SIGNAL NOXGEN III

NO2 CONVERTER TESTER

OPERATION MANUAL

NOX III/MAN

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INDEX

		PAGE
1.00	UNPACKING INSTRUCTIONS	3
2.00	INTRODUCTION	4
	2.01 Principle of Operation	4
	2.02 The Ozonizer	5
	2.03 Flow Scheme Diagram	6
	2.04 Remote Control Flow Scheme Diagram	7
3.00	INSTALLATION	8
	3.01 General	8
	3.02 Installation Drawing	9
	3.03 Span Gas Connection	10
	3.04 Oxygen/Air Inlet	10
	3.05 Outlet	10
	3.06 Mains Power	10
	3.07 Remote Control Connections	11
4.00	OPERATION CONTROLS	12
	4.01 Operation	13
	4.02 Remote Control Operation	15

1.00 **<u>UNPACKING INSTRUCTIONS</u>**

This instrument is packed for general freight purposes. It should withstand the occasional "bumps and knocks" which occur during transit.

Please check the instrument for damage however, and report any damage within 24 hours to the factory or its Sales Office or Distributor.

1. Before any connection is made, unscrew the 4 cross head screws on instrument cover lid.

2. Slide lid back to reveal the internal assemblies of the instrument.
   NOTE: Do not take the cover off with power connected.

3. Check that all PCBs are firmly in their mating connectors on the front of each PCB.

4. Check for any loose or broken parts which may have occurred during transit.

5. Slide lid back and re-do the screws (do this before connecting power).

6. Read through the rest of this manual thoroughly and then carry out the installation.

2.00 **INTRODUCTION**

Chemiluminescent NOx analysers, such as Signal's own Model 4000 Series; rely upon the efficiency of the NO2 to NO converter in the analyser. The converter enables a measurement to be made of the total oxides of nitrogen in the sample stream (NOx = NO + NO2).

The 1979 Heavy Duty Register of the U.S. Environmental Protection Agency stipulates that such converters must be checked before the analyser is initially used, and thereafter at weekly intervals, to ensure that they have an efficiency of at least 90%. The Signal NOXGEN III provides known, accurate amounts of NO2 for converter efficiency testing, and fully meets the EPA requirements.

The instrument is compact, inexpensive and provides a precision of control and repeatability of results that were unobtainable with the previous generation of converter testers. Ozone is generated by a high energy lamp using an electronic pulse, which can be varied to adjust the Ozone level. The Noxgen III produces no NO from air, in contrast to the high voltage corona discharge technique.

Stability against mains power variations, and the consequent effects of NO2 concentrations, is ensured by the incorporation of a voltage stabilised electronic circuit, feeding pulses to a high voltage transformer.

2.01 **PRINCIPLES OF OPERATION**

The instrument is fed with nitric oxide and oxygen, the latter being subjected to a high-energy lamp, which partially converts the oxygen to ozone. The oxygen/ozone mixture is passed to the nitric oxide flow, and the nitric oxide is instantly converted by the ozone to give nitrogen dioxide. The reaction between the remaining oxygen and nitric oxide again produces nitrogen dioxide, but this reaction is so slow that it does not need to be taken into account for test purposes.

The amount of nitrogen dioxide generated is determined by measuring the fall of nitric oxide concentration. If, for example, this concentration falls by 400 vpm, then 400 vpm nitrogen dioxide has correspondingly been generated, as the oxidation is a 1 : 1 molecular reaction. The concentration of nitrogen dioxide is therefore directly proportional to the concentration of ozone generated. When connected to the analyser converter, the NO2, should be converted back to NO. From the results obtained the converter efficiency can be determined.

2.02 THE OZONIZER

The signal Model NOXGEN III utilises a very efficient high energy lamp system which ionises oxygen to ozone. The ozonizer is built into a fully self contained enclosure within the instrument. This should not be opened by unauthorised personnel because very high voltages exist within the enclosure, even with power off.

Figure 2.03 Flow Scheme Diagram

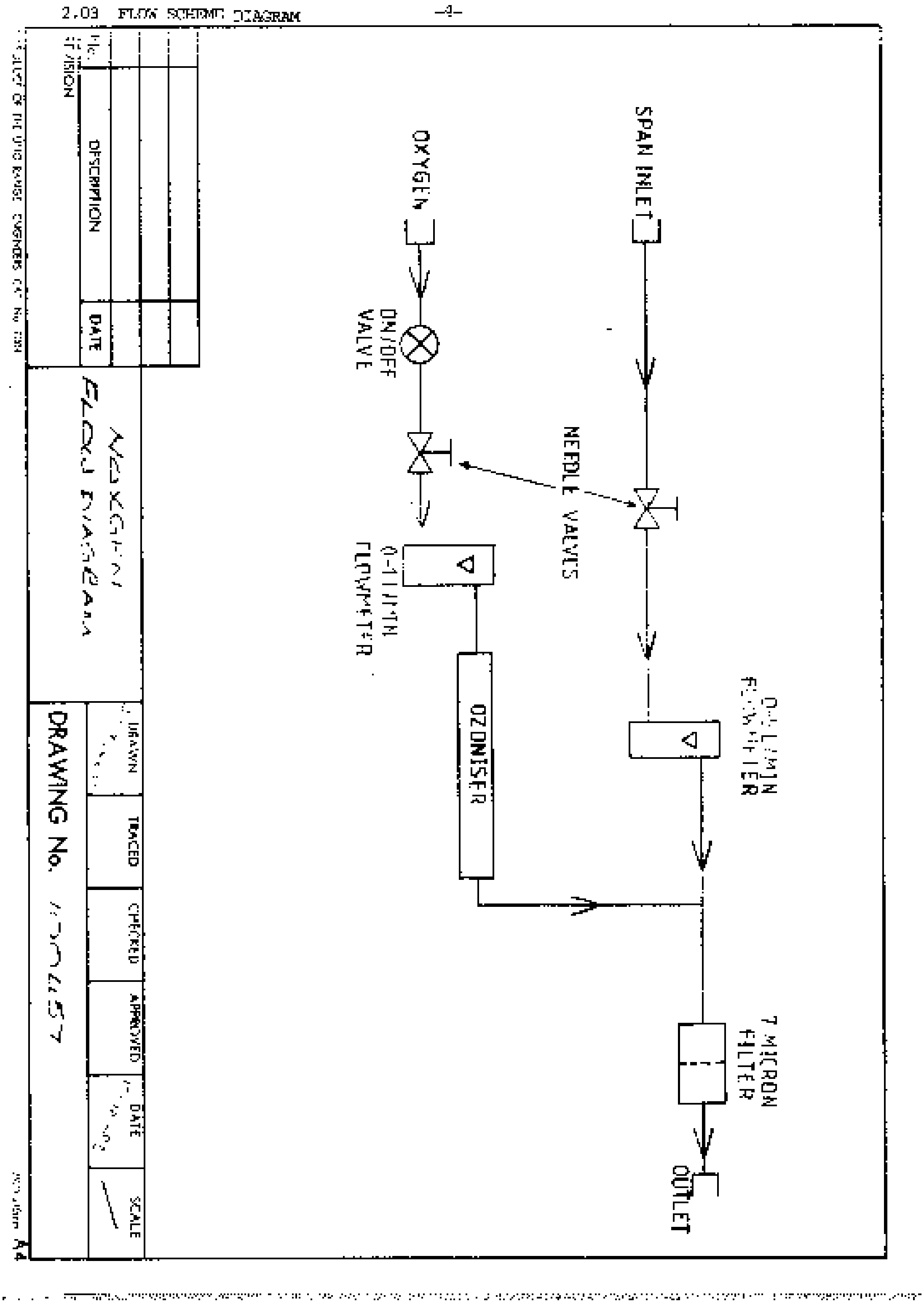
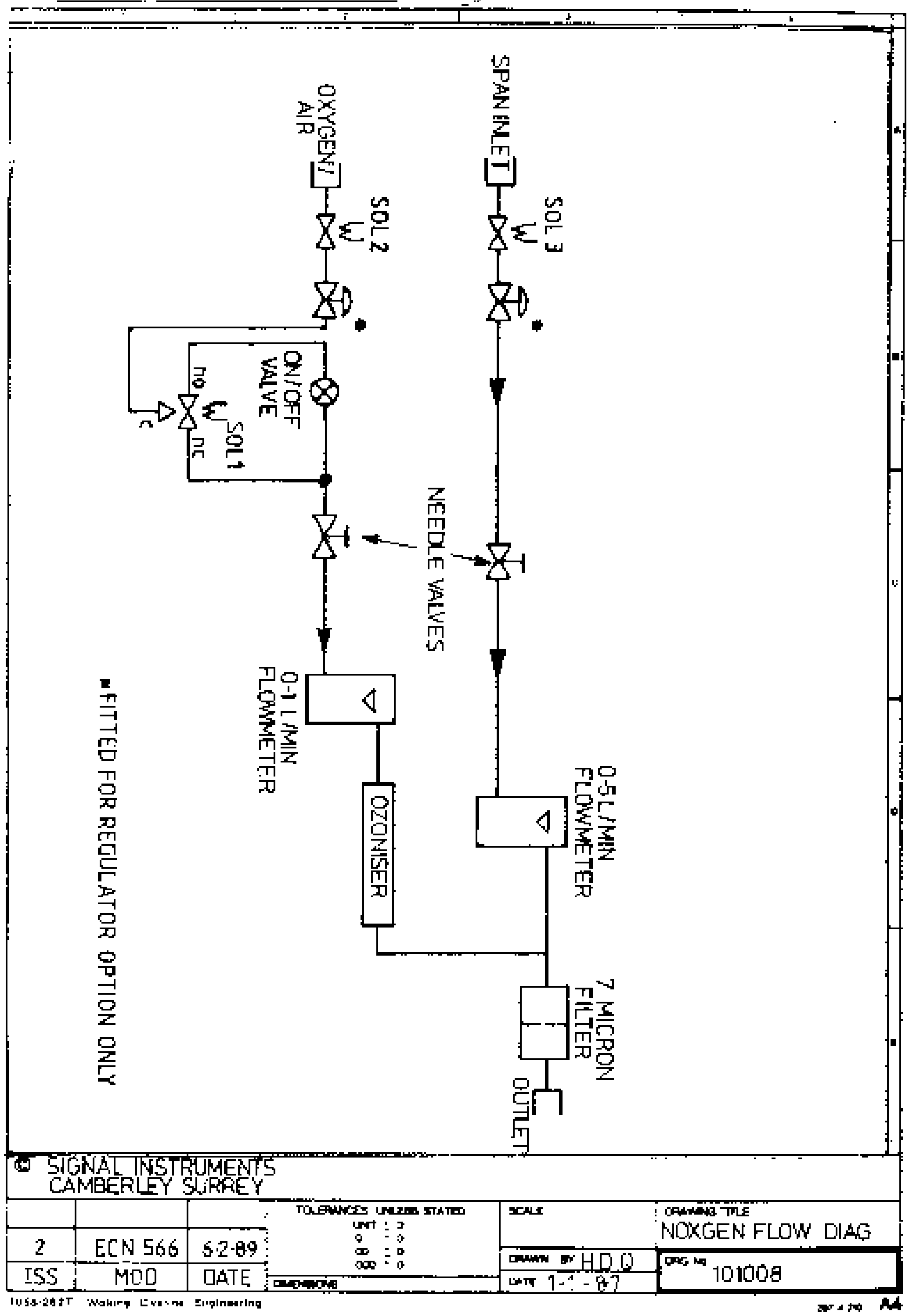


Figure 2.04 Remote Control Flow Scheme Diagram.

2.04 REMOTE CONTROL FLOW SCHEME DIAGRAM -5-



3.00 **INSTALLATION**

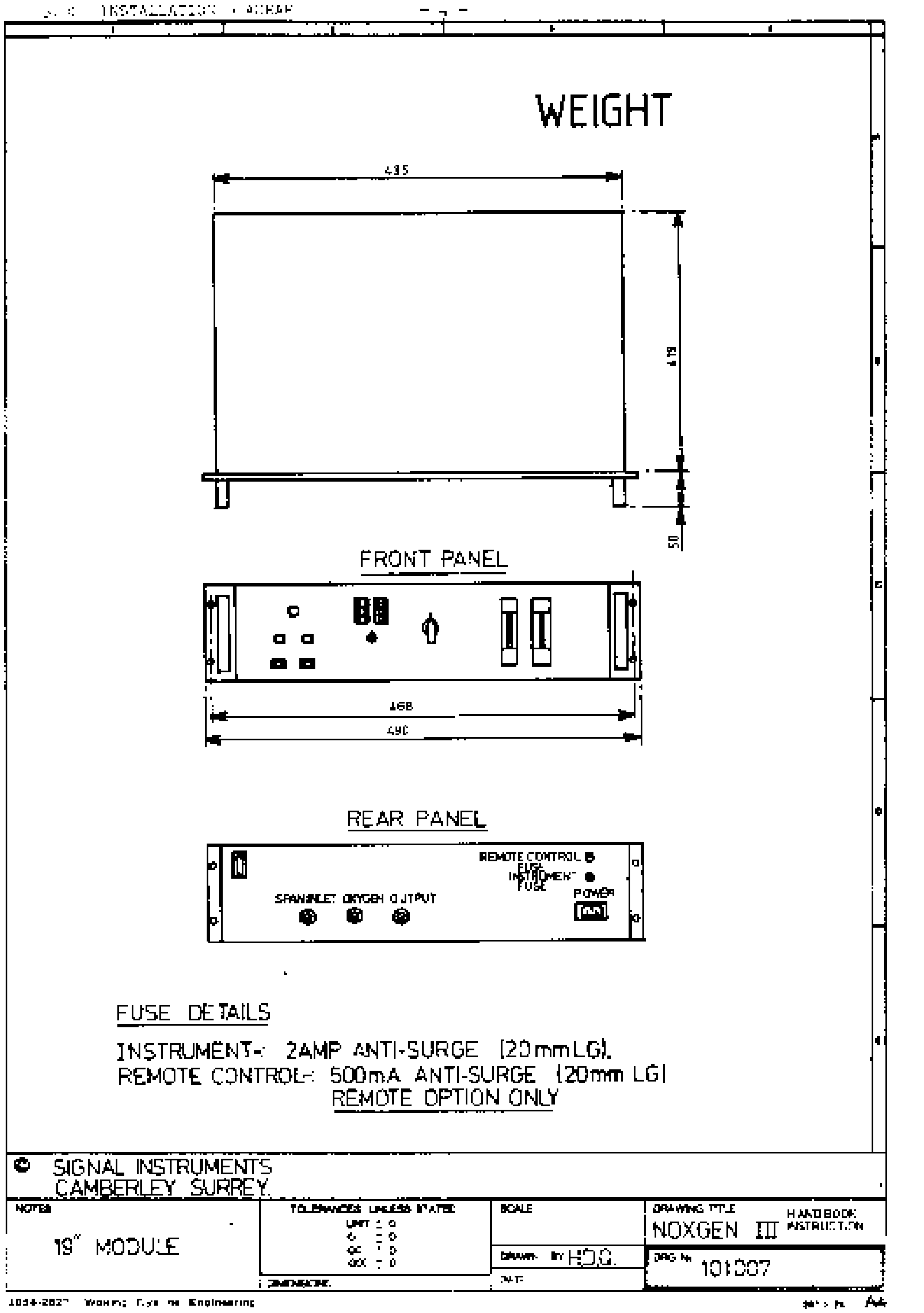
3.01 GENERAL

The Signal NOXGEN III comes in a 19" rack type, 3 units high enclosure. It can be bench top used or fitted into a 19" rack console. For bench top use there are extendible feet at the front which can be used to tilt the angle of the instrument back for ease.

When using this instrument in a 19" rack, the feet will need to be removed. To do this, undo the 4 cross-head screws on the under cover and slide back the cover to remove it. With the cover removed you can easily unscrew the four feet before replacing the cover for installation.

This instrument is fitted with Parker CP1 stainless steel tube fittings. Because of the presence of nitric oxide, nitrogen dioxide and ozone, all of which are toxic gases, great care should be taken to ensure that no leaks occur throughout the tube work. Make the compression fittings off in accordance with the manufacturers recommendations and do not over-tighten the nut.

Figure 3.02 Installation Diagram.



3.03 SPAN GAS CONNECTION

The span gas should be nitric oxide in nitrogen at a concentration about the level, which you expect to use the analyser. The rear of the instrument has a 1/4" compression fitting and you should use either Teflon (PTFE) or stainless steel tubing. DO NOT USE NYLON OR COPPER TUBE.

Do not set the pressure to this line until you start to operate the instrument because as soon as you set a pressure on the gas inlets, a flow will start to occur.

3.04 OXYGEN/AIR INLET

Connect the oxygen or air cylinder to this connection, again using Teflon (PTFE) or stainless steel tubing. It is most common to use oxygen but dry air can be used with almost as high an ozone production as that using oxygen. Also, the Signal Model NOXGEN III has been carefully designed so that no nitric oxide is generated from the nitrogen in air, which means that converter efficiency testing using air can still be done without inaccuracies. The only difference seen will be the level of nitric oxide in the span gas which can be lowered in reading by conversion to nitrogen dioxide, i.e. using air will allow you to change less NO to NO2, using oxygen will allow you to change more NO to NO2.

3.05 OUTLET

This connection, again a 1/4" compression fitting, should have Teflon or stainless steel tube connected to the calibration inlet port of the NOx analyser being tested.

3.06 MAINS POWER

Connect a 220/240V or (110V if specified on rear panel nameplate) using a properly grounded (earthed) supply. 1 amp is the MAXIMUM POWER DEMAND.

3.07 **REMOTE CONTROL CONNECTIONS**

The remote control option is to enable you to control the gas selection functions using TTL inputs. The TTL levels can be either OV inputs via the earth return pins or, for people without a transistor logic controller or computer, a simple short circuit wire link with a switch for ON and OFF can be connected between any of the four earth pins and the function pin.

Before any of the function pins can be utilised, the remote enable must be operated and again, either an OV logic signals via the earth return or a short circuit wire link can be used.

Without the remote enable function being operated, the instrument operates in the same way as the non remote control instrument.

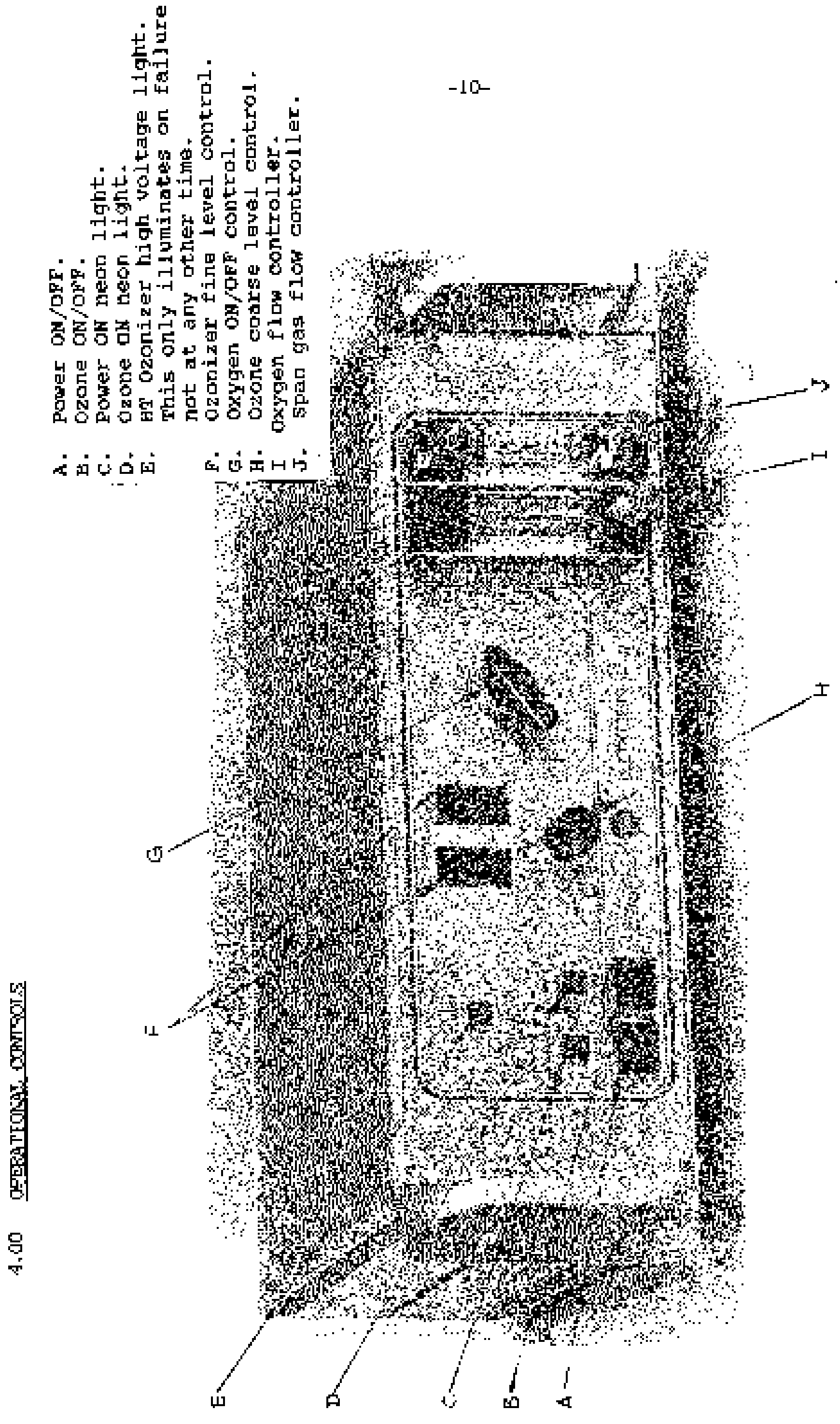
With no power connected, the instrument with the remote control option will shut off all gas flows using the built-in solenoid valves.

PIN NO. (15 WAY D CONNECTOR)	FUNCTION
1	N/C
2	OV RETURN
3	OV RETURN
4	OV RETURN
5	OV RETURN
6	OV RETURN
7	OV RETURN
8	N/C
9	N/C
10	REMOTE ENABLE
11	OXYGEN ON
12	SPAN ON
13	OZONE ON
14	N/C
15	N/C

NOTE:

DO NOT MAKE ANY CONNECTIONS TO N/C PINS

Figure 4.00 Operational Controls



4.01 **OPERATION**

WARNING: DO NOT LEAVE OZONE ON WITHOUT GAS FLOW

1. Ensure that all connections have been made in accordance with the installation instructions.

2. Set 10 psig or 0.75 bar gauge (approx.) to regulators of both the span gas and NO cylinder and the oxygen/air cylinder.

3. Balance the NO and NOx modes of your NOx analyser, ensuring they both zero and span correctly. Select no mode.

4. Press the Power ON switch but not the Ozone switch at this stage.

5. Select OFF position for oxygen.

6. Adjust the span flow control to a suitable rate for your NOx analyser and leave to settle until a suitable reading of the NO span gas is obtained on the analyser.

7. Open the oxygen ON/OFF flow valve on the Noxgen front panel (G) and adjust the flow of this oxygen using the flow control (I) until the analyser reading falls by about 10% of the original reading in step 6. Record this reduced reading (Reading A).

8. Switch on the ozone using the Ozone ON/OFF button B and adjust the ozone level using both the coarse adjust switch (H) and the fine thumbwheel adjust switches (F).

   This adjustment should be made until the analyser reading is further reduced so that it is now about 20% of the reading taken in Step 6. At this stage the ozone in the Noxgen is converting the NO span gas to NO2 and the fall in reading corresponds to the level of NO2 now being generated. Whatever you do, always allow 10% of the reading in Step 6 (A) to remain. Record this new reading from the analyser (Reading B).

9. Having recorded a stable reading B, switch the analyser to the NOx mode and wait for a steady reading. Record this reading (Reading C).

10. Switch off the Ozone and allow the NOx analyser reading to stabilise and record this new reading (Reading D).

11. Shut off the oxygen flow valve on the front panel and observe the analyser reading. This reading should now represent the same as obtained in Step 6. The only difference now from Step 6, is that you have the analyser in its NOx mode, and therefore any NO2 which was in the span cylinder will produce a correspondingly higher reading than at Step 6.

12. Calculate the efficiency using the equation:-

$$\text{Efficiency} = \left(\frac{A}{D} \times \frac{C-B}{A-B}\right) \times 100$$

if A = D i.e. (NO span = NOx span)
the equation simplifies to:-

$$\text{Efficiency} = \frac{(C-B)}{(A-B)} \times 100$$

4.02 REMOTE CONTROL OPERATION

The remote control option (when fitted) has facilities to enable you to control the following functions from remote either TTL or contact closure. See installation instructions for details.

1. Remote enable control ON/OFF.
2. Remote oxygen ON/OFF.
3. Remote span gas ON/OFF.
4. Remote Ozone ON/OFF.

When using the remote control facilities you must firstly set the instrument's flow control and Ozone level manually, exactly the same as previously explained in the Operation Section. Therefore, all the settings will be made manually before going to remote control.

Unless the remote enable control is activated, the instrument will behave the same as the standard manual controlled Noxgen and the operation as explained in Steps 1-11 can be carried out as normal.

With power off, all solenoids will close and gas will be automatically shut off. (This is not so with the remote control versions).

Having set up the Noxgen III in the normal way, to carry out remote control converter test you simply follow the following steps:-

1. Switch power on.
2. Activate remote enable.
3. Activate span gas ON (Reading A).
4. Activate Oxygen gas ON (Reading B).
5. Activate Ozone On (Reading C).
6. Switch analyser from NO to NOx mode (Reading D).
7. Deactivate the Ozone (Reading E).
8. Deactivate the Oxygen gas.

NOTE: In order to allow complete remote control for this test, Signal has designed their own Model 4000 chemiluminescent NOx analyser, complete with remote controlled NO/NOx modes.

Figure 4.02 Chart Display