PUMA

IMPULSE MAGNETIZER



User Manual

Version 1.1 October 2023



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User Manual Conventions

Prohibition symbol is used to prohibit any action which may cause a loss of properties, damage or injury.

Warning symbol is used to draw a special attention to an important information.

Information symbol is used to give a useful hint or tip for more comfortable work with the instrument.

PUMA Controls Conventions

Field	Software interface terms.
START	Software interface buttons.
Main switch	Hardware controls.

General Safety Instructions

Before operating the instrument, review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.



Service procedures should be performed by qualified personnel only!

Do Not Operate Without Covers! To avoid electric shock or fire hazard, do not operate this product with covers or panels removed.

Do Not Operate in Wet or Damp Conditions! To avoid electric shock, do not operate this product in wet or damp conditions.

- Do Not Operate in an Explosive Atmosphere! To avoid injury or fire hazard, do not operate this product in an explosive atmosphere.
- Do Not Disconnect Connectors! To avoid damage of the instrument never disconnect any connector while the device is ON.



Do Not Operate With Suspected Failures! If you suspect there is damage to this product, have it inspected by qualified service personnel.

Ground The Instrument! The instrument is grounded through the Protective Earth lead of the power cord. To avoid electric shock, it is essential to connect the earth terminal of power cord to the Protective Earth terminal before any inputs or outputs.



Do Not Insert Anything into the Holes of Fan! Do not insert anything into the holes of the fan to avoid damaging the instrument.

Use Proper Power Cord! To avoid fire hazard, use only the power cord specified for this product.

Check Connectors! Do not operate the instrument if all connectors are not properly plugged.

Heavy instrument! Due to the weight of the instrument it is strongly recommended to manipulate it with assistance of another person.

Use Proper Mains Voltage! Do not operate this product from a power source that is outside of the specified voltage range.

Use Proper Fuses Only! Do not use fuses which are not specified by the manufacturer. If a fuse with a different characteristics or value is used, the protection is not effective.

Operator's Training! Operator should be familiar with operation of the instrument and Safety Regulations.

Use Manufacturer's Cables Only! Other devices can be connected to the instrument via the appropriate cables only.

Do not drop the product and do not expose it to any major shocks!

Do not operate the product outside the power limits given in the specifications!

Keep the packaging material out of the reach of children to prevent the risk of suffocation!

Unstable or highly disturbed AC power may invoke safety circuits to protect the sensitive electronic parts by switching OFF the instrument or burning inner fuses.



Dispose of packaging material immediately according to locally applicable regulations. However, it is recommended to keep the shipping box and inner foams in case of necessity to send the instrument to AGICO for repair.

Storage and Transportation

The properly wrapped instrument can be stored and transported at a temperature -20 °C to + 55 °C and relative humidity up to 80%. The instrument must be stored at suitable place, free of dust and chemical evaporation. **Handle with care! Instrument is heavy.**

1 PUMA Introduction

The **PUMA** is designed as a precise high field im**pu**lse **ma**gnetizer. Inner diameter of magnetization coil is 41 mm which allows to magnetize standard-sized paleomagnetic specimens in any orientation. PUMA enables to impart isothermal remanent magnetization (IRM) to specimens in the wide range of intensities of magnetic fields from 1 mT up to 5T. The elaborate design of the instrument provides precise setting of the pulse intensity as well as high homogeneity of the field over the entire specimen volume.

1.1 Principle of operation

PUMA uses the well-known principle of charging high quality foil capacitors designed for pulsed discharge and then discharging them into a magnetizing coil. The principal schematics of the instrument is shown on Fig. 1.

The control of the entire magnetization process by the microprocessor ensures precise pulse triggering at voltage which is calculated with respect to the desired pulse intensity and the instantaneous temperature of the magnetizing coil. Accounting for the coil temperature significantly improves the repeatability of the field strength. A number of safety features as well as oversized high grade electrical components ensure the safety and reduce the likelihood of serious malfunction or damage.



Figure 1: Principal schematics of the PUMA

1.2 Instrument description

1.2.1 Technical parameters

- · Dimensions: width \times height \times depth: 715 \times 435 \times 500 mm (28.2 \times 17.1 \times 19.7 inch).
- Mass: 78 kg (172 lbs).
- Power requirements: 230 V, 10 A or 100-115 V, 20 A
- Magnetic field intensity range: 1-5000 mT.
- Pulse duration: ~8 ms. See. Fig.2 for definition.
- \cdot Field intensity precision: range 1-20 mT \pm 1mT, range 21-5000 mT \pm 5%.
- Field homogeneity: better than 97% over volume of the specimen.
- · Inner coil diameter: 41 mm.
- Specimen size:
 - Cylinder: dia 25.4 mm (+0.5 mm,-1 mm), length 22 mm (+2 mm, -10 mm).
 - Cube: edge of 20 mm or 23 mm.



Typical shape of the pulse

Figure 2: Typical pulse waveform

1.2.2 Front and back panel

All instrument controls are located on the front panel (see. Fig.3). These are the **main switch**, **set field dial** for setting the desired field strength, **start button**, **display**, sample **holder lock** and magnetizing coil. Sockets for the power cord and USB-B cable are located on the rear panel.



Figure 3: Front panel of the PUMA Impulse Magnetizer

1.2.3 Coil cooling

Magnetization coil temperature increases during the high intensity pulses, especially if field is higher than 2T. Active cooling of the coil is provided by four fans on the left and rear of the device. The fans start automatically when the coil temperature is above 40 °C and turn off when the temperature is below 35°C. If the coil temperature exceeds 90°C, operation of the instrument is restricted until the temperature drops below 75°C.

Warning Make sure that the ventilation holes are always free with sufficient air access!

1.3 Installation of the instrument

After unpacking, place the unit on a sturdy wooden table with a minimum top size of 60x60 cm. Make sure that the fan outlets on the back and left side of the PUMA are clear. Maintain a distance of at least 15 cm between the fan outlets and any obstruction to allow sufficient air circulation and to ensure adequate cooling of the magnetizing coil.

If you want to control the instrument using the supplied software, we recommend installing the PUMA software before connecting the magnetiser to the computer for the first time. Then plug the USB cable and mains cord into the respective connectors. Make sure to connect the power cable to the correct power supply voltage. Connect the USB cable to the computer (if you want to use the PUMA software) and turn on the main switch. The PUMA pulse magnetizer is now ready for use.

2 Instrument operation

2.1 Specimen handling

2.1.1 Cylindrical specimen

Two cylindrical specimen holders are supplied with the instrument, see Fig. 4.



Figure 4: Cylindrical specimen holders



Figure 5: Proper orientation of the cylindrical specimen inside the shell

- Holder **A** is one-piece holder for magnetization of cylindrical specimens in the principal specimen axes.
- Holder B consists of two pieces (the actual holder and the specimen shell). This design allows magnetization of cylindrical specimens in eighteen directions (see Tab. 1and Fig. 8), a certain sequence of which is necessary to measure the anisotropy of isothermal magnetic remanence. When inserting the specimen into the shell make sure that it is oriented with respect to the reference mark as shown in Fig. 5 and the screw on the side of the shell is tight sufficiently to prevent the specimen from moving.

2.1.2 Cubic specimen

Two holders for cubic specimens differ only in their dimensions - 20 or 23 mm cubes, see Fig. 6. The positioning of the specimen with respect to the 18 direction design is shown in Fig.9



Figure 6: Cubic specimen holder

2.1.3 Holder Insertion

When specimen is correctly fixed inside the holder, the holder can be inserted into the magnetizing coil. Push the holder lock to the right and slide the specimen holder into the coil. Then release the lock. Make sure that the lock pin slides into the small cavity on the side of the specimen holder. It safely locks the holder with specimen in the correct position inside the coil.



Warning: It is necessary to place the locking pin inside the cavity on the ${f A}$ specimen holder.If the lock is in a different position, the pulse cannot be triggered.

User mode	Principal axes	A-mode	B-mode	C-mode	D-mode	P-mode	Direction
Ul	+x-axis			C1	D1	P3	0/0
U2	-x-axis			C2			180/0
U3	+y-axis			C3	D2	P8	90/0
U4	-y-axis			C4			270/0
U5	+z-axis			C5	D3	P13	0/90
U6	-z-axis			C6			0/-90
U7		A1	B1			P2	45/0
U8		A2				P5	225/0
U9		A3	B2			P4	315/0
UIO		A4				Pl	135/0
UII		A5	B3			P7	90/45
U12		A6				P10	270/-45
U13		A7	B4			P9	90/-45
U14		A8				P6	270/45
U15		A9	B5			P12	0/45
U16		A10				P15	180/-45
U17		A11	B6			P14	180/45
U18		A12				PII	0/-45

Table 1: A scheme of eighteen magnetizing directions with a reference to the magne-tizing modes necessary to measure the anisotropy of isothermal magnetic remanence.Directions are presented in specimen coordinate system as declination / inclination.Each pair represents a set of antipodal directions.



Figure 7: Specimen marking convention for cylindric and cubic specimens, righthanded coordinate system. Single arrow represents the x-axis of the specimen.



Figure 8: 18 orientations of the cylindrical specimen



Figure 9: 18 orientations of the cubic specimen

2.2 Specimen magnetization

PUMA can be operated directly in the local mode or in remote mode using a PC connected via USB, which brings additional user comfort as well as possibility of more detailed setting of the pulse intensity. Sharing of the set and measured value of the magnetization field with REMA6 software, if running simultaneously on the same PC, is another benefit. Prior to the work in both modes make sure that the mains cord is properly connected and switch on the **mains switch** on the front panel. The instrument is initialized and several self-tests are executed. PUMA is ready for operation when the text **Hs=1T** is shown on the display and the LED on the **start button** turns green.

2.2.1 Local mode

After successful initialization of the PUMA, the required intensity of the magnetic field pulse can be set by turning the **set field dial**. Clockwise turning increases the requested peak field value, while counterclockwise turning decreases it in the increments shown in Tab. 2.

Field range [mT]	Increment [mT]
1–20	1
21–50	5
51-200	10
201–500	20
501-2000	50
2001–5000	100

Table 2: The increments of the required field when using the set field dial.

1				
8.9	38	Τ,	380	

Figure 10: Typical display screen after the pulse. **Hs** is requested (set) field, **Hm** is measured field and **T** is coil temperature after the pulse in degrees Celsius.

Make sure that specimen is properly mounted in the respective holder and holder is inside the coil with **holder lock** in correct position. To begin magnetization process push the **start button**. **Start button** turns red and charging of the capacitors begins. The charging can be monitored on the **display**. After reaching the required capacitor charge, the pulse is automatically triggered. The actual value of the pulse intensity (**Hm**) is measured and shown on the display as well as the current temperature of the coil (\mathbf{T}) see Fig. 10.

Pulse abortion If the **Start button** is pushed during the capacitors charging the pulse is aborted and capacitors are slowly discharged. Do not operate with specimen and **holder lock** during the discharge of capacitors. Actual voltage on capacitors is shown on the **display**. Discharge is finished when voltage is lower than 24 V.

Display adjustment The brightness and contrast of the display can be adjusted by following procedure:

- · Switch ON PUMA.
- Press start button and hold it for approx. 3 seconds.
- PUMA display shows Brightness or Contrast adjustment mode. To switch between Brightness/Contrast adjustment mode shortly press start button.
- Adjust Brightness/Contrast using set field dial
- To save current setting of the display and return back to normal operation press **start button** and hold it for approx. 3 seconds.

2.2.2 Remote mode

Software installation

The installation of the complimentary MS Windows[®] software is straightforward: run installation file *PUMA_install.exe*, press **OK** buttons and software will be installed into directory *C*:\AGICO\PUMA.

Software activation

Make sure that the PUMA is switched on and interconnected with PC via USB cable. Then run the PUMA software. Press ACTIVATION button on the main screen (Fig.11) and the activation routine with the pop-up window ACTIVATION (Fig.12) is launched. The successful activation as shown in Fig.12A. In this case PUMA is connected via COM4 and firmware version is 1.0 released on March 2023. Press OK to return to main screen. The unsuccessful activation result is shown in Fig.12B, in this case check if the PUMA is switched on and USB cable is properly connected and the press RETRY to try again.

XIII PUMA		_		×
About				
REQUESTED FIELD	0 10	00 [m	ŋ	
START PL	ILSE			
ABORT PL	JLSE			
CHARGING				
MEASURED FIELD	D	[mT]	
COIL TEMPERATURI	E	[°C]		
ACTIVATE		E	KIT	
СОМ4				.:

Figure 11: The main screen of the PUMA software.

a	•		ACTIVATION	- 🗆 🗙
		PUMA Activation		
		Action	Result	
		Instrument connection	Connected via. COM4	
		Firmware version	FW: 1.0, 3/23	
		ОК	RETRY	CLOSE
b			ACTIVATION	- 🗆 🗙
		PUMA Activation		
		PUMA Activation	Result	
		PUMA Activation Action Instrument connection	Result Instrument not found	
		PUMA Activation Action Instrument connection	Result Instrument not found	

Figure 12: The activation window of the PUMA software. a) successful activation, b) unsuccessful activation of the instrument.

Magnetization of the specimen

Make sure that the specimen is correctly fixed in the appropriate specimen holder and the holder is inside the magnetizing coil. Fill the **REQUESTED FIELD**

text box with the desired value of the magnetization field intensity in [mT] and press Enter or hit START PULSE button. The capacitors charging process can be monitored on the CHARGING progress bar. Pulse can be aborted by pressing ABORT PULSE button. In such case the capacitors are slowly discharged and specimen is not affected. After reaching the required capacitor charge the pulse is automatically triggered and the PUMA software displays the actual field value in MEASURED FIELD [mT] and the coil temperature in COIL TEMPERATURE line (see Fig. 11). In the case of some malfunction, PUMA returns an error message which is shown by PUMA software as well as visualized on the PUMA display. See section 3.2 for a list of error messages with suggestions for their resolution.

3 Troubleshooting

PUMA Impulse magnetizer contains plenty of hardware control circuits and software diagnostic tests to prevent any serious damage to the device. Some potential errors and their solution are listed bellow. The best way to solve the problems with **AGICO** devices is to contact the manufacturer via email address **agico@agico.cz**. Lifetime email support is free of charge, so do not hesitate to contact us with any questions.

3.1 Hardware Indicators

Color of the start button

- LED still Instrument is ready for operation. Button is active.
- LED Capacitor charging: button can be used only for pulse abortion, instrument works.
- LED All other situations: indicates some kind of error. See section 3.2
- LED LED LED LED Unspecified error. The error code is shown on the **display** and software. See Tab. 3 for more details.
- LED Instrument is not powered or there is a malfunction of the LED.

Beeper sounds

- Short beep on start-up: PUMA was activated correctly.
- Series of short beeps during operation: Some error occurred, check display or software.
- Long continuous beep: Serious malfunction of the instrument. Immediately switch off using **mains switch**, wait for about three minutes and then disconnect mains cord! Ask **AGICO** for assistance.

3.2 Software Error Messages

Software error messages inform about the actual problems of the PUMA. Table 3 summarizes the recommended troubleshooting steps of the given error.

Error	Solution			
	Capacitors were not sufficiently charged. Usually			
	caused by the low mains voltage. Please check volt-			
	age of your power net.			
	Some voltage is missing. Check fuses according to the			
	sec. 3.3			
ES3 GENERAL ERROR	Ask AGICO for assistance.			
	Check if the holder is properly mounted and check			
E34 LOCK ERROR	the holder lock. Try again.			
	The field intensity value differs by more than 20%			
ES5 FIELD ERROR	from the set value. Try again. If problem persists ask			
	AGICO for assistance.			
	Capacitors were not discharged properly. Try again. If			
ESO DISCHARGE ERROR	problem persists ask AGICO for assistance.			
	Do not use instrument anymore and ask AGICO for			
E37 FAIAL ERROR	assistance.			
ES8 TEMPERATURE	Temperature sensor is disconnected or broken. Ask			
SENSOR ERROR	AGICO for assistance.			

Table 3: List of errors shown by PUMA software or display

3.3 Fuses

The back panel of the PUMA contains two fuses with ratings TIOA / 250V (230V version) or T2OA / 250V (100–115V version). **T** stands for time lag (slow-burn) fuse, 10A or 20A indicates maximum current of fuses and 250V indicates maximum voltage.

If needed the mains fuse can be easily replaced. Switch off the PUMA, wait three minutes then disconnect the mains cable. Use the flat head screwdriver to unlock the socket, then pull out the socket. After replacing the fuse push in the socket and lock it with screwdriver.

Mains cord must be disconnected! The power switch of PUMA must be turned off and mains cord of PUMA must be disconnected during the fuse exchange.

4 Appendix

4.1 EC Declaration of Conformity

We,

AGICO, s.r.o., Purkyňova 99a, CZ - 612 00 Brno, IČO 607 313 54, declare that the product:

Name:	PUMA – Impulse magnetizer
Manufacturer:	AGICO, s.r.o., Purkyňova 99a, CZ - 612 00 Brno,
	IČO 607 313 54
Place of production:	AGICO, s.r.o., Purkyňova 99a, CZ - 612 00 Brno,
	IČO 607 313 54

fulfills the safety requirements for electrical equipment for measurement, control, and laboratory use:

Safety tests

Certificated by Engineering Test Institute, Public Enterprise, Brno, Czech Republic. Certificate number: LVD-B-01655-23 Instrument is certificated by using Government Regulation 118/2016 Coll. and Directive 2014/35/EU (Low voltage) Certification scheme: SZÚ-1a:2020.00 based on ISO/IEC 17067:2014, Scheme 1a

Electromagnetic compatibility test

Certificated by Engineering Test Institute, Public Enterprise, Brno, Czech Republic.

Certificate number: EMC-B-01656-23

Instrument is certificated by using Government Regulation 117/2016 Coll. and Directive 2014/30/EU (Electromagnetic compatibility)

Certification scheme: SZÚ-1a:2020.00 based on ISO/IEC 17067:2014, Scheme 1a

Responsible person: Bc. Petr Pokorný, development engineer



Strojírenský zkušební ústav, s.p. (Engineering Test Institute, Public Enterprise) Certifikační orgán certifikující produkty / Product Certification Body Hudcova 424/56b, Medlánky, 621 00 Brno, Česká republika / Czech Republic

CERTIFIKÁT / CERTIFICATE

nařízení vlády č. 118/2016 Sb. a směrnice 2014/35/EU (Nízké napětí) Government Regulation 118/2016 Coll. and Directive 2014/35/EU (Low voltage)



LVD-B-01655-23

Klient – výrobce: Client – Manufacturer AGICO, s.r.o. Purkyňova 3050/99a 612 00 Brno - Královo Pole Česká republika – *Czech Republic*

Výrobek: Product Pulsní magnetizátor Impulse magnetizer

Typ/Model: Type/Model PUMA

Aplikovaná norma: Standard applied

Sector Contraction (Contraction)

ČSN EN 61010-1 ed. 2:2011

Podklad pro vydání certifikátu: Basis of Certificate issuance Závěrečný protokol č. 31-10942/EZ ze dne 2023-10-16 Final Report 31-10942/EZ of 2023-10-16

Certifikát platí do: Certificate valid until

2028-10-15

Strojírenský zkušební ústav, s.p., potvrzuje, že výše uvedený výrobek je ve shodě se základními technickými požadavky stanovenými v příloze 1 a že technická dokumentace odpovídá příloze 3 k nařízení vlády č. 118/2016 Sb. (odpovídá příloze I a III směrnice Evropského parlamentu a Rady 2014/35/EU). Výsledky přezkoumání technické dokumentace, údaje potřebné k identifikaci výše uvedeného výrobku a závěry přezkoušení jsou obsaženy v závěrečném protokolu. Pravidla pro nakládání s certifikátem jsou uvedena na 2. straně.

Strojírenský zkušební ústav, s.p., Engineering Test Institute, Public Enterprise, hereby confirms that the abovementioned product is in conformity with the essential technical requirements set forth in Annex 1 and that the technical documentation conforms to Annex 3 of Government Regulation 118/2016 Coll. (corresponding to Annex I and Annex III of Directive 2014/35/EU of the European Parliament and of the Council). The results of the technical documentation review, the data necessary for identification of the above-mentioned product and the conclusions drawn from testing are contained in the Final Report. The rules for using the Certificate are specified on Page 2.

Použité certifikační schéma: SZÚ-1a:2020.00 (vychází ze schématu 1a ISO/IEC 17067, založeno na zkoušení a inspekci).

Product certification scheme applied: SZÚ-1a:2020.00 (based on Scheme 1a of ISO/IEC 17067, which is based on testing and inspection).

Brno, 2023-10-16



Ing. Aleš Onderek zástupce vedoucího certifikačního orgánu Deputy Head of Certification Body

LVD-B-01655-23 Strana - Page 1/2

Strojírenský zkušební ústav, s.p., Hudcova 424/56b, 621 00 Brno, Česká republika Engineering Test Institute, public enterprise, Hudcova 424/56b, 621 00 Brno, Czech Republic

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Strojírenský zkušební ústav, s.p. (Engineering Test Institute, Public Enterprise) Certifikační orgán certifikující produkty / Product Certification Body Hudcova 424/56b, Medlánky, 621 00 Brno, Česká republika / Czech Republic

CERTIFIKÁT / CERTIFICATE

nařízení vlády č. 117/2016 Sb. a směrnice 2014/30/EU (Elektromagnetická kompatibilita) Government Regulation 117/2016 Coll. and Directive 2014/30/EU (Electromagnetic compatibility)

> Číslo: Number

EMC-B-01656-23

Klient – výrobce: Client – Manufacturer AGICO, s.r.o. Purkyňova 3050/99a 612 00 Brno - Královo Pole Česká republika – *Czech Republic*

Výrobek: Product Pulsní magnetizátor Impulse magnetizer

Typ/Model: Type/Model PUMA

Aplikovaná norma: Standard applied ČSN EN IEC 61326-1 ed. 3:2022

Podklad pro vydání certifikátu: Basis of Certificate issuance Závěrečný protokol č. 31-10942/EZ ze dne 2023-10-16 Final Report 31-10942/EZ of 2023-10-16

Certifikát platí do: Certificate valid until

2028-10-15

Strojírenský zkušební ústav, s.p., potvrzuje, že výše uvedený výrobek je ve shodě se základními technickými požadavky stanovenými v příloze 1 a že technická dokumentace odpovídá příloze 2 k nařízení vlády č. 117/2016 Sb. (odpovídá příloze I a II směrnice Evropského parlamentu a Rady 2014/30/EU). Výsledky přezkoumání technické dokumentace, údaje potřebné k identifikaci výše uvedeného výrobku a závěry přezkoušení jsou obsaženy v závěrečném protokolu. Pravidla pro nakládání s certifikátem jsou uvedena na 2. straně.

Strojírenský zkušební ústav, s.p., Engineering Test Institute, Public Enterprise, hereby confirms that the abovementioned product is in conformity with the essential technical requirements set forth in Annex 1 and that the technical documentation conforms to Annex 2 of Government Regulation 117/2016 Coll. (corresponding to Annex I and Annex II of Directive 2014/30/EU of the European Parliament and of the Council). The results of the technical documentation review, the data necessary for identification of the above-mentioned product and the conclusions drawn from testing are contained in the Final Report. The rules for using the Certificate are specified on Page 2.

Použité certifikační schéma: SZÚ-1a:2020.00 (vychází ze schématu 1a ISO/IEC 17067, založeno na zkoušení a inspekci).

Product certification scheme applied: SZÚ-1a:2020.00 (based on Scheme 1a of ISO/IEC 17067, which is based on testing and inspection).

Brno, 2023-10-16



Ing. Aleš Onderek zástupce vedoucího certifikačního orgánu Deputy Head of Certification Body

EMC-B-01656-23 Strana - Page 1/2

Strojírenský zkušební ústav, s.p., Hudcova 424/56b, 621 00 Brno, Česká republika Engineering Test Institute, public enterprise, Hudcova 424/56b, 621 00 Brno, Czech Republic

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4.2 Warranty

AGICO warrants that this product will be free from defects in materials and workmanship for a period of usually 1 (one) year from date of delivery. If any such product proves defective during this warranty period, AGICO, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product.

In order to obtain service under this warranty, Customer must notify AGICO of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. AGICO will decide if the repair is to be performed by AGICO technician or AGICO delegated serviceman in customers laboratory, or product shall be sent for repair to the manufacturer. In latter case, customer shall be responsible for packaging and shipping the defective product to the AGICO service center. In both cases, all the costs related to a warranty repair shall be at expenses of AGICO.

The warranty becomes invalid if the Customer modifies the instrument or fails to follow the operating instructions, in case of failure caused by improper use or improper or inadequate maintenance and care, or if the Customer attempts to install the instrument without explicit written permission of AGICO company. AGICO shall not be obligated to furnish service under this warranty

- to repair damage resulting from attempts by personnel other than AGICO representatives to install, repair or service the product;
- to repair damage resulting from improper use or connection to incompatible equipment; or
- to service a product that has been modified or integrated with other products when the effect of such modification increases the time or difficulty of servicing the product.

This warranty is given by AGICO with respect to this product in lieu of any other warranties, expressed or implied. AGICO and its vendors disclaim any implied warranties of merchantability or fitness for a particular purpose. AGICO's responsibility to repair or replace defective products is the sole and exclusive remedy provided to the Customer for breach of this warranty. AGICO and its vendors will not be liable for any indirect, special, incidental, or consequential damages irrespective of whether AGICO or vendor has advance notice of the possibility of such damages.