Motor Vehicle Law tightens stopping standard

Truck brakes face stiffer regulations

by Chet Cunningham

If you aren't up to date on happenings in the field of truck brakes, you may not realize that Motor Vehicle Safety Standard 121 is set to go into effect on September 1, 1974. Your truck's brakes will have to put up or get off the road, so start checking your brakes now to see if they will meet the stiffer standards of stopping.

Bill Tauss of the Grey Rock Div., Raybestos-Manhattan Inc., says that many of the current vehicles, both tractors and trailers, could be improved to operate safely with the equipment sold in 1973 and the tighter regulations. Some units will meet the new stopping laws easily, while others might have to be scrapped.

Standard 121 contains a number of requirements for the performance of air brakes. It specifies transmission time, which is the time required to build up 60 psi of air pressure in the brake chambers as measured from the first movement of the service brake control with 100 psi of air pressure in the reservoirs. This is set at 0.25 sec. Release time is specified as dropping from 95 psi in the brake chambers to 3 or 4 psi in not more than 0.50 sec. Brake retardation force at various air pressures is also set. This corresponds to brake efficiency as measured by percentage of 1 G. This is explained as the brake retardation force at the road surface divided by the gross axle weight rating.

What this all means is that rigs built after January 1, 1973, must have better brakes, and most also will have anti-wheel lockup devices.

Problems come up when you consider what can happen if a tractor made prior to the effective date is operated with a trailer made after the effective date. There is a strong possibility of a lockup of the tractor wheels, which probably would mean a jackknife wreck.

If an old trailer was used with a new tractor, the tractor brakes would activate considerably ahead of the trailer brakes and cause increased maintenance and operating costs.

In conducting a test of your own tractor-trailer brakes, look for the following:

• the right mechanical hookup and adjustment of the foundation brakes

• the speed application and release of brake

• uneven brake distribution between tractor and trailer, and between axles or between brakes on the same axle

• overall efficiency of tractor-trailer unit

Problems in any of the four points listed above can result in unsafe equipment, uneven tire wear, broken brake drums, uneven brake lining wear, increased stopping distance, and many more tire-brake problems.

The new brake regulations shorten the required stopping distances, and this means that more than simply better brakes will be needed.

Makers of drum brakes say they can meet this new need with heavier drums to absorb the greater heat generated in shorter stops. The disc-brake makers claim that only disc brakes can adequately meet the new stopping requirements.

Stephen J. Tompkins, president of the auto divisions, Rockwell Standard Co., said, "In our view, the real impact of MVSS-121 is not so much the braking aspect, as it is the impact on the front end of heavy-duty trucks, the axle, suspension, springs, and steering. All of these components will have to be beefed up considerably to withstand the greatly increased torque stemming from the new brakes and the shorter stopping distance."

Most cars have over half their braking power on front wheels. Up to now, most trucks have had little front-wheel braking, and some Western trucks omit brakes on front wheels of tandem axle tractors entirely. Many brake engineers say that the new brake regulations will mean that new trucks will have to use every possible bit of braking effort that can be put on a truck, especially with the drum brakes.

The front suspensions of trucks might need beefing up to take the sudden shock loads resulting from heavy braking. Auxiliary or overload springs, common on rear axles, may have to be put on front truck axles.

Body mounts and frame attachments to chassis may be other side effects of the new stopping distances. The truck engineers have their hands full, not simply with brakes, but with most of the truck.

Understand truck disc brakes?

Most of the firms deep into the business have been working on truck disc brakes for about 20 years. Disc brakes are more of a problem for trucks than for autos. On cars, the discs are usually on the front, where they get good air cooling. On trucks, the point of impact, it does not matter how hard the ANFO has been hit, as long as full detonation occurs. If the initiation is not sufficiently powerful, the detonation of the ANFO will drop below steady state, and die out.

Below a 2-in. diam borehole, the use of ANFO is so marginal as to be of little consideration. Above that diameter, the following velocities can be assumed with only a few hundred feet per second variation:

3 in.	9,000 fps
3½ in.	10,500 fps
4 in.	11,000 fps
5 in.	12-12,500 fps
6 in.	13,000 fps
6 in. or more	13,500 fps

In a few circumstances, ANFO will detonate consistently in excess of 13,500 fps.

This is not to suggest that there will be no point in the column where the ANFO will detonate in excess of 10,000 fps in a 3-in. borehole. When a cast Pentolite primer, whose velocity may exceed 17,000 fps, is initiated, the particles immediately around the primer will take on the initiating velocity. As the detonating wave travels from particle to particle, it will slow down, so that, by the time this wave has reached approximately the same distance from the point of initiation as the diameter of the initiating primer, it will have slowed down to the steady state.

Some authorities say that the distance will not vary at all, some claim that the distance to steady state will vary with the diameter of the borehole, and some claim it will vary with the diameter of the primer. Whether steady state is reached in 3 in., 3½ in. or in 1-in. is irrelevant; the point is that steady state will be reached and quicky.

Not much will be added to the overall effect if additional boosters are added, as they often are, up the column, every 5 or 10 ft. Boosters may not reach their rated velocities, since they may not be detonated in excess of their steady-state velocity. Boosters, even if they are detonated with caps or Primacord, can only cause the ANFO within those three or more inches around them to detonate at a higher velocity. The overall column is largely unaffected. Steady state is reached and, provided the initial velocity is sufficient to sustain detonation, no increase or decrease will occur.

ANFO loading

In field practice, ANFO is loaded in one of three ways. First, and most common, a "down line" of detonating cord is lowered to the bottom of the hole with one or more cast primers or sticks of dynamite attached. These are seated in the bottom of the hole. ANFO is poured into the void, and the hole is stemmed. Secondly, holes may be loaded as above, with additional primers called "boosters" or "overdrives" added up the column randomly, or with precision, depending upon the practice of the loader. Thirdly, and less common but more efficient, holes are loaded with a blasting cap and primer, or dynamite sticks, and stemmed. As long as the hole is loaded at least the distance of the subdrilling with dynamite or a dense explosive, and care is exercised in wiring, this probably is the best method.

Axial priming

With these facts in mind, consider alternatives to end priming of holes. If the initiating process could continue throughout the column, increased velocities would occur. If the hole could be loaded with cast primers, approximating the diameter of the borehole, no ANFO would be needed. While planning to bring the ANFO to higher velocities, keep in mind that there must not be more ANFO in any direction from the initiator than the diameter of the borehole. The answer, of course, is a column of high explosives through the center of the borehole, continuing up the hole as far as the ANFO will be poured.

Large-diameter detonating cord should be used; 400-grain/ft detonating cord is not sufficient to keep the detonation of ANFO from dying out. Pre-split explosives are, at present, the best answer because most of them come in cartridges of ½x24 in. with cardboard spacers provided to keep the cartridges butted end-to-end. They are manufactured to provide one-fourth pound of explosives per foot of borehole. Although 1¼x8-in. cartridges would provide better detonation, placing them end-to-end presents a problem. One way to overcome this drawback is to drop them down a tube of polyethylene previously dropped into the hole.

Once the holes have been charged with a vertical column of explosives, and primed with an electric blasting cap at the bottom, ANFO is poured into the hole, and stemmed. The column will be hit, when fired, with a continuous high-velocity detonation throughout its length. Dynamites used must exceed 16,000 fps. (Experimentation with two component liquid explosives that have very high velocities is continuing, and these may be the axial priming of the future.)

At the point of initiation, always at the bottom in an axial-primed hole, high velocities will occur, and the particles of ANFO will detonate at these velocities. The distance from impact to the wall of the hole is less than 1¼ in., in any direction. Steady state will not be achieved, since annular distance from the point of impact to the mass of ANFO is not enough to allow for a drop, or falling off, of velocity. There are sufficient explosives and sufficient detonation to avoid a "dead press" (crushing of the prills, but not causing detonation, caused when detonation is too fast, as with detonating cord) and sufficient detonating velocity to keep the ANFO from failing to detonate completely. This phenomenon will continue throughout the column.

The result is to bring the velocities of ANFO into areas where they will approximate those of the explosives used to initiate, and without loss of gas production, so inherent in an ANFO shot, and so necessary to rock movement and breakage.

Why is it necessary to find ways to bring ANFO to these high velocities? Theories of rock mechanics tell us that the breaking medium of rock should at least be of the same velocity as the natural frequency of the rock. More complex matters are involved here, but the basic idea is enough on which to function.

To break dense, hard, massive rock a hard-hitting, fast, brisant explosive must be used. Granite is the prime example. Most granite will have a velocity in excess of 16,000 fps. ANFO used in this type of rock will cause bouldering, poor fragmentation, back break, and all the ills of poorly planned blasting projects. There is not the natural brisance for good fragmentation, nor is there the density, and hence velocity, to pull the toe completely away from the new face. Dynamite is expensive as compared to ANFO. With vertically, or axially, primed holes the low-cost explosive

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they usually are on the back, where they get little cooling by ram air, and the brakes do most of their work on slow downhill runs and under heavy loads. So some basic engineering changes had to be made from the auto-type disc brakes.

One firm committed to disc brakes is the Wagner Electric Corp. of St. Louis. Wagner offers a complete line of hydraulic and air foundation brakes. The disc brake for trucks of 15,000 GVW and up is an addition to the company's line.

Here are some benefits claimed for the Wagner disc brake:

- directional stability
- good stopping without periodic adjustment
- resistance to fading due to heat or water
- excellent driver responsiveness
- adaptability to vehicles using air-hydraulic, vacuum-hydraulic, or power-hydraulic actuation systems

The basic design of the disc brake offers benefits in performance, maintenance, and repair. In a disc brake, heat is dissipated from the same surface on which it is generated, and dissipation is faster since the heat is not transferred from one surface to the opposite surface. Some reasons for this better heat dissipation include:

- The friction surface is not affected by thermal expansion of the metal, since most of the surface is at right angles to the applied braking force.
- Sixty to 75 percent of the friction surface is exposed, since caliper occupies only about 25 to 40 percent of the disc area. Thus heat is dissipated directly by radiation and convection without the heat traveling through any metal.

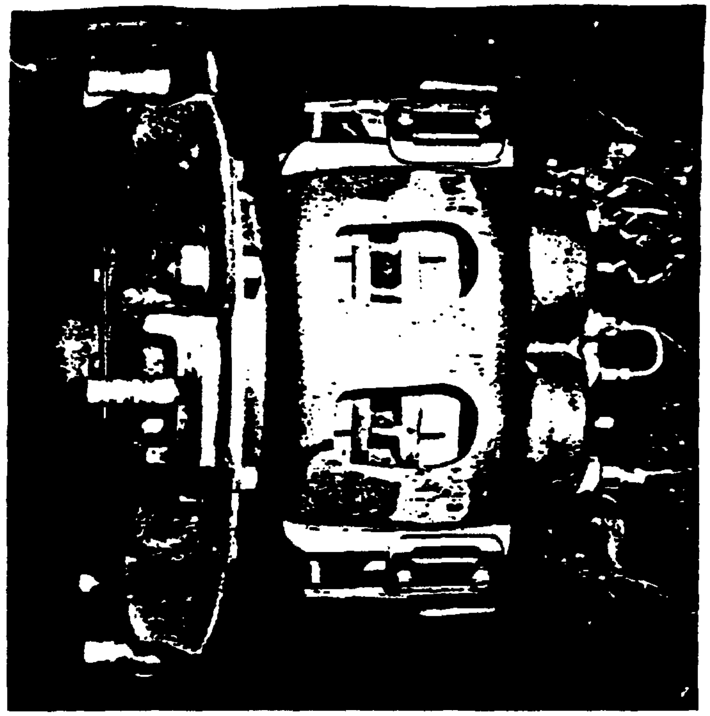
Quick-change linings make maintenance and repair easier, since visual inspection is all that is needed to determine lining condition.

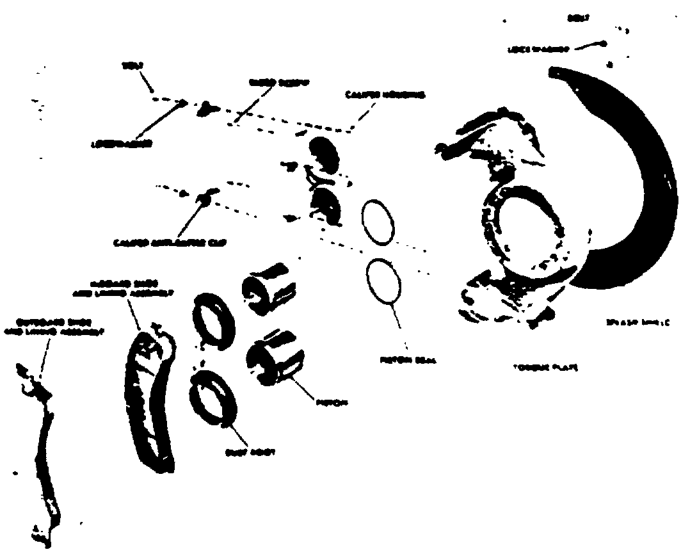
Kelsey-Hayes, another pioneer in disc-brake development now offers *four-wheel* disc brakes *for* trucks. They talk about five advantages to disc brakes for trucks.

(1) Stability—To the driver, this means straight-line stops.

(2) Shorter stopping distances—No firm statistics are available for rock products tests on a comparative basis, but many agree that disc brakes stop rigs quicker.

(3) Cooler operation—Greater exposure, different principle.





Five advantages of disc brakes for trucks are claimed by manufacturers—stability, shorter stopping distances, cooler operation, longer lining life, imperviousness to contamination. Assembled and exploded views of disc brakes for big trucks are shown above. (Courtesy: Kelsey-Hayes Co., Wheel, Drum & Brake Div.)

(4) Longer lining life—Cooler running means longer lining life.

(5) Imperviousness to contamination—No entrapment, self cleaning.

This is just a taste of the new things happening in brakes. Make your own survey, and find out what the new brakes and the new brake regulations will mean to you and your rock products trucks.

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