REPORT
3933 US ROUTE 11 CORTLAND, NEW YORK 13045

Order No. G100147381 Date: September 8, 2010

REPORT NO. 100147381CRT-001

TEST OF SMF/PAPI SYSTEM

RENDERED TO

ARGOS INGEGNERIA SpA
VIA TIBURTINA, 1166
00156 ROME - ITALY

INTRODUCTION

This report contains the results of functional and environmental tests of the above device as requested by the client.

AUTHORIZATION

The testing performed was authorized by signed quote number 500237002.

MATERIAL SUBMITTED

The client submitted one SMF/PAPI system sample. The sample control number is 2010 - 07 - 210577.

MANUFACTURER

ARGOS INGEGNERIA SpA
VIA TIBURTINA, 1166
00156 ROME - ITALY

CONDITION OF SAMPLE: The sample was received by Intertek on July 7, 2010 in undamaged condition, and tested as received.

DATES OF TESTS

July 20, 2010 through September 2, 2010

DESCRIPTION OF DEVICE

SMF/PAPI P/N: PAA 0101
SMF/PAPI S/N: AA 00012
Calibration ID: 40-CCAP-1009-18-10

The SMF/PAPI instrument performs the measurement of the color transition elevation angle of a PAPI LHA; capabilities include the test of CIE chromaticity, the beam intensity and diagnostic tools for the correct focusing and alignment of the PAPI optics and mechanics.

The SMF/PAPI measurement instrument is based on the basic principle of external observation of the PAPI beam. All the components affecting the real elevation of the beam are taken into consideration in the measurement. The measurement is achieved through digital image analysis, by the instrument focusing on the red filters placed inside a conventional PAPI unit. This feature permits the diagnosis of the correct alignment of the PAPI unit optics (reflector and light bulb, red filter, output lens system) when the unit is operative at nominal brilliance and temperature. This allows the optics of the PAPI LHA to be re-aligned and re-focused in the field watching the SMF/PAPI video images. Other additional diagnostic capabilities of the SMF/PAPI include the analysis of light bulb status, the reflector cleanliness, and the transversal tilt of the filters and/or the units.

The unit is hand portable and powered by 12 VDC from a system of rechargeable batteries or through a 110/220 VAC external adapter.

(see picture pages attached to this report.)

EQUIPMENT LIST

Equipment Description	Model Number	Control Number	Calibration Due Date
Optronik Goniophotometer	SMS-10h	O109	10/14/10
Tape Measure	33-428	U011	7/6/11
Cole Parmer Thermometer	---	N858	10/27/10
Starrett Level	---	N1029	1/26/11
Optronics Laboratories Spectral Radiometer	750D	E288	Before use
Thermotron Environmental Chamber	---	S002	10/16/10
Pearson CT	411	A203	11/11/10
Fluke Multimeter	87V	E262	6/1/11
Fisher Scientific Stopwatch	---	N1131	12/31/10

TEST, TEST METHODS AND RESULTS OF TESTS

General Test Description

All of the test procedures were taken from the manufacturer's document SMF/PAPI - LAB-TEST PROCEDURES ID ARG/DT/AC-188-10 REV.1.0. The client trained the Intertek personnel to use the SMF/PAPI system for the measurements during a 1 day meeting.

Test ID	Description
TEST #1	Accuracy test using reference lab
TEST #2	Precision test from a steady position of the instrument
TEST #3	Precision test changing the position of the instrument
TEST #4	Color measurement test
TEST #5	Output light intensity test
High temperature	Operation at 35˚C
Low temperature	Operation at -10˚C

The precision approach path indicator (PAPI) light housing assembly (LHA) used for all of the testing was the New Bedford Panoramex (DTFA01-93-Y-01022) with 3 200W Osram 64382 pk30d lamps installed. The PAPI LHA had been in service at an airport. The PAPI was operated at 6.6A for all testing. The focus of the PAPI was adjusted based on the information provided by the SMF/PAPI system.

TEST, TEST METHODS AND RESULTS OF TESTS

TEST #1 PROCEDURE – Accuracy/Correlation

The SMF/PAPI instrument was positioned relative to the PAPI unit under examination according to the user manual at a distance of 11.14 meters in a centered position. The PAPI LHA was operated at 6.6A. The elevation test measurement procedure was executed according to the instructions contained in the Operating Manual of the instrument and the result recorded. This was repeated 10 times and the mean value and the standard deviation of the collected elevation angle data were evaluated by means of common statistical methods. The result was compared to the measurement made by the goniophotometer. The difference between the mean of SMF/PAPI measurements and the goniophotometer measurement was used to determine the correlation of the instrument with the accredited laboratory. During the execution of the 10 measurements, the SMF/PAPI tripod was not moved from its initial position. The instrument was misaligned using the vertical rotation and vertical shift motorizations between each of the measurements. The accuracy of the measurement of the instrument subject to approval must be better or equal to the one listed on page 11.

The measurement of the elevation angle with the goniophotometer was done by aligning the center of the transition with the photometric axis of the goniophotometer. This provided the zero reference for the measurement.

Results

See the Signed Instrument Test Report attached to this report.

Measurement Description	**Elevation Angle**
Optronik SMS 10h reference measurement	3˚19'12"
Average of 10 SMF/PAPI measurements	3˚19'45"
Standard Deviation of 10 SMF/PAPI measurements	0˚00'13"
Correlation	0˚00'33"

TEST, TEST METHODS AND RESULTS OF TESTS

TEST #2 PROCEDURE – Precision (stable tripod position)

The SMF/PAPI instrument was positioned relative to the PAPI unit under examination according to the user manual at a distance of 11.14 meters in a centered position. The PAPI LHA was operated at 6.6A. The elevation test measurement procedure was executed according to the instructions contained in the Operating Manual of the instrument and the result recorded. This was repeated 10 times and the mean value and the standard deviation of the collected elevation angle data were evaluated by means of common statistical methods. During the execution of the 10 measurements, the SMF/PAPI tripod was not moved from its initial position. The instrument was misaligned using the vertical rotation and vertical shift motorizations between each of the measurements. The precision of the instrument subject to approval must be better or equal to the one listed on page 11.

Results

See the Signed Instrument Test Report attached to this report.

Measurement Description	**Elevation Angle**
Optronik SMS 10h reference measurement	3˚19'12"
Average of 10 SMF/PAPI measurements	3˚19'45"
Standard Deviation of 10 SMF/PAPI measurements	0˚00'13"

TEST, TEST METHODS AND RESULTS OF TESTS

TEST #3 PROCEDURE - Precision (variable tripod position)

The SMF/PAPI measurement instrument was positioned relative to the PAPI unit under examination according to the user manual, at a distance of 11.14 meters in a centered position. The PAPI LHA was operated at 6.6A. The elevation test measurement procedure was performed according to the instructions contained in the Operating Manual of the instrument and the result recorded. This procedure was repeated 10 times after displacing the instrument tripod with respect to its previous position, in multiple directions maintaining the positioning within the limits established by the above mentioned Manual. The average measured value and the standard deviation of the elevation angle was calculated by means of common statistical methods. The measured precision of the instrument subject to approval must be better or equal to the one specified on page 11. The time between each measurement was also recorded.

Results

See the Signed Instrument Test Report attached to this report.

Measurement Description	Measured Value
Optronik SMS 10h reference measurement	2˚58'48"
Average of 10 SMF/PAPI measurements	2˚59'54"
Standard Deviation of 10 SMF/PAPI measurements	0˚00'43"
Average time between each measurement	4 minutes

TEST, TEST METHODS AND RESULTS OF TESTS

TEST #4 PROCEDURE – Color Measurement Test

The SMF/PAPI measurement instrument was placed in the position relative to the PAPI unit under examination according to the indications in the user manual. Distance between the PAPI unit output lens and the SMF/PAPI tripod center was 11 m. The SMF/PAPI instrument was centered with respect to the PAPI beams. The PAPI LHA was operated at 6.6A and allowed to stabilize. The measurement procedure was performed according to the Operating Manual of the instrument (Chromaticity/Intensity Test) and the data was recorded. The test was repeated 10 times. The average measured value and the standard deviation of the chromaticity coordinates was calculated by means of common statistical methods.
The results were compared with the measurement carried out by the reference laboratory instrument. The difference between the mean of the SMF/PAPI measurements and the reference instrument measurement determined the correlation of the instrument with the accredited laboratory. During the execution of the 10 measurements, the SMF/PAPI tripod was not moved from its initial position. The instrument was misaligned using the vertical rotation motorizations between measurements. The measured correlation of the instrument subject to approval must be better or equal to the one specified in the page 11.

The PAPI LHA fixture was tested with the lamps, filters and optical system for color of light emitted. The Intertek reference chromaticity coordinates were calculated from a spectral distribution measured in 5nm increments.

Results

See the Signed Instrument Test Report attached to this report.

Measurement Description	Color	Angular position	Chromaticity coordinates		
			x	y	z
Intertek reference measurement	white	0H, 1.1U	0.4446	0.4120	0.1434
Intertek reference measurement	red	0H, 1.2D	0.6709	0.3288	0.0002
SMF/PAPI measurement average	white	0H, 1.1U	0.45	0.40	---
SMF/PAPI measurement average	red	0H, 1.2D	0.66	0.34	---
correlation	white	0H, 1.1U	0.01	0.01	---
correlation	red	0H, 1.2D	0.01	0.01	---

TEST, TEST METHODS AND RESULTS OF TESTS

TEST #5 PROCEDURE – Intensity Measurement Test

The SMF/PAPI measurement instrument was placed in the position relative to the PAPI unit under examination according to the indications in the user manual. Distance between the PAPI unit output lens and the SMF/PAPI tripod center was 11 m. The SMF/PAPI instrument was centered with respect to the PAPI beams. The PAPI LHA was operated at 6.6A and allowed to stabilize. The measurement procedure was performed according to the Operating Manual of the instrument (Chromaticity/Intensity Test) and the data was recorded. The test was repeated 10 times. The average measured value and the standard deviation of the intensity was calculated by means of common statistical methods.
The results were compared with the measurement carried out by the reference laboratory instrument. The difference between the mean of the SMF/PAPI measurements and the reference instrument measurement determined the correlation of the instrument with the accredited laboratory. During the execution of the 10 measurements, the SMF/PAPI tripod was not moved from its initial position. The instrument was misaligned using the vertical rotation motorizations between measurements. The measured correlation of the instrument subject to approval must be better or equal to the one specified in the page 11.

The PAPI LHA fixture was energized and tested in accordance with the photometric requirements found in FAA AC 150/5345-28F. Photometric axes were established with the horizontal axis passing through the center of the fixture and parallel to the runway centerline and the vertical axis running through the center of the fixture and perpendicular to the ground plane. The fixture was operated until stabilized before taking measurements. The test distance was 25m.

Results

See the Signed Instrument Test Report attached to this report.

Measurement Description	**Measured Value**
Measurement position (white)	0H, 1.1 up
Measurement position (red)	0H, 1.2 down
Optronik SMS 10h reference measurement average (white)	31700 cd
Optronik SMS 10h reference measurement average (red)	8600 cd
Average of 10 SMF/PAPI measurements (white)	34359 cd
Average of 10 SMF/PAPI measurements (red)	9326 cd
Standard Deviation of 10 SMF/PAPI measurements (white)	302 cd
Standard Deviation of 10 SMF/PAPI measurements (red)	64 cd
Correlation (white)	8.3%
Correlation (red)	8.4%

TEST, TEST METHODS AND RESULTS OF TESTS

Photometric Distribution – PAPI

Test unit: NBP
Lamp: 3 X 200W Osram
Input: 6.6A
Test distance: 25m

All intensity measurements are in candela

Vertical Angles (deg)	Horizontal Angles (degrees)										
	-10	-8	-6	-4	-2	0	2	4	6	8	10
4	142	1146	3710	8277	12282	14230	11398	7482	3725	1147	348
3.6	182	1329	4262	9531	14196	16850	13431	8427	4188	1302	403
3.2	229	1510	5171	10669	16835	19035	15649	9396	4408	1458	461
2.8	273	1698	5806	11798	19017	21435	17817	10342	4895	1623	518
2.4	314	1876	6413	12883	21043	24125	20008	11435	5380	1804	584
2	355	2071	7001	14073	23132	26679	22118	12682	5843	1986	658
1.6	393	2234	7013	15371	25308	29113	24299	13989	6334	2176	732
1.2	419	2418	7489	16519	27176	31217	26202	15174	6783	2355	462
0.8	446	2590	7915	17392	28641	33010	27882	16330	7282	2847	501
0.4	515	2782	8330	18065	29550	34081	29111	17258	7736	3023	534
-0.4	177	1007	2537	5178	8167	9349	8176	5085	2467	915	260
-0.8	178	1041	2622	5197	8053	9103	8111	5217	2586	951	271
-1.2	178	1054	2673	5107	7614	8468	7738	5242	2694	996	343
-1.6	172	1063	2666	4873	7038	7654	7250	5138	2748	1011	351
-2	160	1056	2668	4701	6498	6899	6694	4976	2759	1008	350
-2.4	146	1025	2622	4472	5913	6099	6125	4817	2742	987	349
-2.8	133	987	2521	4257	5133	5257	5506	4621	2665	947	269
-3.2	120	934	2401	4014	4695	4462	4868	4415	2561	897	249
-3.6	103	873	2236	3723	4022	3737	4103	4114	2451	833	312
-4	85	802	2073	3420	3301	2959	3351	3759	2276	761	282

High Temperature Test

The SMF/PAPI unit installed on its tripod was placed in an environmental chamber, and brought to a temperature of 35°C and allowed to stabilize with the sample de-energized. After stabilization, the unit was exposed to a 4 hour soak at these conditions. While at ambient temperature, and the extreme temperature, the elevation angle test was conducted per the operations manual.

Results

The unit operated properly and no deterioration of materials or performance was observed.

Temperature	SMF/PAPI Elevation Angle	Clinometer Elevation Angle
ambient	1°54'44"	1°55'
35°C	1°55'17"	1°56'

Low Temperature Test

The SMF/PAPI unit installed on its tripod was placed in an environmental chamber, and brought to a temperature of -10°C and allowed to stabilize with the sample de-energized. After stabilization, the unit was exposed to a 4 hour soak at these conditions. While at ambient temperature, and the extreme temperature, the elevation angle test was conducted per the operations manual.

Results

The unit operated properly and no deterioration of materials or performance was observed.

Temperature	SMF/PAPI Elevation Angle	Clinometer Elevation Angle
ambient	1°43'14"	1°42'
-10°C	1°41'57"	1°42'

TEST, TEST METHODS AND RESULTS OF TESTS

TEST RESULTS SUMMARY

The Argos SMF/PAPI instrument determined the transition elevation angle in the range of 0° to 10° with the accuracy of 1' required by ICAO recommendations. The instrument measured the overall inclination of the output beam of a PAPI in degraded service condition, with simulated varied terrain under the tripod, using the built-in self-stabilising platform. The average time required for each measurement was 4 minutes.

The optics of the PAPI LHA under test were re-focused based on the information provided by the SMF/PAPI system.

The SMF/PAPI instrument demonstrated the determination of the transition elevation angle through external observation of the PAPI optical beam as with flight inspection methods.

The measured performance of the instrument was in compliance with the specifications provided by the Manufacturer.

Manufacturer's Specifications:

- Accuracy for color transition elevation angle: better than 1 arc-minute
- Precision: better than 1 arc-minute
- Accuracy for intensity tests: 10 %
- Accuracy for chromaticity: 0.03 on CIE x, y coordinates
- Diagnostic capabilities for optimal aligning and focusing the PAPI unit optics
- Operating temperature: -10℃ /+35℃ (Instrument s et to temperate climate)
- Capable of use on variable terrain
- Instrument tripod positioning done without special equipment

In Charge Of Tests:

Jeremy N. Downs, P.E.
Engineering Team Leader
Lighting Division

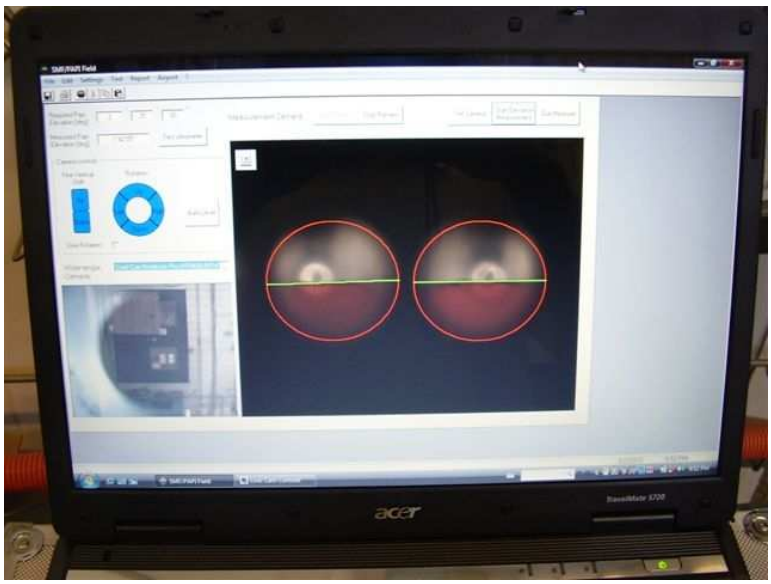
Report Reviewed By:

Christopher W. Metcalf
Project Engineer
Lighting Division

Attachment: Four picture pages
Signed Instrument Test Report (6 pages)

TEST OF SMF/PAPI SYSTEM

TESTED FOR ARGOS INGEGNERIA SpA



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