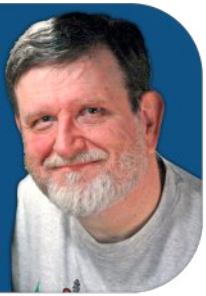
PUBLISHER'S MUSINGS



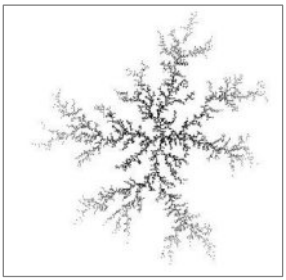
Model Railroad Hobbyist | January 2024

VIEW READER COMMENTS

JOE FUGATE: LATEST ON TRACK CLEANING AND SOLVENT HEALTH CONCERNS ...

BACK IN MY MAY 2019 EDITORIAL, I FIRST LOOKED AT TRACK CLEANING WITH NON-POLAR SOLVENTS.

I examined a scientific analysis of the black gunk on model railroad track and much of it appears to be oxides created by an electrical arc [1]. If you want to go back and read that editorial, visit this link: mrhmag.com/magazine/mrh2019-05/publishers-musings



1. A microscopic examination of fresh "black gunk" deposits on model railroad track railhead form a dendrite pattern reminiscent of lightning strike burns. In other words, much of the metal oxides come from micro-arcing.

Chemists who know how to clean metal contacts on electrical parts know that you want to use non-polar solvents to clean the surfaces. Non-polar solvents inhibit the micro-arcing, which means things will stay clean longer.

These chemists know you don't want to clean with *polar* solvents. While polar solvents may do a great job cleaning up the metal oxide deposits, the contact surfaces are primed to microarc like crazy, so they will *get dirty again quickly.*

Latest solvent polarity list

Here is an updated solvent dielectric constant / polarity list.

I recommend the solvents in red as ideal. I also recommend you *avoid* the items with a line through their name.

Low dielectric constant is not the only factor when looking for a good track and wheel cleaning solvent. There's also solvents that are nasty (Carbon tetrachloride) or solvents that don't age well like Goo-Gone or kerosene, gasoline, diesel, or turpentine.

Goo-Gone, for example, cleans great, but it's made of limonene, a citrus extract. Limonene *quickly* ages into a pitch-like substance that's a good insulator. Cleaning your track with Goo-Gone works great at first, but you will find the thin Goo-Gone residue on the track or wheels quickly ages into an insulator, making contact issues even worse than before. And in this pitch-like state, Goo-Gone is nearly impossible to remove!

Kerosene, gasoline, diesel, or turpentine also age into a thick pitch-like insulator over time – it just takes them a bit longer than Goo-Gone. Avoid using them as well.

Solvent	Dielectric constant
~~Kerosene~~	1.8
Deluxe Materials Track Magic	1.9
WD-40 contact cleaner	1.9
CRC contact cleaner & protectant	2.0
DeoxIT D5	2.0
~~Gasoline~~	2.0
Neverstall	2.0
~~Diesel~~	2.1
Mineral spirits	2.1
Wahl clipper oil	2.1
~~Turpentine~~	2.2
~~Carbon tetrachloride~~	2.2
No-Ox-IDA	2.3
~~Goo-Gone~~	2.3
WD-40 (regular)	2.4
Graphite (microscopic thin layer)	1.8-3.0
CRC 2-26	4.6
Automatic transmission fluid	4.8
Rail-zip	4.8
Bachmann track cleaner	4.8
Butyl acetate	5.1
Butyl cellosolve	5.3
~~Ethyl acetate~~	6.0
Graphite (thick layer)	10.0-15.0
Isopropyl alcohol (IPA)	18.0
Methyl Ethyl Ketone (MEK)	18.9
CRC QD contact cleaner	20.0
Lucas contact cleaner	20.0
Acetone	20.7
Vinegar	24.0
Ethyl alcohol (e.g. vodka, wine)	25.0
Radio Shack electronics cleaner	25.0
Ammonia solution	31.6
Propylene glycol	32.0
Lacquer thinner	33.6
Glycerine	47.0
Hydrogen peroxide	60.0
Water	80.4

Non-polar

Semi-polar

Polar

2. Updated solvent dielectric constant / polarity chart. The red items are recommended. Don't use the ~~strikethrough~~ solvents, however.

Mineral Spirits

Mineral spirits does not age into a pitch-like substance, and it has a very long shelf life (decades), as compared to the other petrochemicals I just mentioned. And at 2.1, it's very non-polar.

Some folks don't like the odor of mineral spirits, which comes from benzene – the same stuff that creates that noxious gas smell at the gas station.

Larry Pucket (the DCC Guy) recently posted a video on YouTube (youtu.be/25hxO0tqRTY) where he mentioned my track cleaning editorial. However, Larry expressed concern over the benzene fumes from mineral spirits. Instead, Larry recommends an isopropyl alcohol (IPA) + Deoxit 5 solution.

Deoxit 5 is on my list as a good non-polar option for cleaning track and wheels, so that makes sense. However mixing Deoxit with IPA makes little sense since you get a highly polar cleaning solution that ruins the non-polar benefits of Deoxit. More on Deoxit in a bit.

Let's look into Larry's concern over benzene exposure.

Benzene is considered a carcinogen, which means it's known to cause cancer from prolonged exposure. It also can mess with your nervous system and damage it if you get exposed to benzene regularly.

Standard mineral spirits do contain a small amount of benzene. Refer to this **Sage Journal** study, *Review of the Toxicology of Mineral Spirits:*

mrhmag.com/url/sage-mineral-spirits-study

Regarding the concentration of benzene typically found in mineral spirits, it says:

"The specification for benzene content in mineral spirits is usually <0.1%, but in practice benzene levels are typically

below 0.005% (<50 ppmv) due to the refining and distillation techniques."

This is a very detailed study with lots of use cases examined and measured very carefully. At the bottom of the study, they have these conclusions:

- Mineral spirits have a low order of acute toxicity by the oral, dermal, and inhalation routes of exposure.
- In humans, acute high-level inhalation exposure to mineral spirits can produce a variety of CNS [central nervous system] effects such as dizziness, headaches, and lack of coordination.
- At current occupational exposure levels, there is no compelling evidence that mineral spirits produce irre-

versible CNS [central nervous system] effects, although this remains controversial.

- A causal relationship between exposure to mineral spirit and reproductive and/or developmental effects has not been demonstrated.
- Several associations with cancer have been reported, but these are generally weak, inconsistent as to cancer site, and may be due to confounding or bias.

In short, alarm about bad long-term health damage from exposure to mineral spirits is likely unfounded, per this very detailed study.

Modelers' infrequent use for track cleaning is far below "occupational level" exposure where you're exposed daily for hours on end.

Nor do I consider occasional track/wheel cleaning with mineral spirits to result in "acute high-level inhalation exposure" unless you're directly sniffing the open container for minutes on end.

Ironically, you're likely to get a higher benzene exposure by pumping your own self-service gasoline than you'll get in the layout room using mineral spirits:

mrhmag.com/url/benezene-at-gas-stations

The irony doesn't end here. Larry likes Deoxit 5, so I looked up its MSDS sheet to find its chemical formula. Deoxit 5 is 95% petroleum naphtha and the rest is proprietary.

Looking up what's in petroleum naphtha, I find: ~40% liquid benzene, 20% liquid toluene, and the rest various xylenes. That makes Deoxit 5 close to 38% benzene in liquid form. Toluene however, is considered safer than benzene, since it's not a carcinogen. For more on benzene exposure concerns, see:

https://mrhmag.com/url/benzene-exposure

This document says, "Since benzene penetrates normal intact human skin more rapidly than many small organic molecules, and is potentially toxic, the skin should be considered a portal of entry for benzene. Good hygiene should be maintained and care taken to avoid lengthy exposure to solvents containing benzene."

Also see: mrhmag.com/url/naptha-benzene , which says:

"... it was concluded that a benzene hazard can be produced by naphtha with a rather low benzene content."

Based on all this, I would rate Deoxit 5 to be more likely to cause unhealthy benzene exposure than mineral spirits. Almost certainly you should wear rubber gloves when working with the Deoxit 5 solvent straight.

One interesting footnote to all this came when I researched the main ingredient in No-Ox ID: of all things, it's *mineral spirits.*

Odorless mineral spirits

Thanks to odorless mineral spirits, it's possible to avoid benzene exposure almost entirely:

"Odorless Mineral Spirits are benzene-free and formulated to dry residue-free. A great choice if you are sensitive to chemical odors."

For more, see: mrhmag.com/url/odorless-mineral-spirits

The bottom line, I recommend ***odorless mineral spirits*** as a safe and effective solvent for cleaning your track and wheels that's also quite affordable. You don't need to be fearful that you're in any serious danger when using it.

That said, when working with any chemical solvent, it never hurts to wear rubber gloves to reduce the chance of any skin irritation. ☑