# Modern Grandfather Clock Weights

Since much of the work I do involves overhauling grandfather clocks, problems relating to their designs and performance have been part of the challenge. The plot thickens with modern mechanisms because they are mass-produced in prodigious quantities, made possible by newer methods of production and choice of raw materials that facilitate time-saving and cost-cutting techniques essential to mass production and the long-term reduction in costs to the consumers. While these techniques are truly effective in cutting costs, they frequently compromise the overall quality and durability of the products.

One technique frequently used by manufacturers is to use the same weights for several different mechanisms, making it possible to order larger quantities of particular sizes, thereby benefiting from economies of scale and lower cost per unit. I have seen many clocks made since the 1960’s that have weights that are far too heavy. For example, I have a German clock with a Kieninger movement (one second pendulum, Westminster chime, chain driven, ca 1968) with a 9 pound time weight, giving the pendulum extraordinary overswing.

Antique clocks, while frequently equipped with heavier weights than necessary, have movements that were less precisely engineered than the modern, machine-made ‘technowunders’, which makes them more forgiving to work on. For example, the antique British grandfather clocks (circa 1830) with recoil escapements frequently have 17 pound time weights, yet they work well!

I began collecting data by recording information about the mechanisms that came in for repair and weighing the weights that came with them. After overhauling them, I would observe and compare them. The most common observation was that many chain-driven clocks were severely overpowered because the manufacturers of the clock cases used the same weights for the chain-driven clocks as they did for the cable-driven clocks. All else being equal, the cable-driven clock needs twice the weight, so these chain-driven clocks probably had twice as much weight as they should have been equipped with! It is almost as if the manufacturers had simply reached for whatever weights happened to be on the shelf (in inventory).

While I collected data for all weights, I have not yet found it necessary to question a manufacturer’s choice of chime or strike weight, only the time weight. Collecting data for all weights, however, enabled me to compare different clocks and to look for patterns in the data. In general, 9 pounds is far too heavy for a clock like the abovementioned Kieninger, especially for a Graham escapement. The same clock would run well with 5 to 6 pounds. Hermle recommends 4.5 pounds for their grandmother movements (451), and I have seen many equipped with 6 pounds. A clock is certainly more likely to run better if it has some excess power, but it will wear more and will probably continue to run long after the lubricant has failed, simply grinding away.

After collecting data from about fifty clocks, I began to compare the results and to study their escapements to see if I could draw some conclusions. In general, for example, I feel that a Recoil escapement should have about 50% more power (weight) than if the same clock had a Graham escapement. A clock with a big and heavy lyre pendulum may need 20 to 30% more weight than the same clock with a light and simple wooden stick pendulum of the same length. A clock with very narrow swing of pendulum will require considerably less weight that one with a very wide swing: whereas my Hermle grandmother movement would run well with 4.5 pounds, my Kieninger grandfather movement needs about six pounds because the latter has a much wider pendulum swing. I am suggesting that different clock designs should have different weight requirements, yet most of the data I have collected suggest a clear pattern of using certain weight sizes for a wide variety of different clocks. The benefits for mass production can cause problems at the bench, particularly since most repairers are likely to believe that the weight that came with the clock must unquestionably be correct. However, many may not have thought that the manufacturers of the cases would even consider using weights other than those specified by the manufacturers of the mechanisms (assuming that the specifications provided by the manufacturers of the mechanisms were correct?).

I suggest that the repairer should collect data to determine when it may be necessary to change the weight. While this is not necessary very often, the repairer would be providing a better service to the customer if the repairer knew when the manufacturer of the clock cabinet had provided weights that are too heavy or not heavy enough. The weights provided are usually moderately overpowered, say by 20%, which is acceptable and should not be changed. However, if I see a 9 pound weight on a clock that I know would run well with 6 pounds, I would change it, particularly if I had collected enough data to support this conclusion.

A few clocks come in for repair with weights that are not heavy enough. If the clock ran for ten years with that weight, that weight must surely be enough. The customer said it ran for ten years, yet it does not have a lot of wear that you can see: sometimes the information given to the repairer is intended to minimize the problem so that the estimate of the repair costs would be lower. The repairer must base his decisions on past experience working with other similar clocks of similar age. If the pendulum has no visible overswing after it is overhauled, then it has just barely enough weight to keep it going: the overswing should be small but visible during the test run. If the overswing were very large, the weight should be changed for a smaller one. If there were no visible overswing, the weight should be increased by a small amount (by 10 to 20%).

When collecting information, you want to record the year, make and model of the movement, type of escapement, number of chimes, chain or cable driven, and the distance the weights travel down over seven days (P.E.=mgh). If the clock has a second hand with several additional gears in the time train and a friction spring, the time weight should be heavier than for the same clock without a second hand, so this is an important feature to record. Another important feature to record is whether the escapement has a self-adjusting beat incorporated into its design because the design of the pallets is compromised in order to achieve this (the pallet's impulse face angles are less than 45° relative to the impulse provided by the escape wheel, so the efficiency of the power transfer is less than without the compromise). A self-adjusting beat design would require more weight than an optimally-designed Graham escapement.

I would like to discuss two modern clocks, for which I have found it necessary to increase the time weight because, even if the clock runs with the weight provided, it is just barely running. A small increase in weight would reduce the chances of the repairer getting a come-back and yet would not cause a large increase in wear, thereby enabling the repairer to provide the customer with a higher level of service!

**Hermle grandfather movement (e.g.. 1161-853), triple chime, cable driven.**

Some of these clocks have second hands, some do not. If it has a second hand and the time weight weighs 8 to 8.5 pounds, check the pendulum swing carefully. I have seen many that had no visible overswing. Increasing the weight by 16 to 24 ounces solves this problem and provides a small amount of visible overswing. The same clock without a second hand is less likely to need added weight. It appears that both models are equipped with the same weight. Newer Hermles with the new self-adjusting beat design should be watched particularly carefully.

**Urgos grandmother and grandfather movements ('03', '32', and '66'), Westminster chime or triple chime, cable driven.**

These clocks have self-adjusting beat, Graham-style escapements with escape wheels that have very small teeth. This design is very unforgiving in that it is either correctly adjusted or it is incorrect (the parameters of adjustment are very limited). The pallet impulse face angles are considerably less than 45°, rendering the efficiency of power transfer very low. In addition, the weights travel down slowly over seven days, less distance than for most other cable-driven clocks. Yet these clocks are equipped with 8 pound weights for the time train. Some of these clocks have second hands with four extra gears in the time train and a friction spring. With 8 pounds there is no visible overswing, so increasing the weight is necessary. However, the small escape wheel teeth do not allow for as much overswing as other escape wheel designs, so the repairer must be cautious because 9.5 to 10 pounds are too much. If you overhaul one of these clocks and see no visible overswing, increase the time weight to 9 pounds and observe the pendulum. These escapements are difficult and unforgiving, but there are too many grandfather clocks out there with these mechanisms for repairers to avoid working on them!

To see some examples of weight specifications provided by the manufacturers of the mechanisms, go to the website of a clock movement supplier: click here to see HERMLE WEIGHTS and to see URGOS AND KININGER WEIGHTS. Looking at the data, you can see that for the Hermle 1161 grandfather clock, 5.7 pounds for the chain-driven version would be equivalent to 11.4 pounds for the cable-driven version, yet the chart recommends only 7.7 pounds for the cable-driven version. I think 11.4 pounds for the cable-driven version would be really good for the time train, especially if it has a second hand! The same information is true for the Hermle 461. As a second example, consider the Urgos chart, in which the UW030 with a lyre pendulum should have a 9.5 pound weight if it is chain driven (equivalent to 19 pounds if cable driven), yet the chart says it should have an 8.5 pound weight if it is cable driven! Furthermore, if you see a UW66 cable-driven clock with a 4 or 6.6 pound time weight, you would probably have difficulty keeping it running! Compare that with the same recommendations for the UW32 chain-driven movement: someone forgot that cable-driven clocks should have heavier weights than chain-driven clocks (twice as heavy). The information in those charts were provided by the manufacturers of the mechanisms. If the manufacturers of the cases used whatever weights happened to be on the shelf, and the manufacturers of the mechanisms provided inconsistent and even questionable weight specification information, then the repairman could not assume that the weights that came with the clock were correct. Look at the charts to see if you can find more examples of inconsistencies! (If the charts on the website of the clock supplier are not available, select This Link.)

A few purists may be inclined to believe that the pendulum swing should be minimized because of circular error. While they are correct in theory, the pendulum swing of most modern clocks could not be significantly changed without altering the design of the escapement, which would be difficult and very risky. The increase in pendulum swing caused in the two examples above is very small, and the small change in timekeeping resulting from this is not only outweighed by the improvement in reliability of the timepiece, but also easily corrected by adjusting the nut at the bottom of the pendulum.

To conclude, a word of caution: be sure that every aspect of the repair and adjustment of the mechanism has been correctly performed before you consider changing the weights. Solve all other problems first! Please do not increase the weight to avoid repairing a clock properly, replacing bushings, polishing pivots, repairing and adjusting the escapement, etc. Doing so would make a badly worn clock worse. While determining the correct weight to use is not a precise science, you need to collect data before you consider making changes because you are making an ‘educated guess’.

Mark Headrick