

Pipetting accuracy and precision with ART universal pipette tips

Thermo Scientific™ ART™ universal pipette tips provide accuracy and precision that meet or exceed the specifications for Eppendorf™ pipette tips. Experience greater accuracy and precision at a lower price by switching to ART universal pipette tips.

Eppendorf Reference™ 2 twelve-channel variable-volume pipette

All pipettes used for testing were received new from the manufacturer. NIST-traceable calibration of the pipettes was performed in-house using appropriate Eppendorf tips according to the manufacturer's guidelines.

All testing was conducted by the Thermo Fisher Scientific Laboratory Plastics Essentials pipette services team in an accredited laboratory in compliance with ISO 17025, ANSI/NCSL Z540.3, and ANSI/NCSL Z540-1 requirements.

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Note: Of the 18 tests performed with ART tips at various volumes, 15 had lower systematic errors than the pipette manufacturer reported.

Pipette evaluated	Volume tested	Specification or reported value	Systematic error*		Random error**		
			Median	Median volume	Median	Median volume	
Eppendorf Reference 2 (12-channel) 0.5–10 µL	1 µL	Eppendorf	±8%	±0.08 µL	±5%	±0.05 µL	
		ISO 8655	±24%	±0.24 µL	±16%	±0.16 µL	
		Thermo Scientific Cat. No.					
		2139-HR	±7.65%	±0.08 µL	±7.55%	±0.08 µL	
		3501-HR	±9.68%	±0.1 µL	±7.44%	±0.07 µL	
	5 µL	Eppendorf	±4%	±0.2 µL	±2%	±0.1 µL	
		ISO 8655	±4.8%	±0.24 µL	±3.2%	±0.16 µL	
		Thermo Scientific Cat. No.					
		2139-HR	±1.55%	±0.08 µL	±1.72%	±0.09 µL	
		3501-HR	±1.6%	±0.08 µL	±1.67%	±0.08 µL	
	10 µL	Eppendorf	±2%	±0.2 µL	±1%	±0.1 µL	
		ISO 8655	±2.4%	±0.24 µL	±1.6%	±0.16 µL	
Thermo Scientific Cat. No.							
2139-HR		±0.95%	±0.1 µL	±0.98%	±0.1 µL		
3501-HR		±0.39%	±0.04 µL	±0.93%	±0.09 µL		
Eppendorf Reference 2 (12-channel) 5–100 µL	10 µL	Eppendorf	±3%	±0.3 µL	±2%	±0.2 µL	
		ISO 8655	±16%	±1.6 µL	±6%	±0.6 µL	
		Thermo Scientific Cat. No.					
		3771-HR	±4.68%	±0.47 µL	±1.33%	±0.13 µL	
		3772-HR	±4.76%	±0.48 µL	±1.29%	±0.13 µL	
	50 µL	Eppendorf	±1%	±0.5 µL	±0.8%	±0.4 µL	
		ISO 8655	±3.2%	±1.6 µL	±1.2%	±0.6 µL	
		Thermo Scientific Cat. No.					
		3771-HR	±0.70%	±0.35 µL	±0.54%	±0.27 µL	
		3772-HR	±0.73%	±0.37 µL	±0.39%	±0.2 µL	
	100 µL	Eppendorf	±0.8%	±0.8 µL	±0.3%	±0.3 µL	
		ISO 8655	±1.6%	±1.6 µL	±0.6%	±0.6 µL	
		Thermo Scientific Cat. No.					
		3771-HR	±0.53%	±0.53 µL	±0.4%	±0.4 µL	
		3772-HR	±0.51%	±0.52 µL	±0.24%	±0.24 µL	
	Eppendorf Reference 2 (12-channel) 15–300 µL	30 µL	Eppendorf	±3%	±0.9 µL	±1%	±0.3 µL
			ISO 8655	±26.67%	±8 µL	±10%	±3 µL
			Thermo Scientific Cat. No.				
3771-HR			±0.65%	±0.2 µL	±1.59%	±0.48 µL	
3772-HR			±0.8%	±0.24 µL	±1.32%	±0.4 µL	
150 µL		Eppendorf	±1%	±1.5 µL	±0.5%	±0.75 µL	
		ISO 8655	±5.33%	±8 µL	±2%	±3 µL	
		Thermo Scientific Cat. No.					
		3771-HR	±0.31%	±0.47 µL	±0.55%	±0.83 µL	
		3772-HR	±0.40%	±0.60 µL	±0.6%	±0.9 µL	
300 µL		Eppendorf	±0.6%	±1.8 µL	±0.3%	±0.9 µL	
		ISO 8655	±2.67%	±8 µL	±1%	±3 µL	
		Thermo Scientific Cat. No.					
		3771-HR	±0.14%	±0.42 µL	±0.35%	±1.06 µL	
		3772-HR	±0.13%	±0.40 µL	±0.30%	±0.90 µL	

* Systematic error is consistent and reproducible error that does not occur by chance. Measurements affected by systematic error may be precise but are not accurate.

** Random error is inconsistent error due to inconsistent measurement. Measurements affected by random error are imprecise, although the average value reported after repeat measurements may be accurate.

Note: Each median value was taken after averaging values for all 12 channels. Specifications noted in the table are for 95% confidence intervals.

Eppendorf Reference™ 2 eight-channel variable-volume pipette

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Note: Of the 18 tests performed with ART tips at various volumes, 14 had lower systematic errors than the pipette manufacturer reported.

Pipette evaluated	Volume tested	Specification or reported value	Systematic error		Random error	
			Median	Median volume	Median	Median volume
Eppendorf Reference 2 (8-channel) 0.5–10 µL	1 µL	Eppendorf	±8%	±0.08 µL	±5%	±0.05 µL
		ISO 8655	±24%	±0.24 µL	±16%	±0.16 µL
		Thermo Scientific Cat. No.				
		2139-HR	±8.25%	±0.08 µL	±7.05%	±0.07 µL
		3501-HR	±12.20%	±0.12 µL	±7.26%	±0.07 µL
	5 µL	Eppendorf	±4%	±0.2 µL	±2%	±0.1 µL
		ISO 8655	±4.8%	±0.24 µL	±3.2%	±0.16 µL
		Thermo Scientific Cat. No.				
		2139-HR	±1.62%	±0.08 µL	±1.67%	±0.08 µL
		3501-HR	±1.84%	±0.09 µL	±1.60%	±0.08 µL
	10 µL	Eppendorf	±2%	±0.2 µL	±1%	±0.1 µL
		ISO 8655	±2.4%	±0.24 µL	±1.6%	±0.16 µL
		Thermo Scientific Cat. No.				
		2139-HR	±0.91%	±0.10 µL	±0.85%	±0.09 µL
		3501-HR	±0.71%	±0.07 µL	±0.96%	±0.1 µL
Eppendorf Reference 2 (8-channel) 5–100 µL	10 µL	Eppendorf	±3%	±0.3 µL	±2%	±0.2 µL
		ISO 8655	±16%	±1.6 µL	±6%	±0.6 µL
		Thermo Scientific Cat. No.				
		3771-HR	±4.67%	±0.47 µL	±1.09%	±0.11 µL
		3772-HR	±4.21%	±0.42 µL	±0.92%	±0.09 µL
	50 µL	Eppendorf	±1%	±0.5 µL	±0.8%	±0.4 µL
		ISO 8655	±3.2%	±1.6 µL	±1.2%	±0.6 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.87%	±0.44 µL	±0.37%	±0.19 µL
		3772-HR	±0.75%	±0.38 µL	±0.42%	±0.21 µL
	100 µL	Eppendorf	±0.8%	±0.8 µL	±0.3%	±0.3 µL
		ISO 8655	±1.6%	±1.6 µL	±0.6%	±0.6 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.44%	±0.44 µL	±0.41%	±0.41 µL
		3772-HR	±0.33%	±0.33 µL	±0.44%	±0.44 µL
Eppendorf Reference 2 (8-channel) 15–300 µL	30 µL	Eppendorf	±3%	±0.9 µL	±1%	±0.3 µL
		ISO 8655	±26.67%	±8 µL	±10%	±3 µL
		Thermo Scientific Cat. No.				
		3771-HR	±1.25%	±0.38 µL	±1.54%	±0.46 µL
		3772-HR	±1.47%	±0.44 µL	±1.14%	±0.34 µL
	150 µL	Eppendorf	±1%	±1.5 µL	±0.5%	±0.75 µL
		ISO 8655	±5.33%	±8 µL	±2%	±3 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.41%	±0.62 µL	±0.39%	±0.59 µL
		3772-HR	±0.51%	±0.77 µL	±0.29%	±0.44 µL
	300 µL	Eppendorf	±0.6%	±1.8 µL	±0.3%	±0.9 µL
		ISO 8655	±2.67%	±8 µL	±1%	±3 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.14%	±0.43 µL	±0.33%	±0.99 µL
		3772-HR	±0.17%	±0.51 µL	±0.2%	±0.6 µL

Note: Each median value was taken after averaging values for all 8 channels. Specifications noted in the table are for 95% confidence intervals.

Eppendorf Reference™ 2 single-channel variable-volume pipette

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Pipette evaluated	Volume tested	Specification or reported value	Systematic error		Random error	
Eppendorf Reference 2 (single-channel) 0.5–10 µL	1 µL	Eppendorf	±2.5%	±0.02 µL	±1.8%	±0.02 µL
		ISO 8655	±12%	±0.12 µL	±8%	±0.08 µL
		Thermo Scientific Cat. No.				
		2139-HR	±2.02%	±0.02 µL	±2.2%	±0.02 µL
	5 µL	Eppendorf	±1.5%	±0.07 µL	±0.8%	±0.04 µL
		ISO 8655	±2.4%	±0.12 µL	±1.6%	±0.08 µL
		Thermo Scientific Cat. No.				
		2139-HR	±0.76%	±0.04 µL	±0.76%	±0.04 µL
	10 µL	Eppendorf	±1%	±0.1 µL	±0.4%	±0.04 µL
		ISO 8655	±1.2%	±0.12 µL	±0.8%	±0.08 µL
		Thermo Scientific Cat. No.				
		2139-HR	±0.82%	±0.08 µL	±0.35%	±0.04 µL
Eppendorf Reference 2 (single-channel) 10–100 µL	10 µL	Eppendorf	±3%	±0.3 µL	±0.70%	±0.07 µL
		ISO 8655	±8%	±0.8 µL	±3%	±0.3 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.65%	±0.06 µL	±1.35%	±0.14 µL
	50 µL	Eppendorf	±1%	±0.5 µL	±0.3%	±0.15 µL
		ISO 8655	±1.6%	±0.8 µL	±0.6%	±0.3 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.13%	±0.07 µL	±0.24%	±0.12 µL
	100 µL	Eppendorf	±0.8%	±0.8 µL	±0.2%	±0.2 µL
		ISO 8655	±0.8%	±0.8 µL	±0.3%	±0.3 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.27%	±0.27 µL	±0.3%	±0.3 µL
Eppendorf Reference 2 (single-channel) 20–200 µL	20 µL	Eppendorf	±2.5%	±0.5 µL	±0.7%	±0.14 µL
		ISO 8655	±8%	±1.6 µL	±3%	±0.6 µL
		Thermo Scientific Cat. No.				
		2069-HR	±1.72%	±0.34 µL	±1.78%	±0.36 µL
	100 µL	Eppendorf	±1%	±1 µL	±0.3%	±0.3 µL
		ISO 8655	±1.6%	±1.6 µL	±0.6%	±0.6 µL
		Thermo Scientific Cat. No.				
		2069-HR	±0.78%	±0.78 µL	±0.4%	±0.4 µL
	200 µL	Eppendorf	±0.6%	±1.2 µL	±0.2%	±0.4 µL
		ISO 8655	±0.8%	±1.6 µL	±0.3%	±0.6 µL
		Thermo Scientific Cat. No.				
		2069-HR	±0.27%	±0.54 µL	±0.21%	±0.42 µL
Eppendorf Reference 2 (single-channel) 30–300 µL	30 µL	Eppendorf	±2.5%	±0.75 µL	±0.7%	±0.21 µL
		ISO 8655	±13.33%	±4 µL	±5%	±1.5 µL
		Thermo Scientific Cat. No.				
		3771-HR	±1.41%	±0.42 µL	±1.83%	±0.55 µL
	150 µL	Eppendorf	±1.0%	±1.5 µL	±0.3%	±0.45 µL
		ISO 8655	±2.67%	±4 µL	±1%	±1.5 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.61%	±0.92 µL	±0.28%	±0.42 µL
	300 µL	Eppendorf	±0.6%	±1.8 µL	±0.2%	±0.6 µL
		ISO 8655	±1.33%	±4 µL	±0.5%	±1.5 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.57%	±1.71 µL	±0.19%	±0.57 µL
		3772-HR	±0.64%	±0.96 µL	±0.37%	±0.56 µL
		3772-HR	±0.64%	±0.96 µL	±0.37%	±0.56 µL
		3772-HR	±0.6%	±1.8 µL	±0.2%	±0.6 µL
		3772-HR	±1.33%	±4 µL	±0.5%	±1.5 µL
		3772-HR	±0.57%	±1.71 µL	±0.19%	±0.57 µL
		3772-HR	±0.61%	±1.83 µL	±0.2%	±0.6 µL

Note: Specifications noted in the table are for 95% confidence intervals.

Eppendorf Research™ Plus twelve-channel variable-volume pipette

All pipettes used for testing were received new from the manufacturer. NIST-traceable calibration of the pipettes was performed in-house using appropriate Eppendorf tips according to the manufacturer's guidelines.

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Note: Of the 18 tests performed with ART tips at various volumes, 14 had lower systematic errors than the pipette manufacturer reported.

Pipette evaluated	Volume tested	Specification or reported value	Systematic error		Random error	
			Median	Median volume	Median	Median volume
Eppendorf Research Plus (12-channel) 0.5–10 µL	1 µL	Eppendorf	±8%	±0.08 µL	±5%	±0.05 µL
		ISO 8655	±24%	±0.24 µL	±16%	±0.16 µL
		Thermo Scientific Cat. No.				
		2139-HR	±6.4%	±0.06 µL	±7.38%	±0.07 µL
		3501-HR	±7.68%	±0.08 µL	±7.53%	±0.08 µL
	5 µL	Eppendorf	±4%	±0.2 µL	±2%	±0.1 µL
		ISO 8655	±4.8%	±0.24 µL	±3.2%	±0.16 µL
		Thermo Scientific Cat. No.				
		2139-HR	±1.58%	±0.08 µL	±1.66%	±0.08 µL
		3501-HR	±1.4%	±0.07 µL	±1.75%	±0.09 µL
	10 µL	Eppendorf	±2%	±0.2 µL	±1%	±0.1 µL
		ISO 8655	±2.4%	±0.24 µL	±1.6%	±0.16 µL
		Thermo Scientific Cat. No.				
		2139-HR	±0.80%	±0.08 µL	±0.83%	±0.08 µL
		3501-HR	±0.67%	±0.07 µL	±1%	±0.1 µL
Eppendorf Research Plus (12-channel) 10–100 µL	10 µL	Eppendorf	±3%	±0.3 µL	±2%	±0.2 µL
		ISO 8655	±16%	±1.6 µL	±6%	±0.6 µL
		Thermo Scientific Cat. No.				
		3771-HR	±3.39%	±0.34 µL	±1.04%	±0.10 µL
		3772-HR	±3.90%	±0.4 µL	±0.73%	±0.07 µL
	50 µL	Eppendorf	±1%	±0.5 µL	±0.8%	±0.4 µL
		ISO 8655	±3.2%	±1.6 µL	±1.2%	±0.6 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.36%	±0.18 µL	±0.28%	±0.14 µL
		3772-HR	±0.3%	±0.15 µL	±0.28%	±0.14 µL
	100 µL	Eppendorf	±0.8%	±0.8 µL	±0.3%	±0.3 µL
		ISO 8655	±1.6%	±1.6 µL	±0.6%	±0.6 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.24%	±0.24 µL	±0.22%	±0.22 µL
		3772-HR	±0.19%	±0.19 µL	±0.25%	±0.25 µL
Eppendorf Research Plus (12-channel) 30–300 µL	30 µL	Eppendorf	±3%	±0.9 µL	±1%	±0.3 µL
		ISO 8655	±26.67%	±8 µL	±10%	±3 µL
		Thermo Scientific Cat. No.				
		3771-HR	±4.68%	±1.40 µL	±2.28%	±0.68 µL
		3772-HR	±5.2%	±1.56 µL	±1.87%	±0.56 µL
	150 µL	Eppendorf	±1%	±1.5 µL	±0.5%	±0.75 µL
		ISO 8655	±5.33%	±8 µL	±2%	±3 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.72%	±1.08 µL	±0.54%	±0.81 µL
		3772-HR	±0.72%	±1.08 µL	±0.27%	±0.41 µL
	300 µL	Eppendorf	±0.6%	±1.8 µL	±0.3%	±0.9 µL
		ISO 8655	±2.67%	±8 µL	±1%	±3 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.26%	±0.78 µL	±0.35%	±1.05 µL
		3772-HR	±0.27%	±0.81 µL	±0.20%	±0.60 µL

Note: Each median value was taken after averaging values for all 12 channels. Specifications noted in the table are for 95% confidence intervals.

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Pipette evaluated	Volume tested	Specification or reported value	Systematic error		Random error	
			Median	Median volume	Median	Median volume
Eppendorf Research Plus (8-channel) 0.5–10 µL	1 µL	Eppendorf	±8%	±0.08 µL	±5%	±0.05 µL
		ISO 8655	±24%	±0.24 µL	±16%	±0.16 µL
		Thermo Scientific Cat. No.				
		2139-HR	±8.71%	±0.09 µL	±7.9%	±0.08 µL
		3501-HR	±12.90%	±0.13 µL	±6.50%	±0.07 µL
	5 µL	Eppendorf	±4%	±0.2 µL	±2%	±0.1 µL
		ISO 8655	±4.8%	±0.24 µL	±3.2%	±0.16 µL
		Thermo Scientific Cat. No.				
		2139-HR	±1.78%	±0.09 µL	±1.46%	±0.07 µL
		3501-HR	±2.29%	±0.11 µL	±1.59%	±0.08 µL
	10 µL	Eppendorf	±2%	±0.2 µL	±1%	±0.1 µL
		ISO 8655	±2.4%	±0.24 µL	±1.6%	±0.16 µL
		Thermo Scientific Cat. No.				
		2139-HR	±1.30%	±0.13 µL	±0.80%	±0.08 µL
		3501-HR	±1%	±0.1 µL	±1.02%	±0.11 µL
Eppendorf Research Plus (8-channel) 10–100 µL	10 µL	Eppendorf	±3%	±0.3 µL	±2%	±0.2 µL
		ISO 8655	±16%	±1.6 µL	±6%	±0.6 µL
		Thermo Scientific Cat. No.				
		3771-HR	±2.82%	±0.28 µL	±0.8%	±0.08 µL
		3772-HR	±3.25%	±0.33 µL	±0.7%	±0.07 µL
	50 µL	Eppendorf	±1%	±0.5 µL	±0.8%	±0.4 µL
		ISO 8655	±3.2%	±1.6 µL	±1.2%	±0.6 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.21%	±0.11 µL	±0.31%	±0.16 µL
		3772-HR	±0.12%	±0.06 µL	±0.21%	±0.11 µL
	100 µL	Eppendorf	±0.8%	±0.8 µL	±0.3%	±0.3 µL
		ISO 8655	±1.6%	±1.6 µL	±0.6%	±0.6 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.16%	±0.16 µL	±0.23%	±0.23 µL
		3772-HR	±0.22%	±0.22 µL	±0.21%	±0.21 µL
Eppendorf Research Plus (8-channel) 30–300 µL	30 µL	Eppendorf	±3%	±0.9 µL	±1%	±0.3 µL
		ISO 8655	±26.67%	±8 µL	±10%	±3 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.69%	±0.21 µL	±0.92%	±0.28 µL
		3772-HR	±0.86%	±0.26 µL	±0.93%	±0.28 µL
	150 µL	Eppendorf	±1%	±1.5 µL	±0.5%	±0.75 µL
		ISO 8655	±5.33%	±8 µL	±2%	±3 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.14%	±0.21 µL	±0.4%	±0.6 µL
		3772-HR	±0.20%	±0.30 µL	±0.38%	±0.57 µL
	300 µL	Eppendorf	±0.6%	±1.8 µL	±0.3%	±0.9 µL
		ISO 8655	±2.67%	±8 µL	±1%	±3 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.19%	±0.57 µL	±0.38%	±1.14 µL
		3772-HR	±0.06%	±0.18 µL	±0.23%	±0.69 µL

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Note: Of the 24 tests performed with ART tips at various volumes, 21 had lower systematic errors than the pipette manufacturer reported.

Pipette evaluated	Volume tested	Specification or reported value	Systematic error		Random error	
Eppendorf Research Plus (single-channel) 0.5–10 µL	1 µL	Eppendorf	±2.5%	±0.02 µL	±1.8%	±0.02 µL
		ISO 8655	±12%	±0.12 µL	±8%	±0.08 µL
		Thermo Scientific Cat. No.				
		2139-HR	±0.66%	±0.007 µL	±2.32%	±0.02 µL
	3501-HR	±8.19%	±0.08 µL	±2.55%	±0.03 µL	
	5 µL	Eppendorf	±1.5%	±0.07 µL	±0.80%	±0.04 µL
		ISO 8655	±2.4%	±0.12 µL	±1.6%	±0.08 µL
		Thermo Scientific Cat. No.				
		2139-HR	±0.6%	±0.03 µL	±0.008%	±0.0004 µL
	3501-HR	±1.43%	±0.07 µL	±0.78%	±0.04 µL	
	10 µL	Eppendorf	±1.0%	±0.1 µL	±0.40%	±0.04 µL
		ISO 8655	±1.2%	±0.12 µL	±0.80%	±0.08 µL
Thermo Scientific Cat. No.						
2139-HR		±0.16%	±0.02 µL	±0.47%	±0.05 µL	
3501-HR	±0.41%	±0.04 µL	±0.45%	±0.05 µL		
Eppendorf Research Plus (single-channel) 10–100 µL	10 µL	Eppendorf	±3%	±0.3 µL	±0.01%	±0.07 µL
		ISO 8655	±8%	±0.8 µL	±3%	±0.3 µL
		Thermo Scientific Cat. No.				
		3771-HR	±4.47%	±0.45 µL	±0.76%	±0.08 µL
	50 µL	Eppendorf	±1%	±0.5 µL	±0.3%	±0.15 µL
		ISO 8655	±1.6%	±0.8 µL	±0.6%	±0.3 µL
		Thermo Scientific Cat. No.				
		3771-HR	±1.03%	±0.52 µL	±0.38%	±0.19 µL
	100 µL	Eppendorf	±0.8%	±0.8 µL	±0.2%	±0.2 µL
		ISO 8655	±0.8%	±0.8 µL	±0.3%	±0.3 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.36%	±0.36 µL	±0.3%	±0.3 µL
Eppendorf Research Plus (single-channel) 20–200 µL	20 µL	Eppendorf	±2.5%	±0.5 µL	±0.7%	±0.14 µL
		ISO 8655	±8%	±1.6 µL	±3%	±0.6 µL
		Thermo Scientific Cat. No.				
		2069-HR	±0.41%	±0.082 µL	±1.35%	±0.27 µL
	100 µL	Eppendorf	±1%	±1 µL	±0.3%	±0.3 µL
		ISO 8655	±1.6%	±1.6 µL	±0.6%	±0.6 µL
		Thermo Scientific Cat. No.				
		2069-HR	±0.36%	±0.36 µL	±0.35%	±0.35 µL
	200 µL	Eppendorf	±0.6%	±1.2 µL	±0.2%	±0.4 µL
		ISO 8655	±0.8%	±1.6 µL	±0.3%	±0.6 µL
		Thermo Scientific Cat. No.				
		2069-HR	±0.1%	±0.2 µL	±0.3%	±0.6 µL
Eppendorf Research Plus (single-channel) 30–300 µL	30 µL	Eppendorf	±2.5%	±0.75 µL	±0.7%	±0.21 µL
		ISO 8655	±13.33%	±4 µL	±5%	±1.5 µL
		Thermo Scientific Cat. No.				
		3771 HR	±1.57%	±0.47 µL	±0.8%	±0.24 µL
	3772-HR	±0.54%	±0.16 µL	±0.94%	±0.28 µL	
	150 µL	Eppendorf	±1%	±1.5 µL	±0.3%	±0.45 µL
		ISO 8655	±2.67%	±4 µL	±1%	±1.5 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.36%	±0.54 µL	±0.34%	±0.51 µL
	3772-HR	±0.49%	±0.74 µL	±0.32%	±0.48 µL	
	300 µL	Eppendorf	±0.6%	±1.8 µL	±0.2%	±0.6 µL
		ISO 8655	±1.33%	±4 µL	±0.5%	±1.5 µL
Thermo Scientific Cat. No.						
3771-HR		±0.45%	±1.35 µL	±0.32%	±0.96 µL	
3772-HR	±0.49%	±1.47 µL	±0.17%	±0.51 µL		
Eppendorf Research Plus (single-channel) 100–1,000 µL	100 µL	Eppendorf	±3%	±3 µL	±0.06%	±0.06 µL
		ISO 8655	±8%	±8 µL	±3%	±3 µL
		Thermo Scientific Cat. No.				
		3101-HR	±0.35%	±0.35 µL	±0.74%	±0.74 µL
	2279-HR	±1.52%	±1.52 µL	±0.70%	±0.7 µL	
	500 µL	Eppendorf	±1%	±5 µL	±0.2%	±1 µL
		ISO 8655	±1.6%	±8 µL	±0.6%	±3 µL
		Thermo Scientific Cat. No.				
		3101-HR	±0.74%	±3.7 µL	±0.26%	±1.3 µL
	2279-HR	±0.09%	±0.45 µL	±0.33%	±1.65 µL	
	1,000 µL	Eppendorf	±0.6%	±6 µL	±0.2%	±0.001 µL
		ISO 8655	±0.8%	±8 µL	±0.3%	±3 µL
Thermo Scientific Cat. No.						
3101-HR		±0.45%	±4.5 µL	±0.2%	±2.0 µL	
2279-HR	±0.49%	±4.9 µL	±0.18%	±1.8 µL		

Note: Specifications noted in the table are for 95% confidence intervals.

Eppendorf Xplorer™ Plus twelve-channel variable-volume pipette

All pipettes used for testing were received new from the manufacturer. NIST-traceable calibration of the pipettes was performed in-house using appropriate Eppendorf tips according to the manufacturer's guidelines.

All testing was conducted by the Thermo Fisher Scientific Laboratory Plastics Essentials pipette services team in an accredited laboratory in compliance with ISO 17025, ANSI/NCSL Z540.3, and ANSI/NCSL Z540-1 requirements.

Use our [compatibility guide](#) to find the correct ART pipette tips for your Eppendorf pipettes. To request samples, visit thermofisher.com/art.

Note: Of the 18 tests performed with ART tips at various volumes, 13 had lower systematic errors than the pipette manufacturer reported.

Pipette evaluated	Volume tested	Specification or reported value	Systematic error		Random error	
			Median	Median volume	Median	Median volume
Eppendorf Xplorer Plus (12-channel) 0.5–10 µL	1 µL	Eppendorf	±5%	±0.05 µL	±3%	±0.03 µL
		ISO 8655	±24%	±0.24 µL	±16%	±0.16 µL
		Thermo Scientific Cat. No.				
		2139-HR	±7.65%	±0.08 µL	±8.26%	±0.08 µL
		3501-HR	±4.1%	±0.04 µL	±8.23%	±0.08 µL
	5 µL	Eppendorf	±3%	±0.15 µL	±1.5%	±0.075 µL
		ISO 8655	±4.8%	±0.24 µL	±3.2%	±0.16 µL
		Thermo Scientific Cat. No.				
		2139-HR	±0.50%	±0.03 µL	±1.63%	±0.08 µL
		3501-HR	±1.04%	±0.05 µL	±1.77%	±0.09 µL
	10 µL	Eppendorf	±2%	±0.2 µL	±0.8%	±0.08 µL
		ISO 8655	±2.4%	±0.24 µL	±1.6%	±0.16 µL
		Thermo Scientific Cat. No.				
		2139-HR	±0.23%	±0.02 µL	±0.87%	±0.09 µL
		3501-HR	±0.62%	±0.06 µL	±0.90%	±0.1 µL
Eppendorf Xplorer Plus (12-channel) 5–100 µL	10 µL	Eppendorf	±2%	±0.2 µL	±2%	±0.2 µL
		ISO 8655	±16%	±1.6 µL	±6%	±0.6 µL
		Thermo Scientific Cat. No.				
		3771-HR	±3.5%	±0.35 µL	±1.31%	±0.13 µL
		3772-HR	±3.35%	±0.33 µL	±1.6%	±0.16 µL
	50 µL	Eppendorf	±1%	±0.5 µL	±0.8%	±0.4 µL
		ISO 8655	±3.2%	±1.6 µL	±1.2%	±0.6 µL
		Thermo Scientific Cat. No.				
		3771-HR	±1.05%	±0.53 µL	±0.47%	±0.24 µL
		3772-HR	±1.01%	±0.51 µL	±0.43%	±0.22 µL
	100 µL	Eppendorf	±0.8%	±0.8 µL	±0.25%	±0.25 µL
		ISO 8655	±1.6%	±1.6 µL	±0.6%	±0.6 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.62%	±0.62 µL	±0.36%	±0.36 µL
		3772-HR	±0.58%	±0.58 µL	±0.35%	±0.35 µL
Eppendorf Xplorer Plus (12-channel) 15–300 µL	30 µL	Eppendorf	±2.5%	±0.75 µL	±1%	±0.3 µL
		ISO 8655	±26.67%	±8 µL	±10%	±3 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.63%	±0.19 µL	±2.79%	±0.84 µL
		3772-HR	±0.48%	±0.14 µL	±0.77%	±0.23 µL
	150 µL	Eppendorf	±1%	±1.5 µL	±0.5%	±0.75 µL
		ISO 8655	±5.33%	±8 µL	±2%	±3 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.14%	±0.21 µL	±0.4%	±0.6 µL
		3772-HR	±0.12%	±0.18 µL	±0.34%	±0.51 µL
	300 µL	Eppendorf	±0.6%	±1.8 µL	±0.25%	±0.75 µL
		ISO 8655	±2.67%	±8 µL	±1%	±3 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.22%	±0.66 µL	±0.26%	±0.78 µL
		3772-HR	±0.16%	±0.48 µL	±0.21%	±0.63 µL

Note: Each median value was taken after averaging values for all 12 channels. Specifications noted in the table are for 95% confidence intervals.

Eppendorf Xplorer™ Plus eight-channel variable-volume pipette

All pipettes used for testing were received new from the manufacturer. NIST-traceable calibration of the pipettes was performed in-house using appropriate Eppendorf tips according to the manufacturer's guidelines.

All testing was conducted by the Thermo Fisher Scientific Laboratory Plastics Essentials pipette services team in an accredited laboratory in compliance with ISO 17025, ANSI/NCSL Z540.3, and ANSI/NCSL Z540-1 requirements.

Use our [compatibility guide](#) to find the correct ART pipette tips for your Eppendorf pipettes. To request samples, visit thermofisher.com/art.

Note: Of the 18 tests performed with ART tips at various volumes, 15 had lower systematic errors than the pipette manufacturer reported.

Pipette evaluated	Volume tested	Specification or reported value	Systematic error		Random error	
			Median	Median volume	Median	Median volume
Eppendorf Xplorer Plus (8-channel) 0.5–10 µL	1 µL	Eppendorf	±5%	±0.05 µL	±3%	±0.03 µL
		ISO 8655	±24%	±0.24 µL	±16%	±0.16 µL
		Thermo Scientific Cat. No.				
		2139-HR	±5.77%	±0.06 µL	±7.99%	±0.08 µL
		3501-HR	±5.15%	±0.05 µL	±9.35%	±0.09 µL
	5 µL	Eppendorf	±3%	±0.15 µL	±1.5%	±0.075 µL
		ISO 8655	±4.8%	±0.24 µL	±3.2%	±0.16 µL
		Thermo Scientific Cat. No.				
		2139-HR	±0.93%	±0.05 µL	±1.75%	±0.09 µL
		3501-HR	±0.64%	±0.03 µL	±2.05%	±0.10 µL
	10 µL	Eppendorf	±2%	±0.2 µL	±0.8%	±0.08 µL
		ISO 8655	±2.4%	±0.24 µL	±1.6%	±0.16 µL
		Thermo Scientific Cat. No.				
		2139-HR	±0.65%	±0.07 µL	±0.94%	±0.09 µL
		3501-HR	±0.25%	±0.03 µL	±0.95%	±0.1 µL
Eppendorf Xplorer Plus (8-channel) 10–100 µL	10 µL	Eppendorf	±2%	±0.2 µL	±2%	±0.2 µL
		ISO 8655	±16%	±1.6 µL	±6%	±0.6 µL
		Thermo Scientific Cat. No.				
		3771-HR	±2.64%	±0.26 µL	±1.33%	±0.13 µL
		3772-HR	±1.75%	±0.18 µL	±1.7%	±0.17 µL
	50 µL	Eppendorf	±1%	±0.5 µL	±0.8%	±0.4 µL
		ISO 8655	±3.2%	±1.6 µL	±1.2%	±0.6 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.97%	±0.49 µL	±0.45%	±0.23 µL
		3772-HR	±0.96%	±0.49 µL	±0.45%	±0.23 µL
	100 µL	Eppendorf	±0.8%	±0.8 µL	±0.25%	±0.25 µL
		ISO 8655	±1.6%	±1.6 µL	±0.6%	±0.6 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.61%	±0.61 µL	±0.24%	±0.24 µL
		3772-HR	±0.58%	±0.58 µL	±0.25%	±0.25 µL
Eppendorf Xplorer Plus (8-channel) 30–300 µL	30 µL	Eppendorf	±2.5%	±0.75 µL	±1%	±0.3 µL
		ISO 8655	±26.67%	±8 µL	±10%	±3 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.59%	±0.18 µL	±0.93%	±0.28 µL
		3772-HR	±0.26%	±0.08 µL	±0.76%	±0.23 µL
	150 µL	Eppendorf	±1%	±1.5 µL	±0.5%	±0.75 µL
		ISO 8655	±5.33%	±8 µL	±2%	±3 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.1%	±0.15 µL	±0.29%	±0.44 µL
		3772-HR	±0.07%	±0.11 µL	±0.28%	±0.42 µL
	300 µL	Eppendorf	±0.6%	±1.8 µL	±0.25%	±0.75 µL
		ISO 8655	±2.67%	±8 µL	±1%	±3 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.08%	±0.24 µL	±0.26%	±0.78 µL
		3772-HR	±0.21%	±0.63 µL	±0.28%	±0.84 µL

Note: Each median value was taken after averaging values for all 8 channels. Specifications noted in the table are for 95% confidence intervals.

Eppendorf Xplorer™ Plus single-channel variable-volume pipette

All pipettes used for testing were received new from the manufacturer. NIST-traceable calibration of the pipettes was performed in-house using appropriate Eppendorf tips according to the manufacturer's guidelines.

All testing was conducted by the Thermo Fisher Scientific Laboratory Plastics Essentials pipette services team in an accredited laboratory in compliance with ISO 17025, ANSI/NCSL Z540.3, and ANSI/NCSL Z540-1 requirements.

Use our [compatibility guide](#) to find the correct ART pipette tips for your Eppendorf pipettes. To request samples, visit thermofisher.com/art.

Note: Of the 21 tests performed with ART tips at various volumes, 17 had lower systematic errors than the pipette manufacturer reported.

Pipette evaluated	Volume tested	Specification or reported value	Systematic error		Random error		
Eppendorf Xplorer Plus (single-channel) 0.5–10 µL	1 µL	Eppendorf	±2.5%	±0.25 µL	±1.8%	±0.018 µL	
		ISO 8655	±12%	±0.12 µL	±8%	±0.08 µL	
		Thermo Scientific Cat. No.					
		2139-HR	±0.78%	±0.01 µL	±2.24%	±0.02 µL	
	5 µL	Eppendorf	±1.5%	±0.07 µL	±0.8%	±0.04 µL	
		ISO 8655	±2.4%	±0.12 µL	±1.6%	±0.08 µL	
		Thermo Scientific Cat. No.					
		2139-HR	±1.44%	±0.07 µL	±0.52%	±0.03 µL	
	10 µL	Eppendorf	±1%	±0.1 µL	±0.4%	±0.04 µL	
		ISO 8655	±1.2%	±0.12 µL	±0.8%	±0.08 µL	
		Thermo Scientific Cat. No.					
		2139-HR	±0.26%	±0.03 µL	±0.42%	±0.04 µL	
Eppendorf Xplorer Plus (single-channel) 5–100 µL	10 µL	Eppendorf	±2%	±0.2 µL	±1%	±0.1 µL	
		ISO 8655	±8%	±0.8 µL	±3%	±0.3 µL	
		Thermo Scientific Cat. No.					
	50 µL	Eppendorf	±1%	±0.5 µL	±0.3%	±0.15 µL	
		ISO 8655	±1.6%	±0.8 µL	±0.6%	±0.3 µL	
		Thermo Scientific Cat. No.					
	100 µL	Eppendorf	±0.8%	±0.8 µL	±0.2%	±0.2 µL	
		ISO 8655	±0.8%	±0.8 µL	±0.3%	±0.3 µL	
		Thermo Scientific Cat. No.					
	Eppendorf Xplorer Plus (single-channel) 15–300 µL	30 µL	Eppendorf	±2.5%	±0.75 µL	±0.7%	±0.21 µL
			ISO 8655	±13.33%	±4 µL	±5%	±1.5 µL
			Thermo Scientific Cat. No.				
3771-HR			±1.89%	±0.57 µL	±0.9%	±0.27 µL	
150 µL		Eppendorf	±1%	±1.5 µL	±0.3%	±0.45 µL	
		ISO 8655	±2.67%	±4 µL	±1%	±1.5 µL	
		Thermo Scientific Cat. No.					
		3771-HR	±0.71%	±1.07 µL	±0.38%	±0.57 µL	
300 µL		Eppendorf	±0.6%	±1.8 µL	±0.2%	±0.6 µL	
		ISO 8655	±1.33%	±4 µL	±0.5%	±1.5 µL	
		Thermo Scientific Cat. No.					
		3772-HR	±0.5%	±1.5 µL	±0.19%	±0.57 µL	
Eppendorf Xplorer Plus (single-channel) 50–1,000 µL	100 µL	Eppendorf	±3%	±3 µL	±0.06%	±0.06 µL	
		ISO 8655	±8%	±8 µL	±3%	±3 µL	
		Thermo Scientific Cat. No.					
	500 µL	Eppendorf	±0.93%	±0.93 µL	±0.7%	±0.7 µL	
		ISO 8655	±0.5%	±0.5 µL	±0.74%	±0.74 µL	
		Thermo Scientific Cat. No.					
	1,000 µL	Eppendorf	±1%	±5 µL	±0.2%	±1 µL	
		ISO 8655	±1.6%	±8 µL	±0.6%	±3 µL	
		Thermo Scientific Cat. No.					

Note: Specifications noted in the table are for 95% confidence intervals.



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