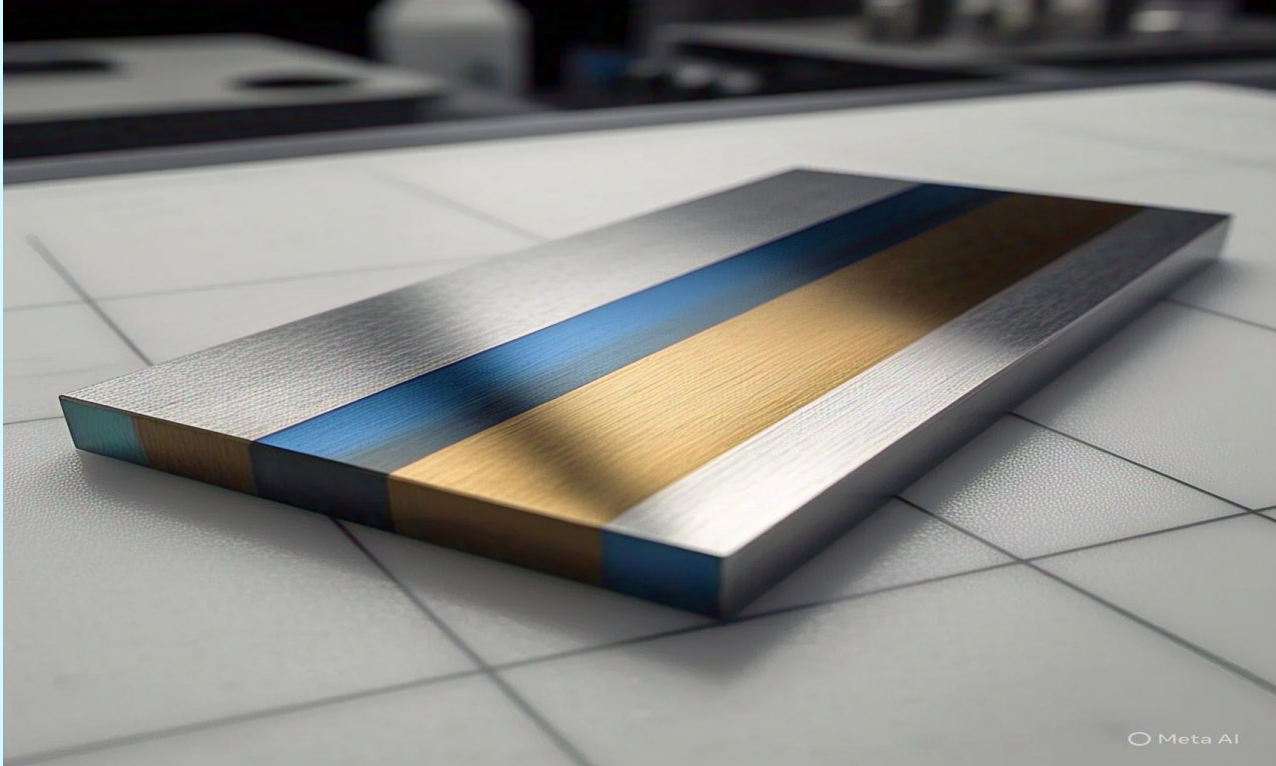


# DIY ELECTROPLATING



## SOLDERING ONTO STEEL

# What can I plate onto what?

(Complicated – Chemistry & Physics)

PERIODIC TABLE OF ELEMENTS																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 <b>H</b> Hydrogen 1.008	2 <b>He</b> Helium 4.0026																
3 <b>Li</b> Lithium 6.94	4 <b>Be</b> Beryllium 9.0122																
5 <b>B</b> Boron 10.81	6 <b>C</b> Carbon 12.011	7 <b>N</b> Nitrogen 14.007	8 <b>O</b> Oxygen 15.999	9 <b>F</b> Fluorine 18.998	10 <b>Ne</b> Neon 20.180												
11 <b>Na</b> Sodium 22.990	12 <b>Mg</b> Magnesium 24.305															17 <b>Cl</b> Chlorine 35.45	18 <b>Ar</b> Argon 39.948
19 <b>K</b> Potassium 39.098	20 <b>Ca</b> Calcium 40.078	21 <b>Sc</b> Scandium 44.956	22 <b>Ti</b> Titanium 47.867	23 <b>V</b> Vanadium 50.942	24 <b>Cr</b> Chromium 51.996	25 <b>Mn</b> Manganese 54.938	26 <b>Fe</b> Iron 55.845	27 <b>Co</b> Cobalt 58.933	28 <b>Ni</b> Nickel 58.693	29 <b>Cu</b> Copper 63.546	30 <b>Zn</b> Zinc 65.38	31 <b>Ga</b> Gallium 69.723	32 <b>Ge</b> Germanium 72.630	33 <b>As</b> Arsenic 74.922	34 <b>Se</b> Selenium 78.971	35 <b>Br</b> Bromine 79.904	36 <b>Kr</b> Krypton 83.798
37 <b>Rb</b> Rubidium 85.468	38 <b>Sr</b> Strontium 87.62	39 <b>Y</b> Yttrium 88.906	40 <b>Zr</b> Zirconium 91.224	41 <b>Nb</b> Niobium 92.906	42 <b>Mo</b> Molybdenum 95.95	43 <b>Tc</b> Technetium (98)	44 <b>Ru</b> Ruthenium 101.07	45 <b>Rh</b> Rhodium 102.91	46 <b>Pd</b> Palladium 106.42	47 <b>Ag</b> Silver 107.87	48 <b>Cd</b> Cadmium 112.41	49 <b>In</b> Indium 114.82	50 <b>Sn</b> Tin 118.71	51 <b>Sb</b> Antimony 121.76	52 <b>Te</b> Tellurium 127.60	53 <b>I</b> Iodine 126.90	54 <b>Xe</b> Xenon 131.29
55 <b>Cs</b> Caesium 132.91	56 <b>Ba</b> Barium 137.33	57–71	72 <b>Hf</b> Hafnium 178.49	73 <b>Ta</b> Tantalum 180.95	74 <b>W</b> Tungsten 183.84	75 <b>Re</b> Rhenium 186.21	76 <b>Os</b> Osmium 190.23	77 <b>Ir</b> Iridium 192.22	78 <b>Pt</b> Platinum 195.08	79 <b>Au</b> Gold 196.97	80 <b>Hg</b> Mercury 200.59	81 <b>Tl</b> Thallium 204.38	82 <b>Pb</b> Lead 207.2	83 <b>Bi</b> Bismuth 208.98	84 <b>Po</b> Polonium (209)	85 <b>At</b> Astatine (210)	86 <b>Rn</b> Radon (222)
87 <b>Fr</b> Francium (223)	88 <b>Ra</b> Radium (226)	89–103	104 <b>Rf</b> Rutherfordium (261)	105 <b>Db</b> Dubnium (268)	106 <b>Sg</b> Seaborgium (269)	107 <b>Bh</b> Bohrium (270)	108 <b>Hs</b> Hassium (270)	109 <b>Mt</b> Meitnerium (278)	110 <b>Ds</b> Darmstadtium (281)	111 <b>Rg</b> Roentgenium (282)	112 <b>Cn</b> Copernicium (285)	113 <b>Nh</b> Nihonium (286)	114 <b>Fl</b> Flerovium (289)	115 <b>Mc</b> Moscovium (290)	116 <b>Lv</b> Livermorium (293)	117 <b>Ts</b> Tennessine (294)	118 <b>Og</b> Oganesson (294)
For elements with no stable isotopes, the mass number of the isotope with the longest half-life is in parentheses.																	
57 <b>La</b> Lanthanum 138.91	58 <b>Ce</b> Cerium 140.12	59 <b>Pr</b> Praseodymium 140.91	60 <b>Nd</b> Neodymium 144.24	61 <b>Pm</b> Promethium (145)	62 <b>Sm</b> Samarium 150.36	63 <b>Eu</b> Europium 151.96	64 <b>Gd</b> Gadolinium 157.25	65 <b>Tb</b> Terbium 158.93	66 <b>Dy</b> Dysprosium 162.50	67 <b>Ho</b> Holmium 164.93	68 <b>Er</b> Erbium 167.26	69 <b>Tm</b> Thulium 168.93	70 <b>Yb</b> Ytterbium 173.05	71 <b>Lu</b> Lutetium 174.97			
89 <b>Ac</b> Actinium (227)	90 <b>Th</b> Thorium 232.04	91 <b>Pa</b> Protactinium 231.04	92 <b>U</b> Uranium 238.03	93 <b>Np</b> Neptunium (237)	94 <b>Pu</b> Plutonium (244)	95 <b>Am</b> Americium (243)	96 <b>Cm</b> Curium (247)	97 <b>Bk</b> Berkelium (247)	98 <b>Cf</b> Californium (251)	99 <b>Es</b> Einsteinium (252)	100 <b>Fm</b> Fermium (257)	101 <b>Md</b> Mendelevium (258)	102 <b>No</b> Nobelium (259)	103 <b>Lr</b> Lawrencium (266)			

Ptable® is a registered trademark of Michael Dzyuban (support@pstable.com). For a fully-interactive edition in 50 languages with property trend visualization, 3-D orbitals, isotopes, compound mixing, lesson plans, free printouts, wallet cards, and installable apps, visit Ptable.com.

Meade, J.; Collins, R.; Berggren, M., et al. (2016). Atomic weights of the elements 2013 (IUPAC Technical Report). Pure and Applied Chemistry, 88(3), pp. 265–291.

# For IRON (Steel) . . .

- If the surface is for rust protection . . .

Zinc — ~~Iron~~

- If the surface is for wear and tear . . .

Nickel — ~~Iron~~

- If the surface is for soldering . . .

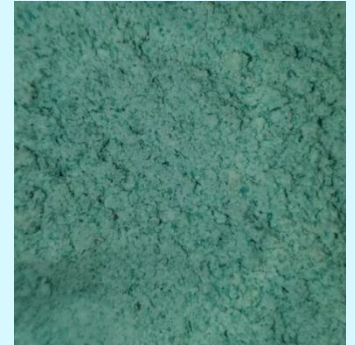
Copper — ~~Nickel~~ — ~~Iron~~

# ELECTROLYTE BATHS

- We want to create a liquid bath that has our plating metal as ions AND conducts electricity well.
- For ease of production and *safety* concerns we will choose Metal-Acetates dissolved in water.

# METAL ACETATES

- Nickel Acetate  
A nice Green
- Copper Acetate  
A nice Blue
- Zinc Acetate  
Clear in solution



# ELECTROLYTE PRODUCTION

- Container – 1 quart Mason Jar almost full of **distilled** water (or jelly jar)
- “Plating Metal” Acetate Hydrate powder, start with  $\frac{1}{2}$  teaspoon
- 1 tablespoon table salt (NaCl) NO IODINE
- Mix it all in the jar. **LABEL THE JAR**

# POWER SUPPLY

- Something relatively small – say an old phone charger  
1 ADC @ 5 VDC  
[I used a lab bench power supply]
- **CONCERNS:** This process liberates oxygen, hydrogen, and aerosolized metal ions. Hydrogen at the cathode (negative)
- The bigger the power supply, the faster, thicker, and erode plating will be vs. time.



# PRACTICAL PLATING

What are some items I need to plate?

- Solder iron tips
- Steam locomotive rods, crossheads, valve gear
- Lionel and American Flyer both used steel + copper stranded wire. They electro welded these to steel light brackets, power pickup brackets, and reversing unit brackets.



# **SOLDER TIPS**

- Solder tips are either solid copper or copper with a steel threaded insert.
- Copper oxidizes rapidly with heat, plus getting brittle and pitting.
- Nickel plating (thick) adds oxidizing protection AND durability

# **WHY WASTE MY TIME WITH SOLDER TIPS?**

- Most commercial solder tips are only nickel plated on the tip.
- The black oxide that develops further down the tip actually reduces tip heating.
- Full-length plating is a more efficient solder tip. Plus you can form the tip exactly as you prefer, then plate it.

# **YUCKY**

**(Official Engineering Term)**



# PREP





# 2 HOUR NICKEL PLATE



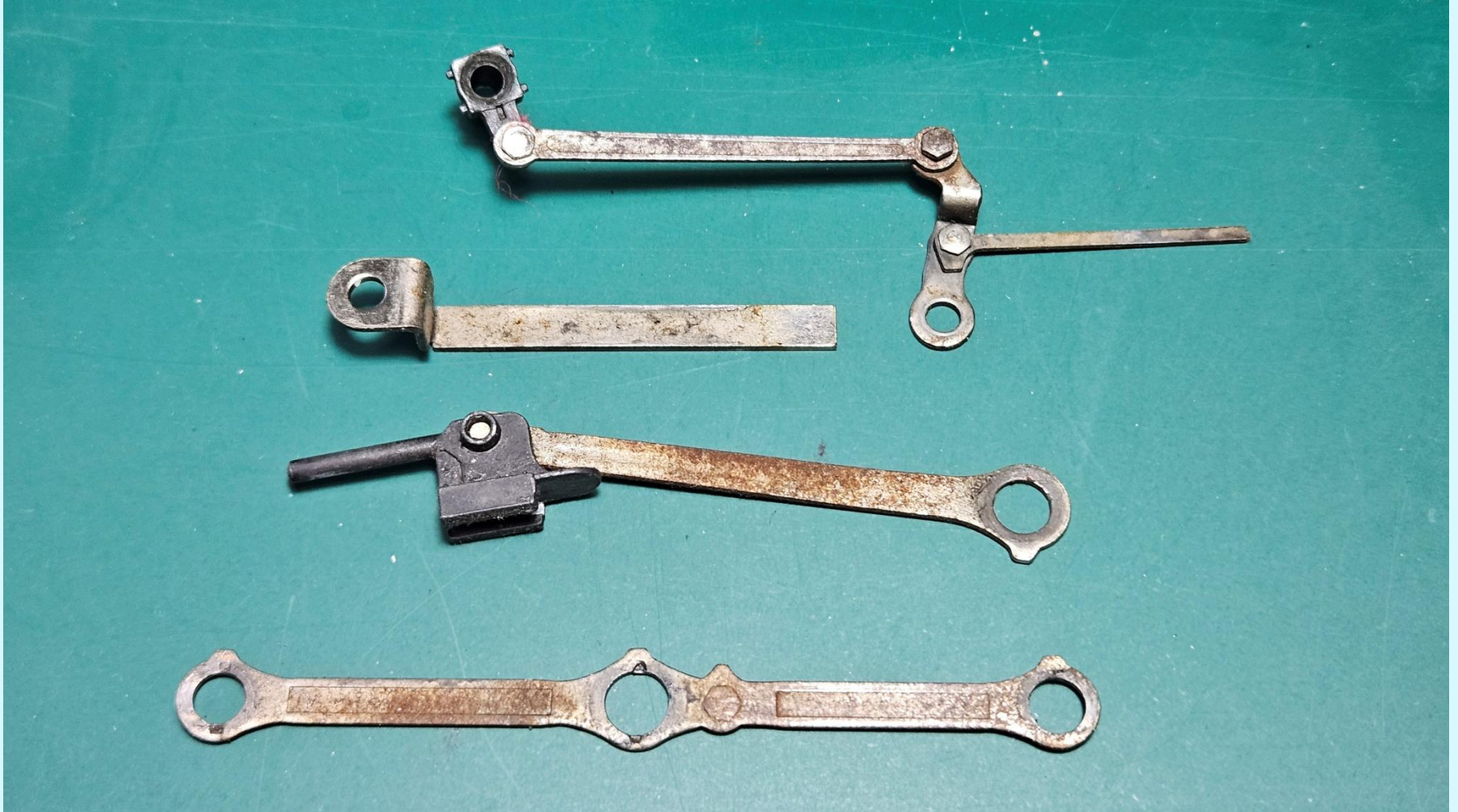
It might not  
look pretty but  
it gets hotter  
faster

# COMMERCIAL NICKEL PLATED SOLDER TIPS



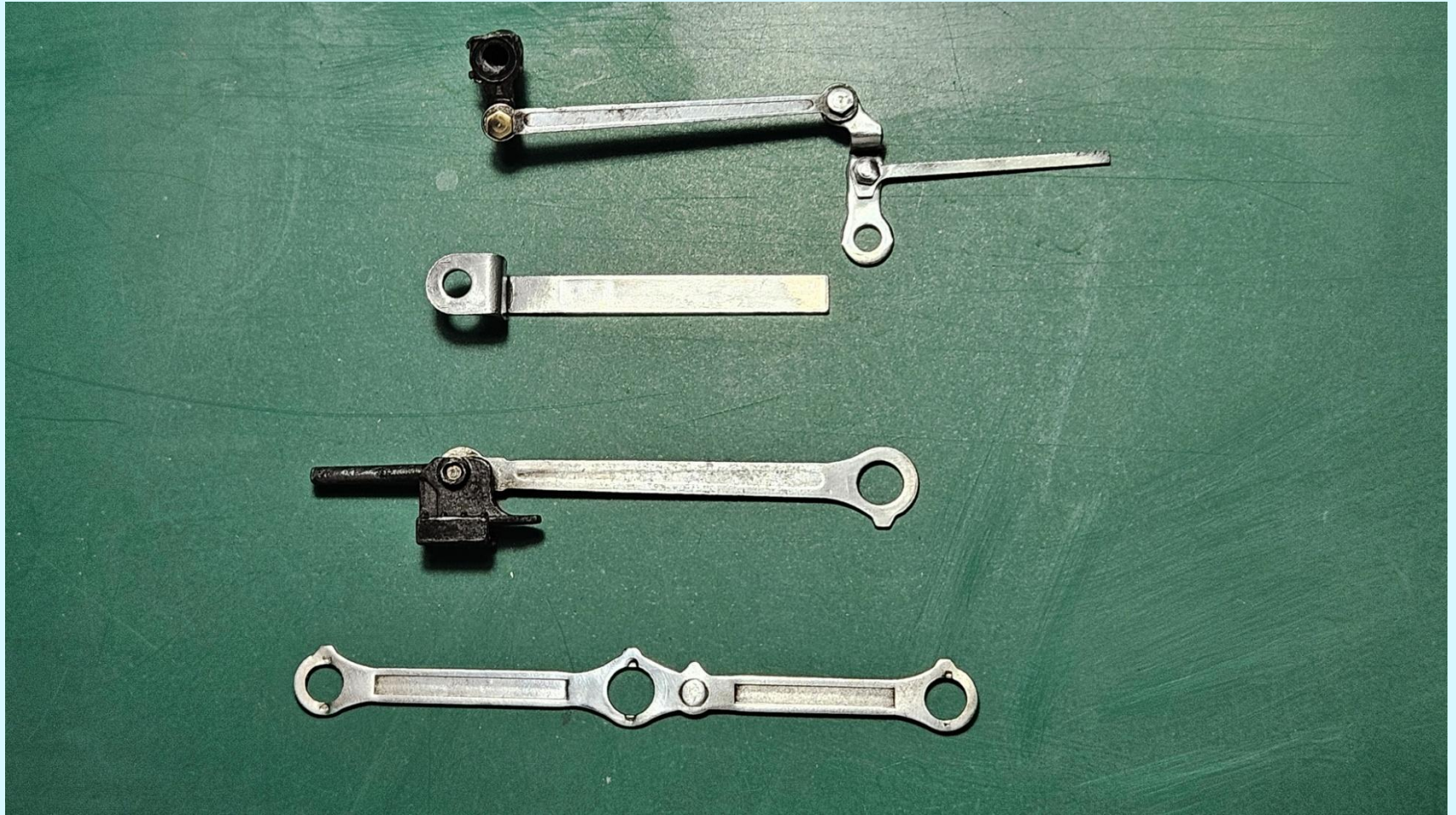


# LEFT LOCO VALVE GEAR BEFORE



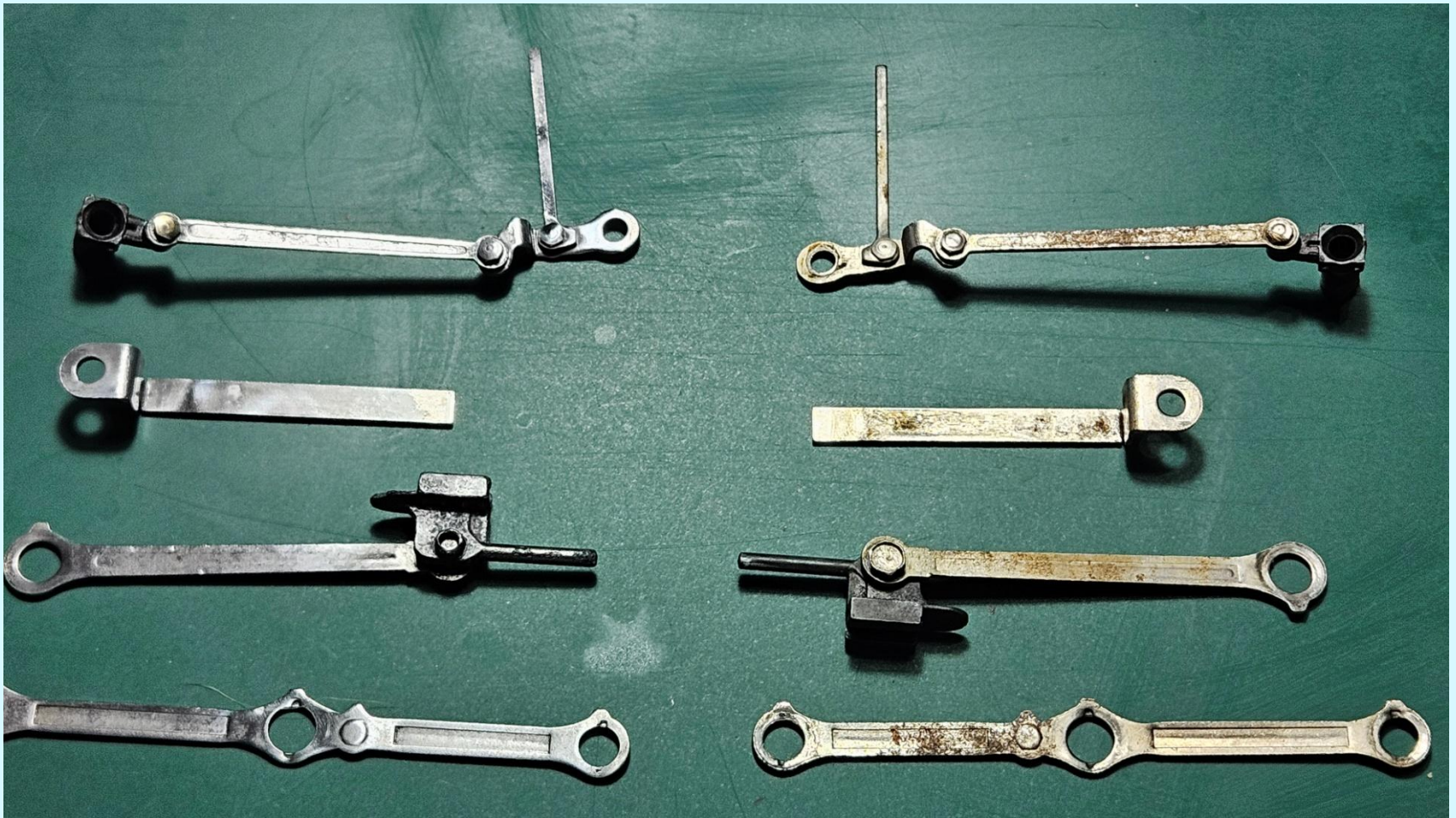


# LEFT LOCO VALVE GEAR AFTER





# LEFT vs RIGHT



# TRY IT - IT'S FUN

[THERE HAVEN'T BEEN ANY BUGS NEAR MY HOUSE SINCE]



*Q*

*E*

*A*