

BRANSON/IPC
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BRANSON INTERNATIONAL PLASMA CORPORATION

INSTRUCTION MANUAL
for
BRANSON/IPC 3000 SC SERIES
PLASMA SYSTEM

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WARRANTY

INTERNATIONAL PLASMA CORPORATION

IPC warrants that for a period of one year they or their representatives will repair or replace any part that is found to be defective in factory materials or workmanship (except tubes, which are warranted separately by their manufacturers, and glassware).

Under this warranty, repairs or replacements by IPC representatives will be made free of charge for both parts and labor for the first 90 days after delivery, and with no charge for parts for the first year.

This guarantee does not cover abuse, neglect, tampering by unauthorized personnel, or damage inadvertently caused by the user. IPC's only obligation shall be to repair or replace such parts of the equipment proved to be defective in accordance with this warranty. All parts to be replaced under warranty are to be returned to IPC for inspection and subsequent dispensation. IPC shall not be liable for any injury, loss or damage, direct or consequential, arising out of the use of, or the inability to use, the equipment.

IPC reserves the right to modify the specifications and to incorporate desirable electrical or mechanical changes in the equipment prior to delivery.

No statement or recommendation not contained herein shall have any force or effect unless in an agreement signed by officers of International Plasma Corporation.

INSTRUCTION MANUAL

IPC 3000 SERIES PLASMA SYSTEM

1.0 INTRODUCTION

1.1 Description:

The IPC 3000 Series Plasma Systems generate a low pressure, low temperature gaseous plasma. In this machine plasma reactions, such as ashing, etching, and polymer surface modification can be performed quickly and reproducibly. The machine comprises a source of RF electrical power, means for coupling the RF power into the plasma treatment chambers, and a system to control the flow of reactant plasma gases.

The reactor treatment chambers vary from model to model in this series. Each chamber has a hinged access door through which samples are inserted or removed. The door is sealed with a bell jar gasket. The RF generator in this series provides RF power, dynamically regulated to maintain constant level into a normal load or to limit power output if the load is removed.

Two separate units are provided which are interconnected by gas hoses and electrical cables. These are the RF GENERATOR and the REACTOR CENTER. The REACTOR CENTER contains the Reactor Chambers, the Gas Controls, RF Power Matching Controls, and Timer.

1.2 Specifications:

Specifications for the IPC 3000 Series of plasma machines depends on two sets of specifications for the two individual units which make up the system. Reactor center specifications are given on the following page. Specifications for the generator-control console are given in the generator section of this manual.

1.2 (Continued)

MODEL ----- PM _____ REACTOR CENTER

Enclosure Dimensions ---- Width _____ inches

Height _____ inches

Depth _____ inches

Reactor Chamber Dimensions ----- Diameter _____ inches

Length _____ inches

Weight _____ pounds

Weight ----- pounds

Power Rating ----- watts continuous input

Impedance Control ----- Matches from 10 to _____
watts to present input impe-
dance of 50 ohms at input
connector.

Operating Pressure Range ----- 0.1 to 5 torr

Pressure Transducer ----- thermocouple type

Vacuum Seals ----- Silicone "O" rings and silicone bell
jar gasket.

Flow Meters ----- Range - 0 to 900cc/min.

Timer ----- Selects process period

Chart Recorder ---- (Optional) provided with DPS-1000
only; 1div./min. range - 0 to 1mA;
input impedance - 100 ohms.

2.3 Equipment Supplied:

The following equipment is supplied to:

Under P. O. Number: _____

Model Number: IPC _____, comprising:

PM _____ R.F. Generator (Serial No. _____)

PM _____ Reactor Center (Serial No. _____)

PM 906 Integral Programmer (Serial No. _____)

DPS-2300 EOP Detector (Serial No. _____)

PM 921C Temperature Controller (Serial No. _____)

Cables as follows:

_____ P/N 1163-001

_____ Plus P/N 04010

_____ P/N 2349-005

_____ Cap. P/N 5970-0026

_____ P/N 2350-005

_____ P/N 2351-001

_____ P/N 2492-001

_____ P/N 3895-001

_____ P/N 2973-002

_____ P/N 6548-001

Instruction Manual

Vacuum Pump (Serial No. _____)

Special Features:

2.0 INSTALLATION

2.1 Unpacking and Handling:

The IPC 3000 Series Plasma System is thoroughly tested and inspected, then carefully packed for shipment. The units should be unpacked with the care due any precision instrument. If the packages show that they have been dropped or handled roughly, return them to the carrier unopened.

Remove the packing cartons, being careful not to scar or damage the units. Make a complete visual inspection of the equipment, checking for damage or loose or broken components.

Careful inspection of glass components for damage should be made at this time.

2.2 General Placement:

No special difficulties should be encountered when installing the instrument. The Reactor Center should be placed in a fairly close proximity to the R.F. Generator.

A location must be chosen that will allow the placement of the vacuum pump within four feet of the Reactor Center.

Do not impede air circulation of the system's cooling fans.

2.3 Cable Connections:

Connect the cables between the generator and the Reactor Center consoles as indicated by the panel labeling and designation on the cable identification tags.

BE SURE TO REMOVE SHORTING WIRES ON METERS IN GENERATOR BEFORE OPERATION!

DO NOT, at this time, CONNECT ANY CABLE TO THE AC POWER LINE.

2.4 Gas Connections:

The unit requires industrial gases at an input pressure of 5 PSIG.* A common single stage gas regulator plus gas cylinder may be used. (A typical regulator would be a Matheson Gas Products #IL-540 or equal). Plastic or metal tubing may be run from the gas regulator to the fittings at the back of the Reactor Center.

There are two 1/4" Swage-lock fittings in the back of the Reactor Center. One is for the reactive gas and one is for the purge gas, and they are so marked.

(Insure that the gas connections are tight).

2.5 Vacuum Connections:

The mechanical vacuum pump is supplied with its own installation instructions. These should be referred to for installation, addition of pump oil and attachment of the power cord.

The exhaust manifold extension protrudes from an opening in the rear of the Reactor Center. The flexible hose provided is coupled directly from the exhaust manifold extension to the vacuum pump. Hose clamps are provided for each hose connection.

(Insure that the hose clamps are tight.)

3.0 OPERATION

3.1 General:

A nominal 115 volt, 20 amp service outlet is required for the IPC 3000 Series Plasma System. Under ordinary load conditions the service will be called on to deliver 15 amps maximum.

The IPC 3000 Series Plasma System uses a standard three pin "U" ground plug. If the wall outlet is not supplied with the proper receptacle, it will be necessary to provide the proper receptacle. It is recommended that the outlet be checked with a tester to insure that it is wired properly.

The IPC 3100 system uses a 208-240V 20a 3 wire circuit.

*See process tips section for recommended parameters.

3.2 Controls and Indicators:

The operating controls and indicators of the IPC 3000 Series Plasma System are located on the front panels of the generator and the Reactor Center. The connectors are on the rear panel. In the text all operating controls and rear panel connectors are described in the following tables:

3.2.1 Generator Front Panel Controls and Indicators

- 1) AC POWER ON/OFF SWITCH..... Applies AC power to the generator.
- 2) AC POWER INDICATOR..... The lamp above AC POWER switch lights when the AC POWER is ON.
- 3) READY INDICATOR..... The lamp to the left of the RF POWER switch lights approximately three minutes after AC POWER is turned ON, indicating the generator is warmed up and ready to provide RF POWER.

3.2.2 Generator Rear Panel Connectors

- 1) AC POWER CORD..... A three-wire cord through which the line power is obtained.
- 2) VACUUM TRANSDUCER CONNECTOR Allows the vacuum transducer which drives the vacuum meter to be attached to the generator. It supplies power to the transducer and couples the return signal to the meter.
- 3) AUXILLIARY POWER OUTPUT CONNECTOR..... Supplies AC power to auxiliary units and connects to an interlock switch which removes RF Power when the switch is activated. Also supplies the vacuum trigger signal from the generator to the Reactor.

3.2.2 (Continued)

- 4) RF POWER OUTPUT CONNECTOR..... Connects generator output power to the load via UHF type connector.

3.2.3 Reactor Center Front Panel Controls and Indicators

- 1) MODE CONTROL SWITCH..... Selects either automatic or manual operation.
- 2) START PUSHBUTTON..... Starts automatic sequence.
- 3) RESET PUSHBUTTON..... Actuates purge at end of automatic sequence.
- 4) VACUUM ON/OFF SWITCH Actuates exhaust valve for chamber evacuation.
- 5) PURGE ON/OFF SWITCH Controls entrance of purge gas.
- 6) FLOW NEEDLE SWITCH Sets flow rate of reactant gas.
- 7) GAS ON/OFF SWITCH Actuates gas flow.
- 8) FLOWMETER Measures gas flow in cc/min.
- 9) MATCHING FINE*..... Fine control for impedance matching network.
- 10) MATCHING COARSE*..... Coarse control for impedance matching network.
- 11) TIMER Setable timer to control run time in automatic mode.
- 12) RF POWER ON/OFF SWITCH Allows RF drive to be applied to Generator power amplifier. In the ON position the RF power is determined by the setting of the level control.

*Not provided if system includes AutoMatch option.

3.2.3 (Continued)

- 13) RF POWER LEVEL
CONTROL Provides continuous control
of RF power from zero to
the maximum available.
- 14) REFL/FWD
SWITCH Selects whether the wattmeter
displays Forward or Reflected
power.
- 15) VACUUM METER..... Reads Reactor Chamber Pres-
sure in Torr.
- 16) POWER METER Reads the power passing
through the output connector
of the generator. When the
REFL/FWD switch is in the
FWD position the meter reads
power transmitted to the load.
When the REFL/FWD switch is in
the REFL position the meter
read power reflected by the
load.

3.2.4 Reactor Center Rear Panel Connectors

- 1) VACUUM TRANSDUCER
CONNECTOR This is an octal plug
which mates with the
socket of the vacuum
transducer cable to the
generator.
- 2) RF CABLE
CONNECTOR UHF type connector through
which RF power to the reactors
is obtained.
- 3) AUXILIARY POWER
CONNECTOR Connects to generator and
provides power for fans,
solenoid valves, lights,
RF interlock, and vacuum
trigger.
- 4) EXHAUST MANIFOLD
EXTENSION Hose from the vacuum
pump fits over this
extension.

3.2.4 (Continued)

- 5) GAS INLET
CONNECTORS (3) Gas to the reactor
chambers enters through
these connectors.

3.3 Manual Operation of the IPC 3000 Series Plasma Machine:

3.3.1 General Comments*

The following sections deal with the operation and use of all the controls and functions of the IPC 3000 Series Plasma Machine. These procedures are a necessary preliminary to the fully automatic programmed operation described in the following section of this manual. At this point the modules should be completely connected by cables and the gases installed as described in the previous sections. The switches on the generator should be in the positions described below:

AC POWER OFF

On the Reactor Center the switches should be in the following position:

R.F. POWER OFF
POWER LEVEL CONTROL Fully Counterclockwise
R.F. METER-
FORWARD/REFLECTED FORWARD
FLOW ON/OFF OFF
FLOW METERING VALVE Fully Clockwise
VACUUM PURGE OFF
VACUUM OFF
MODE MANUAL
TIMER Set to Zero
FINE MATCHING Arbitrary Position
COARSE MATCHING Arbitrary Position

Check the gasket on the Reactor Center. Remove any foreign material and see that gasket is seated snugly against Reactor Chamber lips. Close Reactor doors.

Plug in the R.F. Generator and the vacuum pump. Turn ON the vacuum pump.

To operate the plasma system, turn ON the AC POWER switch on the generator. The amber light should now be lit and the fans should be operating.

* See process tips for recommended parameters.

3.3.2 Chamber Evacuation

Throw the vacuum switch to the ON position. The pump noise will noticeably increase and the Reactor doors will be sealed against the gasket. Observe the vacuum gauge on the generator, it should fall below 0.2 torr within a few minutes.

3.3.3 Gas Flow Control

Turn on the Gas flow control and adjust to the desired flow rate. As flow is adjusted, observe the torrmmeter until the pressure stabilizes at about 1 torr.

3.3.4 R.F. Power Level Control & Matching

If the READY lamp has lit, turn on the R.F. power switch on the generator. Turn the R.F. level Control clockwise and observe the R.F. Power Meter.

3.3.4.1 Systems with AutoMatch Option

The AutoMatch will automatically cause the plasma to strike and then tune. The operator need only adjust the R.F. level to the desired value. Verify that a match exists by switching the R.F. switch to REFL and observe that the "reflected power" on the lower scale is less than 2% of the forward power rating.

3.3.4.2 Systems with Manual Matching

Turn COARSE adjust counterclockwise until plasma ignites. Once the plasma is ignited and sustained turn the FINE and COARSE Impedance Matching Network controls until a maximum of forward power is obtained. The forward power is monitored with a FORWARD/REFLECTED switch on the generator. Then adjust for minimum of reflected power with both the COARSE and FINE controls simultaneously. The Matching Network is wide ranging, but must be set initially. Once set, only occasional adjustments will be needed to maintain a good match from run to run. A good matching condition is obtained when the reflected power is less than 5% of the forward power.

3.3.5 Review of the Initial Start Up and Manual Operation Procedures

- 1) Vacuum Pump ON.
- 2) Main AC power ON.
- 3) Vacuum ON to obtain low pressure.
- 4) R.F. switch ON and R.F. level set to desired value.
- 5) Gas flow ON and set to flow rate desired.
- 6) Match the impedance of the load.

3.3.6 Turning Off the Plasma and Purging the Chambers

To turn the plasma off at the end of a run and remove the samples from the chamber, perform the following steps in the listed sequence:

- 1) R.F. OFF (level control remains in the run Position).
- 2) Vacuum OFF
- 3) Purge ON.

3.3.7 Restarting the Plasma

- 1) Load new samples and close doors.
- 2) Purge OFF.
- 3) Vacuum ON (wait for pressure to decrease below about 0.2 torr).
- 4) R.F. ON.
- 5) Gas ON.

Note that these operations involve actuating the right switches. The gas flow and R.F. level have been set up in the previous run and the impedance matching remains the same from run to run.

3.4 Automatic Operation - Single Program:

3.4.1 Starting the Automatic Sequence

The following steps describe the operation of the IPC 3000 Series Plasma System in the automatic mode. The conditions of R.F. power level and gas flow should have been set up and established in the manual mode previously described in section 3.3.

- 1) MODE switch to AUTO.
- 2) R.F. ON.
- 3) Gas flow ON.
- 4) Purge ON.

3.4.1 (Continued)

- 5) If reset light comes on, push RESET button.
- 6) Set TIMER for desired run time.
- 7) Load samples and close door.
- 8) Push START button.

Step #8 above actuates a fully automatic sequence which consists of the following steps:

- a. The chamber is pumped down to a preset vacuum level (about 0.2 torr).
- b. The R.F. power will come on at this preset vacuum level.
- c. The gas flow will start at this preset vacuum level.
- d. The plasma will be sustained for the time set on the timer.
- e. After the timer has run down to zero, the gas flow and the R.F. power go off.
- f. The red light above the reset button comes on, along with a sonic alert to tell the operator that the cycle is complete.

3.4.2 Changing Samples in the Automatic Mode

The red light over the RESET button and the sonic alert signal the end of the automatic sequence. To change samples, push the RESET button. This actuates the purge and resets the timer. Once the chambers have returned to atmosphere, remove the samples, reload the chamber, and the machine is ready to run again.

4.0 MAINTENANCE

4.1 General:

This section covers procedures used to keep the IPC Plasma System operating at maximum efficiency. These procedures are primarily inspection and adjustment of all components on a periodic maintenance schedule. Maintenance of the R.F. Generator-Control Console is covered in the separate manual at the rear of this system manual.

4.2 Reactor Chambers:

The principal maintenance requirement in the module is to treat the Reactors and doors with care; do not slam or scratch or spill chemicals on the doors or in the reactors. When evacuated the reactors are under an atmospheric force of hundreds of pounds. Doors, reactors, and gaskets are easily cleaned with ordinary agents.

NOTICE

ALL QUARTZWARE SHOULD BE HANDLED WITH COTTON GLOVES

In case of breakage the reactors and doors can be readily replaced with new units.

4.3 Vacuum System:

The vacuum pump is the key to trouble-free operation of the vacuum system. Refer to the pump manual for information on oil changes, ballast adjustment, and general maintenance. "o" rings or gaskets damaged by extreme temperatures or corrosive gases should be replaced.

4.4 Flow Control:

The gas system is simple so that little trouble should be expected here. All joints should be checked for leaks with a soap solution if disconnected and remade. Swagelok fittings should be tightened one and one-quarter turns past finger tight. If the ball in the flowmeter gets dirty, the unit may be disassembled and cleaned. Watch for tiny parts. If valves fail to function, they may be disassembled and the gaskets cleaned or replaced.

4.5 R.F. Electrodes:

Electrodes should last indefinitely. If the reactors are run at extreme temperatures the Teflon support buttons may melt or flow, requiring replacement. They are snapped into perforations in a uniform pattern.

4.6 Impedance Matching Network:

As these parts are purely mechanical they should provide years of trouble-free service. If, through some accident, the inductor or capacitor contacts arc over to burn they will need to be replaced.*

*For systems with AutoMatch, see AutoMatch section for maintenance and calibration.