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. 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.

			Systematic error*		Random error**	
Pipette evaluated	Volume tested	Specification or reported value	Median	Median volume	Median	Median volume
		Eppendorf	±8%	±0.08 µL	±5%	±0.05 µL
		ISO 8655	±24%	±0.24 µL	±16%	±0.16 µL
	1 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
		Eppendorf	±4%	±0.2 µL	±2%	±0.1 µL
		ISO 8655	±4.8%	±0.24 µL	±3.2%	±0.16 µL
Eppendorf Reference 2	5 µL	Thermo Scientific Cat. No.				
(12-channel) 0.5=10 μL		2139-HR	±1.55%	±0.08 µL	±1.72%	±0.09 µL
		3501-HR	±1.6%	±0.08 µL	±1.67%	±0.08 µL
		Eppendorf	±2%	±0.2 µL	±1%	±0.1 µL
		ISO 8655	±2.4%	±0.24 µL	±1.6%	±0.16 µL
	10 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	±3%	±0.3 µL	±2%	±0.2 µL
		ISO 8655	±16%	±1.6 µL	±6%	±0.6 µL
	10 µL	Thermo Scientific Cat. No.				
		3771-HR	±4.68%	±0.47 μL	±1.33%	±0.13 μL
Eppendorf Reference 2 (12-channel) 5–100 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
		Eppendorf	±0.8%	±0.8 µL	±0.3%	±0.3 µL
		ISO 8655	±1.6%	±1.6 µL	±0.6%	±0.6 µL
	100 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	±3%	±0.9 µL	±1%	±0.3 µL
		ISO 8655	±26.67%	±8 µL	±10%	±3 µL
	30 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
		Eppendorf	±1%	±1.5 μL	±0.5%	±0.75 μL
Ennonderf Beference 2		ISO 8655	±5.33%	±8 µL	±2%	±3 µL
(12-channel) 15–300 uL	150 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
		Eppendorf	±0.6%	±1.8 µL	±0.3%	±0.9 µL
		ISO 8655	±2.67%	±8 µL	±1%	±3 µL
	300 µL	Thermo Scientific Cat. No.				
		3771-HR	±0.14%	±0.42 µL	±0.35%	±1.06 µL
	and the second	3772-HB	+0.13%	+0.40 ul	+0.30%	+0.90 ul

* 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 measurements. 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.

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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.

			Syst	ematic error	Random error	
Pipette evaluated	Volume tested	Specification or reported value	Median	Median volume	Median	Median volume
		Eppendorf	±8%	±0.08 µL	±5%	±0.05 μL
		ISO 8655	±24%	±0.24 µL	±16%	±0.16 μL
	1 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
		Eppendorf	±4%	±0.2 µL	±2%	±0.1 μL
		ISO 8655	±4.8%	±0.24 µL	±3.2%	±0.16 μL
Eppendorf Reference 2 (8-channel) 0.5-10 ul	5 µL	Thermo Scientific Cat. No.				
(0-channel) 0.0-10 µE		2139-HR	±1.62%	±0.08 µL	±1.67%	±0.08 µL
		3501-HR	±1.84%	±0.09 µL	±1.60%	±0.08 µL
		Eppendorf	±2%	±0.2 µL	±1%	±0.1 μL
		ISO 8655	±2.4%	±0.24 µL	±1.6%	±0.16 μL
	10 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	±3%	±0.3 µL	±2%	±0.2 μL
		ISO 8655	±16%	±1.6 µL	±6%	±0.6 μL
	10 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
		Eppendorf	±1%	±0.5 µL	±0.8%	±0.4 μL
Eppendorf Reference 2 (8-channel) 5–100 μL		ISO 8655	±3.2%	±1.6 µL	±1.2%	±0.6 µL
	50 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
		Eppendorf	±0.8%	±0.8 µL	±0.3%	±0.3 µL
	100 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	±3%	±0.9 µL	±1%	±0.3 μL
		ISO 8655	±26.67%	±8 µL	±10%	±3 μL
	30 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
		Eppendorf	±1%	±1.5 μL	±0.5%	±0.75 μL
		ISO 8655	±5.33%	±8 µL	±2%	±3 μL
Eppendorf Reference 2 (8-channel) 15-300 ul	150 µL	Thermo Scientific Cat. No.				
(0-channel) 10-000 µE		3771-HR	±0.41%	±0.62 µL	±0.39%	±0.59 μL
		3772-HR	±0.51%	±0.77 μL	±0.29%	±0.44 μL
		Eppendorf	±0.6%	±1.8 µL	±0.3%	±0.9 µL
		ISO 8655	±2.67%	±8 µL	±1%	±3 μL
	300 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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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	
		Eppendorf	±2.5%	±0.02 µL	±1.8%	±0.02 µL
		ISO 8655	±12%	±0.12 µL	±8%	±0.08 µL
	1 µL	Thermo Scientific Cat. No.				
		2139-HR	±2.02%	±0.02 µL	±2.2%	±0.02 µL
		3501-HR	±8.33%	±0.08 µL	±2.55%	±0.03 µL
		Eppendorf	±1.5%	±0.07 µL	±0.8%	±0.04 μL
		ISO 8655	±2.4%	±0.12 µL	±1.6%	±0.08 µL
Eppendorf Reference 2 (single-chappel) 0.5–10 ul	5 µL	Thermo Scientific Cat. No.				
(single-channel) 0.0-10 µE		2139-HR	±0.76%	±0.04 µL	±0.76%	±0.04 µL
		3501-HR	±1.65%	±0.08 µL	±0.56%	±0.03 µL
		Eppendorf	±1%	±0.1 µL	±0.4%	±0.04 µL
		ISO 8655	±1.2%	±0.12 µL	±0.8%	±0.08 µL
	10 µL	Thermo Scientific Cat. No.				
		2139-HR	±0.82%	±0.08 µL	±0.35%	±0.04 µL
		3501-HR	±0.64%	±0.06 µL	±0.39%	±0.04 µL
		Eppendorf	±3%	±0.3 µL	±0.70%	±0.07 μL
	10 uL	ISO 8655	±8%	±0.8 µL	±3%	±0.3 µL
	- F	Thermo Scientific Cat. No.				
		3771-HR	±0.65%	±0.06 µL	±1.35%	±0.14 μL
		Eppendorf	±1%	±0.5 µL	±0.3%	±0.15 µL
Eppendorf Reference 2	50 µL	ISO 8655	±1.6%	±0.8 µL	±0.6%	±0.3 µL
(single-channel) 10–100 μL	i i i i i i i i i i i i i i i i i i i	Thermo Scientific Cat. No.	0.400/	0.07	0.0494	0.40
		3771-HR	±0.13%	±0.07 µL	±0.24%	±0.12 µL
	100 µL		±0.8%	±0.8 µL	±0.2%	±0.2 µL
		ISU 8055	±0.8%	±0.8 µL	±0.3%	±0.3 µL
		2771 LID	+0.070/	.0.07l	10.20/	10.2 ul
	20 µL	Eppendorf	+2.5%	±0.27 µL	+0.7%	±0.3 µL
		ISO 8655	+8%	+1.6 ul	+3%	+0.6 µl
		Thermo Scientific Cat. No.		- F		p
		2069-HR	±1.72%	±0.34 uL	±1.78%	±0.36 µL
		Eppendorf	±1%	±1 µL	±0.3%	±0.3 µL
Eppendorf Reference 2	100 1	ISO 8655	±1.6%	±1.6 µL	±0.6%	±0.6 µL
(single-channel) 20–200 µL	100 µL	Thermo Scientific Cat. No.				
		2069-HR	±0.78%	±0.78 µL	±0.4%	±0.4 µL
	000	Eppendorf	±0.6%	±1.2 µL	±0.2%	±0.4 µL
		ISO 8655	±0.8%	±1.6 µL	±0.3%	±0.6 µL
	200 με	Thermo Scientific Cat. No.				
		2069-HR	±0.27%	±0.54 µL	±0.21%	±0.42 µL
		Eppendorf	±2.5%	±0.75 µL	±0.7%	±0.21 µL
		ISO 8655	±13.33%	±4 µL	±5%	±1.5 µL
	30 µL	Thermo Scientific Cat. No.			· · · · · ·	
		3771-HR	±1.41%	±0.42 µL	±1.83%	±0.55 µL
		3772-HR	±0.79%	±0.24 µL	±1.22%	±0.37 µL
		Eppendorf	±1.0%	±1.5 µL	±0.3%	±0.45 µL
Eppendorf Reference 2	150	ISU 6000	±2.01%	±4 µL	±1%	±1.5 µL
(single-channel) 30-300 µL	150 µL	2771 LID	10.010/	.0.001	10.000/	.0.40
		3772-HP	±0.01%	±0.95 m	±0.28%	±0.42 µL
		Enpendorf	+0.6%	±0.30 µL +1 8 µl	+0.2%	+0.6 ml
		ISO 8655	+1.33%	+4 ul	+0.5%	+1.5 µL
	300 ul	Thermo Scientific Cat. No.	1.0070	r PC	10.070	110 με
	a a a a a a a a a a a a a a a a a a a	3771-HR	±0.57%	±1.71 uL	±0.19%	±0.57 uL
		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

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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.

			Systematic error		Random error	
Pipette evaluated	Volume tested	Specification or reported value	Median	Median volume	Median	Median volume
		Eppendorf	±8%	±0.08 µL	±5%	±0.05 µL
		ISO 8655	±24%	±0.24 µL	±16%	±0.16 µL
	1 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
		Eppendorf	±4%	±0.2 µL	±2%	±0.1 µL
Ennenderf Desserab Dive		ISO 8655	±4.8%	±0.24 µL	±3.2%	±0.16 µL
(12-channel) 0 5–10 ul	5 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
		Eppendorf	±2%	±0.2 µL	±1%	±0.1 µL
		ISO 8655	±2.4%	±0.24 µL	±1.6%	±0.16 µL
	10 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	±3%	±0.3 µL	±2%	±0.2 µL
		ISO 8655	±16%	±1.6 µL	±6%	±0.6 µL
	10 µL	Thermo Scientific Cat. No.				
Eppendorf Research Plus (12-channel) 10–100 μL		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
		Eppendorf	±0.8%	±0.8 µL	±0.3%	±0.3 µL
	100 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	±3%	±0.9 µL	±1%	±0.3 µL
		ISO 8655	±26.67%	±8 µL	±10%	±3 µL
	30 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
		Eppendorf	±1%	±1.5 µL	±0.5%	±0.75 μL
Eppendorf Research Plus		ISO 8655	±5.33%	±8 µL	±2%	±3 µL
(12-channel) 30–300 µL	150 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
		Eppendorf	±0.6%	±1.8 µL	±0.3%	±0.9 µL
		ISO 8655	±2.67%	±8 µL	±1%	±3 µL
	300 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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Note: Of the 18 tests performed with ART tips at various volumes, 15 had lower systematic errors than the pipette manufacturer reported.

			Systematic error		Random error	
Pipette evaluated	Volume tested	Specification or reported value	Median	Median volume	Median	Median volume
		Eppendorf	±8%	±0.08 µL	±5%	±0.05 μL
		ISO 8655	±24%	±0.24 µL	±16%	±0.16 μL
	1 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
		Eppendorf	±4%	±0.2 µL	±2%	±0.1 μL
Ennenderf Desserab Dive		ISO 8655	±4.8%	±0.24 µL	±3.2%	±0.16 μL
(8-channel) 0.5–10 ul	5 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
		Eppendorf	±2%	±0.2 µL	±1%	±0.1 µL
		ISO 8655	±2.4%	±0.24 µL	±1.6%	±0.16 µL
	10 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	±3%	±0.3 µL	±2%	±0.2 µL
		ISO 8655	±16%	±1.6 µL	±6%	±0.6 µL
Eppendorf Research Plus (8-channel) 10–100 μL	10 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
		Eppendorf	±0.8%	±0.8 µL	±0.3%	±0.3 µL
	100 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	±3%	±0.9 µL	±1%	±0.3 µL
		ISO 8655	±26.67%	±8 µL	±10%	±3 µL
	30 µL	Thermo Scientific Cat. No.		1	ļ	
		3771-HR	±0.69%	±0.21 µL	±0.92%	±0.28 µL
		3772-HR	±0.86%	±0.26 µL	±0.93%	±0.28 µL
		Eppendorf	±1%	±1.5 µL	±0.5%	±0.75 µL
Eppendorf Research Plus		ISO 8655	±5.33%	±8 µL	±2%	±3 µL
(8-channel) 30–300 µL	150 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
		Eppendorf	±0.6%	±1.8 µL	±0.3%	±0.9 µL
		ISO 8655	±2.67%	±8 µL	±1%	±3 µL
	300 µL	Thermo Scientific Cat. No.				
		3/71-HR	±0.19%	±0.57 µL	±0.38%	±1.14 µL
		3772-HR	±0.06%	±0.18 µL	±0.23%	±0.69 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 Research[™] 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 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		Bandom error	
		Eppendorf	+2.5%	+0.02 µl	+1.8%	+0.02.11
		ISO 8655	+12%	±0.02 µL	1.0%	±0.08 µL
	1.01	Thormo Scientific Cat. No.	1270	10.12 με	1 10/0	±0.00 µE
	ιμε		.0.001/	. 0. 007 ul	.0.000/	.0.00l
		2139-HR	±0.00%	±0.007 µL	±2.32%	±0.02 µL
		3501-HR	±8.19%	±0.08 µL	±2.55%	±0.03 µL
		Eppendorf	±1.5%	±0.07 µL	±0.80%	±0.04 µL
Eppendorf Research Plus		ISO 8655	±2.4%	±0.12 µL	±1.6%	±0.08 µL
(single-channel) 0.5–10 ul	5 µL	Thermo Scientific Cat. No.				
(onigro onamol) ere re pi		2139-HR	±0.6%	±0.03 µL	±0.008%	±0.0004 µL
		3501-HR	±1.43%	±0.07 µL	±0.78%	±0.04 µL
		Eppendorf	±1.0%	±0.1 µL	±0.40%	±0.04 μL
		ISO 8655	±1.2%	±0.12 μL	±0.80%	±0.08 µL
	10 uL	Thermo Scientific Cat. No.				
		2139-HR	±0.16%	±0.02 µL	±0.47%	±0.05 µL
		3501-HB	+0.41%	+0.04 µl	+0.45%	+0.05 µl
		Eppendorf	1.20%	+0.2 μl	+0.01%	±0.07 µL
			10/0	±0.0 µL	10.01/0	10.07 pL
	10 µL		±070	±0.0 µL	±3%	±0.5 µL
		Thermo Scientific Cat. No.	4.470/	0.45.1	0.700/	0.00 1
		3771-HR	±4.47%	±0.45 µL	±0.76%	±0.08 µL
		Eppendorf	±1%	±0.5 μL	±0.3%	±0.15 µL
Eppendorf Research Plus	50 ul	ISO 8655	±1.6%	±0.8 µL	±0.6%	±0.3 µL
(single-channel) 10–100 μL	00 µ2	Thermo Scientific Cat. No.				
		3771-HR	±1.03%	±0.52 μL	±0.38%	±0.19 μL
		Eppendorf	±0.8%	±0.8 μL	±0.2%	±0.2 µL
	100.1	ISO 8655	±0.8%	±0.8 µL	±0.3%	±0.3 µL
	100 µL	Thermo Scientific Cat. No.	· · · · ·		· · ·	
		3771-HR	±0.36%	±0.36 µL	±0.3%	±0.3 µL
		Eppendorf	+2.5%	+0.5 µl	+0.7%	+0.14 µl
		ISO 8655	+8%	+1.6 µL	+3%	±0.6 µl
	20 µL	Thormo Sciontific Cat. No.	1070	±1.0 µL	1070	±0.0 µL
Eppendorf Research Plus (single-channel) 20–200 µL			.0.410/	. 0. 000 vil	.1.050/	.0.07l
		2009-HR	±0.41%	±0.082 µL	±1.35%	±0.27 µL
		Eppendorf	±1%	±1 µL	±0.3%	±0.3 µL
	100 uL	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
		Eppendorf	±0.6%	±1.2 μL	±0.2%	±0.4 µL
	200	ISO 8655	±0.8%	±1.6 µL	±0.3%	±0.6 µL
	200 µL	Thermo Scientific Cat. No.				
		2069-HR	±0.1%	±0.2 µL	±0.3%	±0.6 µL
		Eppendorf	±2.5%	±0.75 µL	±0.7%	±0.21 µL
		ISO 8655	±13.33%	±4 µL	±5%	±1.5 µL
	30 ul	Thermo Scientific Cat, No.	1			
	p-	3771 HB	+1 57%	+0.47 ul	+0.8%	+0.24 ul
		3772-HB	+0.54%	±0.16 µl	+0.94%	±0.28 µL
		Eppenderf	10/	±0.10 µL	+0.2%	±0.25 µL
			±170	±1.5 µL	±0.3%	±0.45 µL
Eppendorf Research Plus	4501	ISU 8055	±2.07%	±4 µL	±1%	±1.5 µL
(single-channel) 30–300 µL	150 µL	mermo Scientific Cat. No.	0.000/	0.51.1	0.0.10/	0.5%
		3771-HR	±0.36%	±0.54 μL	±0.34%	±0.51 µL
		3//2-HR	±0.49%	±0.74 μL	±0.32%	±0.48 µL
		Eppendorf	±0.6%	±1.8 µL	±0.2%	±0.6 µL
		ISO 8655	±1.33%	±4 μL	±0.5%	±1.5 μL
	300 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	±3%	±3 μL	±0.06%	±0.06 µL
		ISO 8655	±8%	±8 µL	±3%	±3 µL
	100 ul	Thermo Scientific Cat. No.		P		r
	.cope	3101-HB	+0.35%	+0.35 ul	+0.74%	+0.74.11
		2279-HB	+1 52%	+1 52 ul	+0.70%	+0.7 ul
		Eppendorf	10/	±1.02 µL	10.00/0	LUI PE
		Lppelluuli 190 9655	±1%	±0 µL	±0.2%	±1 µL
Eppendorf Research Plus	500		±1.0%	±σμ∟	±0.0%	±3 µL
(single-channel) 100–1,000 µL	500 µL	Thermo Scientifić 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
		Eppendorf	±0.6%	±6 µL	±0.2%	±0.001 μL
		ISO 8655	±0.8%	±8 µL	±0.3%	±3 μL
	1,000 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.

			Systematic error		Random error	
Pipette evaluated	Volume tested	Specification or reported value	Median	Median volume	Median	Median volume
		Eppendorf	±5%	±0.05 μL	±3%	±0.03 µL
		ISO 8655	±24%	±0.24 μL	±16%	±0.16 µL
	1 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
		Eppendorf	±3%	±0.15 μL	±1.5%	±0.075 μL
E I. (Mala		ISO 8655	±4.8%	±0.24 μL	±3.2%	±0.16 μL
(12-channel) 0.5-10 ul	5 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
		Eppendorf	±2%	±0.2 µL	±0.8%	±0.08 µL
		ISO 8655	±2.4%	±0.24 µL	±1.6%	±0.16 µL
	10 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	±2%	±0.2 μL	±2%	±0.2 μL
		ISO 8655	±16%	±1.6 μL	±6%	±0.6 μL
	10 µL	Thermo Scientific Cat. No.				
Eppendorf Xplorer Plus (12-channel) 5–100 μL		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
		Eppendorf	±0.8%	±0.8 µL	±0.25%	±0.25 μL
		ISO 8655	±1.6%	±1.6 µL	±0.6%	±0.6 µL
	100 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	±2.5%	±0.75 μL	±1%	±0.3 µL
		ISO 8655	±26.67%	±8 µL	±10%	±3 μL
	30 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
		Eppendorf	±1%	±1.5 μL	±0.5%	±0.75 μL
Ennondorf Valerer Dive		ISO 8655	±5.33%	±8 µL	±2%	±3 μL
(12-channel) 15–300 ul	150 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
		Eppendorf	±0.6%	±1.8 µL	±0.25%	±0.75 μL
		ISO 8655	±2.67%	±8 µL	±1%	±3 µL
	300 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.

			Systematic error		Random error	
Pipette evaluated	Volume tested	Specification or reported value	Median	Median volume	Median	Median volume
		Eppendorf	±5%	±0.05 μL	±3%	±0.03 µL
		ISO 8655	±24%	±0.24 µL	±16%	±0.16 µL
	1 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
		Eppendorf	±3%	±0.15 μL	±1.5%	±0.075 μL
E Is (Mala		ISO 8655	±4.8%	±0.24 μL	±3.2%	±0.16 μL
(8-channel) 0.5-10 ul	5 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
		Eppendorf	±2%	±0.2 µL	±0.8%	±0.08 µL
		ISO 8655	±2.4%	±0.24 µL	±1.6%	±0.16 μL
	10 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	±2%	±0.2 µL	±2%	±0.2 µL
		ISO 8655	±16%	±1.6 µL	±6%	±0.6 µL
Eppendorf Xplorer Plus (8-channel) 10–100 μL	10 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
		Eppendorf	±0.8%	±0.8 µL	±0.25%	±0.25 μL
	100 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	±2.5%	±0.75 μL	±1%	±0.3 µL
		ISO 8655	±26.67%	±8 µL	±10%	±3 μL
	30 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
		Eppendorf	±1%	±1.5 µL	±0.5%	±0.75 μL
Ennondorf Valerer Dive		ISO 8655	±5.33%	±8 µL	±2%	±3 μL
(8-channel) 30–300 uL	150 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
		Eppendorf	±0.6%	±1.8 µL	±0.25%	±0.75 μL
		ISO 8655	±2.67%	±8 µL	±1%	±3 µL
	300 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	±2,5%	±0.25 uL	±1.8%	±0.018 µL
		ISO 8655	±12%	±0.12 µL	±8%	±0.08 µL
	1 uL	Thermo Scientific Cat. No.				
		2139-HR	±0.78%	±0.01 µL	±2.24%	±0.02 µL
		3501-HR	±7.13%	±0.07 µL	±2.85%	±0.03 µL
		Eppendorf	±1.5%	±0.07 µL	±0.8%	±0.04 µL
		ISO 8655	±2.4%	±0.12 µL	±1.6%	±0.08 µL
Eppendorf Xplorer Plus	5 µL	Thermo Scientific Cat. No.				
(single-channel) 0.5-10 µL		2139-HR	±1.44%	±0.07 μL	±0.52%	±0.03 µL
		3501-HR	±1.72%	±0.09 µL	±0.66%	±0.03 µL
		Eppendorf	±1%	±0.1 μL	±0.4%	±0.04 μL
		ISO 8655	±1.2%	±0.12 μL	±0.8%	±0.08 µL
	10 µL	Thermo Scientific Cat. No.				
		2139-HR	±0.26%	±0.03 µL	±0.42%	±0.04 µL
		3501-HR	±0.78%	±0.08 µL	±0.38%	±0.04 µL
		Eppendorf	±2%	±0.2 µL	±1%	±0.1 μL
	10 ul	ISO 8655	±8%	±0.8 µL	±3%	±0.3 µL
	10 µL	Thermo Scientific Cat. No.				
		3771-HR	±4.11%	±0.41 µL	±0.8%	±0.08 µL
		Eppendorf	±1%	±0.5 µL	±0.3%	±0.15 μL
Eppendorf Xplorer Plus	50 ul	ISO 8655	±1.6%	±0.8 µL	±0.6%	±0.3 µL
(single-channel) 5–100 μL	00 µL	Thermo Scientific Cat. No.				
		3771-HR	±0.67%	±0.34 µL	±0.4%	±0.2 µL
		Eppendorf	±0.8%	±0.8 µL	±0.2%	±0.2 µL
	100 uL	ISO 8655	±0.8%	±0.8 µL	±0.3%	±0.3 µL
		Thermo Scientific Cat. No.				
		3771-HR	±0.41%	±0.41 µL	±0.24%	±0.24 µL
		Eppendorf	±2.5%	±0.75 µL	±0.7%	±0.21 µL
		ISO 8655	±13.33%	±4 µL	±5%	±1.5 µL
	30 µL	Thermo Scientific Cat. No.	1.000/	0.57.1	0.00/	0.07.1
		3771-HR	±1.89%	±0.57 µL	±0.9%	±0.27 µL
		3772-HR	±1.57%	±0.47 µL	±0.88%	±0.26 µL
			±1%	±1.5 µL	±0.3%	±0.45 µL
Eppendorf Xplorer Plus	1501	ISU 8000	±2.07%	±4 μL	±1%	±1.5 µL
(single-channel) 15–300 µL	150 με	Thermo Scientific Cat. No.	.0.710/	.1.07	.0.000/	• ±0.2 μL 6 ±0.3 μL % ±0.24 μL 6 ±0.21 μL 6 ±0.21 μL 6 ±0.27 μL 6 ±0.27 μL 6 ±0.27 μL 6 ±0.26 μL 6 ±0.45 μL 9 ±0.57 μL % ±0.57 μL % ±0.39 μL % ±0.6 μL % ±1.5 μL
		3771-AR	±0.71%	±1.07 µL	±0.36%	±0.37 µL
		STT2-FIR	±0.71%	±1.07 µL	±0.20%	±0.39 µL
		ISO 8655	±0.0%	±1.0 µL	±0.2%	±0.0 µL
	300 ul	Thermo Scientific Cat. No	1.0070	±τμε	10.070	±1.0 με
	000 µL	3771-HB	+0.47%	+1.41 µl	+0.25%	+0.75 ul
		3772-HB	+0.5%	+1.5 ul	+0.19%	+0.57 µl
		Eppendorf	+3%	+3 11	+0.06%	+0.06 µl
		ISO 8655	+8%	+8 ul	+3%	+3 ul
	100 uL	Thermo Scientific Cat. No.		- F	1	- F
		2279-HR	±0.93%	±0.93 uL	±0.7%	±0.7 µL
		3101-HR	±0.5%	±0.5 µL	±0.74%	±0.74 µL
		Eppendorf	±1%	±5 μL	±0.2%	±1 µL
		ISO 8655	±1.6%	±8 μL	±0.6%	±3 μL
Eppendorf Xplorer Plus	500 µL	Thermo Scientific Cat. No.			· · · · ·	
(single-channel) 50–1,000 μL		2279-HR	±0.28%	±1.4 µL	±0.33%	±1.65 µL
		3101-HR	±0.75%	±3.75 μL	±0.26%	±1.3 μL
		Eppendorf	±0.6%	±6 µL	±0.2%	±2 μL
		ISO 8655	±0.8%	±8 µL	±0.3%	±3 μL
	1,000 µL	Thermo Scientific Cat. No.				
		2279-HR	±0.25%	±2.5 μL	±0.22%	±2.2 µL
		3101-HR	±0.63%	±6.3 µL	±0.15%	±1.5 µL

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







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