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How to Evaluate Bailout Systems

Given the risks firefighters face every day, more and more departments are acquiring personal bailout equipment for their firefighters. There are a number of options available, at various levels of complexity and price. Thus, choosing the best solution for your department is becoming more difficult…but it is important that firefighters are sufficiently equipped for safe, reliable bailout when the need arises, while meeting your department's budget considerations.

This paper outlines the various criteria on which personal bailout and rescue equipment should be evaluated for safety, reliability, ease of use and practicality, as well as cost.

PRACTICALITY FACTORS

How bailout systems perform for the user goes beyond the emergency bailout situation. Factors of practicality include considerations of comfort, ease of use, portability and versatility.

Comfort – To be ready, firefighters need carry their bailout system every day on call. As a result, the first requirement of a good bailout system is that it is comfortable to carry. Does the pack fit close to the body? Does it spread the load around the body so as not to affect balance? Does it allow squeezing into tight spaces? Does it allow for safely sitting on the contoured seat of a fire truck with a seatbelt on?

Ease and speed of use – Things can go wrong in a hurry, so firefighters need to be able to get out fast. The bailout system must deploy instantly and flawlessly. Rope must deploy without pulling and without twists and kinks that can jam equipment.

Ease of pulling rope through – Once a bailout system is rigged, the firefighter must get from the anchor position to the window (or other escape point) easily. That means rope must flow through the system easily and smoothly too.

Size and weight – Bailout systems are useless if they are sitting on the truck. Already burdened with a heavy load, firefighters are less likely to carry their bailout equipment if it is too heavy or cumbersome.

Use for training – Even the very best bailout equipment requires training to be used flawlessly in an emergency. That means the system must accommodate affordable, repetitive training. Systems with locked-in ropes cannot be used practically for training. Bailout systems that make it easy to change ropes can be used for training by allocating rope for training.

Use to save multiple people – Sometimes others may need to be rescued at the same time as the firefighter bailing out. Systems that allow consecutive descents, quickly and easily without re-rigging, can save lives. Not all systems can get three people down from a 4th floor window in less than one minute.

Works with a variety of anchors – Different firefighters like to use different types of anchors – the Crosby hook, RPI hook, CMC hook and others are all popular. The bailout system must be designed to work with any type of anchor to accommodate the firefighter, not the other way around.

Construction – Firefighters are rough on their gear, and the fireground is even rougher. Bailout systems designed for firefighters must be built tough, with sturdy construction and materials, and ropes that stand up to the heat and harsh conditions.

SAFETY FACTORS

The very nature of bailout equipment means it is used when lives are on the line. A number of factors can help determine whether a particular bailout system is truly safe and reliable in such an extreme situation.

Hands free operation – In a bailout emergency, firefighters are not always able to think clearly. Their hands may be burned and they may be blinded by smoke. Setting an anchor and rolling out the window may be the limit of what is possible. A manual system can get stuck, leaving the firefighter in the way of the next firefighter bailing out. Or worse, manual systems can fail and leave the firefighter in free fall. A system with fully hands-free operation all the way to the ground can ensure safe descent even in the most extreme circumstances.

Speed-limiting technology – The speed at which you hit the ground after falling just 15 feet is the equivalent impact of a getting hit by a car going 21 miles per hour. By contrast, a bailout device that limits descent speed to a safe 3 meters per second reduces the impact to the equivalent of jumping off a chair.

Guards against free-fall - Free falling for one second – the same as falling from a 2nd floor window – results in acceleration to 22 miles per hour and the risk of serious or fatal injury. All manual bailout systems can result in free fall. NFPA ignores the issue of free fall, so NFPA-certification does not eliminate this risk.

Uses redundant brakes – It's simple – built-in redundancy means a higher level of safety and assurance for the firefighter that his bailout equipment is not going to fail.

Lets multiple firefighters bailout quickly – It is not uncommon for more than one firefighter to be trapped in a bailout emergency. If one gets stuck in a window, or it takes time for each firefighter to orient himself to begin descent, it could result in death or serious injury. If more than one firefighter is bailing out, the bailout system must be "set-to-go" so one firefighter can easily clear the window and get out of the way of the next one coming behind. Step-to-stop systems are slower as they can result in window jams. They also require the firefighter to orient himself and manually release a brake lever to initiate descent.

NFPA-certified – NFPA has two classifications of bailout system certification: "component" and "manufactured system." Each has advantages and disadvantages. A bailout system with component certification means each component of that system has been individually tested and certified to NFPA standards. This leaves you to determine that the individual components all work together well, but allows you the flexibility to select components to meet your specific needs. Manufactured system certification means the entire system has been tested and certified as a unit. This provides assurance that the entire system is

"tuned" to work together, but leaves no flexibility to change system components to meet your needs.

Easy to recover – As a firefighter rolls out the window, his bailout equipment can get caught on the window ledge. A system that makes it easy to recover and proceed can mean the difference between safe bailout and no bailout.

COST FACTORS

When comparing bailout system costs, it is not sufficient to look only at the initial price of the system itself. Consider the Total Cost of Ownership (TCO), taking into account the various cost factors of owning, operating and maintaining the system over time.

Initial cost – What is the price of the system, including all required accessories, ropes and other gear needed to properly carry, deploy and use it?

Training costs – In general, the lower the initial cost the higher the training cost. Less expensive systems often require a higher level of initial training and retraining to use safely and effectively. Some bailout equipment manufacturers demand that they train everyone in the department. Others provide train-the-trainer programs that can save on training costs.

Training equipment costs – Systems with locked in ropes cannot be used for training. This means additional units must be purchased specifically for training purposes. And because rope cannot be replaced, these dedicated training units have a limited lifespan before the rope wears out. Systems with replaceable ropes can be used for training, allowing each firefighter to train regularly with the same unit he carries for emergency use.

Other uses vs. other equipment costs – Systems that are useful solely for individual firefighter bailout require the purchase of additional equipment for other rescue and work needs, such as equipment for travel restraint, ladder rescue, rescue of others, etc. Systems that are highly versatile may be useful for a wider array of applications, reducing the total equipment expenditure.

Rope replacement costs – Bailout systems with multiple redundant brakes, where some of the brakes have "away from rope" braking, result in slower wear and tear on the ropes. A rope used in this type of system will wear out in 80 to 100 bailout revolutions. Rope used in a single-cam brake system can wear out much more quickly - after about 40 bailout revolutions – so ropes will need to be replaced more often.

System replacement cost – Manufacturers specify a warranty period and a useful life for their equipment. Equipment with a limited warranty and useful life must be replaced on a schedule. This term will vary from manufacturer to manufacturer. In general, systems with higher initial costs tend to have longer warranties and longer useful lives. Best is a "lifetime warranty" because it means you only purchase once.

Cost of training injuries - If a system fails during bailout training, the injury to the user can be severe and costly. Estimating relative injury rates from one system to the next is difficult. However, systems that operate hands-free, are speed-limited to prevent free-fall, that are Set-to-Go" to protect against shock load, and have redundant brakes are less likely to result in injury. Systems that require two-hands to operate, are not speed limited to prevent free-

fall, are Set-to-Stop and cause shock load with every use, and have a single brake are more likely to result in injury.

Cost of failure – Failure to execute a bailout in a real emergency comes with a high cost, including the potential loss of life. The lifetime cost of injury for a single firefighter is estimated at more than $18,000 in workers compensation payments, insured medical expenses, lost productivity, administration costs and more. (TriData Corp., 2004). Failing to bailout when armed with bailout systems can result from equipment failure, operator error, injury preventing the firefighter from operating the equipment, or because one firefighter was too slow, preventing the next firefighter from bailing out.