# Biocompatibility Testing for Medical Devices


## What Is Biocompatibility Testing?

**Biocompatibility testing** is a process that evaluates **the compatibility of a medical device or biomaterial** to ensure it **does not produce adverse effects** when it comes into contact with the human body and confirms the device's safety for patients.

Guidelines to perform the biocompatibility assessment can be found in ISO 100993-1 and provides the required tests to be performed according to the type of device, the contact duration and the nature of contact with the body. Special focus is required on the material potential to release compounds (associated to the manufacturing process, or the material degradation

At Applus+ Laboratories we can provide you with our excellent medical device testing services, which help you improve the development and the compliance assessment to regulatory standards of your **medical devices and their biocompatibility,** while also checking the safety of your products. Biocompatibility testing is included with our other batch release testing services:

- Cleaning validation
- Packaging validation
- Stability validation
- Material and chemical characterisation

## How Do We Evaluate the Biocompatibility of Medical Devices and Materials with ISO 10993?

Guaranteeing the protection and safety of your medical devices is our main goal at Applus+ Laboratories, especially when talking about their **biocompatibility**. We perform different kinds of testing methods so you can check your products' **safety and compatibility** with the human body.

## Physicochemical, morphological and topographical characterisation of materials

An essential part of the biological evaluation of medical devices, this process involves a **comprehensive analysis of the physical, chemical, and surface properties** of the materials used in medical devices to ensure their **safety, performance, and biocompatibility**. Understanding these properties will help you predict how the material will interact with biological systems.

- **ISO 10993-19**
  The ISO 10993-19 standard **covers many different dimensions**, from the analysis of the elemental and molecular composition of materials to its thermal properties, the surface structure and morphology or the surface wettability and hydrophobicity.

Characterising the material at its initial stage is important to determine the level of risk and releasing chemical compounds or uncontrolled products that could have an impact on the overall safety of the devices. This characterization is the very first step in the elaboration of the biological evaluation strategy and requirement.

## Preparation of samples and reference materials

As its name suggests, this procedure involves the preparation of test samples and reference materials to ensure **the reliability and reproducibility** of biocompatibility tests.

- **ISO 10993-12**
  ISO 10993-12 plays a crucial role in **establishing best practices** for sample preparation and reference materials in the biological evaluation of medical devices, from **creating guidelines for handling test samples** to detailed **descriptions of preparation methods.**

## Extractables and Leachables

This final analysis is focused on **studying the physical and chemical properties of the materials** used in medical devices, being a more direct approach on the chemical characterisation of these materials than the previous and more holistic analysis.

- **ISO 10993-18**
  This standard provides guidance on **identifying and quantifying chemical substances** that could potentially be released from the medical device material, and will be

used for toxicological risk assessment. The experimental protocol depends on medical device contact duration (implantable or not) and involves chromatographic and spectroscopic methods to identify and quantify organic, inorganic and ionic extractables.

- **Monomer and residual solvent**: Analysis of the presence and quantity of unreacted monomers and residual solvents in a material.
- **Organic hydrogen peroxide**: Detection and quantification of organic peroxides.
- **Trace of organic elements**: Identification and quantification of trace organic contaminants that may affect the material's biocompatibility and performance.
- **Trace of metals and inorganic elements**: Determination of trace amounts of metals and inorganic elements.
- **SEM microscopy coupled with EDS analysis**: Scanning Electron Microscopy (SEM) provides detailed images of the material's surface morphology, while Energy Dispersive X-ray Spectroscopy (EDS) analyses the elemental composition.
- **Molar mass (SEC)**: Size Exclusion Chromatography (SEC) is used to determine the molecular weight distribution of polymers.
- **Thermodynamic properties (DSC, DMA)**: Assessed through techniques like Differential Scanning Calorimetry (DSC) and Dynamic Mechanical Analysis (DMA), it evaluates material behaviour under varying temperature and mechanical conditions.
- **Analysis of chemical composition by chromatography (HPLC, GPC)**: High-Performance Liquid Chromatography (HPLC) and Gel Permeation Chromatography (GPC) are used to analyse the chemical composition and molecular weight distribution of materials.
- Uncontrolled degradation by-products and manufacturing product is ultimately something that need to be verifying to ensure long term safety of the devices both in storage conditions and in living conditions

## Identification and quantification of degradation products of polymer-based medical devices

We assess **the long-term stability and safety of polymer-based medical devices**, identifying and quantifying any by-products released as the material breaks down over time.

- **ISO 10993-13**
  ISO 10993-13 is especially important when assessing the safety of polymeric medical devices, providing guidelines for **simulating the conditions** under which a polymeric device is likely to degrade.

## Identification and quantification of degradation products of ceramics-based medical devices

In this process, similar to the previous one, we **evaluate the degradation of ceramic-based medical devices**, ensuring that any released substances do not pose a risk to the patient.

- **ISO 10993-14**
  This standard ensures that any degradation products released from ceramic components are identified and quantified to **evaluate their potential biological impact**, which may happen in medical devices when exposed to body fluids, tissues, or other environmental conditions.
- **ISO 10993-15**
  This standard ensures that any degradation products released from metallic implants are identified and quantified to **evaluate their potential biological impact**, which may happen in medical devices when exposed to body fluids, tissues, or other environmental conditions.

## What Are the Benefits of Biocompatibility Testing for Medical Devices?

Testing the biocompatibility of medical devices is an essential service that we perform to ensure the safety and compatibility of these devices with biological systems and ultimately protect the health and well-being of patients who rely on them for medical treatment and care. Among all the benefits this testing includes, we would like to highlight:

- **Patient Safety Assurance**
  Biocompatibility testing ensures that medical devices do not pose risks such as toxicity, irritation, or allergic reactions when in contact with the human body. This is crucial for protecting patient health and minimising adverse effects from device use.
- **Regulatory Compliance and Market Access**
  Compliance with biocompatibility standards (e.g., ISO 10993 series) is a regulatory requirement for medical device approval and market entry. Testing provides essential data for demonstrating device safety to regulatory authorities.
- **Risk Mitigation and Management**
  Testing helps identify and mitigate potential risks associated with device materials and components early in the development process. This proactive approach reduces the likelihood of adverse events and product recalls, thereby enhancing overall risk management strategies.
- **Quality and Reliability**
  Biocompatibility testing validates the quality and reliability of materials used in medical devices. By confirming that materials meet specified standards for biological safety, manufacturers can ensure consistent device performance and durability over time.

# Why Choose Applus+ Laboratories for Biocompatibility Testing?

Opting for Applus+ Laboratories for your biocompatibility testing means choosing **unparalleled quality assurance and expertise** that guarantee the highest standards of safety and performance for your products. By partnering with us, you align with a leader in the medical device testing industry.

We are dedicated to ensuring that your medical devices achieve exceptional levels of precision, biocompatibility, and reliability. **Our ISO-compliant services** are designed to meet these high standards, and our extensive range of testing capabilities is focused on delivering optimal results and **ensuring customer satisfaction**.

Applus+ Laboratories is committed to being your comprehensive resource for medical device testing, offering a suite of services to expedite your product's journey to market, including:

- Development testing
- Ongoing testing throughout the product's lifecycle
- Qualification of products and processes, including batch release testing
- Contract Manufacturing Organisation (CMO) services

We are a global company and thus we deliver our testing services anywhere in the world, providing top-tier biocompatibility testing to all our clients.

Trust Applus+ Laboratories as your dependable partner for biocompatibility testing. We stand ready to support your efforts with our extensive services and expert insights.