MANUAL

Internal Positive Control (IPC) qPCR quantification kit qPCR detection kit

SYL113

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1. Introduction

The SYL113 Internal Positive Control (IPC) qPCR quantification kit qPCR detection kit, combined with the eTaq flex kit, provides excellent performance for sensitive, robust and accurate qPCR detection. The eTaq flex kit is highly resistant to inhibitory substances commonly found in environmental samples, such as humic acids.

In addition to all components of the eTaq flex kit, this kit contains a primers and probe mix designed to detect a highly specific mitochondrial DNA sequence of Internal Positive Control (IPC) qPCR quantification kit. The primers and probe have been specifically designed and validated for use with eDNA samples. The full validation report is available on the Sylphium website[1].

When this kit is used to support conclusions regarding the absence of the target species, the use of an internal positive control (IPC) is essential. Without an IPC, a negative target result cannot be reliably distinguished from a false-negative result caused by PCR inhibition, DNA degradation, or insufficient DNA recovery during sample processing. For further information on the use and interpretation of controls, refer to **Section 3.2**.

The Internal Positive Control (IPC) qPCR quantification kit has:

- **High resistance to inhibiting factors**. This detection kit uses the **SYL1003 eTaq flex kit**, which is highly resistant to inhibitory substances commonly found in environmental DNA (eDNA) extracts. Standard qPCR mixes may be sensitive to these inhibitors.
- **Strong fluorescence signal with low background noise**. Environmental DNA extracts may contain naturally occurring, auto-fluorescent compounds that can interfere with fluorescence measurements. A strong assay signal is therefore important to minimize the impact of background fluorescence.
- **High analytical sensitivity**. Environmental water samples may contain only very small amounts of target DNA, making high analytical sensitivity essential. The assay has demonstrated detection down to 1-10 target DNA copies per reaction under the validated test conditions.
- **High specificity**. Environmental DNA extracts contain billions of DNA fragments originating from bacteria, protozoa, plants, animals, and other organisms. During primer and probe design, not only closely related species must be considered; all available DNA sequences should be screened for potential nonspecific binding of the primers and probe.

[1] https://sylphium.com/available-downloads/

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1.1. Kit contents, storage, and required equipment

Kit contents:	Required equipment:
• Positive control (cloned target DNA) • Primers & probe mix (10x) (FAM dye) • eTaq DNA polymerase • eTaq qPCR mix • PCR water	• Freezer -20°C • Pipettors • Microcentrifuge (13,000 x *g*) • qPCR machine with FAM detection • PCR cooling rack (optional)

This kit contains sufficient materials for 200 reactions with a final reaction volume of 25 µL. Upon arrival, store all reagents and kit components protected from light at -20°C.

All kits are compatible with major qPCR platforms and are suitable for FAM dye detection on most modern qPCR instruments. They are optimized for use on eDNA isolates purified using **SYL002 Environmental DNA isolation kit**, but also work on isolates purified with other eDNA extraction methods or kits.

1.2. Ordering information

This qPCR detection kit (SYL113), a wide variety of other eDNA qPCR detection kits, eDNA sampling materials and equipment, eTaq flex kits, and eDNA isolation kits can be found and ordered at www.sylphium.com.

1.3. Notices and disclaimers

This product is developed, designed and sold for research purposes only. Sylphium Molecular Ecology B.V. does not take any responsibility and is not liable for any damage caused through use of this product, be it indirect, special, incidental or consequential damages (including but not limited to damages for loss of business, loss of profits, interruption or the like).

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2. Precautions

- **Use separate rooms or PCR cabinets for different workflow steps**. DNA extraction, PCR mix preparation, and amplification should be performed in physically separated areas or dedicated PCR cabinets. In particular, high-concentration positive controls and PCR products should be handled separately to minimize the risk of target DNA contamination. Follow a one-way workflow from clean to potentially contaminated areas. Refer to Appendix B for more details.
- **Prevent DNA contamination**. Before starting an experiment, clean work surfaces and equipment with bleach containing 1% sodium hypochlorite or another suitable DNA-removing agent to remove residual DNA from previous experiments. Wear gloves at all times and clean or replace them between handling different samples. If gloves are cleaned, use a paper towel soaked with diluted bleach.
- **Minimize exposure to light**. Limit light exposure during preparation of PCR mixtures and PCR plates. Primers & probe mixes contain light-sensitive fluorescent probes, and prolonged exposure to light may reduce fluorescence signal intensity.
- **Prevent formation of non-specific products**. Keep the prepared PCR reaction mixture at 0-4°C until amplification to reduce non-specific primer and probe hybridization. Keeping the reaction mixture cooled during preparation may improve assay sensitivity.

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3. Protocol

3.1. Reaction setup

1. **Completely thaw** the eTaq PCR mix (2x), primers & probe mix (10x), positive control, and your sample(s) to ensure that any precipitates are fully dissolved.
2. **Mix all tubes thoroughly** by gentle shaking, then briefly centrifuge them before opening. This ensures that the contents collect at the bottom of the tubes and reduces the risk of spillage.
3. **Prepare the reaction mixture**. Prepare only the amount of reaction mixture required for the analysis, including a few extra reactions to compensate for pipetting losses. For the required volumes, refer to **Table 1**.

Table 1. qPCR reaction setup for a final volume of 25 µL

Component	Volume per reaction
eTaq qPCR mix (2x)	12.5 µL
eTaq DNA polymerase	1 µL
Primers & probe mix (10x)*	2.5 µL
Sample	2-8 µL
ROX Reference Dye§	X µL
PCR grade water	Fill to 25 µL

*When using custom primers & probe mixes, prepare them at 10x the final working concentration. §Not supplied with the kit, refer to your qPCR instrument manual if required. Adjust the volume of PCR-grade water according to the template volume used to obtain the specified final reaction volume.

4. **Mix the prepared reaction mixture** thoroughly but gently to minimize the formation of air bubbles.
5. **Dispense the prepared reaction mixture** into the wells of the PCR plate, using the total reaction volume, minus the template volume per well. To minimize pipetting errors. Use a template volume of at least 2 µL for qualitative assays and at least 5 µL for quantitative assays. Cover the 96-well PCR plate with a seal to protect the reactions from airborne contamination.
6. **Add the template DNA, positive control, or PCR-grade water for the negative control according to the desired plate setup**. To maximize assay sensitivity, minimize the time the reaction mixture is kept at room temperature after addition of the template. The use of a cooling block (approximately 4°C) is recommended.
7. **Briefly centrifuge the plate**, if necessary, to remove air bubbles. These can interfere with fluorescence detection.

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3.2. Controls

PCR positive control (PPC)

The PCR positive control (PPC) consists of PCR reagents to which target species DNA of a known concentration has been added. This control verifies that the qPCR reagents, primers, probe, and amplification conditions function correctly.

At least two positive control reactions should be included each time the kit is used. The PPC must show amplification with the expected Cq value. If the positive control does not show the expected amplification, the results of the qPCR run are considered invalid and the analysis must be repeated.

The positive control contains a relatively high concentration of target DNA and therefore represents a potential source of contamination. To minimize the risk of cross-contamination, add the positive control only after all samples and negative controls have been pipetted and sealed whenever possible. Avoid contact between the positive control and other kit components, samples, equipment, or work surfaces.

PCR negative control (PNC)

The PCR negative control (PNC) consists of PCR reagents without target species DNA. PCR-grade water is added instead of sample DNA. This control is used to detect DNA contamination introduced during preparation of the qPCR reactions.

At least one PCR negative control should be included each time the kit is used. The PNC should not show amplification of target species DNA. Detection of a positive amplification signal indicates possible DNA contamination during preparation of the qPCR reactions. In this case, the results of the qPCR run are considered unreliable, and the analysis should be repeated after identifying and eliminating the potential source of contamination.

Blank procedure

When this qPCR detection kit is used as part of an eDNA workflow, inclusion of a blank procedure control during DNA extraction is recommended. The blank procedure is used to detect DNA contamination introduced during DNA extraction and subsequent analysis. The blank consists of preservation solution without an environmental sample and is processed through all DNA extraction and qPCR analysis steps in the same manner as a regular sample.

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The blank procedure should not show amplification of target species DNA. Detection of target species DNA in the blank indicates that contamination may have occurred during sample processing, DNA extraction, or analysis. In this case, the affected results are considered unreliable and the source of contamination should be investigated before repeating the procedure.

Laboratory work surfaces and equipment should be thoroughly decontaminated before repeating the extraction and analysis.

3.3. Thermal cycling

Table 2. Thermal cycling conditions of the Internal Positive Control (IPC) qPCR quantification kit

Step	Temperature (°C)	Time*	Number of cycles
Initial denaturation	95	5 min	1
Denaturation	95	15 sec	
Annealing	55	15 sec	45
Extension*	72	30 sec	

*Fluorogenic data should be collected during the extension step. *Internal Positive Control (IPC) qPCR quantification kit* DNA is detected in the FAM channel.

In addition to the specific primers and probe mix, this kit contains all components of the **SYL1003 eTaq flex kit**. For a complete description of eTaq flex kit, please refer to corresponding manual on the website[2].

[2] https://sylphium.com/available-downloads/

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4. Interpretation of results

A sample is considered positive when at least one replicate within an analytical series shows positive amplification. Control results must meet the acceptance criteria specified in **Table 4**.

Table 4. Interpretation of assay controls and results

Sample	PPC	PNC	IPC*	Blank§	Result	Action
+	+	-	N/A or +	N/A or -	Positive detection	-
-	+	-	N/A or +	N/A or -	Negative detection	-
-	-	-	N/A or +	N/A	PCR procedure failed	Repeat the PCR procedure
-	+	-	-*	N/A	PCR inhibited, insufficient DNA recovery, or DNA degradation	See **Appendix B**
+	+	-	N/A or +	+§	DNA contamination during DNA extraction	See **Appendix A**
+	+	+	N/A or +	N/A or -	DNA contamination during PCR preparation	See **Appendix A**

PPC: PCR positive control; **PNC**: PCR negative control; "**+**" = positive amplification DNA; "**-**" = no amplification. **IPC**: Internal positive control; **Blank**: blank procedure control; N/A = not applicable or not included. ***** IPC-based interpretation is only applicable when an IPC has been included in the sample workflow and quantified using an appropriate IPC assay. **§** Blank-based interpretation is only applicable when the samples have undergone a DNA extraction workflow in which a blank procedure control was processed alongside the samples. For further explanatory notes see, **Section 3.2**.

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Appendix A: Lab room layout and one-way workflow

To prevent the unwanted spread of target DNA, use separate rooms or dedicated PCR cabinets for DNA extraction, eTaq flex kit preparation, and PCR amplification (**Figure 1**).

Maintain a one-way workflow to minimize the risk of contamination. Do not transfer materials (e.g. pens and markers), consumables, or laboratory equipment (e.g. pipettes) from the DNA extraction area to the eTaq flex kit preparation area. Similarly, do not transfer any materials from the PCR-room to the DNA extraction or eTaq flex kit preparation areas. Color coding of laboratory equipment, lab coats, consumables, and other materials can help maintain this one-way workflow and reduce the risk of cross-contamination. Work instructions and notebooks should also remain within their designated areas. When these rooms are used for activities other than PCR-analysis, personnel should continue to follow the workflow applicable to the PCR areas (**Figure 1**).

In exceptional cases where the transfer of materials, consumables, or laboratory equipment between rooms is unavoidable, thoroughly clean and decontaminate the items using a suitable DNA-removing agent before transfer. Movement should always follow the direction of the workflow, from cleaner areas to more contamination-prone areas.

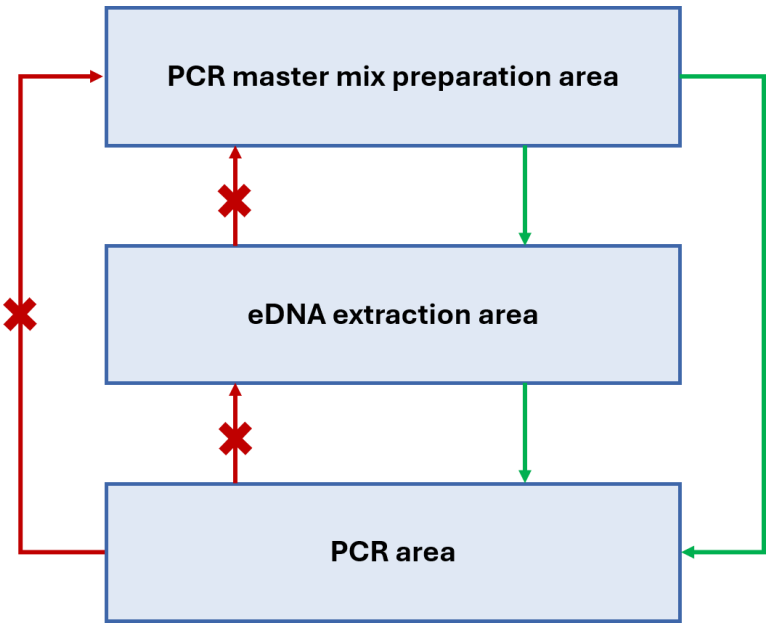


Figure 1. Laboratory room layout and one-way workflow. Transport is permitted only in the direction of the green arrows. Transport in the direction of the red arrows should be avoided, as it increases the risk of target DNA contamination. A dedicated PCR cabinet may function as a separate work area, but the use of physically separated rooms is preferred.

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Appendix B: Steps to overcome inhibition

Environmental samples often contain inhibitory substances, such as humic acids. The eTaq flex kit is highly resistant to these compounds; however, inhibition may still occur in some samples. The absence of a fluorescent signal or an increased Cq value (ΔCq > 2) may indicate PCR inhibition.

There are two main approaches to reduce or overcome inhibition:

1. Dilute the sample

Diluting the DNA-extract reduces the concentration of PCR-inhibitory compounds and may restore reliable amplification. However, dilution also reduces the concentration of target DNA and may therefore decrease the probability of detecting low target concentrations.

2. Use a DNA cleanup kit

Commercial PCR cleanup kits can be used to remove or reduce PCR-inhibitory compounds from the sample. However, the cleanup procedure may result in partial loss of target DNA and/or an increase in the final sample volume. Both effects may reduce the probability of detecting low concentrations of target DNA. If sample cleanup is required, Sylphium recommends the EchoClean DNA Cleanup Kit[3].

[3] https://www.bioecho.com/products/nucleic-acid-cleanup

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