



For Professional Use Only

# eSens MDR KPC/OXA QL PCR kit

**REF ES4302A**

## Instructions for Use

### 1 INTENDED USE

**eSens MDR KPC/OXA QL PCR kit** is an *in vitro* nucleic acid amplification test for detection of acquired carbapenems genes from KPC and OXA-48-like (OXA-48- and OXA-162-type) types in the biological material (DNA extracted from samples of pure bacterial culture, positive blood culture, mixture of bacterial cultures obtained by primary seeding of clinical material (liquor, bronchoalveolar lavage (BAL), traumatic discharge, etc.) to solid or liquid medium) and in the clinical material (urine, oropharyngeal and rectal swabs) using “real-time” fluorescence-hybridization detection of amplified products.

**NOTE:** The results of PCR analysis are taken into account in complex diagnostics of disease.

### 2 PRINCIPLE OF PCR DETECTION

MDR KPC/OXA-48 detection by the polymerase chain reaction (PCR) is based on the amplification of the pathogen genome specific region using specific MDR KPC/OXA-48 primers. In the real-time PCR, the amplified product is detected with the use of fluorescent dyes. These dyes are linked to oligonucleotide probes, which bind specifically to the amplified product during thermocycling. The real-time monitoring of fluorescence intensities during the real-time PCR allows the detection of accumulating product without re-opening the reaction tubes after the PCR run.

The DNA extraction from the biological material is carried out in the presence of the Internal Control-FL, which allows to control the procedure of examination of each sample. Then with the obtained DNA samples the amplification with the aid of specific primers and Taq-polymerase enzyme with the simultaneous detection with the help of specific fluorescently labeled oligonucleotide probes is carried out. The fluorescent labels are attached to oligonucleotide probes specific to different DNA-targets. This allows to register the accumulation of specific amplification product of each DNA-target by the detection of the intensity of fluorescent signal through the relevant channel during the PCR with the help of thermo-cycler with the “real-time” detection of fluorescent signal system.

The PCR kit contains the system for prevention of contamination by amplicons using the enzyme uracil-DNA-glycosylase (UDG) and deoxyuridine triphosphate. The enzyme UDG recognizes and catalyzes the destruction of the DNA containing deoxyuridine, but has no effect on DNA containing

deoxythymidine. Deoxyuridine is absent in the authentic DNA, but is always present in amplicons, because deoxyuridine triphosphate is a part of dNTP mixture in the reagents for the amplification. Due to the deoxyuridine containing contaminating amplicons are sensitive to the destruction by UDG before the DNA-target amplification. So the amplicons cannot be amplified.

The enzyme UDG is thermolabile. It is inactivated by heating at temperature above 50 °C. Therefore, UDG does not destroy the target amplicons which are accumulated during PCR.

The amplification results of KPC-type, OXA-48-like (OXA-48- and OXA-162-type) DNA fragments of acquired carbapenemase genes are registered separately for each type through two different channels, the results of amplification of KPC-type are registered through the channel for the FAM fluorophore, and the results of OXA-48-like are registered through the channel for the JOE fluorophore. Through the channel for the ROX fluorophore the amplification product of Internal Control is detected.

**Table 1**

Channel for fluorophore	FAM	JOE	ROX
DNA target	KPC-type carbapenemase genes	OXA-48-like carbapenemase genes	Internal Control DNA

### 3 CONTENT

**eSens MDR KPC/OXA QL PCR kit (ES4302A)** includes:

Reagent	Description	Volume, ml	Quantity
<b>PCR-mix-1-FRT KPC/OXA-48</b>	clear liquid from colorless to light lilac colour	1.2	1 tube
<b>PCR-mix-2-FRT</b>	colorless clear liquid	0.3	2 tubes
<b>Polymerase (TaqF)</b>	colorless clear liquid	0.03	2 tubes
<b>TE-buffer</b>	colorless clear liquid	0.2	1 tube
<b>Positive Control-2 KPC/OXA-48</b>	colorless clear liquid	0.2	1 tube
<b>Negative Control (C-)*</b>	colorless clear liquid	1.2	1 tube
<b>Internal Control-FL (IC)**</b>	colorless clear liquid	1.0	1 tubes

\* must be used in the extraction procedure as the Negative Control of Extraction.

\*\* add **10 µl** of **Internal Control (IC)** during the DNA extraction procedure directly to the sample/lysis mixture.

**eSens MDR KPC/OXA QL PCR kit** is intended for 110 reactions (including controls).

## 4 ADDITIONAL REQUIREMENTS

- Disposable screwing or tight-fitting polypropylene tubes (1.5-ml) for a pretreatment of the material.
- DNA extraction kit
- PCR box.
- Vortex mixer.
- Desktop centrifuge with a rotor for 2-ml reaction tubes.
- Disposable pipette filter tips (up to 100 µl).
- Pipettes (adjustable).
- Disposable powder-free gloves and laboratory coat.
- Tube racks (for 0.1- or 0.2-ml tube).
- Real-time instruments with five or more separated channels of fluorescence detection (for example, Rotor-Gene Q (QIAGEN, Germany), CFX 96 Touch, CFX 96 Opus (Bio-Rad, USA), QuantStudio 5 (Thermo Fisher Scientific), or equivalent).
- Disposable polypropylene PCR tubes:
  - a) 0.2-ml PCR tubes with optical transparent domed or flat caps if a plate-type instrument is used;
  - b) 0.2-ml PCR tubes with flat caps or strips of four 0.1-ml Rotor-Gene PCR tubes if a rotor-type instrument is used.
- Refrigerator at 2 to 8 °C.
- Deep-freezer at a temperature range from minus 24 to minus 16 °C.
- Reservoir for used tips.

## 5 GENERAL PRECAUTIONS

The user should always pay attention to the following:

- Use sterile pipette filter tips and use a new tip for every procedure.
- Store extracted positive material (samples, controls and amplicons) away from all other reagents and add it to the reaction mix in a separate area.
- Thaw all components thoroughly at room temperature before starting an assay.
- When thawed, mix the components and centrifuge briefly.
- Use disposable gloves, laboratory coats and eye protection when handling specimens and reagents. Thoroughly wash hands afterwards.
- Do not eat, drink, smoke, apply cosmetics, or handle contact lenses in laboratory work areas.
- Do not use a kit after its expiration date.
- Dispose of all specimens and unused reagents in accordance with local regulations.
- Samples should be considered potentially infectious and handled in a biological cabinet in accordance with appropriate biosafety practices.
- Clean and disinfect all sample or reagent spills using a disinfectant, such as 0.5% sodium hypochlorite or another suitable disinfectant.
- Avoid sample or reagent contact with the skin, eyes, and mucous membranes. If any of these solutions come into contact, rinse the injured area immediately with water and seek medical advice immediately.
- Material Safety Data Sheets (MSDS) are available on request.
- Use of this product should be limited to personnel trained in DNA amplification techniques.
- Workflow in the laboratory must be one-directional, beginning in the Extraction Area and moving to the Amplification and Detection Areas. Do not return samples, equipment and reagents to the area in which the previous step was performed.

 Some components of this kit contain sodium azide as a preservative. Do not use metal tubing for reagent transfer.

## 6 SAMPLING AND HANDLING

**eSens MDR KPC/OXA QL PCR kit** is intended for the analysis of the acquired carbapenemase genes of KPC-type and OXA-48-like (OXA-48- and OXA-162-type) types extracted with the DNA extraction kits from the biological material (DNA extracted from samples of pure bacterial culture, positive blood culture, a mixture of bacterial cultures obtained by primary seeding of clinical material (liquor, bronchoalveolar lavage (BAL), traumatic discharge, etc.) to solid or liquid medium) and in the clinical material (urine, oropharyngeal and rectal swabs).

### **Sampling**

#### 6.1 Oropharyngeal and rectal swabs

Oropharyngeal and rectal swabs should be placed in **Transport Medium with Mucolytic Agent** (952-CE).

#### 6.2 A mixture of bacterial cultures

A mixture of bacterial cultures obtained by seeding of clinical material to solid medium  $10^7$ - $10^9$  bacterial cells.

### **Pretreatment**

#### 6.3 Blood cultures, a mixture of bacterial cultures obtained by primary seeding clinical material to liquid medium

Transfer from 0.1 to 0.25 ml the blood culture or the seeding to an enrichment medium in a sterile disposable tube 1.5 ml (use a disposable syringe).

Centrifuge the tubes at 10,000 g (12,000 rpm on MiniSpin, Eppendorf) for 10 min. Discard the supernatant using a vacuum aspirator with trap flask (use a new tip without filter for each sample). Make sure that the pellet is not disturbed.

#### 6.4 Urine

Shake the bottle of urine. Transfer 1 ml of the urine in a sterile disposable 1.5 ml tube (use a new filter tip for each sample). Centrifuge the tubes at 10,000 g (12,000 rpm in MiniSpin, Eppendorf) for 10 min. In case urine contains a lot of salts, resuspended only the upper layer pellet salts in 1 ml, then centrifuged again. Discard the supernatant by using a vacuum aspirator with trap flask (use a new tip without filter for each sample). Make sure that the pellet is not disturbed. Use the pellet for DNA extraction.

Samples (pellets) can be stored at a temperature from minus 24 to minus 16 °C for 1 week and at no more than minus 68 °C for 1 year.

## 7 WORKING CONDITIONS

**eSens MDR KPC/OXA QL PCR kit** should be used at 18–25 °C.

## 8 PROTOCOL

### 8.1 DNA extraction

Any commercial nucleic acid extraction kit, if IVD-CE validated for the indicated specimen types, could be used.

## Ecoli Dx, s.r.o. recommends:

- For the manual extraction

- **DNA-sorb-AM** (K1-12-100-CE) is recommended to use for DNA extraction from the samples of **positive blood cultures, a mixture of bacterial cultures obtained by seeding clinical material to liquid medium**, after pretreatment, the samples **positive blood cultures, a mixture of bacterial cultures obtained by seeding clinical material to solid medium** according to the Instruction Manual of reagents kit.
- **DNA-sorb-AM** (K1-12-100-CE) and **RIBO-prep** (K2-9-Et-100-CE) are recommended to use for DNA extraction from the samples of **urine** after pre-treatment according to the Instruction Manual of the reagents kit.
- **DNA-sorb-AM** (K1-12-100-CE) is recommended to use for DNA extraction from the samples **oropharyngeal and rectal swabs** according to the Instruction Manual of the reagents kit.

- For the automatic extraction

- **ePure Bacterial DNA Extraction Kit** (E2006)

**NOTE:** Extract the DNA according to the manufacturer's protocol.  
The DNA extraction for each sample is carried out in the presence of **Internal Control-F (IC)**.

**NOTE:** In case of extraction from samples that resemble pellets after pre-treatment, the lysis buffer should be added directly to tube with the pellet, using a new filter tip for each sample.

**NOTE:** In case of extraction from samples of a pure bacterial culture or a mixture of bacterial cultures obtained by seeding of clinical material to solid medium a bacterial cells are taken with a sterile loop (or sterile tip) in a quantity  $10^7$ - $10^9$  cells are placed directly into a 1.5 ml tube containing lysis solution of DNA -sorb-AM kit.

**NOTE:** It is not recommended to simultaneously carry out the DNA extraction from blood culture samples, pure culture or mixture of bacterial cultures obtained by seeding to medium and samples of other biological material, simultaneously, because there is a high risk of contamination from positive blood culture or bacterial cultures containing high DNA pathogen concentrations.

## 8.2 Preparing PCR

### 8.2.1 Preparing tubes for PCR

The type of tubes depends on the PCR instrument used for analysis. Use disposable filter tips for adding reagents, DNA and control samples into tubes.

Total volume of the reaction mixture is **25 µl**, including the volume of DNA sample is **10 µl**.

**NOTE:** Prepare the reaction mixture just before use

The reagents are mixed based on one reaction:

**10 µl PCR-mix-1-FRT KPC/OXA-48,  
5 µl PCR-mix-2-FRT,  
0.5 µl of polymerase (TaqF).**

1. Prepare the mixture of **PCR-mix-2-FRT** and **polymerase (TaqF)**. Pour all the content of one tube with **polymerase (TaqF) (30 µl)** into the tube with **PCR-mix-2-FRT (300 µl)** and stir it carefully on the vortex not allowing foaming. Label the tube by the date of the preparation of the mix.

**NOTE:** The prepared mixture is intended for 60 reactions. The mixture is to be stored at 2–8 °C during 3 months and used when it is necessary.

**NOTE:** If the mix can't be used within three months it is necessary to prepare the mix for less number of reactions – for example mix 150 µl of **PCR-mix-2-FRT** and 15 µl of **polymerase (TaqF)** (such mix is intended for 30 reactions).

- Vortex the tube with **PCR-mix-1-FRT KPC/OXA-48**, then centrifuge briefly. Calculate the necessary amount of reactions including tests of examined and control samples. It can be done according to the Table 3. Take into account that even for one test of the tested sample at least **three control reactions should be set up: C+, C– and NCA**. The reagents should be taken with reserve, for example for examining N samples the reagents for (N+1) reactions should be prepared.

**Table 3**

**Scheme of preparation reaction mixture**

Reagent volume per one reaction, µl	Reagent volume for specified number of reactions	
	10.0	5.0
Number of reactions*	PCR-mix-1-FRT KPC/OXA-48	The mixture of PCR-mix-2-FRT and Polymerase (TaqF)
2	60	30
3	70	35
4	80	40
5	90	45
6	100	50
7	110	55
8	120	60
9	130	65
10	140	70
11	150	75
12	160	80
13	170	85
14	180	90
15	190	95
16	200	100
17	210	105
18	220	110

19	230	115
20	240	120
21	250	125
22	260	130
23	270	135
24	280	140
25	290	145

\* Number of test samples (N) including 1 control of extraction stage, 2 controls of amplification, and 1 extra reaction (N+1+2+1).

3. In a separate tube prepare the reaction mixture. Mix appropriate amount of **PCR-mix-1-FRT KPC/OXA-48** and the mixture of **PCR-mix-2-FRT** and **polymerase (TaqF)**.
4. Take the required number of tubes or strips for DNA amplification of examined and control samples.
5. Transfer **15 µl** of the prepared mixture to each tube.
6. Add **10 µl** of DNA samples obtained from the examined samples.
7. Carry out the control reactions:

<b>C-</b>	-	Add <b>10 µl</b> of <b>the sample extracted from the Negative Control reagent</b> to the tube labeled C-.
<b>NCA</b>	-	Add <b>10 µl</b> of <b>TE-buffer</b> to the tube labeled NCA (Negative control of amplification).
<b>C+</b>	-	Add <b>10 µl Positive Control-2 KPC/OXA-48</b> to the tube labeled C+.

## 8.2.2 Amplification

1. Create a temperature profile on your instrument as follows:

**Table 3**

### eSens-1 amplification program

Step	Rotor-type Instruments (e.g Rotor-Gene Q or equivalent)			Plate-type Instruments (e.g CFX 96 Touch, CFX 96 Opus, QuantStudio 5 or equivalent.)		
	Temperature, °C	Time	Cycles	Temperature, °C	Time	Cycles
1	95	15 min	1	95	15 min	1
2	95	5 s	5	95	5 s	5
	60	20 s		60	20 s	
	72	15 s		72	15 s	
3	95	5 s	40	95	5 s	40
	60	20 s Fluorescence acquiring		60	30 s Fluorescence acquiring	
	72	15 s		72	15 s	

Fluorescent signal is detected in the channels for the **FAM**, **JOE** and **ROX** fluorophores.

2. Insert the tubes into the reaction module of the device.
3. Run the amplification program with fluorescent signal detection.
4. Analyze results after the amplification program is completed.

## 8.3 Instrument Settings

### Test settings for rotor-type instruments

Channel	Calibrate/Gain Optimisation	Threshold	Dynamic tube	Slope Correct	More Settings/ Outlier Removal
FAM/Green	from 5 to 10 FI	0.1	On	On	5-15 %
JOE/Yellow	from 4 to 8 FI	0.1	On	On	5-15 %
ROX/Orange	from 4 to 8 FI	0.1	On	On	5-15 %

## Test settings for plate-type instruments

**Note:** Set **Ramp Rate 2,5 °C/s** by clicking the **Step Options** button for each step of cycling.

Channel	Threshold
FAM, JOE/HEX	Set the threshold line for each channel at the level of 10-20 % of maximum fluorescence obtained for the Positive Control in the last amplification cycle.
ROX	Set the threshold line at the level of 10-20 % of maximum fluorescence obtained for the Negative Control of Extraction (C-).

## 9 DATA ANALYSIS

Analysis of the results is performed by software of the used real-time PCR instrument by measuring fluorescence signal accumulation through three channels:

- The signal of the **carbapenemase genes of KPC-type** amplification product is detected through the channel for the **FAM** fluorophore.
- The signal of the **carbapenemases genes of OXA-48-like** amplification product is detected through the channel for the **JOE** fluorophore.
- The signal of the **IC** DNA amplification product is detected through the channel for the **ROX** fluorophore.

Results are interpreted by the crossing (or not-crossing) the fluorescence curve with the threshold line set at the level of exponential growth that corresponds the presence (or absence) of a *Ct* value for the DNA-target in the corresponding column of the result grid.

Principle of interpretation is the following:

- **Carbapenemases genes** are **detected** if the *Ct* value determined in the results grid in the channel for the FAM and/or JOE fluorophore is less than the specified boundary *Ct* value. Moreover, the fluorescence curve of the sample should cross the threshold line in the area of typical exponential growth of fluorescence.
- **KPC-type and OXA-48-like carbapenemases genes** are **not detected** in a sample if the *Ct* value is not determined (absent) in the channels for FAM and JOE fluorophores, whereas the *Ct* value determined in the channel for the ROX fluorophore is less than the specified boundary *Ct* value.
- The result is **invalid** if the *Ct* value is not determined (absent) in the channel for FAM and JOE fluorophores, whereas the *Ct* value in the channel for the ROX fluorophore is not determined (absent) or greater than the specified boundary *Ct* value. In such cases, the PCR analysis should be repeated starting from the DNA extraction stage. If the same result is obtained in the second run, re-sampling of material is recommended.

The result of the PCR is considered reliable only if the results obtained for Negative and Positive Control of amplification as well as for the Negative Control of extraction of DNA are correct (see Table 4 and Table 5).

Table 4

Results for controls

Control	Stage for control	Ct value in the channel for fluorophore	
		FAM, JOE	ROX
C-	DNA extraction	Absent	< boundary value
NCA	PCR	Absent	Absent
C+	PCR	< boundary value	Not evaluated

Table 5

Boundary Ct values

Sample	Rotor-type instruments			Plate-type instruments		
	Channel for fluorophore					
	FAM	JOE	ROX	FAM	JOE	ROX
Positive Control (C+)	<32	<33	-	<34	<34	-
Negative Control (C-)	-	-	<32	-	-	<34
Bacterial cultures samples*	<31	<31	<32	<32	<32	<34
Urine and swabs samples	-	-	<32	-	-	<34

\* Only for samples of positive blood cultures, a mixture of bacterial cultures obtained by seeding of the clinical material, a pure culture.

## 10 TROUBLESHOOTING

Results of the analysis are not taken into account in the following cases:

1. If the Ct value determined for the Positive Control of Amplification (C+) in the channels for the FAM and/or JOE fluorophores is greater than the boundary Ct value or absent, the amplification and detection should be repeated for all samples.
2. If for the Negative Control of DNA extraction (C-) and/or Negative Control of amplification (NCA) the value of the threshold cycle (Ct) is registered through one of the channels for FAM and/or JOE fluorophores. In this case the PCR should be repeated for all the samples for which the Ct value is defined through the channels for FAM and/or JOE, fluorophores.

## 11 TRANSPORTATION

eSens MDR KPC/OXA QL PCR kit should be transported at 2–8 °C for no longer than 5 days.

## 12 STABILITY AND STORAGE

All components of the **eSens MDR KPC/OXA QL PCR kit** are to be stored at 2–8 °C when not in use (except PCR-mix-2-FRT, and polymerase (TaqF)). All components of the **eSens MDR KPC/OXA QL PCR kit** are stable until the expiration date stated on the label. The shelf life of reagents before and after the first use is the same, unless otherwise stated.

**NOTE:** PCR-mix-2-FRT, and polymerase (TaqF) are to be stored at the temperature from minus 24 to minus 16 °C

**NOTE:** PCR-mix-1-FRT KPC/OXA-48 is to be kept away from light

## 13 SPECIFICATIONS

### 13.1 Analytical sensitivity

Biological material	Transport Medium	Nucleic acid extraction kit	Sensitivity, copies/ml*
Blood cultures, a mixture of bacterial cultures obtained by primary seeding clinical material to solid or liquid medium	—	DNA-sorb-AM	1x10 <sup>5</sup>
Urine	—	DNA-sorb-AM	5x10 <sup>2</sup>
		RIBO-prep	
Oropharyngeal and rectal swabs	Transport Medium for Swabs or Transport Medium with Mucolytic Agent	DNA-sorb-AM	2x10 <sup>3</sup>

\* It is necessary to observe the pretreatment rules and the recommended volume of the test sample for obtain this sensitivity.

The carbapenemase genes of the corresponding types were identified using this reagents kit for analysis of the control strains DNA samples, carrying the genes of known carbapenemases of KPC-3- and OXA-48-types.

### 13.2 Analytical specificity

The analytical specificity of **eSens MDR KPC/OXA QL PCR kit** is ensured by selection of specific primers and probes as well as stringent reaction conditions. The primers and probes have been checked for possible homologies to all sequences published in gene banks by sequence comparison analysis.

The non-specific reactions were absent testing the human DNA samples and the following microorganisms' DNA: *Escherichia coli*, *Klebsiella pneumoniae*, *Klebsiella oxytoca*, *Serratia marcescens*, *Pseudomonas aeruginosa*, *Acinetobacter baumannii*, *Proteus mirabilis*, *Enterococcus faecalis*, *Staphylococcus* spp., *Streptococcus* spp., *Candida* spp.

The clinical specificity of **eSens MDR KPC/OXA QL PCR kit** was confirmed in laboratory clinical trials.

## 14 QUALITY CONTROL

The production process, including batch release, is carried out in accordance with an established quality management system certified according to ISO 13485.

## 15 KEY TO SYMBOLS USED

 REF	Catalogue number		Caution
 LOT	Batch code		Contains sufficient for <n> tests
 IVD	<i>In vitro</i> diagnostic medical device		Use-by Date
 VER	Version		Consult instructions for use
	Temperature limit		Keep away from sunlight
	Manufacturer	NCA	Negative control of amplification
	Date of manufacture	C-	Negative control of extraction
 EC REP	Authorized representative in the European Community	C+	Positive control of amplification
		IC	Internal control

### List of Changes Made in the Instruction Manual

VER	Location of changes	Essence of changes
01_04/2022		

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