

Aerosol Neutralizer Radioactivity Measurements



Model 3077A

Application Note 3077A-001 (A4)

TSI® Incorporated's Model 3077A [Aerosol Neutralizer Kr-85 (370MBq/10mCi)] is designed to bring aerosol particles to an equilibrium state of electrostatic charge as they pass through the device. This known charge state is especially important for proper operation of the Model 3082 Electrostatic Classifier or Model 3938 Scanning Mobility Particle Sizer™ (SMPS™) Spectrometer, where the 3077A can be used.

The device contains 10 mCi of Krypton-85 gas completely sealed within a stainless-steel housing. Although the 3077A is very safe by design, being successfully used for decades around the world, users often inquire as to what radiation dose they would incur from the device during normal operation. To address these concerns, TSI® has quantified the exposure from the 3077A when used in different scenarios, including inside a 3082, with and without lead shielding. The following table shows the measured effective dose rate measurements of new 3077A units ($n = 3$) at a distance of 5 cm from the most accessible surface for four different scenarios.

The measurements were taken using a Mazur Model PRM-9000 radiation dose meter (Geiger Counter). This meter has a stated accuracy of $\pm 10\%$ and a resolution of .001 mR/hr. The meter was within the manufacturer's recommended calibration interval when the measurements were taken.

| Scenario | Description | Effective Dose Rate (mRem/hr) | | | |
|----------|--|-------------------------------|--------|--------|---------|
| | | Unit 1 | Unit 2 | Unit 3 | Average |
| 1 | 3077A without lead shielding | 4.31 | 4.28 | 4.45 | 4.37 |
| 2 | 3077A with lead shielding* | 0.33 | 0.32 | 0.32 | 0.32 |
| 3 | 3077A installed in 3082 without lead shielding | 1.08 | 1.13 | 1.10 | 1.10 |
| 4 | 3077A installed in 3082 with lead shielding* | 0.10 | 0.10 | 0.10 | 0.10 |

*For the most stringent safety requirements, an optional lead shield accessory (TSI® PN 6005931) can be installed inside the 3082 to reduce the exposure and effective dose from the 3077A.

For the scenarios in which measurements of the neutralizer were taken as a stand-alone unit (i.e., 1 and 2), the effective dose measurements were taken 5 cm from the outside surface of the 3077A to which the radioactive material vial is mounted. This is the surface of the 3077A where the two tamper-resistant source mounting screws are visible. Therefore, the recorded values reflect the approximate maximum effective dose measurement for these scenarios. See Figures 1 and 2 below.

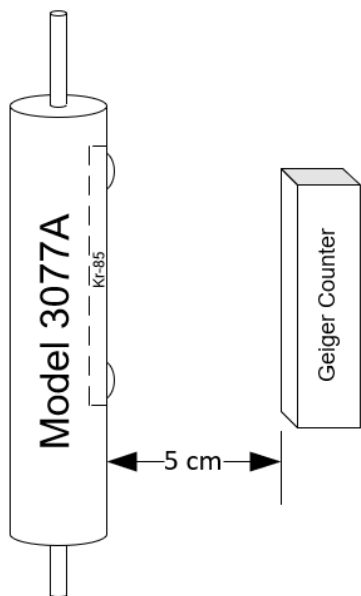


Figure 1: Dose measurement from 3077A without lead shielding, standalone.

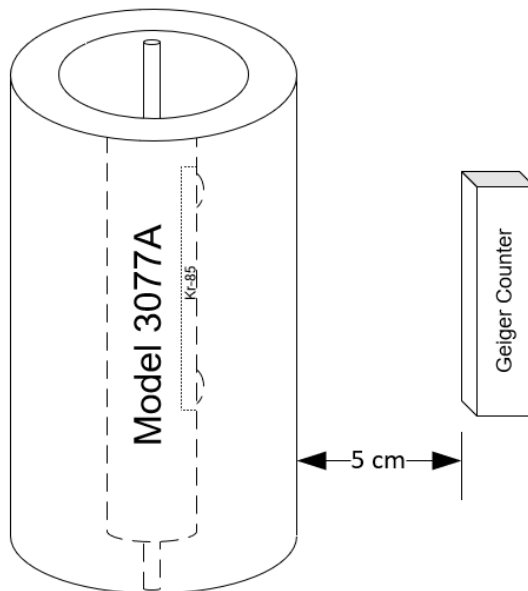


Figure 2: Dose measurement from 3077A with lead shielding, standalone. Note that the lead shield can be used with a 3077A in standalone use if desired, although it was originally designed to work in conjunction with the Model 3082.

For the scenarios in which the 3077A is installed into the Model 3082 (i.e., 3 and 4), the neutralizer and lead shielding was installed in the configuration as instructed by TSI® Incorporated in the Model 3082 operation manual. The effective dose measurements were taken at a distance of 5 cm from the surface of the 3082 in which the effective dose measurements were at a maximum. This point was determined by scanning the outer surface of the 3082 with the meter at a 5 cm distance to determine the maximum reading. See Figures 3 and 4 below.

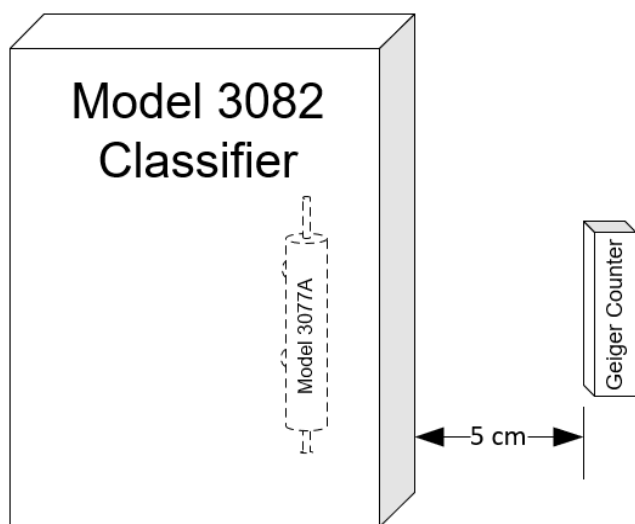


Figure 3: Dose measurement from 3077A without lead shielding, mounted inside the 3082 as prescribed by TSI.

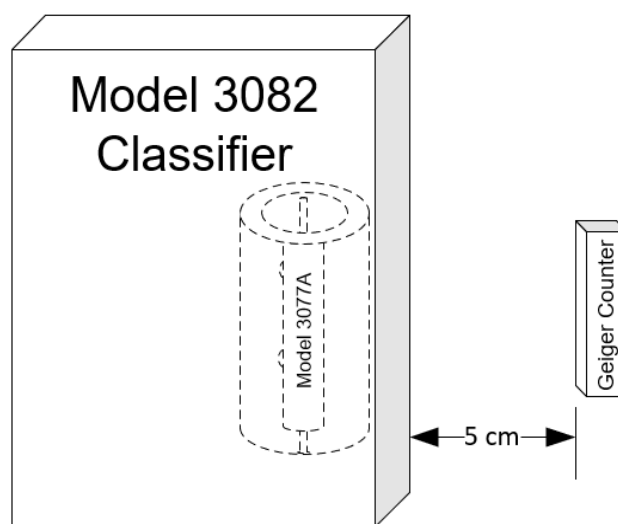
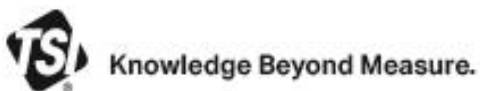


Figure 4: Dose measurement from 3077A with lead shielding, mounted inside the 3082 as prescribed by TSI®.

In conclusion, the addition of the lead shielding (cases 2 and 4) results in an order of magnitude reduction in effective dose compared to the unshielded cases (1 and 3), and use of the 3077A inside the 3082 (cases 3 and 4) results in an additional reduction of approximately a factor of 4 compared to use outside a classifier (1 and 2). Even in the worst case outside of the classifier with no shielding (case 1), average dose rate is less than 5 mrem/hr. For reference, 10 CFR Part 20.1201 (a)(1)(i) permits a maximum total effective dose limit of 5 rem per year. Exceeding this would require the user to remain at this distance (and this configuration) for approximately 1,144 hours per year. Therefore, the user should be confident that the 3077A will be safe to use in the vast majority of applications.

For further information on radiation safety, usage, and care of the Model 3077A, please consult the Operation and Service Manuals for the Model 3077A (TSI® PN 1933077) and Model 3082 (TSI® PN 6006760), or contact TSI® via email at particle@tsi.com.



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