Argos Ingegneria S.p.A.

October 2009

SMF/M

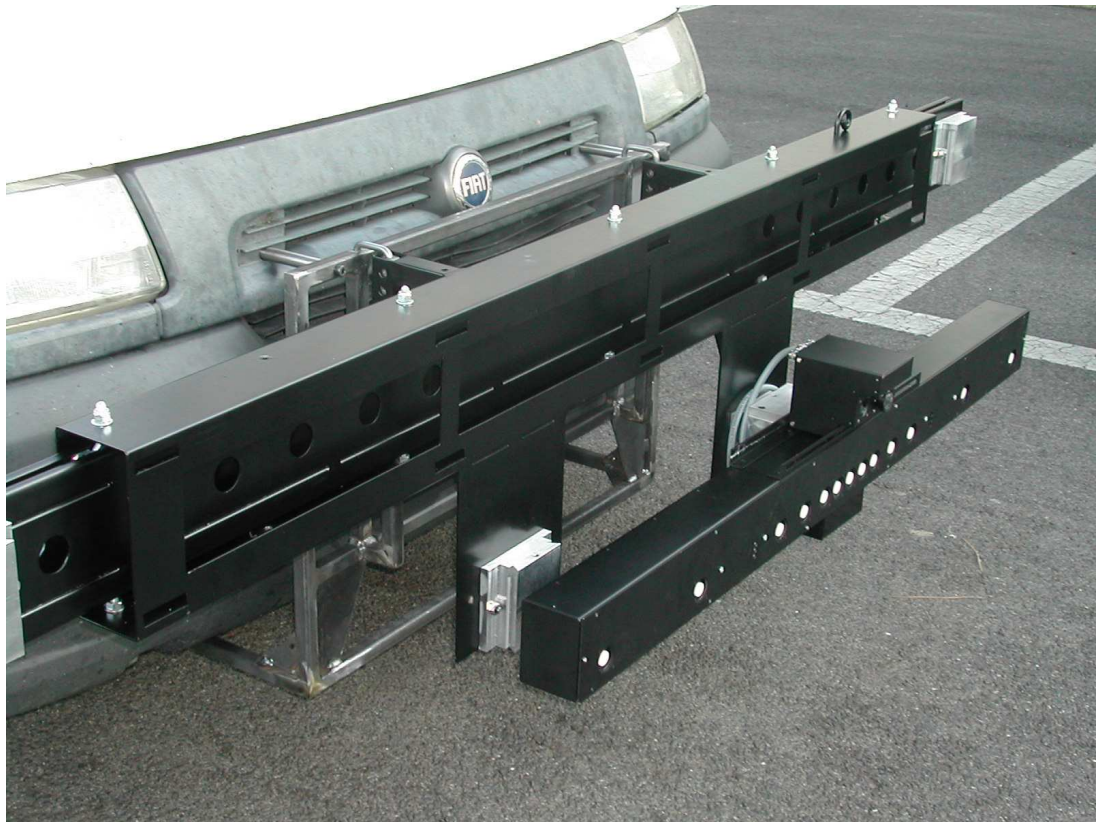
SMF/M – General description

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.

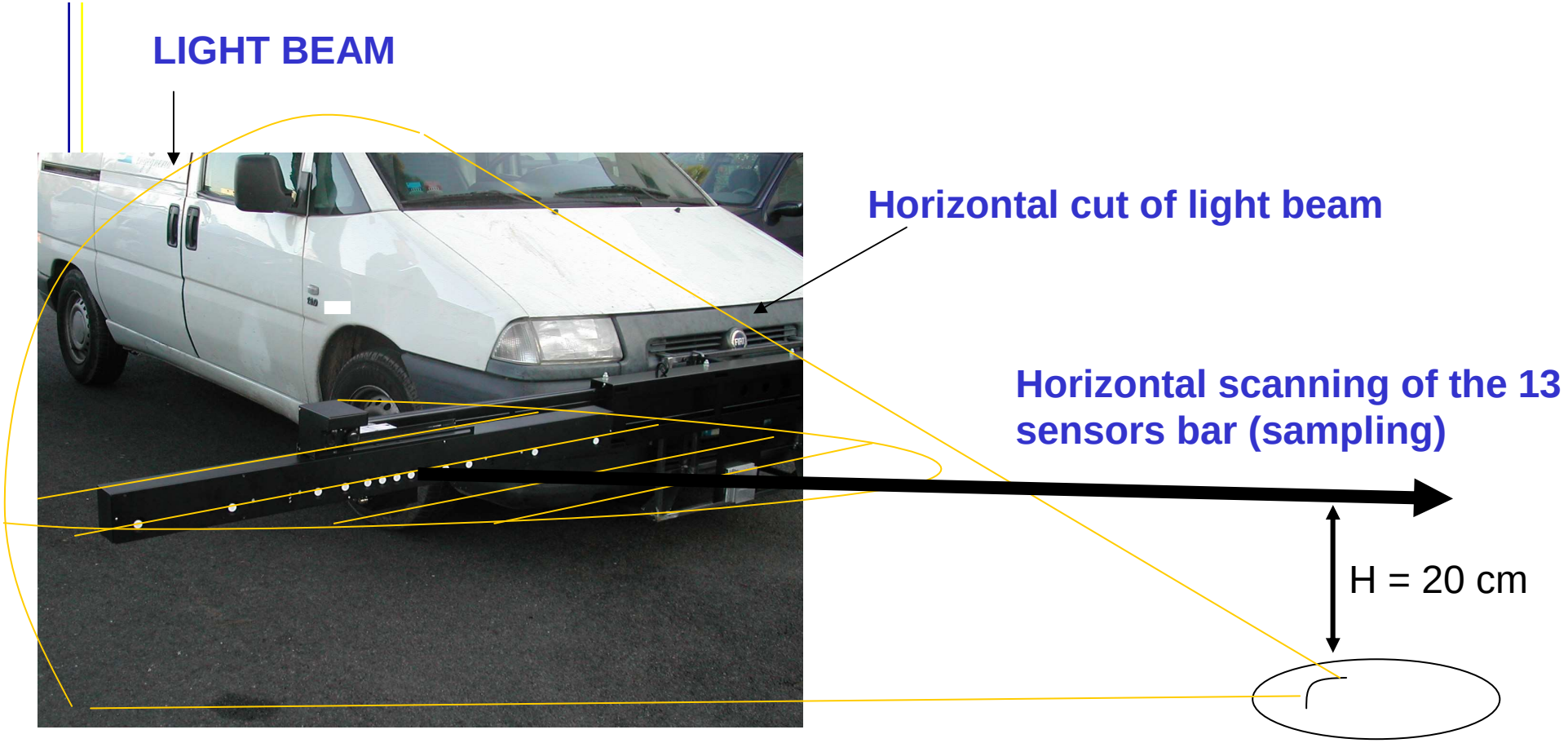
The Customer can decide for a fixed installation on a dedicated vehicle or for a temporary installation if the vehicle must be used for other tasks when not involved in measurement operations.



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



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.

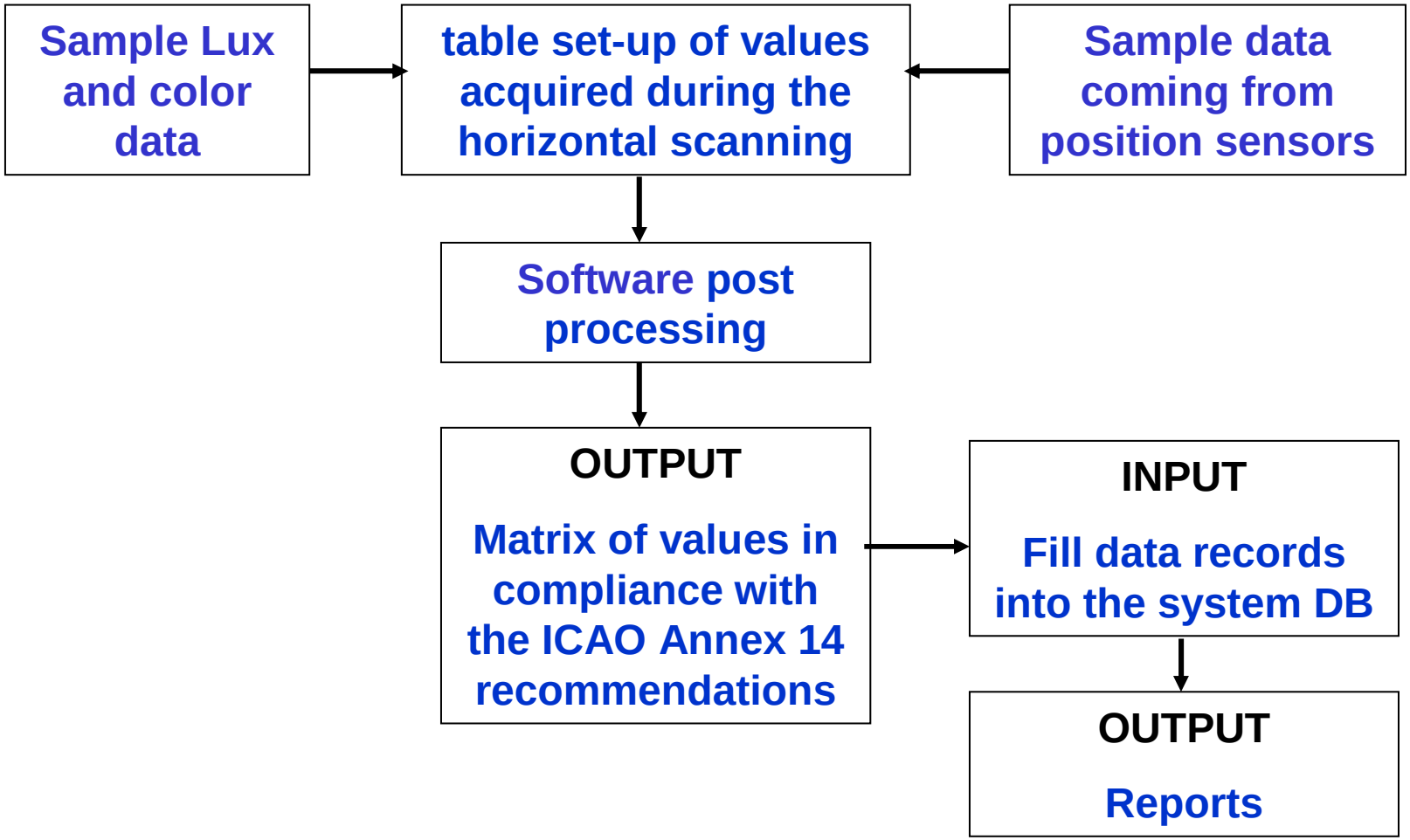
The optical head also includes a CCD camera to give the driver of the mobile the visual reference for the correct alignment of the measurement array with the stream of lights to be measured.

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

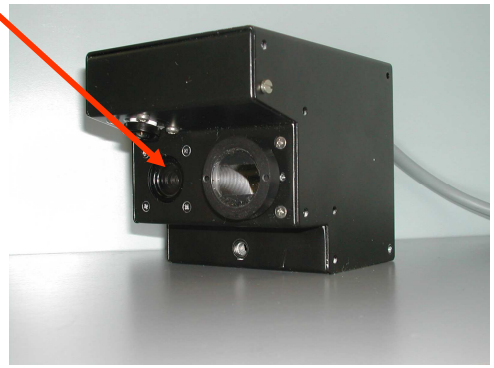


SMF/M – System Components

Alignment monitor and camera

Power Supply

Light beam detectors



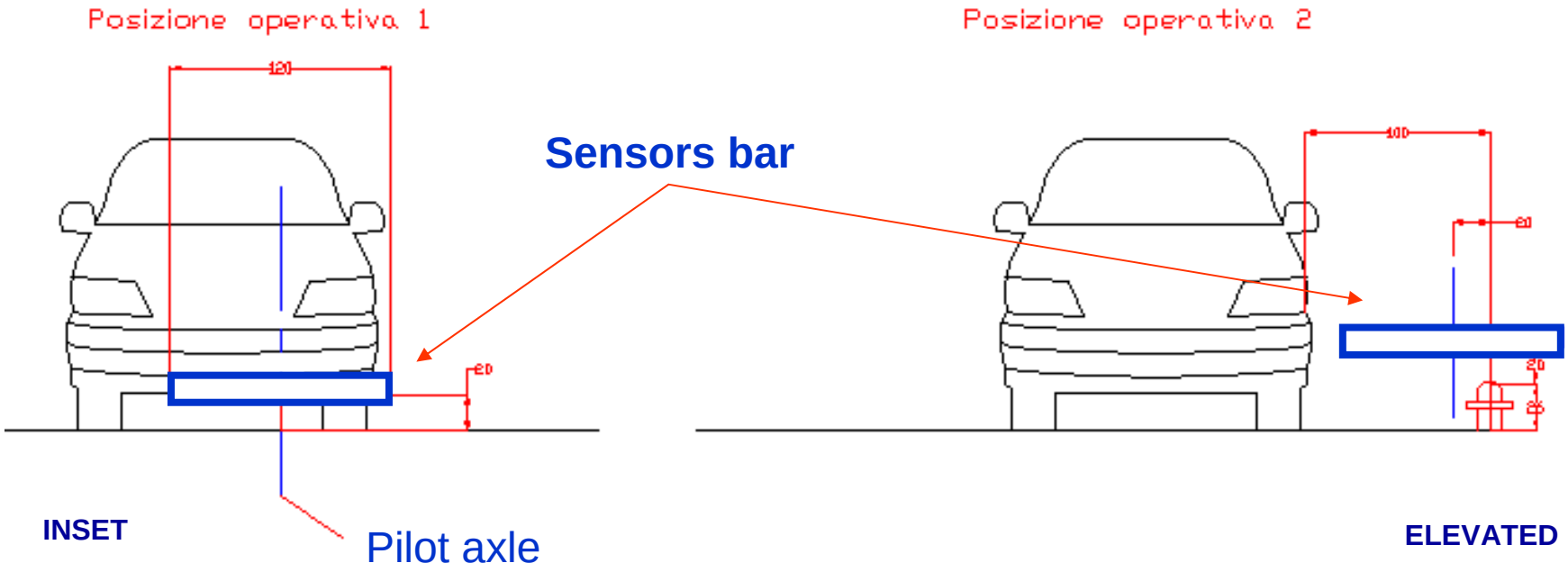
Odometer

Sensors Bar

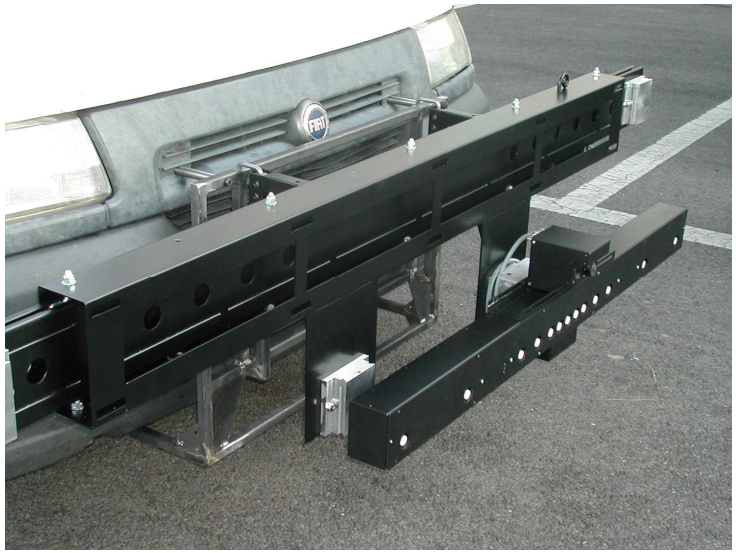
PC

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

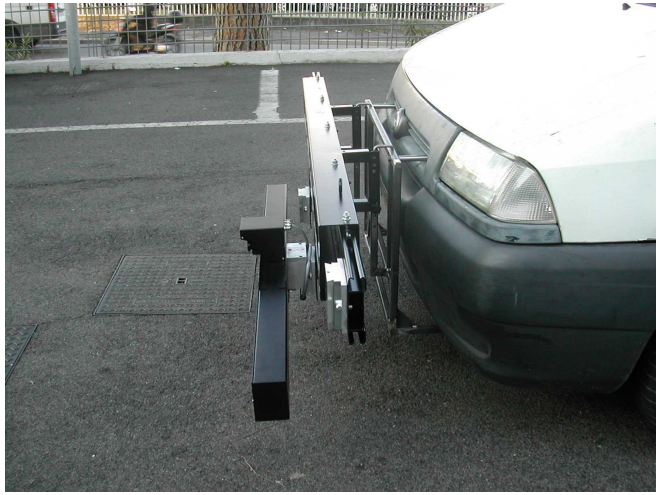


SMF/M – Bar positioning



Bar position n°1 for inset lamps

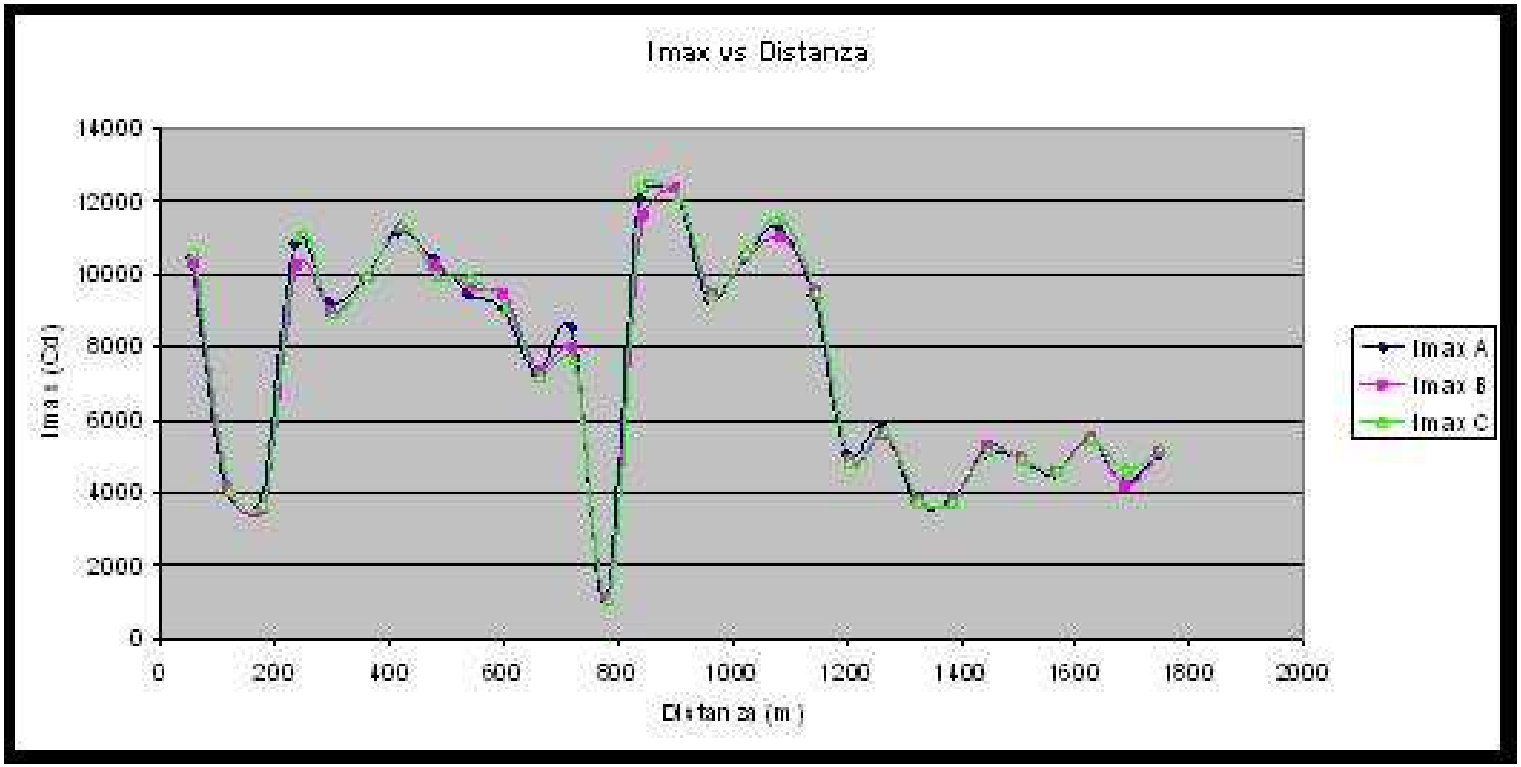
Bar position n°2 for elevated lamps



CAR FITTING ASSEMBLY

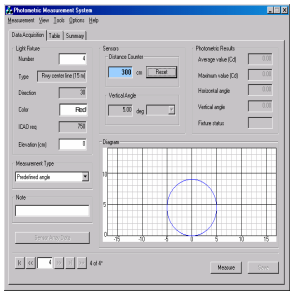
SMF/M - Diagram of Repeatability

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

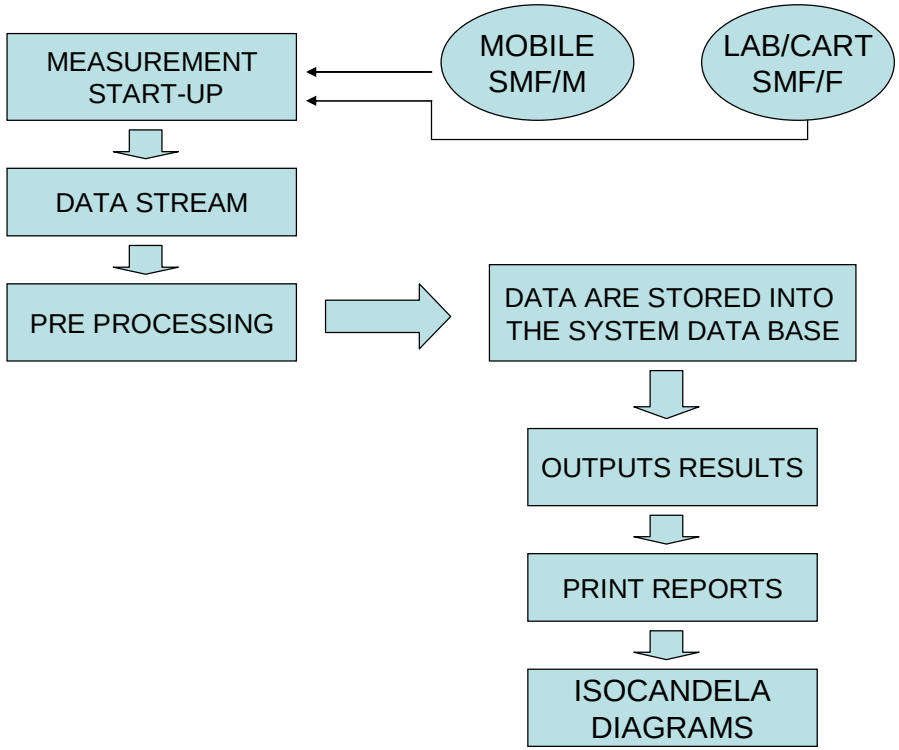
- **ACCURACY : 5% (REFERENCE INSTRUMENT)**
- **PRECISION : 5% (REPEATABILITY)**
- **13 SENSORS BAR – 0.25 LUX resolution**
- **HIGH SPEED ELECTRONICS FOR SENSOR OVERSAMPLING VIA 16 BITS LOW NOISE ADC**
- **2 x CIE 1931 COLOR SENSORS**
- **2 OPTICAL SENSORS FOR BEAM POINTING**
- **DISTANCE MEASUREMENT 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 SYSTEM SOFTWARE (PMS)

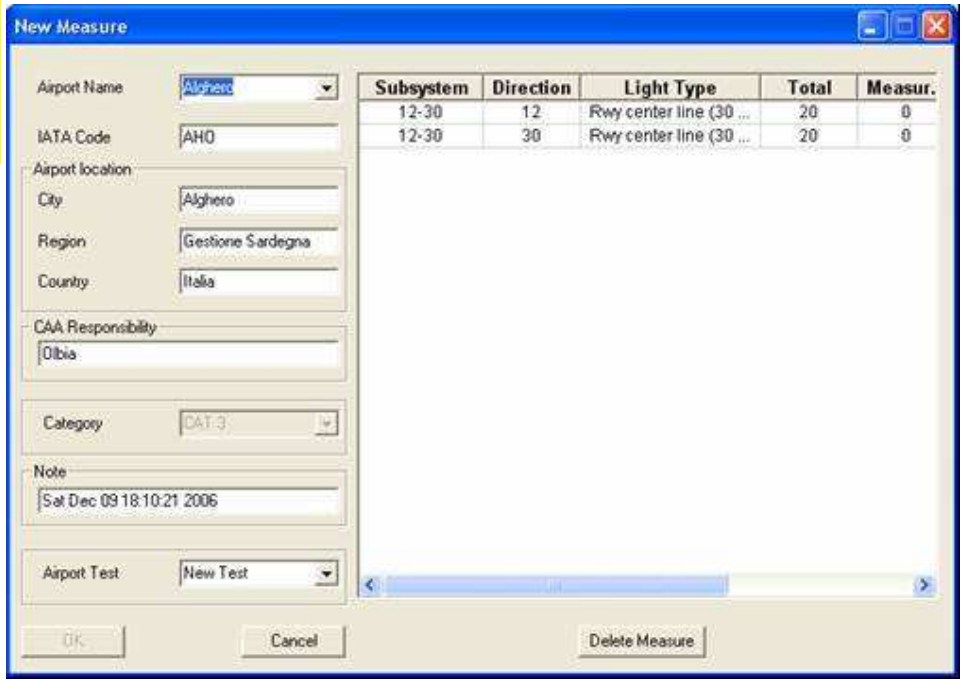
SMF – The PMS System Software Architecture

- **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**

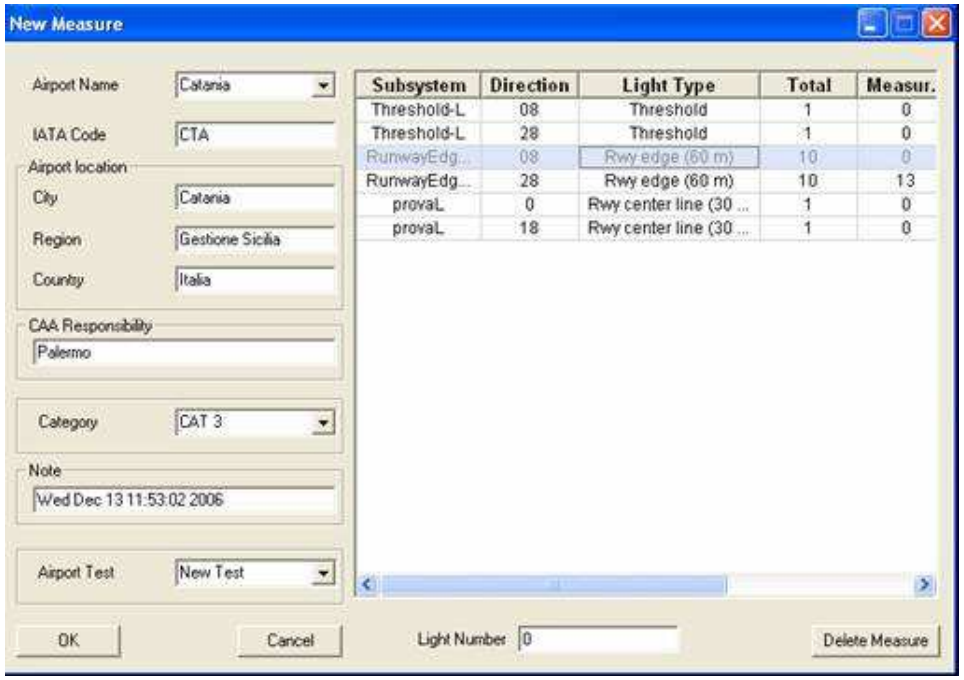


SMF – PMS System Software Mobile HMI

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.



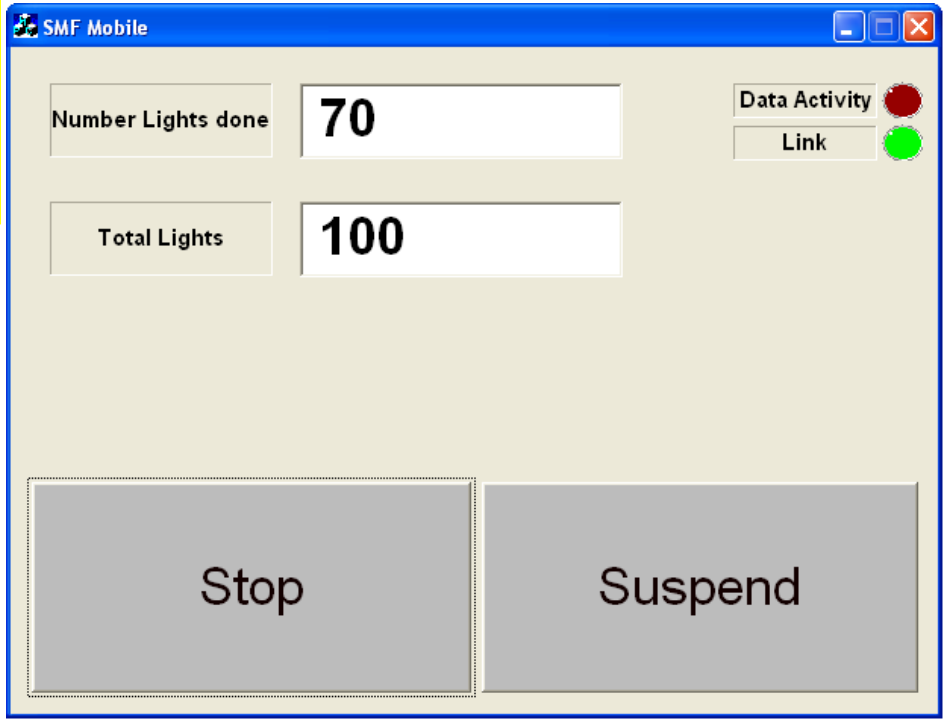
Airport Selection



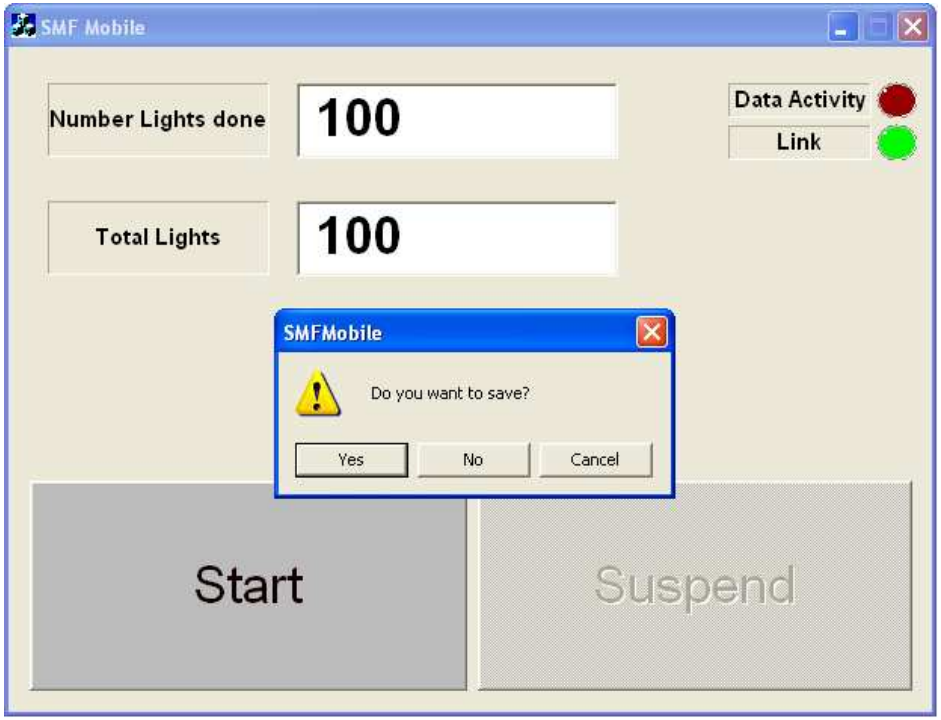
Subsystem Selection

SMF – PMS System Software – Mobile HMI

The following images show the lamp counter and data saving functions



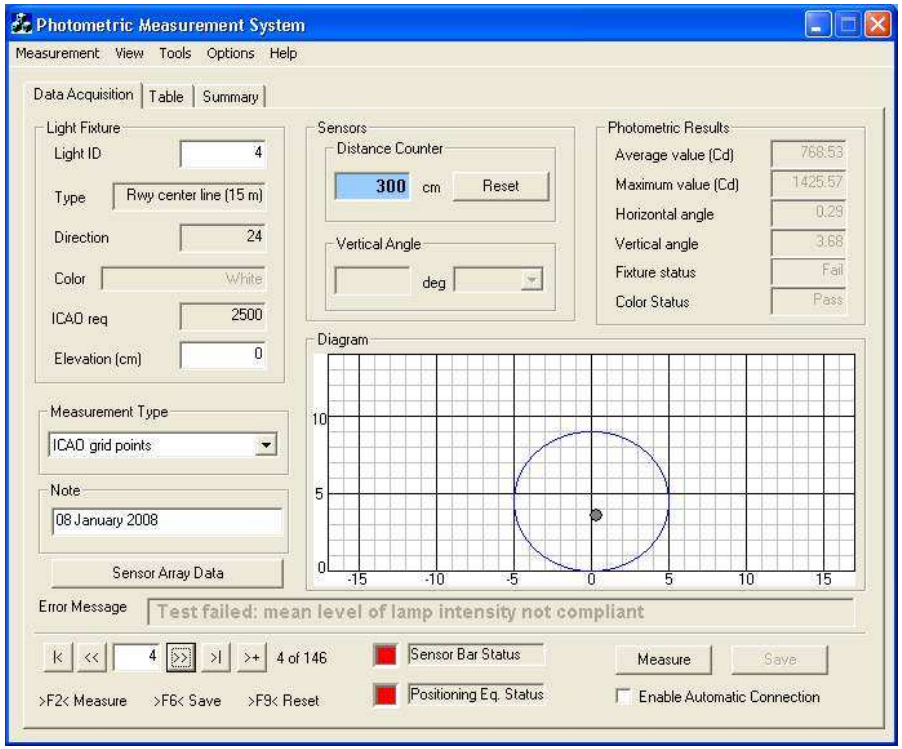
Lights Counter

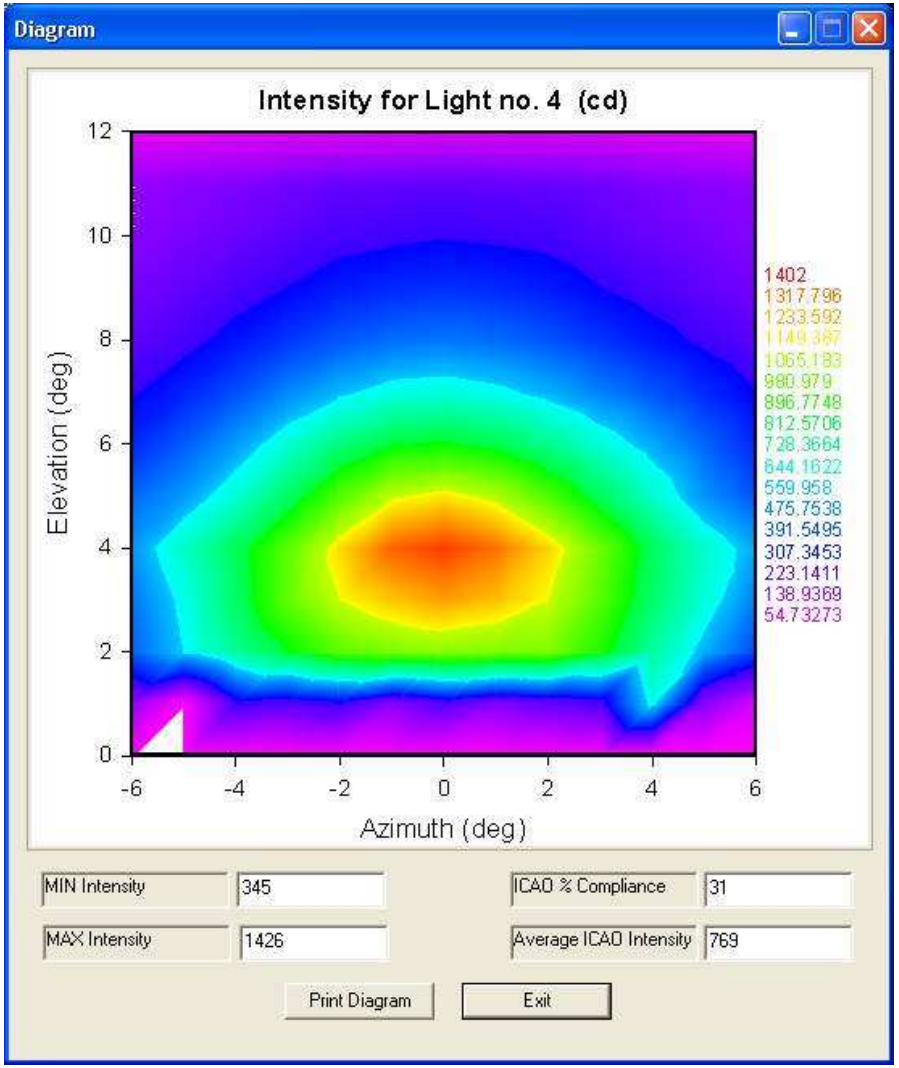


Save Data

SMF – PMS System Software - Reports

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





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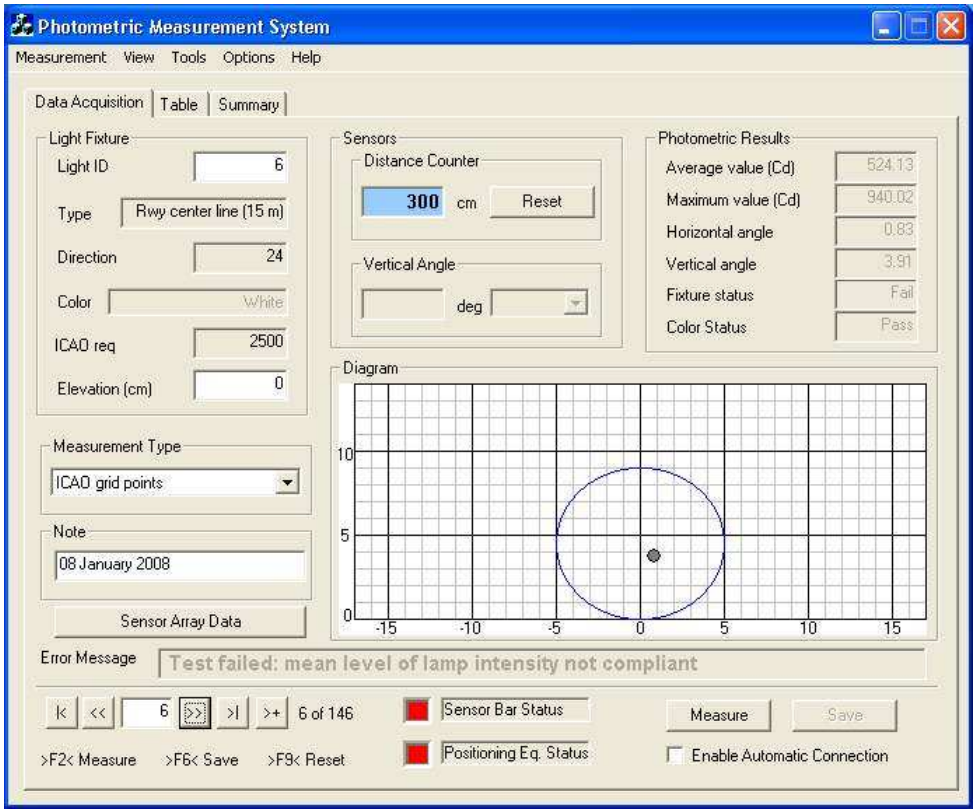
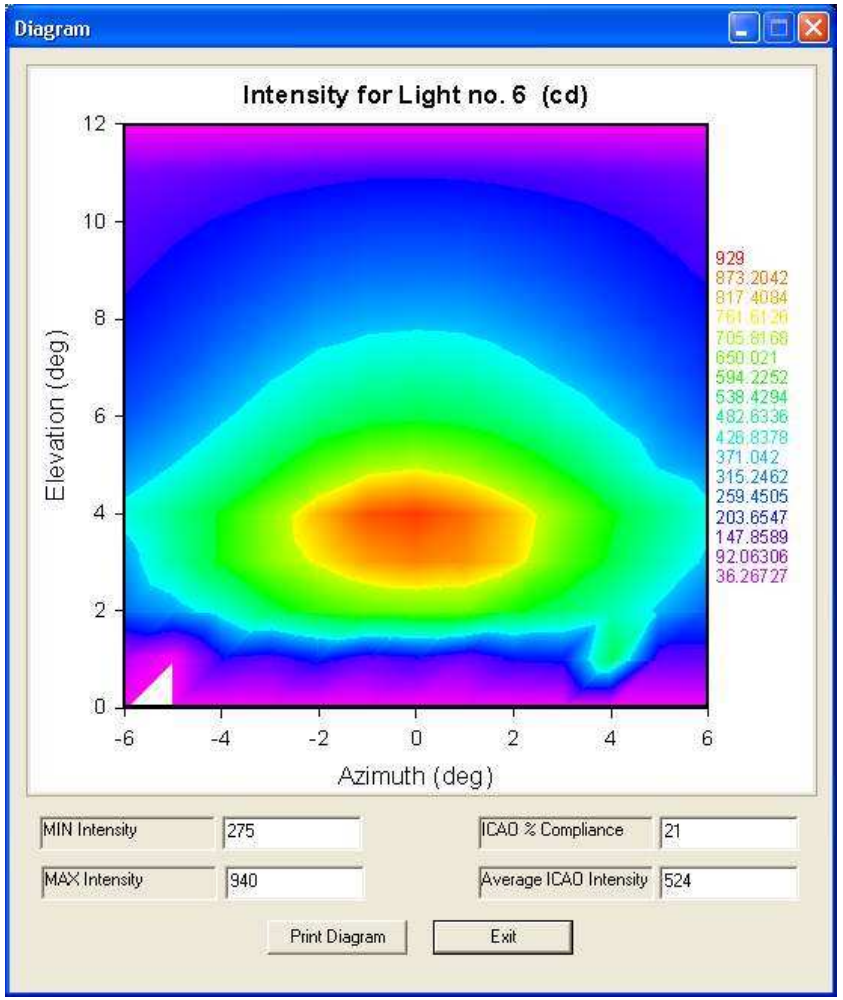
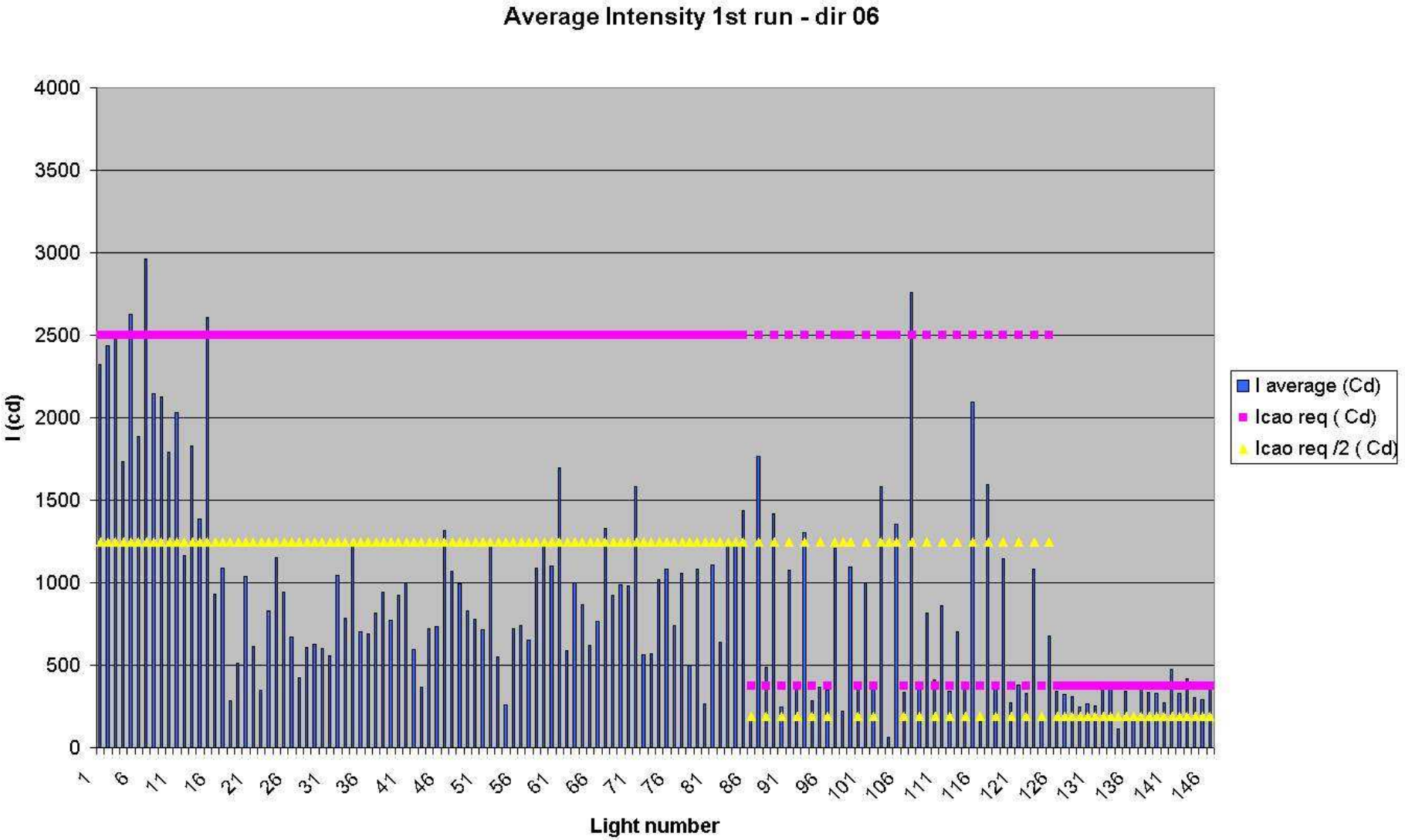
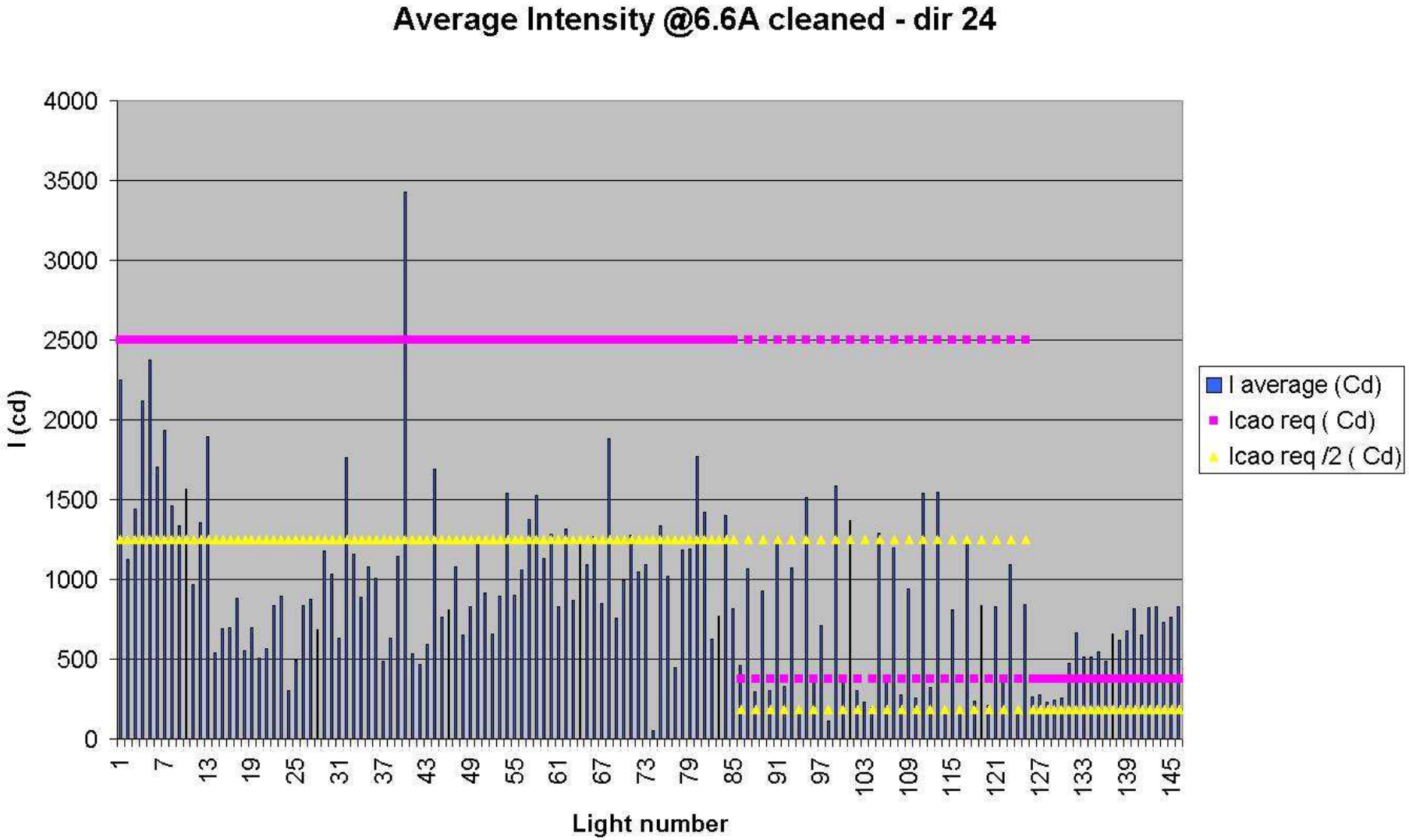




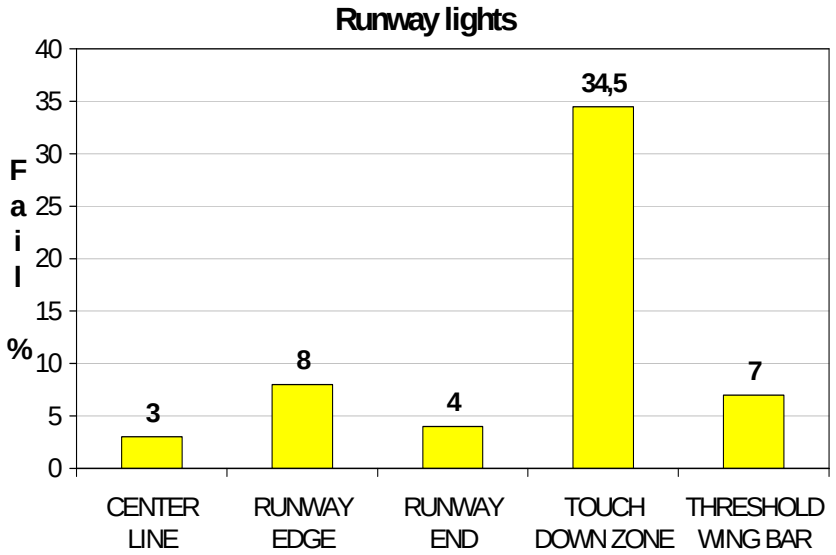
SMF – PMS System Software - AGLS Reports



SMF – PMS System Software - AGLS Reports



SMF – PMS System Software - AGLS Reports



	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