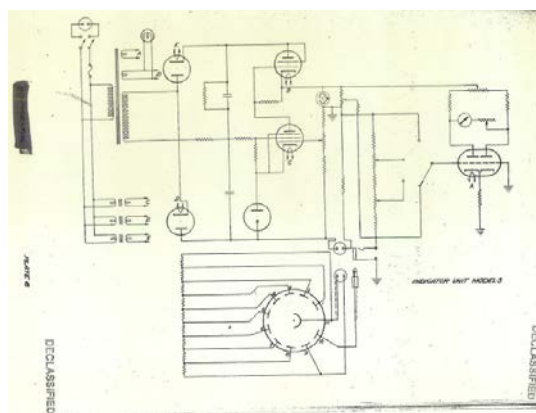
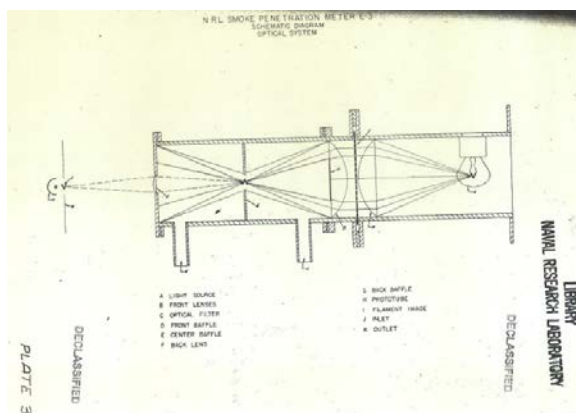




## This is why Aerosol Photometer's require Multipoint Gravimetric Calibration...

The measuring instrument currently called "Aerosol Photometer" was developed in the 1940's at the US Naval Research Laboratory. Since then it has been commercialised and manufactured globally by different companies.

The Aerosol Photometer was not designed for, and was never intended to, measure gravimetrically. It was originally called a "Light Scattering Meter" which seems more appropriate for what it does and is an unique, forward angle, light scattering design developed along with "smoke" generators specifically for in-place HEPA filter system leak testing during the second world war. Some of the design requirements included: Simple to use, Portable, Rugged, High Flow Rate, High Dynamic Range. Apart from a digital display, control, led light source, etc. the optical system is essentially the same in the latest instruments available today. (see pictures from 1945 NRL report P2642).



The Aerosol Photometer, measures and displays a numerical value "% Light Scatter" (%LS) which is related to the amount of light scattered from the "aerosol" sample being measured, **this is an indirect measurement and as such is not inherently linear**, the aerosol photometer does not have a Calibrated Analytical Balance inside.

The light scatter measurement "%LS", is not linear to gravimetric measure " $\mu\text{g/L}$ " in the range required to be measured and recorded by the latest versions of \* AS1807, ISO14644, IEST-RPCC001, JJF1800 when using PAO4, as can be seen in the graph presented at the end of this article.



When the draft of the revised AS1807 standard was released in 2020, **Fotometrix** analysed the new requirement for gravimetric measurement and in compliance with ISO17025 commissioned research into how to achieve gravimetric calibration of Aerosol Photometer's to meet the new soon to be released requirements.

Despite ISO14644 having the same requirements since 2005, no gravimetric calibration capability existed anywhere in the world and no commercial gravimetric, representative, calibration system was available. IEST-RP-CC13.3 was the only available guideline found.

The result of the above research resulted in a brand new gravimetrically calibrated Aerosol Photometer Calibration System as well as a system to calibrate the mentioned calibrator. This ISO17025 NATA certified system is called **GraviCal**.

**GraviCal** provides an SI traceable, gravimetrically calibrated, PAO4 smoke source, as representative as possible to real life testing conditions, **directly** calibrated with an Analytical Balance over the required range.

Below is a table of Calibration Data for a random selection of Aerosol Photometer's calibrated at **Fotometrix** using **GraviCal**. The data collected was entered in a graph which clearly proves the aerosol photometer non-linearity to gravimetric units.

| Instrument           | As Found Response at 100µg/L* | Maximum conc. Leak test** | GraviCal Output µg/L |      |      |      |     |
|----------------------|-------------------------------|---------------------------|----------------------|------|------|------|-----|
|                      |                               |                           | 100                  | 75   | 50   | 25   | 10  |
| MicronAir (Analogue) |                               |                           |                      |      |      |      |     |
| 1807 #1              | 35                            | 10                        | 100                  | 62   | 35   | 13   | 3   |
| 1807 #2              | 37                            | 10                        | 100                  | 63   | 36   | 14   | 4   |
| 1807 #3              | 39                            | 10                        | 100                  | 61   | 34   | 13   | 4   |
| ATI (Analogue)       |                               |                           |                      |      |      |      |     |
| 2E #1                | 40                            | 10                        | 100                  | 63   | 35   | 14   | 4   |
| 2GA #1               | 39                            | 10                        | 100                  | 64   | 35   | 13   | 4   |
| TEC (Digital)        |                               |                           |                      |      |      |      |     |
| PH-4 #1              | 78.4                          | 20                        | 100.0                | 62.8 | 35.5 | 12.8 | 3.4 |
| PH-4 #2              | 70.6                          | 20                        | 100.0                | 63.2 | 36.4 | 13.5 | 4.2 |
| PH-4 #3              | 80.5                          | 20                        | 100.0                | 63.8 | 38.0 | 14.5 | 4.3 |
| Rigel (Digital)      |                               |                           |                      |      |      |      |     |
| RI7001 #1            | 52                            | 20                        | 100.0                | 64.8 | 37.3 | 15.2 | 4.5 |
| RI7001 #2            | 51                            | 20                        | 100.0                | 64.5 | 37.4 | 15.1 | 4.4 |
| RI7001 #3            | 54                            | 20                        | 100.0                | 65.0 | 37.0 | 15.0 | 4.4 |
| ATI (Digital)        |                               |                           |                      |      |      |      |     |
| 2G #1                | 82.1                          | 20                        | 100.0                | 64.6 | 37.5 | 14.3 | 4.0 |
| 2G #2                | 78.4                          | 20                        | 100.0                | 63.7 | 36.9 | 14.1 | 3.2 |
| 2G #3                | 77.9                          | 20                        | 100.0                | 64.4 | 36.4 | 14.0 | 4.0 |
| 2H #1                | 79.3                          | 20                        | 100.0                | 63.2 | 35.3 | 13.2 | 3.5 |
| 2H #2                | 78.1                          | 20                        | 100.0                | 63.7 | 36.4 | 13.5 | 3.7 |
| 2i #1                | 81.4                          | 20                        | 100.0                | 64.1 | 36.8 | 14.1 | 4.1 |
| 2i #2                | 82.1                          | 20                        | 100.0                | 64.6 | 36.4 | 14.0 | 4.3 |
| 2i #3                | 62                            | 20                        | 100.0                | 64.4 | 37.6 | 14.4 | 4.2 |

\* As Found Response at 100µg/L is the measurement result when the instrument was sampling 100µg/L PAO4 in "As Found" condition.

\*\* Maximum conc. leak test is the minimum gravimetric concentration the instrument can be 100% referenced to when in leak testing mode.

