A-Team Marauder Tuning with Hammer Spring, Hammer Throw, & Valve Metering

https://docs.google.com/document/d/1WFDife1EqVkkDQPEwRZFU6Kawki2sCi0x5KdFarO86U/edit?usp=sharing

Completely re-written by RayK on Sept 2011 and again July 2013

based on this http://www.marauderairrifle.com/forum/viewtopic.php?f=13&t=1323 Here is a very short version (with mimimal explanation) if you want to print the process on one page https://docs.google.com/document/d/11mHCJZoZaYuQTCoUdrhVXB5bMNEvBe282k7B0TJMp2o/edit?usp=sharing

The following guide will help you achieve a tune setting that will give you the desired peak velocity, fill pressure, and number of shots. It will be up to you (the tuner) to achieve the optimal balance for your needs. An optimal setting will give the highest efficiency yielding little to no hammer bounce, reasonable cocking effort, and good shot consistency. You are looking for that fine balance which can only come from lots of trial and measurement. An alternative tuning technique is the Bstaley Hammer Buffer described here https://docs.google.com/document/d/1wsnI6_GJHqhD13YGlihlBpQzb_X91qmCsdCxT4iQtMA/edit?usp=sharing

If you are seeking very high power from your Marauder, you may want to replace your stock hammer spring with a stiffer/stronger one to allow you to adjust for higher velocities. The stronger hammer springs are: for the M-rod, use a .48” OD 2.5” free length, and .054” wire diameter; for the P-rod, use a .30” OD 1.75” free length, and .041” to .048” wire diameter.

There are two extreme approaches (or techniques) of tuning using this method. It is a good learning experience to try each technique so as to learn the characteristics of each in your particular gun. If you have time, start with A (which is very similar to the factory Marauder setting) and then try B (which is preferred by most airgunners and probably where you will leave your settings). After learning each, you can then find a balance between the two. If you are using a stronger-than-stock hammer spring, technique A is usually the best way to tune. If you are after absolute max power possible, technique B is usually better.

While tuning, if you can hear any air burp this is known as “hammer bounce” and is wasteful of air. As the hammer opens the valve, the pressure from the reservoir combined with the valve return spring pressure will close the valve. With a light spring pressure the hammer is likely to be thrown back far enough (and off of the valve stem) that the hammer spring then gets re-tensioned and the hammer gets thrown forward to hit the valve stem again and expel more air. This sounds as though the gun is burping out air for as many as 3 or 4 burps per shot. A no-bounce hammer was briefly offered by Jim Gaska. A Hammer Debounce Device (HDD) is currently being sold by Airguns of Airzona. But this is not an endorsement of either device. Proper tuning can usually eliminate hammer bounce. To reduce hammer bounce, you should adjust more towards a shorter throw higher hammer tension. With heavy hammer spring tension, the hammer can't get thrown back off the valve stem so hammer bounce is eliminated. There is the small possibility that the valve may also close slower, allowing more air to escape, because the added hammer spring tension keeps the hammer against the open valve. This method of tuning usually yields a shorter sharper crack at discharge.

Technique A: A long throw, low spring pressure setting can give long, medium power shot strings. It will give a very light cocking effort and long spring life. It is more prone to hammer bounce.

Technique B: A short throw, high spring pressure setting will yield higher power tune and should eliminate hammer bounce. It may also yield a heavier cocking effort and possibly shorter hammer spring life.

At the end of this guide you will find a method for determining **charge pressure** (how much pressure you should refill to when adding air to your gun, e.g., perhaps filling to 2800 psi is better than filling all the way up to 3000 psi) and shot count (number of shots you can get within a desired range from the maximum velocity, e.g., within 25 fps of the maximum). It is advisable to try each for the 2 different techniques so you can see the difference in shot count and velocity curve which will give you an idea of the efficiency you have achieved in each. After finding your setting for each method, you can determine that setting by inserting the adjustment wrenches and counting how many turns to get back to the end stops.

An example would be 7 turns in hammer spring preload, 5 turns in hammer throw yields 850 fps with Crosman 14.3 grain dome pellets with a 2800 psi charge for 25 shots. Using this method you can always get back to a particular setting while you are trying different settings.

Preliminry Set-up for each tune technique

Make sure you have access to a good chronograph (chrony). Tuning a PCP airgun without one is futile. This one is an affordable good one http://www.midwayusa.com/product/852429/competition-electronics-prochrono-digital-chronograph The poor ones may produce many ERR readings or may only store 10 shots.

A) Hammer Throw (HT): With the gun assembled, adjust the hammer throw to the longest throw position. This is done by inserting 1/8" allen wrench through the spring, into the hammer and catching the Hammer Striker. Then turn counter clockwise until the Striker is fully retracted.

B) Hammer Spring preload (HS): With the gun assembled, adjust Hammer Spring preload to minimum tension. This is done by inserting the 3/16" allen wrench then turning counter clockwise until the Hammer Spring tensioner is fully retracted into the air tube butt cap.

C) For the Marauder rifles, fully open the transfer port adjustment by closing it (fully clockwise) and then back it out 4 to 4.5 revolutions (counter clockwise). For the P-rod, if possible, replace the transfer port but change the ID to .110" or smaller. It is rare that a PCP needs a transfer port larger than .110 to achieve 20 ft lbs. A Transfer Port that is large enough to give you the velocity you desire but no more will give you a flatter velocity curve. If you want a really long, low power string, very small tranfer port is one way to achieve this.

Tuning with Technique A: long throw, low spring pressure

1) Set up gun with a chronograph and pellet back stop.

2) Have initial adjustments of your Marauder set to A, B and C above.

3) Charge gun to a pressure a little above the middle of your desired charge range. Example: if you are looking to charge to 3000 psi and shoot to 2000 psi then charge to 2600 psi for testing. It is even better if you can tether to a large fill tank with pressure in the middle.

4) Increase the hammer spring preload (clockwise) until you feel tension on the hammer spring and then turn in 1 more revolution.

5) Chronograph a shot to see where your velocity is.

6) Increase hammer spring preload 1 turn.

7) Repeat 5 and 6 until your desired velocity is reached.

8) Shorten your hammer throw 1/2 turn (clockwise).

9) Chronograph a shot to see where your velocity is.

10) If your velocity stayed the same go back to step 8. If your velocity decreased, go back to step 6.

11) Keep making adjustments (remember to charge every 5 shots) and chronographing until you are satisfied with the feel of the shot cycle.

Tuning with Technique B: short throw, high spring pressure

1) Set up gun with a chronograph and pellet back stop.

2) Have initial adjustments of your Marauder set to A, B and C above.

3) Charge gun to a pressure a little above the middle of your desired charge range. Example: if you are looking to charge to 3000 psi and shoot to 2000 psi then charge to 2600 psi for testing.

4) Cock Hammer.

5) Increase the hammer spring preload (clockwise) until you reach full coil bind and can not increase hammer spring preload any further (gun may fire during this adjustment). Fire gun. Cock the hammer again. If it will not cock then back off on the tension a little until it will cock. Cock gun again. Repeat until gun will cock reliably. On some guns, the adjustment will max out before you get to full coil bind and you will hear a cliking as you turn the preload adjustment screw. Just leave it at max setting.

6) Reduce hammer spring preload 2 to 3 turns (counter clockwise).

7) Chronograph a shot to see where your velocity is.

8) Shorten your hammer throw 1/2 turn (clockwise).

9) Repeat 7 and 8 until your desired (usually maximum) velocity is reached.

You may see that as throw is decreased, velocity will actually increase. This is common as you converge on a more efficient setting.

10) Keep making adjustments (charging every 5 shots) and chronograph until you are satisfied with the velocity and the feel of the shot cycle.

Finish-up for each tune technique: Valve Metering Screw Adjustment

You can fine tune the velocity with adjustments to your transfer port. M-rods have an adjustable transfer port under the stock, but you must first remove the brass set screw on top of the adjustment screw. Start with the 4 to 4.5 turns out from fully closed described above in the set-up under C. To adjust, 1) turn the adjustment screw in 1/4 turn at a time and chronograph a shot. 2) Make another 1/4 turn adjustment and chronograph another shot. Repeat the process until you reach your desired velocity. As you get close, switch to ⅛ turn adjustments until you reach your desired velocity.

During this process you may notice that your shot gets quieter and blows less air but the velocity does not change much. This is common as you converge on a more efficient setting. Your shot count will increase as well because you are waisting less air. Another benefit of an adjustable transfer port is that you can dramatically flatten a velocity curve by restricting the transfer port and increasing the energy used to open the valve stem. You will widen the usable charge pressure band (e.g., using 1500 psi instead of only 1000 psi per fill) and increase shot count in the process. You can experiment with settings to achieve an optimal balance.

P-rods do not have an adjustable transfer port, but you can drill your blue aluminum transfer port for the P-rod from the stock size of .080” to 7/64” or .109 for higher power shots, but you will reduce your good shot count. Smaller than stock tranfer port, e.g., .06” in the P-rod will allow you to tune for very long and flat shot lower-power shot strings such as seen described for field target or plinking. Here is an excellent video that shows the effect of changing transfer port in the P-rod
http://www.youtube.com/watch?v=qoJnSwFiX8w

Testing for Charge Pressure and Shot Count

1) Decide an acceptable velocity spread (called extreme spread or ES) from your shot string. Field Target or longer range hunting may require an ES of 2 to 3% of your peak velocity, e.g., 18 to 27 FPS ES for 900 FPS tune. Shorter range hunting or plinking, e.g., 25 yards or less, may allow up to 5% of peak velocity, e.g., 45 to 50 FPS ES for 900 FPS tune. You should experiement to see how much ES you can tolerate for your needs. Remember, the point of impact (POI) will drop as your pellet velocity drops and this will be more noticable with longer distances. Here is a great write-up about choosing your acceptable ES http://www.gatewaytoairguns.org/GTA/index.php?topic=62581.0

2) Charge gun to max pressure allowed by manufacturer (e.g., 3000 psi for the M-rod or P-rod). Some slightly overcharge their PCP airguns (e.g., 3200psi) with excellent results due to the valve design, but that is something you must decide to do as it is beyond what the manufacturer recommends. If you are hand pumping or filling from a 3000 PSI SCUBA tank, lower charge pressures, e.g., 2500, will allow easier filling or more fills per tank.

3) Record velocity and gun pressure at each shot. Shoot an entire string of pellets. The velocities will slowly climb, reach a point where they level off or peak and then slowly decrease. Keep shooting until the velocity drops below the starting velocity - no matter how many pellets it takes.

4) Examine your recorded shot string. Find the peak velocity and subtract your acceptable velocity extreme spread from that peak velocity. This is the START and END velocity. As an example: The velocity from shot #1 may have been 800 fps. The velocity peak was 900 fps. The acceptable spread is 25 fps. The start and end velocity of the string should then be 900 - 25 = 875 fps.

5) Look down the recorded shot string till the first instance of a velocity at or above your start velocity (875 fps from our example) is recorded. See what shot number that is. From our example: shot #1 was 800 fps and say, shot #10 was 875 fps.

6) Charge gun to the pressure of shot #1 in the string and fire (from our example) 10 - 1 = 9 shots over the chronograph. Shot #10 would now be the correct velocity, and the **charge pressure** that is in the reservoir is the correct charge pressure to achieve it. Let’s pretend from our example, this charge pressure is 2800 psi.

7) Charge gun to the determined **charge pressure** and shoot over the chronograph recording each shot. When the velocity from shot #1 is reached after the velocity peaks that is the last usable shot from the charge. Shoot a few extra pellets over the chrony to be sure velocity is below the END velocity. Count the number of shots and that is your shot count for the charge for the way the hammer tension and throw are currently balanced.

Record your pellet type, weight, charge pressure, shot count, and end pressure and keep it with your airgun for future reference.