GMC Motorhome Parking Brake Deficiencies and Improvements

Objective

- Why the OEM park brake system was possibly designed the way it was ?
- Let us look at the OEM park brake assembly and its various components
- Discuss each of the components and how they might be improved upon

Why the OEM park brake system was possibly designed the way it was ?

- Let's look back to the early to mid 70' s and ponder the philosophy of the North American auto builders.
- In general ; build it as economically as possible, utilize as many parts as possible from existing inventories and satisfy the rules and conventions of the Federal DOT and the standards of the SAE.

Why the OEM park brake system was possibly designed the way it was ?

- Although safety was important and safety improvements were constantly being implemented, they were always done with an acute eye to economics.

Why the OEM park brake system was possibly designed the way it was ?

- If the GMC Motorhome were to have the very best of everything that was available to the automotive industry when it was being built , GM would have probably have canned it in '75 or '76 instead of 1978. The overall cost would been prohibitive .

Why the OEM park brake system was possibly designed the way it was ?

- Corrosion proof components were simply too expensive or not available at all . Also the automotive market does rely on a significant portion of their revenues supplying replacement parts.

GMC Motorhome Parking Brake
Deficiencies and Improvements

Why the OEM park brake system was possibly designed the way it was ?

- We GMC'ers are in a unique position in that we own and drive a vehicle that statistically is three lifetimes old, we look for the best products available for replacements and quite often if there is a permanent fix, we're all for it as long as it is a good value.

Why the OEM Park Brake System Was Possibly Designed the Way It Was ?

- Warranties and competition back then wasn't what they are today. The pursuit of excellence in design and materials did not bode well for the bottom line of the " Big Three"

Why the OEM park brake system was possibly designed the way it was ?

- With regards to our parking brake, it may have been designed on a Friday afternoon or Monday morning.

  However, rumor has it that the handle location was chosen by a hung-over engineer working overtime on New Years day in 1972.

Why the OEM Park Brake System Was Possibly Designed the Way It Was ?

- BOTTOM LINE :

  Our parking brake system is not of sub standard materials or design . In fact it functioned well when it was new. If all new OEM components were installed and adjusted properly it would be quite acceptable even now. Although newer and higher tech equipment exists today at an affordable cost.

From what information I have been able to gather in the last 2 years, I have basically concluded that the OEM parking brake for the GMC currently suffers from the following deficiencies:

1/ Sufficient force could not be applied to 4 rear brake shoe sets to ensure a positive braking effect on say a 6 to 10 percent grade, forward or backward.

2/ Due to the ergonomics of the parking brake handle, or lack thereof it becomes increasingly difficult for some of us to generate the force required to"set" the parking brake properly so it can do its job.

3/ Due to insufficient force being applied to the 4 rear shoe sets, many GMC'ers complained that they "drove away" with the parking brake engaged, perhaps their "tell tale" lamp was burned out , or missed! Or the switch failed. This of coarse leads to all sorts of nasty consequences regarding brake shoes, drums and bearings.

4/ Even though the OEM park brake assembly would meet the requirements of GM and the US DOT in the 70's when the assemblies were new, properly adjusted and "set", it wasn't long before corrosion and old age took their toll on the system.

GMC Motorhome Parking Brake
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5/ Because of corrosion issues and accompanying " oxide jacking" inside the spiral "bowden" conduits, the core cables gradually became tighter and tighter and eventually seized inside the conduits. This of coarse caused the brakes not to release and caused all sorts of headaches for the coach operator.

6/ Since the cost of replacing the original OEM park brake system with a new OEM system is in the neighbourhood of $300.00 , many GMC'ers concluded " why bother ? ", in 3 or 4 years we'll have the same problem with corrosion and huge friction issues and have a park brake system that we can't trust. Also the warranty has long expired , typically lasting 90 days to 6 months from date of purchase.

Let us look at the OEM park brake assembly and its various components

- ❑Brake drums and shoes
- ❑Parkbrake levers and struts
- ❑Shoe bearing pads
- ❑Auto adjusters
- ❑Backing plate spring hardware
- ❑Backing plate wheel cylinders

OEM Park Brake Assembly and Its Various Components

Brake Shoes :

Two different types and two different widths as well as assorted friction materials.

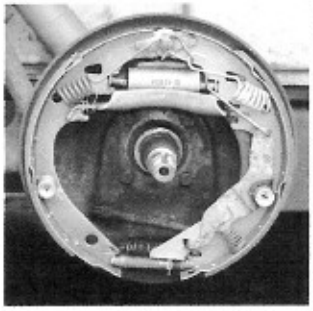


Photo courtesy of Bill Brown

Backing plate wear pads:

Over time these shoe wear pads take quite a beating, when installing new shoes carefully clean and inspect these pads, using a zirconia flap disc one can generally buff out the worst of the wear damage in severe cases the pads have been built up using brazing rod and buffed flat after , due to a new backing plate not being readily available. Ensure these pads are sparingly lubricated with never – seize or a similar compound .

Blank backing plate

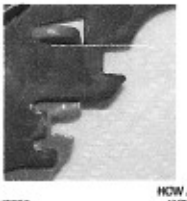
Brake shoes

- Disregarding friction materials, there were two basic shoe configurations. The 1973 and '74 GMC used a shoe set originally designed for the 1969 Pontiac Bonneville S.W. , commonly referred to as a #272 , The park brake lever hole was very high up on the shoe web compared to the later and current shoe used on the 1975 thru '78 GMC's ; the #462 shoe was designed for the 1972 and '73 Pontiac S.W.
- GM essentially recalled all the 1973, '74 and a limited number of '75 rear brake assemblies and reissued completely loaded backing plates of the newer Pontiac vintage, ie. The #462 shoe set.

Brake shoe

- Current shoe type #462 (Low hole)

Note : bottom of park brake lever hole in line with top of piston pushrod notch

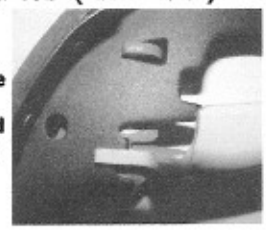


GMC Motorhome Parking Brake
Deficiencies and Improvements

Brake shoe

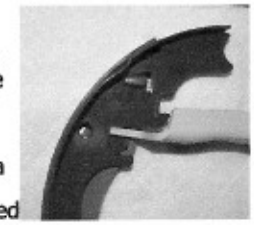
- Current shoe type #462 (Low Hole)

Note how tang on brake shoe aligns correctly with the notch in the park brake lever and that the horizontal strut is centered and level. This is a correct configuration



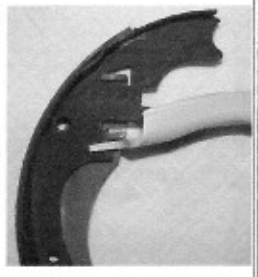
Brake shoe

- This is a pre 1975 shoe ie. #272 with a post 1975 park brake lever, note the severe misalignment due to the high hole on the #272 shoe . This usually occurs when a new owner doesn't realize that GM recalled these assemblies in 1975.



Brake shoe

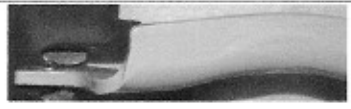
This is a post 1975 shoe ie. #462 with a pre 1975 park brake lever, again severe misalignment due to the lower hole on the shoe and a lever that's too long . This scenario would be very rare due to the recall on the old park brake levers and the inability to purchase new ones.



Brake Shoe / Park Brake Lever Mismatch

- The pre '75 shoe and the current park brake lever is by far the most common mismatch. This type of mismatch will cause severe binding between the cross strut, the park brake lever and shoe. This will impair parking brake operation and to a lesser extent the operation of the service brake as well

Park Brake Strut:



- **Over time the cross strut will wear at both ends leading to excessive play in relation to the PB lever and brake shoe. This will translate to lost motion in the PB cable system. With the total handle travel distance limited to 2.375" , lost motion must be kept to a minimum. With the brakes properly adjusted ; the end play of the PB strut should not exceed 1/32", replacement or building up the worn areas in the notches will be necessary if wear is excessive.**

Auto Adjusters:

- The auto adjusters will work if the coach is backed up with sufficient conviction and the brakes are sharply applied. However the "significant other" will be less than impressed with the rearrangement of the cupboard and fridge contents. THUS: Manual adjustment is strongly advised whenever the brake pedal travel approaches halfway.

Backing plate spring hardware

- The backing plate springs are normally regarded as passive devices, ie. If they are there and in one piece, then all is well. Even if the springs still have the paint on them, they only have a limited lifetime due to constant cycling and heat. They should be replaced at least on every second shoe change.

Backing plate wheel cylinders

- Check for any signs of fluid leakage , rubber boot damage and excessive wear of cylinder push rods.

Park Brake Conduits and cables

- The OEM conduits are of a "spiral bowden" design, essentially a closed flat wire spring with attachment fittings at the ends. The OEM conduit had no outer covering , this is beneficial in that the conduit / cable assembly could dry out after being wetted thus helping to lessen corrosion problems.

Park Brake Conduits and cables

- The inner cable or " strand" is a 1 x 19 steel cable , 1/8" diameter. Sometimes galvanized , sometimes not. This resulted in a steel on steel assembly and friction increases mounted quickly as a function of degrees of bends in the cable system and accompanying corrosion .

Park Brake Conduits and cables

- Cable pull friction is a function of the following:

1/ Materials being used, ie. Steel on steel, galvanized cable being rougher than plain steel .

2/ Total number of degrees of bends in the system.

3/ Total load (pull force) the cable system has to exert.

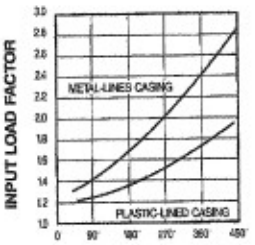
Park Brake Conduits and cables

- Except in very special cases and at the recommendation of the manufacturer , conduit / cable assemblies are never to be lubricated. This will only be a short term fix and due to dirt and metallic particles with accompanying loss of volatiles in the lubricant, friction issues will reappear and be worse than before lubrication.

GMC Motorhome Parking Brake
Deficiencies and Improvements

Park Brake Conduits and cables

- New metal to metal conduit / cable assembly Vs. plastic lined conduits and galv. steel cables. Polished stainless steel cables with teflon lined conduits will perform approx. 50 to 70 % better than even galv. / plastic

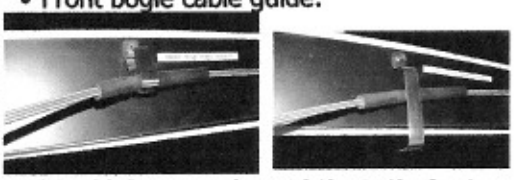


Park Brake Conduits and cables

- Braided stainless steel conduits with teflon liners and polished stainless cables are virtually "bullet proof" they will last a life time provided they are not physically crushed and that their loading is limited to approx. 600 lbs. , ie. A 3.5 to 1 safety factor.

Park Brake Conduits and cables

- Front bogie cable guide:



OEM guide is extremely restrictive to the front bogie conduit movement. It should be modified to a similar configuration as seen in the photo on the right or removed completely.

Photo of homemade conduit guide

Dual Conduit Cable Equalizer

- Brake cable equalizer and adjuster for rear and intermediate axle brake cables. One on each side of the coach, outside the frame rails.

Dual Conduit Cable Equalizer

- **The dual conduit cable equalizer / adjuster turns the rear most cable 180 degrees and allows it to be connected to the front cable via a cable connector.**
- **After a number of years the cable will take a more or less permanent set in the equalizer and corrosion between the cable and the equalizer and between the cable strands themselves will essentially prevent the equalizer from doing its job of balancing the forces applied to the two joined brake cables.**

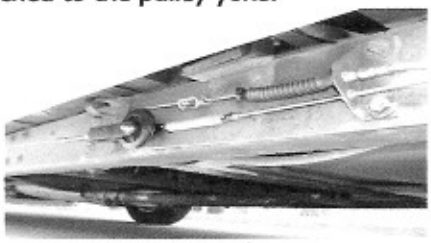
GMC Motorhome Parking Brake
Deficiencies and Improvements

Dual Conduit Cable Equalizer

- To help prevent this problem a number of people have replaced the OEM equalizer with a suitable pulley and yoke assembly. There are a number of folk in the GMC community that sell these pulleys. One pulley possibility is the Stanley garage door pulley, it's about the right diameter. Just seal the small bearing against water and dirt.

Dual Conduit Cable Equalizer

- Note the stainless return spring attached to the pulley yoke.

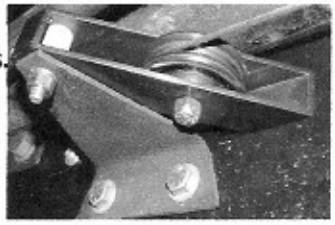


Dual Conduit Cable Equalizer

- The intermediate cable retract springs avoid having to rely on the individual conduit springs to help pull back the intermediate and brake handle cable, thus ensuring positive release of brake shoe tension when the PB handle is released. Together the two stainless springs apply about 35 lbs. pull back force on the above cables.

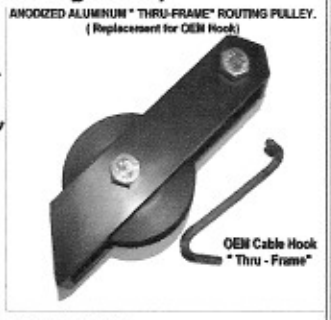
Thru – Frame Routing Pulley

One of these pulleys on each side of the coach to replace the old "S" hooks.

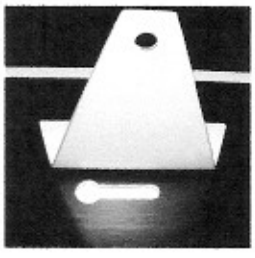


Thru – Frame Routing Pulley

- Pulley is Replacement for the OEM S-hook, pulley mainly added for strength

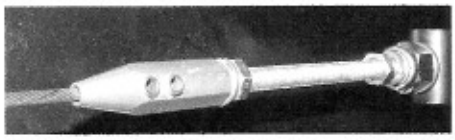


Thru – Frame Routing Pulley



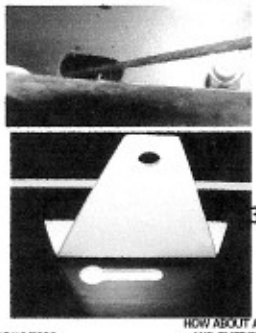
- The keyhole slot in the frame is to provide clearance for the union on the intermediate cable. The OEM slot is approx. 3/8" in height , whereas the new slot is 9/16" in height.

Thru – Frame Routing Pulley



- This union is **not** to be taken apart. A stainless steel cylinder has been swaged onto the cable inside the union to supplement the strength of the two ¼" Allen set screws.

Thru – Frame Routing Pulley



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- **But all is not lost !** When you buy a new frame from the " Frame Doctor" the enlarged slots are included absolutely free of charge !

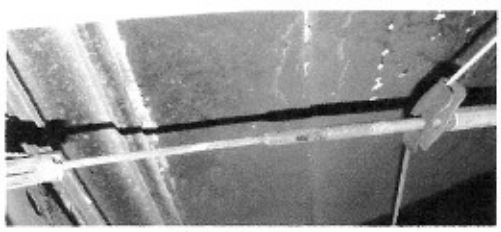
Intermediate Cable

- The OEM intermediate cable was supplied in two lengths , to accommodate the 260's and the 230 coaches as well. Presently there is only one length available to the best of my knowledge. If you own a 230 coach be prepared to tie a few knots in the cable to shorten it up by the required 40 inches. However the new stainless steel intermediate cables come in both lengths !

Intermediate Cable union

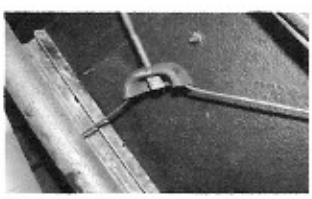
Intermediate Cable

- OEM equalizer to connect intermediate cable to park brake handle cable



Intermediate Cable

- This is the wrong equalizer to use under the coach where the PB handle cable connects to the intermediate cable



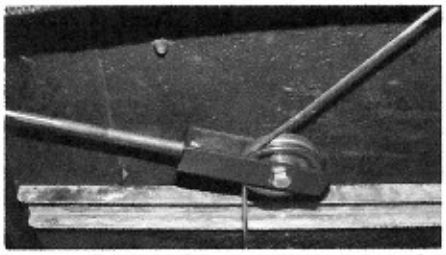
Intermediate Cable

- In the previous slide the equalizer bar is for the dual conduit cables on the side of the coach. With the angles formed by the cable routing , one would have a fixed point equalizer. One can experience differences of 300 to 400 % in pull forces between the two sides of the coach if the cable is old and somewhat corroded.

Intermediate Cable

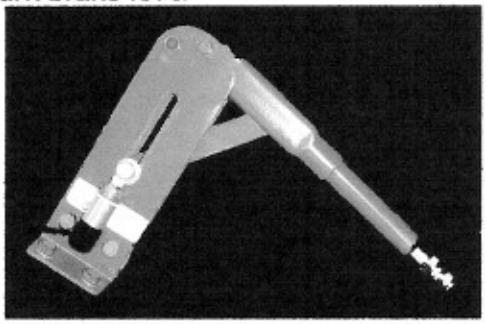
Premium Equalizer **OEM Equalizer** **The "absolutely not" equalizer**

Intermediate Cable



Will balance left and right pull forces to less than 10 % , a 2 to 3 times improvement over OEM Eq.

Park brake lever



Park brake lever

- Due to State and Provincial DOT regulations and civil litigation issues it would appear that we are stuck with the OEM park brake handle and its location forever. I have spent days talking to various state and provincial DOT authorities and the vagueness of their answers was only surpassed by their number of times they requested " please leave a voice message" their general response would make most politicians proud.

Park brake lever

- To "set" the parking brake properly and to achieve the most effectiveness, one should observe the following:

1/ Step firmly on the service brake pedal

2/ Attempt to rock the coach slightly ahead or back in "D" or "R" depending whether the coach is descending or ascending a grade.

Park brake lever

Don't underestimate the effectiveness of the Bendix duo servo brake system! Make it work for you . It's "all in the technique" as I was reminded by an experienced GMC'er who observed me slamming my coach door.

3/ Apply the park brake and try to move the coach under moderate power. It should not move.

Park brake lever

- One should attempt to keep a ¼" adjustment remaining on the PB handle adjustment knob. If less than this amount of travel is remaining, then one should readjust the cables at the equalizers on the side of the coach.

Park brake lever

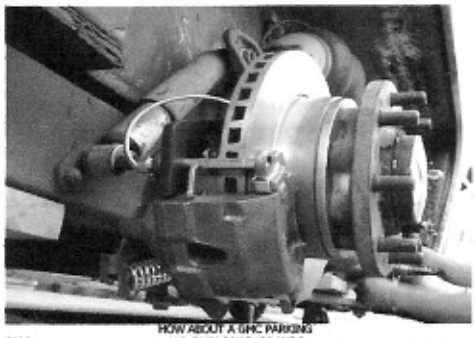
- Relating to our original objectives in summary:

1/ The mechanical aspects of the brake drum and shoe assembly must be addressed.

2/ The cables and conduits must operate freely and be free of corrosion.

3/ The correct technique must be used in applying the park brake.

Disc Brakes



Disc Brakes

- What are our options and what compromises do we have to accept when attempting to apply a park brake function in combination with rear disc brakes ?
- Presently in our GMC community we have generally the following disc brake configurations and perhaps others that I don't even know about.

Disc Brakes

- Large Eldorado type calipers on the intermediate bogies and drums on the rear bogies.
- Large Eldorado type calipers on the intermediate bogies and smaller Eldorado calipers on the rear with park brake feature.
- Large Eldorado type calipers on the intermediate and rear bogies with park brake feature on both.

Disc Brakes

- What's the best combination when considering "service braking" ability in combination with park brake ability and possibly limited emergency braking ?
- " The jury is still out" , at this point we simply do not have enough hard analytical data to answer the above question ! Hopefully we can start gathering it at this rally !

GMC Motorhome Parking Brake
Deficiencies and Improvements

Disc Brakes

- There's no disputing that discs provide the best **"service braking"**, they run cooler, are mechanically much simpler and easier to do maintenance on than drum brakes. HOWEVER: As far as providing a parking brake function or mechanical emergency brake function; Simply put "Discs Suck" , What can we do about this, if anything ?

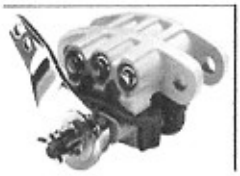
Disc Brakes

- In consultation with the folks at Cinnabar and Skip at TSM Brakes, I have been unable to find out the clamp force exerted by the park brake function of the caliper. None of them knows. I would consider this information a bare minimum when it comes to setting a baseline for park brake performance and evaluation with regards to the Eldorado type calipers.

Disc Brakes

- TSM Eldorado Type caliper. 10,000 lbs. hydraulic clamp force, mechanical unknown

- Hayes ball and ramp caliper, 10,000 lbs clamp force, hydraulic **and** mechanical



Disc Brakes

The Hayes 1-663-1SA Caliper:

Mechanical Park Brake Information:

- Max. lever force @ 4.375" .....450 lbs.
- Lever stroke for 10,000 lbs. of clamp.....27 degrees, or 2.113 inches.
- Lever positions.....30 degree increments

Hydraulic Information:

- Piston Diameter.....2.6 inches or 66 mm
- Max. hydraulic pressure.....2000 psi

Disc Brakes

- **The Hayes 1-663-1SA Caliper:**

  In all fairness the above Hayes caliper will not work on our coaches without a different rotor and caliper mount, but the information simply illustrates that some manufactures do supply this data to their customers and that this data is a must for baseline analysis for calculating park brake requirements.

Disc Brakes

- The following info on the calipers would be most beneficial:

A/ Clamp force as a function of degrees rotation of the PB lever.

B/ Pounds of pull force on the caliper lever to achieve a specific clamping force.

C/ Cable pull distance to achieve a specific clamping force.

D/ Degrees of thread pitch on caliper lever lead screw or ball and ramp mechanical advantage.

Disc Brakes

- On a less scientific and more practical note, what we're looking for is a brave GMC'er in the crowd to stand up and proclaim that he has a set of discs (of any configuration) that work just fine and that his park brake function works efficiently as well , and share with us his secret and let us do some measurements !

Disc Brakes

- What we would like to see is: What magnitude of pull force is required on the Eldorado caliper arm, side cables to hold the coach stationary at 750, 1000, 1250 and 1500 RPM. We have two cable tensiometers that range up to 500 lbs. To measure these forces.

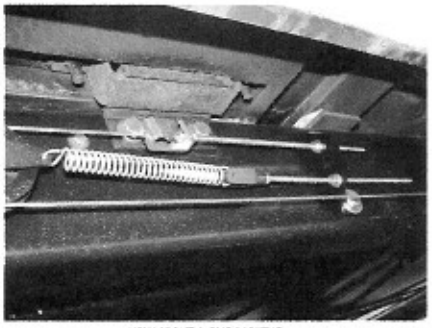
Disc Brakes

- Maryland coach with Harrison discs on the intermediate bogies and drums on the rear.

Disc Brakes

- This coach was fitted with a new frame , suspension parts and a stainless steel park brake cable system recently. The cables were adjusted nominally to hold the coach stationary at approx. 1000 RPM in " Drive", Since the owner didn't have an IR thermometer to monitor the rear drum temperatures it was thought prudent not to adjust the cables any tighter.

Disc Brakes

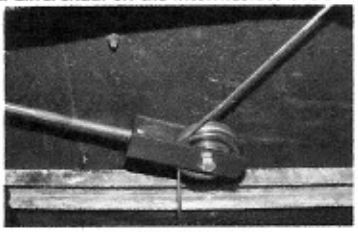


Disc Brakes

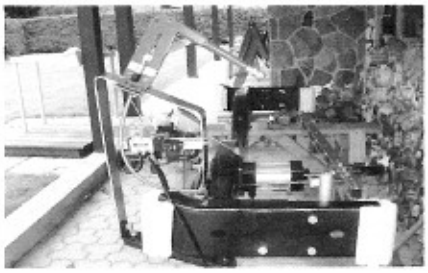
- Since the coach only had rearmost drums the front cable / conduit assembly in the kit was not used. NOTE: The cable connector attached to the rear cable is fitted with a ¼" stainless threaded rod that is attached to a hole in the front bogie conduit bracket. Since the chap was a strapping young lad, we configured the cable ratio to 2 :1, ie. Approx. 275 lbs. Per side on the intermediate cable and 137 lbs. on the drum lever. This ratio could be reversed or made direct 1:1 depending upon the owners requirements.

Disc Brakes

The coach was also fitted with a premium equalizer fitted to the park brake handle cable to achieve the lowest left to right pull differential on the intermediate cable.



Pneumatic Power Assist Actuator:



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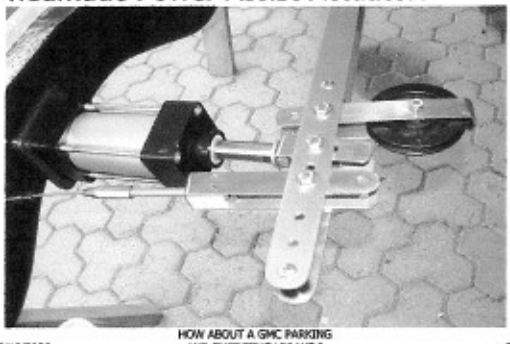
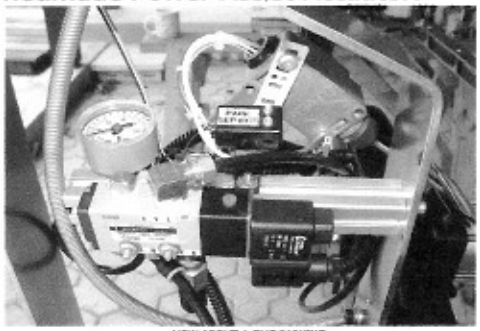


Pneumatic Power Assist Actuator:



Pneumatic Power Assist Actuator:

- Due to State and Provincial DOT regulations and civil litigation issues it would appear that we are stuck with the OEM park brake handle and its location forever as well as its basic mode of operation, therefore a power assist mode on the handle was the **only** option available if one wanted to have a powered park brake circuit.

Pneumatic Power Assist Actuator:

The actuator will have the following features:

- It shall be powered by the coach air system.
- It shall have components that will tolerate a "damp air" supply system.
- It shall permit full OEM operation of the PB handle in the event of an actuator component failure.
- It shall be capable of supplying upwards of 600 pounds pull on the intermediate cable.
- It shall be capable of a complete cycle in under 2 seconds. (emergency brake ?)

Pneumatic Power Assist Actuator:

- Over the years many prototypes have been made, some very good and some so so, everything from spring brakes to snowplow winches to a "tank hatch" opener and closer and even power seat operators. None could really meet **all** the requirements of the previous slide and be a marketable entity as far as I know at this time.

Pneumatic Power Assist Actuator:

- Our first prototype was an electric ball screw actuator. Most folk believe one can set limit switches to the tolerance required for a full cycle in under 2 or 3 seconds. Good luck ! I was never able to achieve it. As well , the last 1/4 " stroke on the park brake handle cable represents almost 70 % of the total pull force. It's extremely difficult to set a limit switch for this kind of resolution and speed. It can be achieved with a current monitoring microprocessor however.

Pneumatic Power Assist Actuator:

- The microprocessor, commercial/ industrial ball screw actuator, hall effect limit switches and H-Bridge switching unit would put the cost well above the $750.00 range, a cost that I felt would simply make the product unmarketable. Only one was built, t'was nice but alas it was one of those things that " seemed like a good idea at the time".

Pneumatic Power Assist Actuator:

- The actuator on display in the commercial area is presently completely duplicated on our coach. About two weeks ago we took the coach out on a flat paved country road and attempted to run an emergency brake test or two.

  Our coach weighs approx. 10,900 lbs and is a 23 footer with OEM rear brakes.

Pneumatic Power Assist Actuator:

- The coach was accelerated to 50 MPH and put on "cruise" , the service brake was depressed just enough to cancel the cruise and bring the stop lights on,

  (the stop light circuit provides power for the actuator solenoid relay) , the coach was left in "Drive" and the park brake was immediately applied. The coach rolled to a stop in 440 feet.

Pneumatic Power Assist Actuator:

- Now 440 feet is nothing to " write home over" but if one takes the old "rule of thumb" that the braking distribution is : 60% on the front, 30% on the intermediate and 10% on the rear. And that a normal hard stop will take about 250 feet, then 440 feet is not that bad.

  It's not just over double the normal stopping distance as one would expect.

Pneumatic Power Assist Actuator:

- It appears as if a very good park brake is achievable and at least a limited emergency brake. Lots of research left to do, any input you can give me would be an asset, ie.. Data, actual experience, photos, technical articles and drawings, etc.

For Questions or Purchase Information,
see www.bdub.net/branscombe/

Or contact:

Albert Branscombe
33 Rae Street, P.O. Box 44
Tiverton , ON , N0G 2T0
CANADA
(519) 368-7129 ~ branscoa@bmts.com