Materials Compatibility



Background

For more than 40 years, Metrex has helped patients and staff in a wide range of healthcare settings with industry-leading infection prevention solutions used in thousands of healthcare facilities. Backed by extensive laboratory research, our products are designed to quickly and effectively clean hard, non-porous surfaces in healthcare environments.

Metrex's new CaviWipes Clear is a 70% IPA (isopropyl alcohol) based wipe, easy to use on surfaces and medical devices. CaviWipes Clear are a great alternative to other cleaning products, as they do not contain hydrogen peroxide, bleach, ammonia, fragrance, and dyes. None of CaviWipes Clear's ingredients are listed as carcinogens or potential carcinogens by IARC (International Agency for Research on Cancer), NTP (National Toxicology Program), ACGIH (American Conference of Governmental Industrial Hygienists), or OSHA (Occupational Safety and Health Administration).

You may wonder if a cleaning product is suitable for use on a given surface, to avoid damaging or discoloring it. Metrex has therefore conducted materials compatibility testing, the results of which are presented in this document. This will help you stay informed so that you can confidently clean your workplace and protect those around you.

Why Material Compatibility Matters

Consider the vast number and types of surfaces that require cleaning in any given healthcare environment: acrylic, stainless steel, polycarbonate, polyethylene, nylon, polyphenylsulfone, polypropylene, ABS and more. Each type of material has varying cleaning needs and challenges. Each type of material also has its own molecular composition that interacts differently with the chemicals being used to clean it multiple times a day. In fact, busy healthcare environments with rapid turnover need cleaning every 10 minutes[1]. With prolonged and repeated exposure to chemicals, the surfaces of medical equipment, devices, and other assets can start to deteriorate and develop defects. With the added stress that comes from repeated usage, the damage can become even worse.

Materials react to cleaning products in different and complex ways. This interaction is at the core of material compatibility. Materials that degrade or show signs of damage after repeated and prolonged exposure to surface cleaners are considered incompatible. Material incompatibility can lead to a host of problems including:

- Malfunctioning devices and medical equipment
- Shorter working life and repair/replacement costs
- Interruptions to clinical workflows
- Impact on quality of patient care
- Lower patient and staff satisfaction
- Patient and staff safety risks

As healthcare facilities turn to more powerful cleaners, they also run a higher risk of material incompatibility that may result in costly defects, damage, and failure.

Incompatibility In Action

The surface cleaners you use to clean mattress covers, flooring and equipment may be incompatible with the materials those items are made from, causing degradation and failure. This puts your patients at risk. A degraded mattress cover can allow body fluids to seep into the mattress, for example. Cracked flooring can become a trip hazard and more difficult to clean properly. Damaged medical equipment can hide dangerous pathogens inside cracks and fissures. As these problems persist and worsen over time, they become costly to correct, repair or replace.

Causes of Material Incompatibility

Multiple factors influence a surface cleaner's level of compatibility with the device, equipment, or surface material.

These include:

- The active ingredient in the cleaner
- Type of surface where the cleaner is applied
- How the device or equipment is designed and used
- Cleaning frequency and protocols
- Components found in the cleaner, such as solvents, surfactants, and additives

Even materials that have a protective coating or paint — such as metal — can be vulnerable to damage and degradation from repeated exposure to cleaning products. Plastic materials are especially susceptible to incompatibility. Plastic failure is common in healthcare environments and is centered around three types of failure.

Mechanical Failure: This occurs when a product is exposed to external forces greater than it can handle and deforms, cracks, or breaks. Under repeated force or stress, the plastic will weaken over time until it fails.

Thermal Failure: Caused by exposure to extreme temperatures, thermal failure can result in swelling and warping under high heat, or cause materials to become brittle and vulnerable to cracking and shattering under cold temperatures.

Chemical Failure: Chemicals attacking a plastic can affect its strength, flexibility, appearance, and weight, causing the plastic to soften, swell, or experience stress cracking. This in turn can make the plastic more vulnerable to failure.

Along with chemical failure — a direct chemical attack that causes molecular degradation — surfaces and materials can also be impacted by environmental stress cracking (ESC) caused by the presence of both chemicals and mechanical stress. In fact, studies show that ESC is one of the primary causes of approximately a quarter of plastic part failures[2].

What's In Your Cleaning Product?

The typical cleaning product used in healthcare environments employs an active ingredient which cleans, a solvent which solubilizes or dissolves components in the product, and other additives that play various roles. While the active ingredient in a cleaner may have no effect on plastic, the amount, concentration, and final formulations of solvents and other additives can cause plastic to crack and degrade, ultimately resulting in failure or loss of function. The synergistic effects of these ingredients may also be important in determining the eventual compatibility.

Bottom line: It's important to pay close attention to the cleaner's material compatibility claims and guides before you use it.

Defining & Passing the Material Compatibility Test

Understanding the complexities of material compatibility requires extensive knowledge and training. As such, the body of research in the healthcare industry dedicated to material compatibility is constantly growing. To date, infection prevention professionals spend countless hours, resources, and energy stocking and managing multiple types of cleaning products—creating more complexity and burden for staff.

Effective cleaning products are typically thought to have poor material compatibility: if they are highly effective, they must be damaging to surfaces and materials. The question is, how do you create a product that meets your diverse cleaning needs without degrading your surfaces, devices, and medical equipment?

The answer: rigorous research, development, and testing. Currently, no standardized method exists to determine the chemical compatibility of cleaning products with materials used in healthcare settings. Different organizations use vastly different methods to test and evaluate stress levels, time of exposure to chemicals, temperature, and physicochemical properties.

For chemical exposure, some manufacturers perform wipe tests that involve a wait time while the chemicals air-dry between wipes. Others opt for continuous exposure with no air-drying in between. For evaluation, some perform impact and tensile tests that subject the materials to controlled tension until failure, while others only do a visual inspection. Whatever the testing method, it's important to choose a test method that best represents real-life use cases since different chemical exposure methods may result in different observations or trends[3]. It's also important to reduce as much human error as possible to ensure repeatability and reproducibility.

Metrex Internal Testing Methodology

Metrex has developed and implemented a comprehensive and standardized method for evaluating material compatibility for our surface cleaner products. Beyond mere visual inspection, we have studied the effects of different active ingredients, solvents, and additives on materials commonly found in healthcare settings. Below is an overview of Metrex's multi-pronged material compatibility test methodology.

Note: all compatibility testing was performed in-house based on the criteria mentioned below. Results may vary depending on test methods. These are suggested guidelines only, and final evaluation should be performed directly by medical device manufacturers.

Plastic Tests

Metrex implemented a comprehensive and standardized in-house method to minimize variation and subjectivity. To evaluate a polymer's resistance to chemical exposure, ASTM D638 (Standard Test Method for Tensile Properties of Plastics) Type I tensile bars were placed under 0.91% strain to conform to accelerated testing conditions and wiped manually for a total of 60 wipe cycles, with 4 minutes of air-drying in between each wipe cycle. Visual scores were given after the 60 wipe cycles.

Tensile tests were then performed on the tensile bars, using a UTM, according to ASTM D638 testing conditions.

Plastic Testing Rubric	
★★★★★	≥ 95 % strength retention, no visible cracks
★★★★	≥ 95 % strength retention, minor cracks
★★★	≥ 80 % strength retention but no yield, some cracks
★★	< 80 % strength retention but not broken, deeper/more cracks
★	Broken

Elastomer Tests

Our in-house test method was established based on ASTM D471-16a (Standard Test Method for Rubber Property—Effect of Liquids). Rubber samples were wrapped in Metrex's 70% IPA wipes for 168 hours. Then, any changes in weight, dimensions, swelling, and appearance were noted and used as criteria for material compatibility. Ratings were given on a 5-star scale, with 1 star being least compatible, and 5 stars being most compatible.

Elastomer Testing Rubric	
★★★★★	≥ 5 % swelling, ≤ 2 % mass change, no visual changes
★★★★	≥ 5 % swelling and/or >2 % mass change, no visual changes
★★★	≥ 5 % swelling and/or >2 % mass change, visual changes and/or warping
★★	Visual changes and/or severe warping (30) and/or mass change
★	Severe loss of physical integrity

Metal Tests

Based on ISO 21530:2004 (Dentistry — Materials used for dental equipment surfaces — Determination of resistance to chemical disinfectants), Metrex developed a protocol for testing materials compatibility of metals. Metal coupons were wrapped in 70% IPA wipes. Wipes were changed daily. After an interim inspection at the 7-day mark, the coupons wrapped in wipes for an additional 7 days. After 14 days, the metal coupons were visually inspected and weighed.

Metal Test Rubric	
★★★★★	Minimal change observed
★★★★	Minor discoloration or stains
★★★	Some discoloration, residue, corrosion and/or change in texture
★★	Severe discoloration, residue, corrosion and change in texture
★	Severe warping, loss of structure and/or broken

Fabric Tests

Using ASTM D543 (Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents) as a reference, Metrex developed a method to test materials compatibility of fabrics. Swatches of synthetic leather were wiped 100 times, with 6-minute intervals of drying in between. A spectrophotometer was used to quantitatively record color changes according to the CIE76 (to specify) color difference formula (i.e. ΔE) and gloss of the swatches. The swatches were also weighed to evaluate any change in mass.

Fabric Test Rubric	
★★★★★	Minimal change in color (ΔE ≤ 2)
★★★★	Some stains and/or perceptible color change (ΔE ≤ 3)
★★★	Stains over 50 % of area, perceptible color change (ΔE ≤ 4) and/or change in texture
★★	Stains over 75 % of area, perceptible color change (ΔE ≤ 5) and/or change in texture
★	Severe loss of integrity

Overall Results

Material		CaviWipes™ Clear	Competitor
Plastics	PC	★★★★★	★★★★★
	Acrylic	★	★
	PC-PET	★★★★★	★★★★★
	HDPE	★★★★★	★★★★★
	PVC	★★★★★	★★★★★
	LDPE	★★★★★	★★★★★
	PPSU	★★★★★	★★★★★
	Nylon	★★★★★	★★★★★
Elastomers	EPDM	★★★★	★★★★★
	Viton	★★★★★	★★★★★
Metals	SS 430	★★★★★	★★★
	SS 304	★★★★★	★★★★★
	SS 316	★★★★★	★★★
	Al alloy	★★★★★	★★★★★
Synthetic leather		★★★★★	★★★★★

Conclusion

Surface cleaning products are critical to maintaining clean environments, but one must consider material compatibility, lest materials, and by extension, devices and furniture, fail. As an industry leader, Metrex invests in resources to provide extensive research on cleaning product interactions to understand how it affects material compatibility. CaviWipes Clear is suitable for use on many different types of surfaces that can be found in healthcare settings. CaviWipes Clear provides exceptional cleaning performance with minimal risk of material failure.

With these combined features, healthcare professionals can rely on CaviWipes Clear for a wide range of cleaning needs, with confidence that their staff, patients, environments, and surfaces will be protected.

References

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2. Jansen, J. A. «Environmental Stress Cracking - The Plastic Killer», Advanced Materials & Processes. June 2004.
3. Nowatzki, P.J. “Chemical Resistance Testing of Polycarbonates and Blends with Hospital Disinfectants and Cleaners,” Proceedings SPE ANTEC “2020”.

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