Analytical Methods for Characteristic Hazardous Waste Determination

This table provides a summary of the analytical methods specified in the hazardous waste regulations when making a characteristic hazardous waste determination. The last column in the table provides additional information and recommended test methods when an analytical method is not described in the regulations.

If you have questions about making a waste determination and/or test methods, please contact your local Hazardous Waste Section Inspector or Chemist. The following is a link to a map showing the contact information and regions for the Hazardous Waste Section Inspectors and Chemists:
https://files.nc.gov/ncdeq/Waste%20Management/DWM/HW/Compliance/Compliance_Map_by_Inspector.pdf

Hazardous Waste Characteristic		Definition Citation	Definition	Test Method Described in Regulation	Recommended Test Methods when not Described in Regulation/Additional Information
Ignitability 40 CFR 261.21 (D001)	Ignitable Liquid	40 CFR 261.21(a)(1)	It is a liquid, other than a solution containing less than 24 percent alcohol by volume and at least 50 percent water by weight, that has a flash point less than 60 °C (140°F).	SW-846 Test Methods for Flash Point: 1010B (Pensky-Martens Closed Cup Tester) - ASTM D93-79, - ASTM D93-80, or - ASTM D8175-18 or 1020C (Setaflash (Small Scale) Closed-Cup Apparatus): - ASTM D3278-78, or - ASTM D8174-18	To determine whether a waste is "Liquid" - Free Liquids is determined by SW-846 Test Method 9095B: Paint Filter Liquids Test
	Ignitable Solid	40 CFR 261.21(a)(2)	It is not a liquid and is capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture or spontaneous chemical changes and, when ignited, burns so vigorously and persistently that it creates a hazard.	No test method specified in hazardous waste regulation.	If there are no free liquids (as determined by SW-846 Test Method 9095B: Paint Filter Liquids Test), then test for one part of the ignitable solid definition: - SW 846 Method 1030 is used to assess the tendency to burn vigorously and persistently but doesn't address the "capable of causing fire through friction, absorption of moisture or spontaneous chemical changes". - SW 846 Method 1050 "Test Methods to Determine Substances Likely to Spontaneously Combust." Test Method A and C are used to determine whether the solid material will spontaneously combust. - If you do one of the ignitable solids test and it fails it, then you may stop (and not do both parts of the test) – it is not an ignitable solid. If it passes the test (e.g., does burn vigorously and persistently) then you need to continue on to the second test.

Analytical Methods for Characteristic Hazardous Waste Determination (continued)					
Hazardous Waste Characteristic		**Definition Citation**	**Definition**	**Test Method Described in Regulation**	**Recommended Test Methods when not Described in Regulation/Additional Information**

Ignitability
 	
40 CFR 261.21 (continued)
 	
(D001)
	Ignitable Compressed Gas	40 CFR 261.21(a)(3)	It is an ignitable compressed gas.
			- The term "compressed gas" shall designate any material or mixture having in the container an absolute pressure exceeding 40 p.s.i. at 70 °F or, regardless of the pressure at 70 °F, having an absolute pressure exceeding 104 p.s.i. at 130 °F; or any liquid flammable material having a vapor pressure exceeding 40 p.s.i. absolute at 100 °F.
			
			- A compressed gas shall be characterized as ignitable if any one of the following occurs:
			  - Either a mixture of 13 percent or less (by volume) with air forms a flammable mixture or the flammable range with air is wider than 12 percent regardless of the lower limit. These limits shall be determined at atmospheric temperature and pressure.
			  - It is determined to be flammable or extremely flammable using 49 CFR 173.115(l).
				"Compressed Gas" determined by:
				- ASTM Test D-323
				
				Compressed Gas is characterized as ignitable by the following method of sampling and test procedure:
				- ASTM E 681-85 or
				- Other equivalent methods approved by the Associate Administrator, Pipeline and Hazardous Materials Safety Administration, U.S. Department of Transportation.
					DOT Test Method: ASTM E681-85 (Standard Test Method for Concentration Limits of Flammability of Chemicals)

	Oxidizer	40 CFR 261.21(a)(4)	It is an oxidizer.
			- An oxidizer for the purpose of 40 CFR 261 is a substance such as a chlorate, permanganate, inorganic peroxide, or a nitrate, that yields oxygen readily to stimulate the combustion of organic matter.
			- An organic compound containing the bivalent -O-O- structure and which may be considered a derivative of hydrogen peroxide where one or more of the hydrogen atoms have been replaced by organic radicals must be classed as an organic peroxide unless:
			  - The material meets the definition of a Division 1.1, 1.2, or 1.3 explosive, as defined in 40 CFR 261.23(a)(8), in which case it must be classed as an explosive,
			  - The material is forbidden to be offered for transportation according to 49 CFR 172.101 and 49 CFR 173.21,
			  - It is determined that the predominant hazard of the material containing an organic peroxide is other than that of an organic peroxide, or
			  - According to data on file with the Pipeline and Hazardous Materials Safety Administration in the U.S. Department of Transportation, it has been determined that the material does not present a hazard in transportation.
				No test method specified in hazardous waste regulation.	On DOT's hazardous materials table at 49 CFR 172.101, Column (3) identifies the Hazard Class of each material and Hazard Class of 5.1 or 5.2 indicates that the material is a DOT oxidizer. Column (3) identifies the primary hazard associated with a given hazardous material. For a complete classification, the generator must also reference Column (6), which identifies the primary and subsidiary hazards associated with a given hazardous material.
					
					Oxidizing Solids: SW-846 Test Method 1040 for Oxidizing Solids
					
					Oxidizing Liquids: UN Manual of Tests and Criteria (previously known as the Recommendations on the Transport of Dangerous Goods) provides information and recommended test methods for oxidizing liquids on page 386.

Analytical Methods for Characteristic Hazardous Waste Determination (continued)

Hazardous Waste Characteristic		Definition Citation	Definition	Test Method Described in Regulation	Recommended Test Methods when not Described in Regulation/Additional Information
Corrosivity 40 CFR 261.22 (D002)	Aqueous	40 CFR 261.22(a)(1)	It is aqueous and has a pH less than or equal to 2 or greater than or equal to 12.5 or	Determined by a pH meter using SW-846 Test Method 9040C for pH Electrometric Measurement	Aqueous wastes must contain at least 20% free water by volume
	Liquid	40 CFR 261.22(a)(2)	It is a liquid and corrodes steel (SAE 1020) at a rate greater than 6.35 mm (0.250 inch) per year at a test temperature of 55 °C (130 °F).	SW-846 Test Method 1110A for Corrosivity Towards Steel	To determine whether a waste is "Liquid" - Free Liquids is determined by SW-846 Test Method 9095B: Paint Filter Liquids Test
Reactivity 40 CFR 261.23 (D003)			A solid waste exhibits the characteristic of reactivity if a representative sample of the waste has any of the following properties: - It is normally unstable and readily undergoes violent change without detonating. - It reacts violently with water. - It forms potentially explosive mixtures with water. - When mixed with water, it generates toxic gases, vapors, or fumes in a quantity sufficient to present a danger to human health or the environment. - It is a cyanide or sulfide bearing waste which, when exposed to pH conditions between 2 and 12.5, can generate toxic gases, vapors, or fumes in a quantity sufficient to present a danger to human health or the environment. - It is capable of detonation or explosive reaction if it is subjected to a strong initiating source or if heated under confinement. - It is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure. - It is a forbidden explosive as defined in 49 CFR 173.54, or is a Division 1.1, 1.2 or 1.3 explosive as defined in 49 CFR 173.50 and 173.53.	No test method specified in hazardous waste regulation.	Representative sample is defined in 40 CFR 260.10. SW-846 Test Method 8330B for Nitroaromatics, Nitramines, and Nitrate Esters by High Performance Liquid Chromatography (HPLC) may be used to determine the concentration of nitroaromatics, nitramines, and nitrate ester explosives in water and soil. On a case by case basis the following could be used. Cyanide and sulfide bearing wastes when solid waste releases more than 250 mg of hydrogen cyanide gas/kg of waste or more than 500 mg of hydrogen sulfide gas/kg of waste these should be regulated as reactive hazardous waste. Examples of Known Reactives (this list is not exhaustive): - Aluminum Alkyls - Ammonium Fulminate - Gold Cyanide - Lead Azide (dry) - Lithium - Nitroglycerine - Picric Acid (crystals) - Potassium Sulfide - Pentaerythrite tetranitrate - Sodium - Sodium-potassium alloy - Sodium sulfide - Silver cyanide - Silver picrate (dry) - Trinitotoluene - White Phosphorous (dry) - Zinc Powder

Analytical Methods for Characteristic Hazardous Waste Determination (continued)				
Hazardous Waste Characteristic	**Definition Citation**	**Definition**	**Test Method Described in Regulation**	**Recommended Test Methods when not Described in Regulation/Additional Information**
Toxicity 40 CFR 261.24 (D004 through D043)		A solid waste (except manufactured gas plant waste) exhibits the characteristic of toxicity if the extract from a representative sample of the waste contains any of the 40 contaminants listed in 40 CFR 261.24 Table 1 (Maximum Concentration of Contaminants for the Toxicity Characteristic) at the concentration equal to or greater than the respective value given in that table.**	SW-846 Test Method 1311 for Toxicity Characteristic Leaching Procedure (TCLP) - Where the waste contains less than 0.5 percent filterable solids, the waste itself, after filtering using the methodology outlined in Method 1311, is considered to be the extract for the purpose of this section.	Representative sample is defined in 40 CFR 260.10. When testing for toxicity, once the TCLP is run, the extract obtained may be analyzed for the 40 constituents listed in 40 CFR 261.24 by any method as long as that method has documented quality control and is sensitive enough to meet the regulatory limits. - Methods 3010 and 6010 for arsenic, barium, cadmium, chromium, lead, silver, and selenium; - Method 7470 for mercury - Method 3510 and 8081 for pesticides - Method 8151 for herbicides - Method 8260 for volatile organics; and - Methods 3510 and 8270 for semi-volatile organics. Total waste analyses in lieu of TCLP results*

*** A generator may alternatively use total waste analyses to determine that a waste does not exhibit the toxicity characteristic. Check with the Hazardous Waste Section Environmental Chemist prior to using totals for waste determination purposes when the waste is a solid or dual-phase waste. The methodology for using total waste analyses to make a toxicity determination varies depending on the type of waste as described below:**

- **Liquids**: Liquids (i.e., wastes that contain less than 0.5% filterable solids) do not require extraction. Instead, per the last sentence of 40 CFR 261.21(a), a generator may characterize such a liquid waste by filtering it, analyzing the total constituent concentrations in the resulting filtrate, and comparing those concentrations directly to regulatory levels.

- **Solids**: For wastes that are 100% physically solid (i.e., contain no filterable liquid), the total concentration of the toxicity characteristic constituent (in Table 1 of 40 CFR 261.24) is determined, and then the total levels is converted to the maximum theoretical leachate concentrations that could possibly result from performing the TCLP. This is accomplished by dividing the total constituent concentration by 20 (reflecting the 20 to 1 weight ratio of extraction fluid to solid in the TCLP) and then comparing the resulting maximum theoretical leachate concentration to the applicable regulatory level (see formula below and Table 1 in 40 CFR 261.24). Using the maximum theoretical leachate concentration for wastes that are 100% solid is known as the "Rule of 20" because of the 20 to 1 weight ratio described in the previous sentence. If the maximum theoretical leachate concentration does not equal or exceed the appropriate regulatory limit for the specific constituent, the solid does not exhibit the toxicity characteristic. If the total concentration is greater than or equal to the toxicity characteristic regulatory level, the TCLP would be required for waste determination. The Rule of 20 can be used to prove a material is not a toxicity characteristic hazardous or it can be used as screen to determine when the TCLP needs to be run.

  M = C/20

  Where: M = maximum theoretical leachate level (mg/L);
  C = concentration of analyte in the soil (mg/kg), total concentration; and mg/L= ppm= mg/kg

- **Dual-phase wastes**: The generator of a dual-phase waste (a waste that has both a solid and a filterable liquid component) can perform a total waste analysis on both the solid and liquid portions and calculate maximum theoretical leachate concentrations for the waste as a whole. This is accomplished by combining results mathematically through use of the following formula:

$$M = \frac{(A \times B) + (C \times D)}{B + (20\ L / kg \times D)}$$

  Where: M = Maximum theoretical leachate concentration (mg/L)
  A = Total concentration of the analyte in the liquid portion of the sample (mg/L)
  B = Volume of the liquid portion of the sample (L)
  C = Total concentration of the analyte in the solid portion of the sample (mg/kg)
  D = Weight of the solid portion of the sample (kg)

**** 40 CFR 261.24 Table 1 - Maximum Concentration of Contaminants for the Toxicity Characteristic**

Maximum Concentration of Contaminants for Toxicity Characteristics			
Waste Code	**Contaminant**	**Concentration (mg/l)**	**Category of Contaminant**
D004	Arsenic	5.0	Metal
D005	Barium	100.0	Metal
D006	Cadmium	1.0	Metal
D007	Chromium	5.0	Metal
D008	Lead	5.0	Metal
D009	Mercury	0.2	Metal
D010	Selenium	1.0	Metal
D011	Silver	5.0	Metal
D018	Benzene	0.5	Volatile Organic Compound
D019	Carbon tetrachloride	0.5	Volatile Organic Compound
D021	Chlorobenzene	100.0	Volatile Organic Compound
D022	Chloroform	6.0	Volatile Organic Compound
D028	1,2-Dichloroethane	0.5	Volatile Organic Compound
D029	1,1-Dichloroethylene	0.7	Volatile Organic Compound
D035	Methyl ethyl ketone	200.0	Volatile Organic Compound
D039	Tetrachloroethylene	0.7	Volatile Organic Compound
D040	Trichloroetheylene	0.5	Volatile Organic Compound
D043	Vinyl chloride	0.2	Volatile Organic Compound
D023	o-Cresol	200.0	Semi-Volatile Organic Compound
D024	m-Cresol	200.0	Semi-Volatile Organic Compound
D025	p-Cresol	200.0	Semi-Volatile Organic Compound
D026	Total Cresols	200.0	Semi-Volatile Organic Compound
D027	1,4-Dichlorobenzene	7.5	Semi-Volatile Organic Compound
D030	2,4-Dinitrotoluene	0.13	Semi-Volatile Organic Compound
D032	Hexachlorobenzene	0.1	Semi-Volatile Organic Compound
D033	Hexachlorobutadiene	0.5	Semi-Volatile Organic Compound
D034	Hexachlorothane	3.0	Semi-Volatile Organic Compound
D036	Nitrobenzene	2.0	Semi-Volatile Organic Compound
D037	Pentachlorophenol	100.0	Semi-Volatile Organic Compound
D038	Pyridine	5.0	Semi-Volatile Organic Compound
D041	2,4,5-Trichlorophenol	400.0	Semi-Volatile Organic Compound
D042	2,4,6-Trichlorophenol	2.0	Semi-Volatile Organic Compound
D020	Chlordane	0.03	Pesticide
D012	Endrin	0.02	Pesticide
D031	Heptachlor (and its epoxide)	0.008	Pesticide
D013	Lindane	0.4	Pesticide
D014	Methoxychlor	10.0	Pesticide
D015	Toxaphene	0.5	Pesticide
D016	2,4-D	10.0	Herbicide
D017	2,4,5-TP (Silvex)	1.0	Herbicide