MilliporeSigma
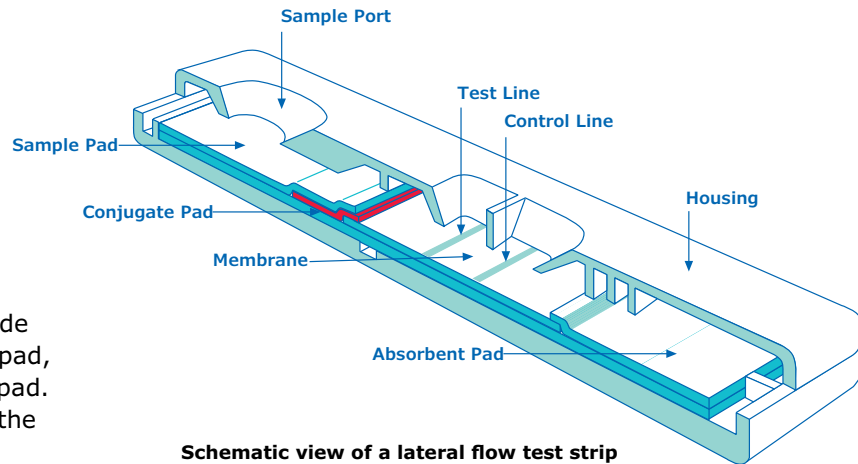

Understanding Lateral Flow Tests

From Development to Deployment

WILEY

What are Lateral Flow Tests?

Lateral flow tests are simple devices used to detect the presence of a target substance in a liquid sample without the need for specialized and costly equipment.

The main components include the sample pad, conjugate pad, membrane, and absorbent pad. Each plays a crucial role in the test's functionality.

Sample Port

Test Line

Control Line

Sample Pad

Housing

Conjugate Pad

Membrane

Absorbent Pad

Schematic view of a lateral flow test strip

Sample types

Blood

Whole Blood: Tests can accommodate whole blood as the sample, with the blood applied directly to the sample pad. This requires a pad material that can filter out red blood cells and yield serum without clogging or causing hemolysis.

Serum: Analytes found in serum can be detected, but efficient separation of blood cells from serum is challenging due to the high solids content in blood.

Urine

Human urine can be tested for various analytes. The sample pad may need to be treated with buffer salts to control pH and ionic strength, as urine can have a pH between 5 and 10.

Environmental Samples

Lateral flow tests can be designed for environmental testing, such as detecting contaminants in water or soil.

Veterinary Samples

Tests can be used for veterinary applications, analyzing samples from animals for various diseases and conditions.

Agricultural Samples

Lateral flow tests can be used in agricultural applications, such as testing for pathogens or quality indicators in crops and livestock.

Product Quality Evaluation

These tests can be employed for product quality evaluation in various industries, ensuring that products meet specific standards and are free from contaminants.

Infectious Disease Organisms

Detection of infectious disease organisms in various matrices, including human and veterinary samples.

Substances of Abuse

Analysis of drugs in biological samples, typically urine, but potentially other fluids as well.

Human Physiology Analytes

Measurement of analytes important to human physiology, such as hormones (e.g., human chorionic gonadotropin for pregnancy tests).
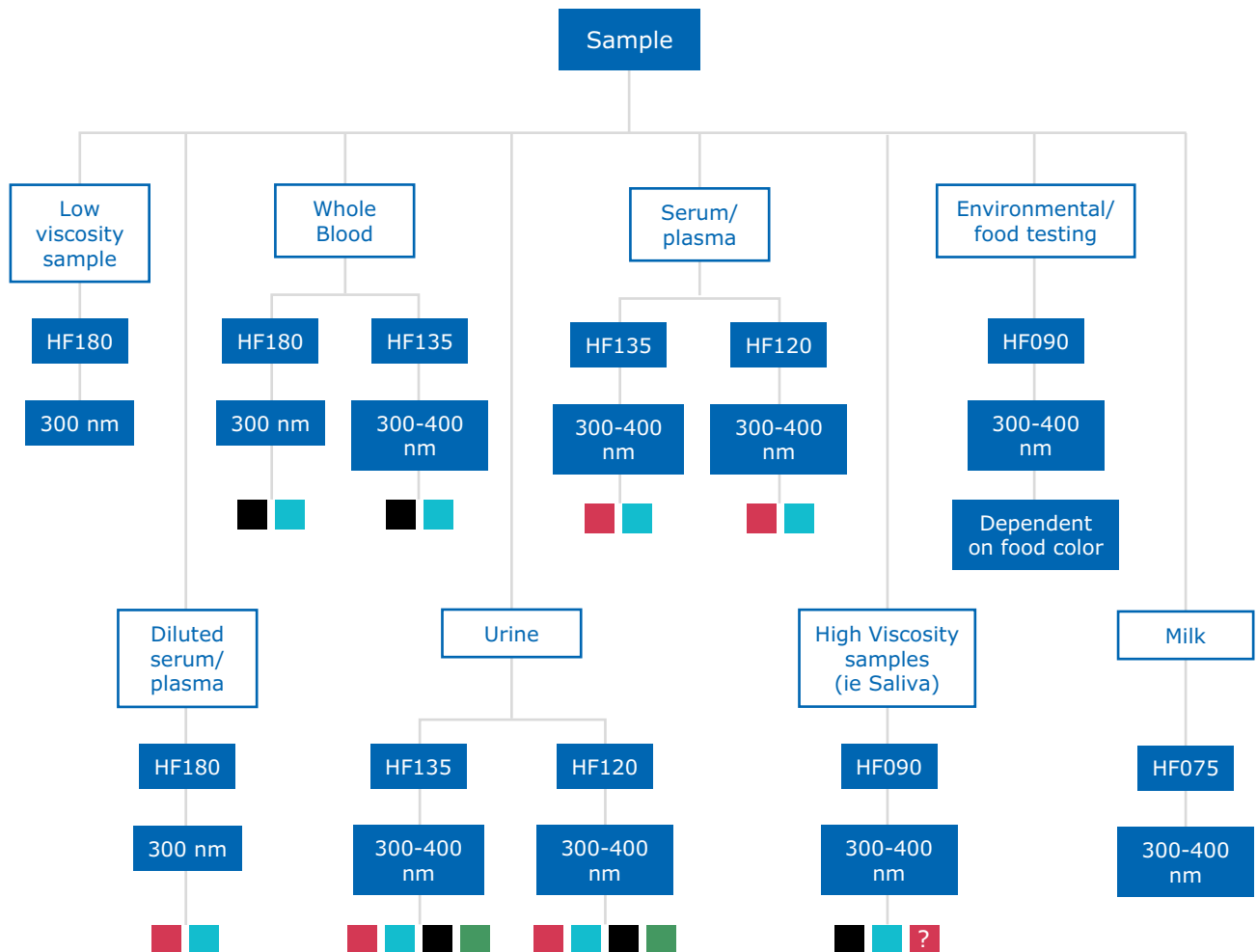
Choosing the Right Membrane

Membrane	CFT	Typical Sample Type	Flow Rate	Sensitivity	Estapor Bead Size	Estapor Bead color
HF180	180 ± 45	Low viscosity spls/ diluted serum or plasma/whole blood	Slowest	Most sensitive	300 nm	
HF135	135 ± 34	Urine/serum or plasma/whole blood			300-400 nm	All/red or blue/ black or blue
HF120	120 ± 30	Urine/serum/plasma			300-400 nm	All/red or blue/ black or blue
HF090	90 ± 23	High viscosity spls (saliva), environmental/food testing samples			300-400 nm	Black or blue or red/dependent on food color
HF075	75 ± 19	Milk, food testing	Fastest	Least sensitive	300-400 nm	All

Hi-Flow™ Plus membranes along with their specifications.

Selecting the appropriate membrane is critical for assay performance. Hi-Flow™ Plus membranes vary in flow rate and sensitivity, catering to different sample types and testing needs.

Sample Types and Membrane Compatibility

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                                    ┌──────────┐
                                    │  Sample  │
                                    └──────────┘

   ┌───────────┐      ┌───────────┐       ┌───────────┐       ┌───────────────┐
   │   Low     │      │  Whole    │       │  Serum/   │       │ Environmental/│
   │ viscosity │      │  Blood    │       │  plasma   │       │  food testing │
   │  sample   │      │           │       │           │       │               │
   └───────────┘      └───────────┘       └───────────┘       └───────────────┘

    ┌────────┐    ┌────────┐ ┌────────┐  ┌────────┐ ┌────────┐    ┌────────┐
    │ HF180  │    │ HF180  │ │ HF135  │  │ HF135  │ │ HF120  │    │ HF090  │
    └────────┘    └────────┘ └────────┘  └────────┘ └────────┘    └────────┘

    ┌────────┐    ┌────────┐ ┌────────┐  ┌────────┐ ┌────────┐    ┌────────┐
    │ 300 nm │    │ 300 nm │ │300-400 │  │300-400 │ │300-400 │    │300-400 │
    └────────┘    └────────┘ │  nm    │  │  nm    │ │  nm    │    │  nm    │
                             └────────┘  └────────┘ └────────┘    └────────┘

                              ■ ■         ■ ■        ■ ■         ■ ■      ┌────────────┐
                                                                         │ Dependent  │
                                                                         │on food color│
                                                                         └────────────┘

   ┌───────────┐          ┌───────────┐        ┌──────────────┐      ┌────────┐
   │ Diluted   │          │   Urine   │        │High Viscosity│      │  Milk  │
   │ serum/    │          │           │        │  samples     │      │        │
   │ plasma    │          │           │        │ (ie Saliva)  │      │        │
   └───────────┘          └───────────┘        └──────────────┘      └────────┘

    ┌────────┐       ┌────────┐ ┌────────┐      ┌────────┐         ┌────────┐
    │ HF180  │       │ HF135  │ │ HF120  │      │ HF090  │         │ HF075  │
    └────────┘       └────────┘ └────────┘      └────────┘         └────────┘

    ┌────────┐       ┌────────┐ ┌────────┐      ┌────────┐         ┌────────┐
    │ 300 nm │       │300-400 │ │300-400 │      │300-400 │         │300-400 │
    └────────┘       │  nm    │ │  nm    │      │  nm    │         │  nm    │
                     └────────┘ └────────┘      └────────┘         └────────┘

     ■ ■            ■ ■ ■ ■    ■ ■ ■ ■         ■ ■ ■(?)
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Estapor Bead color

■ Red   ■ Blue   ■ Black   ■ Green

Flow rate

Slowest → Fastest

Sensitivity

Most sensitive ← Least sensitive

Matching sample types with suitable Hi-Flow™ Plus membranes

Different sample types (low viscosity samples, diluted serum/plasma, whole blood, urine, high viscosity samples, environmental/food testing, milk) require different membranes for optimal performance. For instance, HF180 is ideal for low viscosity samples, while HF090 is suited for high viscosity samples and environmental/food testing.

Sample Types and Membrane Compatibility

Selecting the appropriate membrane is critical for assay performance. Hi-Flow™ Plus membranes vary in flow rate and sensitivity, catering to different sample types and testing needs. Key factors to consider when choosing a membrane include:

1 Capillary Flow Rate:

The speed at which the sample moves along the test strip. Membranes with slower flow rates (e.g., HF180) allow more time for interactions between the target molecule and the capture reagents, increasing sensitivity. Faster flow rate membranes (e.g., HF075) are suitable for applications where speed is critical.

2 Sensitivity:

The ability of the test to detect low concentrations of the target molecule. Higher sensitivity membranes are essential for detecting trace amounts of analytes, such as in infectious disease testing.

3 Sample Type Compatibility:

Different membranes are optimized for various sample types. For instance, HF180 is ideal for low viscosity samples, while HF090 is better suited for high viscosity samples like saliva or food testing.

4 Reagent Consumption:

The amount of reagents required for the test. Slower flow rate membranes generally consume fewer reagents, making them more cost-effective for certain applications.

5 Membrane Material:

The polymer composition of the membrane affects its binding properties. Common materials include nitrocellulose, polyvinylidene fluoride, and polyethersulfone, each with unique characteristics that influence protein binding and assay performance.

iStock
Credit: MarioGuti

Flow Rate and Sensitivity

Membrane	Capillary Flow Time Specification* (sec/4 cm)	Flow Rate	Sensitivity
Hi-Flow™ Plus 180	180 ± 45	Slowest	Most sensitive
Hi-Flow™ Plus 135	135 ± 34		
Hi-Flow™ Plus 120	120 ± 30		
Hi-Flow™ Plus 90	90 ± 23		
Hi-Flow™ Plus 75	75 ± 19	Fastest	Least sensitive

*The range is for all measured values on a roll and represents ± 3 ∂; the acceptable range for the mean is ± 10% of the target.

The relationship between flow rate and sensitivity for various membranes.

The speed at which a sample moves along a test strip is linked to the capillary flow time of the membrane. Generally, faster flow rates correlate with lower sensitivity, while slower flow rates offer higher sensitivity.

Further Resources

Application note

Rapid Lateral Flow Tests: Considerations for Product Development

For more information on lateral flow tests, **visit our website.**