



# Technical Data Bulletin

## OH&ESD

### #191 — NIOSH CBRN Cartridge/Canister Capacity Ratings

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NIOSH has designated four levels of testing for Chemical Biological Radiological Nuclear (CBRN) air purifying respirator cartridges and canisters – Cap (capacity) 1, 2, 3, and 4. To select the appropriate cartridge for a given situation, it is important to understand exactly what the different capacity ratings mean, and just as importantly – what they do not mean. For example, the highest rated cartridge / canister may not always be the best choice.

The Cap rating means that under defined laboratory test conditions specified by NIOSH, the cartridge/canister will not exhibit breakthrough of certain chemical contaminants at a pre-selected level for a specified time duration. For Cap 1, this means that under the test conditions, none of the NIOSH test chemicals will break through to the predetermined level in less than 15 minutes. In actual use, breakthrough may not occur for several hours depending on the specific chemical, concentration, environmental and use conditions. Cap 2 means that break through will not occur for at least 30 minutes; Cap 3 – 45 minutes and Cap 4 at least 60 minutes. More capacity generally means more sorbent and therefore a larger and heavier cartridge and possibly greater cost.

The Cap rating, however, is not a factor in determining when a CBRN air purifying respirator (APR) - either a powered air purifying respirator (PAPR) or negative pressure device may be safely used. CBRN APRs may only be used under conditions defined in OSHA's respirator program requirements (29 CFR 1910.134). As a result, air purifying respirators, including CBRN APRs with either Cap 1, 2, 3 or 4 cartridge/canisters, cannot be

used in oxygen deficient atmospheres, where the contaminant identity is unknown, or to enter areas where the concentration is greater than the Immediately Dangerous to Life or Health (IDLH) level. Additionally, Cap ratings have no relationship to Assigned Protection Factors (APFs). APFs are assigned by OSHA based on the respirator system type and not the cartridges, canisters, or filters being used. Therefore, a CBRN respirator is assigned the same level of protection when utilized with a Cap 1 cartridge as it is with a Cap 4 cartridge.

It is also important to understand that laboratory test conditions and gas challenges do not correlate to real world use conditions. Laboratory test parameters are often selected so that the tests can be conducted in a reasonable amount of time yet provide information relevant to much longer use periods. As such, concentrations of test gases are often several orders of magnitude above what may be allowed under actual use conditions.

The NIOSH test agents are used at concentrations typically 2 to 3 times the IDLH concentrations. Therefore, a cartridge or canister that provides 15 minutes of capacity at an extremely high test concentration may provide ample protection for real world exposures which, to comply with NIOSH certification requirements and OSHA respirator program requirements, must be below the IDLH level.

Service life is generally inversely proportional to concentration. For example, the 3M Breathe Easy PAPR with loose fitting butyl hood and the RBE-57

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cartridge (a CAP 1 cartridge) challenged with sulfur dioxide:

- NIOSH test criteria - 750 parts per million (ppm) [IDLH = 100 ppm]
- NIOSH allowable breakthrough concentration - 5 ppm (also the current OSHA permissible exposure limit - PEL).
- NIOSH test air flow rate - 170 liters per minute (lpm)
- Breathe Easy PAPR with loose fitting hood maximum air flow - 220-250 lpm.

The estimated service life calculation for a potential real world exposure to 10 ppm of sulfur dioxide with a break through defined as 1 ppm (20% of the PEL) is:

$$15 \text{ mins.} \times [750 \text{ ppm}/10 \text{ ppm}] \times [1 \text{ ppm}/5 \text{ ppm}] \\ \times [170 \text{ lpm}/220 \text{ lpm}] = 173.8 \text{ mins (2.9 hours)}$$

Extrapolation can give a rough approximation, but may underestimate or overestimate actual performance especially at concentrations that are much less than the test concentrations. The reader is strongly encouraged to download and read 3M Technical Data Bulletin #180 – Determination of Service Life for NIOSH CBRN approved 3M Cartridges and Canisters at [http://](http://www.mmm.com/occsafety/)

[www.mmm.com/occsafety/](http://www.mmm.com/occsafety/) Media Library;

Technical Data Bulletins.

It is important to note that NIOSH requirements specify that respirators exposed to chemical warfare agents must be taken out of service within 8 hours of exposure – 2 hours if direct liquid contact occurs, even if predictions indicate that the cartridge /canister has a much longer service life

### For more information, please contact:

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