Photoelasticity Unit with Strain Gauges Measurement System and Artificial Vision System

EFOV

EDIBON SCADA System

Control Interface Box

Data Acquisition Board

Software for:
- Control
- Data Acquisition
- Data Management

Artificial Vision Software

Camera
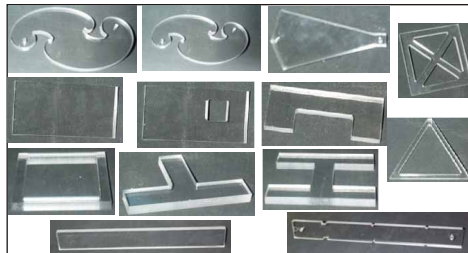
Computer (not included in the supply)
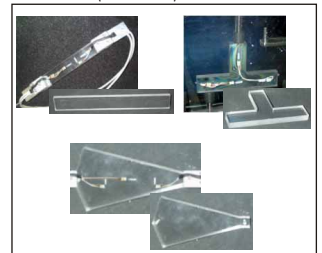
Test Specimens

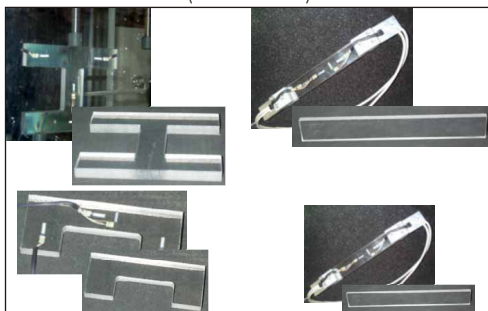EFO-K1. Kit of Static Test Specimens (basic kit)

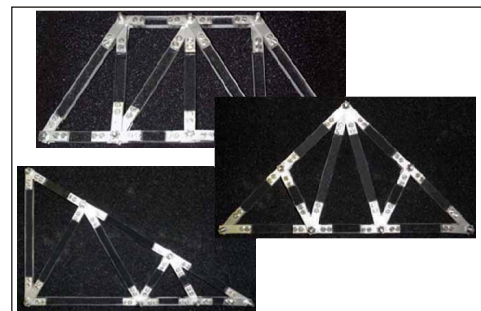EFO-K2. Kit of Static Test Specimens (advanced kit)

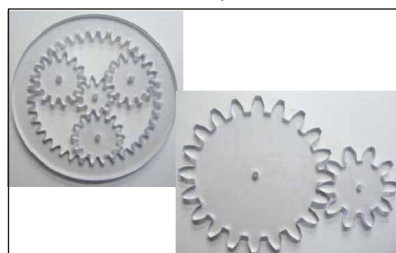EFO-K3. Kit of Test Specimens with Strain Gauges (basic kit)

EFO-K4. Kit of Test Specimens with Strain Gauges (advanced kit)

EFO-K5. Kit of Articulated Structures

EFO-K6. Kit of Dynamic Panels

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↳Products range
↳Units
↳7.-Mechanics & Materials

INTRODUCTION

Photoelasticity is the method of analysing and recording mechanical stresses and strains in components.

The components used are test specimens or models made of transparent special material which becomes optically double-refractive under mechanical loading.

Using polarised light, the distribution of stress in test specimens is investigated.

The polarisation filters represent the distribution of stress in colours.

By using white or monochromatic light and different configuration of linear and circular polarizer / analyzer we can obtain the principal stresses direction and the principal stresses difference.

By using strain gauges we can measure the stress in a certain position and in one direction. With Photoelasticity we can observe the value in the whole element and in all directions.

GENERAL DESCRIPTION

Unit for photoelasticity practices, illustrating the subjects of the Photoelasticity theory, the Elasticity theory, Strength of Materials, and Structure theory.

It is very suitable for the introduction and study of photoelasticity: optical elements, isochromatic, isoclinic, band order, band factor, edge tensionsing, and for strain and stress analysis and measurement with strain gauges.

With the aid of the SCADA system it is possible to analyze and process the captured data during test experiments, making measurements with strain gauges. The artificial vision software allows analyze and process the captured images during test experiments.

Using this unit photoelastic experiments and practices of transparent test specimens (models) may be performed.

The different test specimens are subjected to loading by external forces and have poralised light shone through them.

A load application element can apply tensile, bending, compressive, and distributed and punctual loads to the specimen.

The stresses and strains occurring in the test specimen are represented as bright spots or figures of different colours, and we can visualise the distribution of stress.

We offer a wide range of test specimens for making a variety of practices and experiments.

These specimens show a full color and high contrast results and are also made of a special very hard material that avoids breaking during daily use.

The unit includes specimens with strain gauges and the accessories (electronic, mechanical and software) for acquiring all the values in the computer in real time and allows to compare the advantages of one method with the other.
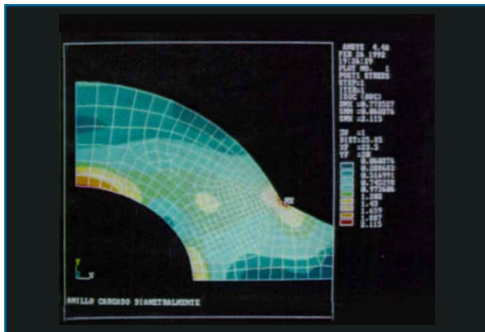
It is also very useful for Young`s module determination of the material and fringe order and band order calculation.

This unit also allows to capture images with PC and do different treatments to help in identifying stresses values and stresses directions.
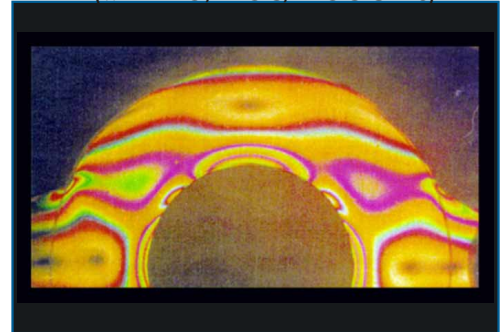
RESULTS

1. Differences between the simulation and the photoelastic reality
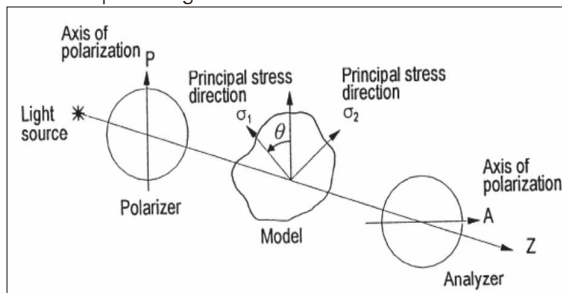
Software Simulation

Real
(with EFO/EFOC/EFOC Units)
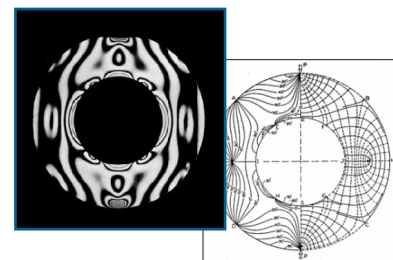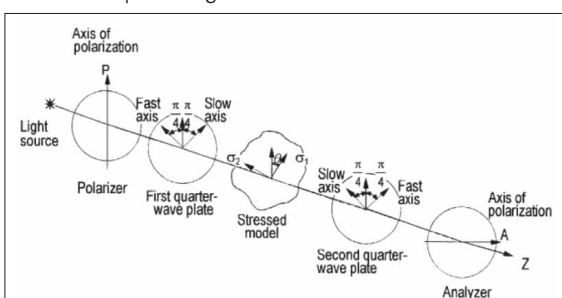

2. Main configurations with EFO/EFOC/EFOV Units
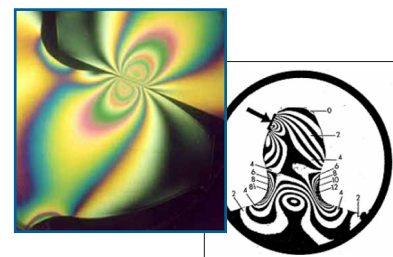
Plane Polariscope configuration

Plane polariscope configuration with monochromatic light, for isoclines and direction of principal stresses determination.
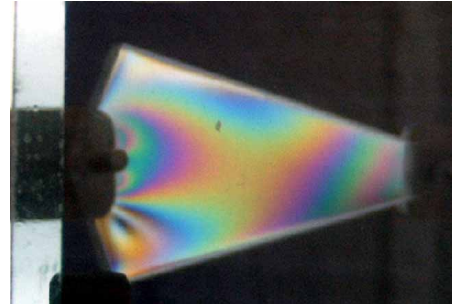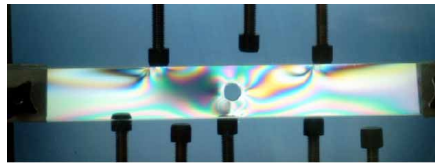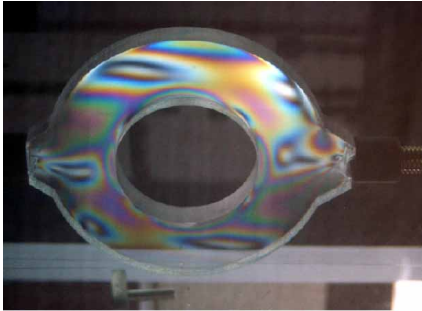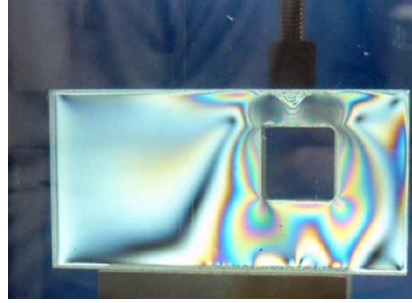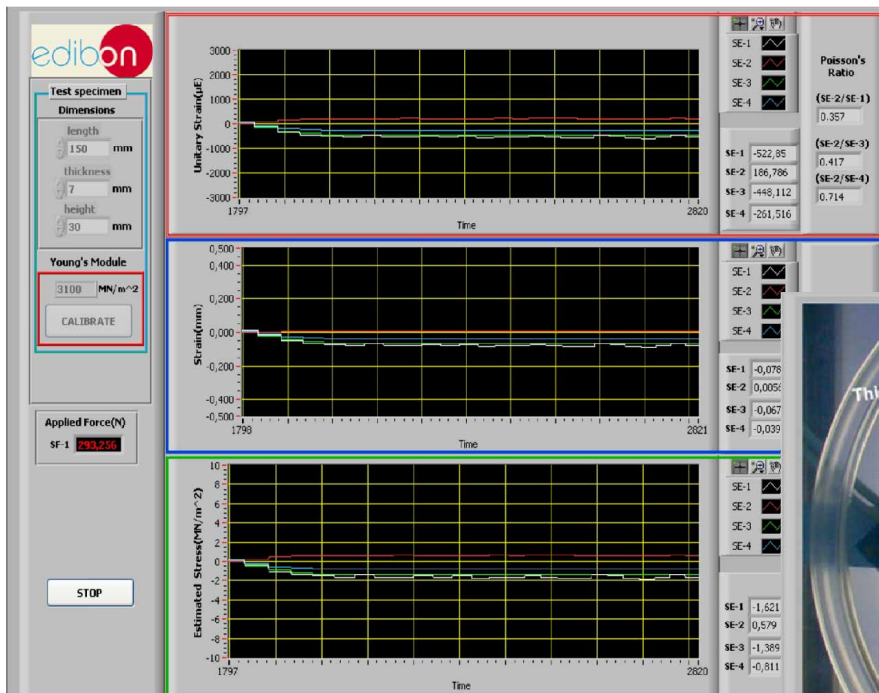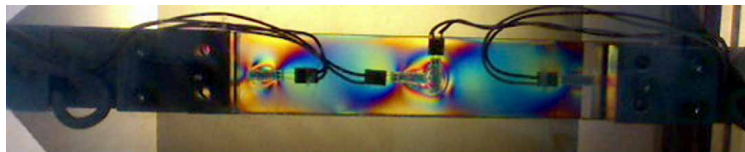
Circular Polariscope configuration

Circular polariscope configuration for isochromatics and principal stresses difference determination.

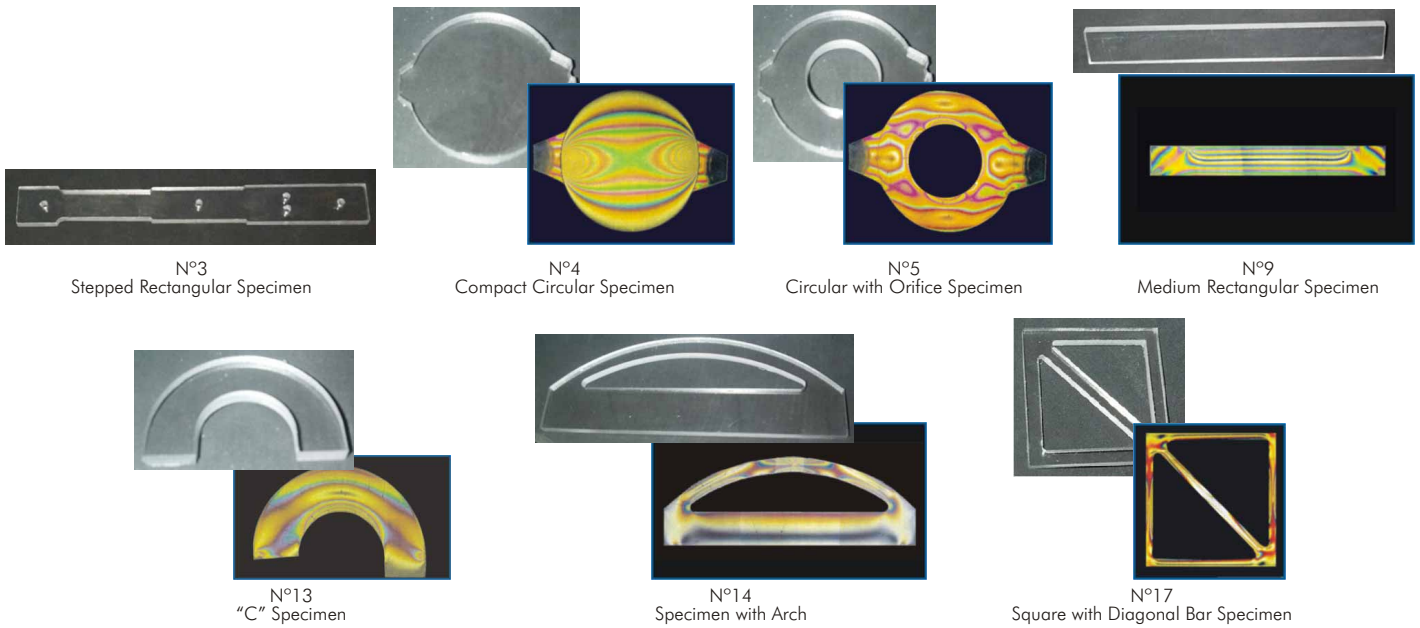### 3. Some typical results with EFO/EFOC/EFOV Units and different specimens

4. Some typical results for strain gauges analysis

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EFO-K1. Kit of Static Test Specimens (basic kit) (always included with the EFOV unit)

N°3
Stepped Rectangular Specimen

N°4
Compact Circular Specimen

N°5
Circular with Orifice Specimen

N°9
Medium Rectangular Specimen

N°13
"C" Specimen

N°14
Specimen with Arch

N°17
Square with Diagonal Bar Specimen

EFO-K2. Kit of Static Test Specimens (advanced kit)

N°1
Big Irregular Specimen

N°2
Small Irregular Specimen

N°6
Notches Rectangular Specimen

N°7
Trapezoidal Specimen

N°8
Big Rectangular Specimen

N°10
Small Rectangular Specimen

N°11
"U" Specimen

N°12
Wide Rectangular Specimen

N°15
Triangular Specimen

N°16
Hollow Square Specimen

N°18
Square with two Diagonal Bars Specimen

N°19
"T" Beam Specimen

N°20
Double "T" Beam Specimen

N°21
Rectangular with Hole Specimen

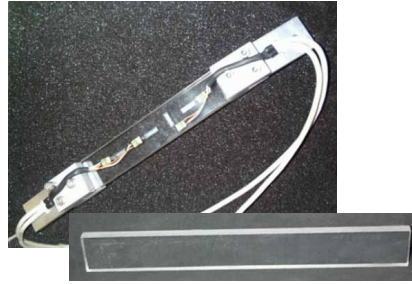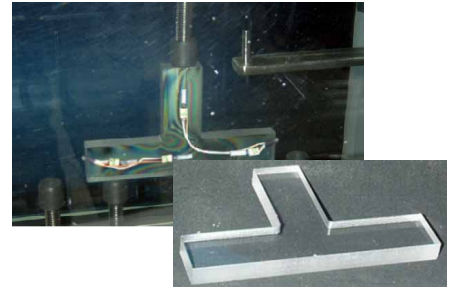## EFO-K3. Kit of Test Specimens with Strain Gauges (basic kit) (always included with the EFOV Unit)
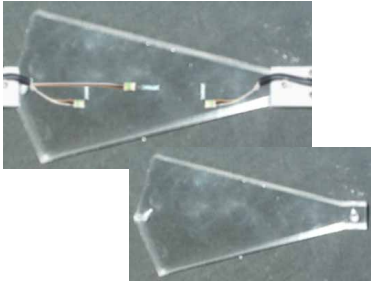
N°7-G
Trapezoidal Specimen with strain gauges
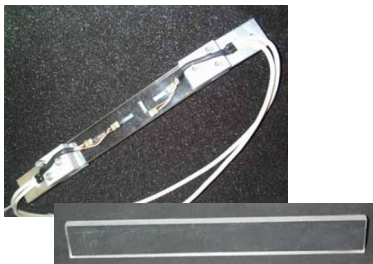+
N°7
Trapezoidal Specimen

N°8-G.
Big Rectangular Specimen with strain gauges
+
N°8
Big Rectangular Specimen

N°19-G.
"T" Beam Specimen with strain gauges
+
N°19
"T" Beam Specimen

EFO-K4. Kit of Test Specimens with Strain Gauges (advanced kit)

N°9-G.
Medium Rectangular Specimen
with strain gauges
+
N°9.
Medium Rectangular Specimen

N°10-G.
Small Rectangular Specimen
with strain gauges
+
N°10.
Small Rectangular Specimen

N°11-G.
"U" Specimen with strain gauges
+
N°11.
"U" Specimen

N°20-G.
Double "T" Beam Specimen
with strain gauges
+
N°20.
Double "T" Beam Specimen

EFO-K5. Kit of Articulated Structures

N°30
Articulated Structure 1

N°31
Articulated Structure 2

N°32
Articulated Structure 3
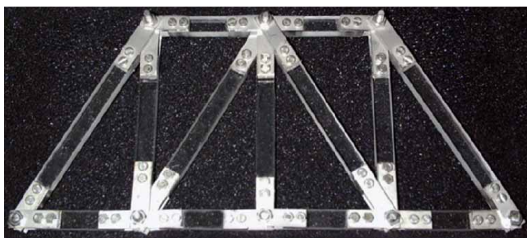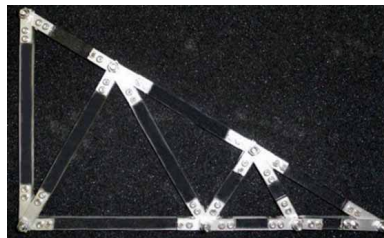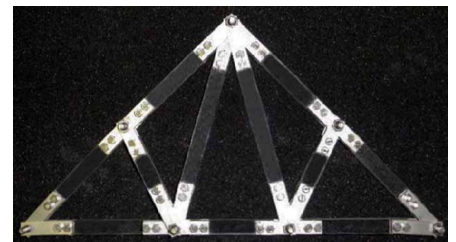
EFO-K6. Kit of Dynamic Panels

N°40
Dynamic Panel 1
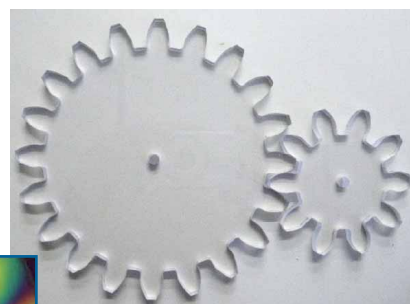
N°41
Dynamic Panel 2
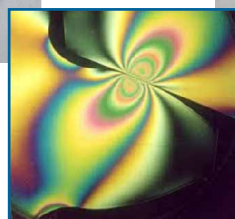
Items always included in the minimum supply

① **EFOV. Unit:**
-EFO. Unit
Bench-top unit.
Anodized aluminium structure.
Main metallic elements in stainless steel.
Light source, two fluorescent tubes of 30 cm and 8W.
Monochromatic light 35W.
Opalescent diffuser plate.
Double effect polarizing filters (linear polarization and circular polarization),
of 30 x 30 cm and protected by methacrylate plates.
Load frame with pulling jack.
10 pressure screws and accessories.
This unit is supplied with:
-EFO-K1. Kit of Static Test Specimens (basic kit), formed by:
N°3. Stepped Rectangular Specimen.
N°4. Compact Circular Specimen.
N°5. Circular with Orifice Specimen.
N°9. Medium Rectangular Specimen.
N°13. "C" Specimen.
N°14. Specimen with Arch.
N°17. Square with Diagonal Bar Specimen.
-EFO-K3. Kit of Test Specimens with Strain Gauges (basic kit), formed by:
N°7-G. Trapezoidal Specimen with strain gauges + N°7. Trapezoidal Specimen.
N°8-G. Big Rectangular Specimen with strain gauges + N°8. Big Rectangular Specimen.
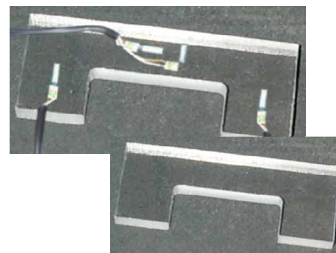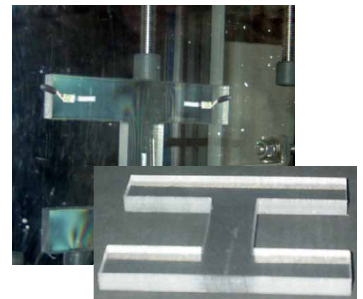N°19-G. "T" Beam Specimen with strain gauges + N°19. "T" Beam Specimen.
-EFOC-KIT.
Load cell for direct force measurement. Electronics, hardware and software for strain gauges measurement from PC, and direct force measurement applied to the specimens.
-EFOV-KIT.
Hardware and software for image acquisition and treatment.

Additional and optional Test Specimens, see page 13. (Not included in the minimum supply)

② **EFOC/V/CIB. Control Interface Box:**
Metallic box.
Sensors connectors.
Main switch.

③ **UDAB. USB Data Acquisition Board:**
USB Data acquisition board (National Instruments).
Bus USB.
Analog input:
Number of channels = 8.
Resolution = 12 bits.
Sampling rate: 10 KS/s (Kilo samples per second).
Analog output:
Number of channels = 2.
Resolution = 12 bits.
Output rate: 150Hz.
Digital Input/Output:
Number of channels = 12 inputs/outputs.
1 Counter/timer. Resolution: 32 bits.

④ **EFOV/CCSOF. Computer Control+Data Acquisition+Data Management Software + Artificial Vision Software.**
Compatible with actual Windows operating systems.
Control and Data Acquisition in real time.
Management, processing, comparison and storage of data.

⑤ **EFOV/CAM. Camera.**

⑥ **Cables and Accessories**, for normal operation.

⑦ **Manuals:** This unit is **supplied with 8 manuals:** Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.
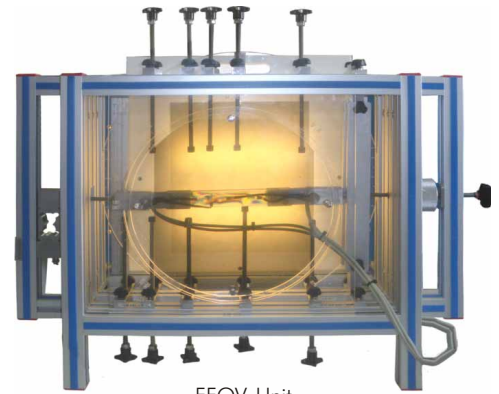
EFOV. Unit
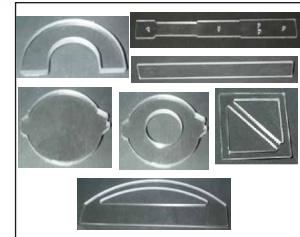
EFO-K1. Kit of Static Test Specimens (basic kit)

EFO-K3. Kit of Test Specimens with Strain Gauges (basic kit)

EFOC/V/CIB

UDAB

EFOV/CCSOF

✱ References 1 to 7: EFOV + EFOC/V/CIB + UDAB + EFOV/CCSOF + EFOV/CAM + Cables and Accessories + Manuals are included in the minimum supply for enabling normal and full operation.

EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Unit:

1.- Introduction to photoelasticity: optical elements, isochromatic, isoclinic, band order, band factor, edge tension sign, etc.

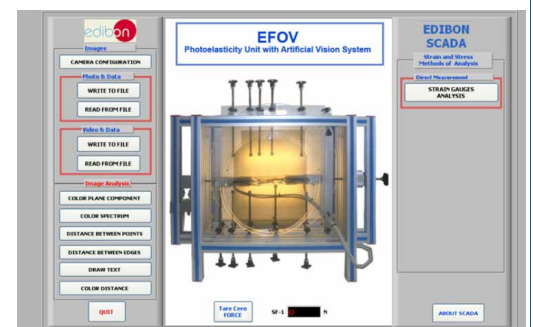2.- Determination of principal stress difference.

3.- Isochromatics.

4.- Illustration of the themes about elasticity, strength of materials and structures using photoelastic tests.

5.- Pure traction/optical-tensional law.

6.- Diametrically compressed disc.

7.- Ring with diametrical compression traction.

8.- Ring with diametrical compression.

9.- Plate with circular drill with traction.

10.- Comparison of the effects from different engraves in piece with traction.

11.- Pure traction in a piece with section linearly variable.

12.- Pure flexion.

13.- Simple flexion.

14.- Simple flexion, compound beams.

15.- Compound flexion.

16.- Compound central core of the section.

17.- Piece with a great curvature subjected to flexion.

18.- Arch built-in with a central charge.

19.- Triangular structure.

20.- Comparison of the structures.

21.- Comparison of the effect of different notches.

22.- Strain and stress analysis and measurements with strain gauges using computer.

23.- Image acquisition and treatment with software.

REQUIRED SERVICES

-Electrical supply: single-phase, 220V./50Hz or 110V./60Hz.

-Computer (PC).
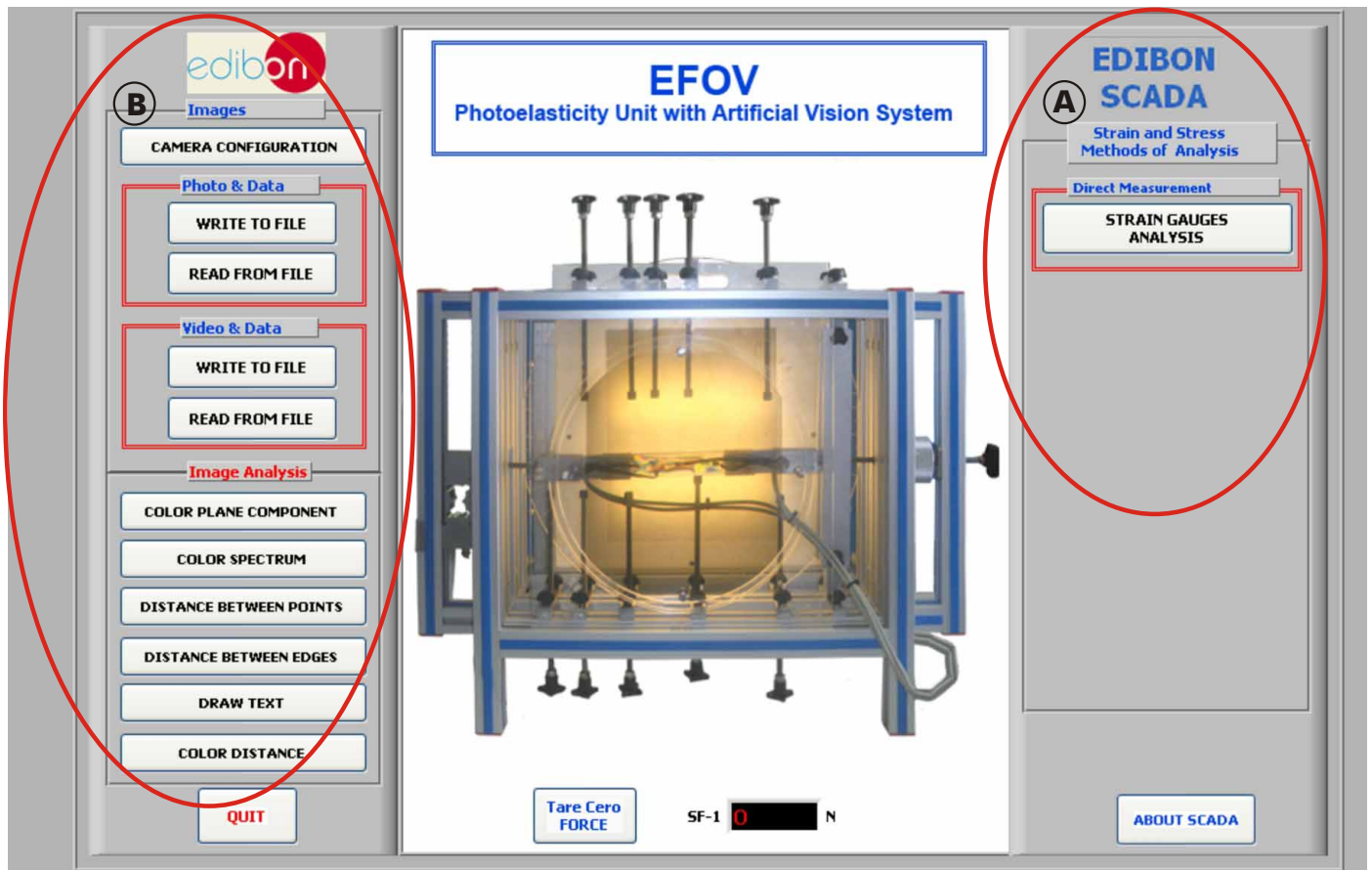
DIMENSIONS & WEIGHTS

EFOV:
  Unit:
    -Dimensions: 750 x 400 x 550 mm. approx.
                (29.53 x 15.75 x 21.65 inches approx.).
    -Weight : 22 Kg. approx. (48.5 pounds approx.).
  Control Interface Box:
    -Dimensions: 310 x 220 x 180 mm. approx.
                (12.20 x 8.66 x 7.09 inches approx.).
    -Weight : 3 Kg. approx. (6.6 pounds approx.).

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Main screen

This is the main screen, where the different tasks that can be carried out with this unit are shown.

There are two main sections:

(A) Strain Gauges Measurement System.
On the right-hand side of the screen , we find the button that controls the action to carry out on the deformation analysis measured with strain gauges.

(B) Artificial Vision System.
On the left-hand side of the screen, we find the main buttons to control the action to be carried out in the photoelasticity analysis.

(A.1) "Strain & Stress analysis" tool
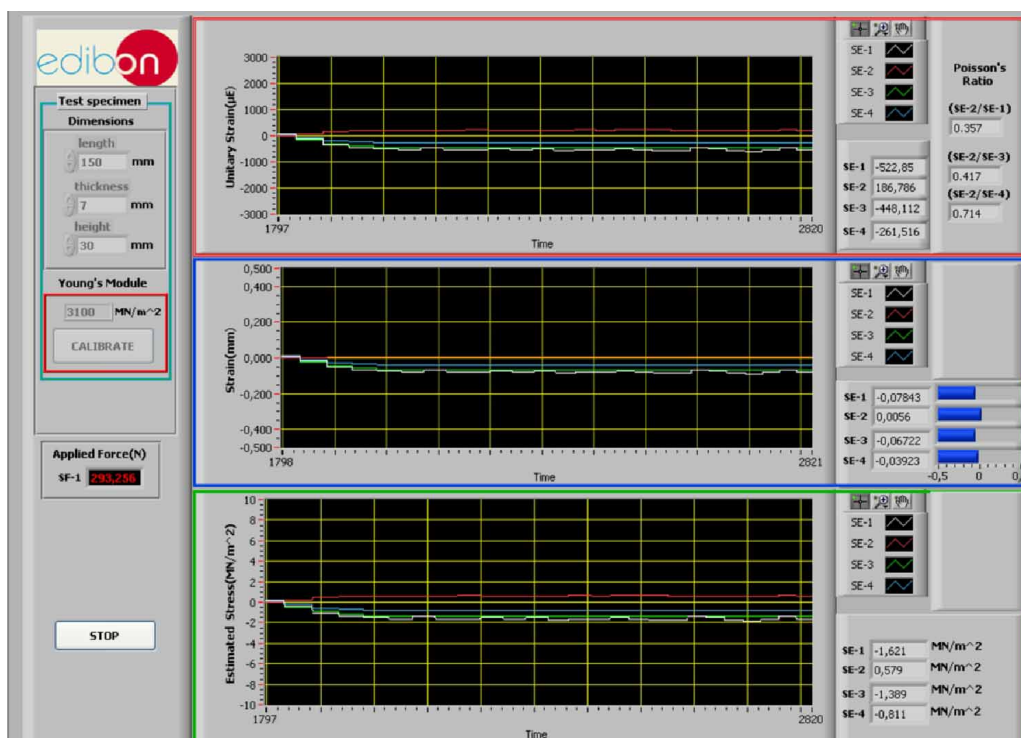
This screen can graphically represent in real time values taken by the sensors and visualise the evolution of those measures in the time.

The digital indicators of the right-hand side are labeled with the names of the sensors.

On the left-hand side of the screen, we find the necessary controls to introduce the geometrical data of the specimen with gauges to analyse.

Clicking on the START button, the data acquisition, in real time, begins for strain measurement and stress suffered on the four points of the specimen.
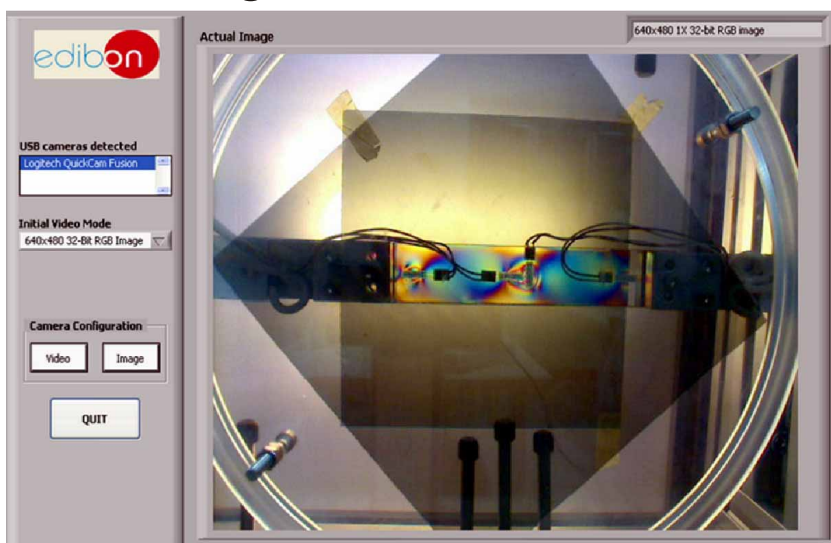
A.2 Young's Module Calibration screen
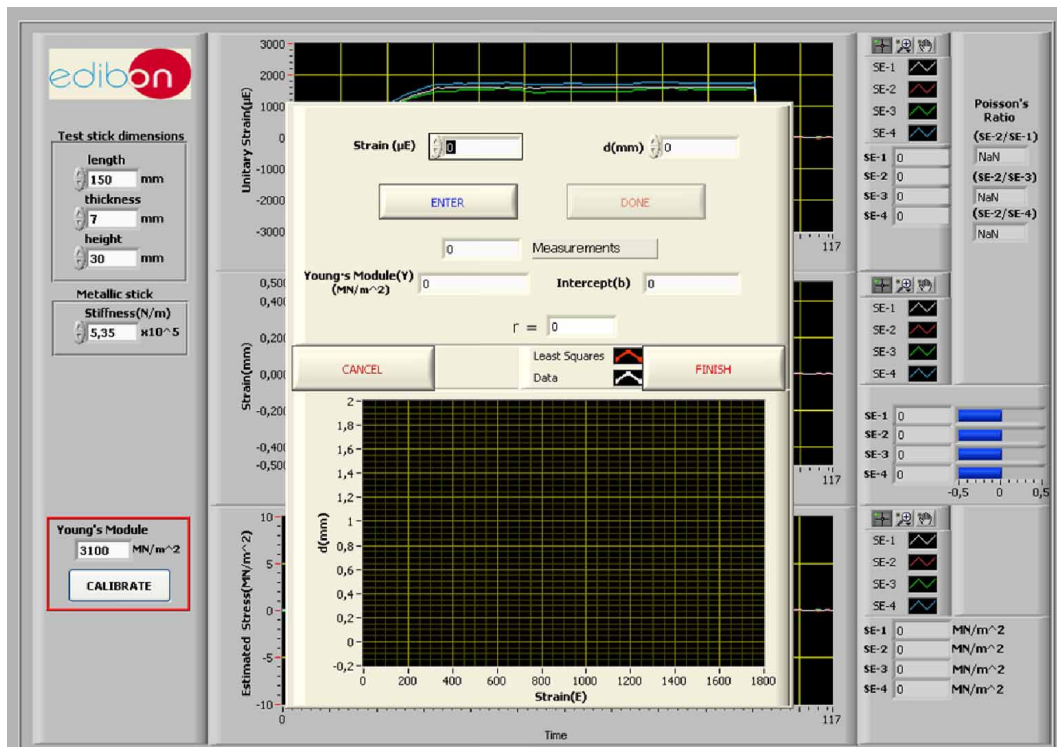
This screen has the necessary tools to obtain the value of Young's module of the specimen, applying least squares method.
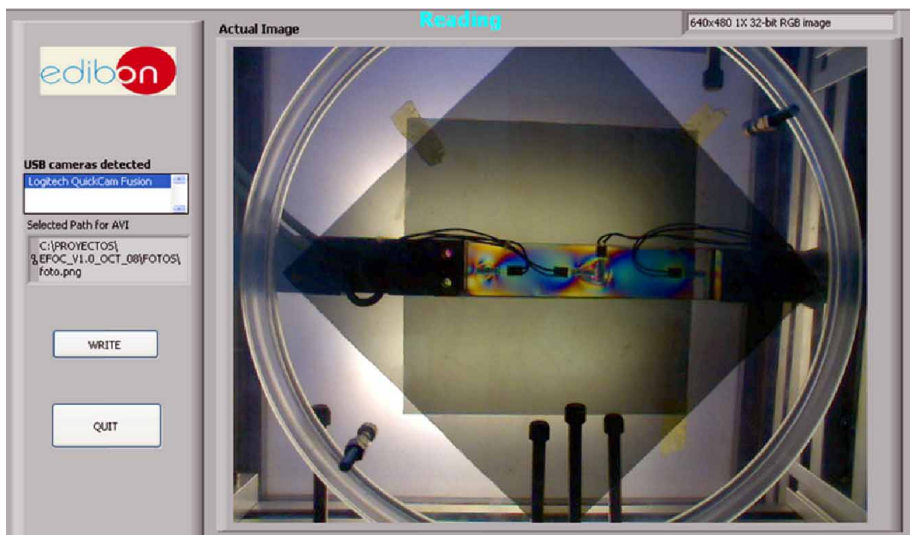
B.1 Camera configuration

With this tool, the photo and video configuration of the webcam used by the unit can be read and modified.

B.2 Photo read tool
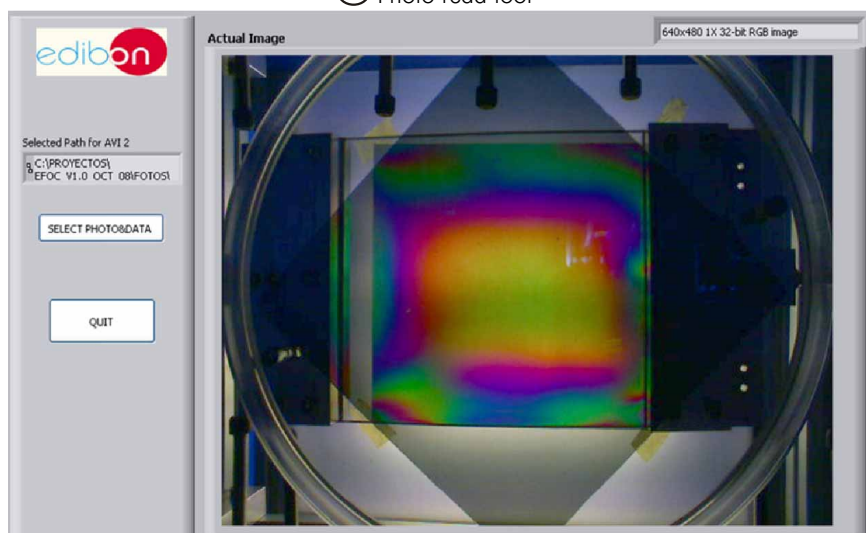
With this tool, folders and photo files stored on the computer can be managed while the experiments are being carried out, as well as modifying their formats.

(B.3) Photo write tool

With this tool, new photos can be captured and saved while the experiments are being carried out, as well as to manage the folders and photo files stored in the computer.
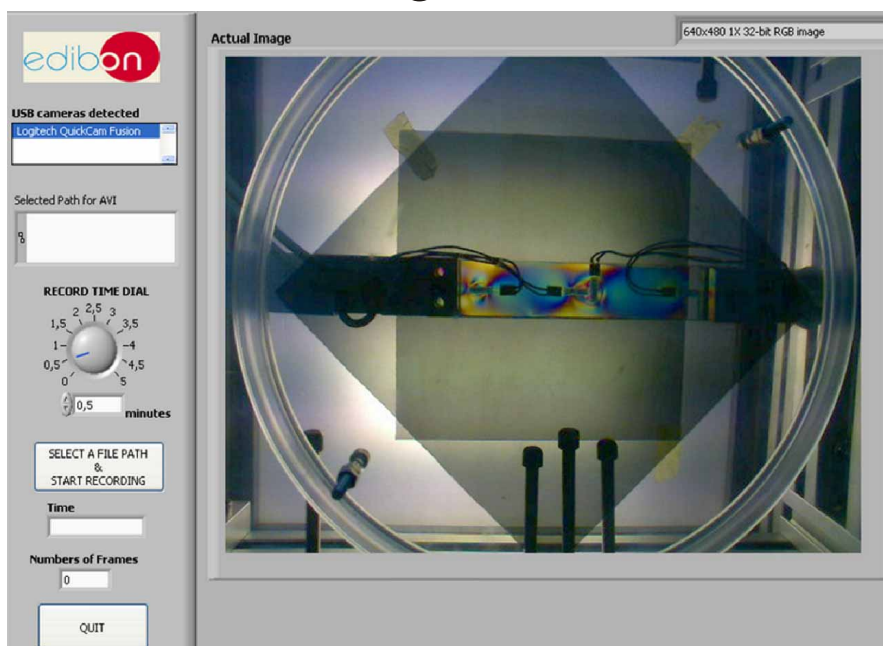
(B.4) Video read tool
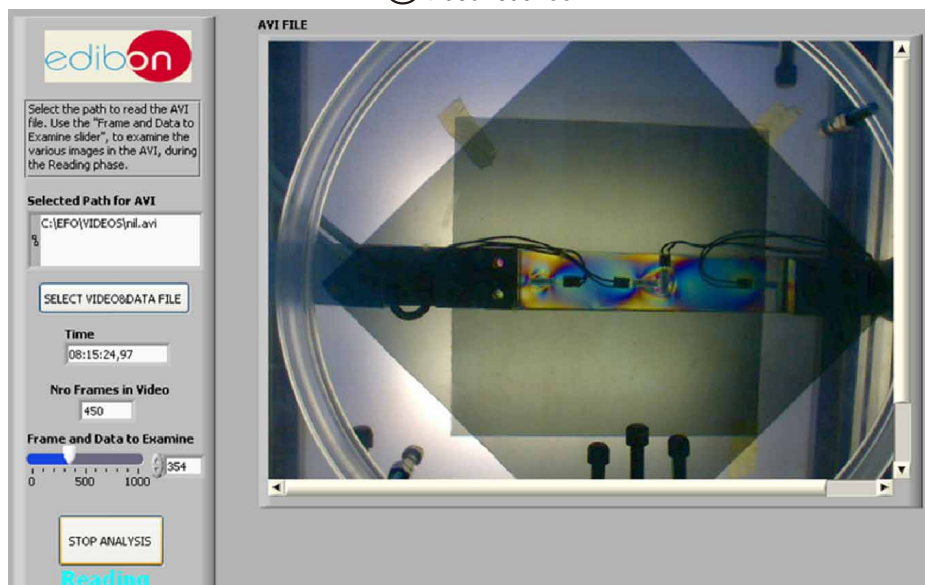
With this tool, the folders and video files saved to the computer can be managed while the experiments are being carried out.

On the left-hand side panel, we find the virtual cursor "Frame and Data to Examine", which allows to analyse the saved video, frame by frame; it is very useful if we want to save a photograph of any of the analysed frames.

(B.5) Video write tool

With this tool, new videos can be captured and saved, as well as to manage folders and video files stored in the computer, while the experiments are being carried out.

On the left-hand side panel we find the virtual dial "Record Time Dial", that allows to select, according to time length, the size of the video file captured frame by frame.
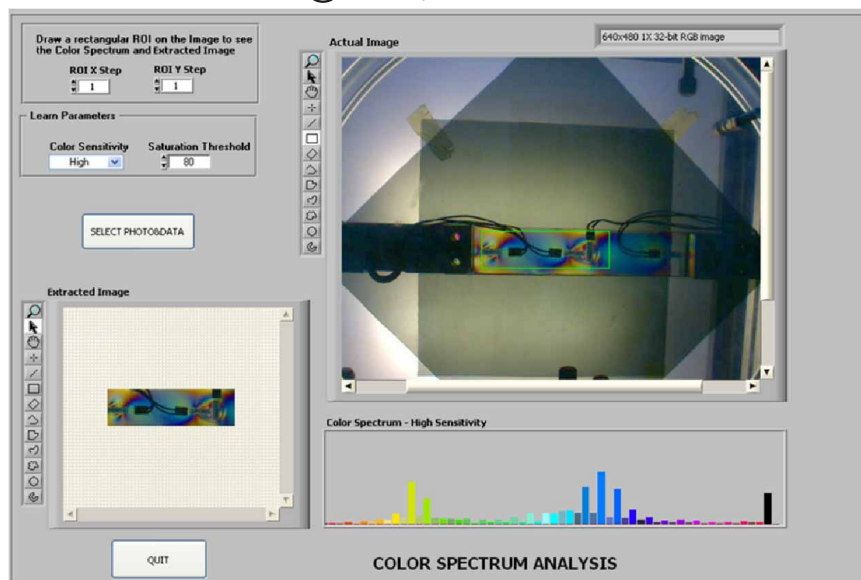
B.6 Color plane component

With this tool, photos captured can be analysed, extracting a specific colour component, while the experiments are being carried out.

On the left-hand side panel, we find the selector "Select Color Plane". Clicking on it, we can select the colour plane to eliminate on the analysed photograph.

B.7 Color spectrum

With this tool, the intensity spectrum of the main colours can be analysed on a photograph or in an interesting part of it, while the experiments are being carried out.

On the left-hand side, different options can be chosen on the selection of the photograph analysed. The selected section of the photograph will be shown on a separate window.
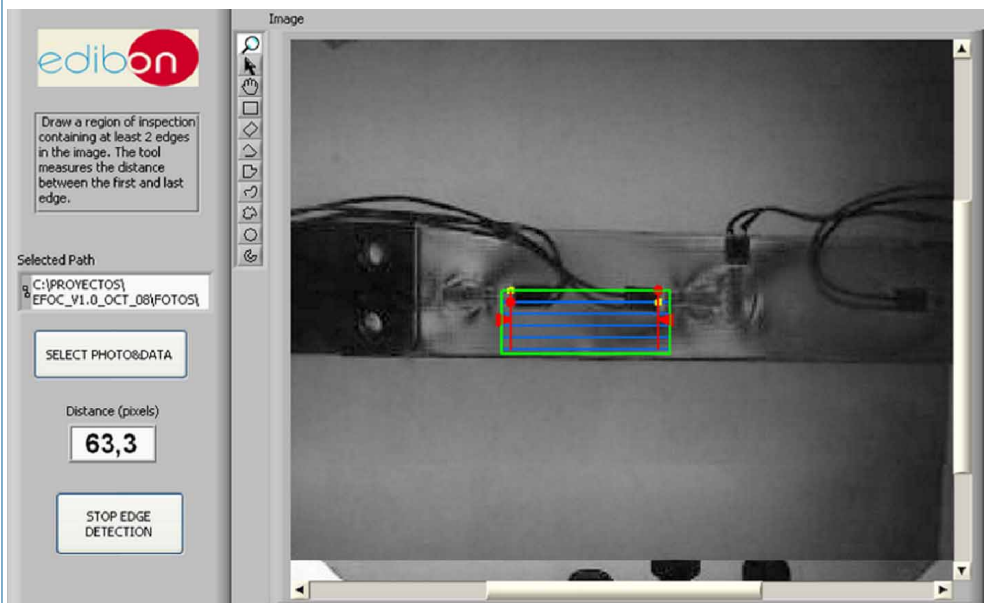
B.8 Distance between points

With this tool, the distance between two interest points, drawn over an image, can be quantitatively measured, while the experiments are being carried out.

We draw a line between the points in which we want to measure the distance. Afterwards, the distance in pixels between the selected points will be shown.
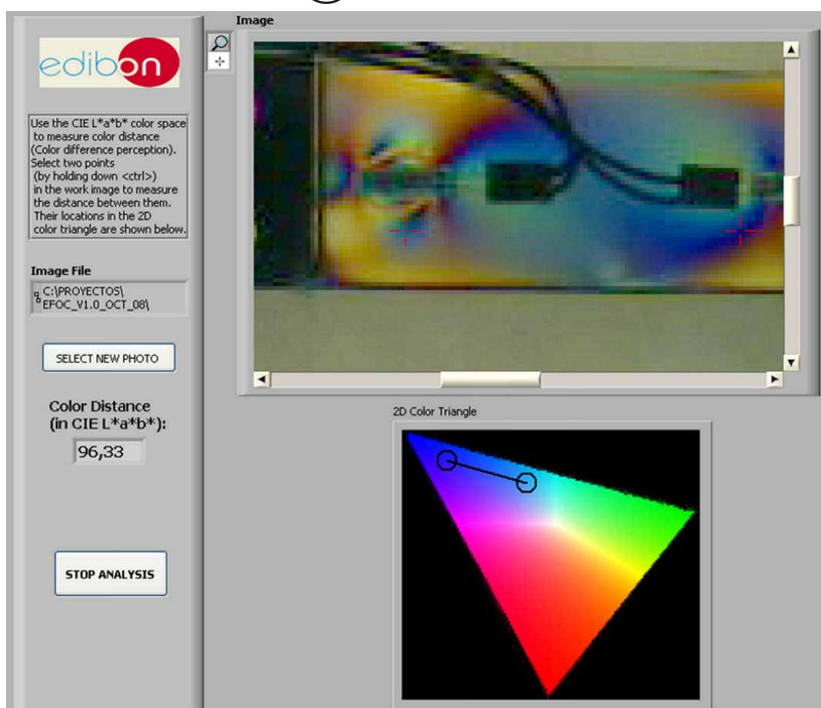
B.9 Distance between edges

With this tool, the distance between the specific edges, drawn in an image, can be quantitatively measured, while the experiments are being carried out.

B.10 Draw text

With this tool, notes and comments can be written over the analysed photographs, to be saved afterwards, while the experiments are being carried out.

B.11 Color distance

With this tool, the difference between two specific colours can be quantitatively measured, while the experiments are being carried out.

-EFO-K2. Kit of Static Test Specimens (advanced kit), formed by:

N°1.   Big Irregular Specimen.

N°2.   Small Irregular Specimen.

N°6.   Notches Rectangular Specimen.

N°7.   Trapezoidal Specimen.

N°8.   Big Rectangular Specimen.

N°10.   Small Rectangular Specimen.

N°11.   "U" Specimen.

N°12.   Wide Rectangular Specimen.

N°15.   Triangular Specimen.

N°16.   Hollow Square Specimen.

N°18.   Square with two Diagonal Bars Specimen.

N°19.   "T" Beam Specimen.

N°20.   Double "T" Beam Specimen.

N°21.   Rectangular with Hole Specimen.

-EFO-K4. Kit of Test Specimens with Strain Gauges (advanced kit), formed by:

N°9-G.   Medium Rectangular Specimen with strain gauges + N°9. Medium Rectangular Specimen.

N°10-G.   Small Rectangular Specimen with strain gauges + N°10. Small Rectangular Specimen.

N°11-G.   "U" Specimen with strain gauges + N°11. "U" Specimen.

N°20-G.   Double "T" Beam Specimen with strain gauges + N°20. Double "T" Beam Specimen.

-EFO-K5. Kit of Articulated Structures, formed by:

N°30.   Articulated Structure 1.

N°31.   Articulated Structure 2.

N°32.   Articulated Structure 3.

-EFO-K6. Kit of Dynamic Panels, formed by:

N°40.   Dynamic Panel 1.

N°41.   Dynamic Panel 2.

AVAILABLE VERSIONS

Offered in this catalogue:

-EFOV.   Photoelasticity Unit with Strain Gauges Measurement System and Artificial Vision System.

Offered in other catalogues:

-EFOC.   Photoelasticity Unit with Strain Gauges Measurement System.

-EFO.   Photoelasticity Unit.

✱ Specifications subject to change without previous notice, due to the convenience of improvements of the product.

REPRESENTATIVE: