



Technical Brief

Specialty Compounds for **GEARS**

A Step-by-Step Specification Guide

► Plastic Gears: An Excellent Metal Replacement

Benefits

- Self-lubricating
- Lower weight
- Reduced noise
- Corrosion resistance
- Cost effective
- Colorable for coding assembly
- Design freedom

Design Considerations

- Lower strength
- Limited heat resistance
- Possible size change due to moisture absorption

The number of injection molded plastic gears manufactured each year is in the billions. Engineers use plastic gears for a wide range of applications in automobiles, computers, electronics, industrial machinery, and medical equipment. They provide a lightweight, low-cost means of transmitting motion and power.



Neat (unfilled) resins are particularly ideal for small, low-power gears. However, applications that require precision motion control, load carrying ability, and/or temperature resistance demand the enhanced performance of plastic gear compounds by RTP Company.

Advances in computer simulation/design tools, resin technology, and processing controls allow designers and molders to hold tighter tolerances and design into higher performance applications.

Future developments may include:

- Ability to mold gears larger than 3" in diameter
- Increased load and power capabilities to accommodate gearing above 5 HP
- Holding tolerances to AGMA Class 6 or more

Customers rely on RTP Company for innovative gear compounds. Whether it's a new design, an existing plastic part that is not meeting expectations, or a planned conversion from metal to plastic, our technical support and product development specialists work closely with you to develop the best compound for your gear application.

► Step 1. Discuss Your Performance Expectations and Design Requirements With Us

Design and Performance Elements

- Molding Accuracy
- Dimensional Stability
- Chemical Resistance
- Impact Resistance
- Mechanical Strength and Stiffness
- Fatigue Resistance
- Wear Resistance
- Heat Resistance
- Electrical Conductivity
- Flame Retardance
- Precolor

► Step 2. Identify Resins and Additives That Optimize Your Design

After determining your requirements, we draw on our wealth of experience to select the appropriate resin and additive that balance performance, price, and other special requirements. Samples are produced from these and other resins and additives that are best suited for gear applications:

Semi-Crystalline

- Chemical resistance
- Fatigue resistance
- High duty cycles
- Frequent actuation

Acetal (RTP 800 Series) - Rigid, creep resistant and strong. Possesses low coefficients of friction, remains stable in high temperatures, and offers good resistance to hot water environments.

Aliphatic Polyketone/Carilon® (RTP 4500) - Desirable combination of toughness, stiffness, and thermal characteristics similar to amorphous polymers. It has low permeability and chemical resistance similar to and exceeding many other semi-crystalline polymers.

Liquid Crystal Polymers (RTP 3400 Series) - Outstanding strength at extreme temperatures and resistance to virtually all chemicals, weathering, radiation and burning. Its high melt flow and fast setup permits it to be molded into large, heavywalled parts as well as thinwalled components.

Nylon (RTP 200 Series) - Absorbs more moisture than most polymers, affecting processability, dimensional stability and physical properties. However, as moisture content rises, significant increases occur in impact strength and general energy absorbing characteristics. Low coefficient of friction, excellent electrical properties and chemical resistance.

Polybutylene Terephthalate (RTP 1000 Series) - Crystallizes rapidly, so mold cycles are short and molding temperatures can be lower than for many engineering plastics. Very good dimensional stability, high heat resistance, chemical resistance and good electricals.

Polyetheretherketone/PEEK™ (RTP 2200 Series) - High temperature thermoplastic with excellent chemical resistance, high strength and good resistance to burning.

Polyphenylene Sulfide (RTP 1300 Series) - Offers an excellent balance of properties, including high temperature resistance, flame retardance, chemical resistance, flowability, dimensional stability and electrical characteristics.

Thermoplastic Polyimide (RTP 4200 Series) - Most heat resistant thermoplastic available. Excellent physical, chemical and wear resistance properties. Inherently flame retardant.

Amorphous

- Precision Parts
- Low Speed, Low Load

Polycarbonate (RTP 300 Series) - Excellent impact strength, high heat resistance and good dimensional stability. Stable in water, mineral and organic acids. Good electrical properties.

Polyetherimide (RTP 2100 Series) - Offers strength and rigidity at elevated temperatures, long term heat resistance, dimensional stability, inherent flame retardance, and resistance to hydrocarbons, alcohols and halogenated solvents.

Additives

PTFE - Lowest coefficient of friction of any internal lubricant. Forms a lubricious film on part surface. Modifies mating surface after initial break-in period. Facilitates higher dynamic load bearing.

Molybdenum disulfide ("Moly") - Creates a harder and more wear resistant surface in nylons. Ideal for applications where nylon wears against metals as Moly fills metal's microscopic pores, making the mating metal surface feel slippery.

Graphite - Ideal lubricant for many underwater applications.

Silicone - Acts as a boundary lubricant because it migrates to surface over time. As a partial alloying material with the base resin, some of it remains in the compound over its service life-time. This continuous migration reduces start-up wear for low pressure and high speed applications.

Glass fiber - Improves mechanical and thermal performance of compound. Increases coefficient of friction and mating surface wear (which can be decreased through the addition of lubricants).

Carbon fiber - Improves mechanical and thermal performance of compound. Strengthened compound may have lower friction coefficients than the base resin. Unlike glass, carbon is softer and less abrasive. Carbon fiber compounds can dissipate static electricity.

Aramid fiber - Commonly known as Kevlar®. Not a reinforcing fiber. Softer and less abrasive than carbon or glass fiber. Decreases friction coefficients and increases wear resistance.

► Step 3. Fine Tune Your Gear Compound

Resin	RTP Product	Gear Application	Industry	Dimensional Accuracy	Speed Range	Load Range
Acetal	RTP 800 TFE 15	Spur, Helical	Business Machines, Automotive	Good	Low/Moderate	Low/Moderate
Acetal	ESD 800	Spur, Helical, Electrically Conductive	Business Machines	Good	Low/Moderate	Low/Moderate
Carilon®	RTP 4599 X 72427 B	Spur, Helical, Worm	Business Machines, Automotive, Industrial	Good	Moderate	Moderate
Carilon®	RTP 4599 X 74599	Spur, Helical, Worm	Business Machines, Automotive, Industrial	High	Moderate	Moderate
Nylon	RTP 285 TFE 15 SI 2	Spur, Helical, High Temperature	Business Machines, Automotive, Industrial	Fair	Moderate/High	High
Nylon	RTP 205 TFE 15	Spur, Helical, High Temperature	Business Machines, Automotive, Industrial	Fair	Low/Moderate	High
Nylon	RTP 285 TFE 15	Spur, Helical, High Temperature, Electrically Conductive	Business Machines, Automotive, Industrial	Fair	Moderate	High
Nylon 6/12	RTP 200 D MS	Spur, Helical, Steel Pinion, Low Moisture, Good Dimensional Stability	Business Machines, Automotive	Good	Low/Moderate	Low/Moderate
PC	RTP 300 TFE 10	Spur, Helical	Business Machines, Printers	High	Low/Moderate	Low
PC	RTP 303 TFE 15	Spur, Helical	Business Machines, Printers	High	Low	Moderate
PC	RTP 383 TFE 15	Spur, Helical, Electrically Conductive	Business Machines, Printers	Good/High	Low/Moderate	Moderate
PEI	RTP 2199 X 71009 C	Spur, Helical, High Temperature	Business Machines, Automotive, Fluid Handling, Industrial	High	Moderate/High	Moderate
PEEK™	RTP 2285 HF TFE 15	Spur, Helical, Electrically Conductive, High Temperature	Business Machines, Automotive, Fluid Handling, Industrial	Fair	Moderate/High	Moderate/High
PPS	RTP 1378	Spur, Helical, High Temperature	Business Machines, Automotive, Fluid Handling, Industrial	Fair	Moderate	Moderate
PPS	RTP 1385 TFE 15	Spur, Helical, Electrically Conductive	Business Machines, Automotive, Fluid Handling, Industrial	Fair	Moderate/High	Moderate
TPI	RTP 4285 TFE 15	Spur, Helical, Electrically Conductive, High Temperature	Business Machines, Automotive, Fluid Handling, Industrial	Fair	Moderate/High	Moderate/High

This chart is intended as a starting point for materials development. RTP Company can modify and customize materials to meet your demands for precision motion control, load carrying ability, temperature resistance, color, geometry, and other requirements.

Data sheets on these and other RTP Company compounds are available on our website at www.rtpcompany.com or by calling Customer Service at 1-800-433-4787.



Successful gear applications rely on the right choice in gear compounds AND in gear design techniques. Standard metal gear design guidelines do not apply to plastic gears. In addition to working with RTP, you may wish to consult with additional experienced professionals (including molders, consultants, computer design software, AGMA, or your in-house engineers) who are familiar with plastic gear tooth profiles and other design modifications.

Right Compound
+
Right Design
=
Success

RTP Company utilizes a broad range of injection molding, thermoforming, extrusion, and testing equipment for product and process evaluations. Our Technical Service department provides expert assistance in processing considerations, molding trials, troubleshooting, and other customer needs. Arrangements for on-site visits can be scheduled through your sales representative or directly with our Technical Services group.

► Successful Applications

Industry	Application	Resin	Design Consideration
Automotive	Actuators	Nylon	Switch components
Automotive	Motor scooter gear box	Nylon	Small transmission gear
Business equipment	Printer photo roll drive gear	PC	Accuracy, wear resistant
Business equipment	Paper shredder drive gear	Nylon, Acetal	Impact resistant, mechanical strength
Fluid Handling	Gear pumps	PPS, PEEK, LCP	Chemical resistant
Industrial	Lighting system drive gears	PK, PEI, Nylon	Heat resistant, accuracy, wear resistant
Industrial	Cam shaft timing gear	Nylon	Small engine
Power Tools	Cordless screw driver drive gear	Nylon	Mechanical strength, impact resistant



Teledyne Water Pik turned to RTP Company for a precolored, glass-filled, lubricated nylon 6/6 for its tooth polisher's bevel gears. The addition of glass fiber improves the stiffness, ensuring the gear teeth do not flex under initial torque. The 90 degree bend in the device makes frictional forces a major concern, as significant slippage occurs during initial gear mesh. The addition of a lubricant minimizes gear face wear during startup.



RTP Company
P.O. Box 5439
580 East Front Street
Winona, MN 55987

Tel: 1 (800) 433-4787
1 (507) 454-6900
Fax: 1 (507) 454-8130

Web: www.rtpcompany.com
Email: rtp@rtpcompany.com