FAMA BUYER'S GUIDE

TC049

REAR SUSPENSION

Prepared by the FAMA Chassis Subcommittee

This guide does not endorse any manufacturer or product

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Rear Suspension

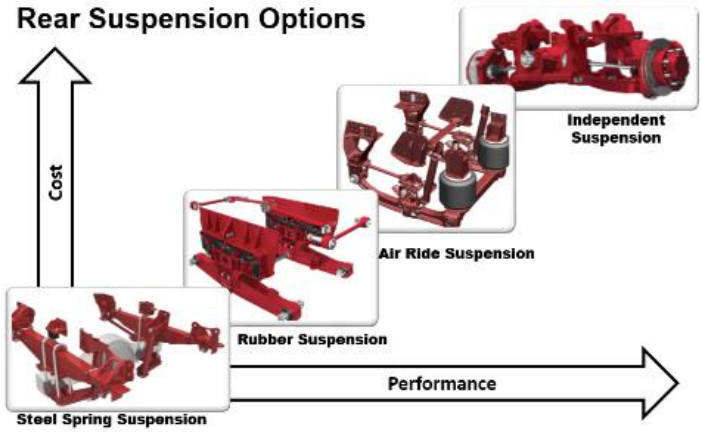
Introduction

Vehicle suspension systems are an important factor in the ride quality, stability, and ongoing maintenance of an apparatus. When developing specifications for the rear suspension on a fire apparatus, consideration should be given to handling, ride quality, chassis/equipment protection, initial cost, and total cost of ownership.

Overview

Ride quality is a function of wheel travel and the spring rate of the suspension. Ride quality is not only a benefit for vehicle occupants but can also provide protection for the vehicle and the equipment it carries. The amount of allowable wheel travel is determined by vehicle packaging and the spring rate of the system.

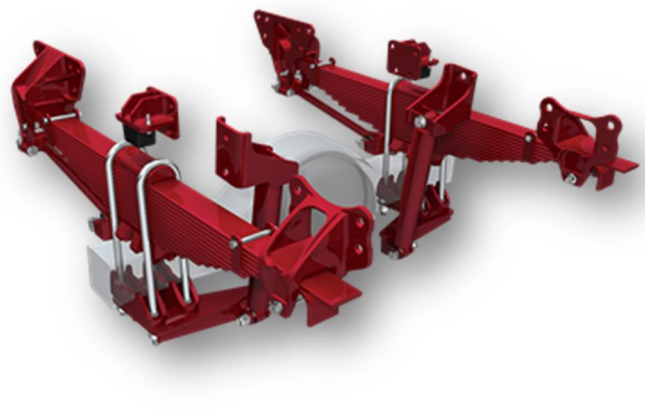
Roll stiffness is a key consideration for vehicle design due to the high center of gravity that fire apparatus typically exhibits. There is a balance between roll stiffness and ride quality. Less roll stiffness results in better off road mobility and may introduce a feeling of instability in a high center of gravity apparatus. Higher roll stiffness may result in lower ride quality but will offer better stability during high speed maneuvers.



There are 4 primary rear suspension types – spring, rubber, air ride, and independent suspension. This guide will provide a description, pros and cons, operating environment considerations, and capacity ranges for each suspension type.

Generally speaking, higher cost suspensions often times result in better operating characteristics such as ride quality and cost of maintenance. In this guide we will cover spring, rubber, and air ride suspensions. Rear independent suspension is generally used for military applications and not common in fire apparatus.

Steel Spring Suspension



This system is currently the most common in fire apparatus. A steel spring suspension is a stack of individual leaf springs between the vehicle frame rails and the axle. Spring suspensions are available for both single axle and tandem axle applications and are typically not equipped with a transverse torque rod to control vehicle roll.

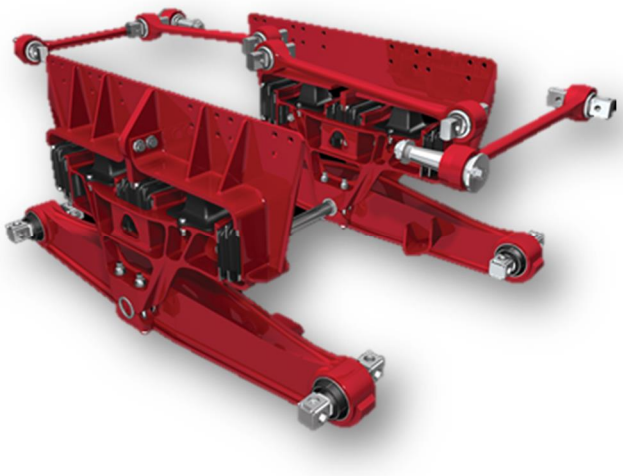
PROS OF SPRING

- Low cost
- Readily available parts
- Good serviceability

CONS OF SPRING

- Lowest ride quality
  - Reduced equipment protection
  - Load affects ride height and ride quality
- Requires load balancing to prevent vehicle lean
- Less resistance to corrosion resulting in lower overall durability
- Heavier than other systems

Rubber Suspension



As the name implies, rubber is used to provide the "spring" between the axle and frame. Differing rubber hardness, or durometer, can be used to achieve the desired weight capacity and ride quality.

PROS OF RUBBER SUSPENSION

- Improved ride quality over steel leaf spring
- Durability
- Lowest maintenance
- Lowest life cycle cost
- Lighter weight than spring
- Walking beam suspensions* provide good off-road mobility
- Better corrosion protection

CONS OF RUBBER SUSPENSION

- Requires transverse torque rods
- Higher initial cost than leaf spring
- Weight sensitivity (loaded vs. unloaded)
- Load balancing required
- More difficult to adjust for lean or ride height

* **walking beam suspension** is used to refer to a type of suspension system without leaf springs and made up of one primary beam that oscillates in the center and allows for easier vertical movement of the axle on uneven terrain

Air Ride Suspension

Air ride suspensions are available in both single and tandem axle configurations. This system uses a rubber bladder, referred to as an air spring, and includes a height control valve. Air ride suspensions are the 2nd most common suspension system used in the fire service.

PROS OF AIR RIDE

- Best ride quality
- Excellent equipment protection
- Similar ride quality when both loaded and empty
- Maintain constant ride height
- Built in side to side leveling - no lean
- Easier to service due to lighter weight air springs

CONS OF AIR RIDE

- More expensive than spring and rubber
- Airbags are susceptible to damage or punctures
- More complex installation
- Transverse torque rods and/or V-rods are required

Suspension Capacity

Departments should select the correct capacity rated products. Selecting higher capacity ratings does not increase vehicle durability, it can decrease the life of chassis/body/equipment. It can also decrease ride quality resulting in driver fatigue, lower resistance to rollover, and negatively impact handling.

Suspension capacities for single rear axles range from 23,000 to 35,000 pounds and for tandem rear axles from 40,000 to 70,000 pounds overall. Single rear axles typically use spring or air ride suspensions while tandem rear axles can use spring, rubber, or air ride.

Other Considerations

Departments should consider the most common driving routes – city driving may result in higher vibrations due to road quality. Spring suspensions can typically transmit up to 50% more vibration to the apparatus compared to an air ride suspension.

Departments in northern environments where salts are applied, you may benefit from selecting the more corrosion resistant rubber suspensions or air ride suspensions. The reason for this is that the leafs in a multi-leaf spring suspension can develop rust which increases the resistance to movement and can lower ride quality over time. Because there is relative motion between leafs, it is not possible to coat the individual leafs to prevent rust.

Summary

While initial cost of ownership may be higher for certain systems, departments should consider overall total cost of ownership which includes maintenance, ease of service, and wear and tear from reduced ride quality. With the inclusion of more sensitive electronic equipment, reduction in vibration becomes even more important.