# A Productivity Analysis of the Neogen® Petrifilm® Plate Reader Advanced

## Introduction

Artificial intelligence (AI) systems have enabled businesses to see gains in productivity and profitability, increasing output of manual tasks while permitting technicians to perform more value-added activities where their skills are better applied.[1] In food safety testing, automated colony enumeration systems[2] can replace traditional manual counting by technicians.

Automated colony enumeration systems like the Neogen Petrifilm Plate Reader Advanced can provide colony counts that are equivalent to human-derived counts.[3] The Neogen Petrifilm Plate Reader Advanced may increase a laboratory's efficiency, productivity, and capacity.

To examine differences in productivity using manual colony counting versus counting with an automated system, a study was conducted using Neogen Petrifilm Plates and the Neogen Petrifilm Plate Reader Advanced. The study compared the time required for technicians to manually count Neogen Petrifilm Aerobic Count Plates and Neogen Petrifilm Rapid Aerobic Count Plates that contained low, medium, and high levels of colonies with the time required for the Neogen Petrifilm Plate Reader Advanced to count the same Neogen Petrifilm Plates.

### Neogen® Petrifilm® Plates

Neogen® Petrifilm® Plates facilitate time and labor savings, eliminating the time-consuming agar plate preparation process. Neogen Petrifilm Plates provide consistent, reliable results and third-party validations confirm the method is repeatable and has performed equal to or better than the reference method to which it was compared.

Neogen Petrifilm Plates have more than 100 global recognitions and validations including:

- AOAC® *Official Methods of Analysis*℠
- AOAC® *Performance Tested Methods*℠
- MicroVal Certification
- NF VALIDATION by AFNOR Certification
- Numerous regional and local recognitions

## Methods

This protocol was repeated for each of the three 3rd party laboratories that participated in the study. Technicians 1 - 3 are from lab A, technicians 4 - 6 are from lab B, technicians 7 - 9 are from lab C and technicians 10 - 12 are from Neogen Food Safety.

## Sample Preparation

- One to three colonies of Staphylococcus aureus (ATCC 6538) were placed into 5 mL of tryptic soy broth and incubated at 32°C for 18-24 hours.
- Six samples of skim milk were diluted in Butterfield's phosphate-buffered dilution water to achieve 1:10, 1:100, and 1:1000 dilutions.
- Two sets of the diluted samples were spiked using the overnight culture of Staphylococcus aureus (ATCC 6538) at a low inoculum level, two sets at a medium inoculum level, and two sets at a high inoculum level. The inoculum levels were designed to target approximately 37 CFU/mL, 100 CFU/mL, and 275 CFU/mL when plated on to the Neogen Petrifilm Aerobic Count Plates and Neogen Petrifilm Rapid Aerobic Count Plates.

## Inoculation and Incubation

- One set of the diluted samples was used to inoculate 75 Neogen Petrifilm Aerobic Count Plates for each dilution.
- The other set of the diluted samples was used to inoculate 75 Neogen Petrifilm Rapid Aerobic Count Plates for each dilution.
- The Neogen Petrifilm Aerobic Count Plates were incubated at 32°C for 48 ± 3 hours.
- The Neogen Petrifilm Rapid Aerobic Count Plates were incubated at 32°C for 24 ± 2 hours.

## Enumeration Methods (manual and automated)

- Each stack of 75 Neogen Petrifilm Plates per dilution (low, medium, high) was split into stacks of 25 plates—one stack for each of the three technicians (a total of 75 plates per technician).
- Each stack of 25 Neogen Petrifilm Plates per dilution was fed through the Neogen Petrifilm Plate Reader Advanced and the time was recorded from the first plate entering to the last plate exiting the device.
- The same stacks of 25 Neogen Petrifilm Plates per dilution were manually counted by the same technician that had fed them through the Neogen Petrifilm Plate Reader Advanced; the time was recorded from when the technician counted the first colony on the first plate until the technician counted the last colony on the last plate.

## Deviations

- Technicians one, two, and three repeated the protocol three times with the low inoculum level for both the Neogen Petrifilm Aerobic Count Plate and Neogen Petrifilm Rapid Aerobic Count Plate in order to achieve the target CFU/mL. Due to the preparation of one of the samples, the medium inoculum level was not achieved for technicians one, two, and three. In order to supplement the data, technicians ten, eleven, and twelve from Neogen conducted the study at the medium inoculum level.

## Results

Comparisons were made between the time required for technicians to manually count the Neogen Petrifilm Plates versus the time required for the Neogen Petrifilm Plate Reader Advanced to count the same plates.

**Table 1. Provides an example of the collected data from Technician 10 and the Neogen Petrifilm Aerobic Count Plate at the medium inoculum level**

| Stack of Neogen Petrifilm Plates (Each stack contains 25 plates) | Technician 10 Time to Results (Min:Sec) | Neogen Petrifilm Plate Reader Advanced Time to Result (Min:Sec) |
|---|---|---|
| **Stack B, 1:10** | 14:38 | 2:21 |
| **Stack B, 1:100** | 14:07 | 2:27 |
| **Stack B, 1:1000** | 13:11 | 2:37 |
| **Total Time** | 41:56 | 7:25 |

Tables 2-7 summarize the analysis of the manual versus automated counting approach. The tables show the average time savings that users can achieve with the Neogen Petrifilm Plate Reader Advanced compared to manual counting.

**Table 2. Third-party lab results for the Neogen Petrifilm Aerobic Count Plate at low inoculum levels**

| Technician # | Average Time Savings | Average Colony Count | Total Number of Plates |
|---|---|---|---|
| **Technician 1** | 51 % | 28 | 225 |
| **Technician 2** | 47 % | 30 | 225 |
| **Technician 3** | 55 % | 35 | 225 |
| **Technician 4** | 74 % | 25 | 75 |
| **Technician 5** | 67 % | 27 | 75 |
| **Technician 6** | 72 % | 29 | 75 |
| **Technician 7** | 66 % | 38 | 75 |
| **Technician 8** | 64 % | 42 | 75 |
| **Technician 9** | 72 % | 40 | 75 |
| **Average** | 63 % | 33 | 125 |

**Table 3. Neogen and third-party results for the Neogen Petrifilm Aerobic Count Plate at medium inoculum levels**

| Technician # | Average Time Savings | Average Colony Count | Total Number of Plates |
|---|---|---|---|
| **Technician 4** | 89 % | 90 | 75 |
| **Technician 5** | 91 % | 90 | 75 |
| **Technician 6** | 87 % | 93 | 75 |
| **Technician 7** | 86 % | 95 | 75 |
| **Technician 8** | 86 % | 102 | 75 |
| **Technician 9** | 88 % | 107 | 75 |
| **Technician 10 – Neogen** | 82 % | 95 | 75 |
| **Technician 11 – Neogen** | 83 % | 97 | 75 |
| **Technician 12 – Neogen** | 83 % | 95 | 75 |
| **Average** | 86 % | 96 | 75 |

**Table 4. Third-party lab results for the Neogen Petrifilm Aerobic Count Plate at high inoculum levels**

| Technician # | Average Time Savings | Average Colony Count | Total Number of Plates |
|---|---|---|---|
| **Technician 1** | 94 % | 286 | 75 |
| **Technician 2** | 94 % | 295 | 75 |
| **Technician 3** | 94 % | 312 | 75 |
| **Technician 4** | 94 % | 171 | 75 |
| **Technician 5** | 94 % | 157 | 75 |
| **Technician 6** | 92 % | 168 | 75 |
| **Technician 7** | 94 % | 202 | 75 |
| **Technician 8** | 93 % | 215 | 75 |
| **Technician 9** | 94 % | 222 | 75 |
| **Average** | 94 % | 225 | 75 |

**Table 5. Third-party lab results for the Neogen Petrifilm Rapid Aerobic Count Plate at low inoculum levels**

| Technician # | Average Time Savings | Average Colony Count | Total Number of Plates |
|---|---|---|---|
| **Technician 1** | 55 % | 27 | 225 |
| **Technician 2** | 33 % | 27 | 225 |
| **Technician 3** | 42 % | 28 | 225 |
| **Technician 4** | 65 % | 24 | 75 |
| **Technician 5** | 57 % | 23 | 75 |
| **Technician 6** | 54 % | 24 | 75 |
| **Technician 7** | 66 % | 41 | 75 |
| **Technician 8** | 58 % | 41 | 75 |
| **Technician 9** | 71 % | 61 | 75 |
| **Average** | 56 % | 33 | 125 |

**Table 6. Neogen and third-party results for the Neogen Petrifilm Rapid Aerobic Count Plate at medium inoculum levels**

| Technician # | Average Time Savings | Average Colony Count | Total Number of Plates |
|---|---|---|---|
| **Technician 4** | 87 % | 90 | 75 |
| **Technician 5** | 86 % | 84 | 75 |
| **Technician 6** | 85 % | 89 | 75 |
| **Technician 7** | 83 % | 92 | 75 |
| **Technician 8** | 79 % | 95 | 75 |
| **Technician 9** | 85 % | 99 | 75 |
| **Technician 10 – Neogen** | 81 % | 86 | 75 |
| **Technician 11 – Neogen** | 83 % | 89 | 75 |
| **Technician 12 – Neogen** | 82 % | 89 | 75 |
| **Average** | 83 % | 90 | 75 |

**Table 7. Third-party lab results for the Neogen Petrifilm Rapid Aerobic Count Plate at high inoculum levels**

| Technician # | Average Time Savings | Average Colony Count | Total Number of Plates |
|---|---|---|---|
| **Technician 1** | 92 % | 250 | 75 |
| **Technician 2** | 91 % | 260 | 75 |
| **Technician 3** | 91 % | 268 | 75 |
| **Technician 4** | 91 % | 148 | 75 |
| **Technician 5** | 93 % | 138 | 75 |
| **Technician 6** | 89 % | 156 | 75 |
| **Technician 7** | 91 % | 219 | 75 |
| **Technician 8** | 90 % | 202 | 75 |
| **Technician 9** | 93 % | 209 | 75 |
| **Average** | 91 % | 206 | 75 |

In addition, Table 8 shows the average time savings, average colony count, and total number of plates using the Neogen Petrifilm Plate Reader Advanced to count the Neogen Petrifilm Aerobic Count Plate and the Neogen Petrifilm Rapid Aerobic Count Plate across all inoculum levels.

**Table 8. Average time savings using the Neogen Petrifilm Plate Reader Advanced versus Manual Counting across all inoculum levels**

| Neogen Petrifilm Plate | Average Time Savings | Average Colony Count | Total Number of Plates |
|---|---|---|---|
| **Neogen Petrifilm Aerobic Count Plate** | 81 % | 118 | 2,475 |
| **Neogen Petrifilm Rapid Aerobic Count Plate** | 77 % | 110 | 2,475 |

## Discussion

The results for Neogen Petrifilm Aerobic Count Plate and Neogen Petrifilm Rapid Aerobic Count Plates demonstrate time savings, on average of 94% and 91%, respectively for plates with high inoculum levels. Even plates with low inoculum levels were counted in about half the time as a manual count using the Neogen Petrifilm Plate Reader Advanced (See Table 9).

**Table 9. Average time savings using the Neogen Petrifilm Plate Reader Advanced**

| | Average Time Savings | | |
|---|---|---|---|
| Neogen Petrifilm Plate | Low Level Inoculum Third-Party Results | Medium Level Inoculum Neogen Results | High Level Inoculum Third-Party Results |
| **Neogen Petrifilm Aerobic Count Plate** | 63 % | 86 % | 94 % |
| **Neogen Petrifilm Rapid Aerobic Count Plate** | 56 % | 83 % | 91 % |

## Conclusion

Use of the Neogen Petrifilm Plate Reader Advanced greatly reduced the amount of technician time required to count colonies on Neogen Petrifilm Rapid Aerobic Count Plates and Neogen Petrifilm Aerobic Count Plates.

Find more information online at neogen.com.

### Neogen Petrifilm Plate Reader Advanced

The Neogen® Petrifilm® Plate Reader Advanced provides results in 6 seconds and processes up to 600 plates per hour.

The system recognizes barcodes and allows users to determine the information to be captured by the software, such as sample ID, dilution level, food matrix, technician name, etc. In addition, the software automatically stores results, saving time and preventing transcription errors. The system also provides result trending and analysis.

The system enumerates 11 different Neogen Petrifilm Plates, including the entire Neogen Petrifilm Rapid Plate portfolio and the 3 Neogen Petrifilm Staph Express Disk:

- Neogen Petrifilm Rapid Aerobic Count Plates
- Neogen Petrifilm Rapid Coliform Count Plates
- Neogen Petrifilm Rapid *E. coli*/Coliform Count Plates
- Neogen Petrifilm Rapid Yeast and Mold Count Plates
- Neogen Petrifilm Aerobic Count Plates
- Neogen Petrifilm Coliform Count Plates
- Neogen Petrifilm *Enterobacteriaceae* Count Plates
- Neogen Petrifilm *E. coli*/Coliform Count Plates
- Neogen Petrifilm Lactic Acid Bacteria Count Plates
- Neogen Petrifilm Select *E. coli* Count Plates
- Neogen Petrifilm *Staph* Express Count Plates and Disks

## References and Resources:

1. M Raj, R Seamans (2018), The Economics of Artificial Intelligence. *Artificial Intelligence, Labor, Productivity, and the Need for Firm-Level Data.* National Bureau of Economic Research.

2. V Fotheringham (2006), Quality Control DPI. *A Comparison of Manual and Automated Colony Counting.*

3. Technical Bulletin (2020), *Manual Microbial Interpretation vs. Automated Interpretation Using the Neogen Petrifilm Plate Reader Advanced.*

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