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Texas Commission on Environmental Quality

Protecting Texas by Reducing and Preventing Pollution

February 26, 2019

Dr. Cary B. Jackson, Ph.D.
Director of Regulatory Affairs Complex Solutions Strategic Business Development
Hach Company
5600 Lindberg Drive
Loveland, Colorado 80539

Subject: Clarification for the Use of an Alternative Technology to Monitor the Turbidity in Drinking Water Produced by Membrane Units at Public Water Systems in Texas

Dear Dr. Jackson:

On March 16, 2018, the Texas Commission on Environmental Quality (TCEQ) received an email from the Hach Company, dated March 16, 2018, requesting the approval to use an alternative membrane turbidity monitor method to the Hach FilterTrak Method 10133 specified in Title 30 of the Texas Administrative Code (30 TAC) §290.42(g)(3)(C) and 30 TAC §290.111(f)(3)(B) for individual filter effluent turbidity measurements from membrane units provided for pathogen removal. The request is for the use of the following laser turbidimeter manufactured by the Hach Company (Hach), which does not utilize Hach FilterTrak (FT) Method 10133:

- Hach TU5400 sc.

Your submittal included the method for the Hach TU5400 sc turbidimeter, the Hach TU5400 sc instrument manual, test site data and a validation study report submitted to the Environmental Protection Agency (EPA) for the approval of alternative test procedures for the analysis of contaminants under the Safe Drinking Water Act. In addition, the TCEQ notes that the Federal Register, Vol. 81, No. 138, Thursday, July 19, 2016, Rules and Regulations, contains EPA approval for the Hach TU5400 sc turbidimetric method (Hach Method 10258). The TCEQ evaluated the information submitted by Hach to consider the use of the Hach turbidity measurement method as an alternative membrane turbidity monitor method to the Hach FT Method 10133.

Based on the TCEQ review of the supporting information submitted by Hach, the proposed Hach method and turbidimeter described below are **approved** by the TCEQ as an alternative membrane turbidity monitor method and technology for individual filter effluent turbidity measurements from membrane units provided for pathogen removal, as required by 30 TAC §290.42(g)(3)(C) and §290.111(f)(3)(B). A public water system (PWS) <u>will not be required</u> to submit an exception request to the TCEQ Technical Review and Oversight Team for the use of the TCEQ approved Hach method and turbidimeter listed below:

- The Hach Method 10258, Revision 1.0, January 2016, using the Hach TU5400 sc (laser) turbidimeter.
- The Hach Method 10258, Revision 2.0, March 2018, using the Hach TU5400 sc (laser) turbidimeter.

Site Specific Design, Operation, Maintenance and Reporting Requirements

The TCEQ has determined that to satisfy the intent of 30 TAC §290.42(g)(3)(C) and §290.111(f)(3)(B), PWSs that utilize a TCEQ approved Hach turbidimeter will be required to meet TCEQ's rules to use an alternative membrane-turbidity-monitor. The following requirements apply to the use of a Hach TU5400 sc turbidimeter used by a Texas PWS to meet the indirect integrity monitoring requirements for individual filter effluent turbidity measurements from membrane units provided for pathogen removal stated in 30 TAC §290.42(g)(3)(C) and §290.111(f)(3)(B):

- This TCEQ alternative membrane-turbidity-monitor method approval applies only to the Hach methods and turbidimeter stated in this approval letter. The approval does not apply to future revisions of the Hach method and does not apply any design changes to the TU5400 sc turbidimeters;
- Accuracy of an alternative turbidity method turbidimeter must be verified once every seven (7) days, as required by 30 TAC §290.46(s)(2)(B)(iv) and *TCEQ Regulatory Guidance (RG) document 211 (RG-211), Monthly Testing and Reporting at Surface Water Treatment Plants, Section 7.2 Calibrating Instruments and Other Equipment* (Enclosure 1);
- Calibration of the alternative turbidity method turbidimeter must be performed once every ninety (90) days, as required in 30 TAC §290.46(s)(2)(B)(iii), and must meet Quality Control Sample (QCS) criteria specified in the vendor methods;
- Records of calibrations and verifications must be maintained onsite by a PWS for a period of at least three (3) years and be available for TCEQ staff to review upon request as required by 30 TAC §290.46(f)(3)(B)(iv);
- Individual Filter Effluent (IFE) readings must be maintained by a PWS for a period of at least five (5) years and be available for TCEQ staff to review upon request as required by 30 TAC §290.46(f)(3)(C)(iv); and
- Records of a PWS's turbidity monitoring data must be recorded in the PWS Monthly Operating Reports (MOR) and the PWS is required to keep the MOR onsite for ten (10) years, in accordance with 30 TAC §290.46(f)(3)(E)(i). MORs are required to be available for TCEQ staff to review upon request.

Basis for Approving the Request

30 TAC §290.46(s)(2)(B)(iv) contains a provision which allows for the use of a comparison method to verify the accuracy of an online turbidimeter. Guidance for the comparison method in 30 TAC §290.46(s)(2)(B)(iv) is detailed in Section 7.2 of RG–211. RG–211 provides a method for comparing on-line turbidimeters with bench top turbidimeters but does not provide criteria for comparing on-line turbidimeters in use on membrane units with other on-line turbidimeters. The TCEQ used the RG-211 comparison criteria as the basis for determining comparison criteria when the instruments being compared are on-line turbidimeters for use on membrane systems provided for pathogen removal. For the studies summarized in this letter, the criteria in RG–211 was adjusted to account for the low turbidity levels found in water treated by membrane units and the low regulatory turbidity trigger levels set by EPA and TCEQ (see Figure 1).

Figure 1: Comparison Criteria used to Analyze Alternative Turbidity Methods for Individual Filter Effluent Turbidity Measurements from Membrane Units Provided for Pathogen Removal

NTU* Range	Requirement
≤1.0 NTU	On-line turbidimeter reading cannot differ by more than 0.05 NTU from a reference turbidimeter reading (±0.05 NTU difference).
>1.0 NTU	On-line turbidimeter reading cannot differ by more than 10% from a reference turbidimeter reading (±10% difference).

*Nephelometric Turbidity Unit

The decision to approve this turbidimeter for use by Texas PWSs for individual filter effluent turbidity measurements from membrane units provided for pathogen removal was based on the following substantiated documentation. This documentation was used to determine if the Hach TU5400 sc turbidimeter generated results that are comparable to a Hach FT 660 turbidimeter.

- Dr. Cary B. Jackson, Director of Regulatory Affairs Complex Solutions Strategic Business Development of the Hach Company, submitted the following information for the TU5400 sc turbidimeter:
    - The Hach Method 10258, Determination of Turbidity by 360°Nephelometry, Revision 1.0, January 2016, which is the applicable method for the Hach TU5400 sc turbidimeter.
    - The Hach Method 10258, Determination of Turbidity by 360°Nephelometry, Revision 2.0, March 2018, which is the applicable method for the Hach TU5400 sc turbidimeter.
    - The Federal Register, Vol. 81, No. 138, Tuesday, July 19, 2016, where the Hach 10258 method is approved by the EPA as "equally effective as the approved Hach FilterTrak Method 10133."
    - The Hach TU5400 sc Basic User Manual, Edition 4, March 2017. The manual contains specifications, operation details, calibration, and calibration verification instructions for the Hach TU5400 sc turbidimeter.
    - Report of Hach Method 10258, Measurement of Turbidity in Drinking Water by 360 Degree Nephelometry, December 5, 2014. This is the validation study submitted by Hach to the EPA, which summarizes results obtained from the comparison of a Hach TU5400 sc turbidimeter with a turbidimeter using the EPA approved Hach Filter Trak Method 10133. The Federal Register, Vol. 81, No. 138, Tuesday, July 19, 2016, Rules and Regulations document denotes the Hach Company 2014 validation study report as the source of the information used to base the EPA approval of the Hach 10258 method as "equally effective as the approved Hach FilterTrak Method 10133." This report contains response summary graphs which display data comparison of each turbidimeter in a study. In addition, the report includes appendices which contain:
        - Hach Method 10133;
        - Hach Method 10258;
        - Proof of Concept Results and Validation Study Plan, Draft Study Plan for the Validation of Hach Method 10258, Determination of Turbidity in Water Using 360° Nephelometry;
        - Test Stand Fluidics Diagram: This diagram denotes how the matrix spike solution is delivered to the turbidimeters used in comparison testing;
        - Validation Study Standard Operating Procedure, Standard Operating Procedure for the Validation Study of Hach Method 10258, which contains photographic instructions of the procedure used to perform the comparison testing;
        - Log Sheets: These are the raw data sheets used to collect information during testing, such as standard lot numbers and turbidimeter models / serial numbers;
        - Matrix Spike Data: This is the test site comparison raw data which is presented in a series of tables in Appendix G. The comparison data is derived from testing which was performed at seven (7) facilities. Due to the request to use an alternative membrane turbidity monitor method and technology for individual filter effluent turbidity measurements from membrane units provided for pathogen removal, only comparison data from

the following facilities using membrane filtration was reviewed by the TCEQ:

- Facility 2M: Located in southeast Netherlands;
- Facility 3M: Located in Westphalia, Germany;
- Facility 5M: Larimer County, west of Loviland, Colorado; and
- Facility 7M: Adams County, east of Bighton, Colorado.

Please note that the TCEQ did not use the Facility 1M: Dusseldorf, Germany data in this review due to differences in the study protocol.

The test site data includes the following:

- Quality assurance information, to include standard traceability information, and analytical results for calibration verification and quality control standards; and
- Spike recovery comparisons between a Hach TU5400 sc and a Hach FT 660 turbidimeter.

Facility 2M: The results of the tests conducted at the Facility 2M water treatment plant are summarized in Tables 1 and 2. The data included a total of 1098 measurements recorded using primary standards to create solutions containing 0.00141 and 0.09361 NTU (calculated turbidity concentrations).

Table 1: Facility 2M Comparison of 0.00141 NTU Calculated Turbidity Concentration from Hach FT 660 and Hach TU5400 sc turbidimeters

Turbidimeter	Average Result of 0.00141 NTU Spike	0.00141 NTU Range of %Recovery	%Difference from Hach FT 660 (AVG)	Minimum %Difference from Hach FT 660	Maximum %Difference from Hach FT 660
Hach FT 660	0.00114 NTU	53.1 - 92.6% or 0.00075 - 0.00131 NTU	n/a	n/a	n/a
Hach TU5400 sc	0.00119 NTU	61.7 - 104.7% or 0.00087 - 0.00148 NTU	4.92% or 0.00011 NTU	0.00% or 0.00000 NTU	23.3% or 0.00046 NTU

Table 2: Facility 2M Comparison of 0.09361 NTU Calculated Turbidity Concentration from Hach FT 660 and Hach TU5400 sc turbidimeters

Turbidimeter	Average Result of 0.09361 NTU Standard	0.09361 NTU Range of % Recovery	%Difference from Hach FT 660 (AVG)	Minimum % Difference from Hach FT 660	Maximum % Difference from Hach FT 660
Hach FT 660	0.10341 NTU	103.8 - 116.8% or 0.09717 - 0.10934 NTU	n/a	n/a	n/a
Hach TU5400 sc	0.10041 NTU	100.5 - 113.8% or 0.09406 - 0.10651 NTU	1.36% or 0.00278 NTU	0.16% or 0.00032 NTU	2.41% or 0.00503 NTU

The spike recovery comparisons at 0.00141 and 0.09361 NTU demonstrate that at turbidity levels below 0.15 NTU, the Hach TU5400 sc turbidimeter **produces comparable results** to a Hach FT 660 turbidimeter. The maximum NTU difference documented in the 0.00141 and 0.09361 NTU comparisons is 0.00503 NTU, which is well below the 0.05 NTU turbidimetric comparison criteria stated in Figure 1 for this study. Additionally, the review of the study notes that %recoveries outside of 90 - 110% where obtained in the 0.00141 and 0.09361 NTU comparisons, with differences that meet the comparison criteria stated in Figure 1.

Table 3: Facility 2M Comparison of 0.49174 NTU Calculated Turbidity Concentration from Hach FT 660 and Hach TU5400 sc turbidimeters

Turbidimeter	Average Result of 0.49174 NTU Standard	0.49174 NTU Range of % Recovery	%Difference from Hach FT 660 (AVG)	Minimum % Difference from Hach FT 660	Maximum % Difference from Hach FT 660
Hach FT 660	0.50306 NTU	96.6 - 108.7% or 0.47500 - 0.0.53437 NTU	n/a	n/a	n/a
Hach TU5400 sc	0.49043 NTU	94.4 - 110.5% or 0.46397 - 0.54352 NTU	1.49% or 0.01485 NTU	0.002% or 0.00002 NTU	4.44% or 0.04517 NTU

The 0.500 NTU comparison study detailed in Table 3 is greater than 0.15 NTU, thus the study was evaluated using the ±10% calibration verification standard criteria detailed in the Hach 10258 Methods. The Hach TU5400 sc readings were also compared to their respective Hach FT 660 readings using the Figure 1 study criteria of ±0.05 NTU difference for readings less than 1.04 (≤1.0) NTU.

- All of the Hach TU5400 sc turbidity readings yielded differences of less than 0.05 NTU from their respective Hach FT 660 readings and only one of the 610 readings evaluated by the TCEQ was outside of the ±10% calibration verification standard criteria detailed in the Hach 10258 Methods.

The TCEQ notes that while RG-211 contains a provision which allows for the use of a laboratory-based comparison method to verify the accuracy of an online turbidimeter, none of the Hach comparison studies included the comparison of an on-line turbidimeter to a calibrated benchtop turbidimeter. Verification with secondary standards is also acceptable and was performed for all of the comparison studies submitted by Hach, as documented in Tables 4, 8 12, and 16.

Table 4: Facility 2M Quality Control Samples

Day	Verification Standard	Hach TU5400 sc	Hach FT 660
Day 1	1 NTU	0.993 NTU	
	10 NTU	9.85 NTU	
	20 NTU	19.8 NTU	
	0.807 NTU		0.783 NTU
Day 2	10 NTU	9.99 NTU	
	0.807 NTU		0.873 NTU
	0.82611 NTU		0.814 NTU
Day 3	10 NTU	9.83 NTU	
	0.82611 NTU		0.822 NTU
Day 4	10 NTU	9.93 NTU	
	0.82611 NTU		0.9138 NTU

In addition, the following was noted regarding the quality control sample (QCS) analyses detailed in Table 4:

- The Hach FT 660 turbidimeter was factory calibrated and verified prior to comparisons studies utilizing the Hach Stablcal standard listed in Table 4;
- The Hach TU5400 sc turbidimeter was factory calibrated and verified prior to comparisons studies utilizing the Hach Stablcal standards listed in Table 4;
- The Hach Stablcal QCS samples are formazin standards prepared by the Hach Company, which certifies all standards and issues a certificate of analysis; and
- The accuracy of the two turbidimeters was verified according to the study protocol of ±10%. All but one of the verification standards, the 0.82611 NTU Stablcal standard for the Hach FT 660 analyzed on Day 4, met the ±10% criteria detailed in the Hach Method. The non-compliant Day 4 verification standard indicates the need to re-calibrate the Hach FT 660. Verification standard requirements are detailed in 30 TAC §290.46(s)(2)(B)(iv) and apply to on-line instruments used for compliance testing.

Facility 3M: The results of the tests conducted at the Facility 3M water treatment plant are summarized in Tables 5 and 6. The data included total of 1830 measurements recorded using primary standards to create solutions containing 0.00164 and 0.10144 NTU (calculated turbidity concentrations).

Table 5: Facility 3M Comparison of 0.00164 NTU Calculated Turbidity Concentration from Hach FT 660 and Hach TU5400 sc turbidimeters

Turbidimeter	Average Result of 0.00164 NTU Spike	0.00164 NTU Range of %Recovery	%Difference from Hach FT 660 (AVG)	Minimum %Difference from Hach FT 660	Maximum %Difference from Hach FT 660
Hach FT 660	0.00138 NTU	67.1 - 105.7% or 0.00011 - 0.00173 NTU	n/a	n/a	n/a
Hach TU5400 sc	0.00137 NTU	60.5 - 104.0% or 0.00010 - 0.00171 NTU	2.32% or 0.00008 NTU	0.00% or 0.00000 NTU	21.5% or 0.00055 NTU

Table 6: Facility 3M Comparison of 0.10144 NTU Calculated Turbidity Concentration from Hach FT 660 and Hach TU5400 sc turbidimeters

Turbidimeter	Average Result of 0.10144 NTU Standard	0.10144 NTU Range of % Recovery	%Difference from Hach FT 660 (AVG)	Minimum % Difference from Hach FT 660	Maximum % Difference from Hach FT 660
Hach FT 660	0.10594 NTU	102.7 - 106.5% or 0.10418 - 0.10802 NTU	n/a	n/a	n/a
Hach TU5400 sc	0.10236 NTU	99.0 - 102.6% or 0.10046 - 0.10409 NTU	1.71% or 0.00357 NTU	1.09% or 0.00229 NTU	2.32% or 0.00489 NTU

The spike recovery comparisons at 0.00164 and 0.10144 NTU demonstrate that at turbidity levels below 0.15 NTU, the Hach TU5400 sc turbidimeter **produces comparable results** to a Hach FT 660 turbidimeter. The maximum NTU difference documented in the 0.00164 and 0.10144 NTU comparisons is 0.00489 NTU, which is well below the 0.05 NTU turbidimetric comparison criteria stated in Figure 1 for this study. Additionally, the review of the study notes that %recoveries outside of 90 - 110% where obtained in the 0.00164 NTU comparison, with differences that meet the comparison criteria stated in Figure 1.

Table 7: Facility 3M Comparison of 0.50101 NTU Calculated Turbidity Concentration from Hach FT 660 and Hach TU5400 sc turbidimeters

Turbidimeter	Average Result of 0.50101 NTU Standard	0.50101 NTU Range of % Recovery	%Difference from Hach FT 660 (AVG)	Minimum % Difference from Hach FT 660	Maximum % Difference from Hach FT 660
Hach FT 660	0.53432 NTU	105.4 - 107.8% or 0.52813 - 0.54013 NTU	n/a	n/a	n/a
Hach TU5400 sc	0.51548 NTU	101.8 - 104.0% or 0.51015 - 0.52084 NTU	1.79% or 0.01883 NTU	1.36% or 0.01426 NTU	2.28% or 0.02390 NTU

The results of the 0.500 NTU comparison study detailed in Table 7 were evaluated using the ±10% calibration verification standard criteria detailed in the Hach 10258 Methods and the Figure 1 study criteria of ±0.05 NTU difference for readings less than 1.04 (≤1.0) NTU.

- All of the Hach TU5400 sc turbidity readings yielded differences of less than 0.05 NTU from their respective Hach FT 660 readings and none of the 610 readings evaluated by the TCEQ were outside of the ±10% calibration verification standard criteria detailed in the Hach 10258 Methods.

Note: The Table 7: Facility 3M Comparison observations also apply to Table 11: Facility 5M Comparison and Table 16: Facility 7M Comparison.

Table 8: Facility 3M Quality Control Samples

Day	Verification Standard	Hach TU5400 sc	Hach FT 660
Day 1	1 NTU	0.969 NTU	
	10 NTU	10.08 NTU	
	20 NTU	19.64 NTU	
	0.826 NTU		0.871 NTU
Day 2	10 NTU	10.03 NTU	
	0.826 NTU		0.809 NTU
Day 3	10 NTU	10.13 NTU	
	0.826 NTU		0.810 NTU
Day 4	10 NTU	9.81 NTU	
	0.826 NTU		0.814 NTU

In addition, the following was noted regarding the QCS analyses detailed in Table 8:

- The Hach FT 660 turbidimeter was factory calibrated and verified prior to comparisons studies utilizing the Hach Stablcal standard listed in Table 8;
- The Hach TU5400 sc turbidimeter was factory calibrated and verified prior to comparisons studies utilizing the Hach Stablcal standards listed in Table 8;
- The Hach Stablcal QCS samples are formazin standards prepared by the Hach Company, which certifies all standards and issues a certificate of analysis; and
- The accuracy of the two turbidimeters was verified according to the study protocol of ±10% recovery for all verification standards.

Note: The Table 8: Facility 3M QCS analyses observations also apply to Table 12: Facility 5M Quality Control Samples and Table 16: Facility 7M Quality Control Samples.

Facility 5M: The results of the tests conducted at the Facility 5M water treatment plant are summarized in Tables 9 and 10. The data included a total of 1952 measurements recorded using primary standards to create solutions containing 0.00143 and 0.09656 NTU (calculated turbidity concentrations).

Table 9: Facility 5M Comparison of 0.00143 NTU Calculated Turbidity Concentration from Hach FT 660 and Hach TU5400 sc turbidimeters

Turbidimeter	Average Result of 0.00143 NTU Spike	0.00143 NTU Range of %Recovery	%Difference from Hach FT 660 (AVG)	Minimum %Difference from Hach FT 660	Maximum %Difference from Hach FT 660
Hach FT 660	0.00152 NTU	52.4 - 149.4% or 0.00075 - 0.00214 NTU	n/a	n/a	n/a
Hach TU5400 sc	0.00147 NTU	48.8 - 169.1% or 0.00070 - 0.00242 NTU	6.60% or 0.00019 NTU	0.00% or 0.00000 NTU	31.2% or 0.00067 NTU

Table 10: Facility 5M Comparison of 0.09656 NTU Calculated Turbidity Concentration from Hach FT 660 and Hach TU5400 sc turbidimeters

Turbidimeter	Average Result of 0.09656 NTU Standard	0.09656 NTU Range of % Recovery	%Difference from Hach FT 660 (AVG)	Minimum % Difference from Hach FT 660	Maximum % Difference from Hach FT 660
Hach FT 660	0.10886 NTU	109.1 - 116.7% or 0.10532 - 0.11268 NTU	n/a	n/a	n/a
Hach TU5400 sc	0.10756 NTU	99.8 - 133.3% or 0.09064 - 0.12876 NTU	0.90% or 0.00196 NTU	0.01% or 0.00002 NTU	8.64% or 0.02049 NTU

The spike recovery comparisons at 0.00143 and 0.09656 NTU demonstrate that at turbidity levels below 0.15 NTU, the Hach TU5400 sc turbidimeter **produces comparable results** to a Hach FT 660 turbidimeter. The maximum NTU difference documented in the 0.00143 and 0.09656 NTU comparisons is 0.02049 NTU, which is well below the 0.05 NTU turbidimetric comparison criteria stated in Figure 1 for this study. Additionally, the review of the study notes that %recoveries outside of 90 - 110% where obtained in the 0.00143 and 0.09656 NTU comparisons, with differences that meet the comparison criteria stated in Figure 1.

Table 11: Facility 5M Comparison of 0.48865 NTU Calculated Turbidity Concentration from Hach FT 660 and Hach TU5400 sc turbidimeters

Turbidimeter	Average Result of 0.48865 NTU Standard	0.48865 NTU Range of % Recovery	%Difference from Hach FT 660 (AVG)	Minimum % Difference from Hach FT 660	Maximum % Difference from Hach FT 660
Hach FT 660	0.53543 NTU	106.5 - 110.8% or 0.52052 - 0.54118 NTU	n/a	n/a	n/a
Hach TU5400 sc	0.53152 NTU	102.5 - 124.4% or 0.50082 - 0.60788 NTU	0.56% or 0.00596 NTU	0.00% or 0.00003 NTU	5.80% or 0.06667 NTU

The results of the 0.500 NTU comparison study detailed in Table 11 were evaluated using the ±10% calibration verification standard criteria detailed in the Hach 10258 Methods and the Figure 1 study criteria of ±0.05 NTU difference for readings less than 1.04 (≤1.0) NTU.

- All but one of the Hach TU5400 sc turbidity readings yielded differences of less than 0.05 NTU from their respective Hach FT 660 readings and 24 of the 610 readings evaluated by the TCEQ were outside of the ±10% calibration verification standard criteria detailed in the Hach 10258 Methods.

Table 12: Facility 5M Quality Control Samples

Day	Verification Standard	Hach TU5400 sc	Hach FT 660
Day 1	1 NTU	1.09 NTU	
	10 NTU	10.34 NTU	
	20 NTU	20.64 NTU	
	0.786 NTU		0.851 NTU
Day 2	10 NTU	10.31 NTU	
	0.786 NTU		0.861 NTU
Day 3	10 NTU	10.27 NTU	
	0.786 NTU		0.842 NTU
Day 4	10 NTU	10.36 NTU	
	0.786 NTU		0.852 NTU

All of the verification standards in Table 12 met the ±10% study protocol criteria.

Facility 7M: The results of the tests conducted at the Facility 7M water treatment plant are summarized in Tables 13 and 14. The data included a total of 2440 measurements recorded using primary standards to create solutions containing 0.00151 and 0.09870 NTU (calculated turbidity concentrations).

Table 13: Facility 7M Comparison of 0.00151 NTU Calculated Turbidity Concentration from Hach FT 660 and Hach TU5400 sc turbidimeters

Turbidimeter	Average Result of 0.00151 NTU Spike	0.00151 NTU Range of %Recovery	%Difference from Hach FT 660 (AVG)	Minimum %Difference from Hach FT 660	Maximum %Difference from Hach FT 660
Hach FT 660	0.00143 NTU	5.50 - 163.5% or 0.00008 - 0.00247	n/a	n/a	n/a
Hach TU5400 sc	0.00148 NTU	0.20 - 230.1% or 0.00003 - 0.00348 NTU	27.5% or 0.00053 NTU	0.03% or 0.00000 NTU	99.9% or 0.00199 NTU

Table 14: Facility 7M Comparison of 0.09870 NTU Calculated Turbidity Concentration from Hach FT 660 and Hach TU5400 sc turbidimeters

Turbidimeter	Average Result of 0.09870 NTU Standard	0.09870 NTU Range of % Recovery	%Difference from Hach FT 660 (AVG)	Minimum % Difference from Hach FT 660	Maximum % Difference from Hach FT 660
Hach FT 660	0.10612 NTU	104.7 - 114.3% or 0.10334 - 0.11282 NTU	n/a	n/a	n/a
Hach TU5400 sc	0.10409 NTU	100.6 - 116.7% or 0.09934 - 0.11516 NTU	1.00% or 0.00210 NTU	0.001% or 0.00000 NTU	4.40% or 0.00970 NTU

The spike recovery comparisons at 0.00151 and 0.09870 NTU demonstrate that at turbidity levels below 0.15 NTU, the Hach TU5400 sc turbidimeter **produces comparable results** to a Hach FT 660 turbidimeter. The maximum NTU difference documented in the 0.00151 and 0.09870 NTU comparisons is 0.00970 NTU, which is well below the 0.05 NTU turbidimetric comparison criteria stated in Figure 1 for this study. The review of the study does note that while %recoveries outside of 90 - 110% where obtained in the 0.00151 and 0.09870 NTU comparisons, the maximum difference obtained based on the Range of % Recovery was 0.00970 NTU, which is well below the comparison criteria stated in Figure 1. In addition, the 0.00151 NTU study exhibited much more variability than the 1st Level 0.0015 NTU studies for the 2M, 3M, and 5M facilities. Due to the variability, results included in the following categories were excluded from the TCEQ evaluation:

- A matrix spike result which generated a negative matrix spike recovery; and
- A matrix spike result which varied drastically from a previous and subsequent reading.

Table 15: Facility 7M Comparison of 0.48080 NTU Calculated Turbidity Concentration from Hach FT 660 and Hach TU5400 sc turbidimeters

Turbidimeter	Average Result of 0.48080 NTU Standard	0.48080 NTU Range of % Recovery	%Difference from Hach FT 660 (AVG)	Minimum % Difference from Hach FT 660	Maximum % Difference from Hach FT 660
Hach FT 660	0.52394 NTU	107.8 - 110.1% or 0.51827 - 0.52941 NTU	n/a	n/a	n/a
Hach TU5400 sc	0.51647 NTU	105.7 - 110.6% or 0.50843 - 0.53166 NTU	0.74% or 0.00766 NTU	0.08% or 0.00090 NTU	1.63% or 0.01688 NTU

The comparison studies did include a comparison at the 0.500 NTU level, which is detailed in Table 15. The Hach TU5400 sc readings were compared to their respective Hach FT 660 readings using the Figure 1 study criteria of ±0.05 NTU difference for readings less than 1.04 (≤1.0) NTU.

- All of the Hach TU5400 sc turbidity readings yielded differences of less than 0.05 NTU from their respective Hach FT 660 readings and one of the 610 readings evaluated by the TCEQ were outside of the ±10% calibration verification standard criteria detailed in the Hach 10258 Methods.

Table 16: Facility 7M Quality Control Samples

Day	Verification Standard	Hach TU5400 sc	Hach FT 660
Day 1	1 NTU	1.02 NTU	
	10 NTU	10.43 NTU	
	20 NTU	20.72 NTU	
	0.786 NTU		0.852 NTU
Day 2	10 NTU	10.48 NTU	
	0.786 NTU		0.847 NTU
Day 3	10 NTU	10.50 NTU	
	0.786 NTU		0.849 NTU
Day 4	10 NTU	10.44 NTU	
	0.786 NTU		0.862 NTU
	1 NTU	1.05 NTU	
	20 NTU	20.68 NTU	

All of the verification standards in Table 16 met the ±10% study protocol criteria.

- The final appendix includes email correspondence, which provided clarification regarding the following:
    - An email dated April 3, 2018 from Dr. Cary B. Jackson, of the Hach Company, which included Federal Register Expedited Approval of Alternative Test Procedures documentation, the December 5, 2014 Report of Hach Method 10258 submitted to the EPA, and Hach Method 10258. The Federal Register document does include the approval of Hach Method 10258 and cites the December 5, 2014 report as the basis for EPA approval;
    - An email dated April 12, 2018 from Ms. Megan Baxter and Dr. Cary B. Jackson, of the Hach Company which included Hach Method 10258 and turbidimeter details, to include manuals and technical specifications; and
    - Emails dated October 15, 16, and 17, 2018 from Mr. Richard E. Leggett containing detailed Excel reports for all comparison testing performed by Hach. The Excel reports were used by the TCEQ to perform the evaluation of the comparison testing between the Hach FT 660 and Hach TU5400 sc turbidimeters.

Conclusion: The comparability studies data indicate that the Hach TU5400 sc turbidimeter is adequate for meeting the requirements in 30 TAC §290.111(f)(2)(D)(v) for reading turbidity levels in the 0.15 NTU range for direct integrity testing of a membrane unit when using Hach Method 10258, Revision 1.0 (January, 2016) and Revision 2.0 (March, 2018).

Approval for Use in Texas

Please provide a copy of this letter to each of your Texas PWS customers. This letter is **not approval** of:

- Future revisions to the TCEQ approved Hach methods or design changes to the approved turbidimeter;

- Software updates. If there are software updates that impact the method, this TCEQ approval does not cover future revisions of the TCEQ approved Hach methods;

- The use of an unapproved Hach turbidimeter(s) by a Texas PWS to report regulatory individual filter effluent turbidity data from water produced by a membrane unit used for pathogen removal, or

- Changes to a membrane filtration plant. Prior to initiating changes to a treatment plant, a water system is required to notify the TCEQ of the changes, submit plan and specifications to the TCEQ Plan Review Team, and receive TCEQ approval. Plans and specification documentation (engineering documents and other public water system information) can be submitted directly to:

  Ms. Vera Poe, P.E., Team Leader
  Plan Review Team (MC 159)
  Texas Commission on Environmental Quality
  P.O. Box 13087
  Austin, Texas 78711-3087

  Additional information regarding the TCEQ plans and specification process is available on the TCEQ website:

  https://www.tceq.texas.gov/drinkingwater/planrev.html

If you have any questions concerning this letter, or if we can be of additional assistance, please contact Mr. Richard Bosch, at Richard.Bosch@tceq.texas.gov, by telephone at (512) 239-3465, or by correspondence at the following address:

Technical Review & Oversight Team (MC 159)
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

Sincerely,

Joel Kumpp, Manager
Plan & Technical Review Section
Water Supply Division
Texas Commission on Environmental Quality

JPK/rb

Enclosure 1: *TCEQ Regulatory Guidance (RG) document 211 (RG-211), Monthly Testing and Reporting at Surface Water Treatment Plants, Section 7.2 Calibrating Instruments and Other Equipment*

Enclosure 1

RG-211
Revised May 2013

Monthly Testing and Reporting at Surface Water Treatment Plants

(Forms TCEQ-00102-C, -00103, -10276, -10277, and -10278)

Water Supply Division

Texas Commission on Environmental Quality

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7.2 Calibrating Instruments and Other Equipment

Before you can effectively use your performance data, it must be accurate. One of the most important ways to ensure this accuracy is to keep your instruments and equipment properly calibrated and maintained. Consequently, we have established some minimum calibration requirements for lab equipment and flowmeters.

Turbidity Meters

Once every three months, you must calibrate your turbidimeter in accordance with the manufacturer's directions. This quarterly calibration must be conducted using primary turbidity standards. If you are using a benchtop turbidimeter, you must restandardize your secondary standards each time that you calibrate the unit with primary standards.

If you are using a benchtop turbidimeter to collect data that you report to us, you must check its calibration with a primary or secondary standard each time that you run a series of samples. If the unit is not giving an accurate reading, you must recalibrate it with primary standards.

If you are using online turbidimeters to collect data that you report to us, you must also check the calibration of your turbidimeter once per week using a primary or a secondary standard, the manufacturer's proprietary calibration device, or by using the following procedure:

1. Check the calibration of the bench-scale turbidity meter with a primary or secondary standard.
2. Record the turbidity reading shown on the online monitor.
3. Collect a sample from the inlet or outlet of the online monitor.
4. Measure and record the turbidity of the sample from the online monitor.
5. Compare the turbidity readings from the two instruments.
    a. If the values differ by more than 0.10 NTU:*
        i. Follow the manufacturer's instructions and recalibrate both the online and bench turbidimeters using primary turbidity standards.
        ii. Repeat Steps 1–6. If the values still differ by more than 0.10 NTU,* contact the instrument's manufacturer for further instructions.
    b. If the values differ by no more than 0.10 NTU,* complete calibration of the units is not required.
6. If a continuous recorder is used, compare the value reported by the recorder with the value reported by the monitor.
    a. If the values differ by more than 0.05 NTU,* adjust the recorder.
    b. If the values differ by 0.05 NTU,* or less, no adjustment of the recorder is needed.

* If the comparison is conducted when turbidity levels are above 1.0 NTU, you may accept differences of up to 10% when comparing the results of two turbidimeters and of up to 5% when comparing the recorder results with that of the turbidimeter.

Regardless of which method you use to check the calibration of the online turbidimeter, you must recalibrate the unit using primary standards if the unit is not providing an accurate reading.