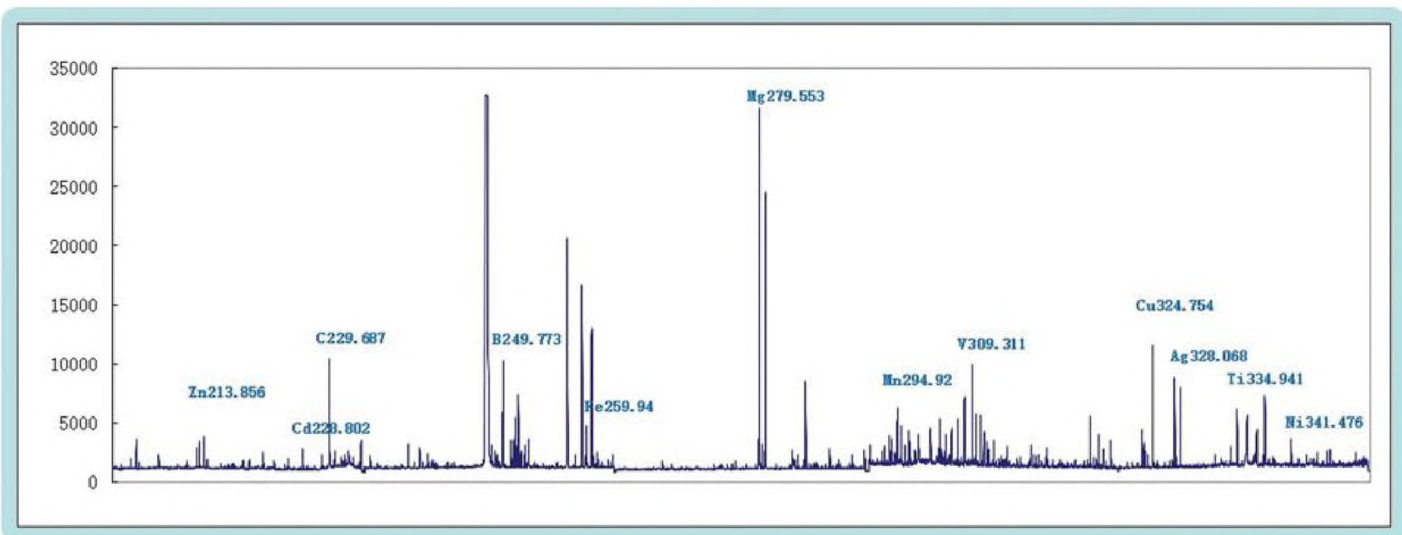
0CI-1 oil spectrum analyzer

0CI-1 oil spectrum analyzer is based on atomic emission spectrum analysis technology, adopts CCD array detection method, can carry out full spectrum analysis of oil multielement, channel selection/change is very flexible, with stable and reliable, fast detection speed, high precision technology advantages, widely used in lubricating oil, hydraulic oil, fuel oil, antifreeze detection. It can be used for real-time monitoring of equipment status by users in many fields, and can also be used in the field of oil quality control.

Performance characteristics

- The sample does not require pretreatment, fast (only 30 seconds to excite a sample), accurate measurement (detection limit below 0.1ppm);
- Designed with advanced artificial intelligence system, with operation prompt function, can prevent damage to the instrument due to misoperation;
- Built-in M computer system, integrated design of the overall structure;
- Can be built into the shock-absorbing chassis, with good shock resistance and mobility;
- Windows platform operating software: data processing speed is fast, data compatibility is strong, software scalability is strong;
- Added user-defined background deduction function, greatly reducing noise interference, improve sensitivity.



Technical parameter

Spectral range	203 ~ 810nm	Meet the standard	ASTM D6595 (Lubricating Oil/Hydraulic Oil) ASTM D6728 (Fuel Oil/Turbine Oil)
Sample consumption	About 2ml	Operating temperature	-10 ~ 50℃
Relative humidity	0 to 90%, no condensation	Operating voltage	220V/50HZ
weight	＜68kg	Shipping box package size	73.7x68.6x83 cm
Data transmission	USB/Ethernet	(L *W* H)	Standby 10W, sample burning process 500W

Detection range

Elements	很 Ag	铝 Al	硼 B	钡 Ba	钙 Ca	«5Cd	铬 Cr	铜 Cu	铁 Fe	钾 K	锂 Li	t|Mg	tiMn	钼 Mo	钠 Na	镍 Ni	磷 P	祐 Pb	择 Sb	硅 Si	银 Sn	钛 Ti	矾 V	锌 Zn	total
Engine oil	0-900	0-900	0-900		0-3000		0-900	0-900	0-900					0-900	0-3000	0-900	0-3000	0-900		0-900	0-900			0-3000	15
Lubricating oil	0-900	0-900	0-900	0-5000	0-5000	0-900	0-900	0-900	0-900	0-900	0-900	0-5000	0-900	0-900	0-5000	0-900	0-5000	0-900	0-100	0-900	0-900	0-900	0-900	0-5000	24
Antifreeze solution		0-50	0-1000		0-50			0-50	0-50	0-10000		0-50		0-500	0-10000		0-2500	0-50		0-500				0-50	13
Fuel oil		0-500			0-500		0-500	0-500	0-500	0-500	0-500	0-1500	0-500		0-100	0-500		0-500		0-300			0-500	0-500	15

Note: Elements that can be extended for users are 砷 As | 祕 Bi | 锦 Ce | 钴 Co | 铟 In | 钨 W | 结 Zr

Packing list

NO	Item	quantity
1	oC1-1 oil spectrum analyzer	1
2	Rod electrode cutter	1
3	220V power cable	2
4	specification	1
5	Certificate of conformity	1
6	Packing box	1
7	Accessory tray	1
8	Smoke pipe	1
9	clamp	1
10	Printing paper	1
11	Storage cup	2
12	Rod electrode (0.242 "X6")	50
13	Disk electrode	200
14	100 3mL plastic straws	400
15	Lens paper	1
16	Base oil	1
17	100ppm standard oil	1
18	900ppm standard oil	1
19	Secondary sample oil cup	200
20	External printer	1
21	External printer paper	1
22	Electronic instruction manual	1
23	Quartz window cleaner	1

浙江康乐集团进出口有限公司
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Customer Name	OOO'CTC'	**Quotation No.**	KLG23
Attn	ELENA	**Currency**	CNY
Contact & info.		**Date**	2023/

No	Description	Qty	Unit Price	Total Price	Sample	Note
1	0CI-1 oil spectrum analyzer	1	1	780,000.00		With the exception of 0CI-1 oil spectrum analyzer, the consumables in the packing list are complimentary. If you want to purchase them separately, the prices below are applicable
	Printing paper	1		110.00		
	Storage cup	2		55.00		
	Rod electrode (0.242 "X6")	50		4950.00		
	Disk electrode	200		3580.00		
	100 3mL plastic straws	400		550.00		
	Lens paper	1		55.00		
	Base oil	1		715.00		
	100ppm standard oil	1		3850.00		
	900ppm standard oil	1		2200.00		
	Secondary sample oil cup	200		550.00		
	Freight to Russia					
	Total					

Freight to Russia		Freight shall be provided after comfirm order
Grand total cost		
Estimated weight		
Total Volume		
Expected Time of Delivery	30days for production after receive full payment, 20-25days for air transport	
Note	valid period of the offer is 15 days	

OCI-1 Oil spectrum analyzer
Operation Manual

Kindly Reminder

Thank you for purchasing OCI-1 series oil spectrum analyzer. Before using this product, please read the manual instructions carefully in order to get familiar with its performance and use this product correctly. Please keep the operation manual properly for future reference after reading. This manual describes how to safely and correctly use the oci-1 series oil analyzer. Make sure you understand the instructions correctly and follow the steps described in the instructions. Please contact our technicians in case of any questions when operating (see the back cover for contact information). Operation should be done under the instruction of the technicians. Do not disassembly the equipment yourselves to avoid any man-made damage.

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1 Instruments Overview

1.1 brief introduction

Our OCI-1 oil spectrum analyzer is designed basing on atomic emission spectrum technology and the rotating disk electrode, which is used in the technical development of the oil metal abrasive, pollutants and additive elements in quantitative analysis. It is an high-performance spectrum analyzer which has the feature of sturdy and durable, Compact and easy to transport, High precision and accuracy. Our instruments fulfill the requirements of ASTM D6595 Standard Method for Determination of Wear Metals and Contaminants in Used Lubricating Oils or Hydraulic Fluids. The OCI-1fulfills the requirements of ASTM D6595 Standard Method for Determination of Wear Metals and Contaminants in Used Lubricating Oils or Hydraulic Fluids. The instrument is suitable for fast oil analysis in laboratory and field in-situ analysis. The appearance of oci-1 oil analyzer is shown in Fig. 1-1.

The measurement principle of oci-1 oil analyzer is shown in Fig. 1-2. The instrument adopts ac arc as excitation light source, in the rod electrode and rotating disc electrode to form an arc, stimulating the rotating disc electrodes attached to the oil sample and to produce characteristic spectrum signals, then spectrum signal go through optical fiber into the spectral system.

Fig. 1-1 OCI-1 Oil Analyzer

The spectroscopic system disperses the spectral signal of the complex color, so then the characteristic spectral lines of elements of different wavelengths are separated. The signal strength of the separated characteristic spectral lines is measured by CCD array detector. The measured characteristic spectral line intensity data are transmitted to the computer for processing to obtain the concentration of each element.

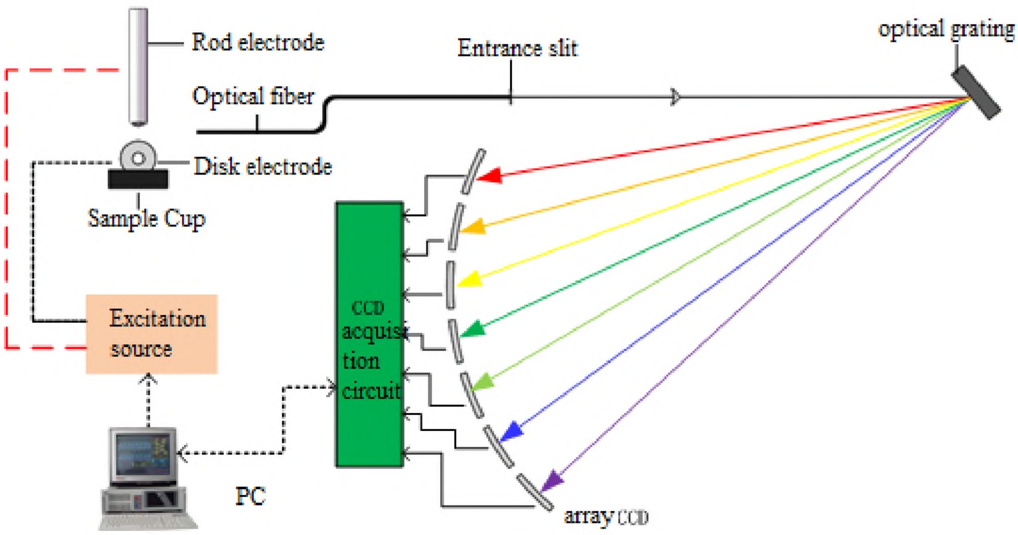

Fig. 1-2 Principle Diagram of OCI-1 Oil Analyzer

1.2 instrument parameter

items	Index
Samples determined	Lubricating oil, fuel oil, cooling fluid
Detecting elements	Fe、Al、Cu、Cr、Ni、B、Mn、Mo、Ti、Cd、Pb、Sn、Si、Ag　Dozens of elements（Can be added according to user requirements）
Testing time	Less than 31s
Spectrum range	200-800nm
Optical system	Paschen-Runge
Analytical precision	ASTM D6595
Working voltage	220V±10%
Operating temperature	0-40℃
Storage temperature	-40~60℃
Operating humidity	0~90%, non-condensing
Light source	AC arc
Dimension	630X520X800(mm)
Weight	100Kg

1.3 features

The instrument adopts advanced design concept and technology. The concentration information of trace elements in oil sample can be obtained quickly and the analysis accuracy and accuracy are good and it is able to meet ASTM D6595 standards of application requirements in oil and hydraulic oils. The features are as follows:

◎ Multi - slice high - resolution linear array CCD is used as spectral detector to achieve full spectrum acquisition and flexible spectral line selection

◎ The spectroscopic system adopts intelligent temperature control with the precision of 0.1 ℃. Ensure long - term operation of the optical system without drift and long - term stability of the instrument running.

◎ Humanized design of the excitation cabin. Facilitate daily analysis, sample replacement and system maintenance.

◎ Integrated design. Built-in the high - reliability industrial control and micro-printer. Easy to get the output and analyze results, and for easy storage.

◎ Simple installation and maintenance only with the power lines connecting to the outer space.

◎ Equipped with special transportation box, convenient for field use.

1.4 Application Fields

OCI-1 oil analyzer can be widely used in the analysis of lubricating oil, coolant and fuel elements of heavy machinery equipment in aviation, petrochemical, mining, ship, electric power and other fields. It can also be used for quality control of new oil production process.

2. Instrument Composition

2.1 overall structure

OCI-1 spectrum analyzer consists of an excitation light source, an excitation chamber, an optical system, a data acquisition system, an industrial control unit, a printer and some other associated accessories, and consumables. The appearance and external interface of the instrument are shown in Fig 2-1. This section will introduce some certain components when in daily use.

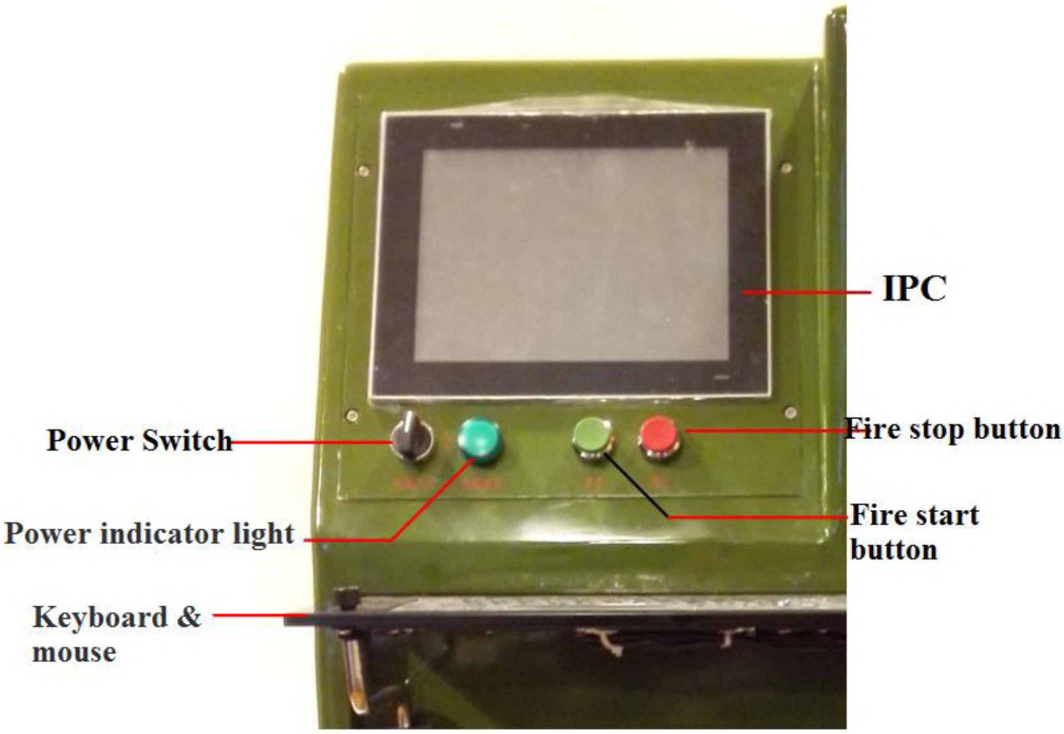

Fig 2-1a instrument front

Fig 2-1b the back of the instrument

2.2 Excitation chamber

The excitation chamber is the right side of the instrument. It is used for exciting the sample oil, generating spectral signals. The excitation chamber mainly includes graphite rod electrode, graphite disc electrode, sample bench and sample clearance setting unit, electrode holding unit and other parts. Fig 2-2 shows the appearance of the excitation chamber. Fig 2-3 is the inner structure diagram of the excitation chamber. Shown below:

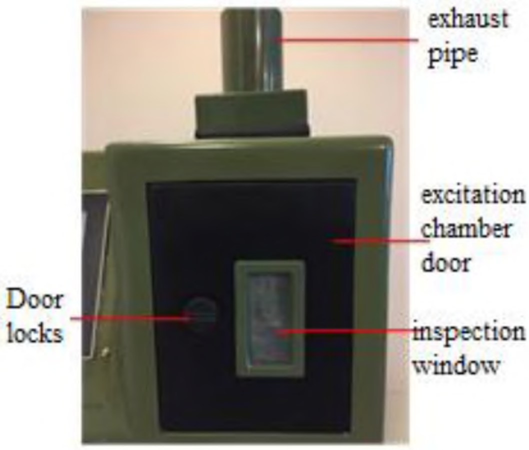

Fig. 2-2 appearance of the excitation chamber

Stimulating chamber door: There are door switches and observation windows on the door of the excitation chamber. The door is closed when the sample is excited and to be isolated from the outside world. It has the electromagnetic interference function of shielding excitation light source.

Rod electrode: The diameter is 0.62cm and the length is 15cm. The bottom is cut into 160 ° taper tip as a pole of arc discharge.

Rod electrode clamp block and rod electrode handle: The clamping mechanism of rod electrode is formed by the clamping block of rod electrode and the handle of rod electrode. The rod electrode clamp block is a fixed copper block, and the rod electrode clamp handle is an elastic mechanism. The rod electrode is placed in a v-shaped slot in the middle of the clamping block.

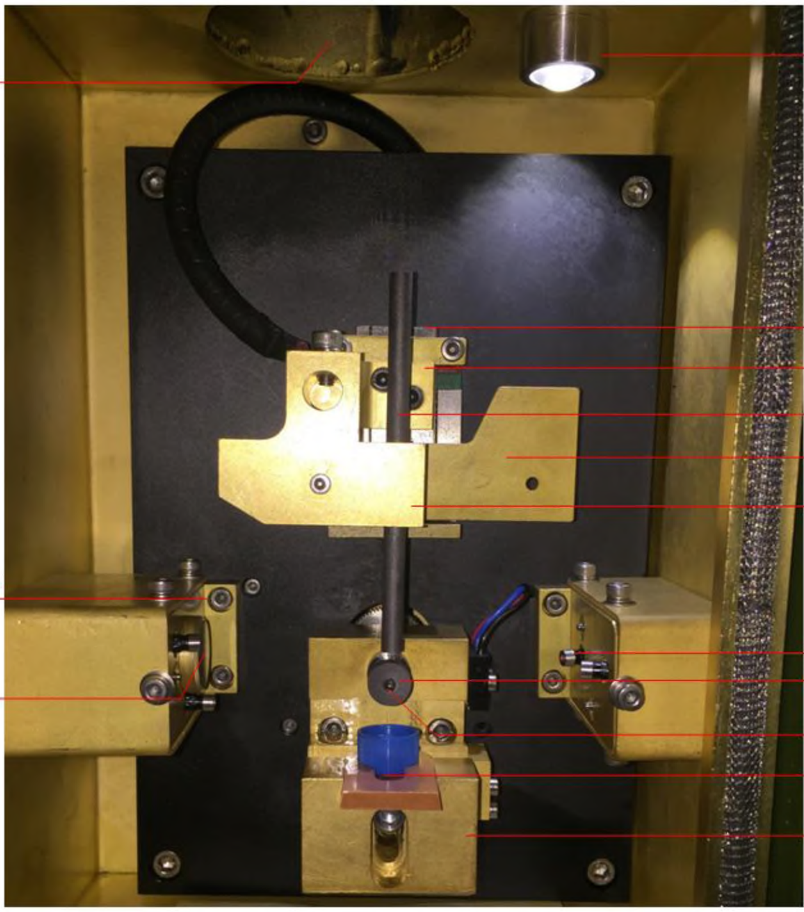

Fig. 2-3 excitation interior structure

Rotating Disk Electrode: Disk 1.22cm in diameter and 0.5cm in width. The rod electrode is partially immersed in the sample cup containing the oil. The disc electrode rotates the oil sample into the discharge clearance between the rod electrode and the disc electrode

Disk electrode shaft: The disk electrode is mounted on the disk electrode axis through a middle round hole. When installing the disk electrode, push the disk electrode directly in along the axial direction and push it to the upper limit of the axis.

The electrode spacing setting and slide rail: The electrode clearance slider is an elastic slider, which can slide up and down on the track to set the distance between the rod electrode and the disk electrode.

Quartz window and fiber lens installation tube: Quartz Windows are used to isolate fiber optic coupling lenses. Prevent the fiber coupling lens from being contaminated by splash oil during sample excitation. The optical fiber lens is used to couple the spectral signal generated by the excited oil sample into the optical fiber.

Lamp: The lamp is a small LED bulb. Due to the closed around in the excitation chamber and insufficient internal light, it is may easy to replace the sample by mistake. The lamp can provide a bright operating environment, and use intelligent switch control, when excited chamber door opens, the lamp on, when excited chamber door closes, the lamp closes automatically.

Exhaust pipe: A fan is built into the exhaust pipe. The fan is opened when the power of the instrument is switched on. The exhaust gas produced when the sample oil is excited is pumped out through the exhaust pipe.

Sample cup: The sample cup is a plastic bottle cap used to hold oil samples for analysis.

Sample platform: The sample platform is located directly below the rod electrode and is a nylon block. A T - shaped copper block with holes was installed on the sample platform. During the analysis, the sample cup containing the oil is placed in the hole of the t-shaped block.

2.3 control panel

The control panel is the human-computer interaction interface of the instrument, including an industrial controller, various switch buttons, indicator lights, keyboard and mouse operation desk, etc., as shown in figure 2-4. The control operation of the instrument can be completed on the control panel.

IPC: Industrial control machine is the instrument control center. It is the operation platform of the software. It can realize the instrument control, condition monitoring, and data analysis.

Power switch: The power switch controls the power on and off of the external access power of the instrument. The position shown in the figure above is in the closed state. The power can be switched on by rotating the switch clockwise.

Power indicator light: the power indicator light is green. When the power switch is on, the indicator light is on.

Fire start button: the fire start button is a green pushing button. When the sample is analyzed, pushing the button inward can fire start the light source to be excitation.

Fire stop button: the fire stop button is a red pushing button. When there is an abnormity during the instrument is on, push the button inward can stop immediately.

Keyboard and mouse: The keyboard and mouse console is a drawer type platform. Used to place keyboard and mouse. The platform can be slid out when operating the instrument, and the platform can slide into the instrument when the instrument is standby.

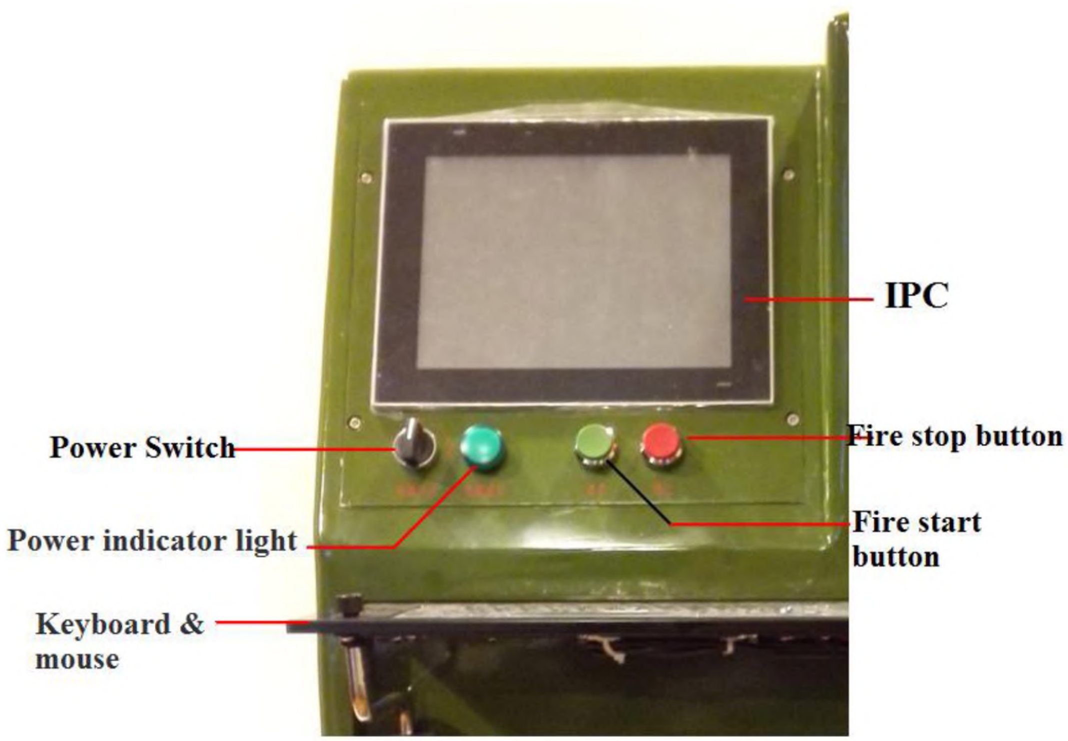

Fig. 2-4 control panel

2.4 Accessories

2.4.1 Standard Oil

Standard oil is an essential part of OCI-I oil analyzer. Like other spectrometers, the oci-1 oil analyzer must be calibrated and periodically checked to ensure the accuracy of analysis of unknown oil samples. In order to calibrate the oci-1 oil analyzer accurately, a series of standard oils with different element contents are needed. The content of elements in these standard oils is within a very strict tolerance range. The common standard oil is divided into parts per million by element content usually are: 0ppm、3ppm、5ppm、10ppm、30ppm、50ppm、100ppm、300ppm、500ppm、 900ppm, As shown in Fig 2-5.

Fig. 2-5 spectrometer accessories

2.4.2 Graphitized Electrode

Oci-1 oil analyzer is an arc emission spectrometer that combines the technology of rotating graphite electrode. The rotating graphite disc electrode introduces the oil sample into the arc discharge channel between the graphite disc electrode and the graphite rod electrode to generate the spectral signal. The shape of the rod electrode has a great influence on the performance of the instrument. Because the rod electrode and disc electrode are made of high purity graphite, the electrode can be easily contaminated if the hand electrode is not reasonable. See section 4-1-3 for the replacement steps of graphite electrodes. The related parameters of graphite electrode are shown in table 2-1.

Table 2-1 graphite electrode parameters

	Size	Note
Rotating Disk electrode	Length 15cm, diameter 6.1mm	Cut into 160 ° pointed cone electrode end
Rod electrode	Thickness 5.08mm; Diameter 12.5mm	

2.4.3 Rod Electrode Cutter

Rod electrode cutter is mainly composed of a motor and a blade. Cut the rod electrode into 160 ° pointed cone with the cutter. As a result of the analysis, the tip of the rod electrode will be ablated and flattened. The rod electrode can be reused after being treated by the cutter. The electrode cutting operation is relatively simple. Insert one end of the electrode of the hand-held rod into the cutter and give a certain pressure. Press and hold about 10s to remove the electrode. See the 4-1-2.

Note: the cutter will be serious heat, please turn off the motor when not in use.

2.4.4 Sample Cup

The sample cups are used to hold the standard oil samples or samples to be tested. The sample cup is made of polyethylene plastic and is disposable. The sample cup is usually kept in a sealed container to prevent contamination. When the operator grabs the sample cup, be careful not to touch the inside of the sample cup.

2.4.5 Keyboard& Mouse

The keyboard and mouse are used for the operation of industrial computer. The mouse is a wireless mouse, which needs to insert a receiver into the USB interface of the industrial computer. Since the mouse is powered by battery, the switch under the mouse should be closed at the end of each operation to extend the battery life.

2.4.6 Transport Case

The transport box is an optional accessory for wild field or in-field use. The transport case can accommodate the oci-1 host itself and all other accessories, as shown in figure 2-6. There are four wheels under the case, and there are brakes with the wheels. The transport case can be easily dragged or fixed. It's a mobile "oil analysis lab." The transportation case is made of polyethylene, waterproof, corrosion resistant, shock resistant, high and low temperature resistant.

Fig 2-6

3 Installation of the OCI-1

There are several considerations that should be taken into account regarding the installation of any analytical instrument. Careful consideration of the site selection and prior knowledge of installation requirements will expedite the installation of the OCI-1 and establish an efficient analytical environment. The following items in the specified sections must be considered before commissioning the OCI-1 .

Location in the Laboratory

Initial Spectrometer Setup

Input Power Requirements

Initial Power Application

Exhaust Ventilation

Environmental Conditions

3.1 Location in Laboratory

The location that is selected for the OCI-1 in a laboratory application is important. Do not locate the instrument close to open windows and/ or heating units. Proper site selection will ensure that the instrument will remain stable without special environmental controls and that recommended periodic maintenance can be conducted as required. Sufficient work space should be left clear around the perimeter of the spectrometer to provide maintenance personnel with access to the various panels. The dimensions for the OCI-1 are shown in Table 3-1. Since the OCI-1 can always be moved to provide panel access, it can also be located in tight fitting locations. However, care must be taken to avoid blocking the rear air intake and exhaust ports.

Table3-1 OCI-1 Dimensions

Depth	630mm
Width	520mm
Height	800mm
Weight	100mm

3.2 Initial Spectrometer Setup

The OCI-1 is normally delivered as a complete system and in one shipping container. The container includes the OCI-1 and all accessories(figure 3-1).

To unpack the OCI-1 for operation, the following procedure is recommended:

1. Before unpacking, move the instrument as close as possible to where it will be installed.

2. To uncrate the instrument remove screws along the base of the container and lift the

top off the shipping pallet.

3. Remove four fixed screws from the bottom of the shipping pallet with a wrench.

4. Lift the instrument off the shipping pallet and move the instrument to the site selected for operation.

5. Locate input power cable. Refer to Figure 3-2.

3.3 Input Power Requirements

The input power requirements for the OCI-1 are determined by the customer and set at the factory prior to delivery. Voltage tolerances and maximum power consumption are shown in Table 5-1 and Table 5-2 provides technical information about the wiring requirements for the input plug.

Table 5-1 Input Power Specifications

Item	
Input Voltage	220V±10%
Frequency	50Hz
Power Consumption	800W

Table 5-2 Main Power Connections

Wire Color	Line
Brown	Live
Blue	Neutral
Yellow	Ground

Table 5-2 is to be consulted if any other plug other than the CEE 7/7 or Hubbell 125 V~ is to be installed on the input power cord of the OCI-1. It is recommended that a qualified electrical contractor, civil engineer or electrical technician be consulted to make any changes to the input power plug.

**Note:* It is imperative that a good ground connection is applied to the spectrometer. The ground connection can be verified with an AC voltmeter. Measure the voltage between the AC return and power earth ground of the receptacle. This voltage must be less than 5 V~. If not, locate another receptacle and repeat the process or con-tact an electrician for assistance.*

3.4 Exhaust Ventilation

The OCI-1 incorporates the rotating disc arc discharge technique for the excitation source. This technique vaporizes the oil sample during the analysis process and consequently produces a fume that is exhausted from the sample excitation chamber. The sample excitation chamber of the OCI-1 is designed with an internal exhaust fan which produces 35 cfm (cubic feet per minute) (1 m3/min) of air flow to exhaust these fumes.

These fumes must be vented to the out-side environment.

The exhaust fan in the OCI-1 is inside a chimney which is located above the sample stand. Refer to Figure 3-3. An exhaust duct must be connected to the chimney to ventilate the fumes to the outside environment. Up to 20 feet (6 meters) with internal diameter 76 mm flexible exhaust duct is recommended. In order to maintain ample airflow, it is recommended that the length of this exhaust duct not exceed 20 feet (6 meters). For greater distances, an additional fan may be required to provide supplemental air flow.

4 Operating conduction

4.1 General Operating Requirements

4.1.1 Applying Power and Turning on The OCI-1

This sections assumes that the OCI-1 has been installed correctly. To turn on the OCI-1, turn the switch on the control panel from “OFF” to "ON" clockwise(Figure 4-1). At this time, the power indicator lights up and the industrial computer automatically launch. After the industrial computer is switched on, double-click the OCI-1 oil spectrum analyzer analysis software on the desktop to enter the main interface of software operation, as shown in Figure 4-2.

There is a temperature indicator indicating the current temperature of the optical system in the upper right corner of the main interface. Under normal circumstances, when the temperature reaches 40 degrees (about half an hour) and is stable for another a half to one hour, then the instrument can start the oil analysis task. In order to ensure the stability of the instrument, it is recommended to keep the OCI-1 oil spectrum analyzer on when the instrument is not used.

To turn off the OCI-1, first close the program and shut down the industrial computer. Then turn the switch on the control panel from “ON” to "OFF" counter-clockwise.

4.1.2 Rod Electrode Sharpening

The preparation of the tip of the rod electrode plays a significant role in obtaining repeatable analytical data. The rod electrode must be cleaned prior to inserting it into the electrode sharpener. This is accomplished by taking a clean paper towel and removing the components of the burn residue from the previous analysis. Remove all residue from the tip and sides of the electrode by rotating the rod in the paper towel while applying pressure with the fingers of the opposite hand.

Note: The paper towel should be laboratory grade and free of silicon.

To sharpen the rod electrode:

1. Insert the rod into the rotating electrode guide hole until it comes in contact with the cutter blade.

2. Apply inward pressure until approximately1/8 to 3/16 inch (3 to 5 mm) is cut from the end of the rod.

3. Slightly decrease the inward pressure on the rod electrode, but still maintain its contact with the cutter blade. This will polish the rod electrode tip.

4. Remove the rod electrode and visually inspect the tip. It should have a clean cut withno apparent chipping around the circumference of the rod. The surface should be very smooth and have a polished mirrored looking surface(Figure 4-3).

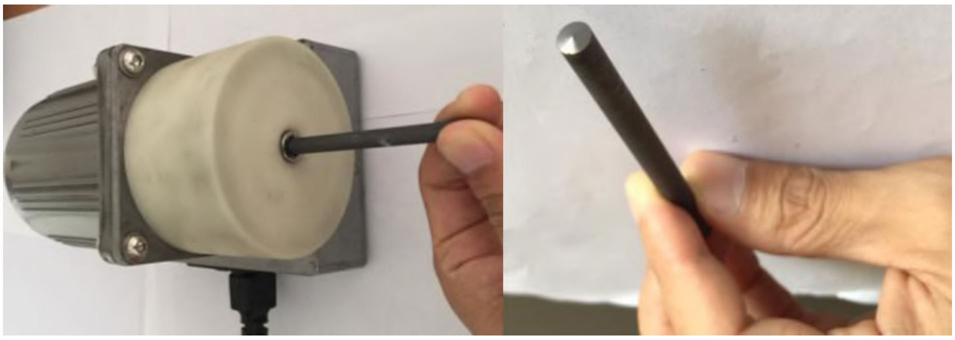

Figure 4-3

Remove the rod, inspect the surface quality and if acceptable, place the rod electrode into the original box for storage until ready for use. To prevent contamination of a sharpened rod electrode, do not touch the tip or edge of the tip of the sharpened electrode with the fingers or metallic surfaces or anything but a fresh, clean laboratory grade paper towel. Do not use a rod electrode for analysis if the surface appears to have been damaged.

Note: The electrode sharpener should be turn off after using.

4.1.3 Installing the Disc Electrode

The disc electrode is the most significant contributor to the accuracy of the instrument. They are manufactured and then purified to strict specifications to ensure that they do not contain unacceptable levels of trace element contamination for the elements of interest. The care taken to properly install the disc on the shaft will help to ensure that excitation parameters will be kept as constant as possible, thus resulting in repeatable analytical data.

To install the disc electrode on the shaft:

1. Pour out a few disc electrodes onto a clean laboratory grade paper towel.
2. Take a laboratory grade paper towel and double it to be sure that no contamination from the fingers will be absorbed into the disc. If large size paper towels are used, they should be cut with scissors into two inch squares to facilitate easy handling.
3. Place the towel over the disc electrodes, and with the forefinger and thumb, grab one disc from the pile and place the disc on the shaft.
4. With firm pressure, push the disc electrode onto the shaft until it comes to rest against the index shoulder of the shaft(figure 4-4). If the disc electrode does not offer some resistance to the shaft as it is being inserted, remove and discard this electrode.

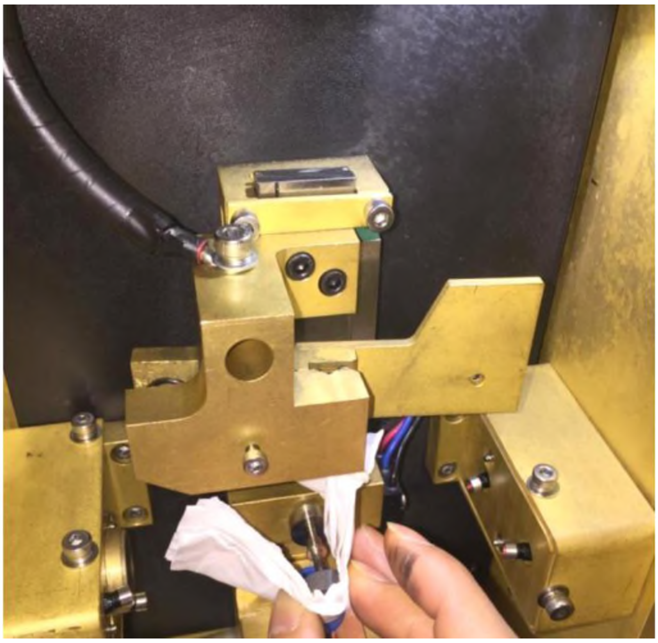

Figure 4-4

Caution: ***The disc electrode shaft is designed to be replaced by the operator using a small jeweler's screwdriver. The shaft has right hand threads for tightening it into the commentator. When pushing the disc electrode on the shaft, do not apply counter-clockwise rotation on the disc electrode as this may cause the disc electrode shaft to loosen.***

Caution: ***The disc electrode may be very hot to the touch. Use a towel to remove a disc electrode from the shaft after an analysis, and to wipe away any oil which may have spilled over from the burn.***

4.1.4 Installing the Rod Electrode and Setting the Analytical Gap

The rod electrode is installed after the disc electrode is already in place. To install the rod electrode:

1. take the rod in the fingers of the right hand and with the left hand apply

inward pressure to the rod electrode clamp knob, Figure 4-5. This will open the clamp door approximately 9 mm.

2. Insert the rod electrode into the vertical “v” shaped channel until the sharpened tip can be seen protruding from the bottom of the rod holder and gap setting device.

3. Release the rod clamp handle and the rod electrode will be pinched between the back of the rod clamp and the centering “v” channel.

4. Press and then release the rod clamp handle again and the rod electrode will drop by gravity and come to rest on the disc electrode(Figure 4-5).

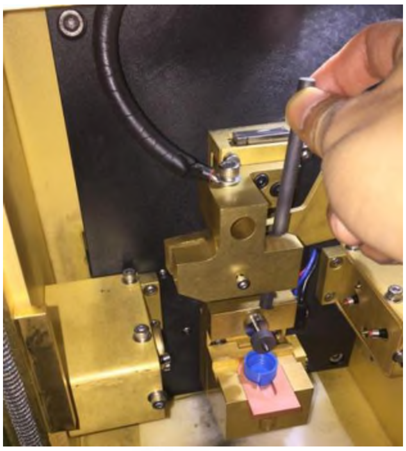

Figure 4-5

Then setting the analytical gap. To set the analytical gap:

1. Raise the analytical gap setting lever(yellow block in 4-6). This action will drive the rod electrode holder and slide mechanism downward along the vertical axis. As the slide mechanism moves downward, the rod electrode remains in the installed position, because there is zero clearance between the disc and rod electrodes. The analytical gap setting lever will reach the end of its travel when it is raised to the full upward position.

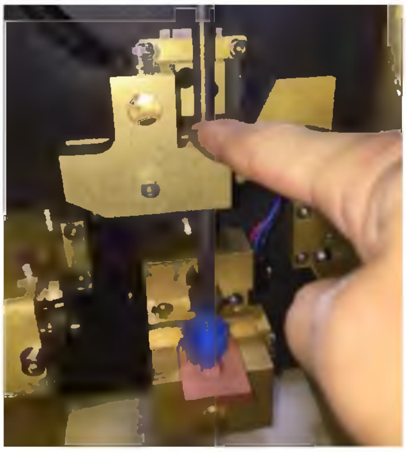

Figure 4-6

2. Release the analytical gap setting lever to the lowered position. As the lever begins to return to the lowered position, the rod electrode holder and slide mechanism begins to raise upward along the vertical axis until it is stopped by the analytical gap adjustment screw. This time the rod electrode, which is clamped in the rod electrode holder and slide mechanism, will travel upward with the slide mechanism. An analytical gap distance has now been precisely set.

The analytical gap distance has been set during factory calibration and should not be readjusted during routine operation.

4.1.5 Installing and Positioning the Sample Holder

Installing the oil sample to be analyzed should be the last step in loading the sample stand for analysis. When performing fluid analysis, an important consideration which has an effect on the reproducibility of the analysis is the quantity of the sample introduced into the analytical gap. This parameter is one for which the instrument cannot adjust. Proper level of oil in the sample holder is, therefore, part of any good operator technique. Standards and samples are analyzed either in disposable plastic sample holders or a reusable sample holder. In either case, it is recommended that the sample holder be filled level with the top.

1. Place a disposable sample holder on the adapter and fill it up.
2. pick up the sample adapter and place it in the slot at the top of the sample table(Figure 4-7)

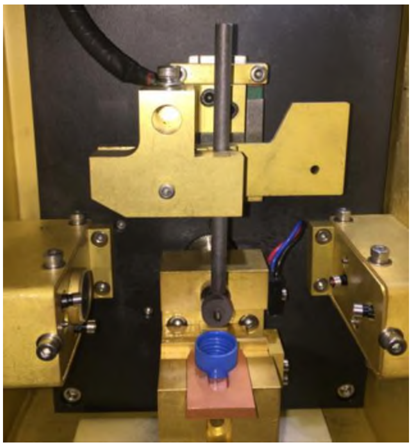

Figure 4-7

Note: Do not touch the oil in the sample holder.

4.1.6 Cleaning the Sample Stand

The OCI-1 incorporates the rotating disc arc emission technique for excitation of the fluid sample. This technique produces a fine carbon residue which, when combined with oil droplets, produces an oil coating over the sample stand and door area. If allowed to accumulate, this coating will collect the carbon particles and eventually produce a lower resistance path than the analytical gap. If this occurs, the high voltage will not discharge across the analytical gap, but will discharge along the lower resistance path causing damage to the sample stand components.

To prevent arc-over, it is recommended that the operator perform the simple cleaning procedures outlined in this section.

Caution: Do not use any chlorinated solvents inside or externally on the instrument.

Cleaning After Each Burn Cycle

Take the paper towel used to remove the disc electrode from the shaft and clean the shaft, the sample table, and the sample plate area between the disc electrode shaft and the rod electrode clamp.

Cleaning After Each Operating Shift

After 8 hours of operation, the complete sample stand area must be wiped clean of the oil film buildup created by the burn cycles. If performed routinely, the sample stand can be cleaned simply with paper towels and moderate rubbing. How-ever, if this procedure is performed sporadically or inadequately, an oil dispersant may be required to remove the buildup. A general purpose foam type spray detergent is recommended to dissolve the oil film buildup. A spray detergent is capable of contacting those areas which are hard to reach. Remove all detergent by wiping dry with paper towel.

Cleaning the Quartz Window

The quartz window, protects the lens and fiber optic must be cleaned frequently depending upon the type of fluid being analyzed. In general, this should be done at least every 5 burn cycles.

To clean the protective quartz window:

1. take a clean, soft, disposable laboratory tissue and wet one corner of the towel with isopropyl rubbing alcohol or ammonia based window cleaner(Figure 4-8).

2. With the forefinger, rub the wetted portion of the paper towel along the surface of the window while applying moderate clockwise pressure on the window. This will disperse the oil film.

3. Now take the dry portion of the paper towel and repeat this procedure until no oil can be seen on the tissue paper. A cotton swab can also be used for this purpose. A diluted solution of ammonia and water may be used.

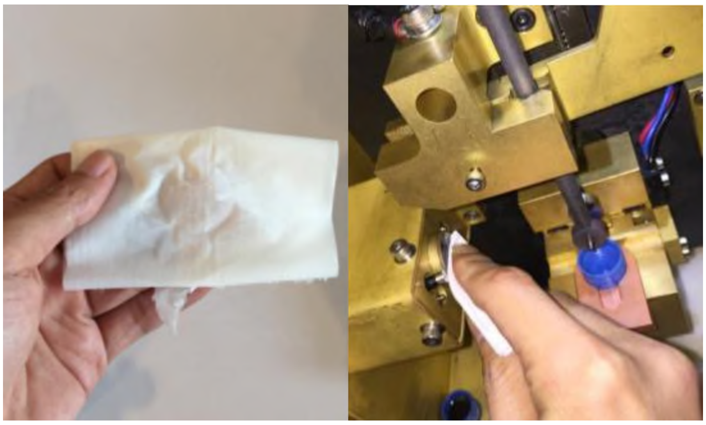

Figure 4-8

CAUTION: The lens protected by the window does not require cleaning and should only be disassembled by a qualified engineer.

Cleaning Solutions

The OCI-1 is designed to analyze petroleum and synthetic base products. In operation, the handling and actual analysis of these products create spillage and often leave an oily film on the instrument. In general, these spills can be adequately cleaned simply by wiping the surface with paper towels. There are occasions, however, where the petroleum/synthetic product may re-quire a detergent to dissolve the petroleum base. For these occasions and for routine cleaning, a general purpose spray and wipe detergent is recommended for internal and external instrument components.

Paper Tissue for Operating and Paper Towels for Cleaning

Disposable paper tissues and towels are recommended for use in the daily operation of the OCI-1. The type of paper tissue used to handle the disc electrodes is very important. Most household tissue paper is treated with certain elements to make it softer or more absorbent. If used to handle the disc electrodes, these elements will contaminate the electrodes and produce erratic results, especially for silicon. Therefore, it is recommended that a laboratory grade paper tissue be used for this operation.

Paper towels are useful to clean the sample stand components and wipe spills which occur during routine operation. The type of paper towel used for this function is not critical. Typical household towels or C-fold janitorial towels work best for this function because of their absorbent characteristics.

4.1.7 Waste Oil Disposal Container

A waste oil container for oil analysis applications is required to properly dispose of the remaining oil sample after the analysis cycle. It is recommended that this waste oil container be in the form of a rectangular pan approximately 6 inches long, 4 inches wide, and 1 inch deep, with a screened cover to permit the remaining oil to drain through the screen. If a drain tube is in-stalled on the bottom of the waste oil container, the waste oil container can continuously empty into a large capacity reservoir for proper disposal. Good laboratory procedures should be exercised in the disposition of all waste oils.

4.2 Daily Operation

This section details those procedures that will be routinely used in the day-to-day operation of the OCI-1. The operator must be familiar with the general operating requirements described in Section 1.0. A flow chart of the normal daily routines is shown on the next page in Figure 2.0-1. For convenience, the parentheses after each step in the chart refer to the corresponding sections in this chapter. The various procedures are explained in brief, easy to follow step-by-step instructions.

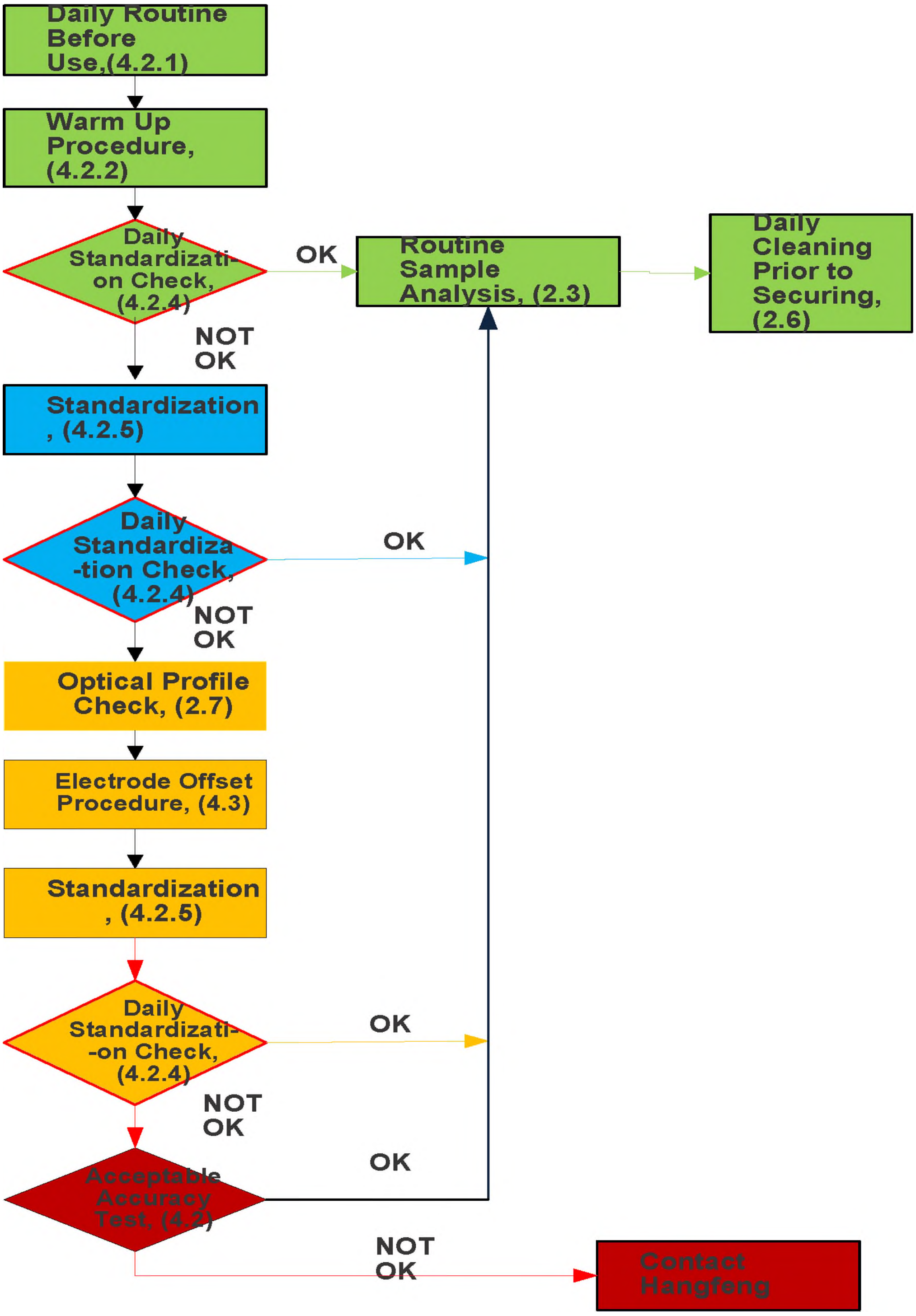

Figure 4-9

4.2.1 Daily Routine Before Use

1. Turn the switch on the control panel of the OCI-1 from OFF to ON, Start the OCI-1 analyze software. Figure 4-10.

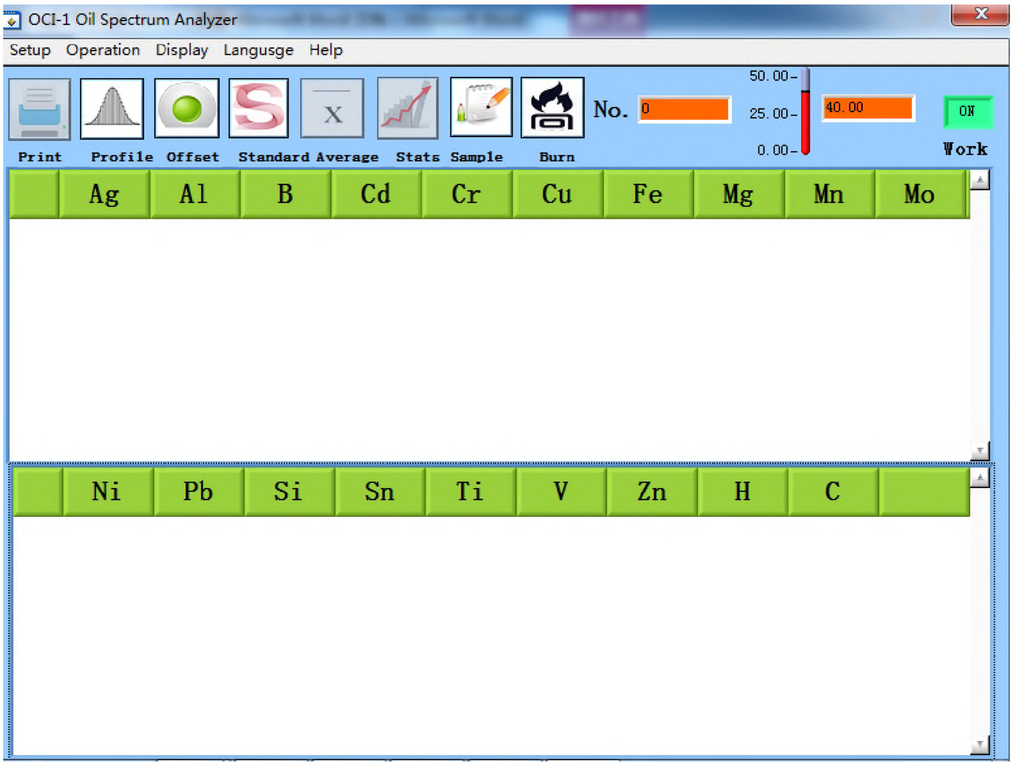

Figure 4-10

2. Ensure the temperature of the optical system reaches 40℃ and keeps stable.
3. Verify positive action from the sample stand exhaust system. With the sample stand door open, hold a piece of tissue paper up to the exhaust filter. It should be sucked up and held in place against the filter. Remove the tissue.
4. If used, turn printer ON and check to see that sufficient paper is available.
5. Ensure that an ample supply of sample holders, sharpened electrodes and discs are on hand.
6. Select standards for daily use and shake vigorously for at least 30 seconds.

7. Have an oil waste container on hand.
8. Have cotton swabs, contaminant free tissue paper and paper towels on hand.

4.2.2 WARM-UP PROCEDURE

If the OCI-1 has been idle for several hours, it may be necessary to conduct a series of burns to introduce light into the optics and to allow the electronics to become warm. This warm-up exercise can be conducted with any oil sample or standard and can use electrodes which have been burned before. It is recommended that at least three warm-up burns be conducted.

Analyze or "burn" three or four samples (do not burn the same sample more than twice to prevent sample ignition) in accordance with the instructions.

NOTE: For the warm-up cycle only, the same disc and rod electrodes can be utilized for up to four consecutive burns but the electrodes have to be regapped after each one.

4.2.3 Routine Sample Analysis

This paragraph details the steps to follow to analyze or "burn" any type of sample, whether it is a used oil sample, an oil standard, or a coolant sample. Refer to the referenced sections for details.

NOTE: When a new lot of disc electrodes is started, either from a new manufacturer or a different lot from the same manufacturer, the disc electrode offset procedure must be performed.

1. The PC’ s video monitor should display the Analysis Program screen, Figure 4-11. If a screen saver is in use, the Analysis Program screen will not be displayed. Press any key on the PC’ s keyboard to terminate the screen saver and re-display the Analysis Program screen.

2. Install a carbon disc on the disc shaft using a clean laboratory grade tissue to avoid contact with fingers (Section 4.1.3).

3. Press inward on the spring loaded rod electrode clamp knob to open the jaws of the clamp. Insert a graphite rod electrode until the tip (Section 4.1.4) of the carbon rod is in contact with the disc electrode, then release the knob to secure the electrode in the clamp.

4. Set the analytical gap mechanism by raising and then lowering the analytical gap setting lever. This will set a gap distance of 2.45mm between the disc and rod electrodes (Section 4.1.4).

5. Fill a sample holder with sample to be ana-lyzed. Be sure to always fill sample holders to the rim (Section 1.4).

6. Place the filled sample holder on the table and slide it back to the end of the groove on the table (Section 4.1.5).

7. Close the sample stand door and press the START button.

8. After the burn is complete, results will appear on the video screen.

9. After the burn is complete, open the sample stand door and remove the rod electrode. Set it aside for subsequent re-sharpening before it is used again.

10. Remove and discard the sample holder.

11. Using a paper towel to protect fingers from the hot disc, remove and discard disc electrode.

12. Using a tissue or paper towel, wipe excess, spilled or splattered sample fluid from sample table and disc electrode shaft.

NOTE: The quartz protective window should be cleaned at least every 5 burns.

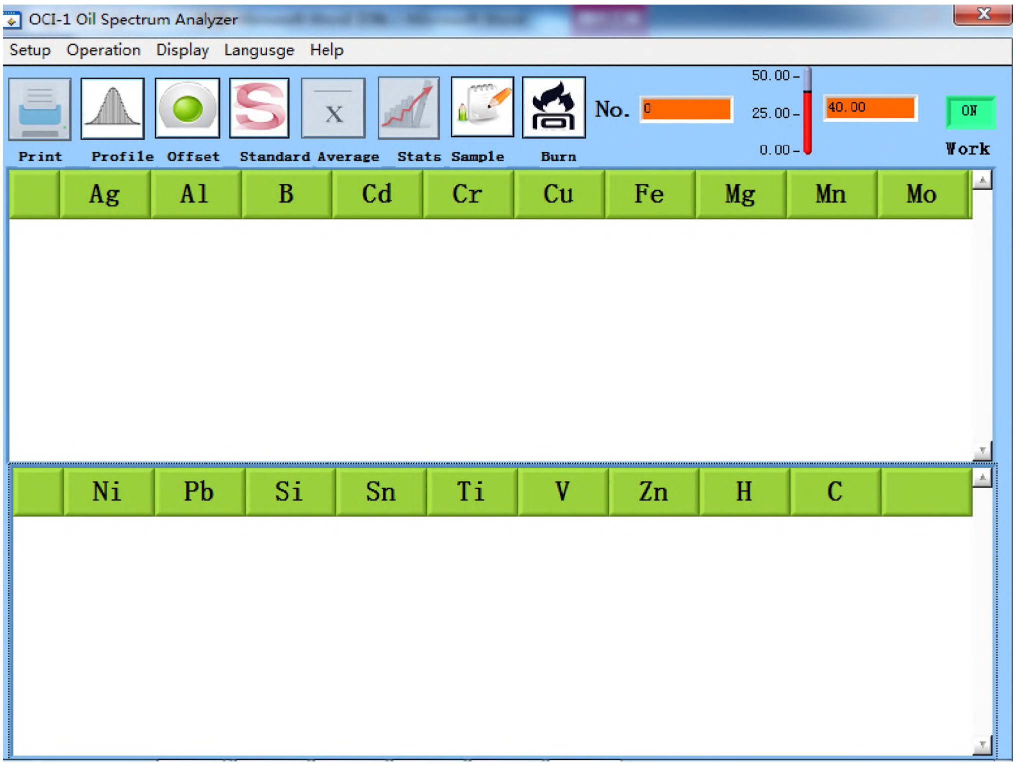

Figure 4-11

4.2.4 Daily Standardization Check

The standardization check is performed to verify that the instrument has remained in calibration. It is a quick method of verifying that the instrument can give accurate results without conducting a full standardization.

This procedure requires that the operator analyze at least three different levels of calibration standard. One of the standards should be a base oil (0 ppm standard), the next standard should be at the high end of the concentration range expected in the unknown samples, and the third standard should be some concentration between the 0 ppm and the high standard. For example, if the samples to be analyzed are used oils which normally have iron concentrations as high at 100 ppm and silver concentrations as low as 1.0 ppm or less, the recommended standards for the daily standardization check should be the base oil (0 ppm) and the 100 ppm standard. These two standards will cover the complete calibrated range from 0 ppm to 100 ppm for all elements. The third standard may be 10 or 30 ppm.

For aircraft applications, the 0, 5, 10 and 30 ppm standards generally cover the complete range of expected concentrations. The following steps should be conducted only after the warm-up procedure has been completed and the quartz window has been cleaned in accordance with Section 4.1.6.

1. Prepare sample stand in accordance with Daily Routine Prior to Use, Section 2.1.

2. Make 3-4 warm-up burns using waste oil.

3. Choose three standards in the expected range of the in-service (used) oil samples to be analyzed.

4. Clean the quartz window.

5. Make one burn of a standard selected in step 3 above.

6. Compare the results of this burn with Table 4-1. If all the elements are within the acceptable range, proceed to Step 8, 9, or 10. If the results are not within the range, proceed to Step 7.

7. Make a two more (total of three) burns of the standard selected in step 5 above and calculate the average. If all elements are within the range, proceed to step 8, 9, or 10. If not, perform complete Standardization Procedure in accordance with the Daily Operating Procedure Flow Chart.

8. Choose the second standard from step 3 and repeat steps 4- 7.

9. Choose the third standard from step 3 and repeat steps 4-7.

10. Daily Standardization Check is now complete.

NOTE: Table 4-1 provides a recommended range that all elements should fall between during a daily standardization check. The ranges are narrow because they are based on one or three analyses and should not be confused with the actual accuracy and repeatability specifications for the spectrometer given in Tables 4-2 and 4-3 which

are based on ten analyses. If Table 4-1 ranges can be met, then it is assumed that by default, Tables 4-2 and 4-3 will be satisfied.

Table 4-1

Content/ppm	**Minimum/ppm**	**Maximum/ppm**
0	0	1
5	3.8	6.2
10	8.5	11.5
30	27.0	33.0
50	45.0	55.0
100	90.0	110.0
300	255.0	345.0

4.2.5 Complete Stand Ardization

Complete standardization is a procedure per-formed to place the calibration of the instrument as close to the standard values as the instrument originally produced during factory calibration. This procedure involves burning oil standards at predetermined points along the calibration curve. After these standards are analyzed, the computer software will determine mathematical factors to correct for any change in the calibration. Complete standardization is performed under the following conditions:

• When the instrument has been relocated to another site for operation.

This is generally performed after the optical profile procedure has been completed.

- When results from the daily standardization check fall outside of acceptable limits for operation.
- After optical profiling procedure has been performed.

A complete standardization is performed by burning two or more calibration standards that have been preselected during factory calibration of the instrument. The concentration levels for complete standardization have been selected based on the application and typical operating range for the elements of interest. In general, all elements are standardized at 0 ppm to determine the background level, all wear metal and contaminant elements are standardized at 100 ppm and additive elements on commercial instruments are standardized at 900 ppm. These concentration levels are programmed into the software and are displayed at the appropriate time in the following procedure.

From theAnalysis Program screen, select the Operations/Standardize pull down menu. The software will automatically clear all previous measurements from the video display. A dialog with the name of the first calibration standard the instrument will expect to measure will appear. Refer to Figure, 4-12, 4-13.

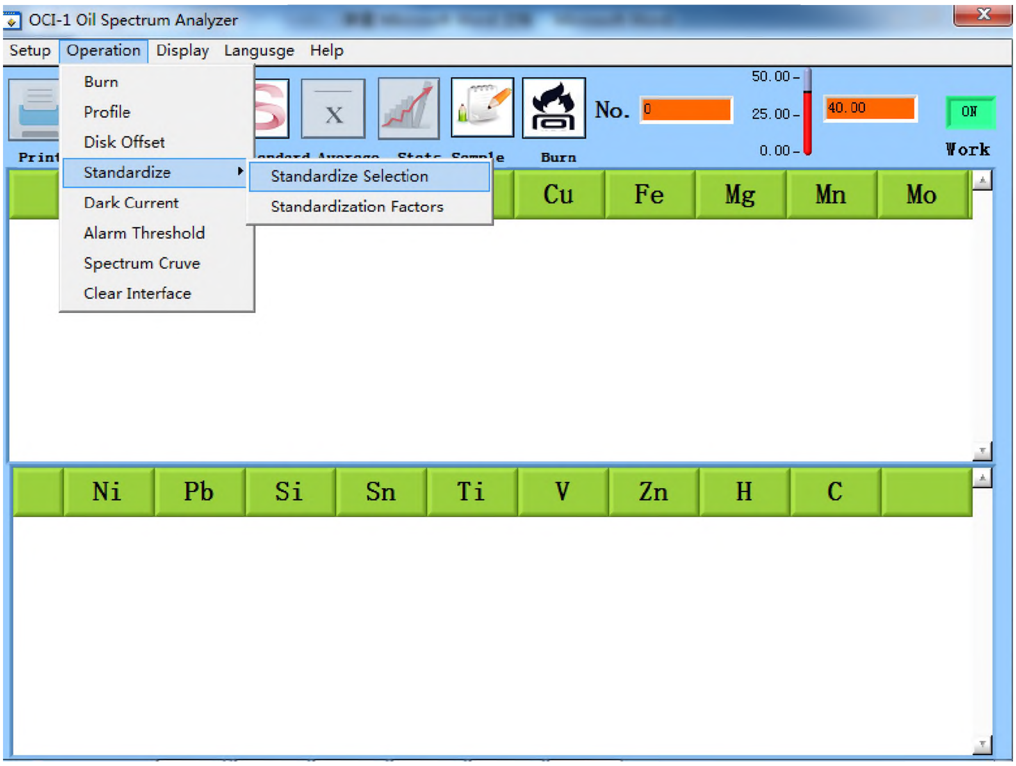

Figure 4-12

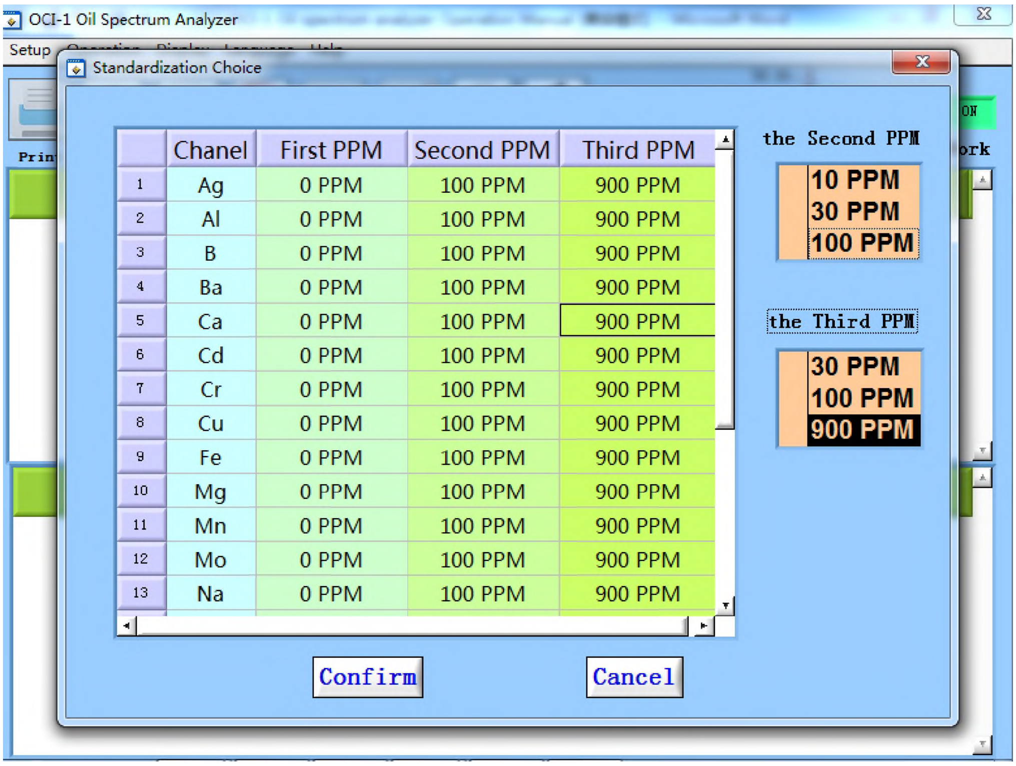

Figure 4-13

There are three default choices when the dialog appears, the first option is 0ppm sample. The second option is 100ppm sample. The final option is 900ppm sample, and the sample can be selected according to customer needs. In the interface of the standardization in 4-13, left is the concentration that you want to change, and select the desired concentration in the available samples to change. As shown in Figure 4-14, samples that need standardization are selected for users.

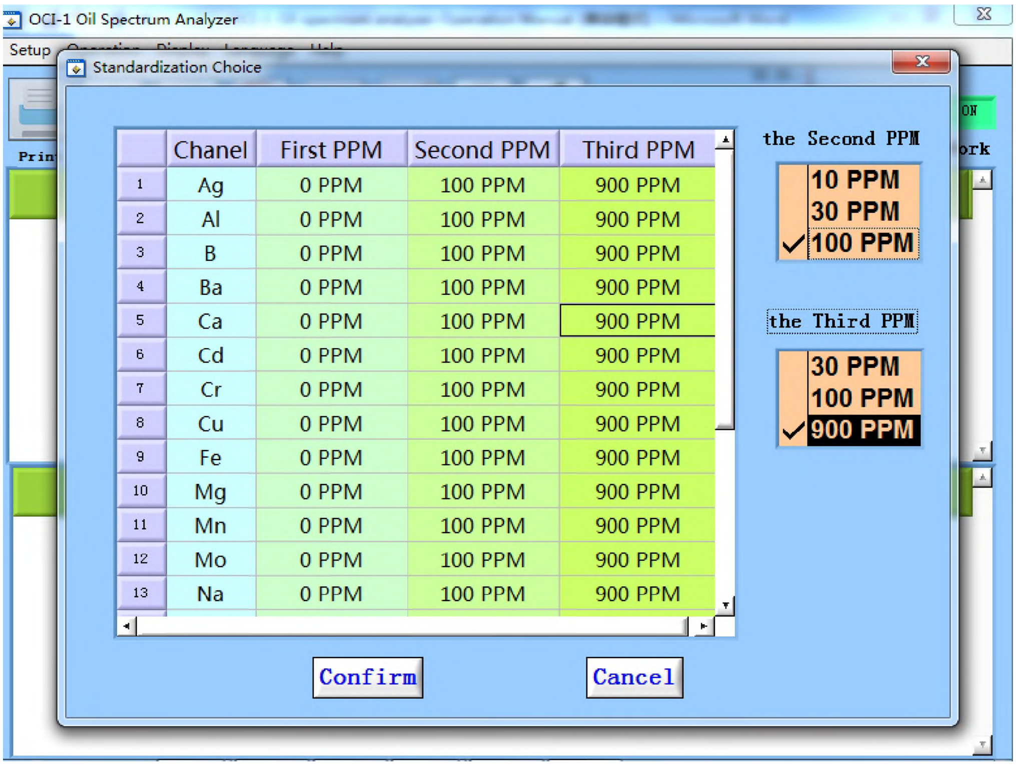

Figure 4-14

4.2.6 Daily Routine Prior to Securing

1. Remove disc and rod electrodes.
2. Clean disc electrode shaft with a paper towel.
3. Clean and wipe the entire sample stand area.
4. Clean the quartz protective lens using a clean soft disposable

laboratory tissue.

5. Wipe all oil standard bottles clean.
6. Clean and wipe used oil container.
7. Clean the working area.
8. Sharpen all rod electrodes and store them so they are protected from inadvertent contamination.

4.2.7 OPTICAL PROFILING

The OCI-1 optical system is shock mounted in a light-sealed and environmentally protected temperature stabilized enclosure. Consequently, the optics do not need to be profiled frequently. However, detection limit and repeatability suffer when the optics are off profile. Unfortunately, there is no one rule which ensures that the optics are on profile. The following guidelines are pre-sented to indicate when profiling should be done:

- At least once every months.
- After the instrument has been transported to a new location.
- Whenever the instrument has been subjected to temperature variations greater than 15° F (10° C).

If one of these apply, it is also reasonable to per-form a standardization as detailed in Section 4.2.5.

Follow the next steps as detailed in this procedure to determine the optimum optical peak profile position for operation.

1. Prepare the sample stand with new elec-trodes in accordance with the appropriate

paragraphs of the General Operating Re-quirements section of this manual.

NOTE: it is important to only a 100 PPM standard for the profiling procedure.

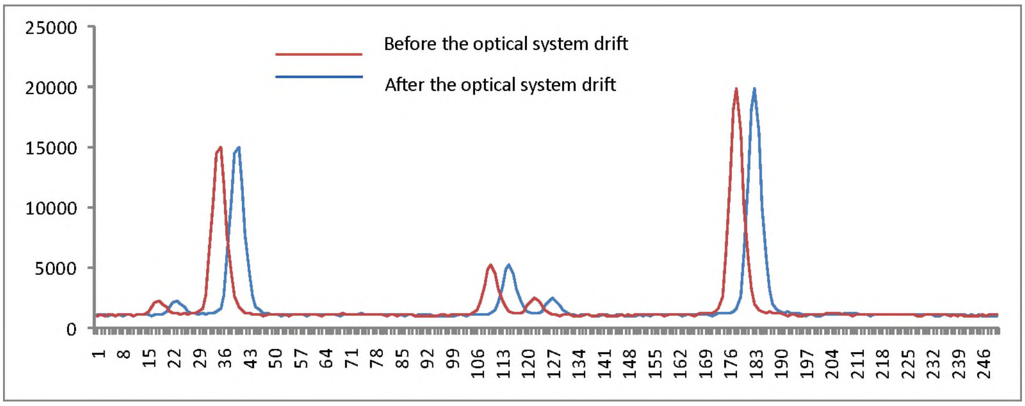

Figure 4-17

The steps of the optical profile are as follows:

Selecting the operation / profile. after installing the disk electrode, rod electrode and 100ppm standard, click "start profile" on the left. When the profile is completed, the result of the profile is displayed (Figure 4-18), the second column shows the current profile position, and the third column is the previous profile position, click "OK” to save the position of the current profile. Click "Cancel" to keep the last profile position.

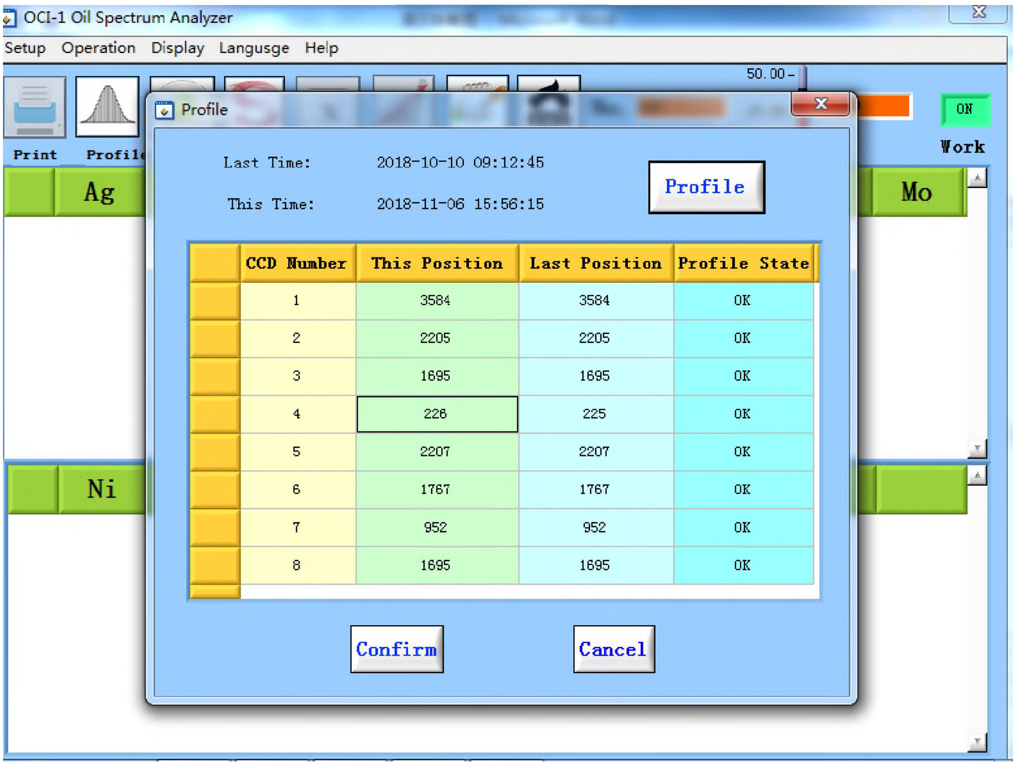

Figure 4-18

4.2 Disc Electrode Offset Procedure

The OCI-1 is designed to incorporate a background measurement and correction system. The purpose of this system is to offset or null the output of all CCD chips when measuring a 0 ppm standard. This is also known as measuring background light because 0 ppm has no concentration of elements present in the sample. Therefore, the light produced when analyzing a 0 ppm standard must only be background emission.

In practice, elemental contamination is present in everything used for the analysis process. The sample holders may pick up contamination from the environment, the 0 ppm standard may have sub-ppm trace levels of certain elements, and the graphite disc electrodes are known to have trace contamination of certain elements. Manufacturers of graphite electrodes commonly list and quantify the known trace or spot impurities on each box of disc electrodes. The purpose of this procedure is to offset these trace contaminates in the consumables and is absolutely necessary to be performed.

This procedure should be performed every time a new batch and/or lot number of disc electrodes are to be used. For maximum efficiency in a laboratory operation, all graphite disc electrodes should be grouped and stored by batch and lot number. Only one batch or lot should be used at a time until it is totally consumed. Once a new lot is opened and the instrument is standardized to the new lot, the low end of the calibration curve (5 ppm and/or 10 ppm) should always be checked. If accuracy at these levels fails to meet the specified criteria, it may be due to variance in trace contaminants levels and the following procedure should be performed to correct for the presence of this contamination.

To perform the disc electrode offsets operation, selecting the operation /Disc Electrode Offsets. After installing the disk electrode, rod electrode, and 0ppm standard sample, left "OK" to starts the first background measurement process, replacing the disk electrode, rod electrode and oil sample, and after complete three background measurements according to the hint, the result will be displayed (Figure

4-24), the third column shows the spectral line strength, and fourth columns are listed. Background intensity, fifth are background correction coefficient, click "OK" to save the current result or click "Cancel" to keep the previous result.

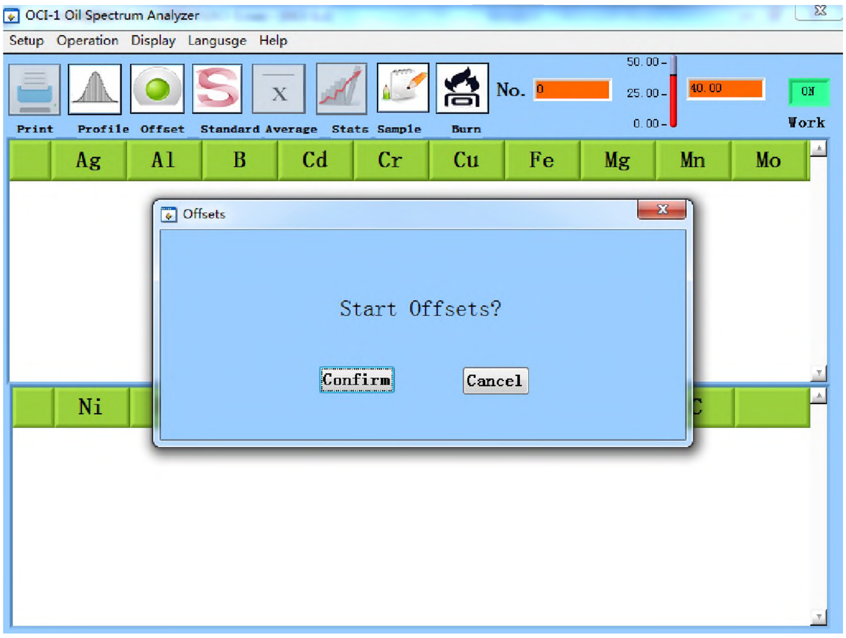

Figure 4-19

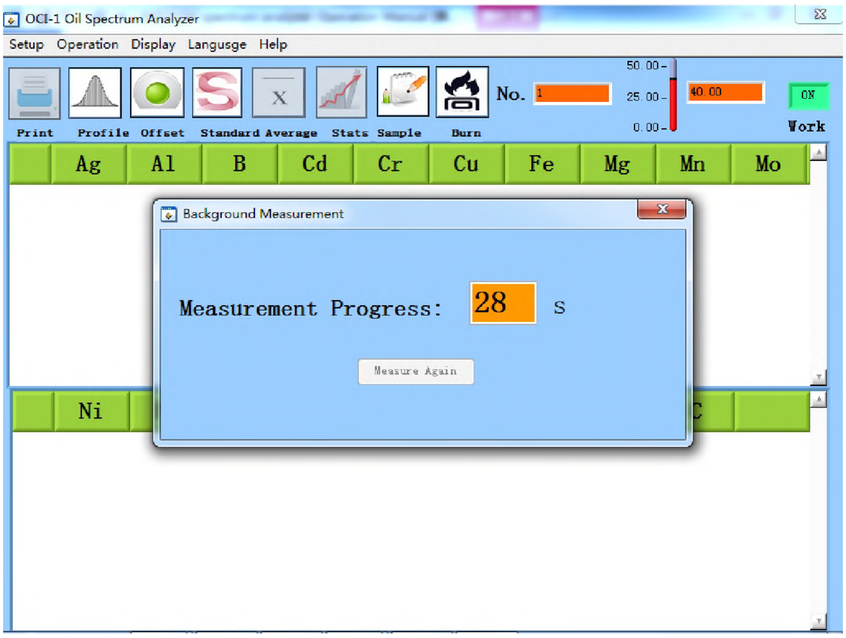

Figure 4-20

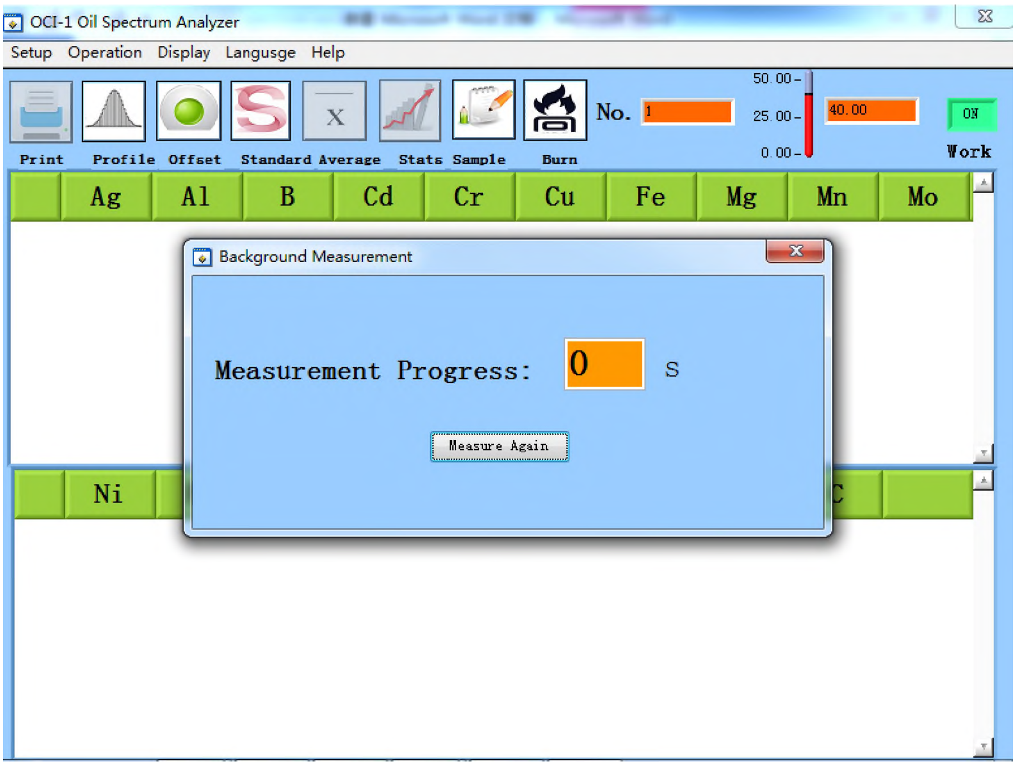

Figure 4-21

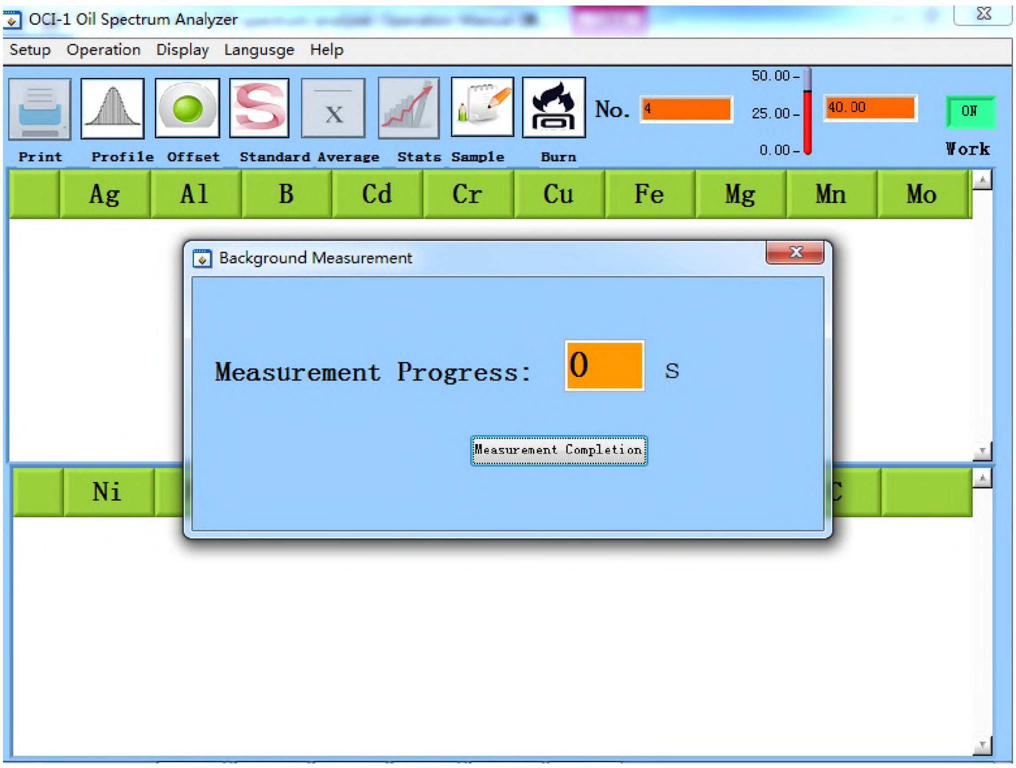

Figure 4-22

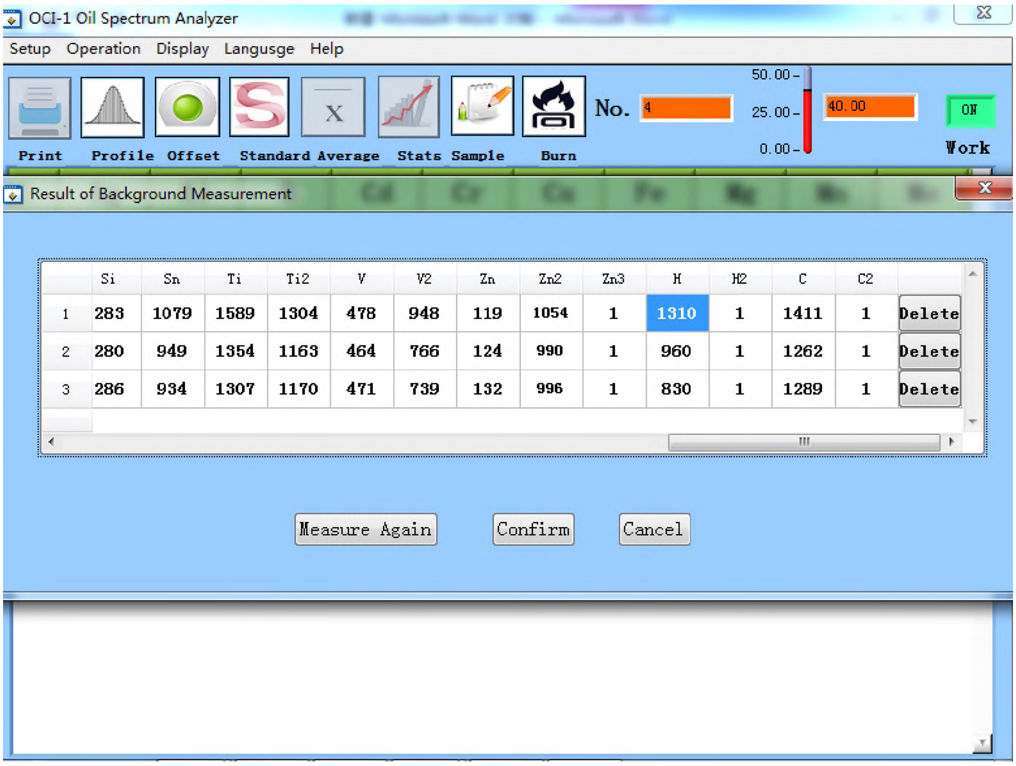

Figure 4-23

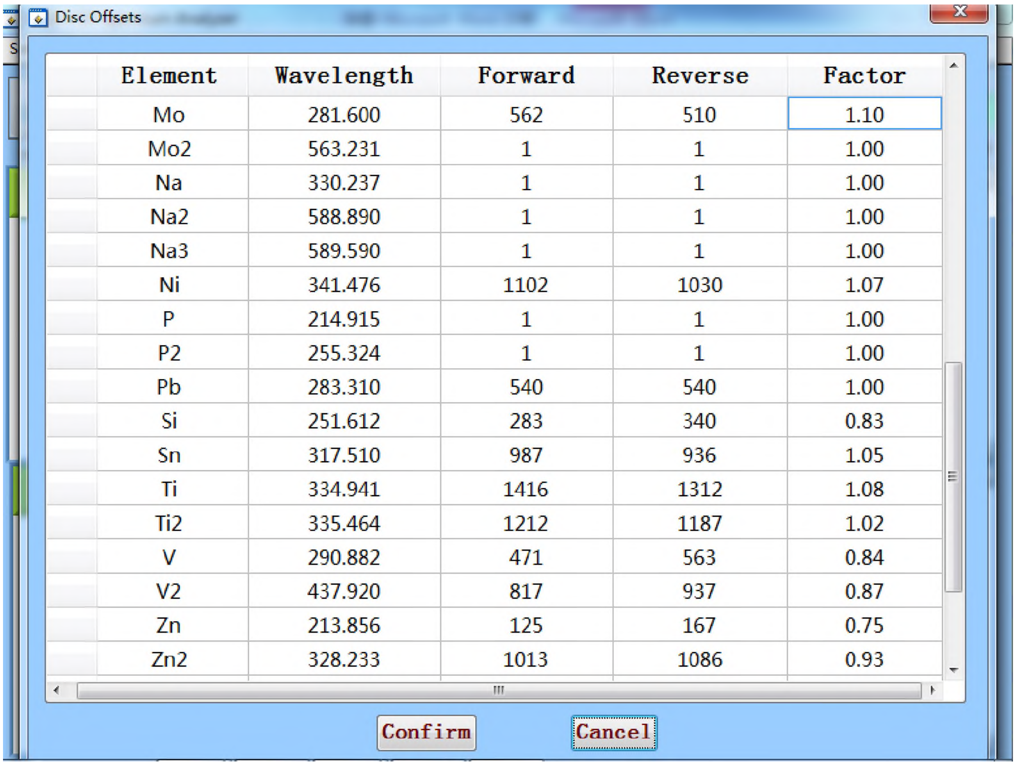

Figure 4-24

4.3 Calibration Curve Verification

The purpose of performing a calibration curve verification is to determine if the instrument repeats the curve generated at the factory or by an authorized service representative.

To perform a calibration curve verification, the instrument must first be standardized. Refer to Section 2.5 in this manual for a detailed procedure on daily standardization. The calibration curve verification can be performed after the instrument has been standardized using the assigned calibration standards,

Calibration curve verification consists of performing an analysis of each synthesized standard as if it were an unknown sample. It is recommended that the operator conduct ten analyses of each standard and perform statistics on the measurements to obtain the average and standard deviation for each element. Instrument performance for wear metal analysis should be within the limits listed in Tables 4-1 and 4-2.

4.4 Repeatability Testing

Perhaps one of the most important technical characteristics of a spectrometer is its ability to perform the same measurement over and over again with the same result. This characteristic is referred to as repeatability, reproducibility, sigma, standard deviation or precision. Repeatability is determined by the standard deviation of a series of measurements made on the same sample. Mathematically, standard deviation is calculated as:

$$SD = \sqrt{\frac{\Sigma\ (x_i - \mu)^2}{N-1}}$$

where:

N = the number of analyses (normally 10) $\Sigma Xi2$ = is the sum of the 10 squared individual measurements($\Sigma Xi)2$ = is the square of the sum of the 10individual measurements.

For the purpose of conveniently comparing thestandard deviation to the mean for a series of measurements, relative standard deviation, or R.S.D., is used. R.S.D. expresses the standard deviation as a percent of the mean and is calculated as:

$$RSD = \frac{SD}{\mu} \times 100\%$$

The OCI-1 automatically calculates mean,standard deviation and R.S.D. for a series of measurements by pressing function key 5 (F5).

NOTE: At 0 ppm, R.S.D. is not considered a valid statistic. A minimum of three warm-up burns must be made prior to the performance of statistical analysis.

4.4.1 Repeatability Specifications

The OCI-1 is expected to perform within prescribed repeatability specifications. The repeatability performance of the OCI-1 is part of the final test. The repeatability specification to which the OCI-1 conforms is summarized in Table 4-1. This table gives standard deviation values as a function of element and concentration.

Table 4-2 Acceptable Repeatability Indices for Wear Metals - Standard Deviation

Conc. ppm	***Fe, Al, Cr, Cu Mg, Ni, Si***	***Ti, B***	***Ag, Na, Mo***	***Pb***	***Sn***	***Zn***	***V, Mn, Cd, Ca, Ba***	***P***
0	0.5	0.50	0.50	0.9	1.00	0.5	0.5	N/A
5	0.56	0.58	0.64	0.95	1.04	0.78	N/A	N/A
10	0.71	0.78	0.94	1.08	1.17	1.3	0.75	N/A
30	1.58	1.87	2.45	2.01	2.06	3.63	1.75	5.5
50	2.55	3.04	4.03	3.13	3.16	6.02	2.75	7.5
100	5.03	6.02	8.02	6.07	6.08	12	3.75	10

Conc. ppm	***Fe Ag Mo***	***Al, Cr Ni Si***	***Cu Mg***	***Na***	***Pb, Sn Ti, B***	***Zn***	***V***	***Mn***	***Cd Ba***	***Ca***	***P***
300	24.0	15.0	27.0	48.0	18.0	36.0	10	12	10	10	15
500	40.0	25.0	45.0	80.0	30.0	60.0	20	25	20	20	25
700	56.0	35.0	63.0	112	42.0	84.0	N/A	N/A	N/A	N/A	N/A
900	72.0	45.0	81.0	144	54.0	108	45	40	40	40	40
5000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	150	120
10000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	300	300

4.3.2 Repeatability Test

An element’ s repeatability value is obtained by burning the same standard ten times in succession. Select Operations/Statistics to obtain the mean, standard deviation and R.S.D.

To save time, it is possible to verify repeatability after five burns. If it meets the specification of Table 4-2, the test can be terminated. If it does not, burn the sample 5 more times and Select Operations/Statistics.

If the repeatability is not acceptable, read section 4.1.3 and proceed as follows:

(1) Perform an Optical Profile Check, Section 4.2.7.

(2) Perform the Disc Electrode Offset Procedure,

(3) Perform the Standardization Procedure

(4) Repeat Repeatability Test

If the test passes, it is complete. If it fails again, contact Customer Support at Spectrum Inc.

4.3.3 Factors Affecting Repeatability

In order to achieve this level of repeatability or better, the repeatability test must be done under ideal conditions. Many factors affect repeatability. Among them are:

1. The sample must be homogenous. The repeatability test is always done with standards. Routine samples are never used for repeatability testing because it cannot be assured they do not contain agglomerates, second phases and large particulates, all of which will affect repeatability.

2. The OCI-1 must be on profile. If analytical lines are off profile, the repeatability will be adversely affected. If the repeat-ability specifications cannot be met, one of the first diagnostic tests is to check profile (Section 4.2.7).

3. The quality and handling of the disc and rod electrodes will affect

repeatability. The density, and hence the porosity, residual contamination and dimensional accuracy of the disc and rod electrodes will affect repeatability. Care must be taken to properly sharpen the rod electrode (Section 4.1.2). Proper care must also be exercised when installing the electrodes (Sections 4.1.3 and 4.1.4).

4. The sample must be homogenized by shaking before filling the sample holders.

5. The sample holders must be filled to the same level (Section 4.1.5).

6. Line voltage to the OCI-1 must be within specification.

7. Electronic stability of the OCI-1 will affect repeatability.

8. Sample stand geometry will affect repeat-ability. The rod electrode to disc electrode gap distance, the quartz lens assembly to arc distance, the position of the fiber optic within the lens assembly mounting block, and the angle of the quartz lens assembly with respect to the arc will affect not only the intensity of the light entering the entrance slit of the polychromatic (optical assembly), but will also affect the repeatability. The calibration of the OCI-1 at the factory optimizes these adjustments.

9. A variety of mechanical or electronic faults could degrade repeatability. Among these arefaulty CCD chips, damage to the entrance slit, or damage to the fiber optic cable.

The operator has control over the first five factors. If care is taken to properly operate the OCI-1 and repeatability is still worse than specification and if the OCI-1 passes the Dark Current Test and is on profile, then it is recommended that Beijing Hangfeng be consulted. It is strongly recommended that adjustments to the sample stand as described in 8 above be made only by Hangfeng personnel or at the direction of Hangfeng personnel.

4.5 Accuracy Testing

The OCI-1 is expected to perform within accuracy specifications in the same way that it performs within repeatability specifications. Accuracy is the ability of a spectrometer to give the correct concentration value of a standard. Table 4-3 gives acceptable accuracy readings for wear metal elements as a function of the concentration of the standard.

Column 1 of Table 4-3 gives concentration values in ppm. For example, if a 50 ppm multielement standard is burned on the OCI-1, the average of ten burns for Aluminum is expected to be 50 ppm, plus or minus 5.12 ppm. Therefore, an average in the range of 44.88 to 55.12 ppm would be acceptable. Zinc is a more difficult element to accurately measure. At 50 ppm, an acceptable average of ten burns is 50 ppm plus or minus 13.1 ppm. Therefore, an average in the range of 36.9 to 63.1 ppm would be acceptable.

The same factors that affect repeatability as described in Section 4.3.3 also affect accuracy. A complete standardization of the OCI-1 should be performed prior to testing for accuracy. The average of ten burns should be used to determine the reading of a particular standard. Ac-curacy failures at low concentrations may be due to contamination and spot impurities in the disc electrodes. The effect of the contamination and impurities can be compensated for by performing the electrode offset procedure. Beijing Hangfeng should be consulted if the OCI-1 is unable to meet the accuracy criteria presented in Table 4-3.

Table 4-3 Acceptable Accuracy Indices for Wear Metals - Mean

ppm	Al Cr Ni Si	Ti B	Fe Ag Mo	Cu Mg	Pb Sn	Zn	Na	V Mn Cd Ba	Ca	P
0	0.88	0.89	0.91	0.92	1.60	0.96	1.01	0.5	0.5	N/A
5	1.2	1.3	1.50	1.61	1.98	1.99	2.59	N/A	N/A	N/A
10	1.59	1.78	2.21	2.44	2.43	3.19	4.36	1.5	1.5	N/A
30	3.33	3.93	5.23	5.91	4.47	8.15	11.6	3.25	3.25	15.5
50	5.12	6.14	8.29	9.43	6.64	13.1	18.9	5.5	5.5	18.2
100	9.65	11.7	16.0	19.2	12.2	25.6	37.1	10	10	20
300	27.8	33.9	46.7	53.5	34.3	75.6	110	32	32	35
500	46	56.1	77.5	88.8	56.6	126	183	53	53	60
700	64.2	78.3	108	124	78.8	176	255	N/A	N/A	N/A
900	82.4	101	139	159	101	226	328	95	95	105

5 Equipment Maintenance and Troubleshooting

In order to ensure the stable operation of oci-1, the instrument needs to be maintained regularly. Maintenance can be divided into two parts:

◎daily maintenance

◎routine maintenance

5.1 Daily Maintenance

This section introduces the daily maintenance requirements of users in detail. These maintenance operations are mainly aimed at the parts used by the operator, such as the sample laboratory bench, the readout and control panel and the printer. Any maintenance required in the excitation light, optical components or computer circuit elements shall be carried out by specialized technicians. Table 5-1 shows the maintenance that the operator can do. Table 5-1 shows the maintenance that the operator can do.

Table 5-1 maintenance that the operator can perform

Assembly unit	Maintenance required	Frequency	Level
Control panel, fixture, sample bench assembly	Apply oil and carbon powder, especially between the disc electrode axis and the rod electrode, as shown in section 4.1.6.	Every 5 burns	users
Quartz protection window	Clean paper towels with isopropyl alcohol or Windows containing ammonia and wipe off spilled oil and carbon powder. Refer to section 4.1.6.	Every 3~5 burns	users
The sample area	Clean the entire sample room to remove the spilled oil and carbon powder, as shown in	Twice per day	users

	section 4.1.6.		
Stimulate chamber door	Check for spilled oil and carbon residue, if yes, remove with a soft cleaner.	Twice per day	users
Electrode cutter	Rotate the cutting blade to a new piece (operate normally until all three chips are damaged), refer to section 5.3	According to demand	users
Read and control panel	Check for spilled oil and carbon residue, and if yes, remove with a soft cleaner.	Once a day	users
Framework and external components	Check for spilled oil and carbon residue, and if yes, remove with a soft cleaner. *Note: please do not use alcohol or chlorinated solvents to clean plastic or painted face.*	Once a day	users

5.2 Regular Maintenance

This section of manual details the work that needs to be done on a regular basis to maintain oci-1. Regular maintenance will keep the instrument in good working condition and help the staff to find it before the failure causes serious consequences. The following table will classify periodic maintenance by parts and items. Each project introduces what kind of maintenance work needs to be done, the maintenance cycle and who should carry out it. Please see as follows:

Table 5-2 external maintenance and testing

Assembly unit	Maintenance required	Frequency	Level
A filter on a heat exchanger	Check for dust and dirt, and rinse with detergent or water	Once a week or as required by instrument condition	users
Filter pad for sample bench exhaust fan	Check for dust and dirt, and clean or replace the filter pad if the hole is blocked	weekly	users
Frames and external panels	Check for oil, dust, dents, scratches and rust. Use a soft cleaner and, if necessary, sandpaper	monthly	users
Components	Check for loose or missing parts, tighten loose parts and replace rusty parts	monthly	users
external cable	Check for loose connection and damage	monthly	users
Disk electrode shaft	Remove the residue from the end of the rack with an eraser	monthly	users

Table 5-3 internal maintenance inspection of instruments

Component	Required Maintenance	Frequency	Maintenance Level
Fans	Inspect for smooth rotation. Check for dust and dirt buildup on blades. Replace if binding is evident. Clean blades if necessary. Frequency - Six months	Six Months	Operator
Wiring	Inspect for broken or bent wiring connections. Inspect for frayed or	Six Months	Operator

	burned insulation.		
Fuses	Inspect for open or over rated fuse usage. Replace as required.	Six Months or as Required	Operator
Transformers	Inspect for good electrical connection and signs of overheating.	Six Months or as Required	Operator
Signal Connectors	Inspect all connectors for proper seating in sockets. ***CAUTION: Do not remove or connect any signal cables with the power on.***	Six Months	Operator

Table 5-4 Excitation source and power distribution maintenance inspection

Component	Required Maintenance	Frequency	Maintenance Level
Component Mounting Boards	Inspect the board for proper connector seating. Inspect for burn marks or discolored components. Inspect lower cabinet for dust and dirt buildup. V~uum if necessary.	Six Months or as Required	Operator/Technician
Capacitors	Check each capacitor for signs of bulging, discolored containers or signs of leaking. Replace if signs of overheating are evident.	Six Months or as Required	Operator/Technician
Resistors	Check each resistor for signs of bulging or discoloration. Replace if overheating is evident.	Six Months or as Required	Operator/Technician
Contactors	Inspect for good electrical connection. Observe relay operation. Replace if intermittent or sluggish.	Six Months or as Required	Operator/Technician

Transformers	Inspect for signs of arc-over and over-heating. Replace if evident.	Six Months	Operator/Technician
Analytical Gap	Inspect the rod electrode holder and gap setting device for smooth sliding and release. If tight or binding, adjust or remove and replace gap setting device, refer to the Maintenance Manual Section 2.4.1.1. Check the analytical gap distance. It should be 0.090 inches.	Six Months or Every 2,000 Burns	Operator/Technician
Auxiliary Gap	Polish tips to remove corrosion.	Six Months or Every 2,000 Burns	Operator/Technician
Auxiliary Gap	Check electrode shape. If electrode points are flat, remove electrodes and replace them. At sea level, reset the auxiliary gap distance to approximately 0.135 inches.	Six Months or Every 2,000 Burns	Operator/Technician
Motor, Disc Electrode	Check motor rotation. If loose or binding, align and tighten.	Six Months	Operator/Technician
Cables	Check high voltage cables in the excitation source for signs of arc-over or damage. Check electrical connections. Replace cables if arc-over is evident. Tighten connections if loose.	Six Months	Operator/Technician
Shaft, Disc Electrode	Check to be sure that the disc electrode shaft is tight and properly aligned. See the	Six Months	Operator/Technician

	Maintenance Manual Section 2.4.1.2 for replacement procedure and tracking check.		
Disc Electrode to Rod Electrode Alignment	Check the alignment. If the rod point is more than 25% away from disc center, adjust. See the Maintenance Manual Section 2.4.1.3	Six Months	Operator/Technician

Table 5-5 Controller (CCD Compartment) maintenance inspection

Component	Required Maintenance	Frequency	Maintenance Level
Printed Circuit Assemblies	Inspect each card for signs of discoloration due to component overheating. If present, replace the appropriate card. Check each card for proper connector seating. Re-seat if necessary.	Six Months	Operator/Technician
Optical Fibers	Inspect each fiber optic in the M58000 and M59200 cards for a tight mounting. If loose, remove the fiber and re-seat. If broken, replace. Frequency - Six months	Six Months	Operator/Technician
Cables, Interconnecting	Check both connectors of each interconnecting cable. If loose, Re-seat the connector in the appropriate plug. If broken or damaged, replace. CAUTION: Do not remove or connect any signal cables with the power on	Six Months	Operator/Technician

5.3 Procedure to Replace Electrode Cutter Blade

The cutter blade has three sharpened edges and can be rotated and used three times before it has to be replaced.

To replace or rotate the cutter blade to a new cutting edge, unplug the sharpener power connector at the rear of the spectrometer. Next, remove the graphite collector barrel assembly to empty out any accumulated graphite and to expose the cutter blade, Figure 5-1.

CAUTION: The sharpener barrel will most likely be filled with graphite that has been removed from rod electrodes. Carefully follow the procedure below to avoid spilling graphite.

To remove the barrel assembly, locate the sharpener over a waste basket with the collector barrel pointing downward. Grasp the barrel with the opposite hand and rotate it while pulling it away from the motor mount and face plate. Once the O-ring disengages the face plate, it will be easy to separate and empty.

Use a flat blade screw driver to remove the #4- 40 screw which mounts the cutter blade. When replacing or rotating the cutter blade, be sure to place the rear edge of the cutter blade tight against the cutter head. This is the reference point to achieve the correct angle on the graphite rod electrode. Replace the barrel assembly and reconnect the sharpener to its power connector.

Figure 5-1 Electrode Sharpener Blade