MONROE®
OE SOLUTIONS

PRODUCT PORTFOLIO

2024

TENNECO

MONROE
OE SOLUTIONS

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INTRO

At MONROE, we pride ourselves on a steadfast commitment to innovation, technological excellence, and collaborative partnerships, positioning us as a trailblazer in the ever-evolving landscape of automotive technology.
With a rich legacy spanning over 100 years, our values form the foundation of our journey, where we consistently strive to engineer cutting-edge solutions that exceed the unique needs of our customers.

Our Core Values: Innovation, Technology, Partnership

Innovation: We redefine industry standards and push the boundaries of what is possible, focusing on customer-centric solutions that meet and exceed expectations.

Technology: Pioneering state-of-the-art technology, we lead the market with an expert approach, setting benchmarks for excellence in the automotive technology landscape.

Partnership: Collaboration is at the heart of what we do. From engineer to engineer, we foster close partnerships, ensuring that the solutions we provide resonate with the DNA of our clients, guaranteeing mutual success.

ENGINEERING EXCELLENCE

UNVEILING OUR CAPABILITIES

Leveraging our knowledge and expertise accumulated over X years,
MONROE's engineering prowess encompasses a comprehensive range of capabilities:

RESEARCH AND DEVELOPMENT
Unleashing the power of innovation through continuous research and development efforts.

PROTOTYPE TESTING AND VALIDATION
Rigorous testing processes to ensure the highest standards of performance and reliability.

CAD CAE
Utilizing advanced computer-aided design and engineering for precision and efficiency.

RIDEWORK FINE TUNE
Meticulous fine-tuning to achieve optimal ride dynamics and comfort.

ENGINEERING PROCESS
A streamlined and efficient engineering process for consistent and high-quality results.

VIRTUAL SIMULATION
Harnessing the capabilities of virtual simulations for enhanced efficiency and accuracy.

GLOBAL ENGINEERING MANUFACTURING
A global presence in engineering and manufacturing, ensuring a widespread impact.

NVH ANALYSIS
In-depth analysis of Noise, Vibration, and Harshness for superior vehicle performance.

MATERIALS AND SEALINGS TECHNOLOGIES
Utilizing cutting-edge materials and sealing technologies for durability and reliability.

VEHICLE PERFORMANCE MEACHATRONICS
Integrating mechatronics for unparalleled vehicle performance.

BENEFITS OF MONROE SOLUTIONS:

ELEVATING YOUR DRIVING EXPERIENCE

The results of our capabilities and commitment to excellence translate into a myriad of benefits for our customers:

- **HANDLING AND CONTROL**
  Unmatched control over vehicle dynamics.
- **PERFORMANCE**
  Optimal performance, pushing the boundaries of what your vehicle can achieve.
- **RIDE COMFORT**
  A smooth and comfortable ride, mitigating impacts for an enjoyable driving experience.
- **SAFETY**
  Prioritizing safety through stability, traction and braking performance.
- **SUSTAINABILITY**
  Environmentally conscious solutions for a sustainable automotive future.
- **NOISE REDUCTION**
  Minimizing noise for a quieter and more pleasant driving environment.
- **DURABILITY**
  Exceptional durability to withstand the rigors of diverse driving conditions.

HOW A DAMPER WORKS

MASTERING THE ART OF CONTROL

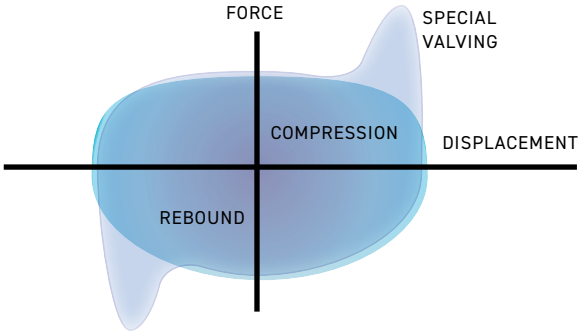
A crucial component in providing a smooth and controlled ride, a damper or shock absorber, manages the motion and vibration of the vehicles' suspension system.

The primary function is to absorb energy generated by springs when encountering road irregularities, ensuring optimal tire contact with the road surface.

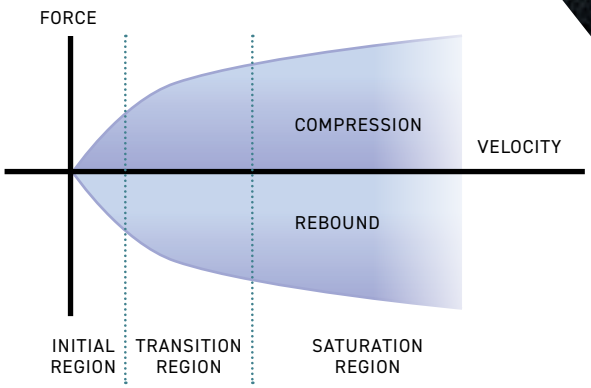
KEY ASPECTS OF DAMPER FUNCTIONALITY:

During its operation, the kinetic energy is converted into thermal energy, thanks to the oil flow through tiny orifices, from a well selected stack of valves and the compression of the inner gas.

FORCE VS. DISPLACEMENT



FORCE VS. VELOCITY



COMPRESSION STROKE

When the wheel moves upward (compression), the piston is pushed into the damper's cylinder. Hydraulic fluid is forced through small passages or valves, creating resistance and converting kinetic energy into heat.

REBOUND STROKE

As the wheel moves downward (rebound), the piston is pulled out of the cylinder. Again, hydraulic fluid flows through valves, providing controlled resistance against the spring's expansion.

VELOCITY-SENSITIVE DAMPING

Modern dampers are velocity-sensitive, adjusting resistance based on the speed of the piston's movement. Faster piston movement (as in sudden impacts) increases damping force, enhancing control.

INITIAL REGION

At lower velocities, the damping force is relatively low. This represents the behavior when the damper is experiencing slow movements, such as handling maneuvers.

TRANSITION REGION

As velocity increases, there is a noticeable increase in damping force. This region represents the transition from low to high damping force typical from comfort to control.

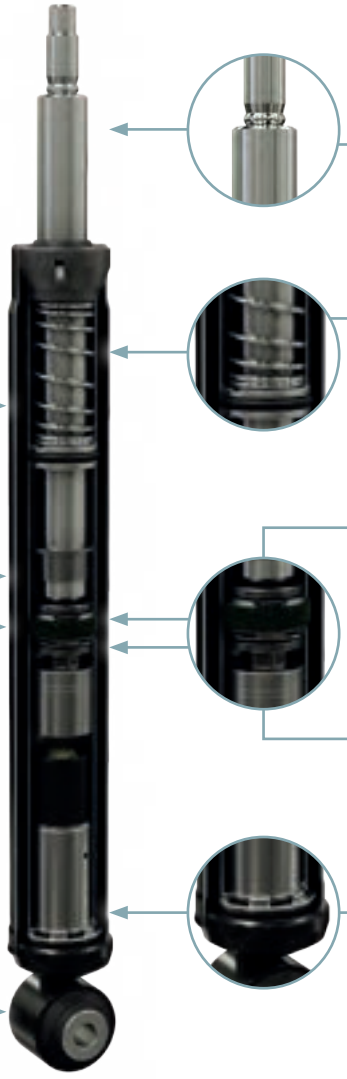
SATURATION REGION

At high velocities, the damping force tends to stabilize or saturate.

PARTS OF A DAMPER

PRECISION IN EVERY COMPONENT

Each component plays a crucial role in the overall functionality of a damper, ensuring it absorbs and dissipates energy, controls motion, and enhances stability and comfort.



1. **OUTER TUBE**
   Protects internal components, contains the oil and provides structural support.
2. **CYLINDER**
   Primary chamber for reciprocating piston motion, filled with hydraulic fluid.
3. **PISTON**
   Rod and main piston valve.
4. **BUSHING**
   Made of elastomeric materials, isolates damper from vibrations.
5. **ROD**
   Transmits forces between the piston and external suspension components.
6. **REBOUND AND COMPRESSION STOPS**
   Prevent metal to metal contact at the end of the stroke.
7. **MAIN PISTON VALVE**
   Precision-engineered to control hydraulic fluid flow, determining damping characteristics.
8. **ADD-ON VALVE**
   Supplementary damping element to improve specific vehicle attributes.
9. **BASE VALVE**
   Regulates hydraulic fluid flow, controlling damping during compression stroke.

MONROE® RIDE SOLUTIONS

EXPLORE THE COMPREHENSIVE RANGE OF MONROE RIDE SOLUTIONS FOR OEMS, METICULOUSLY DESIGNED AND ENGINEERED TO TRANSFORM YOUR DRIVING EXPERIENCE.

MONROE OE SOLUTIONS

- CONSTRUCTION
- PISTON VALVES
- RIDEREFINE™
- CTOH

MONROE INTELLIGENT SUSPENSION

- CVSAe 1 VALVE
- CVSA2 2 VALVES
- KINETIC®

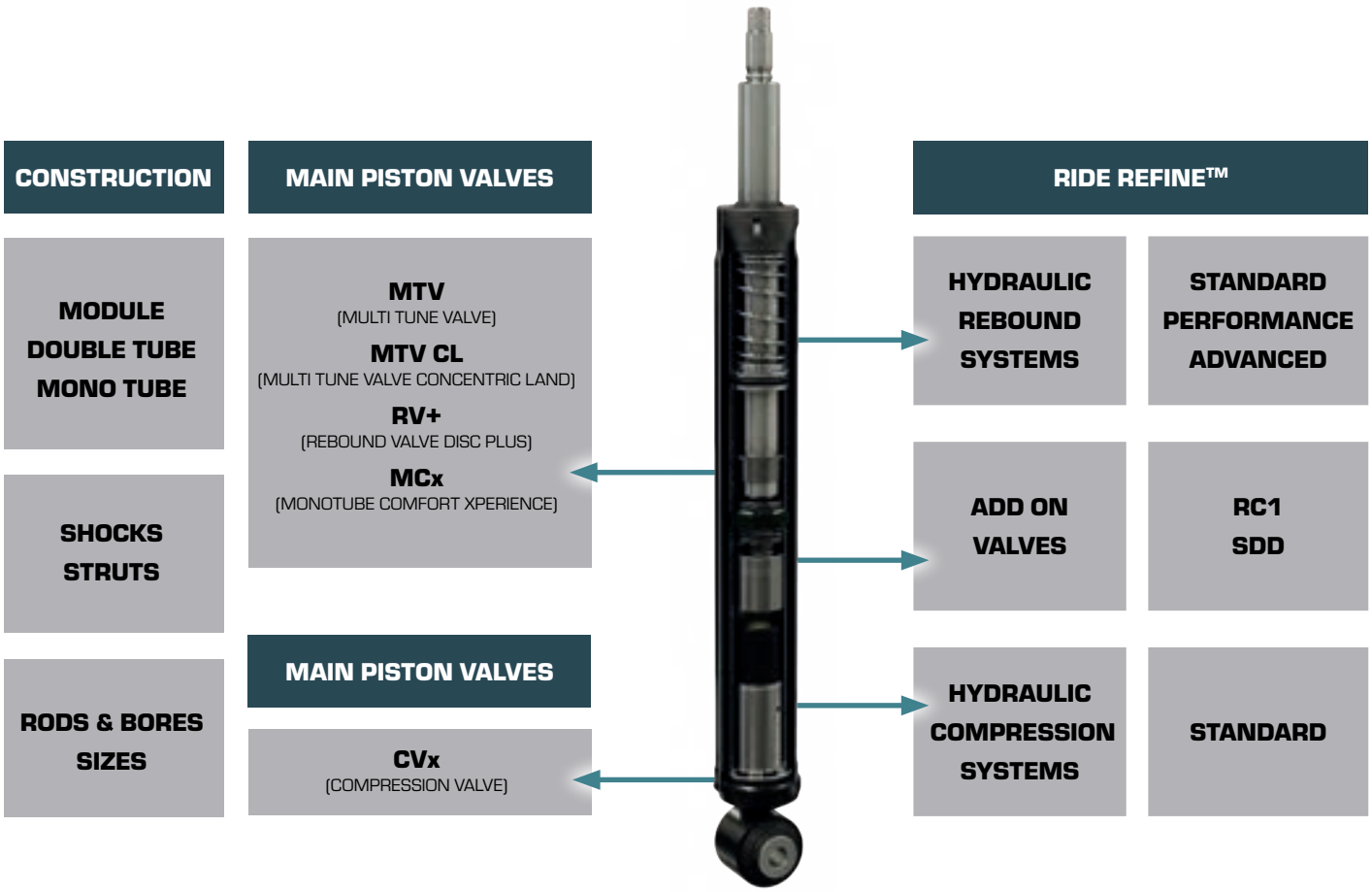
PASSENGER VEHICLES

COMMERCIAL OFFER OVERVIEW

Tailored for various driving conditions, our solutions include shock absorbers for independent suspension and struts for added structural support.

With an extensive range of rods and bores sizes, MONROE ensures a seamless fit across vehicle types. Our Main Piston Valves, including MTV, MTV CL, RV+, MCx, and Base valve CV+, provide precise and tailored damping control, enhancing stability and comfort.

Explore the future of ride customization with Ride Refine™ technology, offering hydraulic rebound stops, hydraulic compression stops, and add on valves enabling you to shape your driving experience with a harmonious blend of performance, comfort, and adaptability on diverse terrains.



CONSTRUCTION

DOUBLE TUBE SHOCKS

Shock absorbers consisting of a pressure tube and a reserve tube. Widely used in light vehicle and commercial trucks and off highway segments.

DOUBLE TUBE STRUTS

Double tube construction dampers providing structural support on the vehicle. Used in Mc Pherson front suspensions.

MONO TUBE SHOCKS

Single tube construction dampers preferred by premium brands and trim levels for more responsive and sportier performance.

MAIN PISTON VALVES

MTV

Multi-Tuneable Valve system offers a uniquely broad range of tuning options. MTV enhances damper performance by providing a more precisely defined blend of ride, handling and NVH.

MTV offers a cost-effective design and has unique capabilities for noise-critical application. A nozzle bleed variant enhances temperature stability.

Flexible, full-displacement valve design allows for quick damper response and offers multiple tuning architectures to address a variety of vehicle performance attributes. This solution provides best-in-class noise performance.

MTV is available for all LV segments and on a global basis.

MTV CL

An extension of MTV technology, the MTV CL adds digressive characteristics for enhanced handling performance. This solution is appropriate for all LV segments.

Improved temperature stability

Premium valve technology offers an optimal blend of comfort and handling.

MTV CL 1616HD design provides more refined comfort characteristics (smooth blow-off point) and improved NVH performance.

RV+

The RV+ standard piston valve technology is applicable to monotube dampers. The basic rebound clamped disc valve offers a cost-efficient design that is available in all standard sizes.

Common applications include those with high rebound to compression and damping ratios. Available for all vehicle segments.

Enhanced comfort performance and temperature stability.

MCx

The best-in-class MCx delivers low damping force at low speed and digressive compression characteristic attributes preferred for high-end vehicle applications.

Independent tuning features on rebound and compression for enhanced damping rate characteristics.

Reduced damping force at low speeds improves comfort performance.

RIDE REFINE™ TECHNOLOGY PORTFOLIO

Add-on valves to enable vehicle light-weighting and expand ride tuning parameters on complex global platforms.

RIDE REFINE™	
HYDRAULIC REBOUND SYSTEM	STANDARD PERFORMANCE ADVANCED
ADD-ON VALVE	RC1 SDD
HYDRAULIC COMPRESSION SYSTEMS	STANDARD

Ride Refine™ technology introduces a spectrum of Add-on valves that enable vehicle light-weighting and expand ride tuning parameters on complex global platforms.

RIDE REFINE™ RC1

Monroe® Ride Refine™ RC1 add-on valve utilizes frequency dependent damping to smooth out high-frequency wheel motions. This add-on valve is highly tunable, enabling vehicle manufacturers to select the ideal comfort profile for short piston strokes in each vehicle model.

At low frequencies, the damper's main valve resumes normal operation.

At high frequencies, main-valve bybass directs oil into RC1 valve, providing separate, tunable damping of wheel frequencies for more balanced, refined and agile ride.

RIDE REFINE™ SDD

Monroe® Ride Refine™ SDD (stroke dependent damping) add-on valve provides highly refined, luxury-level ride characteristics. SDD technology dramatically enhances comfort by improving plushness and road isolation, enabling manufacturers to tune vehicles for greater everyday comfort with minimal impact on handling.

Piston valve

Main-valve bypass directs oil into SDD valve, providing separate, tunable damping of small strokes for reduced vibration and harshness.

Following completion of small piston stroke, damper's main valve resumes normal operation.

RIDE REFINE™ HCS

Monroe RideRefine Hydraulic Compression Stop (HCS) improves ride comfort and body control by enabling a better trade-off between ride height and end-stroke compression damping.
It significantly reduces impact forces transferred to the vehicle body structure near the end of a damper's compression stroke.

It can be easily integrated with Monroe's standard piston valves and double-tube damper assembly processes.
HCS works quickly and smoothly, significantly reduces bottoming load and filters out noise and harshness experienced in high-impact road events that can occur when driving over curbs and potholes. Testing on a leading luxury SUV platform showed a reduction in bottoming load of up to 30% compared to dampers without HCS.

By controlling peak end-stop force, this technology helps manufacturers reduce the structural requirements of vehicles that typically carry heavier loads – including battery packs – and/or have limited ground clearance.
It also is ideal for vehicles equipped with larger tires, such as Sport Utility (SUV) and Crossover models, which can generate higher end-stop loads.

RIDE REFINE™ HRS

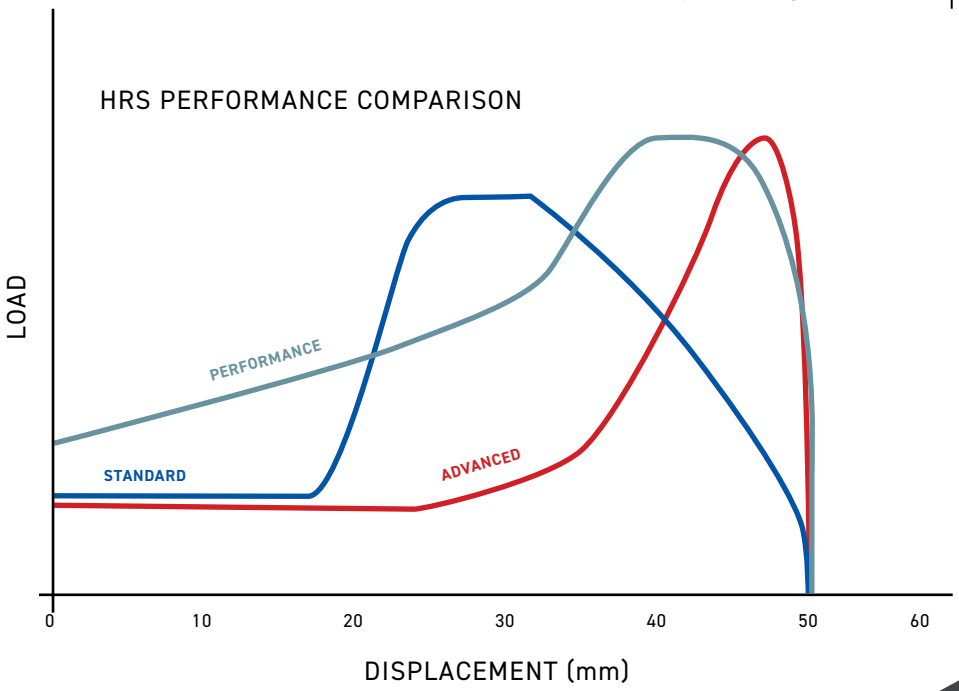
3 types of hydraulic stop technologies to serve wide range of customer specific needs and requirements

STANDARD REBOUND SYSTEM
Peak load management in a cost efficient and simple design

PERFORMANCE REBOUND SYSTEM
Performance tunability

ADVANCED REBOUND SYSTEM
Superior noise reduction and enhanced packaging

Advanced HRS system offers a revolutionary solution for absorbing peak loads and minimizing noise during maximum damper extension. Ensuring optimal energy absorption without compromising comfort.



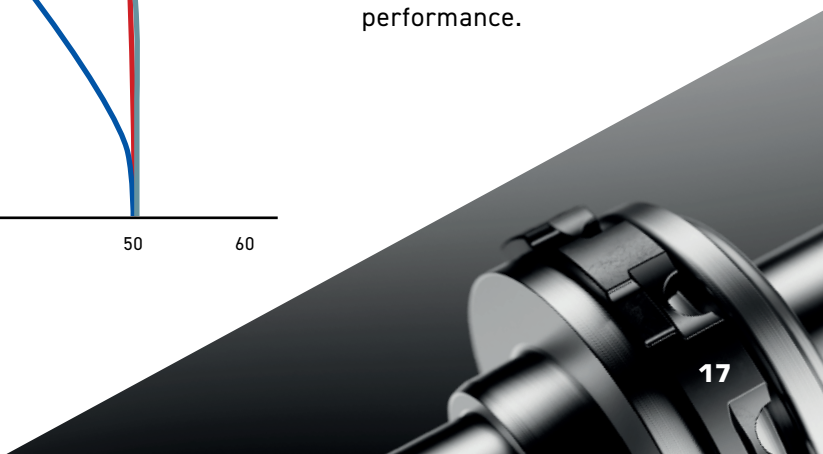
Innovative Design
The system incorporates an inventive grooved and swaged pressure tube, coupled with a high-strength sealing ring, ensuring a seamless transition to HRS activation. Compact Design, Space-saving and efficient.

Customizable Tuning
Tailor the system to meet the unique load requirements of any vehicle, empowering OEMs to deliver outstanding ride comfort in all situations.

Advanced Effectiveness
High damping forces for optimal load absorption.

Lightweight
Enhances overall vehicle efficiency.

Durability
Built to withstand rigorous conditions for long-lasting performance.



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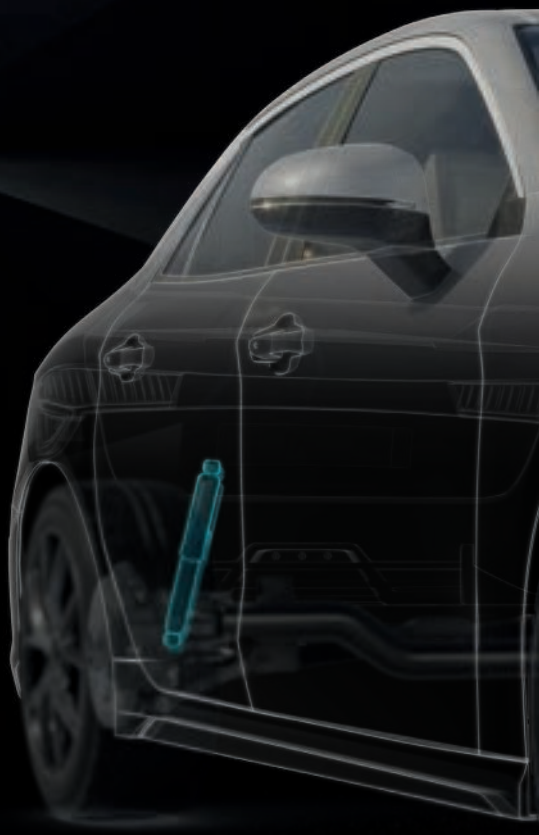

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