POM-H

Polyoxymethylene Homopolymer

Comprehensive Technical Guide

Document Generated: December 19, 2025

Table of Contents

1. Introduction to POM-H

POM-H (Polyoxymethylene Homopolymer) is a high-performance engineering thermoplastic that belongs to the family of acetal resins. Also known as Delrin (DuPont's trademark), POM-H is characterized by its exceptional mechanical properties, dimensional stability, and excellent wear resistance. The material was discovered by German chemist Hermann Staudinger in the 1920s, who later received the Nobel Prize in Chemistry in 1953 for his pioneering work on macromolecules. DuPont commercialized the homopolymer version in 1956, and it has since become one of the most widely used engineering plastics in precision engineering applications.

POM-H is particularly valued for its ability to replace metal components in many applications, offering significant weight reduction, corrosion resistance, and cost savings while maintaining high mechanical performance. The material is produced from anhydrous, monomeric formaldehyde through anionic polymerization, resulting in a highly crystalline structure (typically 64-77% crystallinity) that gives the material its excellent mechanical properties.

2. Chemical Structure and Composition

POM-H consists of a linear polymer chain with the repeating unit -CH■-O- (methylene-oxy backbone). This simple, regular molecular structure allows for high crystallinity and excellent mechanical properties. The polymer chain is formed through anionic catalysis in an organic liquid reaction medium, followed by stabilization with acetic anhydride to prevent thermal decomposition.

Key Chemical Characteristics:

- Chemical Formula: (CH■O)n
- Molecular Structure: Linear polyether backbone
- Crystallinity: 64-77% (highly crystalline)
- End-group stabilization: Acetate groups (CH■COO-) for thermal protection
- Density: Approximately 1.41-1.43 g/cm^3

3. Physical and Mechanical Properties

POM-H exhibits outstanding mechanical properties that make it suitable for demanding engineering applications. The high crystallinity contributes to its exceptional strength, stiffness, and creep resistance.

Property	Value	Unit
Density	1.41 - 1.43	g/cm^3
Tensile Strength	60 - 80	MPa
Tensile Modulus	2,800 - 3,400	MPa
Elongation at Break	20 - 45	%
Flexural Modulus	2,700 - 3,100	MPa
Impact Strength (Notched Izod)	6 - 8	kJ/m^2
Hardness (Rockwell)	M94	-
Coefficient of Friction	0.15 - 0.20	-
Water Absorption (24h)	< 0.2	%

4. Thermal Properties

POM-H demonstrates excellent thermal stability over a wide temperature range, making it suitable for applications where temperature variations are common. The material maintains its mechanical properties from sub-zero temperatures to moderately elevated temperatures.

Property	Value	Unit
Melting Point	172 - 184	°C
Glass Transition Temperature	-77 to -85	°C
Continuous Service Temperature	-40 to +100	°C
Short-term Maximum Temperature	120 - 140	°C
Thermal Conductivity	0.23 - 0.31	W/(m·K)
Coefficient of Linear Thermal Expansion	100 - 120	×10■■/K
Heat Deflection Temperature (1.8 MPa)	100 - 110	°C

5. Electrical Properties

POM-H possesses excellent electrical insulating properties, making it suitable for electrical and electronic applications. The material maintains these properties across a wide range of temperatures and humidity levels.

- Volume Resistivity: > 10^{13} Ω·cm
- Surface Resistivity: > 10^{1}■ Ω
- Dielectric Strength: > 20 kV/mm
- Dielectric Constant (1 MHz): 3.7 - 3.8
- Dissipation Factor: 0.001 - 0.005

6. Chemical Resistance

POM-H exhibits excellent resistance to many chemicals, oils, and solvents, making it suitable for use in chemically aggressive environments. However, it does have some limitations that must be considered.

Excellent Resistance To:

- Alcohols and aldehydes

- Oils, greases, and fuels (gasoline, diesel)
- Weak acids (pH 4-9)
- Alkalis at low concentrations
- Most organic solvents
- Hot water (with some limitations)

Poor Resistance To:

- Strong acids (concentrated mineral acids)
- Strong oxidizing agents
- Chlorine and chlorinated water
- UV radiation (requires stabilization)
- Strong bases at elevated temperatures

7. POM-H vs POM-C Comparison

Understanding the differences between POM-H (Homopolymer) and POM-C (Copolymer) is essential for selecting the appropriate material for specific applications. While both are excellent engineering plastics, they have distinct characteristics that make them better suited for different uses.

Property	POM-H	POM-C
Melting Point	172-184°C	160-175°C
Tensile Strength	70 MPa	61 MPa
Elastic Modulus	4,623 MPa	3,105 MPa
Elongation	25%	40-75%
Glass Transition Temp	-85°C	-60°C
Processing Temp	194-244°C	172-205°C
Crystallinity	Higher	Lower
Stiffness	Higher	Lower
Chemical Resistance	Good	Better
Hydrolysis Resistance	Lower	Higher
Centerline Porosity	Present	Not present
Market Share	~25%	~75%
Cost	Higher	Lower

8. Manufacturing and Processing

POM-H can be processed using various methods, with injection molding being the most common. The material requires careful control of processing parameters due to its sensitivity to thermal degradation.

Processing Methods:

- Injection Molding: Most common method for complex parts

- Extrusion: For rods, sheets, and profiles
- CNC Machining: Excellent machinability for precision parts
- Blow Molding: For hollow containers
- Compression Molding: For specific applications

Processing Recommendations:

- Pre-drying: 80-90°C for 2-4 hours (moisture sensitive)
- Melt Temperature: 194-244°C
- Mold Temperature: 60-120°C
- Injection Pressure: 80-140 MPa
- Shrinkage: 1.8-2.5%
- Avoid excessive residence time to prevent degradation

9. Industrial Applications

POM-H's unique combination of properties makes it suitable for a wide range of demanding applications across multiple industries. The material often serves as a replacement for metals in precision components.

Automotive Industry:

- Fuel system components (sender units, pumps, valves)
- Door lock mechanisms and window regulators
- Gear wheels and belt guides
- Seat belt components
- Climate control actuators

Electrical & Electronics:

- Electrical connectors and insulators
- Switch components and housings
- Keyboard mechanisms
- Fan wheels and pump impellers

Mechanical Engineering:

- Gears, bearings, and bushings
- Conveyor belt components
- Springs and clips
- Valve bodies and pump components
- Precision mechanical parts

Medical Devices:

- Insulin pen mechanisms
- Metered dose inhalers
- Surgical instrument components
- Drug delivery systems

Consumer Products:

- Zippers and fasteners
- Toy components (LEGO-type elements)
- Sporting goods mechanisms
- Musical instrument parts

10. Advantages and Limitations

Key Advantages:

- Exceptional mechanical strength and stiffness
- Excellent dimensional stability and low moisture absorption
- Outstanding wear resistance and low friction
- Good fatigue and creep resistance
- Excellent machinability for precision parts
- Can replace metals in many applications
- Wide operating temperature range (-40°C to +100°C)
- Good electrical insulating properties
- Chemical resistance to many substances

Limitations:

- Susceptible to strong acids and oxidizing agents
- Poor UV resistance without stabilization
- Centerline porosity in thick sections
- Difficult to bond with adhesives
- Flammable (releases formaldehyde when burning)
- Higher cost compared to POM-C
- Sensitive to hydrolysis in hot water
- Limited availability (only DuPont and Asahi produce)

11. Commercial Grades and Brands

Several major manufacturers produce POM-H under various trade names. The most recognized brand is Delrin by DuPont (now Delrin USA LLC), which was the first commercially available POM-H.

Brand Name	Manufacturer	Notes
Delrin®	Delrin USA LLC (DuPont)	Original POM-H, most recognized
Tenac®	Asahi Kasei	Japanese manufacturer
Acetron® H	Mitsubishi Chemical	Stock shapes available
Ertacetal® H	Mitsubishi Chemical	European distribution
TECAFORM® AD	Ensinger	Made from Delrin resin
Sustarin® H	Röchling	Industrial applications

Specialty Grades Available:

- PTFE-filled grades (AF series) - Enhanced wear and friction properties
- Glass fiber reinforced - Increased stiffness and strength
- UV-stabilized grades - For outdoor applications
- FDA/food contact compliant grades
- Metal and X-ray detectable grades
- Various colors including natural (white) and black

12. Future Trends and Developments

The POM industry continues to evolve with new developments aimed at enhancing performance, sustainability, and expanding application areas.

Emerging Trends:

- High-Performance Fillers: Graphene-reinforced POM with improved tensile strength (+20%) and thermal conductivity (+30%)

- Biodegradable Blends: POM blended with PLA or PHA for improved environmental profile
- Enhanced Recycling: Development of chemical recycling processes for POM waste
- Flame-Retardant Grades: Halogen-free formulations meeting UL 94 V-0 standards
- Nanotechnology: Carbon nanotube and nanoparticle reinforcements
- Sustainable Production: Bio-based formaldehyde sources under development
- Industry 4.0 Integration: Smart processing with real-time quality monitoring

Conclusion

POM-H remains one of the most versatile and reliable engineering thermoplastics available today. Its unique combination of high strength, excellent dimensional stability, low friction, and good chemical resistance makes it indispensable in precision engineering applications across automotive, electrical, medical, and consumer industries. While it has some limitations, proper material selection and design considerations can help engineers take full advantage of its exceptional properties. As technology advances, we can expect continued improvements in POM-H formulations and processing methods, further expanding its application potential.

References and Sources

- Mitsubishi Chemical Advanced Materials (MCAM)
- NETZSCH Analyzing & Testing
- K.D. Feddersen Distribution - Polymer Information
- Wikipedia - Polyoxymethylene
- SpecialChem - Polyacetal Guide
- Ensinger Plastics Technical Documentation
- Protolabs Network - Delrin Material Guide
- LangHe Industry - POM Technical Overview
- ScienceDirect - Polyoxymethylene Research