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XEROS HIGH PERFORMANCE WORK WEAR, INC.

TEST REPORT

SCOPE OF WORK
Performance Testing of Reflective Trim to NFPA 1971 *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*, 2018 Edition, Modified

REPORT NUMBER
103505017CRT-004

ISSUE DATE
September 6, 2018

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TEST REPORT FOR XEROS HIGH PERFORMANCE WORK WEAR, INC.

Report No.: 103505017CRT-004
Date Issued: September 6, 2018

MANUFACTURER

Xeros Technology Group
195 Dupont Drive
Providence, RI 02907
USA

TEST STANDARD

NFPA 1971 *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*, 2018 Edition, modified as described in the Test Procedure below

AUTHORIZATION

Proposal Number:	Qu-00876874
Date Authorized:	April 17, 2018

SAMPLE INFORMATION

Dates Samples Received:	May 11, 2018 (Machine) and May 21, 2018 to June 19, 2018 (Fabric Samples)
Condition of Samples:	Production Run
Dates of Testing:	June 7, 2018 to July 30, 2018

SECTION 1
TEST PROCEDURE

Performance testing of Structural Fire Fighting clothing was conducted in accordance with the below test methods of NFPA 1971 *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*, 2018 Edition, after various laundering conditions.

Testing was done on outershell material, thermal liners, moisture barriers, moisture barrier seams, and reflective trim as outlined below. The number of specimens tested for each condition was in accordance with the annual recertification requirements of NFPA 1971-18 Section 4.4.2(3) and 4.4.2(4).

Two different laundering systems as detailed below were used, each having a sample set taken after 10, 30, and 50 cycles. In accordance with NFPA 1851 *Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*, 2014 Edition, the outershell and reflective trim samples were laundered separately from the thermal liner and moisture barrier samples. In order to create a full laundry load, retired structural firefighting garments were used as ballast material, outershells being separated from thermal liners and thermal liners being turned inside out. In order to maintain the same load size as samples were removed after 10 and 30 cycles, their mass was replaced in the laundry load with 7.5 oz/yd^2 woven 93 percent meta-aramid, 5 percent para-aramid, 2 percent antistat fiber ballast.

Laundered samples were 15 inch square fabric swatches for outershells, and thermal liners; samples for moisture barrier and moisture barrier seams were 15 inch composites of moisture barriers sewn to thermal liners; samples for reflective trim were 12 inch lengths of trim sewn to 15 inch outershell swatches.

OUTERSHELL TESTING*	
SECTION	**TEST**
7.1.3	Flame Resistance 1
7.1.11	Tear Resistance
7.1.18	Water Absorption Resistance
7.2.4	Cleaning Shrinkage Resistance
7.2.5	Breaking Strength

MOISTURE BARRIER TESTING**	
SECTION	**TEST**
7.1.12	Tear Resistance
7.1.14	Water Penetration Resistance
7.1.15	Liquid Penetration Resistance[1]
7.1.16	Viral Penetration Resistance[1]

[1]Moisture Barrier Seam Testing

THERMAL LINER TESTING***	
SECTION	**TEST**
7.1.3	Flame Resistance 1
7.1.12	Tear Resistance

REFLECTIVE TRIM TESTING	
SECTION	**TEST**
7.2.3	Retroreflectivity and Fluorescence

*Outershell Testing reflected in Intertek Test Report 103505017CRT-001
**Moisture Barrier Testing reflected in Intertek Test Report 103505017CRT-002
***Thermal Liner Testing reflected in Intertek Test Report 103505017CRT-003

SAMPLE INFORMATION

Outershell:	PBI Max 7.0 oz/yd^2 with Teflon FPPE (Black and Tan)
	Omni Vantage (Dark Brown and Light Brown)
Thermal Liner:	Defender ™ M SL2
Moisture Barrier:	Steadair 3000
	Crosstech Black 2F
Reflective Trim:	3 inch Triple Trim Orange with Trim Trax
	3 inch Perforated Diamond Triple Trim

LAUNDERING SYSTEMS

XEROS LAUNDERING SYSTEM

Machine: XEROS Model XGQ50FWL-60-215H

Detergent: XEROS, INC Pack-1 Laundry Detergent

Additive: 100% Corn Oil*

*50mL of corn oil used as foam suppression

XEROS OUTERSHELL LAUNDERING PROGRAM

STEP #	DESCRIPTION	Detergent/Additives
1	Prepare water/detergent	150 mL detergent, 50 mL corn oil
2	Spray in	
3	Prepare extra wash water	
4	Spray in	
5	Top-up water, start beads	
6	First wash	
7	Drain, prepare water/detergent	100 mL detergent
8	Second wash	
9	Drain, prepare rinse water	
10	Spray in	
11	Drain, prepare rinse water	
12	Spray in	
13	Extract, prepare rinse water	
14	Spray in	
15	Prepare rinse water	
16	Spray in	
17	Extract	
18	Remove beads	

Water from cold inlet only

XEROS LINER SYSTEMS LAUNDERING PROGRAM

STEP #	DESCRIPTION	Detergent/Additives
1	Prepare water/detergent	150 mL detergent, 50 mL corn oil
2	Spray in	
3	Prepare extra wash water	
4	Spray in	
5	Top-up water, start beads	
6	First wash	
7	Drain, prepare water/detergent	100 mL detergent
8	Second wash	
9	Drain, prepare rinse water	
10	Spray in	
11	Drain, prepare rinse water	
12	Spray in	
13	Extract, prepare rinse water	
14	Spray in	
15	Prepare rinse water	
16	Spray in	
17	Extract	
18	Remove beads	

Water from cold inlet only

MILNOR LAUNDERING SYSTEM

Machine: Milnor Model 30022V6J

Detergent: Citrosqueeze® Personal Protective Clothing & Turnout Gear Cleaner

Additive: 100% Corn Oil*

*30mL of corn oil used as foam suppression

MILNOR LAUNDERING PROGRAM

STEP #	DESCRIPTION	Detergent/Additives
1	Water Fill (40°C) / Detergent	177 mL detergent, 30 mL corn oil
2	Wash cycle (15 min)	
3	Drain (1 min)	
4	Low Spin (1 min)	
5	Water Fill (21°C)	
6	Rinse (5 min)	
7	Drain (1 min)	
8	Low Spin (1 min)	
9	Water Fill (21°C)	
10	Rinse (5 min)	
11	Drain (1 min)	
12	Low Spin (1 min)	
13	Water Fill (21°C)	
14	Rinse (6 min)	
15	Drain (1 min)	
16	Low Spin (4 min)	

SECTION 2
CONCLUSION

This test report completes the testing covered by Proposal No. Qu-00876874.

If there are any questions regarding the results contained in this report, or any of the other services offered by Intertek, please do not hesitate to contact the undersigned.

Please note: this Test Report does not represent authorization for the use of any Intertek certification marks.

Project Owner:	Benjamin Hanna	**Project Reviewer:**	Jason Allen
Title:	Engineer	**Title:**	Technical Advisor
Signature:		**Signature**	
Date	September 6, 2018	**Date:**	September 7, 2018

SECTION 3

NFPA 1971-2018 REFLECTIVE TRIM TEST DATA SHEETS

SECTION 7.2.3
RETROREFLECTIVITY AND FLUORESCENCE TEST

TEST METHOD: In accordance with Section 7.2.3 and Section 8.45

DRY SAMPLES

Model	3 Inch Triple Trim Orange with Trim Trax						
Sample Number	Observation Angle	Entrance Angle	Rotation angle	Measured CIL/m² (cd/lux*m²)	Rotation angle	Measured CIL/m² (cd/lux*m²)	>100 P/F
Pristine Specimen #1	12' (0.2º)	5º	0º	545	90º	503	Pass
Pristine Specimen #2	12' (0.2º)	5º	0º	538	90º	503	Pass
Pristine Specimen #3	12' (0.2º)	5º	0º	539	90º	506	Pass
Pristine Specimen #4	12' (0.2º)	5º	0º	533	90º	492	Pass
MILNOR 10 Cycles Specimen #1	12' (0.2º)	5º	0º	452	90º	429	Pass
MILNOR 10 Cycles Specimen #2	12' (0.2º)	5º	0º	434	90º	408	Pass
MILNOR 30 Cycles Specimen #1	12' (0.2º)	5º	0º	251	90º	249	Pass
MILNOR 30 Cycles Specimen #2	12' (0.2º)	5º	0º	252	90º	243	Pass
MILNOR 50 Cycles Specimen #1	12' (0.2º)	5º	0º	216	90º	209	Pass
MILNOR 50 Cycles Specimen #2	12' (0.2º)	5º	0º	175	90º	168	Pass
XEROS 10 Cycles Specimen #1	12' (0.2º)	5º	0º	479	90º	454	Pass
XEROS 10 Cycles Specimen #2	12' (0.2º)	5º	0º	502	90º	477	Pass
XEROS 30 Cycles Specimen #1	12' (0.2º)	5º	0º	417	90º	401	Pass
XEROS 30 Cycles Specimen #2	12' (0.2º)	5º	0º	401	90º	381	Pass
XEROS 50 Cycles Specimen #1	12' (0.2º)	5º	0º	355	90º	345	Pass
XEROS 50 Cycles Specimen #2	12' (0.2º)	5º	0º	334	90º	329	Pass

Model	3 Inch Perforated Diamond Triple Trim						
Sample Number	Observation Angle	Entrance Angle	Rotation angle	Measured CIL/m² (cd/lux*m²)	Rotation angle	Measured CIL/m² (cd/lux*m²)	>100 P/F
Pristine Specimen #1	12' (0.2º)	5º	0º	357	90º	356	Pass
Pristine Specimen #2	12' (0.2º)	5º	0º	361	90º	346	Pass
Pristine Specimen #3	12' (0.2º)	5º	0º	329	90º	328	Pass
Pristine Specimen #4	12' (0.2º)	5º	0º	336	90º	332	Pass
MILNOR 10 Cycles Specimen #1	12' (0.2º)	5º	0º	290	90º	300	Pass
MILNOR 10 Cycles Specimen #2	12' (0.2º)	5º	0º	252	90º	245	Pass
MILNOR 30 Cycles Specimen #1	12' (0.2º)	5º	0º	155	90º	149	Pass
MILNOR 30 Cycles Specimen #2	12' (0.2º)	5º	0º	146	90º	118	Pass
MILNOR 50 Cycles Specimen #1	12' (0.2º)	5º	0º	98	90º	96	Fail
MILNOR 50 Cycles Specimen #2	12' (0.2º)	5º	0º	97	90º	92	Fail
XEROS 10 Cycles Specimen #1	12' (0.2º)	5º	0º	365	90º	361	Pass
XEROS 10 Cycles Specimen #2	12' (0.2º)	5º	0º	370	90º	368	Pass
XEROS 30 Cycles Specimen #1	12' (0.2º)	5º	0º	344	90º	344	Pass
XEROS 30 Cycles Specimen #2	12' (0.2º)	5º	0º	325	90º	317	Pass
XEROS 50 Cycles Specimen #1	12' (0.2º)	5º	0º	323	90º	316	Pass
XEROS 50 Cycles Specimen #2	12' (0.2º)	5º	0º	304	90º	274	Pass

RAINFALL SAMPLES

Rainfall Rate - Measured	274.2mm/hr
Rainfall Angle - Measured	10°

Model	3 Inch Triple Trim Orange with Trim Trax						
Sample Number	Observation Angle	Entrance Angle	Rotation angle	Measured CIL/m^2 (cd/lux*m^2)	Rotation angle	Measured CIL/m^2 (cd/lux*m^2)	>100 P/F
Pristine Specimen #1	12' (0.2º)	5º	0º	361	90º	295	Pass
Pristine Specimen #2	12' (0.2º)	5º	0º	325	90º	317	Pass
Pristine Specimen #3	12' (0.2º)	5º	0º	326	90º	307	Pass
Pristine Specimen #4	12' (0.2º)	5º	0º	325	90º	296	Pass
MILNOR 10 Cycles Specimen #1	12' (0.2º)	5º	0º	236	90º	259	Pass
MILNOR 10 Cycles Specimen #2	12' (0.2º)	5º	0º	229	90º	271	Pass
MILNOR 30 Cycles Specimen #1	12' (0.2º)	5º	0º	132	90º	123	Pass
MILNOR 30 Cycles Specimen #2	12' (0.2º)	5º	0º	143	90º	113	Pass
MILNOR 50 Cycles Specimen #1	12' (0.2º)	5º	0º	105	90º	110	Pass
MILNOR 50 Cycles Specimen #2	12' (0.2º)	5º	0º	104	90º	94	Pass
XEROS 10 Cycles Specimen #1	12' (0.2º)	5º	0º	246	90º	253	Pass
XEROS 10 Cycles Specimen #2	12' (0.2º)	5º	0º	261	90º	274	Pass
XEROS 30 Cycles Specimen #1	12' (0.2º)	5º	0º	263	90º	254	Pass
XEROS 30 Cycles Specimen #2	12' (0.2º)	5º	0º	233	90º	261	Pass
XEROS 50 Cycles Specimen #1	12' (0.2º)	5º	0º	199	90º	212	Pass
XEROS 50 Cycles Specimen #2	12' (0.2º)	5º	0º	194	90º	211	Pass

Model	3 Inch Perforated Diamond Triple Trim						
Sample Number	Observation Angle	Entrance Angle	Rotation angle	Measured CIL/m^2 (cd/lux*m^2)	Rotation angle	Measured CIL/m^2 (cd/lux*m^2)	>100 P/F
Pristine Specimen #1	12' (0.2º)	5º	0º	220	90º	235	Pass
Pristine Specimen #2	12' (0.2º)	5º	0º	202	90º	211	Pass
Pristine Specimen #3	12' (0.2º)	5º	0º	190	90º	197	Pass
Pristine Specimen #4	12' (0.2º)	5º	0º	215	90º	210	Pass
MILNOR 10 Cycles Specimen #1	12' (0.2º)	5º	0º	183	90º	178	Pass
MILNOR 10 Cycles Specimen #2	12' (0.2º)	5º	0º	167	90º	160	Pass
MILNOR 30 Cycles Specimen #1	12' (0.2º)	5º	0º	104	90º	98	Pass
MILNOR 30 Cycles Specimen #2	12' (0.2º)	5º	0º	101	90º	88	Pass
MILNOR 50 Cycles Specimen #1	12' (0.2º)	5º	0º	77	90º	69	Fail
MILNOR 50 Cycles Specimen #2	12' (0.2º)	5º	0º	80	90º	69	Fail
XEROS 10 Cycles Specimen #1	12' (0.2º)	5º	0º	233	90º	240	Pass
XEROS 10 Cycles Specimen #2	12' (0.2º)	5º	0º	239	90º	244	Pass
XEROS 30 Cycles Specimen #1	12' (0.2º)	5º	0º	219	90º	224	Pass
XEROS 30 Cycles Specimen #2	12' (0.2º)	5º	0º	205	90º	210	Pass
XEROS 50 Cycles Specimen #1	12' (0.2º)	5º	0º	218	90º	209	Pass
XEROS 50 Cycles Specimen #2	12' (0.2º)	5º	0º	196	90º	180	Pass

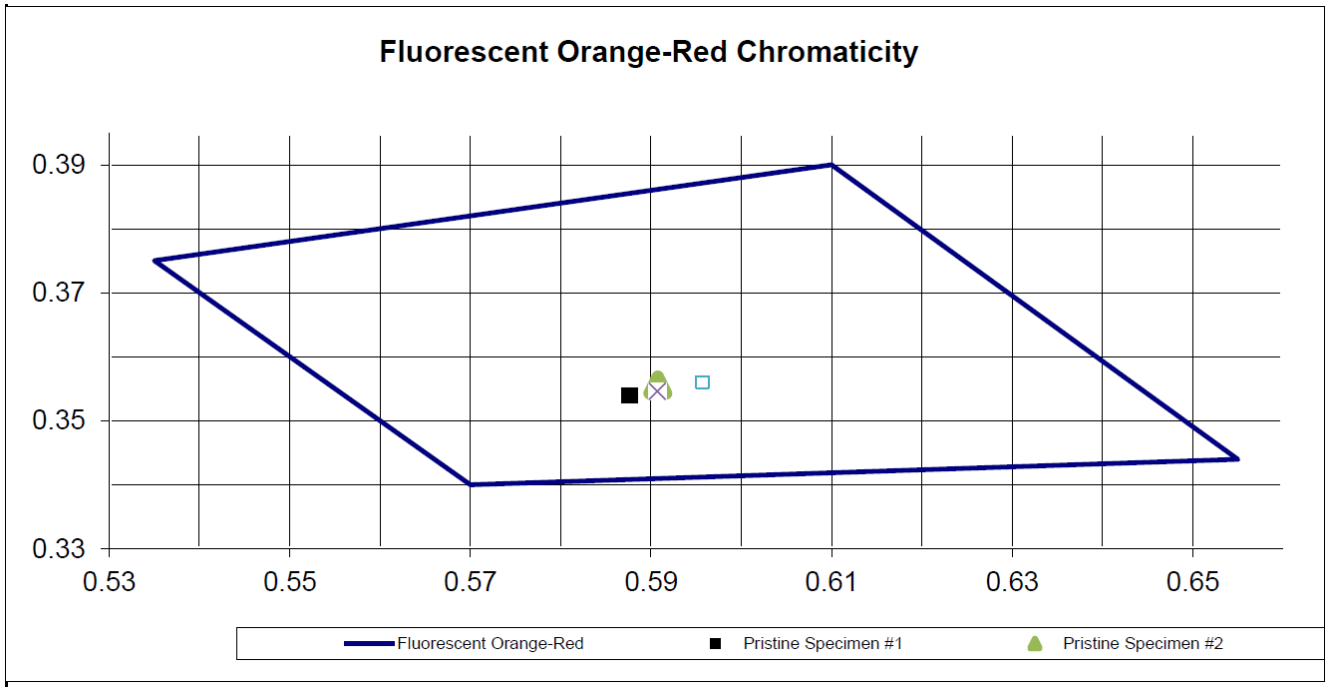
SECTION 7.2.3
RETROREFLECTIVITY AND FLUORESCENCE TEST

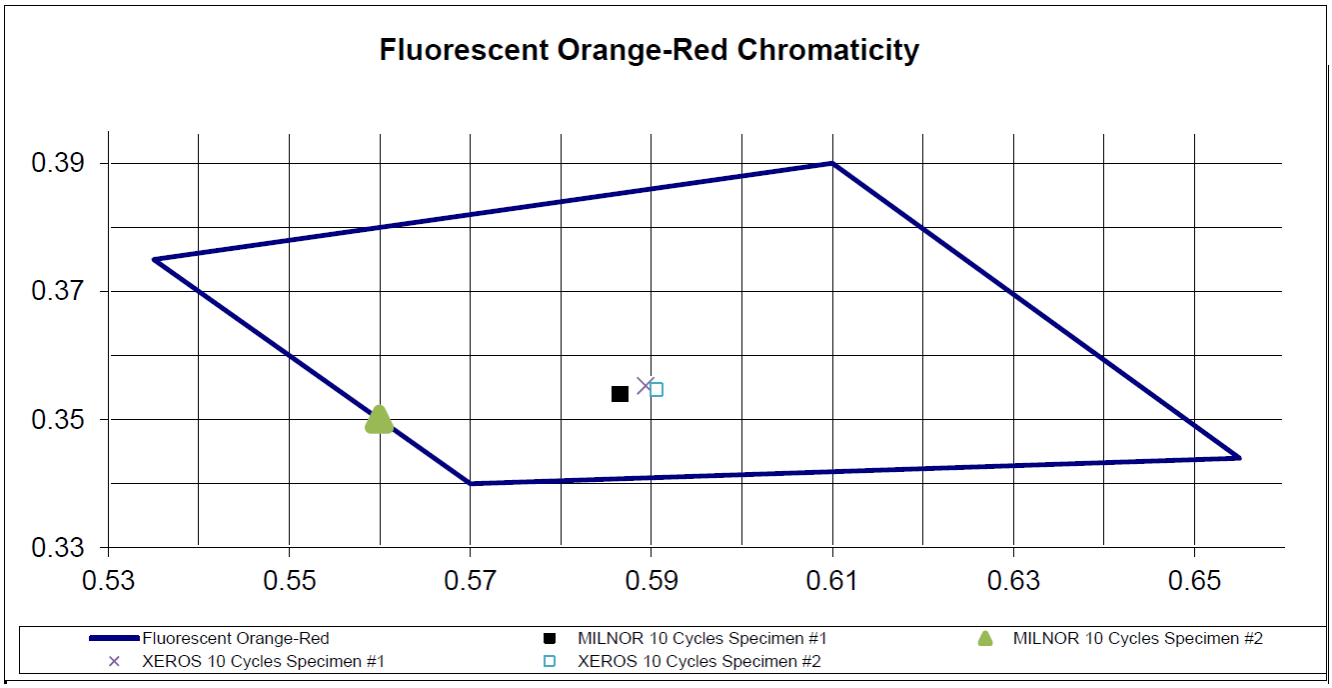
TEST METHOD: In accordance with Section 7.2.3 and Section 8.45

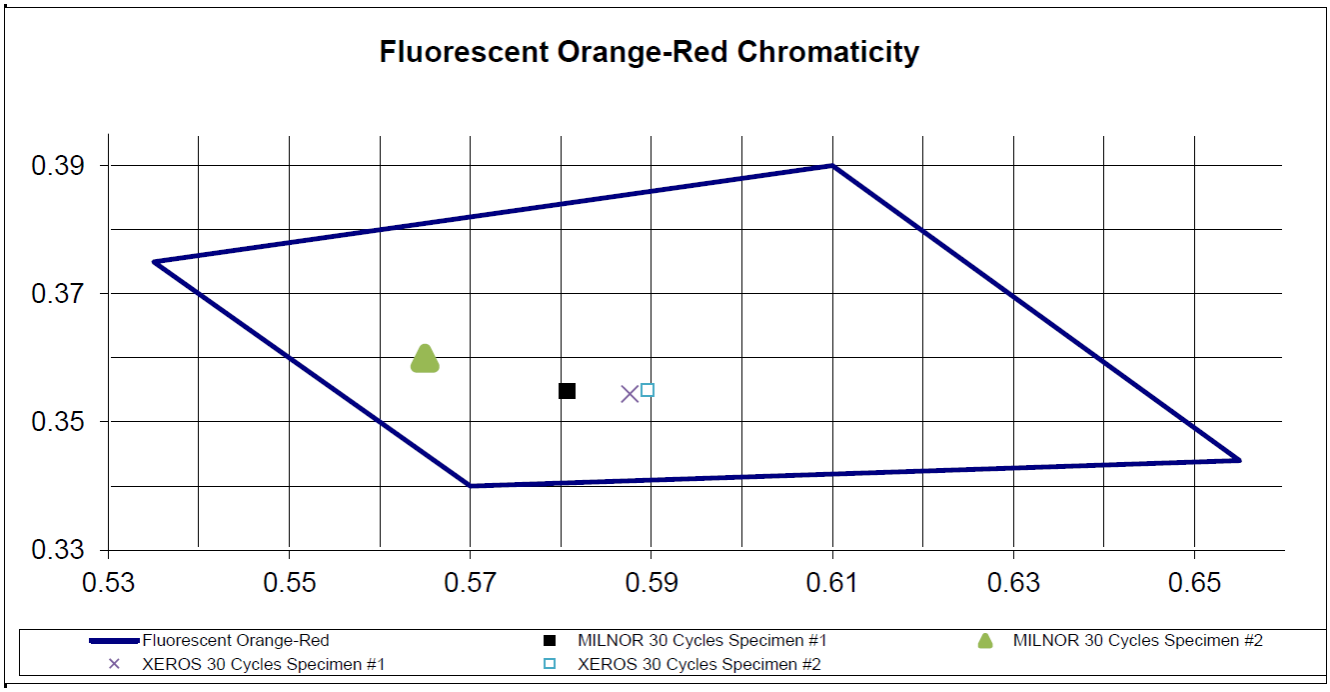
COLOR PERFORMANCE – 3 INCH TRIPLE TRIM ORANGE WITH TRIM TRAX

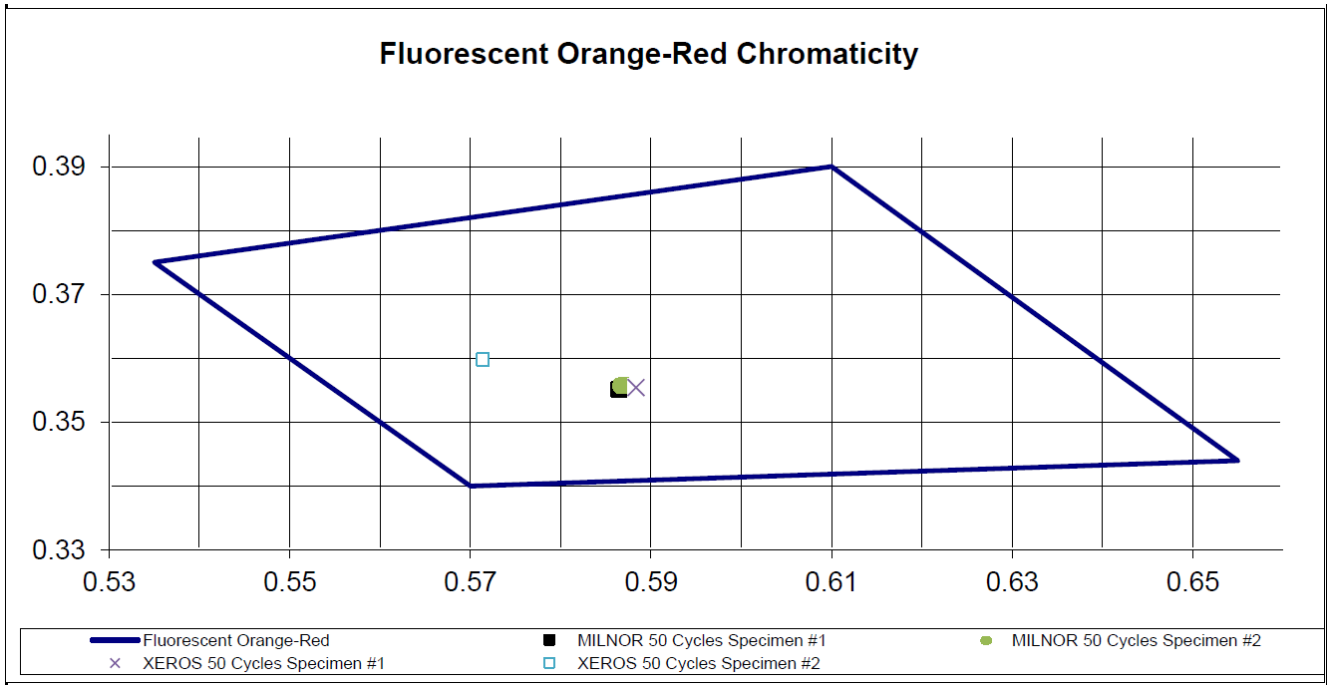
Sample ID	x	y	L (Y) > 40	Complies Y/N
Pristine Specimen #1	0.588	0.354	60.4	Yes
Pristine Specimen #2	0.591	0.356	61.8	Yes
Pristine Specimen #3	0.591	0.355	56.4	Yes
Pristine Specimen #4	0.596	0.356	63.2	Yes
MILNOR 10 Cycles Specimen #1	0.587	0.354	46.5	Yes
MILNOR 10 Cycles Specimen #2	0.560	0.350	41.2	Yes
MILNOR 30 Cycles Specimen #1	0.581	0.355	45.9	Yes
MILNOR 30 Cycles Specimen #2	0.565	0.360	41.7	Yes
MILNOR 50 Cycles Specimen #1	0.586	0.355	41.0	Yes
MILNOR 50 Cycles Specimen #2	0.586	0.356	46.4	Yes
XEROS 10 Cycles Specimen #1	0.589	0.355	50.1	Yes
XEROS 10 Cycles Specimen #2	0.591	0.355	54.5	Yes
XEROS 30 Cycles Specimen #1	0.588	0.354	49.4	Yes
XEROS 30 Cycles Specimen #2	0.590	0.355	54.7	Yes
XEROS 50 Cycles Specimen #1	0.588	0.355	50.1	Yes
XEROS 50 Cycles Specimen #2	0.571	0.360	48.0	Yes

Chromaticity Coordinates	
x	y
0.610	0.390
0.535	0.375
0.570	0.340
0.655	0.344
0.610	0.390


Fluorescent Orange-Red Chromaticity
0.39
0.37
0.35
0.33
0.53
0.55
0.57
0.59
0.61
0.63
0.65
Fluorescent Orange-Red
Pristine Specimen #1
Pristine Specimen #2


Fluorescent Orange-Red Chromaticity
0.39
0.37
0.35
0.33
0.53
0.55
0.57
0.59
0.61
0.63
0.65
Fluorescent Orange-Red
MILNOR 10 Cycles Specimen #1
MILNOR 10 Cycles Specimen #2
XEROS 10 Cycles Specimen #1
XEROS 10 Cycles Specimen #2


Fluorescent Orange-Red Chromaticity
0.39
0.37
0.35
0.33
0.53
0.55
0.57
0.59
0.61
0.63
0.65
Fluorescent Orange-Red
MILNOR 30 Cycles Specimen #1
MILNOR 30 Cycles Specimen #2
XEROS 30 Cycles Specimen #1
XEROS 30 Cycles Specimen #2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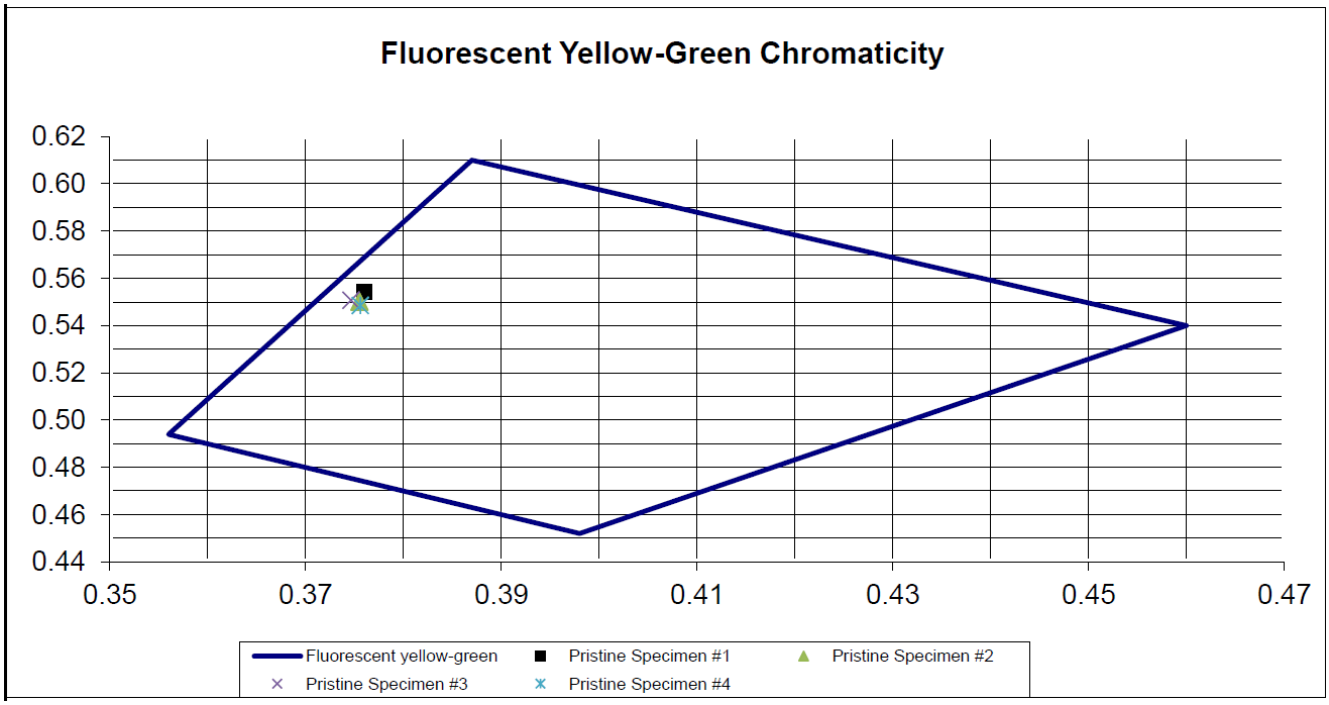
0.39
0.37
0.35
0.33
0.53
0.55
0.57
0.59
0.61
0.63
0.65
Fluorescent Orange-Red
MILNOR 50 Cycles Specimen #1
MILNOR 50 Cycles Specimen #2
XEROS 50 Cycles Specimen #1
XEROS 50 Cycles Specimen #2

COLOR PERFORMANCE – 3 INCH PERFORATED DIAMOND TRIPLE TRIM

Sample ID	x	y	L (Y) > 70	Complies Y/N
Pristine Specimen #1	0.376	0.554	94.2	Yes
Pristine Specimen #2	0.376	0.550	95.8	Yes
Pristine Specimen #3	0.375	0.551	92.1	Yes
Pristine Specimen #4	0.376	0.549	93.9	Yes
MILNOR 10 Cycles Specimen #1	0.374	0.549	91.9	Yes
MILNOR 10 Cycles Specimen #2	0.375	0.549	89.7	Yes
MILNOR 30 Cycles Specimen #1	0.375	0.551	90.0	Yes
MILNOR 30 Cycles Specimen #2	0.375	0.545	86.2	Yes
MILNOR 50 Cycles Specimen #1	0.374	0.544	86.5	Yes
MILNOR 50 Cycles Specimen #2	0.372	0.541	86.1	Yes
XEROS 10 Cycles Specimen #1	0.375	0.547	92.1	Yes
XEROS 10 Cycles Specimen #2	0.376	0.553	92.5	Yes
XEROS 30 Cycles Specimen #1	0.376	0.550	91.4	Yes
XEROS 30 Cycles Specimen #2	0.375	0.549	92.2	Yes
XEROS 50 Cycles Specimen #1	0.374	0.542	91.7	Yes
XEROS 50 Cycles Specimen #2	0.374	0.542	91.1	Yes

Chromaticity Coordinates	
x	y
0.387	0.610
0.356	0.494
0.398	0.452
0.460	0.540
0.387	0.610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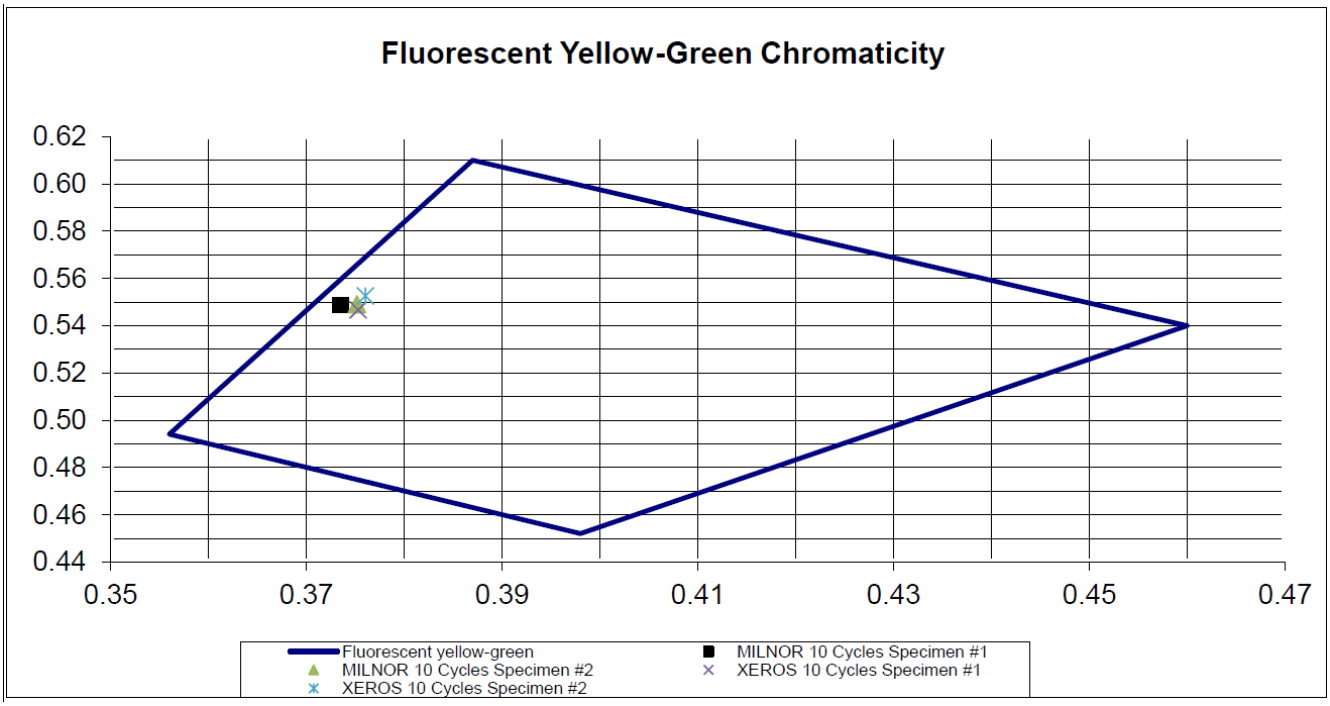
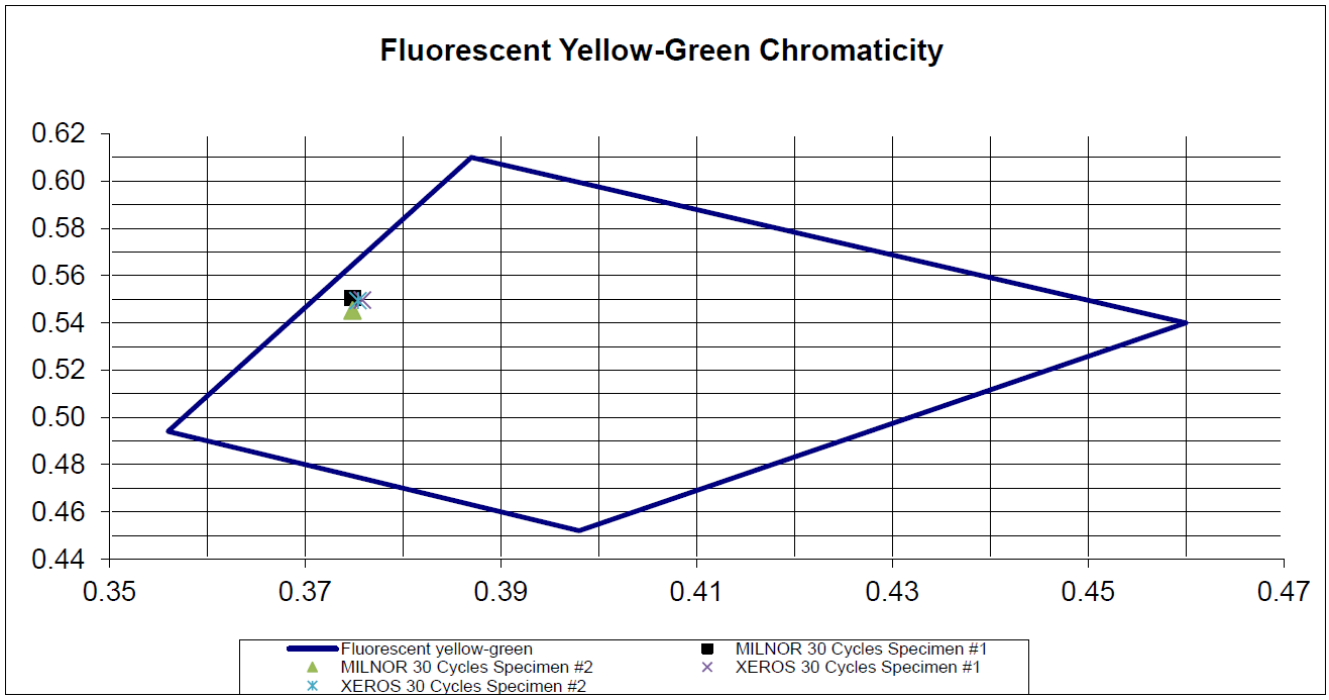
0.60
0.58
0.56
0.54
0.52
0.50
0.48
0.46
0.44
0.35
0.37
0.39
0.41
0.43
0.45
0.47
Fluorescent yellow-green
Pristine Specimen #1
Pristine Specimen #2
Pristine Specimen #3
Pristine Specimen #4


Fluorescent Yellow-Green Chromaticity
0.62
0.60
0.58
0.56
0.54
0.52
0.50
0.48
0.46
0.44
0.35
0.37
0.39
0.41
0.43
0.45
0.47
Fluorescent yellow-green
MILNOR 10 Cycles Specimen #1
MILNOR 10 Cycles Specimen #2
XEROS 10 Cycles Specimen #1
XEROS 10 Cycles Specimen #2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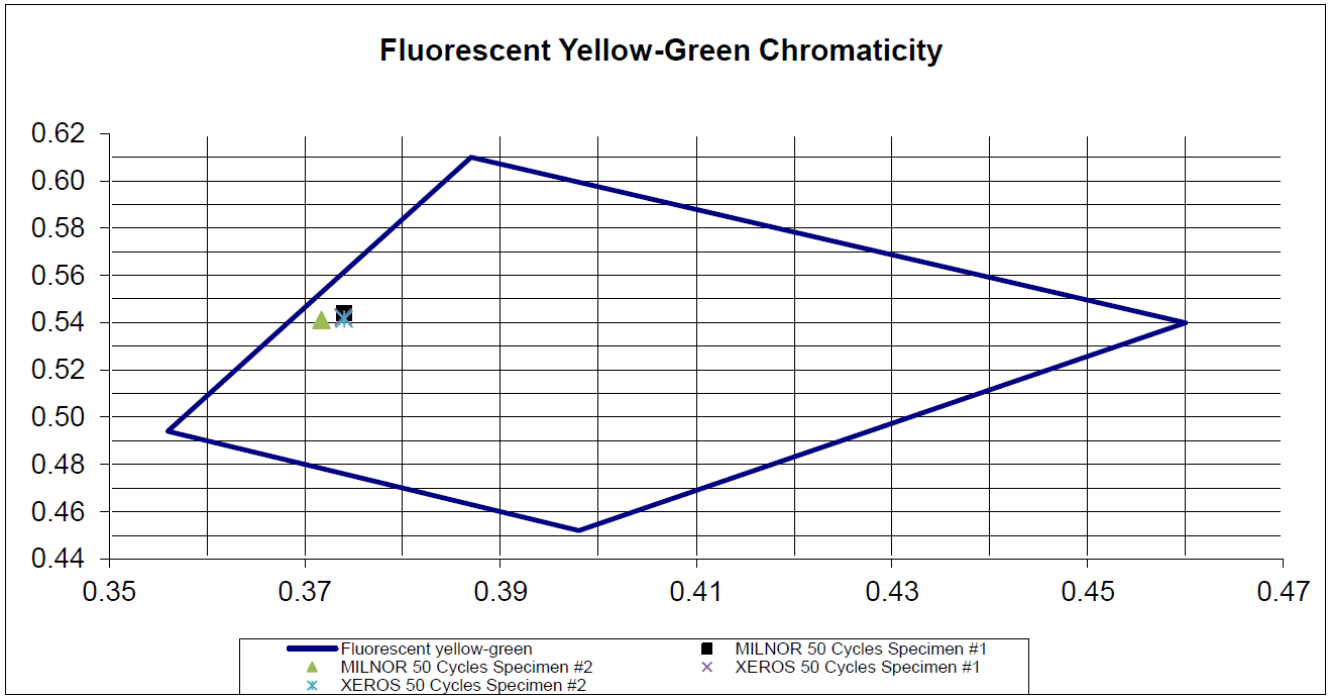
0.58
0.56
0.54
0.52
0.50
0.48
0.46
0.44
0.35
0.37
0.39
0.41
0.43
0.45
0.47
Fluorescent yellow-green
MILNOR 30 Cycles Specimen #1
MILNOR 30 Cycles Specimen #2
XEROS 30 Cycles Specimen #1
XEROS 30 Cycles Specimen #2


Fluorescent Yellow-Green Chromaticity
0.62
0.60
0.58
0.56
0.54
0.52
0.50
0.48
0.46
0.44
0.35
0.37
0.39
0.41
0.43
0.45
0.47
Fluorescent yellow-green
MILNOR 50 Cycles Specimen #1
MILNOR 50 Cycles Specimen #2
XEROS 50 Cycles Specimen #1
XEROS 50 Cycles Specimen #2

SECTION 4
PHOTOGRAPHS

3 INCH TRIPLE TRIM ORANGE WITH TRIM TRAX LAUNDERED SWATCHES
TOP: XEROS OUTERSHELL LAUNDERING 10 CYCLES, 30 CYCLES, 50 CYCLES
BOTTOM: MILNOR OUTERSHELL LAUNDERING 10 CYCLES, 30 CYCLES, 50 CYCLES
LEFT: PRISTINE

3 INCH PERFORATED DIAMOND TRIPLE TRIM LAUNDERED SWATCHES
TOP: XEROS OUTERSHELL LAUNDERING 10 CYCLES, 30 CYCLES, 50 CYCLES
BOTTOM: MILNOR OUTERSHELL LAUNDERING 10 CYCLES, 30 CYCLES, 50 CYCLES
LEFT: PRISTINE