

Primerdesign™ Ltd

# Newcastle Disease Virus

M gene

genesig® Advanced Kit

150 tests

GENESIG

Kits by Primerdesign

For general laboratory and research use only

# Introduction to Newcastle Disease Virus

Newcastle Disease Virus (NDV) is a single-stranded RNA virus of the Paramyxoviridae family that causes a contagious disease in birds. The linear RNA genome comprises just over 15K nucleotides that encode 6 genes. The spherical viral particle is enveloped and has external spikes formed by two proteins, hemagglutinin and neuraminidase.

The virus can survive for several weeks in warm environments such as in manure or between bird feathers but is destroyed easily by UV light and dehydration. The viral particle enters the host by ingestion of contaminated food stuffs or contact with contaminated bodily fluids and attaches to the host cell surface. The viral envelope fuses to the plasma membrane via viral fusion proteins and the nucleocapsid is released into the host cell. The viral RNA is transcribed into mRNA and a positive-sense RNA template is created. New negative-sense RNA as well as viral proteins are packaged into a new virion which is enveloped as it leaves the host cell. Transmission from infected birds is via contact with bodily discharges such as faeces and mouth, nose and eye secretions.

Isolates are grouped into 3 strains in accordance with their virulence and subsequent symptoms of infection: velogenic (highly virulent) strains are responsible for digestive and neurological conditions, mesogenic (intermediate virulence) strains are associated with neurological or respiratory symptoms and lentogenic (mild virulence) strains causing predominantly respiratory conditions. After a 2-15 day incubation period the infection can cause symptoms including muscle tremors or paralysis, diarrhea and coughing and sneezing.

A prophylactic vaccine is available and is commonly used in the commercial poultry industry and although this does not necessarily prevent infection, infections in unvaccinated birds have a mortality rate of almost 100%. There is currently no treatment for Newcastle disease.

Transmission to humans can cause mild conjunctivitis and flu-like symptoms but is not particularly dangerous. Research in cancer studies has suggested NDV as an alternative treatment.

# Specificity

The Primerdesign genesig Kit for Newcastle Disease Virus (NDV) genomes is designed for the in vitro quantification of NDV genomes. The kit is designed to have a broad detection profile. Specifically, the primers represent 100% homology with over 95% of the NCBI database reference sequences available at the time of design.

The dynamics of genetic variation means that new sequence information may become available after the initial design. Primerdesign periodically reviews the detection profiles of our kits and when required releases new versions.

Our kit for Newcastle Disease Virus (NDV) has been designed for the specific and exclusive in vitro quantification of serotypes including virulent and vaccine strains. The M gene has previously been shown to be a good target sequence for broad detection of NDV species (A. Steyer et,al 2010). The primers and probe sequences in this kit have 100% homology with over 95% of reference sequences in the NCBI database based on a comprehensive bioinformatics analysis.

If you require further information, or have a specific question about the detection profile of this kit then please send an e.mail to [enquiry@primerdesign.co.uk](mailto:enquiry@primerdesign.co.uk) and our bioinformatics team will answer your question.

# Kit contents

- **NDV specific primer/probe mix (150 reactions BROWN)**  
FAM labelled
- **NDV positive control template (for Standard curve RED)**
- **Internal extraction control primer/probe mix (150 reactions BROWN)**  
VIC labelled as standard
- **Internal extraction control RNA (150 reactions BLUE)**
- **Endogenous control primer/probe mix (150 reactions BROWN)**  
FAM labelled
- **RNase/DNase free water (WHITE)**  
for resuspension of primer/probe mixes
- **Template preparation buffer (YELLOW)**  
for resuspension of internal control template, positive control template and standard curve preparation

## Reagents and equipment to be supplied by the user

### Real-time PCR Instrument

#### Extraction kit

This kit is recommended for use with genesig Easy DNA/RNA Extraction kit. However, it is designed to work well with all processes that yield high quality RNA and DNA with minimal PCR inhibitors.

#### **oasig™ lyophilised OneStep or Precision®PLUS OneStep 2X RT-qPCR Master Mix**

Contains complete OneStep RT-qPCR master mix

#### Pipettors and Tips

#### Vortex and centrifuge

#### Thin walled 1.5 ml PCR reaction tubes

## Kit storage and stability

This kit is stable at room temperature but should be stored at -20°C on arrival. Once the lyophilised components have been resuspended they should not be exposed to temperatures above -20°C for longer than 30 minutes at a time and unnecessary repeated freeze/thawing should be avoided. The kit is stable for six months from the date of resuspension under these circumstances.

If a standard curve dilution series is prepared this can be stored frozen for an extended period. If you see any degradation in this serial dilution a fresh standard curve can be prepared from the positive control.

Primerdesign does not recommend using the kit after the expiry date stated on the pack.

## Suitable sample material

All kinds of sample material suited for PCR amplification can be used. Please ensure the samples are suitable in terms of purity, concentration, and RNA/DNA integrity (An internal PCR control is supplied to test for non specific PCR inhibitors). Always run at least one negative control with the samples. To prepare a negative-control, replace the template RNA sample with RNase/DNase free water.

## Dynamic range of test

Under optimal PCR conditions genesig NDV detection kits have very high priming efficiencies of >95% and can detect less than 100 copies of target template.

## Notices and disclaimers

This product is developed, designed and sold for research purposes only. It is not intended for human diagnostic or drug purposes or to be administered to humans unless clearly expressed for that purpose by the Food and Drug Administration in the USA or the appropriate regulatory authorities in the country of use. During the warranty period Primerdesign genesig detection kits allow precise and reproducible data recovery combined with excellent sensitivity. For data obtained by violation to the general GLP guidelines and the manufacturer's recommendations the right to claim under guarantee is expired. PCR is a proprietary technology covered by several US and foreign patents. These patents are owned by Roche Molecular Systems Inc. and have been sub-licensed by PE Corporation in certain fields. Depending on your specific application you may need a license from Roche or PE to practice PCR. Additional information on purchasing licenses to practice the PCR process may be obtained by contacting the Director of Licensing at Roche Molecular Systems, 1145 Atlantic Avenue, Alameda, CA 94501 or Applied Biosystems business group of the Applied Biosystems Corporation, 850 Lincoln Centre Drive, Foster City, CA 94404. In addition, the 5' nuclease assay and other homogeneous amplification methods used in connection with the PCR process may be covered by U.S. Patents 5,210,015 and 5,487,972, owned by Roche Molecular Systems, Inc. and by U.S. Patent 5,538,848, owned by The Perkin-Elmer Corporation.

## Trademarks

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The PCR process is covered by US Patents 4,683,195, and 4,683,202 and foreign equivalents owned by Hoffmann-La Roche AG. BI, ABI PRISM®, GeneAmp® and MicroAmp® are registered trademarks of the Applied Biosystems (Applied Biosystems Corporation). BIOMEK® is a registered trademark of Beckman Instruments, Inc.; iCycler™ is a registered trademark of Bio-Rad Laboratories, Rotor-Gene is a trademark of Corbett Research. LightCycler™ is a registered trademark of the Idaho Technology Inc. GeneAmp®, TaqMan® and AmpliTaqGold® are registered trademarks of Roche Molecular Systems, Inc., The purchase of the Primerdesign™ reagents cannot be construed as an authorization or implicit license to practice PCR under any patents held by Hoffmann-LaRoche Inc.

# Principles of the test

## Real-time PCR

A NDV specific primer and probe mix is provided and this can be detected through the FAM channel.

The primer and probe mix provided exploits the so-called TaqMan® principle. During PCR amplification, forward and reverse primers hybridize to the NDV cDNA. A fluorogenic probe is included in the same reaction mixture which consists of a DNA probe labeled with a 5`-dye and a 3`-quencher. During PCR amplification, the probe is cleaved and the reporter dye and quencher are separated. The resulting increase in fluorescence can be detected on a range of qPCR platforms.

## Positive control

For copy number determination and as a positive control for the PCR set up, the kit contains a positive control template.

This can be used to generate a standard curve of NDV copy number / Cq value. Alternatively the positive control can be used at a single dilution where full quantitative analysis of the samples is not required. Each time the kit is used, at least one positive control reaction must be included in the run. A positive result indicates that the primers and probes for detecting the target NDV gene worked properly in that particular experimental scenario. If a negative result is obtained the test results are invalid and must be repeated. Care should be taken to ensure that the positive control does not contaminate any other kit component which would lead to false-positive results. This can be achieved by handling this component in a Post PCR environment. Care should also be taken to avoid cross-contamination of other samples when adding the positive control to the run. This can be avoided by sealing all other samples and negative controls before pipetting the positive control into the positive control well.

## Negative control

To validate any positive findings a negative control reaction should be included every time the kit is used. For this reaction the RNase/DNase free water should be used instead of template. A negative result indicates that the reagents have not become contaminated while setting up the run.

### **Internal RNA extraction control**

When performing RNA extraction, it is often advantageous to have an exogenous source of RNA template that is spiked into the lysis buffer. This control RNA is then co-purified with the sample RNA and can be detected as a positive control for the extraction process. Successful co-purification and qPCR for the control RNA also indicates that PCR inhibitors are not present at a high concentration.

A separate qPCR primer/probe mix are supplied with this kit to detect the exogenous RNA using qPCR. The PCR primers are present at PCR limiting concentrations which allows multiplexing with the target sequence primers. Amplification of the control cDNA does not interfere with detection of the NDV target cDNA even when present at low copy number. The Internal control is detected through the VIC channel and gives a Cq value of 28+/-3 depending on the level of sample dilution.

### **Endogenous control**

To confirm extraction of a valid biological template, a primer and probe mix is included to detect an endogenous gene. Detection of the endogenous control is through the FAM channel and it is NOT therefore possible to perform a multiplex with the NDV primers. A poor endogenous control signal may indicate that the sample did not contain sufficient biological material.

## Resuspension protocol

To minimize the risk of contamination with foreign DNA, we recommend that all pipetting be performed in a PCR clean environment. Ideally this would be a designated PCR lab or PCR cabinet. Filter tips are recommended for all pipetting steps.

- 1. Pulse-spin each tube in a centrifuge before opening.**  
This will ensure lyophilised primer and probe mix is in the base of the tube and is not spilt upon opening the tube.
- 2. Resuspend the primer/probe mixes in the RNase/DNase free water supplied, according to the table below:**  
To ensure complete resuspension, vortex each tube thoroughly.

| Component - resuspend in water                       | Volume |
|--|--------|
| <b>Pre-PCR pack</b>                                  |        |
| NDV primer/probe mix (BROWN)                         | 165 µl |
| Internal extraction control primer/probe mix (BROWN) | 165 µl |
| Endogenous control primer/probe mix (BROWN)          | 165 µl |

- 3. Resuspend the internal control template and positive control template in the template preparation buffer supplied, according to the table below:**  
To ensure complete resuspension, vortex each tube thoroughly.

| Component - resuspend in template preparation buffer | Volume |
|--|--------|
| <b>Pre-PCR heat-sealed foil</b>                      |        |
| Internal extraction control RNA (BLUE)               | 600 µl |
| <b>Post-PCR heat-sealed foil</b>                     |        |
| NDV Positive Control Template (RED) *                | 500 µl |

\* This component contains high copy number template and is a VERY significant contamination risk. It must be opened and handled in a separate laboratory environment, away from the other components.

## RNA extraction

The internal extraction control RNA can be added either to the RNA lysis/extraction buffer or to the RNA sample once it has been resuspended in lysis buffer.

**DO NOT add the internal extraction control RNA directly to the unprocessed biological sample as this will lead to degradation and a loss in signal.**

- 1. Add 4µl of the Internal extraction control RNA (BLUE) to each sample in RNA lysis/extraction buffer per sample.**
- 2. Complete RNA extraction according to the manufacturer's protocols.**



# OneStep RT-qPCR detection protocol

## For optimum performance and sensitivity.

All pipetting steps and experimental plate set up should be performed on ice. After the plate is poured proceed immediately to the OneStep amplification protocol. Prolonged incubation of reaction mixes at room temperature can lead to PCR artifacts that reduce the sensitivity of detection.

1. **For each RNA sample prepare a reaction mix according to the table below: Include sufficient reactions for positive and negative controls.**

| Component  | Volume       |
|--|--------------|
| oasig OneStep or PrecisionPLUS OneStep 2X RT-qPCR Master Mix | 10 µl        |
| NDV primer/probe mix (BROWN)                                 | 1 µl         |
| Internal extraction control primer/probe mix (BROWN)         | 1 µl         |
| RNase/DNase free water (WHITE)                               | 3 µl         |
| <b>Final Volume</b>  | <b>15 µl</b> |

2. **For each RNA sample prepare an endogenous control reaction according to the table below (optional):**  
This control reaction will provide crucial information regarding the quality of the biological sample.

| Component  | Volume       |
|--|--------------|
| oasig OneStep or PrecisionPLUS OneStep 2X RT-qPCR Master Mix | 10 µl        |
| Endogenous control primer/probe mix (BROWN)                  | 1 µl         |
| RNase/DNase free water (WHITE)                               | 4 µl         |
| <b>Final Volume</b>  | <b>15 µl</b> |

3. **Pipette 15µl of these mixes into each well according to your qPCR experimental plate set up.**
4. **Pipette 5µl of RNA template into each well, according to your experimental plate set up.**  
For negative control wells use 5µl of RNase/DNase free water. The final volume in each well is 20µl.

5. If a standard curve is included for quantitative analysis prepare a reaction mix according to the table below:

| Component  | Volume       |
|--|--------------|
| oasig OneStep or PrecisionPLUS OneStep 2X RT-qPCR Master Mix | 10 µl        |
| NDV primer/probe mix (BROWN)                                 | 1 µl         |
| RNase/DNase free water (WHITE)                               | 4 µl         |
| <b>Final Volume</b>  | <b>15 µl</b> |

6. Preparation of standard curve dilution series.

- 1) Pipette 90µl of template preparation buffer into 5 tubes and label 2-6
- 2) Pipette 10µl of Positive Control Template (RED) into tube 2
- 3) Vortex thoroughly
- 4) Change pipette tip and pipette 10 µl from tube 2 into tube 3
- 5) Vortex thoroughly

Repeat steps 4 and 5 to complete the dilution series

| Standard Curve                | Copy Number                |
|-------------------------------|----------------------------|
| Tube 1 Positive control (RED) | 2 x 10 <sup>5</sup> per µl |
| Tube 2                        | 2 x 10 <sup>4</sup> per µl |
| Tube 3                        | 2 x 10 <sup>3</sup> per µl |
| Tube 4                        | 2 x 10 <sup>2</sup> per µl |
| Tube 5                        | 20 per µl                  |
| Tube 6                        | 2 per µl                   |

7. Pipette 5µl of standard template into each well for the standard curve according to your plate set-up

The final volume in each well is 20µl.

## OneStep RT-qPCR Amplification Protocol

Amplification conditions using oasig OneStep or PrecisionPLUS OneStep 2X RT-qPCR Master Mix.

|             | Step                     | Time   | Temp  |
|-------------|--------------------------|--------|-------|
|             | Reverse Transcription    | 10 min | 55 °C |
|             | Enzyme activation        | 2 min  | 95 °C |
| Cycling x50 | Denaturation             | 10 s   | 95 °C |
|             | <b>DATA COLLECTION *</b> | 60 s   | 60 °C |

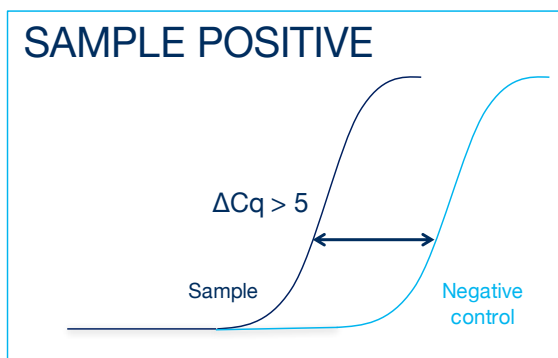
\* Fluorogenic data should be collected during this step through the FAM and VIC channels

# Interpretation of results

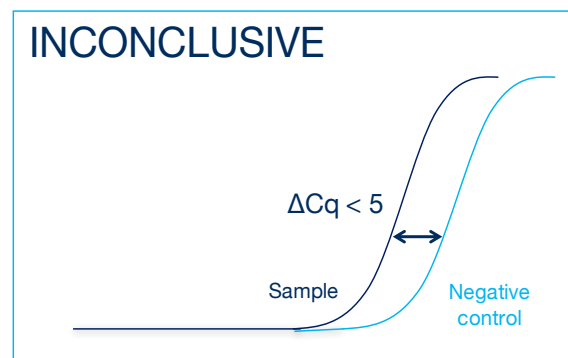
| Target (FAM) | Internal control (VIC) | Positive control | Negative control | Interpretation   |
|--------------|------------------------|------------------|------------------|--|
| ≤ 30         | + / -                  | +                | -                | <b>POSITIVE QUANTITATIVE RESULT</b><br>calculate copy number   |
| > 30         | +                      | +                | -                | <b>POSITIVE QUANTITATIVE RESULT</b><br>calculate copy number   |
| > 30         | -                      | +                | -                | <b>POSITIVE QUALITATIVE RESULT</b><br>do not report copy number as this may be due to poor sample extraction |
| -            | +                      | +                | -                | <b>NEGATIVE RESULT</b>   |
| + / -        | + / -                  | +                | ≤ 35             | <b>EXPERIMENT FAILED</b><br>due to test contamination  |
| + / -        | + / -                  | +                | > 35             | *  |
| -            | -                      | +                | -                | <b>SAMPLE PREPARATION FAILED</b>   |
| + / -        | + / -                  | -                | + / -            | <b>EXPERIMENT FAILED</b>   |

Positive control template (**RED**) is expected to amplify between Cq 16 and 23. Failure to satisfy this quality control criterion is a strong indication that the experiment has been compromised.

\*Where the test sample is positive and the negative control is positive with a Cq > 35, the sample must be reinterpreted based on the relative signal strength of the two results:



If the sample amplifies > 5 Cq earlier than the negative control then the sample should be reinterpreted (via the table above) with the negative control verified as negative.



If the sample amplifies < 5 Cq earlier than the negative control then the positive sample result is invalidated and the result should be determined inconclusive due to test contamination. The test for this sample should be repeated.

**Internal PCR control**

The C<sub>q</sub> value obtained with the internal control will vary significantly depending on the extraction efficiency, the quantity of RNA added to the RT and PCR reaction and the individual machine settings. C<sub>q</sub> values of 28±3 are within the normal range. When amplifying a NDV sample with a high genome copy number, the internal extraction control may not produce an amplification plot. This does not invalidate the test and should be interpreted as a positive experimental result.

**Endogenous control**

The signal obtained from the endogenous control primer and probe set will vary according to the amount of biological material present in a given sample. An early signal indicates the presence of a good yield of biological material. A late signal suggests that little biological material is present in the sample.