

Auxiliary Braking Systems: The Retarder

By Terry Eckert and Al Conkle

Thanks to the NFPA 1901 Standard we now have to install auxiliary braking systems on apparatus that weigh over 36,000 lbs. GVW. This is a good thing. Brake overheating, wear, and complete failure have always been a problem with fire apparatus. A braking assist is definitely needed. However NFPA stopped short on specifying the braking horsepower required for the weight and for the service brakes that were installed on the vehicle. Often the choice of auxiliary system was not a wise one. Often the cheapest system is installed because of cost and low bidding procedures. The correct choice should be made when you spec a vehicle. Currently there are 4 types of auxiliary braking systems. The price and performance (braking horsepower) varies tremendously. You must also consider your geographical area, for example, hills, top speeds, heavy traffic, distance between traffic lights. A generically built apparatus may not have the auxiliary braking that will best fit your needs. To install the proper system may mean saving your department on maintenance costs and liability problems from poor braking. Review the systems offered by your manufacture and consider your stopping needs. The following is a review of the systems.

1. **The Telma or Jacobs Electromagnetic** retarder is the quickest to react, provides the greatest amount of braking, and takes the least amount of maintenance. That is the good side, now the negatives, They are the most demanding on the electrical system, almost 100 amps per stage when the vehicle is under load, (lights and sirens ect)so when fully applied, all four (4) stages this is an additional 400 amp load on an already taxed electrical system . To compensate for this you need to add a minimum of Two (2) and preferably four (4) group 31 950 - 1000 CCA High Cycle batteries to a regular 6 pack of group 31's. You will also need to go to the next UP size of Alternator to keep up with the electrical demand. Then you must be aware of the extreme heat created by the absorption of "Energy" at the retarder. So you can see this is the best retarder on the market, however for every Plus you must deal with the negatives also. This is also the most expensive way to go. This system has had a history of great success if spec-ed correctly!
2. **The "Hydraulic" retarder, either the Allison or the Voith** are very reactive, work well with ABS and have tremendous energy absorption power! The Hydraulic units are not very sensitive to engine rpm and that is good; they deal with rotor speed or driveline speed. They have a big paddle wheel in a cavity with torisque cups on both sides. The cavity is flooded with oil and the driveline energy is then transferred to the oil via the paddle wheel. This system requires planning on how to apply it. I recommend on Fire Apparatus an 1/3% Auto Apply on the Accelerator Pedal, the second third% on a 2 to 4 PSI switch in the brake system and a third stage apply on an 7-11 psi switch in the brake system. This system makes it all happen quick in an emergency, however it allows it to happen slow and not that aggressive in a normal stopping condition. Biggest downfall on the hydraulic retarder is the "Heat" absorbed by the transmission oil. Now you

- have to cool it, or dissipate/transfer that heat energy. The cooling system **MUST** be sized to handle the heat of the hydraulic retarder. Transmissions overheating warning devices are suggested. The hydraulic retarder is just a little slower to react than the electromagnetic retarder and is just a good bit less expensive.
3. **Compression brakes** (commonly known as “Jake Brakes”) are less reactive than the hydraulic retarder, and do not have the braking ability that the hydraulic retarder have. The Jake Brake is RPM hungry, it needs High Engine RPM to be effective and at times that may hurt applications on fire apparatus. The system uses electrical solenoids to change the engine valve timing, so that the engine compression works as the brake. The new Jake Brakes are much better on the newer 4 cycle engines, are getting much better as far as HP absorption and quickness, and also getting quieter. Jake brakes are the best value for the dollars spent. They come in close to the hydraulic retarder for braking IF THE RPM is kept HIGH!! They have no extreme heat issues, nor do they have high electrical demands. The solenoids and electrical connections are extremely sensitive to moisture or condensation internally in the engine, which may cause problems as engine ages. This system is far less expensive than the electromagnetic or the hydraulic system.
 4. Last but not least is the "**Exhaust Retarder**". Some people confuse this with the compression “Jake Brake”. Although “Jake” also manufactures an exhaust retarder, this system theory and effectiveness is completely different. The exhaust retarder is extensively used in lower HP engines, less than 325 hp. They are the least effective, slowest to react and least costly. They DEMAND HIGH ENGINE RPM for any type of effective braking. The exhaust brake is simply a flapper type valve that closes off the exhaust directly behind the turbo. The unit that seems to be the most effective and most trouble free is the "SMART BRAKE" and the unit that seems to be the least effective and the least trouble free is the Blue Ox, Williams Control.

The last item we have to address is the training the driver/operator needs to operate the braking systems properly. Our newer apparatus is designed to use the auxiliary braking system at all times. The service brakes alone may not be designed to stop the vehicle alone. Your apparatus is always loaded close to the GVW. To turn the system off when normal driving conditions exist could be disastrous. When the retarder is turned off for slippery conditions or overheating, speed **MUST** be reduced, and stopping and following distances **MUST** be increased. It seems we can always tell when a driver returns from a run when the retarder is turned off, the brakes are smoking! The damage is done. Training is a must!

There are some departments that have SOP's not to use the installed retarder. The reasons vary from, it taxes the system, makes too much noise, the chief don't like it. Most technicians, manufacturers and NFPA seem to support the use of the auxiliary braking system. Imagine the liability problems that these type of SOP's could cause, if something happened.