Magazine Article

BUSTING MYTHS ABOUT MICROPLATE READER INJECTORS

Many of today's most popular assays, e.g. reporter gene assays, calcium monitoring or enzyme kinetics require tracing of the light emission instantaneously from the beginning. This is achieved by using a reagent injector injecting starter material into the sample while the sample is in a measuring chamber (for example a well of a microtiter plate) in front of the detector. Thus, injector qualities can have a direct impact on the performance of the assay.

The ideal injector

We often get asked the question what to consider when talking about the ”ideal injector”. So, let's first take a look at what we would consider to be important when taking a closer look at injectors and then compare different types of injectors against those parameters:

- Injection accuracy and reproducibility: seems to be very obvious, but is often balanced against other features of an instrument.
- Time required to perform the injection: this is important e.g. for luminescence assays with so-called flash-kinetics such as aequorin or acridinium esters. In these assays the light emission reaches its peak just after several hundred milliseconds, and more than 90% of the light is emitted after only 2 to 3 seconds.
- Reagent consumption: what is the total dead volume from the reagent container to the injector tip? How many priming sequences are required to achieve a homogeneous mix of 99% at the tip? This is extremely important to guarantee that the same reagent concentration has been injected into A1 through H12 for proper results. Furthermore, the more sequences, the higher the reagent consumption and the associated reagent costs will be.
- Maintenance costs: can a frictionless operation be achieved to avoid mechanical failure and costly maintenance?
- Design & additional functions: how is the injector being built? What are the resulting shearing forces of the injector? This is an important consideration e.g. when working with living cells, e.g. in Aequorin-based Calcium assays.

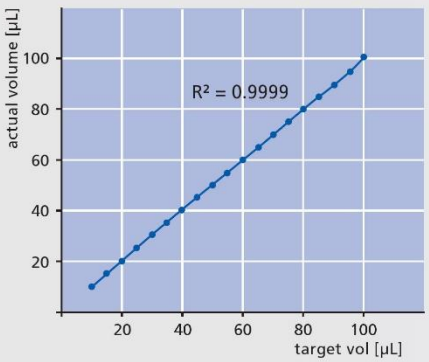
Syringe injectors vs JET injectors

As you will see in the following, all injectors are not created equal. Take a look at Table 1 for a detailed comparison. Starting with a high-level view, two different designs are used, based on either syringe or bellows. What these injectors have in common is that they use a stepper motor and a 3-way solenoid valve to direct the flow of the liquid.

Parameter	Syringe-based injector	JET injector
Injection accuracy & reproducibility	**Very High**. But potential accuracy issues when injecting small volumes. Accuracy for 10µl can be as low as just 90%	**Very high.** 98% over the entire volume range.
Time required per injection	Many syringe type injectors cannot perform ultra-fast injections with adequate mixing to capture the first 150ms of a kinetic assay.	Ultra-fast injection enabling the measurement of the first 150ms of a kinetic assay.
Reagent consumption	**High.** High dead volume. Need to be primed up to 5 times their volume to achieve a 99% homogeneous mix at the tip.	**Low**. Low dead volume. Recovers up to 60% of the reagent in the injector line. A single priming sequence is sufficient to achieve a 99% homogeneous mix at the tip.
Maintenance costs	**High.** Syringe based injectors are very expensive (typically >$3,000 each). Tend to wear out over time due to friction and need to be replaced.	**Low**. Frictionless operation for extended lifetime. Typically, more than 3 million injections without mechanical failure.
Design & additional functions	Material mix that can produce stronger shear forces.	100% Teflon resulting in negligible shear forces enabling injection of cell suspensions.

The syringe-based injector is by far the most common type of injector being used today. This type of injector contains a syringe and a Teflon coated barrel. The piston moves within the glass syringe which can cause friction, resulting in increased maintenance costs.

On the other hand, most microplate readers from Berthold Technologies use up to 3 or 4 software-controlled JET Injectors which, as detailed above, have many advantages that are relevant in many types of assays. A sophisticated Prime Mode reduces the reagent consumption while ensuring homogeneous filling. JET Injectors are built for extreme longevity and fast injection times to guarantee very efficient mixing.



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