

Analysis and Solutions for Compatibility between Electrical Contact Grease and Plastic Parts

Wallimore lubricant for electrical switches and contacts



Contact lubricant

- EXTEND CONTACT LIFESPAN
- IMPROVE SIGNAL QUALITY
- ENHANCE OPERATIONAL STABILITY
- REFINE SWITCH FEEL
- PREVENT SWITCH CONTAMINATION
- SILICONE-FREE

1. Core Mechanisms

There is a direct correlation between electrical contact grease and plastic part cracking. The core reason is the poor compatibility between the contact grease and the plastic material, which triggers chemical or physical interactions that damage the structural integrity of the plastic.

1.1 Plastic Swelling and Stress Cracking (Most Common)

- If the base oil (e.g., mineral oil, synthetic oil) or additives in the electrical contact grease are incompatible with the plastic (e.g., PA, PC, ABS), they can penetrate into the plastic, causing the molecular chains to separate, leading to volume expansion and softening. This disrupts the internal stress balance of the plastic, creating localized stress concentration.

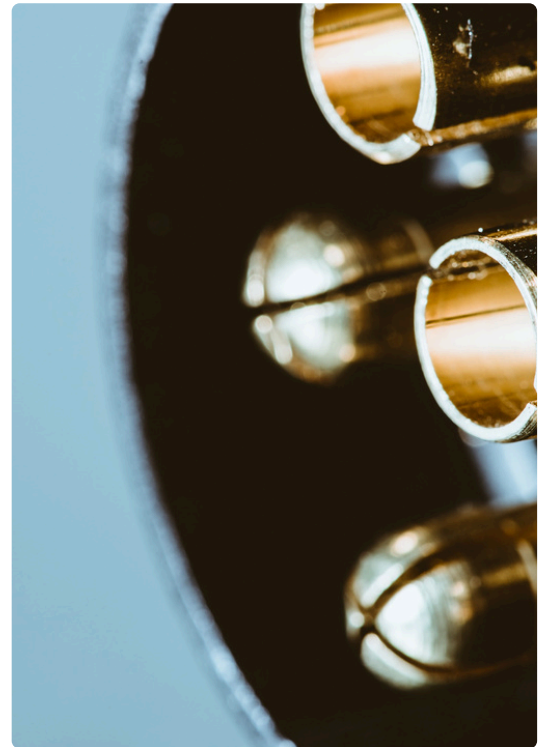
- When the plastic part is subjected to external forces (e.g., assembly pressure, temperature changes), cracking initiates at these stress concentration points. This is especially prone to happen in thin-walled or complex structural parts.

1.2 Chemical Degradation Damaging Molecular Structure

- Active additives in the contact grease (such as antioxidants, extreme pressure agents, metal passivators) may react chemically with the plastic.
- For example: Ester-based oils may hydrolyze to produce acidic substances, corroding polyester plastics; Additives containing sulfur or phosphorus may break the chemical bonds of the plastic, leading to embrittlement, reduced strength, and eventual cracking.

1.3 Plasticizer Extraction Leading to Embrittlement

- Some plastics (e.g., PVC, soft ABS) contain plasticizers to maintain flexibility. If the contact grease has strong solvating power, it can extract the plasticizer from the plastic.
- After losing the plasticizer, the plastic becomes hard and brittle, with significantly reduced toughness, leading directly to cracking under minor deformation or environmental stress.



2. Key Influencing Factors

Maintaining low contact resistance and insertion/withdrawal force is crucial under frequent operation requirements. Therefore, using lubricants on electrical contacts becomes necessary.

2.1 Plastic Material Properties

- Polar plastics (e.g., PA, PC, PVC) are more sensitive to ester, alcohol-based oils, prone to swelling;
- Non-polar plastics (e.g., PP, PE) are relatively tolerant to mineral oils, PAOs, but may be affected by strongly polar additives.

2.2 Contact Grease Formulation

- Base oil type (esters, mineral oil, PFPE, etc.) determines core compatibility;
- Additive types (e.g., chlorine, sulfur, phosphorus-containing EP agents) may exacerbate plastic corrosion.

2.3 Operating Environment

- High temperatures (e.g., from electrical contact heating) accelerate the interaction between grease and plastic, amplifying swelling or degradation effects;
- Long-term contact (static sealing or continuous immersion scenarios) allows the grease to fully penetrate the plastic, resulting in a higher risk of cracking.

3. Verification Directions (Quickly Confirm Correlation)

- Comparative Test: Place identical batch plastic parts not exposed to contact grease and the cracked parts in the same environment, observe if only the grease-exposed parts crack;
- Visual Inspection: Check cracked part surfaces for signs of softening, stickiness, discoloration (typical signs of swelling or degradation);
- Compatibility Test: According to ASTM D3236 (weight change), ASTM D4289 (volume swell) standards, immerse plastic samples in the contact grease, test for significant weight/volume changes or strength reduction.

4. Compatibility Reference Table for Common Plastics and Electrical Contact Grease Base Oils

Plastic Type	Common Applications	Types of base oils for electrical contact grease					
		Mineral Oil	Polyalpha olefin (PAO)	Perfluoropoly ether (PFPE)	Polyglycol (incl. Polyether Alcohol)	Synthetic Ester	Silicone Oil (non-silicone type)
Polyethylene (PE) (HDPE/LDPE)	Contact housing, connector base	Good	Excellent	Excellent	Good	Fair	Excellent
Polypropylene (PP)	Switch panel, small contact bracket	Good	Excellent	Excellent	Good	Fair	Excellent
Polycarbonate (PC)	Transparent contact cover, precision connector	Fair	Good	Excellent	Poor	Poor	Good
ABS Plastic	Electronic switch housing, contact protective cover	Fair	Good	Excellent	Poor	Poor	Good
Polyamide (PA/Nylon)	High-stress contact bracket, connector pin holder	Good	Excellent	Excellent	Fair	Good	Excellent
Polyoxymethylene (POM)	Precision contact slider, gear-type switch parts	Fair	Good	Excellent	Poor	Fair	Good
Polytetrafluoroethylene (PTFE)	High-temp contact gasket, insulating parts	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
Polyvinyl Chloride (PVC)	Low-end contact cable insulation, housing	Poor	Fair	Excellent	Poor	Poor	Fair

Notes:

Compatibility Level Definition – Excellent (No swelling/embrittlement, suitable for long-term contact), Good (Slight effect, suitable for short-term contact), Fair (Require limited usage/temperature, use with caution), Poor (Prone to swelling/cracking, prohibit use).



5. Solution Recommendations

- **Change Contact Grease:** Select a formulation compatible with the target plastic (e.g., PFPE-based, high-purity silicone-based contact greases generally offer better compatibility with most plastics);
- **Confirm Plastic Material:** Identify the plastic type (via material identification or IR spectroscopy), select the base oil type of the grease accordingly;
- **Pre-treatment Protection:** Apply a compatible barrier coating on the contact surface between the plastic part and the grease, or select contact greases with low migration and low solvating power.

6. Scenario-Specific Adaptation Recommendations

6.1 Sensitive Plastic Scenario (PC/ABS Housing)

Recommended Base Oils: PFPE, PAO; Prioritize products explicitly labeled "Suitable for sensitive plastics", avoid polyglycol, synthetic ester base oils to prevent swelling and cracking.

6.2 High-Temperature High-Stress Scenario (PA Bracket + High Current Contact)

Recommended Base Oils: PAO (Temp resistance $-40\sim 160^{\circ}\text{C}$), PFPE (Temp resistance $-50\sim 260^{\circ}\text{C}$); Use with lithium complex or modified inorganic thickeners to balance compatibility and anti-wear performance, avoiding the migration risk of mineral oils under long-term high temperatures.

6.3 Low-Cost General Scenario (PE/PP Housing)

Recommended Base Oils: Mineral oil, PAO; No need for high-end synthetic oils, control costs while ensuring no embrittlement risk, prioritize "Compatible with most plastics" general-purpose products.

6.4 High-Temperature Insulation Scenario (PTFE Gasket + High Voltage Contact)

Recommended Base Oils: PFPE; Utilize its extreme temperature resistance and compatibility with all plastics, suitable for high-temperature arc environments, avoiding insulation performance fluctuations of silicone oils under high voltage.

7. Key Considerations

7.1 Plastic Grade Impact

Different molecular weights, fillers in the same plastic type (e.g., ABS) lead to compatibility differences (low molecular weight ABS is more susceptible to oil influence), must be based on the actual plastic grade used.

7.2 Additive Risk

Even if the base oil is compatible, extreme pressure agents (S/P containing), metal passivators in the contact grease might still corrode plastics. Prioritize selecting "non-active additives" or "low-corrosion formulations".

7.3 Mandatory Compatibility Test

According to ASTM D4289 standard, immerse plastic samples in the contact grease (placed at actual operating temperature for 7-14 days), check volume change rate ($\leq 5\%$ is safe) and appearance for cracking.

7.4 Avoid Cross-Contamination

When changing contact grease, clean residual old grease to prevent compatibility degradation after mixing different base oils (e.g., mixing mineral oil with polyglycol may exacerbate PVC swelling).



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UNDER HARSH CONDITIONS"**