

ACCEPTABLE TENORM ASSAY METHODS FOR RADIUM-226 AND RADIUM-228

At the request of the Ohio Department of Natural Resources (ODNR) and in coordination with the Ohio Environmental Protection Agency (OEPA), the Ohio Department of Health (ODH) has established this list of methods for assaying Radium-226 (Ra-226) and Radium-228 (Ra-228) to assist ODNR permit holders in determining the concentration of Ra-226 and Ra-228 in materials as required by Ohio Revised Code 1509.074 and to assist OEPA permitted solid waste disposal site operators in verifying that:

- All solid waste containing Technologically Enhanced Naturally Occurring Radioactive Material (TENORM) has been accurately assayed for Ra-226 and Ra-228 using an acceptable method; and
- The reported "combined Ra-226 / Ra-228" concentration for solid waste being received for disposal, satisfies the exempt TENORM concentration criteria listed in paragraph (A) of rule 3701:1-43-07 of the Ohio Administrative Code, making the waste acceptable for disposal at their facility.

NOTE:

Exempt TENORM concentrations for solids are <5 picocuries per gram (<5 pCi/g) combined Ra-226 / Ra-228 excluding natural background radiation. Statewide natural background for combined Ra-226 / Ra-228 is 2 pCi/g. ODH may approve a request for an alternate location-specific background on a case-by-case basis.

- TENORM loads accepted at solid waste landfills permitted by OEPA pursuant to Ohio Revised Code Chapter 3734 must be accompanied by lab results identifying the analytical method(s) used from Table 1 and/or Table 2 below.
- A representative composite sample¹ must be obtained from each conveyance of solid waste defined as TENORM that is presented for disposal at a landfill in Ohio.

¹ Note: Taking one sample for a production operation or geographic region is not acceptable.

TABLE 1 Analytical Methods for Radium-226 and Radium-228 in TENORM Solids

PARAMETER	METHOD	REFERENCE	METHODOLOGY
Ra-226	901.1M	EPA, 1980 www.epa.gov/waste/hazard/testmethods/sw846/index.htm	Gamma spectroscopy (after 21-day ingrowth period) - water method modified (M) for solids.
Ra-226	903.1	EPA, 1980 http://www.epa.gov/homeland-security-research/epa-method-9031-radium-226-drinking-water-radon-emanation-technique	Radiochemistry
Ra-226	9315M	Florida NELAP Accreditation #E87688 to Summit Environmental Technologies, Cuyahoga Falls, OH (330) 253-8211	Radiochemistry
Ra-226	Ra-03-RC	HASL-300, 28 th edition, 1997 Volume 1, Section 4 http://www.ornl.gov/ptp/PTP%20Library/library/DOE/eml/hasl300/HASL300TOC.htm	Radiochemistry
PARAMETER	METHOD	REFERENCE	METHODOLOGY
Ra-226, Ra-228	EMSL-LV-0539-17	EPA, 1979 EMSL-LV-0539-17 (pgs. 19 - 32) http://nepis.epa.gov/Simple.html	Radiochemistry
Ra-228	904	EPA, 1980 www.epa.gov/waste/hazard/testmethods/sw846/index.htm	Radiochemistry
Ra-228	9320M	Florida NELAP Accreditation #E87688 to Summit Environmental Technologies, Cuyahoga Falls, OH (330) 253-8211	Radiochemistry
Ra-228/Ac-228, Pb-212, Bi-214	901.1M	EPA, 1980 www.epa.gov/waste/hazard/testmethods/sw846/index.htm	Gamma spectroscopy - water method modified (M) for solids.

TABLE 2 Screening Methods for Radium-226 and Radium-228 in TENORM Solid Waste for Disposal.

PARAMETER	METHOD	REFERENCE	METHODOLOGY
Ra-226, Ra-228	ODH 901.1M - Ra226 Direct	<p>Approved method for ODH radioactive materials use licensee(s):</p> <ul style="list-style-type: none"> • #03225150000 - Shale Testing Solutions LLC, Warren, OH (330) 502-7882 • #03122780029 - Summit Environmental Technologies, Inc., Cuyahoga Falls, OH (330) 253-8211 • #03123850006 - Microbac laboratories, Inc. Marietta, OH (740) 373-4071 x 4172 • #03219150000 – Armada EP OH, New Concord, OH (740) 255-0357 • #03219160000 – Buckeye Brine LLC, Uhrichsville, OH (740) 295-9331 • #03219150001 – K2 Environmental Leetonia, OH (330) 277-7686 	Gamma spectroscopy - Ra-226 by 186.2 keV (sumpeak with U-235 185.7 keV), Ra-228 by Ac-228 peak
Ra-226, Ra-228	ODH In-Situ Radium	<p>Approved method for ODH radioactive materials use licensee(s):</p> <ul style="list-style-type: none"> • #03219070000 – Austin Master Services LLC, Martins Ferry, OH (740) 609-3800 	Limited to in-situ Gamma spectroscopy of containerized TENORM solids.

Ra-226, Ra228	ND-DOH Screening for Disposal	<p>North Dakota Department of Health Approved Screening for Disposal Method.</p> <p>For a list of ND-DOH approved labs, see:</p> <p>https://deq.nd.gov/aq/Radiation/TENORM.aspx</p>	<p>Gamma spectroscopy (utilizing Ra-226 186 keV peak with 0.571 correction factor), Ra-228 by Ac-228 peak</p>
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NOTE: Accredited laboratories located outside of Ohio may have approved screening for disposal methods equivalent to those identified in Table 2 above. To be added to Table 2, the out-of-state lab must submit a copy of the approval documentation from its state regulatory authority by email to BRadiation@odh.ohio.gov with the subject line "TENORM Method Approval". If the state regulatory authority's review and approval process is similar to or stricter than Ohio's review process, then the lab will be added to Table 2.