Maintaining adequate brake pedal height on the GMC Motorhome

The GMC motorhome was designed with 4 rear dual servo drum brakes in the rear and 11 inch disc brakes on the front of the coach, the motive force for actuating these 6 brake assemblies was a 1-1/4" bore dual master cylinder (M/C) coupled to a dual diaphragm vacuum booster. The system by and large worked well although somewhat anemic for a vehicle weighing 12,000 pounds or more.

With the advent of folks adding disc brakes to the rear of the coach, problems arose regarding maintaining adequate brake pedal height. This was generally attributed to supposing that the addition of calipers (being much larger than wheel cylinders) was the cause of this problem. This turns out to be both true AND false. Brake calipers in and of themselves DO NOT take more fluid to actuate as compared to wheel cylinders. The square rubber type piston seal ring and its intricately cut recess in the caliper body is a marvel of engineering technology. This cut recess is not a simple square cut with 90degree walls, the outer wall cut is composed of at least 2 tapered angles. These angles allow the rubber seal to distort outward when the brakes are applied and subsequently retract the caliper piston slightly when the pedal is released. The typical travel of this piston is well under 10 thousands of an inch when retracted by the square seal ring.

The causes of low pedal height can be summed up as follows: friction material clearances, design clearances and wear in linkages, swelling of hydraulic hoses, slight compression of hydraulic fluid, compression of air bubbles in the hydraulic fluid, bending of pedal, linkages or brackets and deflection of calipers, drums, backing plates or caliper mounts and caliper piston knock back issues. Caliper " piston knock back" issues tend to be greater than the previously mentioned "low pedal" factors put together. There are a number of reasons for piston knock back, these include: Brake rotor lateral " run-out", Wheel bearing slackness & misadjusted bearings. Abnormal retraction of the caliper piston via the square piston seal, Caliper bridge deflection, Sticking of the caliper on its rails or slide pins, Bent wheel spindles.

The largest factor of all contributing to caliper piston knock back and accompanying low brake petal and thus the need for the P-30 type master cylinder is BRAKE CALIPER MOUNTING PLATE FLEX. Two factors are prevalent here #1 – The caliper itself cocks in its mount and #2 – The caliper mount flexing relative to its attachment point on the spindle. The distance of the backing plate attachment point to the center line of the rotor disc also has an effect on the piston knock back, the greater the distance, the more flex one will get in the backing plate. This is why the modified Caddy backing plate is unsuitable for the GMC, it was barely suitable for the Caddy, which weighed less than half of what the GMC weighs. Similarly the Harrison backing plate suffers from the same problem, in that its attachment axis is offset significantly from the rotor axis. The material thickness of the Harrison type mount coupled with the 12.5" rotor, ensures the plate will flex and cause piston knock back issues.

We all would like wheels for our GMC that could accommodate 12 or 14 inch rotor discs but it's the old " be careful what you wish for", most certainly there would be a significant offset but in addition to the offset, just the standard slackness of our tapered wheel bearings will be amplified by having the larger rotor, this is assured to have some effect on piston knock back and having to use a larger capacity master cylinder. There are those that have proclaimed more than once on the GMC net forum that the OEM and the P-30 type master cylinders have more than enough pressure output to lock up all 6 wheels of a GMC motorhome, this is simply not true. There are GMC coaches on the road that weigh in excess of 15,000 pounds and have a braking capacity of 0.4G's or less. General rule of thumb is that eminent " lock up" will occur to one or more wheels at 0.7 to 0.8 G's.
What one has to realize is that by using the P-30 type master cylinder, a loss of approx. 12% of your potential hydraulic pressure is lost. While this might not sound like a lot, it affects all 6 wheels. Let's take the example of installing 12.5" rotor discs on the front and mid wheel set and say and an 11" rotor disc on the rearmost wheel set along with 80mm calipers on the two large rotor discs and a 63.5mm caliper on the rear and using a P-30 type master cylinder to supply hydraulic pressure to them all and then compare that to all 11 inch discs with the same calipers but with the OEM 1-1/4"

bore master cylinder. The potential braking force in the first instance with the large discs works out to 0.73G's, in the second scenario the braking force is 0.75G's, this assumes a 12,000 pound coach in each case. As can be seen, the installation of 2 sets of 12.5" rotor discs is totally negated by having to use the P-30 type master cylinder as compared to the OEM master cylinder. The OEM M/C is assumed to have an output pressure of 825 psi and the P-30 to have 720 psi for the purposes of calculation. Anyone wanting to see or use the calculation spread sheet, just email me and I send it to you.

A big thanks goes out to the gents at the Bean Station get together in May of 2015. Paul Doane, Ken Henderson & Kerry Pinkerton were kind enough to start swapping master cylinder connections from back to front on the OEM M/C and discovered that in fact the primary piston of the M/C does indeed move more fluid per inch of stroke than does the secondary piston. Ie. The piston nearest the vacuum booster moves the most fluid per inch of stroke. I had surmised this in the late fall of 2014 when doing an installation and was puzzled that about 950 psi was showing at the 80mm front calipers but only 750 psi on the rear 4 calipers. Obviously the secondary M/C piston that supplies the rear brakes was " bottoming out", shared this info with Paul and he took it to the next step at Bean Station and proved the assumption correct. This info was published in mid May of 2015 and it's something we all benefit from. A big thanks goes out to all those folk that do beneficial research and share with the rest of us. Gene Fisher's site has probably helped hundreds of folks in the GMC community with questions they had, Thanks Gene and Thanks to all the others who share their info for our benefit.

When I installed my rear wheel discs and calipers back in 2010, I had already purchased a P-30 M/C but decided to at least bleed the brakes with the OEM M/C, probably bled the brakes about 4 times over a period of a couple of months. Every time I got more air out of them and was pleasantly surprised by the pedal height so decided not to install the P-30 until later, like after the pads got broke in, had installed new pads on all six wheels at once, won't do that again, had a good pedal but the stopping ability of the new pads left a lot to be desired. Was pleasantly surprised AND puzzled by the pedal height and attributed the success to the fact that I used a forked caliper mount (same design as the front mount) with an 80mm caliper and a rail type caliper mount on the rearmost wheel set with a 66mm caliper. On our coach, one can feel the start of braking at the 1st. inch of pedal travel and full braking at 2 inches, or in other words, full braking at about 40% pedal travel. The forked and railed caliper mounts go a long way in avoiding caliper piston knock back and subsequent low pedal conditions. Many folks deem the rail mounts as obsolete but if one looks closely, GM is still using them on the front wheels of their 4500 and 5500 series trucks, they are an extremely rigid mount.

To summarize, if one uses caliper mounts that are sized to the calipers in use , ie. No more than say 10 thou. larger than the caliper and are of a sufficient design to prevent the caliper from attempting to twist and a backing plate that minimizes flex , then one should never have to use the P-30 type M/C with all its " bumps and warts", especially now that we know we can get more fluid displacement to the rear brakes by reversing the lines at the OEM master cylinder. If you are not into replacing the old cast iron combo valve with the new brass PV4, Ken Henderson has posted an excellent piece on modifying the OEM combo valve so it supplies equal pressure to all 6 wheels. Do not be complacent about changing out your brake fluid. When pulling our trailer during a tour of Cape Breton Island a couple of years ago, I managed to confirm boiling on at least one occasion, spongy pedal and lower than normal but OK the next day when the steam had condensed back into water, that was with almost 5 years on the fluid. Won't wait that long before the next change. One more thing I should mention, more and more I'm seeing fabric reinforced rubber type brake lines run from the bogie box to the caliper. One must remember that for every inch of this flex line you use, down goes your pedal another few thou. Braided stainless is OK to use from the bogie box to the caliper because of its negligent expansion but REMEMBER, every shortcut one takes on the braking system is cumulative and the height of your pedal will reflect this. Hope I've been some help and if You have questions contact me at ; branscoa@bmts.com ……..Cheers…..Albert Branscombe