



## **FAMA BUYER'S GUIDE**

### **TC036**

# **Apparatus Seating**

Prepared by the FAMA Chassis Subcommittee

This guide does not endorse any manufacturer or product



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## Introduction

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In the most basic terms, a seat is a set of surfaces that contact and support the human body and provide an interface between the sitting occupant and the environment. In most cases the purpose of a seat is to support the back of the human body so that work can be done with the front of the body, with the hands or extended feet. In a modern fire apparatus, seats provide an interface between the human firefighter and the mechanical vehicle. The seats need to provide support and positioning for the human body and must allow the firefighter to perform the required work, whether that is driving or some other task. Positioning must locate the human body in a place of safety with respect to any restraint system and the rest of the internal cab environment.

Of primary consideration is defining the room available for the human occupants of a fire fighting vehicle. The external dimensions of the fire apparatus are limited due to a variety of variables. Maximum height is defined by bridge clearances or overhead door clearance or by center of gravity concerns. Maximum width may be restricted by a state department of transportation or door frame clearance or lane widths in the response area. Maximum length is determined by the need to be maneuverable in the streets and roads.

Inside of this maximum envelope there are quite a few components to take into consideration, such as sheet metal, frame rails, engine, transmission, wheels, axles and all the other bits and pieces that define the automotive style chassis. There are tools that need to be stowed such as shovels, axes, breathing apparatus, chain saws, and hooks as well as a lot of small equipment like flashlights thermal imaging cameras, radios, and EMS supplies that can be necessary. Additionally, there can be a pump, water tank, ladders, and lots of hose of varying diameters.

In many cases, the apparatus is made within the size constraints, filled with the required PPE, tools, and other components, and often the actual fire fighters themselves get whatever room is left. This sets the stage for the complexity of manufacturing seating solutions that are simultaneously comfortable, safe, and high performance.

## Overview

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Seats for fire apparatus tend to be of modular construction. If you start with a basic fixed cushion crew seat, other options and features can be added to the base model.



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This is how we will frame the discussion about seats. The most basic seat available for a fire apparatus is a fixed back bucket seat with fixed seat cushion with no adjustments. This is the type normally supplied in the passenger location of a 2-door commercial chassis. This seat must only meet the minimum seating surface dimensions as specified by NFPA standards and have some provision for occupancy sensing. However simple as the seat may be, there are some important considerations.

The National Fire Protection Agency (NFPA) creates and maintains standards related to the equipment used for fire suppression. The NFPA 1901 standard covers requirements for Automotive Fire Apparatus. NFPA 1901 can be purchased or viewed for free online at the NFPA.org website.

## PRIMARY SEAT CONSIDERATIONS

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### SEATING LOCATIONS IN THE CAB

According to the most current NFPA 1901 regulations, as will be referenced throughout this document, each crew riding position should be within a fully enclosed personnel area, with each crew riding position provided with a seat and an approved seat belt designed to accommodate a person with and without heavy clothing (NFPA 14.1.3). Each seating space should have a minimum width of 22" at the shoulder level.

Fire truck seats are often categorized as driver, officer, and crew because each occupant often requires different seating features and functionality. For example, operating the truck may require a specific seat suspension for optimal vehicle control, whereas the crew may be focused on rapidly deploying from the vehicle ready to engage in the emergency situation.

### DRIVER SEAT

The driver seat is the most important seating location in the fire apparatus. This is because the driver needs to be able to reach all of the vehicle controls in order to safely operate the vehicle. Also, the driver needs to be able to see the dashboard and out of the windows. SAE (Society of Automotive Engineers) standards provide guidance on where the seat should be positioned relative to the steering wheel and pedals. These standards are a baseline for fitting a wide range of operators and should be sufficient in most cases if followed by the seat installer. If a department has some operators on the smaller or larger end of the



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population, they may want to request some specific accommodations for the installation of the driver seat.

The driver position usually has a non-SCBA seat (explained further in “SCBA Versus Non-SCBA”). At a minimum, the driver seat needs a fore and aft adjustment to allow the seat to be positioned relative to the steering wheel and pedals. Typically, a driver seat will have a back recline.

Driver seats may include an electric position adjuster to customize fore and aft, height adjustment, and tilt functions. Some versions of electric seats may have more adjustments such as recline and lumbar, depending on the model. Electric seats allow for a wide range of seating positions to suit an individual operator.

Driver seats may include an air, mechanical or electrically controlled suspension that can help to smooth out the ride for the driver. See section on “Suspensions” for more specific information.

Driver seats, along with officer seats are most likely to include additional adjustments and comfort features, as discussed below.

### **OFFICER SEAT (FRONT PASSENGER)**

Any non-SCBA seat available in the driver position is usually available in the officer position, though in many instances the officer position in a fire apparatus may be more dimensionally constrained, thereby reducing available seat models or options in this position.

The officer seat is usually an SCBA seat and in some cases, is fixed with no adjustments. However, SCBA seats are available with many of the same range of adjustments as the driver seats, with the general exception of adjustable recline in the case of SCBA seats. If there is a computer or control or communication device mounted for the officer seat, a fore and aft adjustment can ensure that a range of personnel can correctly use these items. Officer SCBA seats are available with electric adjustment and air suspensions.

### **CREW SEATS**

Rear crew positions can use either SCBA or non-SCBA seats. Crew seats will not usually have any adjustments because adjustable seats require additional space in the cab to allow for the adjustment, and the adjusters themselves consume valuable space that can be used to store equipment. Most custom chassis allow



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for both forward-facing and rear-facing crew seats. The combination of forward and rearward facing crew seats should be specified to allow for a sufficient walkway between seats. Most custom fire apparatus chassis are wide enough to have four seats in either the forward-facing and rear-facing rows. It is most common to have 4-6 total crew seats in a custom cab in some arrangement of forward and rearward facing seats. Some custom chassis will include an enclosed pump panel in the rear crew area. In this case there may not be an option to use forward facing crew seats. It is also important to keep in mind that forward and rearward facing seats have different seat belt safety requirements, which is covered under the "Seat Belt" section.

In order to create more room for personnel movement, the rear crew seats will often have a folding cushion. The folding can be by spring loading the cushion upward or by having an over center spring that will hold the cushion up or down.

Most of the time crew seats will be mounted to a riser extending from the floor. In some cases, the crew seats will be mounted to a wall to create a shallower installed depth to save room. These wall-mounted seats may consist of a separate SBCA back mounted over a separate folding cushion, or there may be a fold-up cushion under a flat back cushion to provide a low profile non-SCBA seating position.

## SCBA VERSUS NON-SCBA

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SCBA seats contain an integrated SCBA locking system with either mechanical or electrical release system. This allows the fire fighter to quickly exit the vehicle fully equipped with their SCBA. The SCBA seat also provides a valuable storage space for each SCBA since apparatus typically include one SCBA and spare air cylinders for each of the crew. These SCBA locking systems come in a variety of options and configurations depending on cab layout, bottle configuration, etc. A headrest, designed to allow easy SCBA exit, either by the SCBA opening shape or by mechanically opening upon SCBA exit, must be supplied to SCBA seats for occupant safety.

It is also important to consider retention and presentation of the wearable SCBA strap in SCBA seats. Some seats contain backrest surface grooves, pockets or magnetic straps for this purpose. When SCBA pack cylinders are inserted into seats with these features,



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and SCBA components (harness straps, regulator hose, etc) are properly positioned, such features help speed occupant ingress. These features allow more rapid and tangle-free donning of the SCBA cylinder and seat belts.

Every SCBA seat should include an SCBA bracket that meets NFPA 1901 standards for SCBA retention in a dynamic event. However, when evaluating SCBA holder options it is important to consider the following questions and/or review current options:

*Is it easy to get the SCBA in and out of the holder?*

*If the department has cylinders of varying lengths, is it possible to quickly adjust the holder for a new cylinder length?*

*Is the SCBA holder adjustable to get a good fit for the harness and cylinders used?*

*Does the SCBA holder have enough adjustment if the SCBA manufacturer or cylinder is changed in the future?*

Below are some common types of SCBA holders that are available:

### **STRAP BRACKETS**

Strap brackets have a safety strap that wraps around the entire SCBA assembly. The cylinder rests against two v-shaped stops in the rear and the cylinder valve is supported on a foot. The strap is released with a remote cord or lanyard that hangs out between the SCBA and edge of the seat cavity.

Strap brackets are the lowest cost SCBA holders that meet NFPA standards. Depending on the SCBA it may be difficult to latch the strap around the harness and sometimes the release cord can become caught or tangled. Strap brackets are available from a variety of manufacturers.

### **MECHANICAL BRACKETS**

Many manufacturers make mechanical locking brackets that retain the SCBA by grabbing on the cylinder. These may hold around the diameter of the cylinder or hold the top and bottom of the cylinder. Some of these brackets are automatically locking and others require the user to actively lock the cylinder in place and release it by means of a pull chord, cable or handle. Other brackets use an electric solenoid to lock the bracket and only release it when the parking brake is applied. Depending on the bracket model, there are a variety of release options and locations available.

## SEAT BELTS: ABTS VERSUS NON-ABTS

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Because fire trucks typically have a high center of gravity, occupant safety and rollover protection are of great importance. Seating considerations for driver, officer, and crew can vary greatly depending on variables such as terrain, accessibility to PPE, and space need for quick ingress and egress from the vehicle. The seatbelts for these seats can be cab mounted or contained within the seat itself, coined with the phrase "All Belts to Seat" or ABTS. Seatbelts can come in a variety of configurations.

A 2-point seatbelt is considered a Type 1 harness belt and is for pelvic restraint only. A 3-point seatbelt or Type 2 harness contains a lap belt as well as a torso belt that travels over the shoulder and across the occupant's torso. A 3-point, Type 2 seatbelt is most standard. A Type 2 seat belt can have either a single retractor or dual retractors, but is required in order to meet NFPA standards for all forward-facing seats (14.1.3.5).

Some manufacturers offer dual-retractor seat belts which provide faster, stronger retraction, preventing snags on equipment and damage to the belts from apparatus doors. These dual-retractor systems also provide more total webbing payout to accommodate larger occupants and/or bulky occupant-worn gear. Also available are options which customize the height of the seat belt to fit various sized fire fighters.

## SUSPENSIONS

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As large emergency response vehicles, fire trucks are often moving, braking, and turning at fast speeds. A vehicle's suspension is the system of parts that connects the frame to the wheels, thus isolating it from the road, allowing for relative motion.

Over the years, seating manufacturers have developed two primary types of suspensions that provide a safer and more comfortable ride for fire fighters – air suspensions and mechanical suspensions. Air suspensions have an air spring that provides the lift spring forces, with hydraulic dampers or shock absorbers to control excessive motion, and are easier to adjust than mechanical suspensions. Mechanical suspensions have a steel spring that provides spring motion and are only necessary where there is no available compressed air supply, and therefore are not very common.



It is important to keep in mind that by NFPA requirements, seats with suspensions require additional head clearance, which can affect seat installed height and allowable seat suspension travel.

## CUSHIONS

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Drivers typically utilize a fixed seat cushion option for optimal stability. However, often times in order to make more room in the cab, especially in the crew compartment, a flip up seat may be an option to make more room for fire fighter egress. The minimum width for a seat cushion is 18" and 15" from the front of the cushion to the face of the seat back.

Fire fighters are also often in need of wider seats, due to PPE, tools, gear, etc. which must be taken into consideration as well. Most manufacturers offer wider seat (typically 20" or 22") options.

Also needed to be taken into consideration is the incredible wear these cushions must endure from fire fighter PPE, dirt, and other harsh conditions. More information about covering material can be found under "Considerations for Seat Specifications."

## SWITCHES

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According to NFPA 1901 each fire apparatus must be equipped with a seat belt warning system that provides a visual and audible warning if an occupant is seated but not belted. Each designated seating position must have a seat occupancy sensor switch in the seat cushion and a switch in the buckle.

Reference the NFPA 1901 standard for required seat belt warning system functionality.

In some cases, it may be necessary to have more than one circuit operated by a seat switch to support parking brake interlocks or other devices. In these cases, it may be necessary to have a separate switch for each circuit.



## ADJUSTMENTS

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Over the years, innovations in comfort and contouring have provided enhanced performance options. These adjustments are available in mechanical, air and electrical options with a variety of controls. Examples include seat recline, adjustable lumbar support, fore/aft seat adjustment, height adjustment, seat tilt, and customized seat belt fit.

SCBA seats have additional adjustments. For example, most SCBA seats will have a depth adjustment so the SCBA holder can be moved forward or rearward to compensate for cylinder diameter. This depth adjustment feature may be either a user-adjustable system allowing each occupant to adjust the depth of the back by back pressure and a reset handle each time the seat is occupied, or more permanent system, requiring tools to adjust. SCBA seats may have additional hole patterns such that the SCBA holder can be mounted off-center to allow better ingress and egress of the SCBA. Some SCBA seats have configurable side pads to allow better fit with certain types of SCBA harnesses.

## CONSIDERATIONS FOR SEAT SPECIFICATIONS

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### COVERING MATERIAL

There are a variety of options when considering upholstery material for seats. Fire fighters' turnout gear can be rough on seats, and can also carry along dirt and residue that can contain unknown or potentially hazardous substances. Strength, wear-ability, durability, ability to clean and replace easily if needed, and if the material needs to be waterproof are items that need to be taken into account.

Options for covering material can range from vinyl to heavy-duty woven composites. While vinyl maybe perceived as being easier to clean, it is more easily punctured or ripped, exposing the base foam, making it nearly impossible to clean. A waterproof woven composite may be the best option due to its clean-ability and durability. Another point to consider is materials that can withstand UV rays that can degrade a



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material's performance. It is also necessary that the material meets FMVSS 302 flammability standards for safety.

### HEAD CLEARANCE

NFPA 1901 standards specify how much head clearance is needed from the seat to the cab roof (14.1.7.1). This clearance is specified from the H-point which approximates the hip pivot point of a medium sized male. H-points are also used to determine control layouts in the cab. For suspension seats, the head clearance must be 37" when the suspension is in its **highest** position. For height-adjustable seats without suspension the head clearance must at least be 35" when the height adjustment is in its **lowest** position. If comparing between a suspension seat with 3" of vertical travel and an electric seat with 2" of vertical adjustment, the electric seat can be mounted higher off the floor and still meet the head clearance requirements.

Seating choice for driver and officer seats can affect the installed seat height, which can affect comfort, lines of sight to controls and out the windows, and distance to controls.

Per NFPA standards, the seat-to-ceiling height shall be measured at the lowest surface in the area immediately above the projected area of the seat as it moves through its horizontal travel with any soft headliner material depressed by hand (14.1.7.3). H-point height can be approximated at 3" above the compressed seating surface according to the Annex of NFPA 1901. However, this approximation can give a result far different than the actual H-point of the seat. This is because firmness of the foam, type of foam support and foam contour all affect H-point. Seat manufacturer's and chassis builder's measurements should be used whenever possible to determine H-point clearance.

### ACCESSORIES AND ADDITIONAL COMFORT FEATURES

#### AIRBAGS AND PASSIVE SAFETY SYSTEMS

Fire trucks are notoriously top-heavy and therefore at a greater risk of rollover. Many fire trucks install cab side airbags, however, many seat manufacturers now have side airbags available right from the seat side.

Typically, these are deployed as part of an overall rollover protection system of pretensioners and suspension pull downs. These systems tighten every seat belt to keep occupants in their seats securely, then pull down the suspension seats to



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the lowest position to increase survivable space. Lastly, side airbags in every outboard position deploy to reduce head and neck injuries.

Keep in mind that safety system integration can affect which seating options are available. Air bags require a minimum "deployment corridor" or gap to expand through. If there is not sufficient space, then the airbag will not deploy to the correct position to protect the occupants. To provide enough room for the airbag a chassis OEM may have to limit seat width, seat position or seat type for a particular seating position. Seat belt pretensioners may also affect how the seat can be installed into the cab.

### **ARMRESTS**

Some apparatus seats are capable of mounting armrests. Armrests may be fully trimmed and padded or may just have a molded pad on top of a metal support. Generally, armrests provide improved comfort and can get in the way of ingress and egress. However, in cases where there is a long drive, emergency armrests may reduce fatigue. Armrests will add width to a seat, so consult with your chassis OEM to see if armrests will work with your cab layout.

### **BACK SUPPORT WITH SCBA REMOVED**

Seat manufacturers offer several types of products to cover the SCBA cavity. One product is a padded fabric panel that hangs at the front of the SCBA cavity. This can offer some limited support when the SCBA is removed or it can sit between the SCBA and the occupant in non-emergency situations to provide additional comfort. A second type of product is rigidly fixed to the seat frame and provides a positive backrest for the seat occupant. When considering optional back supports, consider how and when they might be used and specify accordingly.

### **FACE MASK AND EQUIPMENT STORAGE**

Some seat manufacturers offer a flexible storage pouch and/or an integrated hook for SCBA seats which can be used for storing the SCBA face mask, gloves, or other items. Depending on the seat position or the cab configuration, these storage pouches may be difficult to access once the cab is fully outfitted.



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### **INTEGRATED ELECTRONICS**

Some seat manufactures offer integrated communications technology, either in the form of a removable headset or integrated microphone into the seat headrest itself. This technology can enhance intercom or dispatch communications and comes in a wide range of options.

Some seat manufacturers offer low-level directed lighting options as well as integrated USB charging ports for dedicated and easy occupant access in all seated positions.

### **TEMPERATURE CONTROL**

Some seat manufacturers offer seat heating and/or seat cooling. While these features may be useful in automobiles, they may have limited value to occupants when wearing thermally insulating turnout gear. In cases where turnout gear is not worn while the vehicle is in motion, as can be the case with drivers and officers, the option of seat surface heating and/or cooling can provide increased comfort over long drives.

In all seating positions, seat heating or cooling can also aid in recovery of rescue personnel after an emergency event. A heated seat can help raise body temperature after cold exposure, whereas a cooled seat can help reduce body temperature after extended heat exposure, such as in a fire fighting environment.