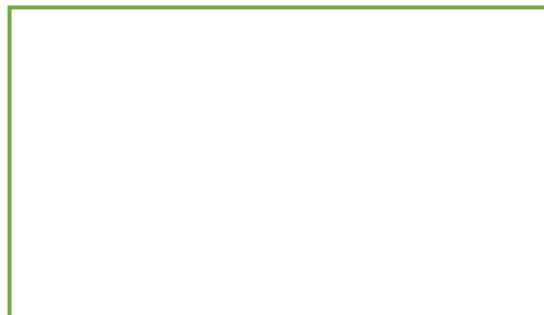




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DI-Check Legionella pneumophila kit

MBK0081 - 100 reactions

INTRODUCTION AND PRODUCT DESCRIPTION

Legionella, which is responsible for Legionellosis, is a gram- bacterium ubiquitously present at low concentration in natural aquatic ecosystems. *Legionella* can easily reach and contaminate man-made aquatic environments, such as buildings water systems, cooling towers and fountains which are important sources of infection for humans. Among the described *Legionella* species, *L. pneumophila* is one of the most important water-based bacterial pathogens in developed countries.

The reference method for enumerating *Legionella* in water is culture, but apart from requiring up to 14 days for analysis. In this context, quantitative real-time PCR is an alternative tool for rapid and accurate detection or quantification of *L. pneumophila* in water samples.

The DI-Check Legionella pneumophila kit is intended for the detection and/or quantification of *L. pneumophila*. The assay is based on dual-labelled real-time PCR technology. Dye-labeled probes target unique DNA sequences specific to *L. pneumophila* and synthetic internal amplification control DNA (IAC). Target DNA, if present, is amplified by PCR and detected in real-time using fluorescent hydrolysis probe chemistry. The fluorescence signal that is generated is detected by the real-time PCR instrument and interpreted by the analysis software.

The kit provides a ready to use PCR mix highly resistant to PCR inhibitors and with an extremely stringent automatic hot-start allowing reaction assembly and temporary storage at room temperature prior to PCR amplification. This robust PCR mix contains an internal control to assess the efficiency of amplification reaction revealing the presence of inhibitory factors in the sample. Quantification of the target *Legionella* species is carried out based on a standard curve covering a concentration range of 25000–25 genome units (GU) per PCR reaction.

Procedure overview

The DI-Check Legionella pneumophila method allows to detect and quantify *L. pneumophila* in all types of water samples in less than four hours. The method is based on 3 steps:

- Water samples filtration using 0.45 µm polycarbonate membrane filter
- DNA extraction using DNAPure Water Isolation kit (code MBK0080)
- PCR amplification for the detection or quantification of *L. pneumophila* DNA using DI-Check Legionella pneumophila kit (code MBK0081)

The performances of the kits are guaranteed when the DNA is extracted using DNAPure Water Isolation kit (code MBK0080).

CONTENTS AND STORAGE

The DI-Check Legionella pneumophila kit allows to detect up to 98 samples. For quantification test the kit contains reagent to quantify 45 samples.

Component	Volume
<i>L. pneumophila</i> PCR Mix	2 x 1200 µL
Standard DNA	1 x 10 µL
Dilution Buffer	5 x 1500 µL
Negative PCR Control	1 x 100 µL
Reference Material	2 x 50 µL

Shipping at room temperature has no detrimental effect on the performance of this kit. Upon arrival, store the kit at -20°C, protect from light. If properly stored, see the expiration date for the stability of the kit.

ADDITIONAL EQUIPMENT AND MATERIAL REQUIRED

Reagents and disposables

- Micropipettes and filter tips,
- Vortexer,
- Micro-centrifuge,
- Powder free gloves,
- 1.5 mL tubes,
- PCR plastics (tubes or PCR plates, sealing tapes and caps) compatible with the PCR cycler to be used.

Instruments and software

- Applied Biosystems™ QuantStudio 96-well (Thermo Fisher Scientific),
- CFX96 Touch™ Real-Time PCR Detection System; CFX96 Touch™ Deepwell detection system (Biorad),
- Rotor-Gene Q (Qiagen),
- DI-Check Analysis Software for *L. pneumophila* Ver 2.2 (Diatheva).

For the use on different PCR cyclers please contact Diatheva.

PRECAUTIONS AND RECOMMENDATIONS

- **For the quantification, it is necessary to test Samples, Negative PCR Control (NTC), Standards and Reference Material in duplicates at each amplification series.**
- The test must be performed by specialised, trained and authorised staff,
- Do not use reagents after the expiry date printed on the label,
- Use gloves as well as sterile pipet tips with filters. Change gloves often, especially if you suspect a possible contamination of them,
- It is suggested to provide separate and dedicated spaces, material and equipment for pre- and post-PCR amplification stages,
- Clean working space periodically with at least 5% sodium hypochlorite or another decontaminant agent.

RELEVANT ASSAY CONTROLS

Internal Amplification Control

Each vial of *L. pneumophila* PCR Mix contains an internal amplification control (IAC) that is co-amplified with the DNA from the sample, allowing to account for the presence of PCR inhibitors in the DNA extract.

Standard DNA

Two vials of Standard DNA are provided to prepare the standard curve. It is provided to allow for 5 independent quantification experiments. The Standard DNA should be diluted to obtain 4 levels of *L. pneumophila* genome unit (GU): 25000, 2500, 250 and 25 GU/5 µL. It is recommended to analyze samples and standards in duplicate.

Positive PCR Control

Positive PCR Control contains purified *L. pneumophila* DNA ATCC®33152. The Positive PCR Control should be included in each qualitative amplification series to verify the success of the amplification step ensuring the confidence in your PCR results.

Reference Material

The Reference Material contains purified *L. pneumophila* ATCC®33152 DNA connected to the Standard Reference Material. The Reference Material is a ready to use DNA solution corresponding to a concentration of 1200 GU/5 µL, that shall be tested according to ISO/TS 12869 standard. During a quantification experiment the verification of the Reference Material genome units ensures preparation of an accurate standard curve and a correct quantification calculation.

Negative PCR Control

Negative PCR Control should be included in each amplification series to check for possible contamination of the assay during reaction setup. Instead of adding sample DNA to a reaction vial containing *L. pneumophila* PCR Mix, add the same volume of Negative PCR Control.

PROCEDURE

1. SAMPLE PREPARATION

1.1 WATER SAMPLE FILTRATION AND DNA EXTRACTION

For sample preparation please refer to the product information of DNApure Water Isolation kit (code MBK0080). DNA sample should be mixed and centrifuged briefly prior to amplification.

1.2. BACTERIAL COLONY (not in the scope of NF VALIDATION)

Real-time PCR could be used for GVPC or BCYE colony confirmation.

- Dispense 100 µL of sterile water *Legionella*-DNA free in a 1.5 mL tube and dissolve the colony using a sterile loop.
- Boil the sample for 10 minutes.
- Centrifuge at 14 000 rpm for 10 minutes.
- Transfer 50 µL of supernatant in a new 1.5 mL tube taking care to do not disrupt the pellet.
- Vortex, centrifuge briefly and use 1 µL of the DNA in the real-time PCR reaction.

2. PCR MIX PREPARATION

2.1 QUALITATIVE TEST

Samples are tested in single. Include in each amplification series a Negative PCR Control (NTC- No template Control) and a Positive PCR Control (Positive Control).

- Thaw the L. pneumophila PCR Mix and Negative PCR Control. Vortex 15" and briefly spin vials in a microcentrifuge before opening.
- Aliquot 20 µL of L. pneumophila PCR mix in the PCR tubes or in the plate prepared for the experiment.

Note: once aliquoted the L. pneumophila PCR mix may be stored for 3 h at 4°C.

- Add 5 µL of Negative PCR Control in the corresponding tube.
- In a separate area, add 5 µL of DNA samples to be tested, into the corresponding PCR tubes or wells containing amplification mixes.
- Add 5 µL of Positive PCR Control (prepared as indicated in section 3) into the corresponding PCR tubes or wells containing amplification mixes.
- Seal hermetically the PCR tubes or plate and load into the real-time PCR instrument, following the manufacturer's instructions.

2.2 QUANTITATIVE TEST

It is necessary to test each Samples, Standards, Negative PCR Control (NTC) and Reference Material (Positive Control) in duplicates.

- Thaw the L. pneumophila PCR Mix and Negative PCR Control. Vortex 15" and briefly spin vials in a microcentrifuge before opening.
- Aliquot 20 µL of L. pneumophila PCR mix in the PCR tubes or in the plate prepared for the experiment.

Note: once aliquoted the L. pneumophila PCR mix may be stored for 3 h at 4°C.

- Add 5 µL of Negative PCR Control in the corresponding tubes.
- In a separate area, add 5 µL of DNA samples to be tested, into the corresponding PCR tubes or wells containing amplification mixes.
- Add 5 µL of standard curve dilutions (prepared as indicated in section 4) into the corresponding PCR tubes or wells containing amplification mixes.
- Seal hermetically the PCR tubes or plate and load into the real-time PCR instrument, following the manufacturer's instructions.

Note: for PCR instrument with 96 wells block check that the reagents are at the bottom of each well, if not, briefly centrifuge at 800 x g for 1 minute.

3. POSITIVE PCR CONTROL PREPARATION (only for qualitative test)

The Standard DNA could be used for the preparation of Positive PCR Control:

- Thaw one vial of Dilution Buffer and Standard DNA,
- Vortex 10" and briefly spin the vial in a microcentrifuge before opening Standard DNA,
- Pipette 998.7 µL of Dilution Buffer into a 1.5 mL tube,
- Pipette 1.3 µL of Standard DNA into the STD1 tube,
- Vortex 10" and centrifuge briefly.

Note: Once prepared the Positive PCR Control could be stored at -20°C for 3 months.

4. STANDARD CURVE PREPARATION (only for quantitative test)

The Standard DNA and Dilution Buffer reagents are provided to prepare the standard curve. In a separate area proceed with the preparation of serial dilutions to create the standard curve.

Standard	Concentration to be entered as standard [GU/5 μ L]
<i>25000</i>	25000 GU/5 μ L
<i>2500</i>	2500 GU/5 μ L
<i>250</i>	250 GU/5 μ L
<i>25</i>	25 GU/5 μ L

- Thaw one vial of Dilution Buffer and Standard DNA,
- Vortex 10" and briefly spin the vial in a microcentrifuge before opening Standard DNA,
- Prepare four 1.5 mL tubes in series named from *25000* to *25*,
- Pipette 998.7 μ L of Dilution Buffer into tube *25000* and 90 μ L into the three remaining tubes (*2500*, *250*, *25*),
- Pipette 1.3 μ L of Standard DNA into the *25000* tube,
- Vortex 10" and centrifuge briefly,
- Pipette 10 μ L from tube *25000* into tube *2500*,
- Vortex 10" and centrifuge briefly,
- Repeat steps, to complete the dilution series for *250* and *25*.

Note: Once prepared the standard curve solutions could be stored at 4°C for 3 hours.

Continue with Section:

- A. QuantStudio:** if you work with real-time PCR instrument QuantStudio 96-wells
- B. CFX:** if you work with real-time PCR instrument CFX96 Touch™ Real-Time PCR Detection System; CFX96 Touch™ Deepwell detection system
- C. Rotor-Gene Q:** if you work with real-time PCR instrument Rotor-Gene Q

Section A: QuantStudio

5. PROGRAM SETUP

Program PCR instrument before preparing the reaction mix.

Use the following real-time PCR-protocol for the DI-Check Legionella pneumophila kit. For details on how to program the experimental protocol, see the Instrument Operator's Manual of your real-time PCR cyclers:

Step	Temperature and times	Cycles
Initial denaturation	95°C	1 X
Denaturation	3 min	45 X
	95°C	
Annealing-extension	15 sec	
	60°C	
	90 sec	

Fluorescence is detected during annealing-extension step on green channel (FAM dye) for *L. pneumophila* and yellow channel (VIC dye) for Internal Amplification Control.

Select ROX as passive reference dye and specify the type of probes quencher. The DI-Check Legionella pneumophila kit contains probes with a non-fluorescent quencher (NFQ).

6. PLATE SETUP

Define the plate set-up.

Qualitative Test: Fill in information in each well according to the table below

Controls and Samples	Task	Sample Name
Negative PCR Control	NTC	NTC
Positive PCR Control	Unknown	Positive Control
Sample	Unknown	Assign different names to different samples

Quantitative Test: Fill in information in each well according to the table below

Controls, Standards and Samples	Task	Sample Name
Negative PCR Control	NTC	NTC
Reference Material	Unknown	Reference Material
Standard	Standard	25000, 2500, 250, 25
Sample	Unknown	Assign different names to different samples

Check that the instrument is ready and start the run.

7. DATA ANALYSIS

The analysis of the results must be done with the program of the PCR instrument, please refer to the manual for detailed information.

- Analyse the PCR run for the two fluorophores separately, positioning the threshold as indicated in the table below:

Threshold Value	
<i>L. pneumophila</i> FAM	Internal Amplification Control VIC
0.3	0.05

- Select "Export" function. In the opened window, please check that (*.xls) is selected in File Type, select the Location and click on the upper right "Export" function.
- Open the generated excel file. Open the "Results" sheet.
- In the Task column, for Qualitative Test assign the name "Positive control" to Positive PCR Control. For quantitative Test assign the name "Positive control" to Reference Material, moreover, for the Standard (25000, 2500, 250 and 25) assign the task "standard" also for VIC (Internal Amplification Control).
- Copy the lines from line (Well, Well position, Omit...) of the excel sheet and proceed with the DI-Check Analysis Software Ver 2.2 for *L. pneumophila* according to the section below.

8. INTERPRETATION AND EXPRESSION OF RESULTS

Using the DI-Check Analysis Software Ver 2.2 for *L. pneumophila* the interpretation of samples and controls will be performed automatically.

- Open the DI-Check Analysis Software Ver 2.2 for *L. pneumophila*
- Select QuantStudio function and paste the copied data, from excel file, on cell A1 in the "insert data QS" sheet of the DI-Check Analysis Software Ver 2.2 for *L. pneumophila*
- Click on "Qualitative analysis" box for Qualitative Test or "Quantitative analysis" box for Quantitative Test. The Quantitative analysis requires that the function "Selection unlock" is activated using the following password "Diatheva".

8.1 QUALITATIVE TEST

a. Quality Control

Before proceeding with the analysis of samples, check the validity of controls. If the software DI-Check Analysis Software Ver 2.2 for *L. pneumophila* shows that both controls are "OK", the operator can proceed with the result interpretation of samples. Otherwise, if controls are "KO", the PCR is invalid and must be repeated (see table below).

Control type	Control validity	<i>L. pneumophila</i> result	Internal Amplification Control result
Negative PCR Control	OK	N/A*	27≤Ct≤37
	OK	Ct>Intercept value**	27≤Ct≤37
	KO	Ct<Intercept value**	Non-significant
Positive PCR Control	OK	20≤Ct≤30	Non-significant
	KO	20>Ct>30	Non-significant

* N/A means "Not Applicable". The software indicates N/A when the fluorescence curve doesn't rise above the threshold.

**The intercept value to be considered in the context of Qualitative analysis is Ct=43. This value is used to give an indication of the intercept value chosen during the validation.

b. Samples

Sample results shall be interpreted as shown in the table below

Interpretation using the software DI-Check Analysis Software Ver 2.2 for <i>L. pneumophila</i>			Interpretation without using the software DI-Check Analysis Software Ver 2.2 for <i>L. pneumophila</i> (not in the scope of NF VALIDATION)	
<i>Detection of L. pneumophila</i>	<i>Inhibition</i>	<i>Results and expression per Liter (GU/L)</i>	<i>L. pneumophila result</i>	<i>Internal Amplification Control result</i>
Positive	Inhibition	L. pneumophila detected	Ct≤Intercept value*	Non-significant
	No Inhibition			
Negative	No Inhibition	L. pneumophila not detected	Ct>Intercept value*	27≤Ct≤37
	Inhibition-Redo test	Inhibition. Dilute the extracted DNA using Elution Buffer (MBK0080) or PCR grade water and repeat PCR amplification	Ct>Intercept value*	Ct>37

* The intercept value to be considered in the context of Qualitative analysis is Ct=43. This value is used to give an indication of the intercept value chosen during the validation.

c. Detection limit of the molecular method (LOD_{meth})

The limit of detection of the PCR step corresponds to the smallest number of genome units that provides a positive PCR result at the 90% threshold (ISO/TS 12869:2019). The LOD of the PCR step is 5 GU per 5 µL of extracted DNA. The LOD of the method (LOD_{meth}) depends on the volume of water sample filtered according to the following formula:

$$\text{LOD}_{\text{meth}} = \frac{5 \times F \times D}{V}$$

Where:

F = conversion factor GU/5 µL to GU/L. The F conversion factor of DNAPure Water Isolation kit (MBK0080) is 64. For more information refer to the manual of the kit.

V= volume of water sample filtered expressed in litres.

D= DNA dilution factor (if the DNA has been diluted before PCR run).

8.2 QUANTITATIVE TEST

a. Controls and Standard

Before proceeding with the analysis of the samples, check the validity of controls and Standard curve. If the software DI-Check Analysis Software Ver 2.2 for *L. pneumophila* shows that parameters are "OK", the operator can proceed with the result interpretation of samples. Otherwise, if parameters are "KO", the PCR is invalid and must be repeated (see table below).

Parameter	Quality Control validity	<i>L. pneumophila</i> result	Internal Amplification Control result
Negative PCR Control	OK	N/A ^a	$27 \leq Ct \leq 37$
	OK	$Ct > \text{Intercept value}^b$	$27 \leq Ct \leq 37$
	KO	$Ct < \text{Intercept value}^b$	Non-significant
Slope	$-3.75 \leq \text{Slope} \leq -3.00$	$-3.75 \leq \text{Slope} \leq -3.00$	Non-significant
Correlation coefficient (R^2)	≥ 0.95	≥ 0.95	
Reference Material	OK	$601 \leq \text{GU/well} \leq 2398^c$	Non-significant
	KO	$601 \geq \text{GU/well} \geq 2398^c$	Non-significant
LOQ	OK	Compliant to ISO-TS 12869 standard	Non-significant
	KO	Compliant to ISO-TS 12869 standard	Non-significant

^a N/A means "Not Applicable". The software indicates N/A when the fluorescence curve doesn't rise above the threshold

^b The intercept value to be considered in the context of Quantitative analysis is systematically calculated in the calibration function of the amplification run.

^c The Reference Material shall be tested according to ISO-TS 12869 standard

The above values were determined during the method validation.

b. Samples

Detection of <i>L. pneumophila</i> N GU/5 μL	Inhibition ^a	<i>L. pneumophila</i> detection Results and expression per liter (GU/L) ^b	Note
N < 5	No Inhibition	LQ <i>L. pneumophila</i> not detected	Refer to paragraph 8.2.d for LOD _{meth} calculation
	Inhibition	LQ The sample DNA shall be diluted and PCR run repeated	
$5 \leq N < 25$	No Inhibition	LQ <i>L. pneumophila</i> detected below the limit of quantification	Refer to paragraph 8.2.d for LOD _{meth} calculation
	Inhibition	LQ The sample DNA shall be diluted and PCR run repeated	
$25000 \geq N \geq 25$	No Inhibition	<i>L. pneumophila</i> quantitatively detected	Refer to paragraph 8.2.c
	Inhibition	The sample DNA shall be diluted and PCR run repeated	
N > 25000	No Inhibition	<i>L. pneumophila</i> detected above the upper limit of quantification	Refer to paragraph 8.2.d for UQL _{meth} calculation. The quantification can be obtained after DNA dilution
	Inhibition	The sample DNA shall be diluted and PCR run repeated	

^a For the interpretation of results without using the software DI-Check Analysis Software Ver 2.2 for *L. pneumophila* (not in the scope of NF VALIDATION), the Internal Amplification Control (VIC) is compliant if $27 \leq Ct \leq 37$, (No Inhibition).

^b Please if the sample has been diluted the Result GU/L must be multiplied by the dilution factor

c. Calculation of *L. pneumophila* concentration in water samples

The software DI-Check Analysis Software Ver 2.2 for *L. pneumophila* automatically calculate the *L. pneumophila* GU/L by entering the filtered water volume (mL) in the column "Filtration volume" for each sample.

To calculate the amount of *L. pneumophila* in the water sample analysed without using the software DI-Check Analysis Software Ver 2.2 for *L. pneumophila* (not in the scope of NF VALIDATION), it is necessary to consider (1) the volume of sample filtered in litres and (2) the F conversion factor. The F conversion factor of DNAPure Water Isolation kit (MBK0080) is 64. For more information refer to the manual of the kit.

The instrument software automatically calculates the amount of GU of *L. pneumophila* per reaction (in 5 μL), this value corresponds to **N** parameter. To obtain the *L. pneumophila* GU contained in 1 Liter please use the following formula:

$$L. pneumophila \text{ Genome Units per liter} = \frac{N \times F \times D}{V}$$

Where:

N= number GU of *L. pneumophila*/5 µL (PCR result)

F = conversion factor GU/5 µL to GU/L.

V= volume of water sample filtered expressed in litres

D= DNA dilution factor (if the DNA has been diluted before PCR run)

Express the results in number of Genome Units of *L. pneumophila* per litre of water sample, considering two significant figures: ex. 12 312 GU/L of *L. pneumophila* is expressed as "12 000 GU/L of *L. pneumophila*".

d. Theoretical detection limit (LOD_{meth}, Quantification limit (LOQ_{meth}), and Upper quantification limit (UQL_{meth}) of the molecular method

The detection limit of the PCR step is 5 GU/5 µL. The LOD of the method (LOD_{meth}) is 320 GU/L when 1 Liter is filtered. LOD_{meth} depends on the volume of water sample filtered and can be calculated according to the following formula:

$$\text{LOD}_{\text{meth}} = \frac{5 \times F}{V}$$

The limit of quantification of the PCR step is 25 GU/5 µL. The LOQ of the method (LOQ_{meth}) is 1600 GU/L when 1 Liter is filtered. The LOQ_{meth} depends on the volume of water sample filtered and can be calculated according to the following formula:

$$\text{LOQ}_{\text{meth}} = \frac{25 \times F}{V}$$

The upper quantification limit of the method (UQL_{meth}) is 1.6 x 10⁶ GU/L when 1 Liter is filtered. The UQL_{meth} can be obtained with the following formula:

$$\text{UQL}_{\text{meth}} = \frac{25\,000 \times F}{V}$$

Where:

F = conversion factor GU/5 µL to GU/L.

V= volume of water sample filtered expressed in litres

Section B: CFX

5. PROGRAM SETUP

Program PCR instrument before preparing the reaction mix.

Use the following real-time PCR-protocol for the DI-Check Legionella pneumophila kit. For details on how to program the experimental protocol, see the Instrument Operator's Manual of your real-time PCR cycler:

Step	Temperature and times	Cycles
Initial denaturation	95°C 3 min	1 X
Denaturation	95°C 15 sec	45 X
Annealing-extension	60°C 90 sec	

Fluorescence is detected during annealing-extension step on green channel (FAM dye) for *L. pneumophila* and yellow channel (HEX dye) for Internal Amplification Control.

6. PLATE SETUP

Define the plate set-up.

Qualitative Test: Fill in information in each well according to the table below

Controls and Samples	Content	Sample
Negative PCR Control	NTC	NTC
Positive PCR Control	Positive Control	Positive Control
Sample	Unknown	Assign different names to different samples

Quantitative Test: Fill in information in each well according to the table below

Controls, Standards and Samples	Content	Sample
Negative PCR Control	NTC	NTC
Reference Material	Positive Control	Reference Material
Standard	Standard	25000, 2500, 250, 25
Sample	Unknown	Assign different names to different samples

Check that the instrument is ready and start the run.

7. DATA ANALYSIS

The analysis of the results must be done with the program of the PCR instrument, please refer to the manual for detailed information.

- Analyse the PCR run for the two fluorophores separately, positioning the threshold as indicated in the table below:

Threshold Value	
<i>L. pneumophila</i> FAM	Internal Amplification Control HEX
200	100

- Select "Export" function. In "Export All Data Sheets" select "Excel 2007" or "Excel 2003" on the bases of your pc excel version. Select the location where save the excel files.
- Open the generated "Quantification Summary" excel file. Open the "0" sheet.
- Copy the entire "0" sheet and proceed with the DI-Check Analysis Software Ver 2.2 for *L. pneumophila* according to the section below.

8. INTERPRETATION AND EXPRESSION OF RESULTS

Using the DI-Check Analysis Software Ver 2.2 for *L. pneumophila* the interpretation of samples and controls will be performed automatically.

- Open the DI-Check Analysis Software Ver 2.2 for *L. pneumophila*.
- Select CFX function and paste the copied "0" sheet in the "insert data CFX" sheet of the DI-Check Analysis Software Ver 2.2 for *L. pneumophila*.
- Click on "Qualitative analysis" box for Qualitative Test or "Quantitative analysis" box for Quantitative Test. The Quantitative analysis requires that the function "Selection unlock" is activated using the following password "Diatheva".

8.1 QUALITATIVE TEST

a. Quality Control

Before proceeding with the analysis of samples, check the validity of controls. If the software DI-Check Analysis Software Ver 2.2 for *L. pneumophila* shows that both controls are "OK", the operator can proceed with the result interpretation of samples. Otherwise, if controls are "KO", the PCR is invalid and must be repeated (see table below).

Control type	Control validity	<i>L. pneumophila</i> result	Internal Amplification Control result
Negative PCR Control	OK	N/A*	27≤Ct≤37
	OK	Ct>Intercept value**	27≤Ct≤37
	KO	Ct<Intercept value**	Non-significant
Positive PCR Control	OK	20≤Ct≤30	Non-significant
	KO	20>Ct>30	Non-significant

* N/A means "Not Applicable". The software indicates N/A when the fluorescence curve doesn't rise above the threshold.

**The intercept value to be considered in the context of Qualitative analysis is Ct=42. This value is used to give an indication of the intercept value chosen during the validation.

b. Samples

Sample results shall be interpreted as shown in the table below

Interpretation using the software DI-Check Analysis Software Ver 2.2 for <i>L. pneumophila</i>			Interpretation without using the software DI-Check Analysis Software Ver 2.2 for <i>L. pneumophila</i> (not in the scope of NF VALIDATION)	
<i>Detection of L. pneumophila</i>	<i>Inhibition</i>	<i>Results and expression per Liter (GU/L)</i>	<i>L. pneumophila result</i>	<i>Internal Amplification Control result</i>
Positive	Inhibition	<i>L. pneumophila</i> detected	Ct≤Intercept value*	Non-significant
	No Inhibition			
Negative	No Inhibition	<i>L. pneumophila</i> not detected	Ct>Intercept value*	27≤Ct≤37
	Inhibition-Redo test	Inhibition. Dilute the extracted DNA using Elution Buffer (MBK0080) or PCR grade water and repeat PCR amplification	Ct>Intercept value*	Ct>37

* The intercept value to be considered in the context of Qualitative analysis is Ct=42. This value is used to give an indication of the intercept value chosen during the validation.

c. Detection limit of the molecular method (LOD_{meth})

The limit of detection of the PCR step corresponds to the smallest number of genome units that provides a positive PCR result at the 90% threshold (ISO/TS 12869:2019). The LOD of the PCR step is 5 GU per 5 µL of extracted DNA. The LOD of the method (LOD_{meth}) depends on the volume of water sample filtered according to the following formula:

$$LOD_{meth} = \frac{5 \times F \times D}{V}$$

Where:

F = conversion factor GU/5 µL to GU/L. The F conversion factor of DNAPure Water Isolation kit (MBK0080) is 64. For more information refer to the manual of the kit.

V= volume of water sample filtered expressed in litres.

D= DNA dilution factor (if the DNA has been diluted before PCR run).

8.2 QUANTITATIVE TEST

a. Controls and Standard

Before proceeding with the analysis of the samples, check the validity of controls and Standard curve. If the software DI-Check Analysis Software Ver 2.2 for *L. pneumophila* shows that parameters are "OK", the operator can proceed with the result interpretation of samples. Otherwise, if parameters are "KO", the PCR is invalid and must be repeated (see table below).

Parameter	Quality Control validity	L. pneumophila result	Internal Amplification Control result
Negative PCR Control	OK	N/A ^a	27≤Ct≤37
	OK	Ct>Intercept value ^b	27≤Ct≤37
	KO	Ct<Intercept value ^b	Non-significant
Slope	-3.75≤ Slope ≤-3.00	-3.75≤ Slope ≤-3.00	Non-significant
Correlation coefficient (R ²)	≥0.95	≥0.95	
Reference Material	OK	601≤ GU/well ≤2398 ^c	Non-significant
	KO	601≥ GU/well ≥2398 ^c	Non-significant
LOQ	OK	Compliant to ISO-TS 12869 standard	Non-significant
	KO	Compliant to ISO-TS 12869 standard	Non-significant

^a N/A means "Not Applicable". The software indicates N/A when the fluorescence curve doesn't rise above the threshold

^b The intercept value to be considered in the context of Quantitative analysis is systematically calculated in the calibration function of the amplification run.

^c The Reference Material shall be tested according to ISO-TS 12869 standard

The above values were determined during the method validation.

b. Samples

Detection of <i>L. pneumophila</i> N GU/5 µL	Inhibition ^a	<i>L. pneumophila</i> detection Results and expression per liter (GU/L) ^b		Note
N < 5	No Inhibition	LQ	<i>L. pneumophila</i> not detected	Refer to paragraph 8.2.d for LOD _{meth} calculation
	Inhibition	LQ	The sample DNA shall be diluted and PCR run repeated	
5 ≤ N < 25	No Inhibition	LQ	<i>L. pneumophila</i> detected below the limit of quantification	Refer to paragraph 8.2.d for LOD _{meth} calculation
	Inhibition	LQ	The sample DNA shall be diluted and PCR run repeated	
25000 ≥ N ≥ 25	No Inhibition		<i>L. pneumophila</i> quantitatively detected	Refer to paragraph 8.2.c
	Inhibition		The sample DNA shall be diluted and PCR run repeated	
N > 25000	No Inhibition		<i>L. pneumophila</i> detected above the upper limit of quantification	Refer to paragraph 8.2.d for UQL _{meth} calculation. The quantification can be obtained after DNA dilution
	Inhibition		The sample DNA shall be diluted and PCR run repeated	

^a For the interpretation of results without using the software DI-Check Analysis Software Ver 2.2 for *L. pneumophila* (not in the scope of NF VALIDATION), the Internal Amplification Control (HEX) is compliant if 27≤ Ct ≤37, (No Inhibition).

^b Please if the sample has been diluted the Result GU/L must be multiplied by the dilution factor

c. Calculation of *L. pneumophila* concentration in water samples

The software DI-Check Analysis Software Ver 2.2 for *L. pneumophila* automatically calculate the *L. pneumophila* GU/L by entering the filtered water volume (mL) in the column "Filtration volume" for each sample.

To calculate the amount of *L. pneumophila* in the water sample analysed without using the software DI-Check Analysis Software Ver 2.2 for *L. pneumophila* (not in the scope of NF VALIDATION), it is necessary to consider (1) the volume of sample filtered in litres and (2) the F conversion factor. The F conversion factor of DNAPure Water Isolation kit (MBK0080) is 64. For more information refer to the manual of the kit.

The instrument software automatically calculates the amount of GU of *L. pneumophila* per reaction (in 5 µL), this value corresponds to N parameter. To obtain the *L. pneumophila* GU contained in 1 Liter please use the following formula:

$$L. pneumophila \text{ Genome Units per liter} = \frac{N \times F \times D}{V}$$

Where:

N= number GU of *L. pneumophila*/5 µL (PCR result)
F = conversion factor GU/5 µL to GU/L.
V= volume of water sample filtered expressed in litres
D= DNA dilution factor (if the DNA has been diluted before PCR run)

Express the results in number of Genome Units of *L. pneumophila* per litre of water sample, considering two significant figures: ex. 12 312 GU/L of *L. pneumophila* is expressed as "12 000 GU/L of *L. pneumophila*".

d. Theoretical detection limit (LOD_{meth}, Quantification limit (LOQ_{meth}), and Upper quantification limit (UQL_{meth}) of the molecular method

The detection limit of the PCR step is 5 GU/5 µL. The LOD of the method (LOD_{meth}) is 320 GU/L when 1 Liter is filtered. LOD_{meth} depends on the volume of water sample filtered and can be calculated according to the following formula:

$$\text{LOD}_{\text{meth}} = \frac{5 \times F}{V}$$

The limit of quantification of the PCR step is 25 GU/5 µL. The LOQ of the method (LOQ_{meth}) is 1600 GU/L when 1 Liter is filtered. The LOQ_{meth} depends on the volume of water sample filtered and can be calculated according to the following formula:

$$\text{LOQ}_{\text{meth}} = \frac{25 \times F}{V}$$

The upper quantification limit of the method (UQL_{meth}) is 1.6 x 10⁶ GU/L when 1 Liter is filtered. The UQL_{meth} can be obtained with the following formula:

$$\text{UQL}_{\text{meth}} = \frac{25\,000 \times F}{V}$$

Where:

F = conversion factor GU/5 µL to GU/L.

V= volume of water sample filtered expressed in litres

Section C: Rotor-Gene Q

5. PROGRAM SETUP

Program PCR instrument before preparing the reaction mix. Use the following real-time PCR-protocol for the DI-Check Legionella pneumophila kit. For details on how to program the experimental protocol, see the Instrument Operator's Manual of your real-time PCR cyclers:

Step	Temperature and times	Cycles
Initial denaturation	95°C 3 min	1 X
Denaturation	95°C 15 sec	45 X
Annealing-extension	60°C 90 sec	

Fluorescence is detected during annealing-extension step on green channel (FAM dye) for *L. pneumophila* and yellow channel (VIC dye) for Internal Amplification Control.

For Rotor-Gene Q instruments that allows the gain optimization on the acquiring channels, set the gain optimization on NTC sample (tube position 1).

6. PLATE SETUP

Define the plate set-up.

Qualitative Test: Fill in information in each well according to the table below

Controls and Samples	Type	Name
Negative PCR Control	NTC	NTC
Positive PCR Control	Positive Control	Positive Control
Sample	Unknown	Assign different names to different samples

Quantitative Test: Fill in information in each well according to the table below

Controls, Standards and Samples	Type	Name
Negative PCR Control	NTC	NTC
Reference Material	Positive Control	Reference Material
Standard	Standard	25000, 2500, 250, 25
Sample	Unknown	Assign different names to different samples

Check that the instrument is ready and start the run.

7. DATA ANALYSIS

The analysis of the results must be done with the program of the PCR instrument, please refer to the manual for detailed information.

- Analyse the PCR run for the two fluorophores separately, positioning the threshold as indicated in the table below:

Threshold Value	
<i>L. pneumophila</i> FAM	Internal Amplification Control VIC
0.085	0.18

- In "Quantitation Results" window, click the right mouse button and select "Export to excel". Select the location where save the excel file. Export data for both fluorescent channels (FAM and VIC), two separates excel files are saved.
- Open the generated excel files.
- Copy the lines from line (No, Name, Type...) of the opened excel file obtained for the FAM dye. For the VIC dye proceed to copy the lines without line (No, Name, Type...), and proceed with the DI-Check Analysis Software Ver 2.2 for *L. pneumophila* according to the section below.

8. INTERPRETATION AND EXPRESSION OF RESULTS

Using the DI-Check Analysis Software Ver 2.2 for *L. pneumophila* the interpretation of samples and controls will be performed automatically.

- Open the DI-Check Analysis Software Ver 2.2 for *L. pneumophila*

- Select Rotor-Gene Q function and paste the copied FAM excel data on cell A1 of the "insert data 36" sheet of the DI-Check Analysis Software Ver 2.2 for *L. pneumophila*
- Paste the copied VIC excel data immediately below the FAM pasted data in the "insert data 36" sheet of the DI-Check Analysis Software Ver 2.2 for *L. pneumophila*
- Click on "Qualitative analysis" box for Qualitative Test or "Quantitative analysis" box for Quantitative Test. The Quantitative analysis requires that the function "Selection unlock" is activated using the following password "Diatheva".

8.1 QUALITATIVE TEST

a. Quality Control

Before proceeding with the analysis of samples, check the validity of controls. If the software DI-Check Analysis Software Ver 2.2 for *L. pneumophila* shows that both controls are "OK", the operator can proceed with the result interpretation of samples. Otherwise, if controls are "KO", the PCR is invalid and must be repeated (see table below).

Control type	Control validity	<i>L. pneumophila</i> result	Internal Amplification Control result
Negative PCR Control	OK	N/A*	22≤Ct≤32
	OK	Ct>Intercept value**	22≤Ct≤32
	KO	Ct<Intercept value**	Non-significant
Positive PCR Control	OK	18≤Ct≤28	Non-significant
	KO	18>Ct>28	Non-significant

* N/A means "Not Applicable". The software indicates N/A when the fluorescence curve doesn't rise above the threshold.

**The intercept value to be considered in the context of Qualitative analysis is Ct=38. This value is used to give an indication of the intercept value chosen during the validation.

b. Samples

Sample results shall be interpreted as shown in the table below

Interpretation using the software DI-Check Analysis Software Ver 2.2 for <i>L. pneumophila</i>			Interpretation without using the software DI-Check Analysis Software Ver 2.2 for <i>L. pneumophila</i> (not in the scope of NF VALIDATION)	
<i>Detection of L. pneumophila</i>	<i>Inhibition</i>	<i>Results and expression per Liter (GU/L)</i>	<i>L. pneumophila result</i>	<i>Internal Amplification Control result</i>
Positive	Inhibition	<i>L. pneumophila</i> detected	Ct≤Intercept value*	Non-significant
	No Inhibition	<i>L. pneumophila</i> not detected	Ct>Intercept value*	22≤Ct≤32
Negative	Inhibition-Redo test	Inhibition. Dilute the extracted DNA using Elution Buffer (MBK0080) or PCR grade water and repeat PCR amplification	Ct>Intercept value*	Ct>32

* The intercept value to be considered in the context of Qualitative analysis is Ct=38. This value is used to give an indication of the intercept value chosen during the validation.

c. Detection limit of the molecular method (LOD_{meth})

The limit of detection of the PCR step corresponds to the smallest number of genome units that provides a positive PCR result at the 90% threshold (ISO/TS 12869:2019). The LOD of the PCR step is 5 GU per 5 µL of extracted DNA. The LOD of the method (LOD_{meth}) depends on the volume of water sample filtered according to the following formula:

$$\text{LOD}_{\text{meth}} = \frac{5 \times F \times D}{V}$$

Where:

F = conversion factor GU/5 µL to GU/L. The F conversion factor of DNAPure Water Isolation kit (MBK0080) is 64. For more information refer to the manual of the kit.

V= volume of water sample filtered expressed in litres.

D= DNA dilution factor (if the DNA has been diluted before PCR run).

8.2 QUANTITATIVE TEST

a. Controls and Standard

Before proceeding with the analysis of the samples, check the validity of controls and Standard curve. If the software DI-Check Analysis Software Ver 2.2 for *L. pneumophila* shows that parameters are "OK", the operator can proceed with the result interpretation of samples. Otherwise, if parameters are "KO", the PCR is invalid and must be repeated (see table below).

Parameter	Quality Control validity	<i>L. pneumophila</i> result	Internal Amplification Control result
Negative PCR Control	OK	N/A ^a	22 ≤ Ct ≤ 32
	OK	Ct > Intercept value ^b	22 ≤ Ct ≤ 32
	KO	Ct < Intercept value ^b	Non-significant
Slope	-3.75 ≤ Slope ≤ -3.00	-3.75 ≤ Slope ≤ -3.00	Non-significant
Correlation coefficient (R ²)	≥ 0.95	≥ 0.95	
Reference Material	OK	601 ≤ GU/well ≤ 2398 ^c	Non-significant
	KO	601 ≥ GU/well ≥ 2398 ^c	Non-significant
LOQ	OK	Compliant to ISO-TS 12869 standard	Non-significant
	KO	Compliant to ISO-TS 12869 standard	Non-significant

^a N/A means "Not Applicable". The software indicates N/A when the fluorescence curve doesn't rise above the threshold

^b The intercept value to be considered in the context of Quantitative analysis is systematically calculated in the calibration function of the amplification run.

^c The Reference Material shall be tested according to ISO-TS 12869 standard

The above values were determined during the method validation.

b. Samples

Detection of <i>L. pneumophila</i> N GU/5 µL	Inhibition ^a	<i>L. pneumophila</i> detection Results and expression per liter (GU/L) ^b	Note
N < 5	No Inhibition	LQ <i>L. pneumophila</i> not detected	Refer to paragraph 8.2.d for LOD _{meth} calculation
	Inhibition	LQ The sample DNA shall be diluted and PCR run repeated	
5 ≤ N < 25	No Inhibition	LQ <i>L. pneumophila</i> detected below the limit of quantification	Refer to paragraph 8.2.d for LOD _{meth} calculation
	Inhibition	LQ The sample DNA shall be diluted and PCR run repeated	
25000 ≥ N ≥ 25	No Inhibition	<i>L. pneumophila</i> quantitatively detected	Refer to paragraph 8.2.c
	Inhibition	The sample DNA shall be diluted and PCR run repeated	
N > 25000	No Inhibition	<i>L. pneumophila</i> detected above the upper limit of quantification	Refer to paragraph 8.2.d for UQL _{meth} calculation. The quantification can be obtained after DNA dilution
	Inhibition	The sample DNA shall be diluted and PCR run repeated	

^a For the interpretation of results without using the software DI-Check Analysis Software Ver 2.2 for *L. pneumophila* (not in the scope of NF VALIDATION), the Internal Amplification Control (VIC) is compliant if 22 ≤ Ct ≤ 32, (No Inhibition).

^b Please if the sample has been diluted the Result GU/L must be multiplied by the dilution factor

c. Calculation of *L. pneumophila* concentration in water samples

The software DI-Check Analysis Software Ver 2.2 for *L. pneumophila* automatically calculate the *L. pneumophila* GU/L by entering the filtered water volume (mL) in the column "Filtration volume" for each sample.

To calculate the amount of *L. pneumophila* in the water sample analysed without using the software DI-Check Analysis Software Ver 2.2 for *L. pneumophila* (not in the scope of NF VALIDATION), it is necessary to consider (1) the volume of sample filtered in litres and (2) the F conversion factor. The F conversion factor of DNAPure Water Isolation kit (MBK0080) is 64. For more information refer to the manual of the kit.

The instrument software automatically calculates the amount of GU of *L. pneumophila* per reaction (in 5 µL), this value corresponds to N parameter. To obtain the *L. pneumophila* GU contained in 1 Liter please use the following formula:

$$L. pneumophila \text{ Genome Units per liter} = \frac{N \times F \times D}{V}$$

Where:

N= number GU of *L. pneumophila*/5 µL (PCR result)

F = conversion factor GU/5 µL to GU/L.

V= volume of water sample filtered expressed in litres

D= DNA dilution factor (if the DNA has been diluted before PCR run)

Express the results in number of Genome Units of *L. pneumophila* per litre of water sample, considering two significant figures: ex. 12 312 GU/L of *L. pneumophila* is expressed as "12 000 GU/L of *L. pneumophila*".

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The detection limit of the PCR step is 5 GU/5 µL. The LOD of the method (LOD_{meth}) is 320 GU/L when 1 Liter is filtered. LOD_{meth} depends on the volume of water sample filtered and can be calculated according to the following formula:

$$\text{LOD}_{\text{meth}} = \frac{5 \times F}{V}$$

The limit of quantification of the PCR step is 25 GU/5 µL. The LOQ of the method (LOQ_{meth}) is 1600 GU/L when 1 Liter is filtered. The LOQ_{meth} depends on the volume of water sample filtered and can be calculated according to the following formula:

$$\text{LOQ}_{\text{meth}} = \frac{25 \times F}{V}$$

The upper quantification limit of the method (UQL_{meth}) is 1.6 x 10⁶ GU/L when 1 Liter is filtered. The UQL_{meth} can be obtained with the following formula:

$$\text{UQL}_{\text{meth}} = \frac{25\,000 \times F}{V}$$

Where:

F = conversion factor GU/5 µL to GU/L.

V= volume of water sample filtered expressed in litres

9. VALIDATIONS



DI-Check *Legionella pneumophila*
Certificate reference No. DTV 41/01-12/19, with end of validity 04-Dec-2027
WATER ANALYSIS METHODS

The method is validated for the detection and quantification of *L. pneumophila* in all types of water samples, by comparison to the reference method NF T90-471 (2015) and ISO/TS 12869 (2019) and according AFNOR certification's validation protocol for the detection and enumeration of *L. pneumophila* by PCR.

<https://nf-validation.afnor.org/>

10. REFERENCES

1. Ballard, A. L., Fry, N. K., Chan, L., Surman, S. B., Lee, J. V., Harrison, T. G. & Towner, K. J. (2000). Detection of *Legionella pneumophila* using a real-time PCR hybridization assay. *J Clin Microbiol* 38, 4215–4218.
2. ISO/TS 12869:2019 Water quality — Detection and quantification of *Legionella* spp. and/or *Legionella pneumophila* by concentration and genic amplification by quantitative polymerase chain reaction (qPCR).
3. NF T90-471 (06/2015). Water quality - Detection and quantification of *Legionella* and/or *Legionella pneumophila* by concentration and genic amplification by real time polymerase chain reaction (qPCR).