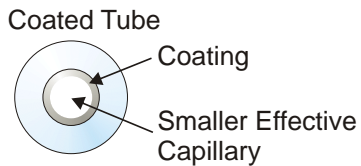
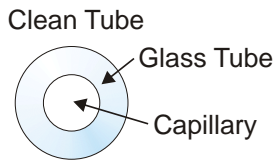


# The qVisc Difference White paper

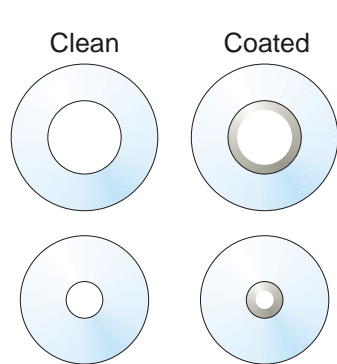
In ASTM D445, viscosity is measured by allowing the oil to flow under gravity through a glass capillary tube held at a constant temperature in a bath. The time the oil takes to flow between two marked points is measured and is proportional to the kinematic viscosity. The tube is usually calibrated by timing a known oil and generating what is known as the "tube constant". Viscosity is simply the time multiplied by the tube constant.

With used oil samples, an unfortunate fact of life is that soot, suspended solids, oxidation and nitration products, and other organic and inorganic compounds, plate out of the oil onto the glass capillary tube forming a coating. This changes the effective diameter of the tube.



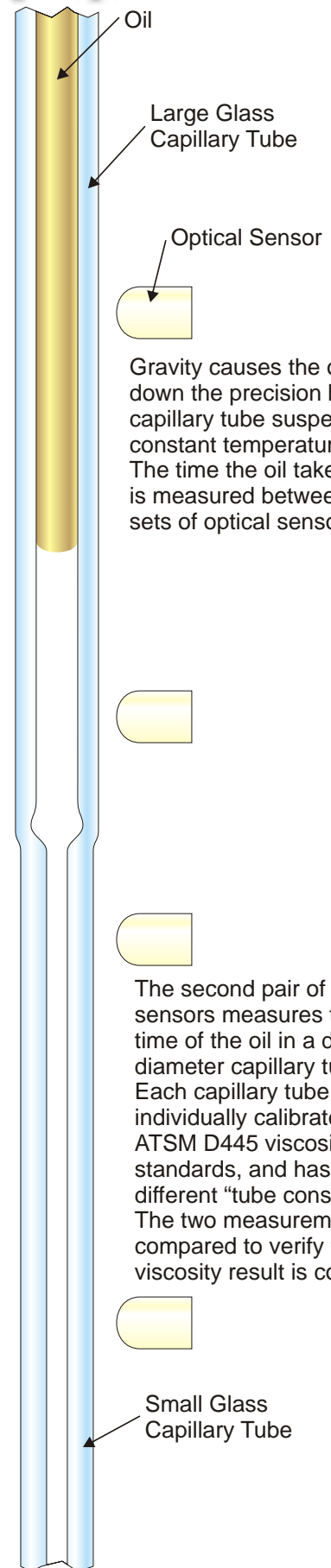
If left uncorrected, the measurements made with the tube in this state will be slower than normal. This results in an incorrectly high viscosity. Importantly, it does not matter how many times you repeat the measurement. Because the tube's diameter has changed since the tube was last calibrated, all of the measurements will be wrong in the same way. You will measure the same

incorrect viscosity every time. The only way to detect this problem is by re-checking the tube constant against a known standard. The tube can then be restored by cleaning it with acid.



The qVisc uses a patented\* tube design (shown on the right) which allows the instrument to automatically detect this problem. By using two different diameter capillary tubes, when a coating of deposits builds up it affects the remaining tube area by differing amounts. The smaller tube's effective capillary is changed by a much larger percentage than the larger tube, with the same amount of coating applied to both tubes. The instrument uses this effect to

detect the presence of the coating, and automatically rejects the incorrect measurement. **Far better than simply repeating the measurement, this tube design verifies that the oil flows as predicted by the physics that underlie the methodology used. Accordingly, it only produces a measurement when that methodology is valid.** This tube design also allows the instrument to detect all manner of other problems, such as air bubbles, particles partially blocking the tube, excessive water (that can boil), dissolved gases, and immiscible substances. In addition, an incorrect volume of oil, injected due to an autosampler malfunction, will be detected.



Gravity causes the oil to flow down the precision bore glass capillary tube suspended in a constant temperature bath. The time the oil takes to flow is measured between two sets of optical sensors.

The second pair of optical sensors measures the flow time of the oil in a different diameter capillary tube\*. Each capillary tube is individually calibrated using ASTM D445 viscosity standards, and has a different "tube constant". The two measurements are compared to verify that the viscosity result is correct.



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\*US Patent 5,756,883.