POM-C ESD

Technical Material Guide

Comprehensive Overview of Electrostatic Discharge Polyoxymethylene Copolymer

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1. Introduction

POM-C ESD (Polyoxymethylene Copolymer with Electrostatic Discharge properties) is a high-performance engineering thermoplastic specifically designed for applications requiring static charge dissipation. This material combines the excellent mechanical properties of standard POM-C (acetal copolymer) with specialized antistatic additives that enable controlled electrical conductivity.

The material is manufactured by incorporating special anti-static agents or conductive carbon black into the POM-C base resin. This modification creates a stable charge conduction path within the material, providing permanent antistatic properties that remain consistent even after machining or surface grinding.

2. Material Definition & Classification

2.1 Chemical Composition

POM-C ESD is a semicrystalline engineering plastic based on polyoxymethylene copolymer. The base polymer is derived from fine chemical synthesis and modified with either conductive carbon black, carbon nanotubes (CNT), or permanent antistatic agents to achieve the desired electrical properties.

2.2 ESD Classification Categories

Classification	Surface Resistivity (Ω/sq)	Primary Application
Antistatic	10■ - 10^{11}	General ESD protection
Static Dissipative	10■ - 10■	Semiconductor manufacturing
Conductive	10^{2} - 10■	High-conductivity requirements
EMI Shielding	< 10^{2}	Electromagnetic interference protection

3. Technical Properties

3.1 Mechanical Properties

Property	Value	Test Standard
Density	1.38 - 1.45 g/cm³	DIN EN ISO 1183-1
Tensile Strength	45 - 70 MPa	DIN EN ISO 527
Tensile Modulus	1,500 - 2,800 MPa	DIN EN ISO 527
Elongation at Break	10 - 30%	DIN EN ISO 527
Flexural Strength	57 - 80 MPa	DIN EN ISO 178
Flexural Modulus	1,800 - 2,800 MPa	DIN EN ISO 178
Impact Strength (Izod, notched)	69 J/m	ASTM D256
Hardness	78 - 83 Shore D	DIN 53505

3.2 Electrical Properties

Property	Value	Test Standard
Surface Resistivity	10^{3} - 10■ Ω/sq	IEC 60093
Volume Resistivity	10^{2} - 10■ Ω·cm	IEC 60093 / ASTM D257
Comparative Tracking Index (CTI)	≥ 600 V	IEC 60112
Dielectric Strength	15 - 20 kV/mm	IEC 60243

3.3 Thermal Properties

Property	Value	Test Standard
Melting Point	164 - 168°C	ISO 11357
Operating Temperature Range	-40°C to +100°C	-
Heat Deflection Temperature (1.8 MPa)	90 - 110°C	DIN EN ISO 75
Thermal Conductivity	0.23 - 0.31 W/(m·K)	DIN 52612
Coefficient of Linear Thermal Expansion	80 - 110 × 10■■ K■¹	-

4. Key Features & Advantages

• **Permanent Antistatic Properties:** The ESD protection is inherent to the material and does not degrade over time, unlike surface treatments or coatings.

• **Excellent Mechanical Strength:** Maintains high tensile strength (45-70 MPa), stiffness, and hardness comparable to metals, making it suitable for structural applications.

• **Superior Wear Resistance:** Exhibits excellent wear properties with specific wear rates approximately 1.1 × 10■■ mm³/Nm, ideal for sliding and bearing applications.

• **Outstanding Chemical Resistance:** Resistant to a wide range of organic solvents, acids, alkalis, and cleaning agents used in manufacturing environments.

• **Low Moisture Absorption:** Absorbs minimal moisture (0.2-0.5%), ensuring dimensional stability in varying humidity conditions.

• **Excellent Machinability:** Can be easily machined using standard CNC equipment, maintaining stable antistatic values after machining or surface grinding.

• **Dimensional Stability:** Low creep tendency and excellent dimensional consistency under thermal and mechanical loads.

• **Good Sliding Properties:** Low coefficient of friction enables smooth operation in moving parts and fixtures.

5. Commercial Grades & Trade Names

Several manufacturers produce POM-C ESD materials under various trade names, each with specific formulations optimized for different applications:

Trade Name	Manufacturer	Key Characteristics
TECAFORM AH ELS	Ensinger	Carbon black filled, semiconductor grade
Sustarin C ESD 60	Röchling	Conductive, high mechanical stability
Sustarin C ESD 90	Röchling	Antistatic, no carbon black
Semitron ESD 225	Mitsubishi Chemical (MCG)	Quick static dissipation
Semitron CNT	Mitsubishi Chemical (MCG)	Carbon nanotube filled
Ertacetal C ELS	MCG	Electrically conductive POM-C
Comco POM-C ESD AST	Comco	Antistatic grade
Comco POM-C ELS EC	Comco	Electrically conductive grade

6. Industry Applications

6.1 Semiconductor Industry

POM-C ESD is extensively used in semiconductor manufacturing due to its ability to protect sensitive electronic components from electrostatic discharge damage. Key applications include:

- Wafer processing fixtures and carriers
- Cleanroom trays and handling equipment
- Silicon wafer processing jigs
- Test sockets and burn-in fixtures
- Precision instrument components

6.2 Electronics Industry

The electronics sector utilizes POM-C ESD for manufacturing components that require protection against static electricity:

- Hard disk drive fixtures and components
- High-speed electronic printing components
- PCB handling equipment
- Connector housings and insulators
- Computer housings and peripheral device components

6.3 Automotive Industry

Automotive applications benefit from POM-C ESD's combination of mechanical strength and ESD protection:

- Electronic control unit (ECU) assembly fixtures
- Sensor mounting components
- Fuel system components (explosion-safe requirements)
- Interior trim parts requiring static control

6.4 Other Industries

Additional applications span across various sectors including aviation, medical equipment manufacturing, LCD/TFT production, mechanical engineering, and safety-critical environments where static control is essential.

7. Processing Guidelines

7.1 Pre-Processing Requirements

Unlike standard POM, ESD grades require proper drying before processing due to moisture sensitivity. The recommended drying conditions are: temperature above 80°C for a minimum of 2 hours, with target moisture content below 0.1% to prevent defects such as bubbles and silver streaks.

7.2 Injection Molding Parameters

Parameter	Recommended Range
Barrel Temperature	180 - 210°C
Mold Temperature	60 - 90°C
Injection Pressure	50 - 100 MPa
Molding Shrinkage	1.5 - 3.0%

7.3 Extrusion Parameters

Parameter	Recommended Range
Barrel Temperature	180 - 210°C
Extrusion Pressure	5 - 20 MPa
Traction Speed	1 - 5 m/min

7.4 CNC Machining

POM-C ESD exhibits excellent machinability with good chip formation and fine surface finishes. Key considerations for CNC machining include: using sharp cutting tools to prevent heat buildup, ensuring adequate cooling, and avoiding machining materials in chilled conditions as this reduces toughness and resistance to machining stresses. The antistatic properties remain stable after machining operations.

8. Available Forms & Dimensions

POM-C ESD is commercially available in various semi-finished forms to suit different manufacturing requirements:

Form	Typical Dimensions
Rods	Diameter: 6 - 350 mm
Sheets/Plates	Thickness: 6 - 180 mm; Size: 615 × 1220 mm
Tubes	Various OD/ID combinations
Custom Blanks	Available per specification

Available colors typically include natural (ivory/beige) and black, with custom colors available upon request from select manufacturers.

9. Comparison: POM-C ESD vs. Standard POM-C

Property	Standard POM-C	POM-C ESD
Surface Resistivity	> 10^{13} Ω/sq (insulator)	10^{3} - 10^{11} Ω/sq
Static Charge Dissipation	Does not dissipate	Controlled dissipation
Mechanical Strength	Standard	Slightly reduced (5-15%)
Chemical Resistance	Excellent	Excellent
Color Options	Wide range	Limited (natural, black)
Cost	Lower	Higher (20-50% premium)

10. Relevant Standards & Compliance

POM-C ESD materials are typically tested and certified according to the following international standards:

- **DIN EN 15860:** Standard for acetal semi-finished products
- **IEC 60093:** Methods of test for volume resistivity and surface resistivity
- **IEC 60112:** Comparative tracking index (CTI) determination
- **IEC 60243:** Dielectric strength testing
- **ISO 9001:** Quality management system certification
- **FDA & EN regulations:** Food contact compliance (specific grades)
- **USP Class VI:** Biocompatibility certification (medical grades)

11. Conclusion

POM-C ESD represents a critical advancement in engineering plastics, combining the established benefits of acetal copolymer with specialized electrostatic discharge protection. Its unique combination of permanent antistatic properties, excellent mechanical strength, superior wear resistance, and outstanding chemical resistance makes it an indispensable material for modern semiconductor manufacturing, electronics production, and other industries where static control is paramount.

When selecting POM-C ESD for an application, engineers should consider the specific resistivity requirements, mechanical load conditions, chemical exposure, and processing methods to choose the optimal grade from the various commercial options available. Proper material handling and processing according to manufacturer guidelines ensures maximum performance and reliability of the final components.