RL20/30 advanced guide.

These instructions are intended primarily for those wishing to use RL20 or RL30 for a non-standard application (e.g. gas turbine powered helicopters) but may be of interest to the contest pilot who wishes to establish the optimum performance from 'first principles'. It expands on the information given in the **RL20/30 Tuning quick reference guide**.

To avoid repeating the work the procedures outlined here should only be undertaken once the engine has been fully run-in and the mixture etc. has been set to provide a clean throttle response with minimum achievable lag both for increasing and decreasing power.

Start with the default settings but with the **Integral Gain reduced to zero.** In the case of RL30, the Collective management should be disabled while the main governor set-up is optimised either by setting the collective pull-off limit to zero or by simply by-passing RL30 with the collective signal (taking it directly to the collective servo or CCPM mixer). The collective management should be restored once the main governor set-up is complete.

Test fly in a series of sustained climbs and descents and find the highest responsivity at which the engine does not hunt. Pay special attention to the light load situation in the descents. Note that with no integral gain set there will be some speed variation with load.

Re-test using acceleration gains above and below the default value (say 150% and 70%). Select the acceleration gain that allows the highest hunt-free responsivity to be used. The degree of fine-tuning you apply to this stage is a matter of personal preference.

Now set the integral gain to 40% and re-test. To avoid hunting a very small reduction in the responsivity relative to the no integral term case may be needed. In exceptional circumstances a large loss of responsivity may occur at 40% Integral Gain in which case an even lower value may need to be adopted.

At this stage the minimum control point can be set. Try descending the model steeply for several seconds with the governor engaged (e.g. in idle up). Set the minimum control point to the highest value that does not cause the engine to over speed in the descents. Where a multi speed setup is being used do this test at the lowest required headspeed.

Now the correct level of integral gain can be established. Fly with successively higher integral gain values, say 50%, 75%, 100%, and 125%. If little or no reduction in responsivity is needed to prevent hunting try increasing the integral gain further. If however a large reduction in responsivity is needed the integral gain is now too high and should be reduced again. As with the acceleration gain setting the degree of fine tuning you apply to this adjustment is a matter of personal preference.

The following adjustments of acceleration limit and acceleration threshold have only very slight effects in normal operation and the default values can be used in the majority of cases. However the following procedures are given for completeness.

Acceleration Limit: To find the best acceleration limit try a climb-out with the collective pitch just a little too high for the engine to maintain speed. Listen to the recovery of the headspeed at the top of the climb and reduce the acceleration limit to quicken recovery to normal engine speed. Don't reduce the acceleration limit so far that it starts to introduce hunting in light load situations.

Acceleration threshold: This reduces small amplitude servo activity that occurs if the engine does not run very consistently causing the speed to fluctuate a small amount from stroke to stroke. These movements can usually be reduced to low levels by the correct choice of plug and fuel together with correct mixture settings. In situations where a tuned exhaust is being used it may be necessary to reduce the compression ratio by increasing the shimming under the cylinder head of the engine. However, where the amount of servo activity remains high regardless of engine tuning an increase in the acceleration deadband can be used at some cost to the tightness of the rpm control to reduce the wear on the servo.

Sub-responsivities
The internal **sub-responsivity** values allow independent responsivity adjustment for each mode. In remote operation the sub-responsivities for Modes A and B act in conjunction with the master responsivity controlled by the 'Adjust' pot. The overall responsivity of Mode A, for example, depends both on the pot position and the internal Mode A sub-responsivity. If, for example you find that the engine tends, at a given 'adjust' position, to hunt in Mode A but not in Mode B then the internal responsivity of Mode A can be reduced to correct this until the onset of hunting occurs at the same adjust position for both modes. In general, where a tuned exhaust is employed, higher RPMs are more easily stabilised and can sustain higher responsivity than lower RPM settings.

Note that in manual operation The 'Adjust' pot is used for rpm setting so the **internal Manual Mode responsivity** value is the only way of adjusting the overall responsivity.

Full-Throttle throw limiter operation
By default the unit has this set to "all the time" and prevents the throttle servo being driven beyond the programmed full throttle point even when cyclic to throttle mixing is used on a transmitter that does not prevent overtravel of the throttle channel. Where specialist applications require it the **"only while governor active"** option turns off the limiter function when the governor is inactive.

Setting a mode to operate as an RPM limiter (RL20 only)
If you want RevLock to operate simply as an RPM limiter this is done by selecting the **"RPM limiter only"** option under the **"RPM control action"** heading for the mode or modes required.

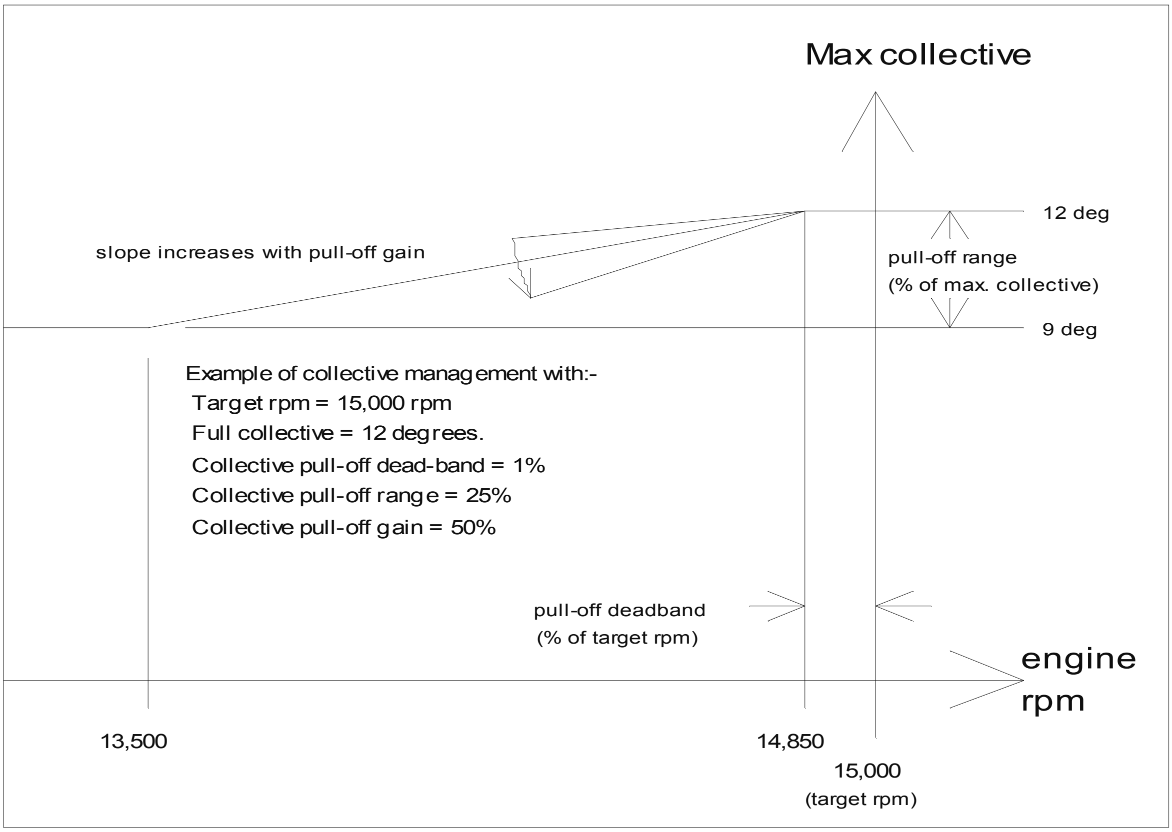
Note that the integral term is not used for limiter operation. When using one of the modes for RPM limiter action you should adjust the proportional term gain to set the sharpness of the limiter action. Generally the proportional term gain will need to be increased from the default value for governor action. A proportional gain of 130 is a reasonable starting point and the responsivity should be adjusted so that under light load conditions (where the limiter will be active) the RPM are steady. An excess of responsivity will give rise to fairly rapid fluctuations in the engine RPM.

Stick gain (RL30 only)
This parameter sets the degree to which the governor makes use of the incoming throttle signal to assist in the control of the throttle. There are a two main considerations when setting this parameter:-
The higher the governor responsivity being used the lower the Stick gain should be set.
In the more violent 3D type of flying the incoming throttle signal is often not a good indicator of likely load and the governor becomes more accurate when lower Stick gain values are used.
Where you are using a crisp throttling engine (and consequently a high governor responsivity) and where you are doing hard 3D manoeuvres consider turning the Stick gain to zero.

RL30 Collective management
Collective management is a technique to allow a greater collective pitch range (or longer or broader chord blades) to be used without the pilot having to consciously limit the amount of collective used in order to prevent excessive loss of engine RPM in certain flight situations. The maximum collective pitch that can be sustained depends on the flight situation. In straight, fast forward flight for example higher collective pitch can be employed than in high g manoeuvres. Indeed maximum forward speed and maximum climb speeds are usually obtained by increasing the collective pitch to the point that the engine, even at full throttle is loaded to a point towards the bottom of its power band. Although this causes slightly less power to be produced the reduced blade speed causes less power to be expended overcoming the drag of the blades leaving a greater proportion to propel the helicopter forwards or upwards. The low g-loading on the blades in these situations mean that the loss of maximum lift capability is not significant. Neither is the slight reduction cyclic authority noticed. In aerobatic manoeuvres the maintenance of head speed is more important as reduced headspeed leads to a reduction in available thrust for high g as well as a reduction in the speed and crispness of the cyclic response. It is important to realise that the maximum thrust of the rotor falls off very rapidly with falling headspeed so higher g values are maintained by sacrificing small amounts of pitch in order to keep the speed up. It is this trade-off that RL30 manages for the pilot.

By relying on the inertia of the blades it is possible to make good momentary use of very high collective pitch angles. However, There is usually not enough power available to sustain these in high g situations beyond a fraction of a second without significant loss of headspeed.

RL30, when engaged controls the throttle to ensure the engine RPM are maintained within a tight tolerance of the target RPM. However, once the throttle has been opened to the maximum no further power increase is possible and it is then only possible to manage the RPM by unloading the engine in a controlled manner to prevent the RPM dropping outside the power band of the engine. For each of its modes RL30 has 3 internal parameters which set how the unit acts on the collective during periods of reduced RPM. The following diagram shows how these parameters control the way RL30 reduces the maximum collective pitch when the RPM drop below the target value.



Collective pull-off gain
The higher the value of this gain the faster the maximum collective pitch will be reduced as the RPM falls and the faster the maximum collective pitch will be restored as the RPM recover towards the target value.

Collective pull-off limit
This sets the degree to which the collective pitch can be reduced. The default value of 25% means that if the maximum collective pitch is set to 12 degrees then RL30 will be allowed to reduce this by up to 25% or 3 degrees leaving at least 9 degrees of collective pitch even with large RPM loss. Note that during autorotations RevLock is disengaged and does not modify the collective pitch in any way.

Pull-off dead band
This parameter allows for a small RPM loss before any reduction of collective is applied. This allows for the brief use of the maximum collective pitch in manoeuvres such as tick-tocks where the inertia of the blades can be relied on to provide the extra energy needed during very short high g situations. The value displayed in the PC interface is the percentage of the target RPM by which the engine speed can fall before any collective reduction occurs.

Notes on adjusting the collective management parameters of RL30.
The default setup of the RL30 collective management system is applicable for the majority of models: we would recommend adjusting them only after significant flight testing has suggested an improvement is possible.

Climb speed and forward flight speed.
If the engine power output is high and the available collective pitch range is somewhat restricted so that it has not been possible to significantly increase the collective pitch when installing RL30 it may be that the collective management adversely affects these areas of performance. In these situations consider if it is possible to fit longer main blades without danger of a main-tail blade clash. Failing this a change of gear ratio to allow slightly higher headspeeds may also be of benefit. Failing all these options you may wish to modify the Collective management response of RL30 by reducing the collective pull-off range and/or reducing the collective pull-off gain.

Sustained high g manoeuvres
In sustained high g manoeuvres such as pie dishes RL30 should, where needed back off the collective in order to keep the engine speed in the power band. If the loss of head speed is too great in these situations then try slightly increasing the collective pull-off gain. If you find that there is something of a compromise between the ideal setup for climb and fast flight and high g situations consider the possibility of using RL30 in, say mode A for aerobatics and Mode B for fast forward flight and using different Collective management setups in each mode. This should not be needed so long as sufficient collective pitch range is available.

Transient high g manoeuvres.
In short-term high g situations such as tick tocks collective pitch reductions can usefully be delayed to allow extra thrust from the rotor disk to be used while absorbing inertia from the rotor disk. If you find that the headspeed is excessively low out of these 'punched' high g manoeuvres then try reducing the pull-off deadband. Generally, large models with heavy blades will accept larger value for the pull-off deadband than a small model with light blades.