

April 2020

# AdnaTest LungCancer Handbook

For detection of cancer-associated gene  
expression in enriched tumor cells

For molecular biology applications

**REF**

395092 (AdnaTest CTC-Select)  
396052 (AdnaTest LungCancerDetect)



QIAGEN GmbH, QIAGEN Strasse 1, 40724 Hilden, GERMANY

# Contents

Kit Contents .....	3
Shipping and Storage .....	4
Intended Use .....	4
Abbreviations .....	5
Symbols .....	5
Safety Information .....	6
Quality Control .....	6
Introduction .....	7
AdnaTest CTC-Select and AdnaTest LungCancerDetect .....	7
Equipment and Reagents to Be Supplied by User .....	10
AdnaTest CTC-Select .....	10
AdnaTest LungCancerDetect .....	11
Important Notes .....	12
Sample preparation .....	12
Handling .....	12
Protocol: Enrichment of Tumor Cells using AdnaTest CTC-Select .....	14
Protocol: Detection of Cancer-Associated Gene Expression in Enriched Tumor Cells using AdnaTest LungCancerDetect .....	18
Protocol: PCR and Fragment Analysis .....	23
Troubleshooting Guide .....	29
Ordering Information .....	30
Document Revision History .....	31

# Kit Contents

<b>AdnaTest CTC-Select</b>	
<b>Cat. no.</b>	<b>395092</b>
<b>Number of tests</b>	<b>12</b>
<hr/>	
<b>AdnaTest CTC-Select</b>	<b>Box 1</b>
Collection Tubes (1.5 ml)	24
Collection Tubes (1.5 ml)	3 x 5
CTC-Select Beads	1.2 ml
AdnaTest Lysis/Binding Buffer	2 ml
<b>AdnaWash Leukocyte Reducer</b>	<b>Box 2</b>
AdnaTest Leukocyte Reducer	2 x 125 ml
Quick-Start Protocol	1

The AdnaTest CTC-Select reagents are sufficient to process 12 blood samples.

<b>AdnaTest LungCancerDetect</b>	
<b>Cat. no.</b>	<b>396052</b>
<b>Number of tests</b>	<b>12</b>
<hr/>	
<b>AdnaTest RNA Reagent Box</b>	<b>Box 1</b>
AdnaTest Lysis/Binding Buffer	2ml
Oligo(dT) <sub>25</sub> Beads	355 µl
RNA Purification Buffer A	4 ml
RNA Purification Buffer B	4 ml
Tris-HCL Buffer	2 ml
<b>AdnaTest LungCancerDetect Box</b>	<b>Box 2</b>
PrimerMix EMT-2-Detect	144 µl
Positive Control EMT-2 (C+)	40 µl
PrimerMix LungDetect	144 µl
Positive Control Lung (C+)	40 µl
Quick-Start Protocol	1

The AdnaTest LungCancerDetect reagents are sufficient to analyze 6 PCR controls and 12 blood samples.

---

## Shipping and Storage

The AdnaTest CTC-Select system (cat. no. 395092) is delivered in 2 boxes. The AdnaTest CTC-Select (Box 1) should be stored at 2–8°C. The AdnaWash Leukocyte Reducer (Box 2) must be stored in a constant-temperature freezer at –30 to –15°C; however, for short- and medium-term storage, the AdnaWash Leukocyte Reducer can be stored at 2–8°C. To prevent possible contamination and repeated temperature changes, aliquot the AdnaWash Leukocyte Reducer. Under these conditions, the components are stable, without showing any reduction in performance and quality, until the expiry date indicated on the label.

The AdnaTest LungCancerDetect system (cat. no. 396052) is delivered in 2 boxes. The AdnaTest RNA Reagent Box (Box 1) should be stored at 2–8°C. The AdnaTest LungCancerDetect Box (Box 2), containing the AdnaTest PrimerMix EMT-2-Detect, AdnaTest PositiveControl EMT-2, the AdnaTest PrimerMix LungDetect, and the AdnaTest Positive Control Lung, must be stored in a constant-temperature freezer at –30 to –15°C. To prevent possible contamination and repeated temperature changes, aliquot the primer mixes and positive controls. Under these conditions, the components are stable, without showing any reduction in performance and quality, until the expiry date indicated on the label.

## Intended Use

AdnaTest LungCancer is for molecular biology applications. This product is not intended for the diagnosis, prevention, or treatment of a disease.

All due care and attention should be exercised in the handling of the products. We recommend all users of QIAGEN® products to adhere to the NIH guidelines that have been developed for recombinant DNA experiments, or to other applicable guidelines.

# Abbreviations

AdnaMag-L	magnetic particle concentrator (large)
AdnaMag-S	magnetic particle concentrator (small)
Akt-2	protein kinase B
ALDH1	aldehyde dehydrogenase 1
bp	base pairs
cDNA	complementary deoxyribonucleic acid
DNA	deoxyribonucleic acid
dNTPs	deoxynucleotide triphosphates
GA733-2	gastrointestinal-tumor-associated antigen 733-2
kb	kilobases
mRNA	messenger ribonucleic acid
PCR	polymerase chain reaction
PI3K $\alpha$	phosphoinositol-3-kinase
RNase	ribonuclease
rpm	revolutions per minute
RT	reverse transcription
TWIST1	transcription factor

# Symbols



Use by



Temperature limitation



Catalog number



Consult instructions for use



Manufacturer

---

# Safety Information

When working with chemicals, always wear a suitable lab coat, disposable gloves, and protective goggles. For more information, please consult the appropriate safety data sheets (SDSs). These are available online in convenient and compact PDF format at [www.qiagen.com/safety](http://www.qiagen.com/safety) where you can find, view, and print the SDS for each QIAGEN kit and kit component.

# Quality Control

In accordance with QIAGEN's ISO-certified Quality Management System, each lot of AdnaTest LungCancer is tested against predetermined specifications to ensure consistent product quality.

---

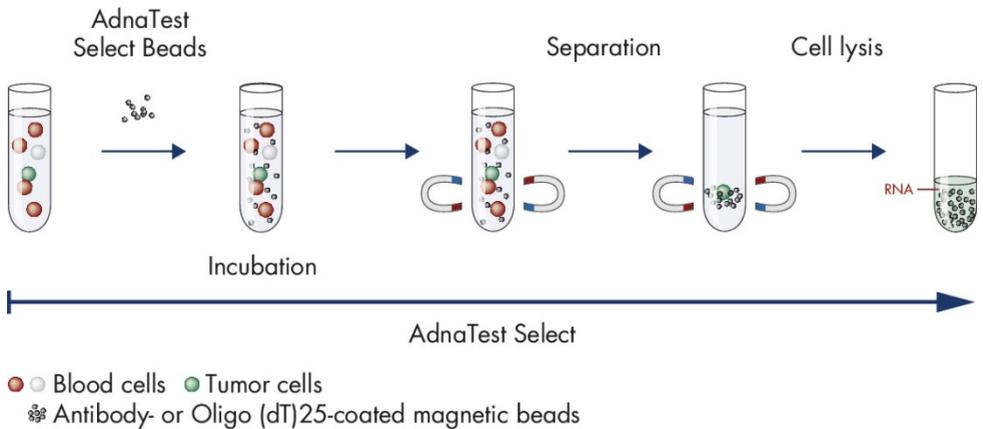
# Introduction

The AdnaTest LungCancer system in combination with the AdnaTest CTC-Select is based on the AdnaTest EMT-2/StemCell Kit and is used for analysis of epithelial-mesenchymal transition (EMT), epithelial and cancer cell stemness characteristics in immunomagnetically enriched tumor cells. The AdnaTest CTC-Select is used for enriching CTCs from whole blood, while the AdnaTest LungCancerDetect is subsequently used for the analysis of lung-cancer-associated and EMT-associated gene expression. The specificity of the detection is at least 90%. Using EMT markers in spiking experiments, 30 tumor cells in 5 ml of whole blood are detected at a recovery rate of at least 70%. Using a StemCell and an epithelial marker in spiking experiments, 10 tumor cells in 5 ml blood are detected at a recovery rate of at least 70%.

Successful CTC detection is based on the combination of combinations principle (COCP). Each AdnaTest has a unique combination of tumor-associated markers and an optimized combination of antibodies for cell selection. By combining a highly specific immunomagnetic cell-selection system using an optimized antibody combination with highly sensitive RT-PCR technology using a combination of mRNA tumor markers, the highest degrees of specificity and sensitivity can be expected. The AdnaTest uses a 2-step process (select and detect) to generate results within 5 hours.

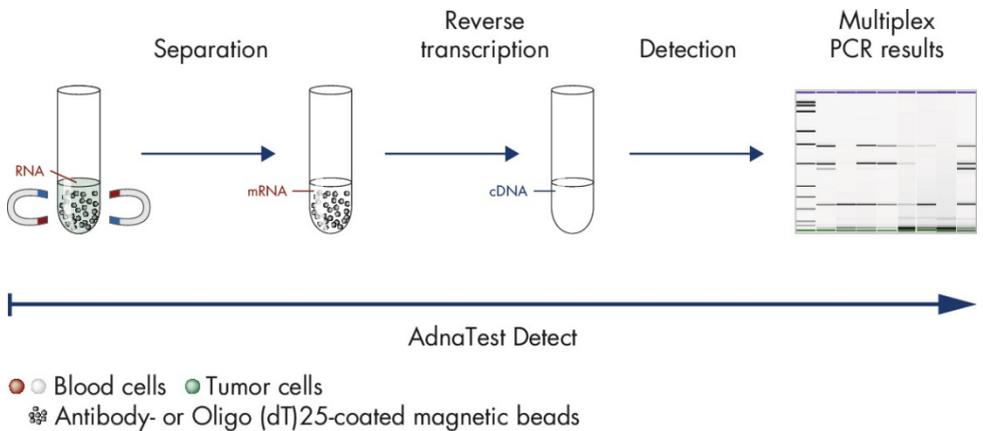
## AdnaTest CTC-Select and AdnaTest LungCancerDetect

AdnaTest CTC-Select enables the immunomagnetic enrichment of tumor cells via epithelial and tumor-associated antigens. Antibodies against epithelial and tumor-associated antigens are conjugated to magnetic beads for labeling of tumor cells in whole blood. Labeled cells are extracted by a magnetic particle concentrator (AdnaMag-L and AdnaMag-S) using AdnaWash Leukocyte Reducer, which reduces leukocyte cross-reactions, and are subsequently lysed (Figure 1). The cell lysate is used for further analysis.



**Figure 1. AdnaTest CTC-Select: Immunomagnetic cell selection with multiple tumor-associated antibodies.** In the first step, the CTCs in the blood are enriched (AdnaTest CTC-Select). This is achieved using antibody-coated magnetic particles (beads). Several antibodies are used, which bind with high specificity and affinity to the corresponding cancer cells. The enriched cells are lysed and subsequently purified several times to extract mRNA.

In the second step, Oligo(dT)<sub>25</sub> Beads are used for the isolation of mRNA from the lysate of enriched tumor cells. Reverse transcription results in cDNA, which is subsequently used as template for tumor-cell detection and characterization by multiplex PCR. The AdnaTest PrimerMix EMT-2-Detect allows the amplification of 3 tumor-associated antigens and 1 control gene. The PrimerMix LungDetect allows the amplification of 2 tumor-associated antigens (Figure 2).



**Figure 2. AdnaTest LungCancerDetect: Multiplex PCR of various cancer-associated tumor markers.** In a second step, the enriched cells are examined by RT-PCR for tumor-associated expression patterns. The mRNA strands are reverse transcribed into cDNA. Subsequently, several associated tumor markers can be amplified using multiplex PCR and visualized.

The PrimerMix EMT-2-Detect generates fragments of the following sizes:

- PI3K $\alpha$ : 551 bp
- Akt-2: 309 bp
- TWIST1: 201 bp
- Actin: 120 bp (internal PCR control)

The PrimerMix LungDetect generates fragments of the following sizes:

- GA733-2: 395 bp
- ALDH1: 161 bp

**Note:** Fragment sizes may vary slightly. Make sure to use the AdnaTest Positive Control EMT-2 and AdnaTest Positive Control Lung for assignment of the detected signals.

---

# Equipment and Reagents to Be Supplied by User

When working with chemicals, always wear a suitable lab coat, disposable gloves, and protective goggles. For more information, consult the appropriate safety data sheets (SDSs), available from the product supplier.

## AdnaTest CTC-Select

### Equipment

- Tube rotator for 15 ml and 1.5 ml tubes (e.g., ELMi Ltd. cat. no. IMIX-03)
- Magnetic particle concentrators
  - AdnaMag-L (cat. no. 399921)
  - AdnaMag-S (cat. no. 399911)

### Material

- AdnaTubes (cat. no. 399932), when working with BD Vacutainer® ACD-A Tubes (Becton Dickinson GmbH cat. no. 366645 [EU]; 364606 [US])
- Sterile, RNase-free 10 ml glass or plastic pipettes and pipettor
- Sterile, RNase-free 1.5 ml reaction tubes (e.g., Sarstedt cat. no. 72.690)
- Pipettes and RNase-free pipette tips with aerosol barrier, suitable for pipetting volumes from 100 µl to 1000 µl

### Reagents

- Phosphate buffered saline (PBS), pH 7.0–7.3 (e.g., Fisher cat. no. VX14190169, D-PBS)

---

# AdnaTest LungCancerDetect

## Equipment

- Tube rotator for 1.5 ml tubes
- Magnetic particle concentrator AdnaMag-S
- Thermal block or water bath (50°C)
- Thermal cycler with a heated lid and a heating rate of 2°C/s.
- Agilent® 2100 Bioanalyzer® (Agilent Technologies)

## Material

- Sterile, RNase-free, thin-wall 0.2 ml PCR tubes
- Sterile, RNase-free, 1.5 ml reaction tubes
- Pipettes and RNase-free pipette tips with aerosol barrier, suitable for pipetting volumes from 1 µl to 200 µl

## Reagents

- Sensiscript® RT Kit (cat. no. 205211, 50 reactions)

**Note:** When using the Sensiscript RT Kit with AdnaTest LungCancerDetect, the volume is sufficient for only 25 samples because twice the volume is required for each reaction.

- Recombinant RNasin®, RNase-inhibitor, 2500 U (Promega cat. no. N2511)
- HotStarTaq® Master Mix Kit (cat. no. 203443, 250 U)
- Crushed ice

# Important Notes

## Sample preparation

- Blood samples must be taken before the application of therapeutic substances. Do not use the AdnaTest CTC-Select earlier than 7 days after the last therapeutic intervention.
- Blood collection: If sample transportation is less than 4 hours, use tubes containing EDTA as anticoagulant (e.g., S Monovette® K3 EDTA, Sarstedt cat. no. 01.1605.001) to draw at least 7.5 ml of whole blood.
- If sample transportation is longer than 4 hours, use BD Vacutainer ACD-A Tubes to draw at least 8.5 ml of whole blood. Before further processing using the AdnaTest, 5 ml ACD-A blood must be transferred into an AdnaTube.
- Blood must be stored at 2–8°C immediately.
- Samples should be processed as soon as possible, not later than 4 hours after blood withdrawal (when using standard EDTA tubes) or within 30 hours (when using BD Vacutainer blood collection tubes in combination with AdnaTubes).
- The blood sample must not be hemolyzed.

## Handling

- CTC-Select Beads contain sodium azide as preservative. Sodium azide is cytotoxic and must, therefore, be removed before using the beads. (See “Protocol: Enrichment of Tumor Cells using AdnaTest CTC-Select”, page 14).
- All components and additional reagents provided by other suppliers must be stored according to their instructions. Safety advice of the corresponding manufacturers applies.
- Wear protective gloves to avoid contamination with DNA, RNA, and RNases.
-  The test must be performed in the sequence described and must comply with all specifications stated with respect to incubation times and incubation temperatures.

- 
- Discard samples if the CTC-Select Beads agglutinate during cell enrichment.
  - Perform sample processing, including reverse transcription and subsequent analysis of amplified PCR products, in different rooms, if possible, to avoid cross-contamination.
  - The use of products from suppliers other than those suggested may adversely affect the results.
  - The safety and hygiene regulations of the laboratory must be respected (e.g., wear lab coats, protective goggles, and gloves).

---

# Protocol: Enrichment of Tumor Cells using AdnaTest CTC-Select

## Important points before starting

- Before beginning the procedure, read “Important Notes” (page 12).
- It is necessary to remove sodium azide by washing the CTC-Select Beads prior to use, as described below in “Procedure A: Preparation of the CTC-Select Beads”.
- Use the provided 1.5 ml collection tubes only for the protocol step indicated.

## Things to do before starting

- Ensure that the AdnaTest Lysis/Binding Buffer and AdnaWash Leukocyte Reducer are equilibrated to room temperature (15–25°C). If precipitate is observed, equilibrate the reagents to room temperature and mix until the precipitate is completely dissolved.

## Procedure A: Preparation of the CTC-Select Beads

1. Resuspend the CTC-Select Beads thoroughly by pipetting.

**Important:** Do not vortex.

2. Calculate the volume of CTC-Select Beads required for all samples to be processed (100 µl per sample), and transfer the calculated volume into a 1.5 ml reaction tube (not provided).

If more than 10 samples are processed, use additional 1.5 ml reaction tubes.

3. Place the tube into the AdnaMag-S rack.
4. After 1 min, remove the supernatant with a pipette.

**Important:** Do not touch the beads when removing the supernatant.

## 5. Wash steps:

- 5a. Remove the magnet slider from the AdnaMag-S rack.
  - 5b. Add 1 ml PBS and resuspend the beads by repeated pipetting.
  - 5c. Place the magnet slider into the AdnaMag-S rack.
  - 5d. After 1 min remove the supernatant completely with a pipette.
  - 5e. Repeat steps 5a–5d twice (3 washes in total).
6. Remove the tube from the AdnaMag-S rack, and resuspend the beads in PBS to the original volume (100  $\mu$ l per sample). Proceed with “Procedure B: Selection of tumor cells” below.

## Procedure B: Selection of tumor cells

1. When using standard EDTA tubes, pipet 5 ml of blood sample into a 15 ml collection tube (provided). When using ACD-A blood in a BD Vacutainer ACD-A Tube, transfer 5 ml of blood into an AdnaTube.  
**Note:** AdnaTubes are mandatory when using BD Vacutainer ACD-A Tubes.
2. Resuspend the CTC-Select Beads thoroughly (prepared in step 6 of Procedure A) by pipetting, and add 100  $\mu$ l of these beads to each blood sample.
3. Rotate tubes slowly (approximately 5 rpm) for 30 min at room temperature on a device that allows both tilting and rotation.
4. Place tubes into the AdnaMag-L rack without the magnet slider. Swing the AdnaMag-L rack downward to release blood droplets captured in the cap.
5. Insert the magnet slider and incubate the tubes in the AdnaMag-L rack for 3 min at room temperature.
6. Remove the supernatant completely with a 10 ml pipette without touching the beads.  
**Important:** Do not touch the beads when removing the supernatant.

---

7. Wash steps:

- 7a. Remove the magnet slider from the AdnaMag-L rack.
  - 7b. Add 5 ml AdnaWash Leukocyte Reducer. Close the tubes and shake the AdnaMag-L rack gently back and forth 5 times to resuspend the magnetic bead/cell complexes.
  - 7c. Swing the AdnaMag-L rack with the tubes downward twice to release droplets captured in the cap.
  - 7d. Place the magnet slider into the AdnaMag-L rack and incubate for 3 min at room temperature.
  - 7e. Remove supernatant completely with a pipette.
  - 7f. Repeat steps 7a–7e twice (3 washes in total).
8. Remove the magnet slider from the AdnaMag-L rack.
9. Resuspend the magnetic bead/cell complexes in 1 ml AdnaWash Leukocyte Reducer and transfer each sample into a 1.5 ml reaction tube.
10. Place reaction tubes into the AdnaMag-S rack with an inserted magnet slider.
- Note:** The magnet slider of the AdnaMag-S rack can be inserted in 2 positions. Always insert the slider with the white plastic film facing forward to make sure that the magnets are next to the reaction tubes.
- 11. After 3 min, remove the supernatant with a pipette.
  - 12. Remove the magnet slider from the AdnaMag-S rack.
  - 13. Resuspend the magnetic bead/cell complexes in 1 ml PBS
  - 14. Place the magnet slider into the AdnaMag-S rack.
  - 15. After 1 min, remove the supernatant completely with a pipette to optimize the subsequent cell lysis.
  - 16. Remove the magnet slider from the AdnaMag-S rack.
  - 17. Add 200  $\mu$ l AdnaTest Lysis/Binding Buffer (equilibrated to room temperature) to each reaction tube. Resuspend by pipetting at least 5 times.
  - 18. Insert the magnet slider into the AdnaMag-S rack, and incubate for 1 min.

- 
19. Transfer each supernatant (cell lysate) into a new 1.5 ml reaction tube.
  20. Discard the tubes that contain the beads.
  21. Continue with mRNA isolation (see "Protocol: Detection of Cancer-Associated Gene Expression in Enriched Tumor Cells using AdnaTest LungCancerDetect", page 18) immediately, or store the cell lysates at  $-20^{\circ}\text{C}$  for up to 2 weeks.

---

# Protocol: Detection of Cancer-Associated Gene Expression in Enriched Tumor Cells using AdnaTest LungCancerDetect

## Important points before starting

- Before beginning the procedure, read “Important Notes” (page 12).
- Procedures A–C describe the isolation of mRNA and reverse transcription.
- Use the provided 1.5 ml collection tubes only for the protocol step indicated.

## Things to do before starting

- Ensure that AdnaTest Lysis/Binding Buffer is equilibrated to room temperature. If precipitate is observed, equilibrate the reagents to room temperature and mix until the precipitate is completely dissolved.
- Equilibrate RNA Purification Buffer A and RNA Purification Buffer B to room temperature. Place Tris-HCL Buffer on ice.
- Thaw 10x Buffer RT and dNTPs from the Sensiscript RT Kit at room temperature. Mix by vortexing. Centrifuge briefly and store on ice. Thaw RNase-free water (also from the Sensiscript RT Kit).
- Adjust a thermal block or water bath to 50°C.

## Procedure A: Preparation of Oligo(dT)<sub>25</sub> Beads

1. Resuspend the Oligo(dT)<sub>25</sub> Beads thoroughly by pipetting.

**Important:** Do not vortex.

2. Calculate the volume of the beads required for all samples to be processed (20 µl per sample, plus 10%), and transfer the calculated volume into an RNase-free 1.5 ml reaction tube (not provided).

3. Place the tube into the AdnaMag-S rack.

**Note:** The magnet slider of the AdnaMag-S rack can be inserted in 2 positions. Always insert the slider with the white plastic film facing forward to make sure that the magnets are next to the reaction tubes.

4. After 1 min, remove the supernatant with a pipette.

5. Wash steps:

5a. Remove the magnet slider from the AdnaMag-S rack.

5b. Add the original volume (step 2, page 18) AdnaTest Lysis/Binding Buffer and resuspend the beads by repeated pipetting. Resuspend gently to avoid foaming.

5c. Insert the magnet slider into the AdnaMag-S rack.

5d. After 1 min, remove the supernatant completely.

5e. Repeat steps 5a–5d once (2 washes in total).

6. Remove the tube from the AdnaMag-S rack, and resuspend the beads in AdnaTest Lysis/Binding Buffer to the original volume (step 2, page 18). Proceed with “Procedure B: mRNA isolation” below.

### Procedure B: mRNA isolation

1. Add 20  $\mu$ l of Oligo(dT)25 Beads (step 6, above) to each tube containing cell lysate (step 19 of “Procedure B: Selection of tumor cells”, page 17).

2. Rotate tubes slowly (approximately 5 rpm) for 10 min at room temperature on a device that allows both tilting and rotation.

3. Place the tubes into the AdnaMag-S rack without the magnet slider. Swing the AdnaMag-S rack downward to release beads and liquid captured in the cap.

4. Insert the magnet slider, wait for 1 min, and then remove the supernatant.

5. Wash steps 1:

- 5a. Remove the magnet slider from the AdnaMag-S rack.
- 5b. Add 100  $\mu$ l RNA Purification Buffer A to each tube and resuspend the beads by repeated pipetting. To avoid any loss of beads, rinse lid and tube wall thoroughly.
- 5c. Insert the magnet slider into the AdnaMag-S rack.
- 5d. After 1 min, remove the supernatant completely.
- 5e. Repeat steps 5a–5d once (2 washes in total).

6. Wash steps 2:

- 6a. Remove the magnet slider from the AdnaMag-S rack.
- 6b. Add 100  $\mu$ l RNA Purification Buffer B to each tube. Resuspend the beads by pipetting, and transfer into new 1.5 ml reaction tubes (provided).
- 6c. Insert the magnet slider into the AdnaMag-S rack.
- 6d. After 1 min, remove the supernatant completely. This step must be carried out carefully (watch the pellet), because the beads might slide and could be removed by mistake.
- 6e. Using the same reaction tubes, repeat steps 6a–6d once (2 washes in total).

7. Remove the magnet slider from the AdnaMag-S rack.

8. Add 100  $\mu$ l ice-cold Tris-HCL Buffer to each tube, and resuspend the beads by pipetting.

9. Insert the magnet slider into the AdnaMag-S rack.

10. After 1 min, remove the supernatant completely.

11. Remove the magnet slider from the AdnaMag-S rack.

12. Resuspend the mRNA/bead-complex in 29.5  $\mu$ l RNase-free water.

13. Transfer the tubes to a thermal block or water bath, and incubate for 5 min at 50°C.

14. Place the tubes on ice immediately for at least 2 min.

15. Continue immediately (within 5 min) with the reverse transcription “Procedure C: Reverse transcription using the Sensiscript RT Kit” below.

**Important:** Do not store the mRNA/bead complex.

## Procedure C: Reverse transcription using the Sensiscript RT Kit

1. Prepare the RT Master Mix on ice. The RT Master Mix is prepared as shown in Table 1 according to the number of samples.

The volume of RT Master Mix should be 10% greater than calculated for the total number of reverse-transcription reactions. A negative control reaction without addition of mRNA must always be prepared (RT control).

**Table 1. Reverse transcription reaction setup**

Component	Volume
<b>RT Master Mix</b>	
10x Buffer RT	4.0 $\mu$ l
dNTP Mix (5 mM each dNTP)	4.0 $\mu$ l
RNase inhibitor, 40 U/ $\mu$ l (Promega)	0.5 $\mu$ l
Sensiscript Reverse Transcriptase	2.0 $\mu$ l
<b>Template RNA*</b>	
mRNA/bead complex or RNase-free water	29.5 $\mu$ l
<b>Total volume</b>	<b>40.0 <math>\mu</math>l</b>

\* As RT control, add 29.5  $\mu$ l of RNase-free water instead of mRNA/bead complex. The volume of the mRNA/bead complex may vary slightly. Always use the total volume of this in the reverse transcription reaction.

2. Vortex the RT Master Mix. Centrifuge briefly, and pipet 10.5  $\mu$ l for each reaction into 0.2 ml PCR tubes.
3. Resuspend the mRNA/bead complexes (step 10, page 20) carefully with a pipette. Transfer the total volume into the 0.2 ml PCR tube containing the RT Master Mix. Mix thoroughly by repeated pipetting.

4. cDNA is synthesized in a thermal cycler under the following conditions (Table 2).

**Table 2. Reverse transcription program**

<b>Step</b>	<b>Time</b>	<b>Temperature</b>
Reverse transcription	60 min	37°C
Denaturation	5 min	93°C
Cooling	∞	4°C

5. Place reaction tubes with the cDNA on ice or store at –30 to –15°C for a maximum of 4 weeks.
6. Continue with “Protocol: PCR and Fragment Analysis”, next page.

---

# Protocol: PCR and Fragment Analysis

## Important point before starting

- Before beginning the procedure, read “Important Notes” (page 12).

## Things to do before starting

- Thaw HotStarTaq Master Mix, AdnaTest Positive Control EMT-2, AdnaTest Positive Control Lung, AdnaTest PrimerMix EMT-2-Detect, AdnaTest PrimerMix LungDetect, and RNase-free water. Vortex, centrifuge quickly, and store on ice.

## Procedure A: Multiplex PCR (EMT-2)

1. Prepare the PCR Master Mix as shown in Table 3 according to the number of samples. The volume of the PCR Master Mix should be at least 10% greater than the requirement calculated from the number of samples. Note that an AdnaTest Positive Control, RNase-free water as negative control, and the RT control must always be included.
2. For each preparation, dispense 21.0  $\mu$ l of the PCR Master Mix into 0.2 ml PCR tubes. Resuspend the cDNA/bead mix by pipetting, and add 4.0  $\mu$ l of it to each reaction tube.  
**Note:** As negative control, add 4.0  $\mu$ l of RNase-free water instead of cDNA.

**Table 3. Preparation of the multiplex PCR**

Component	Volume
<b>Multiplex PCR Master Mix</b>	
HotStarTaq Master Mix	12.5 µl
RNase-free water	4.5 µl
PrimerMix EMT-2-Detect	4 µl
cDNA <i>or</i> RT control <i>or</i> Negative control (RNase-free water) <i>or</i> Positive control, each:	4 µl
<b>Total volume</b>	<b>25 µl</b>

3. A thermal cycler is used for the PCR following the program described in Table 4. Run the thermal cycler with a ramp of 2°C/second. The PCR is performed with a total of 35 cycles.

**Table 4. PCR cycling program (EMT-2)**

Step	Time	Temperature
<b>Initial activation step</b>	15 min	95°C
<b>3-step cycling (35 cycles)</b>		
Denaturation	30 s	94°C
Annealing	30 s	60°C
Extension	60 s	72°C
<b>Final extension</b>	10 min	72°C
<b>Cooling</b>	∞	4°C

## Procedure B: Duplex PCR (LungDetect)

1. Prepare the PCR Master Mix as shown in Table 5 according to the number of samples. The volume of the PCR Master Mix should be at least 10% greater than the requirement calculated from the number of samples. Note that an AdnaTest Positive Control, RNase-free water as negative control, and the RT control must always be included.

- For each preparation, dispense 21.0  $\mu\text{l}$  of the PCR Master Mix into 0.2 ml PCR tubes. Resuspend the cDNA/bead mix by pipetting and add 4.0  $\mu\text{l}$  of it to each reaction tube.

**Note:** For negative control, add 4.0  $\mu\text{l}$  of RNase-free water instead of cDNA.

**Table 5. Preparation of the duplex PCR**

Component	Volume
<b>Multiplex PCR Master Mix</b>	
HotStarTaq Master Mix	12.5 $\mu\text{l}$
RNase-free water	4.5 $\mu\text{l}$
PrimerMix LungDetect	4 $\mu\text{l}$
cDNA <i>or</i>	
RT control <i>or</i>	4 $\mu\text{l}$
Negative control (RNase-free water) <i>or</i>	
Positive control, each:	
<b>Total volume</b>	<b>25 <math>\mu\text{l}</math></b>

- Use a thermal cycler for the PCR following the program described in Table 6. Run the thermal cycler with a ramp of 2°C/second. The PCR is performed with a total of 35 cycles.

**Table 6. PCR cycling program (LungDetect)**

Step	Time	Temperature
<b>Initial activation step</b>	15 min	95°C
<b>3-step cycling (35 cycles)</b>		
Denaturation	30 s	94°C
Annealing	30 s	51°C
Extension	30 s	72°C
<b>Final extension</b>	5 min	72°C
<b>Cooling</b>	$\infty$	4°C

## Fragment analysis on the Agilent 2100 Bioanalyzer

Analysis is performed with the Agilent 2100 Bioanalyzer (Agilent Technologies) on a DNA 1000 LabChip®. Follow the instructions of the DNA 1000 LabChip manual and make sure that no beads are transferred into the LabChip. Magnetic beads in the gel can cause false results.

1. Start the Bioanalyzer software “2100 expert”. Select **Instrument** (under **Contexts**) and then click the **Assay** button (next to **Assay Selection**).
2. Select **Electrophoresis > DNA 1000 Series II.xsy**. Prepare the chip and start the run.
3. For evaluation of the results, set a detection threshold:
  - 3a. Under **Contexts**, select **Data** and then click the **Assay Properties** tab. Select **Global** and **Normal** from the drop-down menu on the right.
  - 3b. Select **Sample Setpoints > Integrator > height threshold (FU)** and set this value to **0** (default value is **20**) to detect all signals.

## Analysis of the LungDetect results

The test is considered positive if a PCR fragment of at least 1 tumor-associated transcript is clearly detected.

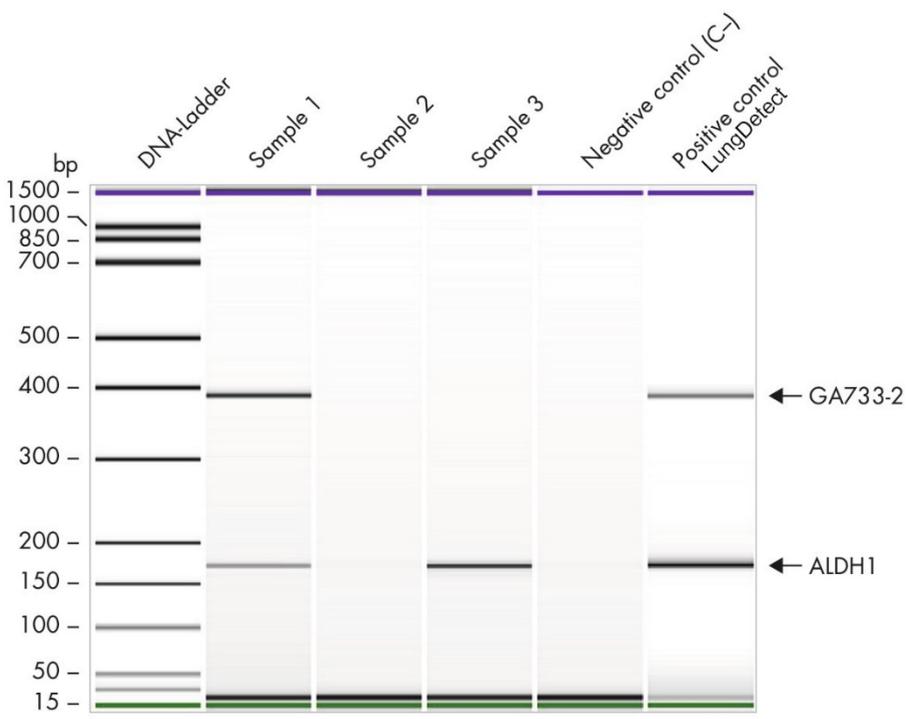
Using the Agilent 2100 Bioanalyzer, peaks with a concentration  $\geq 0.15$  ng/ $\mu$ l are positive (Figure 3).

Negative control and RT control samples must not show any bands larger than 80 base pairs (primer-dimers).

A fragment larger than 1000 bp indicates contamination with genomic DNA, suggesting that a problem occurred during cell separation. The results are invalid in this case.

**Important:** Not following the protocol exactly may result in false-negative or false-positive results.

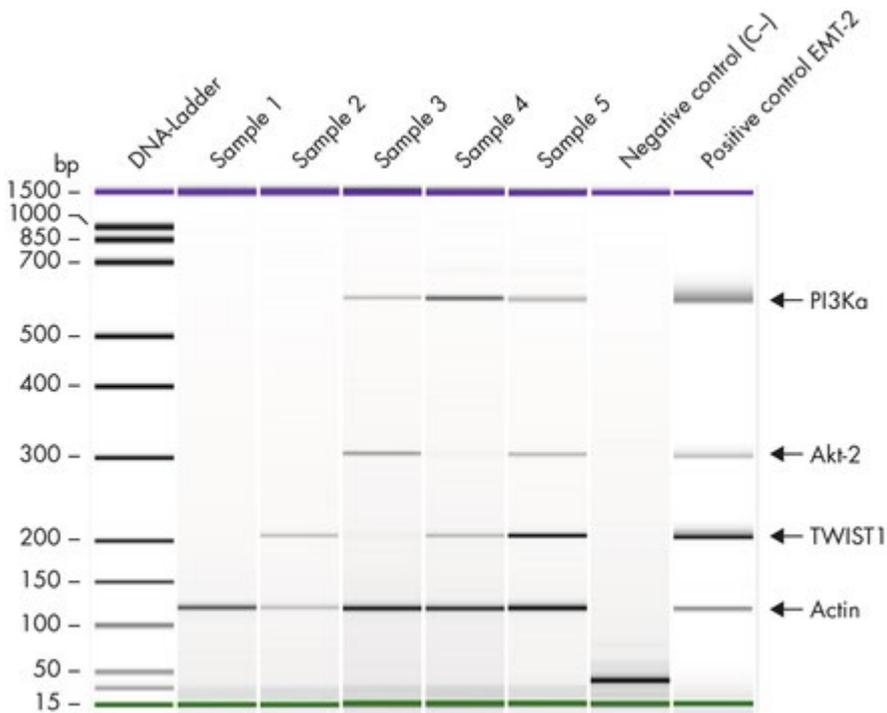
If assistance is needed to interpret the results, please contact QIAGEN Technical Services at [support.qiagen.com](mailto:support.qiagen.com).



**Figure 3. AdnaTest LungCancerDetect results of duplex PCR samples:** The first lane shows the DNA size standard (DNA-Ladder). Samples 1 is positive for ALDH1 and GA733.2, sample 3 is positive for ALDH1, and sample 2 is negative. The PCR negative control (C-) and the positive control (LungDetect) are shown in the last 2 lanes.

## Analysis of the EMT-2 results

The test is considered positive if a PCR fragment of at least 1 transcript associated with EMT-2 (PI3K $\alpha$ , Akt-2, or TWIST1) is clearly detected. When analysis is performed on the Agilent 2100 Bioanalyzer, peaks with a concentration  $\geq 0.15$  ng/ $\mu$ l are positive (Figure 4).



**Figure 4. AdnaTest LungCancerDetect results of samples using an Agilent 2100 Bioanalyzer: EMT-2-associated gene expression.** The first lane shows the DNA size standard (DNA-Ladder). Sample 1 is negative. Sample 2 is positive for TWIST1, sample 3 is positive for Akt-2 and PI3K $\alpha$ , and sample 4 is positive for PI3K $\alpha$  and TWIST1. Signals for all 3 EMT-2 markers can be detected in sample 5, and actin is detected in samples 1–5. The PCR negative control (C-) and the positive control (EMT-2) are shown in the last 2 lanes.

---

The fragment of the control gene actin must be detected in all samples (internal PCR control). An actin signal provides a positive control for successful cell separation, reverse transcription, and multiplex PCR. No bands larger than 80 bp may be detected in the negative control and RT control samples, because bands larger than 80 bp indicate primer–dimers.

A fragment larger than 1000 bp indicates contamination with genomic DNA, suggesting that a problem occurred during cell separation. The results are invalid in this case.

**Important:** If the protocol is not followed exactly, this may result in false-negative or false-positive results.

If assistance is needed to interpret the results, please contact QIAGEN Technical Services at [support.qiagen.com](http://support.qiagen.com).

## Troubleshooting Guide

See the Frequently Asked Questions page at our Technical Support Center: [www.qiagen.com/FAQ/FAQList.aspx](http://www.qiagen.com/FAQ/FAQList.aspx). The scientists in QIAGEN Technical Services are always happy to answer any questions you may have about either the information and/or protocols in this handbook or sample and assay technologies (for contact information, visit [www.qiagen.com](http://www.qiagen.com)).

# Ordering Information

Product	Contents	Cat. no.
AdnaTest CTC-Select	For isolation of CTCs and the subsequent extraction of mRNA from human whole blood for 12 preparations	395092
AdnaTest LungCancerDetect	RT-PCR kit for detection of cancer associated gene expression in enriched tumor cells	396052
<b>Related products</b>		
AdnaTube	12 sample tubes containing EDTA. Use only with anticoagulated blood collected in ACDA blood collection tubes from BD (Becton Dickinson, 8.5 ml)	399932
AdnaMag-L	Magnetic rack for 8 x 15 ml tubes	399921
AdnaMag-S	Magnetic rack for 8 x 1.5 ml tubes	399911
Sensiscript RT Kit (50)	For 50 reverse-transcription reactions:* Sensiscript Reverse Transcriptase, 150 µl 10x Buffer RT, 100 µl dNTP Mix (contains 5 mM of each dNTP), 1.1 ml RNase-free water	205211
HotStarTaq master Mix kit (250 U)	3 x 0.85 ml HotStarTaq Master Mix (contains 250 units HotStarTaq DNA Polymerase, PCR Buffer with 3 mM MgCl <sub>2</sub> , and 400 µM of each dNTP) and 2 x 1.7 ml RNase-free water	203443

\* The Sensiscript RT Kit (50) is sufficient for only 25 samples using AdnaTest LungCancerDetect because twice the volume is required for each reaction.

For up-to-date licensing information and product-specific disclaimers, see the respective QIAGEN kit handbook or user manual. QIAGEN kit handbooks and user manuals are available at [www.qiagen.com](http://www.qiagen.com) or can be requested from QIAGEN Technical Services or your local distributor.

# Document Revision History

Date	Changes
07/2018	Corrected cat. no. for AdnaTest CTC-Select to 395092.
04/2020	Increased volume of Oligo(dT) <sub>25</sub> Beads in the AdnaTest LungCancerDetect to 355 µl, from the previous 280 µl. Removed statement that license from Hoffmann-La Roche AG, Basel, is required to use AdnaTest LungCancerDetect, because that patent has expired. In "Sample preparation", changed blood storage temperature to 2–8°C, from 4°C. Added quick-start protocols to kit contents.

## Limited License Agreement for AdnaTest LungCancer

Use of this product signifies the agreement of any purchaser or user of the product to the following terms:

1. The product may be used solely in accordance with the protocols provided with the product and this handbook and for use with components contained in the kit only. QIAGEN grants no license under any of its intellectual property to use or incorporate the enclosed components of this kit with any components not included within this kit except as described in the protocols provided with the product, this handbook, and additional protocols available at [www.qiagen.com](http://www.qiagen.com). Some of these additional protocols have been provided by QIAGEN users for QIAGEN users. These protocols have not been thoroughly tested or optimized by QIAGEN. QIAGEN neither guarantees them nor warrants that they do not infringe the rights of third-parties.
2. Other than expressly stated licenses, QIAGEN makes no warranty that this kit and/or its use(s) do not infringe the rights of third-parties.
3. This kit and its components are licensed for one-time use and may not be reused, refurbished, or resold.
4. QIAGEN specifically disclaims any other licenses, expressed or implied other than those expressly stated.
5. The purchaser and user of the kit agree not to take or permit anyone else to take any steps that could lead to or facilitate any acts prohibited above. QIAGEN may enforce the prohibitions of this Limited License Agreement in any Court, and shall recover all its investigative and Court costs, including attorney fees, in any action to enforce this Limited License Agreement or any of its intellectual property rights relating to the kit and/or its components.

For updated license terms, see [www.qiagen.com](http://www.qiagen.com).

Trademarks: QIAGEN®, Sample to Insight®, HotStarTaq®, Sensiscript® (QIAGEN Group); Agilent®, Bioanalyzer® (Agilent Technologies, Inc.); LabChip® (Caliper Life Sciences, Inc.); RNasin® (Promega Corporation); Sarstedt®, S-Monovette® (Sarstedt AG and Co.); Vacutainer® (Becton Dickinson and Company). Registered names, trademarks, etc. used in this document, even when not specifically marked as such, are not to be considered unprotected by law.

04/2020 HB-2519-003 © 2020 QIAGEN, all rights reserved.

---

Ordering [www.qiagen.com/shop](http://www.qiagen.com/shop) | Technical Support [support.qiagen.com](http://support.qiagen.com) | Website [www.qiagen.com](http://www.qiagen.com)