RC Shock Damping: Understanding the Basics

Shock Damping Explained

- **Damping:** The process of controlling the movement of a shock absorber.
- **Low-Speed Damping:** Resistance to slow movements of the shock piston.
- **High-Speed Damping:** Resistance to fast movements of the shock piston.
- **Shock Locking Up:** When the shock becomes too stiff and prevents further movement.
- **Adjusting Damping:** RC shocks are adjusted to control how the shock packs up (locks up) at different speeds.
- **Real-World vs. RC Shocks:** Real-world shocks have separate adjustments for high-speed and low-speed damping, while RC shocks currently do not.

Fluid Dynamics and Shock Damping

- **No-Slip Condition:** The velocity of a liquid at a surface is the same as the velocity of the surface itself.
- **Shear Rate:** The rate of change in velocity of a fluid.
- **Friction:** Resistance to movement caused by shear rate.
- **Piston Hole Size:** Smaller holes create higher shear rates and more friction, causing the shock to pack up earlier at lower speeds. Larger holes create lower shear rates and less friction, causing the shock to pack up later at higher speeds.

Piston Hole Size and Damping

- **Piston Hole Area:** The size of the holes in the piston determines the amount of oil that can flow through them.
- **Example:** A five-hole piston with 1.5mm holes has a total area of 8.83mm^2, while an eight-hole piston with 1.2mm holes has a total area of 11.30mm^2.
- **Impact on Damping:** The larger the total area of the piston holes, the less resistance there will be to the flow of oil, resulting in less damping.

Table of Piston Hole Sizes and Damping Characteristics

Piston Type	Number of Holes	Hole Size (mm)	Total Area (mm^2)	Damping Characteristics
Five-Hole	5	1.5	8.83	Packs up earlier at lower speeds
Eight-Hole	8	1.2	11.30	Packs up later at higher speeds

Note: This table is a simplified example and does not represent all possible piston configurations.

Understanding Piston Hole Area and Circumference in Suspension Tuning

Piston Hole Area and Suspension Feel

- **Piston hole area** directly influences the **thickness of the shock coil** needed for optimal suspension feel.
- **Suspension feel** refers to the subjective experience of how the suspension reacts to bumps and movements.
- **Larger piston hole area** generally results in a **softer suspension feel**.
- **Thicker shock oil** is required with larger piston hole area to maintain a similar feel.

Piston Hole Circumference and Pack

- **Piston hole circumference** is a crucial factor in determining **suspension pack**.
- **Pack** refers to the resistance the suspension offers to compression.
- **Larger piston hole circumference** leads to **higher pack** due to increased oil friction.
- **Area to circumference ratio** can be used to compare the relative impact of these two factors.

Comparing 5-Hole and 8-Hole Pistons

Feature	5-Hole Piston	8-Hole Piston
Piston Hole Area	Smaller	Larger
Piston Hole Circumference	23.55 mm	30.14 mm
Pack	Lower	Higher
Feel	Generally firmer	Generally softer

- **8-hole pistons** have **more pack** than **5-hole pistons** due to their larger circumference, even with similar shock oil viscosity.
- **5-hole pistons** allow for **thicker shock oil** and a **firmer suspension setup** due to their lower pack.

Tuning for Different Track Conditions

- **High-grip tracks** benefit from a **firmer suspension** with **thicker shock oil** and **5-hole pistons** to maintain stability and control.
- **Loose or bumpy tracks** may require a **softer suspension** with **8-hole pistons** to absorb impacts and maintain traction.

Summary

- **Piston hole area** influences suspension feel, while **piston hole circumference** determines pack.
- **Larger piston hole area** leads to a softer feel, while **larger circumference** results in higher pack.
- **5-hole pistons** are suitable for high-grip tracks, while **8-hole pistons** are better for loose or bumpy conditions.

Shock Piston Tuning: A Guide to Fine-Tuning Your RC Car's Suspension

Piston Hole Size and Suspension Setup

Description: The size and number of holes in a shock piston directly impact the suspension's performance. Larger holes allow for more oil flow, resulting in a softer suspension, while smaller holes restrict oil flow, leading to a firmer suspension.

Key Points:

- **Fewer, larger holes:**
  - Creates a **calmer and more stable** ride.
  - Ideal for **loose or uneven tracks** with bumps, rocks, or rough terrain.
  - Allows for a **firmer suspension setup** with **harder springs and thicker shock oil**.
- **More, smaller holes:**
  - Creates a **more responsive ride** with **better grip**.
  - Allows for a **softer suspension setup** with **softer springs and thinner shock oil**.
- **Pack:**
  - Refers to the **resistance of the suspension** to compression.
  - **Larger holes** allow for more pack, while **smaller holes** allow for less pack.

Fine-Tuning with Mixed Hole Sizes

Description: By combining different hole sizes within a single piston, you can achieve a more nuanced suspension response. This allows for a softer feel at low speeds while maintaining a firm feel at higher speeds.

Key Points:

- **Adding small holes:**
  - Increases **low-speed damping**, creating a **softer and more plush** ride.
  - **High friction** in small holes restricts oil flow at higher speeds, maintaining **good pack**.
- **Split piston designs:**
  - Use a combination of different hole sizes to achieve a specific balance of low-speed damping and pack.
  - Example: Three 1/3" holes and three 1/4" holes versus six 1/3" holes.

  - **Maintains similar low-speed damping** while **altering pack characteristics** due to the staggered hole sizes.

Piston Shape and Thickness

Description: The shape and thickness of the piston also influence suspension performance. Thicker pistons provide more pack, while conical pistons offer a smoother transition through the oil.

Key Points:

- **Piston Thickness:**
  - **Thicker pistons:**
    - **Increased pack** due to larger surface area for friction.
    - **More aggressive suspension** at higher speeds.
    - **Less noticeable effect at low speeds**.
  - **Thinner pistons:**
    - **Reduced pack** due to smaller surface area for friction.
    - **Less aggressive suspension** at higher speeds.
- **Conical Pistons:**
  - **Smoother oil flow** due to the tapered shape.
  - **Faster oil flow** on the tapered side.
  - **Larger hole opening** on the tapered side, allowing for more oil flow.

Summary Table: Shock Piston Tuning

Feature	**Effect**
Piston Hole Size	
Fewer, larger holes	Calmer, more stable ride; firmer suspension setup
More, smaller holes	More responsive ride, better grip; softer suspension setup
Piston Shape	
Thicker piston	More pack, more aggressive suspension at higher speeds
Thinner piston	Less pack, less aggressive suspension at higher speeds
Conical piston	Smoother oil flow, faster oil flow on tapered side

Piston Design and Function in Suspension Systems

Piston Hole Size and Oil Flow

- **Larger hole size:** Allows for easier oil flow, resulting in faster suspension response.
- **Tapered side:** Typically placed on the rebound side (underside of the piston) for faster rebound.

Tapered Piston Orientation and Suspension Response

- **Tapered side on rebound:** Leads to faster rebound and slower compression. This is a common setup for many drivers.
- **Tapered side on compression:** Results in slower rebound and faster compression. This setup is beneficial on smooth tracks where corner speed is prioritized, but can make the car less stable on bumpy tracks.

The Impact of Faster Rebound

- **Faster rebound:** Can make the car feel more "nervous" and less stable, even if it provides more grip.
- **Flat side down, cone shape up:** A preferred setup for many drivers, as it promotes a more stable and predictable car.

MIP Pistons and Their Unique Design

- **MIP pistons:** Feature a valve on top of the piston that restricts oil flow during compression and opens for increased flow during rebound, resulting in a very fast rebound.
- **Potential benefits:** May be beneficial on cars that are naturally less responsive, such as the Mugen.
- **Potential drawbacks:** Can make the car too responsive and "nervous" on some cars, leading to a less stable ride.

Piston Design and Track Conditions

- **MIP pistons on rough tracks:** Can provide more traction and better bump handling with the right setup.
- **Faster rebound:** Can be advantageous on rough tracks where traction is crucial.

Conical Pistons with Angled Holes

- **Angled holes:** Increase the length of the oil flow path, creating more surface area for friction.
- **Potential benefits:** Allows for a soft and plush suspension setup while still providing sufficient "pack" for fast response.
- **Ideal track conditions:** Medium to loose tracks that are relatively smooth.

Ultimate Racing Pistons

- **Ultimate Racing pistons:** Offer a flat side and a conical side with angled holes, providing a versatile option for tuning suspension response.

Summary of Piston Design Concepts

- **Piston design:** Plays a crucial role in determining suspension response and handling characteristics.
- **Understanding piston function:** Essential for optimizing suspension setup and achieving desired performance.

Table: Piston Design and Suspension Response

Piston Design	Compression	Rebound	Track Conditions
Tapered side on rebound	Slower	Faster	Most tracks
Tapered side on compression	Faster	Slower	Smooth tracks
MIP pistons	Restricted	Fast	Rough tracks
Conical with angled holes	Soft and plush	Fast	Medium to loose, smooth tracks

Key Takeaways

- Piston design significantly impacts suspension response and handling.
- Understanding the different piston designs and their effects is crucial for optimizing suspension setup.
- Consider track conditions and desired handling characteristics when choosing piston design.