Argos Ingegneria S.p.A.

April 2009

Argos
ingegneria
C

Photometric Measurement System

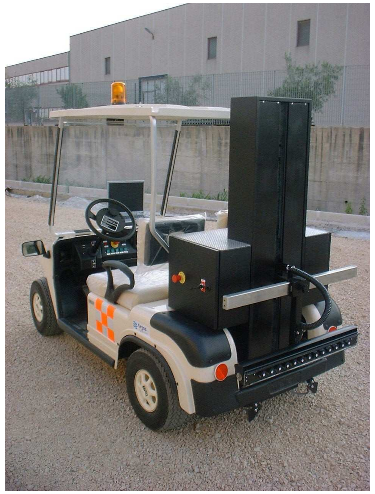
SMF products family for AGLS and PAPI

SMF products family

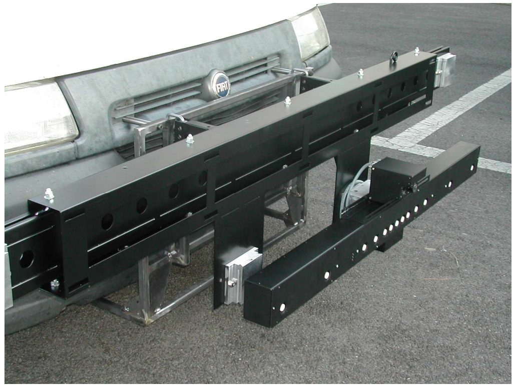
The purpose of the SMF family of systems is to measure accurately and efficiently , in field or in a lab environment , the photometric output of Airfield Ground Light System (AGLS) and compare this output with the ICAO (International Civil Aviation Organization) requirements and recommendations for photometric performance of the light fixtures.

The family also includes SMF/PAPI , the revolutionary system for fully automatic in field measurement of PAPI alignment.

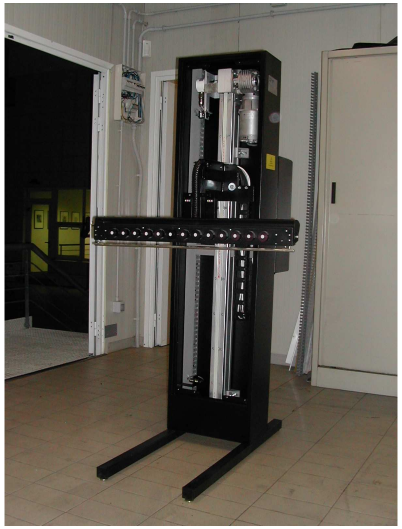
SMF
Photometric Measurement System



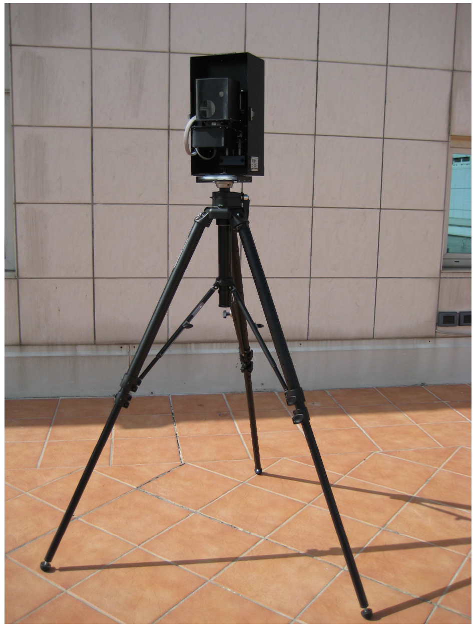
SMF/F



SMF/M



SMF/L



SMF/PAPI

SMF represents a family of photometric measurement systems for AGL equipments especially designed and developed by ARGOS INGEGNERIA Spa to operate both in the workshop of the airfield lights department and/or along runways and taxy.

SMF/L/M/F are able to compute the light beam intensity in candela, the elevation, azimuth and the isocandela diagram according to ICAO grid points requirements.

SMF/F is the field photometric system able to perform the stop and go measurement via a 13 sensors array which vertically scans the beam of the light under test to get the photometric values.

SMF/M is the mobile photometric system able to perform the measurement of the airfield lights while moving (no stop) along runways and taxiways.

SMF/L is the lab system and it is recommended for indoor operations of customers requiring a precise measurement of all inset and elevated fittings of AGL in order to certificate the performances of fixture before the installation in the airfield.

SMF/PAPI is the system especially designed to perform the fully automatic measurement of PAPI alignment parameters.

SMF/F

SMF/F – General description

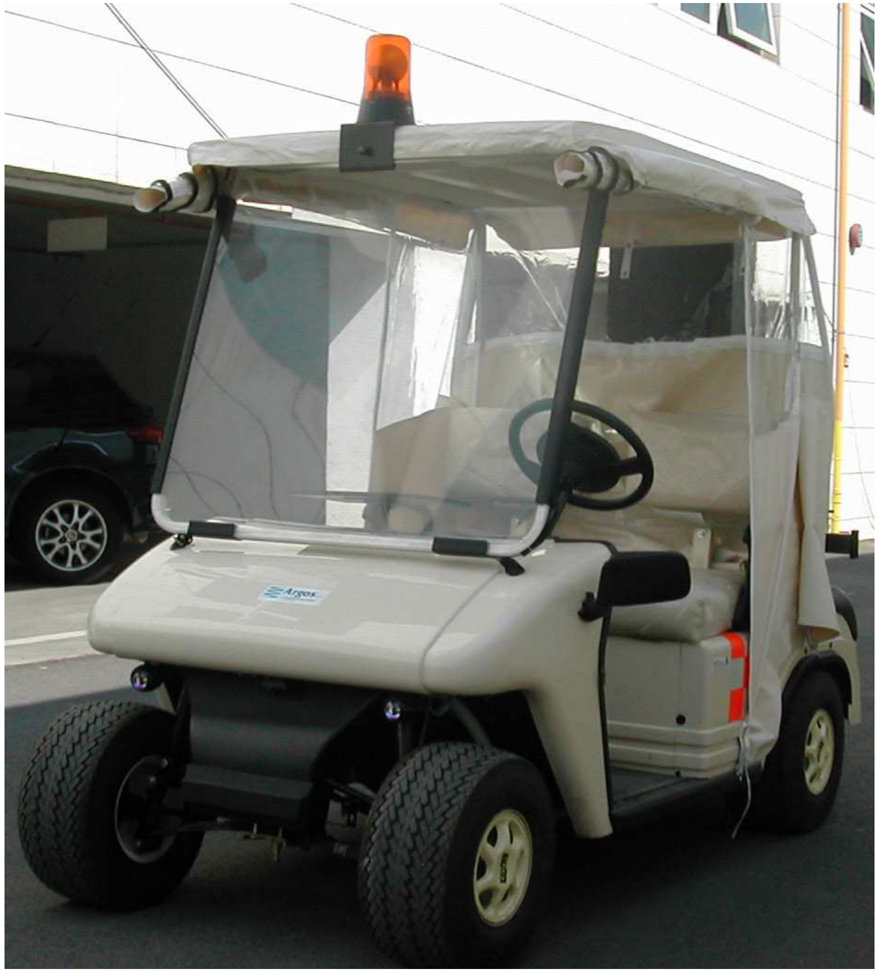
The SMF/F is a self moving testing equipment able to be positioned in front of AGL fixtures, included also vertical signs, in order to perform the measurement of photometric parameters according to ICAO specifications.

SMF/F consists of a golf cart equipped with a special frame integrating all the devices necessary to allow a full automatic operation for the photometric measurement. The SMF/F system software running on the on-board PC will assist and drive the operator during each step of the measurement procedure.

Before to start the measurement session the operator will select the section of AGLS he wants to measure as defined during the AGL configuration phase allowed by the system software.

Once driven the cart in the proper position the operator will enter the ID of lamp and type of test and start the measurement.

The results of measurement will be automatically inserted in the system data-base and displayed in the main system panel of application software.

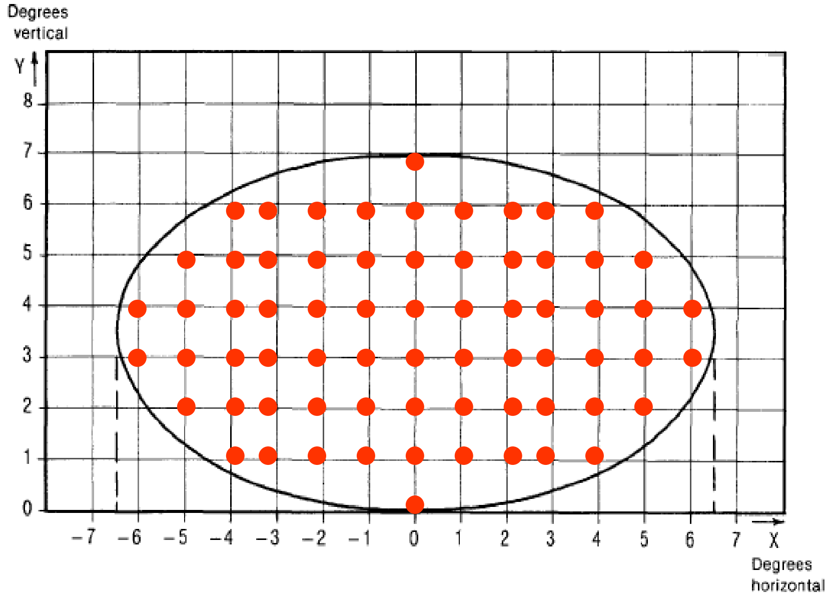


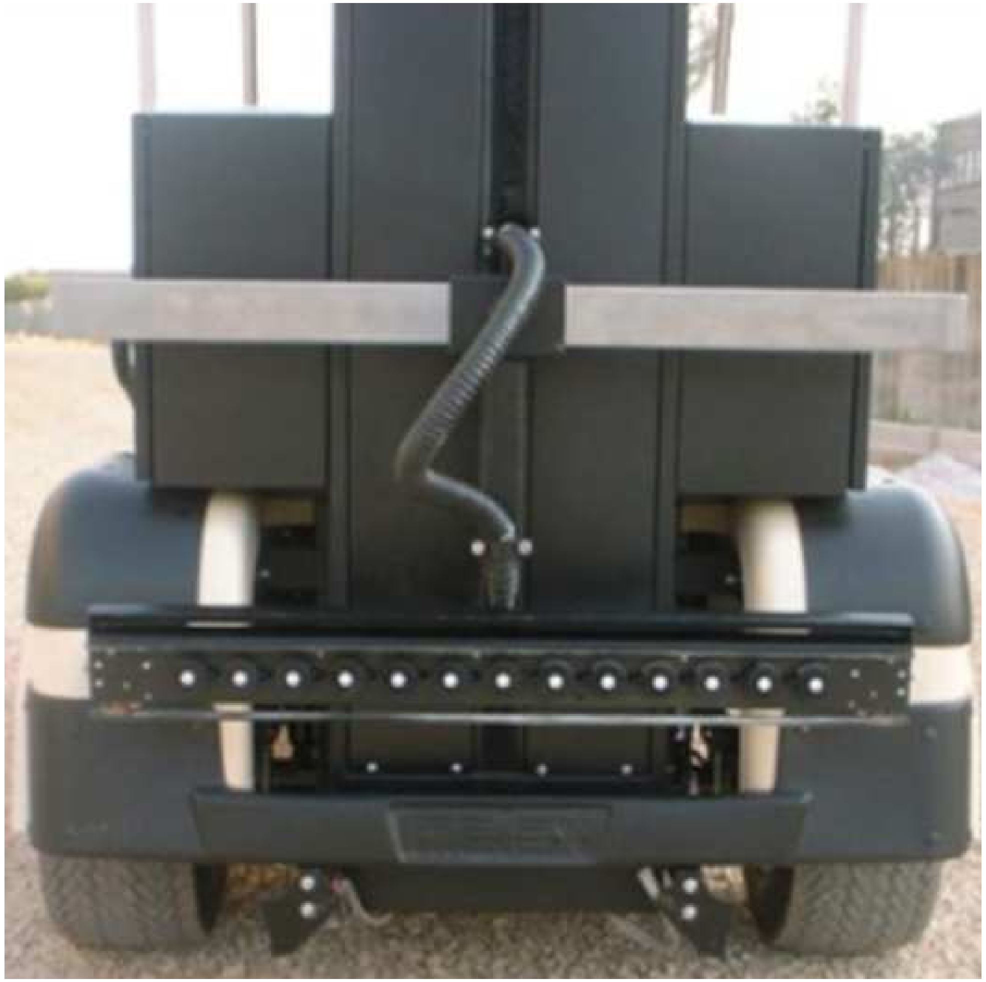
SMF/F - OPERATION THEORY

The vertical scanning of lamp beam is performed according to the type of the lamp and ICAO recommendations.

The bar is automatically moved at steps of 1° to accomplish the standard ICAO grid points (7 steps, see the figure below) or the extended grid (13 steps) in order to increase the sampling window.

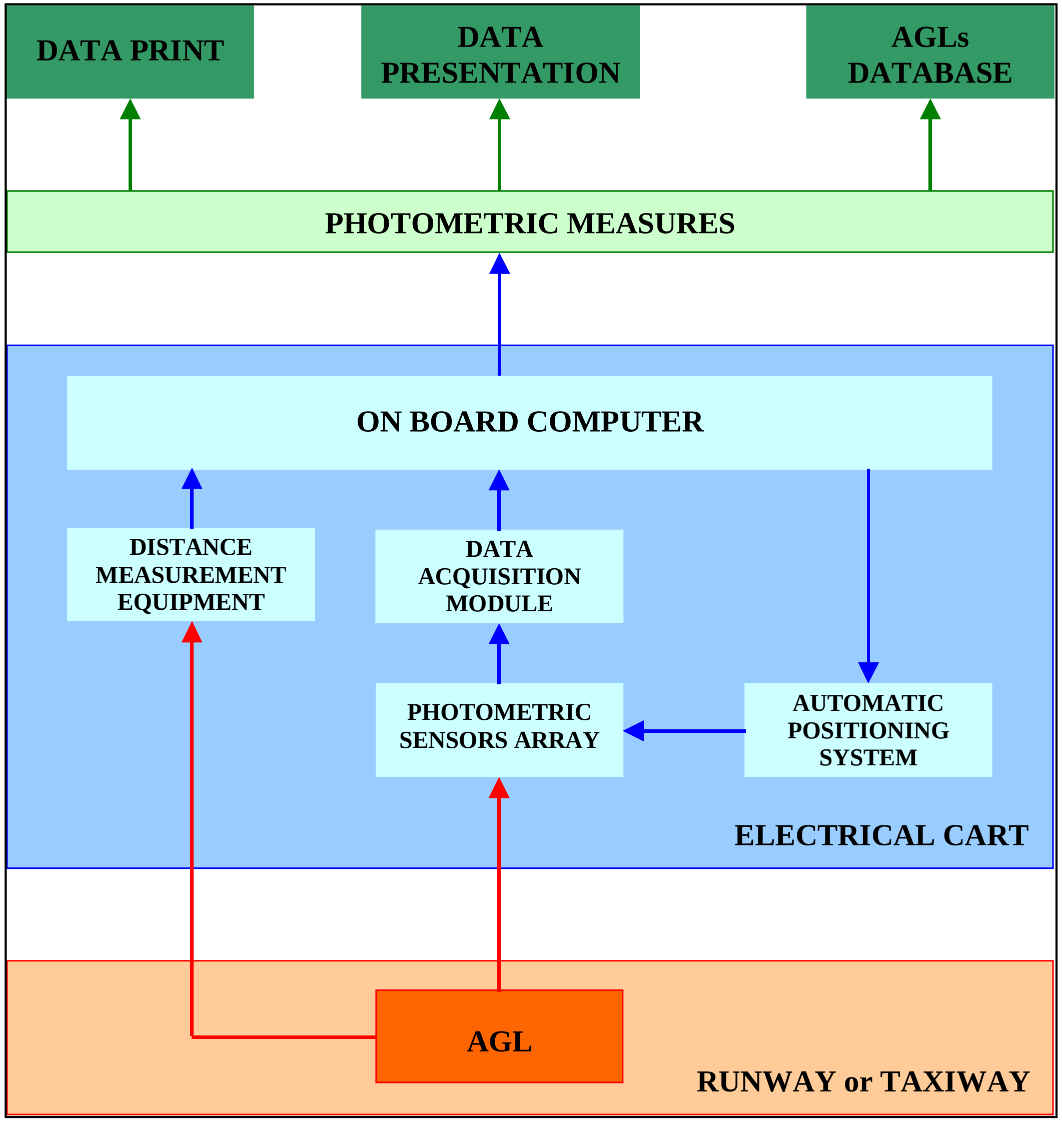
In case of inset lamps the scanning starts from the ground while for the elevated ones a proper offset is applied according to the lamp type.





SMF/F – The 13 sensors array bar

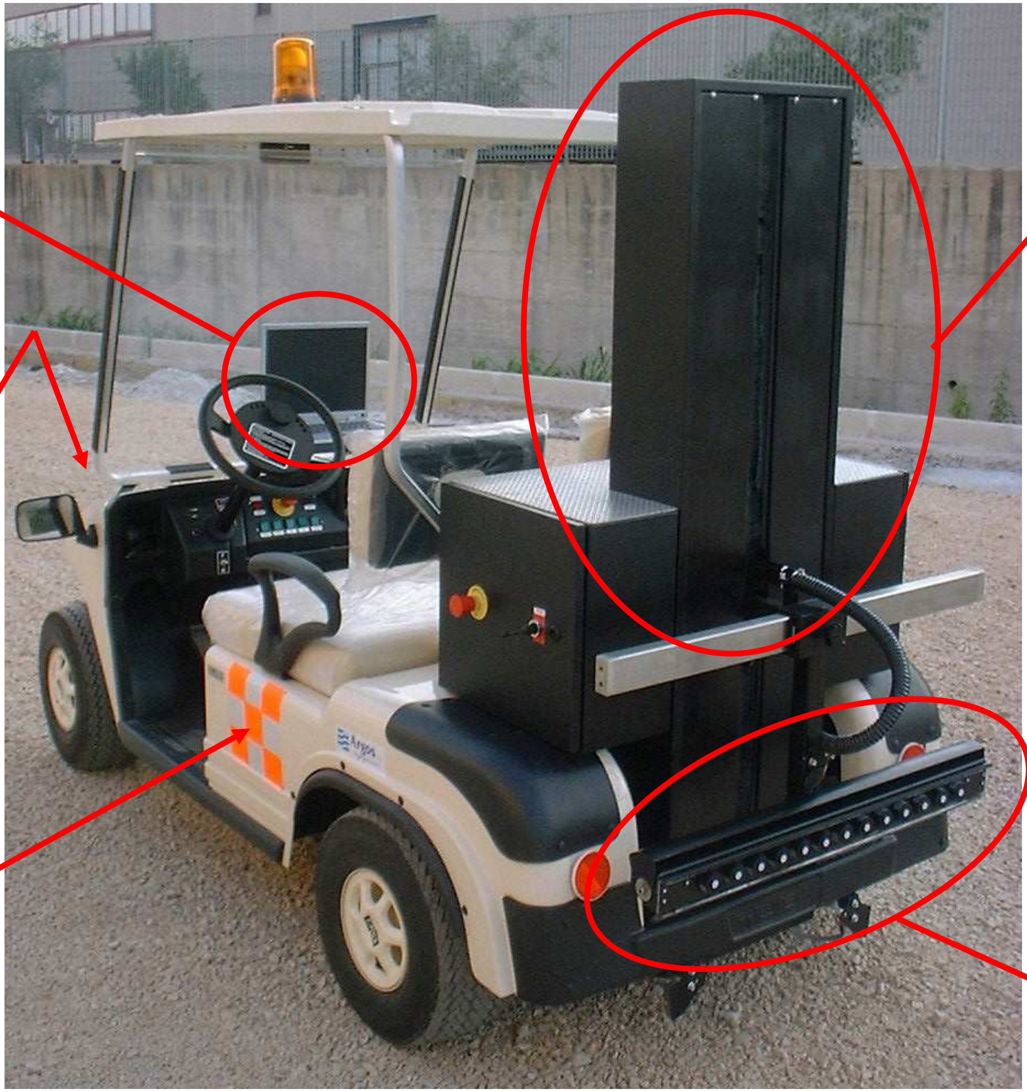
SMF/F - Functional diagram


DATA PRINT
DATA PRESENTATION
AGLs DATABASE
PHOTOMETRIC MEASURES
ON BOARD COMPUTER
DISTANCE MEASUREMENT EQUIPMENT
DATA ACQUISITION MODULE
PHOTOMETRIC SENSORS ARRAY
AUTOMATIC POSITIONING SYSTEM
ELECTRICAL CART
AGL
RUNWAY or TAXIWAY

CPU	Mobile Intel Pentium IV, 2.0 GHz
RAM	256 Mb DDR RAM
HDD	160 Gb
Storage	DVD/CD-RW
Dispaly	15.1”
Comm	LAN/Modem 56 kbit/sec
OS	Windows XP Prof

SMF/F - Technical Description

Layout



On-board Mobile Computer

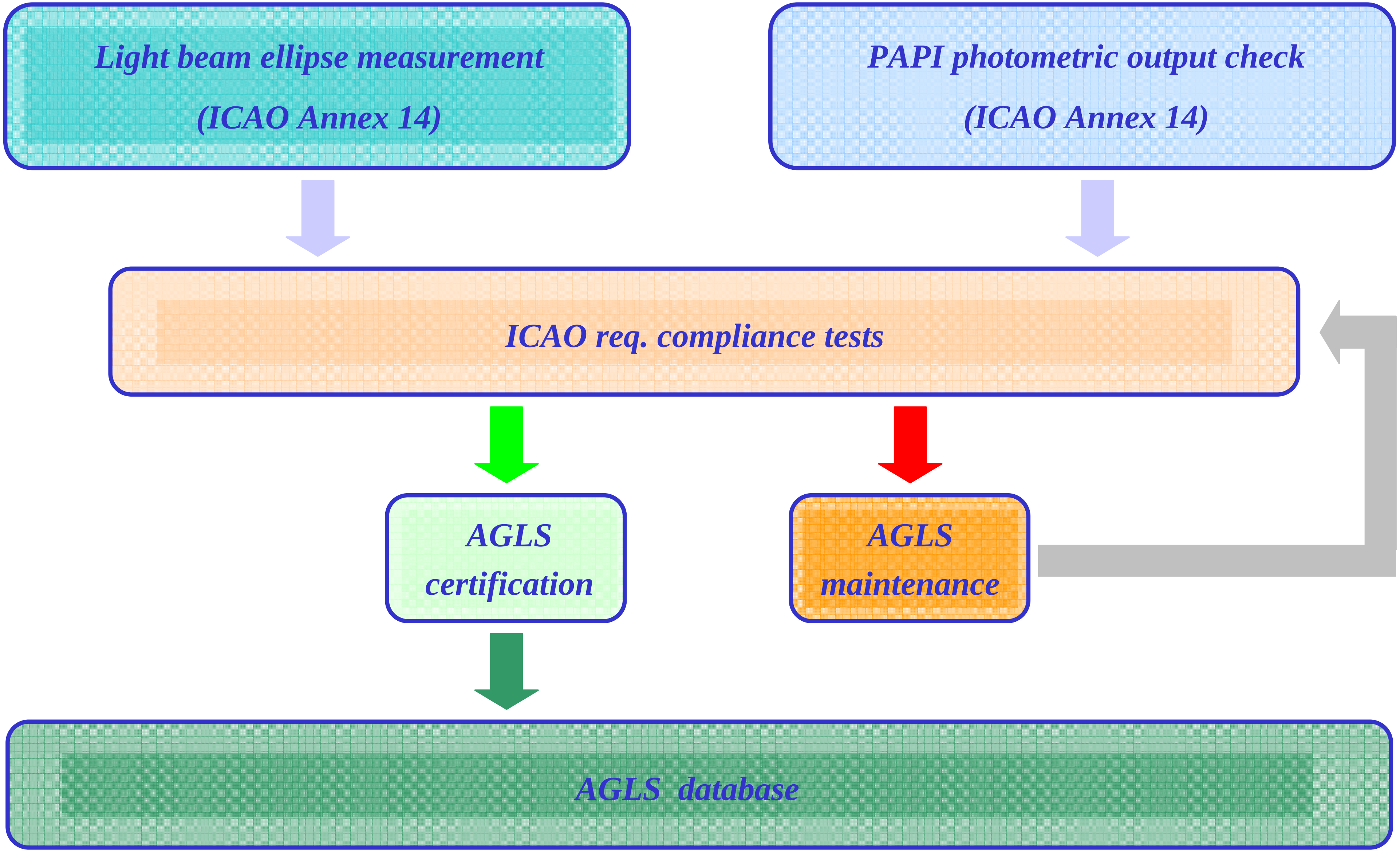
Cart-Lamp Distance Measurement System

Electrical Cart

Automated Positioning System

Photometric Sensors Array

SMF/F - What SMF/F allows to do



Light beam ellipse measurement

(ICAO Annex 14)

PAPI photometric output check

(ICAO Annex 14)

ICAO req. compliance tests

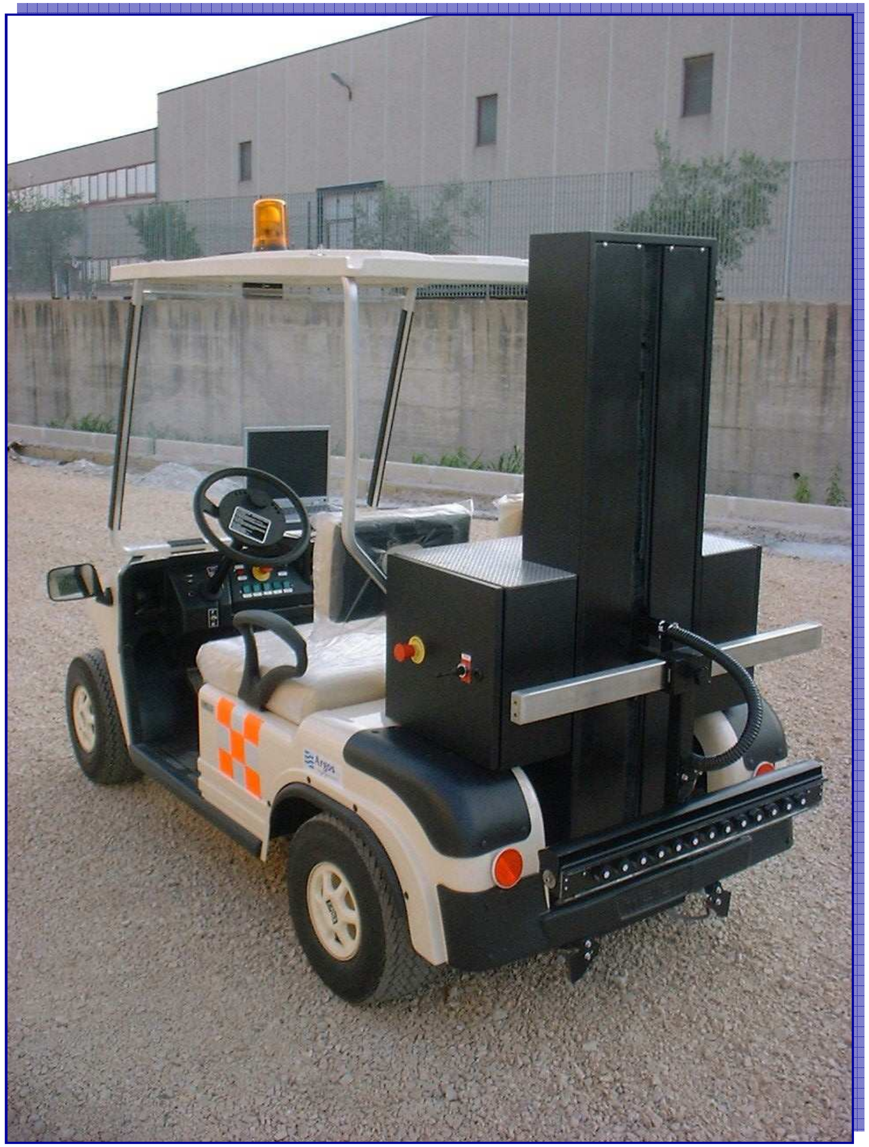
AGLS certification

AGLS maintenance

AGLS database

SMF/F - Main features

- 4 wheel battery operated vehicle
- Length: 260 cm; width: 110 cm;
- Weight: 600Kg
- Max speed: 50 Km/h
- Range capability: 100 Km
- Front lights for night operations
- Special capote to make the operator comfortable during operations
- Encoder for distance measuring
- 3 Laser pointers
- 13 sensors bar , 1 m length
- Vertical automatic bar positioning
- 1° horizontal aperture for each sensor at 3m
- 1° vertical resolution (single step)
- Accuracy : 5%
- Precision : 3%



SMF/M

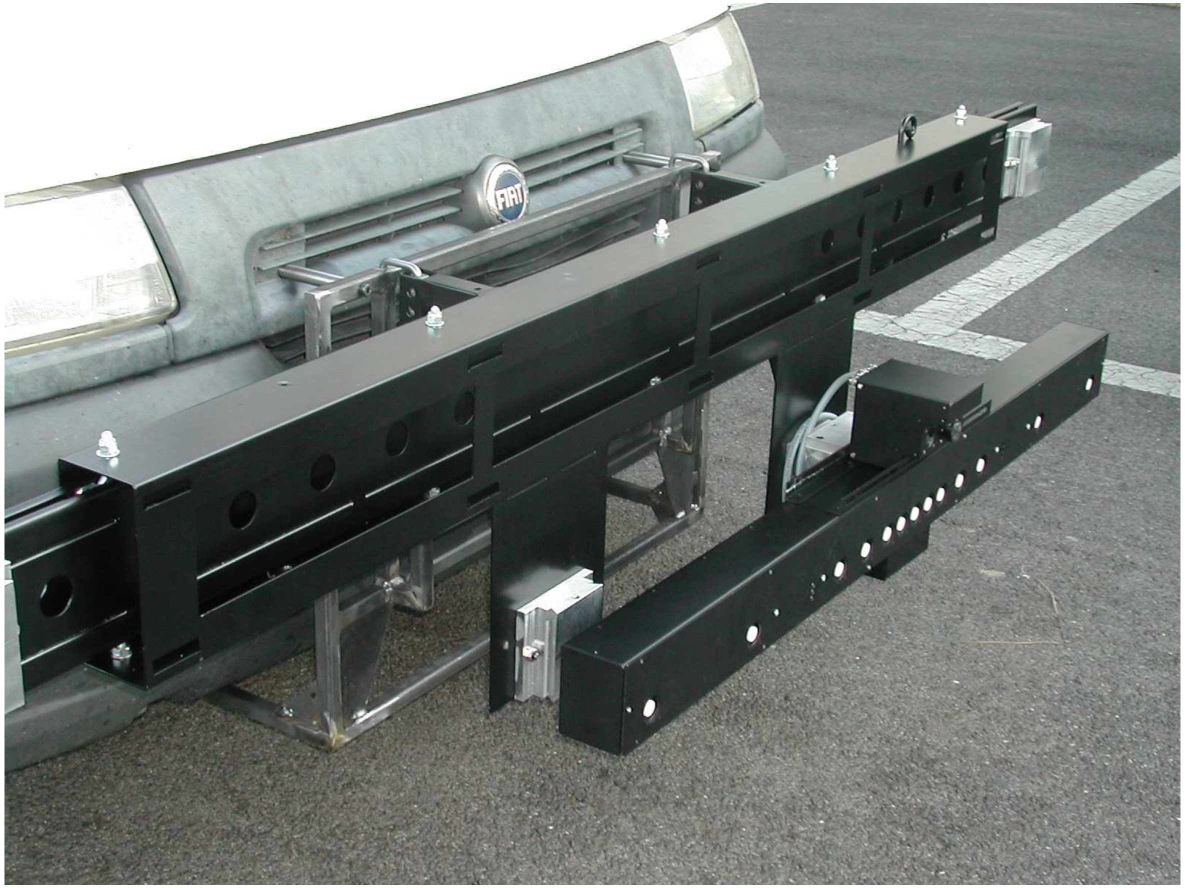
SMF/M – General description

SMF/M is the photometric measurement system for AGL equipment especially designed and developed by ARGOS INGEGNERIA to perform the measurement of the airfield lights while moving along runways and taxiways (no-stop mode).

SMF/M can be easily installed on the front of any commercial vehicle suitable to operate in the airfields.

SMF/M is easy to use: the operator is assisted step by step by the system software running on the on-board PC.

The Customer can decide for a fixed installation on a dedicated vehicle or for a temporary installation if the vehicle must be used for other tasks when not involved in measurement operations.



SMF/M – The Working principle

SMF/M is a based on the principle of a fixed and steady bar moving on the same (or parallel) line where lamps to be measured lie.

The bar of SMF/F is installed to be orthogonal to the direction line and thus is able to cut the light beam emitted by the fixture in its lower part when the bar is far and in its the upper part as soon as the bar comes closer is to the fixture.

The vertical scan requested by the ICAO grid points is therefore accomplished by a reconstruction done by the system software on the basis of the samples acquired during the travel of the bar between the current lamp under measurement and the next one.

The bar hosts 13 Lux sensors and 2 color sensors according to CIE 1931 distributed over the bar in order to get the best resolution/distance ratio. The bar also hosts a special head containing 2 fixture positioning sensors and the alignment camera.

The sampling frequency is given by the traveled space and not by the time: the system is therefore not critical and user can stop the vehicle of SMF/F and restart it without affecting the measurement.

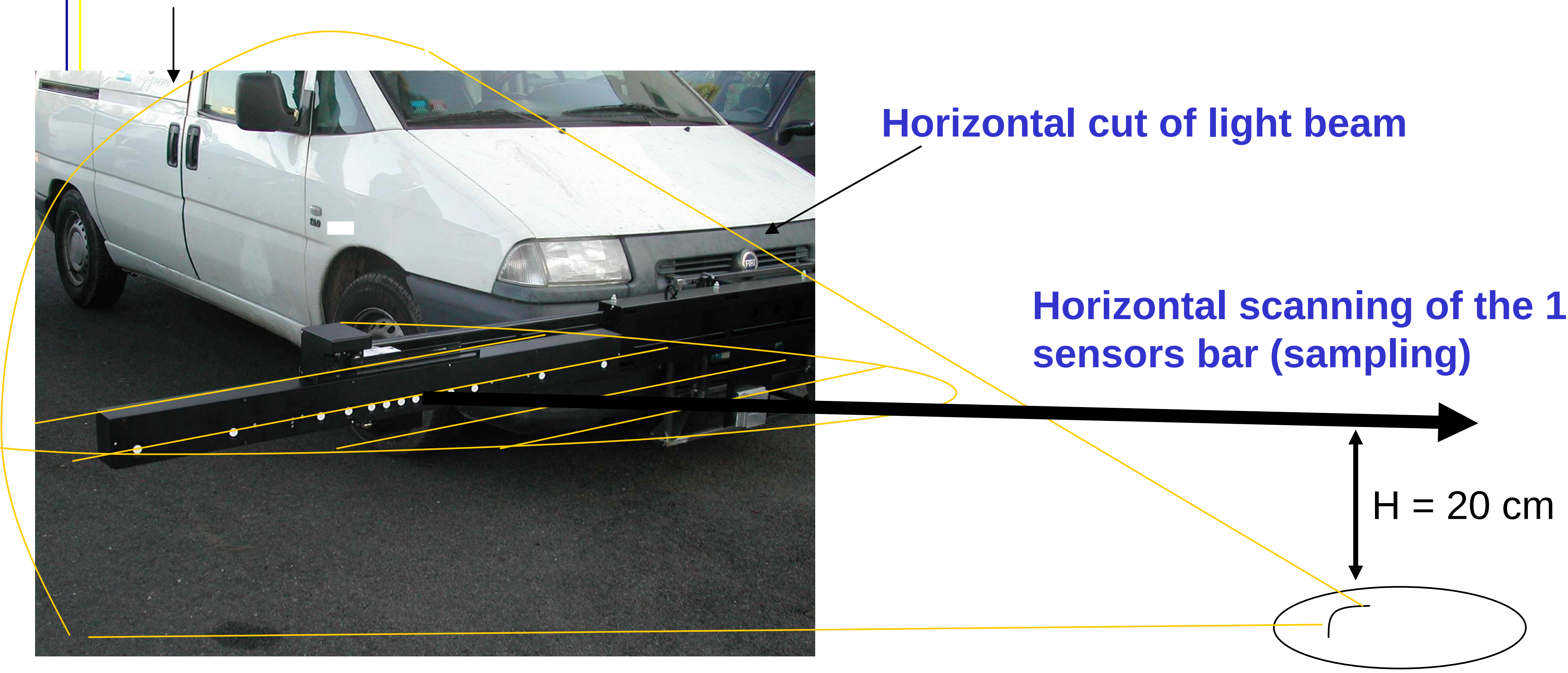
The SMF/F takes a sample every 10 cm of traveled distance measured by a high resolution odometer (1 pulse every 0.7 mm) . SMF/M can consequently count on the amount of data necessary to reach the figure of accuracy and precision requested by the application.

The user can precisely drive the vehicle using the alignment camera which reports the current position of the bar respect to the ideal line to be followed.

Once acquired, the ICAO grid points of all the measured fixtures are processed and posted in the system data base so that the user can analyze all data relevant to the performance of a single fixture or the whole AGLS. The photometric data are provided through tables or diagrams, including the ISOCANDELA diagram requested by ICAO recommendations.

The data base structure is common to all the products of SMF family: the user can therefore operate different systems (LAB and MOBILE) without changing the human machine interface (HMI).

SMF/M – Scanning of the beam

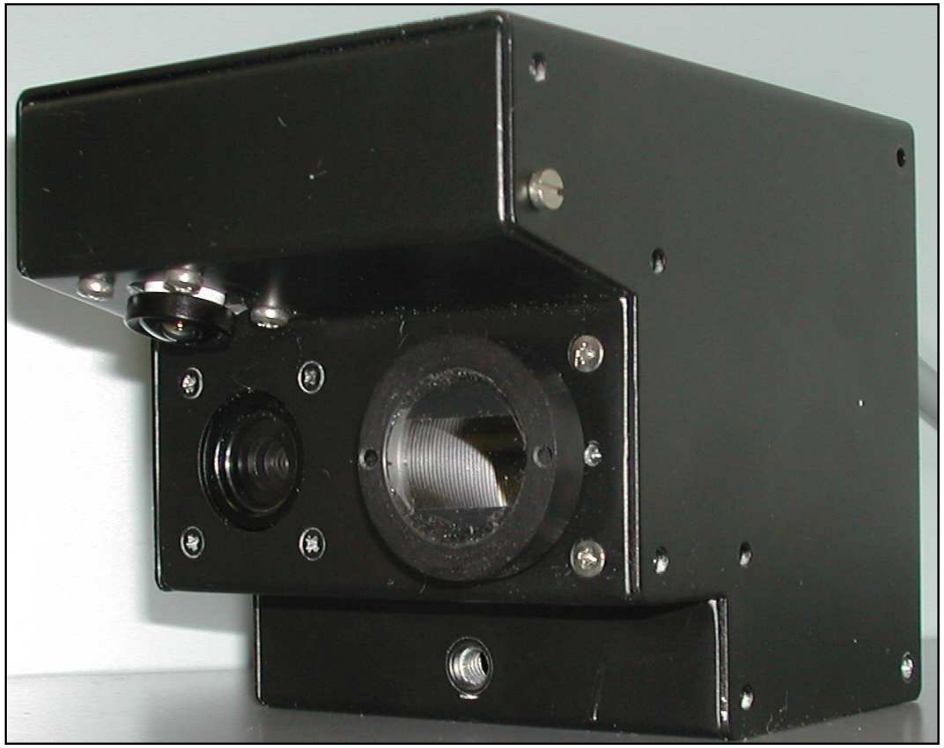


LIGHT BEAM

Horizontal cut of light beam

Horizontal scanning of the 13 sensors bar (sampling)

SMF/M - The positioning sensors head



In order to allow a precise measurement of all inset and elevated fittings of the airfield SMF/M implements a special multifunction optical sensor's head able to continuously determine the angle under which each light appears to the measurement array and the transversal position of the lamp when the array is flying over the fixture.

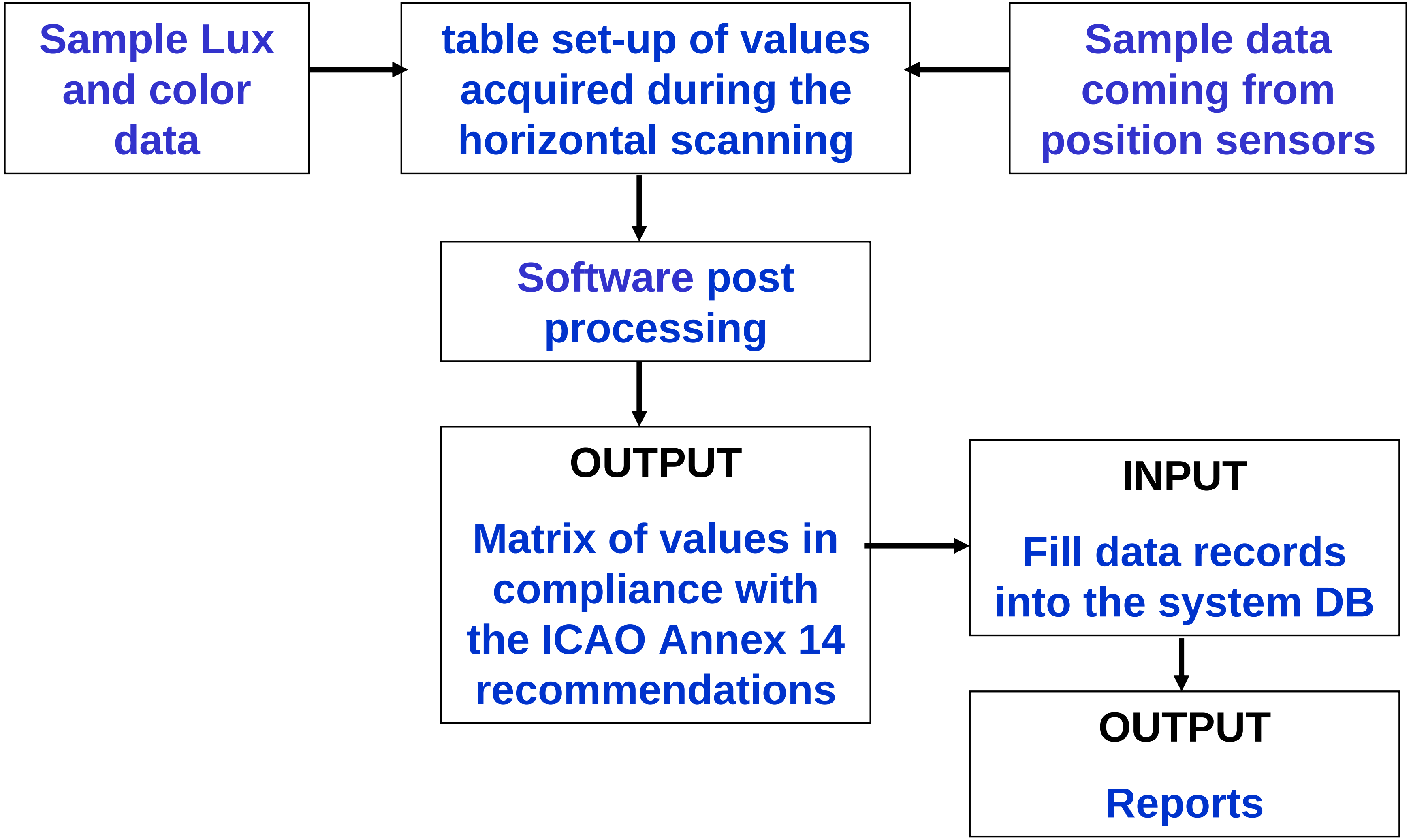
The optical head also includes a CCD camera to give the driver of the mobile the visual reference for the correct alignment of the measurement array with the stream of lights to be measured.

The head is equipped with two optical sensors:

S1, which is responsible for the detection of the lamp (target) and calculation of transversal positioning of the lamp at moment of crossing (vertical alignment of the bar over the lamp).

S2 , which is responsible for the measurement of the angle formed by the ideal line running from the lens of S2 and the nearest lamp . When the bar of SMF/M is moving toward the lamp, the angle of the lamp under investigation increases as much as the lamp is closer to the bar. The value of the angle is therefore used to determine the precise height of the light source in order to improve the accuracy of photometric measurement.

SMF/M – Data flow



Sample Lux and color data

table set-up of values acquired during the horizontal scanning

Sample data coming from position sensors

Software post processing

OUTPUT

Matrix of values in compliance with the ICAO Annex 14 recommendations

INPUT

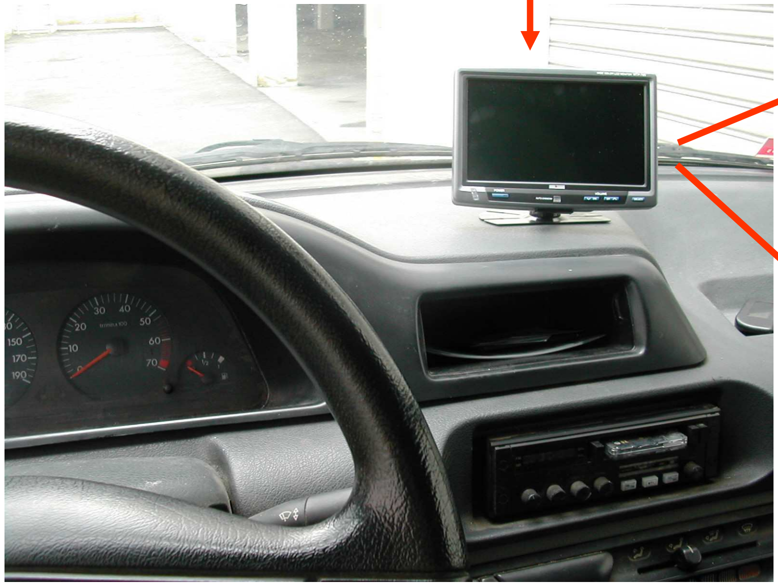
Fill data records into the system DB

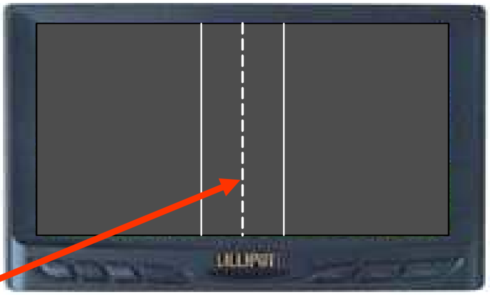
OUTPUT

Reports

SMF/M – System Components

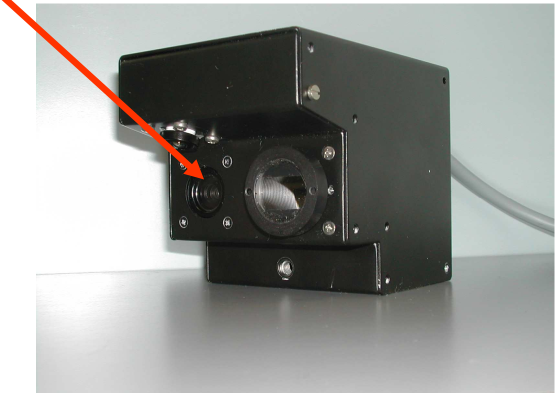
Alignment monitor and camera





Power Supply

Light beam detectors



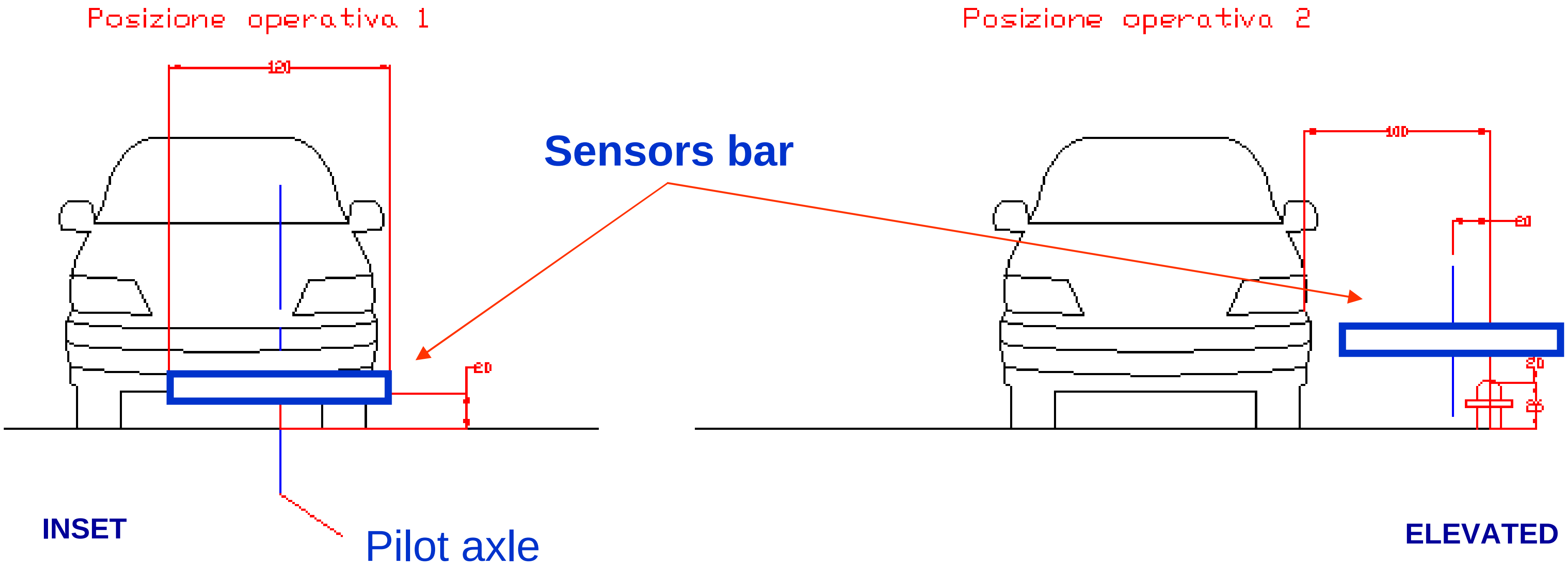
Odometer

Sensors Bar

PC

SCANNING INSET OR ELEVATED LIGHTS

Using the sliding support the operator can easily move the bar in the position suitable to the type of lamps to be measured


Posizione operativa 1
120
20
Posizione operativa 2
100
20
20

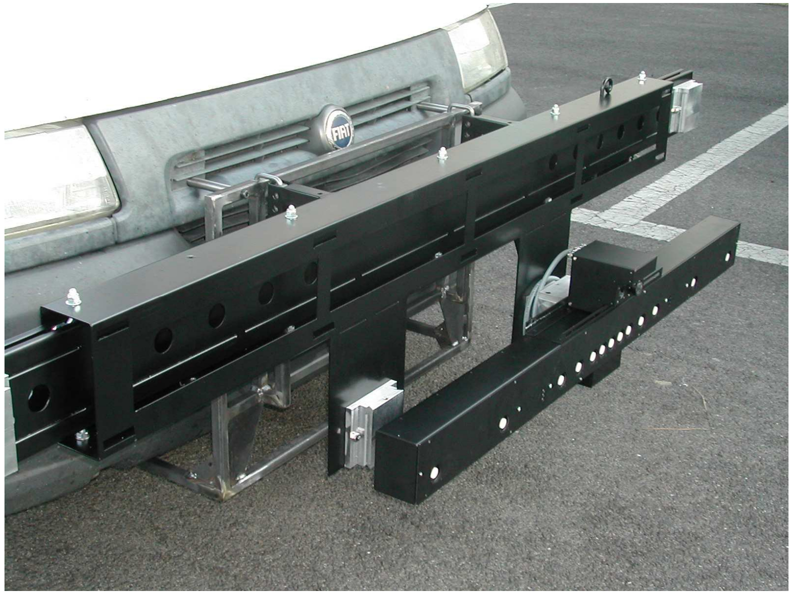
Sensors bar

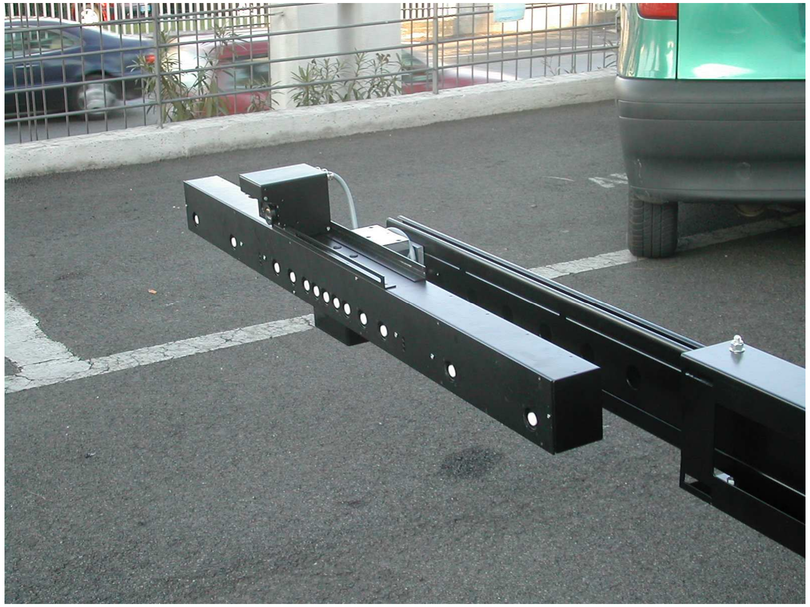
INSET

Pilot axle

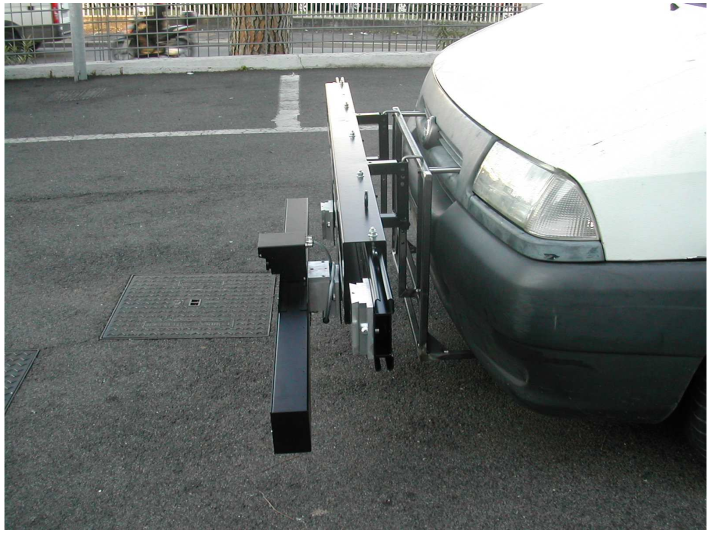
ELEVATED

SMF/M – Bar positioning





Bar position n°1 for inset lamps

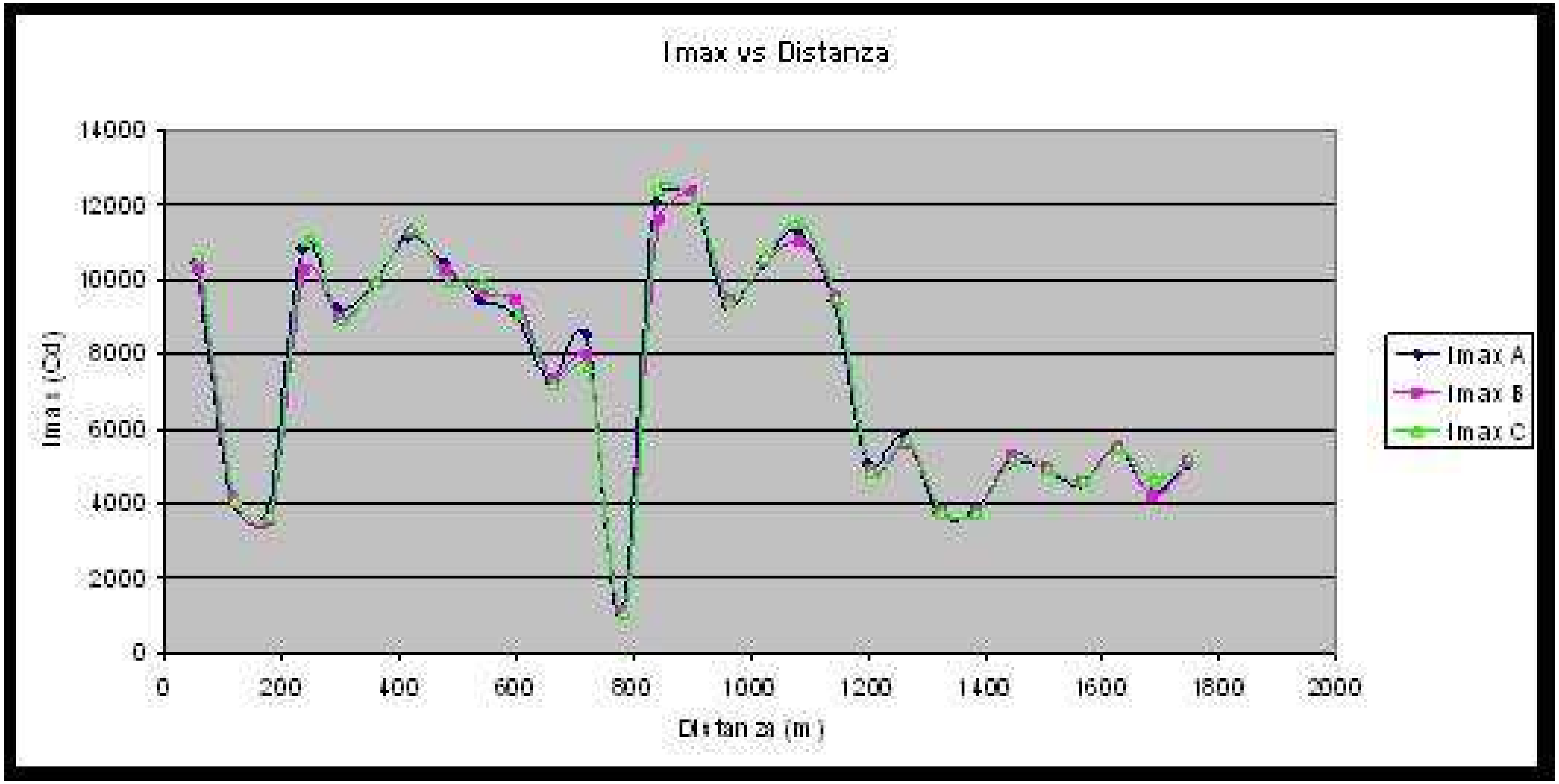


Bar position n°2 for elevated lamps

CAR FITTING ASSEMBLY

SMF/M - Diagram of Repeatability

The diagram represents the repeatability of SMF/M system in terms of dispersion of data measured in different sessions within a given time interval and referred to the same source. In this case the diagram reports the centerline of an airport measured 3 times in the same sequence with X axis representing the distance and Y axis representing the value of CD measured. The resulting 3 curves are close to be fully overlapped within 5% of averaged difference.

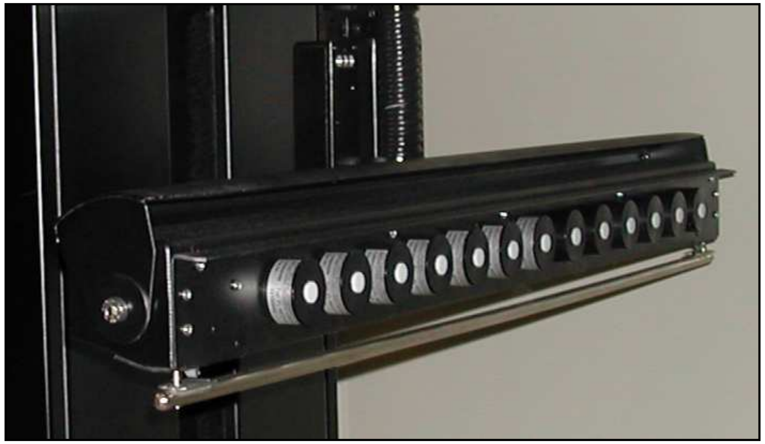


SMF/M – System Performances

- **ACCURACY : 5% (REFERENCE INSTRUMENT)**
- **PRECISION : 5% (REPEATABILITY)**
- **13 SENSORS BAR – 0.25 LUX resolution**
- **HIGH SPEED ELECTRONICS FOR SENSOR OVERSAMPLING VIA 16 BITS LOW NOISE ADC**
- **2 x CIE 1931 COLOR SENSORS**
- **2 OPTICAL SENSORS FOR BEAM POINTING**
- **DISTANCE MEASUREMENT RESOLUTION: 0.7 mm**
- **BUILT IN CAMERA FOR BAR ALIGNMENT**
- **MAX SPEED : 60 Km/h**
- **MAX OPERATING TEMPERATURE : 30°C**
- **EASY TO INSTALL**
- **EASY TO USE**

SMF/L

SMF/L – General description



SMF/L is a photometric measurement system for AGL equipment especially designed and developed by ARGOS INGEGNERIA to operate in the workshop of the airfield lights department.

SMF/L belongs to the ARGOS ‘s product family for AGL measurement. It is specially recommended for indoor operations of customers already equipped with ARGOS’s mobile systems. It allows a precise measurement of all inset and elevated fittings of AGL in order to certificate the performances of fixture before the installation in the airfield.

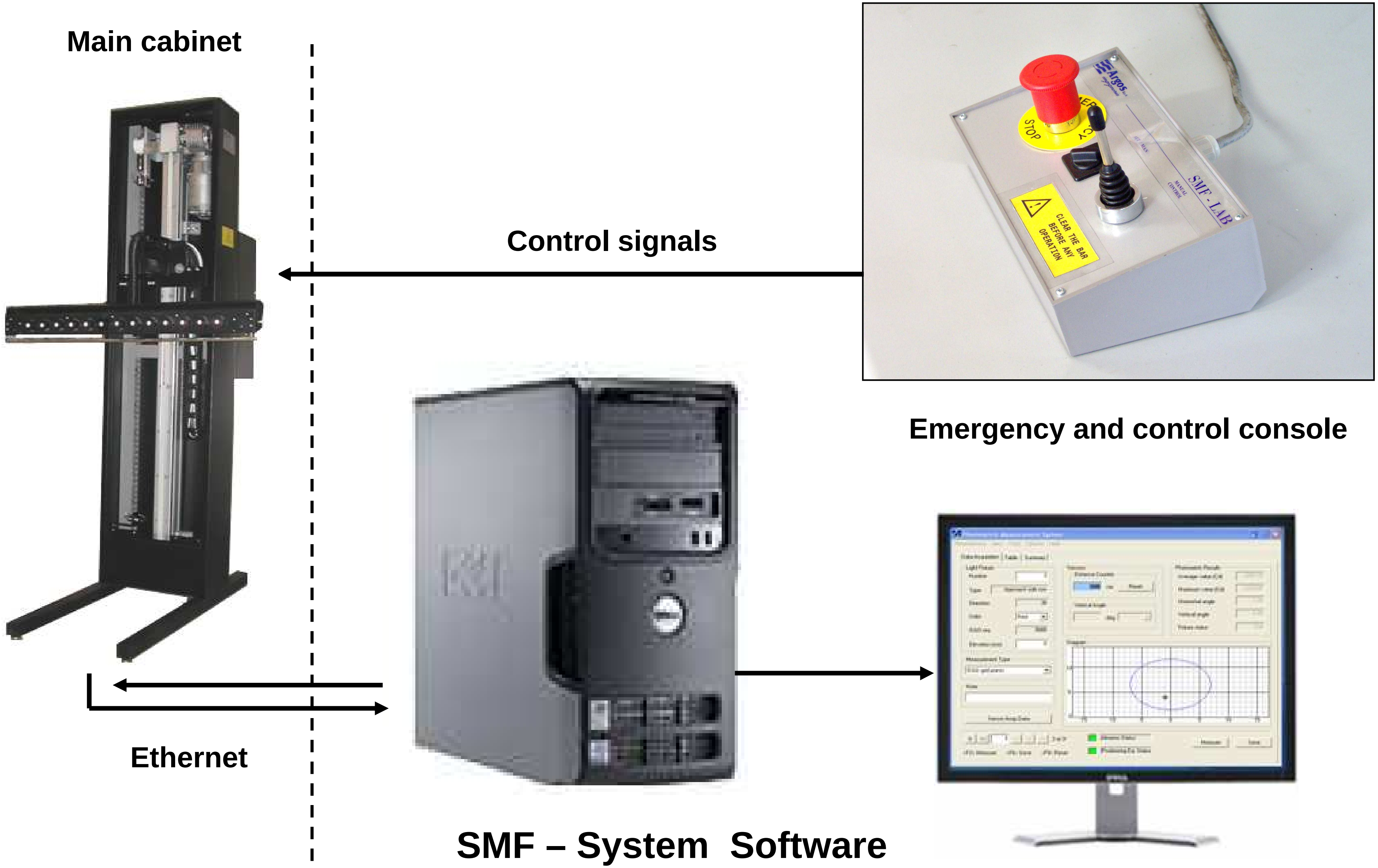
The measurement is performed by a 13 sensors array which vertically scans the beam of the light under test to get the photometric values necessary to compute the light beam intensity in candela , elevation , azimuth and the isocandela diagram according to ICAO grid requirements. The measuring bar is equipped with a color sensing device according to CIE 1931 recommendation.

Measurement operations are fully automated and allow single step measurement, 7x13 grid points measurement, 13x13 extended grid points measurement. Manual positioning of the bar is also allowed for special measurements defined by user.

The system is fully controlled by a user friendly application software which includes all the functions necessary to create the data base, to set up the system parameters , to save, display and print the results of measurement, to compute and display the ICAO isocandela diagrams.

The system software runs on a Windows XP platform. All the data acquired during the measurement sessions are stored into the system data base and can be exported to other MS Office programs for any further application.

SMF/L – System components



Main cabinet

Control signals

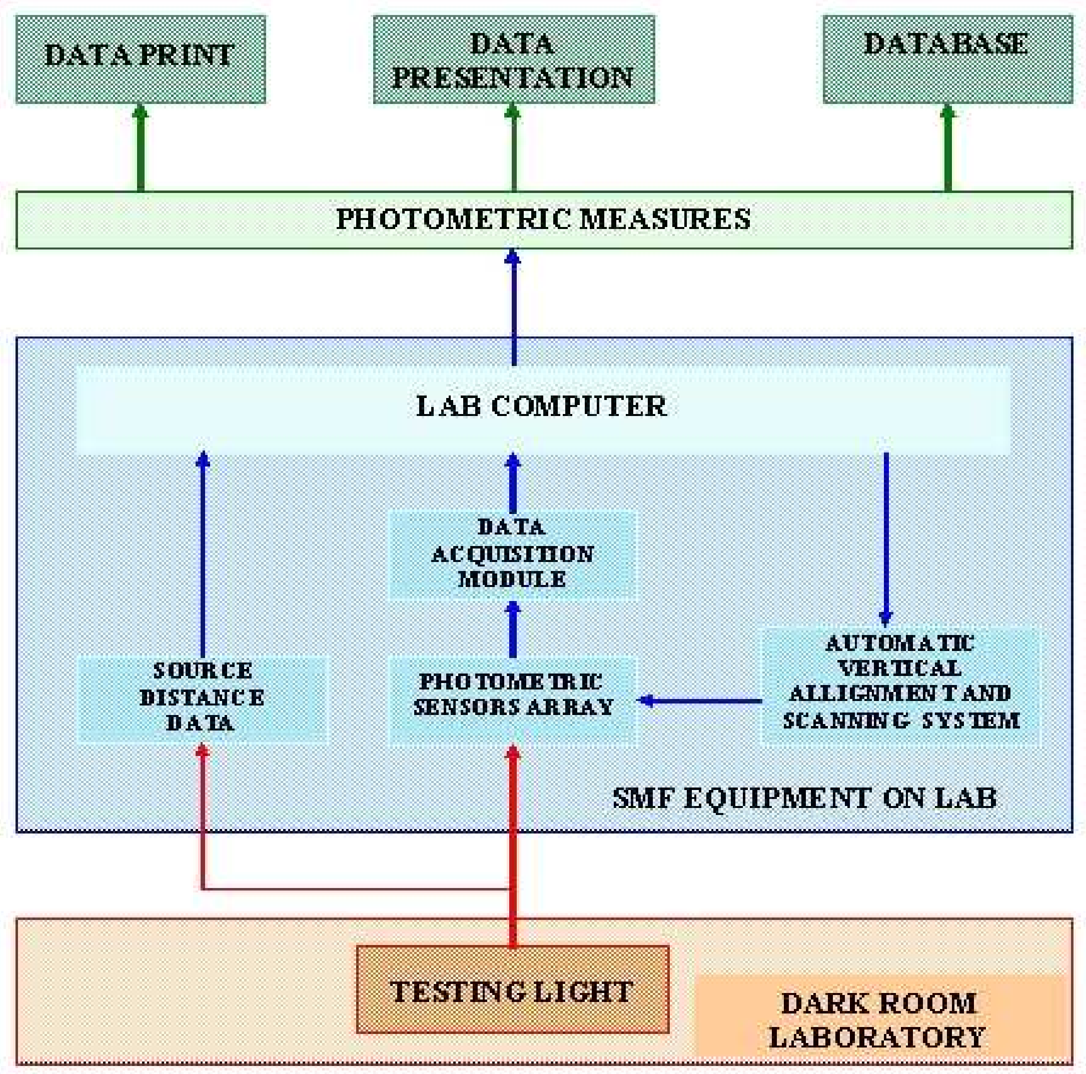
Emergency and control console

Ethernet

SMF – System Software

STOP
CLEAR THE BAR BEFORE ANY OPERATION
Argos
SMF - LAB

SMF/L – System components


DATA PRINT
DATA PRESENTATION
DATABASE
PHOTOMETRIC MEASURES
LAB COMPUTER
DATA ACQUISITION MODULE
SOURCE DISTANCE DATA
PHOTOMETRIC SENSORS ARRAY
AUTOMATIC VERTICAL ALLIGNMENT AND SCANNING SYSTEM
SMF EQUIPMENT ON LAB
TESTING LIGHT
DARK ROOM LABORATORY

SMF/L Functional diagram

SMF/L integrates the same measurement components of SMF/F, with the following differences:

- **Main power supply is 220 VAC;**
- **The system computer is a desktop PC**

The system software is the same and allows the same functions, having set to 3m the distance of the bar from the special supports for fixtures provided with the main cabinet.

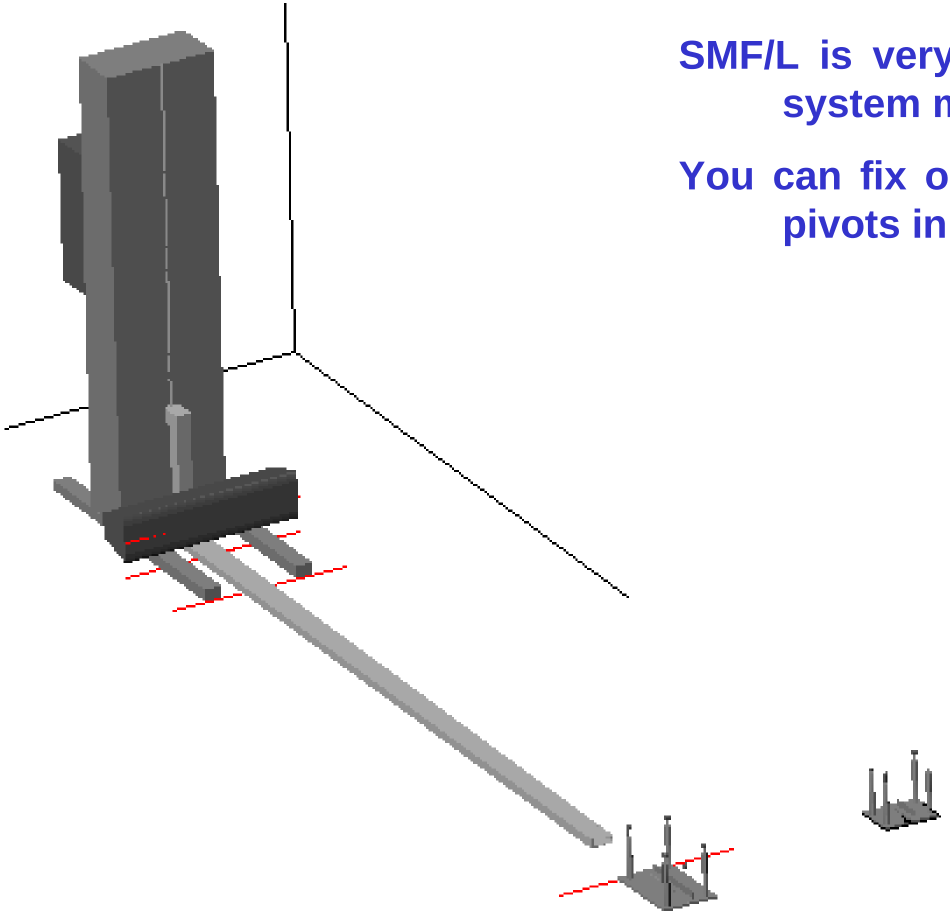
CPU	Intel Pentium IV, 3.0 GHz
RAM	512 Mb DDR RAM
HDD	160 Gb
Storage	DVD/CD-RW
Dispaly	17”
COMM	LAN/Modem 56 kbit/sec, USB 2
OS	Windows XP Professional

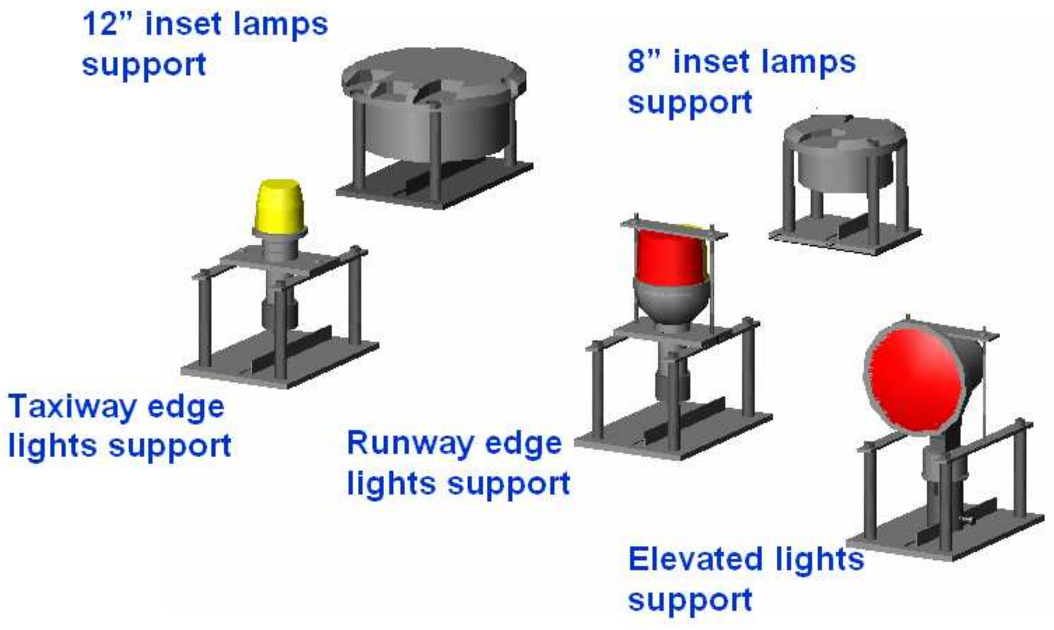
SMF/L PC configuration

SMF/L – Installation

SMF/L is very easy to install following the instructions given in the system manual.

You can fix on the floor the lamps' support using a pair of butterfly pivots in order to easily remove and change the support.



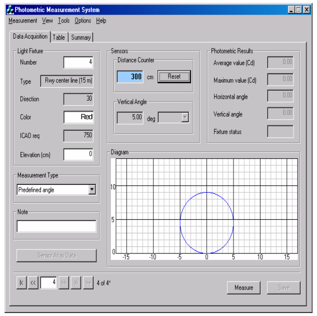

12" inset lamps support
8" inset lamps support
Taxiway edge lights support
Runway edge lights support
Elevated lights support

Setting the position of special supports for lights alignment to the measurement bar

SMF/L – System Performances

- High precision computer controlled bar positioning system
- 13 LUX sensors with 1° spacing at 3 meters (ICAO), with 0.25 LUX resolution
- 1 Color measuring device conforming CIE 1931 recommendation (ICAO)
- 7x13 (ICAO) or 13x13 extended grid points diagram
- Average and maximum values (Cd) of beam intensity
- Vertical and horizontal angle determination
- SQL compatible system data base
- LAN communication
- Power supply: 220 Vac, 300 W
- Accuracy : +/- 3%
- Repeatability :+/- 2%

SMF
Photometric Measurement System


Photometric Measurement System
Measurement View Tools Options Help
Data Acquisition
Table
Summary
Reset
Sensor Array Data
Measure
Save
Diagram
10
5
0
-15
-10
-5
0
5
10
15

Light Fixture
Number: 4
Type: Rwy center line (15 m)
Direction: 30
Color: Red
ICAO req: 750
Elevation (cm): 0

Measurement Type: Predefined angle

Note:

Sensors
Distance Counter: 300 cm
Vertical Angle: 5.00 deg

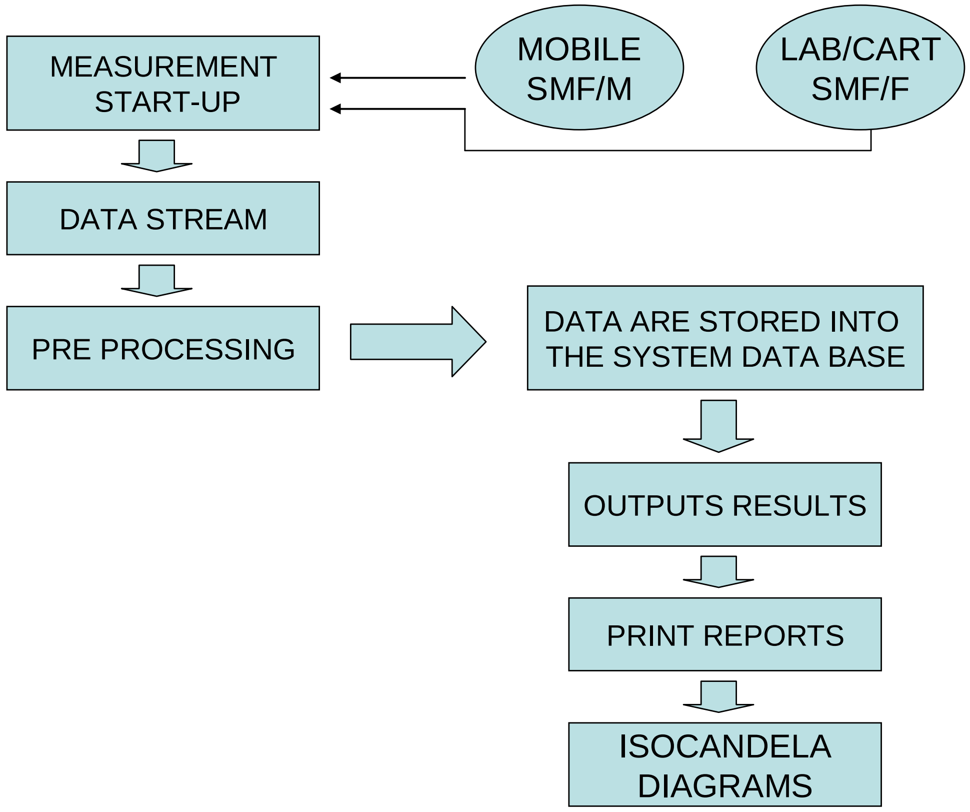
Photometric Results
Average value (Cd): 0.00
Maximum value (Cd): 0.00
Horizontal angle: 0.00
Vertical angle: 0.00
Fixture status:

4 | 4 of 4*

SMF SYSTEM SOFTWARE (PMS)

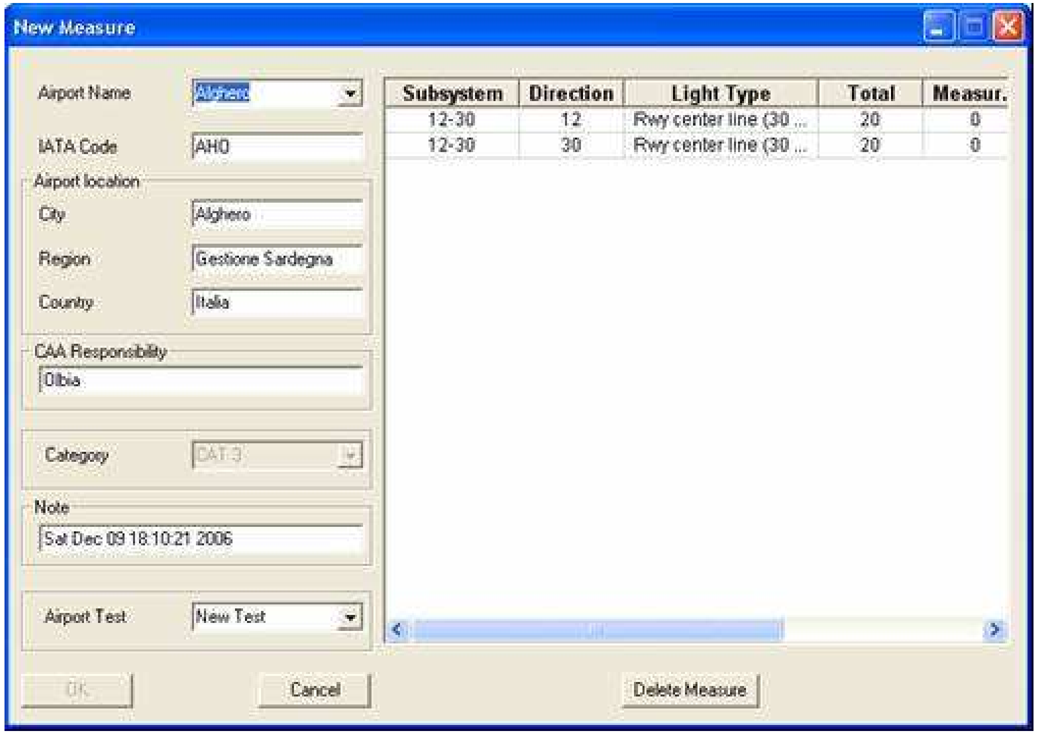
SMF – The PMS System Software Architecture

- **The PMS system software has been designed to operate for Mobile , Lab and Cart operations. It is therefore organised in two different modules:**
- **Mobile measurement module**
- **Lab/Cart measurement module with a common data base and analysis procedures module for Lab/Cart/Mobile**


MEASUREMENT START-UP
MOBILE SMF/M
LAB/CART SMF/F
DATA STREAM
PRE PROCESSING
DATA ARE STORED INTO THE SYSTEM DATA BASE
OUTPUTS RESULTS
PRINT REPORTS
ISOCANDELA DIAGRAMS

SMF – PMS System Software Mobile HMI

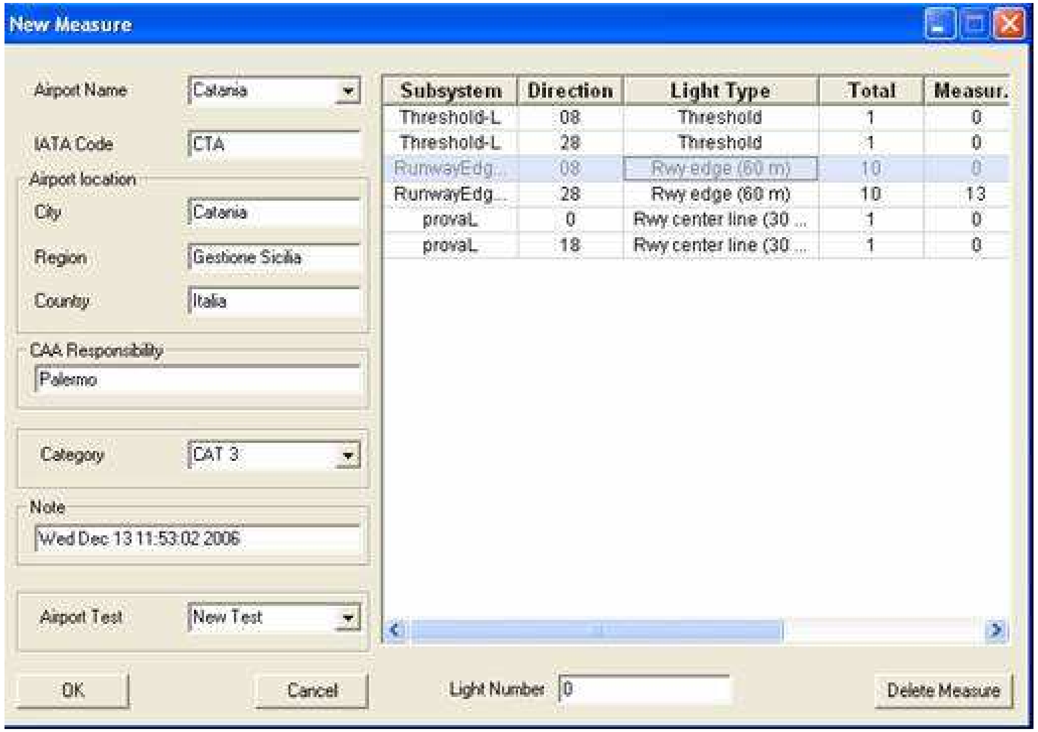
This module is dedicated to data collection and is run by the operator on the portable PC of SMF/M on-board of the vehicle equipped for the measurement campaign. The following images show the initial set-up of the measurement session.



Airport Name: Alghero
IATA Code: AHO
Airport location
City: Alghero
Region: Gestione Sardegna
Country: Italia
CAA Responsibility: Olbia
Category: CAT 3
Note: Sat Dec 09 18:10:21 2006
Airport Test: New Test

Subsystem	Direction	Light Type	Total	Measur.
12-30	12	Rwy center line (30 ...	20	0
12-30	30	Rwy center line (30 ...	20	0

Airport Selection



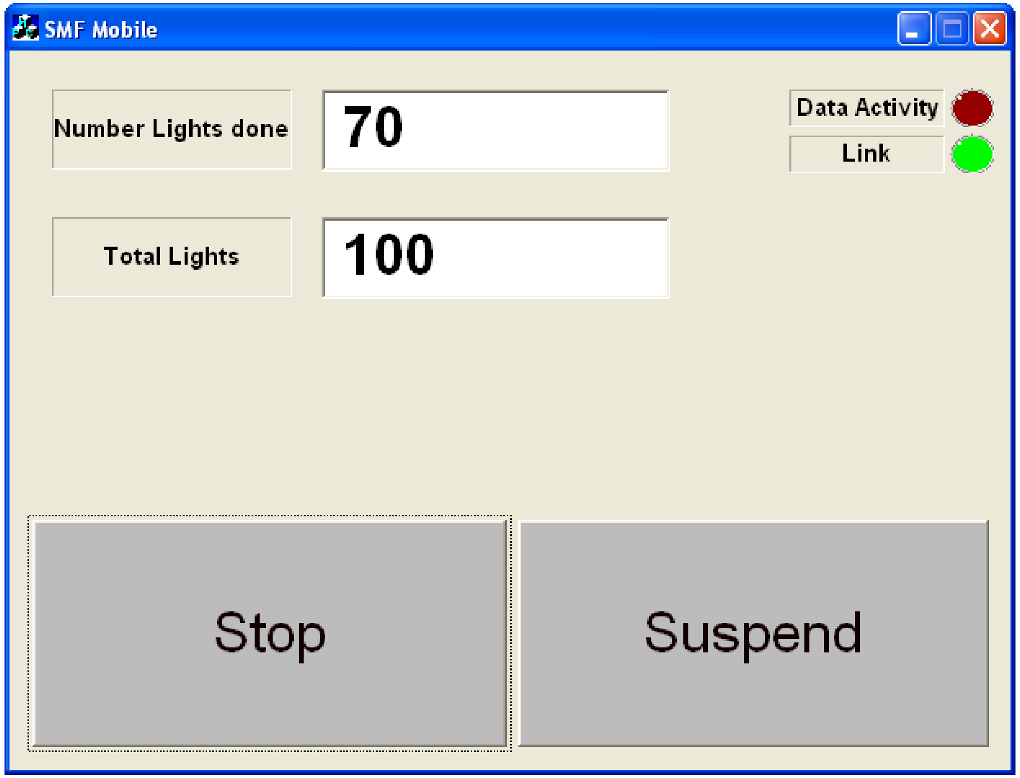
Airport Name: Catania
IATA Code: CTA
Airport location
City: Catania
Region: Gestione Sicilia
Country: Italia
CAA Responsibility: Palermo
Category: CAT 3
Note: Wed Dec 13 11:53:02 2006
Airport Test: New Test
Light Number: 0

Subsystem	Direction	Light Type	Total	Measur.
Threshold-L	08	Threshold	1	0
Threshold-L	28	Threshold	1	0
RunwayEdg...	08	Rwy edge (60 m)	10	0
RunwayEdg...	28	Rwy edge (60 m)	10	13
provaL	0	Rwy center line (30 ...	1	0
provaL	18	Rwy center line (30 ...	1	0

Subsystem Selection

SMF – PMS System Software – Mobile HMI

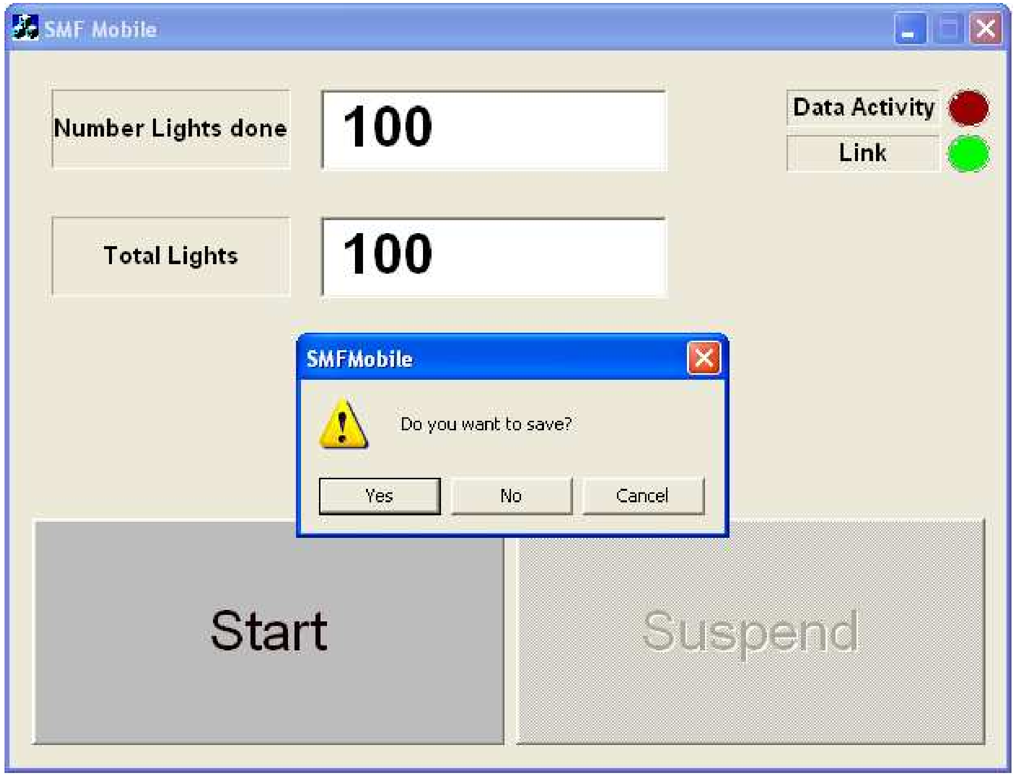
The following images show the lamp counter and data saving functions


SMF Mobile
Data Activity
Link
Stop
Suspend

Number Lights done 70

Total Lights 100

Lights Counter


SMF Mobile
Data Activity
Link
SMFMobile
Yes
No
Cancel
Start
Suspend

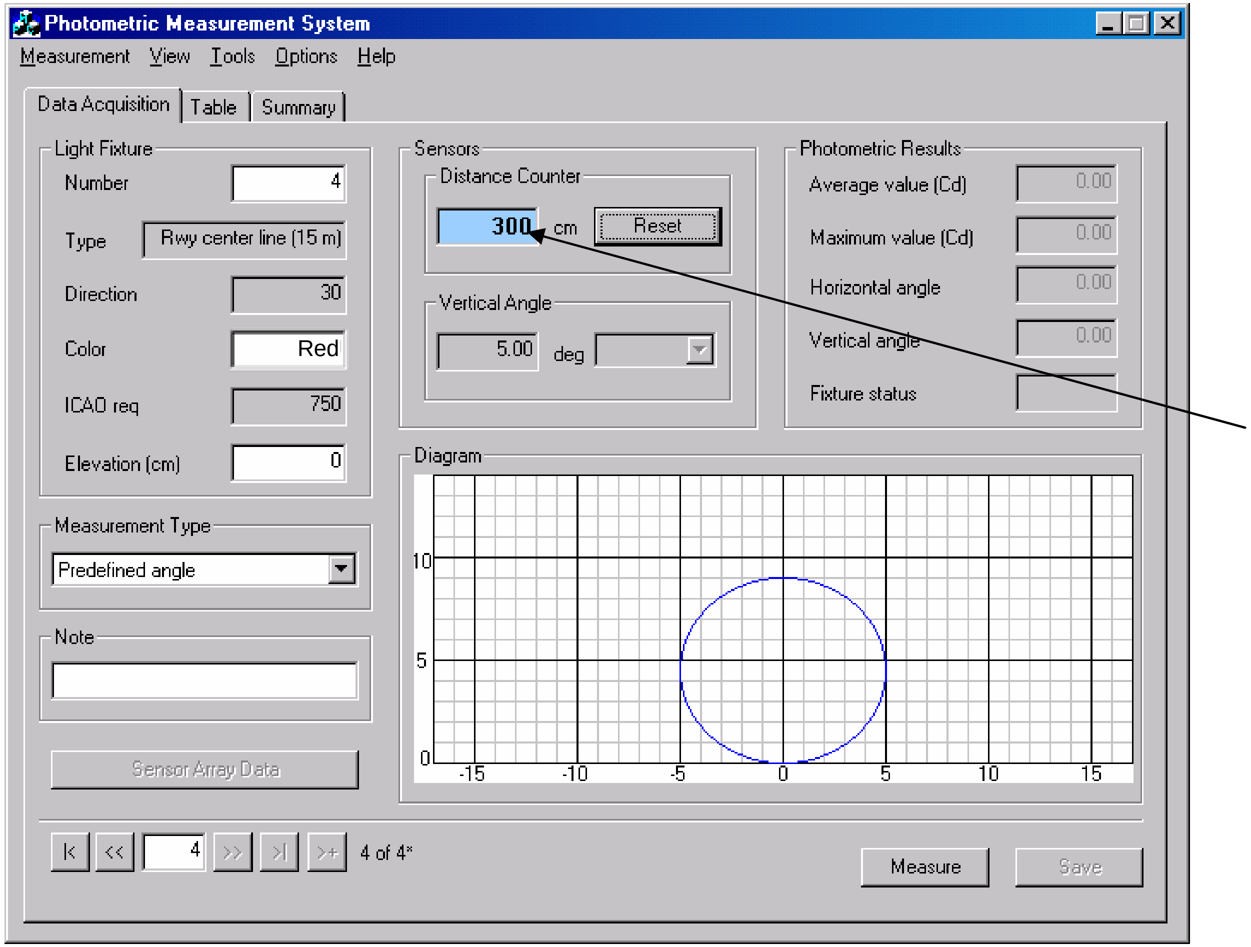
Number Lights done 100

Total Lights 100

Do you want to save?

Save Data

SMF – PMS System Software – SMF/F & SMF/L


Photometric Measurement System
Measurement View Tools Options Help
Data Acquisition
Table
Summary
Reset
Diagram
10
5
0
-15
-10
-5
0
5
10
15
Sensor Array Data
Measure
Save

Light Fixture

Number 4

Type Rwy center line (15 m)

Direction 30

Color Red

ICAO req 750

Elevation (cm) 0

Measurement Type

Predefined angle

Note

Sensors

Distance Counter

300 cm

Vertical Angle

5.00 deg

Photometric Results

Average value (Cd) 0.00

Maximum value (Cd) 0.00

Horizontal angle 0.00

Vertical angle 0.00

Fixture status

4

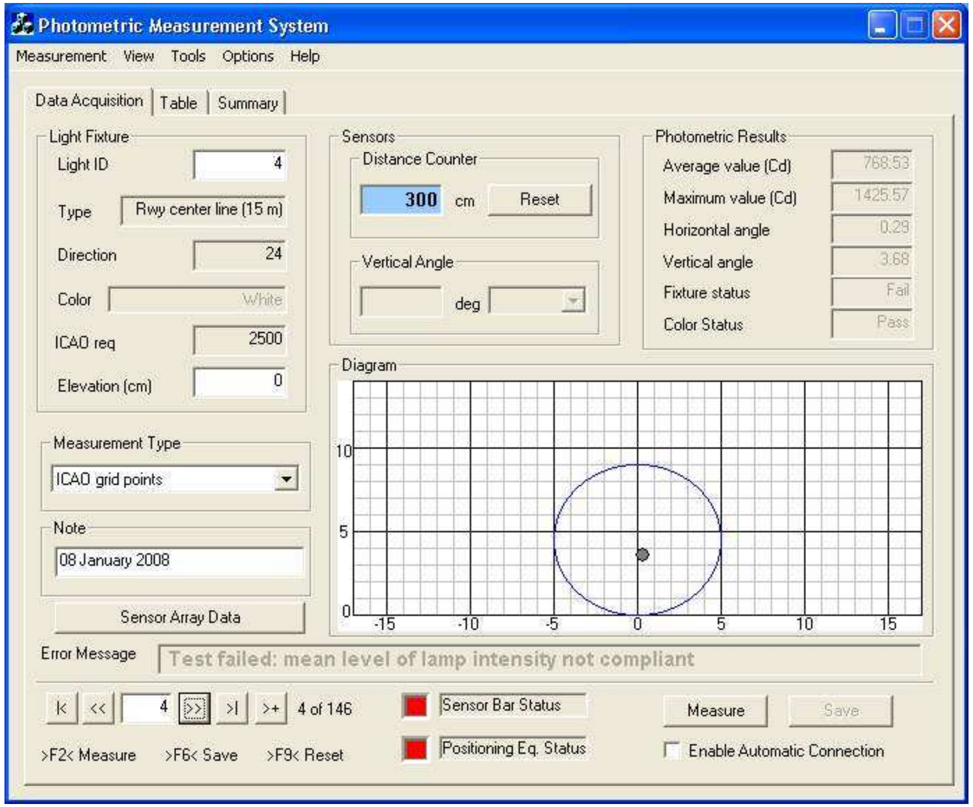
4 of 4*

Distance Counter

Measurement operations of SMF/F are very close to SMF/Lab system ones. The only difference consists in the calculation of the distance between the machine and the fixture, that is performed according to the real position of the cart driven by the operator. In the Lab system the distance is always fixed to the value stated at moment of the installation.

SMF – PMS System Software - Reports

Functions for data analysis and reports are the same for SMF/M, SMF/F and SMF/L


Photometric Measurement System
Measurement
View
Tools
Options
Help
Data Acquisition
Table
Summary
Reset
Diagram
10
5
0
-15
-10
-5
0
5
10
15
Sensor Array Data
|<
<<
>>
>|
>+
Measure
Save

Light Fixture
Light ID: 4
Type: Rwy center line (15 m)
Direction: 24
Color: White
ICAO req: 2500
Elevation (cm): 0

Sensors
Distance Counter: 300 cm
Vertical Angle: deg

Photometric Results
Average value (Cd): 768.53
Maximum value (Cd): 1425.57
Horizontal angle: 0.29
Vertical angle: 3.68
Fixture status: Fail
Color Status: Pass

Measurement Type: ICAO grid points

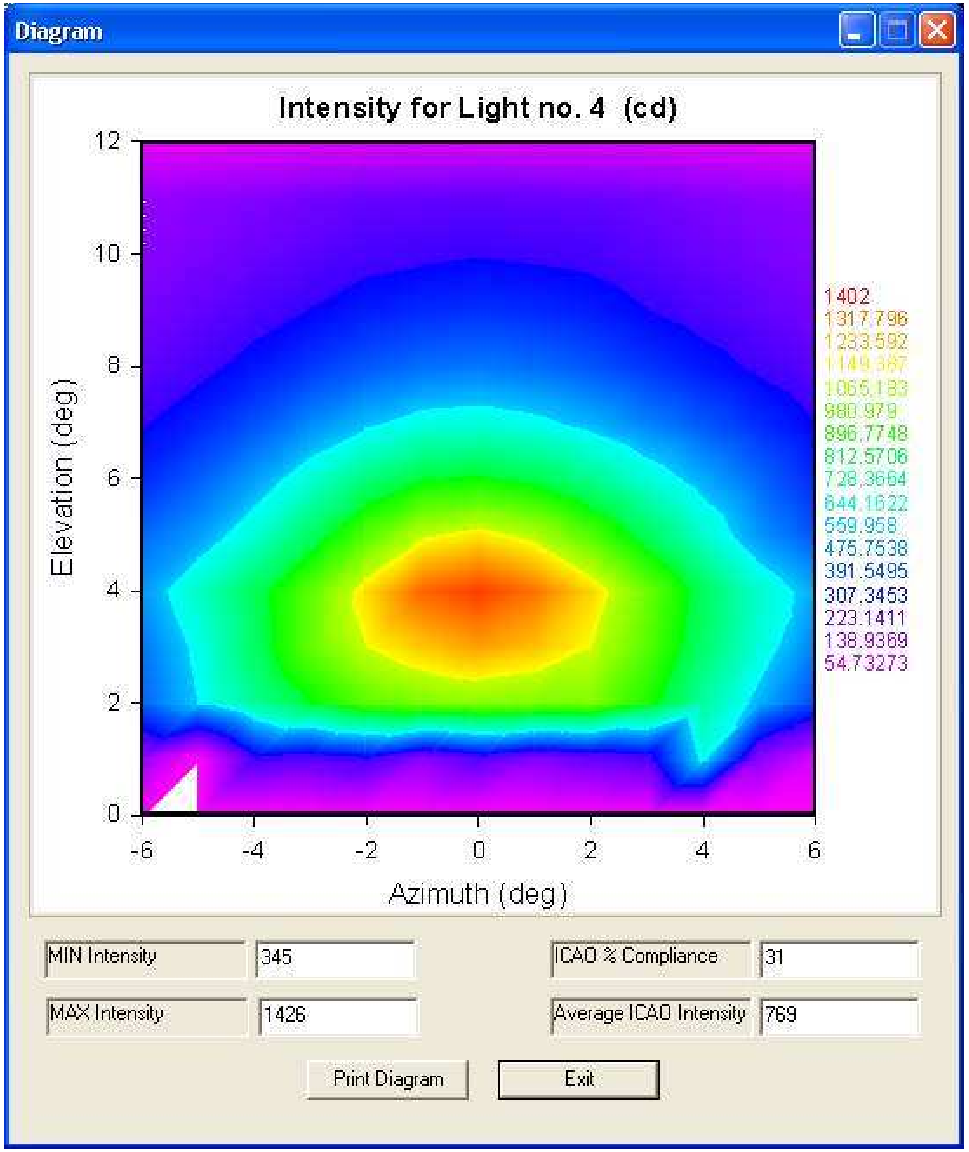
Note: 08 January 2008

Error Message: Test failed: mean level of lamp intensity not compliant

4
4 of 146

🟥 Sensor Bar Status
🟥 Positioning Eq. Status
☐ Enable Automatic Connection

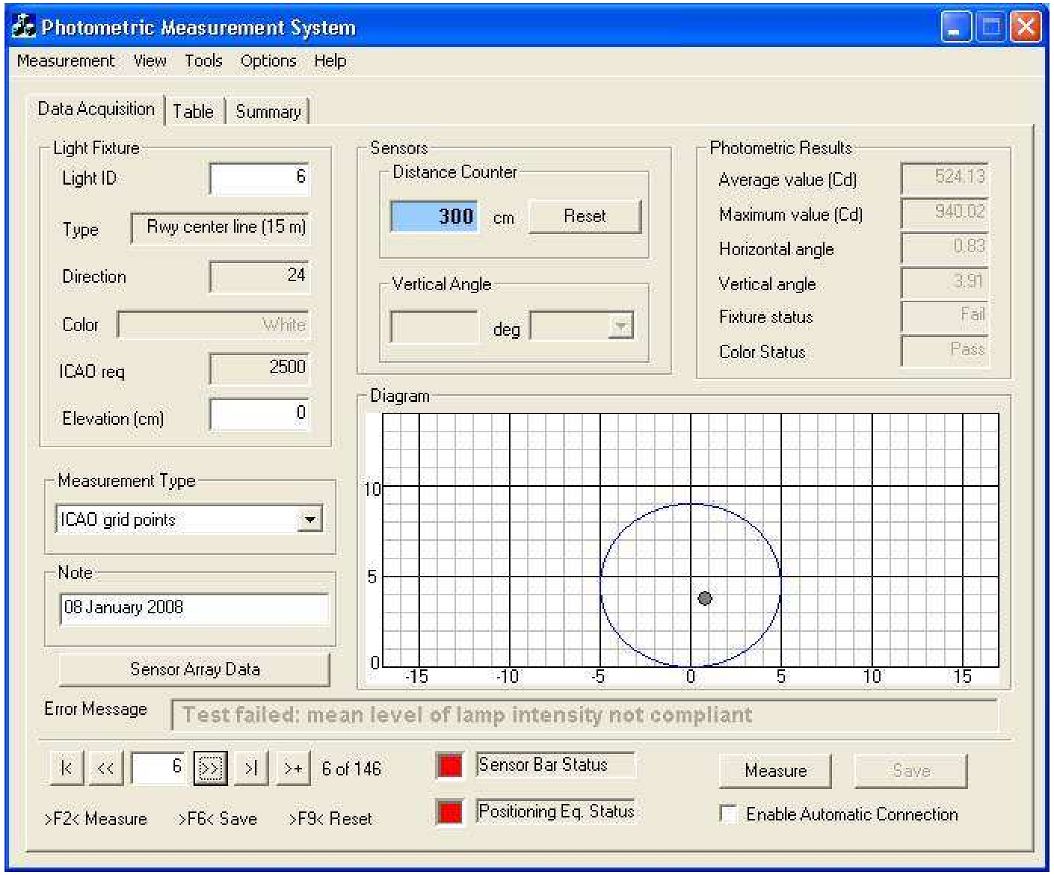
>F2< Measure >F6< Save >F9< Reset



MIN Intensity: 345
MAX Intensity: 1426
ICAO % Compliance: 31
Average ICAO Intensity: 769

SMF – PMS System Software - Reports

Functions for data analysis and reports are the same for SMF/M, SMF/F and SMF/L


Photometric Measurement System
Measurement View Tools Options Help
Data Acquisition
Table
Summary
Light Fixture
Sensors
Distance Counter
Reset
Vertical Angle
Photometric Results
Diagram
10
5
0
-15
-10
-5
0
5
10
15
Measurement Type
Note
Sensor Array Data
|<
<<
>>
>|
>+
Sensor Bar Status
Positioning Eq. Status
Measure
Save
>F2< Measure
>F6< Save
>F9< Reset
☐ Enable Automatic Connection

Light ID: 6

Type: Rwy center line (15 m)

Direction: 24

Color: White

ICAO req: 2500

Elevation (cm): 0

Distance Counter: 300 cm

Vertical Angle: deg

Average value (Cd): 524.13

Maximum value (Cd): 940.02

Horizontal angle: 0.83

Vertical angle: 3.91

Fixture status: Fail

Color Status: Pass

Measurement Type: ICAO grid points

Note: 08 January 2008

Error Message: Test failed: mean level of lamp intensity not compliant

6 6 of 146

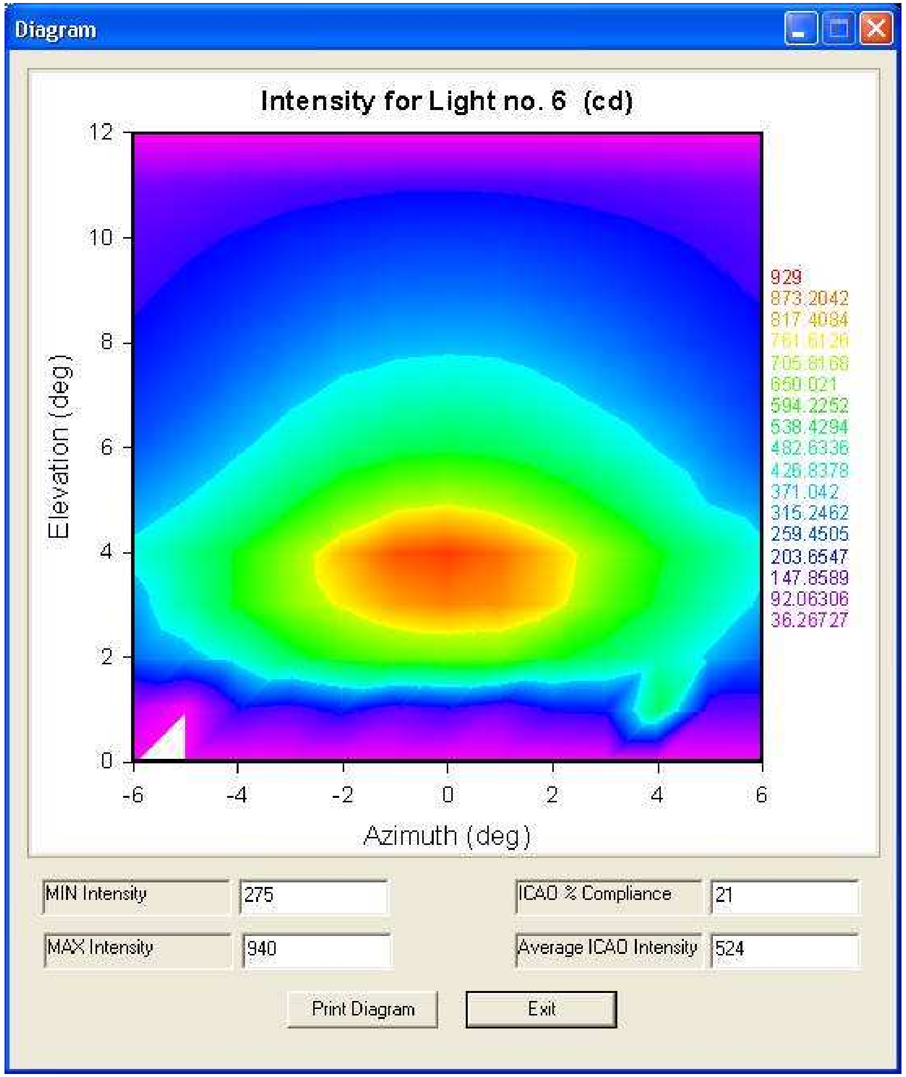


Diagram
Intensity for Light no. 6 (cd)
Elevation (deg)
Azimuth (deg)
12
10
8
6
4
2
0
-6
-4
-2
0
2
4
6
929
873.2042
817.4084
761.6126
705.8168
650.021
594.2252
538.4294
482.6336
426.8378
371.042
315.2462
259.4505
203.6547
147.8589
92.06306
36.26727
Print Diagram
Exit

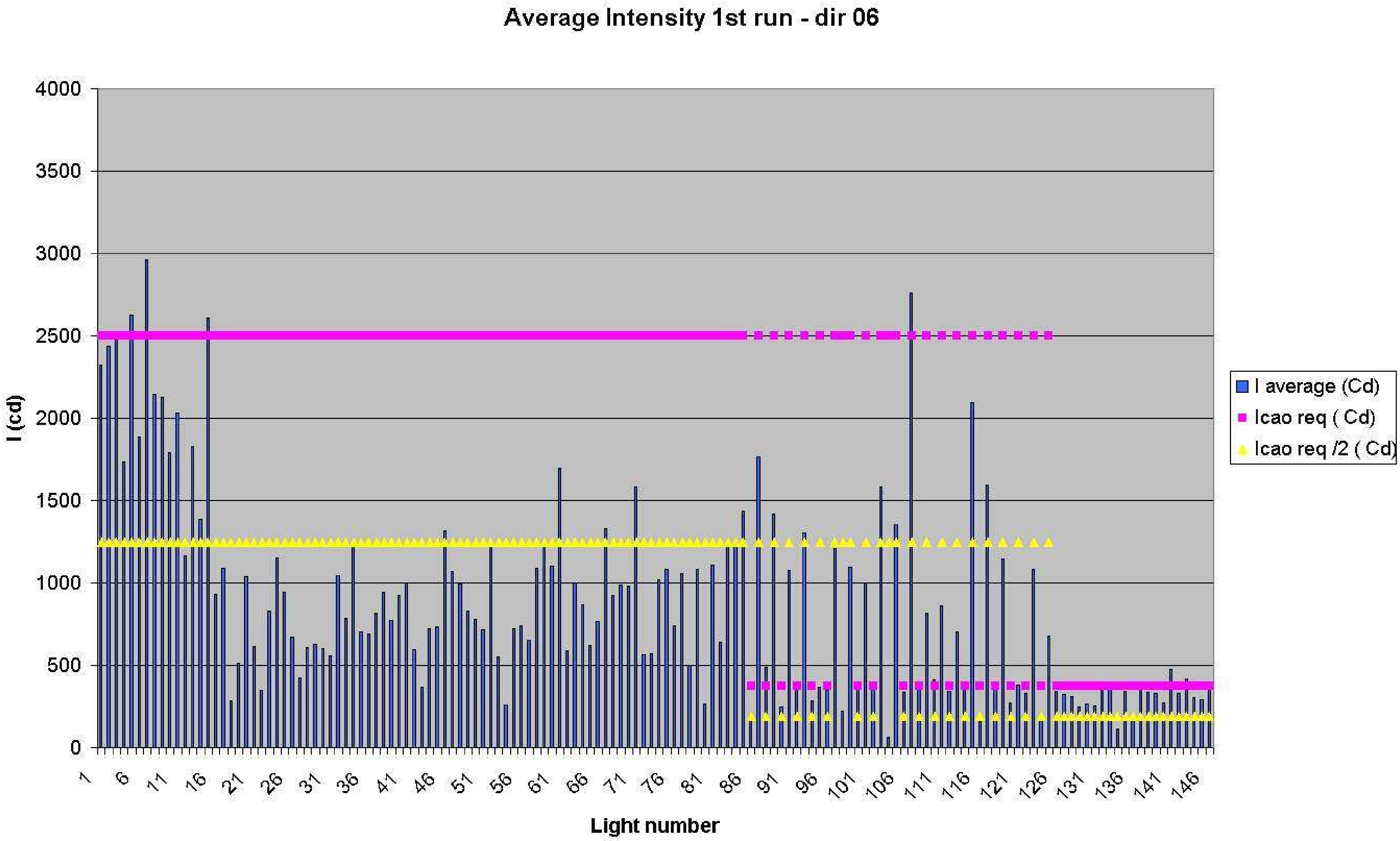
MIN Intensity: 275

MAX Intensity: 940

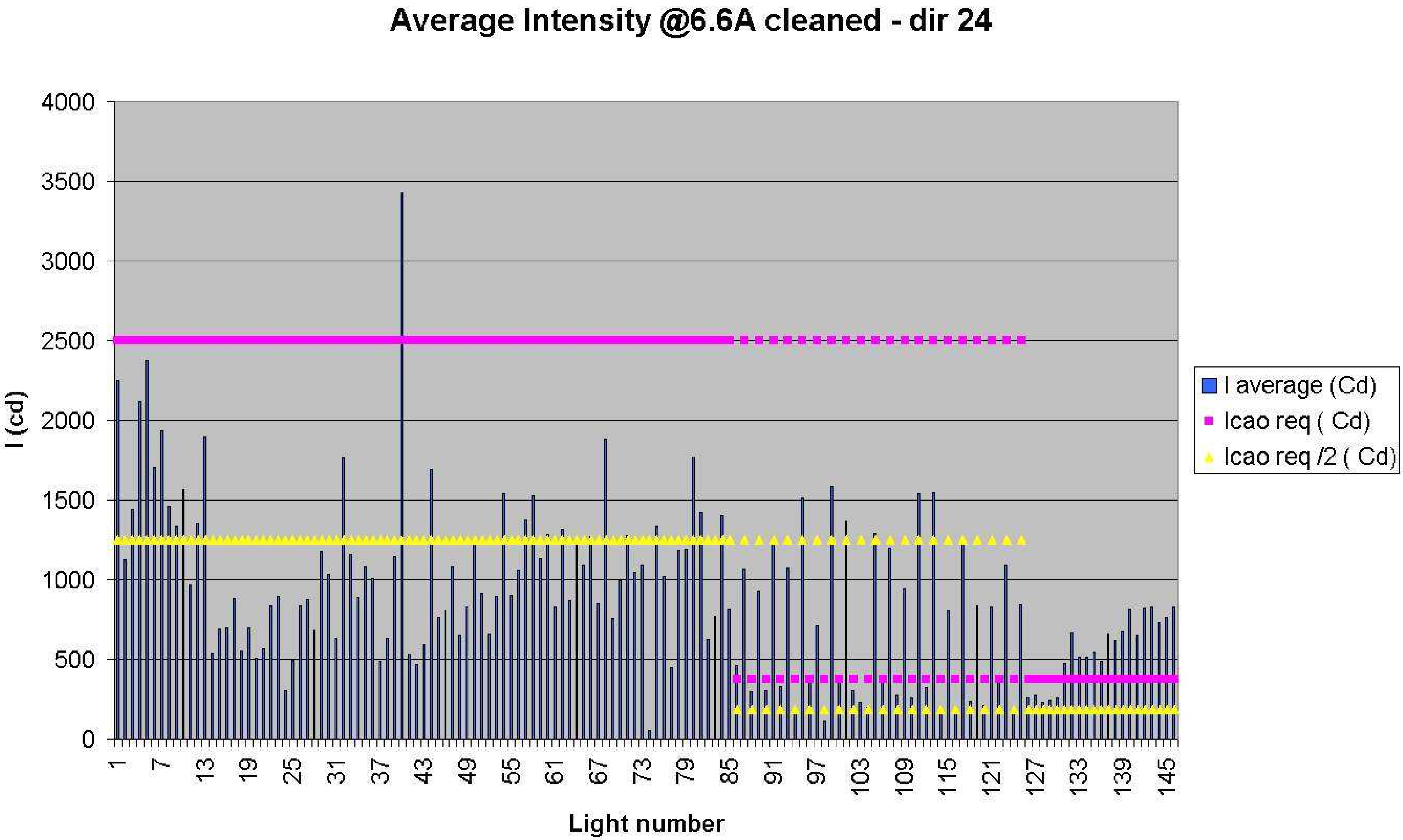
ICAO % Compliance: 21

Average ICAO Intensity: 524

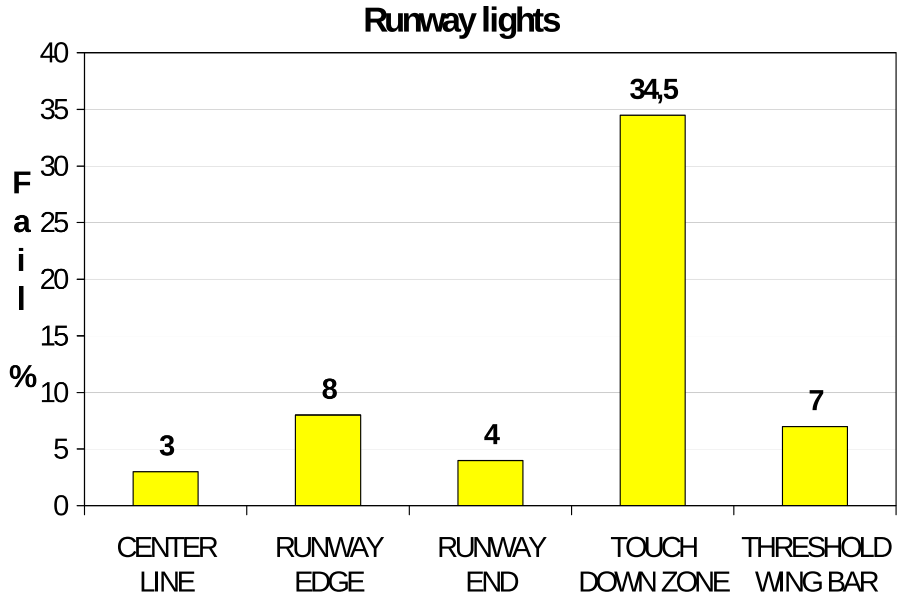
SMF – PMS System Software - AGLS Reports



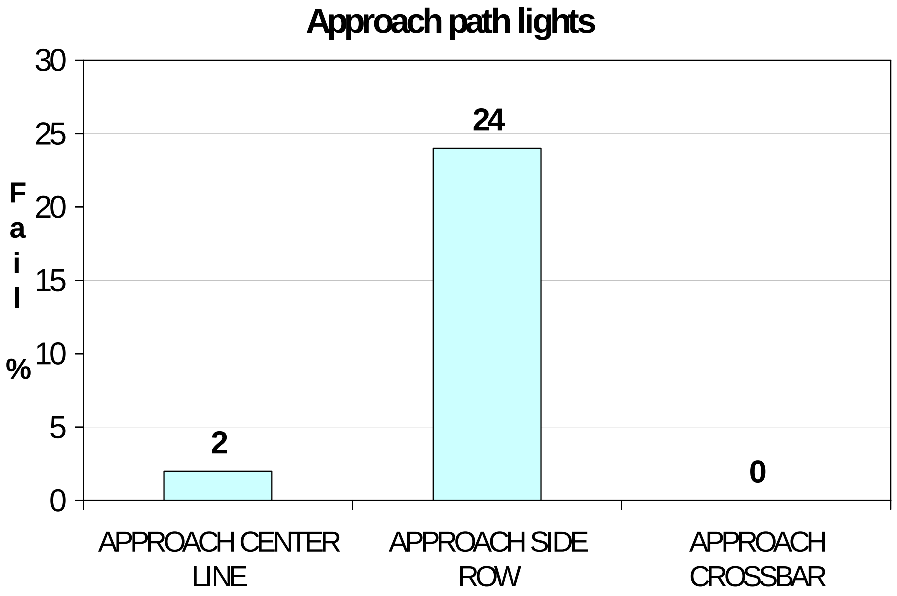
SMF – PMS System Software - AGLS Reports

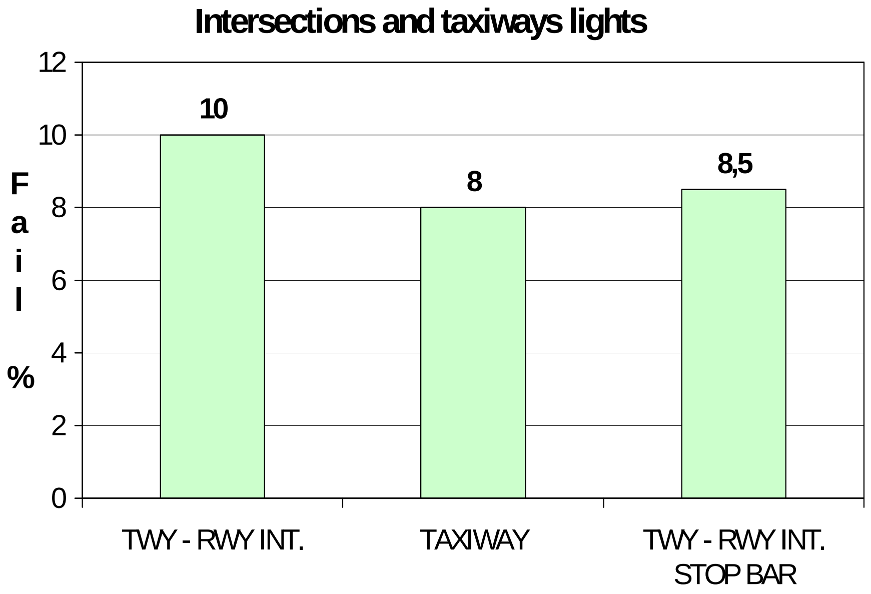


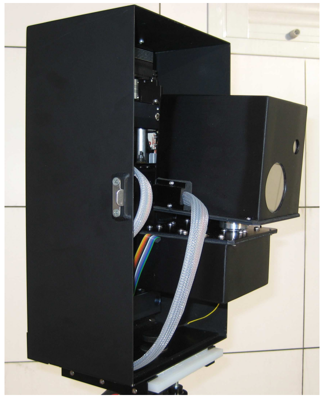
SMF – PMS System Software - AGLS Reports


Runway lights

	AVL	ICAO REQUIREMENT [cd]	Fail %
APP	APPROACH CENTER LINE	20000 (W), 5000 (R)	2
	APPROACH SIDE ROW	5000	24
	APPROACH CROSSBAR	20000	0
RWY	CENTER LINE	5000 (W), 750 (R)	3
	RUNWAY EDGE	10000 (W), 4000 (Y), 2500 (R)	8
	RUNWAY END	2500	4
	TOUCH DOWN ZONE	5000	34,5
	THRESHOLD WING BAR	10000	7
TWY	TWY - RWY INT.	200	10
	TAXIWAY	200	8
	TWY - RWY INT. STOP BAR	200	8,5


Approach path lights


Intersections and taxiways lights



SMF/PAPI

SMF/PAPI – General description

SMF/PAPI has been designed as a stand alone equipment fully devoted to the measurement of the correct setting and alignment of PAPI (Precision Approach Path Indicator) of AGLSs .

SMF/PAPI is built around a special photometric sensor head able to determine via a fully automatic procedure all the alignment parameters of the PAPI unit under test . A simple and comfortable procedure running on a portable PC will provide the maintenance operator with the precise indications about how to adjust the PAPI mechanical trimmers in order to meet the perfect alignment.

The measurement procedure of SMF/PAPI is quick and easy (less than 10 minutes per unit) and can be repeated by the user periodically or when some special maintenance is requested for the unit (i.e unit repair or replacement).

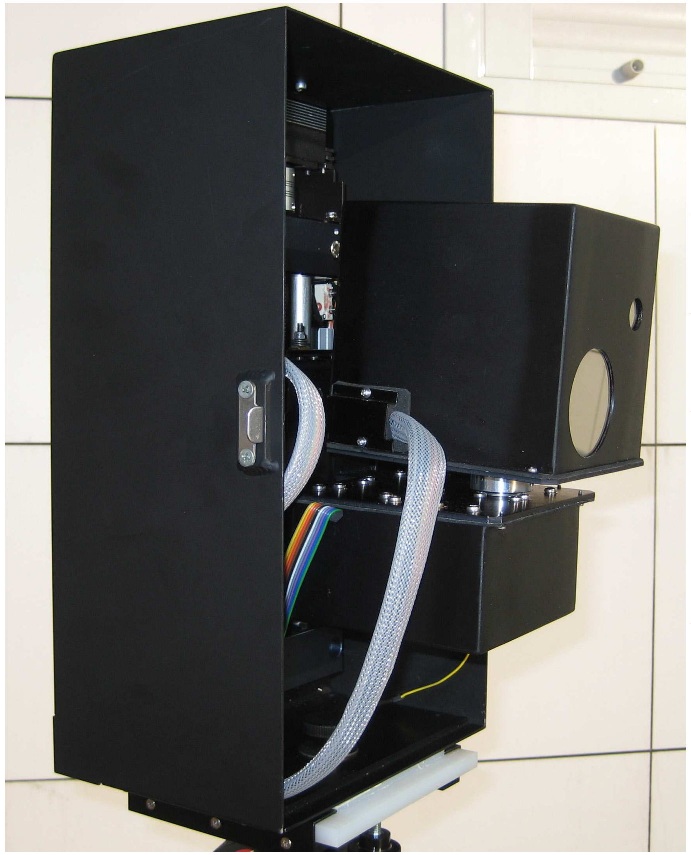
The user is therefore allowed to ask for a flight check only when it's strictly needed (i.e only for check of harmonization of PAPI lights with ILS), having previously used SMF/PAPI for alignment and monitoring, thus saving time and money.

The SMF/PAPI system can save in the system data base all the PAPIs settings (i.e the elevation angles of each unit) set at the time of the certification flight , with or without ILS , and get them as the reference values for further measurements. The user is therefore guaranteed that should the units need to be realigned after a maintenance intervention , they always will assume the same parameters set at the time of certification flight.

A very important feature allowed by the high level of accuracy and precision of SMF/PAPI consists in the possibility to use the PAPI lights as reference for checking the ILS alignment . In fact a monthly measurement of PAPI units allows the user to check and maintain a perfect alignment of PAPI lights so that should occur a misalignment with ILS , it must be investigated as depending by ILS equipment.

SMF/PAPI is a patented product and has been certified by the Italian CAA ENAC, Ente per l'Aviazione Civile as conforming to APS -01 recommendation for equipment for PAPI alignment in alternative to flight check.

SMF/PAPI – Head components



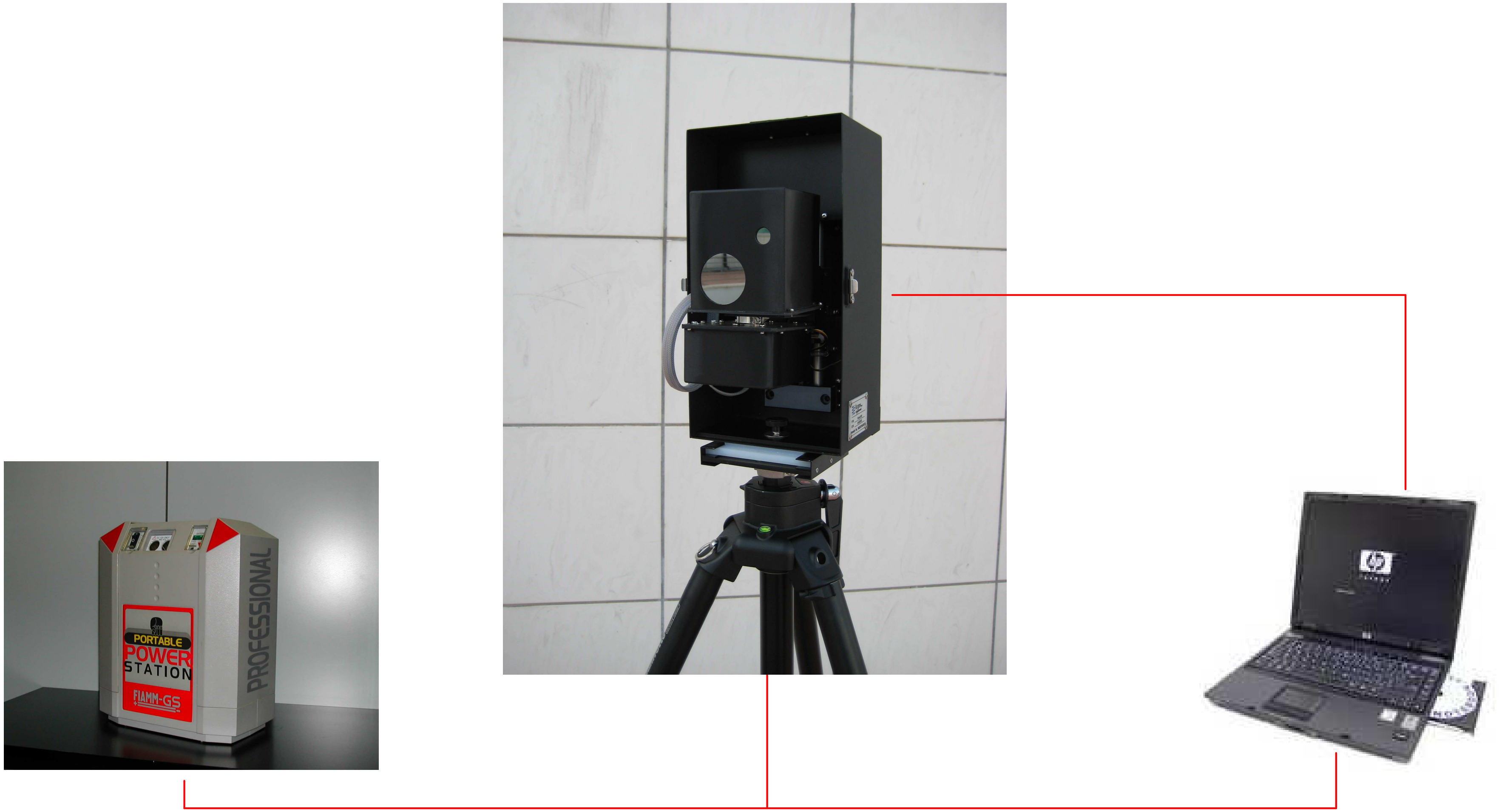
ALIGNMENT & MEASUREMENT HEAD

POINTING DIGITAL CAMERA

MAIN DIGITAL CAMERA

STABILIZED PLATFORM

SMF/PAPI – System components

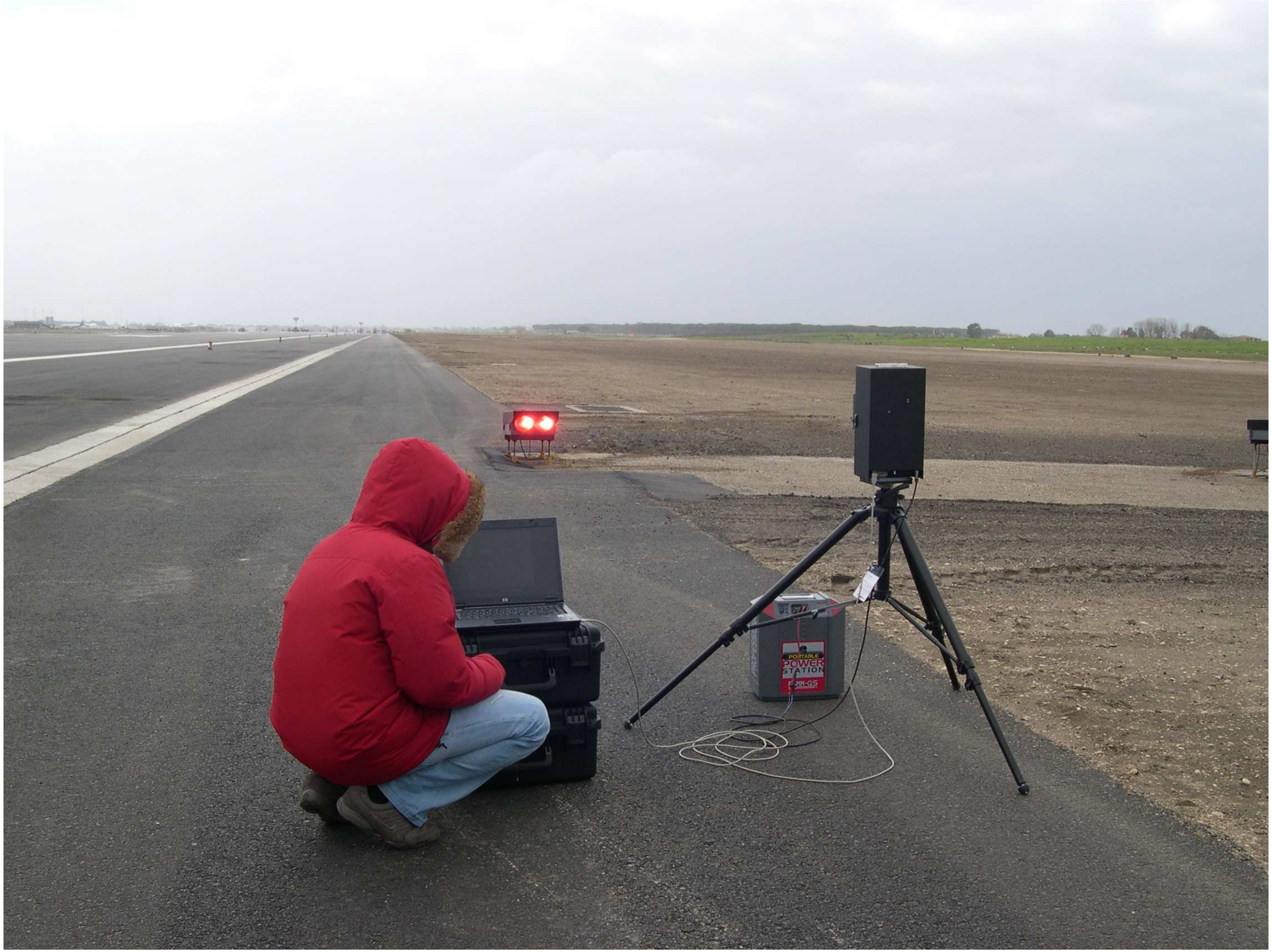

PORTABLE
POWER
STATION
FIAMM-GS
PROFESSIONAL

MAIN UNIT and TRIPOD

12VDC PORTABLE STATION

SMF/PAPI SYSTEM PC

SMF/PAPI - Operations at Fiumicino Airport

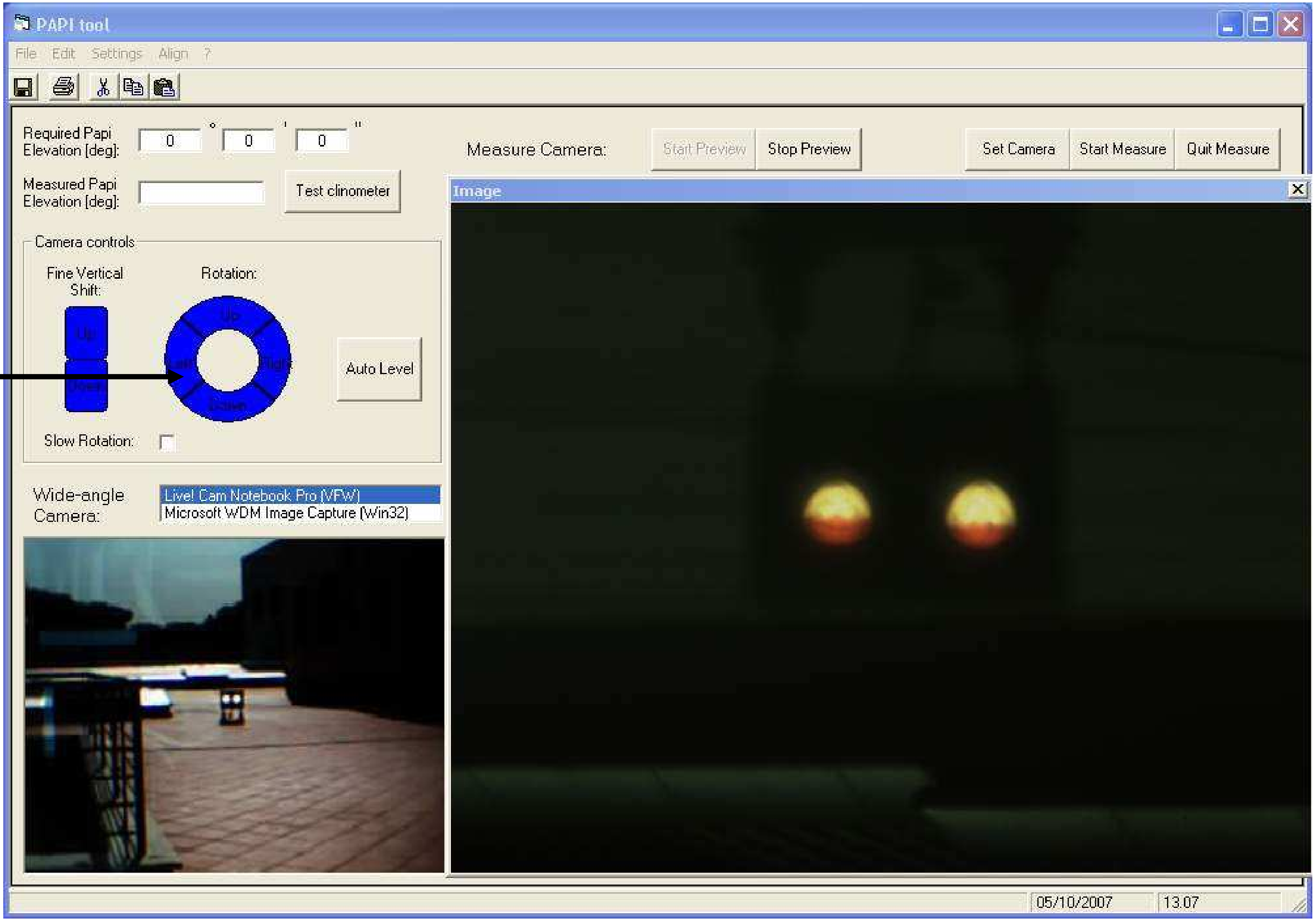

PORTABLE
POWER
STATION

SMF PAPI – Measurement Procedure

- **SMF/PAPI equipment is positioned between 12 and 15 m far from PAPI under measurement**
- **Operator targets the PAPI moving the head of SMF/PAPI via the joystick and the built in camera**
- **SMF/PAPI automatically stabilizes itself in the horizontal position**
- **SMF/PAPI starts the observation of PAPI light beam emulating the eye of the pilot in the search of red/white transition**
- **SMF/PAPI automatically looks for the axial alignment of the main observation camera with the light beam**
- **Once the axial alignment is reached, SMF/PAPI automatically reads the inclination using very high precision MIL electronic clinometer**
- **SMF/PAPI automatically gives feedback to the operator about the corrections to be done on PAPI legs to get an alignment in full accordance with the installation requirements**

SMF/PAPI - Measurement Procedure : Operator targets the unit

JOYSTICK


PAPI tool
File Edit Settings Align ?
Measure Camera:
Start Preview
Stop Preview
Set Camera
Start Measure
Quit Measure
Test clinometer
Image
Camera controls
Fine Vertical Shift:
Up
Down
Rotation:
Up
Left
Right
Down
Auto Level
Slow Rotation: ☐

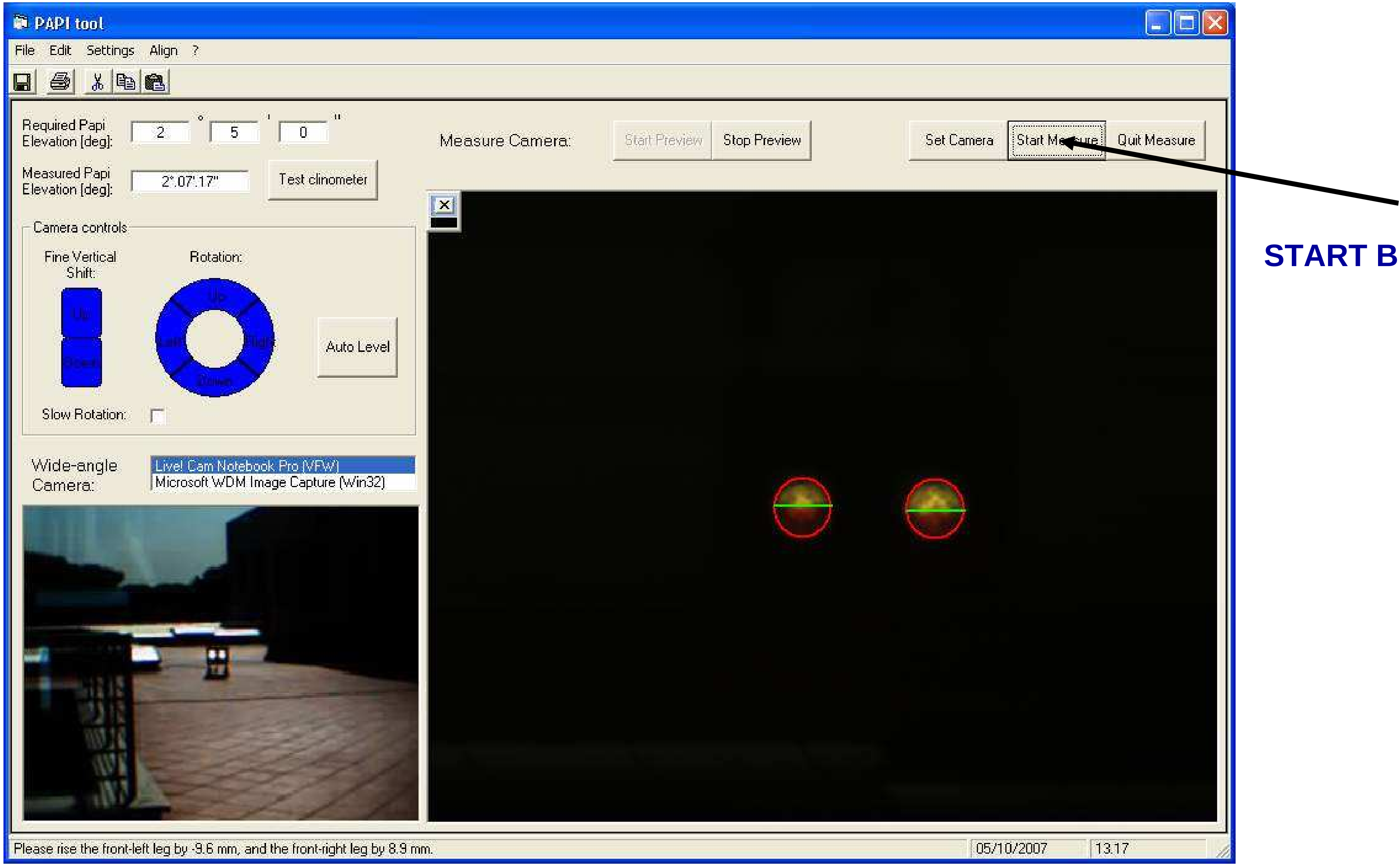
Required Papi Elevation [deg]: 0 ° 0 ' 0 "

Measured Papi Elevation [deg]:

Wide-angle Camera:
Live! Cam Notebook Pro (VFW)
Microsoft WDM Image Capture (Win32)

05/10/2007 13.07

SMF/PAPI Measurement Procedure: Start & Running


PAPI tool
File
Edit
Settings
Align
?
Test clinometer
Measure Camera:
Start Preview
Stop Preview
Set Camera
Start Measure
Quit Measure
Camera controls
Fine Vertical Shift:
Up
Down
Rotation:
Up
Left
Right
Down
Auto Level

Required Papi Elevation [deg]: 2 ° 5 ' 0 ''

Measured Papi Elevation [deg]: 2°.07'.17''

Slow Rotation: ☐

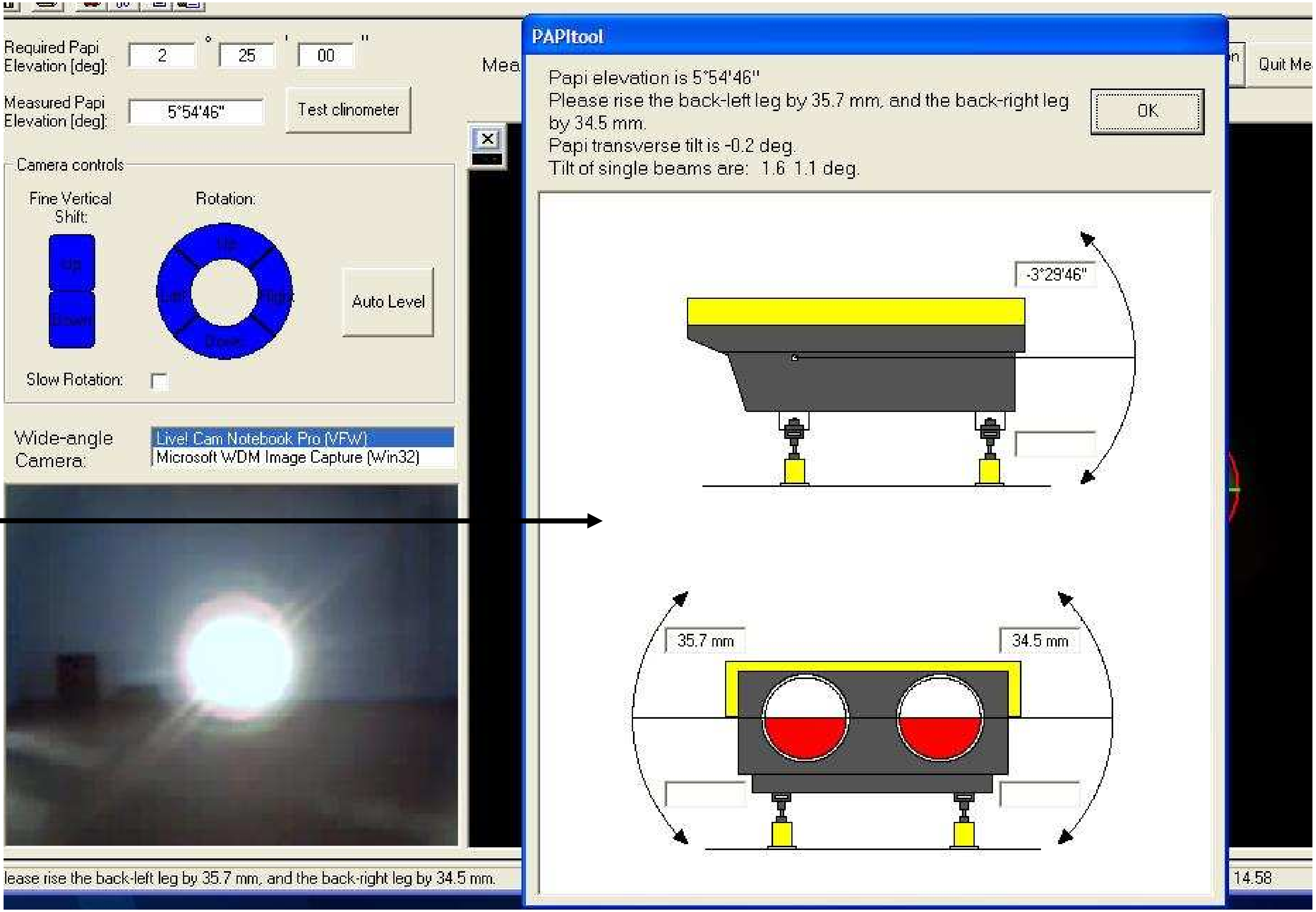
Wide-angle Camera:
Live! Cam Notebook Pro (VFW)
Microsoft WDM Image Capture (Win32)

Please rise the front-left leg by -9.6 mm, and the front-right leg by 8.9 mm. 05/10/2007 13.17

START BUTTON

SMF/PAPI – End of Measurement

RESULT



Required Papi Elevation [deg]: 2 ° 25 ' 00 "

Measured Papi Elevation [deg]: 5°54'46"

Wide-angle Camera: Live! Cam Notebook Pro (VFW) / Microsoft WDM Image Capture (Win32)

PAPItool

Papi elevation is 5°54'46"
Please rise the back-left leg by 35.7 mm, and the back-right leg by 34.5 mm.
Papi transverse tilt is -0.2 deg.
Tilt of single beams are: 1.6 1.1 deg.

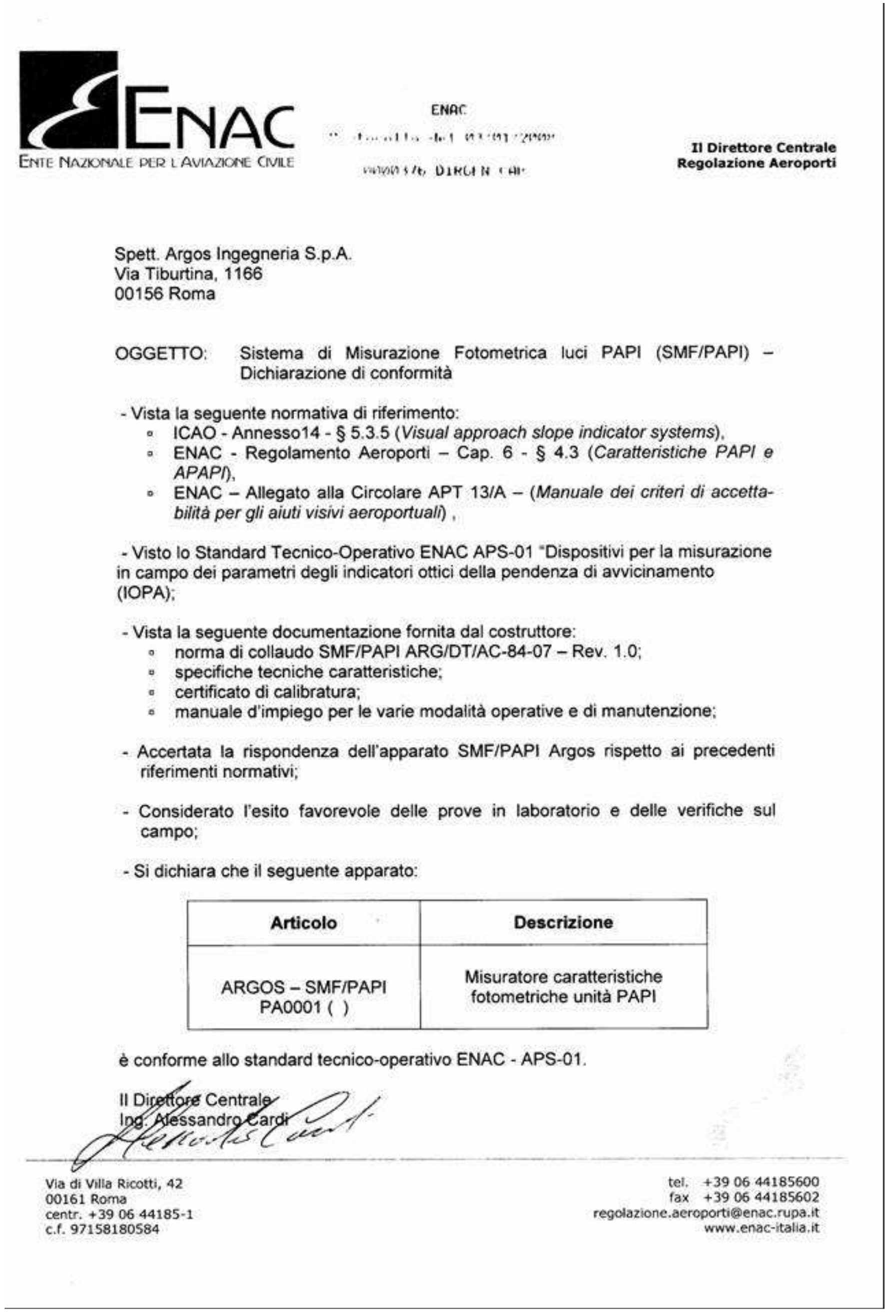
lease rise the back-left leg by 35.7 mm, and the back-right leg by 34.5 mm.

Test clinometer
Camera controls
Fine Vertical Shift:
Up
Down
Rotation:
Up
Left
Right
Down
Auto Level
Slow Rotation: ☐
Mea
OK
Quit Me
-3°29'46"
35.7 mm
34.5 mm
14.58

SMF/PAPI – System Performances

- **PRECISION : better than 1’**
- **ACCURACY : better than 1’**
- **DURATION OF TEST PER PAPI UNIT : 10 minutes**
- **NIGHT AND DAY OPERATION (direct sun illumination not allowed)**
- **FULLY AUTOMATIC OPERATIONS**
- **INSTANT FEEDBACK TO CORRECT THE ALIGNMENT**
- **MAX OPERATING TEMPERATURE : 45°C**
- **EASY TO USE**
- **12 VDC BATTERY OPERATED**
- **HAND PORTABLE**

SMF/PAPI - Certification from Italian CAA-ENAC



ENTE NAZIONALE PER L'AVIAZIONE CIVILE

ENAC
[illegible]
[illegible] DIRGEN CAP

Il Direttore Centrale
Regolazione Aeroporti

Spett. Argos Ingegneria S.p.A.
Via Tiburtina, 1166
00156 Roma

OGGETTO: Sistema di Misurazione Fotometrica luci PAPI (SMF/PAPI) – Dichiarazione di conformità

- Vista la seguente normativa di riferimento:
  - ICAO - Annesso14 - § 5.3.5 (*Visual approach slope indicator systems*),
  - ENAC - Regolamento Aeroporti – Cap. 6 - § 4.3 (*Caratteristiche PAPI e APAPI*),
  - ENAC – Allegato alla Circolare APT 13/A – (*Manuale dei criteri di accettabilità per gli aiuti visivi aeroportuali*) ,

- Visto lo Standard Tecnico-Operativo ENAC APS-01 "Dispositivi per la misurazione in campo dei parametri degli indicatori ottici della pendenza di avvicinamento (IOPA);

- Vista la seguente documentazione fornita dal costruttore:
  - norma di collaudo SMF/PAPI ARG/DT/AC-84-07 – Rev. 1.0;
  - specifiche tecniche caratteristiche;
  - certificato di calibratura;
  - manuale d'impiego per le varie modalità operative e di manutenzione;

- Accertata la rispondenza dell'apparato SMF/PAPI Argos rispetto ai precedenti riferimenti normativi;

- Considerato l'esito favorevole delle prove in laboratorio e delle verifiche sul campo;

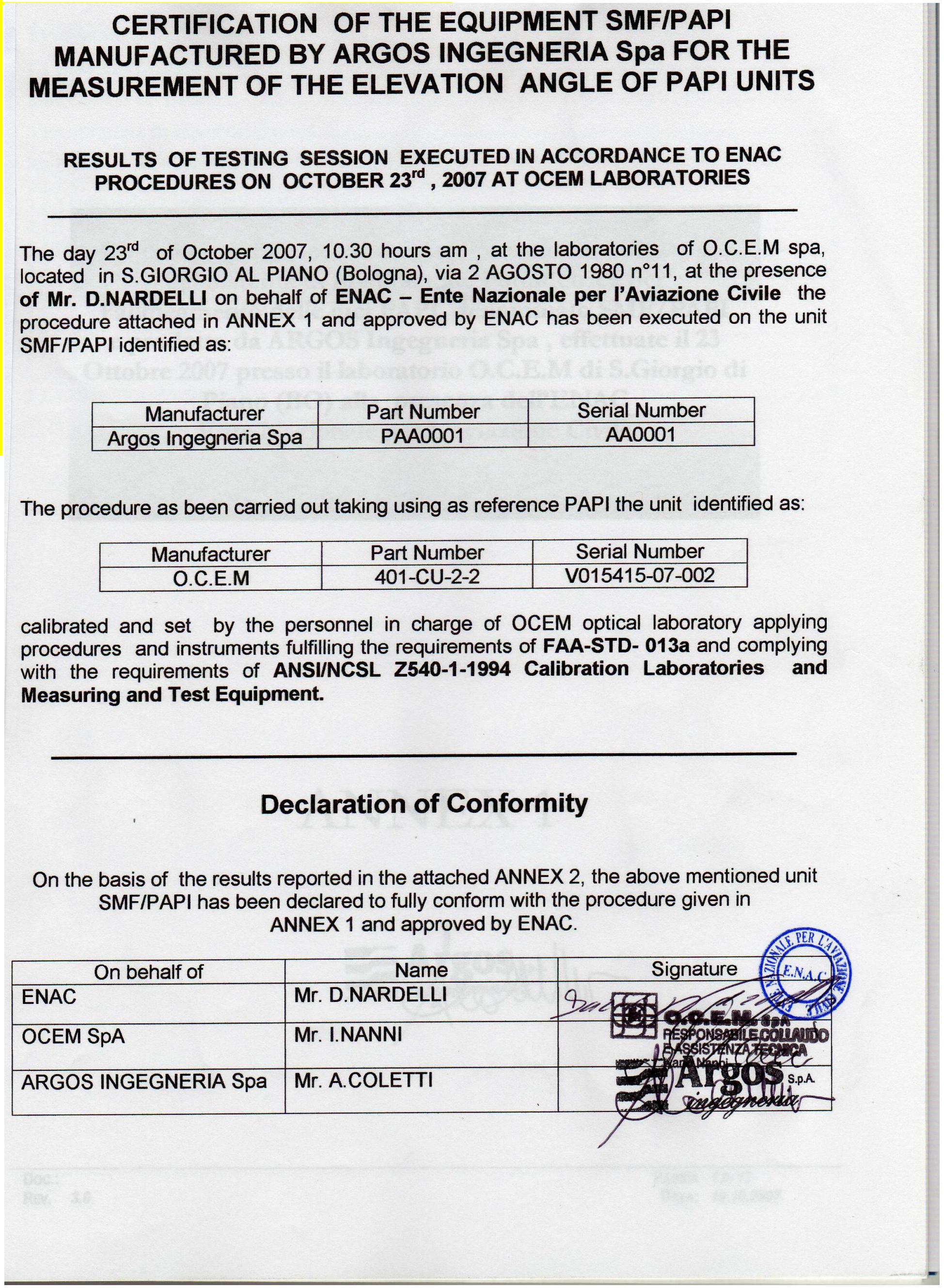
- Si dichiara che il seguente apparato:

Articolo	**Descrizione**
ARGOS – SMF/PAPI PA0001 ( )	Misuratore caratteristiche fotometriche unità PAPI

è conforme allo standard tecnico-operativo ENAC - APS-01.

Il Direttore Centrale
Ing. Alessandro Cardi

SMF/PAPI – Lab test by Italian CAA-ENAC



CERTIFICATION OF THE EQUIPMENT SMF/PAPI MANUFACTURED BY ARGOS INGEGNERIA Spa FOR THE MEASUREMENT OF THE ELEVATION ANGLE OF PAPI UNITS

RESULTS OF TESTING SESSION EXECUTED IN ACCORDANCE TO ENAC PROCEDURES ON OCTOBER 23rd , 2007 AT OCEM LABORATORIES

The day 23rd of October 2007, 10.30 hours am , at the laboratories of O.C.E.M spa, located in S.GIORGIO AL PIANO (Bologna), via 2 AGOSTO 1980 n°11, at the presence **of Mr. D.NARDELLI** on behalf of **ENAC – Ente Nazionale per l'Aviazione Civile** the procedure attached in ANNEX 1 and approved by ENAC has been executed on the unit SMF/PAPI identified as:

Manufacturer	Part Number	Serial Number
Argos Ingegneria Spa	PAA0001	AA0001

The procedure as been carried out taking using as reference PAPI the unit identified as:

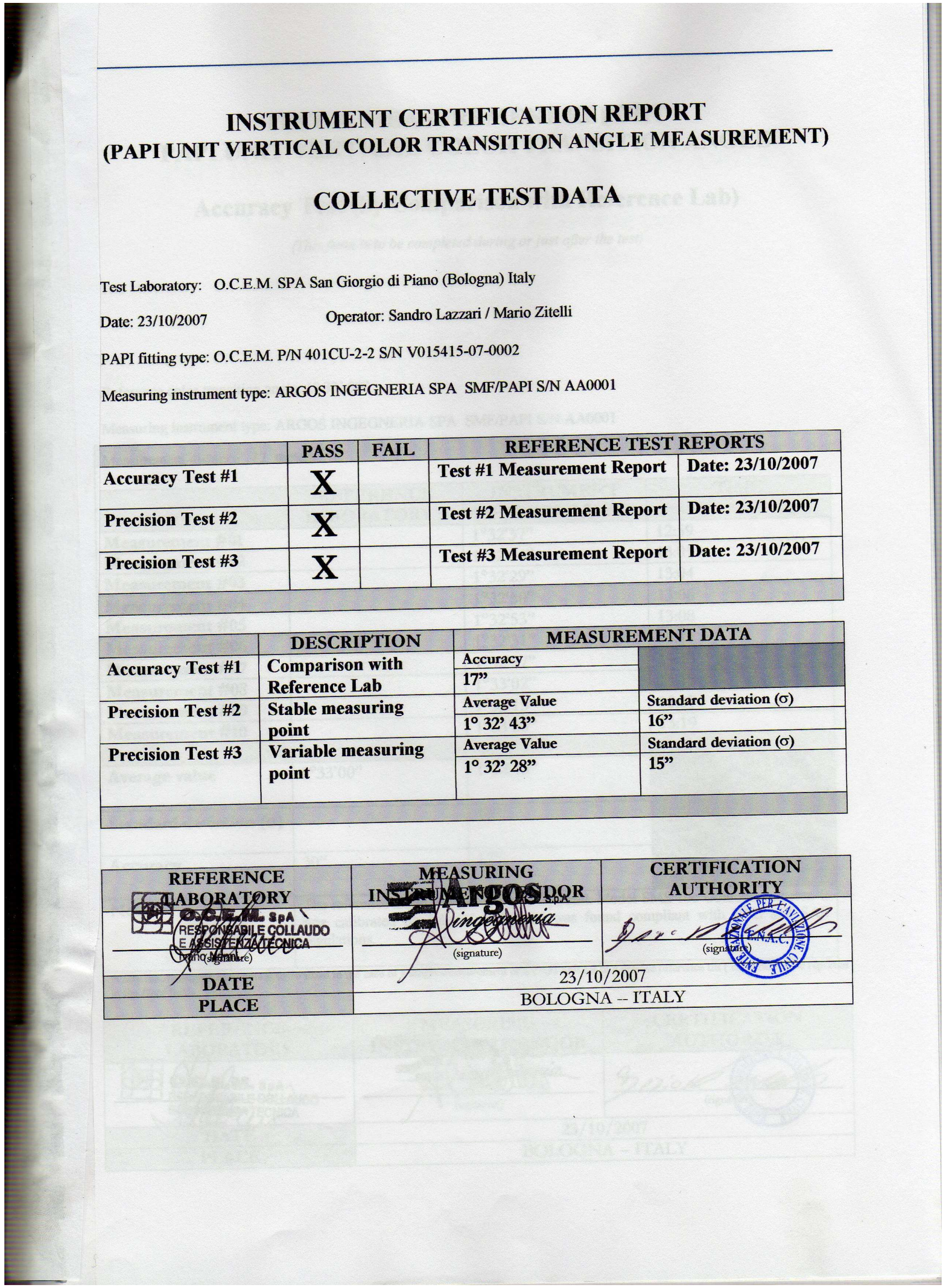
Manufacturer	Part Number	Serial Number
O.C.E.M	401-CU-2-2	V015415-07-002

calibrated and set by the personnel in charge of OCEM optical laboratory applying procedures and instruments fulfilling the requirements of **FAA-STD- 013a** and complying with the requirements of **ANSI/NCSL Z540-1-1994 Calibration Laboratories and Measuring and Test Equipment.**

Declaration of Conformity

On the basis of the results reported in the attached ANNEX 2, the above mentioned unit SMF/PAPI has been declared to fully conform with the procedure given in ANNEX 1 and approved by ENAC.

On behalf of	Name	Signature
ENAC	Mr. D.NARDELLI	
OCEM SpA	Mr. I.NANNI	O.C.E.M. SpA RESPONSABILE COLLAUDO E ASSISTENZA TECNICA Ivano Nanni
ARGOS INGEGNERIA Spa	Mr. A.COLETTI	Argos S.p.A. ingegneria



INSTRUMENT CERTIFICATION REPORT
(PAPI UNIT VERTICAL COLOR TRANSITION ANGLE MEASUREMENT)

COLLECTIVE TEST DATA

Test Laboratory: O.C.E.M. SPA San Giorgio di Piano (Bologna) Italy

Date: 23/10/2007 Operator: Sandro Lazzari / Mario Zitelli

PAPI fitting type: O.C.E.M. P/N 401CU-2-2 S/N V015415-07-0002

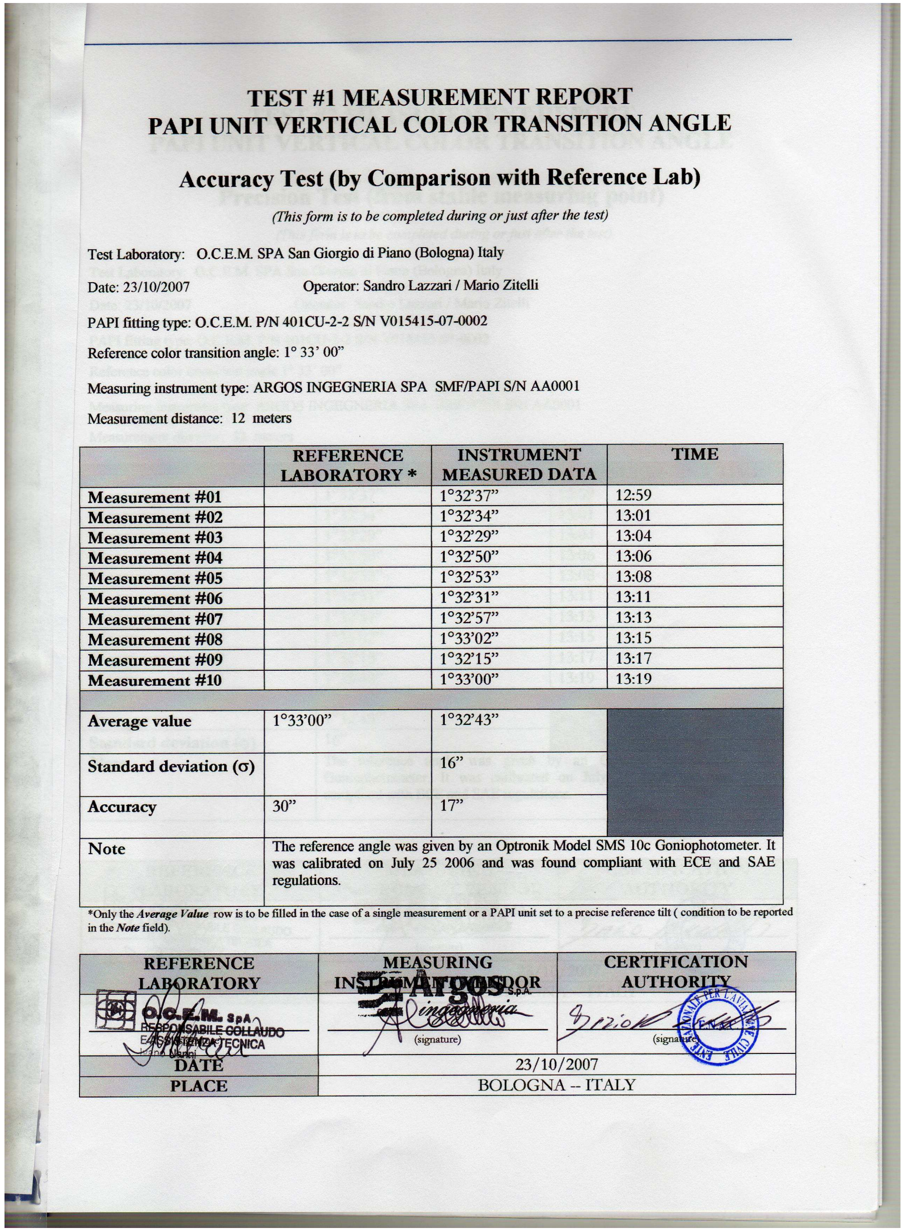
Measuring instrument type: ARGOS INGEGNERIA SPA SMF/PAPI S/N AA0001

	PASS	FAIL	REFERENCE TEST REPORTS	
Accuracy Test #1	X		**Test #1 Measurement Report**	**Date: 23/10/2007**
Precision Test #2	X		**Test #2 Measurement Report**	**Date: 23/10/2007**
Precision Test #3	X		**Test #3 Measurement Report**	**Date: 23/10/2007**

	DESCRIPTION	MEASUREMENT DATA	
Accuracy Test #1	**Comparison with Reference Lab**	Accuracy 17"	
Precision Test #2	**Stable measuring point**	Average Value 1° 32' 43"	Standard deviation (σ) 16"
Precision Test #3	**Variable measuring point**	Average Value 1° 32' 28"	Standard deviation (σ) 15"

REFERENCE LABORATORY	MEASURING INSTRUMENT VENDOR	CERTIFICATION AUTHORITY
O.C.E.M. SpA RESPONSABILE COLLAUDO E ASSISTENZA TECNICA Ivano Nanni (signature)	Argos S.p.A. ingegneria (signature)	E.N.A.C. (signature)
DATE	23/10/2007	
PLACE	BOLOGNA -- ITALY	

SMF/PAPI – Lab test by Italian CAA-ENAC



TEST #1 MEASUREMENT REPORT
PAPI UNIT VERTICAL COLOR TRANSITION ANGLE

Accuracy Test (by Comparison with Reference Lab)

(This form is to be completed during or just after the test)

Test Laboratory: O.C.E.M. SPA San Giorgio di Piano (Bologna) Italy

Date: 23/10/2007 Operator: Sandro Lazzari / Mario Zitelli

PAPI fitting type: O.C.E.M. P/N 401CU-2-2 S/N V015415-07-0002

Reference color transition angle: 1° 33’ 00”

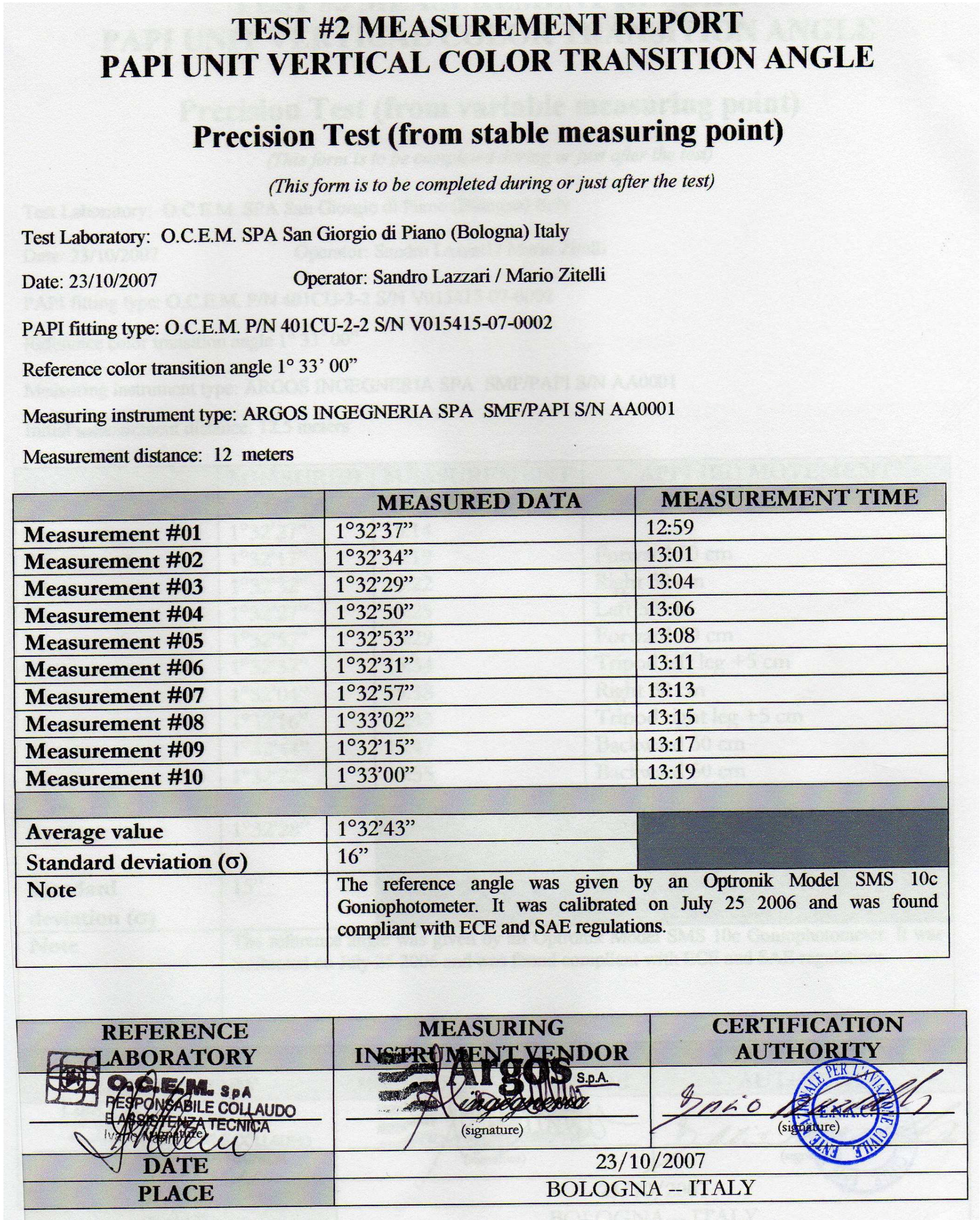
Measuring instrument type: ARGOS INGEGNERIA SPA SMF/PAPI S/N AA0001

Measurement distance: 12 meters

	REFERENCE LABORATORY *	INSTRUMENT MEASURED DATA	TIME
Measurement #01		1°32’37”	12:59
Measurement #02		1°32’34”	13:01
Measurement #03		1°32’29”	13:04
Measurement #04		1°32’50”	13:06
Measurement #05		1°32’53”	13:08
Measurement #06		1°32’31”	13:11
Measurement #07		1°32’57”	13:13
Measurement #08		1°33’02”	13:15
Measurement #09		1°32’15”	13:17
Measurement #10		1°33’00”	13:19
Average value	1°33’00”	1°32’43”	
Standard deviation (σ)		16”	
Accuracy	30”	17”	
Note	The reference angle was given by an Optronik Model SMS 10c Goniophotometer. It was calibrated on July 25 2006 and was found compliant with ECE and SAE regulations.		

*Only the *Average Value* row is to be filled in the case of a single measurement or a PAPI unit set to a precise reference tilt (condition to be reported in the *Note* field).

REFERENCE LABORATORY	MEASURING INSTRUMENT VENDOR	CERTIFICATION AUTHORITY
O.C.E.M. SpA RESPONSABILE COLLAUDO E ASSISTENZA TECNICA (signature)	Argos S.p.A. ingegneria (signature)	E.N.A.C. (signature)
DATE	23/10/2007	
PLACE	BOLOGNA -- ITALY	



TEST #2 MEASUREMENT REPORT
PAPI UNIT VERTICAL COLOR TRANSITION ANGLE

Precision Test (from stable measuring point)

(This form is to be completed during or just after the test)

Test Laboratory: O.C.E.M. SPA San Giorgio di Piano (Bologna) Italy

Date: 23/10/2007 Operator: Sandro Lazzari / Mario Zitelli

PAPI fitting type: O.C.E.M. P/N 401CU-2-2 S/N V015415-07-0002

Reference color transition angle 1° 33’ 00”

Measuring instrument type: ARGOS INGEGNERIA SPA SMF/PAPI S/N AA0001

Measurement distance: 12 meters

	MEASURED DATA	MEASUREMENT TIME
Measurement #01	1°32’37”	12:59
Measurement #02	1°32’34”	13:01
Measurement #03	1°32’29”	13:04
Measurement #04	1°32’50”	13:06
Measurement #05	1°32’53”	13:08
Measurement #06	1°32’31”	13:11
Measurement #07	1°32’57”	13:13
Measurement #08	1°33’02”	13:15
Measurement #09	1°32’15”	13:17
Measurement #10	1°33’00”	13:19
Average value	1°32’43”	
Standard deviation (σ)	16”	
Note	The reference angle was given by an Optronik Model SMS 10c Goniophotometer. It was calibrated on July 25 2006 and was found compliant with ECE and SAE regulations.	

REFERENCE LABORATORY	MEASURING INSTRUMENT VENDOR	CERTIFICATION AUTHORITY
O.C.E.M. SpA RESPONSABILE COLLAUDO E ASSISTENZA TECNICA (signature)	Argos S.p.A. ingegneria (signature)	E.N.A.C. (signature)
DATE	23/10/2007	
PLACE	BOLOGNA -- ITALY	