

CTS™ Compleo™ Fill and Finish System Protocol Builder USER GUIDE

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For descriptions of symbols on product labels or product documents, go to [thermofisher.com/symbols-definition](https://www.thermofisher.com/symbols-definition).

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A	5 January 2026	New document for CTS™ Compleo™ Fill and Finish System Protocol Builder.

The information in this guide is subject to change without notice.

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Product description

The CTS™ Compleo™ Fill and Finish System is an automated, closed-flow benchtop instrument with the flexibility to perform a broad range of formulation, fill and finish workflows.

The CTS™ Compleo™ Single-Use Kit is specifically designed to allow protocol flexibility with 11 user-configurable input/output sterile weldable tubes, an air inlet filter and a carrier frame for ease of loading and error free tube management.

The CTS™ Compleo™ Protocol Builder Application allows users to create, edit, and save protocols for subsequent use on the instrument.



Figure 1 CTS™ Compleo™ Fill and Finish System Protocol Builder

2

Software installation

The Compleo™ Protocol Builder application can be installed on any Windows™ 10 or 11 compatible computer including the Dell™ laptop provided with the instrument. Released versions of the Compleo™ Protocol Builder are available for download from thermofisher.com.



CAUTION! Prior to installing a new release of the Compleo™ Protocol Builder Application, it is important to uninstall the existing application.

Install software

1. Right-click the **Windows** icon in the bottom left corner of the laptop screen and select **Apps and Features**.



Figure 2 Windows ▶ Apps and Features

2. Left-click the **CompleoProtocolBuilder** application, then select **Uninstall**.

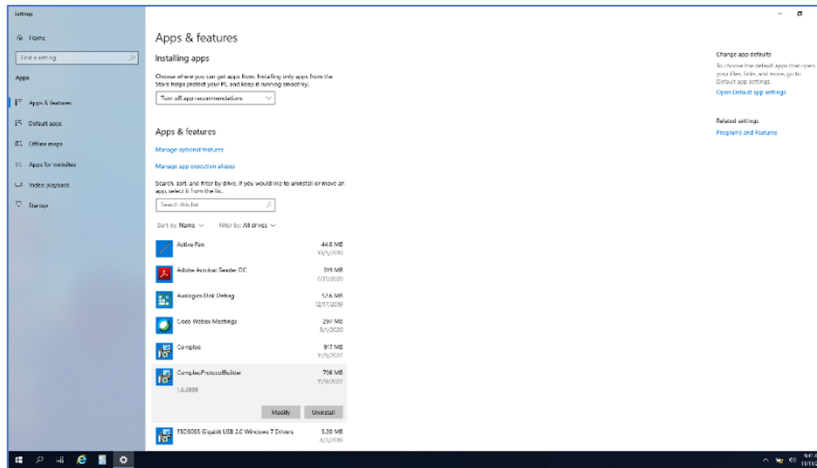


Figure 3 CompleoProtocolBuilder ▶ Uninstall

3. Click **Close**, once uninstall is completed.
4. Download the required **CompleoProtocolBuilder** installer from thermofisher.com and save it to an accessible network folder or portable storage device.

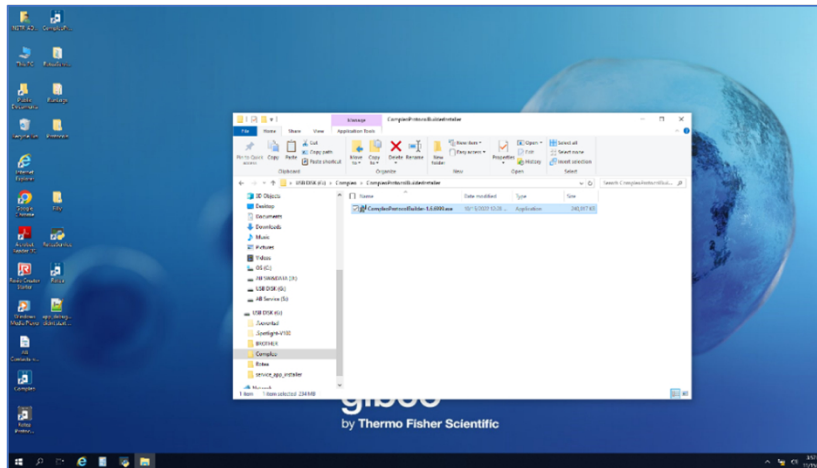


Figure 4 CompleoProtocolBuilder installer

5. Run the **CompleoProtocolBuilder** installer, then click **Install**.
The application will be installed in C:\Program Files (x86)\Compleo\
6. Click **Close** to finish the application installation.

3

Creating and editing protocols

Users can create new protocols or modify existing protocols using the Compleo™ Protocol Builder Application.

Welcome screen

The welcome screen of the Compleo™ Protocol Builder allows the user to select from two available options:

- **Select a Protocol**
- **Create New**

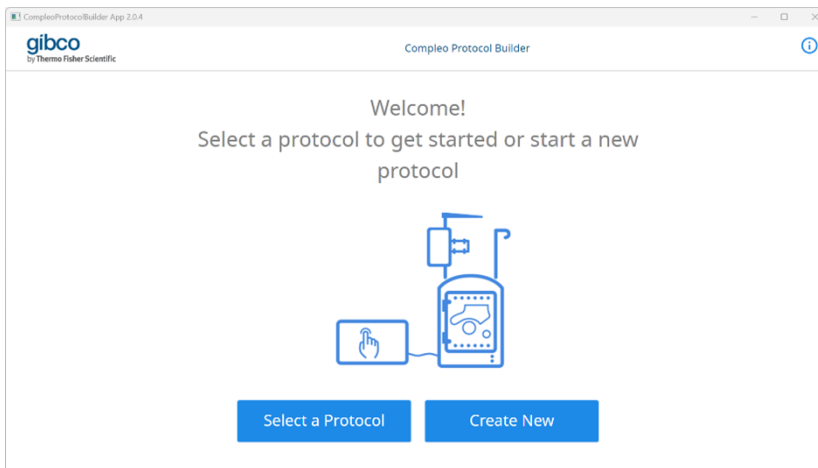
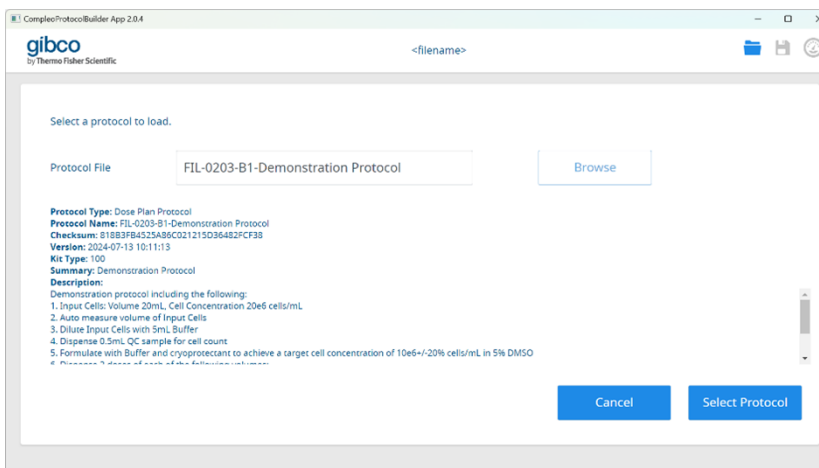
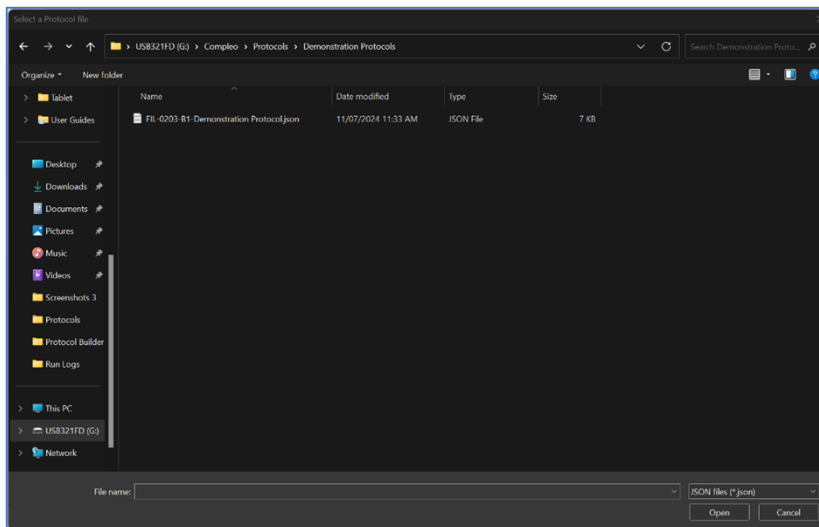
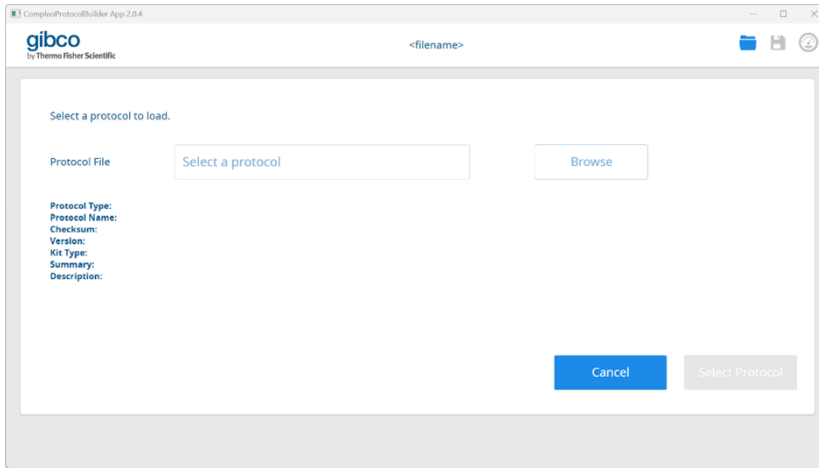


Figure 5 Welcome screen

Select a Protocol

This option enables the user to open an existing protocol from an accessible local or external folder.

Click **Browse** to search and select a desired protocol. Once selected, click **Select a Protocol**.



The protocol opens on the **Information** tab of the main navigation page.

The kit configuration for the protocol is displayed to help the user in assembling the kit. It includes details such as attached bags and tubing line lengths, volume and concentration of input cells, volume of input buffers, output/dose concentrations and volumes, and maximum bag capacities.

The information panel on the right side of the display provides details about the kit type and calculation method used, along with a summary and detailed description of the protocol.

Compleo protocol builder navigation

Main screen

The main screen provides quick access to the various elements of the Compleo™ Protocol Builder.

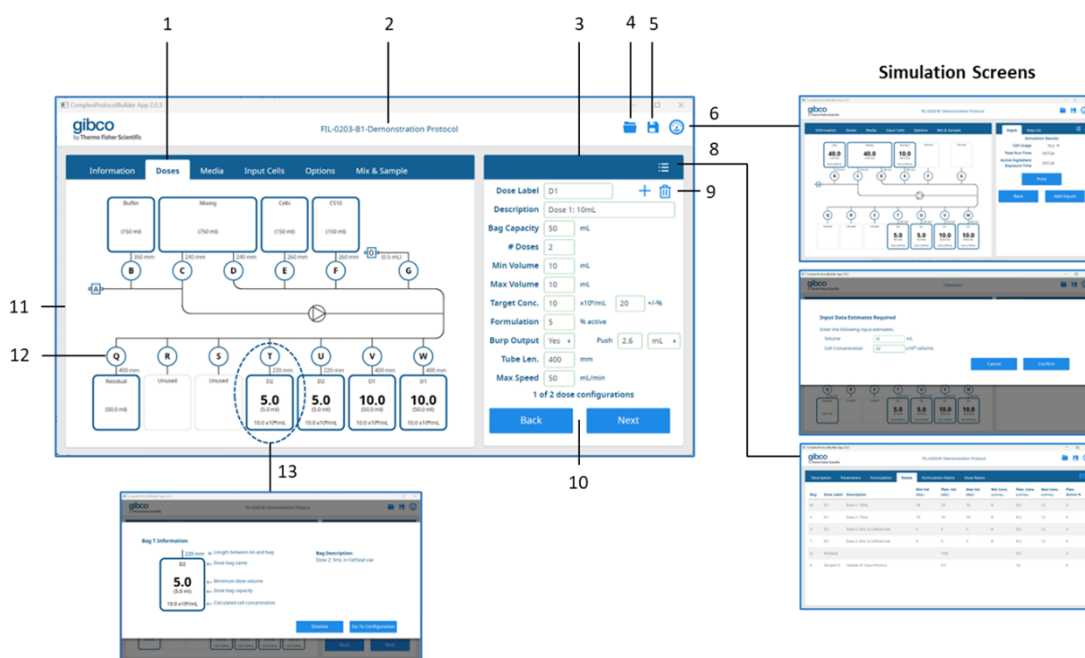


Figure 6 Main screen

- ① Navigation tabs
- ② Protocol file name
- ③ Data input panel
- ④ Open file
- ⑤ Save file
- ⑥ Protocol simulator
- ⑦ Protocol simulator data entry
- ⑧ Formulation and Dose volume summary tables
- ⑨ Add/Delete Doses and Media
- ⑩ Wizard buttons
- ⑪ Kit view
- ⑫ Kit connection labels
- ⑬ Input/Output bag/vial details

Navigation tabs

Clicking the navigation tabs enables the user to quickly navigate to any of the data entry screens in the wizard.

Wizard buttons

The **Back** and **Next** buttons allow the user to navigate backward and forward through the protocol.

Note: The **Next** button becomes active only when all required information on the current screen has been entered correctly.

Input and Output details

Click any Input or Output bag to display the Bag Information.

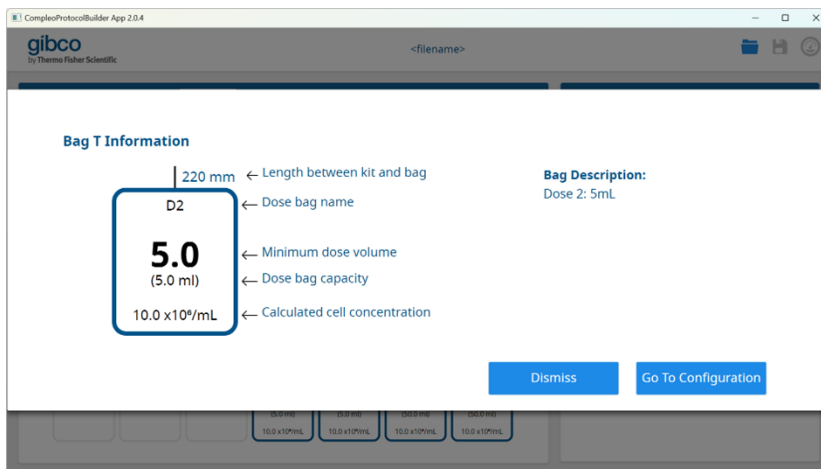


Figure 7 Input and Output details

Mouseover

Position the pointer over the text to view detailed definitions for protocol data entry fields.

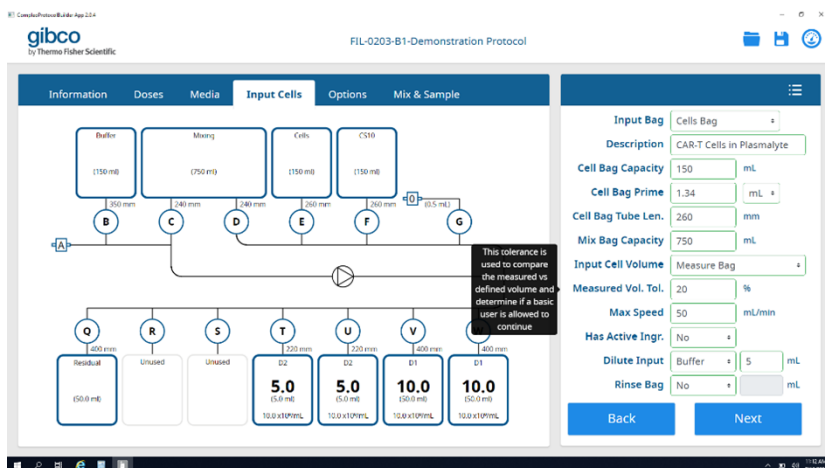



Figure 8 Mouseover

Protocol simulator

1. Click the  (**simulator**) icon to access the simulator data entry screen.
2. Enter the necessary input data to view the simulation results. The Protocol Step List, Formulation Summary, and Dose Summary tables will be automatically populated and can be accessed using their respective tabs.

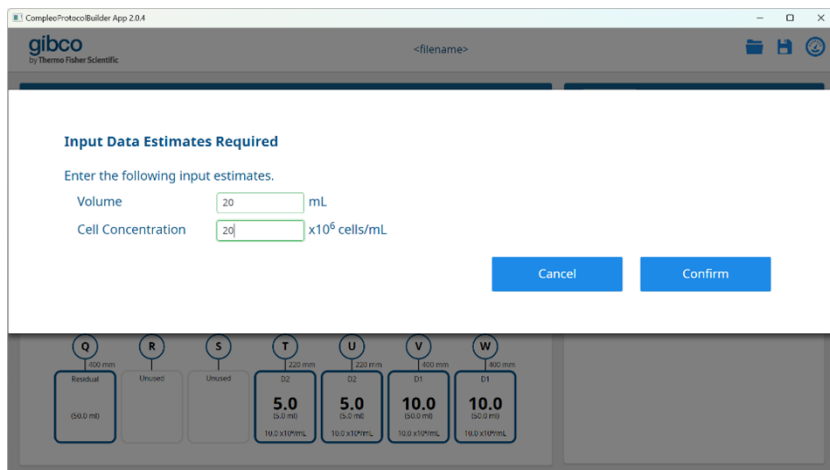
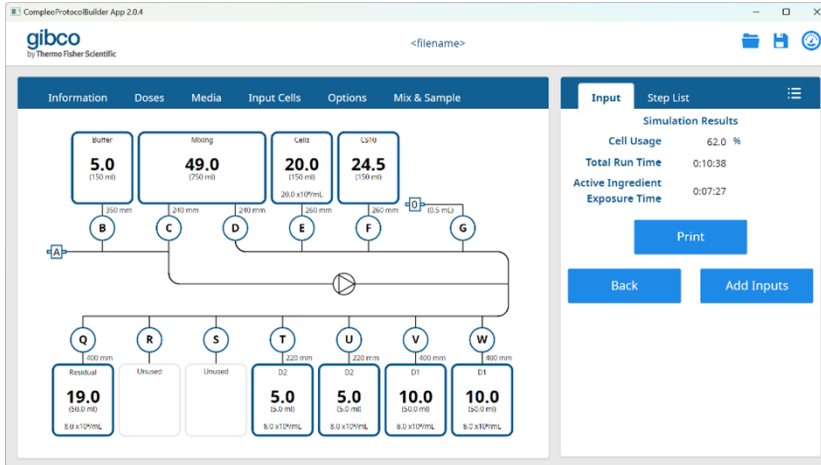


Figure 9 Protocol simulator



Input Step List

Simulation Results

Cell Usage 62.0 %

Total Run Time 0:10:38

Active Ingredient Exposure Time 0:07:27

Print

Back Add Inputs

Description			Formulation Ratios		Dose Ratios				
Bag	Dose Label	Description	Min Vol (mL)	Plan. Vol (mL)	Max Vol (mL)	Min Conc. (x10 ⁶ /mL)	Plan. Conc. (x10 ⁶ /mL)	Max Conc. (x10 ⁶ /mL)	Plan. Active %
W	D1	Dose 1: 10mL	10	10	10	8	8.0	12	5
V	D1	Dose 1: 10mL	10	10	10	8	8.0	12	5
U	D2	Dose 2: 5mL	5	5	5	8	8.0	12	5
T	D2	Dose 2: 5mL	5	5	5	8	8.0	12	5
Q	Residual			19.0			8.0		5
0	Sample: 0	Sample of: Input Product		0.5			16		0

Create new protocol

This section guides the user through the process of creating a new protocol using the Compleo™ Protocol Builder.

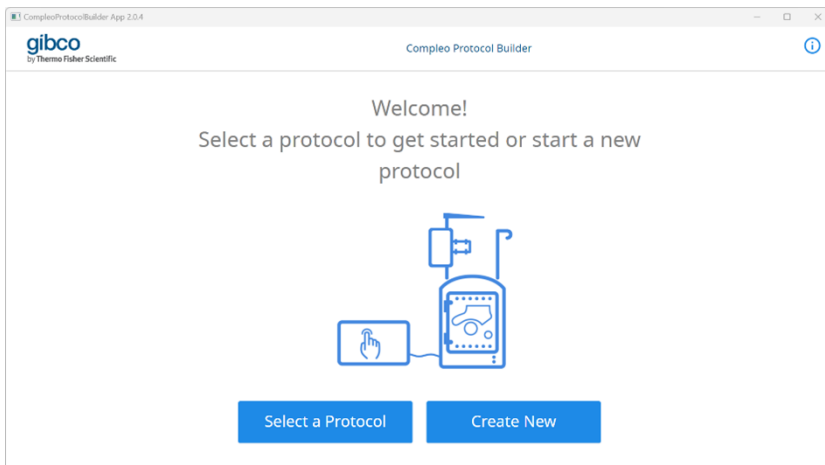


Figure 10 Create new protocol

The protocol will open on the **Information** tab of the main navigation page.

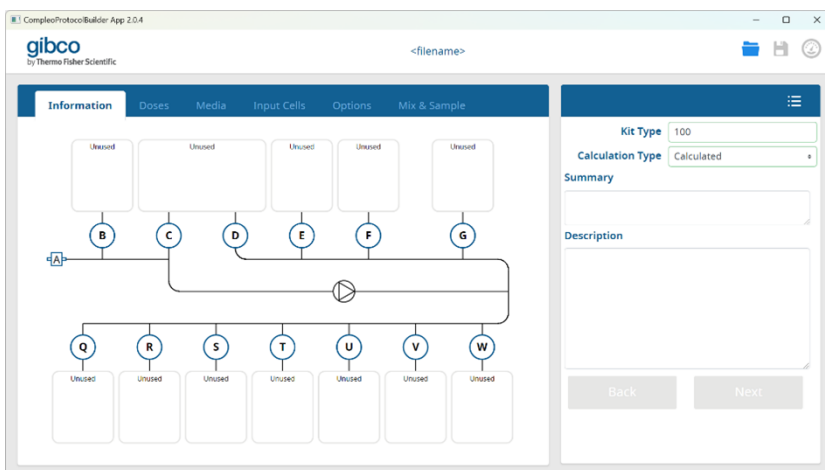


Figure 11 Information tab

The wizard will then guide the user through the process of defining the key requirements for the protocol using the **Doses**, **Media**, **Input Cells**, **Options**, and **Mix & Sample** tabs.

Information

The Information tab provides users with a brief overview of the protocol including the kit schematic, kit type, summary, and description.

1. **Kit Type:** Enter a valid kit type that meets the requirements of your protocol. The kit type for the standard Compleo™ Single-Use Kit (SKU [A58165](#), 5pk) is type 100 — See the kit type field in Figure 12.

Note: The 2D Barcode on the Compleo™ Single-Use Kit is automatically verified during loading to the instrument to ensure that it matches the kit type specified in the protocol.

2. **Calculation Type:** There are two types of protocols that can be written, both of which share many common parameters and features. The user guide uses the **Calculated** type as the baseline with the differences noted within each section.

Note: A calculated protocol can be easily converted into a manual protocol and vice versa, by selecting the required **Calculation Type** from the dropdown list and updating any missing information.

- **Calculated** protocols automatically update and optimize dose formulations within the limits and options defined in the protocol, based on the concentration and volume of the input cells being processed.

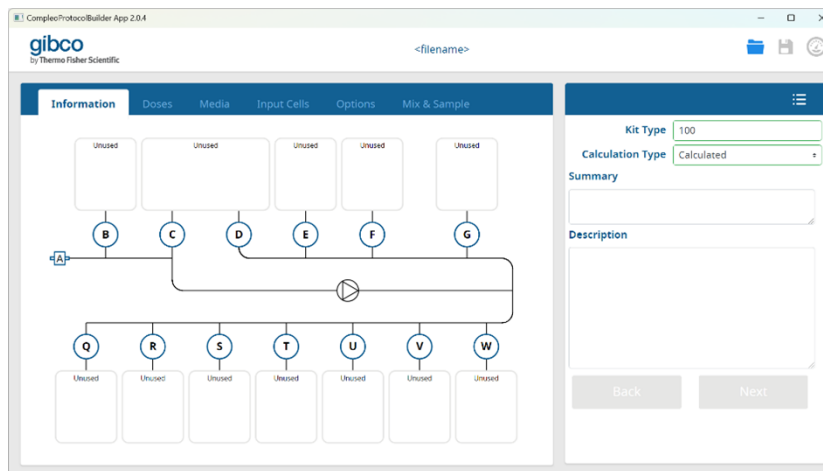


Figure 12 Calculated

- **Manual** protocols require the user to manually calculate and enter the volume of the various input media to be formulated. When this option is used, the system does not automatically calculate or optimize dose formulations or cell concentrations.

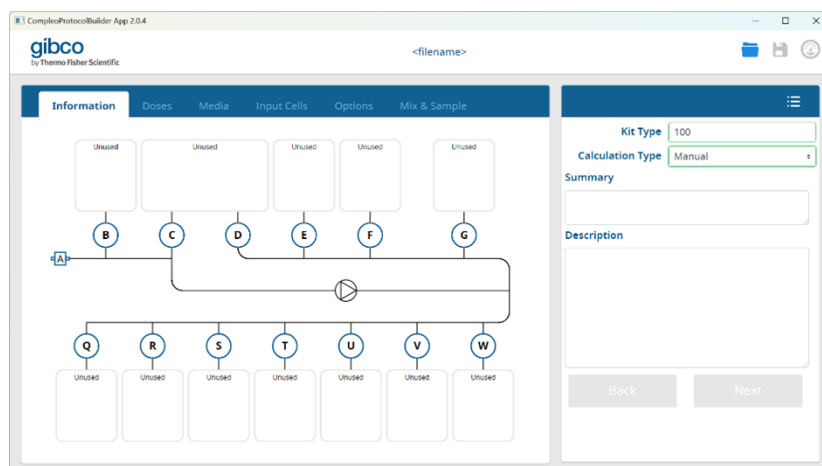
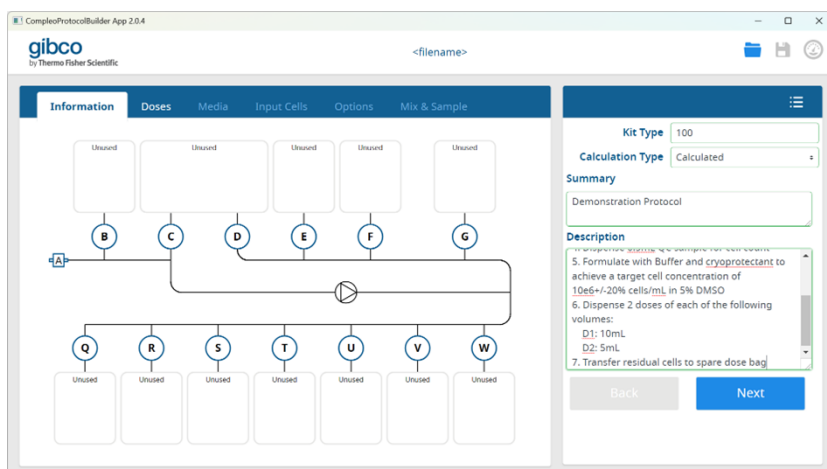


Figure 13 Manual

3. **Summary:** Enter a title for the protocol.
 4. **Description:** Enter a description of the protocol (for example, its purpose and typical input data estimates).
- Click **Next** to continue.



Note: The kit view is automatically generated as the user progresses through the Protocol Builder wizard.

It is recommended to review and update the **Description** after using the simulator to analyze the expected operating range and optimize the protocol.

Doses

The **Doses** tab enables the user to define the properties of each dose to be dispensed.

Enter the parameters for the first dose type in the Data Input Panel.

1. **Dose Label** allows the user to differentiate between various dose types. The label is permanently displayed on the corresponding bag in the kit schematic.

Note: A brief description of each parameter can be seen by hovering over the parameter with the mouse.

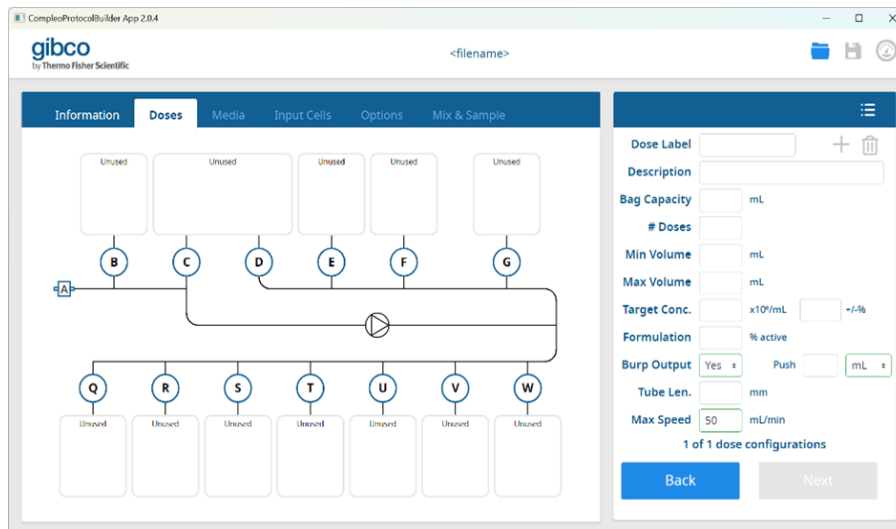


Figure 14 Dose Label

2. **Description** of the dose type enables other users of the protocol to understand the expected output. The description is displayed when hovering over the corresponding bag in the kit schematic.

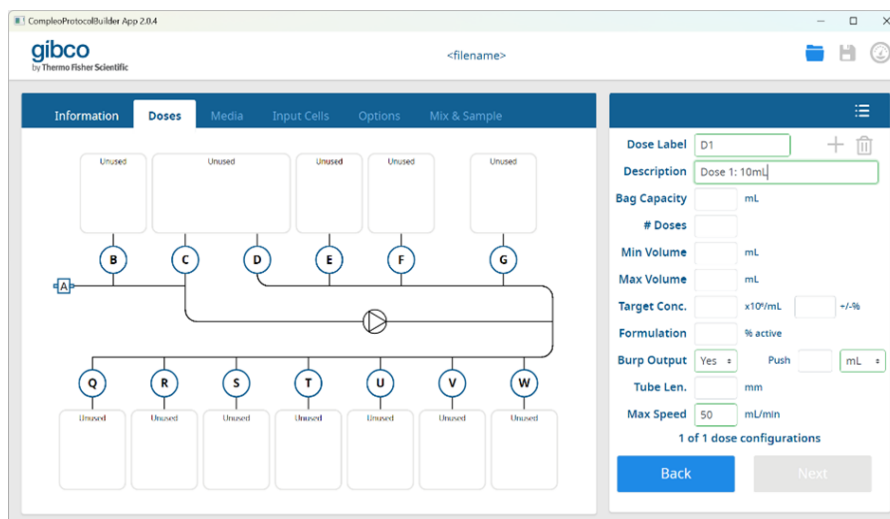


Figure 15 Description

3. **Bag Capacity** is the maximum capacity (mL) of the output dose bag.

Note: The target dose volume cannot exceed this value.

Note: The user may choose a maximum capacity that is less than the stated bag size to prevent overfilling, which could cause complications during freezing or cryogenic storage.

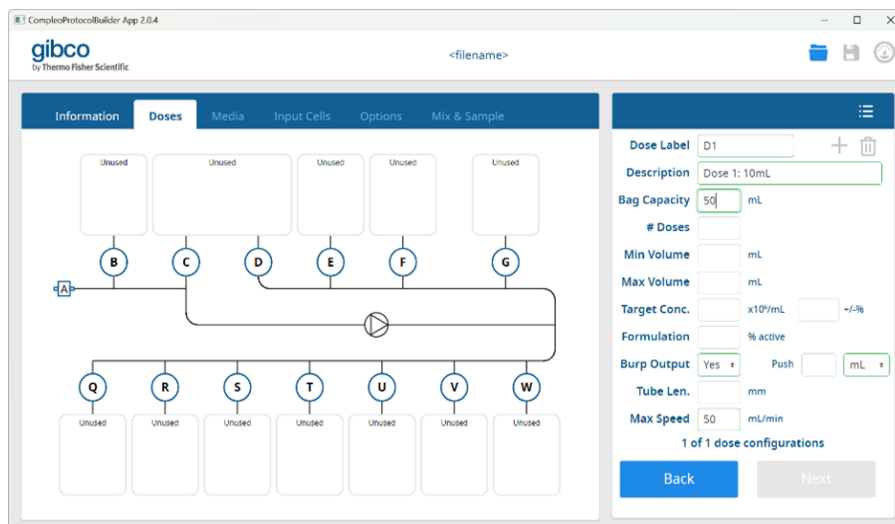


Figure 16 Bag Capacity

4. **# Doses** tab requires the user to enter the number of desired doses.

Once the number of doses is specified, the dose bags will appear in the kit schematic, including the **Dose Label** and **Bag Capacity**.

Note: While creating a protocol, check how it functions across the full range of operating conditions — for example, when the number of input cells is higher or lower than expected. The **# Doses** is one such parameter where the best practice would be to write the protocol so that the **# Doses** represents the minimum required to meet the release specifications of the final product.

See “Options” on page 34 for an explanation of how the **Extra Doses** feature can be used.

When using the **Calculated** mode, the software will automatically optimize the volume of the dose to maximize the use of cells. If the **# Doses** is fixed, the volume and concentration of cells will be maximized. If the option to make extra doses is selected, then the volume and concentration will be reduced towards the bottom end of the range.

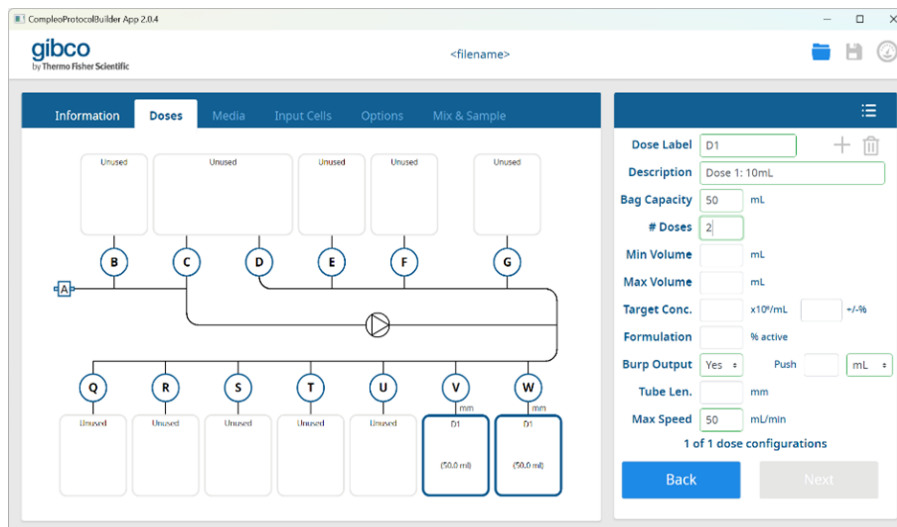


Figure 17 # Doses

5. **Min Volume** and **Max Volume** are the minimum and maximum acceptable volumes for the dose.



CAUTION! The **Min Volume** and **Max Volume** defined for each dose should be within the specifications for the final product, including expected system tolerances. To dispense a specific dose volume (for example, 10 mL), the **Min Volume** and **Max Volume** need to be the same.

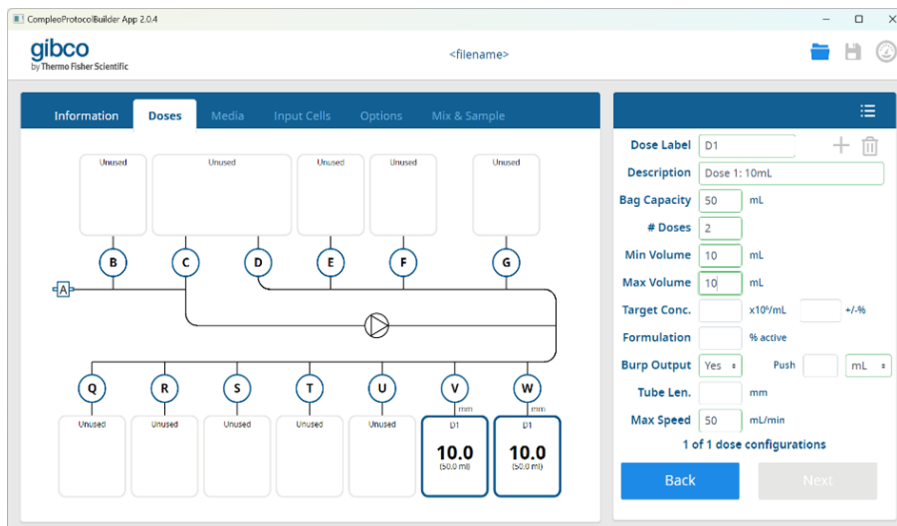


Figure 18 Min Volume and Max Volume

6. **Target Conc.** specifies the target concentration defined for each dose and the tolerance (+/- %) to be used by the dose plan optimizer algorithm for dose calculations.



CAUTION! The **Target Conc.** defined for each dose should be within the specifications for the final product, including expected system tolerances.

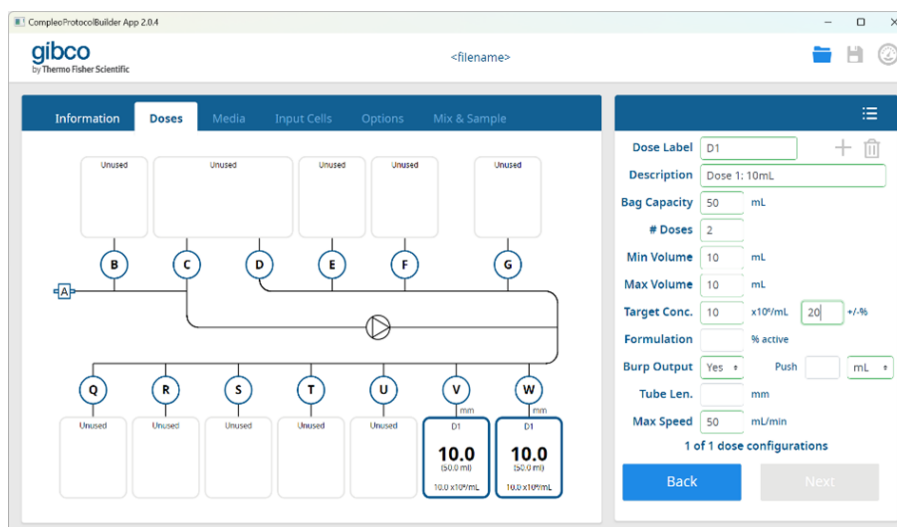


Figure 19 Target Conc.

- Formulation** percentage will be required if the dose plan uses an active ingredient, for example, DMSO.

Note: The dose plan optimizer algorithm only allows one active ingredient to be defined.

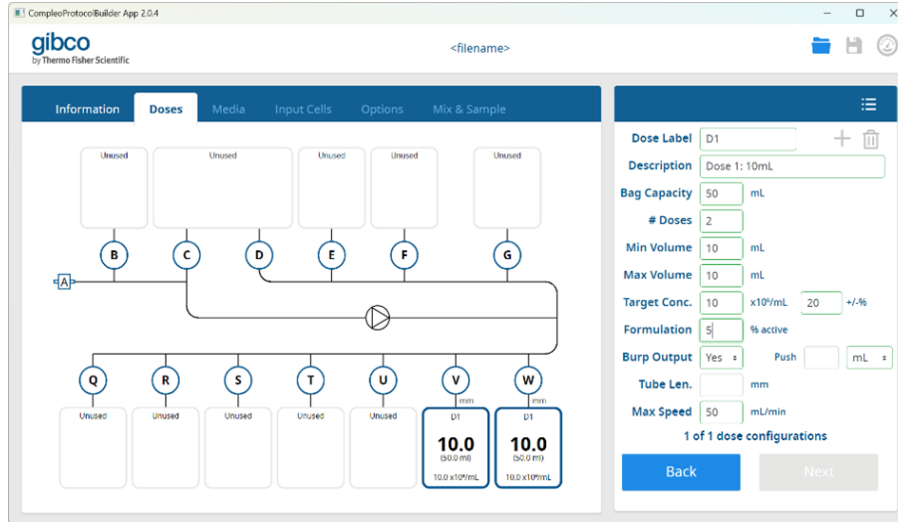


Figure 20 Formulation

8. **Burp Output** can be selected from the options in the dropdown list. When burping is selected, the instrument automatically removes air from specified dose bags in preparation for cryogenic freezing. The user can choose to burp pre-dispense, post-dispense, or pre and post-dispense.

Note: Post-dispense burping is the most common method to remove air in dose bags before cryogenic freezing. Pre-dispense burping can be helpful when the dose bags contain a significant volume of air at the start of a protocol, shortening the post-dispense burping step and minimizing cell exposure time to cryoprotectant.

The post-burping process uses the peristaltic pump of the instrument to extract air from designated dose bags until liquid is detected at its corresponding Bubble Sensor. Once a bag has been burped, the pump will reverse, drawing filtered air from line A to push the fluid in the line back into the dose bag based on the **Push** volume defined for that line.



CAUTION! Burping requires the dose container (for example, cryobag) to collapse as air is removed until the liquid within the container is drawn back up the line and triggers the Bubble Sensor. Therefore, rigid containers cannot be burped — for example, rigid cryovials.

The screenshot shows the GIBCO protocol builder interface. The top navigation bar includes 'Information', 'Doses', 'Media', 'Input Cells', 'Options', and 'Mix & Sample'. The 'Doses' tab is active, displaying a schematic diagram of the instrument's flow path. The diagram shows a central pump connected to various reservoirs and dose bags. Reservoirs include Buffer (150 ml), Mixing (750 ml), Cells (150 ml), and CS10 (150 ml). Dose bags include Residual (50.0 ml), Unused, D2 (5.0 ml), and D1 (50.0 ml). The right panel shows configuration parameters for a dose labeled 'D1':

- Dose Label: D1
- Description: Dose1: 10mL
- Bag Capacity: 50 mL
- # Doses: 2
- Min Volume: 10 mL
- Max Volume: 10 mL
- Target Conc.: 10 x10⁶/mL, 20 +/-%
- Formulation: 5 % active
- Burp Output: Pre & Pos, Push 5 mL
- Tube Len.: 400 mm
- Max Speed: 50 mL/min

At the bottom of the right panel, it indicates '1 of 2 dose configurations' and has 'Back' and 'Next' buttons.

Figure 21 Burp Output

9. **Push (mL)** is the additional volume of air required to ensure that fluid in the output line reaches the dose bag/vial when being dispensed, and when returning fluid to a dose bag after burping.

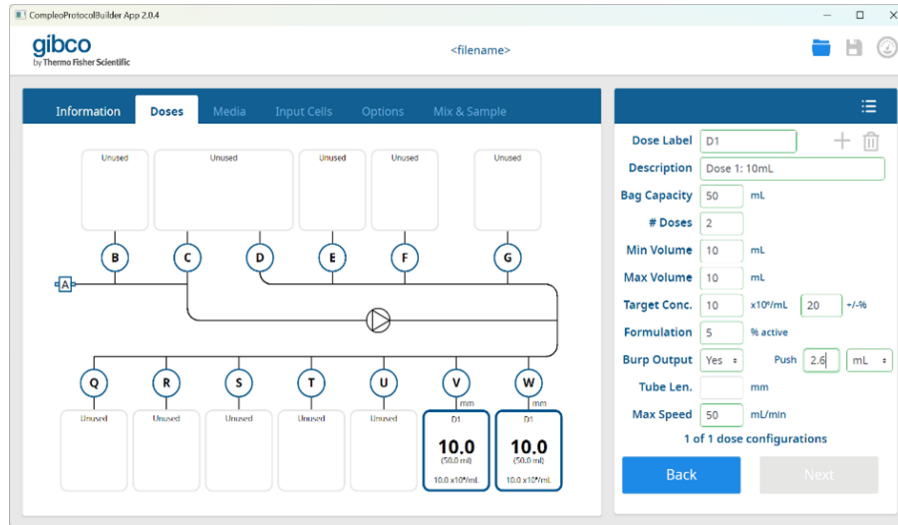


Figure 22 Push

10. **Tube Length (mm)** is included in the kit view to provide a simple aid for kit assembly and is not intended to replace detailed work instructions.

The tube length can relate to any useful dimension on the input/output line such as distance from the edge of the tube carrier to the input line of the dose bag. Although the tube length is not used for any calculations, the push volume assumes that the kit has been assembled based on the defined tube length.

A kit with a longer tube length than specified may result in the dose not being fully dispensed into the bag/vial while a shorter tube length may cause more air to be pumped into the dose bag/vial during filling and burping.

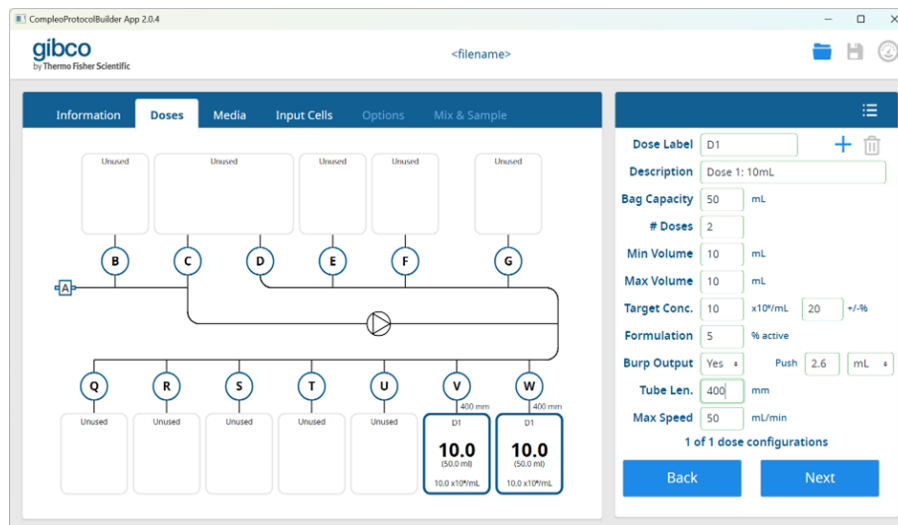


Figure 23 Tube Length (mm)

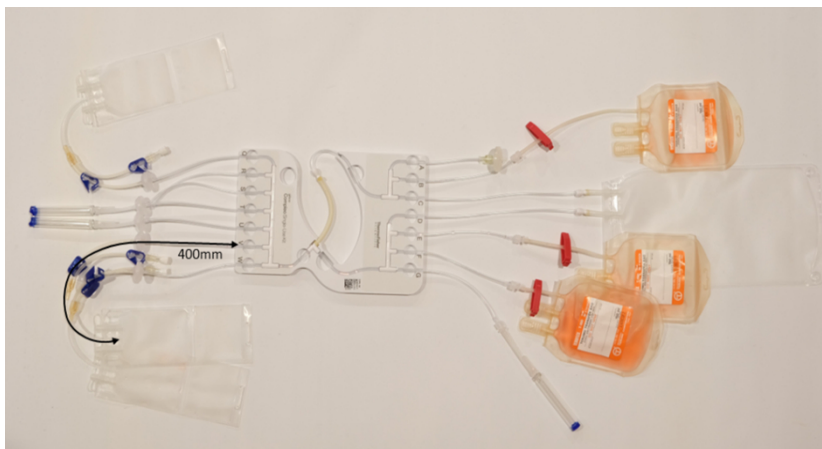


Figure 24 Assembled kit

11. **Max Speed** (mL/minute) is the maximum flow rate to be used when dispensing the dose. The default maximum speed/flow rate is 50 mL/minute, but the user can also specify a lower flow rate (5–50 mL/minute). In the example below, a flow rate of 10 mL/minute is defined for dispensing 5 mL doses into 5 mL vials to improve precision and reproducibility. For larger volumes, a higher flow rate could be used to reduce the overall processing time.

If the flow rate specified is <20 mL/minute, the pump will remain at this flow rate for the entire transfer. If the flow rate is >20 mL/minute, the pump will start pumping at 20 mL/minute and then increase gradually to the maximum flow rate until the dose has been dispensed.



CAUTION! Dispensing at low flow rates increases the likelihood of bubbles becoming trapped in the Bubble Sensors while fluid continues to flow. While the volume of fluid dispensed by the pump is likely still accurate, the check volume (volume pumped while the Bubble Sensor is detecting fluid) will be reduced.

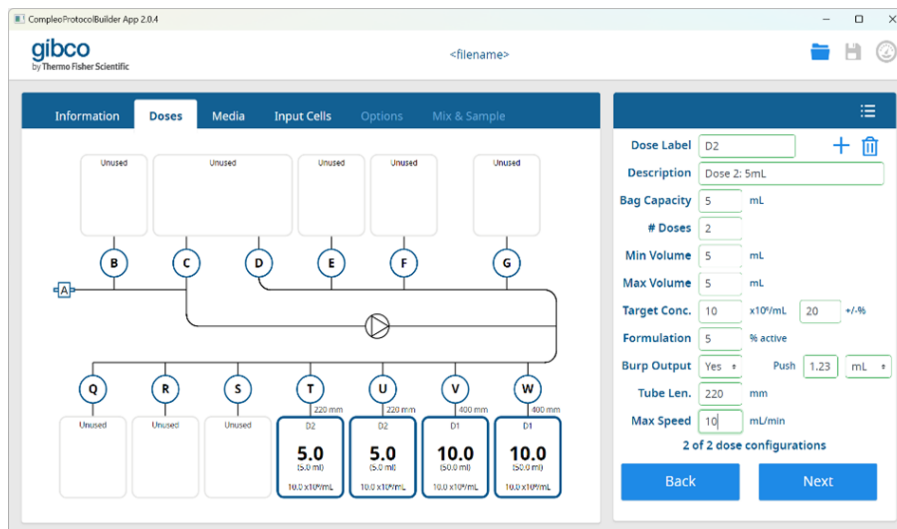

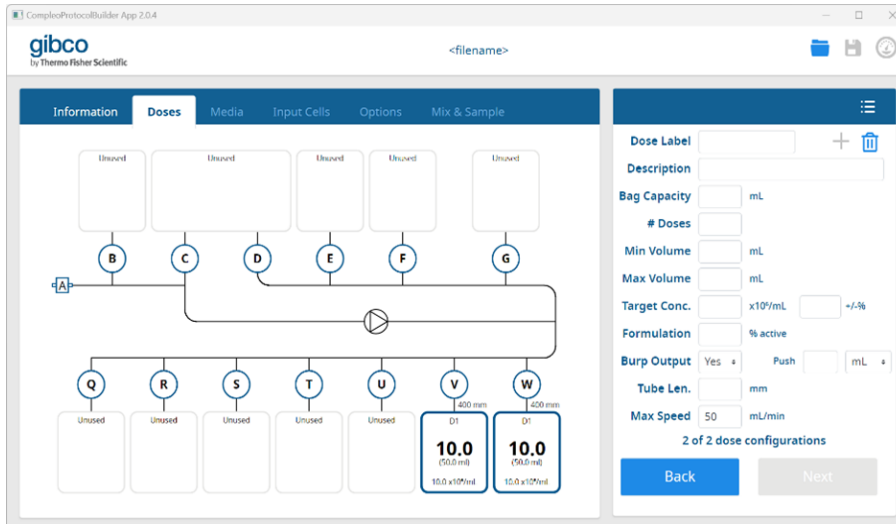


Figure 25 Maximum Speed

12. Click +  icons to add or remove doses and enter parameters required.

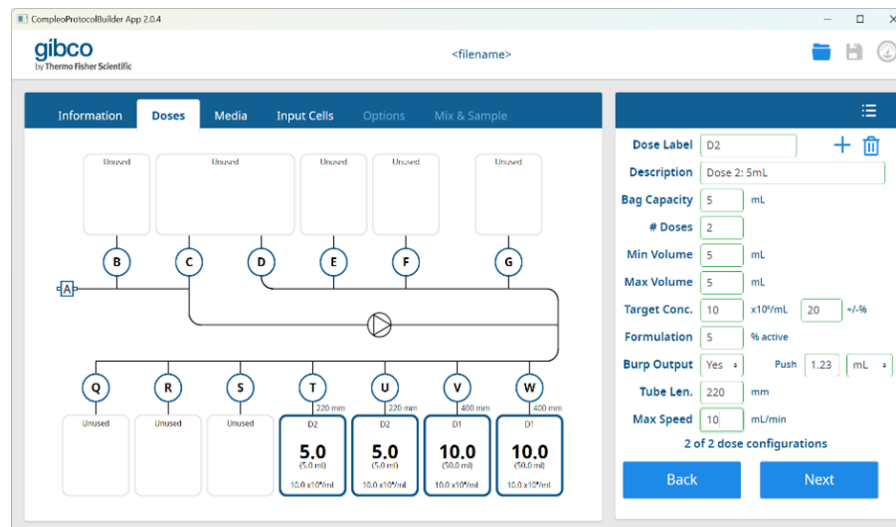
Note: At least one dose must be defined.



The screenshot shows the 'Doses' configuration screen in the GIBCO Compleo Protocol Builder App 2.0.4. The interface is divided into a top navigation bar (Information, Doses, Media, Input Cells, Options, Mix & Sample) and a main workspace. The workspace contains a flow diagram with reservoirs A through W. Reservoirs B-G are 'Unused', and reservoirs Q-S are also 'Unused'. Reservoirs T, U, V, and W are active, with T and U containing 5.0 (50.0 mL) and 10.0 (50.0 mL) respectively, and V and W containing 10.0 (50.0 mL) and 10.0 (50.0 mL) respectively. The configuration panel on the right shows the following parameters for the selected dose configurations:

- Dose Label: (empty)
- Description: (empty)
- Bag Capacity: (empty) mL
- # Doses: (empty)
- Min Volume: (empty) mL
- Max Volume: (empty) mL
- Target Conc.: (empty) x10⁹/mL +/-%
- Formulation: (empty) % active
- Burp Output: Yes + Push (empty) mL
- Tube Len.: (empty) mm
- Max Speed: 50 mL/min

2 of 2 dose configurations



The screenshot shows the 'Doses' configuration screen with updated parameters. The flow diagram is the same as in the previous screenshot. The configuration panel on the right shows the following parameters for the selected dose configurations:

- Dose Label: D2
- Description: Dose 2: 5mL
- Bag Capacity: 5 mL
- # Doses: 2
- Min Volume: 5 mL
- Max Volume: 5 mL
- Target Conc.: 10 x10⁹/mL 20 +/-%
- Formulation: 5 % active
- Burp Output: Yes + Push 1.23 mL
- Tube Len.: 220 mm
- Max Speed: 10 mL/min

2 of 2 dose configurations

13. Once all dose types are defined, click **Next** to define the Media for the protocol, **Back** to see the parameters for prior doses, or select any completed tab within the wizard.

Manual calculation type - The concentration and formulation parameters have been removed, since these are now derived from the user input volumes, rather than calculated or optimized by the software. There is also only a single target volume, rather than the ability to set a minimum and maximum.

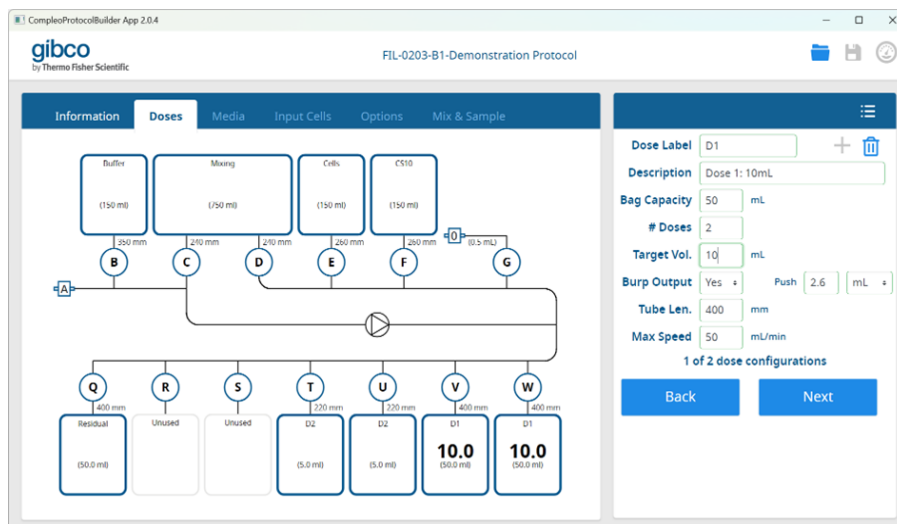


Figure 26 Manual calculation type

Media

The **Media** tab enables the user to define the properties for up to 3 different media solutions with or without an active ingredient, for example, DMSO.

Note: Only one active ingredient can be defined across all media, but the concentration can vary.

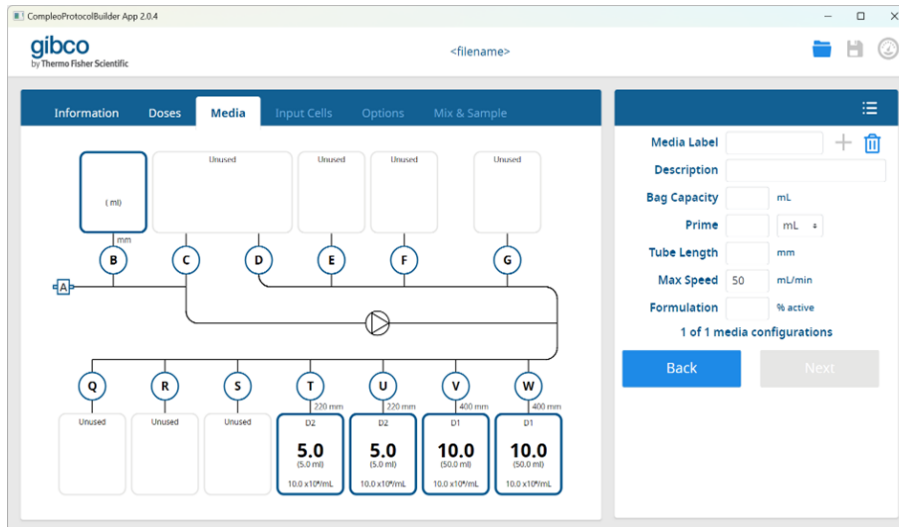


Figure 27 Media

1. **Media Label** allows the user to differentiate between various media types. The label is permanently displayed on the corresponding bag in the kit view.
2. **Description** provides a detailed definition of the media composition. The description is displayed when hovering over the corresponding bag in the kit view.
3. **Bag Capacity** shows the maximum volume of media that the bag can hold.
 - **CAUTION!** Ensure that the selected media bag can accommodate the maximum expected volume for the protocol.
4. **Prime** is the volume (mL) between the media bag output port and the wet prime position in the kit.

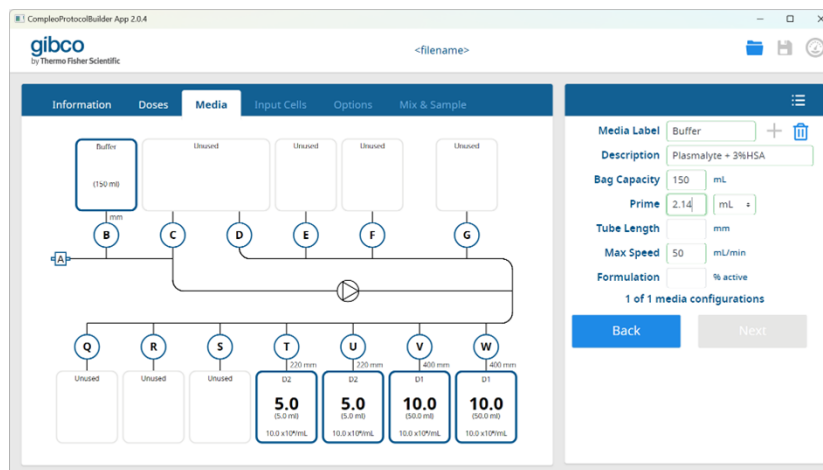


Figure 28 Prime

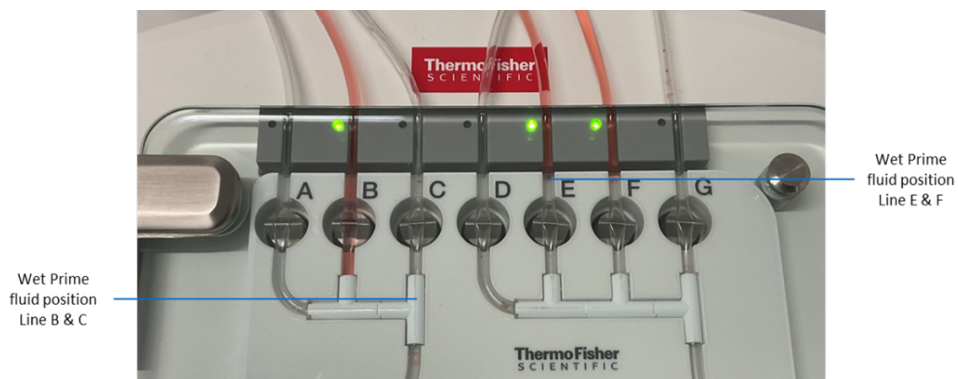


Figure 29 Wet Prime Fluid Position

5. **Tube Length** is included in the kit view to provide a simple aid for kit assembly.

Note: To enable the buffer bag to be supported using the mixer bag pin on the side of the bag mixer module, the tube length has been set to 350 mm.



Figure 30 Bag Mixer Module

6. **Max Speed** defines the default maximum speed for transferring media to the Mixing Bag, which is 50 mL/minute. The user can also specify a lower flow rate (5–50 mL/minute); for example, a lower flow rate may be advantageous when dispensing cryoprotectant, while a higher flow rate can be used for larger volumes to reduce the overall processing time.

If the flow rate specified is <20 mL/minute, the speed remains at the specified speed for the entire transfer. If the speed is >20 mL/minute, the pump starts pumping at 20 mL/minute, then increases gradually until the volume is transferred or the maximum flow rate is reached.

7. **Formulation** percentage is required if the dose plan utilizes an active ingredient, for example, DMSO.

Note: This is the percentage of active ingredient in the input media, not the final dose.

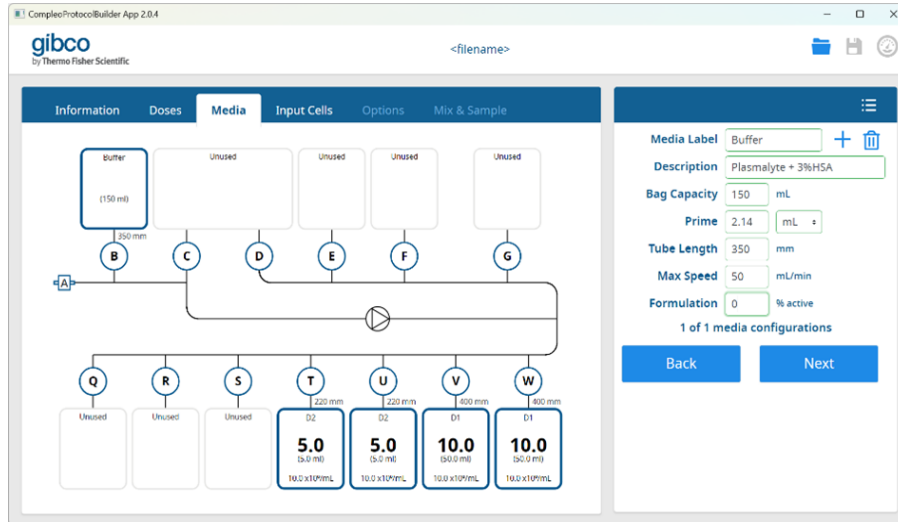
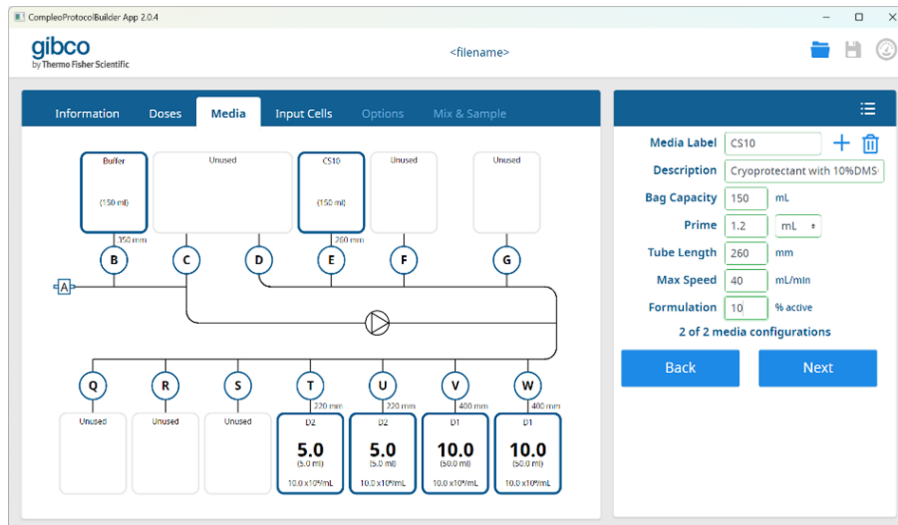


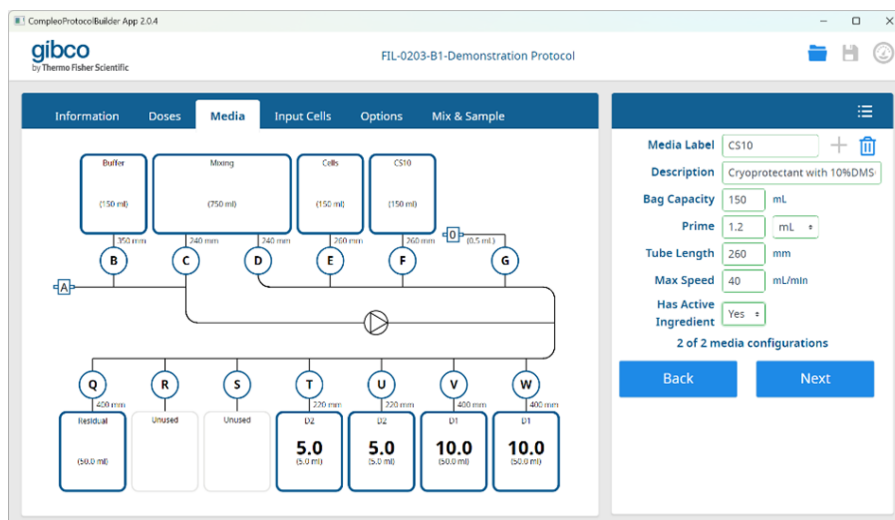
Figure 31 Input Media Formulation

8. Click the + 🗑️ icons to add or remove media and enter required parameters. For example, CS10 with 10% active will be transferred to the Mixing Bag at pump speed of 40 mL/minute.



- Once all media types have been defined, click **Next** to define the input cells for the protocol or **Back** to review the parameters for prior Media. You can also select any completed tab within the wizard to navigate directly to that section.

Manual calculation type – The % **active** parameter for **Formulation** has been replaced with a **Yes/No** selection to indicate whether the media has active ingredient. This enables the Compleo™ User Interface to track the Active Ingredient Exposure Time during a run.



Input Cells

The **Input Cells** tab enables the user to define the starting position and parameters for the input cells.

- Input Bag:** The default starting position for input cells is a separate cell bag attached to line E. This setup enables input cells from an upstream process — for example CTS™ Rotea performing concentration and buffer exchange — to be connected to the kit using a tube welder. The input cells volume is automatically measured as it is transferred to the Mixing Bag via line C and verified using the Bubble Sensors on lines C and E.

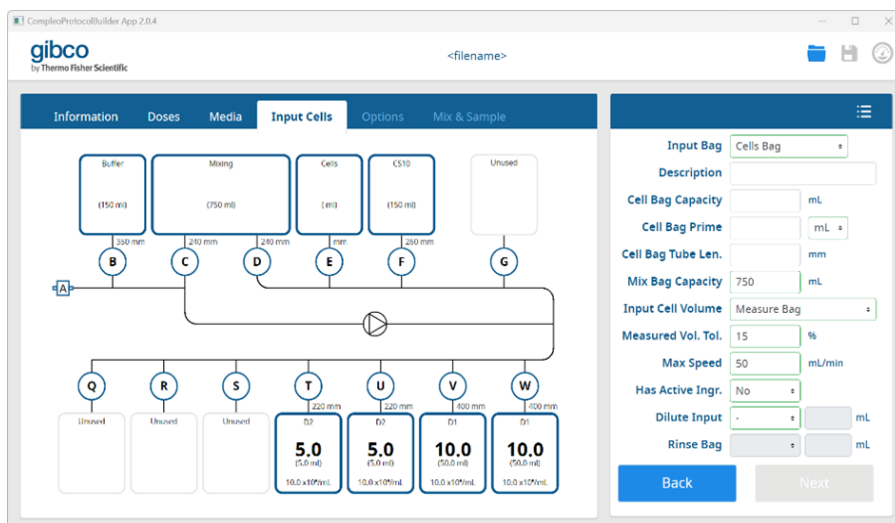
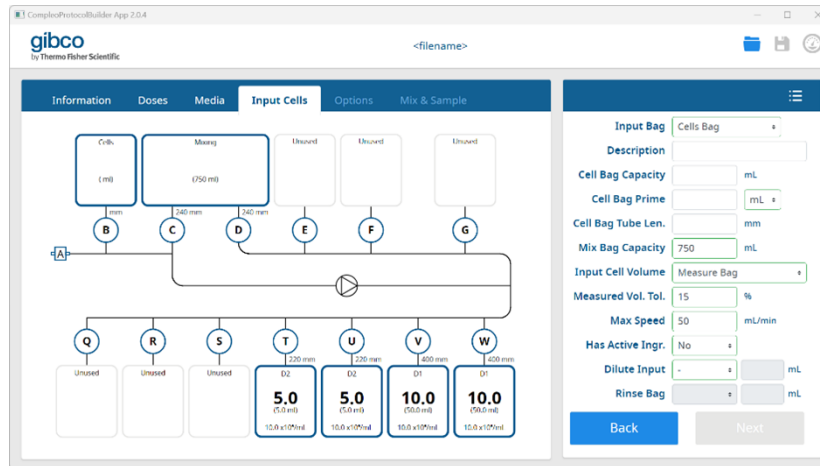


Figure 32 Input Bag

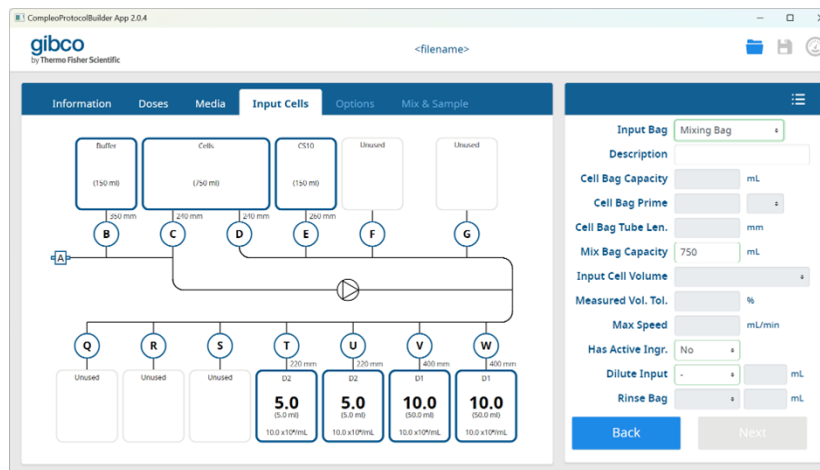
If the protocol does not require any media — for example, when the input cells have been preformulated, the Cells Bag position will default to line B. This maximizes the number of lines available for Outputs. In the example below, the Cells Bag is assigned to line B leaving lines E, F, G, Q, R and S available for additional doses.

Note: In this scenario, the input cells volume is measured as it is transferred to the Mixing Bag using line D, and checked using the Bubble Sensors on lines B and D.



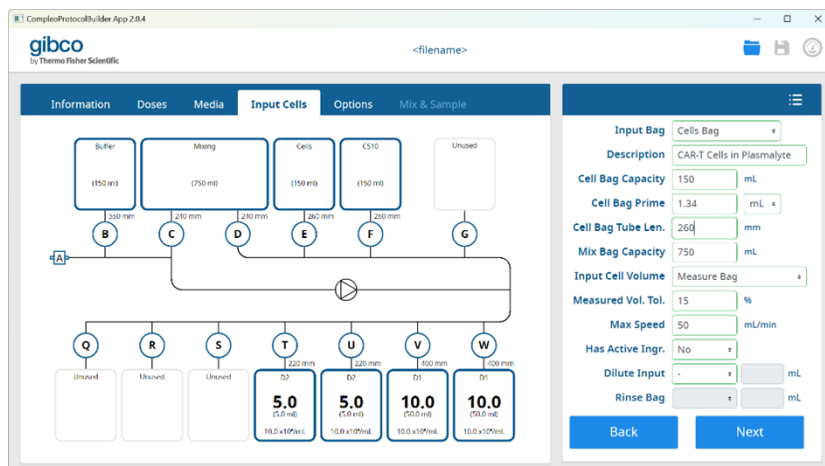
The Mixing Bag can also be selected for input cells — for example, when writing a recovery protocol in which the input cells or formulated product are already in the Mixing Bag.

Note: Data entry fields that are not required will be disabled.



2. **Cell Bag Capacity** is the maximum volume of the cells bag.
3. **Cell Bag Tube Length** is included on the kit view to provide a simple aid for kit assembly.
4. **Mix Bag Capacity** defines the maximum allowable volume in the Mixing Bag at any point within the protocol. The default volume of 750 mL is the maximum recommended volume when using the FP-FLEX1000A bag. This provides enough space to displace the formulated media within the bag during mixing without stalling the mixing paddles. While the user can adjust the **Mix Bag Capacity** to suit their specific protocol, they must ensure that both the system and protocol operates correctly.

5. **Input Cell Volume** can be set to one of three options and requires an estimated or measured volume to be entered by the user prior to running the protocol.



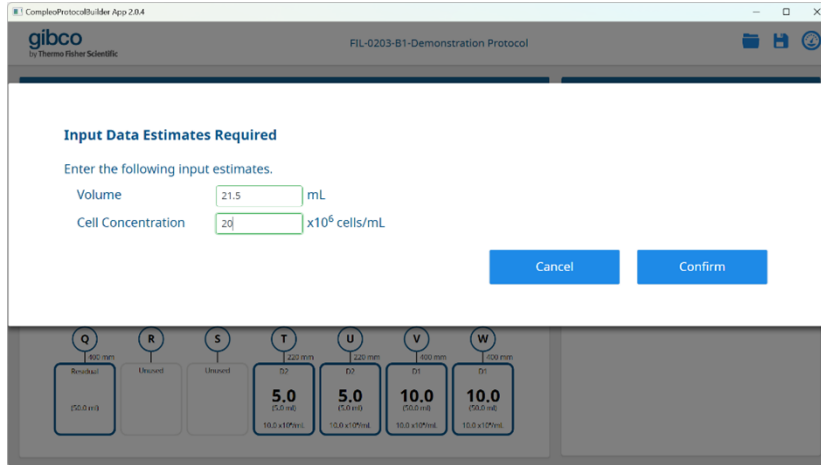
- **Partial Dispense** transfers a target volume from the Cells Bag to the Mixing Bag based on the current pump calibration factor. Excess input volume remains in the Cells Bag.

Note: The user must ensure that the initial volume in the Cells Bag is greater than the target volume to be transferred.

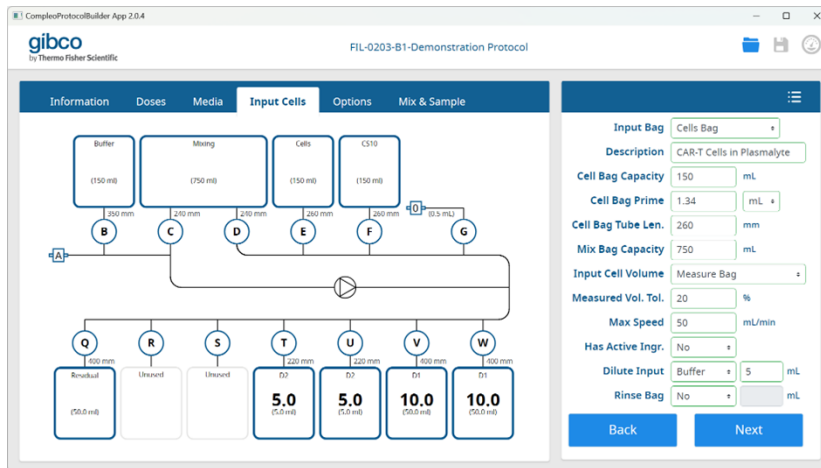
- **Measure Bag** transfers the entire contents of the Cells Bag to the Mixing Bag. The transferred volume is calculated based on the number of pump revolutions required to empty the Cells Bag multiplied by the current pump calibration factor. Bubble Sensors on the input and output lines detect the presence of fluid while the pump is running. This enables the wet volume to be calculated for each Bubble Sensor and compared to determine whether the measurement is valid.
- **Measure + Kit Correction** measures the entire contents of the Cells Bag as per **Measure Bag** and compares the measured volume to the input cell volume entered by the user. The Compleo™ User Interface then automatically calculates the kit correction factor required to compensate for kit-to-kit variability in the pump tube.



CAUTION! The **Volume** entered at the start of the protocol is assumed to be correct when calculating the kit correction factor. Therefore, for the **Measure + Kit Correction** feature to improve volume reproducibility, the **Volume** of input cells entered must be accurately measured (for example, 21.5 mL) before attaching the input cells bag to the kit.



6. **Measured Volume Tolerance** (default 15%) defines the acceptable range within which the measured volume must be relative to the Input Data Estimate Volume entered, for the protocol to proceed.
7. **Maximum Speed** (default 50 mL/minute): The user can specify a flow rate between 5–50 mL/minute.
8. **Has Active ingredient:** The user selects whether the input cells contain an active ingredient, for example, DMSO. This is used by the Compleo™ User Interface to track the Active Ingredient Exposure Time when running a protocol and typically applies only to preformulated input cells.
9. **Dilute Input:** The user can select to predilute the input cells with a specified volume of an available media before dispensing an in-process sample. This helps, for example, to minimize volume loss during in-process sampling when the input cell concentration is very high and the volume is small.

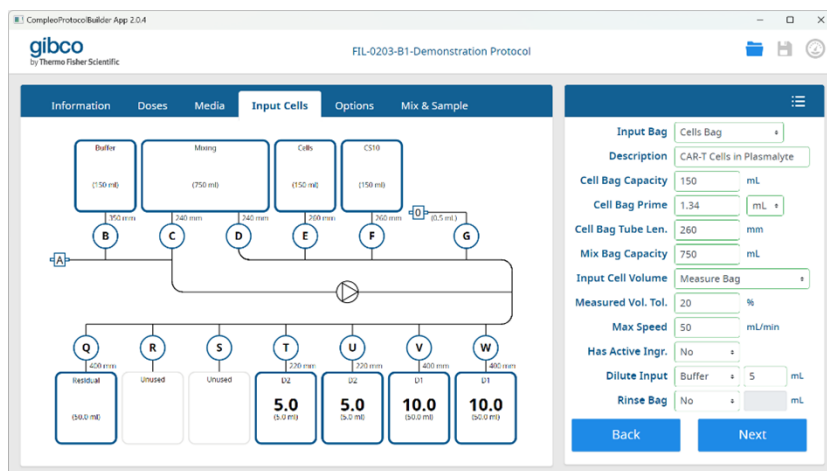


10. **Rinse Bag** allows users to rinse out the Cells Bag after transferring the initial volume to maximize cell recovery. The rinse volume is then transferred to the Mixing Bag and the volume and cell concentration in the Mixing Bag are updated to compensate for the rinse volume added.

Note: The Rinse Bag volume defined by the user must be less than or equal to the **Dilute Input** volume.

- Once the **Input Cells** tab has been defined, click **Next** to define additional options, **Back** to see the parameters for previous tabs, or select any completed tab within the wizard.

Manual calculation type – Same as for **Calculated**.



Options

The **Options** tab is used to define additional protocol settings and options:

- Volume Alert** (default is 5%) defines the percentage variance that triggers a flag when the wet volume measured during the transfer of media to the Mixing Bag or dispensing of doses and in-process samples should be independently verified.



CAUTION! The tighter the tolerance, the greater the likelihood that volume will require independent checking.

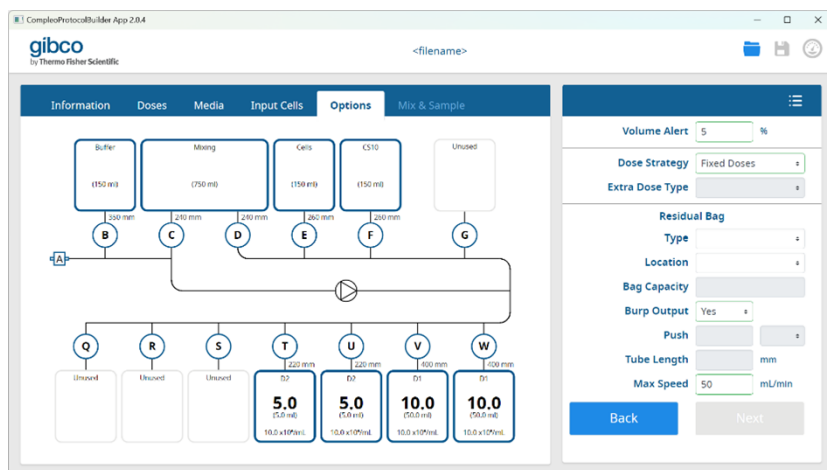


Figure 33 Volume Alert

Volumes flagged for checking during a protocol will be displayed in the dose plan tables at the end of each step, summarized on the user interface at the end of the protocol, and reported in the `run_log`.

gibco by Thermo Fisher Scientific Dose Plan Step List scinogy Notifications 0

Description		Parameters	Formulation			Doses			Formulation Ratios			Dose Ratios	
Bag	Dose Label	Description	Min Vol (mL)	Plan. Vol (mL)	Meas. Vol (mL)	Max Vol (mL)	Min Conc. (x10 ⁹ /mL)	Plan. Conc. (x10 ⁹ /mL)	Meas. Conc. (x10 ⁹ /mL)	Max Conc. (x10 ⁹ /mL)	Plan. Active %	Meas. Active %	
W	D1	Dose 1: 10mL	10	10	9.7	10	8	8	8.2	12	5	4.9	
V	D1	Dose 1: 10mL	10	10	10	10	8	8	8.2	12	5	4.9	
U	D2	Dose 2: 1mL in cryovial	4.5	5	4.9	5	8	8	8.2	12	5	4.9	
T	D2	Dose 2: 1mL in cryovial	4.5	5	5.1	5	8	8	8.2	12	5	4.9	
Q	Residual			20.2	20.1			8	8.2		5	4.9	
0	Sample: 0	Sample of: Input Product		0.5	0.6			16.1	16.3		0	0	

gibco by Thermo Fisher Scientific Filly 0026 scinogy Notifications 1

Protocol Complete

Protocol **FIL-0203-B1-Demonstration Protocol** completed successfully.
Please check the following doses: 0. The measured volumes or concentrations are out of specification.

Okay

Active Ingr. Exposure time: 0:10:03

Show Notification

Manual Burp **End**

Doses

Bag	Dose Label	Min Volume (mL)	Planned Volume (mL)	Measured Volume (mL)	Max Volume (mL)	Min Conc (x10 ⁹ /mL)	Planned Conc (x10 ⁹ /mL)	Measured Conc (x10 ⁹ /mL)	Max Conc (x10 ⁹ /mL)	Planned Active %	Measured Active %
W	D1	10	10.0	9.7	10	8.0	8.0	8.2	12.0	5	4.9
V	D1	10	10.0	10.0	10	8.0	8.0	8.2	12.0	5	4.9
U	D2	4.5	5.0	4.9	5	8.0	8.0	8.2	12.0	5	4.9
T	D2	4.5	5.0	5.1	5	8.0	8.0	8.2	12.0	5	4.9
Q	Residual		20.2	20.1			8.0	8.2		5	4.9
0	Sample: 0		0.5	0.6			16.1	16.3		0.0	0.0

Sequence Volumes

Step	Description	Planned Mixer Bag Volume (ml)	Measured Mixer Bag Volume (ml)	Planned Volume Added (ml)	Measured Volume Added (ml)	Planned Concentration (x10 ⁹ /mL)	Measured Concentration (x10 ⁹ /mL)	Planned Active %	Measured Active %
1	Dry Prime Kit	0	0	0	0	0	0	0	0
2	Wet Prime Kit	0	0	0	0	0	0	0	0
3	Measure Input Product	20.6	21.9	20.6	21.9	20.0	20.0	0.0	0.0
4	Confirm Measured Volume	20.6	21.9	0	0	20.0	20.0	0.0	0.0
5	Check Dose Plan Cell Volume	20.6	21.9	0	0	20	20	0	0.0
6	Dilute with: Buffer	25.6	26.9	5	5.0	16.1	16.3	0.0	0.0
7	Mix: Input Product	25.6	26.9	0	0	16.1	16.3	0.0	0.0
8	Sample 0: Input Product	25.1	26.3	-0.5	-0.6	16.1	16.3	0.0	0.0
9	Check Dose Plan Concentration	24.6	26.3	0	0	16.1	16.1	0	0.0
10	Dilute with: CS10	49.7	51.4	25.1	25.1	8.0	8.2	5.1	4.9
11	Mix: Conc: 10±20%, Active: 5%	49.7	51.4	0	0	8.0	8.2	5.1	4.9
12	Dispense Dose: W	39.7	41.7	-10.0	-9.7	8.0	8.2	5.1	4.9
13	Dispense Dose: V	29.7	31.7	-10.0	-10.0	8.0	8.2	5.1	4.9
14	Dispense Dose: U	24.7	26.9	-5.0	-4.9	8.0	8.2	5.1	4.9
15	Dispense Dose: T	19.7	21.8	-5.0	-5.1	8.0	8.2	5.1	4.9
16	Dispense Dose: Q	-0.5	1.7	-20.2	-20.1	8.0	8.2	5.1	4.9
17	Burp Bags: W, V, Q	-0.5	1.6	0	-0.0	8.0	8.2	5.1	4.9

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2. **Dose Strategy:** Select **Fixed Doses** or **Make Extra Doses** from the dropdown list.

- **Fixed Doses** – The system will not dispense any doses beyond what is specifically required by the protocol.

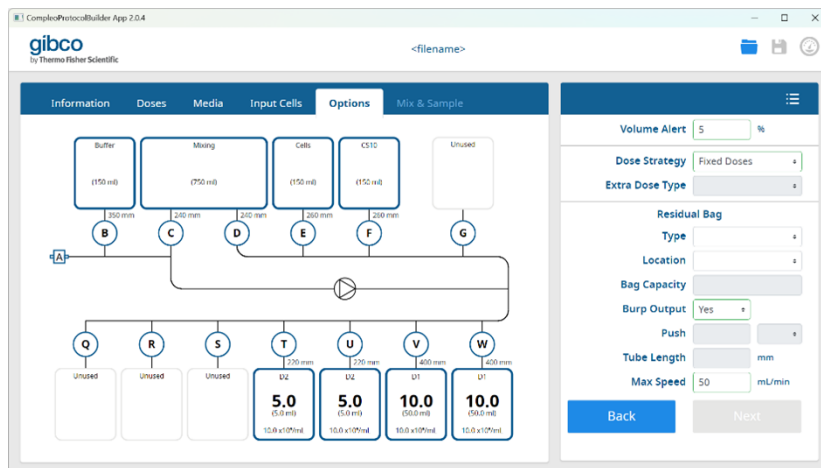


Figure 34 Fixed Doses

- **Make Extra Doses** – The system dispenses additional doses when sufficient formulated material is available, and an output line is available to meet the dose specification. For example, lines G, Q, R and S are still available for additional doses, depending on **Mix & Sample** selections.

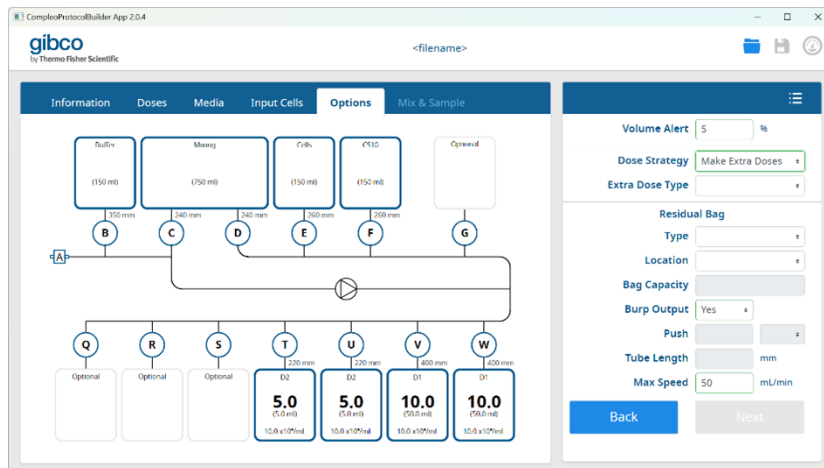
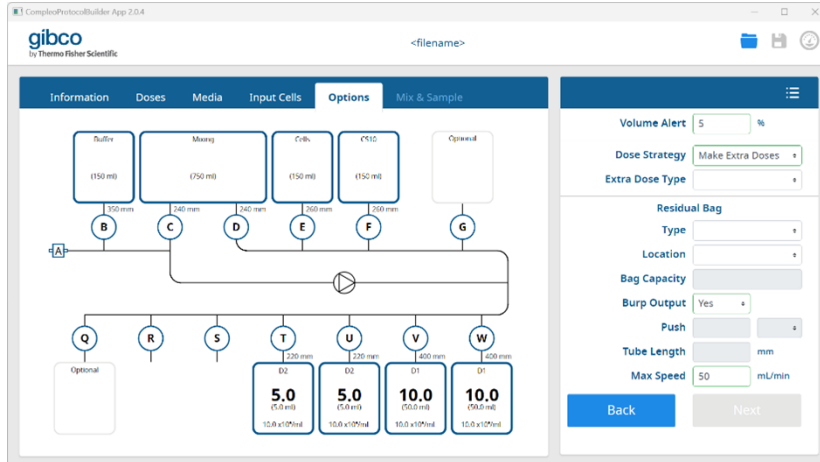


Figure 35 Make Extra Doses

Note: To limit the number of extra doses dispensed, click the letter associated with an available output line on the kit view. In the following example, lines R and S have been disabled and will not be available for the protocol.

Note: If the defined protocol requires the use of a specific output line, that output line cannot be disabled for it to run.



3. **Extra Dose Type:** Select the dose type from the available options in the dropdown list.

Note: This parameter will be disabled if **Fixed Doses** option is selected for the **Dose Strategy**.

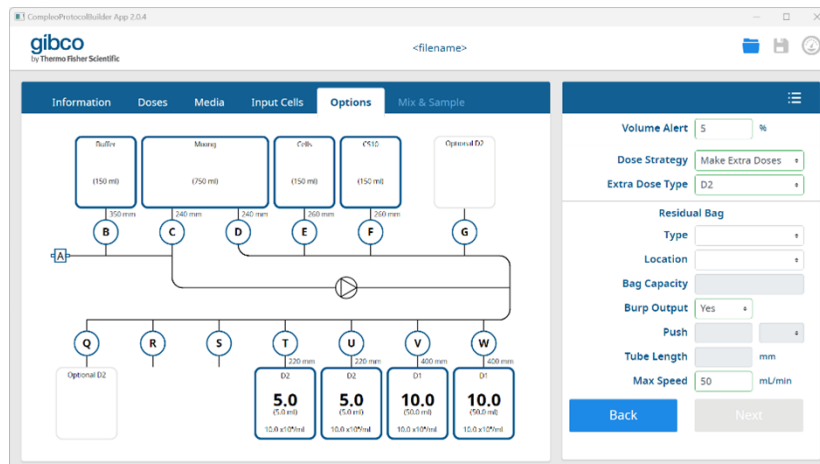


Figure 36 Extra Dose Type

4. **Type:** Select the product formulation for the residual product from the dropdown list.

Note: Only one product formulation can be assigned for the residual. If input product is chosen for residual, the Compleo™ User Interface will use the volume and cell concentration of the input cells to calculate the volume required to satisfy the protocol parameters. The residual input cells will then be returned to the input bag before formulation with media.

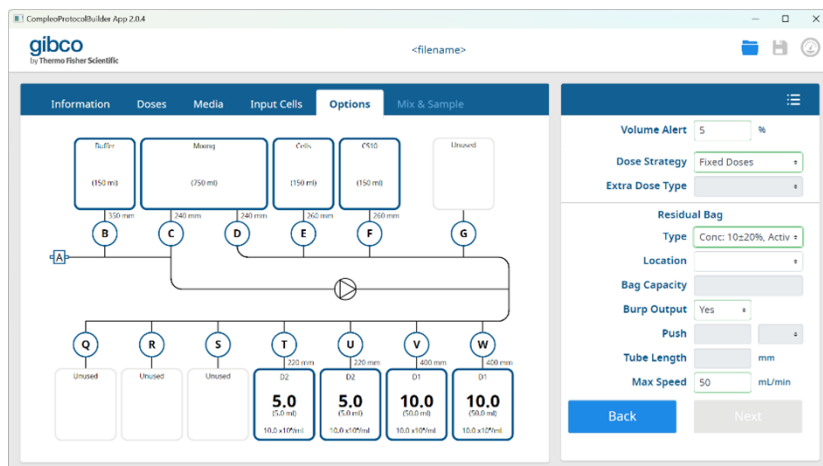


Figure 37 Type

5. **Location:** Select the residual location from the available options in the dropdown list:
 - **Dose Bag:** This option would typically be used if the residual is to be stored for future use and requires an additional bag to be attached to the kit.

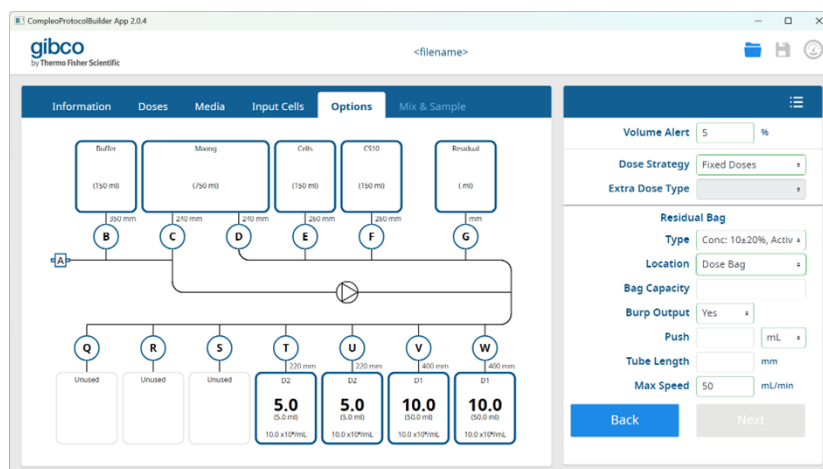


Figure 38 Dose Bag

Note: For this option, the **Residual Bag** is automatically assigned to the last available output line to optimize the kit configuration for extra doses. In the example above, the residual would be assigned to line G, leaving lines Q, R, and S unused.

- **Mixing Bag:** This option does not require an additional bag to be added. It would typically be used if the residual won't be used or if storage in the mixing bag is appropriate.

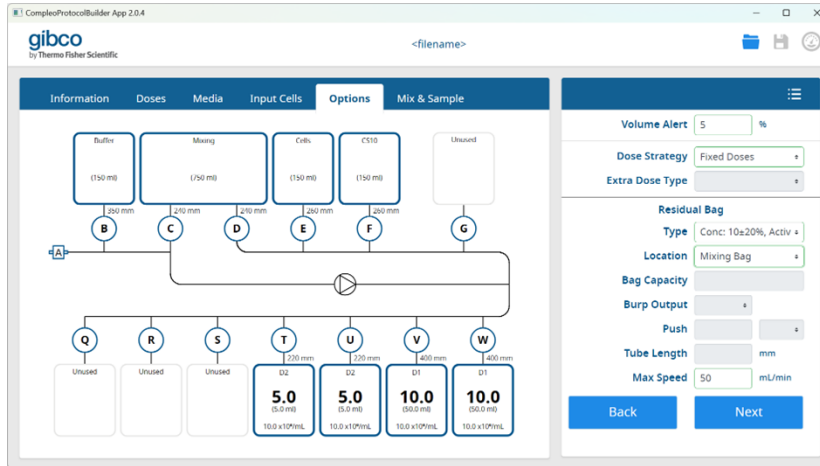


Figure 39 Mixing Bag

- **Cells Bag:** This option does not require an additional bag to be added. It would typically be used if the residual won't be used or if storage in the **Cells Bag** is appropriate — for example, the **Residual Type** is input product.

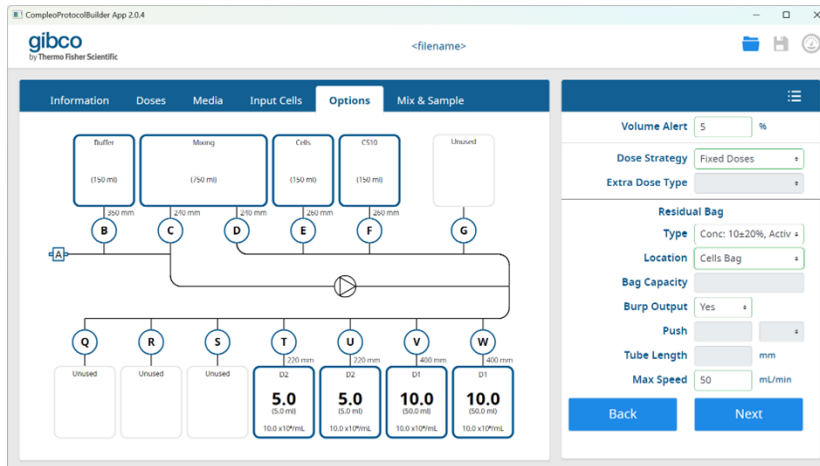


Figure 40 Cells Bag

6. **Bag Capacity** defines the maximum capacity of the **Residual Bag** in mL.
7. **Burp Output:** Select **Yes** or **No** from the dropdown list.
8. **Push** is the additional volume of air required to ensure that fluid in the output line reaches the Residual Bag.
9. **Tube Length** is included on the kit view to provide a simple aid for kit assembly.

Note: This is only required for the **Dose Bag** option, since the Mixing Bag and input Cells Bag tube lengths are already defined.

10. **Max Speed** is the default maximum speed to dispense the residual (50 mL/minute). The user can also specify a lower flow rate (5–50 mL/minute).

11. **Mixing Bag Losses** tab is the approximate volume of liquid that cannot be removed from the Mixing Bag. 1.2 mL is the default value based on the FP-FLEX1000A Mixing Bag pre-attached to the Compleo™ consumable. It is important to define the Mixing Bag loss so the system can account for it. For example, if Cells Bag is chosen as the location for the residual, the system will leave the volume required for the doses plus the expected loss in the Mixing Bag, ensuring that sufficient volume remains to meet the dose criteria.
12. Once the **Options** are defined, click **Next** to define the **Mix & Sample** parameters for the protocol or **Back** to see the parameters for prior tab, or select any completed tab within the wizard.

Mix & Sample

After input cells and buffer have been transferred to the Mixing Bag, the Mixer Module starts automatically. The two bag mixer paddles open and close across the bottom corner of the Mixing Bag based on the number of cycles and frequency (cycles/minute) defined in the protocol. The mixing motion displaces the contents of the Mixing Bag vertically and horizontally to ensure comprehensive and efficient mixing.

Media in the Mixing Bag is also recirculated from line C to D during mixing to improve mixing efficiency, avoid concentration of cells at the inlet and outlet port ports, ensure homogeneity of media regardless of where it is within the fluid path and ensure that the line C is fully primed before proceeding.

Recirculation requires a minimum of 7 mL of media to fill the recirculation line and bridge between ports C and D of the Mixing Bag. This reduces the likelihood of air entering the fluid path during recirculation and impacting subsequent volume transfers.



CAUTION! To ensure proper mixing, it is important that the Mixing Bag has sufficient excess capacity to accommodate the fluid displaced when the mixing paddles close.

The **Mix & Sample** tab enables the user to define the mixing parameters (# cycles and cycles/minute) for each unique formulation created within the protocol, including input cells. The data input panel will be automatically populated with a description for each unique formulation, along with data entry fields for their associated mixing and sampling parameters.

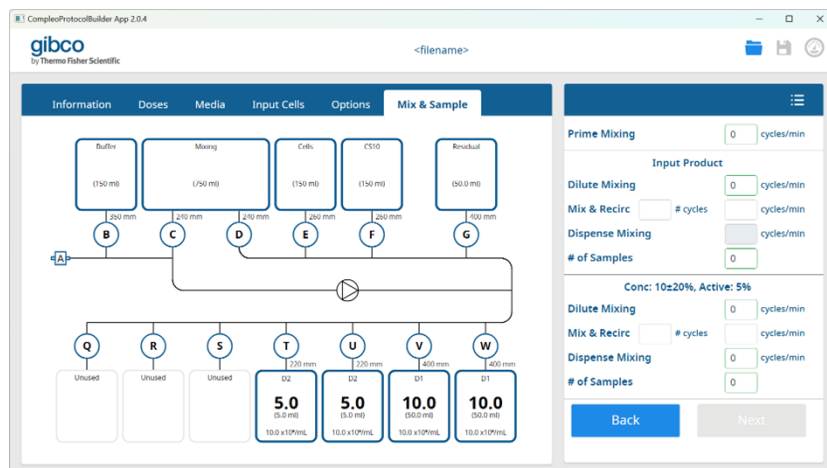


Figure 41 Mix & Sample

The description for each formulation is a combination of the cell concentration and the percentage of active ingredient. For example, **Conc: 10+/-20%, Active: 5%** means that the formulation in the Mixing Bag has a cell concentration of 10×10^6 cells/mL +/-20% and contains 5% of the active ingredient.

Manual calculation type – Formulations are defined by their dose label rather than cell concentration and % active.

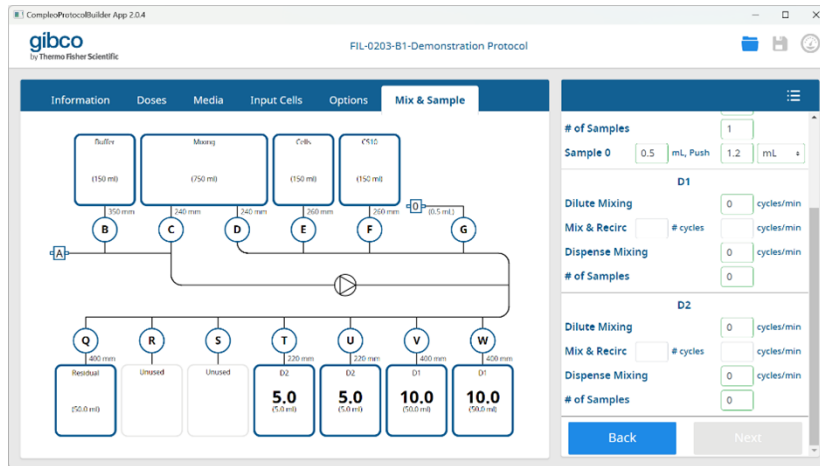


Figure 42 Manual calculation type

Note: When required, a scroll bar will be provided to display additional formulations within the Data Input Panel.

The user will be prompted to define the mixing parameters for the input product (Input Cells) and each unique formulation.

1. **Prime Mixing** tab sets the mixing speed (cycles/minute) during the dry and wet priming steps. The default value is “0” since the Mixing Bag will be empty during priming unless input product has been previously transferred to the Mixing Bag – for example, when running a recovery protocol.

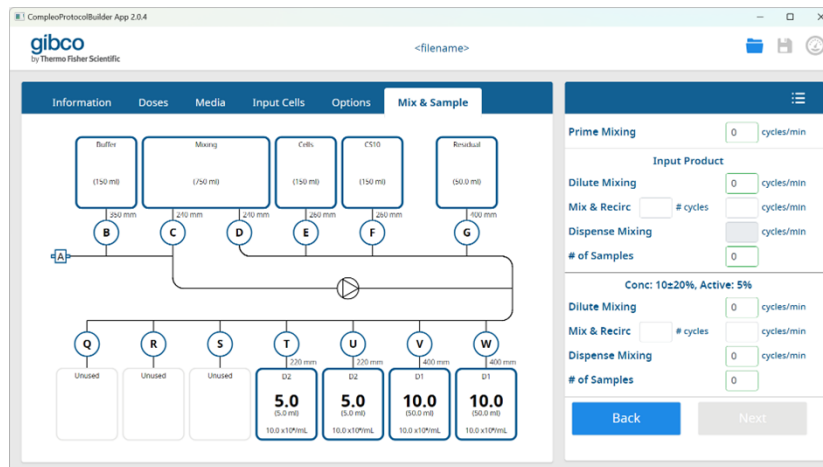


Figure 43 Prime Mixing

2. **Dilute Mixing** tab sets the mixing speed during dilution steps — for example, while adding cryoprotectant to the Mixing Bag. Set to “0” to disable.

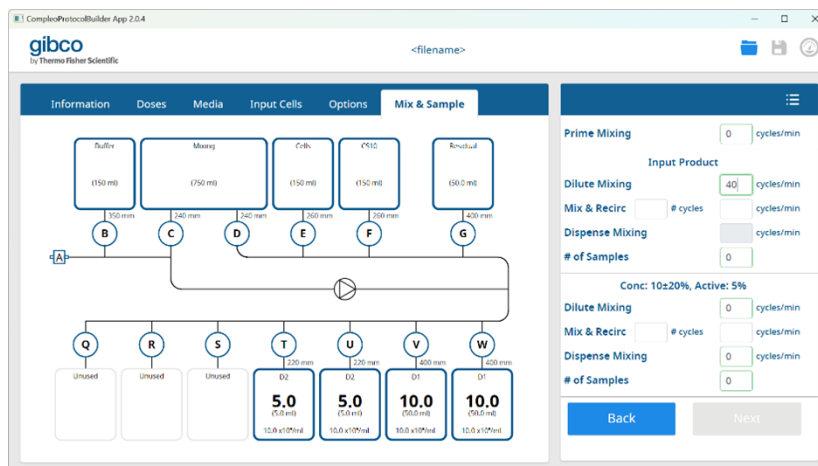
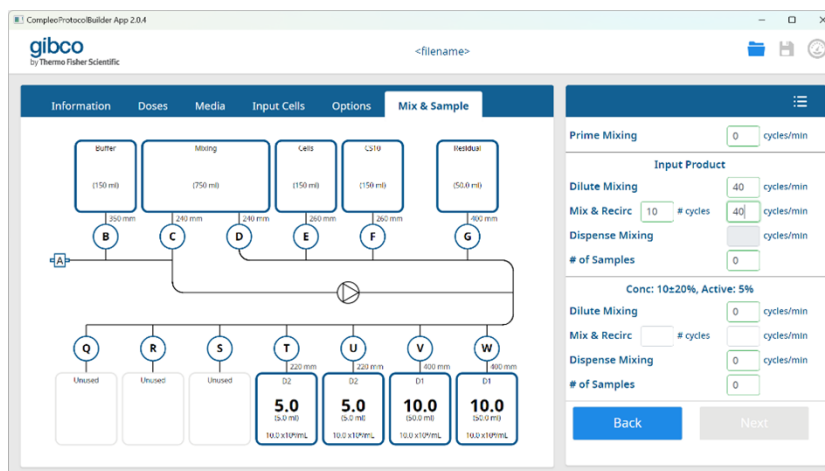


Figure 44 Dilute Mixing

3. **Mix & Recirc** tab defines that mixing is automatically initiated after each new “formulation” is created in the Mixing Bag and immediately prior to dispensing a QC sample or dose.

Note: If **Dilute Mixing** tab has been used, then the **Mix & Recirc** settings can usually be reduced.



- Dispense Mixing** tab sets the mixing speed during dispensing of doses. Set to “0” to disable.

Note: Mixing while dispensing doses is more likely to be beneficial when processing larger volumes to prevent cells from settling in the Mixing Bag.

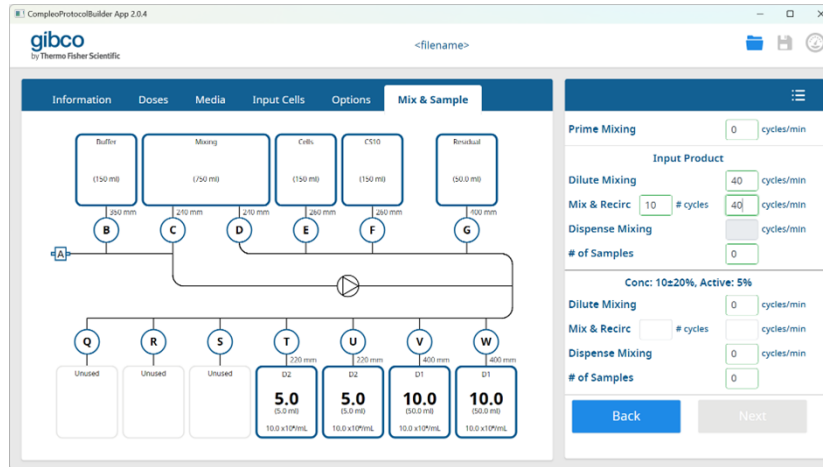


Figure 45 Dispense Mixing

- # of Samples** tab sets the number of in-process samples to be dispensed for each formulation.

The in-process samples will be added to the kit schematic including the sample # and volume (mL). Each sample will be added to the input panel including the parameters that need to be entered.

The Compleo™ system can automatically dispense up to 100 unique in-process samples into suitable sample containers connected to line G for subsequent sterile removal by the user, for example, to determine the cell concentration and cell viability, or for further testing.

Note: While the software allows the user to dispense up to 100 samples, Thermo Fisher has validated the collection of only up to 10 samples from line G.

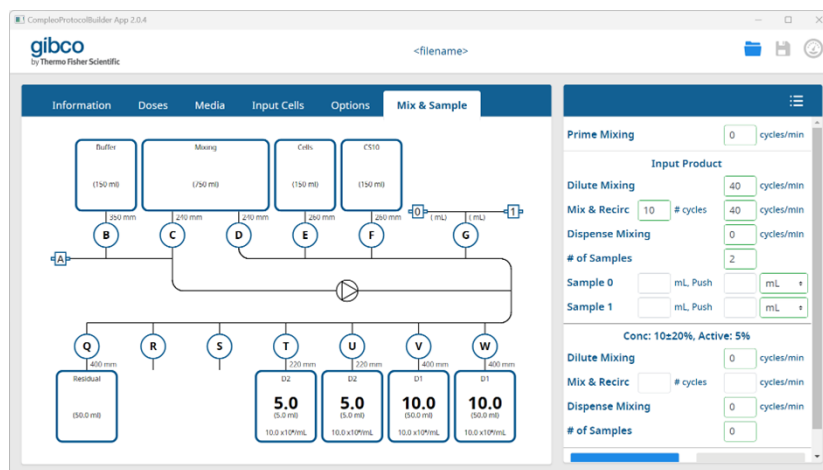


Figure 46 # of Samples

6. **Sample 0, 1,** The sample volume (minimum volume of 0.2 mL) and the **Push** volume (mL) need to be defined for each sample, where **Push** is the additional volume of air required to ensure that the sample reaches the container when being dispensed.



CAUTION! Dispensing of in-process samples involves the instrument pumping a small volume of air to check that manual clamps on sample lines have been opened and then dispensing the sample including the Push volume to deliver the sample to the container. Sample containers therefore need to be able to accommodate the sample volume plus the additional air, for example, if using syringes for in-process samples, ensure that the total volume of air and sample dispensed does not exceed the volume of the syringe.

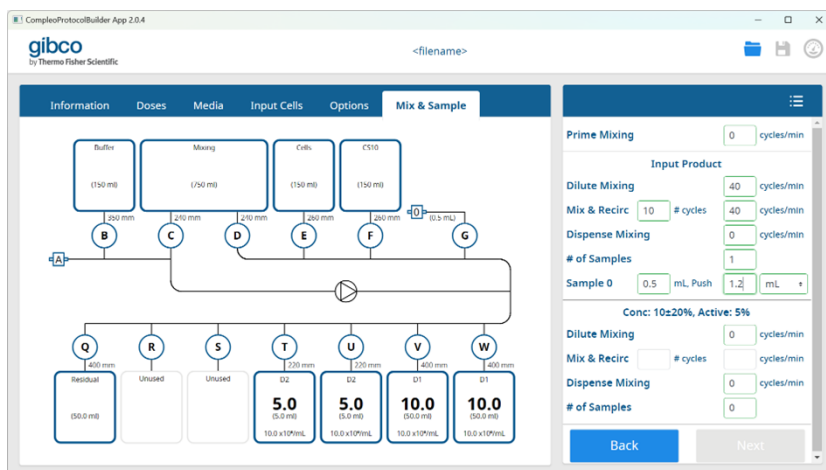


Figure 47 Sample 0, 1,

7. Repeat the above for each unique formulation.

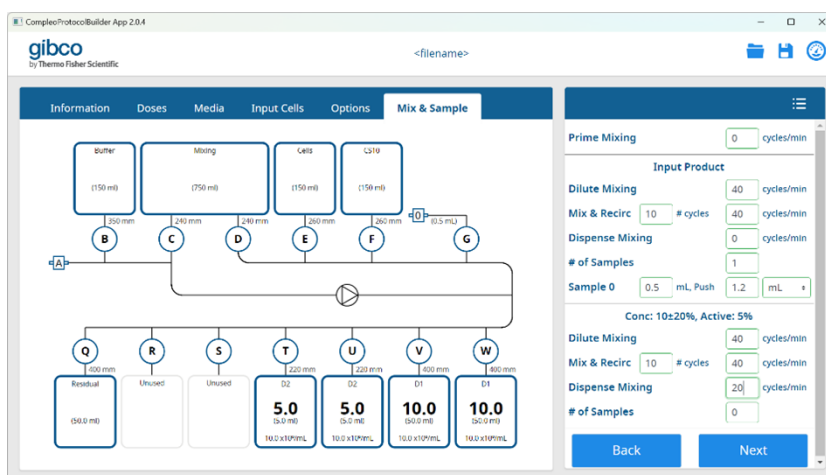



Figure 48 Next and Back buttons

8. Once **Mix & Sample** parameters are defined for all formulations, click **Next** to define some parameters for the protocol simulator or **Back** to see the parameters for prior tab, or select any completed tab within the wizard.

Save Protocol

1. Click the  (**save**) icon to open the windows browser.
2. Select an applicable directory to save the protocol.
3. Enter the **File name** for the new protocol, then click **Save**.



Protocol simulation

Simulator features

The Compleo™ Protocol Builder includes a simulator that enables the user to input the anticipated cell volume and cell concentration.

The simulator then determines the following data:

- Kit configuration
- Optimized dose volumes (mL) and cell concentrations ($\times 10^6$ cells/mL)
- Volume of media required to formulate the doses (mL)
- Cell usage (%) *i.e.*, the percentage of input cells used in the doses
- Total Run Time (hours:minutes:seconds)
- Active Ingredient Exposure Time (hours:minutes:seconds)

It is recommended to perform a protocol simulation in the following situations:

- **When creating or editing a protocol**, to explore its ability to accommodate the expected variations in the volume and concentration of input cells.
- **Before processing a specific batch of cells**, to ensure buffer volumes and bag capacities are adequate to complete the protocol.

Note: The Compleo™ User Interface and Protocol Builder use the same protocol simulator. Once a protocol is selected to run on the instrument and the relevant input data are provided, the Compleo™ User Interface will display the same schematic in the kit view panel on the dashboard. Bag information is also available at any time during the run by clicking on the bag of interest.

1. Select a **Protocol**.
2. Click the  (**simulator**) icon in the top right of the screen followed by **Add Inputs**.

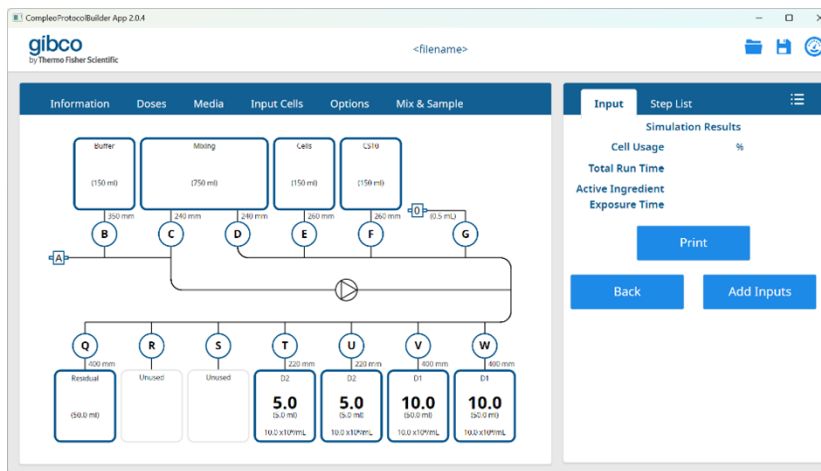


Figure 49 Compleo™ User Interface

3. Enter the input data estimates for the run — for example, Volume: 20 mL and Cell Concentration: 20×10^6 cells/mL, then select **Confirm** to simulate the run.

The screenshot shows the 'Input Data Estimates Required' dialog box. The user has entered the following values:

- Volume: 20 mL
- Cell Concentration: 20 $\times 10^6$ cells/mL

Buttons for 'Cancel' and 'Confirm' are visible. The schematic diagram from the previous figure is partially visible at the bottom of the screen.

Manual calculation type – For manual protocols, enter the volume of all inputs including cells and each media to be added for each dose (for example, D1 and D2).

Note: If all doses have the same cell concentration and formulation, then the volume of media required needs to be added to prepare the first dose, with no further media addition for subsequent doses.

Input Data Estimates Required

Enter the following input estimates.

Cell Volume mL

Volume Media added for D1

Buffer mL

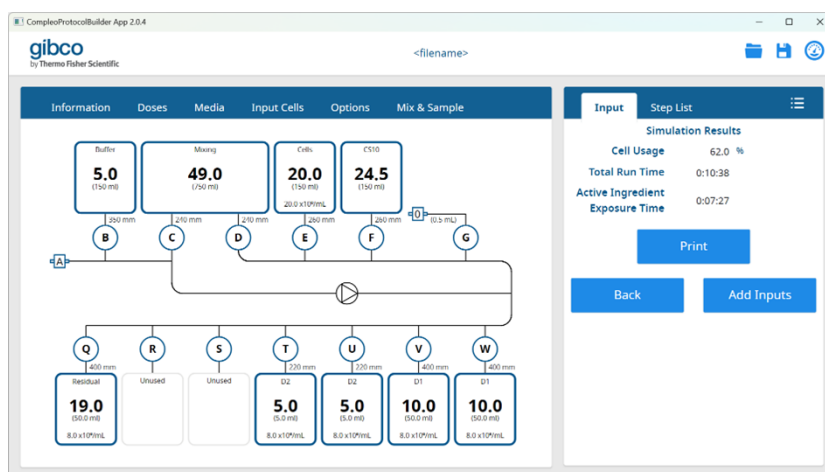
CS10 mL

Volume Media added for D2

Buffer mL

CS10 mL

The simulator displays a schematic of the Compleo™ Single-Use Kit including output container connections, tube lengths, bag capacities, input volumes for cells and media, output volumes and cell concentration for doses, cell usage (%), Total Run Time, and Active Ingredient Exposure Time (hours:minutes:seconds).

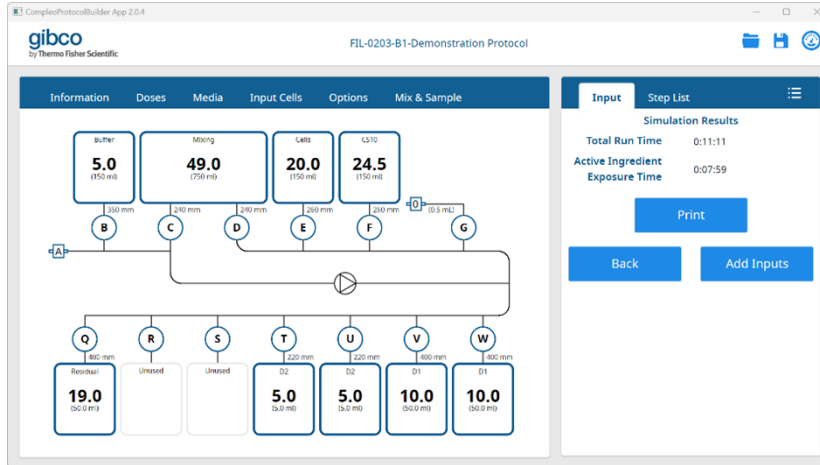


Manual calculation type – for manual protocols, cell usage will not be calculated.

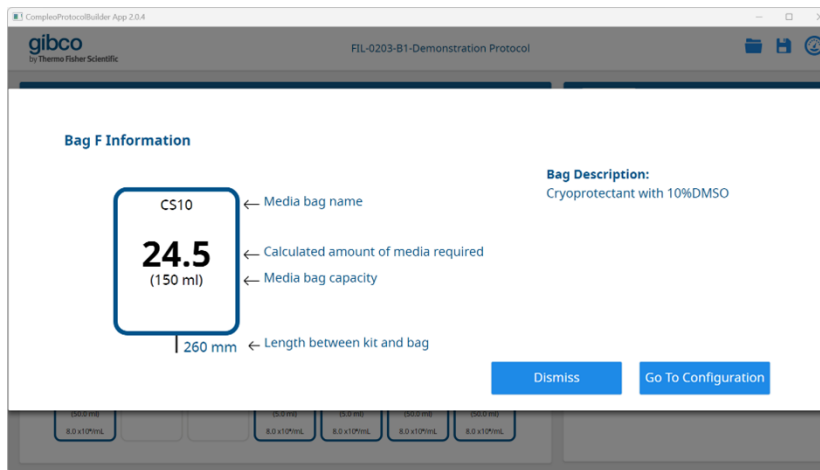
Note: The protocol builder has been developed and optimized for the primary purpose of formulating cells with media. For manual protocols, the only difference between input cells and media is the ability to automatically measure the input volume and, if selected, determine a kit correction factor.

Manual protocols are therefore useful in the following situations:

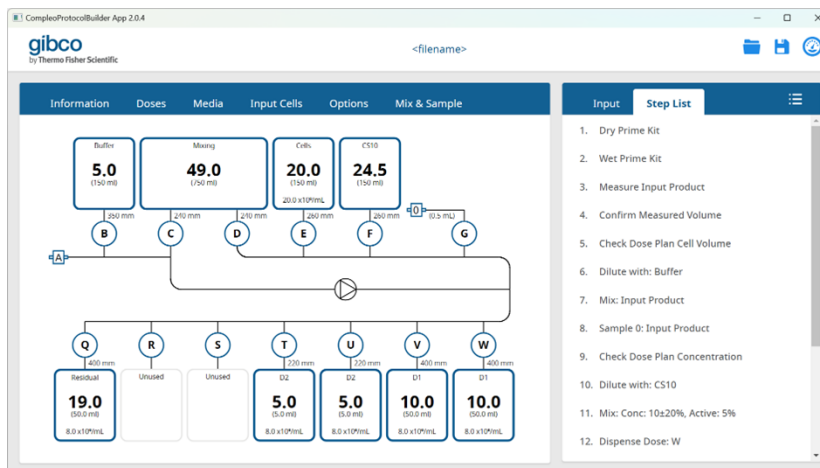
- Input cells have been preformulated.
- Formulation with media is a direct ratio to the input cell volume and therefore easily calculated.
- No cells present in the input cells; it is simply another media.



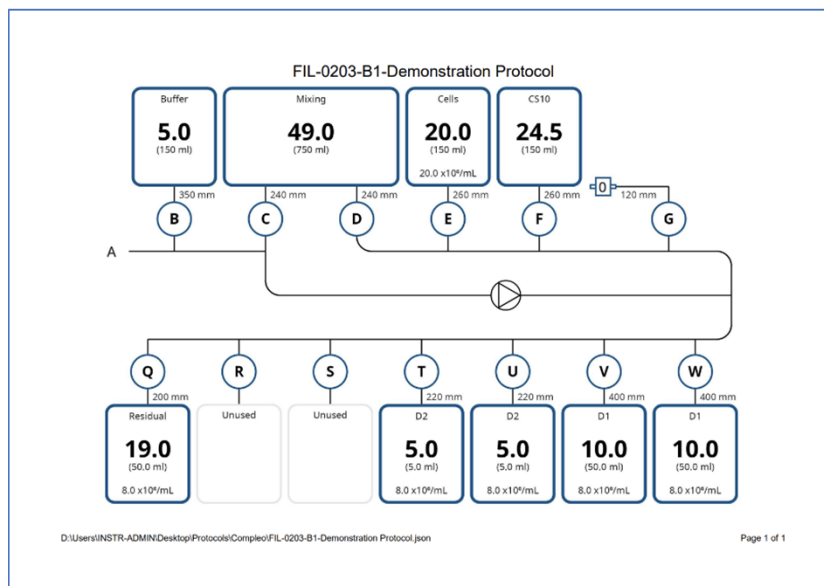
Click an individual bag to display the bag information.



Tap the **Step List** to display a summary of the steps within the protocol.



The kit configuration based on the simulated inputs can also be printed by clicking the **Print** button and selecting an available printer.



Protocol refinement

It is recommended to write protocols to meet product specifications based on the lowest expected volume and concentration of input cells but remain flexible to accommodate larger volumes and higher concentrations when available. This can be achieved by using broad tolerances for the volume and cell concentration of doses, and the **Make Extra Doses** and **Residual** features.

The simulator helps protocol developers test the operating limits based on the expected range of input cell volumes and concentrations. It also highlights when the protocol parameters cannot be met based on the input data, and where possible, provides an explanation of the root cause.

gibco by Thermo Fisher Scientific <filename>

Information Doses Media Input Cells Options Mix & Sample

Input Step List Find Limits

Simulation Results

Cell Usage	24.1 %
Total Run Time	0:22:46
Active Ingredient Exposure Time	0:13:22

Print

Back Add Inputs

Only 50x10⁶ cells provided, dose plan requires a minimum of 204.8x10⁶ cells

Figure 50 Protocol refinement

Find Limits

Tap **Find Limits** for a visual simulation of the input cell volume and concentration limits within which the protocol can be used.

Note: It is recommended that users utilize the **Find Limits** function before initiating a protocol to ensure the protocol can be completed as defined with the available input material.

To perform the simulation, the user defines the minimum and maximum concentration and cell volume to be plotted by the simulator. In the **# Steps** fields, the user defines the increments for each axis of the plot. The **Max 'Buffer'** and **Max 'CS10'** fields are automatically populated based on the maximum volume of input media required across the simulation space.

After the user clicks the blue **Find Limits** button, the simulator generates the graph shown in the following Figure 51.

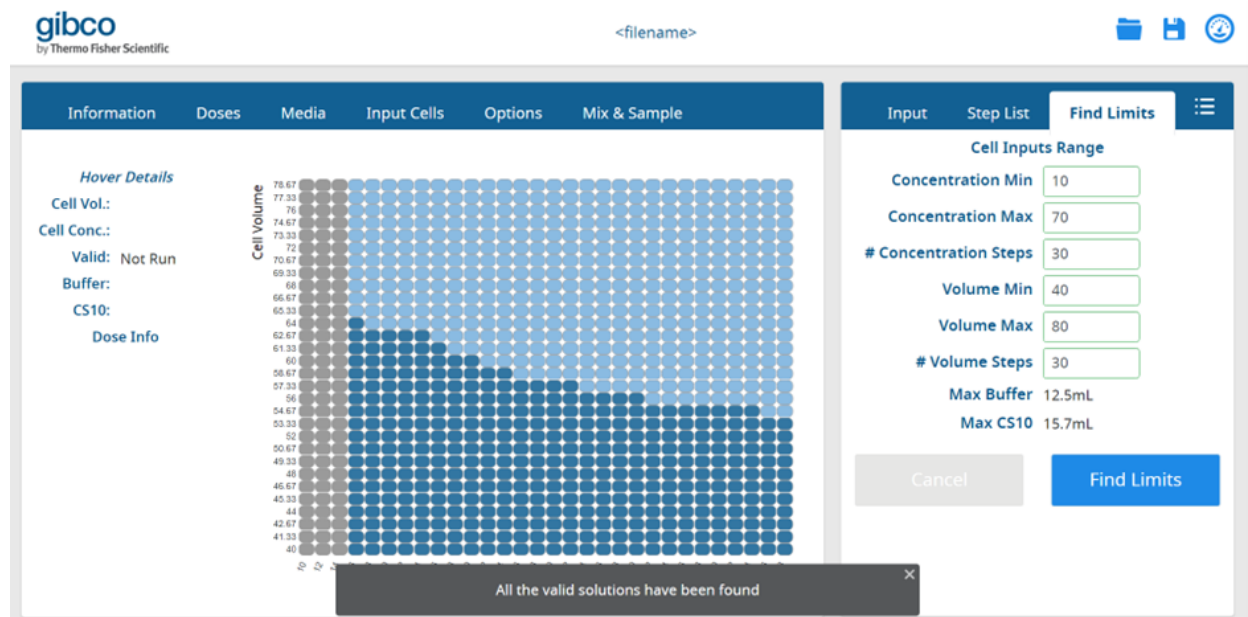


Figure 51 Find Limits

Solutions shown in **dark blue** (Figure 52) represent valid protocols that can be completed as currently defined. Users can hover over each point in the plot to view information on the input cell volume and concentration, the amount of input media used, and the output dose volumes and concentrations.

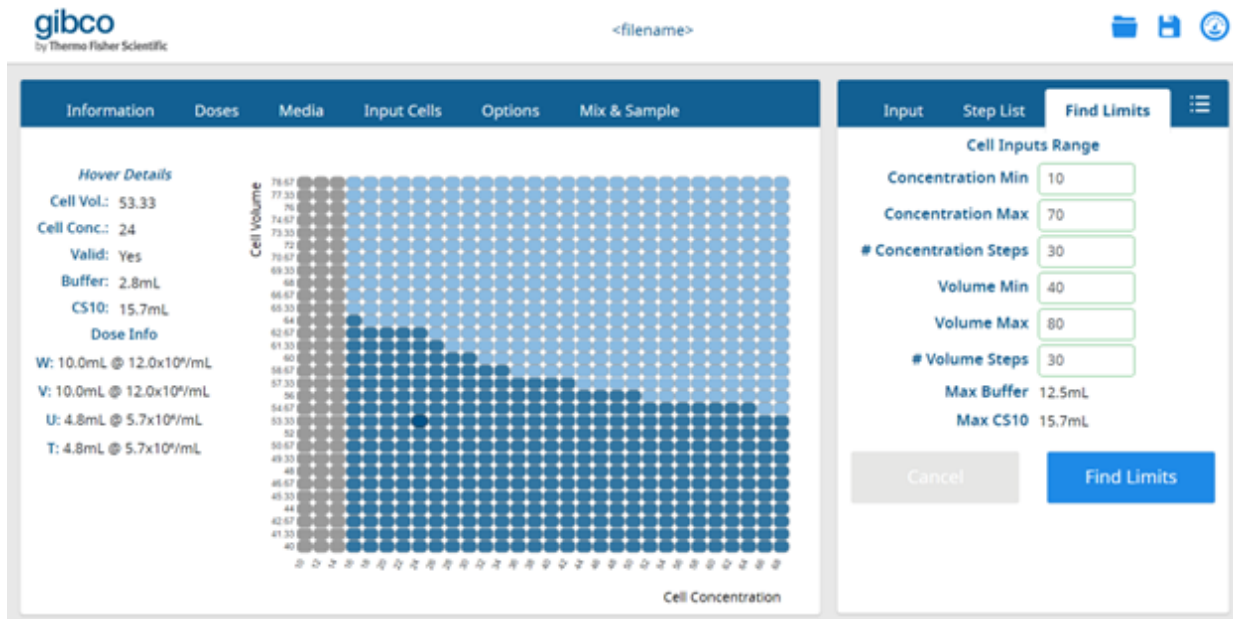


Figure 52 Find Limits - Dark Blue color in graph represents valid protocols

Solutions shown in **light blue** (Figure 53) represent protocols that are nearly valid but require minor modifications. For example, in Figure 53, the warning message in the upper right indicates that the residual volume (59.7 mL) exceeds the **Dose Bag** capacity (50 mL). The user should increase the bag capacity for the residual before initiating the protocol to prevent complications during the run.

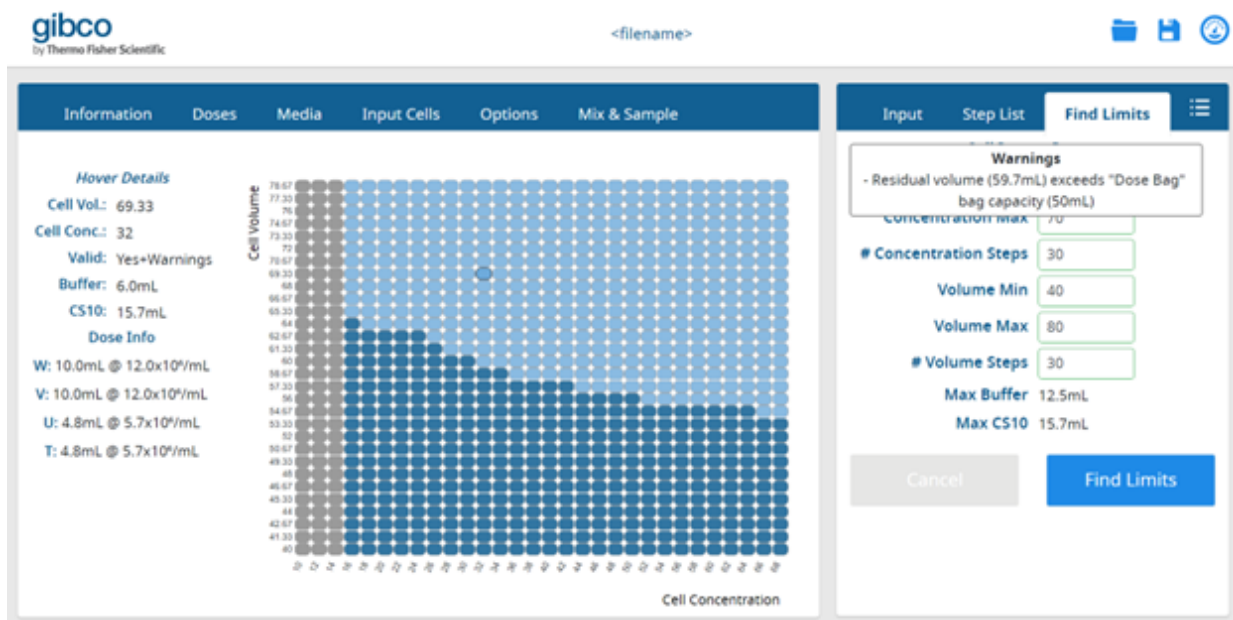


Figure 53 Find Limits - Light blue color in graph represents nearly valid protocols

Solutions shown in **gray** (Figure 54) represent cell volume and concentration combinations for which the protocol is not valid. Modifications to the volume and/or concentration of the input material, or to the dose specifications, would be required to make the protocol valid.

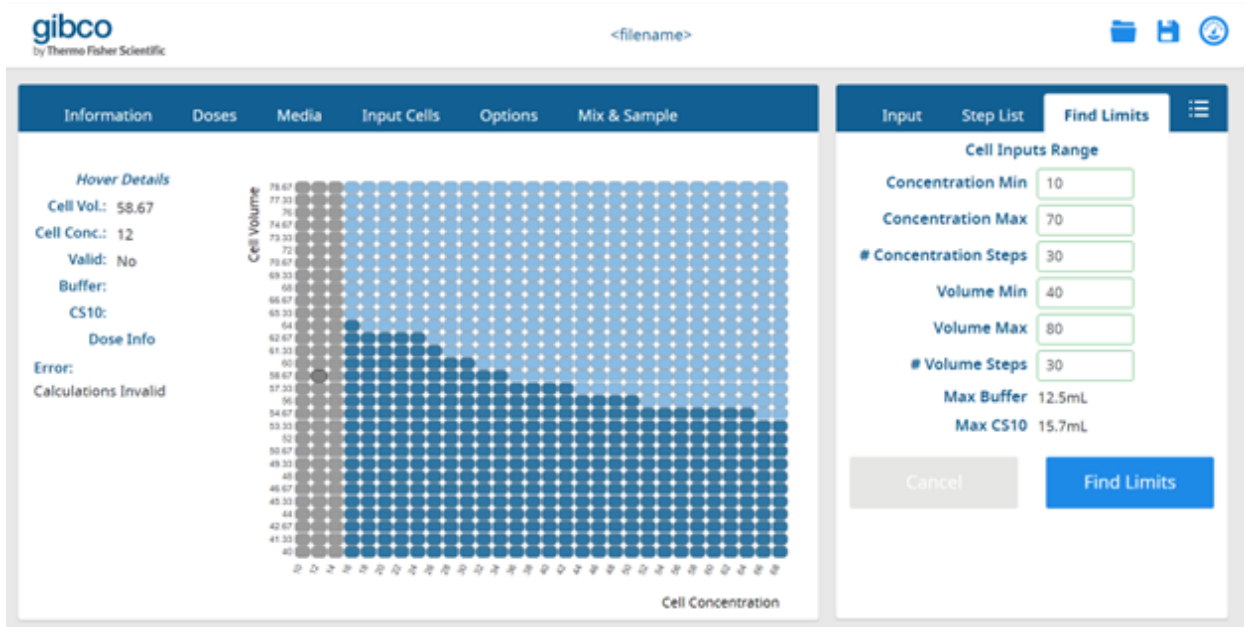



Figure 54 Find Limits - Gray color in graph represents invalid protocols

Protocol verification

Protocol parameters

Click the  icon in the top right corner of the simulation page to view the simulation outputs based on the input data entered including the following features.

1. **Description** tab contains the summary and detailed description contained in the **Information** page of the Protocol Builder.

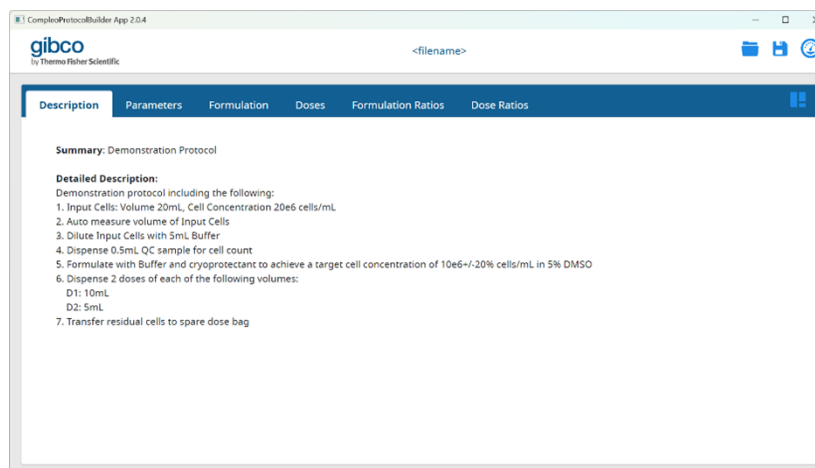


Figure 55 Description

2. **Parameters** tab provides a summary of the variables defined for the doses, media, input cells, options, and mix and sample.

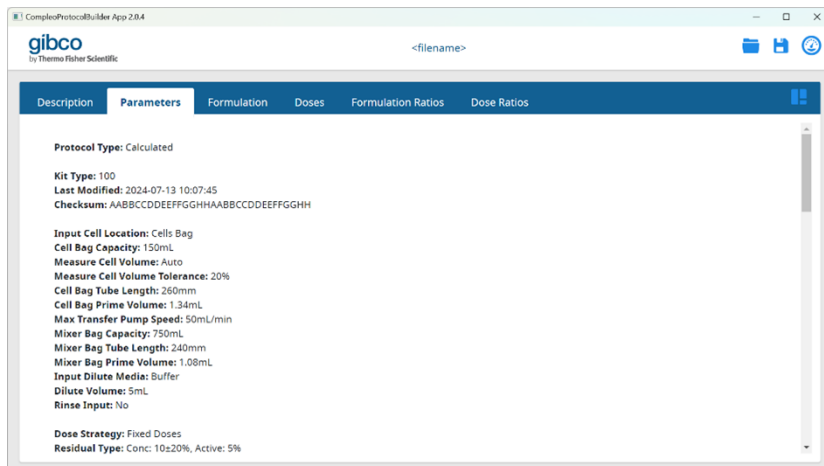


Figure 56 Parameters

3. **Formulation** tab records the cumulative volume, cell concentration, and active percentage in the Mixing Bag at the end of each step as the protocol runs. This can be used to manually check that the simulator has correctly calculated the volume additions to achieve the product specification.

The screenshot shows the 'Formulation' tab in the CompleoProtocolBuilder App 2.0.4. The table displays the following data:

Step	Description	Planned Mixer Bag Volume (mL)	Planned Volume Added (mL)	Planned Conc. (x10 ⁷ /mL)	Planned Active %
1	Dry Prime Kit	0	0	0	0
2	Wet Prime Kit	0	0	0	0
3	Measure Input Product	20	20	20	0
4	Confirm Measured Volume	20	0	20	0
5	Check Dose Plan Cell Volume	20	0	20	0
6	Dilute with: Buffer	25	5	16	0
7	Mix: Input Product	25	0	16	0
8	Sample 0: Input Product	24.5	-0.5	16	0
9	Check Dose Plan Concentration	24.5	0	16	0

Figure 57 Formulation

- Doses** tab displays the calculated volumes, concentrations, maximum and minimum limits, and percentage of active for each dose, including residual and in-process samples.

Bag	Dose Label	Description	Min Vol (mL)	Plan. Vol (mL)	Max Vol (mL)	Min Conc. (x10 ⁹ /mL)	Plan. Conc. (x10 ⁹ /mL)	Max Conc. (x10 ⁹ /mL)	Plan. Active %
W	D1	Dose 1: 10mL	10	10	10	8	8.0	12	5
V	D1	Dose 1: 10mL	10	10	10	8	8.0	12	5
U	D2	Dose 2: 5mL	5	5	5	8	8.0	12	5
T	D2	Dose 2: 5mL	5	5	5	8	8.0	12	5
Q	Residual			19.0			8.0		5
0	Sample: 0	Sample of: Input Product		0.5			16		0

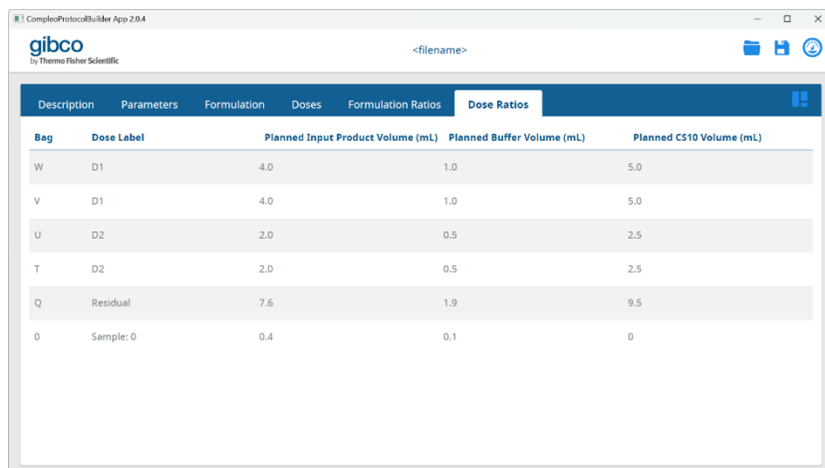
Figure 58 Doses

- Formulation Ratios** tab shows the volume ratio of input cells and media in the Mixing Bag at the end of each step as the protocol runs.

Step	Description	Planned Input Product Volume (mL)	Planned Buffer Volume (mL)	Planned CS10 Volume (mL)
1	Dry Prime Kit	0	0	0
2	Wet Prime Kit	0	0	0
3	Measure Input Product	20	0	0
4	Confirm Measured Volume	20	0	0
5	Check Dose Plan Cell Volume	20	0	0
6	Dilute with: Buffer	20	5	0
7	Mix: Input Product	20	5	0
8	Sample 0: Input Product	19.6	4.9	0
9	Check Dose Plan Concentration	19.6	4.9	0

Figure 59 Formulation Ratios

6. **Dose Ratios** tab provides the volume ratio of input cells and media in each dose, residual and in-process sample.



Bag	Dose Label	Planned Input Product Volume (mL)	Planned Buffer Volume (mL)	Planned CS10 Volume (mL)
W	D1	4.0	1.0	5.0
V	D1	4.0	1.0	5.0
U	D2	2.0	0.5	2.5
T	D2	2.0	0.5	2.5
Q	Residual	7.6	1.9	9.5
0	Sample: 0	0.4	0.1	0

Figure 60 Dose Ratios

Compleo™ Single-Use Kit

The CTS™ Compleo™ Single-Use Kit includes a tube carrier that positions all tubes correctly, with labels containing the letters A to G and Q to W to designate each input/output line.



Figure 61 Tube carrier showing tube labels

The letters on the tube carrier also correspond with the kit view displayed by the CTS™ Compleo™ application, the kit schematic in the CTS™ Compleo™ Protocol Builder, and the printed kit configuration.

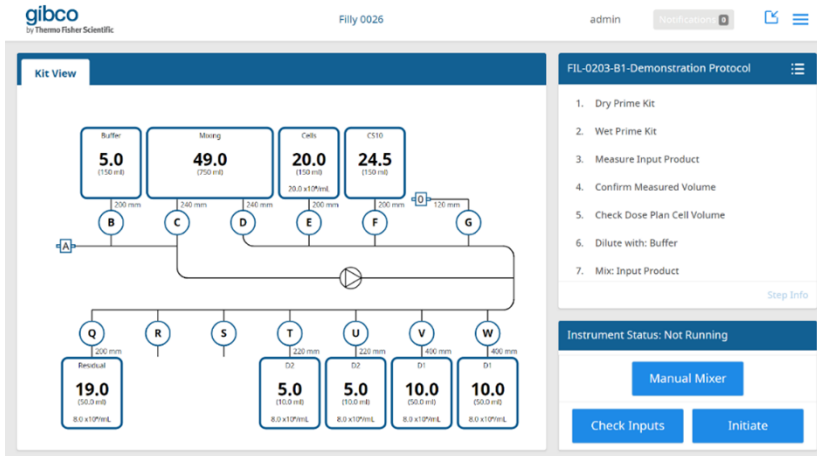


Figure 62 CTS™ Compleo™ application – kit view

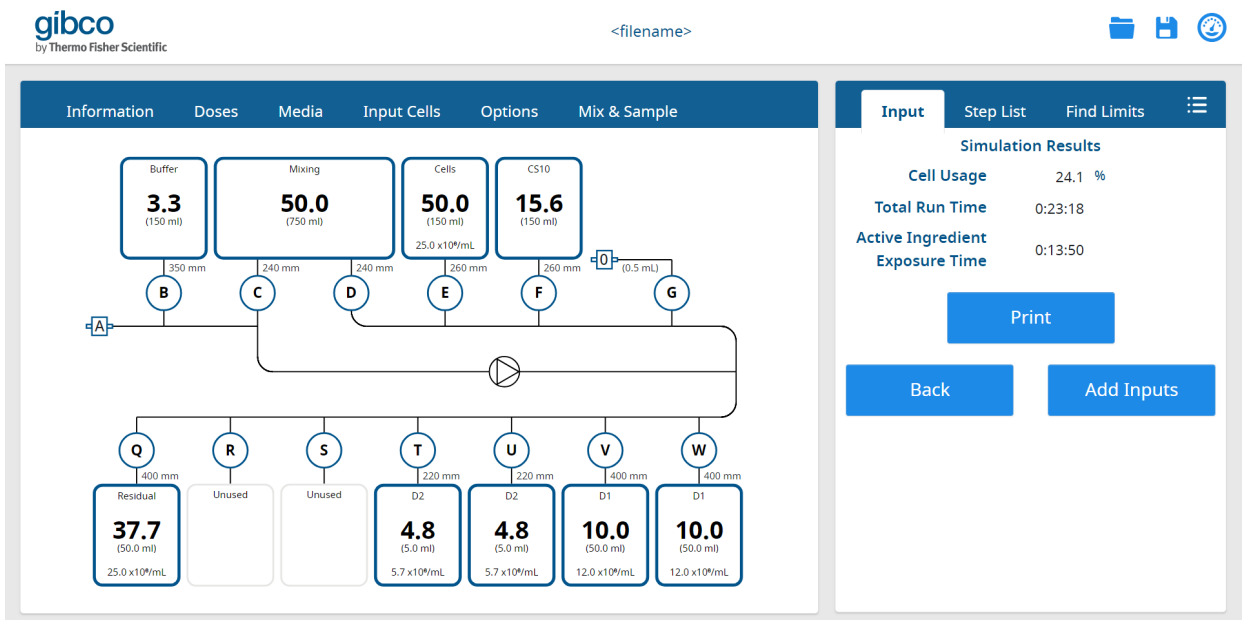


Figure 63 CTS™ Compleo™ Protocol Builder – kit schematic

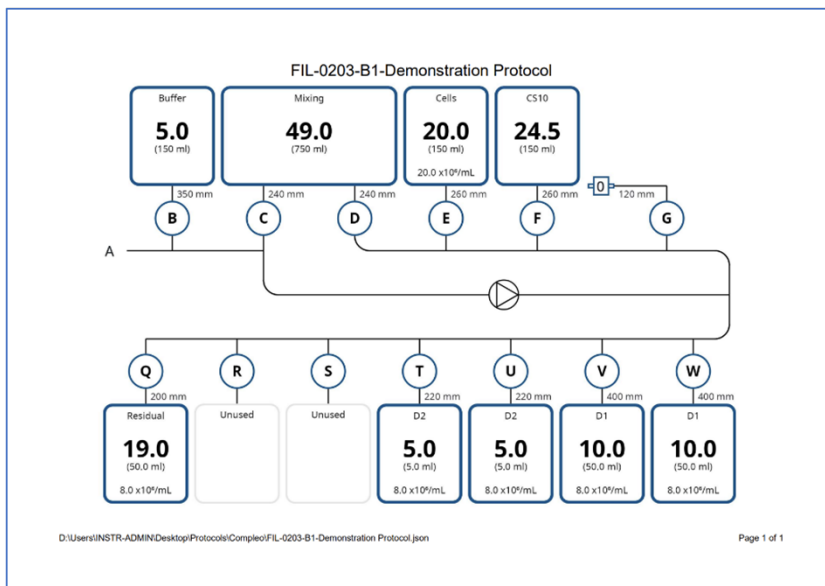


Figure 64 Print/pdf of Kit configuration for simulated run

The user can also apply matching identification labels to media bags, input cells bag, in-process samples and dose bags that are part of the CTS™ Compleo™ Single-Use Kit. When defining the CTS™ Compleo™ Single-Use Kit, bag volumes and descriptions can also aid in kit preparation.

2D barcode (automatically included)

The 2D barcode identifies the Compleo™ Single-Use Kit type. When the kit is loaded onto the instrument, the 2D barcode is automatically checked to ensure that it matches the kit type specified in the protocol.

Dry prime kit (automatically included)

Every protocol will start with a dry priming sequence of all connected lines using air to ensure that there are no blockages in the kit. Typical examples of blockages include manual clamps being closed, tube welds not being "popped," or a kit being left in the instrument for an extended period with the door and pinch valves closed.

Dispensed volumes

The Compleo™ system includes several features that enhance the precision and reproducibility of dispensed volumes, including:

1. The Compleo™ system dispenses volumes based on the number of pump revolutions specified by the **last calibration factor (mL/rev)**. The Compleo™ User Interface allows the user to maintain the instrument in a calibrated state. When tighter tolerances are required, the optional **Measure + Kit Correction function** enables the user to also correct kit-to-kit pump tube variability.
2. The internal tube lengths of the Compleo™ Single-Use Kit have been kept as short as practical to minimize fluid loss to tube walls, and tube length variability is controlled by the tube carrier geometry.
3. Bubble Sensors are used to set a known starting position for fluid within the kit during wet priming, reducing the influence of user attached input and output containers.
4. After transferring media and input cells, filtered air is used to purge tubing to a controlled position.
5. The mix and recirculation sequence is performed prior to dispensing doses to ensure that line C of the Mixing Bag is fully primed. Filtered air is then drawn into the kit to precisely set the starting position for subsequent dose volume measurements using the peristaltic pump. A user-defined **Push** volume of air is then used to complete the transfer of the dose to the container.
6. To verify the dispensed volumes, Compleo™ includes an independent volume-checking feature that measures the volume dispensed through the detection of liquid at the Bubble Sensors (**Wet volume**).
7. When measuring the volume of input cells, the wet volume will be measured on the input and output lines as the input cells are transferred to the Mixing Bag. These measurements are then compared to the input volume entered at the beginning of the protocol to ensure that they are within an acceptable range to be considered a valid measurement.
8. Discrepancies between the target volume and pumped volume will be reported in the run_log.



Documentation and support

Customer and technical support

Visit [thermofisher.com/support](https://www.thermofisher.com/support) for the latest service and support information.

- Worldwide contact telephone numbers
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- Order and web support
- Product documentation
 - User guides, manuals, and protocols
 - Certificates of Analysis
 - Safety Data Sheets (SDSs; also known as MSDSs)

Note: For SDSs for reagents and chemicals from other manufacturers, contact the manufacturer.

Limited product warranty

Life Technologies Corporation and its affiliates warrant their products as set forth in the Life Technologies' General Terms and Conditions of Sale at www.thermofisher.com/us/en/home/global/terms-and-conditions.html. If you have questions, contact Life Technologies at www.thermofisher.com/support.

