Welcome and enjoy tuning your Manitou ABS+ Compression Damping System! Purposefully engineered to raise your expectations.

The ABS+ Damper is part of Manitou's patent Twin Piston Chamber (TPC) technology. TPC is a damping arrangement that improves consistency and responsiveness by ensuring that oil is always pushed through the damping circuit and never pulled through. This prevents cavitation and reduces aeration.

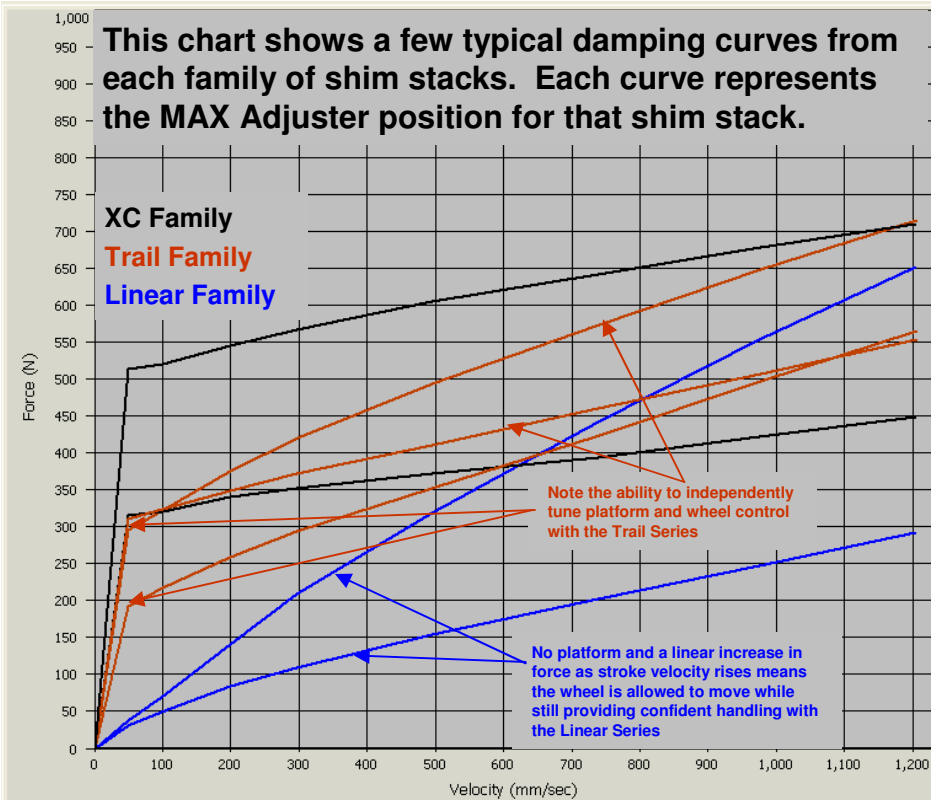
ABS+ is the compression damping portion of TPC. This is basically a shim stack based damper using a special piston design that allows us to create platform force by preloading the shims. Depending on how much preload the shim stack receives, the force required to blow-off the platform can be tuned. Platform can also be completely eliminated, resulting in a system better suited to Gravity applications.

We have presented 3 families of shim stacks, each with a unique characteristic and application. Within each family, there are a range of settings that can be achieved to satisfy any rider preference and condition.

The **XC Family** of shim stacks is primarily focused on the platform force. When a firm platform is needed for XC race/Marathon duty, look here. The platform can be tuned with shim stack to achieve as much or as little blow-off as needed to for your weight, riding style and power. Once the threshold is exceeded, the damping force is relatively flat to allow the wheel to move over the obstacle without any more harshness than necessary.

The **Trail Family** of shim stacks combines the ideal platform force along with a velocity dependant damping characteristic to handle bigger hits and drops without burning through available travel. The possibilities within the Trail Family offer an endless combination of efficiency and compliant control.

The **Linear Family** of shim stacks eliminates all platform and focuses on achieving the best combination of plushness and handling.



PLEASE READ SERVICE INSTRUCTIONS PRIOR TO BEGINNING WORK.

Getting started and using this document:

While revalving your ABS+ equipped Manitou fork takes a modest amount of mechanical skill, you will want to pay attention to details like cleanliness, assembly orientation, oil level, and proper torque. Do not expect to immediately understand what shim stack to select, or what the damping curves mean. Rather, the best way to learn is to experiment. Take notes. Compare the supplied dyno curves to your ride notes. Only after comparing the dyno curves with your observations of ride quality and performance will the level of understanding suddenly take off, and the mystery surrounding suspension will start to disappear. We believe that with this new skill, your riding enjoyment will improve and the value and performance to be realized with Manitou suspension fully appreciated.

When viewing the damping curves, note that each curve represents 1 click on the ABS+ adjuster. The upper most line represents MAX, or lock-out. Each subsequent curve is 1 additional click open. The Vertical, "Y" Axis is Force in Newtons, and the Horizontal "X" Axis is stroke Velocity in millimeters/second. Newtons can be converted to pounds by dividing by 4.448.

When using this information, ask the rider (or yourself) what they like and dislike about their current set-up. Also find out at what adjuster position they ride most frequently. Do they change the adjuster for climbing, descending, or pedaling on the flats? Are improvements needed at these specific positions?

•Do they ride with the adjuster maxed? (Are they using the platform?) If not, consider a shim stack with a lower blow-off force.

•When riding at lock-out (MAX), is the platform solid enough? If not, select a shim stack with more blow-off force. Does the fork bottom too easily, or have excess dive when the adjuster is opened to the preferred plush position? (Does comfort result in a trade-off with control?) If so, then selecting a shim stack with more velocity dependency, perhaps from the Trail Series, will help.

•Note that reducing blow-off or platform force will allow the rider to ride with the adjuster in tighter, creating more chassis control without added harshness.

•Don't forget proper spring set-up, and rebound damping adjustment. Manitou offers spring kits for ACT Air and MARS Air. If a spring is too soft, then stepping up to a firmer rate can improve both RIDE QUALITY and CONTROL! This in turn allows a softer setting on the ABS+, and you are on your way to an optimized set-up that needs little adjusting as the riding conditions and terrain change.

•For TS or ISO Air systems, an extra 5-10cc of semi-bath oil on the air piston will increase the ramp-up of the air spring, reducing bottoming and improving control overall for some riders.

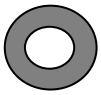
***During service, make sure everything is clean, and be sure there are no dings or scratches on the piston, which may degrade performance.

SHIM INDEX

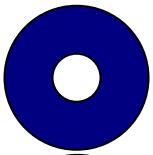
This table aids in understanding at a glance the shim stacks used on each damping (dyno) curve. The shim specs are shown as OD x Thickness, in millimeters (mm). For example, 19mm x 0.15t = 19mm outer diameter, and 0.15mm thick.

When stacking up shims of the same OD, increasing quantity has a linear increase in stiffness, resulting in a linear change in the damping force. Thickness however, has a cubic relationship to stiffness (t^3), therefore, increasing the thickness of an individual shim has a significantly higher effect on damping force.

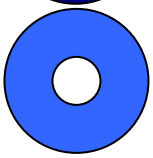
Clamp Shim 11mm x 0.5t
PN: 141-26930-K015



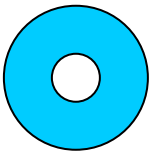
Clamp Shim 13mm x 0.1t
PN: 141-26930-K005



Blow-Off Shim 19mm x 0.2t
PN:141-26930-K013



Blow-Off Shim 19mm x 0.15t
PN:141-26930-K009



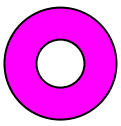
Blow-Off Shim 19mm x 0.10t
PN:141-26930-K004

Clamp Washer 13mm x 1.1t
PN:141-26930-K029

Thickness		Relative Stiffness
0.10	=	0.001
0.15	=	0.00337
0.20	=	0.008

It would take (8) shims 0.10mm thick to equal 1 shim that is 0.20mm thick (OD being equal)

Velocity Dependant Shim 17.5mm x 0.20t
PN:141-26930-K012



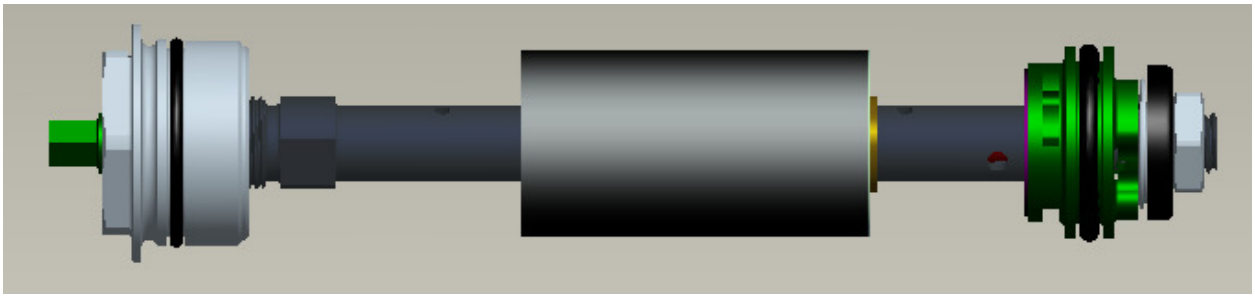
Velocity Dependant Shim 17.5mm x 0.15t
PN:141-26930-K008

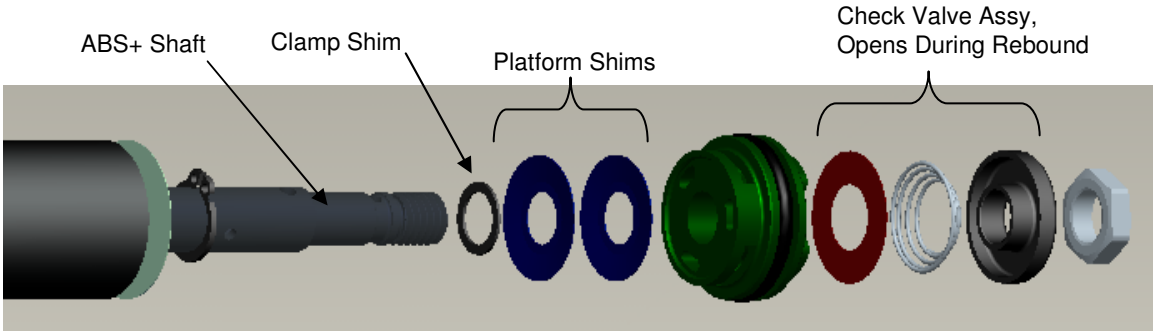
Velocity Dependant Shim 17.5mm x 0.10t
PN:141-26930-K003

Velocity Dependant Shim 15mm x 0.10t
PN:141-26930-K001

Preload Reducer Shim 10mm x 0. 25t
PN:141-26930-K031

XC Series Shim Stacks





The first damping graph in this series is a compilation comparing "MAX" or Lock-Out for each shim stack. Use this to quickly locate the change for your specific situation. Then each of the following 5 damping curves and shim stacks provide the details, with performance at each click of adjustment. The curves have minimized velocity dependency, and are presented at various levels of platform. Different shim arrangements, size, quantity, and preload amounts are used in order to educate the rider or technician on the affects of each type of change.

All graphs are displayed with the same scaling in order to make the differences readily apparent. In some cases, an inset graph with large scaling is included to better show detail.

TUNING TIPS:

1. The best ride quality will be achieved when the platform force is just enough for the needs of the rider.

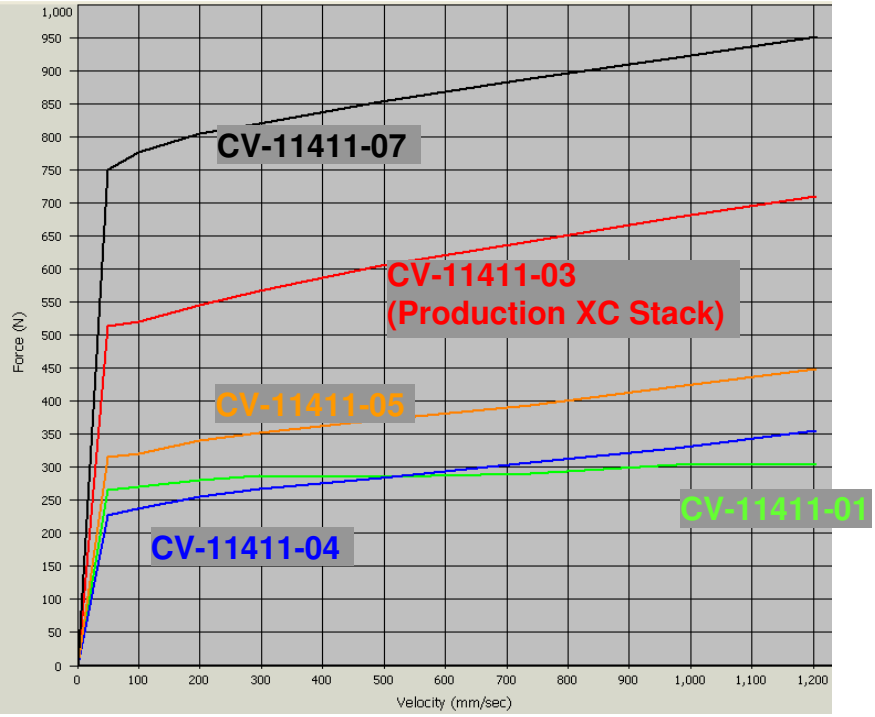
2. A lighter rider, or one with a more upright riding position, may need less platform to achieve maximum efficiency.

3. If the rider does their aggressive pedaling at 1 or 2 clicks out from max, a selection from the Trail series may be more suitable.

4. If a strong platform is needed (XC Race or Marathon applications especially) the XC Series is usually the best bet, as the wheel is allowed to travel more easily *after* the platform is exceeded, minimizing the harshness that might be felt with a high blow-off force.

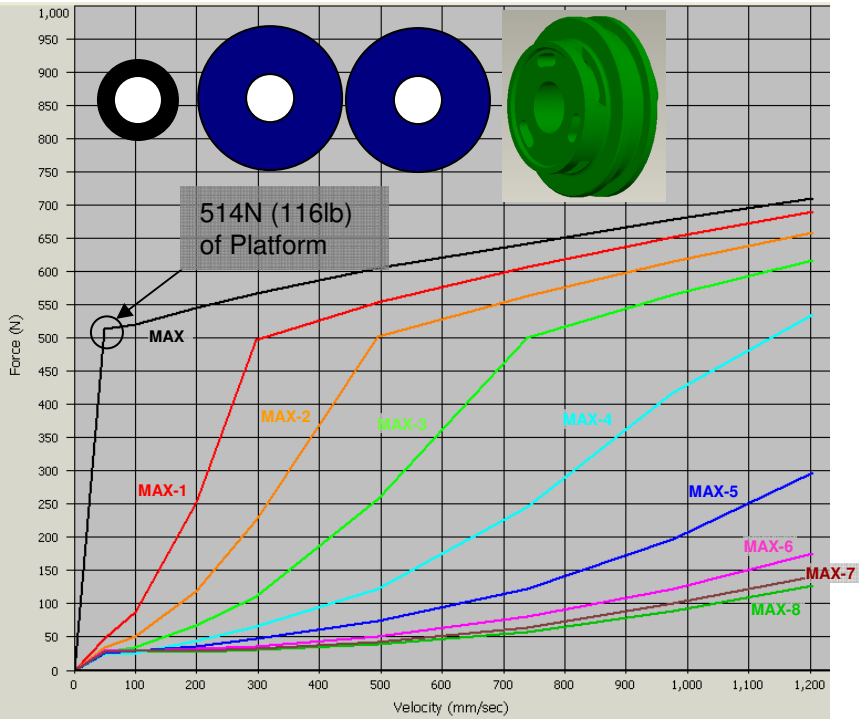
XC SERIES

XC Stacks, at Lock-Out or "MAX" Positions, Overlaid for Comparison



XC Stacks at MAX adjuster position, overlaid.

The technician can develop performance curves in between those shown by adding or subtracting shims from these documented shim stacks.



CV-11411-03

Production "XC Stack"

(2) 19x0.2t blow-off shims provide a solid Platform and some Velocity Dependency because the shims don't lift off the piston very easily as flow increases.

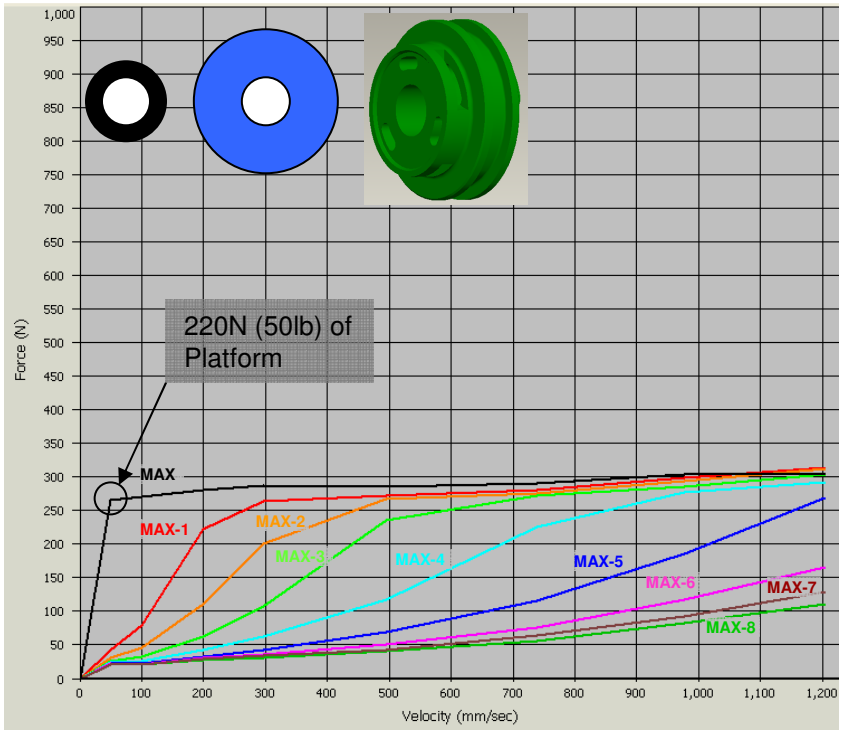
Starting From Shaft

11 x 0.5t x (1)

19 x 0.2t x (2)

Piston

XC SERIES



CV-11411-01

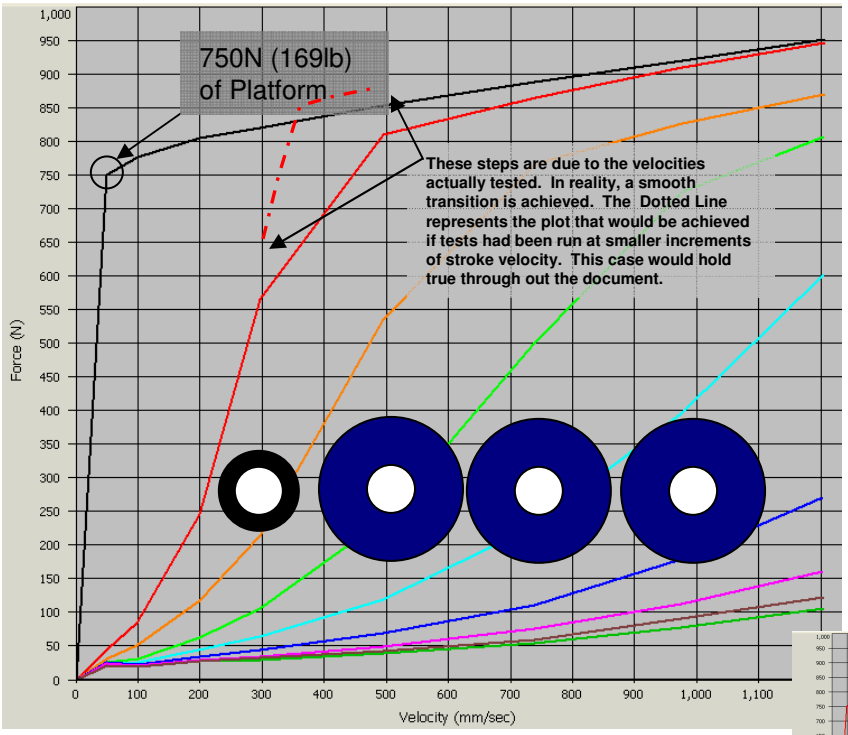
1 Blow-Off Shim

Starting From Shaft

11 x 0.5t x (1)

19 x 0.15t x (1)

Piston



CV-11411-07

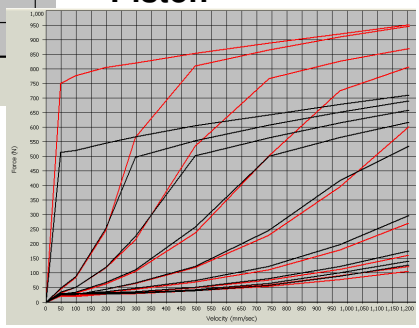
1 additional blow-off shim added vs. the "Production XC STACK". Note the %increase in platform equals %increase in shim qty when thickness is equal.

Starting From Shaft

11 x 0.5t x (1)

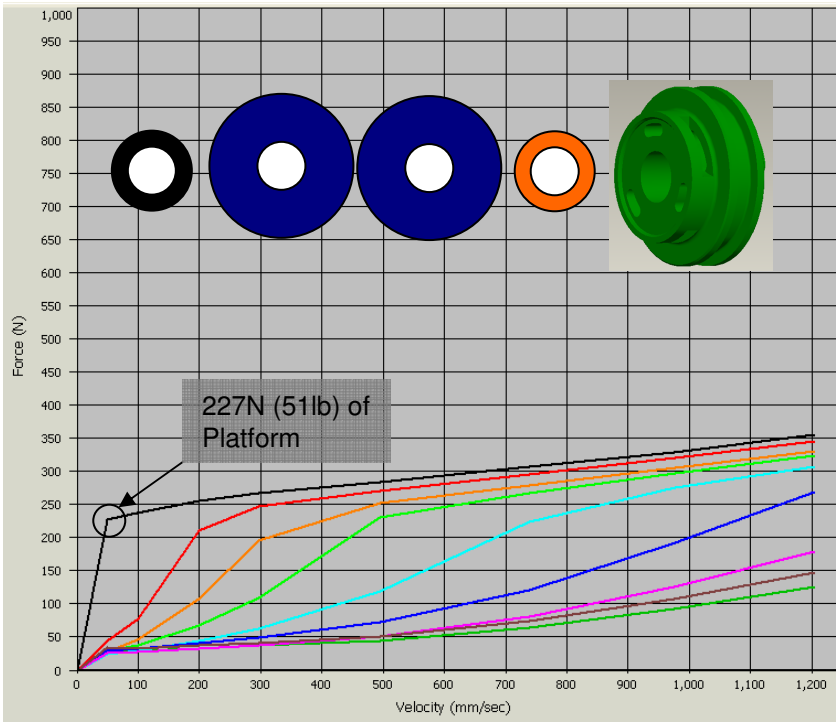
19 x 0.2t x (3)

Piston



CV-11411-07 vs. CV-11411-03 overlaid to highlight the affect of simply adding platform. Prior to shim blow-off the characteristic created by the needle is the same.

XC SERIES



CV-11411-04

The preload on the blow-off shim is reduced by the use of a small shim against the face of the piston. Compare to CV-11411-03.

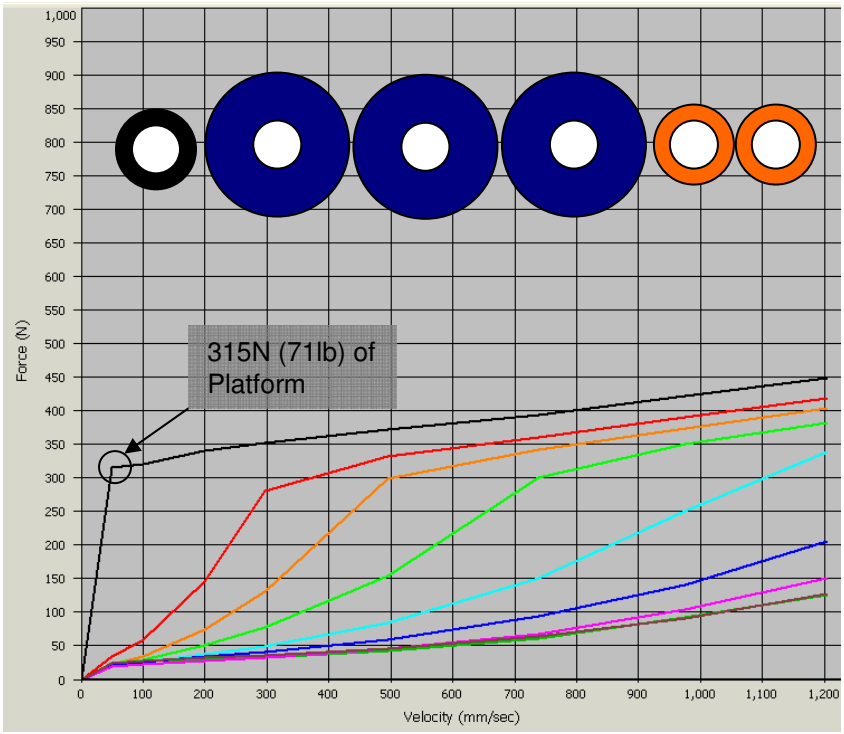
Starting From Shaft

11 x 0.5t x (1)

19 x 0.2t x (2)

10 x 0.25t x (1)

Piston



CV-11411-05

Compared to the above curve, the preload is further reduced, while shim qty is increased. The increase of shim qty was more influential in this case than the reduction of preload.

Starting From Shaft

11 x 0.5t x (1)

19 x 0.2t x (3)

10 x 0.25t x (2)

Piston

Trail Series Shim Stacks

The following 10 damping curves and shim stacks are from the “Trail Series”. The curves gain velocity dependency, by adding a “speed shim” which lays flat on the top of the piston and meters oil flowing out of the 3 oval ports. Compared to the “Platform” shims, the speed shims need to open further to pass a given amount of oil. This causes the shim stiffness, or rate, to become more dominant and results in a damping curve that responds to stroke velocity. The “Platform” shims continue to be primarily affected by the amount they deflect down into the recess in the piston face. This amount of preload, along with thickness and quantity of Platform shims, controls the initial blow-off force. Different shim arrangements, size, quantity, and preload amounts are used in order to educate the rider or technician on the affects of each type of change.

All graphs are displayed with the same scaling in order to make the differences readily apparent. In some cases, an inset graph with large scaling is included to better show detail.

TUNING TIPS:

1. The Trail Series is the place to start for do-everything performance.

2. The best ride quality will be achieved when the platform force is just enough for the needs of the rider.

3. As platform or blow-off force is reduced, the velocity dependant characteristic (every thing to the right on the graph) becomes more and more important.

4. Platform is still useful for those who don’t ride in the locked or “Max” position, because it can be used to generate excellent control and traction feedback especially when the adjuster is 1 or 2 clicks open.

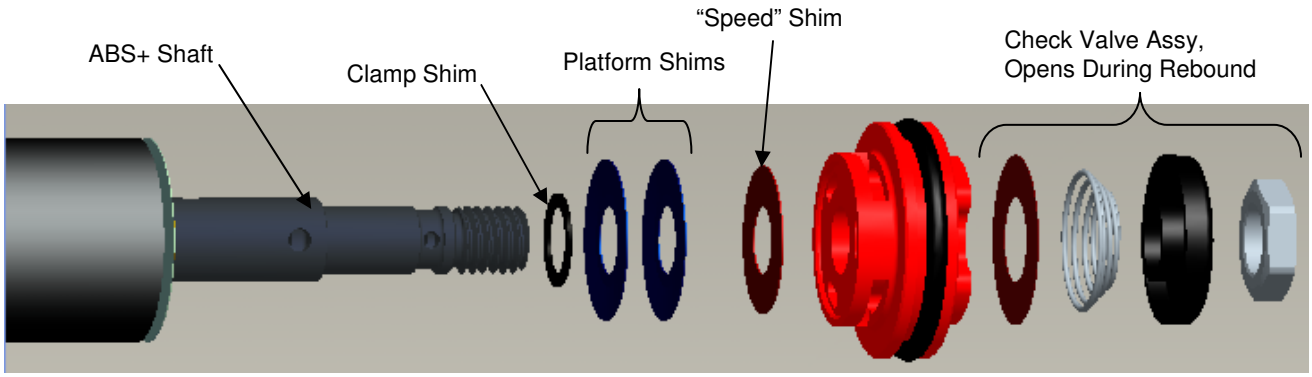
5. Increasing ramp-up or velocity dependency will reduce dive in g-outs, when dropping into a wash, and somewhat during hard braking*.

6. Riders with the XC stack sometimes ask for reduced brake dive and reduced harshness, which seems contradictory at first. Selecting a Trail Series stack allows the use of a lower platform for reduced harshness, increasing the ramp up as velocity climbs for better bottoming control, and the use of an extra click or two in the adjuster for better chassis dive control.

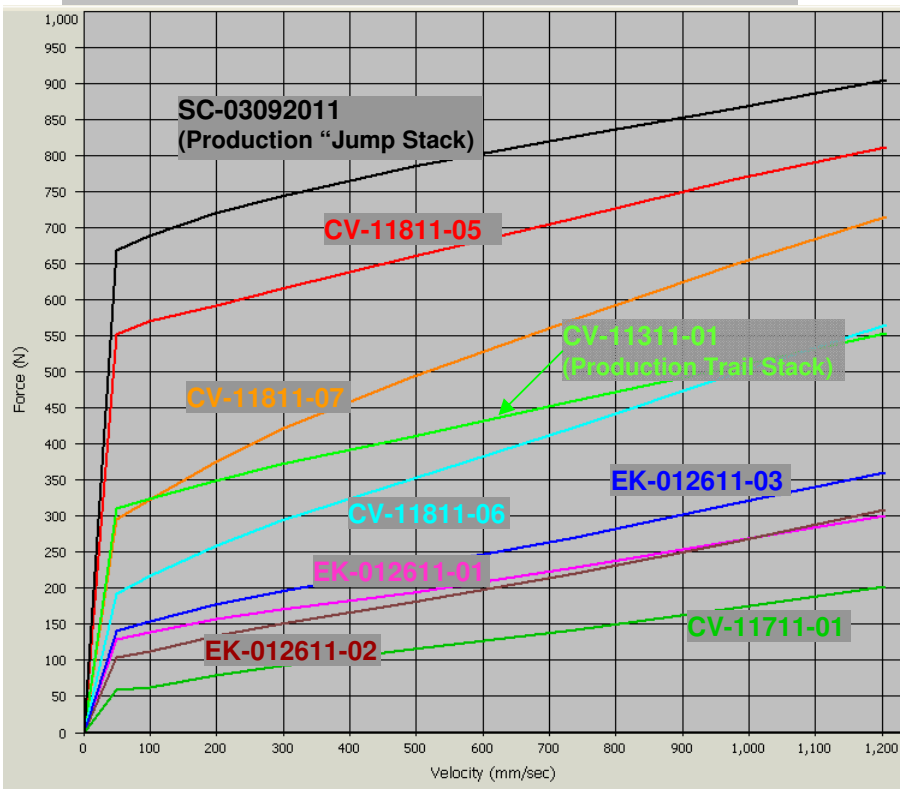
7. Dorado Lead Engineer Nick Pye prefers shim stack EK-012611-02 in his Minute Pro. Nick’s local terrain is described as a mix of technical (slow) single-track littered with roots, rocks and fallen trees with mid-speed flowing sections and the occasional short climb. This set-up has good high-shaft-velocity characteristics for square edge rocks and roots, and the platform is well matched for the platform of my air shock.

* Don’t forget Ride Kits for the Spring! Nothing adds control and reduces brake dive like a firmer spring rate. Conversely, going too firm will hurt small bump compliance and result in unused travel.

TRAIL SERIES



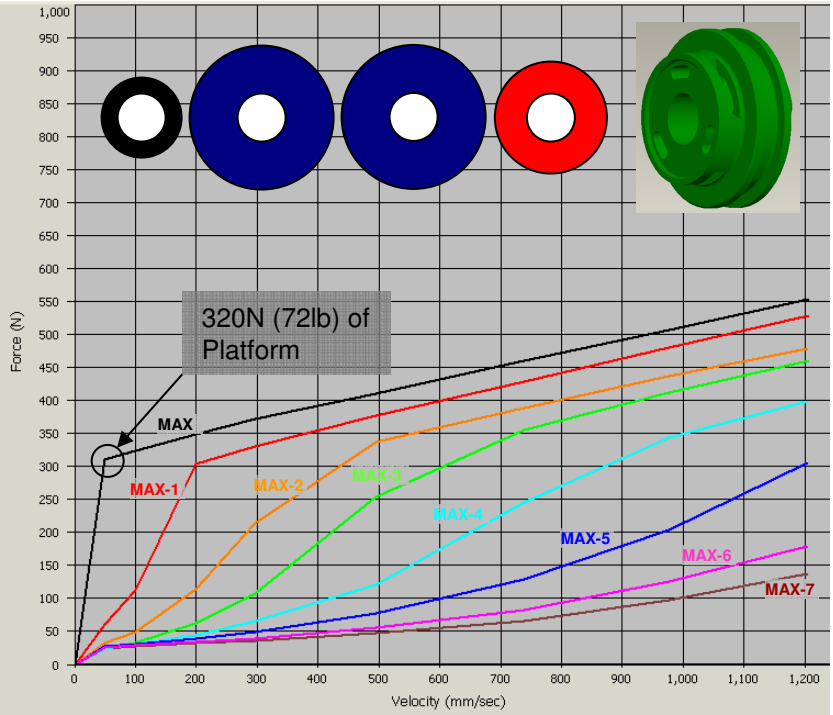
TRAIL Stacks, at Lock-Out or "MAX" Positions, Overlaid for Comparison



TRAIL Stacks at MAX adjuster position, overlaid.

The technician can develop performance curves in between those shown by adding or subtracting shims from these documented shim stacks.

TRAIL SERIES



CV-11311-01

Production "Trail Stack"

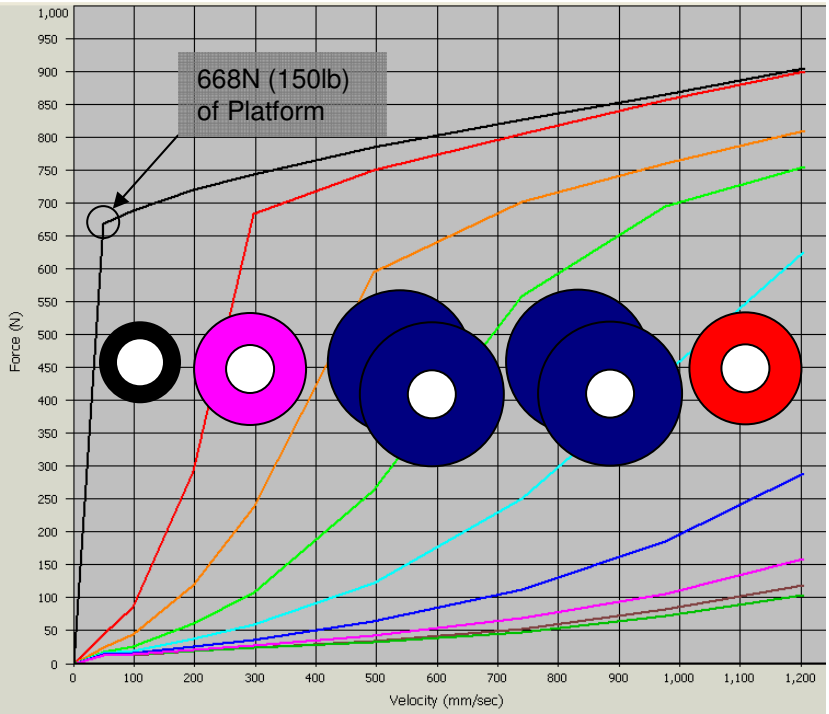
Starting From Shaft

11 x 0.5t x (1)

19 x 0.2t x (2)

17.5 x 0.2 x (1)

Piston



SC-03092011

Production "Jump Stack"

Starting From Shaft

11 x 0.5t x (1)

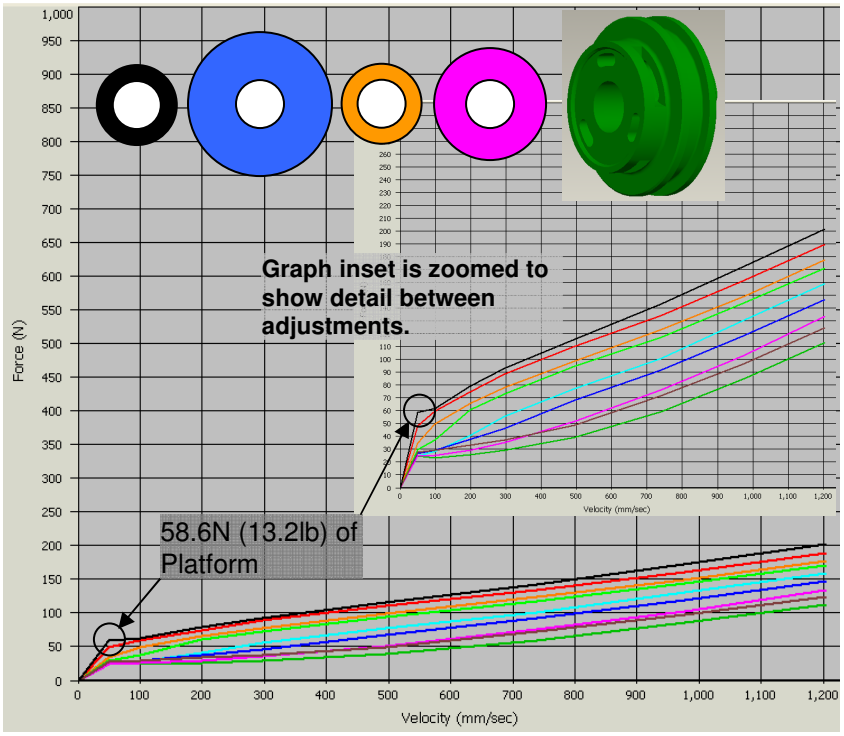
17.5 x 0.15t x (1)

19 x 0.2t x (4)

17.5 x 0.2 x (1)

Piston

TRAIL SERIES



CV-11711-01

Minimal Platform and Minimal Velocity Dependant Shimming.

Starting From Shaft

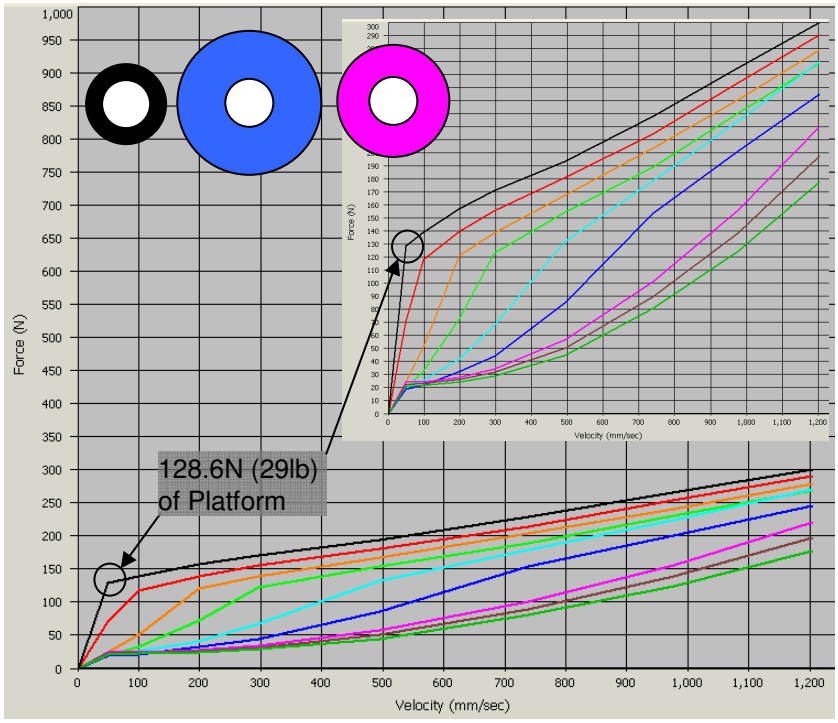
11 x 0.5t x (1)

19 x 0.15t x (1)

10.5 x 0.2t x (1)

17.5 x 0.15 x (1)

Piston



EK-012611-01

Increase platform by removing preload spacer shim.

Starting From Shaft

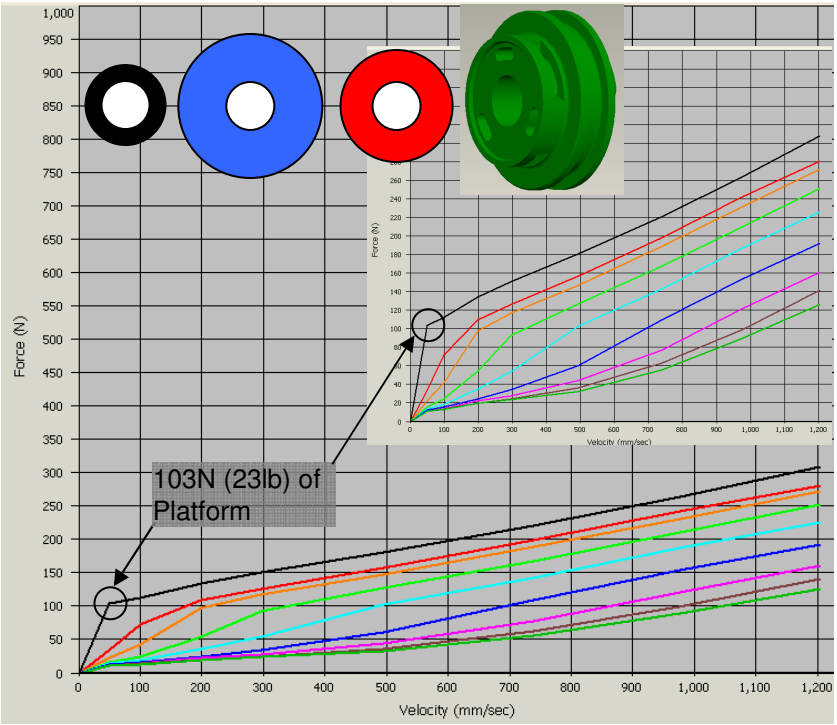
11 x 0.5t x (1)

19 x 0.15t x (1)

17.5 x 0.15 x (1)

Piston

TRAIL SERIES



EK-012611-02

Slightly increased velocity sensitivity seen with a thicker "speed" shim vs EK012611-01, while reduced preload due to slightly thicker speed shim lowers the platform.

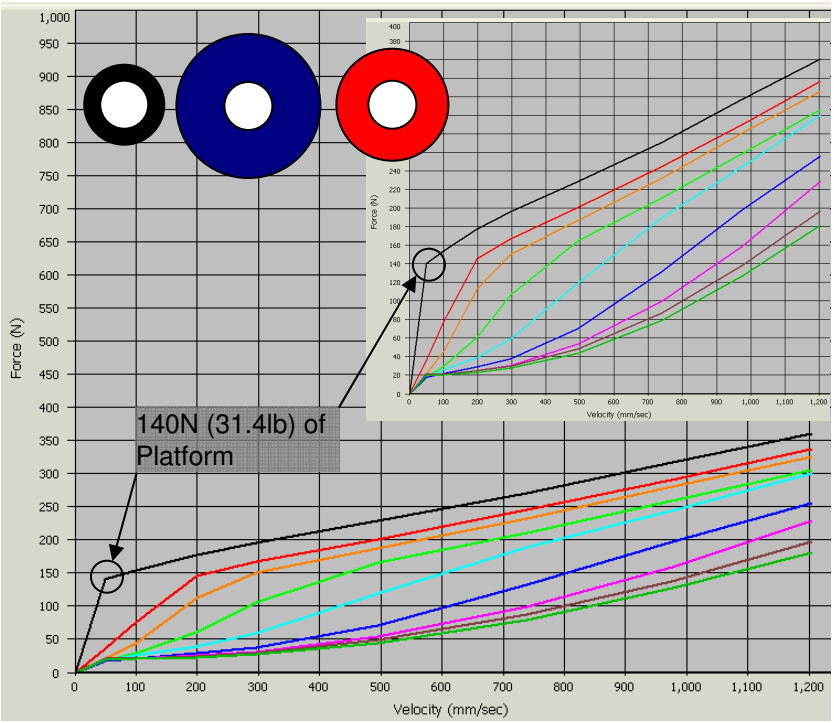
Starting From Shaft

11 x 0.5t x (1)

19 x 0.15t x (1)

17.5 x 0.20 x (1)

Piston



EK-012611-03

Compared to EK-012611-02, the results show a modest increase in platform and velocity dependency

Starting From Shaft

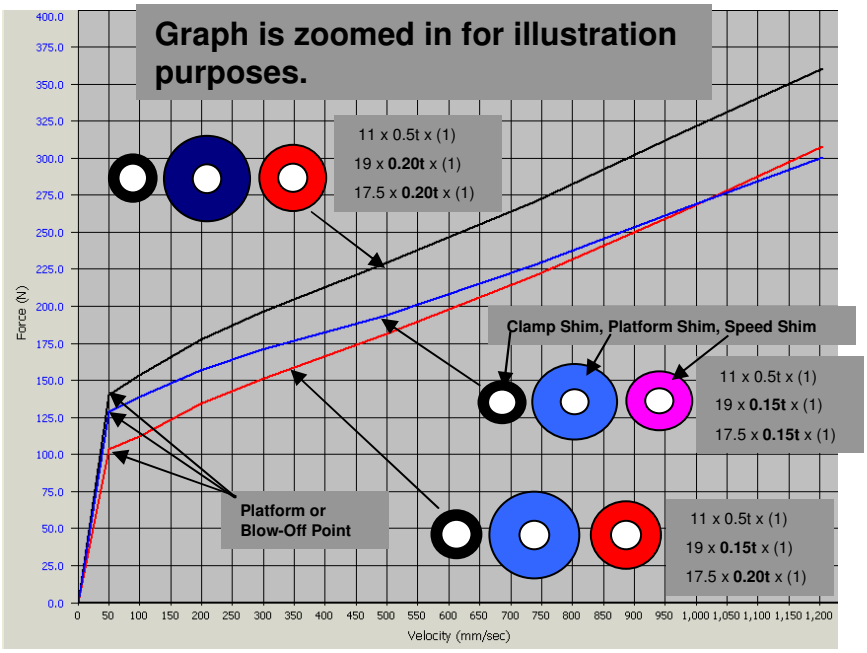
11 x 0.5t x (1)

19 x 0.20t x (1)

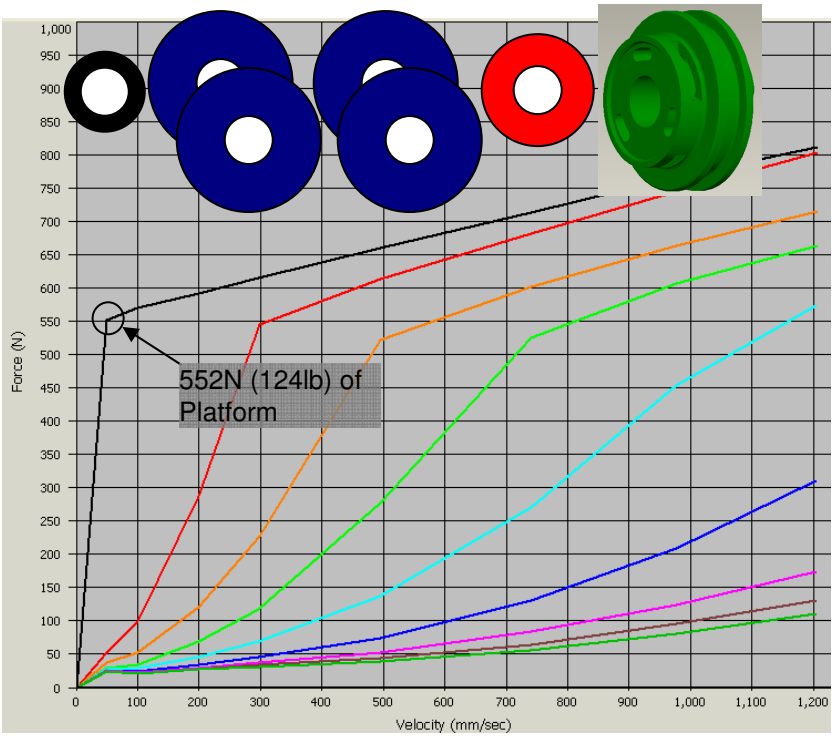
17.5 x 0.20 x (1)

Piston

TRAIL SERIES



This graph shows the MAX position for each of the three previous curves, overlaid on each other. This shows how the slope of the curve increases when a thicker speed shim is used. In turn, this thicker speed shim slightly decreases preload, which reduces the blow–off force. When a thicker platform shim is used, the blow-off force is brought back up.



CV-11811-05

Significant increase in platform achieved with (4) preload shims. Extrapolate in between this and previous curves by going to 2 or 3 19mm shims.

Starting From Shaft

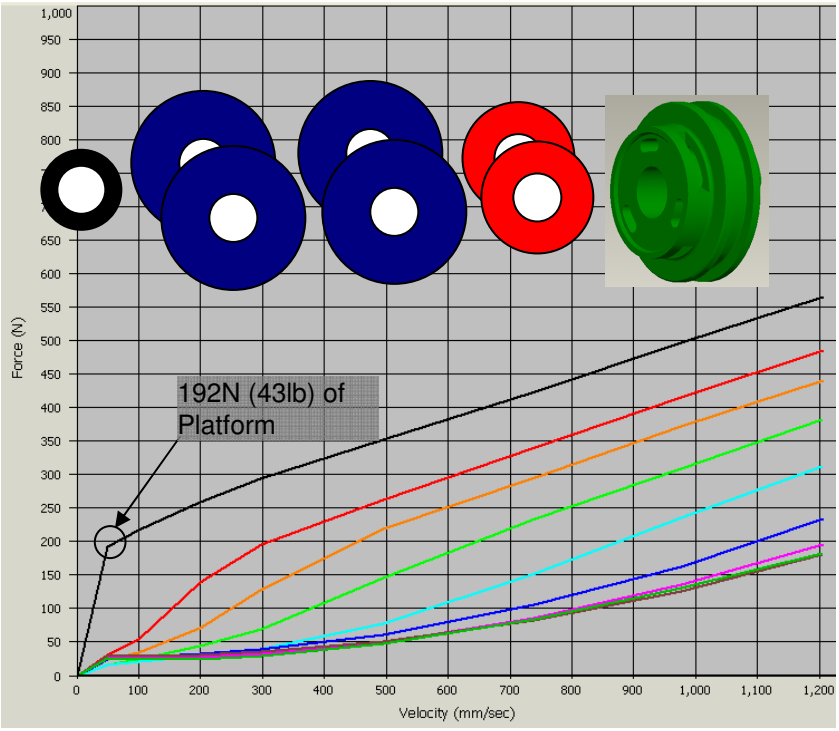
11 x 0.5t x (1)

19 x 0.20t x (4)

17.5 x 0.20 x (1)

Piston

TRAIL SERIES



CV-11811-06

Significant velocity dependent characteristics with 2 “speed” shims. However, reduced preload results on the platform shims.

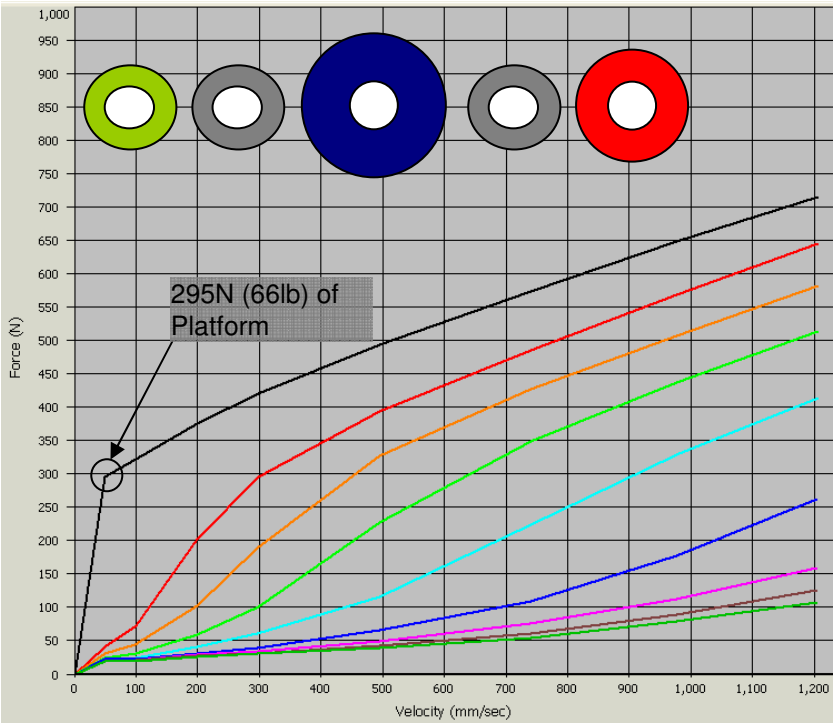
Starting From Shaft

11 x 0.5t x (1)

19 x 0.20t x (4)

17.5 x 0.20 x (2)

Piston



CV-11811-07

This shim stack shows how increasing the clamp shim size enables a reduction of shim qty. A larger clamp shim produces a shorter, stiffer bending length on the working shims. Note that when the clamp shim OD increases beyond 11mm, it is necessary to use a washer to provide support and prevent the clamp shim from becoming a bending shim.

Starting From Shaft

13 x 1.1t x (1)

13 x 0.1 x (1)

19 x 0.20t x (1)

13 x 0.1 x (1)

17.5 x 0.20 x (1)

Piston

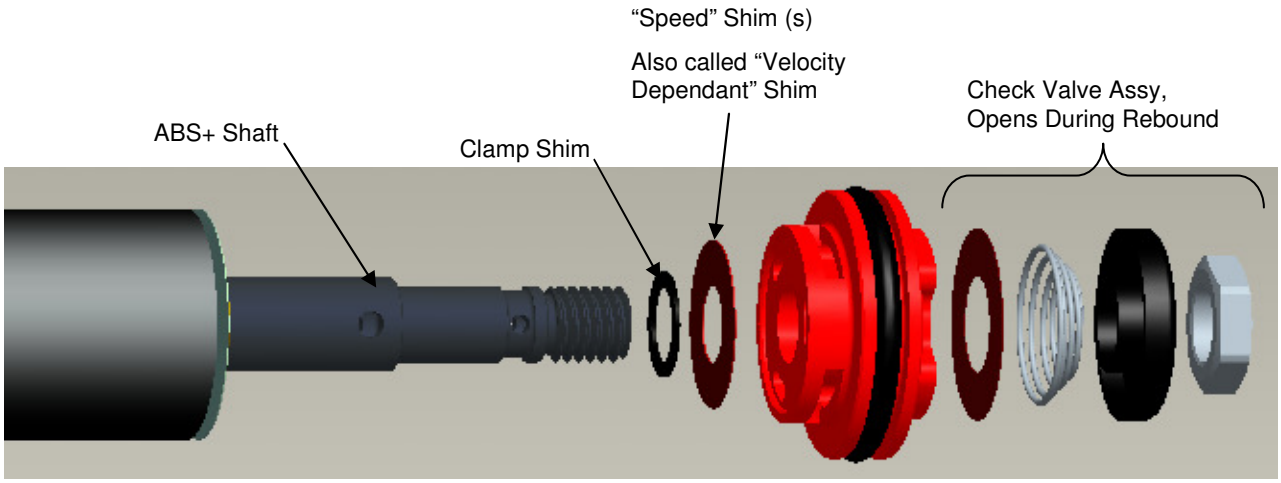
LINEAR Series Shim Stacks

The “Linear Stack” Series removes any platform by eliminating the 19mm shims which sit on top of the raised shelf of the piston. This series of shim stacks is best used when no pedal platform is desired, and big hit plushness, bottoming resistance, and dive control are all needed. Without the platform, the adjuster needle can be run closer to max for improved chassis control (more low-speed damping), while not hurting the fork’s ability to absorb larger inputs.

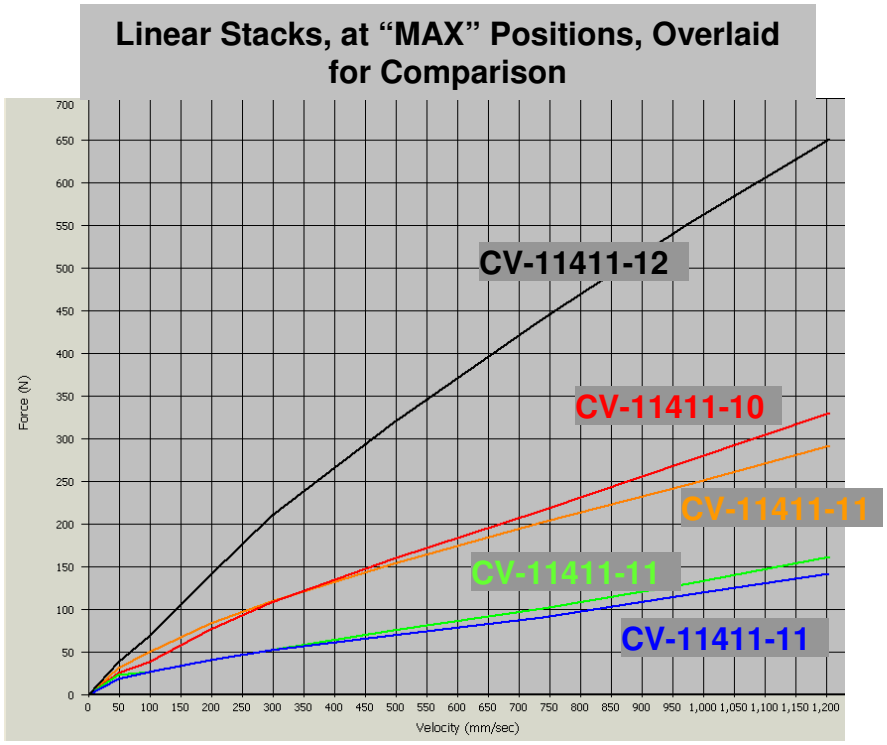
Tuning Tips:

1. Note the damping force generated in your current favorite adjuster position, if using either the production XC or Trail stack or another of the previously shown curves.
2. Look for a dyno curve in the Linear series which has a similar amount of damping in the middle of it’s range (say 4 clicks open).
3. Test this recipe out on your favorite trail. Are you able to gain mid corner chassis control by dialing in the adjuster without loss of ride comfort?
4. Larger clamp shims increase the slop of the damping curve, so this enables a greater increase at high velocity vs low and mi-velocity. (Small bump compliance coupled with bottoming resistance.)
5. Adding more bending shims coupled with smaller clamp shim boost mid-velocity damping force without creating excess damping force at high stroke velocity. (More control with out undue harshness.)

NOTE: These dyno curves are displayed on a larger scale than previous curves in order to better illustrate the differences between each.

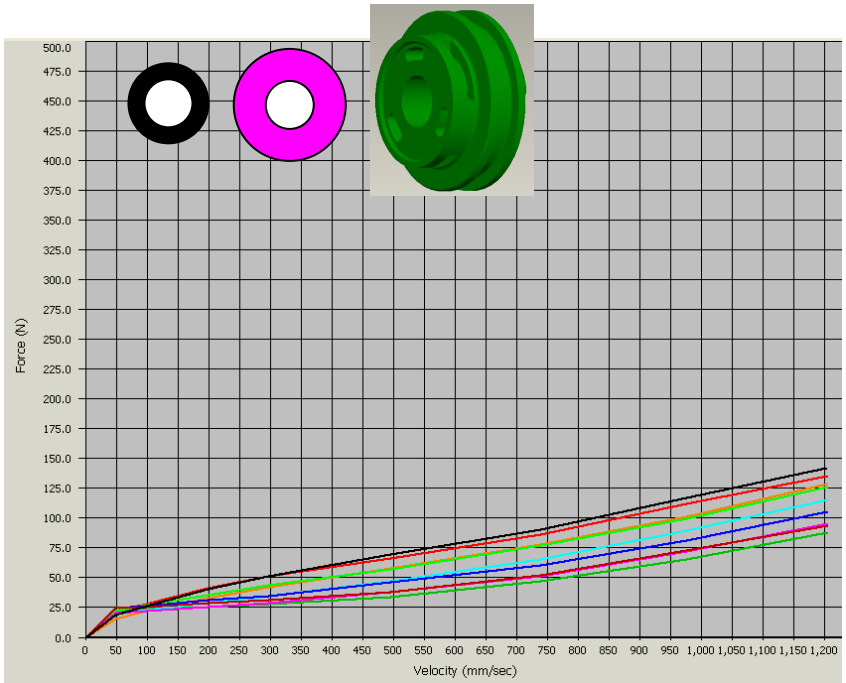


LINEAR SERIES



Linear Stacks at MAX adjuster position, overlaid.

The technician can develop performance curves in between those shown by adding or subtracting shims from these documented shim stacks.



CV-11411-08

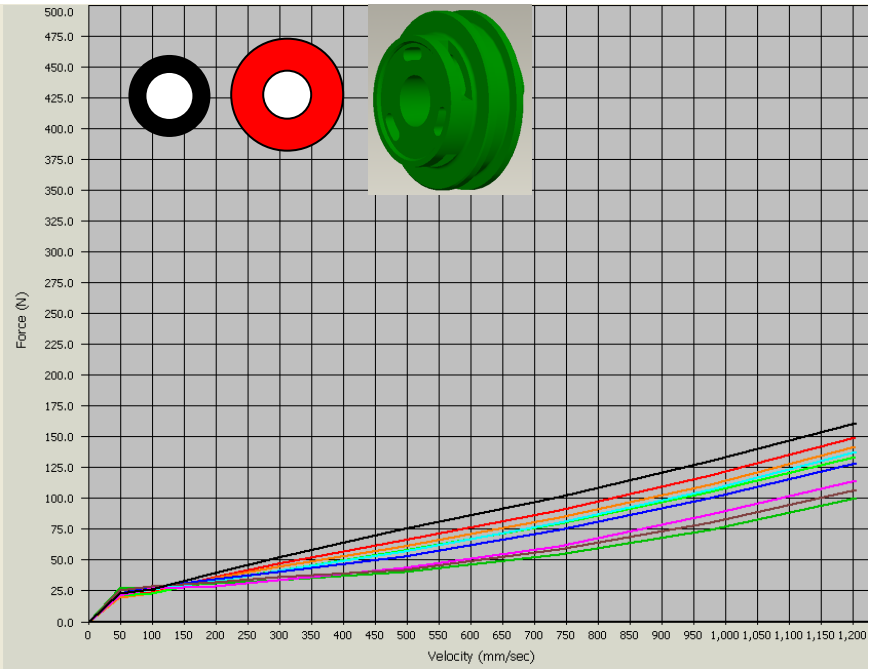
Starting From Shaft

11 x 0.5t x (1)

17.5 x 0.15t x (1)

Piston

LINEAR SERIES



CV-11411-09

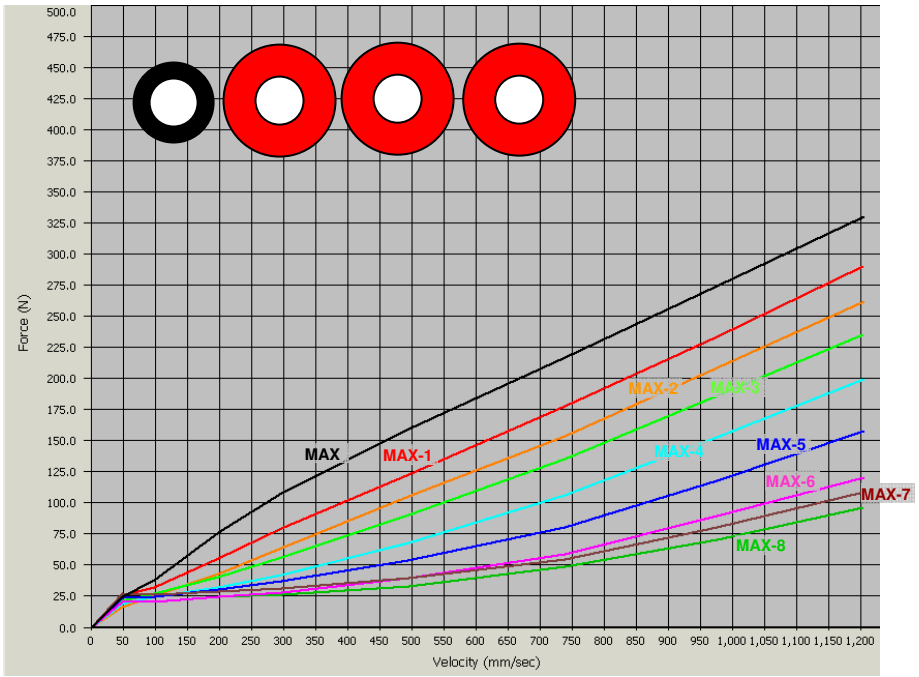
The damping curve rises faster vs. CV11411-08

Starting From Shaft

11 x 0.5t x (1)

17.5 x 0.20t x (1)

Piston



CV-11411-10

Adding 2 more shims provides substantially higher damping force than above graph.

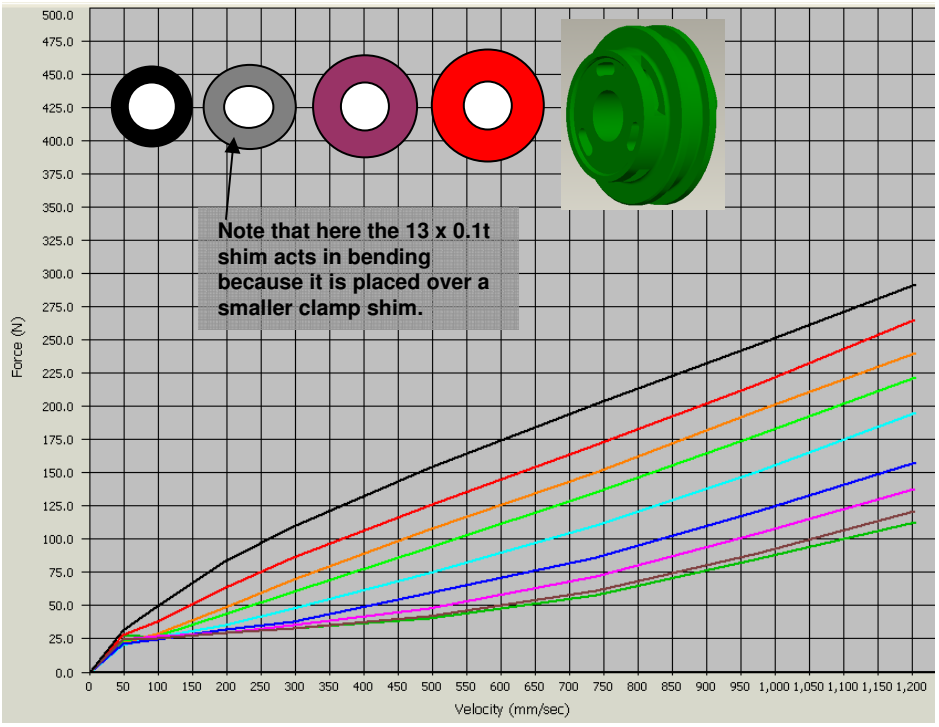
Starting From Shaft

11 x 0.5t x (1)

17.5 x 0.20t x (3)

Piston

LINEAR SERIES



CV-11411-11

Starting From Shaft

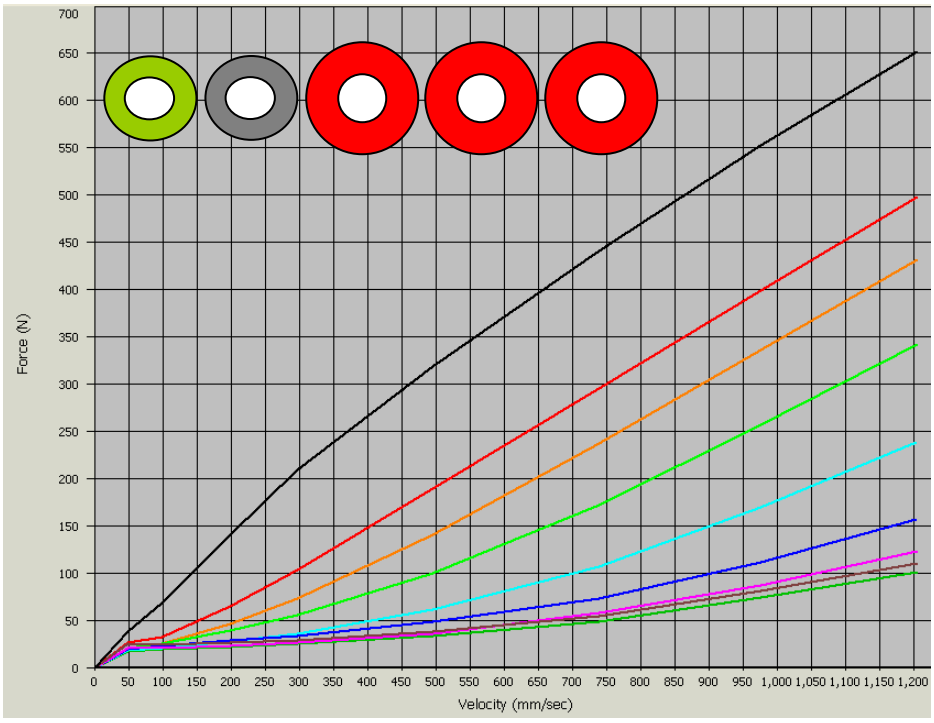
11 x 0.5t x (1)

13 x 0.1t x (1)

15 x 0.10t x (1)

17.5 x 0.20t x (1)

Piston



CV-11411-12

Note how increasing the clamp shim diameter has a dramatic effect on the curve vs CV11411-10

Starting From Shaft

13 x 1.1t x (1)

13 x 0.1t x (1)

17.5 x 0.20t x (3)

Piston