



## FlexISH

### ERBB2/CEN 17 Dual Color Probe

|     |            |   |             |
|-----|------------|---|-------------|
| REF | Z-2166-50  | Σ | 5 (0.05 ml) |
| REF | Z-2166-200 | Σ | 20 (0.2 ml) |

For the qualitative detection of human ERBB2 gene amplifications and alpha satellites of chromosome 17 by fluorescence *in situ* hybridization (FISH)



In vitro diagnostic medical device  
according to EU directive 98/79/EC

#### 1. Intended use

The FlexISH ERBB2/CEN 17 Dual Color Probe (PL122) is intended to be used for the qualitative detection of human ERBB2 gene amplifications as well as the detection of chromosome 17 alpha satellites in formalin-fixed, paraffin-embedded specimens such as human breast cancer or gastric cancer tissues by fluorescence *in situ* hybridization (FISH). The probe is intended to be used in combination with the FlexISH-Tissue Implementation Kit (Prod. No. Z-2182-5/-20).

Interpretation of the results must be made within the context of the patient's clinical history with respect to further clinical and pathologic data of the patient by a qualified pathologist.

#### 2. Clinical relevance

The ERBB2 gene (a.k.a. HER2 and NEU) is located in the chromosomal region 17q12 and encodes a 185-190 kDa transmembrane glycoprotein, p185, acting as a cellular growth factor receptor. The p185 protein belongs to the EGFR (epidermal growth factor receptor) subgroup of the RTK (receptor tyrosine kinase) superfamily also including EGFR (ERBB1), ERBB3 (HER3), and ERBB4 (HER4). Amplification of the proto-oncogene ERBB2, observed in approximately 20% of all breast cancer samples, has been correlated with a poor prognosis of the disease. Similar results have been obtained for a variety of other malignant neoplasms, e.g., ovarian cancer, stomach cancer, and carcinomas of the salivary gland.

#### 3. Test principle

The fluorescence *in situ* hybridization (FISH) technique allows for the detection and visualization of specific nucleic acid sequences in cell preparations. Fluorescently-labeled DNA fragments, so called FISH probes, and their complementary target DNA strands in the preparations are co-denatured and subsequently allowed to anneal during hybridization. Afterwards, unspecific and unbound probe fragments are removed by stringency washing steps. After counterstaining the DNA with DAPI, hybridized probe fragments are visualized using a fluorescence microscope equipped with excitation and emission filters specific for the fluorochromes with which the FISH probe fragments have been directly labeled.

#### 4. Reagents provided

The FlexISH ERBB2/CEN 17 Dual Color Probe is composed of:

- ZyGreen (excitation 503 nm/emission 528 nm) labeled polynucleotides (~10.0 ng/μl), which target sequences mapping in 17q12-q21.1\* (chr17:37,572,531-38,181,308) harboring the ERBB2 gene region (see Fig. 1).
- ZyOrange (excitation 547 nm/emission 572 nm) labeled polynucleotides (~1.0 ng/μl), which target sequences mapping in 17p11.1-q11.1 specific for the alpha satellite centromeric region D17Z1 of chromosome 17.
- Formamide based hybridization buffer

\*according to Human Genome Assembly GRCh37/hg19

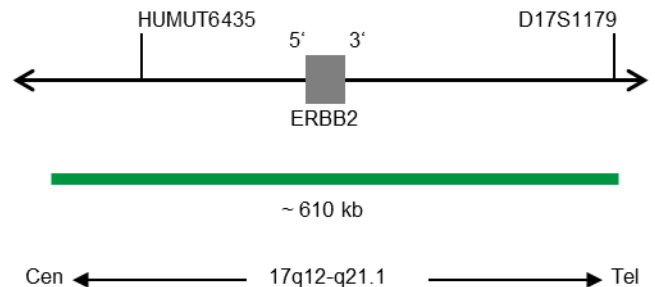


Fig. 1: ERBB2 Probe map (not to scale)

The FlexISH ERBB2/CEN 17 Dual Color Probe is available in two sizes:

- Z-2166-50: 0.05 ml (5 reactions of 10 μl each)
- Z-2166-200: 0.2 ml (20 reactions of 10 μl each)

#### 5. Materials required but not provided

- FlexISH-Tissue Implementation Kit (Prod. No. Z-2182-5/-20)
- Positive and negative control specimens
- Microscope slides, positively charged
- Water bath (37°C, 98°C)
- Hybridizer or hot plate
- Hybridizer or humidity chamber in hybridization oven
- Adjustable pipettes (10 μl, 25 μl)
- Staining jars or baths
- Timer
- Calibrated thermometer
- Ethanol or reagent alcohol
- Xylene
- Deionized or distilled water
- Coverslips (22 mm x 22 mm, 24 mm x 60 mm)
- Rubber cement, e.g., Fixogum Rubber Cement (Prod. No. E-4005-50/-125) or similar
- Adequately maintained fluorescence microscope (400-1000x)
- Immersion oil approved for fluorescence microscopy
- Appropriate filter sets

#### 6. Storage and handling

Store at 2-8°C in an upright position protected from light. Use protected from light. Return to storage conditions immediately after use. Do not use reagents beyond expiration date indicated on the label. The device is stable until expiration date indicated on the label when handled accordingly.

## 7. Warnings and precautions

- The probe should not be exposed to light, especially strong light, for a longer period of time, i.e. all steps should be accomplished, where possible, in the dark and/or using lightproof containers!
- Read the instruction for use prior to use!
- Do not use the reagents after the expiry date has been reached!
- This product contains substances (in low concentrations and volumes) that are harmful to health and potentially infectious. Avoid any direct contact with the reagents. Take appropriate protective measures (use disposable gloves, protective glasses, and lab garments)!
- If reagents come into contact with skin, rinse skin immediately with copious quantities of water!
- A material safety data sheet is available on request for the professional user.
- Do not reuse reagents.
- Avoid cross-contamination of samples as this may lead to erroneous results.

### Hazard and precautionary statements:

The hazard determining component is Formamide.



**Danger**

|                  |  |
|------------------|--|
| H319             | Causes serious eye irritation.   |
| H351             | Suspected of causing cancer.   |
| H360FD           | May damage fertility. May damage the unborn child.   |
| H373             | May cause damage to organs through prolonged or repeated exposure.   |
| P201             | Obtain special instructions before use.  |
| P260             | Do not breathe dust/fume/gas/mist/vapours/spray.   |
| P280             | Wear protective gloves/protective clothing/eye protection/face protection.   |
| P305+P351 + P338 | IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. |
| P308+P313        | IF exposed or concerned: Get medical advice/attention.   |
| P337+P313        | If eye irritation persists: Get medical advice/attention.  |

## 8. Limitations

- For *in vitro* diagnostic use.
- For professional use only.
- The clinical interpretation of any positive staining, or its absence, must be done within the context of clinical history, morphology, other histopathological criteria as well as other diagnostic tests. It is the responsibility of a qualified pathologist to be familiar with the FISH probes, reagents, diagnostic panels, and methods used to produce the stained preparation. Staining must be performed in a certified, licensed laboratory under the supervision of a pathologist who is responsible for reviewing the stained slides and assuring the adequacy of positive and negative controls.
- Specimen staining, especially signal intensity and background staining, is dependent on the handling and processing of the specimen prior to staining. Improper fixation, freezing, thawing, washing, drying, heating, sectioning, or contamination with other specimens or fluids may produce artefacts or false results. Inconsistent results may result from variations in fixation and embedding methods, as well as from inherent irregularities within the specimen.
- The probe should be used only for detecting loci described in 4. "Reagents provided".
- The performance was validated using the procedures described in this instruction for use. Modifications to these procedures might alter the performance and have to be validated by the user.

## 9. Interfering substances

Red blood cells present in the specimen might exhibit autofluorescence which hinders signal recognition.

The following fixatives are incompatible with ISH:

- Bouin's fixative
- B5 fixative
- Acidic fixatives (e.g., picric acid)
- Zenker's fixative
- Alcohols (when used alone)
- Mercuric chloride
- Formaldehyde/zinc fixative
- Hollande's fixative
- Non-buffered formalin

## 10. Preparation of specimens

Prepare specimens as described in the instructions for use of the [FlexISH-Tissue Implementation Kit](#).

## 11. Preparatory treatment of the device

The product is ready-to-use. No reconstitution, mixing, or dilution is required. Bring probe to room temperature (18-25°C) before use, protect from light. Prior to opening the vial, mix by vortexing and spin down briefly.

## 12. Assay procedure

### Specimen pretreatment

Perform specimen pretreatment (dewaxing, proteolysis) according to the instructions for use of the [FlexISH-Tissue Implementation Kit](#).

### Denaturation and hybridization

1. Pipette 10 µl of the probe onto each pretreated specimen.
2. Cover specimens with a 22 mm x 22 mm coverslip (avoid trapped bubbles) and seal the coverslip.  
*We recommend using rubber cement (e.g., Fixogum) for sealing.*
3. Place slides on a hot plate or hybridizer and denature specimens for 10 min at 75°C.
4. Perform hybridization for 2 h up to 16 h (i.e. overnight) at 37°C by either transferring the slides to a hybridizer or to a humidity chamber and a hybridization oven.

*It is essential that specimens do not dry out during the hybridization step.*

### Post-hybridization

Perform post-hybridization processing (washing, counter-staining, fluorescence microscopy) according to the instructions for use of the [FlexISH-Tissue Implementation Kit](#).

## 13. Interpretation of results

With the use of appropriate filter sets, the hybridization signals of the probe appear green (ERBB2 gene region) and orange (CEN 17).

**Normal situation:** In interphases of normal cells or cells without an amplification involving the ERBB2 gene region, two green and two orange signals appear (see Fig. 2).

**Aberrant situation:** In cells with an amplification of the ERBB2 gene region, an increased number of green signals or green signal clusters will be observed (see Fig. 2).

Overlapping signals may appear as yellow signals.

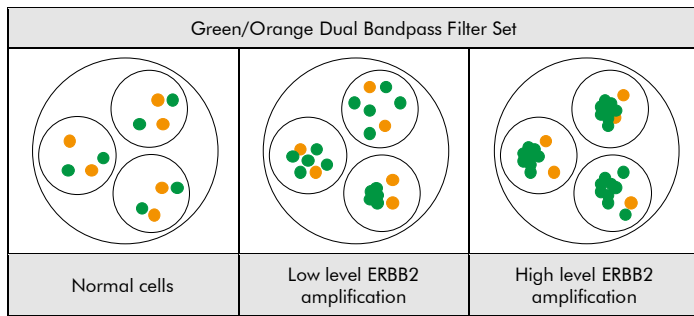


Fig. 2: Expected results in normal and aberrant interphase nuclei

Other signal distribution may be observed in some abnormal samples which might result in different signal patterns than described above, indicating variant rearrangements. Unexpected signal patterns should be further investigated.

**Please note:**

- Due to decondensed chromatin, single FISH signals can appear as small signal clusters. Thus, two or three signals of the same size, separated by a distance  $\leq 1$  signal diameter, should be counted as one signal.
- Do not evaluate overlapping nuclei.
- Do not count over-digested nuclei (recognized by dark areas visible inside of the nuclei).
- Do not count nuclei with strong auto-fluorescence, which hinders signal recognition.
- A negative or unspecific result can be caused by multiple factors (see chapter 17).
- In order to correctly interpret the results, the user must validate this product prior to use in diagnostic procedures according to national and/or international guidelines.

**14. Recommended quality control procedures**

In order to monitor correct performance of processed specimens and test reagents, each assay should be accompanied by internal and external controls. If internal and/or external controls fail to demonstrate appropriate staining, results with patient specimens must be considered invalid.

**Internal control:** Non-neoplastic cells within the specimen that exhibit normal signal pattern, e.g., fibroblasts.

**External control:** Validated positive and negative control specimens.

**15. Performance characteristics**

**Accuracy:** The location of hybridization of the probe was evaluated on metaphase spreads of a karyotypically normal male. In all tested specimens the probe hybridized solely to the expected loci. No additional signals or cross-hybridizations were observed. Therefore, the accuracy was calculated to be 100%.

**Analytical sensitivity:** For the analytical sensitivity assessment, the probe was evaluated on metaphase spreads of karyotypically normal males. All nuclei showed the expected normal signal pattern in all tested specimens. Therefore, the analytical sensitivity was calculated to be 100%.

**Analytical specificity:** For the analytical specificity assessment, the probe was evaluated on metaphase spreads of karyotypically normal males. In all tested specimens, all signals hybridized solely to the expected target loci and no other loci. Therefore, the analytical specificity was calculated to be 100%.

**16. Disposal**

The disposal of reagents must be carried out in accordance with local regulations.

**17. Troubleshooting**

Any deviation from the operating instructions can lead to inferior staining results or to no staining at all.

**Weak signals or no signals at all**

| Possible cause  | Action   |
|---|--|
| No target sequences available   | Use appropriate controls   |
| Specimen has not been properly fixed  | Optimize fixing time and fixative  |
| Heat pretreatment, proteolysis, denaturation, hybridization, or stringency wash temperature not correct | Check temperature of all technical devices used, using a calibrated thermometer  |
| Proteolytic pretreatment not carried out properly   | Optimize pepsin incubation time, increase or decrease if necessary   |
| Probe evaporation   | When using a hybridizer, the use of the wet stripes/water filled tanks is mandatory. When using a hybridization oven, the use of a humidity chamber is required. In addition, the coverslip should be sealed completely, e.g., with Fixogum, to prevent drying-out of the sample during hybridization. |
| Too low concentrated stringency wash buffer   | Check concentration of stringency wash buffer  |
| Old dehydration solutions   | Prepare fresh dehydration solutions  |
| Fluorescence microscope wrongly adjusted  | Adjust correctly   |
| Inappropriate filter sets used  | Use filter sets appropriate for the fluochromes of the probe.<br><i>Triple-bandpass filter sets provide less light compared to single or dual-bandpass filter sets. Consequently, the signals may appear fainter using these triple-bandpass filter sets.</i>  |
| Photo-damage of the probes/fluorophores   | Accomplish hybridization and washing steps in the dark   |

**Cross hybridization signals; noisy background**

| Possible cause  | Action   |
|---|--|
| Incomplete dewaxing   | Use fresh solutions; check duration of dewaxing  |
| Proteolytic pretreatment too strong                             | Optimize pepsin incubation time  |
| Probe volume per area too high                                  | Reduce probe volume per section/area, distribute probe dropwise to avoid local concentration |
| Slides cooled to room temperature before hybridization          | Transfer the slides quickly to 37°C  |
| Too high concentrated stringency wash buffer                    | Check concentration of stringency wash buffer  |
| Washing temperature following hybridization too low             | Check temperature; increase if necessary   |
| Dehydration of sections between the individual incubation steps | Prevent dehydration by sealing the slides and performing incubation in humid environment     |

**Overlapping nuclei**

| Possible cause                               | Action                                       |
|--|--|
| Inappropriate thickness of specimen sections | Prepare 2-4 $\mu\text{m}$ microtome sections |

**Tissue morphology degraded**

| Possible cause                                    | Action                            |
|---|-----------------------------------|
| Specimen has not been properly fixed              | Optimize fixing time and fixative |
| Proteolytic pretreatment not carried out properly | Optimize pepsin incubation time   |
| Insufficient drying before probe application      | Extend air-drying                 |

**Specimen floats off the slide**

| Possible cause                      | Action                                      |
|-------------------------------------|---|
| Unsuitable slide coating            | Use appropriate (positively charged) slides |
| Proteolytic pretreatment too strong | Shorten pepsin incubation time              |

**Weak counterstain**

| Possible cause                 | Action   |
|--------------------------------|--|
| Low concentrated DAPI solution | Use DAPI/DuraTect-Solution (ultra) (Prod. No. MT-0008-0.8) instead |
| DAPI incubation time too short | Adjust DAPI incubation time  |

**18. Literature**

- Baselga J, et al. (1999) *Semin Oncol* 26: 78-83.
- Brockhoff G, et al. (2016) *Histopathology* 69: 635-46.
- Brunello E, et al. (2012) *Histopathology* 60: 482-8.
- Brunner K, et al. (2010) *Anal Quant Cytol Histol* 32: 78-89.
- Coussens L, et al. (1985) *Science* 230: 1132-9.
- Ethl T, et al. (2012) *Br J Cancer* 106: 719-26.
- Hwang CC, et al. (2011) *Histopathology* 59: 984-92.
- Hynes NE & Stern DF (1994) *Biochim Biophys Acta* 1198: 165-84.
- Kievits T, et al. (1990) *Cytogenet Cell Genet* 53: 134-6.
- Moelans CB, et al. (2011) *Crit Rev Oncol Hematol* 80: 380-92.
- Park JB, et al. (1989) *Cancer Res* 49: 6605-9.
- Popescu NC, et al. (1989) *Genomics* 4: 362-6.
- Sassen A, et al. (2008) *Breast Cancer Res* 10: R2.
- Slamon DJ, et al. (1987) *Science* 235: 177-82.
- Voutsas IF, et al. (2013) *Int J Radiat Biol* 89: 319-25.
- Wilkinson DG: *In Situ Hybridization, A Practical Approach*, Oxford University Press (1992) ISBN 0 19 963327 4.
- Wolff AC, et al. (2013) *J Clin Oncol* 31: 3997-4013.

Our experts are available to answer your questions.  
Please contact [helptech@zytovision.com](mailto:helptech@zytovision.com)



ZytoVision GmbH  
Fischkai 1  
27572 Bremerhaven/ Germany  
Phone: +49 471 4832-300  
Fax: +49 471 4832-509  
[www.zytovision.com](http://www.zytovision.com)  
Email: [info@zytovision.com](mailto:info@zytovision.com)

**Trademarks:**

ZytoVision® and FlexISH® are trademarks of ZytoVision GmbH.