insights into

PRECISION CLEANING

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Founded in 1959 by Carl Verheyen and Jim St. Clair during the accelerating Space Race between the U.S. and the USSR, Astro Pak filled a growing need amid the great technological rivalry of the Cold War that created vast opportunities for the small precision cleaning contractor.

Securing various approvals to service all major missile manufacturers, as well as other aerospace clients, fueled the firm's desire to take their success from that industry into other sectors.
Today, Astro Pak boasts a new, state of the art Cleanroom that is amongst the largest Contract Cleaning Cleanrooms of this class, in the United States.
ASTRO PAK PRECISION CLEANING

Today

PreClean Area
ASTRO PAK PRECISION CLEANING

Today

Cleanroom Packaging Area – ISO Class 6 (Fed Std Class 1000)
ASTRO PAK PRECISION CLEANING

Today

Large Component Cleanroom – ISO Class 6 (Fed Std Class 1000)
ASTRO PAK PRECISION CLEANING

Today

Analysis Lab – ISO Class 5 (Fed Std Class 100)
INDUSTRIES SERVED

- Aerospace
  - Launch Vehicle (rockets)
  - Payload (satellites)
  - Ground Support (launch facilities)
- Military & Defense
- Commercial Airlines
- Medical Device
- Laser
- Semiconductor
- Pharmaceutical
- Biotechnology
- Industrial

Many of our customers have external agencies that drive their cleaning requirements, such as the FDA, NASA and others.
PROVIDING CONSULTATION TO INDUSTRY LEADERS

Projects:

• NIF
• Mars Rover
• NASA Plum Brook
• LIGO
CLEANROOM ENVIRONMENT

Classification: Fed Std 209 & ISO 14644

Airborne particulate and room conditions:

<table>
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<th>ISO Class</th>
<th>FED STD Class</th>
<th>EU GMP</th>
<th>Particles per m³</th>
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<tr>
<td></td>
<td></td>
<td></td>
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Particles in Cleanroom air are counted down to a half of a micron or smaller, depending on the class.
WHAT IS PRECISION CLEANING?

**Definition:** Cleaning components, hardware or systems to meet a measured limit of contaminants, such as the Particle Count and/or Non-Volatile Residue (NVR) requirements, which are supplied by the customer or industry standard.

It is the need for measurement of post-cleaning residual contamination that elevates cleaning into *precision* cleaning.
HOW CLEAN IS CLEAN?

*Particles & Residue (NVR)*

The cleanliness of a component or hardware is most often determined by measuring to ensure that the part is within the acceptable limits for Particulate contamination and/or Non-Volatile Residue (NVR).
HOW CLEAN IS CLEAN?

Particles

Precision Cleaning often requires us to remove particles down to less than a micron in size.

FACTS

What is a micron?

- It is a very small metric unit of measurement also called a “micrometer”.
- 25,400 microns make up one inch.
- A human hair is between 50 and 100 microns in diameter, which is 50 to 100 times larger than the measurements we routinely use.
HOW CLEAN IS CLEAN?

Particles

Although we are concerned with particles ≤ 1 micron, for several of the markets we discussed, we typically only count particles ≥ 5 microns when validating most hardware.

💡 FACTS

• If you line up 5-micron particles, it takes 5,080 to make up one inch!

• One cannot see a 5-micron particle with an unaided eye. If you have very good eyes, in good lighting conditions, you might be able to see a black 50 micron particle on a white background. Therefore, while a part may “look clean”, it could still be dirty relative to Precision Cleaning. The microscopic matters!
**Residue (NVR)**

**Definition:** Residues are amorphous *(shapeless)* contaminants, mainly oils & greases, that we measure in milligrams *(one thousandth of a gram)*.

**FACTS**

- A teaspoon of sugar weighs ~5 grams (5,000 milligrams).
  - *We validate cleanliness down to level A/20, which is 0.05 milligrams per square foot.*

- A fingerprint weighs about 50 micrograms (50 millionths of a gram) which is equal to 0.05 milligrams.
  - *The weight of one fingerprint per square foot is enough to cause us to fail a critical NVR measurement.*
HOW TO VERIFY CLEANLINESS LEVELS

TFS (Total Filterable Solids)

Total Mass of Solid Contaminants

Particle / Fiber Count

Size and Number of Solid Contaminants
HOW TO VERIFY CLEANLINESS LEVELS

Non-Volatile Residue (NVR)

Halogen Gas Detector

Mass of Organic Residue

Halogenated Solvent Dryness Test
HOW TO VERIFY CLEANLINESS LEVELS

Dew Point

Water Dryness Test

PID (Photoionization Detector)

Hydrocarbon Solvent Dryness Test
HOW TO VERIFY CLEANLINESS LEVELS

FTIR
(Fourier Transform Infrared Spectroscopy)

Identification of Organic Compounds

Ultraviolet Light Inspection

Absence of Organic Residue Verification Test
OPTIMAL METHOD & CHEMISTRY

How to decide

**SPEC** *(Scientific Process, Engineered Chemistry)*

The methodology to select or develop the optimal process and chemistry.

**Considerations in the development phase include:**

- Process
- Chemistry
- Percent of Active Ingredients
- Temperature
- Duration
- Technique

**Quality Systems:** i.e. ISO 9001 and AS-9100
ACHIEVING CLEANLINESS LEVELS

Typical Techniques

AQUEOUS CLEANING

Water Based Detergents

SOLVENT CLEANING

Hydrocarbon and Halogenated Solvents
ACHIEVING CLEANLINESS LEVELS

Typical Techniques

ULTRASONIC CLEANING

Use of *cavitation* induced by high frequency sound waves to agitate cleaning solution to dislodge particles

PRESSURE APPLICATION (IMPINGEMENT) CLEANING

High Pressure Spray
ACHIEVING CLEANLINESS LEVELS

Typical Techniques

BAKE OFF

Vaporize Contaminants

MECHANICAL CLEANING

Wipe, Hand Detail
PACKAGING
Protect and Maintain Cleanliness

Types of Materials:

• Polyethylene
• Nylon
• Aclar

What drives the decision for which material and how many bags/layers?

• Specifications and/or customer requirements
• Why are double & triple bagging required?
• When are the use of more expensive materials needed?
The proper format and content for the cleanliness certification label must meet the Specification requirements.

Certification labels typically contain:

- Name of Cleaning Contractor
- Date of Cleaning & Certification
- Specification and Level the hardware is certified to
- Part Number, Serial Number (if any)
- Expiration Date (if any)
- Other Information Required by Specification
CERTIFICATION PACKAGE
What to look for

Complies with QMS/cGMP Guidelines

- Well Organized
- Accurate
- Complete
- Archived
PRECISION CLEANING
Mitigating Common Risks

RISK: “Okay as is, no cleaning needed, save money”

Will the contaminants that are present have the potential to impair function or safety? Can they interact with the intended service media? What is the cost of failure or catastrophe?

MITIGATION: “Clean properly, removing the contaminants”

Lowers the risk of contaminant-induced failure such as line blockage, stuck valves, or O2 fire. Prevention is less costly than failure and repair!
PRECISION CLEANING
Mitigating Common Risks

RISK: “Poor cleaning and rinsing techniques leaves cleaning agents behind on hardware”

The cleaning agents themselves can become contaminants if not properly used!
More likely with untrained personnel.

MITIGATION: “Rinse properly to remove all solvent and cleaning & rinse fluids”

Proper rinsing & drying are necessary so that cleaning solutions are not introduced into process flow or critical environments. This risk can be mitigated by the use of appropriate sensors and detectors. Choose your cleaning contractor carefully!
PRECISION CLEANING
Mitigating Common Risks

**RISK:** “Incompatible cleaning agents can damage hardware”

*Improper selection of cleaning chemistries carries the risk of damage to sensitive materials.*

**MITIGATION:** “Use proper chemistry to achieve cleanliness level and not damage the component/hardware”

*The cleaning contractor must mitigate this risk by having competent chemists and appropriate reference materials available. Choose a cleaning contractor who has experience, expertise, and appropriate equipment!*
Does Passivation Matter?

Passivation is a chemical process that enhances corrosion resistance of Stainless Steel Hardware / Parts. It can also be used to clean Titanium.

Astro Pak uses a proprietary process that provides an optimal Chrome to Iron ratio on Stainless Steel parts, which means that it is most resistant to corrosion, rouge or rust formations.

💡 FACT

The same Passivation process is used on Titanium parts to remove free iron that is present from carbon tooling used in manufacturing or tramp metal from nearby projects.
PRECISION CLEANING PROVIDER
More than just Cleaning & Passivation

- Pressure testing to industry thresholds
  - 30,000 PSI Hydrostatic
  - 10,000 PSI Pneumatic

- Valve and Complex Component Assembly

- Gauge Cleaning & Calibration

- Clean Assembly
  - Assembly of clean sub-components in cleanroom, followed by final clean of the Assembled Unit

- Critical Care Handling of Hardware
  - Large parts in consideration of weight and dimensions
  - Small parts
  - Fine machined surfaces

- Accreditations and Approvals
  - Quality and Specification approvals for facility and processing

- Response time to critical turnaround on government programs
**MYRIAD OF SERVICES**

*We also offer:*

- High-Purity Chemical Cleaning
- Sterilization & Bio-Decontamination
- Mechanical Polishing
- Electropolishing
- Passivation
- Derouging
- Sanitization
- Biofilm Removal
ELECTROPOLISHING & MECHANICAL POLISHING

How does it improve Surface Finish?

Electropolishing and Mechanical Polishing are defined by measuring the Roughness Average Finish (RA) using a Profilometer.

The Result Is:

A more cleanable surface, and one that may enhance the longevity of maintained cleanliness levels.
WHAT IS SIXLOG?

SixLog, a division of Astro Pak, provides Sterilization and Bio-Decontamination services for rooms, spaces and equipment. Using an iHP® (ionized Hydrogen Peroxide) technology, this fast working process, similar to “fogging” a room, can sterilize exposed surfaces on contact.

Advantages include:

✓ Short cycle times offer minimal downtime
✓ Excellent materials compatibility
✓ Environmentally-friendly and non-corrosive
✓ Rapid response
✓ Cost-effective pricing
✓ Nationwide support of trained personnel
QUESTIONS

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