



ABSTRACT

- The COVID-19 pandemic has impeded the global supply of personal protective equipment (PPE), causing mass shortages, scams, fraud, and chaos.
- The consequential result of this PPE supply disaster has presented a humanitarian crisis in the United States.
- Procurement of nitrile gloves has been specifically impacted within U.S. hospitals, nursing homes, dental practices, and by first responders.
- Health workers are fearful of providing care to patients because they lack the necessary protective nitrile gloves.
- Due to the United States' reliance on importation of nitrile gloves, the country is especially vulnerable to COVID-19's detrimental impact on the global supply chain.
- Furthermore, the U.S. has been extremely susceptible, and fallen victim to, the major portion of global PPE fraud and scams because of the lack of federal guidance in the nitrile glove procurement process.
- The COVID-19 pandemic, combined with deficient domestic manufacturing and a lack of federal support, has placed the United States in a humanitarian crisis.
- The U.S. shortage of nitrile gloves and PPE, represents "a gap in our national security (Rep. Stephen Lynch, 2021)".

RAW MATERIALS FOR NITRILE GLOVES

- The primary raw material necessary to produce nitrile gloves is rubber.
- There are two categories of rubber, natural and synthetic. Nitrile glove production uses natural rubber.
- According to the WorldAtlas (2021), the most common source of natural rubber comes from Hevea brasiliensis, or the Para rubber tree.
- World's leading producers of natural rubber include Malaysia, Indonesia, Thailand, and India.

What Type of Glove Do I Need? A "Handy" Reference for Glove Selection



Nitrile, latex, vinyl...how do you pick which glove you need? This guide will help you to choose a glove appropriate to the task at hand.



- NITRILE GLOVES...**
- ☑ Contain NO latex and are powder-free
 - ☑ Are the most puncture resistant
 - ☑ Have a high level of touch sensitivity
 - ☑ Mold to your hand for a good fit
 - ☑ Are good for wearing for an extended amount of time
 - ☑ Work well for high-risk situations involving infectious material
 - ☑ Resist many chemicals
 - ☑ Have a long shelf life
 - ☑ Are blue to help identify if the glove has been punctured
- LATEX GLOVES...**
- ☑ Fit like a second skin
 - ☑ Have a high level of touch sensitivity
 - ☑ Are good for wearing for an extended amount of time
 - ☑ Work well for high-risk situations involving infectious material
 - ☑ Are cost-effective
 - ☑ Are lightly powdered for easy donning (putting on)
 - ☑ Are very elastic and strong
 - ☑ Are biodegradable
- VINYL GLOVES...**
- ☑ Contain NO latex
 - ☑ Have a looser fit
 - ☑ Are good for short term, low-risk tasks
 - ☑ Are the most economic option
 - ☑ Have anti-static properties
 - ☑ Are best for use with non-hazardous materials
 - ☑ Are lightly powdered* for easy donning (putting on)
- *Synthetic alternative to talc powder

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PRODUCTION / MANUFACTURING

- Once a supply of natural rubber is secured from Malaysia, Thailand, or Indonesia, it is transported to a factory for manufacturing.
- A new or existing factory has the equipment to manufacture.

NITRILE GLOVES: A LIFE CYCLE ASSESSMENT

RAW MATERIALS:

Nitrile rubber is composed of two main monomers **acrylonitrile** and **butadiene**. Acrylonitrile (CH₂CHN) is made through the SOHIO process, which reacts propene, ammonia, water, and air in order to synthesize both acrylonitrile and acetonitrile. Acetonitrile is used in the synthesis of butadiene. Butadiene (C₄H₆) is made as a byproduct in the production of ethylene, which happens through steam cracking.

Butadiene is then obtained through extractive distillation; this process filters through heavier byproducts in order to extract the butadiene. Nitrile is then formed through the copolymerization of both acrylonitrile and butadiene, in which they are reacted together and ultimately formed into crude rubber.

Then the nitrile is molded into the glove form.

EMBODIED ENERGY:

The base materials of nitrile are created by steam cracking, where gases are broken down into smaller molecules through intense heating. The thermal energy consumed in heating the steam leads to the production of ethylene, which then creates butadiene. The reaction is extremely brief which greatly reduces the amount of energy previously required to fuel the reaction. Electrical energy is consumed by the machines within the factories that shape and produce the gloves. Human labor is also used to test the finished gloves for impurities. Nitrile gloves are packaged and transported in bulk, which reduces the amount of labor and energy consumption of the delivery process since more gloves are delivered at once. Additional energy is consumed in disposing the gloves, most commonly of which is used in incineration.

WASTE & EMISSIONS:

Raw Materials Emissions: Acrylonitrile and butadiene are both released in the air. Acrylonitrile is also released in water and is only toxic if released in high levels. These monomers break down once released.

Manufacturing Emissions: CO₂ emissions are released as a result of fossil fuel use for heating/production. Accelerators & antioxidants, carbon black, sulfur, zinc oxide, and aromatic extracts are also byproducts of rubber manufacturing.

Transportation Emissions: CO₂ is released from transportation of raw products to facilities and transportation of finished products to facilities.

Disposal Emissions/Waste: If gloves are **consumed**, they will be disposed the same way as some material. If gloves end up in **landfills**, they will eventually **but slowly** decompose. If gloves are **incinerated**, release of water CO₂, non-toxic oxide and nitrogen oxide will be released.

Reprinted: New Chemist, M.S. Ben, "Acrylonitrile" 2007, Dec 4th, Feb 2016
Nitrile glove
Author: Postler Jennifer Jones, Kaitlin Weisner

PORT IN VIETNAM

- Once the nitrile gloves are manufactured, they are transported to a port in Vietnam for shipment to the US.
- The gloves can come from factories in Thailand, China, Vietnam, and Malaysia.
- The products are transported from one or multiple factories in several countries to the port in Vietnam.
- Inmogeia had one order of nitrile gloves alone that required 1,700 box trucks to carry the products to the port every month.
- There are many risk factors presented by the factories in other countries to the port in Vietnam.
- Local authorities are responsible for inspecting factories for crimes like child labor and/or slave labor. If these crimes are observed the US will place a ban on importation of goods from these factories/countries (Madhok, 2021).
- Humanitarian crimes and unethical operations like this are the major risk for manufacturing in new or unknown foreign factories.
- Inmogeia refuses to partner with any potentially risky manufacturers that take part in such humanitarian crimes.
- This is not the case for a lot of companies, but it is what sets Inmogeia apart.
- One of the largest nitrile glove manufacturers TOP glove was banned by the US during the beginning of the pandemic for such humanitarian crimes (Madhok, 2021).
- Once the goods arrive to the port they are inspected by local authorities.
- The quantity must match what is on the shipping order, authorities will open the boxes and make sure that what is labelled on the box is inside and that it all matches the shipping order (United States International Trade Commission, 2021).
- Another major source of fraud that occurs falls under the term transshipment. This can take place in several ways. Companies will send gloves from Malaysia to Vietnam and change the documentation to say that the gloves came from Vietnam, so the US accepts them. This happens when a ship is supposed to be headed for an intended location, but it makes a stop at another location first. That is where documentation is fraudulent, goods are stolen, or illegal (Penna, 2021).
- The one referenced order of nitrile gloves from Inmogeia would take up almost half of a container ship.

TRANSPORTATION TO U.S.

- There are two methods for transporting Nitrile Gloves from Vietnam to the U.S.
- The gloves can be transported by air on a plane, or by water on a massive container ship.

Transportation By Plane

PROS	CONS
Fastest method of transport. (2-5 days)	More expensive
Product is safer	Less capacity
No need for Port	Higher pollution rates

Transportation By Ship

PROS	CONS
More affordable by volume	Takes longer (4-6 weeks)
Much larger capacity	Must go through port (large margin for error)
Lower pollution rates	Transshipment (Ship makes a stop before the destination. Possibility of fraud/theft.

Kenemer, 2020. Sourcing Hub.IO

PORT IN U.S.

- By this point the products are manufactured, have passed inspection at the port in Vietnam, and have been transported to a port in the US.
- There are many US ports that the nitrile gloves can be shipped to.
- The specific port the gloves go to depends on where they are being stored and/or if they are going to a foreign trade zone (FTZ).
- No matter what port they go to, Customs and Border Patrol inspect the goods and certify them for entry (Madhok, 2021).
- If gloves are mislabeled or there are any discrepancies, Customs and Border Patrol will seize the goods. This happened to millions of boxes of gloves at a US port coming from one of the leading world producers, TOP glove (Madhok, 2021).
- The price of import varies per box of gloves depending on the port (Penna, 2021).
- The American Society for Testing and Materials (ASTM) is responsible for testing the quality and efficacy of the gloves (ASTM Testing Programs, 2019).
- The testing takes place at the factory in Asia, but documentation must be valid and provided at the US port.
- Every individual box of gloves must be labeled appropriately.
- The labels must be FDA compliant and accurately describe what is inside the box (Center for Devices and Radiological Health, FDA).
- Because nitrile gloves are used by the healthcare industry the label "patient examination" is placed on the box.
- The label "patient examination" categorizes the gloves as a class I medical device, according to the FDA .
- As a class I medical device the nitrile gloves require documentation called a 510k (Lmg, www.fdahelp.us).
- Inmogeia's glove imports were to go through a port in North Carolina. One of the partners owns a warehouse there where the gloves would be stored and distributed from.
- From the port in North Carolina, 1,700 more box trucks would carry one monthly order to the warehouse.

U.S. WAREHOUSE / DISTRIBUTION

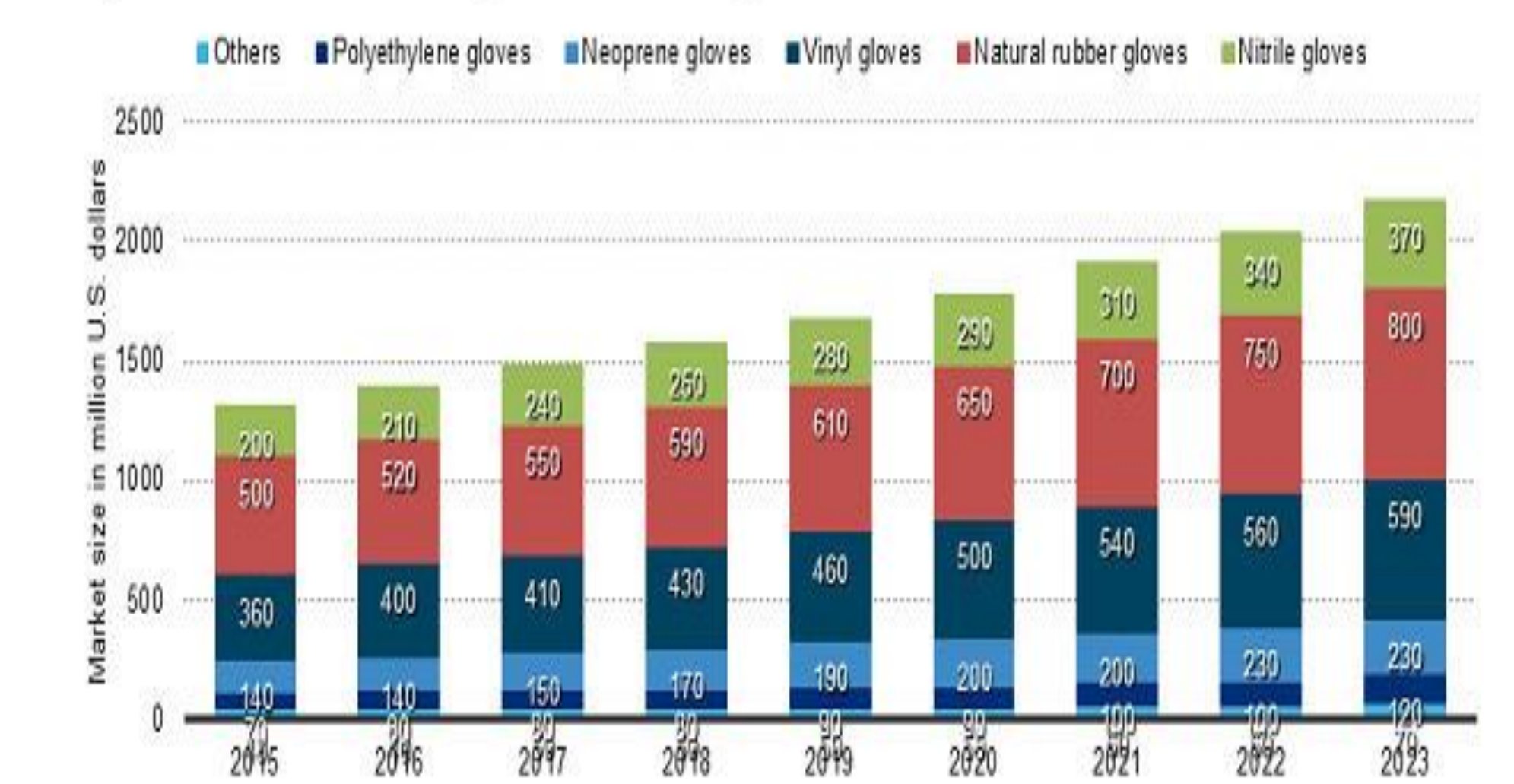
- From the port, the gloves are either transported to the buyer or to a warehouse for storage and later sale.
- Relevant terminology: FTZ(warehouses can be deemed foreign trade zones). Distribution can be Buyer to Buyer (B2B) and/or Buyer to Consumer (B2C).

II THOMAS

Thomas for Industry.

Projection of the U.S. industrial gloves market size from 2015 to 2023, by material (in million U.S. dollars)

Projection of the U.S. industrial gloves market size by material 2015-2023



Note: North America, United States as of February 2017
Further information regarding this statistic can be found on [page 5](#)
Source(s): Statista editorial; Proactive; [IQVIA](#)

CONCLUSION

The market size for nitrile gloves increases every year in US dollars, (Thomas, 2017). From 2015 to the beginning of the pandemic in 2019 the figures increased from around 1.3 billion dollars to just under 1.75 billion dollars. From 2019 to 2023 it is expected to increase from 1.75 billion to almost 2.25 billion dollars. 2019 to 2023 the US glove market was expected to increase around half of a billion dollars. That was before the COVID-19 pandemic changed everything. Since the pandemic, the demand for gloves has increased and these projections have increased. The COVID-19 pandemic has changed the course of the nation's future. This pandemic has hospitalized millions of Americans and taken over half of a million lives. As a nation, the US can not even secure an effective supply of nitrile gloves to protect citizens from this deadly threat. The US is completely dependent on importation of nitrile gloves. The COVID-19 pandemic has impacted the global supply chain. Because of the impeded global supply chain and dependence on importation, the US can not maintain an adequate supply of nitrile gloves. Experiencing a shortage of nitrile gloves during a deadly pandemic is a humanitarian crisis. The country can not provide health workers with the appropriate equipment that they require to safely care for patients. This humanitarian crisis is a national defense issue. This goes beyond a simple supply chain flaw. COVID-19's impact on the US supply of nitrile gloves is cause for immediate action and revision to national defense initiatives. The humanitarian crisis caused by deficient domestic manufacturing and a lack of federal support not only calls for revision of national defense initiatives but demands that domestic manufacturing of products like nitrile gloves be increased. If the US wants to increase domestic manufacturing and provide the nation with more jobs, it needs to be done with products like nitrile gloves and PPE. The pandemic has shown that this necessary protective equipment should not be sourced from other countries for the sole purpose of increasing profit margins. Maintaining a steady and effective supply of nitrile gloves is a matter of national security.