easystiff
A BioMeca Innovation

Instructions for use

1 Manufacturer

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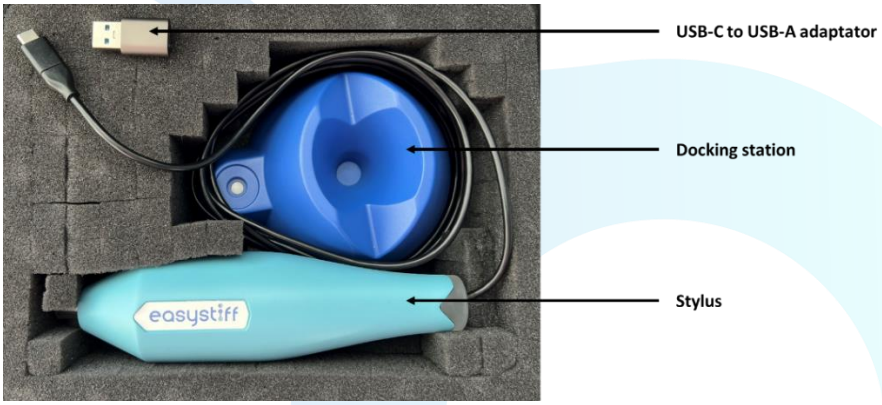
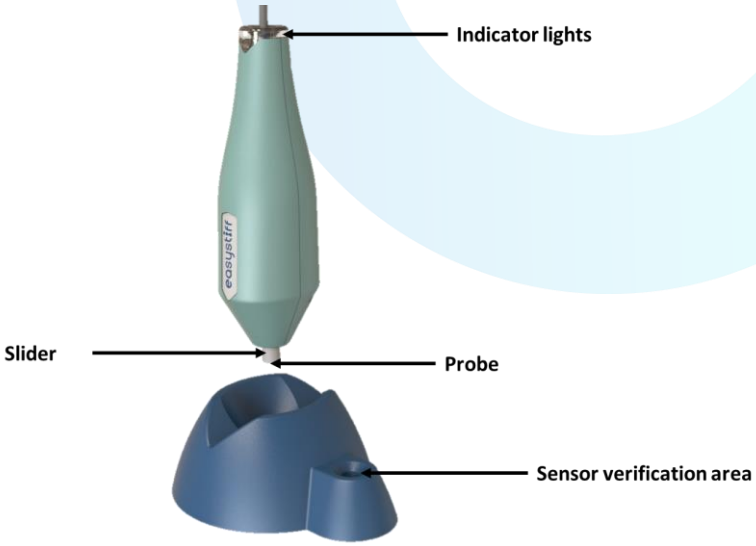
2 Kit content

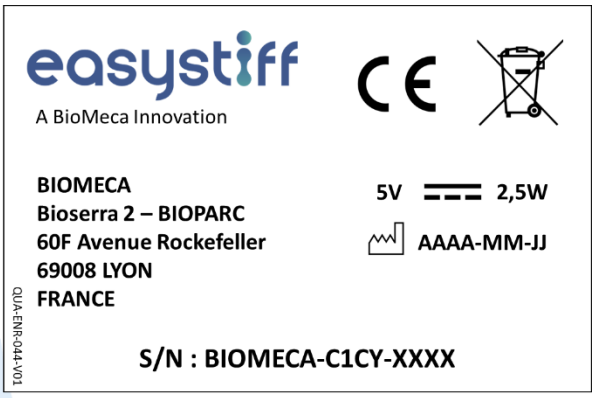
- 1 docking station for resting and calibration
- 1 measuring stylus
- 1 adaptator USB-C to USB-A



3 Description



4 Characteristics



Device characteristics are labelled on the stylus, under its docking station and on its package.

5 Technical principle

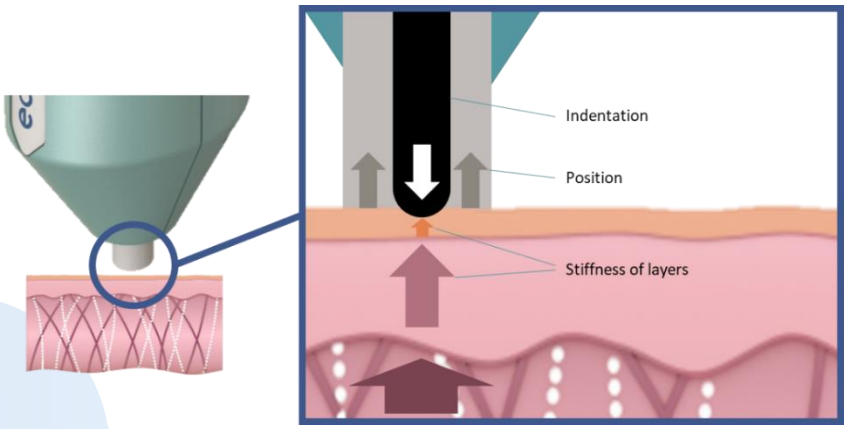
EASYSTIFF[1] is an innovative device developed by BioMeca[2]. It is a fast, easy-to-use, and painless device which enables to extract the mechanical properties of the skin, in vivo.

It is based on the indentation principle: a deformation is done on a chosen skin area (e.g. face, arms, legs…). This 1.2 mm deep deformation enables to create a force/move curve[3].

The chosen skin area is deformed on a surface less than 2 mm^2. Then, the mechanical data of each skin compartments are extracted (stratum corneum, epidermis, dermis). The extracted data are analyzed by our proprietary algorithm.

The elastic modulus is extracted and linked to the appropriate skin compartment according to indentations found in the literature and according to our own laboratory data. Then, computer simulations helped us validate this approach.

[1] Patent number: WO2021165624
[2] https://www.bio-meca.com
[3] Runel, Gaël et al. “Stiffness measurement is a biomarker of skin ageing in vivo.” Experimental dermatology vol. 29,12 (2020): 1233-1237. doi:10.1111/exd.14195
Bachy, Sophie et al. “βig-h3-structured collagen alters macrophage phenotype and function in pancreatic cancer.” iScience vol. 25,2 103758. 10 Jan. 2022, doi:10.1016/j.isci.2022.103758
Runel, Gaël et al. “Biomechanical Properties of Cancer Cells.” Cells vol. 10,4 887. 13 Apr. 2021, doi:10.3390/cells10040887



5.1 Tomography

The tomography analysis consists in fractioning the force/move curve in different segments according to the move. This mechanical analysis was first introduced in atomic force microscopy by *Roduit et al* in 2009[4] and enables to create the depth (z-dimension) of the sample stiffness. This approach was validated using finite element simulation *in silico*. These *in silico* modelling techniques enable to determine the move that a probe must do into the sample to extract its mechanical properties at a chosen indentation (meaning, a chosen skin compartment).

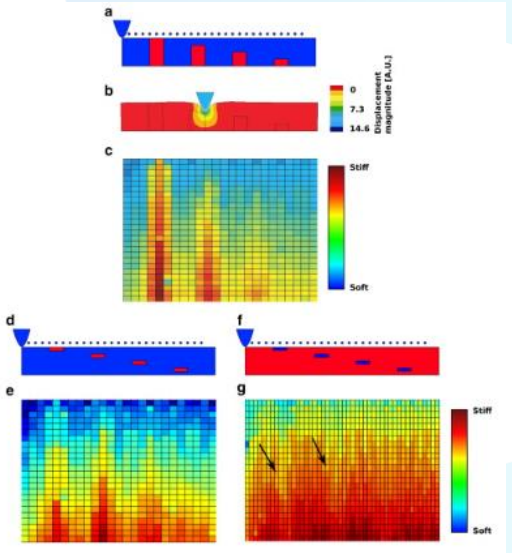


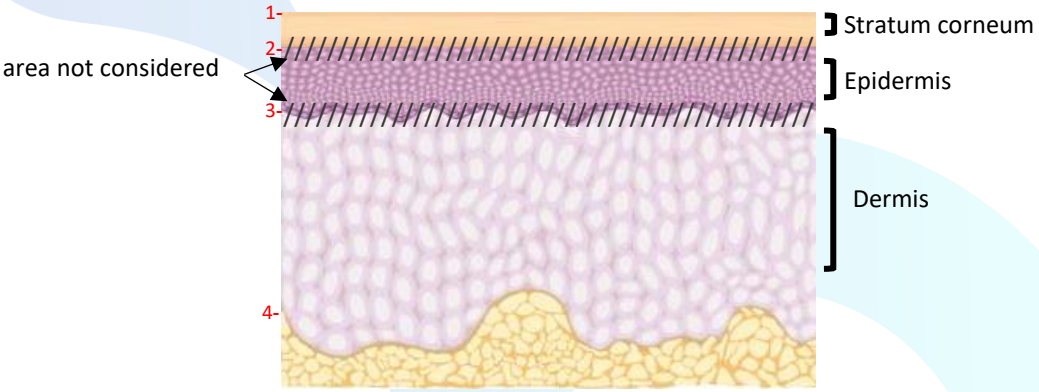
Figure 2 Simulation of the indentation process by using the finite elements method. The sample contains inclusions (*a*) colored in red that have a Young's modulus tree times higher than the bulk of the sample colored in blue. The AFM tip and the spots where indentation was simulated are also represented in blue. During the indentation process the sample deforms as depicted in *b*. The displacement magnitude is displayed in false colors according to the color bar. (*c*) The stiffness tomography analysis results. The false colors represent the stiffness in arbitrary units according to the color bar. (*d* and *f*) Shows similar simulation using three times stiffer and three times softer platforms with their resulting stiffness tomography in e and *g*, respectively. The same data scale is used between e and *g*. One can notice that the stiffness difference appear less contrasted in the case of soft platforms. Arrows in *g* points to stiffness differences induced by the presence of soft platforms.

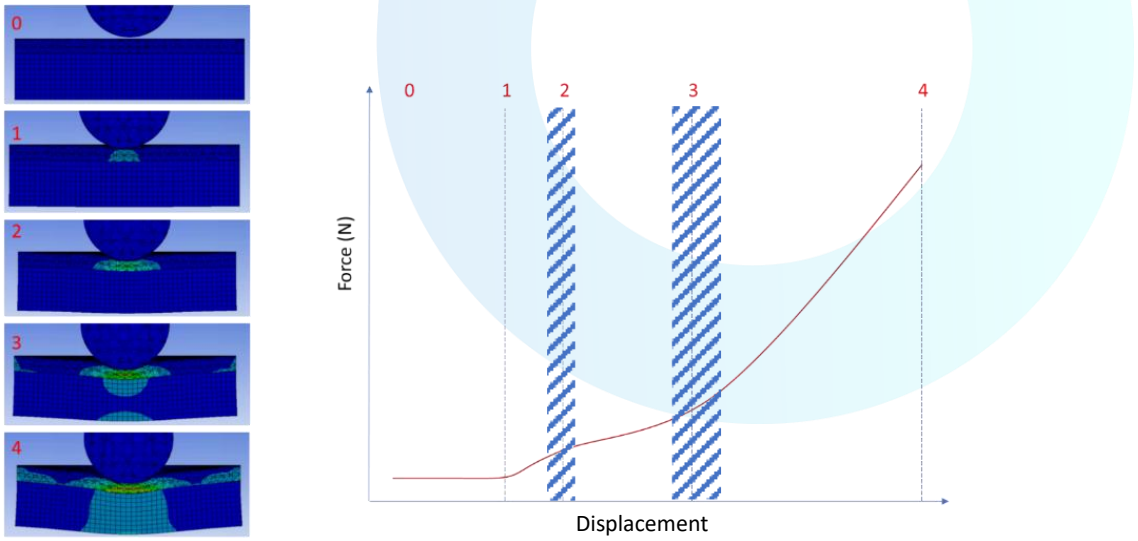
[4] Roduit C, Sekatski S, Dietler G et al., Stiffness tomography by atomic force microscopy, Biophysical Journal, (2009), 674-677, 97(2)

5.2 Compartmentalisation

The thickness of the human skin varies according to its location[5]. Such as many articles, our laboratory data also confirmed this observation. Following the validation of our modelling technique of deformation, we developed an extraction model of the mechanical properties according to the skin compartment and excluding the areas of uncertainties or not considered. Thus, our model is freed from the thickness variations and of the irregular structure of dermo-epidermal junction (wave-like structure).

Regions (*n*: 90)	Epidermis (Ep)(µm)				Dermis (Dm)(µm)				Total skin thickness (Ep + Dm) (µm)			
	Mean	SD	Median	Q1	Mean	SD	Median	Q1	Mean	SD	Median	Q1
Breast (*n*: 15)	76.9	26.2	64	55.7	4717.1	1902.5	4523	2837.5	4794	1905.1	4626.5	2891.7
Scalp (*n*: 15)	111.4	28.1	108	93	2238	773.5	1984	1834.5	2351.5	774.5	2108	1939.5
Abdomen (*n*: 15)	127.2	38.1	125	107	4550	2147.7	5295	2697	4679.5	2166.3	5426	2790.7
Back (*n*: 15)	140.2	36.6	132.5	122.5	3264.8	929.7	3169	2589	3575	1141.3	3363	26689.5
Dorsum of hand (*n*: 15)	195.3	79.2	181	145	2115	946.4	1864	1548	2310.2	953.8	2170	1743
Dorsum of foot (*n*: 15)	267.4	120.6	238	205.7	3184.7	1273.6	3563	1972.5	3488.6	1387.1	3816	2181





[5] Oltulu P, Ince B, Kokbudak N, Findik S, Kilinc F. Measurement of epidermis, dermis, and total skin thicknesses from six different body regions with a new ethical histometric technique. Turk J Plast Surg. 2018;26:56–61.

6 Instructions for use

6.1 Scope

EASYSTIFF is used in standardised studies of viscoelastic materials such as the skin. We do not recommend using EASYSTIFF on hard materials such as: wood, metal, stone, hard plastics, etc.
In cas of doubt, please contact our customer service: contact@easystiff.com
EASYSTIFF must be handled by a trained staff. To be trained, you must watch the following tutorial: Tutorial

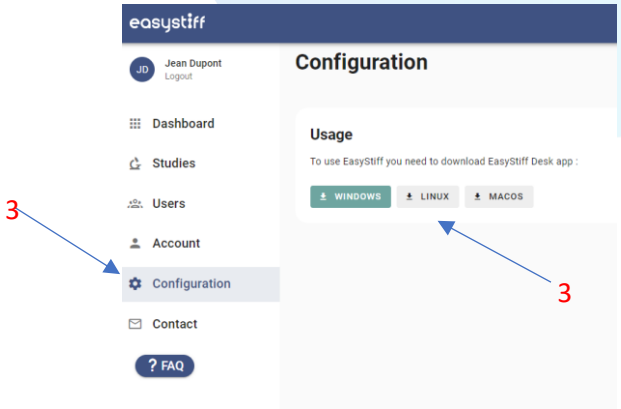
6.2 Connexion to the plateform

NB: The use of EASYSTIFF requires an internet connexion.

1. Go to the website EASYSTIFF
2. Enter your login and your password given by email

6.3 Software download

3. Go to Configuration, download and install the software according to your OS (3)

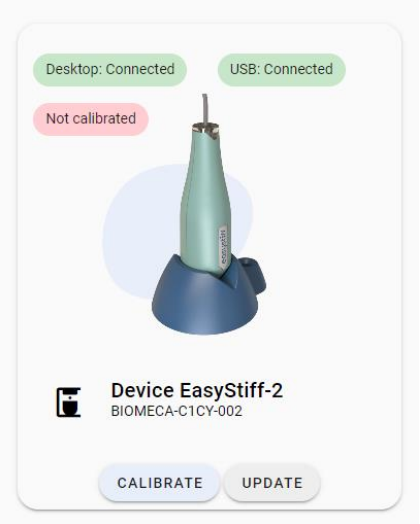


NB: In case you do not see the software, go to §11 Troubleshooting.

4. Launch the software biomeca-usb-ts
5. Connect the cable (the adaptator can be removed if needed)
6. Go back to the Dashboard page

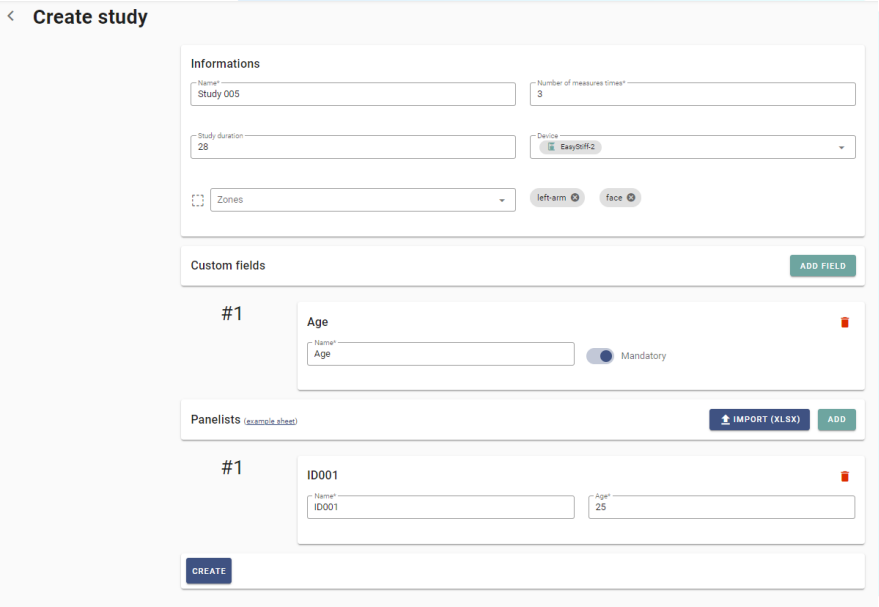
Your device status is:

- Desktop: Connected
- USB: Connected
- Not calibrated



6.4 Create study

7. Click ‘Create Study’
8. Enter study information
   Example: Study 005, 28 days long with 3 measuring time at d0, d7 et d28 and 1 participant (age)



NB: Data can be imported into an Excel template.

9. Click ‘Create’

6.5 Take measure

10. Click ‘Start the Study’
11. Check the study information and click ‘Start’

12. Click ‘Open’ for the participant
13. Choose the area to be tested
14. Click ‘Take Measure’
15. If the device is not calibrated, click ‘Calibrate’ and check the sensors with the docking station according to the picture below.

16. Click ‘Take Measurement’
17. Choose another area or test another participant

6.6 Finish study

18. Once the study is completed (every measuring time has been done, every participant has been tested), click ‘Finish Study’

6.7 See results

19. Ongoing study: you can see your results whenever you want. Go to ‘Back to Study’ then ‘See Results’
20. According to the purpose of the study, choose the participants or create groups of participants, choose the measuring time, areas and the analytical method. Graphs and spreadsheets are instantly updated.

6.8 Using your device

Before the first use, a sensor verification will be automatically required. Then, this verification will be required every 3 hours.

Indicator lights indicate the device status:

- Blue: the device is waiting to take measure
- Green: the measurement is done

When the device is not used, we recommend to disconnect it from the computer.

Measurements must be performed perpendicularly to the tested area.

If the stylus slipped while measuring, we recommend to start again.

Our customer service remains available should you have any questions regarding the use of our device. You can either fill out the contact form directly on the web plateform or send an email to contact@easystiff.com

7 Safety information

Periodically check the entire device: stylus, docking station and USB cable. A damaged or non-functioning unit should no longer be used. Do not modify or repair the device.

Send the defective device (sytlus, docking station and adaptator) in its packaging back to « Service Maintenance – BioMeca » to the address detailed §1 Manufactuer and also write to the customer service. You can either fill out the contact form directly on the web plateform or send an email to contact@easystiff.com

Use this device only for its intended use as described in this document §6.1 Scope. Use only BioMeca approved accessories.

The device is intended to be used in controlled environment (e.g., laboratory): temperature: +23°± 5°C and relative humidity: 50 ± 10%.

The device can be used without any altitude constraints.

Do not use the device near water or other fluids.

If the device is dropped, contact the customer service immediately. You can either fill out the contact form directly on the web plateform or send an email to contact@easystiff.com

Do not open and disassemble the device. The guarantee will become void and a full refund of the value of the device leased will be claimed. See §9 Guarantee for more information.

The device must be connected only into a USB port of a computer. Do not plug the device into a power plug. This can damage the device.

Store in its original packaging in a cool dry place. Do not store the device under temperatures above +50°C.

8 Environmental notice (purchase only)

This device contains recyclable electric waste. For environment protection, do not dispose in house-hold waste, but for recycling take to electric waste collection points provided in your country.

9 Guarantee

Purchase

We grant 2 years limited guarantee from the date of delivery of the good. Within the guarantee period we will eliminate, free of charge, any defects in the device resulting from faults in materials or workmanship, either by repairing or replacing the complete device as we may choose. This guarantee extends to every country where this device is supplied by BioMeca.

This guarantee does not cover: damage due to improper use, normal wear or use, as well as defects that have negligible effect on the value or operation of the device. The guarantee becomes void if repairs are undertaken by unauthorized persons and if original BioMeca parts are not used or if the device is open (tamper evident).

To obtain service within the guarantee period, contact our customer service contact@easystiff.com.

Lease

The device is guaranteed during the lease term.

To obtain service within the guarantee period, contact our customer service contact@easystiff.com.

Within the guarantee period we will eliminate, free of charge, any defects in the device resulting from faults in materials or workmanship, either by repairing or replacing the complete device as we may choose.

This guarantee extends to every country where this device is leased by BioMeca.

This guarantee does not cover: damage due to improper use, normal wear or use, as well as defects that have negligible effect on the value or operation of the device. The guarantee becomes void if repairs are undertaken by unauthorized persons and if original BioMeca parts are not used or if the device is open (tamper evident).

Any deterioration above-mentionned will result in the full refund of the value of the device leased.

10 Cleaning recommendations

We recommend to clean the slider and the probe with alcohol 70° before putting it back on its docking station.

We recommend the following cleaning protocol:

Equipment:

- non-woven synthetic fibre wipe
- Alcohol 70°

Protocol:

1/ Hold the stylus
2/ Put carefully the wipe moistened with alcohol 70° on the slider and the probe
3/ Srub gently
4/ Dispose of the wipe

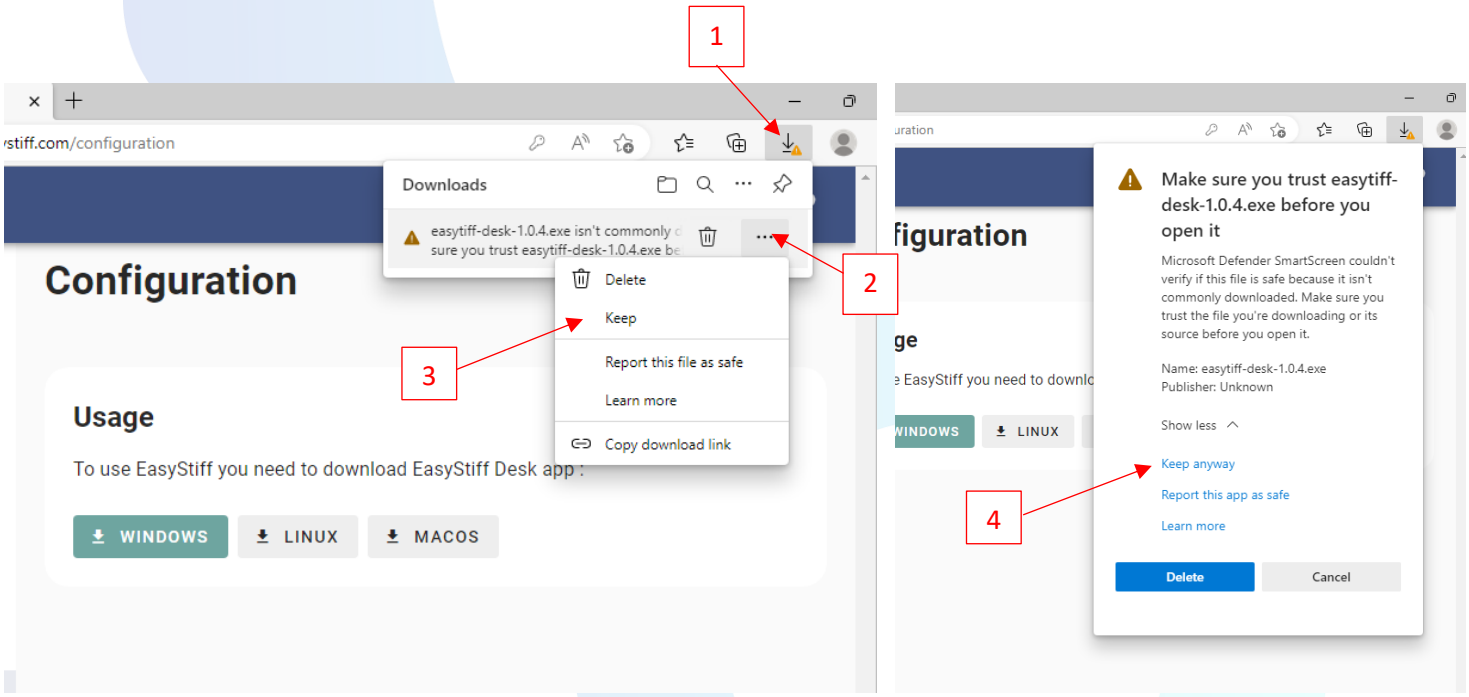
When a study involves several participants, we strongly recommend cleaning between each participant.

11 Troubleshooting

11.1 Where is my software?

In case you cannot find the software once installed, check if it is not blocked by your browser.

1. Click on “downloads”
2. Click on dots “more actions”
3. Click on “keep”
4. Click on “keep anyway”
5. You can start the installation.



5 : Start installation