FIM RACING HOMOLOGATION PROGRAMME

FIM RACING HOMOLOGATION PROGRAMME FOR LIGHT PANELS (FRHPLP)

Homologation manual FRHPlp-01

October 2020

GLOSSARY

FRHP (FIM Racing Homologation Programme)	FIM Programme that grants recognition to products related to safety and required for competitions.
FRHPlp (FIM Racing Homologation Programme for light panels)	FIM Programme that grants recognition light panels that meet the FIM light panels Standard.
FIM Racing Homologation	Confirmation issued by the FIM as an official specification of performance for products related to safety and required for competitions.
FIM Light panels Standard	Ensemble of testing methods and corresponding performance criteria through which light panels are granted a FIM Racing Homologation.
Applicant	Legal entity applying for the FRHPlp and representing the trademark. The applicant shall be the company that markets the light panel to its end-users through customary sales channels (wholesalers/retailers/direct sales) or sells and/or supplies the light panel to circuits. The Applicant may, and in many cases will, also be a light panel manufacturer.
Homologation Manual	Formal document that provides the Technical information and criteria, the Terms and Conditions and the Application Form of the FRHPlp. The Homologation Manual, duly filled in, signed and returned by the Applicant to the FIM, represents the official application to the FRHPlp.
Application Form (homologation or update)	Part of the Homologation Manual, to be completed by the Applicant while applying for the FRHPlp.
Light Panel System	A light emitting object that is activated in conjunction with other elements to display the desired message. It comprises of the following parts: a) A certain number of light panels b) A marshal control device associated with each light panel c) A main server d) A race control management software
Light panel	Flat panel display, which comprises of a frontal and a rear graphic area, and may include the housing, the background-board and/or the front screen. It is activated in conjunction with other light panels to display the desired message.
Graphic area	Flat surface containing an array of light-emitting diodes (LEDs) as pixels. When voltage is applied, pixel clusters are controlled and activated partly or fully, into forming the characters or pattern of the desired message.
Pixel	Smallest element that contains LEDs and is capable of

	generating the full functionality of the graphic areas of a light panel.
Pixel pitch	Distance between corresponding LEDs of adjacent pixels, both horizontally (H_{pitch}) and vertically (V_{pitch}).
Background-board	Structure that surrounds the graphic area of the panel, to provide improved visibility by means of an increased contrast with the surrounding illuminance.
Front Screen	A screen that protects the graphic area and all its parts against dust and water.
Marshal Control Device	Hand-held, water resistant controller, used to execute or change a display message by the local marshal control.
Main Server	Central unit that manages the input signals received from either a Marshal Control Device or the Race Control and elaborates them into power commands, to execute the desired message.
Race Control Management Software Platform	Software used to manage and control all the connected light panels remotely and synchronously.
Variable Message Sign (VMS)	Electronic signs used to transmit information to riders, marshals and track personnel, which may consist of flag coloured signals, and/or symbols and/or text.
Flashing operation	Mode of operation in which the light is switched on and off with a fixed period and duty cycle.
Duty cycle	Fraction of one period in which the light is on during the flashing operation.
Luminance [cd/m2]	The intensity of light emitted from a surface per unit area in the reference axis direction. It carries information about the brightness of the displayed message.
Reference axis	The axis originating on the reference centre of the test module being perpendicular to the frontal surface of the panel, unless otherwise specified by the manufacturer. In case it differs from the mechanical axis (maximum light intensity), the supplier could choose which axis to use for the performance tests.
Test axis	The line from the reference centre of the test module to the luminance meter head.
Colour coordinates	The chromaticity of the colour is set in accordance with the CIE 1931 Standard Colorimetric Diagram unless stated otherwise.
CIE 1931 standard colometric system	A system for specifying the colour by determining the tristimulus values of the spectral power distribution of a coloured light.
Viewing Angles	The horizontal viewing angle is the angle between the test

	axis and the vertical plane passing through the reference axis, and the vertical test angle is the angle between the test axis and the horizontal reference plane passing through the reference axis.
Testing Laboratory	Private or public entity that has received an assignment from the FIM to perform tests according to a certain Homologation Manual and for the FRHPlp.
Test Report	Document issued by the Testing Laboratory that contains the test results relatively to a specific Application Form.
Homologation Notice	Formal document that expresses the granting of the homologation and sets out the rights licensed by the FIM.
Homologation Emblem	Emblem issued by the FIM together with the Homologation Notice. It includes the Applicant logo, the FIM logo, the FRHP logo, the category of product (Light panels), the Light panel Model and colour, the Homologation Manual of reference.
Homologation Refusal	Formal letter transmitted by the FIM to the Applicant in the event that homologation is not granted to an Applicant for a particular light panel.
Homologation Labels	Official labels provided by the FIM to the Applicant once homologation is granted.
Homologation Label cost	Fee associated with the purchase of official labels from the FIM related to the FRHPlp.
Intellectual Property Rights	All trademarks, trade and business names, patents, copyright (including copyright in a computer program), database rights, design rights, registered designs, utility models, semi-conductor topography rights, inventions, know-how, confidential information and all other intellectual property and rights of a similar or corresponding nature in any part of the world, whether or not registered or capable of registration, in respect of such rights which are registrable and all applications for registration of any of the foregoing rights.
Personal Data	Any information relating to an identified or identifiable natural person; an identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person.

I. FOREWORD

Until now, the FIM has referred solely to existing international standards for the approval of light panels for use in its competitions.

In order to take account of a more complete and demanding evaluation of performance, and give specific and exclusive recognition to light panels that meet more demanding criteria, the FIM Technical and Circuit Racing Commissions have now launched a pioneering and unique programme, the FIM Racing Homologation Programme for light panels (FRHPlp), which features the latest state of art methods of testing.

Under this programme, the FIM will grant light panels a homologation certificate and labels, which will be a mandatory prerequisite to be entitled to be used on Circuit for FIM competitions.

To obtain such homologation, the light panel will have to meet the high performance and quality standard set by the FIM, in addition to be approved according to selected international standards.

The light panel properties will be evaluated through a test protocol which should increase the visibility and safety for signalling marshals through remote functionality, as well as enhancing the direct communication of regulatory requirements and notifications to competitors during FIM Championship competitions.

AQs of 2022, FIM Homologated light panels will be mandatory for MotoGP, WSBK and EWC and recommended in all others Circuit Racing FIM World Championships and Prize events. The homologation will allow the FIM to ensure a high quality light panels used in FIM competitions. It will also tend to preserve the interests of the homologated light panels' manufacturers.

This document was prepared under the direction of the FIM International Technical Commission, in collaboration with the FIA and leading road light panel manufacturers. The document provides the TECHNICAL INFORMATION AND CRITERIA, the TERMS AND CONDITIONS and the APPLICATION FORM, for interested parties wishing to apply to the Programme.

As the light panels can also be used for FIA circuits and the requirements are the same, it is recommended to do the homologation for both entities at the same time. In the case of the homologation was already granted by the FIA, the FIM homologation could potentially be granted by using the test report send by the FIA.

This document may be subject to amendments as determined by the FIM.

II. SCOPE

This standard provides objective design and performance requirements for light panels intended for use in motor racing circuits. It addresses systems that are specifically designed for motorsport applications and that provide dual control, such as local stand-alone operation via the marshal control device and remote operation by the Race Control.
This standard defines different homologation Grades as follows:

a) Grade 1 and grade 2 homologation will be for all Circuit Racing FIM World Championships and Prize events;
b) Grade 3 homologation will not be used for Motorcycle competition.

The requirements per Grade 1, 2 and 3 presented herein will ensure that the light panels will have a minimum luminance within a certain range of vertical and horizontal angles as well as the required set of colour coordinates, to improve rider visibility across all the circuit grades. The standard also details the flag signals and their functions during race conditions.

This document is not intended to outline any existing details concerning the location and the number of light panels. It is assumed that the same principles to determine the marshal posts will form the basis for the location and the numbering of the light panel, in either a full circuit or partial circuit installation, and that adjustment in the location and the numbering of the light panels may be required to accommodate the type of racing.

II.1 PRODUCT REQUIREMENT

Light panels shall be based on light-emitting diodes (LED) technology. Each light panel shall have two graphic areas, one on the front and one on the rear side of the panel. The rear area can have different patterns and dimensions of those required for the frontal area, as detailed in **II.1.6 Minimum dimensions requirements**. Each light panel should be able to be controlled either remotely from Race Control or manually from the individual signalling marshal at the track. It should be provided with a system that provides field-adjustable luminance intensity (dimming), to adapt to the background ambient light level in which race events are held. Due to extreme operating conditions, they should be provided with means of protection against thermal overload.

II.1.1 Electrical requirements

The light panel system shall conform to *ISO electrical safety requirements and low voltage Directives* for maximum safety, in compliance with local regulations. Circuits and connectors must be located out of reach of the public, and designed so that exposure to live electrical equipment will not occur in case of the accidental detachment of exposed elements of the system.

The connection of the light panel system to the power supply shall be in accordance with the manufacturer's guidelines. In the event of short voltage interruptions in the supply of specific duration, light panels shall operate as follows:

a) For interruptions of duration less than 50 [ms], there should be no visible effect;
b) For interruptions of duration less than 100 [ms], the panels shall continue displaying the current message;

II.1.2 Material requirements

Materials used for the hardware of the light panels shall be resistant to corrosion. The FIM reserves the right to request manufacturers to carry out testing on the material, to demonstrate the durability of the material by reference to the relevant *European Standard EN 12899-1:2001*, or similar European technical assessment. Additionally, all equipment, cables and controls shall be made out of materials that will not introduce fire or any risks in case of an accident.

II.1.3 Environmental requirements

All equipment must be designed to operate under the following requirements:

a) The minimum degree of protection against ingress of dust and water provided shall be **IP 65** without external casing and **IP 55** with external casing, when tested in according to *BS EN 60529:1992*.
b) Temperature: -20 to +60 [°C]
c) Relative humidity: 30% to 95% RH

The manufacturer shall provide a declaration to the FIM, by which it certifies that the system is capable of exposure to such environmental conditions without suffering any permanent damage. The FIM reserves the right to undergo testing in accordance with the relevant European Standards to check the compliance with these requirements, and to refuse the homologation is the results are deemed unacceptable.

Equipment performance should not degrade or deviate significantly from the homologation test results when operated at the typical ambient temperature extremes seen at the intended installation site.

II.1.4 Structural requirements

All equipment must be designed in order to operate safely under normal conditions by the marshals and other track personnel. The equipment must remain safe after damage by an accident to allow operational safety. Reliability of all equipment, cables and controls shall be guaranteed for a minimum of approximately 5 years extensive usage.

II.1.5 Operational requirements

Each light panel should be able to be locally operated by the signalling marshals on the side of the track and remotely controlled from the Race Control.

II.1.5.1 Local Operation

Light panels shall be locally operated by the signalling marshals via the corresponding marshal control devices, either in direct proximity of the panel or at a nearby location. For system design purposes it should be possible to operate the panel within a distance of up to 250 [m].

II.1.5.2 Marshal Control Device

For panels that are operated locally, the marshal control device should be designed so as to be as compact and light as possible, to be easily operable and transportable, and provide an intuitive user interface. It should avoid the possibility of accidental operations. The control device must be rechargeable and able to be operated while being recharged. It can be either button-based or touched-based. It shall be easy to operate with appropriate gloves and could be equipped with LED light indicators, to display different modes of operation of the unit, as well as an informational display. The display should give information about the status of the device, the corresponding panel and incorporate repeater lights, to show the status of the light panels at the neighbouring marshal posts upstream and downstream.

II.1.5.3 Remote Operation

The information displayed on the light panels should always be relayed directly to the Race Control, who should always have the capability of operating them remotely. Flag signals reserved for the Race Director and the Clerk of the Course must be solely operable by the Race Control.

II.1.5.4 Race Control Management Software

The race control program should give Race Control the complete control of all the light panels around the track, to allow real-time monitoring of the flags' status and diagnose the main system parameters. In particular, the minimum set of features the Race Control program should include is, but is not limited to:

a) Track map displaying all the light panels and their locations on the track;
b) Monitoring of the operating power supply;
c) Monitoring and control of all light panels' status, i.e. which flag type and which light marshal is active on the track;
d) Monitoring of working temperature, and cooling system activation;
e) Display of any malfunctions, such as short circuit, thermal overheating for each individual light panel, LEDs integrity, communication errors;
f) Logs systems stored in the internal memory of the battery, which registers all the operations accomplished as well as the flag incidents on the track, including detailed information on the flag type, the activation point, date and time of the incident;
g) Systems check and communications check with all equipment constituting the system;
h) Option for online servicing and upgrading.

Any command locally executed by a marshal via portable controller should be able to be overruled by the main Race Control.

II.1.6 Minimum dimensions requirements

The minimum required dimensions of the light emitting frontal and rear graphic area of each light panel in direction of the reference axis should be as detailed in the **Table 1**. The aspect ratio of panel shall be 3:2 up to 1:1.

Each panel shall be designed such that the whole of the front and rear graphic areas shall be fully and uniformly populated with pixels.

Grades	Graphic Area (Frontal) in [cm^2]	Graphic Area (Rear) in [cm^2]
Grade 1	4500	360
Grade 2	1890	360
Grade 3	1890	360

Table 1: Frontal/Rear Panel Minimum Dimensions for light emitting area

II.1.7 Weight

A maximum of 50 kg is mandatory for any grade of light panel. This does not include cables, brackets or optional equipment such as controllers.

II.1.8 Front screen

When the light units are provided with additional front screen, the latter should be securely fitted to the external panel housing. It should be made from UV and scratch resistant materials and be easily removable to facilitate maintenance. It is also recommended to have a certain inclination with respect to the vertical axis of the light panel to prevent reflections from the sun light.

Manufacturers should detail the measures they have taken to prevent condensation from forming on the front screen.

II.1.9 Frontal frame

When frontal frame is used, the front contour of the board is matt black or dark coloured, to improve the overall contrast with the surrounding illumination and increase the perception of the information displayed.

II.1.10 Variable Message Sign (VMS)

The information displayed on the panels should be to supplement traditional circuit flags during racing, and shall consist of static or waved coloured signals, with the appropriate brightness level and colour coordinates.

Display in form of symbol or text must be such that the text is abbreviated in English and the height of each character is at least half of the height of the frontal and rear graphic area. It is required that the message can be easily customized for the specific needs and different ways of operation, to accommodate the type of racing event or other FIM Championship requirements. The minimum level and basic functions of static and waved flag signals shall be defined using the specifications detailed in the **VII APPENDIX 2: FLAG DISPLAY MODES**.

II.1.11 Data Communication Protocol

Light panels should be networked with each other and the corresponding marshal control devices, and maintain a two-way communications with the Race Control, via a redundant fibre-optic ring network or a wireless radio communication link.

II.2 PERFORMANCE ASSESSMENT

The light panel system shall be designed such that its integrity is not compromised during its entire service life. Clear and comprehensive guidelines are required to operate the system under normal conditions correctly. The FIM reserves the right to refuse the homologation if the installation and maintenance procedures are deemed unacceptable.

II.2.1 Installation guidelines

When applying for the homologation, the manufacturer must provide installation guidelines of the light panel system to the FIM as part of the homologation application dossier.

These guidelines shall include detailed information to enable the correct installation. The manufacturer undertakes not to modify the fundamental installation procedure included in the guidelines. Variations must be authorised by the FIM. The FIM reserves the right to refuse the homologation if the installation procedure is considered unacceptable.

II.2.2 Maintenance guidelines

When applying for the homologation, the manufacturer must provide maintenance guidelines of the light panel system to the FIM as part of the homologation application dossier, to ensure that any damage does not reduce the efficiency of the system. This shall include details of routine maintenance recommendations of spare parts and details of estimated lifetime of components. For permanently installed systems, all maintenance activities shall be easy to be carried out and ensure maintained performance, as outlined in **II.3 TESTING PROCEDURES**. The manufacturer shall also offer a maintenance service if required.

II.3 TESTING PROCEDURES

The performance requirements presented herein are mandatory for light panel systems. The FIM reserves the right to request further tests if new technology is presented for homologation.

II.3.1 Test parameters

The test module and the test facility shall comply with the requirements set out below.

II.3.1.1 Test module

The test module shall be complete with all the hardware components of a light panel, but also cables, controllers and/or data transmission/reception equipment that are fitted in a production unit, to enable performance testing. The test module shall be selected at random from the production and shall be fully representative of the final product. For the purpose of testing and due to limitations of the currently used test apparatus, the manufacturer is required to inform the FIM and the test laboratory in advance about the overall size and weight of the panel.

If a final prototype is made available for testing, the manufacturer is required to declare and confirm that the characteristics of the final product do not differ from those of the test module considered for the performance testing. The manufacturer commits to obtaining the FIM's approval before any substantial modification to the tested and approved product

is carried out. The FIM reserves the right to refuse the request if the final prototype is deemed unacceptable for the purpose of the homologation testing.

II.3.1.2 Test facility and apparatus

All the performance testing specified herein shall be performed in a temperature-controlled darkroom, whose conditions during testing shall be consistent with **Table 2**.

Condition	Requirement	Remark
Dark-room illuminance	< 2 [lux]*	Near the panel
Room temperature	23 ± 4 [°C]	Near the panel
Relative humidity	10 to 80 %	

Table 2: Test facility requirements (*A lower value is used for colour measurements)

During testing, it is important to eliminate any stray lights. If parts of the equipment used for controlling the test module under test affect the surrounding illuminance, then those parts should be adequately covered.

A calibrated photometric laboratory with light intensity measurement instrumentation is required for the execution of the performance tests.

II.3.2 Test module preparation

The test module should be securely mounted onto a measuring rotating table. Care should be taken to ensure it is securely fixed and the optical orientation of the frontal surface in relation to the measuring device is correct. This is important to assure that the assessment will be done at the required inclinations of the graphic area of the panel, and for good repeatability of the test results. If required for reasons of geometrical or physical constraints of the panel, any alternative mounting outside of normal conditions shall be approved by the FIM prior to testing.

The working distance between the front lens of the measuring device and the frontal graphic area of the test module over which the meter can focus shall be minimum 10 meters.

Before commencing the performance tests, the following checks shall be undertaken:

a) Switch ON the test module in white, non-flashing mode, and check that there is no partial, incomplete or false display;
b) Set the voltage to the specified operating voltage of the light panel, and check that there is no partial, incomplete or false display;
c) Record the specified operating voltage of the test module, which should correspond to the normal user conditions for power supply. If the operating voltage is known to vary in practice, either because of fluctuations of the electricity supply during operation or because the signal is operated at different voltages depending on ambient conditions, measurements shall be made at the lowest and highest likely operating voltage in addition to measurements made at the specified operating voltage.

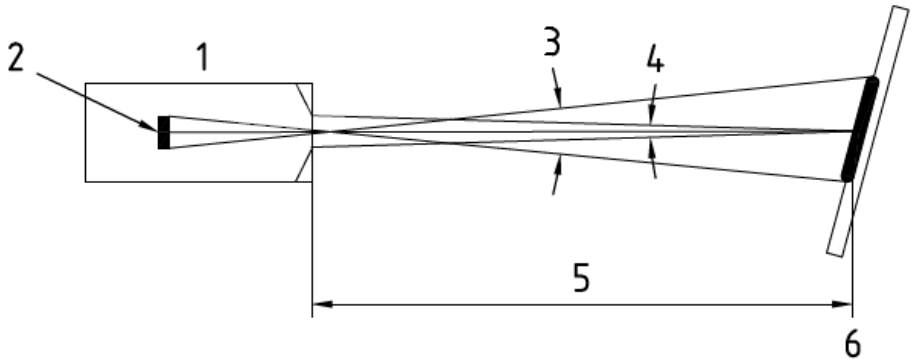


Figure 1

Legend: **1** Luminance meter
2 Photo-sensitive element
3 Field of View (FOV)
4 Acceptance cone
5 Working distance
6 Test module

II.3.2.1 Stabilization phase

The test module shall display the white flag at its maximum brightness, and have been in operation for sufficient time to be stabilised before making any performance measurement. The resulting light on the test module is considered stable when its output luminance, measured in [cd/m^2], does not change more than ± 3 % over a warm-up period of 30 minutes. Similarly, the chromaticity coordinates shall be recorder throughout the warm-up period of 30 minutes at 2 minutes intervals, to assure they lay within the specifications defined in **II.3.3.3 Colour coordinates**. Drop peaks in the luminance measurements at the beginning of the test will not be taken into consideration.

II.3.3 Optical performance

All the performance measurements presented herein shall be performed for the individual flag signal colour, such as White, Yellow, Red, Blue and Green. The test procedures are grouped and shall be conducted in the sequence laid out below for each of these individual flag signal colours.

The test environmental conditions are specified in **II.3.1.2 Test facility and apparatus** of this standard. The measurements shall be made at the specified operating voltages of the light panel, or in accordance with the manufacturer's instructions as per **II.3.2 Test module preparation c)**.

II.3.3.1 Luminance

Luminance gives an indication of the overall perception that result from light reaching the rider's eye. The resulting brightness takes into consideration the measurable luminance of the surface of the light panel, plus any conditions of observation that may affect the perception. Luminance measurements are applicable to the following flag signal colours: white, yellow, red, blue and green.

II.3.3.1.1 Test conditions

I. The measurement configuration shall be arranged so as to have the luminance meter perfectly aligned with the reference centre of the test module, perpendicular to the reference axis. The test will be conducted as follows:
   a) Luminance measurements shall be made with the test module powered to the specified operating voltage, or in accordance with the manufacturer's instructions.
   b) One luminance reading shall be taken per each of the individual flag signal colours in direction of the reference axis, and the corresponding value shall be recorded and expressed in candela per square metre [cd/m^2].

II.3.3.1.2 Performance criteria

When the test module is tested in accordance with this standard:

a) For Grade 1 homologation, the minimum on-axis luminance shall be 60'000 [cd/m^2] for yellow flag signal and 37'000 [cd/m^2] for red flag signals.
b) For Grade 2 homologation, the minimum on-axis luminance shall be 33'000 [cd/m^2] for yellow flag signal and 16'000 [cd/m^2] for red flag signals.
c) For Grade 3 homologation, the minimum on-axis luminance shall be 10'000 [cd/m^2] for yellow flag signal and 8'000 [cd/m^2] for red flag signals.

II.3.3.2 Uniformity of Luminance

The test module shall appear uniformly bright over its entire frontal graphic area, and shall have no abrupt changes of luminance. Luminance uniformity measurements shall be done in accordance with this standard, and shall be applicable to the following flag signal colours: white, yellow, red, blue and green.

II.3.3.2.1 Test conditions

To measure the luminance uniformity, the frontal graphic area of the test module shall be virtually divided into 3 x 3 = 9 test areas and the luminance reading shall be taken and averaged over each of these areas. The corresponding values shall be recorded and expressed in candela per square metre [cd/m^2].

II.3.3.2.2 Performance criteria

When the light panel is tested, the ratio of the greatest and the least luminance readings [cd/m^2] measured from each of these regions shall not deviate more than 20%.

II.3.3.3 Colour coordinates

Colour coordinates specify the allowable colours for steady signal lights and flashing signal lights.

II.3.3.3.1 Test Procedure

The spectral power distribution of the light emitted by a signal light should be measured using a spectroradiometer and the 1931 CIE chromaticity coordinates (x, y) shall be calculated using the methods and tables outlined in the *European Standard CIE S004 Colours of Light Signals*. Alternative methods may be used, provided it has been validated by reference to the spectroradiometric method and approved by the FIM prior to testing.

II.3.3.3.2 Performance criteria

When the light panel is tested in accordance with this standard, the colours of light signals shall have chromaticity coordinates (x,y) that lie inside the following areas (detailed in ***VI* Appendix 1: CHROMATICITY COORDINATES**):

a) **Red** Light Signal Colour: **Class A1**
Red light signal colours shall lie within the chromaticity area ABC'D'[1]
b) **White** Light Signal Colour: **Class A**
White light signal colours shall lie within the chromaticity area IJKL[1] [2]
c) **Green** light signal colour: **Class A**
Green light signal colours shall lie within the chromaticity area MNOP[1]
d) **Blue** Light Signal Colour: **Class A**
Blue light signal colours shall lie within the chromaticity area QRST[1]
e) **Yellow** Light Signal Colour: **Class FIA 1**
Yellow light signal colours shall lie within the chromaticity of the "Selective Yellow" region of the *UNECE R48 standard* (SY1 to SY5, detailed as well in **VI Appendix 1: CHROMATICITY COORDINATES)**
f) **Orange** Light Signal Colour:
Orange light signal shall lie within the chromaticity of the area EFGH of the CIE 1931 standard colorimetric system, (detailed as well in **VI Appendix 1: CHROMATICITY COORDINATES**.

Detailed information concerning the boundaries of the recommended chromaticity areas is detailed in the **VI Appendix 1: CHROMATICITY COORDINATES**.

II.3.3.4 Viewing angles

The viewing angles of a light panel are measured both horizontally and vertically, and indicate on what range and with which luminance the information displayed on the graphic area of the panel is visible in relation to the reference axis of the frontal graphic area of the test module. This is considered of great importance to assure correct perception of the information displayed.

II.3.3.4.1 Test conditions

Tests will be conducted as follows:

a) One luminance reading shall be taken per each of the individual colours at 5 degrees intervals to the right and left of the reference axis and the corresponding values shall be recorded and expressed in candela per square metre [cd/m^2].
b) One luminance reading shall be taken per each of the individual colours at 5 degrees intervals above and below of the reference axis and the corresponding values shall be recorded and expressed in candela per square metre [cd/m^2].

II.3.3.4.2 Performance criteria

The required distribution of luminance should be as follows:

[1] It includes persons in the user group with defective colour vision
[2] Given the fact that the colour of a white signal shifts toward orange-yellow when viewed from longer distances, this class help to distinguish from yellow light signal colours

a) The intensity within 40 [°] to the right and left of the reference axis shall be above 50% of the minimum intensity required for that specific Light Panel grade.
b) The intensity within 15 [°] below and above of the reference axis shall be above 50% of the minimum intensity required for that specific Light Panel grade.

No drastic luminance drop should occur in angles over the indicated above, ±40° and ±15° respectively.

II.3.3.5 Colour shift

During the previous tests, not only the luminance of the Light Panels gets affected, but also the colour perception to the human eye. Although an exclusive performance test is not done regarding this matter, the colour coordinates should be within the chromaticity areas indicated in 6.3.3 Colour coordinates, when the different tests are performed.

II.3.3.5.1 Performance criteria

During the different tests, at least 90% of the evaluated points should be within the specified colour regions.

II.3.3.6 Visible Flicker

Light Flicker is a physical phenomenon which cause changes in the brightness of a light source. Although this can happen due to numerous facts, the performed test will be based on the fluctuations of the power supply voltage.

According to the International Commission on Illumination, flicker can be defined as the "impression of unsteadiness of visual perception induced by a light stimulus whose luminance or spectral distribution fluctuates with time" (CIE, 2011, term 17-443),

II.3.3.6.1 Performance criteria

Minimum flickering frequency should be over 200 Hz. A higher number could be requested in case the symbols, signs and flags are not seen correctly by the racing drivers or by the TV cameras.

II.3.3.7 Sun phantom

Sun phantom is a false light signal caused by reflection of radiation from sun illuminance by the graphic area of the test module. The sun phantom effect makes a light panel appear to be switched ON when in fact it is OFF, thus confusing the rider.

II.3.3.7.1 Test conditions

Tests will be conducted as follows:

a) The frontal surface of the test module shall be illuminated by a projector simulating direct sunlight. The reference axis of the test module and the optical axis of the projector shall form an angle of 10 [°] below the reference axis. The opening angle of the projector emitting surface seen from the front surface of the roundel (angle a) shall be smaller than 1[°], while the opening angle of the photometer seen from the front surface of the roundel shall be smaller than 3 [°]. The distance between the front surface and the photometer lying on the reference axis of the roundel shall be 10 [m].

b) The luminance of the test module should be measured along the reference axis when the test module is switched on and the projector is switched off (L_{signal}).
c) The luminance of the test module should be measured along the reference axis when the test module is switched off and the projector is switched on: ($L_{phant,10klx}$).The projector should produce an illumination in the plane of the front surface of 10'000 [lux]. If the effective illuminance ($E_{t,eff}$) in the plane of the front surface is not 10'000 [lux], then $L_{phant,10klx}$ can be calculated from the measured $L_{phant,eff}$ as specified in the *European Standard CIE S006.1/E*.

II.3.3.7.2 Performance criteria

The phantom light luminance ratio L_{signal} / $L_{phant,10klx}$ of the intensity of the real to false signals shall be at least 15 to 1.

II.4 TEST REPORT

The test report should include all the information recorded as a result of the performance assessment of the light panel in accordance with **II.3 TESTING PROCEDURES**. Additionally, the test report should include at least the following information about the test:

a) Photographs of the light panel system as well as batch number and date of manufacture;
a) A complete listing of the test equipment, which shall include instrument accuracy and calibration certificates copies
b) Photographs of the equipment used for the application of the light panel;
c) Any additional information requested at the discretion of the FIM.

II.5 FIM MARKING AND LABELLING

Each light panel having passed the requirements of this standard will have to be clearly labelled with FIM Label, which include an FIM hologram, to be glued onto the light panel. The FIM Label must be purchased from the FIM.

II.6 MANUFACTURER'S GUIDELINES FOR HANDLING, STORAGE AND DISPOSAL

The manufacturer is required to provide the following documentation with each delivery:

a) Installation guidelines;
b) Handling and Storage Guidelines (if applicable);
c) Maintenance guidelines;
d) Disposal guidelines;
e) FIM Homologation Certificate, based on the template provided by the FIM.

The additional information included herein must always be provided with each FIM homologated light panel. It is possible to provide the same information in electronic version.

IV. APPLICATION FORM (HOMOLOGATION) / FRHPlp-01

To be filled in for each Light panel model and returned by e-mail to frhp@fim.ch

(1) Applicant's information	
(1.1) Name	
(1.2) Address (road, city, ZIP code, country)	
(1.3) E-mail	
(1.4) Phone	
(1.5) Commercial trade mark(s)	
(1.6) Contact name	
(1.7) VAT number/Legal registration number	
(2) Manufacturer's information	
(2.1) Name	
(2.2) Address (road, city, ZIP code, country)	
(2.3) E-mail	
(2.4) Phone	
(2.5) Contact name	

(3) Light panel Information	
(3.1) Commercial name(s)	
(3.2) Date of manufacture (mm, yyyy)	
(3.3) Wished amount of Homologation labels (per year)	

(4) Documents to be mandatorily annexed	
	(4.1) Communication and guidelines for installation, handling and storage, maintenance, and disposal
	(4.2) Photos of the light panel system

By signing this Application Form (homologation), the undersigned Applicant attests to the accuracy of the information provided and that the Samples submitted (in all Sizes and Combinations of accessories) are fully consistent with the indications set forth on the Application Form.

Applicant's representative

Name Signature

On ____/____/____

V. APPLICATION FORM (UPDATE) / FRHPlp-01

To be filled in for each Light panel model and returned by e-mail to frhp@fim.ch

(1) Applicant's information	
(1.1) Name	
(1.2) Address (road, city, ZIP code, country)	
(1.3) E-mail	
(1.4) Phone	
(1.5) Commercial trade mark(s)	
(1.6) Contact name	
(1.7) VAT number/Legal registration number	
(2) Manufacturer's information	
(2.1) Name	
(2.2) Address (road, city, ZIP code, country)	
(2.3) E-mail	
(2.4) Phone	
(2.5) Contact name	

(3) History (to be filled by FIM)	
(3.1) Application Form (homologation) of reference	

(4) Light panel Information	
(3.1) Commercial name(s)	
(3.2) Date of manufacture (mm, yyyy)	
(3.3) Wished amount of Homologation labels (per year)	

(5) Reason for update	
(5.1) Update ○ trademark(s) ○ commercial name(s) ○ guide lines ○ materials ○ others (please specify:_____ _____	

(6) Tests requested (to be filled in by FIM)	

(7) Documents to be mandatorily annexed (<u>if they differ</u>)	
	(7.1) Relevant communication
	(7.2) Relevant photos

By signing this Application Form (update), the undersigned Applicant attests to the accuracy of the information provided and that the Samples submitted (in all Sizes and Combinations of accessories) are fully consistent with the indications set forth on the Application Form.

Applicant's representative

Name Signature

On ____/____/____

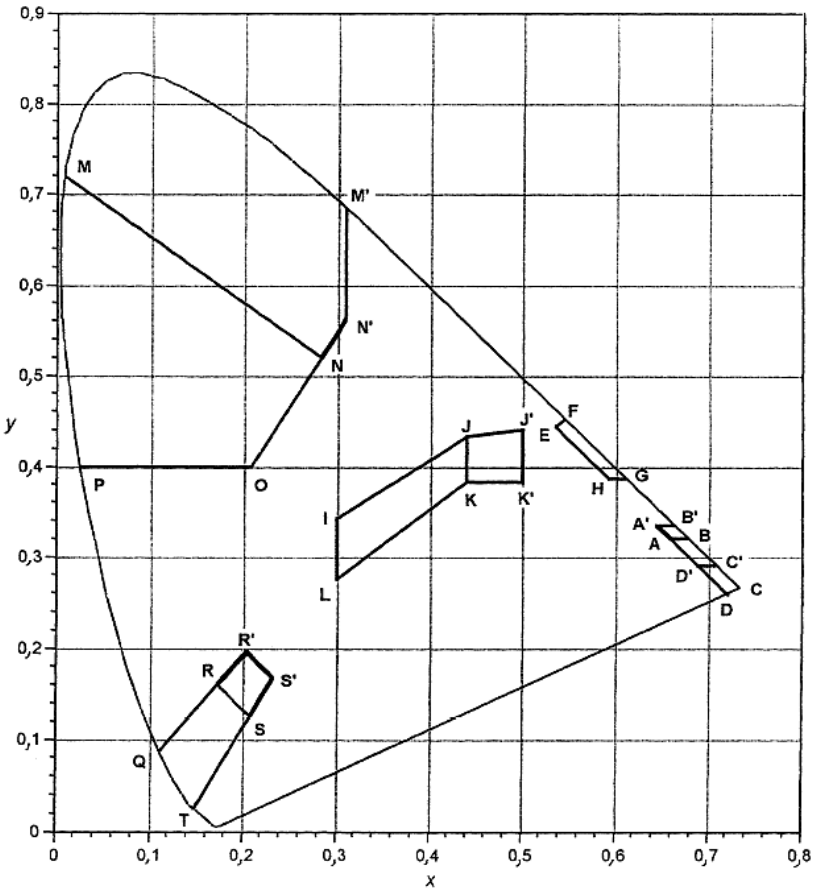
VI. APPENDIX 1: CHROMATICITY COORDINATES

Coordinates of intersection points of allowed chromaticity area boundaries

COLOUR		CHROMATICITY COORDINATES				
RED LIGHT SIGNAL COLOURS CLASS A1[3]		A	B	C'	D'	
	X	0,66	0,68	0,71	0,69	
	Y	0,32	0,32	0,29	0,29	
WHITE LIGHT SIGNAL COLOURS CLASS A[3]		I	J	K	L	
	X	0,30	0,44	0,44	0,30	
	Y	0,34	0,43	0,38	0,28	
GREEN LIGHT SIGNAL COLOURS CLASS A[3]		M	N	O	P	
	X	0,01	0,28	0,21	0,03	
	Y	0,72	0,52	0,40	0,40	
BLUE LIGHT SIGNAL COLOURS CLASS A[3]		Q	R	S	T	
	X	0,11	0,17	0,21	0,15	
	Y	0,09	0,16	0,13	0,03	
YELLOW LIGHT SIGNAL COLOURS CLASS FIA 1		SY1	SY2	SY3	SY4	SY5
	X	0.454	0.480	0.545	0.521	0.500
	Y	0.486	0.519	0.454	0.440	0.440
ORANGE LIGHT SIGNAL COLOURS		E	F	G	H	
	X	0.57	0.61	0.54	0.51	
	Y	0.43	0.39	0.38	0.41	

Table 3: Chromaticity coordinates

[3] Persons with defective colour vision are included in the user group


0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
y
0
0,1
0,2
0,3
0,4
0,5
0,6
0,7
0,8
x
M
M'
N'
N
P
O
I
J
J'
E
F
G
H
K
K'
L
A'
B'
A
B
C'
D'
C
D
R'
R
S'
S
Q
T

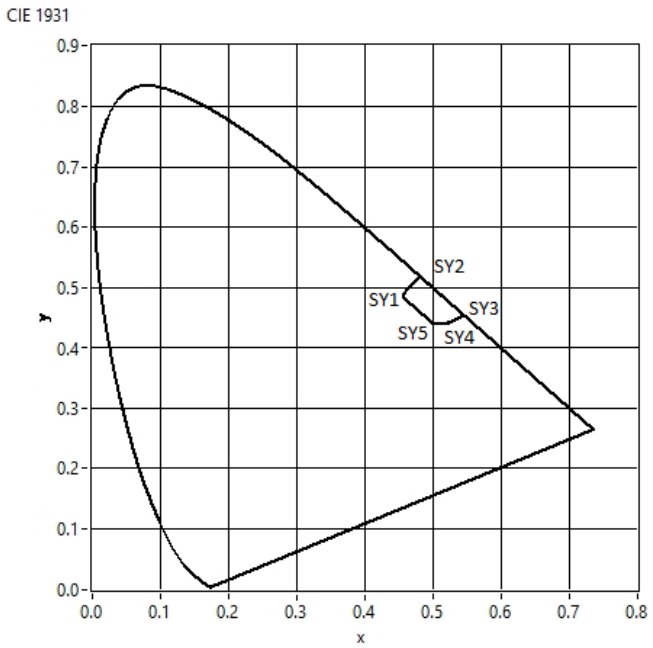
UNECE R48 Extract:

"Selective-yellow" means the chromaticity coordinates (x,y)[4] of the light emitted that lie inside the chromaticity areas defined by the boundaries:

SY12 green boundary	y = 1.290 x - 0.100
SY23 the spectral locus	
SY34 red boundary	y = 0.138 + 0.580 x
SY45 yellowish white boundary	y = 0.440
SY51 white boundary	y = 0.940 - x

With intersection points:

	X	Y
SY1	0.454	0.486
SY2	0.480	0.519
SY3	0.545	0.454
SY4	0.521	0.440
SY5	0.500	0.440



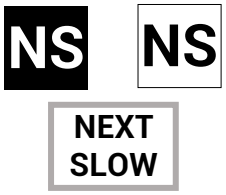
Further information can be found on the UNECE website:

http://www.unece.org/fileadmin/DAM/trans/main/wp29/wp29regs/2015/R048r12e.pdf

[4] CIE Publication15.2, 1986, Colorimetry, the CIE 1931 standard colorimetric observer

VII. APPENDIX 2: FLAGS DISPLAY MODE

Flag Type	Current Design(s)	RECOMMENDED FLASHING FREQUENCY (Hz)
Yellow		2
Double Yellow		2 - 4
White		2
Green		2
Blue		2
Red		2
Slippery surface		Static
Safety Car		2
Virtual Safety Car		2
Full Course Yellow		2
Code 60		Static - 2
Pit Entry		Static
Pit Entry Closed		Static
Custom Blue		2
Standing/Rolling Start		2
Mechanical Problem		2 - 3
Unsportsmanlike behaviour		2- 3

Black		2 - 3
Chequered		2
Next Slow		2
Slow Zone		2
Rain FIM		Static
Rain + Slippery FIM	To de defined	