

Product survey: Pipettes

# Manual Pipetting Risks

I must admit that I never made a big fuss about pipetting techniques or calibration of micropipettes during my time in the laboratory. I just grabbed a micropipette from the rack that covers the desired volume range and started pipetting. Pipetting experts may throw their hands up in horror at this improvidence and ignorance – and they are right to do so.

Standard micropipettes used in everyday pipetting applications are based on the principle of air displacement to aspirate and dispense fluids. On setting the desired volume with the volume adjustment knob, a piston inside the pipette moves to the appropriate position. As soon as the operator pushes the plunger button to the first stop, the piston expels the same volume of air. After dipping the pipette tip into the liquid and releasing the button, a vacuum is created that aspirates the specified volume of liquid into the tip. When pressing the operating button again to the first stop, the air between piston and aspirated liquid is pushed to the tip and moves the liquid out of the tip. To empty the tip completely, the button is pressed to the second or blow-out stop.

## Pipetting pitfalls

It is quite obvious that any factor that affects the volumes of the aspirated liquid and displaced air will also have an influence on the accuracy of the micropipette. These factors are basically temperature, liquid density (which depends on air pressure and temperature) and geographic altitude, i.e. air pressure. According to a brand new paper (article in press) by Pandya *et al.* from Amgen's Department of Pharmacokinetics and Drug Metabolism in Thousand Oaks, California, however, the main reasons for pipetting errors and variabilities seem to be individual pipetting techniques and good or bad pipetting habits (Pandya *et al.*, *J. Pharm. Biomed. Anal.* (2010), *oi*:10.1016/j.jpba.2010.04.025).

Though high throughput liquid handlers and dispensing robots capable of delivering nanolitre volumes are omnipresent in

modern labs, even biotech giants like Amgen still depend on the pipetting skills of their lab personal. This especially applies to pharmacokinetic and toxicokinetic studies that involve a lot of manual pipetting, e.g. to dilute samples into the standard curve range of immunoassays. Pandya *et al.* hence determined the accuracy of manual pipetting during typical pharmacokinetic assays or pipetting tasks such as enzyme-linked immunoassays, long-term stability tests of protein therapeutics and dilution series of samples.

## Pipetting disaster

The outcomes of the Amgen group's pipetting experiments are quite interesting, let's look, for example, at the manual pipetting dilution test. The authors randomly chose eleven people from their lab that simply had to dilute test samples 10 to 10<sup>6</sup>-fold to obtain a final concentration within the range of a standard curve, using a micropipette. And we should not forget participant number twelve, a liquid-handling robot. The results of this experiment may be best described as 'taken from real lab life'. Pandya *et al.* summarise them, "Fig. 4 shows an overall increase in negative bias, with increasing dilution factor for most of the analysts with the exception of analysts one, nine and eleven; and the liquid handler. More important, the inconsistencies among the analysts were high to cause concern. Three distinct patterns were observed: (1) a consistent negative bias, (2) a consistent positive bias, and (3) no observable trend." In other words, the manual pipetting dilution experiment was a bit of a disaster.

The above mentioned Figure 4, however, shows another detail that partly rescues the reputation of the 'human pipettors'. The most accurate and precise pipettor was not the liquid-handling robot as you may assume, it was analyst number nine. The accuracy and precision of this guy is really astonishing and he would, for sure, be one of the big favourites, if he were to participate in the next pipetting Olympics (check out Figure 4 of the original paper for more details).

## Different styles

To gain some clues about the factors that might be responsible for the pipetting variabilities emerging in the dilution test, Pandya *et al.* checked the influence of different pipetting techniques and styles on accuracy. Usually, two different pipetting techniques are prevalent in life science labs: forward and reverse pipetting. Forward pipetting, which is probably the most common technique, simply means that the operator presses the plunger down to the first stop, releases to aspirate and then dispenses the liquid by pressing the plunger to the second stop to blow out any air (Style 1). In a slight variation of forward pipetting (Style 2), some people dispense the liquid by pressing the button to the first stop only. In reverse pipetting, the operator presses the button down to the second stop, releases to aspirate the liquid and then dispenses the liquid by pressing the plunger back to the first stop.

## Theory vs. Practice

Theoretically, the dispensed volumes should be equal for both pipetting techniques; in reality, however, they are obviously not. In a test of forward and reverse pipetting using a calibration system, Pandya *et al.* found a slight but significant positive bias for reverse pipetting to higher volumes; in simple words, reverse pipetting delivers more volume than forward pipetting. A consistent pipetting technique practised by all lab members is, therefore, one of the basic requirements to get clear and valid data – as well as exactly calibrated and well performing pipettes.



Hitting the target with accuracy and precision that's the goal of archery but also of pipetting.

HARALD ZÄHRINGER

Pipettes					
Company/Distributor	Name of Product	Short description	Number of Channels/ Volume	Miscellaneous, Specialities, Generally	Price [EUR]
<b>BD Biosciences</b> Belgium www.bdbiosciences.com/ discovery_labware <b>Contact:</b> Nadine Jossaud Phone +33 476683635 nadine_jossaud@ europe.bd.com	BD Falcon Express Pipette-Aid and accessories	Lightweight pipettors with comfortable grip, interchangeable speeds and detachable stand.	1	-	Consult BD local price list
	BD Falcon, BD Advantage serological pipettes	Individually wrapped or bulk-packaged serological pipettes. Broad product offering including aspirating pipettes, transfer pipettes or 100 ml pipettes.	1	-	Consult BD local price list
<b>Bio-Rad Laboratories</b> www.bio-rad.com	0.5-10 µl Digital Micropipette	Professional adjustable volume digital micropipette	1 channel; 0.5-10 µl	Autoclavable	On request
	2-20 µl Digital Micropipette	Professional adjustable volume digital micropipette	1 channel; 2-20 µl	Autoclavable	On request
	20-200 µl Digital Micropipette	Professional adjustable volume digital micropipette	1 channel; 20-200 µl	Autoclavable	On request
	100-1000 µl Digital Micropipette	Professional adjustable volume digital micropipette	1 channel; 100-1000 µl	Autoclavable	On request
<b>biostep</b> Jahnsdorf, Germany www.biostep.de <b>Contact:</b> Ilona Marzian Phone +49 3721 3905-0 i.marzian@biostep.de	biostep micropipette	Micropipettors with fixed volumes, comfortable and low effort pipetting	1 channel; 5 µl / 10 µl / 20 µl / 25 µl / 50 µl / 100 µl / 200 µl / 250 µl / 500 µl / 1000 µl / 2000 µl / 2500 µl / 5000 µl	Tested and calibrated conforming to EN ISO 8655 and DIN 12650 standards – One-hand operation with minimum user effort – Soft grip with ergonomic finger support – Easy-to read display with large numbers – Fully autoclavable	49.-
	biostep micropipette	Micropipettors with variable volumes, comfortable and low effort pipetting	1 channel; 0.1-2.5 µl / 0.5-10 µl / 2-20 µl / 5-50 µl / 10-100 µl / 20-200 µl / 50-200 µl / 100-1000 µl / 200-1000 µl / 500-5000 µl	Tested and calibrated conforming to EN ISO 8655 and DIN 12650 standards – Soft grip with ergonomic finger support – Easy-to read display with large numbers – Safe counter mechanism prevents accidental volume changes during pipetting – Recalibration with the provided universal tool – Fully autoclavable	89.-
	biostep micropipette	Micropipettors with variable volumes, comfortable and low effort pipetting	8 channel; 0.5-10 µl / 5-50 µl / 30-300 µl	Tested and calibrated conforming to EN ISO 8655 and DIN 12650 standards – Soft grip with ergonomic finger support – Easy-to read display with large numbers – Safe counter mechanism prevents accidental volume changes during pipetting – Recalibration with the provided universal tool – Fully autoclavable	349.-
<b>Biozym Scientific</b> Hessisch Oldendorf, Germany www.biozym.com <b>Contact:</b> Dirk Duven Phone +49 5152 9020 support@biozym.com	Nichiryo LE	Cost-efficient, lightweight pipettes	Single channel; 0.5-10 µl / 2.0-20 µl / 10-100 µl / 20-200 µl / 100-1000 µl	Procedures in line with ISO 9001 – Prevent RSI (Repetitive Strain Injury) – Large, separate tip ejector thumb button – Ejector easily removed for cleaning and maintenance – Large plunger thumb button depresses easily thus relieving hand stress – Accurate volume setting prevents volume drifting – ISO 8655	123.-
	Nichiryo Ex	Cost-efficient, ergonomic and robust high quality pipettes	Single channel; 0.1-2 µl / 0.5-10 µl / 2.0-20 µl / 10-100 µl / 20-200 µl / 100-1000 µl / 1-5 ml / 1-10 ml	Procedures in line with ISO 9001 – Fully autoclave able, UV resistant, volume lock – Ceramic piston (200 µl and over) – 3 pipettes cover 0.5 to 1000 µl – Volume adjustment via top button	175.- to 195.-
	Nichiryo Ex Plus	-	Single channel; 0.1-2 µl / 0.5-10 µl / 2.0-20 µl / 10-100 µl / 20-200 µl / 100-1000 µl / 1-5 ml / 1-10 ml	See above – Durability against organic solvent through special o-ring	215.-
	Biohit Proline Plus	Cost-efficient, ergonomic light weight, high quality pipettes	Single channel; 0.1-2 µl / 0.5-10 µl / 2.0-20 µl / 10-100 µl / 20-200 µl / 100-1000 µl / 1-5 ml / 1-10 ml; fix volume; 8-and 12-channel; 0.5-10 µl / 10-100 µl / 30-300 µl	Procedures in line with ISO 9001 – Fully autoclaveable – UV resistant – Volume adjustment via colored top button – XL display	179.- (single channel) 122.57 (fix volume) 513.97 (8-ch.) 596.37 (12-channel)

Pipettes					
Company/Distributor	Name of Product	Short description	Number of Channels/ Volume	Miscellaneous, Specialities, Generally	Price [EUR]
<b>Brand</b> Wertheim, Germany www.brand.de <b>Contact:</b> Antonio Romaguera Phone +49 9342 808-0 info@brand.de	Transferpette S	Completely autoclavable, ergonomic air-displacement pipette with central pipetting button and real one-handed operation.	1-channel, fixed vol.; 10/20/25/50/100/200/500/1000 µl 1-channel, adjustable volume; 0.1-1 / 0.5-10 / 2-20 / 10-100 / 20-200 / 100-1000 / 500-5000 / 1000-10000 µl 8-/12-channel; 0.5-10 / 5-50 / 10-100 / 20-200 / 30-300 µl	UV-resistant – 4-digit volume display – Adjustment without tool – Multichannel pipettes with separately replaceable single nose cones	119.- (1-channel, fixed vol.) 190.- to 215.- (1-channel, adjustable volume) 518.- (8-ch.) 593.- (12-ch.)
	Transferpette	Ergonomic air-displacement pipette with pipetting button on the side.	1-channel, fixed volume; 5 / 10 / 20 / 25 / 50 / 100 / 200 / 250 / 500 / 1000 / 2000 µl 1-channel, adjustable volume; 0.1-1 / 0.5-10 / 2-20 / 2-20 / 5-50 / 10-100 / 20-200 / 25-250 / 100-1000 / 500-5000 µl 8-/12-channel; 0.5-10 / 2-20 / 2.5-25 / 5-50 / 10-100 / 20-200 / 30-300 µl	UV-resistant – Adjustment without tool – Pipette shaft / manifold completely autoclavable – Multichannel pipettes with separately replaceable single nose cones – CE-IVD-compliant	116.- (1-channel, fixed vol.) 186.- to 211.- (1-channel, adjustable volume) 505.- (8-channel) 577.- (12-channel)
	HandyStep	Ergonomic repetitive pipette with positive displacement tips for difficult media.	1-channel; 2-5000 µl; sizes of tips: 0.1 / 0.5 / 1.25 / 2.5 / 5.0 / 12.5 / 25 / 50ml	One-handed operation – Maintenance-free – Factory adjusted – CE-IVD-compliant – From September forward 1 and 10 ml tips	171.-
	Transferpettor	Positive displacement pipette with glass capillary (up to a nominal volume of 200 µl) or PP-cap (from a nominal volume of 500 µl onward). Suitable for critical liquid e.g. viscous or foaming media.	1-channel, fixed volume; 1 / 2 / 5 / 10 / 20 / 25 / 50 / 100 / 200 µl 1-channel, adjustable volume; 2.5-10 / 5-25 / 10-50 / 20-100 / 100-500 / 200-1000 / 1000-5000 / 2000-10000 µl	Particularly usable with foaming media, liquid with a high vapor pressure, liquid with a high density and highly viscous media	150.- (fixed volume) 262.- (adjustable volume)
<b>Capp ApS</b> www.pipetteworld.com <b>Contact:</b> Magdalena Babut-Carstensen Phone +45 6613 6140 info@capp.dk	ecopipette	Variable & fix volume high quality mechanical single channel pipettes. Innovative, robust & ergonomic design.	1 channel; volume ranges 0.2-5000 µl	Anodized aluminum tip bases with double o-rings – Very low thumb force requirements – Ultimate accuracy & precision over many years of use	On request
	CappAero	Variable & fix volume high quality multichannel pipettes.	8, 12, 16, 48 & 64 channels; volume ranges 0.2-300 µl	Extremely low force requirements by mounting the tips – Ultimate accuracy & precision over all channels – Innovative tip ejection mechanism	On request
<b>Carl Roth</b> Karlsruhe, Germany www.carlroth.com <b>Contact:</b> Nadine Baumann Phone +49 721 5606 182 n.baumann@carlroth.de	Rotilabo-Microlitre	Modern piston pipettes made of high-quality materials, delivered with certificate of conformity. Separate tip ejection and comfortable finger rest.	1 channel; 0.1-2.5 µl / 0.5-10 µl / 5-50 µl / 10-100 µl / 20-200 µl / 100-1000 µl / 1000-5000 µl	Reliable pipette for all laboratory routine applications – Ergonomically designed – Easy-to-read display and quick volume adjustment – Unproblematic maintenance and self-calibration – From volumes 5-50 µl with replaceable Safe-Cone-Filter	119.- (example: 20-200 µl)
<b>Eppendorf</b> www.eppendorf.com <b>Contact:</b> Application Support: Phone +49 1803 666789* (*9 Cent/min) support@eppendorf.com	Research plus fix	Feel the difference in weight, pipetting forces and the spring loaded tip cone.	10 µl / 20 µl / 25 µl / 50 µl / 100 µl / 200 µl / 250 µl / 500 µl / 1000 µl	Ultra light weight – Very low operating force – Spring loaded tip cone – Customer adjustment window – Eppendorf PerfectPiston system	Catalogue, internet or on request
	Research plus fix	See above	0.1-2.5 / 0.5-10 / 2-20 / 10-100 / 20-200 / 30-300 / 100-1000 µl / 0.5-5 ml / 1-10 ml	See above	Catalogue, internet or on request
	Research plus multichannel	See above	8- and 12-channel; 0.5-10 µl / 10-100 µl / 30-300 µl	See above	Catalogue, internet or on request
	Reference fix	Due to the single button technology it sets new standards in precision, accuracy and avoiding decontamination.	1 µl / 2 µl / 5 µl / 10 µl / 20 µl / 25 µl / 50 µl / 100 µl / 200 µl / 250 µl / 500 µl / 1000 µl / 1500 µl / 2000 µl / 2500 µl	Single button operation – Robust – Very high precision & accuracy – Fully autoclavable – IVD conform	Catalogue, internet or on request
	Reference variable	See above	0,1-2.5 µl / 0.5-10 µl / 2-20 µl / 10-100 µl / 50-200 µl / 100-1000 µl / 500-2500 µl	Single button operation – Robust – Very high precision & accuracy – Fully autoclavable – IVD conform	Catalogue, internet or on request
<b>Greiner Bio-One</b> Frickenhausen, Germany www.gbo.com/bioscience <b>Contact:</b> Lara Marchetti Phone +49 7022 948 549 Lara.marchetti@gbo.com	Serological Pipettes	Individually wrapped serological pipettes in plastic/plastic or paper/plastic packaging as well as reclosable plastic bulk packs.	Pipettes range from 1-50 ml; short-format pipettes (5 ml and 10 ml) permit back-saving working	High optical clarity – Maximum accuracy – Drop-free pipetting – Easily legible graduation	On request

					Pipettes
Company/Distributor	Name of Product	Short description	Number of Channels/ Volume	Miscellaneous, Specialities, Generally	Price [EUR]
<b>Socorex Isba</b> Ecublens, Switzerland www.socorex.com <b>Contact:</b> Yves Lachavanne Phone +41 21 651 6000 socorex@socorex.com	Acura manual 825	Excellence in ergonomics, light weight and softness in use. All purpose reliable instrument.	Single channel; volumes 0.1-1000 µl	Adjustable tip ejector fitting most tips – Unsurpassed metrologic performance – Shock, UV-light and autoclaving resistance – 3 year factory warranty – CE certified IVD 98/79 EEC	155.- to 165.-
	Triopack	Includes 3 Acura manual adjustable volume micropipettes.	Single channel; volume 0.1 µl-10 ml	9 different Triopack to choose from – All features of a micropipette with attractive price discount	415.- to 440.-
	Acura manual 835	Macropipette are most adequate for cell culture, bacteriology or environmental tests. They offer reliability in daily pipetting tasks.	Single channel; volumes ranging 0.2-2 ml / 0.5-5 ml / 1-10 ml	Nozzle protection filter included – Adapter for glass Pasteur pipette – Adjustable tip ejector fitting most tips – Shock, UV-light and autoclaving resistance – 3 year factory warranty – CE certified IVD 98/79 EEC	165.- to 190.-
	Acura manual 855	Multichannels extend pipetting possibilities for microplates. They provides best ergonomics and comfort.	8- and 12-channel models; volumes ranging 0.5-350 µl	Adjustable tip ejector fitting most tips – Unsurpassed metrologic performance – Shock, UV-light and autoclaving resistance – 3 year factory warranty – CE certified IVD 98/79 EEC	394.- to 420.- (8-channels) 454.- to 483.- (12-channels)
<b>Thermo Fisher Scientific</b> www.thermoscientific.com/ finnpipette <b>Contact</b> Tero Pasanen Tero.pasanen@thermofisher.com	Thermo Scientific Finnpipette F1	State-of-the-art handheld pipette.	14 single channel pipettes volumes; 0.2 µl-10 ml; 10 multichannel models 8-, 12-, 16-channel, volumes: 1/300 µl	Integrated surface protection – Set-and-forget pipetting button – Adjustable finger rest – Advanced volume gearing mechanism – Light pipetting forces	On request
	Thermo Scientific Finnpipette F2	Superior comfort, performance and reliability.	13 single channel pipettes volumes between 0.2 µl-10 ml; 10 multichannel models 8-, 12-, and 16-channel, volumes 1-300 µl	Advanced volume gearing mechanism – Light pipetting forces – Double-action pipetting button – Very large ergovisio display – Fully autoclavable	On request