

Report

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# Comparative Study of Nitrate Test Strips

## 1. Summary / Abstract

In the following study, QUANTOFIX® Nitrate 250 test strips (REF 91366) from MACHEREY-NAGEL (MN) and Reflectoquant®\* Nitrate Test test strips (REF 1.16971) from Merck\* were tested and compared for their accuracy and precision in determining nitrate values in aqueous solutions. The operators (with and without laboratory experience) performed comparative tests with spiked solutions.

After evaluating the results, the operators were able to correctly determine the nitrate value of the test solutions visually with the product QUANTOFIX® Nitrate 250 test strips (MN) with a rate of 89 % (100 % for ±1 bin).

The operators were also able to determine the nitrate value of the test solutions reflectometrically with the product QUANTOFIX® Nitrate 250 test strips (MN) with 4.9 % average deviation from the reference value and an average standard deviation of 9.4 %. For the Reflectoquant®\* Nitrate Test test strips (Merck\*), these values were 6.8 % average deviation from the reference value and 8.3 % average standard deviation.

## 2. Study Design

In this usability study, two nitrate test strips of the products above were compared. The study details can be found in the following chapters.

### 2.1. Objective

The objective of this study is to determine the accuracy and precision of the QUANTOFIX® Nitrate 250 and Reflectoquant®\* Nitrate Test test strips when used by different types of operators.

### 2.2. Products

The following products were compared (Table 1).

Table 1: List of the products compared.

Product	QUANTOFIX® Nitrate 250	Reflectoquant®* Nitrate Test
company	MACHEREY-NAGEL	Merck*
item number	REF 91366	REF 1.16971
visual gradations [mg/L NO <sub>3</sub> <sup>-</sup> ]	0 • 5 • 10 • 25 • 50 • 100 • 250	n/a
LOT	3662505	41246171

### 2.3. Operators

13 (f: 4, m: 9) of our employees aged between 18 and 55 were selected as test operators. 7 of the 13 participants already had laboratory experience in handling test strips. 6 of the 13 participants were without laboratory experience.

Table 2: Details of the operators.

	Quantity
n (number of operators)	13
gender (f/m)	4/9
without/with laboratory experience	6/7

### 3. Results

#### 3.1. Visual Evaluation

To verify the accuracy of the color scale, the nitrate concentration of a total of 9 unknown aqueous samples was determined visually by 13 operators using QUANTOFIX® Nitrate 250 test strips and the results of this visual evaluation were compared to the actual nitrate values of the samples. Reflectoquant®\* Nitrate Test test strips are not designed for visual evaluation and are not considered in this chapter.

The samples were prepared using a nitrate standard (Certipur®\* Nitrate Standard Solution 1000 mg/L, REF 1.19811). Two intermediate values were evaluated, for which both the color block above and the color block below are considered correct.

The results are summarized in Table 3.

The overall exact agreement for the samples tested is 89 % and the overall agreement within ±1 bin is 100 %.

Table 3: Summary of visual evaluation results using QUANTOFIX® Nitrate 250 test strips.

		Visual evaluation result									Exact agreement [%]	Agreement ±1 bin [%]
NO <sub>3</sub> <sup>-</sup> -conc. [mg/L]		0	5	10	25	40	50	100	150	250		
Target value	0	13	0	0	0	0	0	0	0	0	100	100
	5	0	10	3	0	0	0	0	0	0	77	100
	10	0	1	11	1	0	0	0	0	0	85	100
	25	0	0	1	12	0	0	0	0	0	92	100
	40	0	0	0	7	*	6	0	0	0	100	100
	50	0	0	0	0	2	11	0	0	0	85	100
	100	0	0	0	0	0	3	8	2	0	62	100
	150	0	0	0	0	0	0	7	*	6	100	100
	250	0	0	0	0	0	0	0	0	13	100	100
									mean values	89	100	

\*intermediate values between color block concentrations

### 3.2. Reflectometric Evaluation

To verify the accuracy and precision of the reflectometric evaluation, the nitrate concentration of a total of 9 unknown aqueous samples was determined by up to 13 operators using a system of QUANTOFIX® Nitrate 250 test strips and the QUANTOFIX® Relax instrument and the results of this evaluation were compared to the actual nitrate values of the samples.

Additionally, the samples were analyzed using the system consisting of Merck\* Reflectoquant® Nitrate Test test strips and the RQflex® 20 instrument and the results were compared. Details of the used instruments are shown in Table 4.

Table 4: Details of the instruments used.

	MN	Merck*
instrument name	QUANTOFIX® Relax	RQflex® 20
item number	REF 91346	REF 1.17246
reflectometric measuring range [mg/L NO <sub>3</sub> <sup>-</sup> ]	4 – 250	5 – 225
instrument numbers	QR31429, QR31432	S/N 18010038, S/N 23050084

The samples were prepared using a nitrate standard (Certipur® Nitrate Standard Solution 1000 mg/L, REF 1.19811) and their nitrate values were determined in duplicate using NANOCOLOR® Nitrate Tests (REF 985065, REF 985066 or REF 985064). In the study, measurements were taken across the entire measurement range of the systems. The results of both systems are comparable. The Merck\* system demonstrates a slightly higher precision, with an average standard deviation of 8.3 mg/L (the MN system gives 9.4 mg/L), while MN demonstrates a higher accuracy, with an average deviation of 4.9 % (the Merck\* system gives 6.8 %).

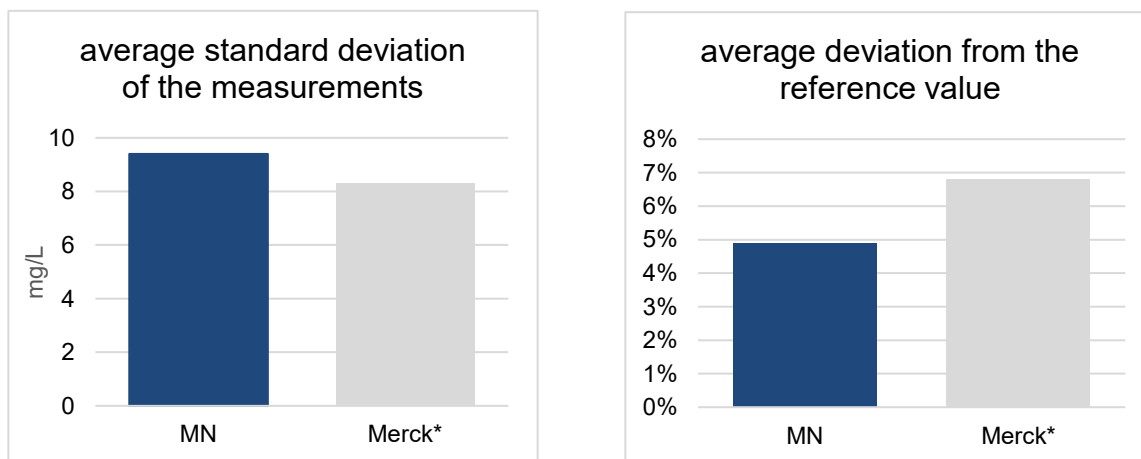


Figure 1: Standard deviation and deviation from reference value using MN and Merck\* test systems (average values over the full measuring range).

## 4. Conclusion

This comparative study shows that MACHEREY-NAGEL's QUANTOFIX® Nitrate 250 test strips and the system together with the QUANTOFIX® Relax instrument are equivalent to Merck's Reflectoquant® Nitrate Test test strips (with RQflex® 20 instrument) in terms of precision in water samples and also gives better results in terms of accuracy.

\*Merck, Certipur®, RQflex® and Reflectoquant® are registered trademarks of Merck KGaA, which is in no way affiliated with MACHEREY-NAGEL GmbH & Co. KG.