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SHERMAN TREATERS

GXR GENERATORS

GX30R TO GX100R

INCLUDING GENERATOR & ELECTRODE MAINTENANCE

CONTENTS

SECTION 1

INTRODUCTION

The GXR range of generators has been developed to provide repeatability and accuracy to corona treatment applications, and, by using the most current technology in power semiconductors to maximize the efficiency of the corona treatment system.

The corona treatment equipment consists of three main parts;

a. Generator
b. HT Transformer
c. Electrode Station

The generator/inverter converts power from the mains input supply to a high frequency supply for production of the corona.

The HT transformer converts the generator/inverter output voltage to a sufficiently high voltage to produce corona discharge at the electrode.

There are various tappings on the HT transformer in order to obtain optimum matching of the generator to the electrode station (ie, maximum efficiency, minimum power loss).

The electrode station consists, basically, of an earthed plane (the base roll), and insulating dielectric (the base roll coating, or in the case of a bare roll treater, the electrode material), an air gap, and a high voltage plane (the electrode). The corona is formed in the air gap between the electrode and the base roll when a high frequency voltage of sufficient level is applied to the electrode.

SECTION 2

SPECIFICATIONS

OPERATING PARAMETERS

MODEL GXR	30	40	50	75	100
TREATMENT POWER	3kW	4kW	5kW	7.5kW	10kW
INPUT AMPS/PHASE	6	8	10	12	16
INPUT FREQUENCY	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz
INPUT kVA MAXIMUM	3.6 kVA	6.0 kVA	9.0 kVA	10.5 kVA	14 kVA
MAXIMUM OUTPUT VOLTS R.M.S.	600	600	600	600	600
OUTPUT AMPS R.M.S.	16	18	20	30	40
OPERATING FREQUENCY	10-25 kHz	10-25 kHz	10-25 kHz	10-25 kHz	10-25 kHz

SECTION 3

INSTALLATION AND CONNECTION OF EQUIPMENT

(Before installation check drawings at rear of manual)

3.1 Generator

It is essential that the generator is located in a clear space for easy access and for cooling purposes.

3.1.1 Mains Supply (PL1 GX30R only)

The generator requires a 3 phase and earth rated as in Section 2. 50/60 Hz supply.
Standard voltages 380, 420, 460, 480. Others on request.

3.1.2 SK2 Underspeed Probe

Socket SK2 takes a 3 core cable and plug for the speed rotation sensor.

3.1.3 Output to H T Transformer (SK3 GX30R only)

The cable supplied with the equipment should be used for generator connection to the HT Transformer. This cable must not be lengthened without reference to Sherman Treaters.

Due to the high operating frequency of the inverter, this cable must not be located in steel conduit as the eddy currents induced will reduce the effective inverter treatment power.

3.1.4 SK4 Interlocks and Skip/Treat

(a) INTERLOCKS

All the treater interlocks (which detect if any windows are open or if extraction has failed etc.) are wired between pins A and B of SK4.

Further customer defined interlocks or a momentary normally closed STOP switch may be wired between pins C and D. If not required connect a link between pins C and D.

Breaking the link between A and B or C and D will turn the generator off. To re-start the generator, the START button must be depressed.

Remote start may be installed by connecting a non-latching normally open switch across pins E & F.

(b) SKIP/TREAT

If gaps are required in the treatment, a proximity sensor may be wired into SK4.

(c) AIR FLOW SWITCH

The Air Flow Switch is fitted to all electrode units to ensure that the extract fan (and the pressurisation fan if fitted) is running.

Adjustment of the Air Flow Switch may have to be carried out to ensure that the interlock circuit is broken and the generator stops when the extract or pressurisation fan is stopped.

The setpoint may be adjusted by removing the Air Flow Switch cover and with the fans running rotating the screw situated in the centre of the switch until the interlock lamp is lit on the generator.

Test that the switch is set up correctly by stopping the fan and ensuring the interlock LED is extinguished.

3.1.5 PL5 Alarm Circuit

This generator has been fitted with both high and low alarm relays whose contacts are closed under the following condition:-

High Alarm : True power exceeds set limit

Low Alarm : True power is less than set limit

The high alarm output (240Vac)s are connected between pins A and B and low alarm between pins C and D.

3.1.6 Remote/Computer Interfacing

With this option, the generator may be monitored and controlled remotely 4-20mA and 0-10v opto-isolated inputs and outputs are provided, as well as STOP, START, RESET and SKIP inputs. Volt free contacts provide status indicating of the generator for rapid and accurate fault diagnosis.

A REMOTE/LOCAL SELECT input allows the user to select remotely whether the generator is to be controlled from the generator or from the remote station.

Details of the interfacing may be obtained on request.

3.2 H T Transformer

Ensure that the cable from the transformer is correctly connected to the generator. Check that the transformer case is firmly connected to the electrode case and earthed, and that the high voltage connection is made from the transformer to the electrode.

The transformer should only be operated in the upright position as indicated on the label.

3.3 Electrode Unit

When lifting the unit it is advised that the lifting eyes are used, as damage may result otherwise.

The electrode unit must be mounted so that the rolls are in line with the machine rolls.

N.B. It is important that the electrode gap is checked prior to the electrode unit being switched on.
All electrode units have the discharge air gap set before they are despatched, however the gap may move out of alignment during transit or installation.
Do not switch the generator power on before rechecking that the air gap is correct (see Section 4).
Failure to follow these instructions could result in damage to the roll covering or the electrode and could invalidate the warranty on these items.

The pneumatic control box should be connected to a lubricated, filtered air supply. Minimum pressure of 60 p.s.i. Maximum 100 p.s.i.

Ozone produced by the corona process must be removed from the area by connecting extraction fans to the ports provided on the electrode unit.

It is recommended that smooth bore ducting is used, to maintain the efficiency of the extraction. The length of ducting between the electrode station and extraction fans should not exceed 4 metres. Any increase on this will result in a decrease in efficiency. The extraction is monitored by airflow switches on the extraction port which are wired into the generator interlock circuit to prevent start-up of the generators if the extraction is inoperative.

Ensure that base roll is securely grounded via brush or slip ring. Resistance < 2.0 ohms.

Interlock switches are installed on the doors and electrode assemblies to prevent generator operation when the station is in a non-operational condition.

The Base Roll is monitored by a speed sensing circuit which is connected into the interlock circuit, and prevents start-up until roll is rotating.

3.3.1 Setting Nip Roll

1. Set nominal air pressure to pneumatic control box i.e. approximately 2 bar.

2. Set nip stops such that the gaps between the nip roll and base roll (at either end of rolls) is slightly less than the material thickness.

3. Do not lock nip stops.

4. Run treater with film and bring nip against stops (with material edges removed).

5. Test rear edges of film for reverse side treatment when running.

6. If no reverse side treatment is present, lock nip stops.

7. If reverse side treatment is in evidence, lower the nip stop $^{1}/_{6}$ turn (to decrease gap).

8. Repeat Steps 5 - 7 until OK.

3.3.2 Doweling of the Nip Arms

It is Sherman Treaters normal practice to dowel both nip arms to the torsion bar. One arm is doweled during build at Sherman Treaters. The other is doweled with the nip roll set parallel to the base roll after the treater has been installed in the line and the final alignment of the sideframes and base roll established.

Some customers prefer not to dowel the second nip arm but to allow the two nip arms to have slight independent movement.

Note: If it is to be doweled then dowel pins should be used and not screws.

SECTION 4

OPERATING THE EQUIPMENT

In order to obtain optimum treatment from the system it is necessary to optimize the match between the generator and electrode system. This is achieved by selecting the correct tap on the H.T. Transformer (Section 5) and the correct setting of the choke in the generator for the electrode type. The choke is factory-set and should not require adjustment.

The equipment is normally set at the factory to ensure maximum corona power when the maximum electrode area is set and the air gap is correct. Normally 1mm for ceramic dielectrics and 2mm for silicone and hypalon dielectrics and Quartz electrodes. Reduction of the electrode area will result in less current being drawn from the generator although there may not be any reduction in treatment level. Care should be taken, however,not to exceed the power handling capability of reduced area electrodes. Frequency adjustment permits a wider range of matching as explained in Section 5.

4.1 Setting Electrodes

The air gap between the electrode and the dielectric sleeve may be adjusted to enable different thickness of material to be treated.
An excessive gap may result in loss of corona power.

Sherman Treaters' standard electrode units are fitted with calibrated dials which provide a direct indication of the air gap. Gap setting mechanisms must be locked after use to prevent inadvertent maladjustment. Careful setting of the gap is essential if even and effective treatment is to be obtained.

4.2 Initial Switch On

Check that all connections have been made as described in Section 3.

4.2.1. OPERATING PROCEDURE.

1. Turn output power control to minimum.

2. Switch on the mains isolator on the door. The mains on lamp, shutdown and low alarm LED's will light.

3. Close the electrodes and start the ozone extraction fans. This will illuminate the interlock closed LED.

4. When the electrode unit base roll is rotating the up to speed LED will illuminate.

5. Press the start button, the shutdown LED will go out, and after a two second delay the output will be enabled.

6. Turn output control to maximum, the treat on LED will light.

7. Switch the frequency/true (kW)/reactive switch to reactive and adjust the frequency control until a zero reading is obtained on the digital display. Switch back to true (kW) position and adjust output control to the required power level. Recheck the reactive power is zero and adjust frequency as required.

NOTE:

For all extrusion lines, the treater should not be run in the treating mode until the extrusion die has been properly flushed through, and good quality film is procured. This means that the electrode assemblies and nip roll (if fitted) need to be in the parked position, ie, not treating. Failure to comply with these instructions could cause the electrode assemblies and nip roll to be damaged and put out of alignment by lumps.

If the following LED's do not illuminate, carry out the suggested checks.

MAINS ON	- Check Mains input supply voltage.
INTERLOCKS CLOSED	- Remove SKT4 and check for continuity between pins A and B (electrode interlocks) and pins C and D (customer interlocks and external stops).
UP TO SPEED	. Rotation sensor is fitted. . Electrode rolls are turning. . Line speed circuit is calibrated. . If UTS facility is not required, override using SW3-B.(up = override).

If full output power is not available, it is probably due to the generator not being correctly matched to the treater.
(See Section 5 for matching).
If the POSITIVE MISMATCH or NEGATIVE MISMATCH indicators light, then in the same way, increase the tap for negative mismatch, reduce the tap for positive mismatch.

Operate the RESET switch to refresh the MISMATCH indicators.

Check that the INTERLOCKS LED extinguishes if the interlocks circuit is broken.

4.3 Normal Operation After Initial Checks

. Switch on the mains isolator on the front door. The mains on and low alarm and shutdown LED's should be lit.

. Depress the START button.

. Set OUTPUT POWER demand potentiometer to required level.

. Depress STOP button to stop treatment.

Always use the START and STOP button for all normal starting - stopping. Use the mains isolator only as an isolator for prolonged shutdown.

To select Automatic frequency matching SW1- on the inverter PCB should be selected in the down position.

SECTION 5

MATCHING THE GENERATOR TO THE ELECTRODE

It is essential that the generator and electrode unit are matched to achieve maximum efficiency and to maintain correct generator operation.

The generator has been designed to operate within set limits of inverter voltage, current and frequency. If the matching is incorrect, the generator will limit the treatment to the load to ensure that the inverter always operates within its safe operating area.

No adjustments are required, or should be made, to the inverter itself.

As high currents flow in the output cables, it is essential that all connectors and mating surfaces are clean and that connections to the transformer are tight and locked using spring washers.

It should be possible to obtain satisfactory matching of the generator to the load simply by selecting the correct tap on the H.T. transformer and by frequency adjustment, by following the procedure in steps 1 to 11 listed below.

1. Press STOP button
2. Switch off isolator on door
3. Set the electrode gaps required, but not exceeding 2mm
4. Remove the terminal cover from the HT transformer
5. Connect the earth (green/yellow) wire to the stud marked 'E'
6. Connect the black wire(s) to Tap 1 (GX75/100 - 2 black wires)
7. Connect the blue wire(s) to Tap 7 (GX75/100 - Blue & Brown wires)
8. Switch on and set Power potentiometer to maximum.
9. Adjust frequency potentiometer to point where reactive power reads zero, and note the true power reading.
10. If maximum power not acheived then proceed with step 11
11. Switch generator off and move blue wire(s) (GX75/100 - Blue & Brown wires) to the next lower tap and repeat steps 8 and 9 to determine the tap which gives the maximum output.

Frequency adjustment sets the optimum True Power and Reactive Power values. At best match the Reactive Power should read zero. Note that as the frequency passes optimum the Reactive Power will change polarity. Reactive Power and Frequency are displayed on the Digital Meter by selecting the switch position on the front panel.

SECTION 6

MAINTENANCE OF SHERMAN GENERATORS & ELECTRODE UNITS

When live high voltages are present within this equipment, ALL maintenance must be carried out with the mains supply disconnected from the system.

SECTION A	ELECTRODE MAINTENANCE
SECTION B	DETAILED ELECTRODE MAINTENANCE
SECTION C	GX GENERATOR MAINTENANCE
SECTION D	FINAL CHECKS
SHEET (A)	GENERATOR CHECK AND CLEAN PERIODS
SHEET (B)	ELECTRODE UNIT CHECK PERIODS
SHEET (C)	ELECTRODE UNIT CLEAN & GREASE PERIODS

SECTION A

Maintenance

When live high voltages are present within this equipment, ALL maintenance must be carried out with the mains supply disconnected from the system.

Electrode Station

The electrode stations should be examined periodically, and accumulations of dust and other particles removed. This should be done using dry, lint free cloths, brushes and suction hose.

Base Roll

The treater roll may be cleaned using warm, soapy water. From a health and safety viewpoint it is recommended that solvents are not used.

Air Gap Adjustment

The calibrated gap adjusters on each electrode assembly are used to set the air gap between the electrodes and the treater rolls. The air gap may be selected by the customer although optimum performance is achieved with an air gap of 1.0mm to 2.0mm.

Adjustment is made by slackening the locking screw, on the side of the adjuster retainer, and rotating the calibrated dial to the required gap setting, then retighten the locking screw.(Do not slacken the grub screw holding the scale collar to the gap adjuster assembly, as this will disturb the calibration of the scale collar and hence the gap setting.

The air gap is set, and the dial calibrated before leaving the factory.

NOTE: Check the air gap at both outer edges of the electrode in the line direction to ensure that the tilt of the electrode is correct. This may be adjusted by rotating the tilt adjust bolts located at one side of each electrode assembly.

When live high voltages are present within this equipment, ALL maintenance must be carried out with the mains supply disconnected from the system.

Pressurised Electrode Station

This is a combination of negative pressure for the extraction of ozone, and positive clean air pressure preventing hazardous vapours etc. entering the electrode station.

The minimum level of pressure within the station is +0.5mm of water (or a level specified by relevant local regulations), and is achieved with damper valves located within the ductwork between the electrode station and the pressurisation fan, and the electrode station and the ozone extraction fan. It is monitored by pressure differential switches which are wired into the generator interlock circuit to prevent start-up of the generators if pressurisation is not achieved. Generators should not be operated until correct pressurisation of the electrode station is established.

It is recommended that smooth bore ducting is used to maintain efficiency. The pressurisation system must have its' own dedicated ducting from its' fan situated in a safe non-hazardous area, to the electrode station. The ozone extraction system must also have its' own dedicated ducting from the electrode station through the fan to atmosphere. The ducting should not be linked into a centralised ducting system as changes to other equipment can upset the pressure balance within the electrode station creating a potentially hazardous situation.

The damper valves are required to be fitted no closer to the fans than 6 times the duct diameter. The pressurisation fan inlet filter must be regularly checked and cleaned (refer to Maintenance and Inspection Procedure section of this manual).

When live high voltages are present within this equipment, ALL maintenance must be carried out with the mains supply disconnected from the system.

Electrode Assembly Removal (ASSEMBLY TYPE UNITS ONLY)

The electrode insulator assemblies may be removed for cleaning by turning the slotted screw inside the gap adjuster tube one quarter turn anti-clockwise. The insulating blocks may then be cleaned using a clean, dry, lint free cloth. The assembly is refitted and locked in position with one quarter turn clockwise of the mechanism.

When an electrode assembly has been removed and refitted it is essential that a resistance check is made for continuity between the HT transformer output and the electrode. The mechanical contact is made by a spring loaded ball and if this is not made arcing can occur at this point causing damage to the macralon and PTFE components of the assembly.

SECTION B

When live high voltages are present within this equipment, ALL maintenance must be carried out with the mains supply disconnected from the system.

Electrode Units

1. Clean dielectric sleeves with soap and water.
   Replace any sleeves that are damaged.

2. Inspect and clean all ceramic and PTFE insulators. Replace any that are broken or show signs of arcing.

3. Remove HT transformer and clean output insulator.

4. Remove and clean quartz tube assembly units with soap and water. (See Section C for removal).

5. Clean inside and outside of unit.

6. Clean aluminium and stainless steel segments with wire brush and separate any that are corroded together.

7. Clean aluminium 'U' section and multi fin electrodes with wire brush.

8. Clean gap adjusters, tilt screws, tension springs and regrease.

9. Set air discharge gaps by moving the calibrated gap adjusters, and tilt adjusters.

10. Check HT links for tightness on electrode bar, and ensure 40mm spacing to earth.

11. Check speed sensor magnets are in correct order on base roll.
    ie, red, blue, red, blue (N, S, N, S).

12. Check speed sensor probe is 5mm away from magnets and 1mm for studs and adjust as required.

13. Check pneumatic cylinders for air leaks and repair as required.

14. Check pneumatic open/close operation of unit or assemblies for smooth opening and closing and adjust as required.

15. Check safety interlock switches are tight.

16. Check for free rotation of base and idler rolls. Replace any worn bearings.

17. Remove HT transformer terminal cover and check tightness of electrical connections.

18. Check ozone extraction ducting for leaks and repair any found.

19. Remove extract fan and clean impeller and fan housing.

20. Remove inlet filter from pressurisation fan and clean (if applicable).

21. Remove pressurisation fan and clean impeller and fan housing (if applicable).

22. Check pressurisation ducting for leaks and repair any found (if applicable).

23. Check gaskets and all seals on station and repair as necessary (if applicable).

SECTION C

When live high voltages are present within this equipment, ALL maintenance must be carried out with the mains supply disconnected from the system.

GX Generator Maintenance

1. Replace any defective LED's.

2. Check speed circuit operation. See Section D, Para 2

3. Check that all cooling fans are rotating and impellers are clean.

4. Check all output cables for damage.

5. Check alarm circuit for correct operation, ie, alarm lamp out when digital meter reading is within the limits set by low and high controls and alarm lamp lit when digital meter reading is outside the limits set by low and high controls.

6. Check that all plugs and sockets are tight.

7. Clean inside of generator compartment, checking tightness of all electrical connections.

8. Remove filters and clean. Replace any filters that are damaged.

9. Clean outside of generator.

SECTION D

When live high voltages are present within this equipment, ALL maintenance must be carried out with the mains supply disconnected from the system.

Final Checks

1. Check interlock circuit for correct operation, ie, interlock LED goes out when:-

    a. any window is opened (if fitted)
    b. electrode is opened or rotated
    c. ozone extract fan is stopped

2. With generator on, and electrode unit open, rotate base roll and check that the speed sensor LED lights, and goes out when base roll stops. Adjust speed threshold as in generator manual.

3. Generator and electrode unit handed back to operator, with instructions to operator to check dyne levels of materials when line is running.

4. When line is running check maximum output of generator that can be achieved.

5. Check interlock circuit again as in Para 1. This time check that treatment stops when (a), (b) & (c) are operated.

SHEET A

CUSTOMER MAINTENANCE AND INSPECTION PROCEDURE

When live high voltages are present within this equipment, ALL maintenance must be carried out with the mains supply disconnected from the system.

GENERATOR CHECK LIST

		MAINTENANCE INTERVAL				
No.	CLEAN	Daily	Weekly	2 Weeks	Monthly	3 Months
1	All lamps light up		☼			
2	Speed circuit operation		☼			
3	Rotation of fan		☼			
4	All output cables for damage				☼	
5	Alarm operation (where fitted)			☼		
6	Tighten plugs and sockets				☼	
7	Tighten screws and nuts					☼

		MAINTENANCE INTERVAL				
No.	CLEAN	Daily	Weekly	2 Weeks	Monthly	3 Months
1	Filters				☼	
2	Outside of generator cabinet					☼
3	Inside of generator cabinet					☼

SHEET B

When live high voltages are present within this equipment, ALL maintenance must be carried out with the mains supply disconnected from the system.

CUSTOMER MAINTENANCE AND INSPECTION PROCEDURE
ELECTRODE UNIT CHECK LIST

		MAINTENANCE INTERVAL					
No.	CHECK	Weekly	2 Weeks	Monthly	3 Months	6 Months	Yearly
1	Air gap	✓					
2	HT links are not arcing	✓					
3	HT links are tight	✓					
4	HT contact ball			✓			
5	HT ball spring for easy movement						
6	Magnets/studs on correct end of base roll		✓				
7	Box opens and closes freely and easily (if applicable)			✓			
8	Pistons and pipes for air leaks		✓				
9	Each tube assembly rotates freely		✓				
10	Each tube assembly opens/closes freely with pneumatics		✓				
11	Window safety switches operate (where fitted)		✓				
12	Safety microswitches function correctly		✓				
13	All interlocks stop generator when operated						
14	Speed probe is 5mm from magnets or 1mm from studs		✓				
15	Base and idler rolls rotate freely			✓			
16	Ozone duct for leaks					✓	
17	Fixing screws are tight					✓	
18	Ozone extract fan impeller						✓
19	Pressurisation ducts for leaks (if applicable)					✓	
20	Condition of door seals & gaskets		✓				
21	Pressurisation fan impeller (if applicable)						✓

SHEET C

CUSTOMER MAINTENANCE AND INSPECTION PROCEDURE

When live high voltages are present within this equipment, ALL maintenance must be carried out with the mains supply disconnected from the system.

ELECTRODE UNIT CHECK LIST

		MAINTENANCE INTERVAL					
No.	CLEAN	Weekly	2 Weeks	Monthly	3 Months	6 Months	Yearly
1	Dielectric roll covering		✓				
2	All electrode insulators			✓			
3	HT transformer insulator			✓			
4	Wipe surface of tubes		✓				
5	Viewing windows (where fitted)		✓				
6	Tube assembly after removal		✓				
7	Drain water from air regulator (if fitted)		✓				
8	Inside and outside of electrode unit				✓		
9	Segments: Discharge surface and movement			✓			
10	U-section and Multifin: Discharge surface			✓			
11	Pressurisation fan filter (if applicable)		✓				

		MAINTENANCE INTERVAL					
No.	GREASE	Weekly	2 Weeks	Monthly	3 Months	6 Months	Yearly
1	Tilt adjuster (where fitted)			✓			
2	Gap adjuster screws			✓			
3	Tilt springs (where fitted)				✓		

SECTION 7

DESCRIPTION OF CIRCUIT OPERATION

7.1 Circuit Overview

The mains passes through a mains filter for EMC requirements.

On operation of the mains isolator on the door, the fan starts and power is fed into the GXR Inverter Control PCB via T1 transformer.

If all the interlocks conditions are met, depressing the START BUTTON will operate K1 and after a short delay K2 and K3.

The mains is rectified by BR1, creating a DC rail of 330V ±30V.

The inverter switches this voltage creating a 660V ± 60V square wave at its output. L1 smooths the output and C2 decouples it.

Feedback control and power measurement is achieved via CT2, the output current transformer and T2, the voltage feedback transformer.

To assist the description, the control relays on the inverter control PCB will be denoted by a lower case k, and the relays mounted on the chassis plate by an upper case K.

7.2 Power Supply

The GXR Inverter Control PCB is powered via T1, which has four independent ac outputs. These enter the PCB by TB10. When rectified these produce four 24 Vdc supplies.

. 24V(A) powers the auxiliary circuits:

Interlocks
Skip/Treat Sensor
Rotations Sensor
Indicators on Door

. +24V(B) and -24V(B) are regulated to produce a dual ±15V (B) board supply, used to power all the analogue circuits.

. 24V(C) powers the computer interface circuits.

The 24V(A) and ±24V(B) zero volt lines are linked at the star earth. The 24V(C) supply is completely isolated and floating.

7.3 'Major or Hard' Interlocks

Refer to the overall circuit diagram and the relay circuit. The interlocks are powered from 24V(A) via SKT4. If all the treater interlocks (door switches, air flow switches etc.) are closed then 24V flows through the external STOP switch (normally closed) and the local STOP switch and enters the Inverter Control PCB at TB1.5.

If all the interlocks and stop switches are closed k6 will operate and the INTERLOCKS LED will illuminate. If none of the thermal switches have opened, k7 will operate.

The generator is now in a stand by state. On depression of the START button, K6 closes and a contact from this closes K1, after a short delay to allow C1 to charge up, K4 and K5 close and contacts from these close K2 and K3 allowing full power to the inverter.

If any of the interlock switches, stop switches or thermal switches open, then the interlock relay K6 will de-energise and this will then remove the 24 volt supply to K4, K5 and K6 relays and in turn will then de-energise K1, K2 and K3 relays and disconnect the supply to the inverter and the output.

To restart the generator, the fault must be remedied and the START button depressed again.

7.4 'Minor or Soft' Interlocks

There are a number of interlocks which prevent the generator from producing an output only while the fault condition exists. It is not necessary to depress the START button again after these faults.

7.4.1 Line Speed

A proximity detector is connected to SKT2 to detect the line speed. The pulses are converted into a dc signal which is normally set to 10V at full line speed, by adjusting RV6 until LED2-J and LED3-A are both flashing at the same rate. SW3-A (normally in the up position) is used to select ranges (3-23Hz or 17-380 Hz). If the line speed signal drops below the voltage (UTS limit), k10 de-energises and a NOT UP-TO-SPEED signal is produced.
Adjustment of the minimum Up To Speed level is adjusted by RV13.

7.4.2 Positive and Negative Mismatch

If the reactive power exceeds a preset value of the full rated output power of the generator, then the positive or negative mismatch relays will operate, depending on the sign of the reactive power signal. For analysis of this fault condition see Section 8.

Although the fault signals produced by these circuits last only as long as the fault, the mismatch and shutdown indicators remain on until the reset switch is operated.

7.4.3. Current Trip

CT2, detects an overcurrent on the inverter output. This would occur should the output become short circuited, or if all the FETS turned on at the same time. The output of CT2 turns off the output rapidly for a severe overload.

7.4.4. Auxiliary Shutdown

An additional shutdown pin, TB6.6, has been incorporated to allow for any other 'soft' interlocks, one of the gates of IC36 will go high and a shutdown signal will appear on pin 13, causing the pulse width modulation (PWM) circuit to turn off all the FETS. When the shutdown signal returns to a low again, the (PWM) circuit goes through a soft-start whereby the output slowly increases to its normal value, allowing time for continued faults to be detected prior to full power being delivered to the treater. The shutdown indicator will remain on until the reset switch is operated.

7.4.5 Skip/Treat - Optional

A skip sensor may be connected to SKT4. If a low voltage is detected, a SKIP/TREAT signal is operated.

The skip signal is applied directly to the PWM circuit. It has a fast response on shut down and recovery, enabling accurate and fast SKIP/TREAT sequences.

The shutdown indicator is not affected by the SKIP signal.

7.5 Power Control

The power demand signal is 0-10V for min - max output power. One of three methods of control is selected by SW2:

. Manual, (switch fully anti-clockwise).
. Proportional, (switch centre position).
. Remote, (switch fully clockwise).

7.5.1 Manual

The power demand signal is varied by the power potentiometer on the cabinet door.

7.5.2 Proportional

If the line speed signal is set to 10V at full line speed, then the output power is proportional to the line speed, giving full power at full line speed. This enables a constant treatment level to be achieved despite fluctuations in line speed.

7.5.3 Remote (Optional)

The remote power demand input is discussed in Section 7.7.1. If this switch is selected then inputs on computer interface will control the output even if the generator is in the local mode.

7.6 Pulse Width Modulation (PWM) Circuit

The power demand signal causes the PWM circuit to switch the inverter at the necessary duty cycle, until the TRUE POWER signal equals the POWER DEMAND signal.

Outputs A and B of the PWM circuit have the same pulse width, but are 180^{o} out of phase. There is always a short deadtime between O/P A going low and O/P B going high, and vice versa, to prevent large switching transients.

The inductor L1 creates a resonant circuit with the capacitance C2 and the impedance of the electrodes in the treater causing a sine wave to appear across the HT transformer input.

7.7 True and Reactive Power Measurement

The O/P voltage and current are sensed by T2 and CT2, multiplied to give true power and conditioned to provide reactive power measurement. They are both calibrated to read 10V at full rated power. The True power signal is used as feedback in the PWM circuit to ensure that the O/P power matches the demand power.

A switch is provided on the door to select between true and reactive power.

7.7.1 Remote

Overall Circuit diagram shows the remote connections where fitted including the following interfaces:

ANALOGUE i/p & o/ps

. 4 - 20mA or 0-10V Power Demand i/p
. 4 - 20mA or 0-10V True Power o/p
. 4 - 20mA or 0-10V Reactive Power o/p

DIGITAL CONTROL SIGNALS

i/p Voltage - 5-24V
i/p Current - 2-10mA

REMOTE/LOCAL SELECT

REMOTE TREAT/SKIP

REMOTE NOT STOP:

REMOTE START	:	In remote mode generator may be started using REM START, EXT START or LOCAL START. To ensure generator may only be started remotely, hold REMOTE NOT STOP low until ready to press REMOTE START.
REMOTE RESET	:	Resets POSITIVE and NEGATIVE MISMATCH, TRIP SHUTDOWN, relays and indicators.

SECTION 8

TROUBLE SHOOTING

In the event of a problem, carefully follow the procedures listed below. Bear in mind that HIGH VOLTAGES exist within the inverter cubicle and any checks within the cubicle must be carried out with the MAIN SUPPLY ISOLATED. 30 SECONDS SHOULD BE ALLOWED AFTER ISOLATION OF SUPPLY FOR THE DISCHARGE OF CAPACITORS WITHIN THE UNIT.

8.1 CBI Trips

This will be due to either a faulty bridge rectifier BR1, or a problem with the capacitor precharge circuit.

8.2 Inverter Overtemperature

(i) Check that the fan is operating and all air inlets and outlets are clear. Change the filter if it is excessively dirty. If the fan has failed, check fuse FS1 on the DIN rail.

(ii) Check that the the generator is not being exposed to excessive heat.

If the problem persists, consult Sherman Treaters Service Department for advice.

8.3 Generator Keeps Tripping

i.e. TRIP light comes on during treatment.
Reset generator at low power and set to operational level. If fault persists, consult Sherman Treaters Service Department.

8.3.1 Poor Match

Select correct tap on transformer. Follow procedure described in (Section 5) for optimizing the match.

8.3.2 Incorrect Electrode Gap

Reset the gap (Section 4.1)

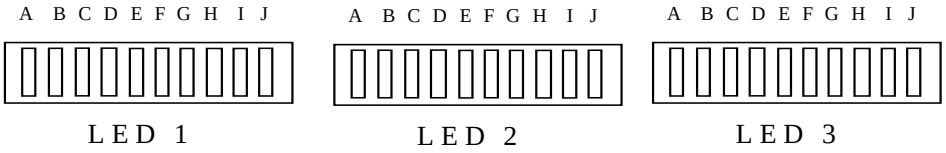
Check that transformer tapping is still optimum.

8.3.3 Fault in Electrode System

Check the electrode unit and look for extraneous flashes in the treater during operation (e.g. from leads to case. Check that all the insulators are clean, and the dielectric sleeve and the discharge tubes are clean and not pinholed).

8.3.4 LED Arrays and SW1, SW2 and SW3 positions

Three LED arrays have been included on the PCBs to assist in trouble shooting. These are designated as below:



LED 1 (GREEN)	A	24V(A)
	B	15V(B)
	C	-15V(B)
	D	15V(C)
	E	Interlock Closed
	F	Over-temperature
	G	24V(B)
	H	Start
	I	Relays Closed
	J	Line up to Speed
LED 2 (RED)	A	Shutdown
	B	Positive Mismatch
	C	Negative Mismatch
	D	Overcurrent Trip
	E	Skip
	F	Skip Signal
	G	Remote Skip/Treat
	H	High Alarm
	I	Low Alarm
	J	Up To Speed Signal

LED 3 (GREEN)

A	Up To Speed Signal
B	Rotation Sensor
C	
D	Treat On
E	
F	
G	No error driver one
H	No error driver two
I	Remote not stop
J	Remote/Local Select

frequency control - up=man down=auto
SW1-B Not used
SW1-C Not used
SW1-D Not used

SW2	LEFT	-	Manual
	CENTRE	-	Proportional
	RIGHT	-	Remote

SW3-A Up To Speed High/Low Frequency	-up=high
SW3-B Up To Speed override	-down=sensor input
SW3-C Skip delay override	-down=override
SW3-D Pwr demand 0-10v/4-20ma	-up=0-10v, down=4-20ma

SECTION 10

PARTS LIST FOR GX30R

CABINET DOOR

CIRCUIT DESCRIPTION

LAMPS		PART NUMBER
LP1 OVERTEMPERATURE	(RED)	122.0109
LP2 MISMATCH	(RED)	122.0109
LP3 TRIP	(RED)	122.0109
LP4 LOW ALARM	(RED)	122.0109
LP5 HIGH ALARM	(RED)	122.0109
LP6 SHUTDOWN	(RED)	122.0109
LP7 UP TO SPEED	(GREEN)	122.0110
LP8 TREAT ON	(GREEN)	122.0110
LP9 INTERLOCKS	(GREEN)	122.0110
LP10 MAINS ON	(AMBER)	122.0111
LP1/9 LAMPHOLDER + 24V LAMP		122.0117
LP1/9 24VOLT LAMP		123.0048
LP10 TRANSFORMER LAMPHOLDER+ 6V LAMP		122.0121
LP10 6 VOLT LAMP		122.0122
SWITCHES		PART NUMBER
SW1 START BUTTON (WHITE) + CONTACT BLOCK		122.0115+ 122.0118
SW2 STOP BUTTON (RED) + CONTACT BLOCK		122.0135 + 122.0119
SW3 RESET/LAMP TEST + CONTACT BLOCK		122.0114 + 122.0118

SWITCHES – GX30R		PART NUMBER
SW4 TRUE/ REACTIVE/FREQUENCY SWITCH		122.0120
SW5 ALARM ON/OFF + CONTACT BLOCK		122.0112 + 122.0118
POTENTIOMETERS		
RV1 POTENTIOMETER 5K + KNOB KIT (POWER)		101.0059 + 101.0061
RV2/3 LOW/HIGH ALARM POTENTIOMETER 5K + KNOB KIT		101.0109 + 101.0150
RV4 FREQUENCY. 10 TURN 5K POTENTIOMETER		101.0089
RV4 POTENTIOMETER DIAL MECHANISM		202.0049
DM1 DIGITAL METER PANEL		125.0016
IS1 MAINS ISOLATOR GX30R-100R		122.0092

PARTS LIST FOR GX40R - 100R

FRONT PANEL & DOOR		
FRONT PANEL		301.4050
POTENTIOMETERS:		
RV1/2/3/4 10 TURN 5K POTENTIOMETER		101.0089
RV1/2/3/4 POTENTIOMETER DIAL MECHANISM		202.0049
DMI DIGITAL METER		125.0016
LAMPS:		
LED 1,2,3,4 GREEN LED		123.0067
LED 5,6,7,8,9,10 RED FLASHING LED		123.0074
LAMP1 TRANSFORMER LAMPHOLDER + 6V BULB		122.0121
LAMP1 6V LAMP		122.0122
SW1/2 P/BUTTON DOUBLE HEADED OPERATOR		122.0144
SW3 P/BUTTON BLUE (RESET)		123.0072
SW5 P/BUTTON GREEN (ALARM)		123.0073
SW4 SELECTOR SWITCH		122.0120
TERMINALS SAK 2.5		127.0014
INVERTER CONTROL PCB (STATE GENERATOR TYPE WHEN ORDERING)		301-3061

CABINET ASSEMBLY GX30R-100R

INVERTER HEATSINK

CIRCUIT DESCRIPTION	PART NUMBER
GX30R 3KW INVERTER HEATSINK ASSEMBLY	103.0194
GX40R 4KW INVERTER HEATSINK ASSEMBLY	103.0165A
GX50R 5KW INVERTER HEATSINK ASSEMBLY	103.0234
GX75R 7.5KW INVERTER HEATSINK ASSEMBLY	103.0196
GX100R 10KW INVERTER HEATSINK ASSEMBLY	103.0196
MAINS FILTER	
MF1 MAINS FILTER GX30R	103.0155
MF1 MAINS FILTER GX40/50R	103.0189
MF1 MAINS FILTER GX75/100R	103.0197
TRANSFORMERS	
T1 PSU TRANSFORMER	111.0107
T2 VOLTAGE FEEDBACK TRANSFORMER	111.0108
T3 MAINS INPUT TRANSFORMER GX30R	111.0114
T3 MAINS INPUT TRANSFORMER GX40/50R	111.0110
T3 MAINS INPUT TRANSFORMER GX75/100R	111.0112
CT1/2 CURRENT TRANSFORMERS GX30/40/50R	111.0085
LI INDUCTOR GX30/40/50R	111.0109
L1 INDUCTOR GX75/100R	111.0113
CT1/2 CURRENT TRANSFORMERS GX75/100R	111.0111

CIRCUIT BREAKER	PART NUMBER
CB1 CIRCUIT BREAKER GX30/40/50R	122.0106
CB1 CIRCUIT BREAKER GX75/100R	122.0125
CONTACTORS	
K1/3 CONTACTOR GX30/40/50R	122.0107
K2 CONTACTOR GX30/40/50R	122.0108
K1/2/3 CONTACTOR GX75/100R	122.0123
K2 AUX CONTACT BLOCK GX75/100R	122.0124
K5 24V RELAY GX40-100R	122.0131
K6/7 24V ALARM RELAYS + K4 RELAY GX40-100R	122.0133
K5 RELAY BASE GX40-100R	122.0132
K6/7/8 RELAY BASE (DPCO) GX40-100R	122.0134
CAPACITORS	
C1 CAPACITORS 1500 uF - GX30R	102.0044
C2 CAPACITORS 0.22uF GX30/40/50R	102.0099
C2 CAPACITORS 0.22uF GX75/100R	102.0029
CAPACITOR GX30R	102.0028
RESISTORS	
R1/2/3 RESISTOR 100R 25W	101.0149
R4 RESISTOR 2K2 25W	101.0113
FUSES	
FS1-4 FUSE HOLDER	123.0058
FS1/2 FUSE 1AMP	123.0012
FS1-4 PCB FUSES 2 AMP	123.0063
FS3/4 FUSE 500 MAMP GX40-100R	122.0068

PLUGS AND SOCKETS	
PL1 MAINS 5 WAY PLUG GX30R	121.0011
SK1 MAINS 5 WAY SOCKET GX30R	121.0012
SK3 HT 7 WAY SOCKET GX30R	121.0083

PL5 ALARM 7 WAY PLUG GX30R	121.0003
SK5 ALARM 7 WAY SOCKET GX30R	121.0004
SK2 ROTATION SENSOR 3 WAY SOCKET - GX30-100R	121.0029
SK4 INTERLOCKS 14 WAY SOCKET GX30-100R	121.0010
SK5 ALARMS 7 WAY SOCKET GX40-100R	121.0014
PL4 INTERLOCKS 14 WAY PLUG GX30-100R	121.0056
PL5 ALARM 7 WAY PLUG GX40-100R	121.0015
FANS	
FAN 230VAC GX40/50R	124.0028
FAN FILTER KIT GX30R	124.0017
FILTER GX40-100R	202.0024
SUPPRESSOR K1,2,3 GX75/100R	122.0155
EMC	
SHIELD BEADS (SINGLE)	132.0124
SHIELD BEADS (DOUBLE)	132.0125
PCB SURGE SUPPRESSOR PCB1	301.6154
PCB SURGE SUPPRESSOR PCB2	301.6155
PCB SURGE SUPPRESSOR PCB3&4	301.6156
TERMINALS	
TERMINAL SAK 6N GX40/50R	127.0043
TERMINAL SAK16 GX75/100R	127.0031
HT TRANSFORMERS	
HT 3 GX30/40/50R	111.0051
HT 8 GX75/100R	111.0079
HT10	111.0082
HT11	111.0126

SECTION 11 Procedure for Setting Reactive Power to Zero

The generator and spare PCB's are sometimes sent to customers without an electrode unit, and it may be necessary to calibrate the reactive power. This is done by the following procedure.

1. Switch the generator into manual frequency control. This is done by switching SW1-A (brown switch) to the up position.

2. Set frequency potentiometer situated on the front panel fully anti-clockwise.

3. Set output power potentiometer to minimum.

4. Switch on generator.

5. Adjust output potentiometer to maximum.

6. Increase frequency until maximum true power is reached.

7. Switch to reactive power and the reading should be zero.

8. If not zero adjust RV3 potentiometer situated on the PCB so that the reactive reading is zero.

Note: If the generator should trip on mismatch during step 6 then reset the generator and note the reactive power reading and adjust RV3 until reactive zero. Then do steps 6,7 and 8.

Auto frequency control

When the reactive is zero and tru power is at maximum switch SW1-A to the down position to run the generator in auto frequency. (This makes the frequency potentiometer inoperative.) The reactive power will have a small reading but this is normal.

MACHINERY SAFETY

1. Corona treatment equipment operates at very high voltages (up to 15000 Volts) at electrodes. It is essential that the utmost caution is taken when operating and maintaining equipment, where dangerous voltages are present they are indicated by the hazardous voltage warning label ISO 3864 No. B.3.6.

No access is permitted to the area indicated by this symbol **UNLESS** the power supply is isolated.

2. The treatment process produces ozone gas as a by product. It is the customer's responsibility to ensure that the unit is connected to a suitable extraction system and or catalytic converter constructed from corrosion resistant materials.
   Ozone extraction outlets are identified by the above label.
   (See Appendix 1.)

3. The generator is equipped with a dust filtration system indicated by the caution symbol ISO 3864 No. B.3.1 symbol. If this system blocks, see routine maintenance section as the unit may overheat.

4. When isolating the Generator supply a small time delay of <5 seconds is needed for power to drain from capacitors via leakage resistors. Service engineers opening the doors should be aware of this.

5. Care must be taken to avoid injury from moving parts, such as rotating rolls, moving electrode assemblies and sensor probes at roll ends. Where risk is considered high guards are fitted.

6. Some machines are designed to be 'open' construction. It is the customer's responsibility to ensure access is safe. Fence type guards or other protection can be ordered separately at order placement or subsequently.

NB Sherman treaters cannot specify guarding of interfaces between their machinery and the machinery into which it is to be incorporated because of the unique requirements of each installation. Therefore Sherman Treaters have supplied machinery with residual mechanical and electrical risks which must be safe-guarded by the user. Access to Sherman Treaters machinery must be prevented at all times when the HT electrodes are energised.

12 Ozone: Health Hazards and Precautionary Methods

Guidance Note EH38 from the
Health and Safety Executive

OZONE : Health Hazards and Precautionary Measures

Environmental Hygiene Series 38 (July 1983)

These Guidance Notes are published under five subject headings: Medical, Environmental Hygiene, Chemical Safety, Plant and Machinery and General.

INTRODUCTION

1. This guidance note contains information on the principal hazards to health from ozone and on potential sources of exposure. General advice on precautionary measures, control techniques and legal requirements is given.

2. Ozone, O3, is a toxic gas possessing a distinctive odour and is a normal constituent of the earth's atmosphere. Ozone is produced deliberately for a variety of industrial purposes and is also produced naturally from oxygen whenever ultra-violet radiation or electrical discharges occur, e.g. at high altitudes or by the action of lightning. Such natural occurrence is unlikely to produce concentrations hazardous to man.

3. Because of its strong tendency to decompose and to release oxygen, ozone is extremely reactive and is a powerful oxidising agent which reacts explosively with oil and grease. Nevertheless it can be used with safety in industry. For example, since it readily oxidises organic matter, it is used as a bactericide and algaecide.

4. Ozone itself is a distinctly blue coloured gas (bp – 111.9ºC) and is about one and a half times heavier than air (density 2.144g/l). Ozone is used as "ozonised air", a colourless gas produced when ozone is generated from part of the oxygen in air (see para 13). Ozone cannot be stored or transported in vessels because it decomposes spontaneously in the presence of oxidisable impurities, humidity and solid surfaces. The rate of decomposition increases with temperature.

5. Background concentrations in our immediate atmosphere vary as a function of season, weather conditions, altitude and humidity.

EFFECTS OF OZONE

6. Low concentrations of ozone have a significant effect upon textiles, fabrics, organic dyes, metals, plastics and paints and cause the characteristic cracking of stressed rubber, commonly called "weathering". A few substances, however, are resistant to the oxidising effect of ozone and these include glass and some stainless steels.

7. The acute toxicity of ozone to man has long been recognised and is well documented[1-8]. The symptomatic and clinical effects of ozone at various concentrations are summarised in Table 1. Ozone is irritant to mucous membranes of eyes and respirator tract, and high concentrations can cause pulmonary oedema.

8. It is possible that there are secondary sites of reaction to ozone characterised by a defect in oxygen dissociation from oxyhaemoglobin in the tissues. Even at an exposure level of 0.1ppm ozone, premature ageing may result in man if exposure is sufficiently prolonged.

EXPOSURE LIMITS

9. The Health and Safety at work etc Act 1974 requires every employer to ensure, so far as is reasonably practicable, the health of all his employees and others who may be affected by the work he undertakes. The Act also places duties in respect of health and safety matters on the self-employed. The Factories Act 1961 requires factory occupiers to take all practicable measures to protect employed persons against inhalation of fume. The general policy adopted by the Health and Safety Executive is that exposure to hazardous substances should be kept at low as is reasonably practicable and in any case exposure should be kept within published standards by the application of engineering controls or other suitable control techniques. The Health and Safety Executive publishes, in guidance notes in the RH series, information on exposure limits applied in the UK.

10. The recommended exposure limit for ozone is 0.1ppm (0.2mg/m^3) calculated as an 8-hour time-weighted average concentration. There is also a short-term exposure limit for ozone of 0.3ppm (0.6mg/m^3) calculated as a 15-minute time-weighted average concentration.

SOURCES OF EXPOSURE

11. Ozone is made using ultra-violet radiation or electrical discharge either intentionally for the purpose of a specific process or incidentally to a process. It is an unstable substance but is rate of decomposition varies widely according to temperature and humidity. A given ozone output yielding a faint trace of ozone in a workroom atmosphere on a humid day may created an undesirable concentration on a dry day.

INTENTIONAL PRODUCTION

12. Ozone is usually produced intentionally by silent electrical discharge in air. Alternative means of production such as bombardment of air with ultra-violet or ionising radiation, or electrolysis of cooled sulphuric acid , are uncommon in practice.

13. There are basically three types of ozone generator in use, working at:

(a) Atmospheric pressure – typically a box through which material to be treated with ozone is passed, and in which a silent electrical discharge is initiated through the air be means of metal electrodes. This system is often used for surface treatment of plastic film.

(b) Reduced pressure – found in swimming pool disinfection plants whereby dried air is drawn through glass tubes across which is a silent electrical discharge is struck. The reduced pressure is generated by a sidestream from the circulating pool water forming a venturi vacuum.

(c) Positive pressure – found in potable water treatment plants and throughout industry generally. Dried air is blown through glass tubes across which a silent electrical discharge is struck and this ozonised air emerges at positive pressure.

14. The processes for which ozone is produced are outlined below.

SURFACE TREATMENT

15. Various industries which manufacture or use plastic packaging in its various forms use ozone to pre-treat the plastic surface immediately before printing.

ELECTRICAL DISCHARGES

16. Ozone is generally produced around high voltage equipment and by electrical discharges in specific processes e.g.

(a) Arc welding – reactive metals such as aluminium and titanium, and also stainless steel are arc welded in an inert shield of argon or carbon dioxide. The intense radiation from the arc produces significant quantities of ozone.

(b) Static eliminators are often used in industry to remove static electricity from recently moulded plastic articles, and continuous use of them in a poorly ventilated room could lead to the build-up of an irritating level of ozone above the recommended exposure limit. The main factor which determines the amount of ozone produced is the voltage across the collector plates; the higher the voltage the more ozone is produced.

(c) Electrostatic precipitators are used to remove dust and some airborne contaminants from the air and they produce ozone also. More ozone is produced if there are rough or sharp edges on, for example, new metal parts since intense local voltage gradients are produced.

VENTILATION

17. Areas into which ozone may escape must be equipped with adequate ventilation and extraction facilities. In ozone plant rooms, it is recommended that ten changes of room air per hour be achieved to enable dangerous accumulations of gas to be dispersed within a few minutes.

18. Ozone should be prevented from entering the workroom air by the use of exhaust appliances placed close to the source of emission. The ozone may then be passed through appropriate filters before discharge to a safe place in the open air. In the case of ozonators operating under negative pressure, the process acts as its own exhaust ventilator. In the case of atmospheric pressure ozonators, effective local exhaust ventilation is necessary because the ozonators are not enclosed. Cinema projection lamps should present no ozone hazard provided adequate mechanical exhaust ventilation is fitted to the lamp housing and the exhausted air is vented to a safe place. Many processes incidentally producing ozone (e.g. welding, ultra-violet curing inks) will have some ventilation provided to deal with other problems from process.

SAFE SYSTEMS OF WORK

19. In order to ensure that plant and processes are properly operated and controlled to minimise risk to health, satisfactory safe systems f work need to be established and maintained by means of appropriate training and supervision.

20. All people operating ozone plant should be given full training in all aspects of the operation of the ozonator and associated equipment and should be trained in emergency and first aid procedures. Emergency action plans should be prepared for all sites where ozone is generated deliberately in potentially hazardous quantities.

21. Special care may be required when opening sealed plant for maintenance purposes. Guidance Note GS5[10] should be consulted for detailed advice on permit-to-work systems and precautions on entry into confined spaces.

22. Work on ozone plant should only be undertaken by a person specifically authorised to do the work. Such a person should be trained and be competent to do the work in a safe manner. When carrying out repairs or maintenance work on an ozonator, the ozonator transformer must be isolated and locked off, and a permit to work must be issued, to avoid risks from ozone and from electrical hazard.

23. The cleaning materials used for cleaning ozone units and pipework must be free from oil or grease.

24. In the event of an ozone leak a plant restart should not be attempted until the source of leakage has been investigated and rectified. Leak detection by nose is not satisfactory because even slight leaks cause the sense of smell to be numbed and lead to the false conclusion that a leak no longer exists.

25. Appropriate warning signs indicating the presence of a potential toxic gas hazard should be displayed on ozone plant access doors or in passageways leading to the plant room.

MONITORING

26. Ozone detectors may be used to provide audible and visual warnings of ozone leaks. Such alarm signals may be used to initiate emergency procedures, or to automatically turn on plant room ventilation and shut down the ozonator. Ozone-in-air monitors are essential in plant rooms where ozonators and associated equipment operate under positive pressure, because of the greater risk of ozone leakage outward. The monitors in such situations should actuate automatic ozonator shut down at 0.3ppm ozone or less, while actuating warning alarms at 0.1ppm or less.

27. Minor ozone leaks can be detected and located by means of moist starch/potassium iodide paper which turns blue on exposure to ozone.

28. It is essential to carry out regular testing and calibration of all sensor equipment used.

EXHAUST EMISSION

29. Process gas venting to atmosphere should pass through an ozone destructor device or be released in such a way as to present no hazard. A destructor is a catalyst filter or other device which causes ozone to decompose in a controlled manner to oxygen. Provided the discharge point allows adequate dilution a destructor device may not be necessary. If a catalyst bed, for example activated carbon, is used as an ozone destructor it is possible that the bed could become exhausted during a period of operation and this should be borne in mind when arranging maintenance schedules.

30. Deflection weather caps are not recommended for discharge stacks since these hinder dispersal. Vertical discharge stacks are recommended with a discharge velocity of 15-20m/s to aid dispersal and avoid re-circulation into buildings. Stacks and extraction vents should be carefully sited so that they do not feed fresh air ventilation intakes.

31. The control of ozone input to a process is crucial since excess ozone can lead to high levels of vented ozone.

32. Activated carbon filters must under no circumstances be exposed to ozone concentrations higher than 20g/m^3 since the reaction may become auto-accelerated and lead to an explosion. The automatic shutdown is a safeguard against this risk.

FIRST AID

33. If a person is overcome by ozone, the following precautions should be adopted:

(a) Remove the patient to a warm uncontaminated atmosphere and loosen tight clothing at the neck and waist.

(b) Keep the patient at rest.

(c) If the patient has difficulty in breathing, oxygen may be administered provided that a suitable apparatus and a trained operator are available.

(d) If breathing is weak or has ceased, artificial respiration should be started. The mouth-to-mouth or mouth-to-nose methods are preferred.

(e) Seek medical aid.

34. Ozone poisoning should be treated symptomatically. This may include bed rest, analgesics to relieve pain, and antibiotics as may be prescribed by a medical practitioner.

SAMPLING AND ANALYTICAL METHODS

35. Sampling strategies to monitor the extent of exposure to ozone or to assess compliance with exposure limits should be carefully planned and the advice of an occupational hygienist may prove useful. Short-term sampling may be used to identify peak exposures and to assist in the prevention of acute gassing incidents. It may not be valid, however, to use the results of such sampling for the determination of time-weighted average long-term exposures. Personal atmospheric sampling is to be recommended when assessing the actual pattern and duration of exposure. (Further information is contained in Health and Safety Executive guidance notes on Exposure Limits).

36. The traditional method of determining ozone in air may be used[12] but continuous ozone monitors are now available which use a variety of techniques including onemiluminescence, ultra-violet photometry and electro-onemical cells. Relatively inexpensive gas detector tubes are also available. These are ideal for spot check, provided that interfering gases, such as oxidising agents, are known to be absent.

STATUTORY REQUIREMENTS

37. The general duties of employers, the self-employed, manufacturers, suppliers and of employees at work are contained in the Health and Safety at Work etc Act 1974. Other relevant statutory provisions include the Factories Act 1961, the Offices, Shops and a Railway Premises Act 1963 and the various regulations and orders made under these Acts. The following is a brief summary of the principal requirements with regard to potential ozone health risks:

(a) Health and Safety at work etc Act 1974

s.2 & 3 general duties of employers and the self-employed

s.6 general duties of manufacturers

s.7 general duties of employees

(b) Factories Act 1961

s.4 provision of ventilation

s.30 dangerous fumes

s.63 removal of dust of fumes

(c) Offices, Shops and Railway Premises Act 1963

s.7 provision of ventilation

(d) The Shipbuilding and Ship-Repairing Regulations 1960 – Regulation 53

The Iron & Steel Foundries Regulations 1953 – Regulation 7

The Non-Ferrous Metals (Smelting and Founding) Regulations 1962 – Regulation 11

The Electricity (Factories Act) Special Regulations 1944

The Notification of Accidents and Dangerous Occurrences Regulations 1980
The Health and Safety (First Aid) Regulations 1981.

NOTE : FOR SAFETY REASONS IT IS RECOMMENDED THAT A SHERMAN TREATERS OZONE DESTRUCT SYSTEM BE FITTED TO ANY TREATER STATION

THIS EQUIPMENT WAS SUPPLIED TO YOU BY:

Corona Supplies Ltd
for all your corona needs

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PLEASE CONTACT US IMMEDIATELY

THANK YOU