Professional Testing Laboratory, Inc.
714 Glenwood Place
Dalton, Georgia 30721

Phone: (706)226-3283
Fax: (706)226-6787
E-mail: protest@optilink.us

TEST NUMBER: 133904 **DATE: 10/21/2010**

Test Method Conducted:

Nilfisk-Advance Efficacy Test Protocol for Tennant ecH2O System.

Professional Testing Laboratory was commissioned by Nilfisk-Advance, Inc. to evaluate the scrubbing performance of a Tennant T5 automatic floor scrubber with the ecH2O option.

	Tennant T5 ecoH2O
Test #1	ecoH2O - Off
Test #2	ecoH2O - On
Test #3	With Detergent

Test Summary

- The machine used in the test was purchased by Professional Testing Laboratory, Inc. (PTL) directly from the machine manufacturer.
- Machine Configuration – See Table 1.
- The test floor consisted of commercial white vinyl tiles prepared using a commercial floor finish. Each test sample area was 2 feet [0.61 m] square. See figure 1.
- Test soil composition was taken from ASTM D 4488 section A5.
- Test soil application was a modification of the same standard to cover a larger surface area and yield a consistent soiling result. See attached test protocols.
- Measurements used for evaluation include both gloss meter readings and spectrophotometer (grayscale) readings taken at 20 points per sample area. See figure 2.
- Each test consisted of six sample areas placed one at a time, each cleaned by a single pass of the scrubber. Representative photos of each test are included.
- The main floor area was scrubbed in between each test to remove soil residue. Scrub pads are flipped to the clean side for this purpose.
- Cleaning efficiencies were calculated using the formula from ASTM D 4488 section A5:

  $$\% \text{ cleaning efficiency} = \frac{(\text{data value of cleaned tile} - \text{data value of soiled tile})}{(\text{data value of tile before soiling} - \text{data value of soiled tile})}$$

Measurement Equipment Used

Color and Gloss Measurement

- Hunter Lab 0/45 degree spectrophotometer-specular excluded
- Gardner Micro-Tri-Glossmeter

Chlorine Measurement Photometer

- Brand: Industrial Test Systems
- Model: Exact Micro 7+
- Serial #: M00001372
- DPD-1 Free chlorine test strips, expiration date 1/2012
- DPD-3 total chlorine test strips, expiration date 5/2011

Total Dissolved Solids (TDS), pH and Temperature Meter

- Hanna Instruments Combination Meter
- Model: HI98129
- No serial number

Voltmeter

- Fluke 114 True RMS Multimeter
- No Serial Number

Table 1

Machine	Tennant T5 ecH2O
Travel Speed	1.7 mph (2.5 ft/sec)
Machine Pre-Run Time	20 seconds
Scrub Head Width	28”
Source Water	Tap
Solution Flow Rate Setting	Fixed, ecH2O, otherwise 1 of 3
Solution Flow Rate Measured	ecoH2O off - 1260 ml/min
Solution Flow Rate Measured	ecoH2O on - 900 ml/min
Solution Flow Rate Measured	Detergent – 1260 ml/min
Scrub Head Pressure Setting	Light/Economy Scrub
Scrub Pad Manufacturer/Type	3M 5100 Red
Detergent Solution	Hillyard Arsenal 17 (6 oz/gal water)
Battery Voltage-Beginning	24.4
Solution Tank Level-Beginning	40 liters

Table 2

Tile and Cleaning Chemical Information	
Substrate	Hardiebacker 500
Vinyl Tile	Armstrong Excelon 56830 Chalk II
Tile Sealer	Hillyard Seal #341
Floor Finish	Hillyard Northstar

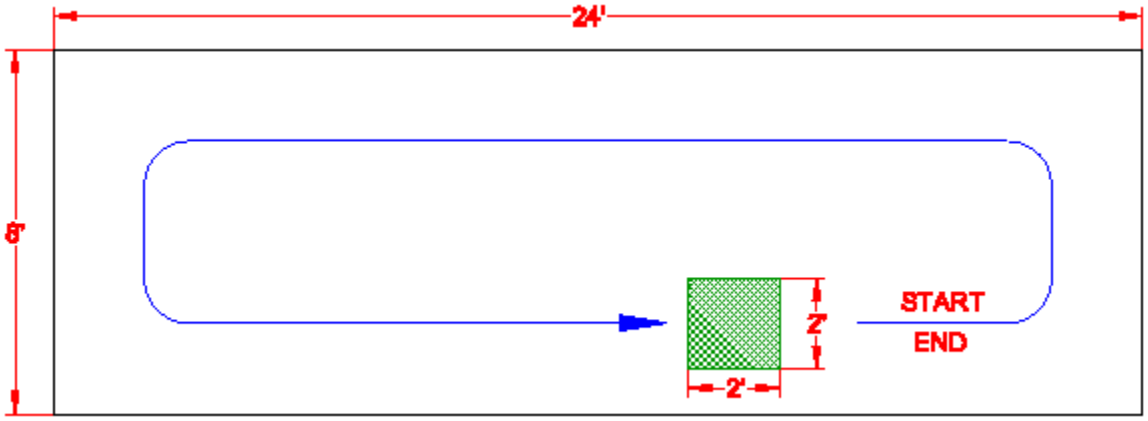


Figure 1 – Test Floor and Sample Area Configuration

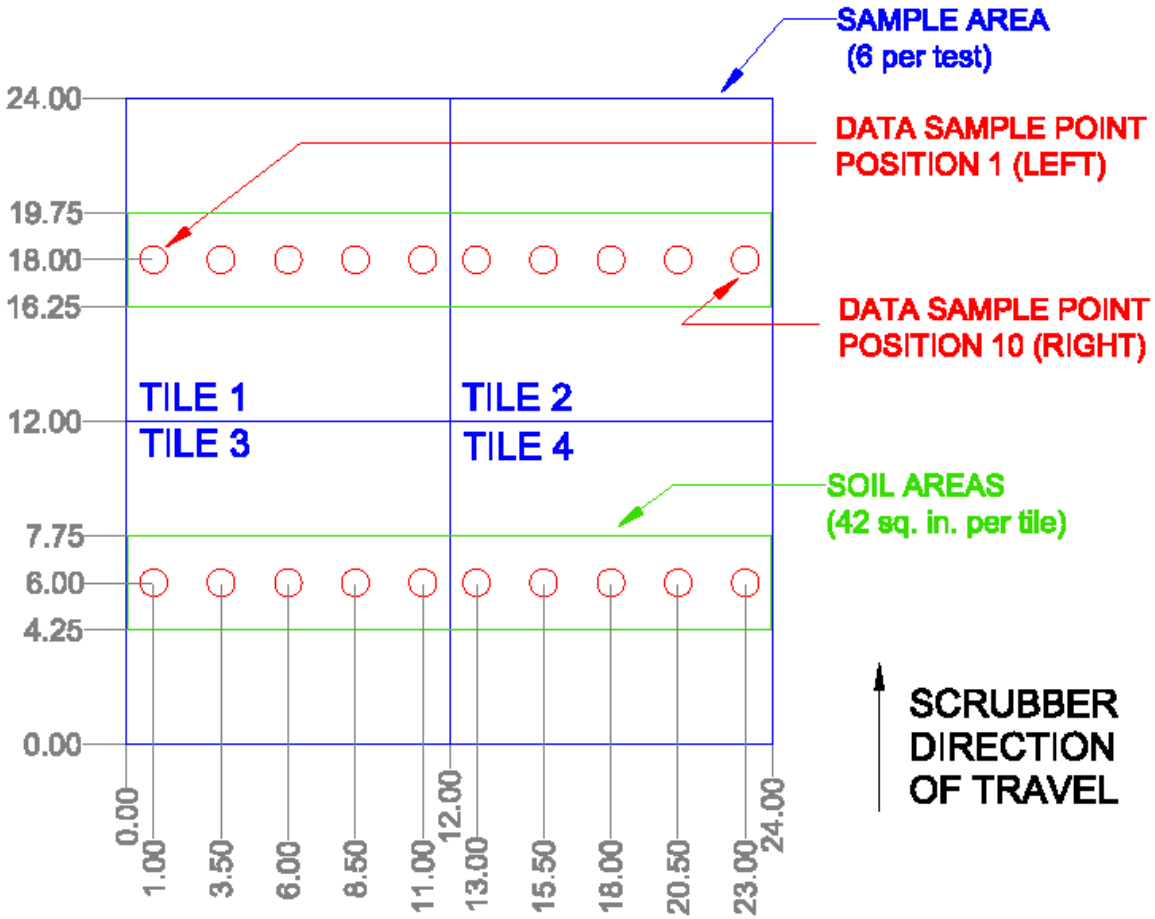
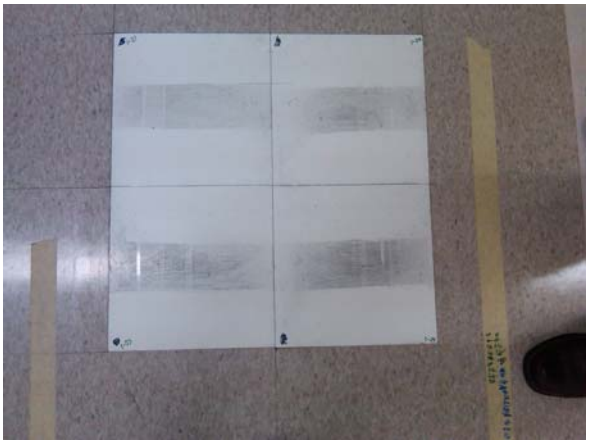


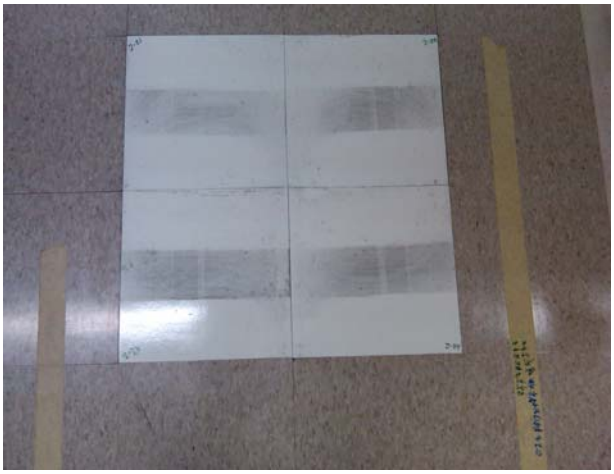
Figure 2 – Sample Area Soil Application and Sampling Locations

Figure 3 – Example of Soiled Test Area

Test Photos - Tennant T5 ecoH2O



Test #1- T5 ecoH2O water only



Test #2- T5 ecoH2O on

Test #3- T5 with Detergent

Test # 1 Gloss and Color Meter Readings - Tennant T5 - Tap Water ecH2O Off

INITIAL TILE READINGS

Initial Gloss Readings - Overall Average = 90

	Position Number 1	2	3	4	5	6	7	8	9	10	
Sample Area 1 - Gloss Average = 89											
Tile 1 Avg = 89	87.7	89.2	87.3	90.2	90.0	85.8	91.0	91.1	91.3	90.6	Tile 2 Avg = 90
Tile 3 Avg = 91	91.0	91.9	90.6	91.0	89.1	88.1	88.0	87.2	87.1	89.6	Tile 4 Avg = 88
Sample Area 2 - Gloss Average = 89											
Tile 5 Avg = 90	91.2	92.3	87.5	90.5	90.6	88.5	87.6	89.2	90.0	91.1	Tile 6 Avg = 89
Tile 7 Avg = 87	86.2	90.6	87.0	87.4	83.9	86.7	89.0	87.3	88.1	88.5	Tile 8 Avg = 88
Sample Area 3 - Gloss Average = 90											
Tile 9 Avg = 90	89.2	92.5	90.0	90.8	87.7	91.2	91.7	88.7	89.7	89.9	Tile 10 Avg = 90
Tile 11 Avg = 89	90.3	91.1	89.4	88.7	87.8	91.3	91.6	87.6	89.9	91.6	Tile 12 Avg = 90
Sample Area 4 - Gloss Average = 91											
Tile 13 Avg = 91	90.5	92.2	91.3	91.2	90.9	92.5	92.3	87.3	91.3	90.6	Tile 14 Avg = 91
Tile 15 Avg = 91	93.0	92.6	89.7	91.7	90.4	86.9	91.2	90.2	90.8	86.5	Tile 16 Avg = 89
Sample Area 5 - Gloss Average = 90											
Tile 17 Avg = 90	87.7	91.0	90.7	90.6	89.9	88.6	91.1	89.8	89.1	89.6	Tile 18 Avg = 90
Tile 19 Avg = 90	91.6	89.1	89.0	89.5	89.8	91.7	92.0	89.1	89.5	91.1	Tile 20 Avg = 91
Sample Area 6 - Gloss Average = 89											
Tile 21 Avg = 89	87.9	89.5	87.4	89.4	90.7	92.0	91.7	89.3	89.8	90.1	Tile 22 Avg = 91
Tile 23 Avg = 87	90.2	84.8	85.2	88.7	86.8	88.9	88.4	87.8	89.6	90.0	Tile 24 Avg = 89
	90	**91**	**89**	**90**	**89**	**89**	**90**	**89**	**90**	**90**	◄ **Gloss Averages by Position**

SOILED TILE READINGS

Soiled Gloss Readings - Overall Average = 2

	Position Number 1	2	3	4	5	6	7	8	9	10	
Sample Area 1 - Gloss Average = 1											
Tile 1 Avg = 1	1.4	1.2	0.9	1.0	0.8	1.7	1.6	1.3	3.1	3.2	Tile 2 Avg = 2
Tile 3 Avg = 1	1.3	1.0	1.0	1.2	1.5	2.1	1.3	1.0	1.0	1.0	Tile 4 Avg = 1
Sample Area 2 - Gloss Average = 2											
Tile 5 Avg = 3	3.1	2.3	2.0	2.5	3.1	1.6	2.0	1.5	2.0	2.9	Tile 6 Avg = 2
Tile 7 Avg = 2	2.2	1.7	1.4	2.0	1.2	2.6	2.8	2.2	4.1	4.2	Tile 8 Avg = 3
Sample Area 3 - Gloss Average = 2											
Tile 9 Avg = 2	3.4	2.5	1.7	2.2	2.0	1.5	1.7	1.0	1.5	2.3	Tile 10 Avg = 2
Tile 11 Avg = 2	1.4	1.3	1.2	1.7	1.9	1.2	1.2	1.2	1.4	2.1	Tile 12 Avg = 1
Sample Area 4 - Gloss Average = 2											
Tile 13 Avg = 2	1.6	2.0	1.6	3.5	2.6	1.5	1.6	1.2	2.0	2.0	Tile 14 Avg = 2
Tile 15 Avg = 1	1.2	1.1	1.3	1.6	1.8	3.3	3.6	1.6	1.9	1.8	Tile 16 Avg = 2
Sample Area 5 - Gloss Average = 2											
Tile 17 Avg = 2	2.2	2.5	1.0	1.6	1.9	1.4	1.5	1.0	1.7	3.5	Tile 18 Avg = 2
Tile 19 Avg = 2	1.6	1.3	1.1	2.0	2.3	2.7	1.8	0.8	1.1	1.6	Tile 20 Avg = 2
Sample Area 6 - Gloss Average = 2											
Tile 21 Avg = 2	2.2	1.4	0.9	1.4	2.5	3.8	3.0	1.3	2.6	2.6	Tile 22 Avg = 3
Tile 23 Avg = 2	3.1	1.6	0.8	1.5	2.3	2.2	2.2	1.5	1.6	3.4	Tile 24 Avg = 2
	2	**2**	**1**	**2**	**2**	**2**	**2**	**1**	**2**	**3**	◄ **Gloss Averages by Position**

CLEANED TILE READINGS

Cleaned Gloss Readings - Overall Average = 26

	Position Number 1	2	3	4	5	6	7	8	9	10	
Sample Area 1 - Gloss Average = 29											
Tile 1 Avg = 29	19.6	37.6	21.7	27.4	38.2	51.3	26.7	23.0	30.3	43.7	Tile 2 Avg = 35
Tile 3 Avg = 29	26.5	27.0	19.3	32.3	39.7	41.3	22.0	6.9	19.9	23.3	Tile 4 Avg = 23
Sample Area 2 - Gloss Average = 27											
Tile 5 Avg = 35	33.6	44.0	27.3	30.1	41.9	38.9	28.1	23.2	32.4	32.8	Tile 6 Avg = 31
Tile 7 Avg = 17	1.7	13.9	15.1	22.7	30.1	26.9	24.4	12.5	27.2	27.9	Tile 8 Avg = 24
Sample Area 3 - Gloss Average = 28											
Tile 9 Avg = 36	32.0	43.1	31.9	38.9	34.6	44.0	36.3	15.4	19.9	31.6	Tile 10 Avg = 29
Tile 11 Avg = 16	9.7	11.7	14.7	16.9	29.0	31.2	39.5	17.1	19.9	36.5	Tile 12 Avg = 29
Sample Area 4 - Gloss Average = 26											
Tile 13 Avg = 30	22.6	34.3	27.6	34.2	30.2	41.2	37.3	21.3	30.2	28.6	Tile 14 Avg = 32
Tile 15 Avg = 20	10.2	9.9	15.4	32.8	32.4	37.1	35.5	15.5	18.1	14.9	Tile 16 Avg = 24
Sample Area 5 - Gloss Average = 28											
Tile 17 Avg = 39	41.1	38.6	36.9	37.1	42.3	57.2	26.0	18.8	25.9	25.0	Tile 18 Avg = 31
Tile 19 Avg = 20	19.3	6.7	26.1	19.8	28.6	54.1	16.4	10.4	9.9	12.2	Tile 20 Avg = 21
Sample Area 6 - Gloss Average = 20											
Tile 21 Avg = 23	23.4	17.9	17.0	27.2	31.4	52.1	26.8	11.5	20.9	22.5	Tile 22 Avg = 27
Tile 23 Avg = 15	16.8	8.5	7.7	11.1	29.2	23.6	15.6	9.4	9.0	21.6	Tile 24 Avg = 16
	21	**24**	**22**	**28**	**34**	**42**	**28**	**15**	**22**	**27**	◄ **Gloss Averages by Position**
	22	**26**	**23**	**29**	**37**	**45**	**29**	**16**	**23**	**28**	◄ **Cleaning Efficiency by Position**

Average Cleaning Efficiency %

Overall Average
All Tiles = 28

Sample Area 1 = 31
Tile 1 = 32
Tile 2 = 37
Tile 3 = 31
Tile 4 = 25

Sample Area 2 = 28
Tile 5 = 37
Tile 6 = 33
Tile 7 = 18
Tile 8 = 24

Sample Area 3 = 29
Tile 9 = 38
Tile 10 = 31
Tile 11 = 17
Tile 12 = 31

Sample Area 4 = 28
Tile 13 = 31
Tile 14 = 34
Tile 15 = 21
Tile 16 = 25

Sample Area 5 = 29
Tile 17 = 42
Tile 18 = 33
Tile 19 = 21
Tile 20 = 21

Sample Area 6 = 21
Tile 21 = 25
Tile 22 = 27
Tile 23 = 15
Tile 24 = 16

Initial Colorimeter Grayscale Readings - Overall Average = 88

	Position Number 1	2	3	4	5	6	7	8	9	10	
Sample Area 1 - Grayscale Average = 88											
Tile 1 Avg = 89	88.91	88.82	88.73	88.67	88.61	88.94	88.69	88.29	88.69	88.55	Tile 2 Avg = 89
Tile 3 Avg = 89	88.89	88.48	87.90	88.75	88.76	88.31	88.13	87.86	87.96	87.81	Tile 4 Avg = 88
Sample Area 2 - Grayscale Average = 89											
Tile 5 Avg = 89	89.10	88.93	88.66	88.57	88.41	88.47	88.30	88.14	88.40	88.34	Tile 6 Avg = 88
Tile 7 Avg = 89	89.04	88.03	88.85	89.12	89.11	88.70	88.36	88.23	88.55	88.42	Tile 8 Avg = 88
Sample Area 3 - Grayscale Average = 88											
Tile 9 Avg = 88	88.81	88.57	88.54	88.35	88.06	89.05	87.97	87.50	87.41	87.88	Tile 10 Avg = 88
Tile 11 Avg = 89	89.16	89.24	89.11	88.81	88.59	88.97	88.46	88.26	88.45	88.39	Tile 12 Avg = 89
Sample Area 4 - Grayscale Average = 88											
Tile 13 Avg = 88	88.28	88.26	87.95	87.48	87.53	88.42	87.86	87.84	87.73	87.76	Tile 14 Avg = 88
Tile 15 Avg = 89	88.76	88.94	88.71	88.31	88.14	88.86	88.50	88.31	88.13	87.78	Tile 16 Avg = 88
Sample Area 5 - Grayscale Average = 88											
Tile 17 Avg = 88	88.75	87.88	87.49	87.78	87.92	88.74	88.74	88.51	88.06	87.72	Tile 18 Avg = 88
Tile 19 Avg = 88	88.88	88.12	87.50	87.97	88.14	88.86	88.77	88.63	88.35	88.14	Tile 20 Avg = 89
Sample Area 6 - Grayscale Average = 88											
Tile 21 Avg = 88	88.52	88.08	87.90	87.99	88.04	88.57	88.35	87.85	87.69	87.60	Tile 22 Avg = 88
Tile 23 Avg = 88	88.23	87.61	87.25	87.46	87.46	88.61	88.30	88.31	87.96	87.99	Tile 24 Avg = 88
	89	**88**	**88**	**88**	**88**	**89**	**88**	**88**	**88**	**88**	◄ **Grayscale Averages by Position**

Soiled Colorimeter Grayscale Readings - Overall Average = 59

	Position Number 1	2	3	4	5	6	7	8	9	10	
Sample Area 1 - Grayscale Average = 54											
Tile 1 Avg = 53	56.94	54.72	49.43	51.69	50.92	57.60	55.72	51.09	58.42	64.87	Tile 2 Avg = 58
Tile 3 Avg = 52	53.77	48.96	47.59	52.28	55.81	55.67	53.82	49.72	49.93	55.13	Tile 4 Avg = 53
Sample Area 2 - Grayscale Average = 59											
Tile 5 Avg = 61	62.66	60.07	56.96	61.11	62.68	58.17	58.36	52.20	59.52	61.72	Tile 6 Avg = 58
Tile 7 Avg = 55	57.30	54.20	52.29	56.27	53.36	62.84	61.87	59.33	66.04	68.36	Tile 8 Avg = 64
Sample Area 3 - Grayscale Average = 56											
Tile 9 Avg = 60	64.68	60.22	55.60	58.38	60.06	56.93	54.48	49.99	53.62	57.50	Tile 10 Avg = 55
Tile 11 Avg = 56	58.77	54.89	52.16	56.21	57.68	56.32	54.23	51.63	53.22	57.76	Tile 12 Avg = 55
Sample Area 4 - Grayscale Average = 58											
Tile 13 Avg = 60	59.40	59.35	56.30	61.84	62.61	56.78	54.76	51.76	56.20	58.64	Tile 14 Avg = 56
Tile 15 Avg = 57	56.94	55.41	54.78	59.44	59.94	64.32	62.93	55.06	58.30	56.06	Tile 16 Avg = 59
Sample Area 5 - Grayscale Average = 64											
Tile 17 Avg = 64	67.89	64.01	59.37	64.43	66.33	66.23	63.81	60.43	65.46	69.53	Tile 18 Avg = 65
Tile 19 Avg = 64	65.90	61.55	61.33	65.41	67.79	63.77	61.78	54.80	61.14	65.02	Tile 20 Avg = 61
Sample Area 6 - Grayscale Average = 63											
Tile 21 Avg = 64	69.75	62.39	55.55	62.61	69.25	71.47	66.45	59.91	64.88	67.62	Tile 22 Avg = 66
Tile 23 Avg = 62	69.35	62.28	55.10	59.89	63.12	68.18	62.90	58.82	49.61	69.19	Tile 24 Avg = 62
	62	**58**	**55**	**59**	**61**	**62**	**59**	**55**	**58**	**63**	◄ **Grayscale Averages by Position**

Cleaned Colorimeter Grayscale Readings - Overall Average = 83

	Position Number 1	2	3	4	5	6	7	8	9	10	
Sample Area 1 - Grayscale Average = 85											
Tile 1 Avg = 86	84.81	86.66	85.32	85.74	86.36	87.43	85.89	84.18	85.99	86.25	Tile 2 Avg = 86
Tile 3 Avg = 85	86.00	84.63	83.17	86.01	86.53	86.63	83.59	76.67	80.72	82.60	Tile 4 Avg = 82
Sample Area 2 - Grayscale Average = 85											
Tile 5 Avg = 86	86.28	87.15	85.66	86.04	86.48	87.05	85.68	84.37	85.06	86.22	Tile 6 Avg = 86
Tile 7 Avg = 83	81.24	81.24	83.82	85.16	85.01	86.44	84.98	79.71	84.66	85.56	Tile 8 Avg = 84
Sample Area 3 - Grayscale Average = 83											
Tile 9 Avg = 86	86.75	87.02	86.06	86.58	85.59	87.33	85.60	80.90	82.26	84.82	Tile 10 Avg = 84
Tile 11 Avg = 79	76.36	76.70	78.65	79.68	84.76	86.65	86.53	81.68	80.60	85.35	Tile 12 Avg = 84
Sample Area 4 - Grayscale Average = 83											
Tile 13 Avg = 85	84.65	85.18	84.32	85.78	84.80	86.73	85.64	83.65	85.09	84.82	Tile 14 Avg = 85
Tile 15 Avg = 81	78.62	77.03	80.53	85.37	84.97	85.66	86.24	80.55	78.77	77.21	Tile 16 Avg = 82
Sample Area 5 - Grayscale Average = 82											
Tile 17 Avg = 84	83.28	83.16	83.99	84.57	83.79	86.54	83.73	82.15	81.52	81.87	Tile 18 Avg = 83
Tile 19 Avg = 80	81.36	73.90	81.42	80.00	82.70	85.55	80.66	75.85	76.60	79.07	Tile 20 Avg = 80
Sample Area 6 - Grayscale Average = 80											
Tile 21 Avg = 83	82.80	82.42	81.93	83.62	83.73	86.78	83.47	77.68	81.26	81.34	Tile 22 Avg = 82
Tile 23 Avg = 78	80.12	75.45	74.40	76.37	82.63	84.88	79.55	71.79	74.76	80.70	Tile 24 Avg = 78
	83	**82**	**82**	**84**	**85**	**86**	**84**	**80**	**81**	**83**	◄ **Grayscale Averages by Position**
	77	**78**	**83**	**84**	**87**	**92**	**86**	**76**	**78**	**80**	◄ **Cleaning Efficiency by Position**

Average Cleaning Efficiency %

Overall Average
All Tiles = 81

Sample Area 1 = 89
Tile 1 = 92
Tile 2 = 91
Tile 3 = 91
Tile 4 = 83

Sample Area 2 = 87
Tile 5 = 91
Tile 6 = 91
Tile 7 = 84
Tile 8 = 83

Sample Area 3 = 85
Tile 9 = 93
Tile 10 = 89
Tile 11 = 70
Tile 12 = 87

Sample Area 4 = 84
Tile 13 = 89
Tile 14 = 92
Tile 15 = 77
Tile 16 = 77

Sample Area 5 = 73
Tile 17 = 82
Tile 18 = 78
Tile 19 = 65
Tile 20 = 67

Sample Area 6 = 69
Tile 21 = 78
Tile 22 = 73
Tile 23 = 62
Tile 24 = 63

Test # 2 Gloss and Color Meter Readings - Tennant T5 - Tap Water ecH2O On

INITIAL TILE READINGS

Initial Gloss Readings - Overall Average = 89

	Position Number 1	2	3	4	5	6	7	8	9	10	
Sample Area 1 - Gloss Average = 88											
Tile 1 Avg = 90	91.1	89.5	89.3	89.9	90.0	86.4	87.0	86.2	87.6	89.3	Tile 2 Avg = 87
Tile 3 Avg = 87	86.2	85.8	86.6	87.5	87.9	89.2	89.1	88.6	88.3	90.6	Tile 4 Avg = 89
Sample Area 2 - Gloss Average = 90											
Tile 5 Avg = 89	90.3	89.4	86.9	89.7	90.8	92.2	90.6	90.7	90.6	90.7	Tile 6 Avg = 91
Tile 7 Avg = 90	90.2	91.0	90.6	87.5	91.3	91.6	91.7	90.2	86.6	91.1	Tile 8 Avg = 90
Sample Area 3 - Gloss Average = 89											
Tile 9 Avg = 87	86.1	87.6	86.8	87.3	88.6	92.4	92.1	89.6	91.6	87.7	Tile 10 Avg = 91
Tile 11 Avg = 91	91.5	90.8	90.6	90.2	91.4	87.7	88.4	84.5	88.4	87.0	Tile 12 Avg = 87
Sample Area 4 - Gloss Average = 89											
Tile 13 Avg = 89	84.9	87.9	89.1	91.5	91.1	90.3	91.2	91.0	91.5	90.7	Tile 14 Avg = 91
Tile 15 Avg = 86	88.1	87.6	88.1	86.8	81.3	90.5	91.3	91.2	91.0	90.3	Tile 16 Avg = 91
Sample Area 5 - Gloss Average = 89											
Tile 17 Avg = 88	83.6	89.1	85.4	90.0	89.8	89.4	90.4	88.7	89.8	84.1	Tile 18 Avg = 88
Tile 19 Avg = 90	88.9	90.1	90.8	91.4	89.8	86.9	88.4	87.9	89.9	87.5	Tile 20 Avg = 88
Sample Area 6 - Gloss Average = 89											
Tile 21 Avg = 90	90.3	88.5	90.6	90.9	91.7	89.9	88.8	89.0	90.7	87.8	Tile 22 Avg = 89
Tile 23 Avg = 85	88.7	87.0	87.2	81.4	81.7	85.6	88.1	91.7	90.7	90.6	Tile 24 Avg = 89
	88	**89**	**89**	**89**	**89**	**89**	**90**	**89**	**90**	**89**	◄ **Gloss Averages by Position**

Initial Colorimeter Grayscale Readings - Overall Average = 89

	Position Number 1	2	3	4	5	6	7	8	9	10	
Sample Area 1 - Grayscale Average = 88											
Tile 1 Avg = 88	88.36	88.23	88.27	88.07	87.90	88.33	88.24	87.95	87.61	87.62	Tile 2 Avg = 88
Tile 3 Avg = 88	88.48	88.39	88.12	87.86	87.84	88.60	88.61	88.49	87.88	88.16	Tile 4 Avg = 88
Sample Area 2 - Grayscale Average = 88											
Tile 5 Avg = 88	88.49	88.37	87.80	87.73	88.08	88.84	88.58	88.21	88.21	87.78	Tile 6 Avg = 88
Tile 7 Avg = 88	88.68	87.93	87.96	87.97	88.12	88.81	88.75	88.47	88.24	88.09	Tile 8 Avg = 88
Sample Area 3 - Grayscale Average = 88											
Tile 9 Avg = 88	88.76	88.41	88.29	88.27	88.40	88.99	88.66	88.29	88.27	88.32	Tile 10 Avg = 89
Tile 11 Avg = 88	88.70	88.49	87.99	88.04	88.41	88.25	87.85	87.90	87.92	88.09	Tile 12 Avg = 88
Sample Area 4 - Grayscale Average = 91											
Tile 13 Avg = 91	90.59	90.63	90.79	90.58	90.51	90.59	90.63	90.84	90.65	90.58	Tile 14 Avg = 91
Tile 15 Avg = 91	90.60	90.51	90.76	90.76	90.60	90.64	90.70	90.76	90.60	90.53	Tile 16 Avg = 91
Sample Area 5 - Grayscale Average = 91											
Tile 17 Avg = 91	90.68	90.67	90.72	90.59	90.43	90.67	90.53	90.66	90.67	90.57	Tile 18 Avg = 91
Tile 19 Avg = 91	90.59	90.59	90.75	90.76	90.54	90.64	90.56	90.66	90.71	90.37	Tile 20 Avg = 91
Sample Area 6 - Grayscale Average = 91											
Tile 21 Avg = 91	90.63	90.58	90.72	90.64	90.60	90.50	90.50	90.63	90.48	90.52	Tile 22 Avg = 91
Tile 23 Avg = 91	90.67	90.42	90.59	90.63	90.59	90.68	90.77	90.68	90.70	90.43	Tile 24 Avg = 91
	90	**89**	**89**	**89**	**89**	**90**	**90**	**89**	**89**	**89**	◄ **Grayscale Averages by Position**

SOILED TILE READINGS

Soiled Gloss Readings - Overall Average = 2

	Position Number 1	2	3	4	5	6	7	8	9	10	
Sample Area 1 - Gloss Average = 2											
Tile 1 Avg = 2	2.2	1.0	0.9	1.7	2.2	0.7	0.9	1.0	0.9	1.9	Tile 2 Avg = 1
Tile 3 Avg = 2	1.6	1.0	1.0	2.9	2.2	2.2	1.5	0.9	1.2	2.6	Tile 4 Avg = 2
Sample Area 2 - Gloss Average = 2											
Tile 5 Avg = 1	1.4	1.3	1.0	1.1	2.6	1.3	1.0	1.0	1.7	3.7	Tile 6 Avg = 2
Tile 7 Avg = 2	1.9	0.9	0.8	2.2	3.2	2.0	1.1	1.0	1.6	2.8	Tile 8 Avg = 2
Sample Area 3 - Gloss Average = 2											
Tile 9 Avg = 1	0.9	0.9	1.2	1.6	1.5	1.5	1.2	0.9	1.6	2.1	Tile 10 Avg = 1
Tile 11 Avg = 2	1.8	1.3	1.0	4.7	3.3	1.5	1.1	0.9	1.2	2.2	Tile 12 Avg = 1
Sample Area 4 - Gloss Average = 2											
Tile 13 Avg = 2	2.2	2.1	2.2	2.5	2.3	1.9	2.2	1.6	2.4	2.2	Tile 14 Avg = 2
Tile 15 Avg = 2	2.3	1.4	1.2	1.6	1.0	1.6	2.0	1.9	1.7	2.4	Tile 16 Avg = 2
Sample Area 5 - Gloss Average = 2											
Tile 17 Avg = 2	1.6	2.0	1.6	1.4	2.4	1.7	2.8	1.5	2.3	2.7	Tile 18 Avg = 2
Tile 19 Avg = 2	2.2	1.4	1.3	1.5	2.5	2.7	1.4	1.0	2.6	2.5	Tile 20 Avg = 2
Sample Area 6 - Gloss Average = 2											
Tile 21 Avg = 2	1.6	1.9	1.4	1.5	1.9	2.3	2.2	1.9	2.2	1.5	Tile 22 Avg = 2
Tile 23 Avg = 1	1.3	1.0	1.0	1.0	1.0	1.2	1.6	1.0	1.4	2.3	Tile 24 Avg = 2
	2	**1**	**1**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	◄ **Gloss Averages by Position**

Soiled Colorimeter Grayscale Readings - Overall Average = 62

	Position Number 1	2	3	4	5	6	7	8	9	10	
Sample Area 1 - Grayscale Average = 61											
Tile 1 Avg = 62	68.98	59.62	57.05	62.25	62.67	57.84	55.93	55.98	56.53	62.50	Tile 2 Avg = 58
Tile 3 Avg = 62	64.09	55.44	58.70	65.17	66.81	68.31	63.56	56.23	59.28	65.72	Tile 4 Avg = 63
Sample Area 2 - Grayscale Average = 62											
Tile 5 Avg = 63	64.53	62.21	61.54	59.73	66.44	63.14	57.52	52.67	62.36	68.98	Tile 6 Avg = 61
Tile 7 Avg = 61	64.64	56.48	56.73	62.54	62.55	66.47	59.07	55.96	60.82	68.02	Tile 8 Avg = 62
Sample Area 3 - Grayscale Average = 62											
Tile 9 Avg = 59	57.65	56.88	57.22	61.09	62.83	61.69	59.53	54.32	60.08	67.31	Tile 10 Avg = 61
Tile 11 Avg = 65	64.23	61.12	56.34	71.37	70.79	63.77	58.19	59.74	60.96	68.31	Tile 12 Avg = 62
Sample Area 4 - Grayscale Average = 62											
Tile 13 Avg = 65	66.16	64.04	64.49	64.93	64.86	64.40	62.66	58.71	65.13	62.03	Tile 14 Avg = 63
Tile 15 Avg = 60	67.68	62.34	56.65	56.92	55.59	64.95	61.02	60.03	60.81	65.52	Tile 16 Avg = 62
Sample Area 5 - Grayscale Average = 63											
Tile 17 Avg = 63	65.82	65.29	61.41	60.39	60.09	59.79	64.23	62.70	65.76	68.61	Tile 18 Avg = 64
Tile 19 Avg = 64	67.95	61.98	60.27	62.92	65.39	70.61	59.19	57.70	57.57	67.24	Tile 20 Avg = 62
Sample Area 6 - Grayscale Average = 62											
Tile 21 Avg = 63	64.80	62.42	59.03	64.22	66.25	69.52	66.91	62.20	63.03	63.36	Tile 22 Avg = 65
Tile 23 Avg = 58	63.57	58.70	55.94	56.57	56.06	60.74	56.78	56.75	60.33	66.04	Tile 24 Avg = 60
	65	**61**	**59**	**62**	**63**	**64**	**60**	**58**	**61**	**66**	◄ **Grayscale Averages by Position**

CLEANED TILE READINGS

Cleaned Gloss Readings - Overall Average = 23

	Position Number 1	2	3	4	5	6	7	8	9	10	
Sample Area 1 - Gloss Average = 33											
Tile 1 Avg = 51	37.0	53.6	47.3	54.9	61.8	57.4	37.5	11.5	25.9	36.9	Tile 2 Avg = 34
Tile 3 Avg = 23	14.0	8.7	19.9	21.5	48.5	56.9	27.8	8.1	13.7	21.2	Tile 4 Avg = 26
Sample Area 2 - Gloss Average = 26											
Tile 5 Avg = 31	21.0	21.9	23.6	34.9	54.3	56.9	30.3	9.3	18.8	29.5	Tile 6 Avg = 29
Tile 7 Avg = 21	11.0	10.5	11.4	25.8	46.6	51.2	18.1	6.8	10.8	35.4	Tile 8 Avg = 24
Sample Area 3 - Gloss Average = 25											
Tile 9 Avg = 31	25.1	33.3	22.5	28.7	45.0	54.2	20.7	10.1	17.0	17.9	Tile 10 Avg = 24
Tile 11 Avg = 22	9.0	9.9	12.4	30.4	50.6	18.9	24.9	13.2	32.0	15.9	Tile 12 Avg = 21
Sample Area 4 - Gloss Average = 18											
Tile 13 Avg = 22	16.2	19.3	14.1	19.9	39.7	57.0	14.7	6.7	13.7	21.6	Tile 14 Avg = 23
Tile 15 Avg = 10	12.3	5.7	9.0	5.3	19.5	45.3	8.9	3.7	8.1	9.9	Tile 16 Avg = 15
Sample Area 5 - Gloss Average = 18											
Tile 17 Avg = 21	9.7	21.0	13.2	17.1	43.8	53.4	20.1	7.6	15.1	28.2	Tile 18 Avg = 25
Tile 19 Avg = 12	7.6	4.4	6.0	9.0	32.1	37.1	8.3	10.5	9.8	11.1	Tile 20 Avg = 15
Sample Area 6 - Gloss Average = 17											
Tile 21 Avg = 21	14.8	19.6	11.0	16.6	45.3	58.2	17.8	9.3	9.4	22.3	Tile 22 Avg = 23
Tile 23 Avg = 11	9.4	5.7	6.5	12.5	19.1	30.5	10.0	4.6	11.6	14.1	Tile 24 Avg = 14
	16	**18**	**16**	**23**	**42**	**48**	**20**	**8**	**15**	**22**	◄ **Gloss Averages by Position**
	16	**19**	**17**	**24**	**46**	**53**	**21**	**8**	**16**	**23**	◄ **Cleaning Efficiency by Position**

Cleaned Colorimeter Grayscale Readings - Overall Average = 81

	Position Number 1	2	3	4	5	6	7	8	9	10	
Sample Area 1 - Grayscale Average = 83											
Tile 1 Avg = 86	84.66	85.71	85.92	85.88	86.25	86.89	85.27	78.82	80.38	83.69	Tile 2 Avg = 83
Tile 3 Avg = 82	80.33	78.00	82.18	82.85	85.04	86.47	83.97	77.73	76.23	80.87	Tile 4 Avg = 81
Sample Area 2 - Grayscale Average = 82											
Tile 5 Avg = 84	83.35	83.44	83.73	85.24	85.68	86.70	84.62	77.71	80.68	82.37	Tile 6 Avg = 82
Tile 7 Avg = 80	78.65	77.34	79.86	81.63	84.79	85.92	82.24	73.64	76.10	82.26	Tile 8 Avg = 80
Sample Area 3 - Grayscale Average = 82											
Tile 9 Avg = 84	83.04	85.51	81.68	82.88	85.05	86.70	83.36	76.04	80.62	79.40	Tile 10 Avg = 81
Tile 11 Avg = 80	76.35	76.99	79.12	84.03	85.28	82.80	82.94	79.35	83.57	79.53	Tile 12 Avg = 82
Sample Area 4 - Grayscale Average = 81											
Tile 13 Avg = 84	82.95	84.01	83.09	83.25	85.75	87.38	83.45	77.09	79.44	82.91	Tile 14 Avg = 82
Tile 15 Avg = 79	81.68	77.33	78.57	76.13	83.60	86.50	79.71	73.35	76.19	77.98	Tile 16 Avg = 79
Sample Area 5 - Grayscale Average = 81											
Tile 17 Avg = 83	81.97	84.44	81.79	82.35	84.60	87.06	83.24	80.00	81.54	83.46	Tile 18 Avg = 83
Tile 19 Avg = 79	77.88	75.54	78.68	78.62	82.82	85.65	78.72	73.17	75.92	78.69	Tile 20 Avg = 78
Sample Area 6 - Grayscale Average = 80											
Tile 21 Avg = 83	84.11	83.84	81.06	82.10	85.39	87.34	82.71	78.18	78.43	81.30	Tile 22 Avg = 82
Tile 23 Avg = 78	78.15	75.02	77.10	79.96	80.47	84.75	79.29	73.47	77.37	79.06	Tile 24 Avg = 79
	81	**81**	**81**	**82**	**85**	**86**	**82**	**77**	**79**	**81**	◄ **Grayscale Averages by Position**
	65	**69**	**73**	**73**	**82**	**86**	**76**	**59**	**63**	**64**	◄ **Cleaning Efficiency by Position**

Average Cleaning Efficiency %

Overall Average
All Tiles = 24

Sample Area 1 = 36
Tile 1 = 56
Tile 2 = 38
Tile 3 = 24
Tile 4 = 27

Sample Area 2 = 28
Tile 5 = 34
Tile 6 = 31
Tile 7 = 22
Tile 8 = 26

Sample Area 3 = 26
Tile 9 = 35
Tile 10 = 25
Tile 11 = 23
Tile 12 = 23

Sample Area 4 = 18
Tile 13 = 23
Tile 14 = 23
Tile 15 = 10
Tile 16 = 15

Sample Area 5 = 19
Tile 17 = 22
Tile 18 = 26
Tile 19 = 11
Tile 20 = 15

Sample Area 6 = 18
Tile 21 = 22
Tile 22 = 25
Tile 23 = 11
Tile 24 = 14

Overall Average
All Tiles = 71

Sample Area 1 = 80
Tile 1 = 90
Tile 2 = 84
Tile 3 = 75
Tile 4 = 72

Sample Area 2 = 76
Tile 5 = 85
Tile 6 = 78
Tile 7 = 72
Tile 8 = 68

Sample Area 3 = 75
Tile 9 = 84
Tile 10 = 74
Tile 11 = 66
Tile 12 = 75

Sample Area 4 = 66
Tile 13 = 74
Tile 14 = 69
Tile 15 = 64
Tile 16 = 58

Sample Area 5 = 64
Tile 17 = 73
Tile 18 = 71
Tile 19 = 56
Tile 20 = 57

Sample Area 6 = 65
Tile 21 = 73
Tile 22 = 65
Tile 23 = 62
Tile 24 = 61

Test # 3 Gloss and Color Meter Readings - Tennant T5 - Detergent

INITIAL TILE READINGS

Initial Gloss Readings - Overall Average = 89

	Position Number 1	2	3	4	5	6	7	8	9	10	
Sample Area 1 - Gloss Average = 89											
Tile 1 Avg = 89	87.7	89.6	88.3	87.9	89.8	89.3	91.3	90.5	87.1	89.3	Tile 2 Avg = 90
Tile 3 Avg = 91	91.0	91.7	87.2	92.0	91.0	89.6	91.2	89.3	88.2	87.0	Tile 4 Avg = 89
Sample Area 2 - Gloss Average = 90											
Tile 5 Avg = 90	87.9	89.2	90.0	90.1	90.3	89.0	91.3	91.7	86.7	90.0	Tile 6 Avg = 90
Tile 7 Avg = 89	83.8	89.9	90.4	90.5	88.0	92.7	92.2	89.8	91.7	90.7	Tile 8 Avg = 91
Sample Area 3 - Gloss Average = 89											
Tile 9 Avg = 89	89.1	89.6	87.4	89.1	87.3	86.1	88.9	90.5	89.4	89.3	Tile 10 Avg = 89
Tile 11 Avg = 90	89.2	86.8	89.4	91.4	91.5	87.5	86.9	86.6	86.1	88.6	Tile 12 Avg = 87
Sample Area 4 - Gloss Average = 87											
Tile 13 Avg = 87	90.2	87.0	88.2	87.4	83.3	89.4	89.1	88.9	87.9	84.3	Tile 14 Avg = 88
Tile 15 Avg = 87	90.1	89.1	86.2	86.1	85.6	90.2	84.2	81.0	84.8	86.6	Tile 16 Avg = 85
Sample Area 5 - Gloss Average = 90											
Tile 17 Avg = 90	91.2	90.9	90.3	89.3	89.8	89.5	90.2	88.8	90.3	87.5	Tile 18 Avg = 89
Tile 19 Avg = 89	89.0	89.5	91.0	87.1	88.9	89.8	90.7	90.4	89.6	89.3	Tile 20 Avg = 90
Sample Area 6 - Gloss Average = 89											
Tile 21 Avg = 88	86.3	88.0	89.8	87.6	86.9	86.4	90.2	90.8	88.6	91.8	Tile 22 Avg = 90
Tile 23 Avg = 90	90.8	90.9	90.3	89.5	88.0	92.7	92.3	90.4	84.0	89.3	Tile 24 Avg = 90
	89	**89**	**89**	**89**	**88**	**89**	**90**	**89**	**88**	**89**	◄ **Gloss Averages by Position**

Initial Colorimeter Grayscale Readings - Overall Average = 91

	Position Number 1	2	3	4	5	6	7	8	9	10	
Sample Area 1 - Grayscale Average = 91											
Tile 1 Avg = 91	90.83	90.81	90.96	90.84	90.90	90.72	90.94	90.78	90.81	90.86	Tile 2 Avg = 91
Tile 3 Avg = 90	90.34	90.48	90.47	90.59	90.45	90.80	90.92	90.87	90.81	90.67	Tile 4 Avg = 91
Sample Area 2 - Grayscale Average = 91											
Tile 5 Avg = 91	90.88	90.87	90.91	90.87	90.89	90.79	90.86	90.77	90.74	90.86	Tile 6 Avg = 91
Tile 7 Avg = 91	90.90	90.99	90.95	90.95	90.80	90.95	90.90	90.97	90.87	90.53	Tile 8 Avg = 91
Sample Area 3 - Grayscale Average = 91											
Tile 9 Avg = 91	91.04	90.95	90.97	90.92	90.53	90.85	90.97	90.92	90.87	90.70	Tile 10 Avg = 91
Tile 11 Avg = 91	90.89	90.57	90.82	90.83	90.78	90.96	90.78	90.83	90.87	90.57	Tile 12 Avg = 91
Sample Area 4 - Grayscale Average = 91											
Tile 13 Avg = 91	90.63	90.94	90.80	90.83	90.54	90.72	90.86	90.95	90.85	90.69	Tile 14 Avg = 91
Tile 15 Avg = 91	90.79	90.81	90.76	90.81	90.85	90.90	90.75	90.91	90.85	90.84	Tile 16 Avg = 91
Sample Area 5 - Grayscale Average = 91											
Tile 17 Avg = 91	90.94	90.79	90.87	90.71	90.60	90.92	90.87	90.83	90.82	90.77	Tile 18 Avg = 91
Tile 19 Avg = 91	90.94	90.90	90.96	90.83	90.86	90.90	90.74	90.91	90.88	90.89	Tile 20 Avg = 91
Sample Area 6 - Grayscale Average = 90											
Tile 21 Avg = 91	90.95	90.89	90.89	90.96	90.87	90.70	90.88	90.78	90.78	90.59	Tile 22 Avg = 91
Tile 23 Avg = 88	88.52	88.52	88.46	88.39	88.39	88.97	88.22	87.92	87.89	88.08	Tile 24 Avg = 88
	91	**91**	**91**	**91**	**91**	**91**	**91**	**91**	**91**	**91**	◄ **Grayscale Averages by Position**

SOILED TILE READINGS

Soiled Gloss Readings - Overall Average = 2

	Position Number 1	2	3	4	5	6	7	8	9	10	
Sample Area 1 - Gloss Average = 2											
Tile 1 Avg = 1	1.1	1.3	1.3	1.4	1.6	1.6	1.6	1.3	1.4	2.2	Tile 2 Avg = 2
Tile 3 Avg = 2	2.9	1.1	1.0	1.2	1.7	1.9	2.2	1.7	2.6	3.8	Tile 4 Avg = 2
Sample Area 2 - Gloss Average = 2											
Tile 5 Avg = 2	1.2	1.6	1.4	1.6	1.9	2.5	2.9	1.7	2.1	2.0	Tile 6 Avg = 2
Tile 7 Avg = 3	2.1	2.9	2.2	3.1	2.2	2.8	2.8	1.8	2.0	2.5	Tile 8 Avg = 2
Sample Area 3 - Gloss Average = 1											
Tile 9 Avg = 1	1.6	1.9	1.3	1.1	1.3	1.4	1.0	1.0	0.9	0.9	Tile 10 Avg = 1
Tile 11 Avg = 2	1.5	1.1	1.2	1.9	1.8	2.4	1.9	1.2	1.6	2.5	Tile 12 Avg = 2
Sample Area 4 - Gloss Average = 2											
Tile 13 Avg = 1	1.0	0.9	1.2	1.0	0.9	1.5	2.4	1.9	2.5	2.5	Tile 14 Avg = 2
Tile 15 Avg = 3	2.4	3.2	2.2	3.0	2.8	2.0	1.7	1.3	2.3	2.7	Tile 16 Avg = 2
Sample Area 5 - Gloss Average = 2											
Tile 17 Avg = 2	2.2	1.9	1.4	2.2	2.0	1.6	2.8	2.7	3.4	3.5	Tile 18 Avg = 3
Tile 19 Avg = 1	1.6	1.7	1.1	1.3	1.3	1.7	1.1	1.3	1.6	1.3	Tile 20 Avg = 1
Sample Area 6 - Gloss Average = 2											
Tile 21 Avg = 1	1.4	1.4	1.1	1.7	1.8	1.8	1.5	1.2	1.9	1.9	Tile 22 Avg = 2
Tile 23 Avg = 2	2.2	1.0	0.8	2.2	2.5	1.9	1.4	1.8	1.0	1.7	Tile 24 Avg = 2
	2	**2**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	◄ **Gloss Averages by Position**

Soiled Colorimeter Grayscale Readings - Overall Average = 62

	Position Number 1	2	3	4	5	6	7	8	9	10	
Sample Area 1 - Grayscale Average = 62											
Tile 1 Avg = 60	58.94	60.17	58.13	60.30	61.43	65.12	62.28	57.08	60.13	65.54	Tile 2 Avg = 62
Tile 3 Avg = 62	68.46	60.11	55.43	58.97	64.64	65.12	65.85	61.77	66.86	70.63	Tile 4 Avg = 66
Sample Area 2 - Grayscale Average = 65											
Tile 5 Avg = 62	62.71	59.70	58.79	60.69	66.44	68.53	67.58	60.05	63.98	62.17	Tile 6 Avg = 64
Tile 7 Avg = 66	63.26	66.21	62.37	70.00	68.15	67.93	68.53	61.62	67.66	66.55	Tile 8 Avg = 66
Sample Area 3 - Grayscale Average = 60											
Tile 9 Avg = 62	67.38	62.81	59.99	59.88	60.26	64.28	57.09	56.22	55.86	54.45	Tile 10 Avg = 58
Tile 11 Avg = 59	60.52	56.40	56.92	59.80	61.40	64.61	63.65	54.83	59.77	63.81	Tile 12 Avg = 61
Sample Area 4 - Grayscale Average = 62											
Tile 13 Avg = 56	55.63	56.51	56.08	55.75	55.23	61.76	65.84	61.56	63.76	66.73	Tile 14 Avg = 64
Tile 15 Avg = 68	69.43	67.64	63.67	70.03	67.49	65.67	61.12	57.40	59.79	62.35	Tile 16 Avg = 61
Sample Area 5 - Grayscale Average = 62											
Tile 17 Avg = 63	61.50	63.23	57.78	64.60	65.81	63.98	66.64	61.82	65.58	68.41	Tile 18 Avg = 65
Tile 19 Avg = 58	62.96	60.15	54.77	55.81	56.67	63.70	60.55	56.92	60.92	58.84	Tile 20 Avg = 60
Sample Area 6 - Grayscale Average = 61											
Tile 21 Avg = 58	58.95	56.22	53.89	59.60	60.12	61.46	59.32	57.83	61.11	64.00	Tile 22 Avg = 61
Tile 23 Avg = 63	67.42	62.48	54.34	64.29	65.77	66.19	61.19	56.59	60.11	62.69	Tile 24 Avg = 61
	63	**61**	**58**	**62**	**63**	**65**	**63**	**59**	**62**	**64**	◄ **Grayscale Averages by Position**

CLEANED TILE READINGS

Cleaned Gloss Readings - Overall Average = 44

	Position Number 1	2	3	4	5	6	7	8	9	10	
Sample Area 1 - Gloss Average = 50											
Tile 1 Avg = 43	46.7	36.0	36.5	37.4	57.9	58.2	63.4	40.1	52.9	53.1	Tile 2 Avg = 57
Tile 3 Avg = 46	39.5	25.4	37.6	60.3	65.3	58.2	66.8	48.5	64.5	57.4	Tile 4 Avg = 59
Sample Area 2 - Gloss Average = 48											
Tile 5 Avg = 45	41.7	25.8	32.1	62.0	64.8	50.4	60.9	54.7	56.8	54.6	Tile 6 Avg = 55
Tile 7 Avg = 41	37.4	33.0	31.8	46.6	57.1	63.8	66.3	32.6	41.1	47.8	Tile 8 Avg = 50
Sample Area 3 - Gloss Average = 41											
Tile 9 Avg = 44	37.5	46.8	52.0	33.0	51.8	54.4	51.4	35.9	31.5	27.8	Tile 10 Avg = 40
Tile 11 Avg = 40	24.4	23.6	57.1	38.4	56.7	66.4	54.2	21.5	27.2	33.2	Tile 12 Avg = 41
Sample Area 4 - Gloss Average = 43											
Tile 13 Avg = 50	42.2	40.5	47.5	61.1	56.8	63.4	58.7	48.5	55.0	36.0	Tile 14 Avg = 52
Tile 15 Avg = 38	23.8	20.8	29.8	53.1	61.3	52.4	39.8	15.4	24.7	19.8	Tile 16 Avg = 30
Sample Area 5 - Gloss Average = 39											
Tile 17 Avg = 39	39.2	22.6	20.3	49.5	63.5	59.9	63.1	37.4	53.1	46.9	Tile 18 Avg = 52
Tile 19 Avg = 31	15.8	18.1	22.8	38.2	60.3	62.2	46.8	16.2	16.9	25.0	Tile 20 Avg = 33
Sample Area 6 - Gloss Average = 43											
Tile 21 Avg = 43	38.4	30.9	39.7	50.6	53.6	53.3	63.6	38.3	45.0	47.5	Tile 22 Avg = 50
Tile 23 Avg = 39	24.4	22.8	29.6	49.3	69.2	69.7	49.6	14.0	24.0	46.7	Tile 24 Avg = 41
	34	**29**	**36**	**48**	**60**	**59**	**57**	**34**	**41**	**41**	◄ **Gloss Averages by Position**
	37	**31**	**40**	**53**	**67**	**66**	**63**	**37**	**46**	**45**	◄ **Cleaning Efficiency by Position**

Cleaned Colorimeter Grayscale Readings - Overall Average = 86

	Position Number 1	2	3	4	5	6	7	8	9	10	
Sample Area 1 - Grayscale Average = 87											
Tile 1 Avg = 87	86.24	86.59	86.35	86.26	87.69	89.62	87.98	86.73	87.45	91-62	Tile 2 Avg = 88
Tile 3 Avg = 87	85.97	85.09	86.31	87.43	88.55	89.50	88.47	87.48	87.66	87.54	Tile 4 Avg = 88
Sample Area 2 - Grayscale Average = 87											
Tile 5 Avg = 86	85.56	85.31	85.85	87.50	88.08	89.29	88.31	87.21	87.17	86.69	Tile 6 Avg = 88
Tile 7 Avg = 86	84.74	84.29	85.78	86.26	87.50	89.26	88.35	85.75	86.62	86.26	Tile 8 Avg = 87
Sample Area 3 - Grayscale Average = 86											
Tile 9 Avg = 86	85.83	87.19	86.55	85.23	86.08	88.80	87.79	85.78	84.25	85.04	Tile 10 Avg = 86
Tile 11 Avg = 85	83.72	83.20	86.51	85.48	85.65	89.86	86.96	83.08	82.62	85.19	Tile 12 Avg = 86
Sample Area 4 - Grayscale Average = 86											
Tile 13 Avg = 87	85.95	86.82	86.30	86.78	87.17	89.31	87.67	87.58	86.71	86.82	Tile 14 Avg = 88
Tile 15 Avg = 85	83.67	81.46	85.39	86.69	87.52	88.80	86.26	83.42	83.56	83.64	Tile 16 Avg = 85
Sample Area 5 - Grayscale Average = 85											
Tile 17 Avg = 85	85.37	85.02	84.12	85.34	87.61	89.22	88.00	85.32	85.98	86.38	Tile 18 Avg = 87
Tile 19 Avg = 84	82.21	82.10	84.37	84.76	86.56	88.86	85.93	79.26	80.49	82.90	Tile 20 Avg = 83
Sample Area 6 - Grayscale Average = 84											
Tile 21 Avg = 86	85.34	85.12	85.36	86.50	86.71	88.95	86.99	85.57	86.07	84.20	Tile 22 Avg = 86
Tile 23 Avg = 83	79.61	81.39	81.72	84.26	85.88	88.21	85.16	78.06	79.65	83.97	Tile 24 Avg = 83
	85	**84**	**85**	**86**	**87**	**89**	**87**	**85**	**85**	**85**	◄ **Grayscale Averages by Position**
	78	**79**	**84**	**84**	**88**	**94**	**88**	**81**	**80**	**81**	◄ **Cleaning Efficiency by Position**

Average Cleaning Efficiency %

Overall Average
All Tiles = 49

Sample Area 1 = 56
Tile 1 = 48
Tile 2 = 63
Tile 3 = 49
Tile 4 = 65

Sample Area 2 = 52
Tile 5 = 50
Tile 6 = 61
Tile 7 = 45
Tile 8 = 54

Sample Area 3 = 46
Tile 9 = 49
Tile 10 = 45
Tile 11 = 44
Tile 12 = 45

Sample Area 4 = 48
Tile 13 = 56
Tile 14 = 58
Tile 15 = 41
Tile 16 = 34

Sample Area 5 = 42
Tile 17 = 42
Tile 18 = 57
Tile 19 = 34
Tile 20 = 36

Sample Area 6 = 47
Tile 21 = 48
Tile 22 = 54
Tile 23 = 42
Tile 24 = 44

Overall Average
All Tiles = 84

Sample Area 1 = 88
Tile 1 = 86
Tile 2 = 90
Tile 3 = 87
Tile 4 = 89

Sample Area 2 = 84
Tile 5 = 85
Tile 6 = 88
Tile 7 = 79
Tile 8 = 85

Sample Area 3 = 83
Tile 9 = 84
Tile 10 = 86
Tile 11 = 82
Tile 12 = 82

Sample Area 4 = 83
Tile 13 = 88
Tile 14 = 88
Tile 15 = 75
Tile 16 = 81

Sample Area 5 = 80
Tile 17 = 81
Tile 18 = 85
Tile 19 = 79
Tile 20 = 76

Sample Area 6 = 82
Tile 21 = 85
Tile 22 = 85
Tile 23 = 77
Tile 24 = 81

	Test Section			
Input Water Measurements	**Tennant T5 - Tap Water ecH2O Off**	**Tennant T5 - Tap Water ecH2O On**	**Tennant T5 - Detergent**	**not used**
Total Dissolved Solids (TDS) [ppm]	71	71		
Free Chlorine [ppm]	0.76	0.76		
Total Chlorine [ppm]	0.83	0.83		
pH	8.34	8.34	12.49	
temperature [°C]	27.8	27.8	27.8	

Output Water Measurements	**Tennant T5 - Tap Water ecH2O Off**	**Tennant T5 - Tap Water ecH2O On**	**Tennant T5 - Detergent**	**not used**
Total Dissolved Solids (TDS) [ppm]		71		
Free Chlorine [ppm]		1.23		
Total Chlorine [ppm]		1.37		
pH		8.08		
temperature [°C]		28.5		

Measured Solution Flow Rates [mL/min]	1260	900	1260	

Measured Battery Voltage [Volts]	24.5	24.4	24.4	

Soil Removal Test Summary

GLOSS METER DATA

	Cleaning Efficiency						Cleaning Efficiency		Average Gloss Readings		
Test	**Sample 1**	**Sample 2**	**Sample 3**	**Sample 4**	**Sample 5**	**Sample 6**	**Average**	**Median**	**Initial**	**Soiled**	**Cleaned**
Tennant T5 - Tap Water ecH2O Off	31	28	29	28	29	21	27.7	28.7	90	2	26
Tennant T5 - Tap Water ecH2O On	36	28	26	18	19	18	24.2	22.6	89	2	23
Tennant T5 - Detergent	56	52	46	48	42	47	48.6	47.4	89	2	44
not used	85	85	85	85	85	85	85.5	85.5	60	5	52

AVERAGE CLEANING EFFICIENCY BY POSITION - GLOSS METHOD

	POSITION ►	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
Average	Tennant T5 - Tap Water ecH2O Off	28	28	28	28	28	28	28	28	28	28	
Average	Tennant T5 - Tap Water ecH2O On	24	24	24	24	24	24	24	24	24	24	
Average	Tennant T5 - Detergent	49	49	49	49	49	49	49	49	49	49	
Average	not used	85	85	85	85	85	85	85	85	85	85	

SPECTROPHOTOMETER (COLOR METER) DATA

	Cleaning Efficiency						Cleaning Efficiency		Average Color Readings		
Test	**Sample 1**	**Sample 2**	**Sample 3**	**Sample 4**	**Sample 5**	**Sample 6**	**Average**	**Median**	**Initial**	**Soiled**	**Cleaned**
Tennant T5 - Tap Water ecH2O Off	89	87	85	84	73	69	81.2	84.3	88	59	83
Tennant T5 - Tap Water ecH2O On	80	76	75	66	64	65	71.1	70.4	89	62	81
Tennant T5 - Detergent	88	84	83	83	80	82	83.5	83.2	91	62	86
not used	58	58	58	58	58	58	58.2	58.2	95	40	72

AVERAGE CLEANING EFFICIENCY BY POSITION - COLOR METHOD

	POSITION ►	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
Average	Tennant T5 - Tap Water ecH2O Off	81	81	81	81	81	81	81	81	81	81	
Average	Tennant T5 - Tap Water ecH2O On	71	71	71	71	71	71	71	71	71	71	
Average	Tennant T5 - Detergent	84	84	84	84	84	84	84	84	84	84	
Average	not used	58	58	58	58	58	58	58	58	58	58	

Nilfisk-Advance Cleaning Efficacy Testing Protocol for Tennant ecH2O System

Purpose:

To establish a non-biased method for measuring the cleaning efficacy characteristics for the Tennant ecH2O system as installed on a model T5 scrubber.

Reference Documents:

- **ASTM D 4488 – 95** (reapproved 2001) Standard Guide for Testing Cleaning Performance of Products Intended for Use on Resilient Flooring and Washable Walls
- **ASTM D 5343 – 06** Standard Guide for Evaluating Cleaning Performance of Ceramic Tile Cleaners

Common Testing Parameters:

Use tap water for baseline testing, ecH2O, and diluting chemicals. Water should be room temperature - between 60 - 75°F [15 - 24°C].

- Follow manufacturers recommended test procedures for using test instruments and other testing media
- Containers used for holding water test samples are to be properly cleaned prior to use.
- For hard-floor tests a Tennant T5 machine will be used.
- After testing, test panels are to be saved and stored such that test surface is not disturbed
- A template shall be used when taking gloss meter and colorimeter readings (5 per tile) to insure that the same locations are being measured for the initial, soiled, and cleaned readings. See recommended measurement locations in figure 1.
- Colorimeter readings will only utilize a grayscale reading.
- Gloss meter readings are assumed to be 0 – 100 (low gloss = 1, high gloss = 100)
- Colorimeter (spectrophotometer) grayscale readings are assumed to be 1 – 100 (1 = black, 100 = white)

Hard Floor Cleaning Efficacy Testing Using Automatic Scrubber:

- **General Requirements**
  - Perform tests using water and ec-H2O system before tests using chemicals to prevent possible contamination of water-only tests with residual chemical.
  - After testing with chemicals, the machine solution system should be thoroughly flushed to remove any residual chemical. This should be accomplished by:
    - Completely drain the solution tank
    - Flush the tank with cold water until there is no sign of chemical suds
    - Flush the tank with hot or warm water to remove any remaining residue
    - Fill the tank with approximately five gallons of hot or warm water
    - Run the scrubber for approximately three minutes at maximum solution flow with the ecH2O module OFF followed by three minutes with the ecH2O module on.
  - Floor type & sample area
    - Commercial vinyl tiles, smooth surface, white, 12” by 12” applied to flat substrate. Armstrong Excelon 56830 Chalk II or equivalent.
    - Hardiebacker 500 or equivalent product is recommended for the tile mounting substrate.

- Each test sample area to be 24” square (4 tiles).
- Number of samples to test: 6 per cleaning agent (24 tiles per test)
- Total recommended test surface area 8’ wide by 24’ long – see figure 2

- Machine configuration
  - Tennant model T5 (28” disc scrub head) with ec-H2O option
  - Scrub pressure setting: 1 of 3 (light / economy scrub)
  - Solution flow rate, conventional mode (ecH2O off): 1 of 3. (0.3 GPM per Tennant specifications). Verify flow rate by capturing output for 60 seconds.
  - Solution flow rate ecH2O mode (ecH2O on): fixed. (0.22 GPM per Tennant specifications). Verify flow rate by capturing output for 60 seconds.
  - Fill solution tank to level specified in the specific procedure. The solution flow rate on gravity-feed systems is affected by the solution level in the tank.
  - Travel speed: 2.5 ft/sec (1.7 MPH – 0.762m/sec). Place mark on the speed limit control knob for future reference.
  - Pad type (2 new pads for each cleaning agent test): 3M – red, 14 inch. Place pads on machine with unmarked side down.
  - Batteries are to be fully charged prior to testing.
  - A calibrated voltmeter with at least 0.1 volt resolution should be connected to the battery terminals of the scrubber. The voltmeter must be readable when operating the machine.
- Tile Preparation
  - Follow manufacturer’s recommendations for all floor coating chemicals.
  - Previously used tiles are to be prepared by stripping any existing coatings using Hillyard Devastator (HIL0014706) commercial floor stripping agent. This is not required if the tiles are new.
  - New or stripped tiles should be coated with a commercial tile sealer. Hillyard Seal #341 (HIL0034106) is recommended.
  - Tiles are to then be coated with three layers of a commercial floor finish. Hillyard Northstar (HIL0052806) floor finish recommended. Floor finish should be applied as evenly and smoothly as possible.
  - Gloss and colorimeter readings are to be taken of the finished floor tiles prior to soiling. Refer to figure 1 for sampling areas. Floor finish must be fully cured prior to taking readings.
  - Average gloss readings per tile are to fall within a +/- 12.0% tolerance range for unsoiled tiles. This tolerance is based on the median gloss value of all unsoiled tiles used in the test. Prepared tiles should be distributed among the tests such that the average gloss value for all tiles in a particular test are within 5% of the tiles used in each of the other tests.
  - Average colorimeter readings per tile are to fall within a +/- 2% tolerance range for unsoiled tiles. This tolerance is based on the median grayscale value of all unsoiled tiles used in the test.
  - Soil test panels to be marked with the test name and sequence prior to executing the test.

- Soil composition
  - ASTM D4488 (particulate and oily soil – section A5)
- Soil application
  - Modification of ASTM D4488 (section A5) method is required to cover large area. Template shall have a 3.5 inch by 12 inch opening. Soil to be applied per figure 1.
  - Place 262mg of the particulate soil on the tile inside the template cutout area.
  - Apply 25 drops of the oily blend on the particulate soil. Mix and spread the soil evenly within the cutout area.
  - Soil is to be applied using a 2 inch foam paint applicator.
  - All soiled tiles should have roughly equivalent drying times before use – for example do not soil tiles on day one and then use some of these tiles on days two & three.
  - Tiles should be allowed to air dry 24 hours prior to cleaning. Adjust drying times for low temperature or high humidity conditions.
  - Gloss and colorimeter readings are to be taken of the soiled floor tiles prior to cleaning. Refer to figure 1 for sampling areas. This should only be done after the drying period.
  - Average gloss readings per tile are to fall within a +/- 2% tolerance range. This tolerance is based on the median gloss value of all soiled tiles used in the test.
  - Average colorimeter readings per tile are to fall within a +/- 7% tolerance range. This tolerance is based on the median grayscale value of all soiled tiles used in the test.
- Soil Removal
  - Single pass of scrubber over test panels
  - Use masking tape guide marks just outside of scrub head path to assist in correct positioning of scrub head over soil sample areas.

- **The steps listed below are in addition to any applicable steps detailed in the ASTM D4488 standard.**

1.1. Soil Removal Test 1 – Tap water – ecH2O unit OFF

1.1.1. Verify that there are approximately 11 gallons [40-43 liters] of tap water in the solution tank. Water temperature should be between 60 - 75°F [15 - 24°C]
1.1.2. Drain approximately ¼ gallon [1 liter] from tank via solution drain hose
1.1.3. Take water sample measurements from the solution in the tank – draw from solution drain hose. Record measurements in table 1.
1.1.4. Verify that the speed limit control is set to the predetermined position for the required travel speed
1.1.5. Install new 3M red scrub pads on the machine
1.1.6. Install new soil test panel(s) in the scrub path
1.1.7. Position machine in the start area
1.1.8. Verify that ecH2O system is **OFF**
1.1.9. Activate the scrub system by pressing the green scrub on/off button
1.1.10. Verify that scrub pressure is set to 1 of 3 (economy - light pressure)

1.1.11. Verify that the solution flow is set for 1 of 3 (economy – low flow)
1.1.12. Lower the squeegee
1.1.13. Pull the control handle bail all the way rearward and scrub the open area for at least 20 seconds prior to scrubbing the sample areas. This is to insure that the desired solution is reaching the scrub head.
1.1.14. At the start of this 20 second period, record the battery voltage.
1.1.15. With the machine up to speed, run the machine over the test area(s)
1.1.16. Perform the next two steps for each remaining sample in test
    1.1.16.1. Install new soil test panel/tiles
    1.1.16.2. Repeat from 1.1.15 until all 6 samples have been completed
1.1.17. Deactivate the scrub system by pressing the green scrub on/off button
1.1.18. Retrieve any remaining solution on the floor using the machine
1.1.19. Raise the squeegee
1.1.20. Wipe squeegee blade to remove any residual soil

1.2. Soil Removal Test 2 - Tap water – ecH2O unit ON

1.2.1. If immediately following test 1.1 then skip to 1.2.5
1.2.2. Verify that there are approximately 11 gallons [40-43 liters] of tap water in the solution tank. Water temperature should be between 60 - 75°F [15 - 24°C]
1.2.3. Drain approximately ¼ gallon [1 liter] from tank via solution drain hose
1.2.4. Take water sample measurements from the solution in the tank – draw from solution drain hose. Record measurements in table 1.
1.2.5. Verify that the speed limit control is set to the predetermined position for the required travel speed
1.2.6. Install new 3M red scrub pads on the machine
1.2.7. Install new soil test panel(s) in the scrub path
1.2.8. Position machine in the start area
1.2.9. Verify that ecH2O system is **ON**
1.2.10. Activate the scrub system by pressing the green scrub on/off button
1.2.11. Verify that scrub pressure is set to 1 of 3 (economy - light pressure)
1.2.12. The solution flow rate is controlled by the ecH2O system. No adjustment required.
1.2.13. Lower the squeegee
1.2.14. Pull the control handle bail all the way rearward and scrub the open area for at least 20 seconds prior to scrubbing the sample areas. This is to insure that the desired solution is reaching the scrub head.
1.2.15. At the start of this 20 second period, record the battery voltage.
1.2.16. With the machine up to speed, run the machine over the test area(s)
1.2.17. Perform the next two steps for each remaining sample in test
    1.2.17.1. Install new soil test panel/tiles
    1.2.17.2. Repeat from 1.2.16 until all 6 samples have been completed
1.2.18. Deactivate the scrub system by pressing the green scrub on/off button
1.2.19. Retrieve any remaining solution on the floor using the machine
1.2.20. Raise the squeegee
1.2.21. Wipe squeegee blade to remove any residual soil

1.2.22. At the front of the machine, disconnect the quick coupling in the ecH2O solution supply line and draw approximately 200mL of fluid from the system. The ecH2O system and scrub system needs to be turned on. Use this sample to take the water property data for the 'tap water – ecH2O on' portion of the data table in table 2.
1.2.23. Reconnect the solution line.

******* DO NOT AT ANYTIME TURN THE ecH2O UNIT ON WITH CHEMICAL MIXTURES IN THE SOLUTION TANK – DAMAGE TO THE ecH2O MODULE MAY RESULT! *******

1.3. Soil Removal Test 3 – cleaner/degreaser – ecH2O unit OFF

1.3.1. Verify that there are approximately 11 gallons [40-43 liters] of tap water and cleaner/degreaser mixture in the solution tank. Solution temperature should be between 60 - 75°F [15 - 24°C]. Mix chemical according to manufacturer's recommendations for low-flow or heavy cleaning. Record the mix ratio used. Chemical to use: Hillyard Arsenal #17 degreaser @ 6oz. per gallon (30oz. for 5 gallons).
1.3.2. Drain approximately ¼ gallon [1 liter] from tank via solution drain hose
1.3.3. Take water sample measurements from the solution in the tank – draw from solution drain hose. Record measurements in table 1.
1.3.4. Verify that the speed limit control is set to the predetermined position for the required travel speed
1.3.5. Install new 3M red scrub pads on the machine
1.3.6. Install new soil test panel(s) in the scrub path
1.3.7. Position machine in the start area
1.3.8. Verify that ecH2O system is **OFF**
1.3.9. Activate the scrub system by pressing the green scrub on/off button
1.3.10. Verify that scrub pressure is set to 1 of 3 (economy - light pressure)
1.3.11. Verify that the solution flow is set for 1 of 3 (economy – low flow)
1.3.12. Lower the squeegee
1.3.13. Pull the control handle bail all the way rearward and scrub the open area for at least 20 seconds prior to scrubbing the sample areas. This is to insure that the desired solution is reaching the scrub head.
1.3.14. At the start of this 20 second period, record the battery voltage.
1.3.15. With the machine up to speed, run the machine over the test area(s)
1.3.16. Perform the next two steps for each remaining sample in test
    1.3.16.1. Install new soil test panel/tiles
    1.3.16.2. Repeat from 1.3.15 until all 6 samples have been completed
1.3.17. Deactivate the scrub system by pressing the green scrub on/off button
1.3.18. Retrieve any remaining solution on the floor using the machine
1.3.19. Raise the squeegee
1.3.20. Wipe squeegee blade to remove any residual soil
1.3.21. Completely drain and flush the solution tank with warm water.
1.3.22. Flush the solutions lines by running machine for 30 seconds with warm water in the solution tank.

1.4. Analysis

1.4.1. Reflectometer readings

1.4.1.1. "Before" reflectometer readings can be taken all at once after test panels have been soiled and dried or they can be taken individually immediately prior to being used in test

1.4.1.2. "After" refelectometer readings can be taken all at once after completion of tests or they can be taken after each test – after enough time has elapsed for residual moisture to evaporate. (allow at least 4 hours dry time)

1.4.2. Colorimeter grayscale readings

1.4.2.1. "Before" grayscale readings can be taken all at once after test panels have been soiled and dried or they can be taken individually immediately prior to being used in test

1.4.2.2. "After" grayscale readings can be taken all at once after completion of tests or they can be taken after each test – after enough time has elapsed for residual moisture to evaporate (allow at least 4 hours dry time).

1.4.3. Cleaning efficiency calculations are based on the following formula taken from ASTM D4488 section A5.4.6:

$$\% \text{ cleaning efficiency} = \frac{(\text{data value of cleaned tile} - \text{data value of soiled tile})}{(\text{data value of tile before soiling} - \text{data value of soiled tile})}$$

1.5. Report Requirements

1.5.1. Nilfisk Advance will provide an Excel workbook with spreadsheets to enter the gloss meter and colorimeter data. This spreadsheet will have cells for each data point taken. This spreadsheet uses the cleaning efficiency formula defined in ASTM D4488 section A5.4.6.

1.5.2. The test report shall include the following machine configuration information for each test:

1.5.2.1. travel speed

1.5.2.2. solution flow rate setting and measured flow rate

1.5.2.3. scrub head pressure setting

1.5.2.4. scrub pad manufacturer and type

1.5.2.5. description of solutions used

1.5.2.6. battery voltage at beginning of test

1.5.2.7. beginning solution tank level

1.5.2.8. ecH2O system on/off

1.5.3. The following chemicals used shall be listed in the report:

1.5.3.1. floor stripper manufacturer and type

1.5.3.2. floor sealer manufacturer and type

1.5.3.3. floor finish manufacturer and type

1.5.3.4. manufacturer and type for any cleaning chemicals used as well as dilution rate used.

1.5.4. Additional report information:

1.5.4.1. floor preparation procedure used

1.5.4.2. soil composition and application – reference ASTM D4488 section A5

1.5.4.3. any deviations from applicable parts of ASTM D4488 that are not already described in this test procedure shall be noted

1.5.4.4. description of exact test surface construction and configuration

1.5.5. Photographs

1.5.5.1. At least one example photo shall be taken of the test surface before soiling, and after soiling.

1.5.5.2. Representative photos of each test shall be taken after the cleaning pass.

1.5.6. List of equipment used and calibration dates if applicable

1.5.7. Conclusion

1.5.7.1. Any sort of conclusion is not to be included in the report. The purpose of the report is to convey the test configuration, test method, and resultant data only.

1.6. Recommended Test Surface Configuration and Sampling Areas

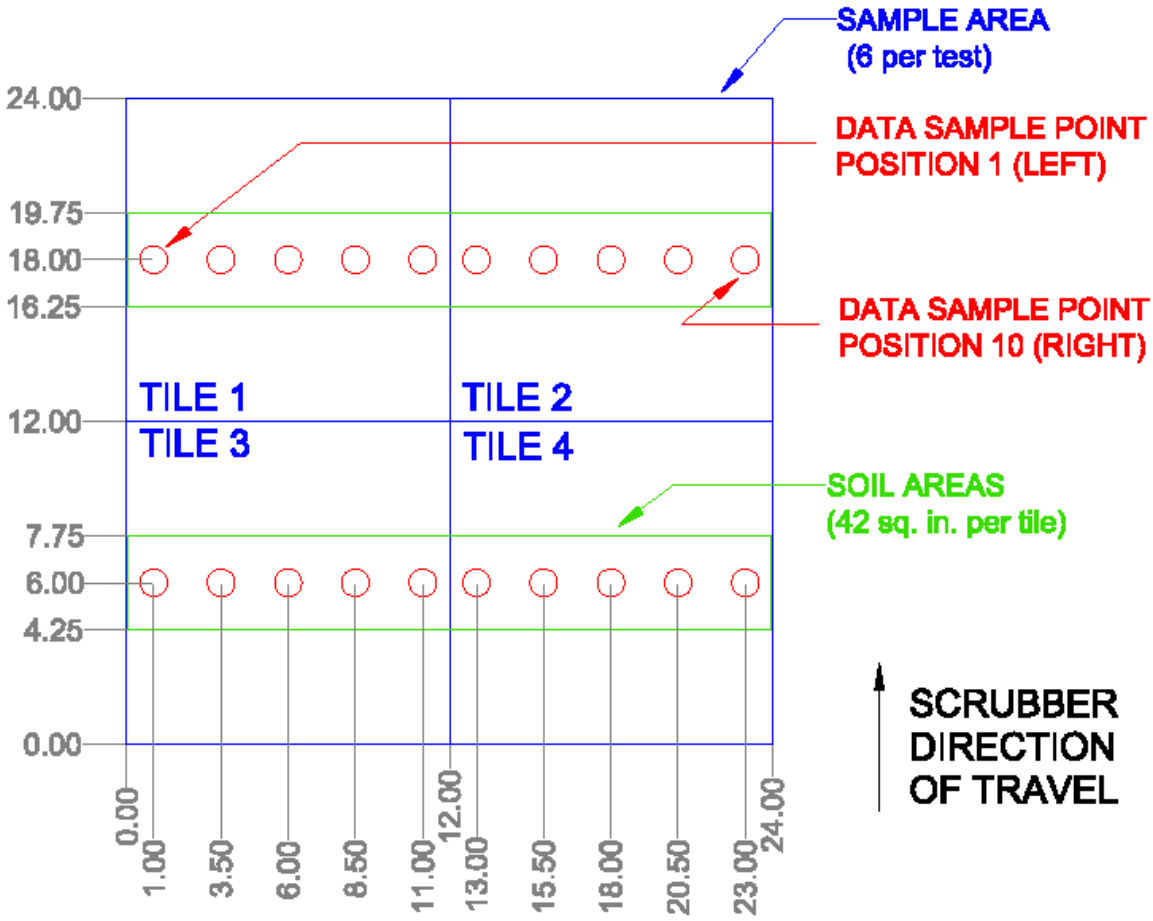


FIGURE 1 – Soil Application and Data Sampling Areas

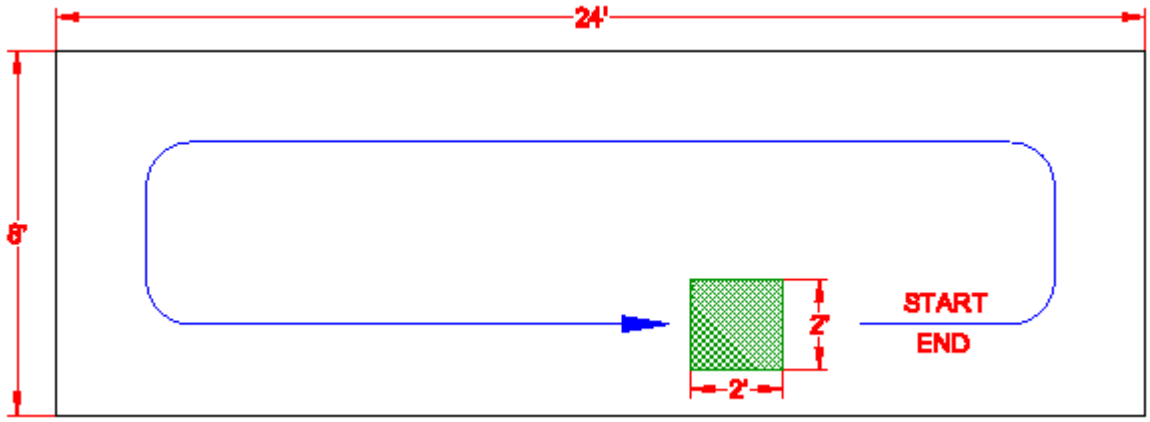


FIGURE 2 – Test Track Configuration

Reference Documents:

- Nilfisk-Advance, Inc. Cleaning Efficacy Testing Protocol T5 – RevC.doc
- ASTM D 4488 – 95 Standard Guide for Testing Cleaning Performance of Products Intended for Use on Resilient Flooring and Washable Walls.

PTL certifies that the tests performed were conducted professionally in an unbiased manner per the test procedures provided and that the data represented in the above referenced report accurately reflects the results of this testing.

APPROVED BY: Gary A. Cleary

President