Seakeeper Gyro Performance Prediction
Grand Banks 59

Objectionable boat roll occurs when the wave encounter period matches or is very close to the boat's natural roll period. This is called natural or resonant rolling. In this condition, a boat will typically roll 3-5 times the slope of the wave and the resulting amplification of the wave slope causes safety concerns, fatigue and motion sickness.

Seakeeper has developed a method of selecting or sizing the gyro configuration by predicting the amount of resonant roll reduction that can be achieved by active gyro stabilization for the case of the vessel operating at zero speed in regular beam waves.

The use of regular waves (all waves have the same period and the wave period equals the boat's natural roll period) provides a ***reference condition*** for evaluating the performance of the gyro stabilizer for ***sizing purposes*** without having to perform motion simulations for a large number of irregular sea conditions. The method assumes that the gyro is actively controlled and always maximizes the gimbal or precession motion for a given boat roll period regardless of the boat's roll amplitude.

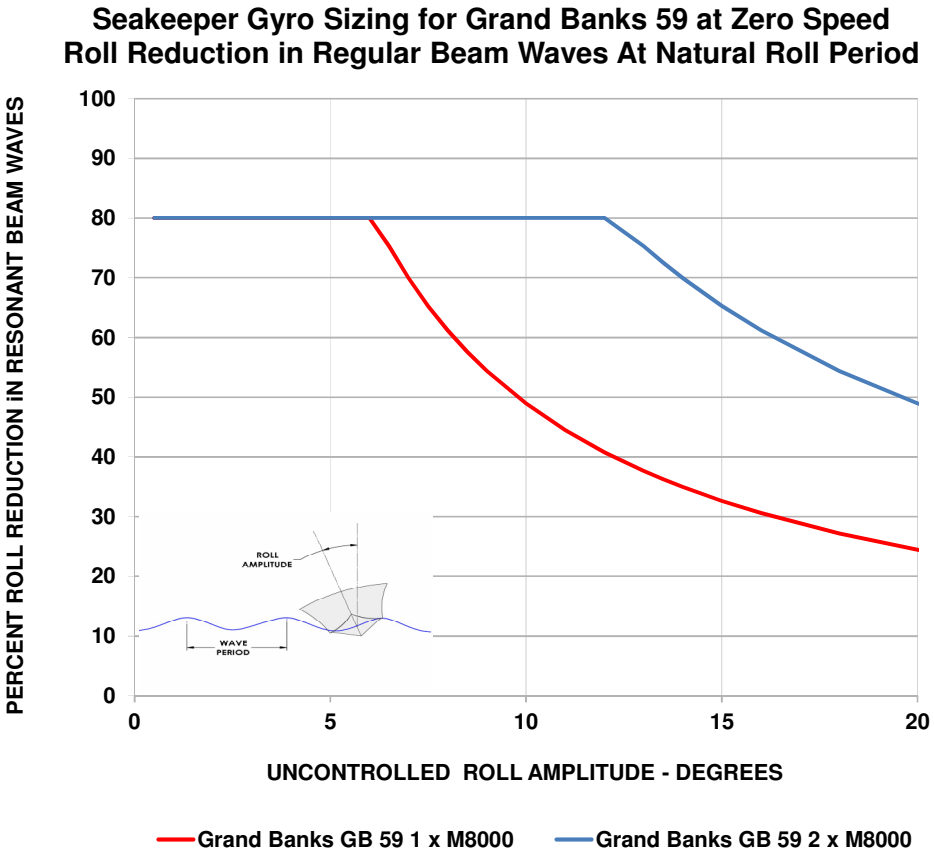
Seakeeper performed the sizing calculation for a Grand Banks 59 using the following data supplied by Twin Disc:

Hull Parameter	Grand Banks 59
LOA – Feet	61.7
BOA - Feet	18
Displacement FLD – Pounds	78,857
GMt – Feet	5.25
LWL – Feet	55.4
BWL Max– Feet	16.1
Deadrise @ BWL Max – Deg	26.0
BWL @ Transom – Feet	14.75
Deadrise @ Transom – Deg	19.0
Draft Hull Body @ FLD - Feet	5

The results are given as percent roll reduction versus roll angle of the boat without gyros (i.e., the uncontrolled roll) as shown on graph on the next page. Results are provided for the vessel fitted with one and two Seakeeper Model 8000 Gyros.

The X-Axis shows the uncontrolled roll amplitude (see the illustration in the graph). The X-Axis is not an average of different amplitudes. Think of the boat as sitting as zero speed in regular beam waves rolling +/- 5, or +/-10, or +/-15….. or +/-20 degrees at its natural roll period.

The Y-Axis shows the amount that the gyro will reduce the uncontrolled roll amplitude. The performance curve for the Grand Banks 59 ends at approximately 80% resonant roll reduction as percent reductions in excess of this amount are overly optimistic due to simplifications inherent in the method.



On a hard chine planning hull like the Grand Banks 59, roll stabilization is mainly required at anchor, while fishing offshore and at long range cruising speeds (typically around 10 knots). The hull contribution to the roll damping increases substantially with speed thereby lessening the need for stabilization the faster the boat speed.

At anchor, the resonant rolls are always the highest and it is Seakeeper's experience that the uncontrolled roll angles are typically below +/-6 degrees as the wave conditions are not severe. For stabilization at anchor, Seakeeper sizes the gyro configuration to achieve a minimum 50% reduction of a +/-10 degree roll for the ***reference condition***. One Model 8000 will reduce roll angles up to +/-10 degrees by 50% so a single unit would just achieve our minimum requirement. Two Model 8000 units will reduce roll angles up to +/-10 degrees by 80% so the performance at anchor will be outstanding.

It is Seakeeper's experience that the maximum uncontrolled roll angles are typically below +/-20 degrees when a vessel like the Grand Banks 59 is offshore and fishing at zero speed or trolling or cruising at low speed. If the maximum roll reaches +/- 20 degrees once in every 100 cycles then the maximum roll every 10 cycles will be on the order of +/-15 degrees. For offshore operations, Seakeeper typically sizes the gyro configuration to achieve a minimum 50% reduction of a +/-15 degree roll for the ***reference condition***. As a single Model 8000 Gyro will reduce uncontrolled roll angles up to +/-15 degrees by 31%, the roll reduction during offshore operations is below Seakeeper's targeted performance level. Two Model 8000 units will reduce

uncontrolled roll angles up to +/-15 degrees by 65%, so the roll reduction during offshore operations will be outstanding even in conditions that are probably at the upper limit for this size vessel.

Please note that the results contained in this report are Seakeeper's estimate of the performance of the various gyro configurations for a ***reference condition*** based on the data provided and the tools available to Seakeeper. Actual performance will vary depending on the accuracy of the methods and variations in actual sea conditions relative to our assumption of regular beam waves and to our assumption that performance underway at low speed in beam seas will be similar to the zero speed ***reference condition.*** In addition, sea conditions are extremely difficult to quantify due to the random nature of wind generated waves and swell. Therefore, no guarantee is expressed or implied.