Spirit Tuning Guide as of 6 /10 /2019

1 RUDDER TUNING

⚠ **Prerequisite step** - You can verify that the rudder servo limits are not too low or either not too high.

If the value is less than 70, then it is too low. That mean that servo precision vs mechanical gain is not good. You can fix the issue with putting ball link on the rudder servo arm closer to the center so that limit can be higher. In case the value is more than 170 there is mostly too high servo precision vs mechanical gain. You should put longer servo arm, so the ball linkage can be further. Be sure you have configured limits so that tail slider is moving from end to end, but without any mechanical binding (servo buzzing). In case your tail mechanics allows a pitch higher than 45°, do not set limits that high. It is not absolutely necessary that limits for both sides are equal.

Tuning Procedure:

1. Set **Sensor/Rotation Rate** for the rudder - this parameter determine how fast the rudder will rotate around its axis. Values between 8-11 are used by allmost all pilots. Default value of 8 is fine for beginners. While value of 11 is good for 3D maneuvers where faster pirouettes are needed.

2. Set **Advanced/Rudder Delay** accordingly for your servo type - please see the Servo list where you can find optimal range. For *Futaba BLS* servos and ultra fast servos it is fine to set 0. Slower the servo is, the higher value should be configured. If you are not sure, leave this parameter (value of 5 should fit for average digital servos).

3. Set **Gyro Gain** (usually in your transmitter) to the value, that tail is holding well, but not oscillating in any maneuver (for example Pitch pumping). This value should be as high as possible always. If you are observing tail oscillation, you should decrease the gain to eliminate it. Please note that it is recommended to change the Gain only in this step. In case that you have achieved 100% Gyro Gain with no oscillation, please increase **Sensor/Rudder Common Gain** which will multiply the Gyro Gain.

4. Now, when your gain is configured, your tail can still not hold the position exactly. That's because your mechanical gain is not high as necessary. You can fix it by increasing the **Advanced/Piro Consistency** value. Increase it by 5 gradually until the tail will hold. The value should be nearly in all cases between 155 - 190. With higher values the rudder will rotate more constantly and so can be even more sharp. With bigger size helicopter the value is often higher. It depends mostly on the helicopter construction (manufacturer), servo arm and servo type. For *Futaba BLS* servos or similar, it is needed to increase the value even more (in rare cases to value of 200). You shouldn't set the parameter too high if not necessary (always set only as high as really necessary), otherwise *tail oscillation* in high extent can occur. You can verify it in a *fast forward flight* or *pitch pumps* whether the value is too high and you can see any oscillations.

5. If the tail is still not holding well the problem could be:

- Head Speed is holding poorly or too agressively during load. (can be improved by Governor settings or Throttle Curve change).

- There is a mechanical issue. Check by spooling up the motor with no blades, then move with the tail push rod carefully by hand from end to end. (push rod disconnected from servo).
- Tail servo is too slow (0.07s/60° or higher) - increase the **Advanced/Rudder Revomix** to value 1-4. Higher values are not recommended.

BK .03 Sec @ 60 ok DS7006-H ✓

Changed (*) Revo mix SET To 2

6. When above steps are done, you can tune the Stopping Behavior. For this purpose use the **Advanced/Rudder Dynamic** parameter. Value determine how aggressive the rudder stops and the steering is. If you like sharp stops, you should set value between 6 to 8. If you like extra sharp behavior, then value higher than 10 are good for you. But high values are very demanding for servos and mechanics, so you should be carefull. If you like smooth stopping so that steering is also very smooth, you should set values between 5-7. If value is too low, the rudder reaction can be even delayed. In case the tail stopping is not equal or overshooting to one side, you can decrease the Rudder End-point for such side (mostly closer to the tail blades) by 0,5-1mm.

2 CYCLIC TUNING

⚠ Make sure the **Cyclic Ring** - Aileron/Elevator range is as high as possible without binding even in min/max collective pitch. Ideally it should be equal angle with your max. collective pitch. But it is extremely important to not exceed angles allowed by the model manufacturer. With models of size 600 and bigger risk of boomstrike is very high with lower RPM.

Tuning Procedure:

1. Increase the **Sensor/Cyclic Gain** if you can observe the cyclic is not level during pitch pumps or flight is not precise. Mostly values around 60% are optimal for all models. You shouldn't set the gain as high as possible always. If it is too high, steering can be even delayed little bit and not that comfortable. Mostly values above 80% are unwanted. If gain is too high, you can see Aileron oscillations, especially when descending slowly or while doing Tic-Toc maneuver. Sometimes it is caused by too soft head dampeners or non-flybarless blades as well. But if you can achieve values higher than 50% then it is optimal. In some cases, if you want very natural feeling, you can set the Cyclic Gain to e.g. 40%, but you will loose some precision. Stability will be still good.

2. Set the **Sensor/Rotation Rate** parameter to the extent that flips and rolls are fast enough. Be carefull to not set it higher than your mechanics can handle. The highest value for the most models is between 11 - 13. If the value is too high, steering is not precise and sometimes you can observe that rate is not constant (Once you finish the cyclic input it will continue for a fraction of second).

3. If input reactions are delayed, you want likely to increase the **Advanced/Cyclic Feed Forward** which plays very important role in overall behavior. If you are switching from e.g. Microbeast, you will be comfortable with values between 4 - 6. If you are switching from V-Bar you will like 6 - 8. If you are switching from Bavarian Demon, you will love values of 8 - 10. The higher values are more demanding for the servos. In bigger helicopter you can even risk Boom Strike with too high values. Too high value will induce too sharp movements and also elevator bounce-back. Too low value will cause very delayed (smooth) steering.

4. Now it is time to set the **General/Flight Style**. This is the last parameter that determines flight characteristics. If you like very linear movements from the stick center to full stick deflection then you will like low values. If you like flybar behavior, so that feeling around center is smooth but with faster input you will get a sharp response, then you want to set high value. With various combinations of Flight Style and Cyclic Feed Forward you can change Cyclic feeling a lot. If you are switching from e.g. Microbeast, you will be comfortable with values between 4 - 6. If you are switching from V-Bar you will like 6 - 8. Difference between settings can be seen especially in a pirouette maneuvers and also Tic-Tocs. If value is too high, then blade' efficiency can decrease and motor can be overloaded. With higher value a sharp movements are transferred faster to the servos. Also if you are doing aggressive maneuvers, it will stop faster when stick is returned to the center. If the value is too low, then a Tic-Tocs can't be done fast enough, Piroflips can't be done precisely, etc. For beginners we recommend to leave default value. This parameter is only about your preference and both low and high value has its positive and negative side. For example, if you want smooth feeling around center with natural characteristics, you can set value of 8 for the Flight Style and Cyclic Feed Forward to 6 - 10.

5. Lastly, you want to eliminate possible Elevator Bounce-Back effect. This can occur with high Cyclic Feed Forward, but it can be reduced by increasing **Advanced/Elevator Filter** parameter. Value between 2-3 should be fine for almost all helicopters. When using an aggressive blades you will need value of 4. Especially for bigger size helicopter, the value can be higher. In case of too high value, elevator movement can be too smooth and in some cases elevator can oscillate with low RPM during hovering. Set it only as high as really necessary.