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NATIONAL SAFETY INSTRUCTION

UK BP/SE/NSI 18 HYDROGEN FILLED MACHINES

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UK BP/SE/NSI 18 HYDROGEN FILLED MACHINES

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1 SCOPE

This National Safety Instruction applies the principles established by the Safety Rules to achieve **Safety from the System** for personnel working on **or near** to hydrogen filled machines.

2 DEFINITIONS

Terms printed in bold type are as defined in the Safety Rules.

3 EQUIPMENT IDENTIFICATION

Equipment on which work is to be carried out must be readily identifiable. Where necessary a means of identification must be fixed to it which will remain effective throughout the course of the work.

4 DANGERS

The main **Dangers** to personnel working on **Equipment** containing hydrogen arise from

- burns or bodily injury from the flammable or explosive nature of the gas
- asphyxiation by the purging gas.

5 GENERAL REQUIREMENTS FOR WORK ON **OR NEAR** HYDROGEN FILLED EQUIPMENT

- 5.1 Smoking in or near hydrogen filled **Equipment**, or associated **Equipment** which may contain hydrogen, is prohibited.
- 5.2 **Persons** approaching hydrogen filled **Equipment** must observe all warning and **Danger** signs
- 5.3 The use of any exposed flame, welding equipment **or spark producing process** must only be allowed after the appropriate safety precautions have been taken.

6 WORK ON HYDROGEN FILLED MACHINES

- 6.1 Before work starts which involves opening up any part of a casing normally containing hydrogen the following precautions must be taken
 - a) the hydrogen supply must be **Isolated** and **Points of Isolation** established
 - b) the casing must be **Purged**
- 6.2 Purging must be by the use of an **Approved** vacuum method or by displacing the hydrogen with known quantities of carbon dioxide or another inert gas. **This must be carried out in accordance with appendix 1**
- 6.3 **Site specific procedures are included for hydrogen filled machines at Sundon, appendix 2, and West Weybridge, appendix 3**

- 6.4 The quantity of hydrogen in carbon dioxide or other inert gas, on completion of the purging process must not be greater than 4 per cent. When using carbon dioxide safety measures must be in accordance with, NS-C4 Use of Carbon Dioxide (CO₂).
- 6.5 When work is to be carried out external to a hydrogen filled machine, such as maintenance of hydrogen seals replacement of the carbon dioxide or other inert gas by air is not necessary providing
- a) no part of the casing is dismantled and
 - b) the work place is well ventilated
- 6.6 For all other work the carbon dioxide or other inert gas must then be replaced by air. This can be achieved by passing air through the **Equipment** for not less than 1½ hours.
- 6.7 Before issuing a **Safety Document** which allows opening of the casing, the **Senior Authorised Person** must, if he considers it necessary, call for a Recommendations for **General Safety** Report from an appropriately qualified specialist to confirm that the **Equipment** has been thoroughly **Purged** and that the atmosphere is safe to enter
- 6.8 A **Safety Document** must then be issued certifying that the **Equipment** is free of hydrogen and purging gas. It must include a statement of further precautions to be taken to ensure adequate ventilation is maintained.

7 WORK ON OTHER HYDROGEN FILLED EQUIPMENT

- 7.1 Before work is started on other **Equipment** that may contain hydrogen the following precautions must be taken
- a) that part of the **Equipment** must be **Isolated** from all sources of hydrogen and **Points of Isolation** established.
 - b) enclosures which may contain hydrogen must, where practicable, be opened to atmosphere and thoroughly ventilated
 - c) before issuing a **Safety Document** the **Senior Authorised Person** must, if he considers it necessary, call for a Recommendations for **General Safety** Report from an appropriately qualified specialist to confirm the way in which the **Equipment** must be **Vented**
 - d) **Safety Document** must then be issued which includes a statement of further precautions necessary to clear that part of the **Equipment** of hydrogen.

APPENDIX 1

PROCEDURES FOR PURGING SYNCHRONOUS COMPENSATORS PRIOR TO ISSUE OF SAFETY DOCUMENTS

This procedure details the method that shall be followed to purge synchronous compensators at all substation sites.

The hydrogen contained in the synchronous compensator shall be purged by displacing the hydrogen with a heavier inert gas such as carbon dioxide. This gas shall be introduced at the bottom of the machine casing.

This process will be continued until an inert gas concentration of at least 96% is obtained when measured at the top vent of the machine casing. The top of the machine is specified because at this position the lighter hydrogen gas will be at its highest concentration.

If the required gas quantity has been introduced and the 96% inert gas concentration has not been obtained, the process shall continue until the required concentration is reached.

The insert gas in the machine casing shall then be displaced by clean air.

A portable air blower will now be installed and connected to the top vent of the machine. The heavier inert gas will now be blown out at the bottom of the machine.

This process shall be maintained continuously for a period not less than 1.5 hours, this will achieve more than 4 complete changes of atmosphere within the machine casing.

Care must be taken to avoid concentrations of both hydrogen and inert gas. Gases should be vented where possible directly to atmosphere.

APPENDIX 2

SITE SPECIFIC CONTROLLED PROCEDURE FOR HYDROGEN FILLED MACHINES AT SUNDON

Specific Gas Purging and Access arrangements for Hydrogen Filled Synchronous Compensators at Sundon Sub Station.

1. SCOPE

This procedure is to be used in conjunction with UK BP/SE/NSI 18 and sets down the specific procedures to be adopted in South East Area for purging and access to the hydrogen filled Synchronous Compensators No.6 & 7 at Sundon 400kV Substation.

2. DEFINITIONS

Definitions are in accordance with the NGC Safety Rules.

3. GENERAL REQUIREMENTS

Mixtures of hydrogen and air are explosive over a very wide range of proportions: from 4% to 74% of hydrogen in air by volume. The purity of the gas in the casing during operation is normally maintained at greater than 95% H₂ in air.

Isolated in the context of this document will mean Aby disconnection from source of hydrogen and carbon dioxideA isolation by valves alone is not acceptable.

4. PURGING OF HYDROGEN

4.1 Purging

4.1.1 The machine will be at rest before purging.

4.1.2 Isolation will be by disconnection from the source of hydrogen and CO₂ supply - an isolation by means of valves alone is NOT acceptable.

4.1.3 The casing and ancillary systems of the Synchronous Compensator must be purged by continuously displacing the hydrogen with carbon dioxide and then replacing the carbon dioxide by air.

4.1.4 The procedure to be adopted is detailed in the manufacturer's handbook:

The English Electric Company Limited Operation and Maintenance Instructions for Hydrogen Cooled 60mVAR Synchronous Compensators and Ancillary Equipment.

Sundon Substation VOLUME 1 Main Machines.

GEC Operation and Maintenance Instructions SC 6&7.

These books are held on site at Sundon Substation.

A copy of the purging and gassing procedure is Appendix A of this document.

4.1.5 Prior to the commencement of the purging process the monitoring Katharometers should be zeroed by admitting a pure sample of the gas involved, i.e. CO₂ or H₂.

- 4.1.6 At all times during purging a positive pressure greater than 1 p.s.i.g. must be maintained in the machine.
- 4.1.7 During the displacement of the hydrogen by carbon dioxide, regular monitoring of the H₂ in CO₂ % should be carried out for the slipring, main oil pump compartment, and the lubricating oil tank.
- 4.1.8 The displacement of H₂ by CO₂ is considered complete when H₂ in CO₂ has fallen to 4%. To achieve this approximately 3200 cubic feet, say 8 cylinders, of CO₂ gas are required. The approximate readings will be recorded on the Purging Record, Form F2.
- 4.1.9 Should the purging process be stopped for any reason for more than one hour, mixing of the gases by diffusion can occur. Special care must then be taken to ensure this stage is properly completed and in this case the H₂ in CO₂ purity should be reduced to 4% before completion.
- 4.1.10 The CO₂ must then be displaced by air until the AIR IN CO₂ reading is 100%. The machine will then be purged with air for at least 1.5 hours. The results are recorded on the Purge Record Sheet.

4.2 Opening of the casing

- 4.2.1 Prior to the issue of a Safety Document to allow opening of the casing, the Senior Authorised Person will obtain the signed Purging Record Sheet.
- 4.2.2 A Safety Document will then be issued certifying that on the basis of the Purge Records the Synchronous Compensator is free from hydrogen and carbon dioxide.

4.3 Access procedure for internal work

- 4.3.1 An appropriately trained competent person will then, with the aid of a suitable probe, test for flammable substances, lack of oxygen and the presence of carbon dioxide.

The instruments available at Sundon are an MSA Explosimeter and a Sabre-3 gas monitor. The Sabre-3 should be checked in air for oxygen %age prior to and after use. The instrument will alarm in the event of levels of O₂ in air of less than 19%. A standardised test sample

The MSA meter should be used to test for explosive mixtures of H₂ in air. Carbon Dioxide drager tubes can be used to check the concentration of CO₂ in the confined spaces before entry if the Sabre is faulty.

The person carrying out these tests MUST NOT enter the casing. Long probes are available for this monitoring.

- 4.3.2 A forced ventilation fan can be set up to blow air into one of the access doors or oil tank compartments.
- 4.3.3 An appropriately trained competent person will issue a general safety report including in it the Purge Record Sheet, the tests carried out, the forced ventilation requirements and the need to carry the Sabre-3 into the machine during work to monitor oxygen deficiency or excess. The Sabre-3 will give an audible alarm to preset O₂% 19/23, Flammables (% LEL) 20, and CO (PPM) 50 levels.

4.3.4 It is the responsibility of the Senior Authorised Person issuing the Safety Document to make sure the appropriately trained competent person is fully aware of the extent and nature of the work to be carried out (e.g. use of solvents, certain types of paint, etc.)

4.3.5 The Senior Authorised Person will cancel the PFW which allowed the opening of the casing (5.2.2). A Safety Document allowing work within the Synchronous Compensator will be issued together with the General Safety Report.

4.3.6 For work on the slip ring ends the Senior Authorised Person will issue a PFW to cover opening of the casing and the work requirements, providing the conditions in 4.2.1 and 4.2.2 are satisfied. Depending upon the nature of the work to be carried out in the slip rings or main oil pump compartments he must satisfy himself whether or not to call for a General Safety Report.

5. PRECAUTION ON COMPLETION OF WORK IN THE SYNCHRONOUS COMPENSATOR

5.1 The recipient of the Safety Document must ensure that the persons under his charge are withdrawn and accounted for before the doors of the Synchronous Compensator are boxed up.

6. PROCEDURE FOR REFILLING THE SYNCHRONOUS COMPENSATOR WITH H₂

6.1 It is equally important during the refilling of the casing with hydrogen that explosive mixtures are not formed. Hence the air is expelled with CO₂ and the CO₂ expelled with hydrogen.

6.2 Displace the air with CO₂ until a purity of less than 20% air in CO₂ is obtained. This should require at least 2400 cubic feet or 6 cylinders of CO₂.

6.3 Displace the CO₂ with hydrogen until a purity of 95% is obtained. This requires approximately 3200 cubic feet of hydrogen, say 20 cylinders.

6.4 Throughout the refilling, the slip ring, main oil pump compartment and oil tank need to be regularly sampled and records kept using Form F1.

6.5 To raise the frame pressure to 30 p.s.i.g requires a further 20 bottles of hydrogen.

7. SAFE HANDLING OF H₂ BOTTLES

H₂ bottle valve threads should not be cleared by Ablasting≡ using the bottle valve but should be blown out with air or N₂.

8. REFERENCES

UK BP/SE/NSI NSI 18 "Hydrogen Filled Machines".

English Electric Company Limited manufacturer's handbooks, held at Sundon Substation.

GEC plc, as successors to English Electric Co Ltd

NGC Safety Rules 2nd Edition.

FORM F1

REFILLING RECORD SHEET

SYNCHRONOUS COMPENSATOR No.

OPERATION	DATES		
<p><u>DISPLACING AIR WITH CARBON DIOXIDE</u></p> <ol style="list-style-type: none"> 1. Calibrate Katharometer 2. Time taken to admit CO₂ at start 3. Casing pressure when CO₂ admission ceases 4. Casing purity air in CO₂ on completion 5. Number of CO₂ bottles used <p><u>DISPLACING CARBON DIOXIDE WITH HYDROGEN</u></p> <ol style="list-style-type: none"> 1. Casing pressure prior to hydrogen admission 2. Casing purity air in CO₂ at start 3. Casing pressure when main vent closed 4. Casing purity when main vent closed - H₂ in CO₂ 5. Time taken to main vent closed 6. Number of H₂ bottles used to main vent closed 7. Time taken from main vent closed to working pressure 8. Number of H₂ bottles used from main vent closed to working pressure 9. Casing purity at working pressure H₂ in air 			
ENGINEER			

FORM F2

PURGING RECORD SHEET

SYNCHRONOUS COMPENSATOR No.

OPERATION	DATES		
<p><u>DISPLACING HYDROGEN WITH CARBON DIOXIDE</u></p> <ol style="list-style-type: none"> 1. Calibrate Katharometer 2. Casing pressure prior to CO₂ admission 3. Time taken to admit CO₂ 4. Casing pressure when CO₂ admission ceases 5. Casing purity H₂ in CO₂ when admission ceases 6. Number of CO₂ bottles used <p><u>DISPLACING CARBON DIOXIDE WITH AIR</u></p> <ol style="list-style-type: none"> 1. Casing pressure prior to air admission 2. Casing purity H₂ in CO₂ at start 3. Casing pressure when air admission ceases 4. Casing purity air in CO₂ on completion 5. Time taken to admit air 			
ENGINEER			

APPENDIX 3

SITE SPECIFIC CONTROLLED PROCEDURE FOR HYDROGEN FILLED MACHINES AT WEST WEYBRIDGE

DETAILED PROCEDURES FOR A SYNCHRONOUS COMPENSATORS 1B AND 3B AT WEST WEYBRIDGE.

1.0 INTRODUCTION

In addition to the requirements of the National Safety Instruction (NSI) and Network Services Procedure WE1018, these additional requirements are mandatory and must be adopted when purging Hydrogen Gas or Air from the frame of the Synchronous Compensators 1B and 3B at West Weybridge Substation.

Mixtures of hydrogen and air are explosive over a wide range of proportions - from 4 to 74 per cent hydrogen by volume. The purity of the gas in the frame of the Bruce Peebles Synchronous Compensators at West Weybridge is normally maintained at 95 to 97 per cent.

For work within the frame of the Synchronous Compensator it is necessary to release and purge the hydrogen without producing explosive mixtures.

This is done by first replacing the hydrogen with carbon dioxide (CO₂) and then replacing the CO₂ with air. To this end the Compensators are provided with gas control systems and a comprehensive alarm and gas purity monitoring system.

IMPORTANT: For synchronous Compensators 1B and 3B a minimum of eleven Carbon Dioxide (CO₂) gas cylinders are required to purge the machine of Hydrogen gas or air.

2.0 DETAILED PURGING PROCEDURE BY CONTINUOUS DISPLACEMENT

2.1 Select eleven full CO₂ cylinders and place adjacent to CO₂ manifold.

Close valves G22, G23, G18, G21. Close the hydrogen cylinder valves and disconnect hydrogen cylinders from manifold.

Open valves G4, G7, G9, G14 gradually. Reset machine hydrogen gas pressure alarm for 2lb/in².

Allow machine pressure to fall to 2 lb/in² (approximately 60 to 90 minutes depending on initial pressure and temperature).

2.2 Switch on vaporiser supply in CO₂ Control Cubicle.

Close valve G4 and open valve G12.

Fit first batch of CO₂ cylinders to CO₂ manifold from group of eleven cylinders. Open CO₂ manifold valve G1 or G2 and CO₂ cylinder valves.

Crack open valves G3 and G3A.

Open CO₂ regulator approximately 2 turn and adjust to give downstream pressure of 2 to 5lb/in² and a flow rate of 600cu ft/hr. Reduce flow rate if icing-up occurs.

As the CO₂ cylinders become empty they shall be replaced with full cylinders, the procedure should be continuous, a pause of some minutes only can be allowed between successive cylinders. Each cylinder change shall be recorded on Record Form 'A' attached.

- 2.3 When pressure in the eleventh CO₂ cylinder has fallen to 300lb/in², carry out check on the purity of the CO₂ within the main body of the machine in the following manner.

Close valves G14, G32, G39. Open valves G34, G36, G38 and throttle open G37 to give correct flow of gas through the analyser. If the percentage hydrogen in CO₂ is less than 10 per cent, proceed to item 2.4. If the percentage hydrogen in CO₂ is greater than 10 per cent, close valve G34, open valve G14 and continue purging until the required purity is obtained.

- 2.4 When the required purity of CO₂ has been achieved in the main body of the machine, the oil tank and pipework may be purged of hydrogen as follows:

Ensure minimum pressure of 300 lb/in² in the CO₂ cylinders, open in order valves G42, G43, G46, G47, G39, G32, G33.

After four minutes close in order valves G34, G36, G33, G32, G35, G38, G39, G47, G46, G43, G42.

Open in order valves G29L, G28L, G20L

After four minutes close in order valves G20L, G28L, G29L.

Open valves G18, G14, G19L.

After four minutes close in order valves G19L, G14, G18. Close valves G3AL, G12, G3L. Set CO₂ regulator to zero and close CO₂ cylinder valves.

Open valves G20, G4, G5, G14. Check valves G6, G7, G8, G9, G10, G11, G13 are open.

Close oil valves O8, O10, O12, O16, and check valve O13 is closed.

Switch on air compressor.

After 12 hours open in order valves G19, G46, G47, G42, G43, G39, G37, G35, G33, G32, G29L, G28L. Check valves G38, G36, G34 are open.

Leave for ten minutes then switch off air compressor.

Open oil valves O8, O10, O12, O13, O16.

Open valve G18 and check G5, G6, G9, G15, G16, G17 and G12 are open. Close valves G4, G19, G10, G11 and check G13, G14, G3L and G21L are closed.

Covers may now be removed from the compensator.

CAUTION: Before internal access is made into framework of the synchronous compensator the provisions of NSI 21 section 5 must be followed.

3.0 DETAILED PURGING PROCEDURE USING A GAS ANALYSER.

- 3.1 Close valves G22, G23, G18, G21. Close the hydrogen cylinder valves and disconnect the cylinders from the manifold.
Open valves G4, G7, G9, G14 gradually.

Reset machine hydrogen gas pressure alarm to 2 lb/in²

Allow machine pressure to fall 2 lb/in² (approximately 60 to 90 minutes depending on initial machine pressure and temperature).

- 3.2 Switch on vaporiser supply in CO₂ Control Cubicle.

Close valve G4, open valve G12.

Open CO₂ manifold valve G1 or G2 and CO₂ cylinder valves.
Slightly open valves G3, G3A.

Open CO₂ gas regulator 2 turn and adjust to give downstream pressure of 2 to 5lb/in² and a flow of 600 cu ft/hr, but reduce flow if icing-up occurs.

After venting for four hours, check should be made of the percentage of hydrogen in CO₂. Close valves G14, G32, G39. Open valves G34, G36, G38 and throttle open G37 to give correct flow through gas analyser.

After the check, valve G34 is closed and G14 opened to continue venting.

Repeat checks by closing valve G14 and opening G34 until the percentage of hydrogen in CO₂ has reached a level of 4 per cent.

Following final check open in order valves G42, G43, G46, G47 G39, G32, G33. Wait four minutes then close in order valves G34, G36, G33, G32, G35, G38, G39, G47 G46, G43, G42.

Open in order valves G29L, G28L, G20L. After four minutes close in order valves G20L, G28L, G29L.

Open in order valves G18, G14, G19L.

After four minutes close in order valves G19L, G14, G18.

Close valves G3AL, G12, G3L. Set CO₂ regulator to zero and close CO₂ cylinder valves.

3.3 Connect air compressor to valve position G20.

Open valves G20, G4, G5, G14. Check valves G6, G7, G8, G9, G10, G11, G13 are open.

Close oil valves 08, 010, 012, 016 and check valve 013 is closed.

Switch on air compressor.

After one hour make check of percentage air in CO₂ (minimum of 95% required).

Open valve G34, G36, G38. Check valves G39, G35, G33 and G32 are closed.

Slightly open valve G37 and adjust for correct flow through gas analyser, if air purity is less than 95 per cent close valve G34, G36, G38 and continue venting.

Repeat check on air every ten minutes until required purity is reached.

When required purity is achieved, open in order valves G19, G46, G47, G42, G43, G39, G37, G35, G33, G32, G29L, G28L. Check valves G38, G36, G34 are open.

Leave for ten minutes then switch off air compressor. Open oil valves 08, 010, 012, 013, 016.

Open valve G18 and check G5, G6, G8, G9, G15, G16, G17 and G12 are open.

Close valves G4, G19, G10, G11 and check G13, G14, G3L and G21L are closed.

Covers may now be removed from the compensator.

CAUTION: Before internal access is made into framework of the synchronous compensator the provision of UK BP/SE/NSI 21 must be followed.

4.0 PROCEDURE FOR PURGING COMPENSATOR OF AIR

- 4.1 With all valves initially closed, connect CO₂ cylinders to manifold, open cylinder valves and manifold valve G1 or G2.

Open valves G3L, G5L, G6L, G7, G8L, G9.

Open CO₂ regulator 2 turn and then adjust to give downstream pressure of 2 to 5 lb/in² and flow rate of 600 cu ft/hr. Reduce flow rate if icing-up occurs.

Open valves G10L, G11L, G12, G13, G14.

After two hours a check should be made of the percentage of air present in CO₂. Close G14, open valves G34, G36, G38 and slightly open valve G37. Adjust valve G37 in conjunction with the gas analyser regulating valves to give a flow of 200 cc/min through gas analyser.

If percentage of air in CO₂ is less than 15 per cent, close G34, G36, G38.

Open G14 and continue to purge for a further 15 minutes and repeat check.

- 4.2 When percentage of air in CO₂ of 15 per cent is achieved, close valve G14.

Open valves in order G24, G25, G26L, G27, G30L, G31, G32, G33, G35, G39, G42, G41, G40, G43, G44, G45, G46, G47, G48, G50. Wait for four minutes and close valves G50, G48, G47, G46, G45, G44, G43, G40, G41, G42, G39, G35, G33, G32, G31, G30L, G27, G26L, G25, G24.

Open valves in order G20L, G28L, G29L, G49L. Wait four minutes then close valves G49L, G29L, G28L, G20L.

- 4.3 The machine is now ready for filling with hydrogen, approximately 36 cylinders of hydrogen will be required to fill the machines.

Check all valves are closed.
Connect first batch of hydrogen cylinders to hydrogen manifold.

Open valves G4, G5L, G6L, G7, G8, G9, G10L, G11L and G13. Open valve G22 or G23 on the hydrogen manifold, open hydrogen cylinder valves.

Open hydrogen regulator 2 turn, open vent valve G14. Slightly open valve G21L to give a pressure of about 2lb/in² between valve and regulator. Adjust regulator to give slow rate of discharge from cylinders, this should be a rate of about one cylinder every ten minutes.

Continue to fill machine with hydrogen for two hours and then close vent valve G14 and make check on the percentage of hydrogen in CO₂. Open valves G34, G36, G38, throttle open valve G37 and adjust for correct flow through analyser by means of the regulating valve and flow meter on the gas analyser.

A check on the gas purity should be made every 20 minutes until a proportion of hydrogen in CO₂ of 85 per cent is achieved.

Open valves G15L, G16L, G17L, G18 and after 20 minutes make a check on the air present in the hydrogen. This should not be less than 96 per cent hydrogen air. When required purity is achieved, close vent valve G14.

Position all valves for running condition as shown on Schematic CSB 523.

Raise hydrogen pressure in the machine to 15lb/in².

The machine is now ready to run.

5.0 ACCESS PROCEDURE FOR INTERNAL WORK WITHIN FRAMEWORK OF SYNCHRONOUS COMPENSATOR

When it is required to gain access internally to the compensator through the side inspection covers, entry will be made in accordance with the requirements of NSI 21.

A Senior Authorised Person shall issue a Permit for Work to enable both inspection side covers to be removed at the end of the compensator to be entered.

The frame of the compensator shall be forced ventilated via these access points for a period of not less than two hours.

The Senior Authorised Person shall satisfy himself by use of gas monitoring equipment that the interior of the compensator is free from gases.

The original Permit For Work can then be cancelled and another Permit For Work issued for the internal work and recommending any precautions which may be required to safeguard the persons carrying out the work.

These precautions shall include the use of a gas monitor to constantly monitor the air within the compensator for oxygen deficiency and inflammable gases.

At all times when work is being carried out inside the frame of the compensator, a Person shall be in attendance outside the entrance and he should be able to communicate with the Person(s) inside.

SYNCHRONOUS COMPENSATORS 1B AND 3B

RECORD FORM 'A'

DATE.....

CO₂ Cylinder Number	Time Cylinder On	Time Cylinder Off	Initial Cylinder Pressure	Final Cylinder Pressure	Signed
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

Final result of gas purity check:

Percentage H² in CO₂ =.....

Percentage Air in CO₂ =.....