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PENETRANT PROFESSOR APPROVED

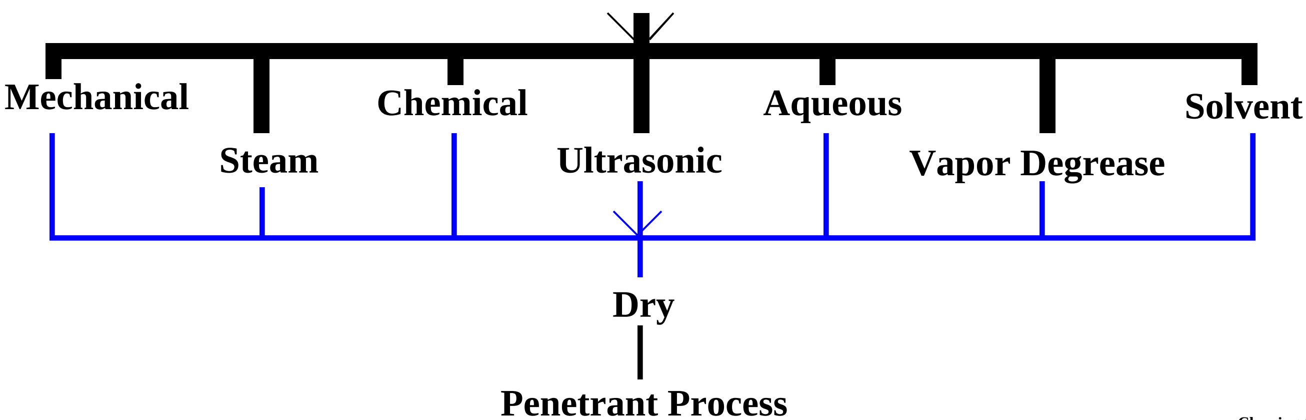
General Guide to Pre and Post Penetrant Inspection Cleaning

Cleaning is an integral part of the penetrant inspection process. Every specification states that the part or inspection surface must be clean and dry. Improper cleaning is often the cause for failure of the penetrant inspection process. For the penetrant process to highlight small cracks and porosity the penetrant must enter all discontinuities. If these are not open then the penetrant inspection process will not work. There are numerous issues involved with proper cleaning.

In newly manufactured components, discontinuities may be blocked by cutting fluids, coolants, mold release agents and general dirt and grime from handling. Some metal working processes will smear metal over the surface closing discontinuities. In overhaul and maintenance inspection, the part surface may have grease, oil, rust, paint, carbonaceous deposits or any number of residues and soils which have been ground in as a result of use. All of these can prevent the penetrant process from working by blocking entrance to a discontinuity.

The above makes it obvious that parts must be cleaned but the right cleaning must be utilized. Solvents used for vapor degreasing will remove organic soils but will not remove inorganic soils. Cleaning residues can cause failure of the inspection process. Acid and alkali residues can cause the dyes in penetrants to loose their color or brightness. There will be no visible or fluorescent indication to show where the penetrant is, even if it entered the discontinuity. Shot peening with media that breaks down may force residues into a discontinuity opening. Silicates, in some cleaning compounds, may precipitate onto the part surface blocking entrance to a discontinuity. After any cleaning process the surface must be thoroughly washed with clean water to eliminate any cleaning compound residues. The part will need to be thoroughly dried to prevent water from blocking penetrant from entering a discontinuity. Part size, geometry, material composition and environment will influence the type of cleaning that may be employed. Typically one or a combination of the following methods should be employed to ensure that the inspection surface is clean and discontinuities are open.

Methods for cleaning a surface to be penetrant inspected



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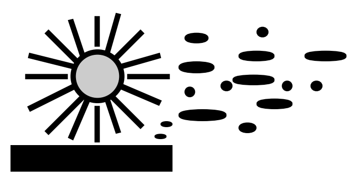
When cleaning parts, consider the type of base materials that are being cleaned and the type of soils to be removed. Clean like materials together, do not mix materials. Segregate materials by composition.

Light Alloys: Aluminum or Magnesium
Titanium Alloys
Low Alloy Steels: Corrodible Steels
Stainless Steels
Nickel/Cobalt Alloys
Composite Materials

Cleaning materials must dissolve, emulsify, oxidize, wet, displace or act in some other way to assist in removing the undesired contaminant and at the same time not attack the base component. Cleaning and base component attack are often directly related to the concentration of the cleaning material, contact time with the cleaning material, the temperature at which the cleaning takes place, and the form of agitation employed.

Mechanical Cleaning is generally not recommended for light alloys which are easily smeared, closing discontinuities. This may happen on harder alloys as well and in such cases a chemical etch is required to remove a small amount of the surface material opening any discontinuities. Mixing base metals can result in embedding traces of dissimilar metals in each other creating sites for corrosion and initiating flaw development. Part surfaces which have been mechanically cleaned will need to be further cleaned with another method to ensure all cleaning residues are removed.

MECHANICAL CLEANING
Consider: **Part Damage**
Smeared Metal
Residues



Steam Cleaning will remove oily soils and with the addition of an aqueous alkaline low foam cleaner, the method is effective on stubborn greasy soils and loosely held rust and scale. This method is limited because of the temperature and pressure employed and the part size and geometry which maybe easily handled. Small parts, hollow or veined parts are not easily cleaned in this way, whereas the weld area of large structures are ideally suited for this type of cleaning approach. Cleaned surface must be dry and cooled to at least 125˚F (52˚C) before application of the penetrant. This method will also effectively remove penetrant inspection residues following the inspection process.

STEAM CLEANING
Consider: **Temperature**
Pressure
Part
Configuration

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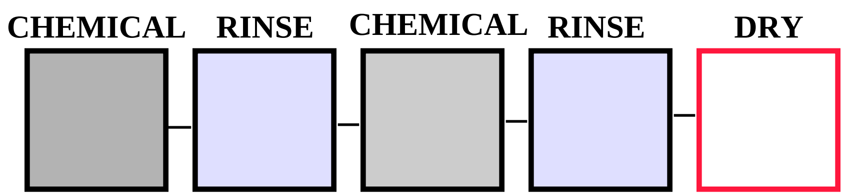
Chemical Cleaning is often employed to remove carbonaceous deposits, heat scale, protective coatings, and heavy greasy soils. This type of cleaning utilizes strong acids and oxidizing agents. The use of high concentrations and or elevated temperatures will increase attack rates on the soil but the base material may also be more readily attacked. To increase useful tank life of these materials, lighter soils must first be removed, often with an aqueous alkaline cleaner. Great care is required in bath make up and operation to protect not only the parts but the operators from the strong chemistry. Disposal of the spent cleaning bath can be quite complicated and costly. Neutralization of the chemicals and thorough rinsing with clean water followed by drying is key to avoiding residue interference with the penetrant process.

CHEMICAL CLEANING

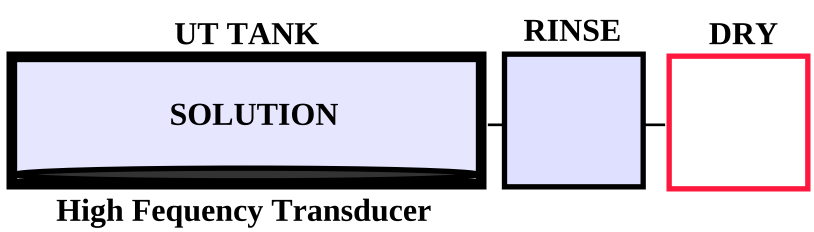
Consider: **Acid**
Caustic
Safety
Concentration
Temperature
Disposal



Ultrasonic Cleaning is a very effective method of cleaning small to medium size parts of geometrically challenged configurations. The addition of aqueous alkaline cleaners to the bath solution increases the effectiveness of this method. The initial cost of high quality Ultrasonic cleaning equipment may appear prohibitive, but the quality and rate of cleaning can often make up for this. Parts should be rinsed and dried after this method before going through the penetrant inspection process. This method is not generally employed for post inspection cleaning of parts, however, TAM panels or other penetrant process monitoring flaw specimens should be ultrasonically cleaned to ensure penetrant process monitoring reliability.

ULTRASONIC CLEANING

Consider: **Initial Cost**
Additives
Disposal



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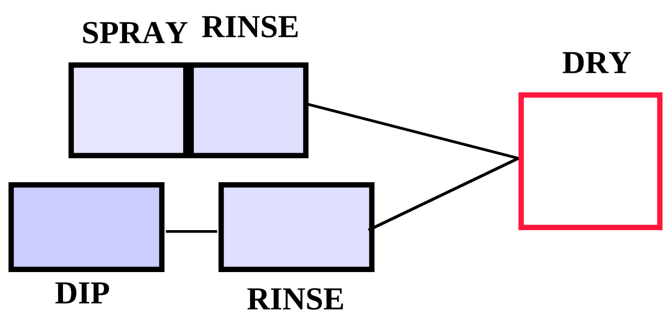
Aqueous Cleaners are widely used for both pre and post penetrant inspection cleaning. They are employed in cabinet spray washers, agitated soak tanks, steam cleaners, ultrasonic cleaners and manual wipe applications. Most aqueous cleaners are slightly alkaline and contain surfactants for effective wetting and removal of oily soils, loosely held particulates, and films. The most effective aqueous cleaners are a balance of additives that clean off the soils while inhibiting base material attack and are environmentally more friendly than the strong chemical cleaners. In spray systems they are used at lower concentrations than in dip or tank applications. Temperatures to 160˚F (71˚C) often are recommended to accelerate their cleaning action, although most will work at ambient temperatures with an increase in contact time. Aqueous alkaline cleaners are often used prior to more aggressive chemical cleaners . This is done to reduce the soil loading of the chemical cleaner tanks. Aqueous cleaners have been effectively used to replace vapor degreasing and solvent cleaning.

AQUEOUS CLEANING

Consider: **Time**
Temperature
Concentration
Disposal

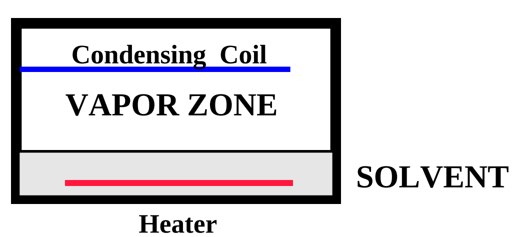


Vapor degreasing and solvent cleaning have been used for years in the metal working industries. Halogenated hydrocarbon solvents were the choice because of their nonflammable characteristics, however, these materials have been found to be carcinogenic or Ozone depleting substances and are now widely banned. Flammable solvents may be used in specially designed vapor degreasers and find wide use as wipe solvent cleaners. Flammability, health concerns, and their contribution to high V.O.C. levels limits their overall use. Solvents are effective at removing oily, resinous organic residues, but are ineffective at removing inorganic materials. This was often not understood by users of vapor degreasers for post penetrant inspection cleaning; penetrant would be removed but not the developer. Proper ventilation must be used wherever solvents are used, whether in large surface wipe cleaning or simple penetrant indication wipe off and redevelopment.

VAPOR DEGREASE & SOLVENT CLEANING

Consider: **VOC's**
Flammability
Non-flammable:
- **OLDS**
- **Carcinogens**

Inorganic Soils



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