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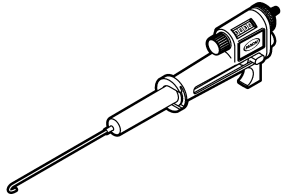
Digital Titrator, Model 16900

05/2024, Edition 1

User Manual



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Section 1 Specifications

Specifications are subject to change without notice.

Digital titrator

Specification	Details
Enclosure	Chemical- and impact-resistant acetal plastic
Weight	132 g (4.7 oz)
Delivery	800 digits/mL or 0.00125 mL/digit
Accuracy[1]	± 1% for readings less than 100 digits ± 1% or less for readings more than 100 digits

Titration cartridges

Specification	Details
Enclosure	Disposable polypropylene or PVDF with PTFE-covered neoprene seals and polyethylene resealable closures to cover the cartridge tip
Volume	13 mL
Concentration of titrant	± 0.5% concentration (typical) with normality and tolerances marked on the label. The titrant concentrations are made for titrations of 10 to 40 turns (100 to 400 digits) of the delivery knob.
Number of tests	50 to 100. Most of the reagents supply 100 typical titrations. The number of tests is dependant on the sample.
Weight	56.7 g (2 oz)

Section 2 General information

In no event will the manufacturer be liable for damages resulting from any improper use of product or failure to comply with the instructions in the manual. The manufacturer reserves the right to make changes in this manual and the products it describes at any time, without notice or obligation. Revised editions are found on the manufacturer's website.

2.1 Safety information

The manufacturer is not responsible for any damages due to misapplication or misuse of this product including, without limitation, direct, incidental and consequential damages, and disclaims such damages to the full extent permitted under applicable law. The user is solely responsible to identify critical application

[1] Sampling, sample volume, dilution (if necessary), end point detection, reagent quality and interferences have an affect on the accuracy.

risks and install appropriate mechanisms to protect processes during a possible equipment malfunction.

Please read this entire manual before unpacking, setting up or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

Make sure that the protection provided by this equipment is not impaired. Do not use or install this equipment in any manner other than that specified in this manual.

2.1.1 Use of hazard information

⚠DANGER

Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠WARNING

Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

⚠CAUTION

Indicates a potentially hazardous situation that may result in minor or moderate injury.

NOTICE

Indicates a situation which, if not avoided, may cause damage to the instrument. Information that requires special emphasis.

2.2 Icons used in illustrations

		
Manufacturer supplied parts	User supplied parts	Look

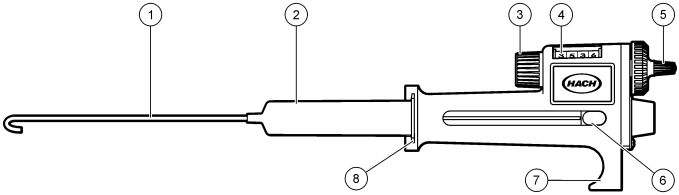
2.3 Intended use

The digital titrator is intended for use by individuals who measure water quality parameters in the laboratory. The digital titrator does not treat or alter water.

2.4 Product overview

Figure 1 shows the digital titrator with a titration cartridge and delivery tube installed. The digital titrator has a handgrip for hand-held operation or it can be attached to a laboratory stand with a clamp for fixed-position titrations.

Figure 1 Product overview

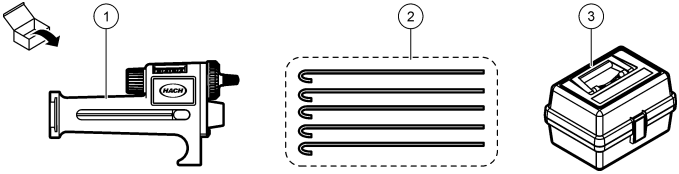


1 Delivery tube—Use a straight delivery tube for hand-held titration. Use a right-angle (90°) delivery tube when the digital titrator is attached to a laboratory stand.	**5** Delivery knob—Turn to slowly move the plunger toward the cartridge to push titrant out of the delivery tube.
2 Titration cartridge	**6** Plunger release button—Push and move forward to move the plunger toward the cartridge. Push and move backward to retract the plunger.
3 Counter reset knob—Turn to set the digital counter back to zero.	**7** Handgrip
4 Digital counter	**8** Cartridge insertion slot

2.5 Product components

Make sure that all components have been received. Refer to Figure 2. If any items are missing or damaged, contact the manufacturer or a sales representative immediately.

Figure 2 Product components



1 Digital titrator (1690001)	**2** Delivery tubes (5x) (1720500)	**3** Case (4660200)

Section 3 Operation

⚠ CAUTION

Chemical exposure hazard. Obey laboratory safety procedures and wear all of the personal protective equipment appropriate to the chemicals that are handled. Refer to the current safety data sheets (MSDS/SDS) for safety protocols.

⚠ CAUTION

Chemical exposure hazard. Dispose of chemicals and wastes in accordance with local, regional and national regulations.

Refer to the operation steps that follow and the applicable method at https://www.Hach.com/WAH to do a titration procedure.

3.1 Install a titration cartridge

1. Select the correct titration cartridge to use. Refer to the table in the titration procedure (method).

   If the expected sample concentration is not known, start with one of the smaller sample volumes and determine the approximate concentration. Then, do the test again with the correct sample volume.

2. Install the titration cartridge. Refer to Figure 3.

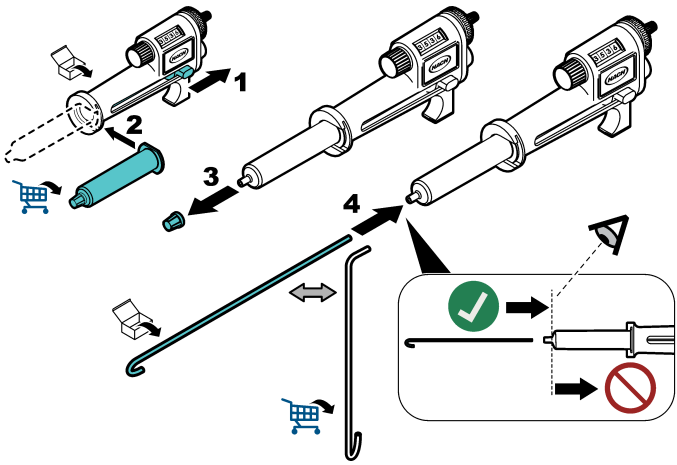
   Use a straight delivery tube for hand-held titrations. Use a 90° delivery tube (4157800) for fixed-position titrations.

   Only put the delivery tube into the cartridge nozzle. It may be necessary to remove a small burr on the cartridge nozzle before the delivery tube can be installed.

3. Flush the delivery tube as follows:

   a. Hold the tip of the cartridge up.
   b. Push in the plunger release button and move the button forward to move the plunger toward the cartridge. Do not push solution out of the delivery tube.
   c. Turn the delivery knob until several drops of solution come out of the delivery tube.
   d. Turn the counter reset knob to set the digital counter to zero.
   e. Wipe the tip of the delivery tube or rinse the tip with deionized water.

Figure 3 Install a titration cartridge



3.2 Titrate the sample

1. Prepare the sample as follows:
   a. Add the applicable sample volume to a 125-mL or 250-mL Erlenmeyer flask. Use the smallest possible size of graduated cylinder or pipet to measure the sample volume.

      Do the sample volume measurement and dilutions accurately. However, the final total volume of titrated solution is not important.
   b. Dilute the sample to the applicable total volume with deionized water, if necessary.
   c. Add the necessary reagents to the sample. Swirl to mix.
2. Titrate the sample as follows:
   a. For fixed-position titration, attach the digital titrator to a laboratory stand and use a magnetic stirrer. Refer to Figure 4.
   b. Turn the counter reset knob to set the digital counter to zero.
   c. Put the delivery tube tip in the solution and swirl the flask while titrating. Turn the delivery knob to titrate.

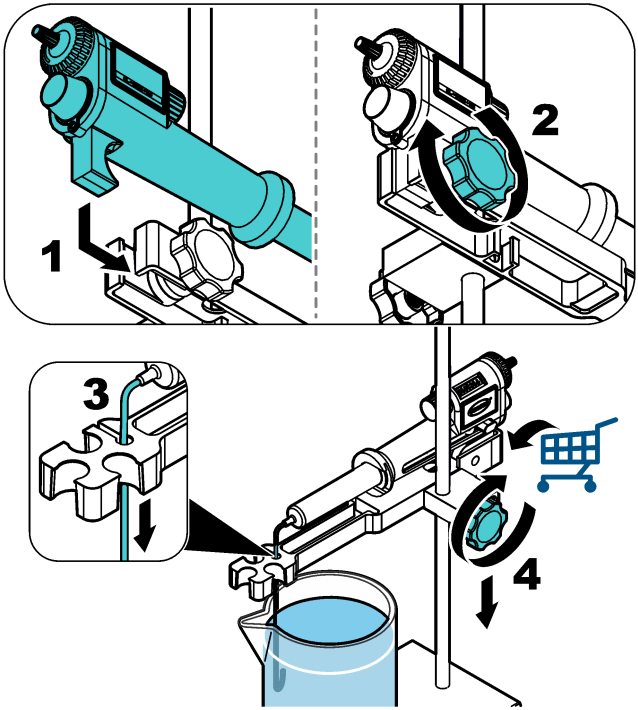
The results will not be accurate if the delivery tube tip is not held in the solution.

d. Add titrant and swirl the sample until the end point. Record the number of digits shown in the digital counter window.

Each digit (1/10 turn of the knob) supplies 0.00125 mL of titrant. For most tests, the solution in the titrant cartridge is made so that digits shown on the digital counter are the same as the concentration of the sample in mg/L.

The number of digits until the end point is usually 100 to 400. If the digits necessary is less than 100 or more than 400, use an alternate sample volume or titrant cartridge.

Figure 4 Attach the digital titrator to a laboratory stand



3.3 Calculate the concentration of the sample

Digits necessary × Digit multiplier = Sample concentration

Where:

Digits necessary—The number shown in the digital counter window

Digit multiplier—The number from the table in the method (titration procedure), which is based on the sample dilution and titrant strength.

3.4 Calculate the titrant volume used

Titrant volume used in mL = Digits necessary ÷ 800

Note: *Many of the titration cartridges are made so that the number of digits used in a titration is the same as the sample concentration in mg/L.*

3.5 Prepare for storage

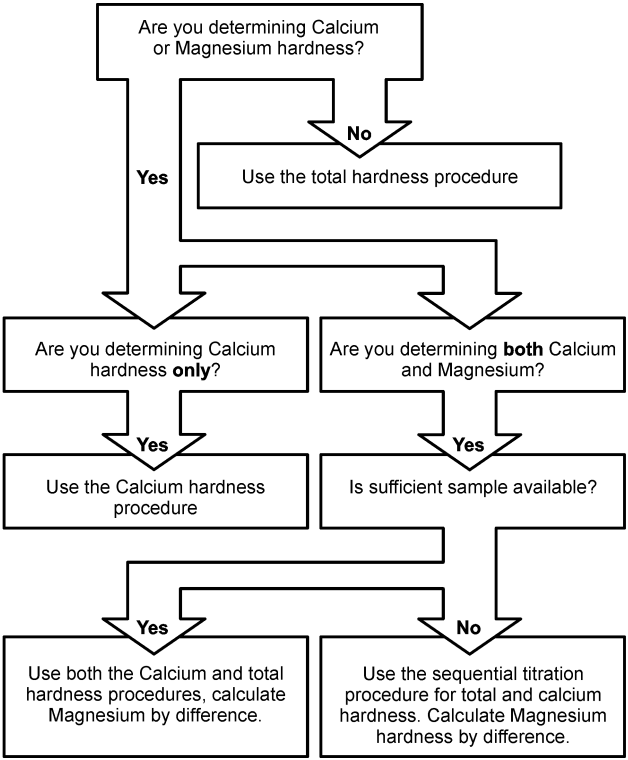
Prepare the digital titrator for storage as follows:

1. Push in the plunger release button and move the button backward to fully retract the plunger.
2. Remove the cartridge.
3. Remove the delivery tube from the cartridge.
4. Seal the cartridge with the polyethylene cap.
5. Discard or clean the delivery tube immediately after use. Push water, then air into the delivery tube opening with a syringe or wash bottle.

Section 4 Select the hardness procedure

Refer to Figure 5 to select the correct hardness procedure to use.

Figure 5 Select the hardness procedure



Section 5 Accuracy check

Use the standard addition method to check the accuracy of the digital titrator and to make sure that the procedure was done correctly. Refer to the *Accuracy check* section of the procedure for the steps.

If the actual number of digits necessary is not within 1% of the expected number of digits during an accuracy check, refer to Troubleshooting on page 13.

Section 6 Adapt a buret titration

Adapt a buret titration method to the digital titrator as follows:

1. Use the equation that follows to calculate the digits necessary to do the buret method.

   Digits necessary = $(N_t \times mL_t \times 800) \div N_c$

   Note: *The digital titrator dispenses 1 mL per 800 digits on the counter.*

   Where:

   $\mathbf{N_t}$—Normality of the buret titrant

   $\mathbf{mL_t}$—Milliliters of the buret titrant necessary for an average titration

   $\mathbf{N_c}$—Normality of the digital titrator cartridge

   If the number of digits necessary is within the range of 70 to 350, use the buret procedure as written and replace the buret with the digital titrator.
2. If the number of digits necessary is not within the range of 70 to 350, make the changes that follow:

   - If more than 350, decrease the sample size to decrease the quantity of titrant necessary.
   - If less than 70, increase the sample size to increase the precision.
   - If the sample size is changed, adjust the amount of buffering or indicating reagents used by the same proportion.
3. Use the digital titrator to do the buret method. Record the number of digits necessary.
4. Convert the digits necessary to the equivalent number of buret milliliters as follows:

   Buret milliliters = Digits necessary × $(N_c \div (800 \times N_t))$

   If the sample size was changed, adjust the buret milliliters as follows:

   - If the sample size was increased, decrease the buret milliliters.
   - If the sample size was decreased, increase the buret milliliters.

   Multiply the buret milliliters by any normally used factors to calculate the concentration (e.g., oz/gal or g/L).

   For example, adapt a buret procedure that normally uses about 20 mL of a 0.4 N titrant to the digital titrator. Try an 8.0 N titration cartridge.

   Digits necessary = $(0.4 \times 20 \text{ mL} \times 800) \div 8.0 = 800$ digits

   Decrease the sample size to ¼ the normal size to decrease the digits necessary to 200. After the titration, calculate the equivalent buret milliliters with the second equation. If the digits necessary is 205:

Buret milliliters = (205 × 8.0) ÷ (800 × 0.4) = 5.13 mL

Multiply the 5.13 mL by 4 to adjust for the decrease in the sample size:

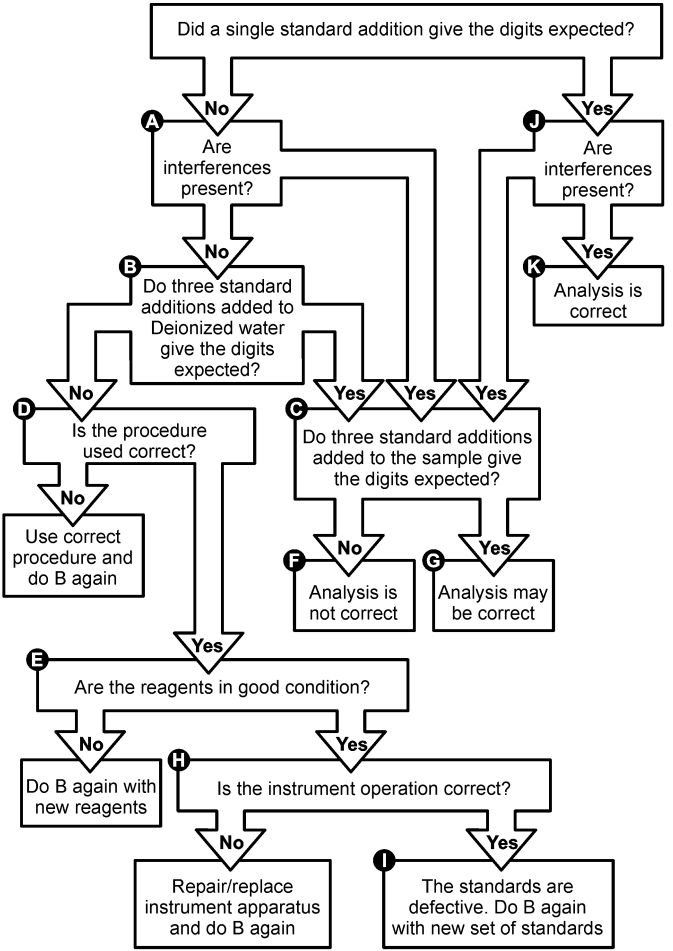
5.13 mL × 4 = 20.5 mL

If the buret method multiplies the number of milliliters of titrant by a factor to calculate the concentration of the sample, multiply 20.5 by that factor.

Section 7 Troubleshooting

If the actual number of digits necessary is not within 1% of the expected number of digits during an accuracy check, refer to Figure 6.

Figure 6 Troubleshooting



Branch	Procedure	Answer
A	Refer to the interferences given in the titration procedure for the parameter.	If interferences are not present or thought to not be present, go to Branch B. If interferences are present, go to Branch C.
B	Titrate deionized water with no standard added, then do three standard additions. Refer to the *Accuracy check* section of the procedure for the steps. Record the digits necessary for each titration. Refer Table 1. Complete the table with the equation: Total standard added mg/L = (Total standard added mL ÷ Sample volume mL) × Standard concentration mg/L Where: **Total standard added mL**—The volume of standard at each addition **Sample volume mL**—The volume of deionized water **Standard concentration mg/L**—The concentation of the standard **Example:** For the chloride procedure, silver nitrate method, add 0, 0.1, 0.2, then 0.3 mL of 12,500-mg/L chloride standard to 50.0 mL of deionized water. Titrate to the end point after each 0.1 mL standard addition.	The chemicals, apparatus, procedures and standards are in good working condition if the total standard added (mg/L) increments the same amount for each standard addition. If the expected increments between the additions are seen, go to Branch C. If the results did not give the expected increments, go to Branch D.
C	Titrate the sample with no standard added, then do three standard additions. Refer to the *Accuracy check* section of the procedure for the steps. Record the digits necessary for the titration end point. Refer Table 1. Then, complete the table with the equation from Branch B.	If the expected increments between the additions are seen, go to Branch G. If the results did not give the expected increments, go to Branch F.
D	Carefully check the instructions or directions for use of the procedure. Make sure that the correct techniques, reagents, titrant, sample volume and digit multiplier were used. Make sure that there is no air or liquid in the delivery tube other than the titrant. Eject several drops of titrant.	If the procedure is found to be in error, do Branch B again with the correct procedure. If the procedure is found to be correct, go to Branch E.

Branch	Procedure	Answer
E	Check the performance of the reagents. Use a known standard solution to do the test or use a new fresh lot of the reagent.	If the reagents used were defective, do Branch B again with new reagents. If the reagents are in good condition, go to Branch H.
F	Non-equal increments between standard additions shows that interferences are in the sample. Refer to Figure 7. In Plot A and B, the four data points are not in a straight line (linear). Plot A shows an interference that becomes gradually worse as the concentration of the standard increases. This type of interference is not common and may be caused by an error or malfunction of the procedure, reagents or apparatus. Do Branch B again to make sure that an interference is present in the sample. Plot B shows a typical chemical interference, which becomes less or even zero as the concentration of the standard increases. The plot shows the first standard addition was consumed by the interference and the remaining additions gave the correct increase of 25 mg/L for each additional 0.1 mL of standard added. The interference in Plot B could be the result of an error made in the standard addition. Do the analysis again with a fresh sample.	Refer to the *Interferences* section of the procedure for the steps to remove the interferences or use a different method that uses a different type of chemistry.

Branch	Procedure	Answer
G	Plots C and D are examples of equal increments between standard additions. Refer to Figure 7. Plots C and D show the effect of interferences on the standard addition and on the substances in the sample. Plot C shows a typical interference with a uniform effect on the standard and the substances in the sample. The four data points form a straight line, but the titration increments between the additions are not correct. Plot D shows the correct results, but may hide a problem for the analyst. The increments found are uniform and the recovery of the standard was complete. If interferences are present, the interference may be sufficient to change the sample result but not sufficient to prevent uniform increments and a complete recovery of the additions. This would be an uncommon situation and results are probably correct, unless unusual interferences are possible.	Refer to the *Interferences* section of the procedure. Apparent interferences can be caused by errors in the method, a defect in the apparatus or standards. To make sure that the interference is chemical in nature, do Branch B again. Other interference effects may also be present or interferences may not be consistent in all samples. Use of another method that is not subject to the interference or remove the interference, which is better than extrapolation or the use of the percent recovery calculation.
H	Check the operation of the instrument used to do the test. Make sure that the correct volumes of sample and standard were used. Check the glassware used in the procedure. Make sure that it is very cleaned. Dirty pipets and graduated cylinders are a source of contamination and will not supply the correct volume.	If a defect is found in the instrument or apparatus, do Branch B again after the instrument or apparatus is repaired or replaced. If the instrument and apparatus are found to be in good condition, go to Branch I.
I	The procedure, reagents and apparatus are in good condition and work correctly. The cause for the accuracy problem is the standard used.	Prepare or get a new set of standards and do Branch B again.
J	If the standard addition gave the correct result, determine if interferences are present. If interferences are not present, the result of the analysis before to the standard addition is correct.	If interferences are present, go to Branch C.

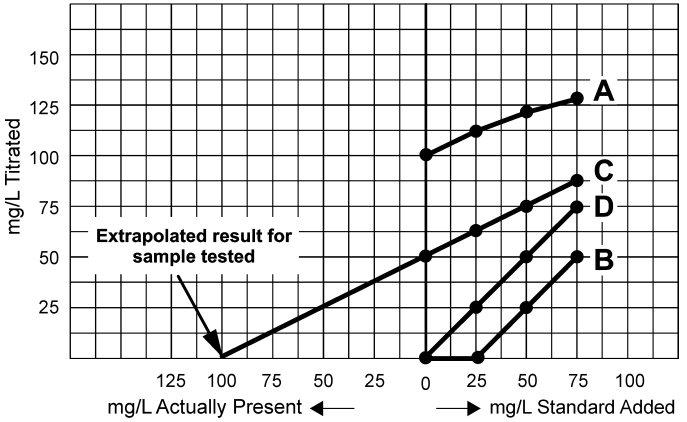
Table 1 Accuracy check data

Total standard added (mL)	Digits necessary	Total standard added (mg/L)	Total parameter found (mg/L)
0		0	
x			

Table 1 Accuracy check data (continued)

Total standard added (mL)	Digits necessary	Total standard added (mg/L)	Total parameter found (mg/L)
2x			
3x			

Figure 7 Standard additions graph



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