GOT RUST? WANT IT GONE?

How to avoid the nuclear option...

by Everett L. Davis 2017

Created for the Shopsmith Forums, but others may find the materials presented here of value as well.
Preface

The Audience I originally wrote this piece for is the Shopsmith Owner Community, I will include a good number of illustrations with photos from posts within the Shopsmith Forums where other owners have used the various methods to remove rust, and link the photos back to the threads from which they came etc. There will be other sources as well. The information will have relevance to almost anyone who faces rust removal tasks.

This document is written with the express goal of removing rust from an item that continues to rust, not to remove rust stains from wood, concrete or items stained by rust, which is a different problem.

This document is for each of you, yet it will not answer everything.

-Everett L. Davis - Jun 2017
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This person said it worked for them.

OK, I will also choose that rust removal process..... Not so fast on the trigger just yet.

- Maybe your intent is to restore something to functional use.
- Maybe you want to sell parts and pieces to recover your investment, and make a small profit.
- Maybe you are servicing something for someone else.

Questions you need answers to before doing anything:

1. Do you fully know how it comes apart?
2. Do you have to remove rust in some places to even take it apart?
3. Are bolts, nuts or set-screws rusted in place or broken off?
4. If you break something else taking it apart, can you find a replacement part?
5. What type metal do you have that is rusted?
6. Is it nickel-chrome, copper, or chrome plated?
7. Is it only one type of metal?
8. Are there any brass sleeves or brass bushings?
9. Are there any stainless steel components?
10. Is it an assembly of components?
11. Is any of it polished aluminum?
12. Is any of it cast aluminum?
13. Is any of it another alloy?
14. Are electrical wires present?
15. Are painted surfaces, decals or emblems present?
16. Are any components rubber, plastic, nylon, phenolic?
17. Are there any circuit boards, electronic components wires, switches or connectors?
18. Can they be removed before the rust removal begins without damaging them?
19. Must sawdust, grease, or wax must be removed; how do I safely do that?
20. What will your rust remover do to the parts, or worse, to you?

As you can well envision, it may not be one rust removal process, but several that need to be staged in the right order on some projects.

Presuming you are successful and did not break anything getting it apart, realize it will start re-rusting immediately if not suitably prepared and protected for storage and later reassembly.

You do have a diagram or pictures of how to reassemble it, and have prepared for the parts to be labeled and stored together once cleaned, right?

Now I have framed the general scope of what we need to consider in selecting the most appropriate rust removal techniques for our tasks, for one item, and they will vary with the items.

As you work through each problem you will become far more proficient in setting out your scope of work.
I will discuss the following methods for removing rust in three basic categories: Electrolysis, Chemical Removal and Physical Removal, along with a variety of products and tools. There are other brands of similar products as well, but I am not as personally familiar with everything on the market.

Obviously there is a fourth method to remove rust when there is a suitable new, new old stock, or used part available to replace it.

With Shopsmiths or any other product that has been around for up to 70 years or more, some parts no longer made are just not going to be on the market when you specifically need them, or where you can find them even if they are out there somewhere.

When restoring anything there are a few basic things that has everything to do with how something is serviced and used:

This thing moves; it is not supposed to?
  •     How do I stop it?
  •     Do I want to stop it?

This thing doesn’t move; is it not supposed to?
  •     How do I enable it?
  •     Do I want to enable it?

Rust – How do I remove it?

Glad you asked... that’s is why I prepared this.

A number of folks with valuable insight have been there and done that, and having a collection of that information to review in one place by someone not selling a product or service, could be helpful to many getting started on their own restoration project.

What is Rust?

Unless you are from another planet and simply have no equivalent point of reference; Rust is a chemical process that occurs in iron and within the iron contained in alloys such as steel used commonly all over the earth by the inhabitants of the earth.

For the rest of us:  It is our common enemy and destroys the very structure of our bridges, buildings, cars, trucks, boats, machinery, tools, equipment and possessions we have and wish to sustain.

For iron to become iron oxide, three things are required: iron, water and oxygen. Here's what happens when the three get together:

When a drop of water hits an iron object, two things begin to happen almost immediately. First, the water, a good electrolyte, combines with carbon dioxide in the air to form a weak carbonic acid, an even better electrolyte. As the acid is formed and the iron dissolved, some of the water will begin to break down into its component pieces – hydrogen and oxygen.

The water can come right out of the air itself in humid weather. Condensation forms on metal objects that rise in temperature and cool overnight forming your own micro rain forest of sorts. Unless there is a barrier, oil, wax, paint or other coating protecting the metal surface, iron oxide (rust) will form on it. Just the salts in your handprint on a piece of unprotected metal can accelerate the process, making portions of, if not the entire handprint, rust more quickly if left unprotected over time.

The chemical compounds found in liquids like acid rain, seawater and the salt-loaded spray from snow-belt roads make them better electrolytes than pure water, allowing their presence to speed the process of rusting on iron and other forms of corrosion on other metals. Less oxygen in higher altitudes, and less moisture in arid climates accounts for rust being less of a problem.

Got Rust? Want it Gone?  Everett L. Davis Jun 2017 - Donated without cost to Worldwide Shopsmith Community
We will start by framing answers to the Twenty Questions.

Do you fully know how it comes apart?

It seems an obvious question, but many a project has gone south early because something was damaged due to someone not knowing something was present, or hidden. Shopsmith for years has placed putty over some embedded set-screws and painted over them. It’s rather difficult to remove something when you can’t see all the things that attach something.

The Set-Screw (upper right) on the Quill’s Knurled Spindle Knob is filled with putty. The Drill Chuck, Saw Arbor, Sanding Disk etc. attach to the Spindle by a Set Screw on the tapered Flat which is exactly in-line with the Spindle Knob, the putty helps prevent loosening the wrong set screw. Hint: That’s why you need to put the putty back when you are done.

Do you have to remove rust in some places to even take it apart?

Shopsmith Forum member mickyd in 2009 began a Restoration Thread on a 1952 Shopsmith 10ER that you will find at: https://www.shopsmith.com/ss_forum/viewtopic.php?p=37199#p37199

It documents in detail his journey. An excellent thread, updated and indexed to help navigation. There will be a number of photos from this thread to illustrate various subjects in this document.

The Headstock, the Variable Speed Control, and the Carriage Assembly, should slide along the rusted way-tubes, but can’t due to rust.

The pictures are generally hot-linked back to the post thread from which they came. Ctrl+Click on the photo to be taken there. This will take you to the post itself, not necessarily the photo within the post.

Are bolts, nuts or set-screws rusted in place or broken off?

The rust in this example is fairly extensive.

Hmmm, if someone had placed putty over this set-screw, would it have rusted as badly? Food for thought.

There are a variety of ways to loosen rusted set-screws that will be discussed later in the document.
If you break something else taking it apart, can you find a replacement part?

This part was broken by a bearing puller when pressure was applied, not being aware of a set-screw holding it on.

This was made in the early 1950’s and the company MAGNA who created the Shopsmith, sold out years ago. No New Parts have been available for decades.

What type metal do you have that is rusted?

When you have Steel, Cast Iron, and Aluminum that has to be disassembled after rust removal, your choice of Rust Removal Products becomes a matter of what you can use where.

An acid based removal product, even a mild acid will potentially be harmful to the Aluminum, especially polished aluminum where etching of the surface can occur very quickly.

One may have to remove various components by de-rusting sections employing different products, procedures and techniques to avoid damage to parts.

Is it nickel-chrome, copper, or chrome plated?

Read the instructions for the product you intend to use to insure it will not damage specialty metals.

Is it only one type of metal?

If it is painted, if it is helpful to use a magnet which will stick to an iron / steel alloy, but not aluminum. If it is stainless steel or chrome, it likely would not have been painted by the factory, but that doesn’t mean a previous owner didn’t paint it.

Are there any brass sleeves or brass bushings?

Acids can have a detrimental effect. Read the instructions for the product you intend to use to insure it will not damage specialty metals.
Are there any stainless steel components?
If one is using electrolysis, it is imperative that the sacrificial metal electrode is not Stainless Steel or Chrome Plated due to hazardous chemicals that are produced, that have to be disposed of with extreme care. Use of plain uncoated re-bar is a very common sacrificial electrode.

Is it an assembly of components?
Assemblies can produce a series of challenges due to dissimilar metals that may be present.

Is any of it polished aluminum?
Acids can have a detrimental effect, etching the finish and making it unusable.

Is any of it cast aluminum?
Acids can have a detrimental effect eating away material, weakening it.

Is any of it another alloy?
Research should be done beforehand. You may need a specific process for that alloy.

Are electrical wires present?
Some processes and acids can destroy insulation, or attack the copper wire inside.

Are painted surfaces, decals or emblems present?
Do you want the rust removal process to remove the paint? Some will, some will not.

Are any components rubber, plastic, nylon, phenolic?
Acid type rust removal can be devastating to those materials.

Are there any circuit boards, electronic components wires, switches or connectors?
Use caution and remove as much of these sorts of items as possible.

Can they be removed before the rust removal begins without damaging them?
Is there a different process one can use in this area? Research...

Must sawdust, grease, or wax must be removed; how do I safely do that?
It depends on what you have. Sometimes you can remove a great deal with compressed air, a rag with diluted vinegar (good for oil and grease) or even a power washer, again dependent on what else is there.

What will your rust remover do to the parts, or worse, to you?
A fellow I know of was about to use ammonia and scrub with a scouring pad with powdered bleach imbedded which will produce levels of toxic gases called chloramines, causing a significant risk to one’s respiratory system.
Ok, Twenty Questions out of the way somewhat, but awareness that other issues exist, and depending on what products and procedures one mixes and matches, other problems can manifest themselves.

My advice would simply be: If you have read through the product information and use guides and are generally aware of what materials are involved in your project, testing first in a small area where possible is always prudent.

**Concept of Electrolysis**

A bit of Science that enables it

I apologize but the science teacher in me surfaces some times, and this next section will begin with a bit of science precisely because understanding that concept helps one understand the processes I will discuss in how to remove, and prevent rust on the machines and tools we love.

If you are not interested in that information at this point, scroll down to --- Class Dismissed --- and continue reading.

--- Class in Session ---

A research scholar in Pharmaceutical Chemistry, in Patiala, Punjab, India - Alka B. Gupta's answer to the question "What is the difference between corrosion and rusting?" can be found at [https://www.quora.com/What-is-the-difference-between-corrosion-and-rusting](https://www.quora.com/What-is-the-difference-between-corrosion-and-rusting) if you are interested in reading it. It is one of tens of thousands of explanations out there. I chose it, because it was one of the first Google responses that answered the question, nothing more.

The key part of his answer for Shopsmith and other tool enthusiasts is defined in his statement "a cathodic and anodic reaction takes place". That's what we are going to use.

A Cathode and an Anode can be described in a myriad of technical and electrical engineering discussions but for simplicity the Anode is + and attracts - and the Cathode is - and expels - negatively charged electrons.

I know there's always some folks who want to go to electron flow versus hole flow and discuss the valence of conductors so I will go back years ago when I used to teach that concept to students myself.

A conductor such as copper is a good conductor because electrons can flow through it readily as the outside valence ring of copper element has an outer ring or 4th shell which is capable of holding 32 electrons, but has only 1 electron in it. That would be opposite of an insulator such as glass or plastic which has a closed outer valence ring.

That means there are 31 potential holes that external electrons can move into or out of if sustained voltage is present.

If a supply of sufficient electrons exist at the Cathode (-) with a voltage (or pressure to push them out) and is connected to a complete circuit to the Anode (+) electrons will move at a rapid rate through the conductor as each valence ring fills with 31 electrons, and pressure (voltage) keeps pushing as it flows atom to atom, through the conductor.

There are folks who will talk about electron flow vs. hole flow which are in opposite direction, and I will describe a way to help you envision that. Imagine if you will a sufficiently high powered camera mounted to an electron microscope capable of capturing a new frame each time an electron moves and spreading them out side by side, frame by frame within the outer valence ring of a copper conductor.

Let’s take the valence ring, and flatten it out showing just two copper atoms valence rings side by side 32 + 32 individual spaces, laid out somewhat like a pipe
For sake of our insight, we will presume the connection has been made and electrons have filled the pipe so to speak, and we will begin our view with one remaining hole (empty spot) "Ο" at the left side of the page, and all other spaces filled with electrons “Θ”. Let’s begin that theoretical “time lapse photography.

Frame 01: The electron Θ on the right of the hole Ο moves into the hole, leaving a hole Ο behind in Frame 02, and so on.

Thus, the electrons Θ are moving left. From another perspective, the holes Ο are moving right.

That’s it. That’s the discussion hole flow vs. electron flow. In another context some will say the electron is moving one direction and the “current” in the opposite.

That is the process that happens in a cathodic and anodic reaction where the moisture in the air and the charge in the air acting upon iron causes iron oxide (rust) to form on iron or iron alloys.

If we set up an environment with a suitable electrolyte, that is a solution that when dissolved in a polar solvent such as water forms an ion-conducting polymer that contains free ions, it promotes conductivity. When we connect an item with deposits of rust, and a suitable piece of donor iron as an electrode to move the rust to, we can use this process to reverse the rust from one item we want to recover (de-rust) to another sacrificial piece of metal. That process is known as rust removal by electrolysis.

Depending on the materials used as anodes and cathodes (electrodes if you will), the compounds forming the electrolytes one can extract material from ore, electroplate protective coatings onto other substrates such as gold-plating, copper-plating, chrome-plating, or remove rust.

There are even hair removal processes that uses the process of electrolysis, used topically. No they don’t submerge you in a tank and ‘hook you up’. Never done it myself, but I have seen it done.

While some other processes involve hazardous chemicals and acids such as in chrome plating, rust removal by electrolysis is a relatively safe environmentally stable relatively green process that one can perform as a DIY project, with select precautions to deal with the gasses slowly produced in the process; specifically 2 parts of hydrogen and 1 part of oxygen that separate water into hydrogen (flammable) and oxygen.

It must be ventilated and the hydrogen slowly produced will dissipate quickly into the surrounding air as will the oxygen produced.

--- Class Dismissed ---
**Rust Removal by Electrolysis**

**What do you need to remove rust by electrolysis?**

- A ventilated area to allow the hydrogen gas to vent and dissipate, not collect and concentrate in an enclosed room.
- A suitable non-conducting container for the liquid you will submerge the material you want to de-rust.
- An electrolyte formed by dissolving washing soda into water (Arm & Hammer Washing Soda) is excellent.
- Sacrificial Electrodes that the rust removed from your material will move to that cannot physically touch your material (that is: not short together)
  
  Re-Bar is an excellent sacrificial electrode - **Danger: Never use Stainless Steel** which produces highly dangerous compounds such as chromates in the electrolyte in which disposal then becomes highly regulated. It cannot be poured down the drain, or on the ground. The normal electrolytes without chromates can be.

- Wire for interconnecting the electrodes together in areas around the part you want de-rusted.
- An automotive battery charger capable of producing 6 to 10 Amps of current.
- An electrical outlet for the battery charger.
- Time for it to work - It can take many hours.
- Washing soda solutions are still alkaline and will irritate the skin and eyes. Use eye protection and gloves. Immediately wash off any solution spilled or splashed onto your body.

**Critical Point:** Connect the **NEGATIVE** Lead of the Battery Charger to the material you want cleaned, and the positive lead to the various sacrificial iron electrodes you interconnected, which are **Not Chrome or Stainless Steel**!

**Washing Soda**

Washing Soda should be in the laundry section of your grocery store. Walmart stocks it. You can find it on-line at Amazon as well at times.

- **Washing Soda** is Sodium Carbonate or "soda ash"(Na2CO3)
- **Baking Soda** is Sodium Bicarbonate (NaHCO3)
- **Borax** is Sodium Tetraborate Decahydrate (Na2B4O7*10H2O)
- **Use ONLY Sodium Carbonate for your Electrolysis rust removal project.**

Yes you can make your own Laundry Soda from Baking Soda. You need to cook baking soda in your oven on a cookie sheet for an hour at just over 300° which then decomposes the Baking Soda into Sodium Carbonate.

You can buy soda ash at your pool supply just as well. It too is Sodium Carbonate.

How much Sodium Carbonate do you need?
Define the container size and you should have a better idea of how much you will need.

Here Mickyd uses a procedure called ‘Localized Electrolysis’ to help disassembly of the headstock portion allowing it to be removed from one end.

Remember you can Ctrl+Click on the photo to go to the post in which the photo appears.

You will need to mix a solution of 5 gallons water to 1/3 to 1/2 cup washing soda and make certain it is dissolved well, then pour it into your container, assuming the 5 gallon bucket itself is not being used as the container, as depicted.

You could build a truly large container from wood with suitable reinforcement to hold the volume of liquid, use an old pick-up bed lined with blankets then lined with heavy plastic to form a tank, use a stock tank, a plastic 55 gallon barrel, a kids plastic swimming pool as Keith Rucker of Vintage Machinery is, a 5 gallon bucket as Mickyd has, or even a quart mason jar if your part is small.

You get the idea – whatever makes sense for an electrically nonconductive container that your part or parts will fit in. Yes, you can suspend a bar over the tank, connect and suspend numerous smaller parts all connected to the NEGATIVE lead, while the sacrificial anodes are connected to the Positive. They just can’t touch, and they both have to be suspended within the solution.

Electrolysis: Use in the Restoration of Machinery by Keith Rucker - VintageMachinery.org

Excellent video and discussion of rust removal using Electrolysis. 27 minute Video – worth the watch.
https://www.youtube.com/watch?v=NKZv14-K71g

Chemical Removal Process

Evapo-Rust

Evapo-rust is a commercial product widely available in Auto Parts Stores, Tractor Supply, Harbor Freight, Northern Tool On-Line, Amazon (free shipping with Prime which is what I use most often) and numerous other outlets. Read more about the product at https://www.evaporust.com/evapo-rust-rust-remover?gclid=ClWlRZ5zp9QCFQuraQodafMEyQ

According to them “Evapo-Rust® is an amazing award winning rust REMOVER which is utilized to remove rust by the U.S. Army, U.S. Navy, U.S. Air Force, FBI, NATO, Government Contractors, Engine Builders, Auto Enthusiasts, Gunsmiths, Forensic Labs, OEM’s, Farmers, Antique Restorers and more.

Evapo-Rust will remove rust from all types of metals containing iron. Evapo-Rust does not remove rust stains. Rust and rust stains are two different things.

EVAPO-RUST is non-corrosive to steel and does not harm brass, copper, aluminum, gold, lead, titanium, steel, cast iron, chrome, solder points, vinyl, plastic, rubber, silicone, glass, cork, or wood. EVAPO-RUST has an indefinite shelf life* and can be
used over and over until it absolutely stops working. On average, one gallon de-rusts up to 300 pounds of light to moderately rusted steel.”

Evapo-rust also sells Rust Bandit which prevents re-rusting for up to one year if de-rusted parts are stored indoors.

One of the advantages beyond its exceptional environmentally friendly product usage profile, and the effective way it works, is that it can be filtered, stored back in the original containers, and re-used for a number of cycles, making it much more efficient.

It is classified as a Non-Toxic, Proprietary non-hazardous chelating agent. It is nonflammable, and may be disposed of by flushing with water into sewer.

That is not the case with all rust removal products, just some.

Rust Block, like Rust Bandit prevents re-rusting for up to one year if de-rusted parts are stored indoors.

When used with an ultrasonic cleaner with a slightly heated solution, the working time can be dramatically reduced.

Click the photo at left, then select the video of the Ultrasonic Cleaner usage as well as any of the other Evapo-Rust® How-To Videos there.

A Shopsmith Forum friend and mentor James Grange Sr. (JPG) had a dialog with Mickyd back in April 2009 in a post regarding Evapo-rust http://www.shopsmith.com/ss_forum/viewtopic.php?p=36841#p36841

“JPG posted pictures of two tubes as he put it “This is one tube 'polished' and the other b4 polishing. I had left them both OUTSIDE in rainy weather for over a week! The coating of Evapo-rust (for the most part) prevented new rust.

This is both of them after polishing and preliminary waxing (not entirely rubbed down). There is still some very light pitting which I decided to leave so as to not remove too much material. I can always sand it down later. I cannot put it back on.”

Shopsmith Forum member Mickyd indicated that was good enough for him to embrace the Evapo-rust in much of his upcoming work outside of the tubes he had begun de-rusting through electrolysis.
In my own shop I have set aside areas for tear down of up to nine Mark V units with way and bench tubes stored between wall studs.

I also built four PVC tubes consistent with JPG’s design including the 1” solid capped PVC tube to put down the center of the way and bench tubes to reduce the volume of Evapo-rust to about one quart per tube, filtering it and recycling it for re-use.

I pour the Evapo-rust out of each tube in to a 5 gallon container, filter it through inexpensive 120 mesh (about 125 microns) paint strainers. I then put it back into 1qt Evapo-rust bottles, which I find easier to pour from into the tubes, topping off what little I lost to evaporation, from a fresh 1 gallon Evapo-rust container.

Harbor Freight has 100 strainers for $5.

Overnight bath on less rusted tubes has been very satisfactory in the past. I have had some severely rusted tubes that were very stubborn to de-rust enough to slide off the headstock and carriage that took two cycles.

I had one that was far worse. My solution on it was one of convenience. I had come across some surplus gauze that had got wet from an air conditioner dripping condensate from a pipe making it useless in a medical clinic even though it had dried out.

They gave it to me just to get rid of it. Yes, I wrapped the tubes in it, including the section inside the headstock, the poured Evapo-rust over it to get it soaked, and covered the soaked gauze with kitchen plastic wrap to keep evaporation down. You could use shop towels, old rags etc. It took four wrappings and I lost a good bit of Evapo-rust I couldn’t squeeze out of gauze.

It looked a bit like a Shopsmith Mummy for a few days, but it worked well enough. Evapo-rust migrated into the areas of the headstock and carriage eventually allowing me to slide them off. Then I soaked them in the PVC.

Working over time, it has become apparent that when the temperature is 80° or higher, the Evapo-rust works more quickly. Which is to say during the winter months they come indoors overnight if I have tubes to process.

While JPG mentions polishing (highly relevant to the restorative process), I will cover that in the section where I discuss the abrasive removal of rust, later in this document. My personal use of Evapo-rust removes the rust, leaving the metal, pitted perhaps like the really bad one, that can all likely be finished with abrasives, and polishing compounds that will remove a couple of thousandths of an inch.

Rust Release® SuperGel

This product originally was introduced in a formula used like Evapo-rust where the part was dipped. The SuperGel sticks to the surface to work. You can find more on it at https://rustrelease.com/product/rust-release-supergel/

I have never used this product personally, but based on the physical accessibility of the area, a gel has some definite advantages if part cannot be submerged in, or have the agent recirculating over the rusted area and reclaimed, discussed later.
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Rust Release SuperGel Instructions state:
1. Scrape any loose rust and dirt away.
2. Brush Rust Release SuperGel liberally on rusted area and leave on until rust becomes loose*.
3. Wipe the solution clean and repeat the process if any rust remains; leave on longer for heavily rusted areas.

*Leave the SuperGel on from 20 minutes to 4 hours depending on the thickness of the rust. You will be able to see if the rust is coming off by rubbing the surface of the metal.
It does not appear to be re-usable.

**Naval Jelly**

Like the SuperGel which can be painted on a will cling to surfaces, Naval Jelly will stay in place better, but unlike SuperGel it is an acid. For the right application, it will produce good results. A Jointer bed or cast iron table top would be a likely application.

Loctite even has a product for Aluminum, called Aluminum Jelly but beware: It is Not Recommended for New or anodized surfaces.

The Jointer at right was de-rusted by Shopsmith Forum member thainglo in post http://www.shopsmith.com/ss_forum/viewtopic.php?p=34402#p34402 with Naval Jelly.

He said: “Took four coats of the jelly, applying with a paper towel over each of the surfaces, letting it sit for about ten minutes, and then rinsing it off with some water. Wipe, rinse, and repeat. Was impressed - the jelly did almost all of the work, especially on the first couple of passes.

After the fourth run, the surfaces were almost cleaned off, and not much was coming off with the jelly application. Switched to 400 grit and wet-sanded, which cleaned off the remaining rust without difficulty. A coat of Johnson's floor paste, and the pieces now glide right across it! Here's a close up of the bed and fence:”

Mickyd commented later in that thread: “Navel jelly IS effective at removing rust BUT, you need to be careful with it. It is an acid. You leave it on too long and you’re in trouble. It will leave a dark, streaky appearance on the metal and it will stain deeply into the base material. You shouldn’t do a localized area with it as it will show. It can also mess up your paint. (Even the vapor as its working can cloud a painted surface). Also, it does take muscle to do a real good cleaning with it.”

**Oxalic Acid**

Forum member DB5 in 2016 mentioned Oxalic Acid in post stating it is made from rhubarb, but no one had yet mentioned it in the thread “Rust on way tubes and other parts” http://shopsmith.com/ss_forum/viewtopic.php?p=220402#p220402


Forum member JeremySavoy added that oxalic acid can be picked up anywhere under the name "Barkeeper's Friend".
Molasses

Yes, Molasses and water mixed 1 part Molasses to 9 parts water. Honestly I have never tried it. If I were working on something big like car doors, hoods, trunk lids, I would be tempted to try it in a big tank to get down into all the nooks and crannies... by the way what is a cranny? Dictionary suggests: a small, narrow space or opening. Synonyms: chink, crack, crevice, slit, split, fissure, rift, cleft, opening, gap, aperture, cavity, hole, hollow, niche, corner... TMI...

Nick Engler, formerly of Shopsmith posted an alternate method of application of the molasses list in post part of which I cite below:

Nick said in 2007: “You can also make your own rust remover, or "chelator" as chemists call it. Mix one part black strap molasses to nine parts water. Paint the mixture on the rusty metal and let set for one or two days. Wash with tap water. If there is still some rust on the metal, repeat. It will take one or two applications of this homebrew chelator to remove a light rust patina, five or six to strip a surface that encrusted with rust. It takes longer, but it removes more rust with considerably less elbow grease.”  https://www.shopsmith.com/ss_forum/viewtopic.php?p=4811#p4811

See the two a two part YouTube video of a fellow Dave Ailey who did car doors and other large parts in an immersion tank. Ctrl+Click the picture to hot link to it. Slow connection at times in some areas. Just wait on it to start.

https://www.youtube.com/watch?v=KZCFcx51Bw in case that doesn’t work.

Again, I am presenting a spectrum of options for you, and not trying to impose my personal preferences. I guess the best way I can put it is: “There is meat in here, but you are going to need to prepare and season it to your own taste. – Everett"

Potatoes

Nick Engler, formerly of Shopsmith also did a Hands Online! Video as he tested rust removal using potatoes. Yes it is the video that is out of focus, not your monitor. You will understand the principles none-the-less.

If a picture speaks a thousand words, his YouTube video of the project should give you much more. It’s about 8 minutes. I remember that he had to reach out to the world to find a set of rusted tubes he could borrow. He could not find a set at the factory. They follow their own instructions, so they had to get a rusted loaner set from an owner to use. Considering what they were going to use for rust removal, I wondered if the tubes came from Idaho... but I digress...

https://www.youtube.com/watch?v=qYgnHDB3VNI

Got Rust? Want it Gone?  Everett L. Davis Jun 2017 - Donated without cost to Worldwide Shopsmith Community
ATF and Acetone 50-50 Mix

Ok, I will make a bit of a departure from rust removal as a whole, and step into the rust removal of frozen set-screws and bolts using a 50-50 ATF / Acetone Mix. **Remember: Acetone is very flammable! It needs to evaporate, leaving the ATF behind.**

I will spend some time on this subject and link back to some posts in forum threads that I personally wrote. I have been using this mix for decades, as well as family members before me. I suggest it deserves a consideration in your arsenal.

I never mix more than ¼ of a shot glass of the mixture at the most, usually even less. It goes a long way, and acetone evaporation begins immediately, so mix only what you want to use right now. - Everett

Kano Labs Kroil, available widely is a commercially produced product that many swear by. I have used it, and it works. One of the more interesting comparisons put Kroil and the ATF / Acetone mix head to head with other products. The results are cited further down. My experience has been the same as their findings. ATF / Acetone mix worked better and cost far less per ounce.

Kano Aerokroil is an aerosol spray can @ $17.99 for 13 oz. at last look, and squirts up to three feet. Yes goggles might be in order in close quarters until you learn how to pull the trigger so to speak. They suggest that you allow 24 hours for Kroil to penetrate. The chart below shows a cost per ounce calculated in the test. At today's prices, it is $1.38 per ounce (opposed to the $0.75 cost in the test) so you definitely want to brush off any loose rust or build-ups of material before you spray to reduce material cost, and promote penetration whichever penetrant you choose.

A trusted mentor of mine, the late Bill Mayo mentioned that he had some problems with the ATF / Acetone mix in a post in 2015. It wasn’t that it didn’t work, but that his wife Ann didn’t like the smell on his hands, and that it evaporated quickly. I wear gloves, and rather aggressively mix what I intend to use to insure even dilution in the mix. Kroil has an odor of its own.

Bill went on to say in 2015 that he had used many dozens of cans of Kroil and was very pleased with the results. Bill was a super guy and a personal mentor I respected very much who passed away recently. Thoughts and prayers to his wife Ann, and his family. I miss talking to Bill and receiving emails from him. He was always willing to share his knowledge with anyone, a truly kind soul.

I posted a reply in 2015 to a post titled “What do you do, when a headstock is stuck on the way tubes?” In it, I also listed the Machinist’s Workshop article I cite below.

I wrote: “I was blessed to work with my uncle for many years growing up, and he taught me how they made oil penetrate rust in the depression. His point was that using what you have not only was often the only choice, but frequently proved better than the purchased products.”
He said a mixture of a lubricant, with a diluent or oil diluted with something that evaporates had been used for years to do this. By the 1950’s his choice was freshly mixing automatic transmission fluid with equal parts of acetone as he generally always had those handy in his shop, and likely wherever he might be working near.

He cautioned me to only mix as much as I needed as the acetone would evaporate out of the unused mixture. He usually poured these into a metal squirt oil can and sloshed them a bit to mix them.

One of the other things he did that I had never seen anyone do before was on some really difficult pieces that were hanging down from frame rails etc. on old cars was to mix a bit of the mixture with some clay and press it over the item that was frozen. Occasionally depending on how it was oriented, he might build a reservoir of clay around and beneath the part, and squirt the mix into that reservoir to hold it there around the part, even using old speaker magnets to keep it in place times.

Since that time I have used 50/50 mix of ATF and Acetone mixing just what I need, and I am very pleased with the results. Someone said they had seen a shoot out of commercial products like Knocker-Loose, PB Blaster, Liquid Wrench, Kroil and others and the home-made stuff was cheaper and faster.”

The April/May 2007 edition of Machinist's Workshop magazine published a test of penetrating oils measuring the force required to loosen rusty test devices using each, and the price per fluid ounce.

<table>
<thead>
<tr>
<th>Penetrating oil</th>
<th>Average load</th>
<th>Price per fluid ounce</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>516 pounds</td>
<td>-none-</td>
</tr>
<tr>
<td>WD-40</td>
<td>238 pounds</td>
<td>$0.25</td>
</tr>
<tr>
<td>PB Blaster</td>
<td>214 pounds</td>
<td>$0.35</td>
</tr>
<tr>
<td>Liquid Wrench</td>
<td>127 pounds</td>
<td>$0.21</td>
</tr>
<tr>
<td>Kano Kroil</td>
<td>106 pounds</td>
<td>$0.75</td>
</tr>
<tr>
<td>ATF-Acetone mix</td>
<td>53 pounds</td>
<td>$0.10</td>
</tr>
</tbody>
</table>

There are other penetrating products they didn’t test such as AMSOIL MP and others on the market. A number of auto, tool or other retail stores will even have their store brand label of these sorts of products. How well each works depends on variables they introduce in their various contents and concentrations.

**Frozen Parts**

When a machine has been left outdoors for years, or in a leaky barn, sometimes it is very hard to get frozen parts such as a rusted drill chuck, a saw arbor, a sanding disk etc. to come off the spindle shaft, even when you have removed the setscrew.

**A new tool for me in the war with frozen drill chucks**

A new tool for me in the war with frozen drill chucks etc. I wrote about in the following Shopsmith Forum post in 2015.


Forum member James Grange Sr. (JPG) also a friend and trusted mentor commented in that thread that “*I would suggest a short thread ‘zerk’ in all cases. 5/16-18 would be the most common need.*”

Since that post, and having exhausted the supply of 5/16-18 threaded Zerks I inherited from my uncle, it is apparent that the original Zerks I had in the massive kit he had, are not commonly available in that thread these days.

His set had SAE, English, and Metric. SAE Products a major supplier of grease zerks stated it is no longer available, but could be custom made for $2,000 set up and a large wait time, and large minimum order. That’s out. Not realizing this fact, I lost some through the years and gave away many to friends who had similar problems. Prior to finding the rejuvenator tool, I had just
used a standard grease gun and forced grease in through the zerk. When I ran out of 5/16-18 threaded Zerks I looked everywhere I could think of. No luck.

So do I give up, and not pursue this method any further, or make a user fabricated adaptation?…..hmm…adaptation it is.

I found an automotive 5/16-18 brass brake line adapter and used a drive in grease zerk that I pressed into it using a drill press. If I can ever find a steel adapter, I will tack weld it in a couple of spots after I drive in zerk to make sure it stays in place. Different set-screw threads means different adapter threads might be required.

I also tried using an extra-long grease zerk, cutting off threads and threading it to 5/16-18 threads, and that worked, but it took more time to fabricate. You will need several thread dies if you go this route. If you have a metal lathe, you might fabricate what you need more easily.

Combined with the Grease Zerk Rejuvenation Tool I got from Northern Tool this process works well. If you use the 50/50 mix, be sure to clean the rubber seals to prevent the Acetone or anything else you use from deteriorating them.

I use the rejuvenator on other grease zerks as well for its intended purpose. If you don’t do this frequently in repairing other things that are frozen, or to truly rejuvenate an existing grease zerk, an alternative method may suit you quite well and reduce your cost to practically nothing.

On rusted Shopsmiths I find something often was left on the spindle and rusted in place for years. The 5/16-18 Set-Screw has to come out of the respective arbor, to get the penetrating solution in.

Once you have it out, and if the quill will rotate the hole to 12 o’clock, fill the hole with your penetrant and let it seep in. You also can take a new 5/16-18 Set-Screw and screw it into the threads which will push the liquid further in.

Repeating this process several times can get the penetrant hydraulically forced deeper into the rust. Take out the set-screw when you believe you can do no more as the acetone if using the ATF / Acetone mix, needs to evaporate. Yes, I have used Evapo-rust, Kroil, or PB-Blaster etc. in a similar manner, but the ATF / Acetone mix appears to work better for me. Point is try using what you have first.

**Spoilers: What if I still haven’t got the set-screw out?**

Depending on what it is threaded into and what is around it, I may use a heat gun, a torch, alternative heating method, vibration, or a combination of them, before I drill it out. If I forced penetrant into the opening, and the machine works mechanically otherwise, I frequently put an new set-screw in and tighten, and just run the Shopsmith Headstock for a time. The vibration and heat generated will help distribute the penetrant, helping free it up. As with rust removal in general, it may take several cycles to get it loose.

Yes, if one can put the Shopsmith in drill press mode, one could simply put a container of Evapo-rust below the spindle and lower the frozen accessory into it. **DO NOT TURN ON THE MACHINE WHILE DOING THIS.**

Equally, if one can remove the quill from the Headstock, one could immerse it with the frozen accessory attached to the spindle in a container of Evapo-rust, or other suitable rust remover to de-rust the assembly.

If the machine cannot be safely turned on, there are even more techniques I have used successfully that I describe in the following 2016 Shopsmith Forum post. You can read the whole thread at [http://www.shopsmith.com/ss_forum/viewtopic.php?p=210220#p210220](http://www.shopsmith.com/ss_forum/viewtopic.php?p=210220#p210220)
I wrote: “Insert a long allen wrench into the setscrew cup and take a small pad sander without paper, maybe a piece of cloth over it, and bring the edge of the pad sander in contact with the edge (not top of) allen wrench. The vibration transferring down the shaft into the setscrew can help the magic happen as it loosens areas of rust letting the penetrant do its work.

Also, if your penetrant isn't flammable and mostly cleared out, you can also take a sacrificial long allen wrench and heat it up in the flame of a propane torch etc. til it glows and then insert it into the cup of the allen screw.

The heat transfer from the center of the cup will go outward causing the screw to expand ever so slightly.

You can gently try to get it to move, while the hot allen wrench is inserted, but don't force it. It's not as strong as it was before you heated it. (You can re-temper it later)

If it's still stuck, when it cools, it shrinks again and that may break up segments of the rust in the threads. If not enough to move the screw, perhaps enough to get penetrating fluid into those crevices. Evapo-Rust works through selective chelation. This is a process in which a large synthetic molecule forms a bond with metals and holds them in solution. Making even the slightest amount of additional space via heat / cooling may aid penetration of the Evaporust if you're using that to penetrate when you reapply.”

What if set-screw it is still stuck?

Without trying to sound like a former vice-presidential candidate, “It’s time to Drill Baby, Drill.” I still cannot embrace the term Ease-Out, since it has not been easy, and it dang sure isn’t out, but that’s what the screw extractor is often referred as.

Let’s explore that. Depending on what is frozen in place, and where the set-screw is, things could hardly be worse. I will use a new disk for illustration. Imagine massive rust.

Let’s make it a Shopsmith 12” Sanding Disk or 10” Saw Blade that is frozen on the spindle shaft. A 12” long thin drill bit will not be a suitable tool, even if you could find one. The set-screw is hardened.

- A small arbor on the back of the sanding disk houses the set-screw attaching it to the spindle.
  - Four counter-sunk screws on the face of the disk, may allow the removal of the disk from the arbor
  - This makes close access to the arbor and set-screw possible.

- Operative word in Spindle is Spin.
  - It will move when you try to drill out the setscrew unless you can secure the spindle for the drilling process.

- A removed quill can be secured in a Drill press vice with spindle secured on back side by opposing vice grips or placing just the arbor itself in the drill press vice if you can secure it.

To illustrate the proper use of an ease out to remove a screw by drilling it out, I refer you to an example video hosted at MidwayUSA arms site where Larry Potterfield, the founder and CEO demonstrates the proper method to remove a frozen screw in a receiver.

It is very representative of what one must do to properly remove a seized screw using this method, and how the part being repaired must be secured regardless of what you are servicing.

I could have attempted a thousand words, but the video gives you the scope of what needs to be done if you have to go there.
If you are a gun enthusiast, a collector, or do some of your own gunsmithing, I think you will find many of his gunsmithing YouTube videos quite informative. He has been doing them for years, and there are many topics you may find to assist you.

Ok, my technical diversion into removing stuck screws and set-screws comes to an end, and we resume with other rust removal techniques. I hope you as a reader are finding the materials I present here helpful. Anyone with a browser and a search engine can find hundreds of similar discussions on rust removal.

**Vinegar**

There are a number of folks who have used vinegar which is a mild acid that will damage metals if used for long periods of time. If you use it, test it to insure you are getting the results you need, and there are no ill effects. I have used it on surface rust.

Vinegar is discussed in that line within a few of the 63 present posts in the thread “The Amazing Evapo-rust” found here:


Using the Jalopy Journal as a reference, I will cite an example where a fellow used it, but left a license plate in it for a few weeks, destroying his part.

He said: “CAUTION WHEN USING VINEGAR ON RUST - I have a large plastic tub I use for soaking rusty parts in white vinegar to remove rust. Usually it works great. I put this IND 1948 plate in the vinegar and let it soak, but I wasn't ready to prime it yet, so I let it set for a few weeks. Well I guess it does a little more than remove rust. I never would have expected it to do this. The plate was rusty but still very solid with 75% of the paint still on it. How long does anyone else leave their parts in for? Anybody else have this happen?”


I am reminded of a chemistry experiment we did in school using Coca-Cola to dissolve a nail. The active ingredient in Coke is phosphoric acid. Its pH is 2.8. It will dissolve a nail over time. Measurable losses exists at 3 days.

People use it both to clean rust, and to remove battery acid from car batteries.

Vinegar is a mild acid, but it is an acid and keeps eating. Do not let it eat. 24 hours maximum without inspecting, 4 hours or so more common.

**Safest Rust Remover by Ultra One**

The Ultra One product has been around a number of years, and I have used it myself. It works as described in the literature. My challenge was getting it in my city due to the shipping from Hackettstown, NJ. I used it before trying Evapo-rust. [http://www.safestrustremover.com/](http://www.safestrustremover.com/)

One can use it in a soaking, spray on, or recirculating manner. It is reusable, and may require water be added to compensate for evaporation. It will lose its effectiveness as it is used, and reused. Filter it and store it sealed so it cannot evaporate.

It has received awards from Popular Mechanics in 2004, Hot Rod Magazine (tested and approved), and Year One (tested and approved).
The most efficient way to buy it was to buy Ultra One Safest Rust Remover Concentrate 1 Gallon which Makes 5 Gallons, when you add 4 gallons of distilled water. I use RO water and it has had no known problems.

1 Gallon of Concentrate costs $100 plus the freight. 1 gallon of the premixed was $35 ($25 on sale) but it would still take 5 of them at $25 to provide the material volume possible from 1 gallon of concentrate, making it $25 more cost, plus the freight of 5 gallons of liquid opposed to 1. It is available in 5 gallon bucket.

Miss Belvedere

If you have never heard of the 1957 Plymouth Belvedere buried in a time capsule in 1957 celebrating Tulsa Oklahoma’s 50 year anniversary, it is an interesting story.

I include three video links, the last showing Miss Belvedere as the car is known being de-rusted in New Jersey using the Safest Rust Remover product. Dwight Foster of Ultra One has committed to preserve the car for the future. And the videos tell the story of how they got here, far better than I could.  Ctrl+Click on one of the videos below to view it.

![1957](image1)
![2007](image2)
![2008](image3)

50 Years buried in water was not kind.

![1958 Red Plymouth Fury from the movie Christine](image4)

I wonder if the 1958 Red Plymouth Fury from the movie Christine was so much a villain because of what was happening to her just slightly older entombed cousin..... Just asking....

Sanding

Now we come to one of the more common methods folks use to remove rust: Sand it off with some sort of abrasive. In Shopsmith restorations, when it comes to bench and way tube restoration, if it is not used exclusively, it is used extensively to resurface the DOM tubing. Progressively moving to higher grit papers can yield exceptional results with high luster on the finished tubes, restoring and extending their service life.
If necessity is the Mother of invention, you will find that mom is alive and well based on the innovative ways Shopsmith owners have engaged this process.

Going back to Shopsmith Forum member Mickyd thread in 2009 titled “How to” Guide to Recondition Your Bench and Way Tubes’ there are 15 posts. The first one has links to numerous other posts about reconditioning bench and way tubes that are extensive. [http://www.shopsmith.com/ss_forum/viewtopic.php?p=33408#p33408](http://www.shopsmith.com/ss_forum/viewtopic.php?p=33408#p33408) there are numerous threads and posts on this subject. They can gets extensive as the first link goes to a Thread that has 39 pages and counting of posts in Mickyd’s thread titled “Restoration Progress on My 1955 Greenie”

The entire tube refinishing issue is encapsulated in taking a way (top) or bench (stand) tube, mounting it in a mechanism that can securely spin it at an appropriate speed to allow one to pass an abrasive, ok, successively pass a progressive series of abrasives over the length of the tube to restore the finish and function.

How is it done? Glad you asked.
As before, you may Ctrl+Click on the various photos to be taken to the post in which the picture was posted in the Shopsmith Forums and read through the thread, scrolling up or down depending on which post the picture originated in.

John Burger (JSBurger), another of my Shopsmith mentors illustrates his method with a lathe chuck. He starts with 320 grit, then 400 grit, then 600 grit and then finish with 0000 steel wool. He then cleans with mineral spirits and waxes with Johnson’s Paste Wax, like Shopsmith has recommended for over 60 years.

The last post I will list here is one of mine in 2014 where I illustrate a method to secure the tubes securely at both ends. While the method I illustrate is capable of spinning the tube at the full speed of the Mark V, I recommend using the slowest settings possible, and like John, place a drop cloth over the way tubes on the Mark V to prevent abrasives and rust falling onto the surfaces and possibly becoming an imbedded abrasive as the headstock and carriage is moved in future use.

An ounce of prevention is worth a pound of cure, seems an appropriate reminder.

In my post at [http://www.shopsmith.com/ss_forum/viewtopic.php?p=175733#p175733](http://www.shopsmith.com/ss_forum/viewtopic.php?p=175733#p175733) my focus was to configure a method that would allow end to end finishing, opposed to having a center support / steady rest as illustrated in the pictures below. The last thing on earth I would want is a heavy DOM Way tube spinning its way off and into me, or tearing its way through the shop.

When I first used it, the Pedestal Base Pillow Block reminded me a bit of a 10er tail stock once I had it mounted up.

In first using it, I envisioned my next iteration which will be an adaptation MAGNA used employing two 10ER Headstocks on one set of way tubes, as shown below.
This production set-up used two Shopsmith Headstocks on one set of tubular ways and was used to ream holes for bracket pins in the table tie bar in manufacturing.

The source for this photo was originally published by MAGNA, in the January 1951 issue of Western Machinery and Steel.

Mine will be similar only in that I will have extended tubular ways, but they will not be tied together with common drive mechanism below it as MAGNA did.

Another one of my trusted mentors Dusty, posted a PDF of that January 1951 issue of Western Machinery and Steel publication where that picture appeared in the post: https://www.shopsmith.com/ss_forum/viewtopic.php?p=183541#p183541

While it is being planned for a future project, mine will have one motor, a variable speed changer, with the second headstock functioning as an extremely stable live tailstock assembly, retaining the adjustable quill. Each headstock will have new precision bearings, and I am designing the extended bench to allow for micro-adjustments to provide laser tight alignment for the two headstocks from end to end.

I am exploring doing some light metal work on it, and fabricating a shield to keep metal cuttings out of the motor, belts and speed changer. It will be staged in my repair shop opposed to my woodworking shop.

I want to turn some oversize columns using faceplates at each end and see what is comfortable to work with. I plan to turn some custom baseball bats, and because it is available, also use it to re-finish and polish bench and way tubes in the shop. I have a 10E with a speed changer that will also do smaller turnings, especially bowls that is in the woodworking shop.

I digress, but as those projects begin, I will document and post how it is done, perhaps next year.

Yes I still have my Mark V 520 Anniversary Edition, numerous other Mark V’s and Mark 5’s, and ton of other gear and accessories that I am restoring for family members. Once I clear most if not all of those projects off my plate, I may consider doing some headstock repairs for others from time to time. By that time, I hope to be retired and have more opportunity to do those sorts of things.

Due to some of the other finish metals on escutcheons and medallions and other controls and control surfaces, there are a variety of other restorative processes for restoring and refinishing them that will be discussed in a future document I plan to prepare on Finishing will include far more details on those processes.

**Media Blasting**

One of the last rust removal techniques is media blasting. I have a rather large Econoline Blast Cabinet that I have used for other larger pieces. One has to be careful that the media doesn’t pit softer metals such as aluminum, especially polished aluminum, and one can generate enough heat to warp light steel door panels, or Shopsmith bench legs etc. Use care.
I will also be updating and refinishing the blast cabinet next year.

I envision a multipurpose use for the cabinet as I will remove the blast media as needed, leave the drain hopper open and place another 5 gallon bucket beneath to give it an alternate life as a recirculation rust removal cabinet. Yes, it too needs some light rust-removal itself as you can see.

It will recirculate a rust removal product such as Evapo-rust or the Safest Rust Remover by Ultra One from a submersible pump in the bucket. Floor space in my service shop has to earn its keep, and this will be one way to insure it does. I just have to plan my work efficiently for each process.

In Conclusion

There are hundreds of posts dealing with rust removal and a myriad of products marketed to do just that which could have been included here. I hope you found this document of benefit whatever your interest in rust removal is. – Everett –

So, what do I finish this document with? The same thing that Shopsmith has recommended for decades for protecting the metal on their gear, especially way tubes, bench tubes, quill, table tops, extension tables, even saw blades…. You do use it, right?