



Super-ARMS[®] *EGFR* Mutation Detection Kit

Detection of 42 mutations in exons 18-21

Instruction for Use

REF 8.01.20213X012E

12 tests

For Stratagene Mx3000P[™], ABI7500, LightCycler 480, cobas[®] z480, SLAN-96S



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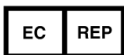
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Background

Due to its association with malignancies, epidermal growth factor receptor (EGFR) has become the target of an expanding class of anticancer therapies, such as gefitinib (Iressa) and erlotinib (Tarceva), which are tyrosine kinase inhibitors (TKIs). These drugs work best on patients whose cancer is driven by abnormal EGFR signaling. Non-small cell lung cancer (NSCLC) patients who experienced rapid, durable, complete or partial responses to TKIs therapy have been found to harbor somatic mutations in the *EGFR* gene. Cancer patients with somatic *EGFR* mutations have shown an impressive 60% response rate, much higher than that for conventional chemotherapy. Therefore, detection of the *EGFR* mutation status in tumor tissue is key to offering tailored, personalized treatment to cancer patients. Resistance to therapy, either in the primary tumor or acquired after TKI treatment, is also associated with somatic mutations.

Both tumor tissue and peripheral blood samples can be used for *EGFR* mutation detection. Currently, tumor tissue is the most frequent specimen for *EGFR* mutation testing. In meanwhile, it is demonstrated that there is cell-free DNA of the apoptotic and necrotic tumor cell existing in peripheral blood. Noninvasive detection of *EGFR* mutation in circulating tumor DNA (ctDNA) extracted from plasma has been proved to be feasible as re-biopsy of tumor tissue was challenging.

Intended Use

The Super-ARMS[®] *EGFR* Mutation Detection Kit is a real-time PCR assay for qualitative detection of 42 somatic mutations in exons 18, 19, 20 and 21 of *EGFR* gene in human genomic DNA extracted from formalin-fixed paraffin-embedded (FFPE) tumor tissue or circulating DNA extracted from plasma sample. The kit is intended to be used to assess *EGFR* mutation status in NSCLC patients and aid in identifying patients who may response to the treatment with *EGFR*-TKI.

The kit is for *in vitro* diagnostic use, and intended to be used by trained professionals in a laboratory environment.

Principles of the Procedure

The kit adopts Amplification Refractory Mutation System (ARMS) and real-time PCR technology, which comprises specific primers and fluorescent probes to detect *EGFR* mutations in human genomic DNA and circulating DNA. During the nucleic acid amplification, the targeted mutant DNA is matched with the bases at 3' end of the primer, amplified selectively and efficiently, then the mutant amplicon is detected by fluorescent probes labeled with FAM. While the wild-type DNA cannot be matched with specific primers, there is no amplification occurs.

The kit is composed of **P-EGFR Reaction Mix**, **P-EGFR Enzyme Mix** and **P-EGFR Positive Control**.

- 1) The contents in **P-EGFR Reaction Mix A** and **P-EGFR Reaction Mix B** formed a mutation detection system and an internal control system. The mutation detection system includes primers and FAM/ROX/CY5-labeled probes specific for designated *EGFR* mutations, to detect the *EGFR* mutation status. The internal control system contains the primers and HEX-labeled probe for a region of genomic DNA without known mutations and polymorphism, to detect the presence of inhibitors and monitor the accuracy of experimental operation.
- 2) The **P-EGFR Positive Control** contains recombinant gene with *EGFR* mutations.
- 3) The **P-EGFR Enzyme Mix** contains Taq DNA polymerase for PCR amplification and uracil-N-glycosylase which works at room temperature to prevent PCR amplicon carryover contamination.

Kit Contents

This kit contains the following materials (see Table 1):

Table 1 Kit Contents

Contents	Main Ingredient	Quantity
P-EGFR Reaction Mix A	Buffer, Mg ²⁺	1540 μL/tube ×2
P-EGFR Reaction Mix B1	Primers, Probes, dNTPs	140 μL/tube ×1
P-EGFR Reaction Mix B2	Primers, Probes, dNTPs	140 μL/tube ×1
P-EGFR Reaction Mix B3	Primers, Probes, dNTPs	140 μL/tube ×1
P-EGFR Reaction Mix B4	Primers, Probes, dNTPs	140 μL/tube ×1
P-EGFR Enzyme Mix	Taq DNA Polymerase, Uracil-N-Glycosylase	30 μL/tube ×1
P-EGFR Positive Control	Plasmid DNA	400 μL/tube ×1

The detailed detection information is listed in Table 2.

Table 2 Detection Information

Reagent	Mutation detected	Fluorescent Signal			
		FAM	HEX	ROX	CY5
P-EGFR Reaction Mix A P-EGFR Reaction Mix B1	19-Del/ L858R	19-Del	IC	L858R	/
P-EGFR Reaction Mix A P-EGFR Reaction Mix B2	T790M	T790M	IC	/	/
P-EGFR Reaction Mix A P-EGFR Reaction Mix B3	G719X/ L861Q/S768I	G719X	IC	L861Q	S768I
P-EGFR Reaction Mix A P-EGFR Reaction Mix B4	20-Ins	20-Ins	IC	/	/

* IC: Internal Control

Storage and Stability

The kit requires shipment on frozen ice packs. All contents of the kit should be stored immediately upon receipt at $-20\pm 5^{\circ}\text{C}$ and protected from light.

The shelf-life of the kit is eight months. The recommend maximum freeze-thaw cycle is five cycles.

Additional Reagents and Equipment Required but Not Supplied

- Compatible PCR instruments:
Stratagene Mx3000P™, ABI7500, LightCycler480, cobas® z480, or SLAN-96S.
- DNA Extraction kit. We recommend use of AmoyDx® FFPE DNA Kit (Cat No.: 8.02.23501X036G) for FFPE tissues, AmoyDx® Circulating DNA kit (Cat No.: 8.02.26201X024G) for plasma sample.
- Spectrophotometer for measuring FFPE DNA concentration.
- Mini centrifuge with rotor for centrifuge tubes.
- Mini centrifuge with rotor for PCR tubes.
- Nuclease-free centrifuge tubes.
- Nuclease-free PCR tubes and caps.
- Adjustable pipettors and filtered pipette tips for handling DNA.
- Tube racks.
- Disposable powder-free gloves.
- Sterile, nuclease-free water.
- 1×TE buffer (pH 8.0).

Precautions and Handling Requirements

For *in vitro* diagnostic use.

Precautions

- Please read the instruction carefully and become familiar with all components of the kit prior to use, and strictly follow the instruction during operation.
- Please check the compatible real-time PCR instruments prior to use.
- DO NOT use the kit or any kit component after their expiry date.
- DO NOT use any other reagents from different lots in the tests.
- DO NOT use any other reagent in the other test kits.

Safety Information

- Handle all specimens and components of the kit as potentially infectious material using safe laboratory procedures.
- Only trained professionals can use this kit. Please wear suitable lab coat and disposable gloves while handling the reagents.
- Avoid skin, eyes and mucous membranes contact with the chemicals. In case of contact, flush with water immediately.
- DO NOT pipet by mouth.

Decontamination and Disposal

- The kit contains positive control; strictly distinguish the positive control from other reagents to avoid contamination which may cause false positive.
- PCR amplification is extremely sensitive to cross-contamination. The flow of tubes, racks, pipets and other materials used should be from pre-amplification to post-amplification, and never backwards.
- Gloves should be worn and changed frequently when handling samples and reagents to prevent contamination.
- Using separate, dedicated pipettes and filtered pipette tips when handling samples and reagents to prevent exogenous DNA contamination to the reagents.
- Please pack the post-amplification tubes with two disposable gloves and discard properly. DO NOT open the post- amplification PCR tubes.
- All disposable materials are for one time use. DO NOT reuse
- The unused reagents, used kit, and waste must be disposed of properly.

Cleaning

- After the experiment, wipe down the work area, spray down the pipettes and equipment with 75% ethanol or 10% hypochlorous acid solution.

Instrument Setup

- Setup the reaction volume as 80 μ L.
- For Stratagene Mx3000P™, if there's low net fluorescence signal (dR) but high background signal (R), please reduce the signal gain setting of instrument properly. We recommend set up the Fliter Set Gain Settings of FAM, HEX, ROX, CY5 as 4, 4, 1, 4 respectively.
- For ABI 7500, please set up as follows: Reporter Dye: FAM, VIC, ROX, CY5; Quencher Dye: TAMRA; Passive Reference: NONE.
- For LightCycler480 and cobas[®] z480 instrument, it's necessary to conduct Color Compensation prior to the first use according to Color Compensation instructions. Please contact AmoyDx Technical Support or Account Manager to get the Super-ARMS[®] EGFR Color Compensation Kit and Color Compensation instructions.
- For SLAN-96S, please set up as follows: Probe mode: FAM, VIC, ROX, CY5. During the result analysis, open the "Preference" window, in "Chart Options" section; select "Selected Wells" for "Y-Axis Scaling Auto-adjust By" and "Absolute Fluorescence Value Normalization" for "Amplification Curve". We recommend set up the Gain of FAM, HEX, ROX, CY5 as 1, 2.5, 2, 7 respectively.
- Refer to the real-time PCR instrument operator's manual for detailed instructions.
- We recommend that all PCR instruments in use should be conducted fluorescence calibration once a year.

Assay Procedure

1. DNA Extraction

The specimen material must be human genomic DNA extracted from FFPE tissue or circulating DNA extracted from plasma sample in NSCLC patients. DNA extraction reagents are not included in the kit. Before DNA extraction, it's essential to use standard pathology methodology to ensure tumor sample quality. Carry out the DNA extraction according to the instructions of DNA extraction kit.

Tumor samples are non-homogeneous, may also contain non-tumor tissue. Data from different tissue sections of the same tumor may be inconsistent. DNA from non-tumor tissue would not be detected with *EGFR* mutations. It's better to use tumor tissue samples with more than 30% tumor cells.

The OD₂₆₀/OD₂₈₀ value of extracted DNA from FFPE tissue should be between 1.8 ~ 2.0 (measured using the spectrophotometer, the NanoDrop 1000 /2000 spectrophotometer is recommended).

The amount of extracted DNA from FFPE tissue used for PCR amplification is shown in Table 3. And the circulating DNA isolated from plasma should be used directly without dilution.

Table 3 Recommended DNA concentration

Tissue	Storage time	DNA concentration	DNA amount per reaction
FFPE sample	≤ 3 years	1 ng/ μ L	15 ng

Note:

- The FFPE tissue should be handled and stored properly, and the storage time should preferably be less than 3 years.
- The plasma sample should be derived from EDTA anti-coagulated peripheral whole blood. The recommended volume of whole blood is no less than 10 mL.
- The extracted DNA should be used immediately, if not, it should be stored at -20 ± 5 °C for no more than 3 months.
- Before detection, dilute the extracted tissue DNA with 1×TE buffer (pH 8.0) to designated concentration. We recommend using at least 5 μ L DNA for 10 times dilution, to ensure the validity of final concentration.

2. Mutation Detection

- 1) Take the **P-EGFR Positive Control**, **P-EGFR Reaction Mix (A, B1~B4)** and **P-EGFR Enzyme Mix** out of the kit from the freezer.
- 2) Thaw the **P-EGFR Positive Control** and **P-EGFR Reaction Mix (A, B1~B4)** at room temperature. When the reagents are completely thawed, invert each tube for 10 times and centrifuge briefly to collect all liquid at the bottom of the tube.
- 3) Briefly centrifuge **P-EGFR Enzyme Mix** prior to use.
- 4) Prepare sufficient P-EGFR Master Mix 1~4 containing P-EGFR Enzyme Mix, P-EGFR Reaction Mix A and P-EGFR Reaction Mix B (B1~B4 respectively) in separate sterile centrifuge tube respectively according to the ratio in Table 4. Mix each Master Mix thoroughly by gently pipetting up and down more than 10 times and centrifuge briefly.

Table 4 P-EGFR Master Mix 1~4

Content	Volume per test (μL)
P-EGFR Reaction Mix A	55
P-EGFR Reaction Mix B (B1/B2/B3/B4)	10
P-EGFR Enzyme Mix	0.48
Total	65.48

Note:

- Every PCR run must contain one PC (Positive control) and one NTC (No template control).
 - Do not vortex enzyme mix or any mixture with enzyme mix.
 - The prepared mixtures should be used immediately, avoid prolonged storage.
 - Due to the viscosity of the enzyme mix, pipet slowly to ensure all mix is completely dispensed from the tip.
 - Pipet enzyme mix by placing the pipet tip just under the liquid surface to avoid the tip being coated in excess enzyme.
- 5) Take out the sample DNA (see Table 3 for FFPE DNA concentration) and nuclease-free water for NTC.
 - 6) Prepare four PCR tubes for NTC: Dispense 65.48 μL of P-EGFR Master Mix 1~4 to each PCR tube respectively. Then add 15 μL of nuclease-free water to each NTC tube and cap the PCR tubes.
 - 7) Prepare four PCR tubes for each sample: Dispense 65.48 μL of P-EGFR Master Mix 1~4 to each PCR tube respectively. Then add 15 μL of each sample DNA to each sample tube and cap the PCR tubes.
 - 8) Prepare four PCR tubes for PC: Dispense 65.48 μL of P-EGFR Master Mix 1~4 to each PCR tube respectively. Then add 15 μL of P-EGFR Positive Control to each PC tube and cap the PCR tubes.
 - 9) Briefly centrifuge the PCR strips to collect all liquid at the bottom of each PCR tube.
 - 10) Place the PCR strip tubes into the real-time PCR instrument. A recommended plate layout is shown in Table 5.

Table 5 PCR Plate Layout

Well	1	2	3	4
A	Sample 1	Sample 3	Sample 5	NTC
B	Sample 1	Sample 3	Sample 5	NTC
C	Sample 1	Sample 3	Sample 5	NTC
D	Sample 1	Sample 3	Sample 5	NTC
E	Sample 2	Sample 4	Sample 6	PC
F	Sample 2	Sample 4	Sample 6	PC
G	Sample 2	Sample 4	Sample 6	PC
H	Sample 2	Sample 4	Sample 6	PC

- 11) Setup the PCR Protocol using the cycling parameters in Table 6.

Table 6 Cycling Parameters

Stage	Cycles	Temperature	Time	Data collection
1	1	95°C	10min	/
		95°C	40s	/
2	15	64°C	40s	/
		72°C	30s	/
3	28	93°C	40s	/
		60°C	45s	FAM/ROX/CY5 and HEX/VIC
		72°C	30s	/

- 12) Start the PCR run immediately.
- 13) When the PCR run finished, analyze the data according to the “Results Interpretation” procedures.

3. Results Interpretation

Before mutation data analysis, the following items should be checked:

- 1) For NTC: The FAM/ROX/CY5 signal of Reaction Mix 1~4 should be no amplification and Ct value should be ≥ 28 , HEX/VIC Ct values of Reaction Mix 1~4 should be ≥ 22 . If not, the data is *INVALID*. The sample should be retested.
- 2) For Positive control: for FAM and HEX/VIC signals, the Ct values of Reaction Mix 1~4 should be < 20 ; for ROX signal, the Ct values of Reaction Mix 1 and 3 should be < 20 ; for CY5 signal, the Ct value of Reaction Mix 3 should be < 20 . If any of the above requirements is not met, the data is *INVALID*. The sample should be retested.
- 3) For the internal control assay for each sample: the HEX/VIC Ct values of Reaction Mix 1~4 should be < 19 . If not, this indicates insufficient DNA or presence of PCR inhibitors. The sample should be retested with increased or re-extracted DNA.

Analyze the mutation assay for each sample:

- 4) Record the mutant FAM/ROX/CY5 Ct values of Reaction Mix 1~4.
- 5) Calculate the Δ Ct value for each tube: Δ Ct value = Mutant Ct value (FAM/ROX/CY5) – HEX/VIC Ct value
- 6) Result interpretation for each tube according to the Cut-off Δ Ct value in Table 7.
 - a) If the Δ Ct value is $<$ the Cut-off Δ Ct value, the sample is determined as positive.
 - b) If the Δ Ct value is \geq the Cut-off Δ Ct value, the sample is determined as negative or under the LOD (limit of Detection) of the kit.
 - c) Two or more *EGFR* mutations may be detected for a sample.

Table 7 Result Determination

Tube No.		FAM	ROX	CY5	
Cut-off Δ Ct value	1	19-Del / L858R	11	11	/
	2	T790M	8	/	/
	3	G719X / L861Q / S768I	12	12	12
	4	20-Ins	11	/	/

Performance Characteristics

The performance characteristics of this kit were validated on Stratagene Mx3000P™, ABI7500, LightCycler480, cobas® z480 and SLAN-96S.

1. Limit of Detection

The Limit of Detection (LOD) of the kit for each mutation is shown in Table 8.

Table 8 LOD for each EGFR mutation

Exon	Mutation	Base Change	Cosmic ID	Name	LOD (%)
Exon 18	G719A	2156G>C	6239	E-18-M1	0.20%
	G719S	2155G>A	6252	E-18-M2	0.80%
	G719C	2155G>T	6253	E-18-M3	0.40%
Exon 19	E746_A750del (1)	2235_2249del15	6223	E-19-M1	0.20%
	E746_A750del (2)	2236_2250del15	6225	E-19-M2	0.20%
	L747_P753>S	2240_2257del18	12370	E-19-M3	0.60%
	E746_T751>I	2235_2252>AAT(complex)	13551	E-19-M4	0.40%
	E746_T751del	2236_2253del18	12728	E-19-M5	0.40%
	E746_T751>A	2237_2251del15	12678	E-19-M6	0.20%
	E746_S752>A	2237_2254del18	12367	E-19-M7	0.20%
	E746_S752>V	2237_2255>T(complex)	12384	E-19-M8	0.20%
	E746_S752>D	2238_2255del18	6220	E-19-M9	0.40%
	L747_A750>P	2238_2248>GC(complex)	12422	E-19-M10	0.40%
	L747_T751>Q	2238_2252>GCA(complex)	12419	E-19-M11	0.20%
	L747_E749del	2239_2247delTTAAGAGAA	6218	E-19-M12	0.40%
	L747_T751del	2239_2253del15	/	E-19-M13	0.40%
	L747_S752del	2239_2256del18	6255	E-19-M14	0.40%
	L747_A750>P	2239_2248TTAAGAGAAG>C(complex)	12382	E-19-M15	0.40%

	L747_P753>Q	2239_2258>CA(complex)	12387	E-19-M16	0.40%
	L747_T751>S	2240_2251del12	6210	E-19-M17	0.80%
	L747_T751del	2240_2254del15	12369	E-19-M18	0.40%
	L747_T751>P	2239_2251>C(complex)	12383	E-19-M19	0.40%
	L747_T751del	2238_2252del15	23571	E-19-M20	0.40%
	L747_S752>Q	2239_2256>CAA	12403	E-19-M21	0.80%
	E746_T751>V	2237_2252>T	12386	E-19-M22	0.60%
	E746_T751>T	2236_2253> ACG	/	E-19-M23	0.80%
	L747_A750>P	2239_2250>CCC	/	E-19-M24	0.40%
	L747_K754>QL	2239_2261>CAATT	/	E-19-M25	0.80%
	E746_K754>EQHL	2238_2261>GCAACATCT	/	E-19-M26	0.40%
	E746_S752>EQ	2238_2256>GCAA	/	E-19-M27	0.60%
	E746_A750>QP	2236_2248>CAAC	13557	E-19-M28	0.60%
	E746_T751>Q	2236_2253>CAA	22999	E-19-M29	0.40%
Exon 20	T790M	2369C>T	6240	E-20-M1	0.20%
	S768I	2303G>T	6241	E-20-M2	0.20%
	H773_V774insH	2319_2320insCAC	12377	E-20-M3	0.40%
	D770_N771insG	2310_2311insGGT	12378	E-20-M4	0.60%
	V769_D770insASV	2307_2308insGCCAGCGTG	12376	E-20-M5	0.60%
	D770_N771insSVD	2311_2312insGCGTGGACA	13428	E-20-M8	0.40%
	V769_D770insASV	2309_2310AC>CCAGCGTGGAT	13558	E-20-M9	0.40%
	H773_V774insNPH	2319_2320insAACCCAC	12381	E-20-M10	0.80%
Exon 21	L858R	2573T>G	6224	E-21-M1	0.20%
	L861Q	2582T>A	6213	E-21-M2	0.20%

2. Cross-reactivity

The cross reaction among the mutant sequences targeted by this kit, the cross reaction with other homologous mutant nucleotide sequence (*HER2* gene, belongs to the same family as *EGFR* gene, the plasmids with five *HER2* hotspot mutations were selected in this study), the cross reaction with wild-type genomic DNA (DNA concentrations are 1~15 ng/reaction), and the cross reaction with non-human gene (the DNA was extracted from *Escherichia Coli*, *Yeast*, *Mycobacterium tuberculosis* and *Streptococcus pneumonia* which were common microorganism causing lung infection) were evaluated, the results shown no cross-reactions.

3. Interference factor

12 common interference substances: endogenous Hemoglobin, Ferritin, Albumin and Triglyceride, exogenous pathogenic microorganism such as *Mycobacterium Tuberculosis* and *Atreptococcus Pneumoniae*, therapeutic drugs such as Taxol, Carboplatin and Tarceva, common anticoagulants such as Heparin sodium, Sodium citrate and EDTA were evaluated in this study. It is confirmed that the potential maximum concentrations: 2 g/L hemoglobin, 37 mmol/L triglyceride, 200 ng/mL Ferritin, 60 g/L Albumin, 10⁶ CFU/mL *Mycobacterium Tuberculosis*, 10⁶ CFU/mL *Atreptococcus Pneumoniae*, 90 µg/mL Taxol, 90 µg/mL Carboplatin, 90 µg/mL Tarceva, 0.645 mol/L Sodium citrate and 27 µmol/L EDTA would not interfere with the test result. While 150 U/mL Heparin sodium would inhibit the test performance. It is stated in DNA Extraction section in the Instructions to avoid using *heparin anticoagulant*.

4. Precision

3 precision controls: negative control, weak positive control (with 1% mutant content) and strong positive control (with 50% mutant content) were used in the validation. 3 batches of the kits were tested with the precision controls by 2 operators twice a day for 20 days on different PCR instruments. The Ct values were calculated, the CV values were all within 5%.

Limitations

- 1) The kit is to be used only by personnel specially trained with PCR techniques.
- 2) The results can be used to assist clinical diagnosis, combining with other clinical and laboratory findings.
- 3) The kit has been validated for use with circulating DNA extracted from plasma sample and human genomic DNA extracted from FFPE tissue.
- 4) Reliable results are dependent on proper specimen collection, processing, transport, and storage.
- 5) The sample containing degraded DNA may affect the ability of the test to detect *EGFR* mutation.
- 6) This kit can only assess the *EGFR* mutation status and detect 42 *EGFR* mutations indicated above.
- 7) Samples with negative result (No mutation detected) may harbor *EGFR* mutations not detected by this assay.

References

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Symbols



Authorized Representative in the European Community



In Vitro Diagnostic Medical Device



Manufacturer



Catalogue Number



Batch Code



Use By



Contains Sufficient for <n> Tests



Temperature Limitation



Consult Instructions For Use



Keep Dry



This Way Up



Fragile, Handle With Care