AB FIA
An Engineering Company
with a Chemistry Profile

Reliable, Repeatable Delivered Dose Uniformity Testing

AB FIA now offers bench-top modules for testing delivered dose uniformity (DDU) of orally inhaled drug products. These modules automate the basic tasks for DDU determination as described in the European [R1] and U.S. pharmaceutical compendia [R2], thereby substantially removing operator error and improving repeatability. With the FIA TriggerBox II or III (TrB), these modules can regulate and actuate a vacuum-generated airflow for a user-defined time through the device and collect the dose on a filter.

The FIA modules utilize the FIA washable glass impinger [R3], eliminating the cumbersome compendial DUSA, which must be disassembled and reassembled to recover the delivered dose and prepare for the next test. The station is equipped with a highly accurate solvent pump that dispenses the solvent into the impinger where the dose is dissolved and from which it is conveniently recovered manually by the analyst.

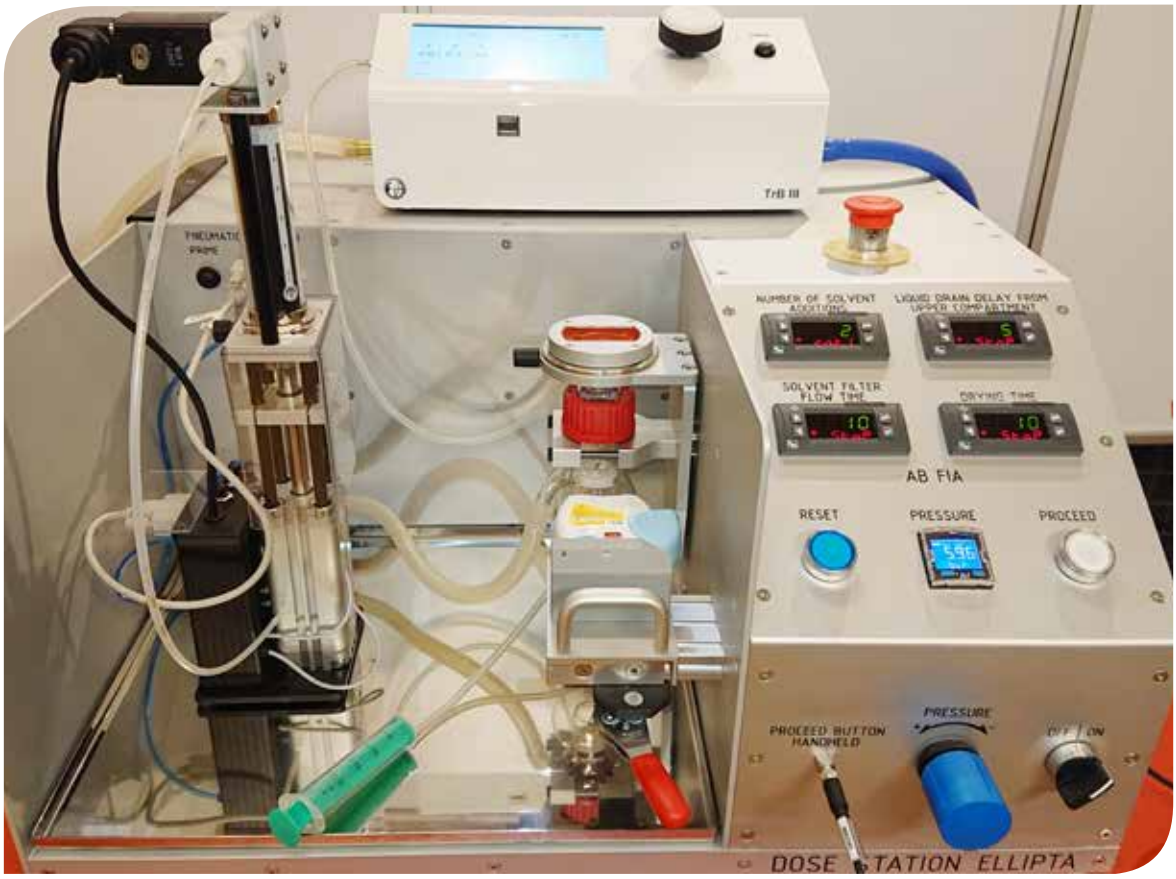

Figure 1. A Dose Station for the Ellipta Device
Intuitive displays of timers and counters allow the user to define the method parameters.

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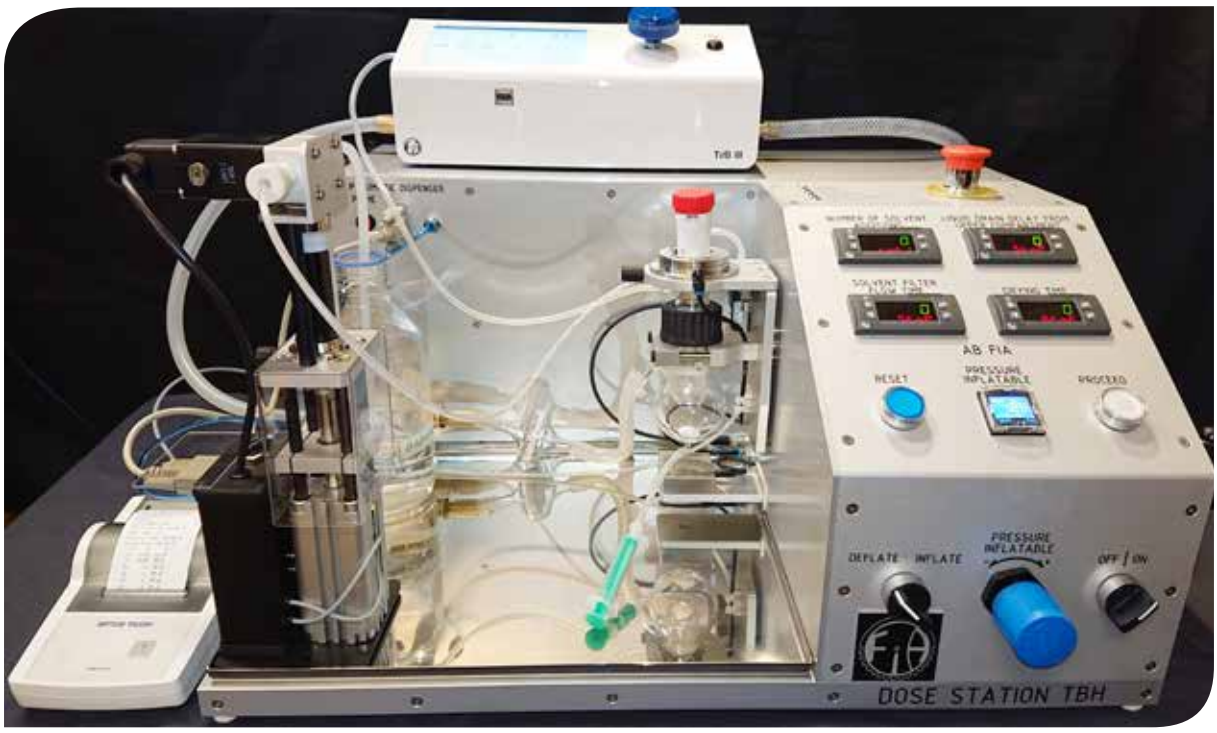

Each bench-top module is customized to the specific inhaler device. Successful applications have been made for devices such as the Turbuhaler® and the Ellipta® inhalers and generics thereof.

Figure 2
A Dose Station for the Turbuhaler Device
Each bench-top module can accommodate dose withdrawal in a desired orientation such as the vertical orienation shown here for the Turbuhaler device.

Customized Device Holders

The station types depicted here are for dry powder inhalers where the operator loads the device manually, and then the equipment withdraws the dose and performs the quantitative dissolution of the dose. The analyst conveniently removes a liquid sample for analytical characterization. The airflow and valve control are managed by the FIA TrB flow controller, and the readings are presented on the screen, on a balance printer, or as an electronic file. The station is equipped with FIA's dependable pneumatic syringe pump which delivers solvent with high precision, as good as 0.04 % RSD (FS).

FIA also offers bench-top modules for other devices, such as DPIs needing agitation or other types of manipulation or pMDIs. Automated mechanical handling is possible with the addition of proper safety shields. Devices with similar characteristics may be tested on the same module by changing only the mouthpiece adapter of the inlet of the dose collector.

Figure 3. Customized Device Holders
Purpose-built brackets hold inhalers tightly to the inlet of the glass frit impinger.

Pressure Tap at Inlet to Impinger

FIA's novel, washable glass frit impinger, provides unparalleled speed and reliability. The glass filter inside the impinger captures the dose very efficiently with moderate pressure drop over the dose collector. A pressure port (P1) is positioned close to the inlet and the pressure is presented together with the flow by the TrB for each dose. The inert glass material is ideal for allowing the user-chosen solvent to dissolve the active pharmaceutical ingredients (APIs). Numerous examples are available from FIA chemists on how to best recover the drug product from the glass filter and to cope with excipients in this context. After addition of the solvent the drug is dissolved and automatically drawn through the filter into the flask where agitation takes place, dissolving the drug product completely and repeatably. The analyst then recovers a sample or samples of the dissolved API through the port at the bottom of the flask for UV-Vis, HPLC or related analyses.

There are several examples where this methodology has proven to give results equal to that of the compendial DUSA method. The glass impinger method provides not only substantial speed and repeatability improvements but also can reduce work-related limb disorders caused by persistent manual handling of the DUSA.

Figure 4. Pressure Tap at Inlet to Impinger
The upper compartment has a pressure tap to measure the P1 value, enabling real-time measurement of the pressure drop across the inhaler device during the dosing event.

Figure 5. Sealing around Unusual Device Geometries
FIA manufactures custom inflatable gaskets to fit demanding mouthpiece geometries.

Order Information

The listed items here are readily available. Other devices can be accommodated with proper configuration changes. The stations require 240 VAC and pressurized air 6 bar.

Station Type	Article Number	Characteristics
Dose Station Ellipta	C010905	A custom bracket to press the Ellipta device against the inlet of the dose collector.
Dose Station Turbuhaler	C013186	An inflatable gasket around the inhaler mouthpiece that achieves an air-tight seal.

References

[R1] European Pharmacopoeia (Ph. Eur.) 10th Edition
Preparations for inhalation (0671)

[R2] United States Pharmacopeia General Chapter <601> Inhalation and Nasal Drug Products: Aerosols, Sprays, and Powders, official as of May 1, 2021

[R3] S. Hugosson, J. Lindberg, T. Lööf, B. Olsson, *Proposals for Standardized Testing of Powder Preparations for Inhalation*, Pharm Forum, Vol 19, 3:5458-5466, 1993.

Modules of the Dose Stations

The dose stations rely on well-established products from FIA, acting as modules on the stations. The user can be confident that the stations are reliable and with long-term support, just as any other of FIA's equipment since the early 90's. Most notable are the TriggerBox (TrB) and the pneumatic dispenser.

The TriggerBox

The TrB II and TrB III ensure compliance with standard pharmacopeial methods, both recording and storing key system parameters. These include run duration and pressure drop (P1), as well as the actual flow rate (TrB III). Many inhaler test methods rely on critical flow conditions across the flow control valve, aiming to ensure the same flow rate on each test. The TrB clearly displays that in-real time and in the presented data, so there are no assumptions.

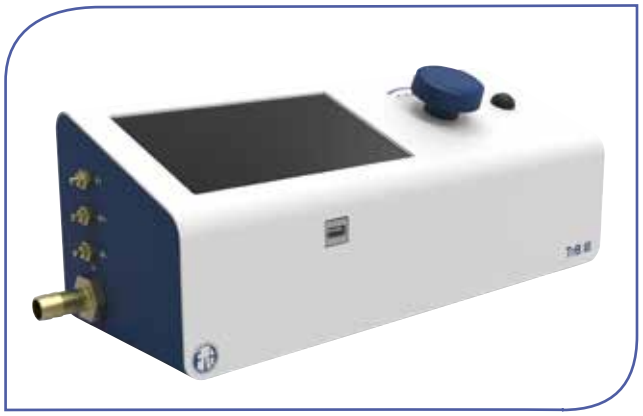

Figure 6. The TriggerBox III

SD Pneumatic Dispenser

FIA's pneumatically operated dispensers are designed for dosing of an aqueous solution, in mix with solvents or for pure solvents (e.g. acetonitrile, methanol, ethanol or heptane). Thanks to the pneumatic operation, they lend themselves to highly demanding tasks such as adding liquid through narrow nozzles and operating in potentially explosive atmospheres. For the latter, ignition protected versions can be provided. The dispensers require compressed air of 6 bar.

- Very accurate with a precision of 0.04% RSD (FS)
- Simplicity in design with long lifetime
- Constructed of glass, Teflon and other inert materials, valves can be selected to minimize leachables
- Suitable for integration in automated systems.
- Available in syringe volumes 1, 5, 10, 25, 100 ml and larger. For the dose stations the 25 ml dispenser is recommended.

Figure 7. Pneumatically Operated Dispenser SD

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