

HUKX

Sensor
Technology

User manual
Albedometer mounting
and leveling fixtures

AMF / ALF
series

Warning statements



Mind the safety of the glass domes at each of the mounting and fixation steps of AMF02 and AMF03 installations.

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Introduction

Hukx offers a practical range of mounting and leveling fixtures to construct albedometers from its popular pyranometers and make installation and leveling easy. Albedometers are increasingly popular in bifacial PV module monitoring. AMF03 allows you to combine pyranometers with housings like those of models SR30-M2-D1 and SR300-D1 into one albedometer.

AMF02 does so for two SR11 or two SR20 series pyranometers. The modular design facilitates maintenance and calibration of the pyranometers. Both albedometer kits include a mounting fixture and a glare screen. ALF01 is a leveling fixture that may be combined with AMF03, AMF02 or SRA series albedometers, and helps leveling the instrument.

With the AMF03 or AMF02 mounting fixture, you may construct albedometers from popular Hukx **pyranometers** yourself. AMF03, AMF02 and SRA series albedometers can be leveled with the ALF01 leveling fixture

Albedo and Albedometers

Albedo, also called solar reflectance, is defined as the ratio of the reflected to the global radiation. It is a dimensionless number smaller than 1. It is a property of the ground surface.

An albedometer is an instrument that measures both global and reflected solar radiation and, by calculation, the solar albedo, or solar reflectance for a particular ground surface. An albedometer is composed of two pyranometers, both installed horizontally, the downfacing one measuring reflected solar radiation.



Figure 0.1 AMF02 or AMF03 albedometer kits are used to mount both an up- and a downfacing pyranometer and construct an albedometer. The image shows the AMF02 mounting fixture and its rod. A glare screen for the downfacing sensor is also included.

In the open field, the solar albedo depends on the directional distribution of incoming radiation and on surface properties at ground level. It is usually expressed as a single number, determined by taking an average over a day with solar elevation $> 10^\circ$. Changes of albedo are typically slow and seasonal, except when it snows. Albedos of typical surfaces range from about 4 % for fresh asphalt and 15 % for green grass to 90 % for fresh snow.

Albedometers are increasingly popular in bifacial PV module performance monitoring.

You may use one **AMF03** albedometer kit and two pyranometers with housings similar to those of models SR30-M2-D1 and SR300-D1 to construct an albedometer. Likewise, the **AMF02** albedometer kit may be used to construct an albedometer out of two SR20 pyranometers.

Depending on the pyranometer used, the albedometer will either be Class A, the highest accuracy class, or the lower accuracy Class B. The modular design facilitates the maintenance and calibration of the pyranometers. By taking the instrument apart you can use normal indoor calibration facilities for instrument calibration. The Class A models SR300-D1, SR200-D1 and SR30-M2-D1 and Class B models SR100-D1 and SR15 are supplied with several outputs; analogue millivolts, 4 to 20 mA current loop and Modbus over RS-485 are the most used.

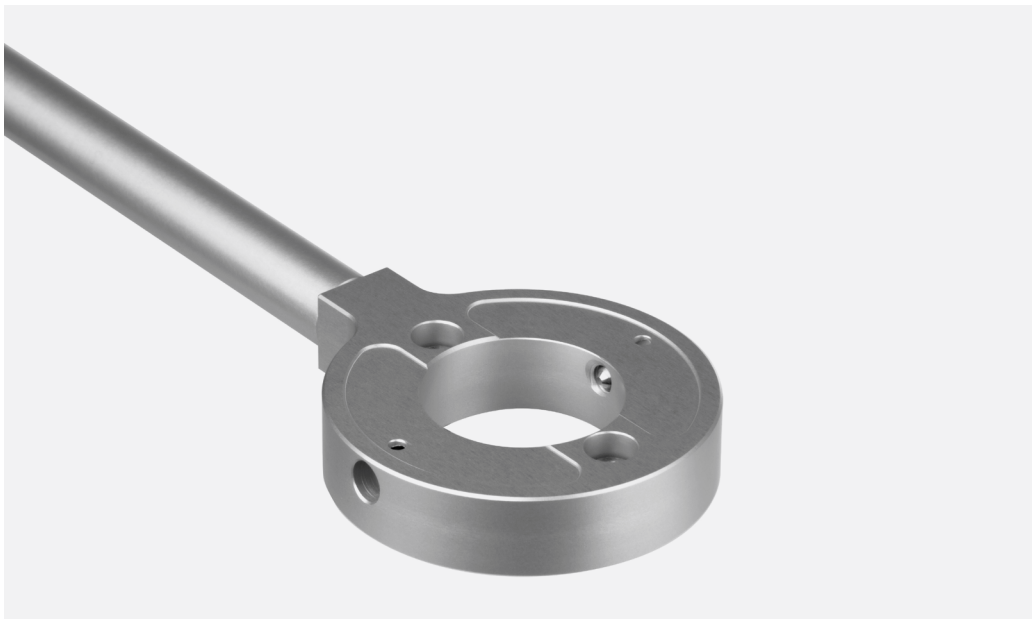


Figure 0.2 AMF03 mounting fixture and its rod. A glare screen for the downfacing sensor is also included in the AMF03 albedometer mounting kit.

Glare screen

AMF02 and AMF03 are supplied with glare screens. A glare screen is a metal ring, mounted on the downfacing sensor. At solar elevations of $< 5^\circ$, when the sun is just above the horizon, the glare screen prevents that direct solar radiation is measured by the downfacing sensor. This is important because it would otherwise lead to unrealistic albedo measurements.

Modern data quality assurance can also attain the data quality by calculating solar elevation and rejecting any data at solar elevations below a certain value, for example $< 10^\circ$. You may decide to mount the glare screen after transport and on-site installation, so that the dome protector can remain on the dome until the albedometer is firmly installed.

AMF03

AMF03 is easy to use. It allows you to combine two separate pyranometers, creating an albedometer. All you need are two mechanically compatible pyranometers and the AMF03 kit. Mounting instructions and a set of hex keys are delivered with AMF03.

AMF02

AMF02 is easy to use as well. It allows you to combine two separate SR20 pyranometers into one albedometer. Mounting instructions and a set of hex keys are delivered with AMF02.

ALF01

ALF01 is a leveling tool that can be used with AMF02, AMF03 or SRA series albedometers to easily level the instrument. ALF01 is mounted on a 1-inch outer diameter crossarm and can be rotated around the tube axis for 360° as well as tilted over $\pm 2^\circ$.



Figure 0.3 ALF01 albedometer leveling tool, can be rotated around the axis of the crossarm to which it is connected, and tilted over $\pm 2^\circ$.

Standards

The applicable instrument classification standards are ISO 9060 and WMO-No. 8. Calibration is according to ISO 9847 and ASTM G207. The use of albedometers for performance monitoring of bifacial PV systems is covered by IEC 61724-1. The use for meteorological observations is covered by WMO-No 8.

Suggested use

- PV monitoring with bifacial solar modules
- high-accuracy meteorological observations
- building physics, roof reflectance studies



Figure 0.4 Installation with AMF03, two SR30-M2-D1 pyranometers and ALF01 leveling fixture.

Example: AMF03 combined with SR30's

The SRA30-M2-D1 albedometer consists of two identical pyranometers model SR30-M2-D1, one facing up, one facing down. The two sensors are delivered with one AMF03 fixture with rod for mounting purposes. A glare screen is part of the AMF03 delivery, too. The user assembles these modular components into an SRA30-M2-D1 albedometer. A mounting instruction is included with AMF03. Leveling and mounting may be completed by using the ALF01 leveling fixture and **CMF01** crossarm mounting fixture to mount the crossarm to a mast.



Figure 0.5 The end result using AMF03 and two SR30-M2-D1 pyranometers: an SRA30-M2-D1 albedometer ready for measuring.

See also:

- **SRA300-D1** industrial Class A albedometer with heating and tilt sensor
- **SRA200-D1** industrial Class A albedometer
- **SRA100-D1** industrial Class B albedometer
- **SRA01** spectrally flat Class C albedometer
- **SR30-M2-D1** digital spectrally flat Class A pyranometer with heating and tilt sensor
- **SR15 series** analog and digital spectrally flat Class B pyranometers
- alternative instrument: **NR01** 4-component net-radiometer for solar and longwave radiation balance
- **PMF01** and **PMF02** pyranometer mounting fixtures
- **CMF01** crossarm mounting fixture

1 Ordering and checking at delivery

1.1 Ordering AMF / ALF series albedometer mounting and leveling fixtures

AMF / ALF series is a range of accessories for use with pyranometers and albedometers. The ordering codes of the different versions in AMF / ALF series are AMF02, AMF03 and ALF01.

Table 1.1.1 Overview of versions in AMF / ALF series.

versions of AMF / ALF series	
AMF02	albedometer mounting kit for 2 x SR20 / SR11 pyranometers
AMF03	albedometer mounting kit for 2 x SR30 / SR15 pyranometers
ALF01	albedometer leveling fixture for AMF02, AMF03 and SRA series albedometers

1.2 Included items

Arriving at the customer, the delivery should include:

– AMF02 albedometer mounting fixture including:

- 1 x glare screen
- 1 x AMF02 fixture with rod
- 2 x o-ring
- 1 x conical positioner
- 2 x plug
- 2 x M5x12 socket head cap screw
- 1 x M6x8 socket head cap screw
- 2 x M6x12 set screw
- 1 x mounting and fixation instruction sheet

– AMF03 albedometer mounting fixture including:

- 1 x glare screen
- 1 x AMF03 fixture with rod
- 1 x conical positioner
- 2 x M5x12 socket head cap screw
- 1 x M6x8 socket head cap screw
- 2 x M8x12 set screw
- 1 x mounting and fixation instruction sheet

– ALF01 leveling fixture including:

- 1 x leveling fixture

2 Specifications of AMF / ALF series

2.1 Specifications of AMF / ALF series albedometer mounting and leveling fixtures

AMF / ALF series is a range of accessories for use with pyranometers and albedometers.

AMF02 is an albedometer mounting kit for 2 x SR20 / SR11 pyranometers. It allows you to combine two separate SR11 or SR20(-D2) pyranometers into one albedometer yourself. Mounting instructions and a set of hex keys are delivered with AMF02. AMF02 also includes a glare screen. AMF02 can only be used in combination with two suitable pyranometers.

AMF03 is an albedometer mounting kit for 2 x SR30 / SR15 pyranometers. It allows you to combine two separate SR30-M2-D1 or SR15 series pyranometers into one albedometer yourself. Mounting instructions and a set of hex keys are delivered with AMF03. AMF03 also includes a glare screen. AMF03 can only be used in combination with two suitable pyranometers.

ALF01 is a leveling tool that can be used with AMF02, AMF03 or SRA series albedometers to easily level the instrument.

Please also refer to your pyranometer or albedometer user manual for a proper installation of that particular instrument with AMF / ALF series mounting and leveling fixtures. The instrument should be used in accordance with the recommended practices of ISO, IEC, WMO and ASTM.

Table 2.1.1 Specifications of AMF / ALF series (continued on next pages).

AMF02 general specifications	
product type	bracket
purpose	construction of an albedometer when combined with 2 pyranometers
instrument compatibility	2 x SR20, SR20-D2 or SR11
measurand	global solar radiation and reflected solar radiation
optional measurand	albedo or solar reflectance
optional measurand	net solar radiation

material	anodized aluminum (bolts made of stainless steel)
rated operating temperature	-40 to +80 °C
rod diameter	15 x 10 ⁻³ m
included parts	1 x glare screen 1 x AMF02 fixture with rod 2 x o-ring 1 x conical positioner 2 x plug 2 x M5x12 socket head cap screw 1 x M6x8 socket head cap screw 2 x M6x12 set screw 1 x mounting and fixation instruction sheet
required tools (included)	hex key no. 2 (2 mm) hex key no. 3 (3 mm) hex key no. 4 (4 mm) hex key no. 5 (5 mm)

AMF02 transport

gross weight	approx. 1 kg
net weight	approx. 0.5 kg

AMF03 general specifications

product type	bracket
purpose	construction of an albedometer when combined with 2 pyranometers
instrument compatibility	2 x SR30-M2-D1, SR30-D1, SR15-A1, SR15-D1 or SR15-D2A2
measurand	global solar radiation and reflected solar radiation
optional measurand	albedo or solar reflectance
optional measurand	net solar radiation
material	anodized aluminum (bolts made of stainless steel)
rated operating temperature	-40 to +80 °C

rod diameter	15 x 10 ⁻³ m
included parts	<ul style="list-style-type: none"> 1 x glare screen 1 x AMF03 fixture with rod 1 x conical positioner 2 x M5x12 socket head cap screw 1 x M6x8 socket head cap screw 2 x M8x12 set screw 1 x mounting and fixation instruction sheet
required tools (included)	<ul style="list-style-type: none"> hex key no. 2 (2 mm) hex key no. 4 (4 mm)

AMF03 transport

gross weight	approx. 1 kg
net weight	approx. 0.5 kg

AMF01 general specifications

instrument compatibility	AMF02 or AMF03 albedometer mounting fixture, or SRA series albedometers: SRA30-M2-D1, SRA30-D1, SRA15-A1 SRA15-D1, SRA15-D2A2, SRA20, SRA20-D2, SRA11
tilt angle adjustment range	± 2 °
rotation able adjustment range	360 °
crossarm outer diameter	1 inch
rod diameter	15 x 10 ⁻³ m
rated operating temperature	-40 to +80 °C
material	anodized aluminum (bolts made of stainless steel)
included parts	ALF01 leveling fixture, including 6 pre-mounted bolts
required tools (included)	hex key no. 4 (4 mm)

AMF01 transport

gross weight	approx. 0.5 kg
net weight	approx. 0.5 kg

2.2 Dimensions of AMF / ALF series

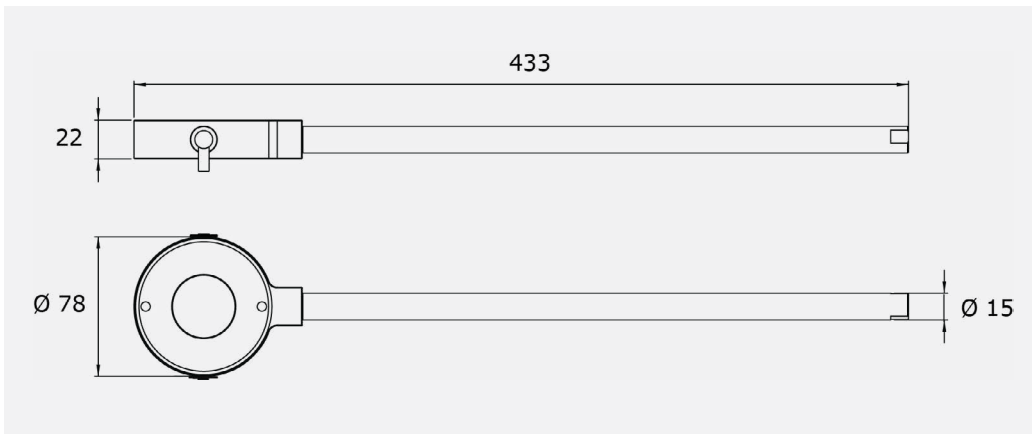


Figure 2.2.1 Dimensions of AMF02 in 10^{-3} m.

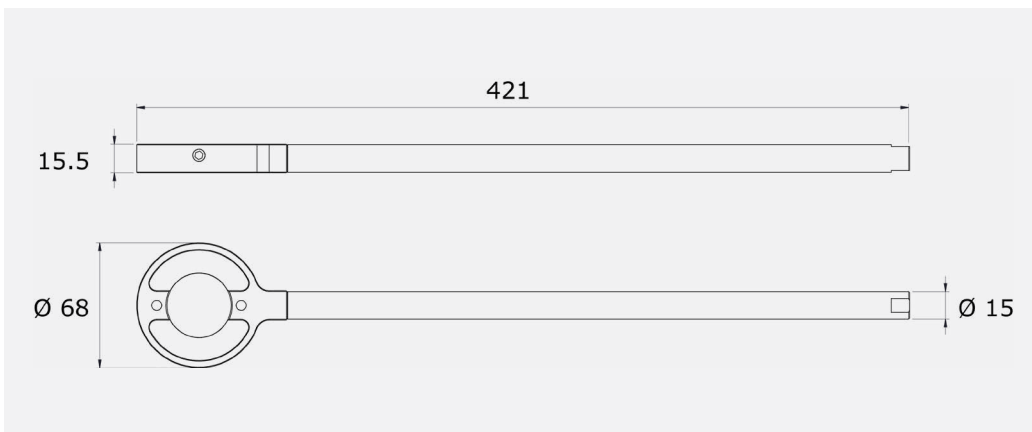


Figure 2.2.2 Dimensions of AMF03 in 10^{-3} m.

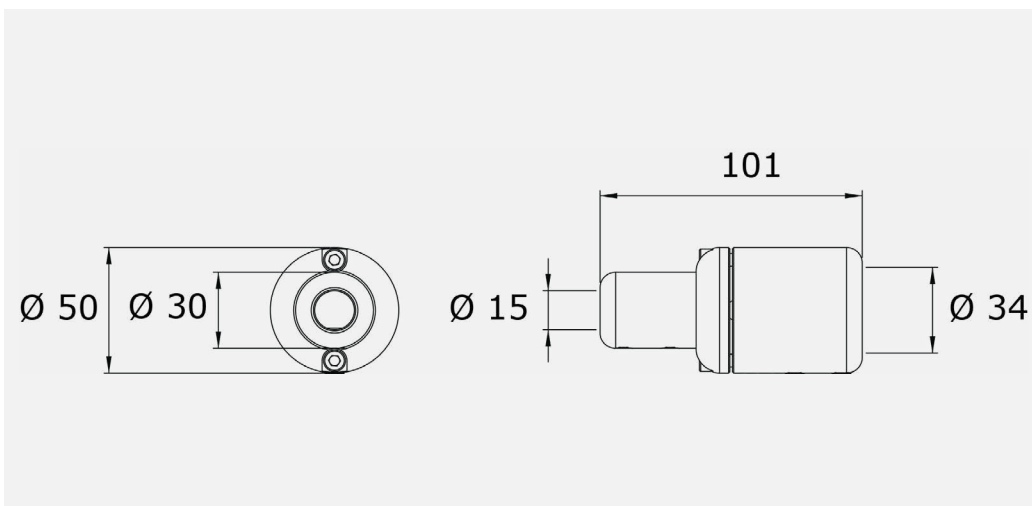


Figure 2.2.3 Dimensions of ALF01 in 10^{-3} m.

3 Installation of AMF / ALF series

3.1 Site selection and installation

Please refer to the user manual of your pyranometer or albedometer for a proper installation of that particular instrument with AMF / ALF series mounting and leveling fixtures. The instrument should be used in accordance with the recommended practices of ISO, IEC, WMO and ASTM.

3.2 AMF02

AMF02 is an albedometer mounting kit for 2 x SR20 / SR11 pyranometers. It allows you to combine two separate SR11 or SR20(-D2) pyranometers into one albedometer yourself.

Please follow the instructions below for either 2 x SR11 or 2 x SR20(-D2), with AMF02. Mind the safety of the glass domes at each step!



Figure 3.2.1 AMF02 with 2 x SR11, mounting and fixation steps 1 to 8.

AMF02 mounting and fixation steps 1 to 8:

1. Remove feet of both sensors.
2. Remove sun screen from downfacing sensor.
3. Install glare screen on downfacing sensor.
4. Remove plugs from fixture.
5. Mount the downward facing SRxx (sensor with glare screen) to the fixture with rod using two M5x12 screws. Ensure that one o-ring is positioned properly between sensor and fixture.
6. Affix the conical positioner to the upward facing SRxx (sensor with sun screen) using one M6x8 screw.
7. Mount the upward facing SRxx (with its sun screen and conical positioner) to the fixture. Ensure that one o-ring is positioned properly between sensor and fixture. Affix with the M6x12 setscrews.
8. Place plugs. Mounting SRxx is complete.



Figure 3.2.2 AMF02 with 2 x SR20(-D2), mounting and fixation steps 1 to 8.



Figure 3.2.3 AMF02 with 2 x SR11.



Figure 3.2.4 AMF02 with 2 x SR20(-D2).

AMF03 mounting and fixation steps 1 to 7:

1. Remove sensor feet of both sensors.
2. Remove sun screen from downfacing sensor.
3. Install glare screen on downfacing sensor using 2 mm hex key.
4. Mount the downward facing SR30 / SR15 (sensor with glare screen) to the fixture with rod using two M5x12 screws and 4 mm hex key.
5. Affix the conical positioner to the upward facing SR30 / SR15 (sensor with sun screen) using one M6x8 screw and 4 mm hex key.
6. Mount the upward facing SR30 / SR15 (with its sun screen and conical positioner) to the fixture. Affix with the M8x12 screws using 4 mm hex key.
7. Mounting SRA30-M2-D1 or SRA15 series is complete.



Figure 3.3.2 AMF03 with 2 x SR30 / SR15.

3.4 ALF01

ALF01 is an albedometer leveling tool that can be used with AMF02, AMF03 or SRA series albedometers to easily level the instrument.

Please follow the instructions below.

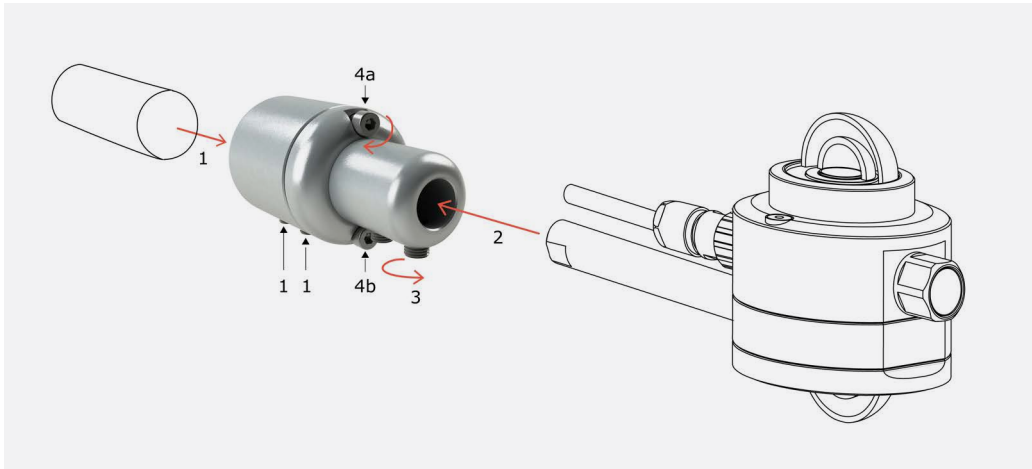


Figure 3.4.1 ALF01 mounting and leveling instructions, steps 1 to 4.

ALF01 mounting and fixation steps 1 to 4:

1. Mount ALF01 onto the 1 inch crossarm and tighten using the 2 bolts.
2. Slide the AMF02 or SRA series rod through the ALF01 fixture.
3. Level the albedometer sensor in the xy-direction (rotation around the tube axis), and tighten the AMF02 / SRA rod with the 2 designated bolts.
4. Level the albedometer sensor in the z-direction (tilting) using the 2 bolts on ALF01:
 - 4a. First position with the top bolt.
 - 4b. Lock position with the lower bolt.



Figure 3.4.2 ALF01 allows a tilt angle adjustment range in the z-direction of $\pm 2^\circ$.



Figure 3.4.3 Installation of an albedometer mounted with AMF02 albedometer mounting fixture and leveled with ALF01 albedometer leveling fixture. The crossarm mounting fixture, connecting the cross arm to a vertical mast is CMF01.

4 Appendices

4.1 Appendix on tools for AMF / ALF series

Table 4.1.1 Specifications of tools for AMF02, AMF03 and ALF01.

tooling required for AMF02	hex key no. 2 (2 mm) hex key no. 3 (3 mm) hex key no. 4 (4 mm) hex key no. 5 (5 mm)
tooling required for AMF03	hex key no. 2 (2 mm) hex key no. 4 (4 mm)
tooling required for ALF01	hex key no. 4 (4 mm)

4.2 Appendix on spare parts for AMF / ALF series

- AMF02 glare screen
- AMF02 fixture with rod
- AMF03 glare screen
- AMF03 fixture with rod
- ALF01 leveling fixture

About Hukx

Hukx is the leading innovator in solar radiation and heat flux sensor technology. We are proud to set the standard in high-accuracy measurement, and to be working at the heart of the energy transition.

Customers worldwide rely on our bestselling pyranometers and heat flux sensors. From sensor design and selection to supply and recalibration, we support you across the entire lifecycle.

Hukx is headquartered in the Netherlands, with locally owned representative sales offices in the USA, Brazil, India, China, Southeast Asia, and Japan.

Let us help you select the best sensor for your application. Get in touch with our experts today via: info@hukx.com

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