump alone (where no BioJet/AirJet™ “device” is installed). |

| **EDIT Submenus**<br>**(BioJet Configuration)** | |
|---|---|
| CHANNEL INFO | Same as AirJet Channel Info menus above (X and Y off). |
| SYRINGE (µl) | This is the syringe size in µl.<br>The value must match the actual syringe on the pump so the programmed dispense volume can be correctly computed. |
| FILL VOLUME (µl) | This is the volume the syringe will draw.<br>It should be equal to or less than the syringe volume. |

| | |
|---|---|
| FORCE: QUARTER/HALF/FULL | FORCE is the force achieved at the end of travel during the syringe plunger motion. It must be controlled to prevent damage to the syringe. FORCE should be selected as follows:<br>▪ QUARTER: If using syringes 100 µl or smaller<br>▪ HALF: If using syringes 250 µl or 500 µl<br>▪ FULL: If using syringes 1.0 ml or larger |
| PRIME (µl/sec)<br>Custom applications may warrant numbers out side of these ranges. | This sets the syringe velocity when priming the BioJet Quanti™ dispenser.<br>BioJet Quanti 3000 syringe pump acceptable prime range is from 2 to 1000 µl/sec.<br>XYZ: Factory setting for a standard 250 µl syringe is 48 µl/sec, but may range between 20-200 µl/sec.<br>AD: Factory setting for a standard 250 µl syringe is 60-80 µl/sec, but may range between 20-200 µl/sec. |
| FILL (µl/sec)<br>Custom applications may warrant numbers out side of these ranges. | This sets the syringe velocity when filling the syringe from the reagent reservoir.<br>Acceptable BJQ syringe pump settings range from 5 to 4000.<br>XYZ: Factory setting for a standard 250 µl syringe is 48 µl/sec, but may range between 20-200 µl/sec.<br>AD: Factory setting for a standard 250 µl syringe is 60-80 µl/sec, but may range between 20-200 µl/sec. |
| WASTE X | The X axis location where the dispenser will move to prime. |
| WASTE Y | The Y axis location where the dispenser will move to prime. |

| **EDIT Submenus (AirJet Configuration)** | |
|---|---|
| CHANNEL INFO | (See X and Y below.) |
| CHANNEL 1 | |
| X OFF (MM) | A field used to inform the platform of the dispenser X axis location relative to the selected origin (home) in millimeters.<br>This is a factory setting. |
| Y OFF (MM) | A field used to inform the platform of the dispenser Y axis location relative to the selected origin (home) in millimeters (user should select). |
| TPU CHANNEL | Is the assigned BioJet channel (example: BioJet Quanti 1-Channel 1-TPU channel 0 would be BioJet channel #1 on the rear panel). |

Remember that there are other CONFIGURATION menu options that are specifically used to configure the RR4500 system. These are discussed in the chapter “RR4500 Operation,” which begins on page 55.

## Prime Dispenser: The HHT Accessory Dispensing Menus

### About the PRIME DISPENSER Menu

The PRIME DISPENSER menu is used to prime any of the available dispensers.

A dispenser should be primed in preparation for dispensing or cleaning. When you select PRIME, you will first be prompted to select a dispenser type, and then the device number (from left to right) where there are more than one of that type of dispenser. Finally, you will enter the number of prime cycles for the dispenser selected.

You then select and activate the Activate field to start the prime cycle at the prime speed set under the configuration menu ( refer to the section “Program and Configuration: The HHT Dispenser Programming Menus” on page 66). For BioJet dispensers, the solenoid valve will operate during the prime cycle at a factory set RATE and ON TIME that is appropriate for the PRIME cycle. The dispenser will continue to prime until you press ESC on the HHT or until the dispenser has completed the number of cycles.

> For any dispenser requiring the Syringe Pump, the first prime after the unit has been activated will not stop when the ESC key is pressed. The first prime after activation is an initialization prime that tells the Syringe Pump where the plunger is.

## Editing an Existing Program

To edit a program, you simply modify the web handling parameters for that program under the EDIT submenu.

To edit a program:

1. Select EDIT under the PROGRAM menu.
2. Select the program to be edited using the arrow keys on the terminal keypad, and press the ENTER key.
3. Make necessary changes, using the arrow keys to select the menu options to be edited, and entering new data on the terminal keypad. Press the ENTER key after each new entry.
4. Save the new data:
   a. Use the ESC key to return to the main menu.
   b. Select SAVE DATA under the DATA STORAGE menu. Your new program is now saved (in non-volatile memory).

## EDIT Submenu

The EDIT submenu contains all the information to dispense lines or dots from one or more of the BioJet Quanti or AirJet Quanti™ dispensers. The Syringe Pump and Frontline dispensers are configured under the CONFIGURATION menu (refer to the section “Creating and Deleting Programs” on page 65).

The following tables describe the submenus for the EDIT submenu options (DOT task not available):

| **EDIT Submenu Options (BioJet Configuration)** | |
|---|---|
| NAME | This is the name of the current program (selected program, under the ➔ SELECT menu).<br>To change the name, simply enter a new name and press ENTER. |
| TANDEM *n* | BJQ # 1 – 3 (checkmark if enabled). |

| | |
|---|---|
| | There is *n* of these menu items, one for each dispenser for which the unit is configured, where the number *n* is the dispenser number from left to right when facing the platform.<br>Submenus appear when a dispenser is selected, and a checkmark appears after the name of the dispenser in the Tandem *n* field.<br>You enter the dispense cycle parameters for each dispenser in the submenus. |
| ACTIVE | This is a toggle field (Yes/No) that sets the pattern state to active or inactive (this overrides the SELECT menu option). |
| RATE (µl/cm) | This field allows you to program the volume of liquid dispensed per unit length expressed in µl/cm and applies when the SHAPE menu has been toggled to the Line option. This field is available for Syringe Pumps or AirJet dispensers only. |
| VOLUME (µl/cm) | This field allows you to program the volume of liquid dispensed per unit length expressed in µl/cm and applies when the SHAPE menu has been toggled to the Line option. |
| PITCH (mm) | This field allows you to program the dot pitch, and is displayed for the Line task only (X and Y start positions are used for the DOT task).<br>Refer to the dispenser rate information on page 107 for appropriate rate settings. |
| ON TIME (ms) | |
| TRANS | This field allows you to program the transition period, in milliseconds, between the end of one syringe pump stroke and the beginning of the other. |

**EDIT Submenu Options (AirJet Configuration)**

| | |
|---|---|
| NAME | This is the name of the current program (selected program, under the ➔ SELECT menu).<br>To change the name, simply enter a new name and press ENTER. |
| TANDEM *n* | AJQ # 1 – 3 (checkmark if enabled).<br>There is *n* of these menu items, one for each dispenser for which the unit is configured, where the number *n* is the dispenser number from left to right when facing the platform.<br>Submenus appear when a dispenser is selected, and a checkmark appears after the name of the dispenser in the Tandem *n* field.<br>You enter the dispense cycle parameters for each dispenser in the submenus. |
| ACTIVE | This is a toggle field (Yes/No) that sets the pattern state to active or inactive (this overrides the SELECT menu option). |
| RATE (µl/cm) | This field allows you to program the volume of liquid dispensed per unit length expressed in µl/cm and applies when the SHAPE menu has been toggled to the Line option. This field is available for Syringe Pumps or AirJet dispensers only. |
| TRANS | This field allows you to program the transition period, in milliseconds, between the end of one syringe pump stroke and the beginning of the other. |

# BioJet Quanti 3000 Operation

## General Operation

The BioJet Quanti dispenser is based on the combination of a solenoid valve to form drops, and a syringe pump to meter reagent. The BioJet Quanti takes advantage of the high-resolution stepper motors that drive the syringe pump by synchronizing the stepper increments with the opening and closing of the solenoid valve in the dispenser.

For continuous dispensing operations, two pumps are operated in tandem. The two pumps signal each other at a given time (the “transition time”) before the end of their stroke, so that the other can begin its stroke at the appropriate time, thereby maintaining a constant pressure in the tubing that feeds the BioJet. The BioJet can be programmed to deliver distinct drops composed of one or more of these stepper increments, or streams of droplets to form lines.

## Programming Considerations

The basic difference between a line and a series of dots is simply the drop pitch. Using the HHT, you program a drop pitch that will increase or decrease the density of drops in a line. For every reagent type, there will be a minimum drop density that is necessary to obtain a continuous line.

> There must also be some consideration of protein binding on the choice of minimum drop density. If the protein binding is extremely fast, then the actual outline of the drop can be seen, giving a scallop effect to the edge of the line. Using smaller drops and a higher drop density to achieve the desired line concentration can minimize this. For high drop densities, the reagent can puddle on the membrane surface. This can result in a splashing effect, as subsequent drops impact the liquid. Using lower table speeds with the same drop density, allowing more time for the reagent to be absorbed by the membrane, can minimize this problem.

The drop pitch is one of four BioJet dispensing parameters that are interdependent. Changes in one of these four parameters must be accompanied by corresponding changes in the others. These parameters are:

- Dispensing rate, in µl/cm
- Drop volume, in nl
- Drop pitch, in mm
- On time, in msec

These parameters form the basis for any BioJet dispensing program, and their values should be selected based on the dispenser rate information on page 107. There are a variety of other dispensing program options, nearly all of which are located under the EDIT menu on the HHT.

The section “Test Programs for BioJet Dispensers” on page 74 contains three test programs for the BioJet dispenser. The test programs serve a dual purpose. They are diagnostic programs and will determine proper functionality of the BioJets. Also, because it is advisable to perform these tests after BioJet installation, they provide programming examples and practice to the new user.

### Line Dispensing

A line-dispensing program is entered using the EDIT submenu under the PROGRAM menu. You will need to create a program name, select the dispenser (or device) to be used, and select the shape (line or dot) to be performed.

To design a line-dispensing program, we suggest you start with the rate, drop volume, drop pitch, and on time values that are appropriate for your application. Use the dispenser rate information on page 107 as a reference to your dispense parameters.

Once these four interdependent program parameters have been selected, you can then build on to your dispensing program using the remaining EDIT submenu option, such as line length, angle, platform speed, etc.

### Dot Dispensing

As mentioned previously, dot dispensing can be accomplished two ways, by using the dot or the line task. To use the line task for dot dispensing, simply select LINE for your SHAPE option under the EDIT submenu. Then input a line-dispensing program with an expanded drop pitch. To use the dot task for dot dispensing, simply select DOT for your SHAPE option under the EDIT submenu, and input a dot dispensing program.

### Priming the Dispenser

You should prime a dispenser in preparation for both dispensing and cleaning. You will use the PRIME DISPENSER menu to perform the priming sequence. Select the priming speed under the CONFIGURATION menu. Refer to the sections “Program and Configuration: The HHT Dispenser Programming Menus” on page 66 and “Prime Dispenser: The HHT Accessory Dispensing Menus” on page 67 for details on priming the BioJet.

### Configuring the Syringe Pumps

To configure the Syringe Pumps, refer to the information in the section “Syringe Pump Operation” on page 73.

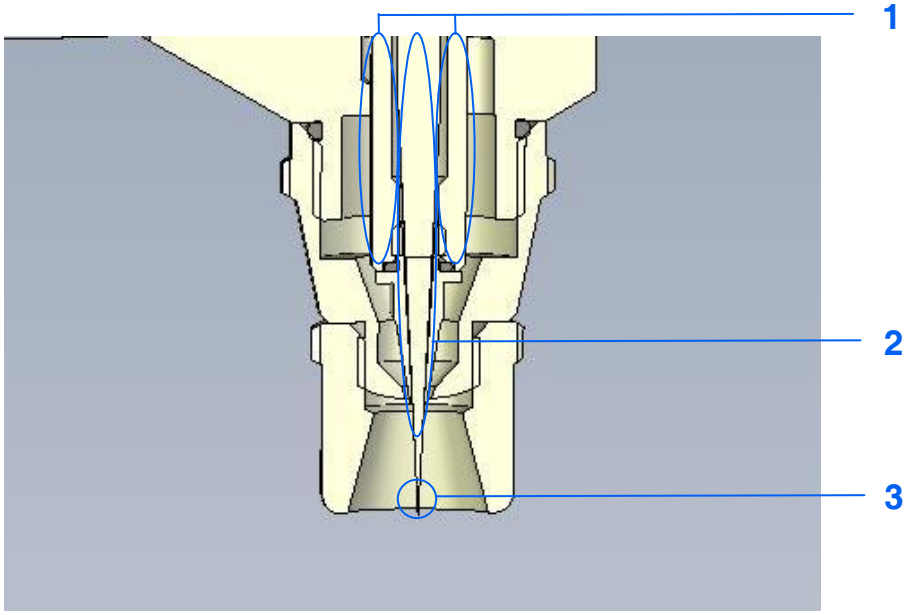
## AirJet Quanti 3000, 2300, and 2400 Operation

### General Operation

The AirJet Quanti dispenser essentially operates by injecting a metered supply of reagent into a flowing air stream. Reagent is then aspirated onto the web material. Flow rate is controlled by the Syringe Pump and by adjustment of the needle micrometer on the AirJet. The AirJet is capable of dispensing lines or dots, with a wide range of dispensing rates and line widths (refer to the section “AirJet Quanti Dispenser Specifications” on page 112).

A cross sectional view of the end of the AirJet is shown in Figure 42.

**Figure 42**




The figure above includes:

1. Air Path
2. Fluid Path
3. Needle Tip

The fluid path opens into an orifice at the AirJet tip that is formed by the needle and nozzle. Adjusting the needle position in the vertical direction, using the needle micrometer, controls the size of the fluid orifice, and thus the rate of flow from the AirJet.

## Control of Line Width and Volume

The needle micrometer on the top of each AirJet is the primary control over the dispensed volume. Turning the micrometer towards a larger number on the micrometer dial (counter-clockwise turn when looking down on the micrometer) backs the needle out of the nozzle, resulting in a larger fluid orifice and corresponding increase in the line width. The dispense rate is not affected by the needle position, but the shape and quality is extremely sensitive to small changes in needle position.

Although the AirJet has been equipped with a positive stopping device to prevent needle/nozzle damage due to overdriving the micrometer, it is still necessary to refrain from using excessive force when closing the fluid orifice. Overdriving the micrometer could seriously damage the AirJet.

The vertical micrometer stage on each AirJet mounting platform is the primary control of line width. Spraying close to the material will result in a finer line. When operating extremely close to the material, it may be necessary to switch to the crown tip, which will allow the air stream to escape from the dispensing area through the cutouts in the tip. The crown tip is supplied in the tool kit and replaces the standard AirJet tip.

### Z Up and Z Down Feature in AirJet Dispensing

For units with a pneumatic Z-Axis the Z Down feature is used to delay premature dispensing of the AirJet. An increase in time on the Z Down will allow the head to come down and wait before dispensing. This is useful in cases where you have a low air supply or worn components in the Z-Axis assembly.

The Z Up feature happens at the end of the dispense cycle and the Z-Axis is in the up position. An increase in time on the Z Up will allow the user time to reposition or remove a substrate. For multiple cycles the Z Up allows time for the previous pattern to set before the second pattern is applied.

> Delays are user and application defined. If you feel you need more time then program more time. If less, then program less. The viscosity of the solution, the rate that you are applying it, and the substrate being used may also be determining factors on how long or short you program delays. It may take some trial and error to determine suitable delay times.

### Line Dispensing

To design a line-dispensing program for the AirJet, we suggest you start with the rate as a basis for your program. A line-dispensing program for the AirJet is entered using the EDIT submenu under the PROGRAM menu. You will need to create a program name, select the dispenser (or device) to be used, and select the shape (line or dot) to be performed.

### Priming the Dispenser

You should prime a dispenser in preparation for both dispensing and cleaning. You will use the PRIME DISPENSER menu to perform the priming sequence. Select the priming speed under the CONFIGURATION menu. Refer to the sections “Program and Configuration: The HHT Dispenser Programming Menus” on page 66 and “Prime Dispenser: The HHT Accessory Dispensing Menus” on page 67 for details on priming the AirJet.

### Configuring the Syringe Pumps

To configure the Syringe Pumps, refer to the information in the section “Syringe Pump Operation” on page 73.

## Frontline Quanti Operation

The Frontline Quanti™ dispenser itself requires no special programming, as the dispense rate from a Frontline Dispenser is simply that of the Syringe Pump.

To operate the Frontline Dispenser, you only have to properly install the specially designed dragging tip(s), set the angle and height of the dispenser per your application needs, and configure the Syringe Pump to deliver the proper rate of flow (refer to the section “Syringe Pump Operation” on page 73.).

## Syringe Pump Operation

The Syringe Pump dispenser contains a high-resolution stepper motor that is has 24,000 distinct “steps” or dispensing units per full stroke. Syringe Pump dispensers can be used alone or in combination with another dispenser (BioJet, AirJet, or Frontline) to dispense reagent. Syringe Pumps can be wired together to work in

tandem. In this case the two pumps signal each other at a given time (the “transition time”) before the end of their stroke, so that the other can begin its stroke at the appropriate time, thereby maintaining a constant pressure in the supply line tubing.

The programming fields for the operation of the Syringe Pump, with or without another dispenser, are located in the CONFIGURATION menu. Where a Syringe Pump is used alone or in combination with a Frontline Quanti Dispenser, only those fields related to Syringe Pump configuration will be shown.

## Test Programs for BioJet Dispensers

This section explains how to determine whether or not the BioJet Quanti dispenser is functioning correctly as well as how to diagnose any observed problems. When using BioJets for any dispense, remember that the quality of the dispense observed can be affected by factors other than the performance of the valve itself, including characteristics of the fluid being dispensed, the material being dispensed onto, and ambient environmental conditions, such as humidity. As a result, determination of the performance of the BioJet valves themselves must be performed under optimized conditions.

Ideally, the fluid you use should be water containing a small amount of detergent (e.g., 0.05% BioTerge). All fluids used should ideally be degassed and 0.2µm filtered before use. The protocol outlined here allows the user to focus on the operation of the valve itself by removing some of the variables of standard operation. Sample test programs are outlined for both old and new format programming (“Old Board” and “New Board”). There are none for “Old first generation boards”.

You should employ these test programs in conjunction with the protocols described in the chapter “Dispenser Cleaning and Maintenance,” which begins on page 87, in attempting to remedy a problem and in determining whether replacement of a valve is warranted.

In determining correct operation of the valve, the operations to be observed are:

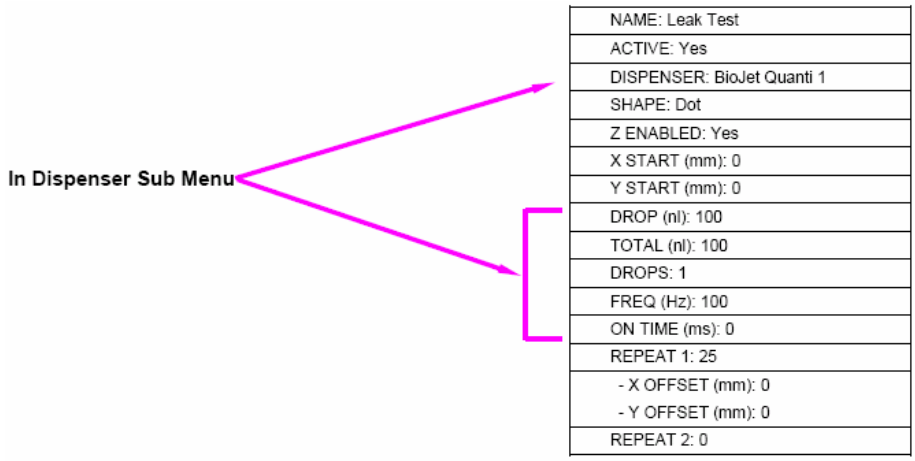
- The ability of the valve to prime correctly
- The integrity of the valve (i.e., whether or not it leaks)
- The ability of the valve to deliver a consistent dot
- The ability of the valve to dispense a consistent line

### Leak Test

This program is designed to determine if the valve is leaking. The aim is to activate the dispenser but not open the valve, thereby determining whether fluid can be forced through a nominally closed valve. This sample program is written for XYZ or ZX platforms, but it may easily be adapted for the RR4500 system.

The leak test program is outlined in Figure 43.

**Figure 43**




This figure outlines the leak test.

To perform the leak test:

1. Using the PRIME DISPENSER command on the HHT, prime the BioJet with 0.05% BioTerge.
2. Observe the dispense stream. The dispense should be in the form of a straight stream of fluid without splashing or sputtering.
3. If splashing or sputtering occurs during dispensing, perform cleaning as described in the chapter "Dispenser Cleaning and Maintenance," which begins on page 87.
4. Wipe the tip clean before each run is performed.
5. Examine the tip of the BioJet valve after the program has run. Determine if a meniscus of fluid has formed at the tip or if a droplet has fallen free. The valve passes (i.e., no leak is occurring) if no fluid has been forced through the valve.

   If a droplet is seen on the tip, a leak has occurred. If so, ensure that the leak has not occurred from the inlet tubing to the valve:

   a. Remove the valve from the housing, leaving the electrical connector attached to the valve.
   b. Wipe the entire valve clean of any fluid.
   c. Repeat the test, watching the inlet tubing specifically as a source of the fluid leak. If no fluid leaks from the inlet line, the valve itself has leaked.

After testing for a leak, you should continue on with the dot dispense test, which tests for consistency in dot dispensing.

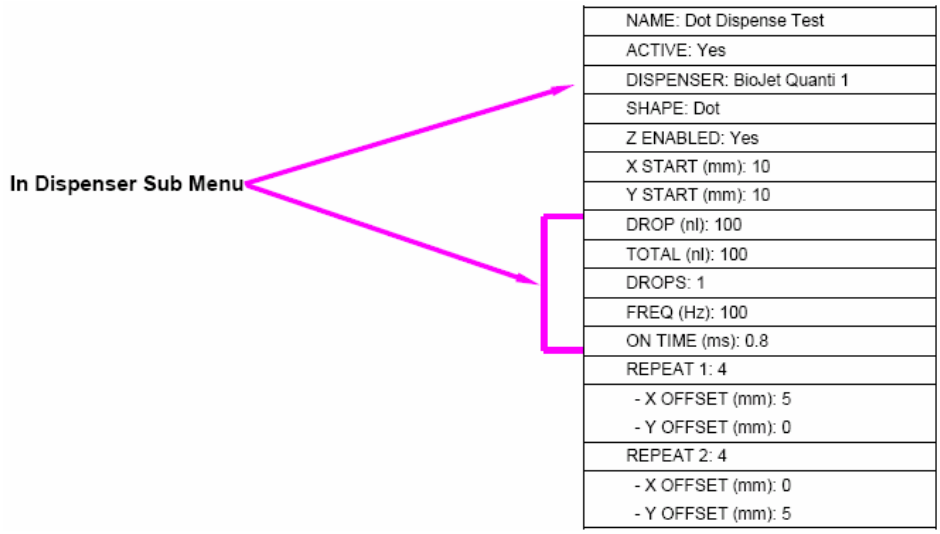
## Dot Dispense Test

This program is designed to determine if the BioJets are capable of dispensing a consistent drop of fluid under optimal dispensing conditions. To do this, you must program an array of drops (using the REPEAT function) of

small to medium size and dispense 0.05% BioTerge onto the dispensing nest for ease of assessment of dot quality.

The dot dispense test program is outlined in Figure 44.

**Figure 44**




This figure outlines the dispense test program.

To perform the dot dispense test:

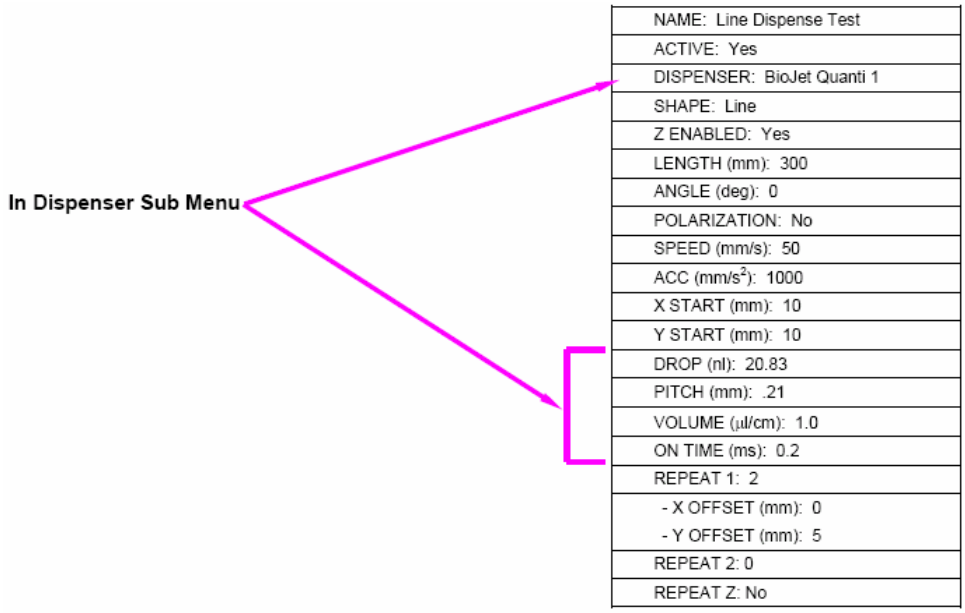
1. Prime the dispenser prior to performing the test.
2. Examine the arrays of dots for drop consistency, for satellite drops or spray, or for missed dispenses. The valve passes if dots are consistent, none have been missed and there is no spray or satellite drop formation.

## Line Dispense Test

This program is designed to determine if the BioJets are capable of dispensing a consistent line of fluid under optimal dispensing conditions. To do this, program an array of lines of medium size and dispense fluid onto a suitable medium for ease of assessment of line quality. Bare in mind that the results of this test can be affected by the material you are dispensing on. Parafilm™ is a good material to use for this purpose as it often creates fewer problems from static electricity than nitrocellulose, for example. Examine the lines for consistency, for satellite drops or spray, or for breaks.

The line dispense test program is outlined in Figure 45.

**Figure 45**




This figure outlines the line dispense test program.

To perform the line dispense test:

1. Prime the dispenser prior to performing the test.
2. Determine if satellite drops are present, there is sputtering from the valve, or there are significant breaks in the dispensed line that are not attributable to air in the fluid lines. The valve passes if none of the above is present.

## Remedial Actions

If the valve fails any of the previous tests, undertake cleaning as described in the chapter “Dispenser Cleaning and Maintenance,” which begins on page 87, and then retest the valve for performance. Once all cleaning procedures, including the unclogging procedures outlined in that protocol, have been performed, retest the valve for performance as above. If the valve passes the inspections it may be considered suitable for continued use. If the valve does not pass the above inspections, it may be concluded that the valve needs to be replaced.

If the valve passes the above tests and inconsistencies are being observed in the dispense of your fluid of interest onto its substrate, then it is likely that factors other than valve performance are involved. Factors which can lead to inconsistent dispenses include:

- Particulates in the fluid, either present intentionally or as artifacts. If possible, filter fluids prior to dispensing.
- Inconsistencies in the receiving substrate. For example, some membranes, particularly if treated with detergents, can contain hydrophobic patches that lead to inconsistent absorption characteristics. Particulates or dust on the surface of nitrocellulose membranes can also result in inconsistent absorption.

- Static electricity. If static is present, either caused by dry ambient conditions (low relative humidity) or by the receiving substrate (e.g., un-backed nitrocellulose can generate a significant static charge), inconsistencies in dispense may be expected as drops are deflected from their trajectory. If possible, use anti-static bars and work in a slightly humid environment to overcome this problem.

CHAPTER 9

# Optional Components Operation

## Introduction

This chapter describes operation procedures for the optional Dip Tank and Dry Tower.

## Dip Tank Operation

This section explains how to operate your BioDot Dip Tank. Do not attempt operation of the Dip Tank until your system is completely installed.

### To operate your Dip Tank:

1. Turn the pump power switch to ON.
2. Route the reeled material above the input roller. The material flows underneath the submersion roller and then in between the power squeegee rollers.
3. If you do not have the fluid sensor, then manually fill the Dip Tank with the solution that will coat, wash, or process the reeled material.

   If you have the fluid sensor option, the fluid sensor will trigger the pump to activate; and the Dip Tank should begin to fill.
4. Begin the dispense cycle using the reel-to-reel dispense platform. Check the material to make sure it is evenly coated. If the power squeegee is not purging a sufficient volume of retained liquid, then gently tighten down the vertical micrometer. This will provide additional tension on the rollers.
5. When you are finished, empty the Dip Tank of excess solution and clean (refer to the section “Dip Tank ” that follows).
6. Turn the pump power switch to OFF.

## Dry Tower Operation

The Dry Tower Systems utilize a heated air stream, which is strategically directed against a moving membrane in order to remove liquid. This is accomplished in a series of enclosed vertical drying chambers, which rely on an external transport mechanism for controlling exposure time. This process involves several functions. which are described in this section.

### Air Induction

A ducted utility blower internally housed in a small plenum draws ambient air into the rear of the drying module through grillwork. The output of this blower is isolated, and slightly pressurizes a second plenum, which forms a reservoir of air for subsequent heating. The airflow is adjusted by varying the aperture of the intake gate located on the intake of the blower on the rear of each drying module. This second plenum drafts air against the exterior side panels to both preheat the air and to cool exterior surfaces to improve efficiency.

### Air Heating

Flowing air is channeled into two identical ducts containing heating elements. These heating elements contain many finned vanes for effectively transferring heat to the flowing air. The surface temperature of the heater elements varies from approximately 300°F (149°C) to over 500°F (260°C), depending on the amount of airflow.

### Heated Air Induction

Once heated, the airflow is again divided and directed to flow through eight openings on opposing walls, which, together with a rear wall and module door, form a vertical membrane duct. In this duct, moisture is transferred from the membrane to the flowing air stream. This ducting is duplicated in such a way that the vertically moving membrane is presented a completely separate drying duct on its return passage through the drying module. The heated air then flows upward towards the top of the drying module, at which point it is diverted up an exhaust flute to an exhaust plenum, exhaust fan. and outlet port from the exhaust module. Exiting air from one drying module is prevented from entering the membrane drying region of an adjacent drying module, because the moisture content shared by both would compromise drying efficiency.

### Membrane Drying

Increasing the air stream temperature enhances liquid extraction from the membrane by the moving air stream. This is because: 1) the local air has become drier, and hence has a greater capacity for absorbed moisture; and 2) the warmed air heats the membrane, reducing the vapor pressure of the contained liquid, thus allowing the membrane to give up its moisture more readily. In addition, the adjacent, but non-contacting walls (supplying heated air) are also heated, and maintain equilibrium with their surroundings by radiating non-ionizing infrared energy. This radiation further enhances the evaporation process by aiding in the lowering of the membrane liquid vapor pressure.

### Air Exhaust

Moisture-laden air used in the drying process is collected from the exhaust flue to the drying modules in a plenum contained in the exhaust module.

### Membrane Travel

The membrane path, which is horizontal as it enters the control module, is translated to the vertical for its travel through the drying modules. At this point, the membrane is freely suspended in a 1/8” (3 mm) wide air duct on the ascending side of the drying module and exits through a 1/8” (3mm) wide slit between successive drying modules.

This narrow aperture prevents moisture-laden air exiting one drying module from commingling with air injected into succeeding drying modules. Once past the uppermost drying module, the membrane direction is reversed and again passed through the drying modules in the opposite direction. Upon entering the control module, a transition is again made to horizontal membrane travel.

## Dry Tower Control

All operating controls are located on the front panel of the control module. This section contains a description of each of the controls.

### Temperature Control

All temperature controls are located with the display module on the front panel of the control module. Six display modules are provided for controlling up to three drying modules independently.

### Air Flow Control

Airflow is controlled by varying the aperture of the intake gate located on the intake of the blower on the rear of each drying module. It is suggested that all blowers be operated simultaneously, and at their maximum speed for most efficient drying.

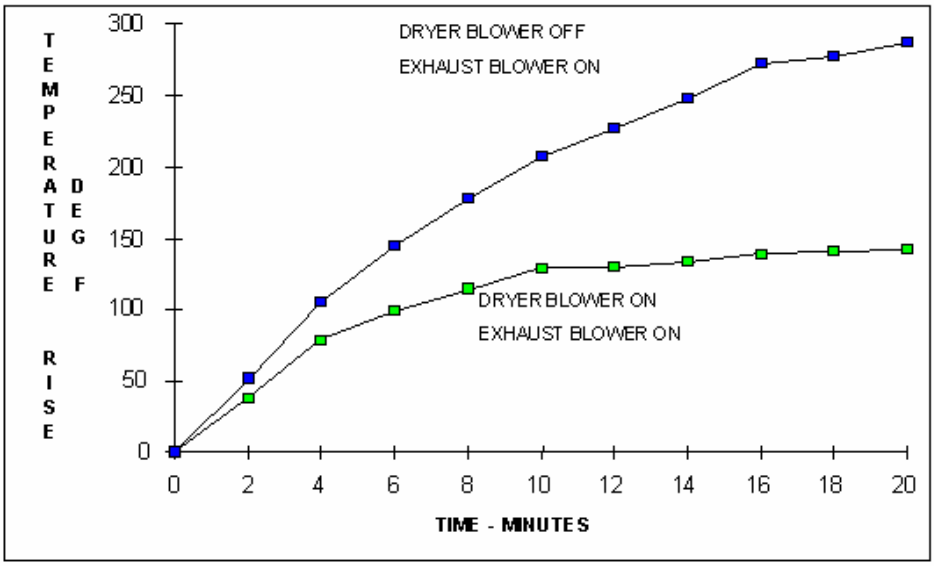
### Membrane Positioning

Positioning of the drying modules relative to the incoming and to the outgoing paths of the membrane is established by a lead screw control, located in the center of the control module. Clockwise rotation of the control will move the drying modules backward. Therefore, the membrane moves forward relative to the center of the Roller Assemblies. Because these rollers are crowned, the membrane will track towards center. Therefore, positioning of the Dry Tower should be set to coincide with the exiting membrane position from the reel-to-reel module.

## Dry Tower Performance

The air temperature rise achievable in the membrane duct in each of the drying modules is shown in Figure 46.

**Figure 46**




This figure depicts air temperature in the dry tower and its relationship with time.

PART IV

# Cleaning and Maintenance

CHAPTER 10

# RR4500 Cleaning and Maintenance

## Introduction

Maintenance of the RR4500 largely depends on operating conditions. Regular cleaning is the key to proper maintenance. Lint and surface contaminants will build up over time with consistent use, and unchecked buildup of these can be harmful to the unit. We recommend that you design a cleaning schedule appropriate to your operating schedule and conditions.

In addition to regular cleaning, maintenance of the base RR4500 system should include monitoring for component surface wear, slack in mechanical tolerances, and build-up of surface contaminants.

This chapter provides a cleaning protocol and a checklist of the components that should be monitored as part of your maintenance procedures.

## General Cleaning

You should perform general cleaning procedures after each period of use.

### To clean your RR4500:

1. Remove loose dust on the outside of the reel-to-reel with a damp lint free cloth, and remove any hard to reach debris with a vacuum or pressurized air nozzle.
2. Use a soft cloth or lens-quality paper towel dampened with water to clean the reel-to-reel. Use care to avoid scratching the clear plastic components such as the outer pay-out or take-up reel flanges and the optional take-up enclosure(s). You can use a low percentage (up to 50%) isopropyl alcohol solution for more efficient cleaning.

> ⚠ To avoid damage to the surface of the reel-to-reel, do not use any abrasive or chemical agents.

## Maintenance Tasks

You should perform the maintenance procedure at least once a month, or as dictated by operating conditions.

### To maintain your RR4500:

1. Check for loose or worn bearings on the pay-out or take-up reels, worn Teflon coating on any of the rollers, and proper function and travel of the dancer mechanisms and auto tracking platforms.
2. Using the hand-held terminal (HHT) system utilities menu, perform a visual check of the Capstan module rollers for unusual wear patterns and proper functionality.
3. Check the dispense tracking and take-up tracking systems for unusual looseness in the slide mechanisms, as well as proper travel and force.
4. If the system has optional tandem syringe pumps, the 3-way switching valve should be checked for proper operation and any signs of leakage around the syringe area. Leakage should warrant removing the valve from the pump and cleaning or replacing.
5. If the system has an optional Dry Tower, check that all of the temperature controllers are displaying/controlling each stage properly, the rollers are turning freely, and that there is no unusual wear on the coated surfaces. Also check that the tower assembly adjustment knob operates freely.

CHAPTER 11

# DISPENSER CLEANING AND MAINTENANCE

## Introduction

This chapter describes preventative maintenance and cleaning procedures for the following dispenser systems:

- BioJet Quanti™ 3000 dispenser
- AirJet Quanti™ 3000, 2400, and 2300 dispenser
- Frontline Quanti™ 1000 dispenser
- Syringe Pump

To achieve optimum performance and maximum life from your dispenser, you should clean the dispenser after each period of use, and perform a more stringent follow-up cleaning regime on a weekly basis. To minimize clogging of the dispensers and/or dispensing tips, and the attendant necessity of performing mechanical cleaning (e.g., sonication, back flushing) which can damage dispenser valve components, we recommend the strict adherence to the cleaning protocols described in this chapter.

### Tools/Equipment

You will need the following tools to clean and maintain your system:

- Set of Allen wrenches (provided with the unit)
- BioTerge (detergent)
- Jetwash (detergent)
- Deionized water

**Figure 47**

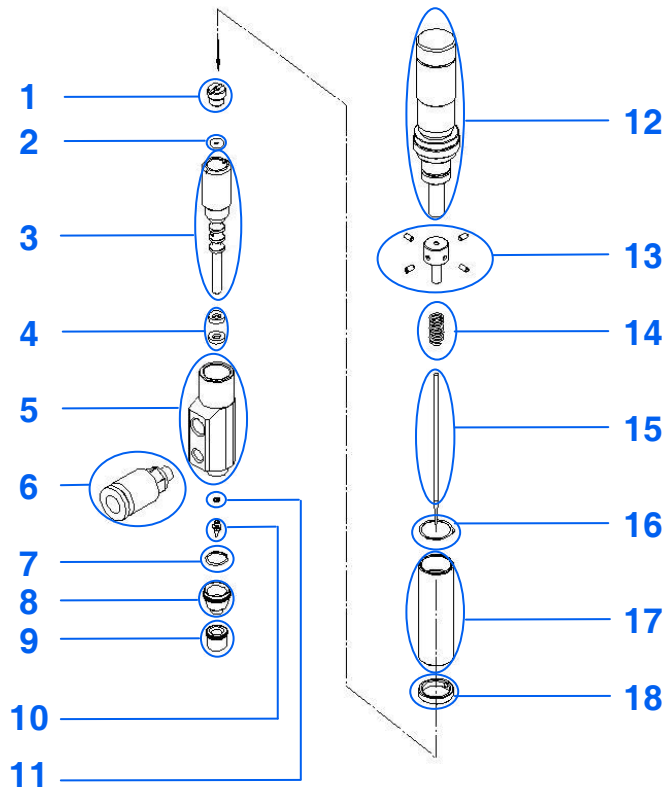

Pictured above are tools for maintenance and cleaning (from left to right): allen wrenches, Bio Terge, and JetWash.

## AirJet 3000 Assembly

This section explains how to assemble the AirJet 3000. Refer to Figure 48 for a breakdown of the AirJet 3000 components. The numbers in the illustration reference the corresponding drawing sheet. Use this reference as you work through each of the assembly steps.

You can use the tools supplied with the system for assembling the AirJet 3000.

**Figure 48**




The figure above includes:

1. Screw, Gland
2. O-Ring, .056ID x .060W
3. Spindle
4. O-Ring, .101ID x .070W
5. AJQ3000 Body
6. Fitting, Male Adapter, ¼ Tube OD
7. O-Ring, .239ID x .025W
8. Nozzle Cap
9. Crown Tip
10. Nozzle
11. O-Ring, .055ID x .016W
12. Micrometer Head
13. Needlehead with Set Screws
14. Compression Spring
15. Needle
16. Shim
17. Micrometer Housing
18. Jamb Nut

## How to Assemble an AirJet3000

### To assemble the AirJet 3000:

1. Assemble the tube connector (item 18) to the AirJet body (item 5) and tighten securely.
2. Place o-ring (item 15) onto thread undercut of AirJet body, making sure that there are no nicks or blemishes on the o-ring surface, which may cause it to leak.
3. Assemble the nozzle cap (item 2) to the AirJet body and tighten firmly by hand. Temporarily set AirJet body aside.
4. Assemble two o-rings (item 14) onto spindle (item 4) by sliding over steps in spindle.

> You may prefer to use an assembly aid, such as some alcohol or water, in order to more easily stretch the o-ring over the diameter step in the spindle.

5. Install o-ring (item 13) into the bore of the spindle so that it is fully seated. It may be difficult to seat the o-ring perfectly flat against the stop. Some o-ring distortion is permissible as long as light can pass through the o-ring inside diameter.
6. Assemble gland screw (item 7) into the spindle and tighten.

   **STOP:** At this time verify that a test needle, similar to item 6, can be installed into the rear of the assembly without snagging or damaging the previously assembled o-ring. The needle should slide smoothly and have a moderate amount of drag. If damage has occurred, replace o-ring as in step 5. Be careful when handling the needle as the tip may easily become damaged.
7. Assemble o-ring (item 16) over the threads of the nozzle (item 3), making sure it is seated against the nozzle flange.
8. Assemble the nozzle into the small end of the spindle and tighten.

> Do not over tighten, as the threads of the nozzle are very weak and will break off easily.

9. Thread the spindle into the body until the tip of the nozzle extends slightly beyond the front face of the nozzle cap. Line up the second hole in the spindle with the hole in the feed line port. The hole goes all the way through the spindle, so you have a ½ turn tolerance. Refer to **Error! Reference source not found.**.
10. Assemble the jam nut to the spindle threads and tighten in place. Use the spanner wrench supplied with the micrometer (item 12) to accomplish this.
11. Insert the four setscrews (item 19) into the needle head (item 8), allowing the tip of the setscrew to remain slightly above flush with the outside of the needle head.
12. Trial fit the needle head into the rear of the spindle so that it is fully seated. Slide the needle (item 6) through the rear of the needle head until it is exposed at the front of the nozzle. At this point, the rear of the needle should be below flush with the rear of the needle head.

> Be extremely careful not to damage the needle tip, as it can be easily damaged. If resistance to insertion is found, stop (refer to “Stop” instructions in step 6) and reexamine the cause before proceeding.

13. While holding the needle head against the spindle and holding the needle fully seated against the nozzle, tighten all four setscrews a like amount and secure needle in place.
14. Remove the assembled needle and needle head, and reassemble with spring (item 17) in place.
15. Assemble the needle cap (item 1) to the front of the AirJet body to protect the needle when fully extended.
16. Assemble the micrometer-housing (item 9) to expose the spindle threads, and tighten by hand.
17. Trial fit the micrometer (item 12) in place at the end of the micrometer housing, and note the position of the fixed scale graduations relative to the incoming fittings on the AirJet body. Add shims(item 11) as necessary so that the graduations are on the opposite side of the AirJet body from incoming air and fluid fittings. Once established, remove the micrometer.

> Make sure the barrel of the micrometer is rotated slightly open to allow the body of the micrometer to be fully seated. If the micrometer barrel is difficult to rotate, loosen locking ring near the base of the micrometer.

18. Rotate the micrometer to close position, and note that the needle extends slightly from the nozzle when viewed from its end. Loosen the setscrew located in the knurled portion of the micrometer. Rotate and slide the micrometer barrel so that the zero hash mark and the edge of the micrometer barrel are positioned at the zero hash mark on the fixed micrometer scale. Tighten the setscrew and rotate the micrometer barrel to confirm proper scale match up at the seated position. If the position cannot be reached, add a few more shims and then try to readjust.
19. Functionally test and observe that liquid flow begins at approximately 1 to 2 mils from fully closed.

    The assembled AirJet should resemble the example in Figure 49.

**Figure 49**

The figure above shows an assembled AirJet.

# Cleaning and Maintenance Procedures for Dispensers

## Daily Cleaning

We recommend the following cleaning procedure for the routine maintenance of your dispensers. You should perform this procedure after each period of use. In general, reagents should not be allowed to dry in the dispensers or their supply lines.

To perform daily cleaning of your dispensers:

1. Purge lines of reagent.
2. Clean and refill the supply bottle with deionized water containing 0.05% BioTerge to enhance scrubbing of interior recesses within the BioJet Quanti.
3. Prime the dispenser for 5 syringe cycles.
4. Repeat steps 1 through 3 with deionized water.

## Weekly Cleaning and Decontamination: Standard Procedure

After prolonged dispensing of reagents, some buildup of protein constituents, salts, latex materials, or other particulate matter may occur. You should perform the following cleaning steps on a weekly basis to dissolve any accumulated materials. This should be performed in addition to the daily cleaning procedure.

To perform the standard weekly cleaning and decontamination of your dispensers:

1. Purge supply lines of reagent.
2. Clean and refill the supply reservoir with a dilute base (0.1N NaOH).
3. Prime the BioJet Quanti for 5 syringe cycles and allow to sit for 10 minutes.
4. Prime using deionized water as in steps 1 and 2 above.
5. Clean and refill the supply reservoir with a dilute acid (0.1N HCl).
6. Prime the BioJet Quanti for 5 syringe cycles and allow to sit for 10 minutes.
7. Purge the supply lines and prime for a minimum of 10 cycles using deionized water.

## Weekly Cleaning and Decontamination: Alternative for Systems With a Narrow pH Tolerance

You should perform this procedure in systems dispensing proteinaceous reagents or where acid/base use is undesirable. You may also perform this procedure as part of the regular weekly cleaning protocol in addition to the standard weekly procedure. It is of particular value in helping to prevent cross-contamination when dispensing multiple reagents from a single dispenser, or to clean protein buildup from the lines and the valve.

> You must validate the decontamination procedure to ensure its adequacy in your own application.

To perform weekly cleaning and decontamination for systems with a narrow pH tolerance:

1. Purge the supply lines of reagent.
2. Prime 3 cycles of deionized water with 0.05% BioTerge through the system.
3. Prime this solution out of the system.
4. Prime Jetwash into the system and allow the solution to sit in the BioJet™ dispensers for 30 minutes.
5. Prime this solution out of the system.
6. Clean and refill the supply reservoir with deionized water.
7. Prime the dispenser for 5-10 syringe cycles.
8. Remove the glass syringe from the syringe pump.
9. Remove the plunger from the syringe and flush deionized water through the open syringe and wash the plunger in deionized water being careful not to damage the plunger seal.
10. Flush deionized water through the ports in the 3-port valve. The valve stem may be turned by hand to switch path positions.

## Unclogging Procedure

If clogging of the BioJet should occur, then you can perform the procedures in this section for sonication and back flushing.

The entire dispenser housing, when removed from the supporting arm, may be sonicated in deionized water if the dispenser becomes partially or totally clogged. Disconnect the dispenser from all electrical power before sonicating. The BioJet should generally not be sonicated unless clogging occurs.

Back flushing simply means to push fluid through the BioJet in the reverse direction from that which is normal.

To perform back flushing:

1. Remove the BioJet from its housing. You can do this by removing the tip, pulling back on the mechanical spring on the top of the housing, and then sliding the BioJet out of the housing.
2. Disconnect the tubing from the top of the BioJet, but leave the electrical lead connected.
3. Obtain a syringe and a blunt 21-gauge needle. The 21-gauge needle fits very snugly inside the end of the BioJet. If you do not have this, you can use tubing that will fit over the syringe end and over the entire BioJet end. You need to create as snug a connection as possible.
4. Fill the syringe with water and carefully insert the needle into the end of the BioJet.
5. Run several Prime cycles and when the BioJet is open to allow fluid through (i.e., when the syringe is dispensing), slowly push the water from the syringe through the BioJet. It may require some pressure at first to “unstuck” the poppet. Once the poppet is unstuck, water should drip from the inlet nozzle of the BioJet.
6. If water comes through the inlet nozzle, then reconnect the tubing and tip to the BioJet as usual and run a prime to verify that fluid can prime through.

If something has solidified in the valve that can be re-dissolved by the use of a solvent, which is compatible with all materials in the BioJet, then that solvent may be used for this procedure.

CHAPTER 12

# Optional Components Cleaning and Maintenance

## Introduction

This chapter describes cleaning and maintenance procedures for the optional Dip Tank and Dry Tower.

## Dip Tank Cleaning

This section explains how to perform preventative maintenance and cleaning procedures on the BioDot Dip Tank.

### Regular Cleaning

To achieve optimum performance and maximum life from the Dip Tank, you should perform the routine cleaning procedure in this section after each period of use (at least once daily).

#### To clean the Dip Tank:

1. Empty the Dip Tank of all solutions.
2. Wash the Dip Tank thoroughly with a mild soap solution and rinse with distilled water.
3. Detach the submersion roller and wash with a mild soap solution. Rinse the roller with distilled water.
4. Rinse the power squeegee with distilled water and clean off any residue that may have accumulated.
5. Carefully wipe the fluid-leveling sensor with a damp cloth.
6. Wash out the pump tubing with a soap solution and rinse with distilled water.
7. Wipe up any spills on or around the Dip Tank, support platform, or pump box.

The use of a sonicator is permissible.

### Decontamination

You should follow the procedures in this section to prevent cross-contamination when coating with multiple reagents from a Dip Tank.

To decontaminate the Dip Tank:

1. Purge the Dip Tank and pump tubing of all reagents.
2. Clean and refill the Dip Tank and pump tubing with deionized water containing a 10% commercial bleach.
3. Rinse out the Dip Tank and pump tubing with deionized water.

### Residue Cleaning

After prolonged use in coating reagents, some buildup of protein constituents, salts, latex materials, or other particulate matter may have occurred. It is recommended that you follow the cleaning steps in this section on a weekly basis to dissolve any accumulated materials.

To clean residue from the Dip Tank:

1. Purge the Dip Tank and pump tubing of reagents.
2. Clean and refill the Dip Tank and pump tubing with a dilute base (0.1N NaOH). Allow the solution to sit for 10 minutes.
3. Rinse the Dip Tank and pump tubing using deionized water.
4. Clean and refill the Dip Tank and pump tubing with a dilute acid (0.1N HCl). Allow the solution to sit for 10 minutes.
5. Rinse the Dip Tank and pump tubing using deionized water.

## Dry Tower Maintenance

Routine maintenance for the BioDot Dry Tower is limited to periodic cleaning, and can be accomplished without the use of special tools. The items most frequently requiring cleaning are those parts that come into contact with liquid chemicals transported by the membrane during the drying process. The following items should be routinely cleaned. Wiping with a lint-free cloth moistened with water or methanol can complete this. The use of abrasive materials **MUST** be avoided, as these will damage components coated with protective finishes.

To perform Dry Tower maintenance:

1. Remove the three roller assemblies by turning the retaining fasteners one-quarter turn counterclockwise. Wipe exterior surfaces only; do not submerge in liquid or attempt to clean the central roller bearing. Be careful to avoid scratching the roller surface as it is coated with a thin layer of Teflon®, and can be easily damaged.
2. Remove module doors by first opening, and then lifting upward to remove from the hinge. Wipe the inside and outside surfaces clean. Do not use organic solvents other than alcohol or water in cleaning since these doors are made from polycarbonate, and will degrade when exposed to many chlorinated hydrocarbon solvents.

3. Remove the support rods and guides for cleaning by simple hand extraction once the doors have been opened. Both may be washed and/or wiped.

4. Remove, empty, and clean the drip tray using the same precautions as for the roller assemblies.

PART V

# Appendixes

APPENDIX A

# TROUBLESHOOTING

## RR4500 Troubleshooting

| Problem | Possible Solution |
|---|---|
| Unit does not power up | ▪ Ensure that the red emergency OFF switch is in the on position.<br>▪ Ensure that the unit is plugged in.<br>▪ Check fuse on main module, replace if necessary. |
| Unit will not dispense | ▪ Ensure that appropriate dispenser has been primed.<br>▪ Ensure that appropriate dispenser has been activated within the Program.<br>▪ Ensure that all reagent lines are installed properly and are free of clogs and leaks. |
| Pump Timeout Error | ▪ Ensure that pump cables are installed correctly and connections are secure. |
| Plunger Overload Error | ▪ Ensure syringe is properly installed on pump.<br>▪ Ensure that the pump has been configured for the proper syringe type, syringe size, and force value.<br>▪ Highly viscous fluids can cause excess backpressure, resulting in error. |
| Homing Error (during start-up) | ▪ Ensure that the dancer arms are able to move freely, and there are no obstructions to the movement paths.<br>▪ Ensure that there is sufficient weight on the dancer arms to allow the arms to reach the lowest, or bottom positions. |
| Homing Error (during Program) | ▪ Ensure that the web has been threaded properly.<br>▪ Ensure that there is sufficient weight on the dancer arms to allow the arms to reach the lowest, or bottom positions.<br>▪ Ensure that the proper rotation of the payout reel (interior or exterior) has been configured.<br>▪ Ensure that the external air source is connected to the unit properly and there is sufficient pressure to the capstan (~30 psi).<br>▪ Ensure that the web cores are not slipping. Tighten the outer flanges. |
| Payout Reel Slips or Stalls | ▪ Ensure that the web cores are not slipping. Tighten the outer flanges. |
| Dispense Tracking Sensors On Continuously | ▪ The web position has caused the dispense tracking system to reach its limit of travel. Re-align the web. Adjust the position of the web cores such that the web travels at the approximate mid-point of travel |

| | |
|---|---|
| | for the dispense station.<br>▪ Ensure that there is no telescoping of the web material being paid out. |
| Web Does Not Track Straight | ▪ Ensure that all of the modules are securely fastened to one another.<br>▪ Ensure there is sufficient air pressure to the capstan.<br>▪ If necessary, re-align the web to correct tracking problems. |
| Valve Overload Error | ▪ Ensure that the 3-way valve has been installed properly.<br>▪ If necessary, remove the valve and check the pump. |
| Capstan makes grinding noise | ▪ Air pressure is too high. Lower the pressure. |
| Capstan doesn't grab material | ▪ Air pressure is too low. Ensure air is attached to the system and increase the air flow through the capstan valve. Check function by toggling the capstan on and off from the System Utilities menu. |
| Dispensed line does not maintain constant position in the y-axis | ▪ Ensure the dispense tracking system is turned on in the program. Ensure the sensors are positioned correctly.<br>▪ Ensure that the dispense platform is approximately in the center of its tracking so that it can move both forwards and backwards. |
| Material does not track correctly on takeup reel | ▪ Ensure that the takeup tracking system is turned on in the program.<br>▪ Ensure the sensors are positioned correctly.<br>▪ Ensure that the takeup reel platform is approximately in the center of its tracking so that it can move both forwards and backwards. |
| Bad part marker does not fire | ▪ Ensure the marker is primed.<br>▪ Ensure the sensing system is turned on in the program.<br>▪ Ensure that the lead to the BioJet™ dispenser is attached.<br>▪ Ensure that there is sufficient air pressure to the marker. |
| Bad part marker fires at the incorrect time | ▪ Ensure the sensor is set at a height such that the light is focused tightly on the material.<br>▪ Ensure that the sensors have been calibrated correctly. Consult the Keyence manual for the correct method of teaching the sensor. Ensure that the sensor is set for "Light On" or "Dark On" as desired.<br>▪ Ensure that there is no vertical "flutter" in the material. If there is, it will be necessary to look at how your system is configured. If the capstan is positioned directly after the dispense platform, flutter is rarely a consideration. If the capstan is moved to another location, it may be necessary to install a stabilizing roller directly after the dispense platform to prevent flutter. |
| Bad part mark does not cover the bad mark fully or goes on for too long | ▪ Ensure that the Offsets are set correctly in the Configuration menu. The Offset is the distance in mm between each valve and the marker. |

## BioJet Dispenser Troubleshooting

| Problem | Possible Solution |
|---|---|
| General Tips | ▪ Ensure that the proper dispenser has been selected in the Program.<br>▪ Ensure that all reagent lines are connected securely and are free of clogs and leaks.<br>▪ Ensure that the proper volume is entered in the Program. Programmed volume should not be less than 0.2 µl/cm or this drop size. Drop size may vary depending on application. |

| | |
|---|---|
| | ▪ Ensure that the pitch and on-time values are appropriate for the dispense volume entered. Consult dispenser tables.<br>▪ Ensure that BioJet valves and PBT tips are clean and free of obvious defects.<br>▪ Ensure that the BioJet cables are connected properly.<br>▪ Ensure that the proper dispense head height is set using the micrometer. Optimum dispense height for BioJets is approximately 2-4 mm from web surface.<br>▪ Ensure that the dispenser has been properly primed.<br>▪ Ensure that the appropriate syringe size has been configured.<br>▪ Ensure that the transition times (Trans 1 and 2) are set correctly for the fluid you are dispensing. These settings are determined empirically and may differ for each fluid and tandem pump set. Having these settings correct will ensure that no gaps or bulges in dispensed lines will occur upon pump transition. |
| BioJet Valve does not fire (as determined by the absence of fluid coming from the valve and the absence of the distinctive sound of the valve firing) | ▪ Ensure that the proper dispenser has been selected in the program.<br>▪ Ensure that the BioJet cables are connected properly. |
| Fluid appears to be leaking from the system | ▪ Ensure that all reagent lines are connected securely and are free of clogs and leaks.<br>▪ Check all connections. Check lines and plunger seal integrity on the syringe. Replace seals or syringe as necessary.<br>▪ Ensure that the pitch and on-time values are appropriate for the dispense volume entered. Pressure build-up due to incorrect on time may lead to leaks in the system. |
| Excessive air bubbles develop in the reagent lines | ▪ De-gas the fluid before attempting to dispense.<br>▪ Check all connections for air-tightness.<br>▪ Check valve for leaks (see protocol attached).<br>▪ Slow the prime speed. |
| BioJet Valve does not prime correctly – the fluid stream is deflected, is not continuous, or splashing is extreme. | ▪ Check the valve with a new tip. If using a molded tip, change to a PBT tip if possible. If this does not solve the problem, the valve may be clogged. Perform cleaning protocol in Chapter Four and retry the valve. If the problem persists, replace the valve. |
| During dispensing, the BioJet Valve does not dispense a continuous line. | ▪ Line quality is derived from a number of factors, including operation of the valve, the characteristics of the material being dispensed onto, the characteristics of the fluid being dispensed and environmental conditions. Do not automatically assume that any one of these parameters is responsible for the absence of the line quality you desire. Most often it is a combination of issues. Typical problems with line dispenses are as follows:<br>▪ Breaks in lines:<br>- Ensure that the proper dispense head height is set using the micrometer. Optimum dispense height for BioJets is approximately 2-4 mm from web surface.<br>- Check the system for air. If bubbles are forming perform the procedure as described above for ridding the system of air bubbles. If air is not visible in the system there can still be an air bubble trapped in the valve. Perform the back flushing procedure outlined in the cleaning protocol. The valve may also be clogged with particulates. All fluids should be 0.2 μm filtered if possible before dispensing to prevent the buildup of particulates in the valve poppet. Some buildup of particulates in the valve is always |

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|---|---|
| | expected. For this reason it is essential that the cleaning procedures outlined in this manual be scrupulously followed.<br>▪ Deflection of droplets. Fluid is spraying away from the line causing satellites or splashing on the material:<br>- This can be caused by a number of things. The valve may be clogged with particulates. Perform the cleaning procedure in Chapter Four. There may be an imperfection in the tip, particularly if the tip is a molded plastic tip. Change the tip if possible, and if possible change to a PBT tip if a molded plastic tip is being used. Static buildup on the material can cause drops to be deflected from their target. If possible, work in relative humidity of >30% when striping nitrocellulose in particular. Humidify the area if necessary.<br>▪ Line quality is generally poor:<br>- Thick lines, breaks in lines, poor absorption into the membrane can all be caused hydrophobic patches in the membrane due to poor quality membrane being used, or membrane being stored for too long or in less than optimal conditions. Try a different membrane for comparison purposes. |
| BioJet Valve is suspected of dispensing incorrect volume | ▪ Check the volume dispensed using the Test Programs for BioJet Dispensers in Chapter Four of the manual. |
| Diagnosing the BioJet valve | ▪ Check for visual signs of damage to the valve.<br>▪ Verify the coil resistance is correct:<br>- If resistance is infinite then the coil winding has broken most likely due to over powering; voltage, or overheating; ambient cooling is too low.<br>- If resistance is too low then the coil winding has broken, or insulation on coil winding has melted, and the electrical flow path is not through the whole coil.<br>▪ Check for contamination internal to the valve, which will cause leakage or no flow, by pressurizing the inlet port with air and routing the outlet port under water via tubing. No visible signs of air bubbles dispensing from the outlet of the tubing should be present. |

## AirJet Dispenser Troubleshooting

| Problem | Possible Solution |
|---|---|
| General Tips | ▪ Ensure that the proper dispenser has been selected in the Program.<br>▪ Ensure that all reagent lines are connected securely and are free of clogs and leaks.<br>▪ Ensure that the proper volume is entered in the Program. Programmed volume should not be less than 1 µl/cm.<br>▪ Ensure that the dispenser has been properly primed.<br>▪ Ensure that the appropriate syringe size has been configured.<br>▪ Ensure that the airlines are connected properly and the appropriate amount of pressure is applied to the AirJet™ dispenser.<br>▪ Ensure the micrometer atop the AirJet is open sufficiently.<br>▪ Ensure that the dispense head is at an appropriate distance from the surface of the substrate (approx. 1-3 cm).<br>▪ Ensure that the air pressure is set appropriately. The AirJet is |

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|---|---|
| | commonly operated at 8-10psi.<br>▪ Ensure that the transition times (Trans 1 and 2) are set correctly for the fluid you are dispensing. These settings are determined empirically and may differ for each fluid and tandem pump set. Having these settings correct will ensure that no gaps or bulges in dispensed lines will occur upon pump transition. |
| Breaks in lines | ▪ Check air pressure, height of dispense head above substrate and opening of micrometer. Generally air pressure is operated at 8-10 psi, and the micrometer is set at 1-3 for commonly dispensed fluids such as gold conjugates or blocking reagents. Alter one parameter at a time until line quality improves. |

## Dip Tank Troubleshooting

| Problem | Possible Solution |
|---|---|
| No power (power squeegee and pump are not operating). | ▪ Check the power cord and switch setting.<br>▪ Check the fuse. Replace if necessary.<br>▪ Check the power connectors. |
| Dip Tank does not refill. | ▪ Check the level of the fluid sensor; it may be too high to sense the solution level.<br>▪ The pick up end of the tube may not be sufficiently immersed.<br>▪ Check to make sure that the pump box power is on. |

## Dry Tower Troubleshooting

| Problem | Possible Solution |
|---|---|
| Membrane material fails to dry upon exiting the Dry Tower. | ▪ Speed of material too great as it passes through the Dry Tower. Reduce speed as required.<br>▪ Additional drying module(s) needed. Up to three may be stacked or multiple 3 stage towers may be put in line.<br>▪ Drying temperature set too low. Increase temperature set point.<br>▪ Doors not fully latched; air leakage occurs. Verify all doors have been closed and latched. |
| Membrane material tracks off center of rollers. | ▪ Positioning on front of control module not in alignment with reel-to-reel module. Realign as necessary.<br>▪ Membrane tension is too low. Adjust take-up reel module to increase tension.<br>▪ Membrane is too thick; crowned rollers become ineffective. Reduce membrane thickness if possible. |
| Membrane material curls upon exiting Dry Tower. | ▪ Drying temperature set too high. Reduce temperature setting.<br>▪ Intermittent membrane motion in moving material through Dry Tower. Avoid repeated start and stop of membrane flow.<br>▪ Possible tracking problem. Check alignment and flatness of mounting platform. |
| Membrane breaks within Dry Tower. | ▪ Membrane tension set too high. Adjust take-up reel module to reduce tension. |

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|---|---|
| | ▪ Slack in membrane path at onset of motion. Remove slack and center membrane on rollers prior to operating. |

APPENDIX B

# BioJet Dispenser Rate Tables

## BioJet Quanti Line Dispensing Parameters: 50-100 µl Syringe, 0.2 to 5.0 µl/cm Dispense Rate

### 50 µl Syringe

| Rate (µl/cm) | Drop Volume (nl) | Drop Pitch (mm) | On Time (msec) |
|---|---|---|---|
| 0.2 | 4.17 | 0.21 | 0.20 |
| | 6.25 | 0.31 | 0.20 |
| | 8.33 | 0.42 | 0.20 |
| .25 | 4.17 | 0.17 | 0.20 |
| | 6.25 | 0.25 | 0.20 |
| | 8.33 | 0.33 | 0.20 |
| | 10.42 | 0.42 | 0.20 |
| 0.3 | 4.17 | 0.14 | 0.20 |
| | 6.25 | 0.21 | 0.20 |
| | 8.33 | 0.28 | 0.20 |
| | 12.50 | 0.42 | 0.20 |
| .4 | 6.25 | 0.16 | 0.20 |
| | 8.33 | 0.21 | 0.20 |
| | 12.50 | 0.31 | 0.20 |
| | 16.67 | 0.42 | 0.20 |
| .5 | 10.42 | 0.21 | 0.20 |
| | 16.67 | 0.33 | 0.20 |
| | 25.00 | 0.50 | 0.20 |
| .6 | 12.50 | 0.21 | 0.20 |
| | 16.67 | 0.28 | 0.20 |
| | 25.00 | 0.42 | 0.20 |
| .7 | 14.58 | 0.21 | 0.20 |
| | 16.67 | 0.24 | 0.20 |
| | 33.33 | 0.48 | 0.25 |
| .8 | 16.67 | 0.21 | 0.20 |
| | 25.00 | 0.31 | 0.20 |
| | 33.00 | 0.42 | 0.25 |
| .9 | 18.75 | 0.21 | 0.20 |
| | 25.00 | 0.28 | 0.20 |
| | 33.33 | 0.37 | 0.25 |

| Rate (µl/cm) | Drop Volume (nl) | Drop Pitch (mm) | On Time (msec) |
|---|---|---|---|
| 1.0 | 20.83 | 0.21 | 0.20 |
| | 33.33 | 0.33 | 0.25 |
| | 50.00 | 0.50 | 0.50 |
| 1.1 | 25.00 | 0.23 | 0.20 |
| | 33.33 | 0.30 | 0.25 |
| | 50.00 | 0.45 | 0.50 |
| 1.2 | 25.00 | 0.21 | 0.20 |
| | 33.33 | 0.31 | 0.30 |
| | 50.00 | 0.42 | 0.50 |
| 1.3 | 27.08 | 0.21 | 0.20 |
| | 33.33 | 0.26 | 0.25 |
| | 54.17 | 0.42 | 0.30 |
| 1.4 | 29.17 | 0.21 | 0.20 |
| | 43.75 | 0.31 | 0.40 |
| | 58.33 | 0.42 | 0.50 |
| 1.5 | 33.33 | 0.22 | 0.25 |
| | 50.00 | 0.33 | 0.50 |
| | 75.00 | 0.50 | 0.70 |
| 2.0 | 50.00 | 0.25 | 0.48 |
| | 75.00 | 0.33 | 0.70 |
| | 100.00 | 0.50 | 0.80 |
| 3.0 | 75.00 | 0.25 | 0.70 |
| | 100.00 | 0.33 | 0.80 |
| | 150.00 | 0.50 | 0.90 |
| 4.0 | 100.00 | 0.25 | 0.80 |
| | 133.33 | 0.33 | 0.87 |
| | 200.00 | 0.50 | 1.00 |
| 5.0 | 125.00 | 0.25 | 0.85 |
| | 166.67 | 0.33 | 0.93 |
| | 250.00 | 0.50 | 1.10 |

### 100 µl Syringe

| Rate (µl/cm) | Drop Volume (nl) | Drop Pitch (mm) | On Time (msec) |
|---|---|---|---|
| .2 | 4.17 | .21 | 0.20 |
| | 8.33 | .42 | 0.20 |
| | 12.5 | .63 | 0.20 |
| .3 | 4.17 | .14 | 0.20 |
| | 8.33 | .28 | 0.20 |
| | 12.5 | .42 | 0.20 |
| .4 | 8.33 | .21 | 0.20 |
| | 12.5 | .31 | 0.20 |
| | 16.7 | .42 | 0.20 |
| .5 | 12.5 | .25 | 0.20 |
| | 16.67 | .33 | 0.20 |
| | 25 | .5 | 0.20 |
| .6 | 16.66 | .21 | 0.20 |
| | 25 | .28 | 0.20 |
| | 33.33 | .42 | 0.20 |
| .7 | 16.66 | .24 | 0.20 |
| | 25 | .36 | 0.20 |
| | 33.33 | .48 | 0.25 |
| .8 | 16.67 | .21 | 0.20 |
| | 25 | .31 | 0.20 |
| | 33 | .42 | 0.25 |
| .9 | 25 | .28 | 0.20 |
| | 37.5 | .42 | 0.30 |
| | 50 | .56 | 0.50 |
| 1.0 | 20.83 | .21 | 0.20 |
| | 33.33 | .33 | 0.25 |
| | 50 | .5 | 0.50 |
| 1.1 | 25 | .23 | 0.20 |
| | 33.33 | .3 | 0.25 |
| | 50 | .45 | 0.50 |

| Rate (µl/cm) | Drop Volume (nl) | Drop Pitch (mm) | On Time (msec) |
|---|---|---|---|
| 1.2 | 25.00 | .21 | 0.20 |
| | 37.50 | .31 | 0.30 |
| | 50.00 | .42 | 0.50 |
| 1.3 | 33.33 | .26 | 0.20 |
| | 50 | .38 | 0.50 |
| | 54.17 | .42 | 0.55 |
| 1.4 | 29.17 | .21 | 0.20 |
| | 50 | .36 | 0.50 |
| | 66.67 | .48 | 0.67 |
| 1.5 | 33.33 | .22 | 0.25 |
| | 50 | .33 | 0.50 |
| | 75 | .5 | 0.70 |
| 1.6 | 33.33 | .21 | 0.25 |
| | 50 | .31 | 0.50 |
| | 66.67 | .42 | 0.70 |
| 1.8 | 37.5 | .21 | 0.30 |
| | 50 | .28 | 0.50 |
| | 75 | .42 | 0.70 |
| 2.0 | 41.67 | .21 | 0.40 |
| | 66.67 | .33 | 0.67 |
| | 100 | .5 | 0.80 |
| 3.0 | 66.67 | .22 | 0.67 |
| | 100 | .33 | 0.80 |
| | 150 | .5 | 0.90 |
| 4.0 | 100 | .25 | 0.80 |
| | 133.33 | .33 | 0.87 |
| | 200 | .5 | 1.00 |
| 5.0 | 125 | .25 | 0.85 |
| | 166.6 | .33 | 0.93 |
| | 250 | .5 | 1.10 |

## BioJet Quanti Line Dispensing Parameters: 250-500 µl Syringe, 0.375 to 10.0 µl/cm Dispense Rate

### 250 µl Syringe

| Rate (µl/cm) | Drop Volume (nl) | Drop Pitch (mm) | On Time (msec) |
|---|---|---|---|
| .375 | 10.42 | .28 | 0.20 |
| | 20.83 | .56 | 0.20 |
| | 31.25 | .83 | 0.25 |
| .50 | 10.42 | .21 | 0.20 |
| | 20.83 | .42 | 0.20 |
| | 31.25 | .63 | 0.25 |
| .75 | 20.83 | .28 | 0.20 |
| | 31.25 | .42 | 0.25 |
| | 41.67 | .56 | 0.40 |
| 1.00 | 20.83 | .21 | 0.20 |
| | 31.25 | .31 | 0.25 |
| | 41.67 | .42 | 0.40 |
| 1.25 | 31.25 | .28 | 0.25 |

| Rate (µl/cm) | Drop Volume (nl) | Drop Pitch (mm) | On Time (msec) |
|---|---|---|---|
| 2.75 | 83.33 | .33 | 0.75 |
| | 114.58 | .42 | 0.80 |
| | 125.00 | .50 | 0.85 |
| 3.00 | 93.75 | .31 | 0.78 |
| | 125.00 | .42 | 0.83 |
| | 166.67 | .45 | 0.94 |
| 3.25 | 125.00 | .38 | 0.85 |
| | 135.42 | .42 | 0.88 |
| | 250.00 | .77 | 1.11 |
| 3.50 | 125.00 | .36 | 0.86 |
| | 166.67 | .48 | 0.95 |
| | 250.00 | .71 | 1.10 |
| 3.75 | 156.25 | .42 | 0.92 |

| | | | |
|---|---|---|---|
| | 41.67 | .37 | 0.40 |
| | 62.50 | .56 | 0.66 |
| 1.50 | 41.67 | .28 | 0.40 |
| | 62.50 | .42 | 0.65 |
| | 83.33 | .56 | 0.76 |
| 1.75 | 41.67 | .24 | 0.40 |
| | 62.50 | .36 | 0.65 |
| | 83.33 | .48 | 0.76 |
| 2.00 | 62.50 | .31 | 0.65 |
| | 83.33 | .42 | 0.75 |
| | 125.00 | .63 | 0.85 |
| 2.25 | 62.50 | .28 | 0.70 |
| | 83.33 | .37 | 0.74 |
| | 125.00 | .56 | 0.86 |
| 2.50 | 83.33 | .33 | 0.70 |
| | 104.17 | .42 | 0.80 |
| | 125.00 | .50 | 0.85 |

| | | | |
|---|---|---|---|
| | 187.50 | .50 | 0.98 |
| | 250.00 | .67 | 1.11 |
| 4.00 | 166.67 | .42 | 0.96 |
| | 250.00 | .63 | 1.10 |
| | 333.33 | .83 | 1.18 |
| 5.00 | 208.33 | .42 | 1.00 |
| | 250.00 | .50 | 1.10 |
| | 500.00 | 1.00 | 1.28 |
| 6.00 | 250.00 | .42 | 1.08 |
| | 333.33 | .56 | 1.17 |
| | 500.00 | .83 | 1.28 |
| 8.00 | 333.33 | .42 | 1.17 |
| | 500.00 | .63 | 1.25 |
| | 666.67 | .83 | 1.37 |
| 10.00 | 500.00 | .50 | 1.30 |
| | 666.67 | .67 | 1.33 |
| | 1000.00 | 1.00 | 3.00 |

## 500 µl Syringe

| Rate (µl/cm) | Drop Volume (nl) | Drop Pitch (mm) | On Time (msec) |
|---|---|---|---|
| .375 | 20.83 | .56 | 0.20 |
| | 41.67 | 1.11 | 0.40 |
| | 62.50 | 1.67 | 0.67 |
| .50 | 20.83 | .42 | 0.20 |
| | 41.67 | .83 | 0.40 |
| | 62.50 | 1.12 | 0.65 |
| .75 | 20.83 | .28 | 0.20 |
| | 41.67 | .56 | 0.40 |
| | 62.50 | .83 | 0.65 |
| 1.00 | 20.83 | .21 | 0.20 |
| | 41.67 | .42 | 0.40 |
| | 62.50 | .63 | 0.65 |
| 1.25 | 41.67 | .33 | 0.40 |
| | 62.50 | .50 | 0.65 |
| | 83.30 | .67 | 0.75 |
| 1.50 | 62.50 | .42 | 0.57 |
| | 83.33 | .56 | 0.76 |
| | 125.00 | .83 | 0.85 |
| 1.75 | 62.50 | .36 | 0.65 |
| | 83.33 | .48 | 0.75 |
| | 125.00 | .71 | 0.86 |
| 2.00 | 62.50 | .31 | 0.62 |
| | 83.33 | .42 | 0.75 |
| | 125.00 | .63 | 0.85 |
| 2.25 | 83.33 | .37 | 0.74 |
| | 125.00 | .56 | 0.86 |
| | 187.50 | .83 | 0.98 |
| 2.50 | 83.33 | .33 | 0.75 |
| | 125.00 | .50 | 0.85 |
| | 166.67 | .67 | 0.95 |

| Rate (µl/cm) | Drop Volume (nl) | Drop Pitch (mm) | On Time (msec) |
|---|---|---|---|
| 2.75 | 83.33 | .30 | 0.76 |
| | 125.00 | .45 | 0.85 |
| | 250.00 | .91 | 1.11 |
| 3.00 | 125.00 | .42 | 0.83 |
| | 166.67 | .56 | 0.94 |
| | 250.00 | .83 | 1.10 |
| 3.50 | 125.00 | .36 | 0.86 |
| | 166.67 | .48 | 0.95 |
| | 250.00 | .71 | 1.10 |
| 4.00 | 166.67 | .42 | 0.96 |
| | 250.00 | .63 | 1.10 |
| | 333.33 | .83 | 1.18 |
| 5.00 | 208.33 | .42 | 1.00 |
| | 250.00 | .50 | 1.10 |
| | 500.00 | 1.00 | 1.28 |
| 6.00 | 250.00 | .42 | 1.08 |
| | 333.33 | .56 | 1.17 |
| | 500.00 | .83 | 1.28 |
| 8.00 | 333.33 | .42 | 1.17 |
| | 500.00 | .63 | 1.25 |
| | 666.67 | .83 | 1.37 |
| 10.00 | 500.00 | .50 | 1.30 |
| | 666.67 | .67 | 1.33 |
| | 1000.00 | 1.00 | 3.00 |
| 15.00 | 625.00 | .42 | 1.33 |
| | 1000.00 | .67 | 3.07 |
| 20.00 | 1000.00 | .50 | 0.30 |

# BioJet Quanti Line Dispensing Parameters: 1.0ml Syringe, 1.0 to 25.0 µl/cm Dispense Rate

## 1.0 ml Syringe

| Rate (µl/cm) | Drop Volume (nl) | Drop Pitch (mm) | On Time (msec) |
|---|---|---|---|
| 1.00 | 41.67 | 0.42 | 0.40 |
| | 83.33 | 0.83 | 0.75 |
| | 125.00 | 1.25 | 0.85 |
| 1.25 | 41.67 | 0.33 | 0.40 |
| | 83.33 | 0.50 | 0.75 |
| | 125.00 | 1.00 | 0.86 |
| 1.50 | 83.33 | 0.56 | 0.76 |
| | 125.00 | 0.83 | 0.85 |
| | 166.67 | 1.11 | 0.96 |
| 1.75 | 83.33 | 0.48 | 0.75 |
| | 125.00 | 0.71 | 0.86 |
| | 250.00 | 1.43 | 1.11 |
| 2.00 | 83.33 | 0.42 | 0.75 |
| | 125.00 | 0.63 | 0.85 |
| | 166.67 | 0.83 | 0.93 |
| 2.25 | 83.33 | 0.37 | 0.74 |
| | 125.00 | 0.50 | 0.70 |
| | 250.00 | 1.11 | 1.11 |
| 2.50 | 83.30 | 0.33 | 0.73 |
| | 125.00 | 0.50 | 0.85 |
| | 166.67 | 0.67 | 0.95 |
| 2.75 | 83.30 | 0.30 | 0.76 |
| | 125.00 | 0.45 | 0.85 |
| | 250.00 | 0.90 | 1.11 |
| 3.00 | 125.00 | 0.42 | 0.83 |
| | 166.67 | 0.56 | 0.94 |
| | 250.00 | 0.83 | 1.10 |
| 3.50 | 125.00 | 0.36 | 0.86 |
| | 166.67 | 0.48 | 0.95 |
| | 250.00 | 0.71 | 1.10 |

| Rate (µl/cm) | Drop Volume (nl) | Drop Pitch (mm) | On Time (msec) |
|---|---|---|---|
| 4.00 | 166.67 | 0.42 | 0.96 |
| | 250.00 | 0.63 | 1.10 |
| | 333.33 | 0.83 | 1.18 |
| 4.50 | 187.50 | 0.42 | 1.00 |
| | 250.00 | 0.56 | 1.10 |
| | 375.00 | 0.83 | 1.18 |
| 5.00 | 208.33 | 0.42 | 1.00 |
| | 250.00 | 0.50 | 1.10 |
| | 500.00 | 1.00 | 1.22 |
| 6.00 | 250.00 | 0.42 | 1.08 |
| | 333.33 | 0.56 | 1.17 |
| | 500.00 | 0.83 | 1.28 |
| 7.00 | 250.00 | 0.36 | 1.11 |
| | 333.33 | 0.48 | 1.19 |
| | 500.00 | 0.71 | 1.29 |
| 8.00 | 333.33 | 0.42 | 1.17 |
| | 500.00 | 0.63 | 1.25 |
| | 666.67 | 0.83 | 1.37 |
| 10.00 | 500.00 | 0.50 | 1.30 |
| | 666.67 | 0.67 | 1.33 |
| | 1000.00 | 1.00 | 3.00 |
| 15.00 | 625.00 | 0.42 | 1.33 |
| | 1000.00 | 0.67 | 3.07 |
| 20.00 | 1000.00 | 0.50 | 3.00 |
| 25.00 | 1000.00 | 0.40 | 2.40 |

APPENDIX C

# SYSTEM SPECIFICATIONS

## RR4500 Specifications

| Property | Specifications |
|---|---|
| Power Requirements | ▪ USA:<br>- 115/220 VAC, 1 Phase, 50/60 Hz, 15A<br>- 120/208 VAC, 3 Phase, 60 Hz 20 Amps (NEMA plug L21-20P)<br>▪ Europe: 230 VAC, 1Phase 50 Hz 15 Amps<br>▪ Japan: 100VAC, 1 Phase 50/60 Hz 20 Amps |
| Air Requirements | ▪ 40 – 80 PSIG (2.8 – 6.3 Kg/cm$^2$)<br>Must be a clean, dry, and filtered air source at constant pressure. |
| Dimensions (Excluding options) | ▪ 64 inches (163 cm) wide at widest point<br>▪ 23 inches (56 cm) high, from bottom of support base to top of supply reel<br>▪ 26 inches (66 cm) deep at deepest point |
| Weight (Excluding options) | ▪ 110 lbs (50 kg) |
| Tolerances<br>(Note that tolerances will vary, dependent on material and process.) | ▪ Web Width: Web widths between 5.0 mm (.2 inches) and 98 mm (3.86 inches).<br>▪ Roll Diameter: Up to 40 cm (16 inches); standard roll size is 13 inches.<br>▪ Reel Hub: Optional hub sizes of 1 inch, 2 inch or up to 4 inch (25 mm, 51 mm, or 101 mm) are available. Standard hubs have a 3-inch (76 mm) core diameter. Custom reel hubs are available.<br>▪ Linear Web Speed: Up to 4 inches/second (125 mm/second).<br>▪ Web Tracking: The auto tracking system can maintain web position to +/- 1 mm on take-up roll, and +/- 0.5 mm on dispense line position relative to web edge. |

## BioJet Quanti 3000 Dispenser Specifications

| Property | Specifications |
|---|---|
| Power Requirements | ▪ None (power derived from the reel-to-reel dispensing platform: 110/220 VAC; 50 – 60 Hz) |

| | |
|---|---|
| Air Requirements | ▪ This dispenser does not utilize air. |
| Dispensing Parameters | ▪ Smallest Drop Volume: 4.2 nl<br>▪ Drop Size Range: 4.2 nl – 1.0 µl<br>▪ Volume Range: 0.5 µl – 30 µl/second (dependent on fluid rheology)<br>▪ Smallest Continuous Line Width: 0.020 inches (0.5 mm) (dependent on fluid rheology and substrate properties)<br>▪ Repeatability: ± 1% Line dispensing, and ± 3% Dot-to-Dot dispensing (dependent on fluid rheology and drop size)<br>▪ Fluid Path Volume: 350 µl (includes feed lines) with a 250 µl syringe at full stroke (depends on how/where lines have been cut)<br>▪ Volume Recovery: 95% |

## AirJet Quanti Dispenser Specifications

### AirJet Quanti 3000 Specifications

| Property | Specifications |
|---|---|
| Power Requirements | ▪ None (power derived from the reel-to-reel dispensing platform: 110/220 VAC; 50 – 60 Hz) |
| Air Requirements | ▪ Air source required: 10 - 40 PSIG (0.70 - 2.80 Kg/cm$^2$)<br>▪ Must be a clean, dry, and filtered air source at constant pressure. |
| Air Pressure | ▪ Tubing 1/8” ID x 1/4” OD Tygon™ |
| Feed Line | ▪ Tubing 1/32” ID TFE |
| Materials | ▪ Titanium/stainless steel |
| Dispensing Parameters | ▪ Dispensing Range: 1 µl/cm - 22 µl/cm (dependent on fluid rheology; based on consistent and reproducible dispense of 0.05% BioTerge in water over a 30 cm path length)<br>▪ Line Width Range: 0.02 inches (0.5 mm) to 0.24 inches (6 mm) (highly dependent on absorption properties of the substrate and fluid rheology)<br>▪ Nozzle/Needle Size: -0.3mm<br>▪ Available syringes: 50µl /100µl /250µl / 500µl / 1ml<br>▪ Repeatability: ± 1% Line dispensing (based on 5µl/cm over 30 cm path)<br>▪ Swept (Dead) Volume: Approximately 1.5 µl (based on 250µl syringe and minimum usable tubing lengths)<br>▪ Volume Recovery: < 98% |

### AirJet Quanti 2300 Specifications

| Property | Specifications |
|---|---|
| Power Requirements | ▪ None (power derived from the reel-to-reel dispensing platform: 110/220 VAC; 50 – 60 Hz) |
| Air Requirements | ▪ Air source required: 10 - 40 PSIG (0.70 - 2.80 Kg/cm$^2$) |

| | |
|---|---|
| | ▪ Must be a clean, dry, and filtered air source at constant pressure. |
| Air Pressure | ▪ Tubing 1/8” ID x 1/4” OD Tygon |
| Feed Line | ▪ Tubing 1/16” ID TFE |
| Materials | ▪ Stainless steel |
| Dispensing Parameters | ▪ Dispensing Range: 1 µl/cm - <30 µl/cm (dependent on fluid rheology; based on consistent and reproducible dispense of 0.05% BioTerge in water over a 30 cm path length)<br>▪ Line Width Range: 0.04 inches (2.0 mm) to 0.60 inches (15.0 mm) (highly dependent on absorption properties of the substrate and fluid rheology)<br>▪ Nozzle/Needle Size: -0.6mm<br>▪ Available syringes: 50µl /100µl /250µl / 500µl / 1ml<br>▪ Repeatability: ± 1% Line dispensing (based on 5µl/cm over 30 cm path)<br>▪ Swept (Dead) Volume: Approximately 1.8 µl (based on 250µl syringe and minimum usable tubing lengths)<br>▪ Volume Recovery: < 98% |

### AirJet Quanti 2400 Specifications

| Property | Specifications |
|---|---|
| Power Requirements | ▪ None (power derived from the reel-to-reel dispensing platform: 110/220 VAC; 50 – 60 Hz) |
| Air Requirements | ▪ Air source required: 10 - 40 PSIG (0.70 - 2.80 Kg/cm$^2$)<br>▪ Must be a clean, dry, and filtered air source at constant pressure. |
| Air Pressure | ▪ Tubing 1/8” ID x 1/4” OD Tygon |
| Feed Line | ▪ Tubing 1/16” ID TFE |
| Materials | ▪ Stainless steel |
| Dispensing Parameters | ▪ Dispensing Range: 1 µl/cm - <80 µl/cm (dependent on fluid rheology; based on consistent and reproducible dispense of 0.05% BioTerge in water over a 30 cm path length)<br>▪ Line Width Range: 0.08 inches (2.0 mm) to 1.00 inches (25.0 mm) (highly dependent on absorption properties of the substrate and fluid rheology)<br>▪ Nozzle/Needle Size: -0.8mm<br>▪ Available syringes: 50µl /100µl /250µl / 500µl / 1ml<br>▪ Repeatability: ± 1% Line dispensing (based on 5µl/cm over 30 cm path)<br>▪ Swept (Dead) Volume: Approximately 1.8 µl (based on 250µl syringe and minimum usable tubing lengths)<br>▪ Volume Recovery: < 98% |

## FrontLine Quanti 1000 Dispenser Specifications

| Property | Specifications |
|---|---|

| | |
|---|---|
| Power Requirements | ▪ None (power derived from the reel-to-reel dispensing platform: 110/220 VAC; 50 – 60 Hz) |
| Air Requirements | ▪ This dispenser does not utilize air. |
| Dispensing Parameters | ▪ Minimum Dispense Volume: 0.1 µl/second (dependent on fluid rheology)<br>▪ Minimum Continuous Line Width: 0.3 mm (line width is highly dependent on fluid rheology and substrate properties)<br>▪ Maximum Fluid Path Volume: < 350 µl (using a 250 µl syringe and 20 cm of standard tubing)<br>▪ Repeatability: ± 1% (dependent on fluid rheology)<br>▪ Volume Recovery: 95% |

## Dip Tank Specifications

| Property | Specifications |
|---|---|
| Power Requirements | ▪ None (power derived from the reel-to-reel dispensing platform)<br>▪ Peristaltic Pump (Option): 115/230 VAC, 50/60Hz, 2A |
| Dimensions | ▪ 15” H x 17” W x 14” D (17” with Connectors)<br>▪ 38 cm H x 43 cm W x 36 cm D (43 cm with connectors) |
| Weight | ▪ 30 lbs. (13.7 kg) |
| Maximum Fluid Volume | ▪ 0.6 Liters<br>▪ Shallow Dip Tank 0.47 Liters |
| Maximum Material Width | ▪ 4.0” ( 11.2 cm) |
| Biocompatibility | ▪ Wetted materials include: Teflon (PTFE) coated Aluminum, Delirin, Polyproylene, Stainless Steel |

## RR3130 Dry Tower Specifications

| Property | Specifications |
|---|---|
| Power Requirements | ▪ USA:<br>- 120/208 VAC 3-Phase Y, 60 Hz, and 1500 VA each Phase<br>- Equipment plug is NEMA L21-20P<br>- Note that each Dry Tower must have its own internal resetable breaker circuit @ min. 30A. Receptacle required is a NEMA L21-20R.<br>▪ Europe: 230VAC, 1-Phase Y, 50/60 Hz, 10A<br>▪ Japan: 100VAC, 1-Phase Y, 50/60Hz, 20A |
| Dimensions | ▪ 53.4” High X 16.7” Wide X 14.1” Deep<br>▪ 136cm High x 46 cm Wide x 36 cm Deep |
| Weight | ▪ 111 Pounds (50 kg) |
| Dryer Type | ▪ Forced heated air convection supplemented with far infrared radiation. |

| | |
|---|---|
| Dryer Speed | ▪ Dependent upon drying temperature, air velocity, number of drying modules used, and liquid content to be removed.<br>▪ Typical speed range is from 5mm/sec to 25mm/sec. |
| Controls | ▪ Independent controls for each drying module<br>▪ Closed loop set point temperature control sensing air temperature at site adjacent to membrane path (using type J thermocouple).<br>▪ Variable external flow controls which sets drying airflow at membrane.<br>▪ Positioning control to move tower transverse to membrane path to accommodate membrane widths of from 1/2” (1.3cm) to 4” (10cm). |
| Temperature Range | ▪ Ambient to 200° F (93° C) at max. airflow. |
| Air Flow Range | ▪ 0 to approximately 700 feet/min. (318 meter/min.) at membrane location. |
| Exhaust Provisions | ▪ 4” (10cm) diameter outlet duct exhausting vertically. |
| Material Size | ▪ Will accommodate membrane or absorbent materials in width spacing of up to 4” (10cm). |
| Material Path Length | ▪ 105” (267cm) |

APPENDIX D

# RECOMMENDED SPARE PARTS

## RR4500 Spare Parts

| Qty to Stock | Description | Part # |
|---|---|---|
| 1 | MOTOR, STEPPER - CAPSTAN | 2016-0020 |
| 1 | MOTOR, STEPPER - PAYOUT/TAKEUP | 2016-0023 |
| 1 | BEARING, BALL, SELF ALIGNING, .250 | 3001-0001 |
| 4 | BEARING, MINI-PRECISION | 3001-0027 |
| 2 | BEARING, MINI-PRECISION | 3001-0030 |
| 2 | BEARING,.500 B,1.125-4" | 3001-0055 |
| 1 | PULLEY, DRIVE | 6007-0029 |
| 1 | ROLLER, DRIVE - TEFLON COATED | 6007-0040 |

* The quantity to stock listed is the quantity of each part that is included if you get the entire RR4500 spare part kit. The entire spare part kit includes all of the listed parts and quantities above and is available as part # 6007-A025.

## BioJet Quanti Dispenser Spare Parts

| Qty to Stock | Description | Part # |
|---|---|---|
| 5 | PBT POLYESTER TIP | 6002-0323 |
| 2 | BIOJET™ CABLE | 6002-C001-01 |
| 4 sets | TUBING ASSEMBLY, BOTTLE TO SYRINGE | 6002-A038-03 |
| 4 sets | TUBING ASSEMBLY, SYRINGE TO BIOJET, FEED LINE | 6002-A059-01 |
| 3 | BIOJET VALVE | 6002-0350 |
| 1 | VALVE, 3-PORT XP SYRINGE | 4011-0000 |
| 1 | JET WASH BIOJET VALVE CLEANER, 10 ML BOTTLE | 0001-A009 |
| 2 | SYRINGE, XP, 250UL | 4008-0020 |
| 2 | GUARD, NOZZLE | 6002-0306 |
| 1 | TUBING, VITON | 4010-0008 |

| | | |
|---|---|---|
| 4 | SEAL, XP, 250UL | 4008-0008 |

* The quantity to stock listed is the quantity of each part that is included if you get the entire BioJet Quanti™ dispenser spare part kit (for units with 4+ pumps). The entire spare part kit includes all of the listed parts and quantities above and is available as part # 6002-A081-02.

## AirJet Quanti 3000 Dispenser Spare Parts

| Qty to Stock | Description | Part # |
|---|---|---|
| 2 | NEEDLE | 6004-0306 |
| 2 | 0-RING | 3020-0002 |
| 2 | 0-RING | 3020-0005 |
| 2 | 0-RING | 3020-0003 |
| 1 | SYRINGE, 1ML, XP PUMP | 4008-0013 |
| 1 | SEAL - FOR 1ML SYRINGE | 4008-0004 |
| 1 | NOZZLE, AIRBRUSH,.3mm | 4002-0009 |
| 1 | CROWN TIP AIRBRUSH,3mm | 4002-0013 |
| 4 | SET SCREW, 0-80, 1/8 LONG | 3030-0050-00 |
| 2 | ASSY, TUBING, 36.0 LG | 6002-A038-03 |
| 1 | VALVE, 3-PORT,120 DEGREES, XP PUMP | 4011-0000 |

* The quantity to stock listed is the quantity of each part that is included if you get the entire AirJet Quanti™ 3000 dispenser spare part kit. The entire spare part kit includes all of the listed parts and quantities above and is available as part # 6004-A081.

## Dip Tank Spare Parts

| Qty to Stock | Description | Part # |
|---|---|---|
| 1 | LINER, DIP TANK | 6012-0105 |
| 1 | SENSOR LEVEL | 1008-0026 |
| 2 | BRG, FLANGED, TEFLON, .191B | 3001-0048 |

* The quantity to stock listed is the quantity of each part that is included if you get the entire Dip Tank spare part kit. The entire spare part kit includes all of the listed parts and quantities above and is available as part # 6012-A025.

## RR3100 Dry Tower Spare Parts

| Qty to Stock | Description | Part # |
|---|---|---|
| 1 | RELAY,SOLID STATE, 25 AMP | 1022-0010 |
| 1 | TEMPERATURE CONTROLLER | 2009-0008 |
| 2 | BEARING,R6,375 ID X.875 0D | 3001-0035 |
| 1 | FASTNER, QUARTER TURN | 3029-0004 |
| 1 | TUBING, TEFLON, 5/32ID X 1/4OD | 4010-0036 |

| | | |
|---|---|---|
| 1 | THERMOCOUPLE, 54.0 | 6010-0117-01 |

* The quantity to stock listed is the quantity of each part that is included if you get the entire RR3100 Dry Tower spare part kit. The entire spare part kit includes all of the listed parts and quantities above and is available as part # 6010-A025.

# GLOSSARY

**Activated:** A toggle field on the hand-held terminal that is set to YES or ON.

**AMP:** An AMP (brand-name) connector is a larger, round (usually black), panel pin-and-socket connector (interfaces with a jack on the back of the unit).

**BNC:** Also Bayonet or Coaxial connectors, a BNC connector is used to interface BioJet™ dispensers with the system platform.

**Cable Assembly:** The grouping of cables factory-assembled to assure proper connection between the syringe pumps, and between the syringe pumps and the system platform. The cable assembly connector is the connection head that attaches to the syringe pump 15-pin connector.

**Center:** The position in the y-axis where web will naturally track, based on the alignment of system components, when the reel-to-reel is in operation.

**Chassis:** The Chassis is the optional support surface available for the reel-to-reel.

**Connection:** Throughout the manual, connection refers to the connection between modules via BNC, Molex, or other cables.

**Crown:** The high point on each crowned roller.

**Crowned Roller:** One of four rollers in the RR4500 tensioning system which have a “crowned” profile; that is, the crowned rollers slope towards the edges so that the peak height is at the center of the roller.

**Datum Edge:** A fixed, straight edge that can be used to position or guide web material.

**Depth:** With regard to aligning the RR4500, the measured distance from front-side to back-side of a reel or reel hub.

**Dispense Rate:** The volume of reagent dispensed per centimeter in a dispensing program, expressed in ul/cm.

**Dispense/Take-up Tracking Sensors:** The two sets of auto tracking sensors, located on the dispense module and take-up module, respectively. The sensors detect the edge of the web material and trigger y-axis adjustment of the dispensing platform or take-up reel in response to changes in web tracking.

**Dispensing Platform:** The mounting surface for the attachment of dispensers; the position of the dispensing platform is adjustable in the X and Y-axis.

**Drop-on-Demand Technology:** Dispensing technology behind the Quanti™ line of dispensers that is based on the combination of a solenoid valve to form drops and a syringe pump to meter reagent; a Quanti dispenser is capable of precisely defined drop sizes or line volumes that are determined by the stepping resolution of the syringe pump and the size of the syringe.

**Drop Volume:** The volume of each drop dispensed, expressed in nl.

**Edit Field:** A field on the hand-held terminal that contains an editable numeric or textual value after the field name (i.e., LENGTH: 200 or NAME: MYPROGRAM). A new value is entered into an edit field by selecting the field with the Up ↑ or Down ↓ arrow keys and then typing the new value using the keypad.

**Exterior Wind:** The manner in which a web material has been wound onto a roll, so that the spray side of the material is facing out (facing away from the roll core).

**Fluid Path Volume:** The volume of reagent within the dispensing system between the syringe pump and the dispenser tip (release point).

**Hand-Held Terminal (HHT):** The user-interface for the instrument. It consists of the keypad and software that control system operation, as well as an LCD display terminal for viewing menu structure, stored data, and system status.

**Horizontal (Y-Axis) Positioning Stage:** An integrated dispensing component of certain BioDot dispensing platforms that is height-adjustable, in the y-axis, through the use of a micrometer; a dispenser and associated components are mounted to the horizontal positioning stage via a universal mounting bracket.

**HPLC Fitting:** The ferrule and nut style fitting used to make the watertight reagent supply line connection on the AirJet™ dispenser.

**Inlet Port:** A point on the dispenser where a reagent feed line attaches. This port may be attached to the reagent line via a plastic fitting and ferrule, barbed fitting and sleeve collar or screw in plastic fitting.

**Installation:** This includes unpacking the equipment, assembling the equipment, and connecting the equipment to its electrical components.

**Interior Wind:** The manner in which a web material has been wound onto a roll, so that the spray side of the material is facing in (facing the roll core).

**Field:** The areas within each line of a menu on the hand-held terminal where data can be entered.

**Guidance Rollers:** The Guidance Rollers are a set of narrow, fixed rollers located upstream of the dispense tracking sensors.

**Keypad:** The set of buttons on the hand-held terminal.

**LCD Screen/Display:** The 4-line liquid crystal display (LCD) screen located on the hand-held terminal.

**Line Presence Inspection System:** An optional dispensing system component, consisting of fiber-optic sensors that detect the presence/absence of a dispensed line; absence of a line is signaled and triggers the placement of an ink line on the web material (see Line Presence Inspection System in Appendix B, for more details).

**Line Volume:** The volume of reagent contained in a line per unit of length.

**Line Width:** The width, in inches, of a dispensed line; dependent on fluid rheology and properties of web material.

**Maintenance:** Cleaning and preventative maintenance procedures.

**Menu:** A specific grouping of information and fields on the hand-held terminal. One menu at a time can be displayed. Menus that are longer than 4 lines are partially displayed on the LCD. The hidden part of the menu can be displayed by scrolling the text up or down with the arrow keys.

**Menu Selector:** The Menu indicator arrow (>) on the hand-held terminal that points to the active menu element.

**Menu Structure:** Hand-held terminal menus are arranged in a hierarchical (tree) structure. The highest level is called the main menu. From this menu you can access only submenus at different levels in the hierarchy; the ESC key is used to return to the previous (higher level) menu.

**Molex:** A Molex (brand-name) connector is a plastic (usually white) in-line pin-and-socket connector (joins two cables).

**Non-volatile Memory:** Memory that keeps its data when power is lost to the unit. Non-volatile memory is used for long-term storage of data.

**On Time:** The length of time (in milliseconds) that a dispenser valve stays open during each unit of a dispensing sequence.

**Options:** The Dip Tank consists of a basic tank with a stepper motor-driven power squeegee. A variety of different options are available including a fluid-leveling sensor and fluid pump.

**Pattern:** The word pattern signifies a programmed series of dispensing actions, which is part of a dispensing program. The menu title PATTERN (found in XYZ/ZX platform software) is used interchangeably with the PROGRAM menu title (found in reel-to-reel platform software), in that they are both used in the creation or editing of programs.

**Pay Out:** To properly unroll or free web material, from the roll on the payout reel and into the RR4500 system.

**Pitch:** The drop pitch describes the distance (in millimeters) between drop centers.

**Program:** A storage location, in non-volatile memory, for a set of patterns that comprise a web-handling process.

**Quick Connect Fitting:** This fitting is used to make the airtight airline connection on a BioDot AirJet.

**Reagent Supply Line:** Teflon tubing used to carry reagent from the supply bottle to the syringe pump and/or dispenser, or directly to the web.

**Reel Flange (Back-side or Front-side Flanges):** The removable portions of either the payout or take-up reel. A reel flange is fitted with a serrated reel hub designed to contact and hold the core of the web material roll without slippage. The flange is released from or tightened onto a reel by a lever that is located on the front side of the reel hub.

**Reel Hub:** The reel component that interfaces with and holds a roll of web material, by fitting snugly against the end of the roll core.

**Repeatability:** The degree to which drop volume is conserved between dispensed drops.

**Rheology:** The flow properties of a dispensed fluid (reagent).

**Roll:** A quantity of web material supplied by the user, which is spooled onto a cardboard or plastic core.

**Set Up:** Preparing the equipment to operate.

**Spray Side:** The side of a web material that is to be treated.

**Supply Bottle:** The reservoir that holds the supply reagent.

**Support Arm:** A universal mounting bracket that a dispenser, via a smaller mounting bracket, is mounted to; the support arm attaches in some platform systems to a vertical and/or horizontal positioning stage.

**Swept Volume:** The average volume of reagent that is retained by (lost to) the dispensing system.

**System Platform:** The machine used for reagent application that incorporates a BioDot dispenser (i.e., XYZ 3000, RR4500 Web Handling System, etc.).

**Take Up:** To properly spool the treated web material after it has passed through the reel-to-reel. The width of the take-up core should always be slightly greater than the width of the web (a minimum increase of .5 inches is recommended).

**Take-Up Tracking/Dispense Sensors:** The two sets of auto tracking sensors, located on the dispense module and take-up module, respectively. The sensors detect the edge of the web material and trigger y-axis adjustment of the dispensing platform or take-up reel in response to changes in web tracking.

**Toggle Field:** A field on the hand-held terminal that is similar to an edit field, except that the associated data are selected from a fixed group of choices. A new choice is selected by using the Up/Down arrow keys to move the menu selector to the field to be changed.

**Troubleshooting:** Identifying and resolving problems with the equipment's operation.

**Vertical (Z-Axis) Positioning Stage:** Also called the "Z-Slide." An integrated dispensing component of certain BioDot dispensing platforms that is height-adjustable (Z axis) through the use of a micrometer; a dispenser is mounted to the vertical positioning stage via a support arm.

**Volume Recovery (%):** The percentage of total reagent that is actually dispensed (total reagent in the dispensing system minus swept volume).

**Web:** The material onto which fluid is dispensed.

**Web Width:** The width of a web material.

**Working Memory:** Memory that is used to create or modify data. Data in working memory is lost when the unit is powered down unless saved under the DATA STORAGE menu.

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