

Acid Determination and Base Determination

Method 8288 and 8289

0 to 25,000 meq/L

Buret Titration

Scope and application: For water, wastewater and seawater.



Test preparation

Before starting

As an alternative to the Phenolphthalein Indicator Powder Pillow, use 4 drops of Phenolphthalein Indicator Solution.

Color or turbidity in the sample can make it difficult to see the color change at the endpoint. For these samples, use a pH meter to determine the titration endpoint. Titrate the sample until the pH is 8.3.

The optional TitraStir Titration Stand can hold the buret and stir the sample.

Review the Safety Data Sheets (MSDS/SDS) for the chemicals that are used. Use the recommended personal protective equipment.

Dispose of reacted solutions according to local, state and federal regulations. Refer to the Safety Data Sheets for disposal information for unused reagents. Refer to the environmental, health and safety staff for your facility and/or local regulatory agencies for further disposal information.

Items to collect

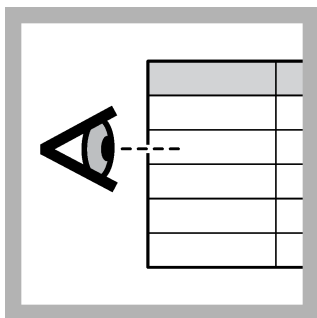
Description	Quantity
Phenolphthalein Indicator Powder Pillow	1
Acid determinations—Sodium Hydroxide Standard Solution (use a concentration that is applicable to the sample range)	varies
Base determinations—Hydrochloric Acid or Sulfuric Acid Standard Solution (use a concentration that is applicable to the sample range)	varies
pH meter and probe (for samples that have a lot of color or turbidity)	1
Buret, Class A, 25 mL	1
Graduated cylinder (use a size that is applicable to the selected sample volume), or TenSette pipet with tips	1
Erlenmeyer flask, 250 mL	1
Funnel, micro	1
Support stand with buret clamp	1
Water, deionized	varies

Refer to [Consumables and replacement items](#) on page 5 for order information.

Sample collection

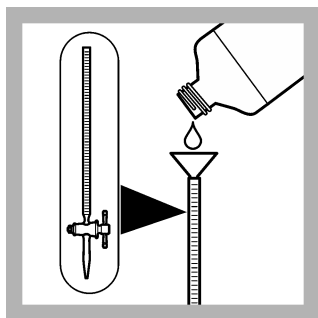
- Collect samples in clean glass or plastic bottles with tight-fitting caps. Completely fill the bottle and immediately tighten the cap.
- Prevent agitation of the sample and exposure to air.
- Analyze the samples as soon as possible for best results.
- If immediate analysis is not possible, keep the samples at or below 6 °C (43 °F) for a maximum of 24 hours.
- Let the sample temperature increase to room temperature before analysis.

Test procedure—Acid determination (Method 8288)

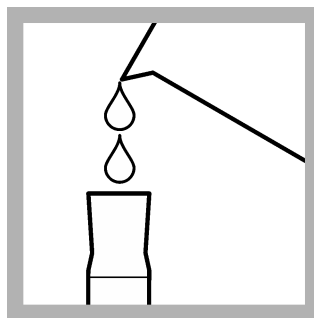


1. Select a sample volume and titrant from [Table 1](#) on page 4.

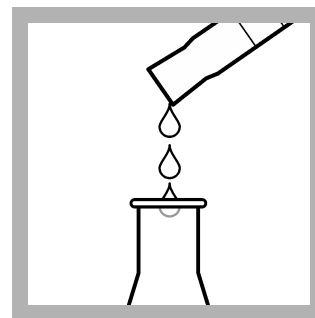
For acid determinations, titrate with a Sodium Hydroxide Standard Solution.



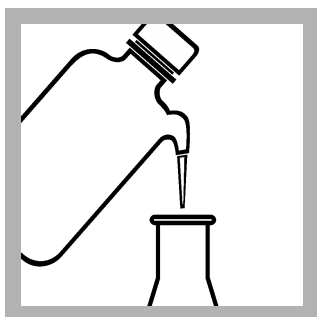
2. Fill a 25-mL buret to the zero mark with the titrant.



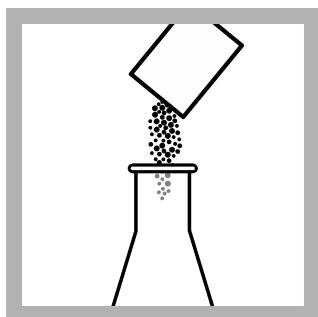
3. Use a graduated cylinder or pipet¹ to measure the sample volume from [Table 1](#) on page 4.



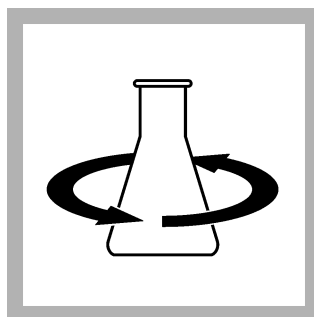
4. Pour the sample into a clean, 250-mL Erlenmeyer flask.



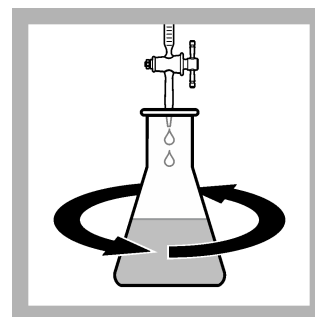
5. If the sample volume is less than 100 mL, dilute to approximately 100 mL with deionized water.



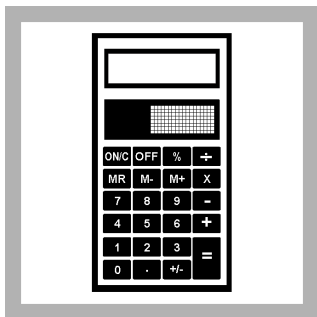
6. Add the contents of one Phenolphthalein Indicator Powder Pillow. The indicator is not necessary if a pH meter is used.



7. Swirl to mix. The solution color does not change if acid is in the sample.



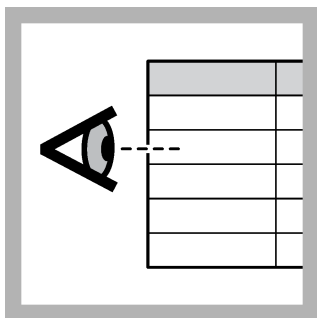
8. Put the flask under the buret. Swirl the flask. Add titrant until the color changes to light pink and stays pink for 30 seconds (pH 8.3).



9. Use the multiplier in [Table 1](#) on page 4 to calculate the concentration.
 $\text{mL of titrant} \times \text{multiplier} = \text{meq/L of acid.}$

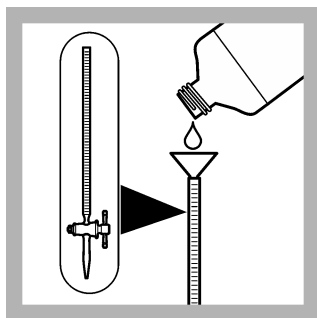
¹ Titration accuracy has a direct relation to the accuracy of the sample volume measurement. For smaller volumes, it is recommended to use a pipet to increase accuracy.

Test procedure—Base determination (Method 8289)

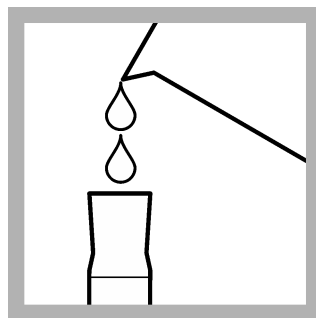


1. Select a sample volume and titrant from [Table 1](#) on page 4.

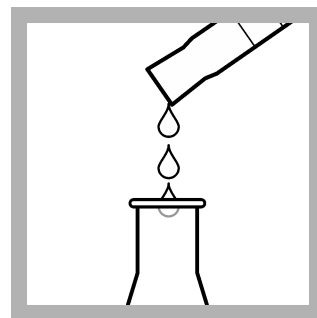
For base determinations, titrate with a Hydrochloric Acid or Sulfuric Acid Standard Solution.



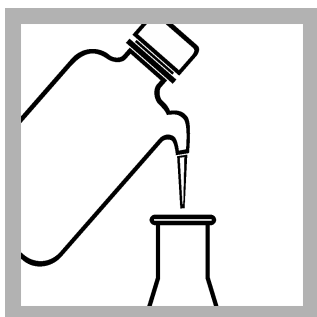
2. Fill a 25-mL buret to the zero mark with the titrant.



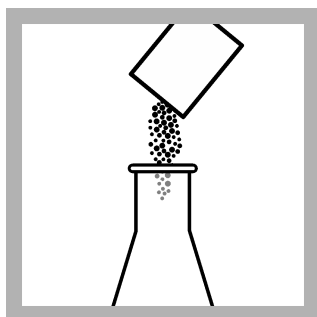
3. Use a graduated cylinder or pipet² to measure the sample volume from [Table 1](#) on page 4.



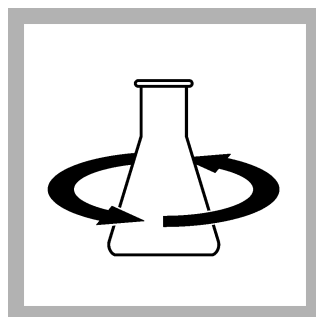
4. Pour the sample into a clean, 250-mL Erlenmeyer flask.



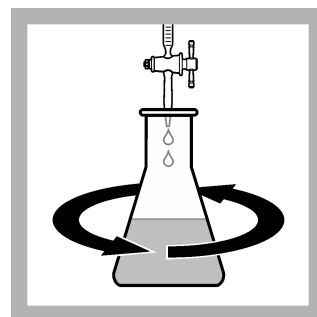
5. If the sample volume is less than 100 mL, dilute to approximately 100 mL with deionized water.



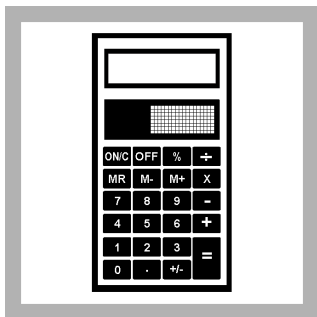
6. Add the contents of one Phenolphthalein Indicator Powder Pillow. The indicator is not necessary if a pH meter is used.



7. Swirl to mix. The solution color becomes pink.



8. Put the flask under the buret. Swirl the flask. Add titrant until the color changes from light pink to clear (pH 8.3).



9. Use the multiplier in [Table 1](#) on page 4 to calculate the concentration. mL of titrant \times multiplier = meq/L of base.

² Titration accuracy has a direct relation to the accuracy of the sample volume measurement. For smaller volumes, it is recommended to use a pipet to increase accuracy.

Sample volumes and multipliers

Select a range in [Table 1](#), then read across the table row to find the applicable information for this test. Use the multiplier to calculate the concentration in the test procedure.

Example: A 50-mL sample was titrated with 1.000 N titrant and 12 mL of titrant was used at the endpoint. The concentration is $12 \text{ mL} \times 20 = 240 \text{ meq/L}$ of acid.

For acid determinations, titrate with a Sodium Hydroxide Standard Solution. For base determinations, titrate with a Hydrochloric Acid or Sulfuric Acid Standard Solution.

Table 1 Sample volumes and multipliers

Range		Sample volume (mL)	Titrant—acid or sodium hydroxide	Multiplier
(meq/L)	(N)			
1–10	0–0.010	50	0.020 N	0.4
10–100	0.010–0.100	25	0.100 N	4
100–500	0.100–0.500	50	1.000 N	20
500–2500	0.500–2.50	10	1.000 N	100
2500–25,000	2.50–25.0	1	1.000 N	1000

Conversions

To change the units or chemical form of the test result, multiply the test result by the factor in [Table 2](#).

Table 2 Conversions

meq/L to...	multiply by...	Example
N (normality)	0.001	$25 \text{ meq/L} \times 0.001 = 0.025 \text{ N}$

Interferences

Color or turbidity in the sample can make it difficult to see the color change at the endpoint. For these samples, use a pH meter to determine the titration endpoint. Titrate the sample until the pH is 8.3.

Accuracy check

Standard solution method

Use the standard solution method to validate the test procedure, reagents, apparatus and technique.

Items to collect:

- Sulfuric Acid Standard Solution or Sodium Hydroxide Standard Solution (use the same concentration as the titrant used for the selected test range)
 - Pipet, TenSette, 1.0–10 mL and pipet tips (or volumetric pipet and pipet bulb)
1. Use a TenSette pipet to add a standard solution to a 250-mL Erlenmeyer flask:
 - Acid determinations—Add 20 mL of Sulfuric Acid Standard Solution to the flask.
 - Base determinations—Add 20 mL Alkalinity Standard Solution to the flask.
 2. Dilute the standard solution to approximately 100 mL with deionized water.
 3. Add one Phenolphthalein Indicator Powder Pillow. Swirl to mix.
 4. Fill a 25-mL buret to the zero mark with the titrant used for the selected test range.
 5. Titrate the prepared standard solution to the endpoint color or pH. The correct quantity for this titration is 20 mL.
 6. Compare the actual result to the correct result. If much more or less titrant was used, there can be a problem with user technique, reagents or apparatus.

Summary of method

A phenolphthalein indicator is added to the sample. For acid determinations, the sample is titrated with a sodium hydroxide standard solution until the indicator changes color at the endpoint pH of 8.3. For base determinations, the sample is titrated with a sulfuric acid or hydrochloric acid standard solution until the indicator changes color at the endpoint pH of 8.3. The quantity of titrant used is directly proportional to the milliequivalents of acid or base in the sample.

Consumables and replacement items

Required reagents

Description	Quantity/Test	Unit	Item no.
Phenolphthalein Indicator Powder Pillows	1 pillow	100/pkg	94299
Sodium Hydroxide Standard Solution, 0.020 N	varies	1 L	19353
Sodium Hydroxide Standard Solution, 0.100 N	varies	1 L	19153
Sodium Hydroxide Standard Solution, 1.000 N	varies	1 L	104553
Sulfuric Acid Standard Solution, 0.020 N	varies	1 L	20353
Sulfuric Acid Standard Solution, 0.100 N	varies	1 L	20253
Sulfuric Acid Standard Solution, 1.000 N	varies	1 L	127053
Hydrochloric Acid Standard Solution, 0.020 N	varies	1 L	2330353
Hydrochloric Acid Standard Solution, 0.100 N	varies	1 L	1481253
Hydrochloric Acid Standard Solution, 1.000 N	varies	1 L	2321353
Water, deionized	varies	4 L	27256

Required apparatus

Description	Quantity/test	Unit	Item no.
Buret clamp, double	1	each	32800
Buret, Class A, 25 mL	1	each	2636540
Support stand	1	each	56300
Funnel, micro	1	each	2584335
Graduated cylinders—Select one or more for the sample volume:			
Cylinder, graduated, 5 mL	1	each	50837
Cylinder, graduated, 10 mL	1	each	50838
Cylinder, graduated, 25 mL	1	each	50840
Cylinder, graduated, 50 mL	1	each	50841
Cylinder, graduated, 100 mL	1	each	50842
Tensette [®] pipets and pipet tips—Select one or more for the sample volume:			
Pipet, TenSette [®] , 0.1–1.0 mL	1	each	1970001
Pipet tips, TenSette [®] Pipet, 0.1–1.0 mL	varies	50/pkg	2185696
Pipet, TenSette [®] , 1.0–10.0 mL	1	each	1970010
Pipet tips, TenSette [®] Pipet, 1.0–10.0 mL	varies	50/pkg	2199796
Flask, Erlenmeyer, 250 mL	1	each	50546

Recommended standards

Description	Unit	Item no.
Alkalinity Voluette® Ampule Standard Solution, 0.500 N (25 g/L as CaCO ₃), 10-mL	16/pkg	1427810
Sulfuric Acid Standard Solution, 0.500 N	100 mL MDB	212132

Optional apparatus

Description	Unit	Item no.
Ampule Breaker, 10-mL Voluette® Ampules	each	2196800
Clippers	each	96800
Stir bar, octagonal	each	2095352
TitraStir® Titration Stand, 115 VAC	each	1940000
TitraStir® Titration Stand, 230 VAC	each	1940010



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