1000µl channels pipetting specifications

Figure 1: STAR Line robot pipetting into a PCR plate with 50µl disposable conductive tips on the CO-RE 1000µl channels.

Verification Procedure

This technical note describes the verification procedure at Hamilton Robotics. It has been applied in the design phase of the Microlab STAR Line to validate the pipetting performance.

Validation

The trueness has been validated by a precision balance (5 digits). The precision of the STAR systems have been validated by photometric analyses during the design phase of its development using a plate photometer and strictly controlled environmental conditions. The specifications in table 1 are those validated under the conditions described in this technical note.

Final QC

Each individual STAR system undergoes final testing in our production environment using a balance. The measurements taken during final testing are made under broader environmental conditions with an assortment of the specifications in table 1. The final testing data are found in the Declaration of Quality (DoQ). The DoQ is part of the documentation delivered with each instrument.

Field verification

Finally, the specifications of the volume field verification

(FV2) allow the use of a transportable balance under a broader variety of environmental conditions, typically those found in laboratories around the globe.

Protocol

Testing of the Microlab STAR Line is done gravimetrically using a high precision balance. The precision of the balance used is less than 1/6 that of the specified pipetting precision (for one channel). The trueness and precision specifications given for the STAR Line refer to an instrument with 8 x 1000µl pipetting channels. The gravimetric method uses 10 single pipettings per channel at the specified volume. For each pipetting (aspiration/dispensation) a new CO-RE disposable tip is used. For volumes > 20µl the applied dispense mode is jet dispense. Volumes ≤ 20µl are dispensed in (liquid) surface mode.

Disposable tip size	Volume	Trueness IRI (%)	Precision CV (%)
10µl	0.5µl	10.0%	6.0%
	1µl	5.0%	4.0%
	5µl	2.5%	1.5%
	10µl	1.5%	1.0%
50µl	0.5µl	10.0%	6.0%
	1µl	5.0%	4.0%
	5µl	2.5%	1.5%
	50µl	2.0%	0.75%
300µl	10µl	5.0%	2.0%
	50µl	2.0%	0.75%
	200µl	1.0%	0.75%
1000µl	10µl	7.5%	3.5%
	100µl	2.0%	0.75%
	1000µl	1.0%	0.75%

Table 1: Pipetting specifications of disposable tips for the STAR Line.

HAMILTON

Volume verification design phase

Careful preparation is essential to set-up the verification procedure described in this technical note. The test equipment is equilibrated with the temperature of the test environment, so it is installed at least 12 hours before the verification starts. The STAR Line instrument requires a warm-up period of at least 1 hour.

Required instruments and resources

▶ Test temperature: 20 ± 2°C

▶ Relative humidity: 50% ± 5%

▶ Balance used: Mettler Toledo WXS

▶ Windshield on the balance stage

▶ Measuring vessel on the balance stage

▶ Test fluid: Hamilton verification solution

▶ 10µl, 50µl, 300µl, 1000µl CO-RE tips

Measurement procedure

1. Pick up the disposable tips

2. Aspirate red sodium salt solution at the corresponding test volume (using the cLLD function to detect the liquid surface)

3. Zero the Balance

4. Dispense the test volume (volumes > 20µl with jet mode, ≤ 20µl surface mode)

5. Measure the weight of the liquid pipetted (stable balance value)

6. Eject disposable tip to the tip waste

Steps 1 – 6 are executed ≥ 10 times per volume and channel

7. Statistical calculation of the volumes is done by using the corresponding liquid density at the test temperature.

Acceptance criteria

Calculated trueness (R) and precision (CV) values are within specifications if they are less than the values appearing in the table above (pipetting specifications of the 1000µl channels).

• Results may vary using other liquid or environmental conditions.

• Environmental conditions such as vibration, ventilation, foot traffic, dust, strong light, and fluctuating temperature and humidity can adversely affect pipetting results.

Applied statistics

$$\Pr ecision = \frac{s}{\bar{x}} \bullet 100\%$$

$$\bar{x} = \frac{\sum\limits_{i=1}^{n} x_i}{n}$$

$$Trueness = \frac{\bar{x} - x_t}{x_t} \bullet 100\%$$

$$s = \sqrt{\frac{\sum\limits_{i=1}^{n}(x_i - \bar{x})^2}{n-1}}$$

n = number of measured values
xi = volume dispensed in pipetting cycle [µl]
xt = nominal volume [µl]
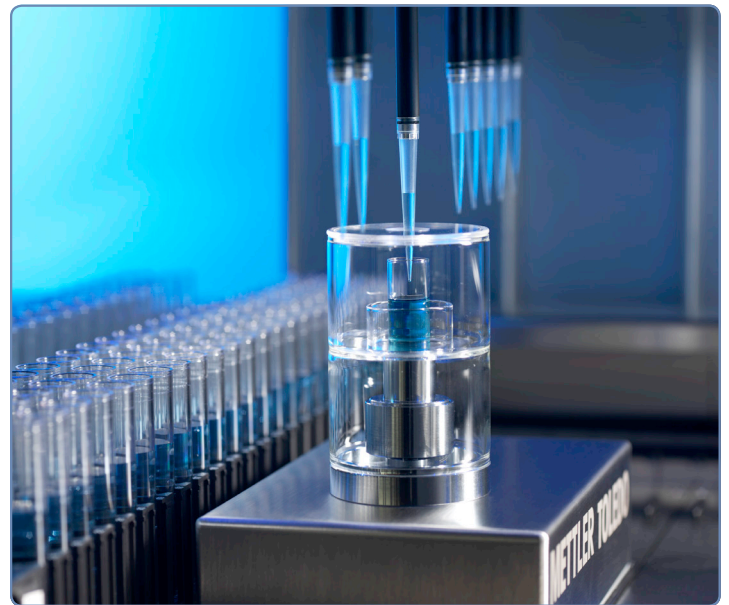s = standard deviation [µl]
x = mean [µl]

Figure 2: Use of the balance on the deck of the STAR system. Clear tips are for illustrative purposes only. The conditions described in this technical note are for black, conductive CO-RE tips.