Chapter NR 516

LANDFILL CONSTRUCTION DOCUMENTATION

Note: Corrections made under s. 13.93 (2m) (b) 6. and 7., Stats., Register, August, 1997, No. 500.

NR 516.01 Purpose. The purpose of this chapter is to help ensure that efficient, nuisance–free and environmentally acceptable solid waste management procedures are practiced in this state and to outline the requirements regarding testing and construction documentation for solid waste landfills. This chapter is adopted under s 227.11 and ch. 289, Stats.

History: Cr. Register, January, 1988, No. 385, eff. 2–6–88; am., Register, June, 1996, No. 486, eff. 7–1–96.

NR 516.02 Applicability. (1) Except as otherwise provided, this chapter governs all landfills as defined in s. 289.01 (20), Stats., except small demolition waste landfills regulated under ch. NR 503, hazardous waste facilities as defined in s. 291.01 (8), Stats., and regulated under chs. NR 600 to 690 and metallic mining operations as defined in s. 293.01 (9), Stats., and regulated under ch. NR 182.

(2) This chapter does not apply to the design, construction or operation of industrial wastewater facilities, sewerage systems and waterworks treating liquid wastes approved under s. 281.41, Stats., or permitted under ch. 283, Stats., nor to facilities used solely for the disposal of liquid municipal or industrial wastes which have been approved under s. 281.41, Stats., or permitted under ch. 283, Stats., except for facilities used for the disposal of solid waste.

History: Cr. Register, January, 1988, No. 385, eff. 2–6–88; correction in (1) made under s. 13.93 (2m) (b) 7., Stats., Register, May, 1994, No. 461; am. (1), Register, June, 1996, No. 486, eff. 7–1–96.

NR 516.03 Definitions. The terms used in this chapter are defined in s. NR 500.03.

History: Cr. Register, January, 1988, No. 385, eff. 2–6–88.

NR 516.04 General requirements. (1) REPORT PREPARATION. A report documenting all aspects of construction shall be prepared for the initial construction of the landfill; the construction of all subsequent phases or portions thereof; the construction of any storm water, groundwater, leachate or gas control structures; the implementation of remedial actions; and the closure of each major disposal area. Approval of a report which documents the construction of any portion of the base of a landfill shall be obtained from the department prior to initiating disposal operations in the newly established area, unless the department does not issue a determination within 60 days after receiving a complete submittal, along with the appropriate review and construction inspection fees specified in ch. NR 520.

(2) QUALITY ASSURANCE. Construction and closure of all landfills shall comply with the following:

(a) A registered professional engineer or qualified technician who is directly supervised by a professional engineer shall be continuously on–site and performing assigned quality assurance duties throughout the following: placement and testing of the clay component of the liner and cover systems, installation and testing of the geosynthetic components of liner and cover systems, all aspects of sump and sideslope riser construction or penetrations of the sidewall liner, manhole and tank installation, and placement of the drainage layer or cover soil above the geosynthetic liner. These personnel shall also be on–site to inspect the following activities after their completion: temporary and permanent erosion control measures such as ditches, fencing and sedimentation basins; subbase and leachate collection line undercut excavation and grading; clay liner surface preparation and grading, leachate, lysimeter and gas piping prior to their being covered with soil; piping with tanks, manholes or vaults and installation of instrumentation and controls; and gas extraction well heads. The department may require by written approval that a registered professional engineer be present during other critical construction activities.

(b) With respect to par. (a), substitution of personnel shall only occur due to substandard performance, vacations or uncontrollable circumstances such as injury, illness, employe termination or resignation. However, if necessary in order to provide experienced personnel, geomembrane installation quality assurance may be performed by a different registered professional engineer or qualified technician directly supervised by that registered professional engineer. In no case, however, may the personnel performing quality assurance for geomembrane installation be employed by the geomembrane manufacturer, fabricator or installer. Also, where justified by the size of the construction project, multiple registered professional engineers or qualified technicians may perform quality assurance work concurrently.

(3) CERTIFICATION. A certification section shall be included as the first section of any construction documentation report prepared for the construction or closure of a portion of a landfill and shall include the following:

(a) The signed certification statement contained in s. NR 500.05(4) as well as the seal of all registered professional engineers who either performed quality assurance work on the project or supervised qualified technicians who did so.

(b) A table clearly identifying each registered professional engineer and qualified technician who performed quality assurance during the construction; which aspects of construction each person provided on site quality assurance for; the number of days each was present at the landfill performing quality assurance work; and the total hours each spent at the site performing quality assurance work. The table shall also clearly identify the registered professional engineer supervising each qualified technician.

(c) A second table identifying who prepared each portion of the construction documentation report including both narrative and plan sheets.

(d) Separate signed statements by the registered professional engineers identified in sub. (2) certifying to the best of their knowledge, information and belief that the construction of each item identified in the following subdivisions was accomplished in conformance with the approved plans and all applicable solid waste administrative code requirements. All observed deviations shall be explicitly noted and discussed including any changes in materials. This certification may not be construed to be either an implied or express guarantee or warranty regarding the performance of the construction documented in this report. No further qualifications to the certification statement may be made and each statement shall also clearly identify the personal observations, knowledge or other information on which the certification is based.

1. The clay component of a liner or cap. The statement shall specifically address:

a. The quality of clay material used and the methods utilized in its placement.

b. Connections with previously placed clay layers.

c. Preparation of leachate collection trenches, sumps, gas header trenches and any pipe penetrations through the clay component.

d. Preparation of the upper portions of the clay component of a composite–lined or composite–capped landfill for installation of the geomembrane, including smoothness of the surface, removal of rocks and other foreign objects, and repair of the clay surface due to rain, rutting or other damage.

e. Placement of soil or other materials placed over the composite liner or composite cap.

2. Geomembranes, grids, fabrics, nets and appurtenances. The statement shall specifically address:

a. Connections with all previously placed geosynthetics.

b. Placement of geomembrane in collection trenches, sideslope riser sump areas and other irregularly shaped areas.

c. Connections of geomembrane around leachate transfer pipes, gas extraction wells and any other penetration of the composite liner or composite cap.

d. Removal of geomembrane wrinkles which were higher than they were wide.

3. Elements of the construction relating to leachate or storm water routing, collection, storage and transportation as well as gas extraction systems. The statement shall include but not be limited to: construction of leachate collection and transfer lines, side slope risers for leachate pumping, all liner penetrations, collection tanks, manholes, lift stations, lysimeters, gas extraction system construction and leachate headwells.

(4) PRECONSTRUCTION MEETINGS. For composite–lined or composite–capped landfills, a preconstruction meeting shall be scheduled prior to the initiation of construction for each phase of construction of the geomembrane component of the liner or cap. The meeting shall be used to clarify or confirm design changes, acceptability of selected construction materials and construction concepts or practices required in the approved plan of operation or identified in the preconstruction report. At a minimum, the meeting shall include the design engineer, the appropriate department district and central office staff, the engineer or engineers responsible for quality assurance of all aspects of construction and the geomembrane installer.

(5) PRECONSTRUCTION REPORTS. A preconstruction report shall be prepared for each phase of construction of the composite liner as well as each phase of the composite cap. The department may also require a preconstruction report for each phase of construction which utilizes a geocomposite clay liner (GCL) or other geosynthetics, or when other geosynthetic materials are used in significant structural features of the landfill. The preconstruction report shall be submitted to the department no later than 15 days prior to the preconstruction meetings for the construction of the geomembrane component of the composite liner or the composite cap. Unless otherwise specified, 2 copies shall be provided to the bureau of waste management in Madison and one copy shall be provided to the appropriate department field office. The preconstruction report shall include, at a minimum, the following:

(a) Any revisions and detail diagrams incorporating all changes and instructions between the owner, the installer and the quality assurance contractor. The report shall highlight and explain any proposed changes to the information provided in the plan of operation as specified in s. NR 514.07(1)(a) and (c) to (h). If, in the department's opinion, major changes are proposed to previously approved plans, a plan modification approval will be required. The report shall indicate the proposed limits of installation and the schedule for construction.

(b) Identification of the manufacturer of the geomembrane and other geosynthetics used in construction, manufacturer qualifications, technical specifications of the resin and polymer selected and results of the manufacturer's quality control tests on the geomembranes supplied to the project. Identification of the fabricator of geotextiles and other geosynthetics used in site construction, technical specifications of the products and materials to be used, methods used to bond the materials together and to connect panels together, installation contractor, contractor qualifications and on–site supervisory staff. Description of the selected materials and source of the sideslope riser pipe, methods proposed to assemble and place the sideslope riser pipe, and measures to be taken to prevent puncture of the geomembrane below the sideslope riser pipe and protective drainage material.

(c) The results of a shear test conducted, in accordance with ASTM method D5321, on the soils and geosynthetic materials selected for use in construction of the liner system and the final cover system. The shear test results shall be used to evaluate the stability of the geomembrane component over the clay component and the drainage layers placed on the geomembrane component. If the materials to be used are the same as those that were tested for a previous construction event then the test need not be conducted again. The department may also waive testing of materials which are proposed exclusively for use on flatter portions of liners or final cover systems.

(d) A quality control plan which provides all information specified in s. NR 514.07 (1) (i), as well as identification of the installation contractor, contractor qualifications and on–site supervisory staff. Any proposed changes to the quality control plan contained in a landfill's approved plan of operation shall be highlighted and explained.

(e) A quality assurance plan which provides all information specified in s. NR 514.07 (1) (j), as well as identification of the registered professional engineer and qualified technician who will be providing quality assurance and a summary of their qualifications and related work experience.

(6) CONSTRUCTION INSPECTIONS. The department may, under s. 289.91, Stats., inspect construction projects for the purpose of determining compliance with ch. 289, Stats., and chs. NR 500 to 536. The district and central office staff shall be notified, by telefax, telephone or letter, at least one week prior to beginning each of the construction events specified by the department. A fee shall be paid to the department for each required inspection in accordance with s. NR 520.04(5). The inspection fees shall be paid at the time the construction documentation review fee is submitted to the department.

History: Cr. Register, January, 1988, No. 385, eff. 2–6–88; r. (1), renum. (2) to be (1) and am., cr. (2) to (6); Register, June, 1996, No. 486, eff. 7–1–96.

NR 516.05 Construction of landfill areas. In addition to the general information specified in s. NR 516.04 (3) (d) reports documenting the construction of all new landfill areas shall contain the following minimum information:

(1) ENGINEERING PLANS. A set of 24 inch by 36 inch engineering plan sheets, or alternative size if approved by the department in writing, shall be prepared in accordance with s. NR 500.05 and contain:

(a) A plan view documenting the constructed grades for the sub–base, sidewalls, leachate collection trench undercuts and all sub–base appurtenances such as lysimeters and drain pipes, prior to liner placement. Documentation of the grades shall consist of spot elevations taken on a maximum 50–foot grid pattern, with leachate collection trench undercut elevations at least every 25 linear feet. If a total station or laser equipment is used to set elevations, the elevations may be taken every 50 linear feet. The

approved sub–base grades shall also be shown for the same area in a clear and legible manner.

(b) Plan view drawings showing the locations of all the various soil and geomembrane testing performed. Each test location shall be clearly labeled with appropriate identification codes. The plan view drawings shall clearly show any areas where removal and recompaction of clay was necessary in order to attain the minimum required specifications. For composite–lined and composite–capped landfills, a plan view drawing shall also clearly show geomembrane panel placement, geomembrane patches and seam repairs, and geomembrane destructive sample locations. Multiple plan views may be shown on a single plan sheet if legibility is not compromised.

(c) A plan sheet documenting the constructed elevations for the liner system. This plan sheet shall contain spot elevations of the base, sidewalls and leachate collection trenches. Documentation of grades shall include spot elevations taken on a maximum 50–foot grid pattern, with leachate collection trench elevations taken every 25 linear feet. If a total station or laser equipment is used to set elevations, the leachate collection trench elevations may be taken every 50 linear feet. The approved base grades shall be shown for the same area in a clear and legible manner.

(d) A plan view drawing showing the constructed base grades as well as the locations and elevations of all leachate collection and transfer piping, manholes, lift stations, culverts, berms and the location of all unsaturated zone, groundwater, gas, leachate monitoring and cleanout devices, surface drainage features and other pertinent structures. This information may be shown on the plan sheet required in par. (c) if legibility is not compromised.

(e) Cross–sections through the constructed area parallel and perpendicular to the base line of the facility. A minimum of 4 cross–sections shall be prepared, 2 of which shall be in each direction. Additional cross–sections shall be prepared as necessary to add clarification. Each of the cross–sections shall show actual and design sub–base and base grade contours, the top of the granular drainage blanket, leachate and groundwater pipe elevations and the actual base and sub–base contours of adjacent filled areas. The design sub–base and base grade contours do not need to be shown if there is not an observable variation from the design grades.

(f) Detail drawings, both plan view and cross–sections, of all manholes, lift stations, storage tanks, sumps and sideslope risers or locations where leachate transfer piping exits the lined area and the secondary containment of these features as well as leak detection monitoring points and other pertinent construction details. At a minimum, these drawings shall show base and top elevations, the invert elevations of all associated piping, pump details, float level elevations and the extent of recompacted clay placed around and below the structures. If float elevations are not available at the time of submittal of the construction documentation report, they shall be provided to the department when they are available.

(g) Cross–section details shall be included to illustrate all important construction features of the liner, lysimeters, leachate collection trenches and sumps, and sediment control and storm water management systems.

(h) Detail drawings shall be included for leachate header lines or drain lines located outside the limits of waste in critical areas of below–ground piping such as where several pipes cross or meet to illustrate sufficient pipe location and invert information.

(i) Additional plan sheets, patterned after those specified in pars. (a) to (h), shall be included for those facilities designed with multiple liners, groundwater gradient control systems or other nonstandard design features.

(2) REPORT PREPARATION. A comprehensive report containing a detailed narrative describing the construction of the area in a logical fashion shall be prepared. Particular emphasis shall be given to any deviations from the approved plan of operation and to the explicit construction methods used for all locations where leachate transfer piping exits the lined waste fill area. This report shall include the following information at a minimum:

(a) An analysis and discussion of all soil and geomembrane testing work performed. All density and moisture content testing results shall clearly indicate which Proctor curve or line of optimums is applicable to the soil being compacted. Any changes in the referenced Proctor curve or line of optimums shall be identified as to when they occurred and why the change was made. All raw data from the soil and geomembrane testing performed shall be included in an appendix to the construction documentation report unless other arrangements were previously approved by the department. The raw data shall be summarized using a tabulated format. Also included shall be the make, model, weight and foot length of each piece of equipment used to compact clay.

(b) A table containing thicknesses of each layer in the liner system on a 100–foot grid pattern.

(c) Discussion of how the leak tests were performed on lysimeters and sideslope riser sumps and a discussion of any problems encountered and how they were resolved.

(d) Documentation of the initial leachate collection pipe cleanout, and pressure testing of force mains and leachate storage tanks. All provisions used to seal pipe connections, manhole sections and leachate storage tanks including protective coatings and corrosion protection shall be described. The manufacturer's recommendations for the installation of all equipment shall be included. Any deviations from the recommendations shall be discussed.

(e) Daily summary reports prepared by the registered professional engineer or qualified technician performing continuous quality assurance for each day that installation of geomembrane or other geosynthetics is either attempted or accomplished when constructing composite–lined sites. The reports shall specifically describe practices employed for base grade preparation and acceptance before geomembrane installation and drainage layer placement, and the following:

1. Identification and location of geomembrane panels placed, with modifications of the fabrication plan noted.

2. Identification of field seams and ends of panels, and results of all destructive and nondestructive field tests of test seams and installed seams.

3. Methods and procedural steps taken prior to field seaming of panels.

4. Identification of wrinkles that were large enough to double over and were cut out and repaired.

5. Identification of repairs and destructive samples and the results of the nondestructive testing of those repairs.

6. Amount and location of geotextile and other geosynthetics used in construction of the liner.

7. Identification of the sources and product information for manufactured items used in site construction including geosynthetics. This shall include the identification of all solvents and other sealants used in pipe construction.

8. Weather conditions and constraints.

(f) A series of properly labeled 35 millimeter color prints documenting all major aspects of facility construction. This shall include close–up photographs of the construction process including clay liner placement, geomembrane placement, leachate pipe placement including all places where transfer piping exits the lined waste fill area or sideslope riser installation, drainage blanket placement and the installation of all manholes, sumps, sideslope risers, lift stations and storage tanks. Panoramic views shall be included showing the prepared sub–base and the completed liner before and after granular blanket placement.

History: Cr. Register, January, 1988, No. 385, eff. 2–6–88; r. (1) (g), (2) (d), renum. (intro. (1), (2) (intro.), (a), (d), (f) from NR 516.06 (intro.), (1), (2) (intro.), (a) (b), (c), cr. (1) (g), (h), (i), (2) (b), (c), (e) and am. (intro.), (1) (a) to (c), (e) (f), (2) (intro.), (a), (f), Register, June, 1996, No. 486, eff. 7–1–96.

NR 516.06 Closure of landfill areas. In addition to the requirements of s. NR 516.04 (3), all construction documentation reports for the closure of landfill areas shall contain the following minimum information:

(1) ENGINEERING PLANS. A set of 24 inch by 36 inch engineering plan sheets, unless an alternative size is approved by the department in writing, prepared in accordance with s. NR 500.05 and including:

(a) A plan sheet documenting the final refuse grades, including daily or intermediate cover. Documentation of grades shall include spot elevations taken on a maximum 100–foot grid after grading has been performed to establish uniform slopes. Documentation of grades for landfills which primarily accept papermill sludge or other low strength wastes may be performed at the surface of the support layer, accompanied with documentation of the thickness of the support layer on a 100–foot grid and the orientation of any geosynthetics and pipe used for reinforcement, separation, filtration or drainage. For areas less than 4 acres, a 50–foot grid shall be used.

(b) A plan view drawing for each one–foot thickness of clay placed showing the locations of the various soil testing performed at each test location. Multiple plan views may be presented on a single engineering plan sheet if legibility is not compromised.

(c) A plan view drawing showing the location of all geomembrane tests, geomembrane panel layout, geomembrane patches and seam repairs, and geomembrane destructive samples.

(d) A plan sheet documenting the constructed final cap grades prior to topsoil placement on a maximum 100–foot grid. Approved final cap grades shall be shown for the same area in a clear and legible manner. For areas less than 4 acres, a 50–foot grid shall be used.

(e) A plan sheet documenting the gas and condensate transfer piping layout, top of header pipe elevation at each gas extraction well, at all major changes in slope and at the driplegs and the condensate tank, and the location of the anti–seep collar around pipes exiting the waste.

(f) Cross–sections through the closed area which are constructed parallel and perpendicular to the base line of the landfill. A minimum of 4 cross sections shall be submitted, 2 of which shall be in each direction. Each of the cross–sections shall show all surficial and subsurface features encountered including gas extraction wells or vents, leachate lines, and other landfill structures and shall be tied into the grades of adjacent previously filled areas. At a minimum, each cross section shall show actual subbase grades, base grades, final refuse grades, and final topsoil grades.

(g) Detail drawings, plan view and cross–section, of typical gas extraction wells or gas vents, bedding and assembly of the lateral and header pipes, header pipe joining details, header pipe exiting the site, valves, driplegs, manholes, lift stations, collection tanks, and blower building and flare.

(h) Cross section details shall be included to illustrate all important construction features of the final cover, drainage systems for gas condensate, and sediment control and storm water management structures.

(i) Detail drawings shall be included for gas header and gas condensate drain lines outside the limits of waste in critical areas of below–ground piping such as where several pipes cross or meet to illustrate sufficient pipe location and invert information.

(2) REPORT PREPARATION. A comprehensive report containing a detailed narrative describing the closure of the area in a logical fashion shall be prepared. Particular emphasis shall be placed on any deviations from the approved plans. This report shall also include the following information at a minimum:

(a) An analysis and discussion of all soil and geomembrane testing work performed. All density and moisture content testing results shall clearly indicate which Proctor curve or line of optimums is applicable to the soil being compacted. Any changes in the referenced Proctor curve or line of optimums shall be identified as to when they occurred and why the change was made. All raw data from the soil and geomembrane testing performed shall be included in an appendix to the closure documentation report unless other arrangements were previously approved by the department. The raw data shall be summarized using a tabulated format. Also included shall be the make, model, weight and foot length of each piece of equipment used to compact clay.

(b) A table containing thicknesses of each layer in the cover system on a 100–foot grid pattern. When determining soil thickness by using surveying information, the table shall contain elevations before and after soil layer placement on the 100–foot grid. For areas less than 4 acres, a 50–foot grid shall be used. As an alternative to the survey method, soil thickness shall be controlled using settlement plates and grade stakes, and clay thickness shall be established on a 100–foot grid using auger borings. Boreholes shall be backfilled with a soil–bentonite mix such that the in–place permeability of the backfilled material is equal to or less than the surrounding clay cap.

(c) When the auger method is used to determine soil layer thicknesses, a discussion of how the auger boreholes were backfilled and the materials used.

(d) A table showing gas extraction well construction information including: location, surface elevation, depth of the borehole, top of casing elevation, elevation and length of the solid and perforated piping, elevation and length of the gravel backfill, bentonite seal and other backfill materials.

(e) Daily summary reports shall be prepared for each day that installation of geomembrane or other geosynthetics is either attempted or accomplished for composite–capped landfills and shall contain the information required in s. NR 516.05 (2) (e).

(f) The rates and types of fertilizer, seed and mulch applied. Liming requirements shall also be included along with the actual rate of application.

(g) A series of properly labeled 35 millimeter color prints which document all major aspects of facility closure. This shall include panoramic views of the closed area as well as close–up photos of the construction process and completed engineering structures such as gas extraction wells or vents, blower and flare stations, cleanout ports, manholes, gas condensate tanks and other pertinent structures.

History: Cr. Register, January, 1988, No. 385, eff. 2–6–88; r. (1) (d), (2) (e) renum. (intro.), (1) (intro.), (a), (b), (d), (f), (2) (intro.), (a), (f), (g) from NR 516.07 (intro.), (1) (intro.), (a), (b), (c), (e), (2) (intro.), (a), (b), (c) and am. (intro.), (1) (a), (b), (f), (2) (intro.), (a), cr. (1) (d), (e), (g) to (i), (2) (b) to (e), Register, June, 1996, No. 486, eff. 7–1–96; **am. (2) (e), Register, August, 1997, No. 500, eff. 9–1–97.**

NR 516.07 Soil and geomembrane testing requirements. Testing shall be performed during the construction and closure of any landfill areas. At a minimum, this testing shall include:

(1) LINER SYSTEM AND FINAL COVER SYSTEM CONSTRUCTION. For all recompacted clay soil construction, the following tests shall be performed:

(a) Dry density and as–placed moisture content shall be determined on an approximate 100–foot grid pattern for each one–foot thickness of clay placed. The grid pattern shall be offset on each subsequent layer of tests. A minimum of 2 density and moisture content tests for each one–foot thickness of clay placed shall be performed to fully define the degree of soil compaction obtained in confined areas where equipment movement is hindered or hand compaction is necessary.

(b) One moisture–density curve or line of optimums analysis shall be developed for every 5,000 cubic yards or less of clay placed and for each major soil type utilized. At least 5 points shall be established on each curve. If a line of optimums analysis is performed, at least 2 curves shall be included for each analysis. A representative sample for every 5,000 cubic yards or less of clay

placed shall be analyzed for grain size distribution through the .002 millimeter particle size and for Atterberg limits. If apparent changes in soil quality are observed during clay placement, a one–point Proctor analysis shall be utilized to verify the applicability of previously analyzed moisture–density curves.

(c) A minimum of one undisturbed sample for each acre or less for every one–foot thickness of clay placement shall be retrieved and analyzed for Atterberg limits, grain size distribution through the .002 millimeter particle size, moisture content and dry density. Laboratory hydraulic conductivity tests using effective stresses less than or equal to 5 psi and hydraulic gradients less than or equal to 30 shall be performed on every third undisturbed sample. The department may require that a portion of the hydraulic conductivity testing for liner documentation be performed using leachate.

(2) GEOMEMBRANE. For all geomembrane installations the following testing shall be performed. The testing shall be performed by the quality assurance engineer or another laboratory not affiliated with the quality control testing.

(a) Conformance sampling and testing shall be conducted on geomembrane materials delivered on site and used in construction. Sampling shall be conducted by the quality assurance engineer or qualified technician.

1. Geomembrane thickness shall be measured at the facility in a minimum of 5 places per roll to ensure that the material delivered meets the approved specifications.

2. Geomembrane tensile properties shall be tested at a minimum of one test per 100,000 ft^2 of geomembrane installed and a minimum of one test on rolls from each batch of resin used to manufacture rolls delivered on site. Tensile properties shall include strength and elongation in yield and break. If the selected resin does not exhibit a distinct yield point, tensile properties shall include strength and elongation in break.

3. Geomembrane density and melt index of the polymer shall be tested at a rate of one test per 100,000 ft^2 of geomembrane installed and a minimum of one test for each batch of resin used to manufacture rolls delivered on site, unless documentation is provided which shows the manufacturer performed testing at the same frequencies.

4. Geomembrane environmental stress cracking resistance documentation shall be provided which shows that the manufacturer performed a minimum of one test for each batch of resin used to manufacture rolls delivered on site.

(b) Pre–qualification tests for geomembrane fusion welding machines shall be conducted by a minimum of 2 pre–qualification seams run per day per welding machine by each seaming technician performing geomembrane welding with that machine. At least one test shall be performed at the start of each work day, with tests at intervals of no greater than 5 hours and with additional test runs following work interruptions, weather changes, changes to machine settings for temperature or speed or as directed by the quality assurance engineer or qualified technician. At start up, extrusion welding machine performance shall be verified by a minimum of 2 test seams per day per machine with additional testing as directed by the quality assurance engineer or qualified technician. A portion of each pre–qualification specimen shall be tested in the field for acceptable tensile strength. Test results shall be collated for documentation along with notes on date, ambient temperature, technician and seaming machine used to make the seam, and results of field tests.

(c) Constructed geomembrane seam testing and sampling shall be completed by or observed by the quality assurance engineer or qualified technician.

1. Nondestructive field seam testing shall be performed on all seams of geomembrane attached by welding or by mechanical attachments to other geomembrane sheet, plastic plate and pipe penetrations.

2. Destructive seam test samples shall be taken at a rate of one sample per 500 feet of fusion seam accomplished, unless another frequency or spacing is approved by the department. A portion of the sample shall be tested both in the field and in the laboratory for shear and peel with a minimum of 5 samples for each test type. The quality assurance engineer or qualified technician shall choose the location of the destructive seam samples.

3. Destructive samples shall be taken from at least one end of each fusion weld greater than 100 feet long and tested. Samples shall be subjected to a minimum of one field test each in shear and peel mode.

4. Field shear and peel tests of geomembrane seams and geomembranes shall be performed using standardized specimen sizes in tensile testing machines. The tensile testing machine shall be equipped with electrically controlled and smoothly moving jaw separation apparatus, shall be capable of adjustments and defined settings for jaw separation rate, and shall display jaw separation rates and tensile loadings exerted on the geomembrane samples. Tensile testing machines shall be accompanied by documentation for calibration conducted within 3 months of the start of geomembrane installation. Geomembrane samples shall be prepared for field analyses by use of templates and cutting tools that prepare uniformly sized samples.

(3) DRAINAGE BLANKET. During placement of the leachate drainage blanket over the liner or the granular drain layer in the final cover, the following testing shall be performed:

(a) If sand is used, one grain size distribution to the #200 sieve for each 1,000 cubic yards of material placed. For lesser volumes, a minimum of 4 samples shall be tested. If washed stone or gravel is used, one grain size distribution to the #200 sieve for each 5,000 cubic yards of material placed. For smaller landfills where construction of a liner or cap area involves lesser volumes, a minimum of 2 samples shall be tested.

(b) One remolded laboratory hydraulic conductivity test for each 2,500 cubic yards of sand drainage material placed. The samples shall be tested at the anticipated field density. The moisture content and density of each sample shall be recorded. The department may require that a portion of the hydraulic conductivity tests be performed using leachate. For smaller landfills where construction of a liner or cap area involves lesser volumes, a minimum of 2 samples shall be tested. No hydraulic conductivity tests are required if washed stone or gravel is used.

(c) The department may require that chemical durability testing of the material when exposed to leachate be performed.

(4) BEDDING MATERIAL. During placement of leachate collection pipes, lysimeter pipes, and groundwater collection pipes, the following tests shall be performed on the backfill material:

(a) One grain size distribution to the #200 sieve for each 1,000 linear feet of trench. For construction projects with combined trench lengths of less than 3,000 feet, a minimum of 3 grain size analyses shall be conducted. Bedding for solid wall piping associated with transfer of leachate, groundwater or lysimeter fluids shall be tested at the same frequency but only to the #4 sieve.

(b) One grain size distribution to the #200 sieve for each 500 cubic yards of drainage material placed in collection sumps.

(c) The department may require that chemical durability testing of the material when exposed to leachate and laboratory hydraulic conductivity testing be performed.

(5) FINAL COVER. During construction of the final cover system, the following tests shall be performed:

(a) Thickness of a support layer in the final cover for landfills which accept primarily papermill sludge or other low strength wastes on a 100–foot grid. The source and composition of the support layer shall be documented by a description of the materials used in the support layer.

(b) One grain size distribution to the #200 sieve for each 1,000 cubic yards of gravel used for pipe bedding and drain outlets for the drain layer and toe drain.

(c) The department may require testing of samples of geotextiles, geocomposite drains or other geosynthetic materials used in construction of the final cover system.

History: Cr. Register, January, 1988, No. 385, eff. 2–6–88; r. (4) (b), (5), renum. (intro.), (1), (3), (4) (intro.), (a), (c), (5) (intro.), (b) from NR 516.05 (intro.), (1), (2), (3) (intro.), (a), (b), (4) (intro.), (a) and am. (intro.), (1) (intro.), (a), (b), (c), (3) (intro.), (a), (b), (4) (intro.).) (a), (5) (intro.) (b), cr. (2), (4) (b), (5) (a), (c), Register, June, 1996, No. 486, eff. 7–1–96; **am. (2) (a) 3. and (b), Register, August, 1997, No. 500, eff. 9–1–97.**