

**Performance of Chamber and EZ1203
Systems Compared to Conventional
Gravel Septic Tank Systems
in North Carolina**

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Accepted System

- Means any wastewater system that:
 - Has been approved as Innovative
 - Has been in general use for 5 years
 - Has been approved by the Commission

Conditions for Approval by CHS

- Clear, convincing and cogent information which:
 - Confirms the findings of the department at the time of Innovative approval
 - Confirms that the product performs in a manner equal to a conventional system

Reasons Manufacturers Wanted Accepted Status

- The public is not receptive to products designated as Innovative
- The state and counties have different permit requirements for innovative compared to conventional systems
- The manufacturers believe accepted systems should be permitted the same as conventional systems.

Rules .1969

- established the requirements for what constituted “sufficient information” for the Commission to make their evaluation.

For trench systems, the Rule requires

- The field evaluation of at least 250 randomly selected innovative systems compared with 250 comparably-aged randomly selected conventional systems,
- At least 100 of each type of surveyed system must be in operation for at least five years.

Rule .1969

- Systems surveyed shall be distributed throughout the three physiographic regions of the state
- And in approximate proportion to their relative usage in the three regions.

- The survey shall determine comparative system failure rates,
- with field evaluations completed during a typical wet-weather season (February through early April),
- with matched innovative and conventional systems sampled during similar time periods in each region”

Rule .1969 Survey Goal

- The petitioner shall provide a statistical analysis of the survey results showing a “one-sided” test where,
 - if the failure rate in the innovative sample is at least 5 percentage points than the failure rate of the conventional sample
 - e.g. **9% Failure Innovative – 4% Failure Conv. = 5%**
 - There is only a 5 % chance that the a difference this large would occur by chance (95% confidence level)

Applicants for Accepted Status

- Infiltrator, Inc.
 - Standard Chamber System
 - PSA and Hancor also participated in the survey
- Ring Industrial Group
 - 1203H Polystyrene Aggregate System

Products Surveyed

- Standard Chamber System
 - 29 inch wide open bottom area
 - 25% reduction in trench length compared to conventional
- EZ1203H Polystyrene Aggregate System
 - 3 cylindrical bundles of polystyrene aggregate laid horizontally
 - Each bundle has a 12-inch diameter
 - The total product is 36 inches wide
 - 25% reduction in trench length compared to conventional

Analysis by Dr. Paul Beusher
with the State Center for Health
Statistics revealed that,

- a sample size of 300 was needed for each type of system surveyed,
- in order to conclude with a 95% confidence that a measured failure rate for an innovative system that is 5 percentage points higher than the failure rate for conventional systems is not due to chance.

Analysis continued

- The calculation of required sample size assumed that the samples have an 80% “power” to detect a **true** difference of 5 percentage points.

Analysis continued

- It was determined that a sample size of 300 for each system would result in valid analysis, regardless of the total number of systems (population) from which the sample was chosen.

Systems were chosen from all 3 Pysiographic Regions of the State

- Coastal Plain Counties
 - Onslow and Wilson
- Piedmont Counties
 - Alamance and Lincoln
- Mountain Counties
 - Buncomb and Henderson

County Selection

- The six counties surveyed were selected on the basis of being representative of the region and the fact that they had a good system of record keeping for septic tank system permits.

County Selection

- Further, counties were chosen that were known to have large numbers of each system type,
- so that it would be likely that a statistically valid sample could be drawn from the records for each system type.

System Selection for the Survey

- Since the total sample size for each system type was required to be at least 300 and there were 6 counties chosen,
- at least 50 systems were selected from each county for the survey.

System Selection for the Survey

- The available records for each type of system were assigned a number.
- Records were then drawn on the basis of a random number generator until the required number of systems to be inspected was achieved.

System inspection

- A team of third party inspectors, unaffiliated with the NC On-Site Wastewater Section or the product manufacturers, was hired to visit each system for which a record was randomly drawn.
- The inspectors were Environmental Health students from Western Carolina University under the supervision of Dr. Paul Berk from WCU.

System Inspection

- The students were trained to inspect septic tank systems by a former employee of the NC Wastewater Discharge Elimination program (Peter Whitacker) now with Western Carolina,
- Peter's primary responsibility had been the identification of failed septic tank systems in need of remediation.

System Inspection

- Systems were surveyed from March through April of 2005
- Each system was inspected by two members of the survey team.
- Only houses, which were known to be occupied, were inspected.

Questions Answered by Each Team

1. Is sewage ponded on the ground surface?
2. Does pressure to the soil surface with a shoe result in sewage coming to the surface?
3. Is there a straight pipe?
4. Is there evidence of past failure?
5. Is there evidence of a repair?

Residence were asked to respond to the following questions

1. Has your tank been pumped for other than routine maintenance?
2. Are you having any of the following problems with your system today: surfacing on the ground; wet over system; odors; back up into the house; other?
3. Have you had problems with the system in the past: surfacing on the ground; wet over system; odors; back up into the house; other?

Residence were asked to respond to the following questions cont'd

4. How was the problem solved?
5. Has system been repaired or replaced?

System Failure

- A yes for one or more of the questions answered by the survey team or the occupant was considered to be a system failure.

Results and Discussion

- A total of 912 systems were inspected,
 - 303 chamber systems
 - 306 EZ systems
 - 303 gravel systems
 - Interviews were completed with 370 of the occupants.

Regional Distribution of Sites

- 290 sites from the Coastal Region
- 317 sites from the Piedmont Region
- 305 sites from the Mountain Region.

Age Distribution of Surveyed Sites

- 307 systems were 2 to 4 years old
- 377 systems were 5 to 7 years old
- 228 systems were 8 to 12 years old

Table 1. System failure rate for conventional gravel, chamber systems, and EZ1203H systems.

System Type	Systems OK	Systems Failed	Total	Percent Failure
Gravel	281	22	303	7.3
Chamber	277	26	303	8.5
EZ1203H	277	29	306	9.5
Total	835	77	912	8.4

Survey Results and Discussion

- The difference in failure rate between the conventional and chamber systems was 1.2%.
- The difference in failure rate between the conventional and EZ1203H systems was 2.2%.
- The purpose of this survey was to determine if there was a 5% difference in the failure rate of chamber and EZ1203H systems compared to conventional gravel systems.

Survey Results and Discussion

- Statistical analysis was performed controlling for both physiographic region and age of system.
- At a 95% confidence level, the null hypothesis of no difference in failure rate could not be rejected for the chamber or EZ1203H system compared to the gravel system, based on the data collected.
- In laymen's terms, we would say that the chamber and EZ1203H systems performed the same as gravel when compared on a statewide basis.

Comparison of failure by Region

- An insufficient numbers of sites were surveyed to statistically compare the performance of each system type by region.
- The data was therefore grouped by region without regard for system type to make the regional comparison.

Table 2. System failure rate by physiographic region disregarding differences in system type.

Region	Systems OK	Systems Failed	Total	Percent Failure
Coast	256	34	290	11.7
Piedmont	286	31	317	9.8
Mountain	293	12	305	3.9
All Regions	835	77	912	8.4

Possible Explanation for Regional Difference

- The difference in failure rate when the mountains region is compared to both the Piedmont and Coast region was statistically significant at the 95% level.
- Most systems in the mountains are long and narrower.
- This factor in conjunction with slope ranging in excess of 25% promotes efficient movement of sewage away from the drain field
- low linear loading rates, and better system performance.

Comparison of failure rate by age

- An insufficient numbers of sites were surveyed to statistically compare the performance of each system type by age.
- The data was therefore grouped by age without regard for system type to make the age comparison.

Table 3. System failure rate by age group
disregarding differences in system type

System Age	Systems OK	Systems Failed	Total	Percent Failure
2 to 4 years	283	24	307	11.8
5 to 7 years	351	26	377	7.4
8 to 12 years	201	27	228	13.4
All Ages	835	77	912	8.4

Explanation for Higher Failure Rate of Older Systems

- clogging of the trench can be expected to increase, as more sewage is disposed in the trenches over time.
- Also, solids will spill over from the septic tank to the absorption field if settled solids are not periodically removed by the owner.

Possible Explanation of Higher failure Rate of Youngest Systems

- We have seen smaller lot sizes in recent years with larger houses, as developers try to maximize density and profit.
- Because of the increased housing density, there is often more site disturbance in the designated septic system area, due to contractors who deliver materials such as bricks and lumber to the site.
- Further, there is more impervious surface per lot, as the ratio of roof and driveway to open space on the lot gets smaller, which tends to make the remaining open space wetter.
- Both site disturbance and wetter site conditions would result in poorer system performance.

Finally

- The average failure rate statewide is 8.4% for systems with an age up to 12 years old.
- Perhaps a side benefit of this survey will be a defensible failure rate for systems statewide upon which to base future discussions.