OPERATING INSTRUCTIONS

Force Ductility Machine

46-4120

ELE International Chartmoor Road, Chartwell Business Park Leighton Buzzard, Bedfordshire, LU7 4WG England phone: +44 (0) 1525 249200 fax: +44 (0) 1525 249249 email: ele@eleint.co.uk http://www.ele.com ELE International, a division of Hach Lange Ltd.	***Distributor:***	**ELE International** Soiltest Product Division PO Box 389,5600 Lindbergh Drive Loveland, CO 80539 USA phone: +1 (970) 663 9780 fax: +1 (970) 663 9781 email: soiltest@eleusa.com http://www.eleusa.com

Contents

1 Safety & Liability

This manual contains important information on the safe use and maintenance of ELE International's Force Ductility Testing Machine and its related components. Please read through the manual carefully before operating the device for the first time and keep it for future reference.

1.1 Liability

ELE's General Terms and Conditions of Sale and Delivery apply in all cases. Warranty and liability claims arising from personal injury and damage to property cannot be upheld if they are due to one or more of the following causes:

- Unauthorised modifications to the device and its components.
- Failure to use the instrument in accordance with its designated use and purpose as described in this manual.
- Failure to adhere to the sections of the manual dealing with the performance check, operation and maintenance of the instrument and its components.
- Incorrect performance check for operation and maintenance of the instrument and its components.
- Damage resulting from the effects of foreign bodies, accidents, vandalism and force majeure.

The instrument is only to be used for its designated purpose as described in this manual. Replace faulty components only with original replacement parts from ELE. Accessories should only be installed or connected to the instrument if they are expressly authorised by ELE. If other accessories are installed or connected to the instrument, ELE will accept no liability and the product guarantee shall be invalidated.

1.2 General Safety Instructions

The equipment must not be operated by children or anyone under the influence of alcohol, drugs or pharmaceutical preparations. Anyone who is not familiar with this manual must be supervised when using the equipment. Carry out the stipulated maintenance properly and at the correct time. Following completion of the maintenance tasks, perform a functional check.

2 Introduction

2.1 Product Description

The Force Ductility Testing Machine is used to determine the ductility of bituminous materials in a briquette mould by measuring the breaking elongation at a constant speed of 50 mm/min. It is designed for testing 3 specimens simultaneously. The internal tank is made of Stainless Steel. The bath is fitted with an immersion heater in order to obtain (in normal conditions) the 25°C test temperature. The Force Ductility device has a cooling unit as standard.

The Force Ductility Testing Machine has 3 load cells, as shown in Figure 1. The accuracy of load cells is ±0,1 N with a maximum capacity of 300 N. The load cells are used in line with each ductility mould and specimen test position, to measure the tensile force and determine the energy absorbing capacity of bitumen binders from traction characteristic. The force measuring system consists of 3 load cells working in flexural mode. They have to be mounted inside the testing bath of the ductility meter. One end of the load cell is fastened to the inner wall of the bath close to the extension mechanism, the other end is connected to the pin that hooks the mould filled with the binder to be tested. During the test the system measures the extension force developed between the pin of the half-mould connected to the mobile carriage and the pin of the other half-mould connected to the L shaped support that acts on the load cell.

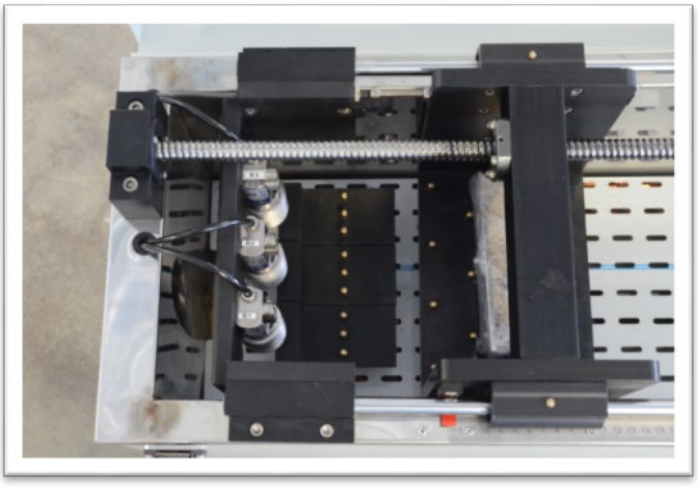


Figure 1: Load cells, located at the left-hand side of the device

The machine is supplied with an external cooling unit. The ductility test gives a measure of adhesive property of bitumen and its ability to stretch. In flexible pavement design it is necessary that binder forms a thin ductile film around aggregates so that physical interlocking of the aggregates is improved. Binder material having insufficient ductility gets cracked when subjected to repeat traffic loads and it provides pervious pavement surface. Ductility of a bituminous material is measured by the distance in centimetres to which it will elongate before breaking when two ends of a standard briquette specimen of material are pulled apart at a specified speed and temperature.

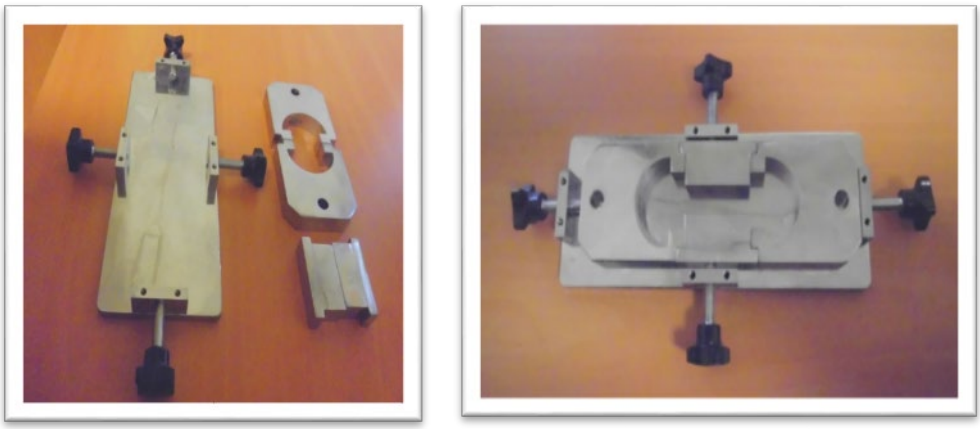


Figure 2: Specimen mould and base plate

2.2 Technical Specifications

Table Speed	5 mm/min - 100 mm/min
Bath Capacity	25 LT
Mains Supply	220 V, 50-60 Hz, 1ph
Power Rating	350 W
Dimensions	300 x 1850 x 550 mm
Net Weight	90 kg

3 Installation

3.1 Environment

Make sure that the room in which the device is to be situated has the correct mains supply compliant with the machine's specifications, and the correct number of plugs for the connection of the device.

Check the voltage (V), ampere (A), frequency (Hz), and the phase of the mains supply.

The main electricity line must be free from instabilities and repetitive power cuts for both the extended life of the device and the continuity of testing. Ensure that the mains supply is well grounded. If the power cuts are frequent or the grounding is not sufficient, the use of an uninterruptible power supply (UPS) is recommended.

Make sure that the device is placed in clean and dry surroundings. Direct contact of the device with sunlight should be avoided. A conditioned room, for example, will comply with the above conditions and will result in best operational performance and measurement results. The apparatus should be easily accessible from the front and sides for connections, testing and maintenance.

3.2 Unpacking

Open the wooden case without damaging the contents and remove all packaging materials. Check the contents are complete and have not been damaged during transportation. Report any irregularities directly to ELE. Take all necessary precautions to carefully transport and place the device in position.

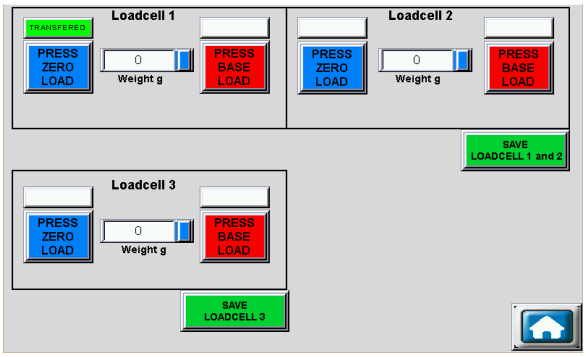
4 Operation

4.1. Graphical Display

HOME SCREEN:
The home screen consists of all sub-menus. Machine Set-up and Calibration sub-menus have to be activated via password. These buttons are disabled by default.

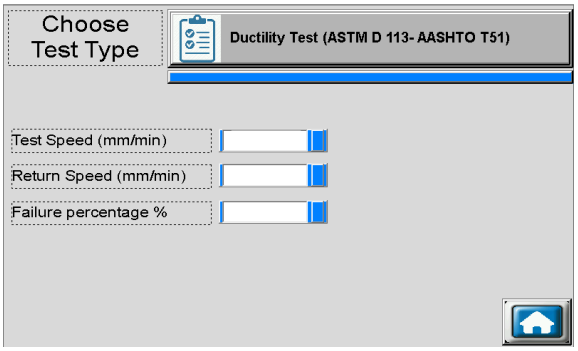
PASSWORD:
The password of the device is **1969**

CALIBRATION:
This page is used for the calibration of the load cells. There are 3 individual boxes for load cells 1, 2 and 3.



The PRESS ZERO LOAD button should be used for starting the process. This button has to be pressed when there is no load applied to the load cell. After defining the zero load, the weight value should be entered in grams in order to describe the calibration reference point load. After applying this load, the PRESS BASE LOAD button should be pressed as a reference point for the device. In order to save the data at the end of calibration, the SAVE button corresponding to that load cell should be pressed.

SPEED AND FAILURE DETECTION:
This page is used for the selection of the test mode. The upper button lets the operator change the test mode. There are 4 modes that can be used with the device. DUCTILITY TEST should be used to perform ductility testing, ELASTIC RECOVERY should be used to perform an elastic recovery test, JOG CONTROL should be used to adjust the mould and RETURN should be used to return the mould back to its original position.

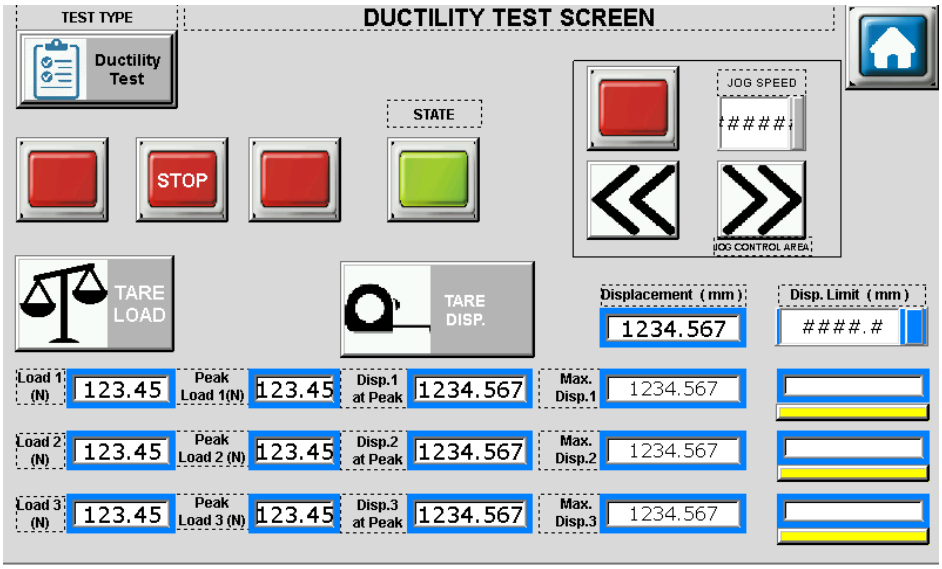


Test speed can be defined to set the movement speed of the mould.

Return speed can be defined to set the return movement speed of the mould.

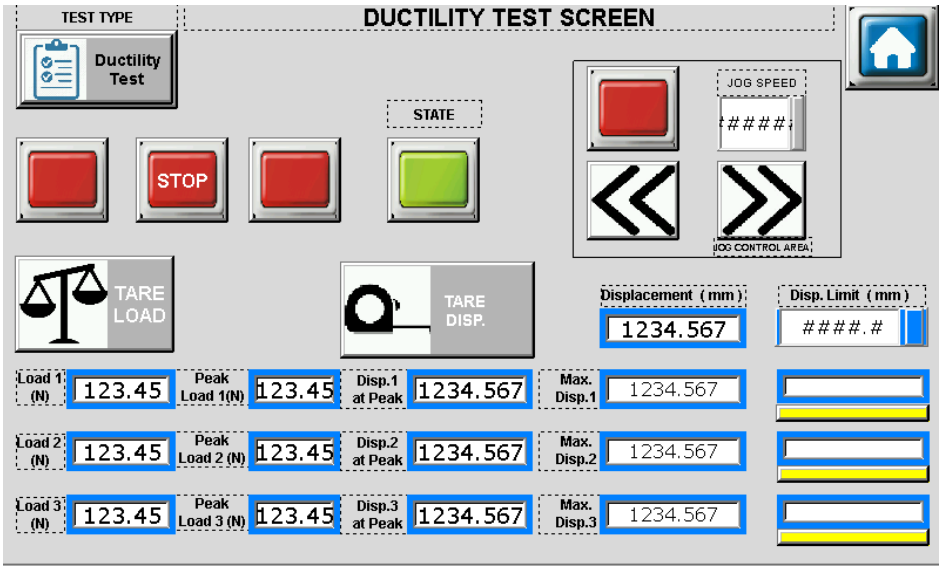
Failure percentage is the proportion of the maximum value at which testing will stop automatically (this value should be left at 100 for bitumen related testing).

DUCTILITY TEST SCREEN:
This screen should be used for Normal ductility and Force ductility testing.



The test type from the upper left button should be confirmed before starting the test. The DISP. LIMIT box can be used to stop the test at a pre-defined displacement. DUCTILITY TEST should be selected as test type for Force and Normal ductility testing. In order to fit different types of moulds, the clip assembly should be adjusted before starting the test. For the mould adjustment to be made, the test type from the top left button should be selected as JOG CONTROL. After this selection the jog speed should be defined and the jog start button at the top right should be pressed. The clip assembly can be moved left or right using arrows below the jog speed slider. Once the STOP button is pressed the device will stop adjusting the mould and the menu will change back to the test screen. After adjustment of the clip assembly, the test mode from the top left button should be changed back to DUCTILITY TEST and the displacement should be zeroed using the TARE DISPLACEMENT button. The TARE LOAD button should then be pressed and, when all readings are zero, the operator can start the test by pressing the START button.

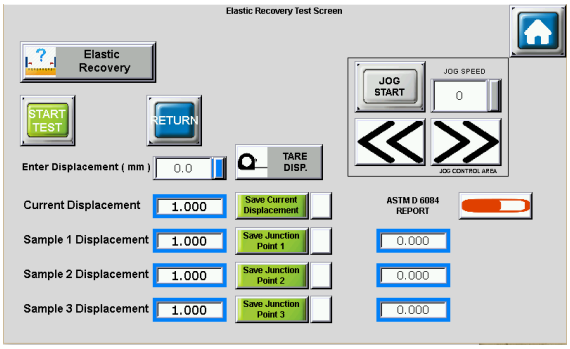
While the test is ongoing, the operator interface will change and a red STOP button will appear on the screen. This button can be pressed to stop the test.



Load (N) value shows the reading from the load cell in real time.
Peak Load (N) value shows the maximum value read from that load cell during the test.
Disp.1 at Peak value shows the displacement at which the maximum load has been reached.
Max Disp. value shows the displacement value at which the force read by the load cell has reached 0.

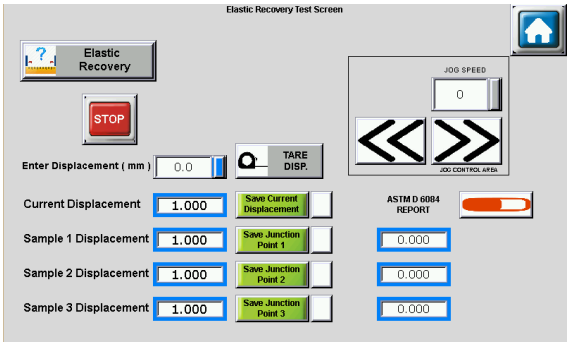
Load vs deformation graphs for each sample can be obtained using computer software.

ELASTIC RECOVERY TEST SCREEN:
This screen should be used for Elastic Recovery testing.



The test type from the upper left button should be confirmed before starting the test. ELASTIC RECOVERY should be selected as the test type for this type of testing. In order to fit different types of moulds the clip assembly shall be adjusted before starting the test. Please refer to the DUCTILITY TEST SCREEN section of the manual for the adjustment of the mould. Once the clip assembly has been adjusted, displacement should be zeroed using the TARE DISPLACEMENT button. The Displacement (mm) value should be entered by the operator to define the distance at which the testing will stop (100 mm for ASTM 6048 and 200 mm for EN 13398).

The test should be started using the START button, and when the displacement has reached the desired value the device will stop. At this point SAVE CURRENT DISPLACEMENT should be used to record the initial displacement value.



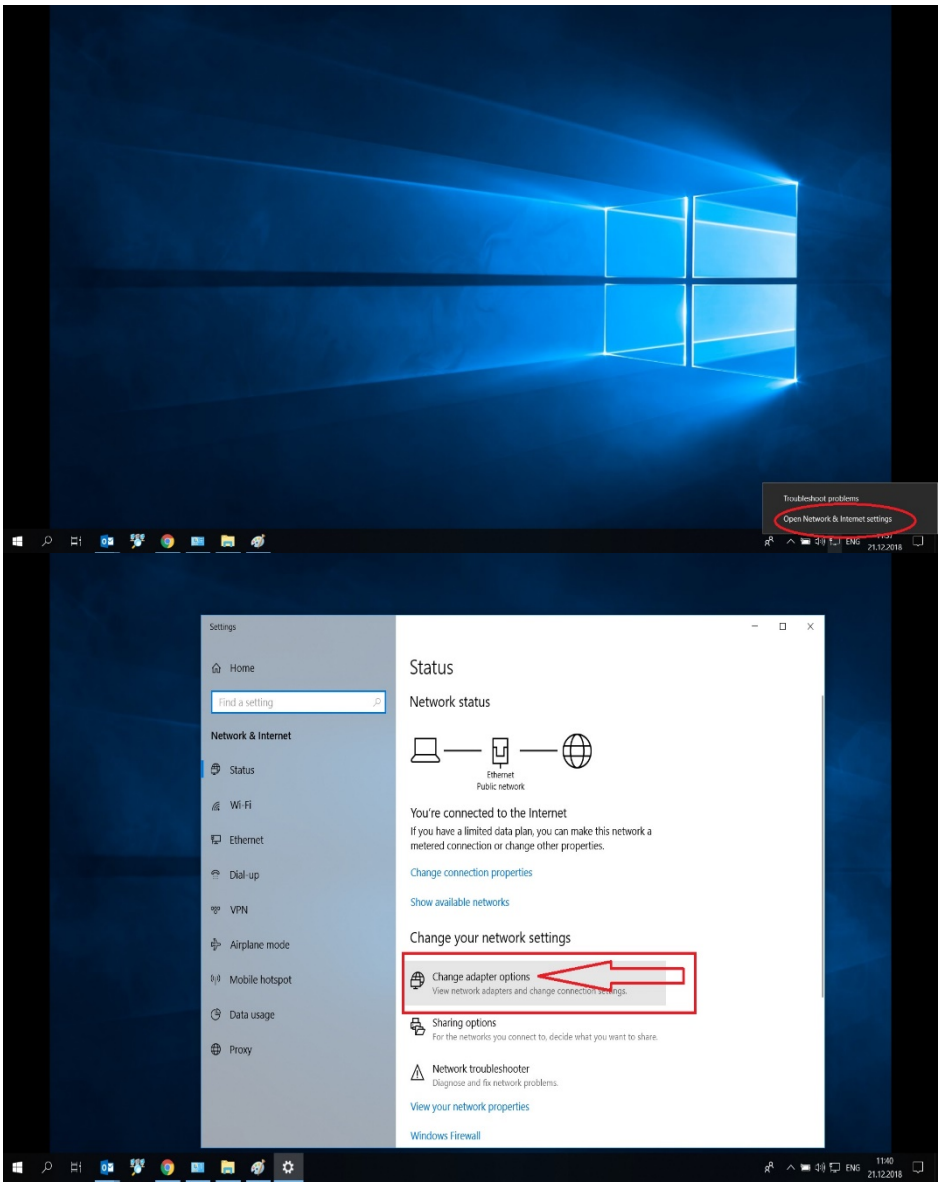
After the bitumen sample is cut and sufficient time according to the standard has passed, the test mode should be changed to RETURN from the top left button. (The return speed should be adjusted from the SPEED AND FAILURE DETECTION menu before this phase. A high return speed would cause the operator to miss the exact point at which the ends of the sample touch each other.) Return of the mould should be initiated using the START button. Once the ends of the bitumen sample from two parts of the mould have touched each other, the STOP button should be used to stop the test. The SAVE ADJACENT POINT button for the corresponding lane should be pressed to record the new displacement value. The difference between initial elongation and recovery for the corresponding sample will be calculated and displayed on the screen. The Method for this calculation can be changed from ASTM 6084 to EN 13398 using the orange slider.

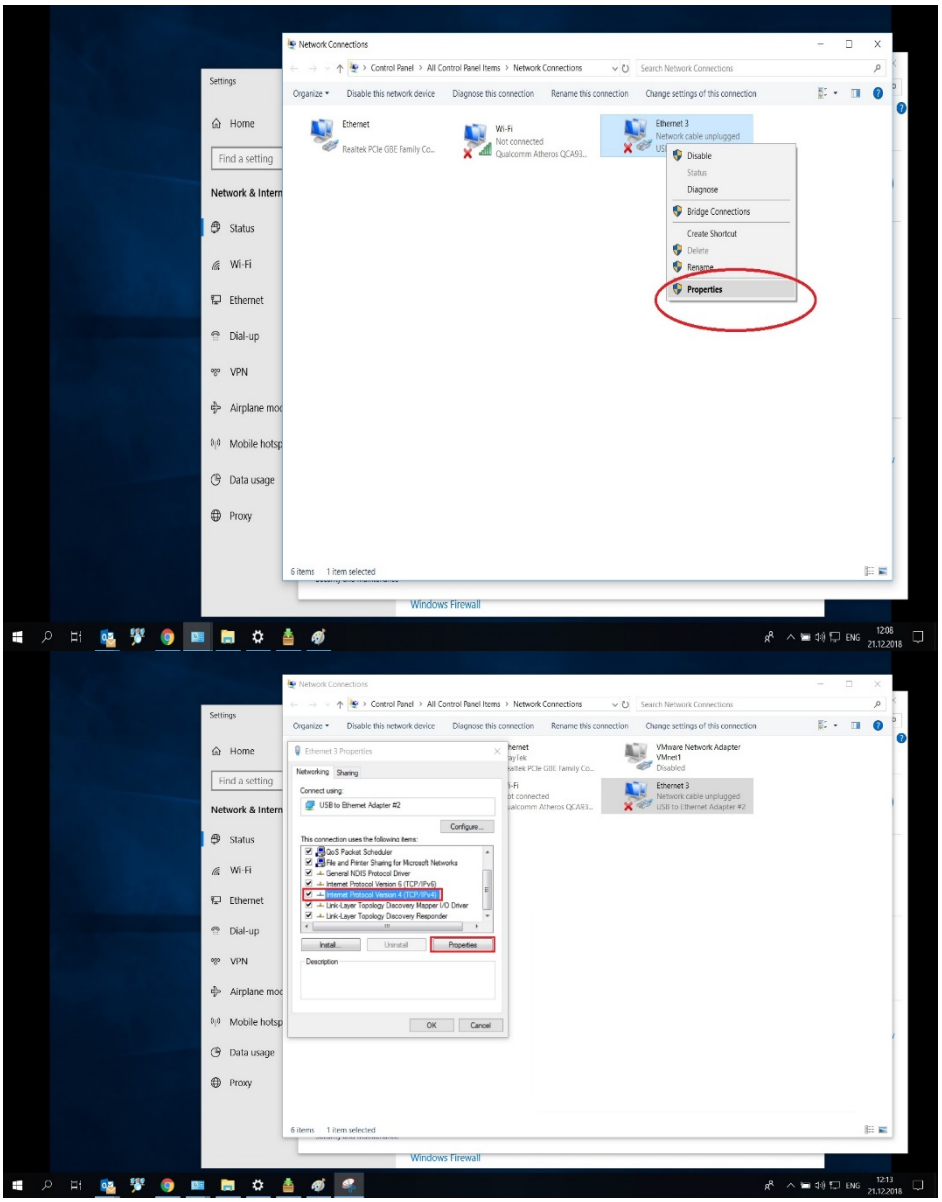
5 Software

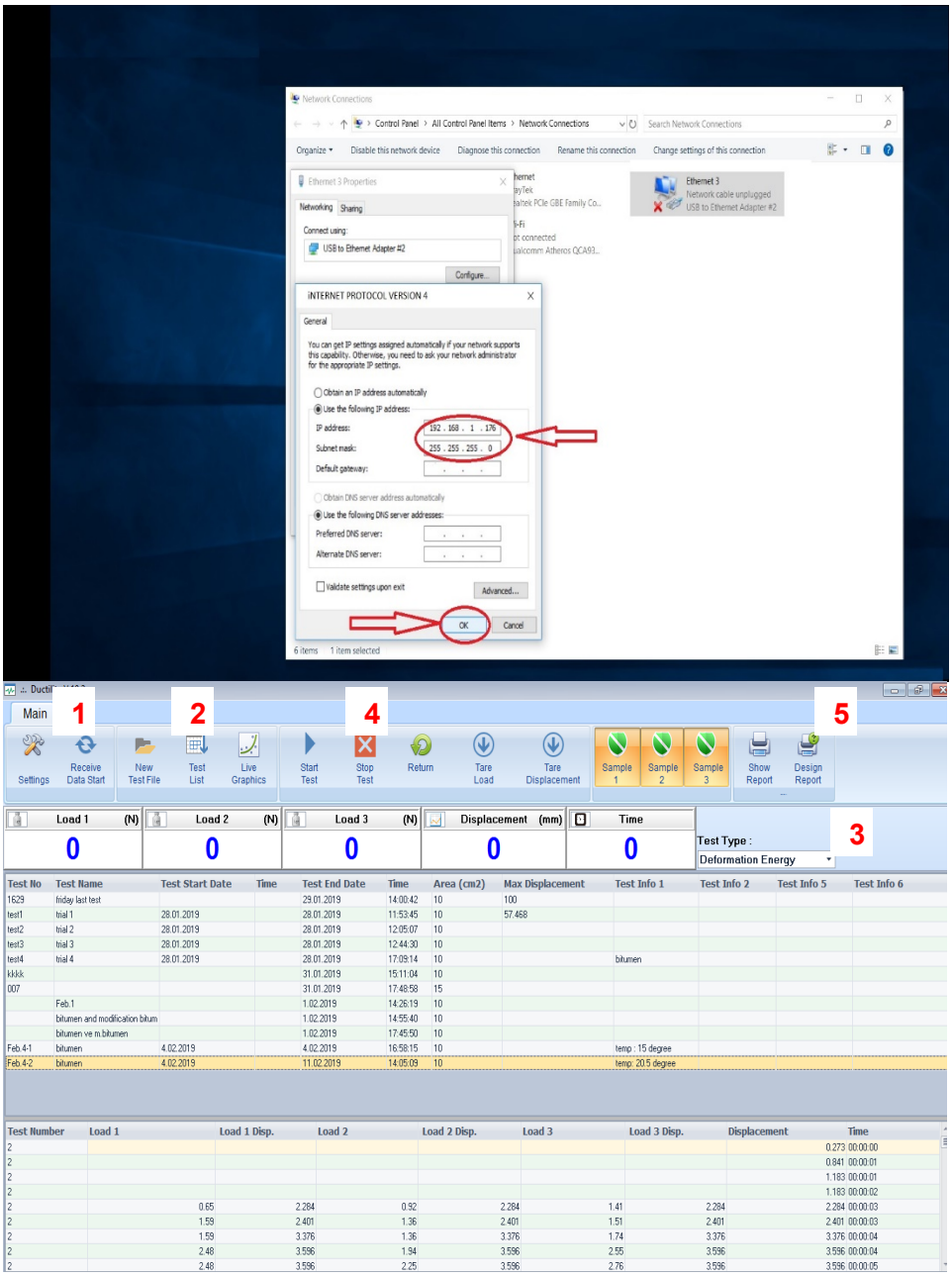
5.1. Force Ductility Software

In order to connect the device, the IP address of the PC should be 192.168.1.176.

When the software is launched connection parameters should be input in the following screen:




Network Connections
Control Panel > All Control Panel Items > Network Connections
Search Network Connections
Organize
Disable this network device
Diagnose this connection
Rename this connection
Change settings of this connection
Ethernet
Realtek PCIe GBE Family Co...
Wi-Fi
Not connected
Qualcomm Atheros QCA93...
Ethernet 3
Network cable unplugged
Disable
Status
Diagnose
Bridge Connections
Create Shortcut
Delete
Rename
Properties
6 items
1 item selected
Settings
Home
Find a setting
Network & Intern
Status
Wi-Fi
Ethernet
Dial-up
VPN
Airplane mo
Mobile hotsp
Data usage
Proxy
Windows Firewall
ENG
12:08
21.12.2018
Ethernet 3 Properties
Networking
Sharing
Connect using:
USB to Ethernet Adapter #2
Configure...
This connection uses the following items:
QoS Packet Scheduler
File and Printer Sharing for Microsoft Networks
General NDIS Protocol Driver
Internet Protocol Version 6 (TCP/IPv6)
Internet Protocol Version 4 (TCP/IPv4)
Link-Layer Topology Discovery Mapper I/O Driver
Link-Layer Topology Discovery Responder
Install...
Uninstall
Properties
Description
OK
Cancel
VMware Network Adapter
VMnet1
Disabled
Ethernet 3
Network cable unplugged
USB to Ethernet Adapter #2
6 items
1 item selected
Windows Firewall
ENG
12:13
21.12.2018

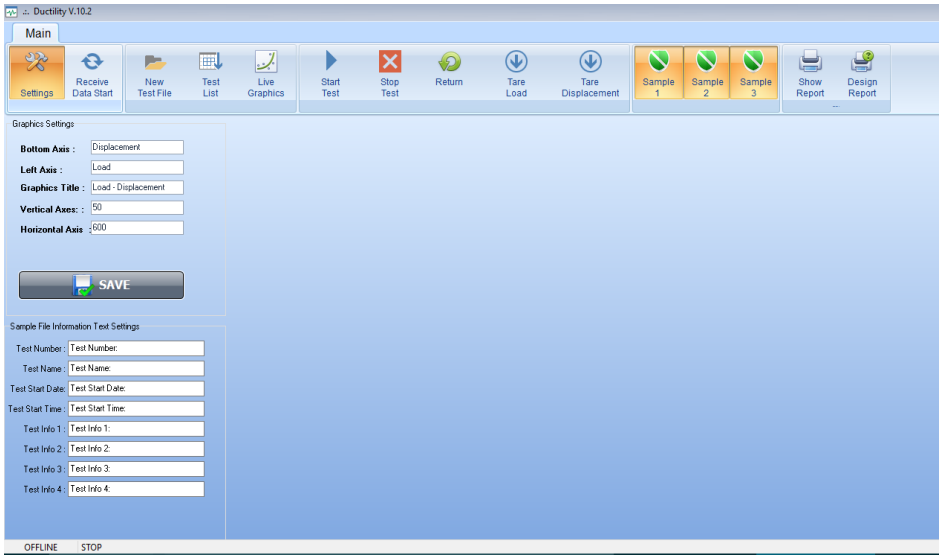


The introduction screen of the software can be divided into 5 parts.

Introduction Screen:

1. Settings menu
2. Test list
3. Test type selection
4. Test initiation and records
5. Test graphs and reports

Settings Screen



Graphics settings menu can be used for determining the titles of axis and graphs.
Data received on start button can be used to initiate receiving of data when the software is launched.
Sample file information test settings can be used to alter the report format of the software. Default format of the reports obtained from the software can be changed by entering parameters in the text boxes.

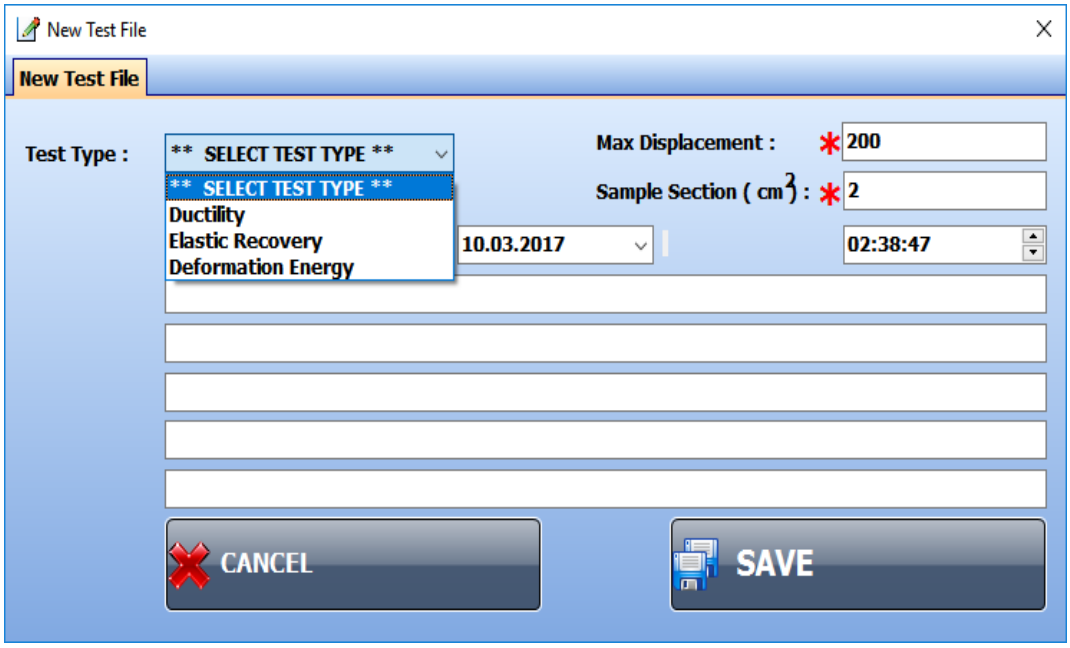
Connection Status

Green icons above numbered samples indicate that data is being received from corresponding samples. Red icons indicate that no data is being transmitted from those samples.

Test Type Selection

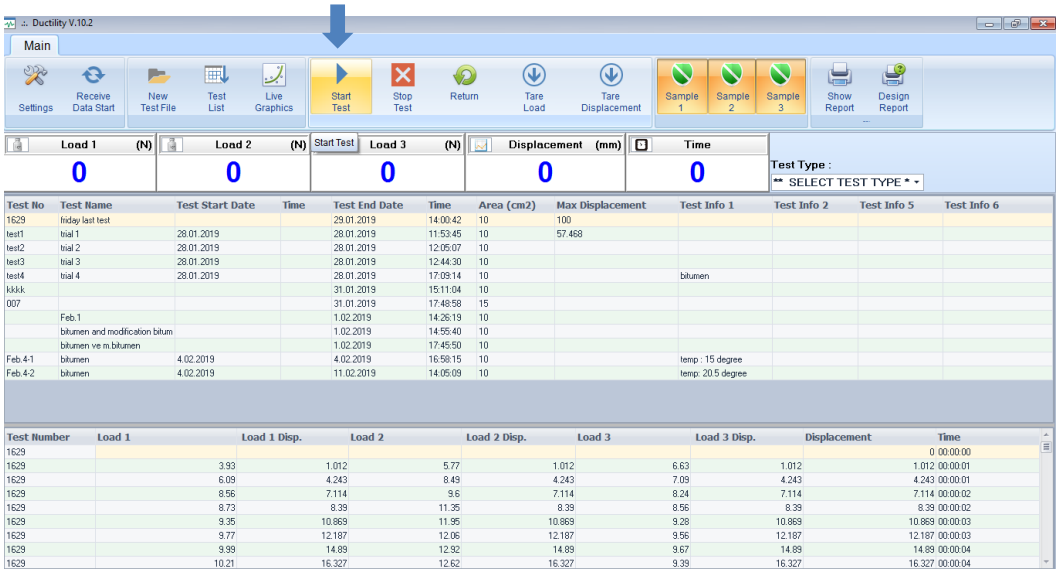
Test type should be selected using this menu. Test type should be selected as:

1. Ductility - for normal ductility testing
2. Elastic Recovery - for elastic recovery testing
3. Deformation energy - for determination of deformation energy using force ductility.

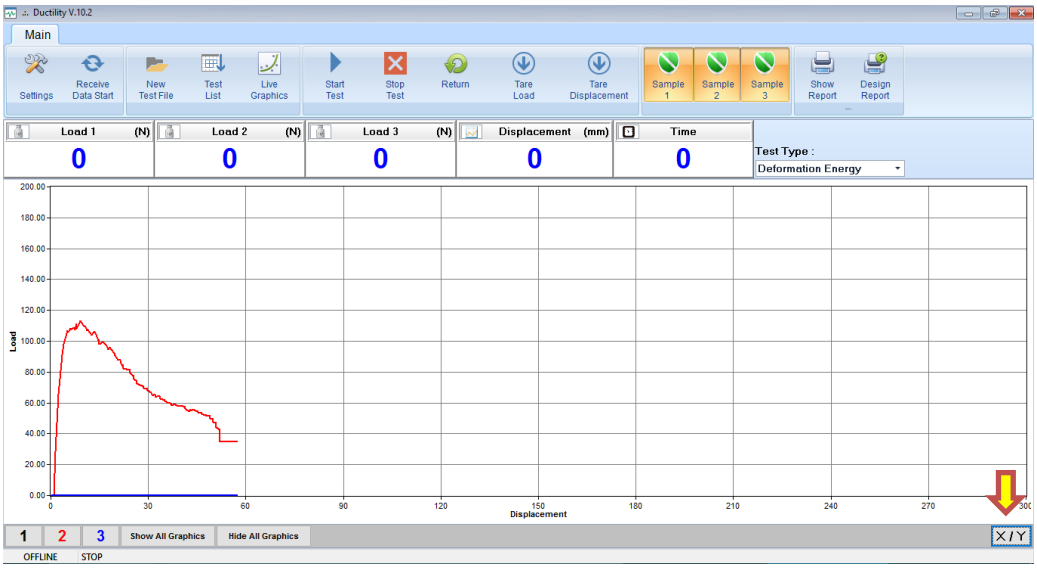


Sample section should be entered as 1 cm^2.

Test Initiation and Records



New tests can be initiated by pressing the right mouse button and selecting the new test. Graphs for previous tests can be displayed by selecting the corresponding record and selecting Graphic sample 1, 2 or 3. Data for each test can be seen on the bottom table and can be exported to excel by right clicking and selecting EXPORT TO EXCEL. An excel file will be created in the same folder with the execution file. To delete a previous test, the DEL button on the keyboard should be pressed.

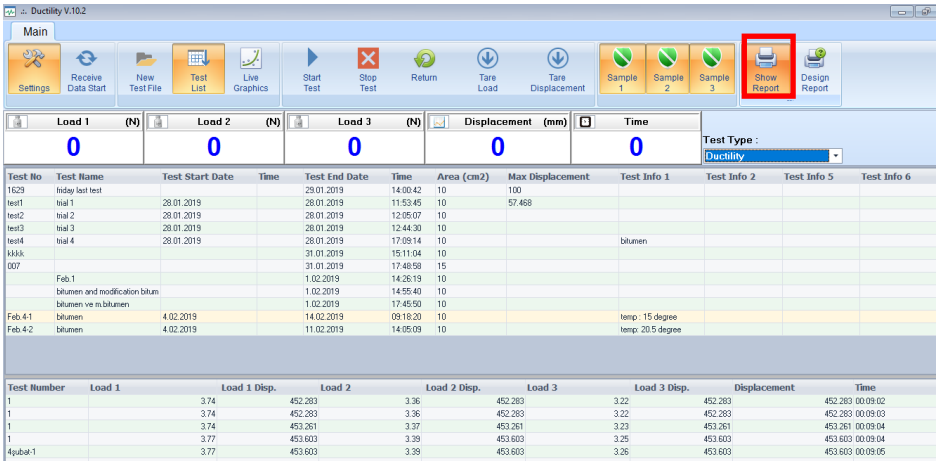


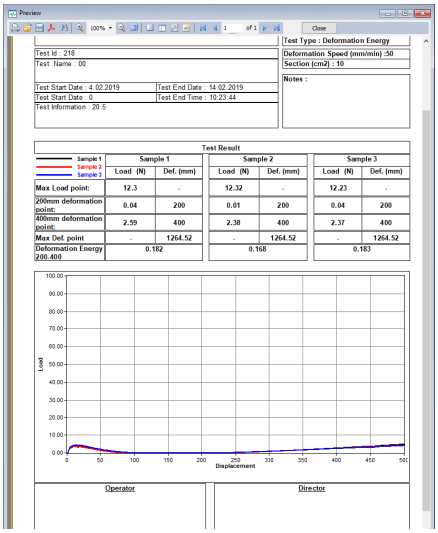
The X/Y button on the bottom right can be used to adjust the axis parameters of the graphs.

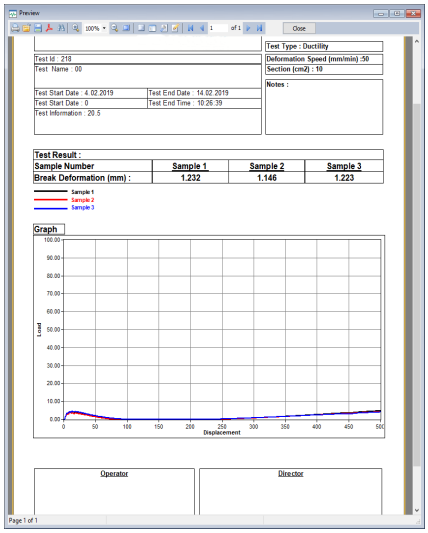
Test Graphs and Reports

Reports for tests can be accessed from this menu.

For Elastic recovery test, initial displacement and elastic recovery value, the distance between moulds when the sample ends have just touched each other should be input to the software. Calculation of elastic recovery percentage will be made and displayed on the right .







For Force Ductility test: maximum load, displacement encountered at maximum load, load encountered at 200 mm displacement, load encountered at 400 mm displacement and maximum deformation can be calculated by the software. Deformation energy corresponding to 200 to 400 mm displacement can be calculated by the software.

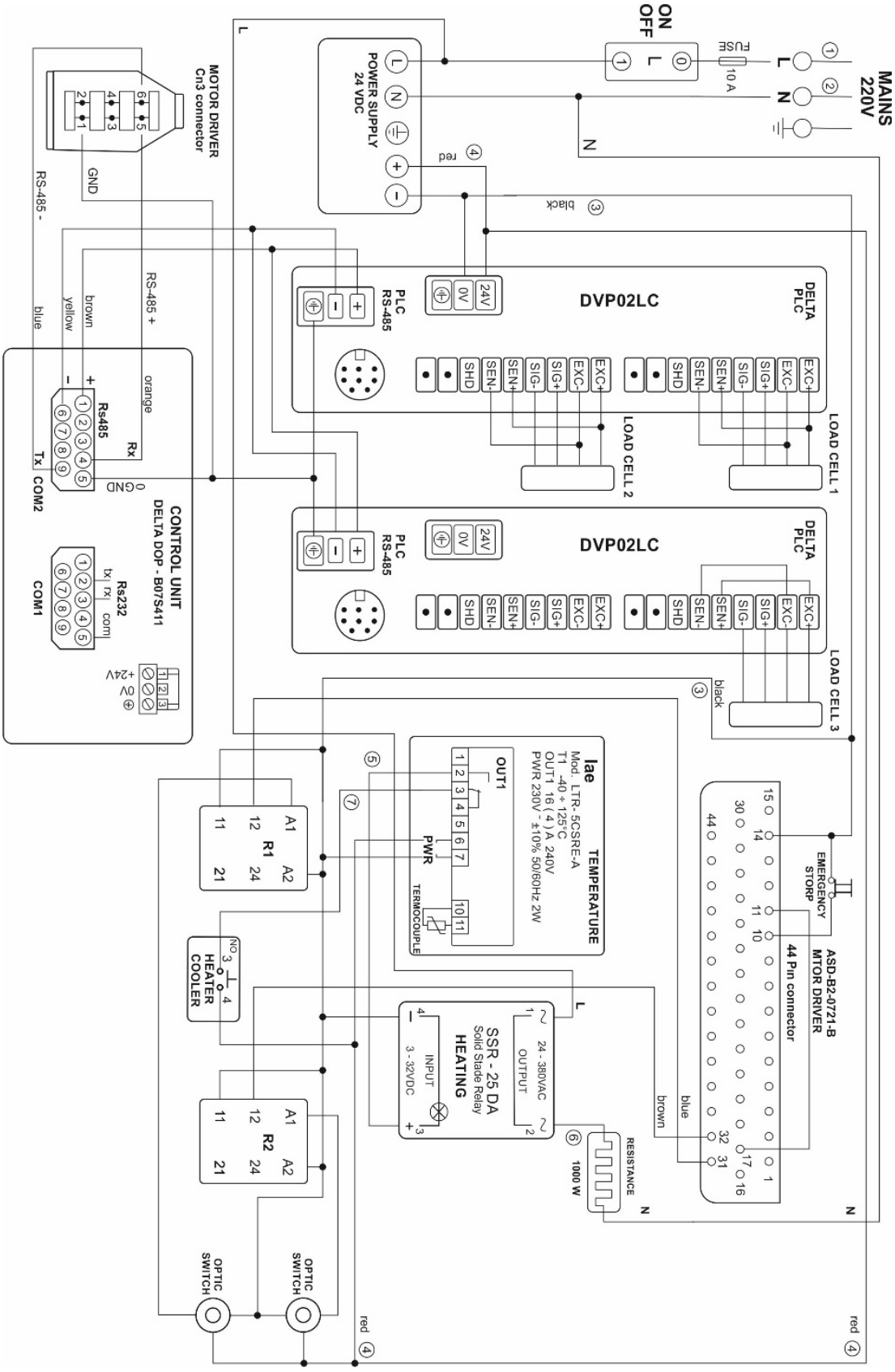
6 Maintenance & Cleaning

Before carrying out any routine maintenance on the system, verify that the electrical feed outlet is disconnected.

Trained technical personnel or an electrician must carry out maintenance of the electric system. For device related electrical issues consult ELE's Service Department.

NOTE: *If the device will not be used for a period of time, disconnect the mains plug, remove the sensors and store them in their original boxes or suitable cases in normal conditions.*

7 Wiring Diagram



DIRECTIVE ON WASTE ELECTRICAL & ELECTRONIC EQUIPMENT (WEEE)

Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August of 2005. In conformity with European local and national regulations (EU Directive 2002/96/EC), European electrical equipment users must now return old or end-of life equipment to the Producer for disposal at no charge to the user.

Note: *For return for recycling, please contact the equipment producer or supplier for instructions on how to return end-of-life equipment for proper disposal.*

Important document. Retain with product records.

GERMAN

Elektrogeräte, die mit diesem Symbol gekennzeichnet sind, dürfen in Europa nach dem 12. August 2005 nicht mehr über die öffentliche Abfallentsorgung entsorgt werden. In Übereinstimmung mit lokalen und nationalen europäischen Bestimmungen (EU-Richtlinie 2002/96/EC), müssen Benutzer von Elektrogeräten in Europa ab diesem Zeitpunkt alte bzw. zu verschrottende Geräte zur Entsorgung kostenfrei an den Hersteller zurückgeben.

Hinweis: *Bitte wenden Sie sich an den Hersteller bzw. an den Händler, von dem Sie das Gerät bezogen haben, um Informationen zur Rückgabe des Altgeräts zur ordnungsgemäßen Entsorgung zu erhalten.*

Wichtige Informationen. Bitte zusammen mit den Produktinformationen aufbewahren.

FRENCH

A partir du 12 août 2005, il est interdit de mettre au rebut le matériel électrique marqué de ce symbole par les voies habituelles de déchetterie publique. Conformément à la réglementation européenne (directive UE 2002/96/EC), les utilisateurs de matériel électrique en Europe doivent désormais retourner le matériel usé ou périmé au fabricant pour élimination, sans frais pour l'utilisateur.

Remarque : *Veuillez vous adresser au fabricant ou au fournisseur du matériel pour les instructions de retour du matériel usé ou périmé aux fins d'élimination conforme.*

Ce document est important. Conservez-le dans le dossier du produit.

ITALIAN

Le apparecchiature elettriche con apposto questo simbolo non possono essere smaltite nelle discariche pubbliche europee successivamente al 12 agosto 2005. In conformità alle normative europee locali e nazionali (Direttiva UE 2002/96/EC), gli utilizzatori europei di apparecchiature elettriche devono restituire al produttore le apparecchiature vecchie o a fine vita per lo smaltimento senza alcun costo a carico dell'utilizzatore.

Nota: *Per conoscere le modalità di restituzione delle apparecchiature a fine vita da riciclare, contattare il produttore o il fornitore dell'apparecchiatura per un corretto smaltimento.*

Documento importante. Conservare con la documentazione del prodotto.

DANISH

Elektriske apparater, der er mærket med dette symbol, må ikke bortskaffes i europæiske offentlige affaldssystemer efter den 12. august 2005. I henhold til europæiske lokale og nationale regler (EU-direktiv 2002/96/EF) skal europæiske brugere af elektriske apparater nu returnere gamle eller udtjente apparater til producenten med henblik på bortskaffelse uden omkostninger for brugeren.

Bemærk: *I forbindelse med returnering til genbrug skal du kontakte producenten eller leverandøren af apparatet for at få instruktioner om, hvordan udtjente apparater bortskaffes korrekt.*

Vigtigt dokument. Opbevares sammen med produktdokumenterne.

SWEDISH

Elektronikutrustning som är märkt med denna symbol kanske inte kan lämnas in på europeiska offentliga sopstationer efter 2005-08-12. Enligt europeiska lokala och nationella föreskrifter (EU-direktiv 2002/96/EC) måste användare av elektronikutrustning i Europa nu återlämna gammal eller utrangerad utrustning till tillverkaren för kassering utan kostnad för användaren.

Obs! *Om du ska återlämna utrustning för återvinning ska du kontakta tillverkaren av utrustningen eller återförsäljaren för att få anvisningar om hur du återlämnar kasserad utrustning för att den ska bortskaffas på rätt sätt.*

Viktigt dokument. Spara tillsammans med dina produktbeskrivningar.

SPANISH

A partir del 12 de agosto de 2005, los equipos eléctricos que lleven este símbolo no deberán ser desechados en los puntos limpios europeos. De conformidad con las normativas europeas locales y nacionales (Directiva de la UE 2002/96/EC), a partir de esa fecha, los usuarios europeos de equipos eléctricos deberán devolver los equipos usados u obsoletos al fabricante de los mismos para su reciclado, sin coste alguno para el usuario.

Nota: *Sírvase ponerse en contacto con el fabricante o proveedor de los equipos para solicitar instrucciones sobre cómo devolver los equipos obsoletos para su correcto reciclado.*

Documento importante. Guardar junto con los registros de los equipos.

DUTCH

Elektrische apparatuur die is voorzien van dit symbool mag na 12 augustus 2005 niet meer worden afgevoerd naar Europese openbare afvalsystemen. Conform Europese lokale en nationale wetgegeving (EU-richtlijn 2002/96/EC) dienen gebruikers van elektrische apparaten voortaan hun oude of afgedankte apparatuur kosteloos voor recycling of vernietiging naar de producent terug te brengen.

Nota: *Als u apparatuur voor recycling terugbrengt, moet u contact opnemen met de producent of leverancier voor instructies voor het terugbrengen van de afgedankte apparatuur voor een juiste verwerking.*

Belangrijk document. Bewaar het bij de productpapieren.

POLISH

Sprzęt elektryczny oznaczony takim symbolem nie może być likwidowany w europejskich systemach utylizacji po dniu 12 sierpnia 2005. Zgodnie z europejskimi, lokalnymi i państwowymi przepisami prawa (Dyrektywa Unii Europejskiej 2002/96/EC), użytkownicy sprzętu elektrycznego w Europie muszą obecnie przekazywać Producentowi stary sprzęt lub sprzęt po okresie użytkowania do bezpłatnej utylizacji.

Uwaga: *Aby przekazać sprzęt do recyklingu, należy zwrócić się do producenta lub dostawcy sprzętu w celu uzyskania instrukcji dotyczących procedur przekazywania do utylizacji sprzętu po okresie użytkowania.*

Ważny dokument. Zachować z dokumentacją produktu.

PORTUGESE

Qualquer equipamento eléctrico que ostente este símbolo não poderá ser eliminado através dos sistemas públicos europeus de tratamento de resíduos sólidos a partir de 12 de Agosto de 2005. De acordo com as normas locais e europeias (Directiva Europeia 2002/96/EC), os utilizadores europeus de equipamentos eléctricos deverão agora devolver os seus equipamentos velhos ou em fim de vida ao produtor para o respectivo tratamento sem quaisquer custos para o utilizador.

Nota: *No que toca à devolução para reciclagem, por favor, contacte o produtor ou fornecedor do equipamento para instruções de devolução de equipamento em fim de vida para a sua correcta eliminação.*

Documento importante. Mantenha junto dos registos do produto.