PART 1 : SECTION 7

CHAPTER 1

OXYGEN SYSTEMS—GENERAL

Introduction

1. The proportion of oxygen to nitrogen in the air is the same at all heights. It is pressure which decreases with height, and it is pressure which forces oxygen through the lungs into the blood. Oxygen breathing apparatus increases the proportion of oxygen breathed in as altitude is gained and in this way counteracts the reduction in pressure.

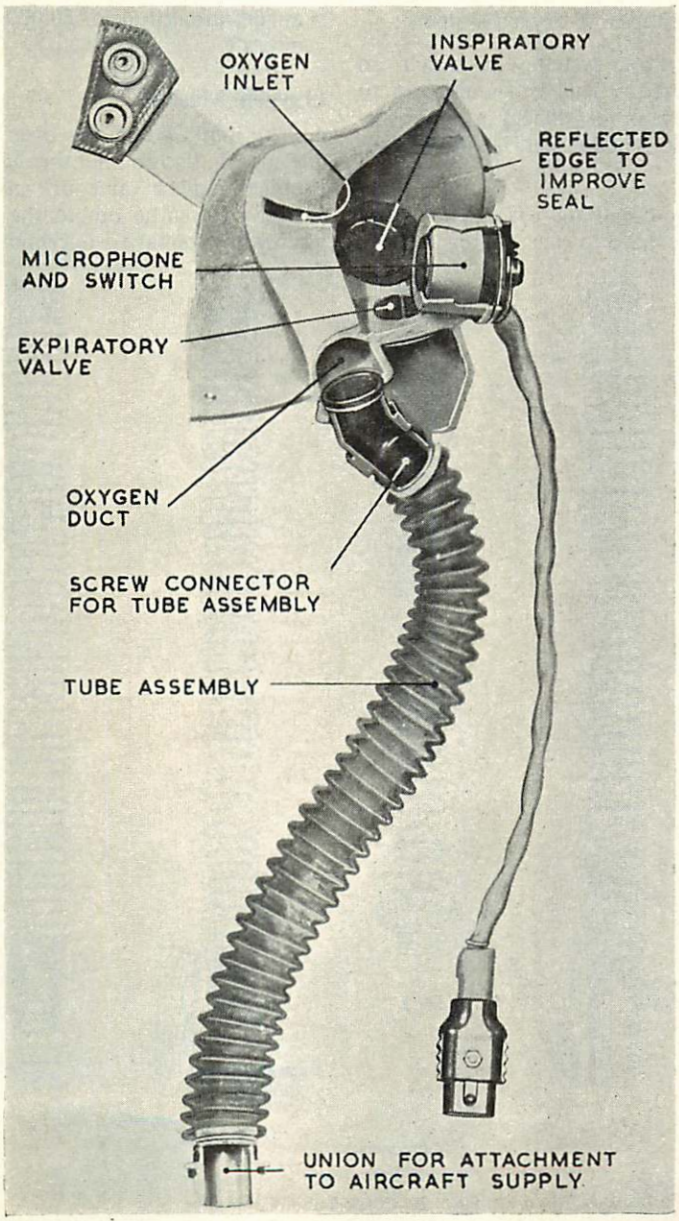

Fig. 1. Oxygen Mask, Type H.

2. This is satisfactory up to heights of about 40,000 feet, where 100 per cent. oxygen is equivalent to conditions at 10,000 feet without oxygen, provided that the aircrew member is at rest. Above this height the pressure is so low that even when breathing pure oxygen there is insufficient pressure to keep the body fully supplied and special breathing apparatus or a pressure cabin must be used.

Types of Oxygen Systems

3. There are three types of oxygen systems :—

(*a*) The direct flow system, in which an economiser is used. This is suitable up to an aircraft altitude of 40,000 feet in unpressurized aircraft, or 43,000 feet in pressurized aircraft.

(*b*) The pressure-breathing system, in which a special waistcoat and mask are used, is suitable up to an aircraft altitude of 44,000 feet in unpressurized aircraft for not more than 15 minutes provided the user is at rest, and an aircraft altitude of 48,000 feet in pressurized aircraft. It is intended for interim use until the automatic pressure-demand system becomes available.

(*c*) The automatic pressure-demand system, in which a demand type regulator is used, is suitable up to an aircraft altitude of 44,000 feet in unpressurized aircraft for not more than 15 minutes provided the user is at rest, or an aircraft altitude of 50,000 feet in pressurized aircraft.

Oxygen Masks

4. The mask, which fits over the wearer's nose and mouth, has an inlet through which oxygen is supplied, and a valve or valves to enable the wearer to breathe out to the atmosphere. All aircrew masks have a microphone embodied.

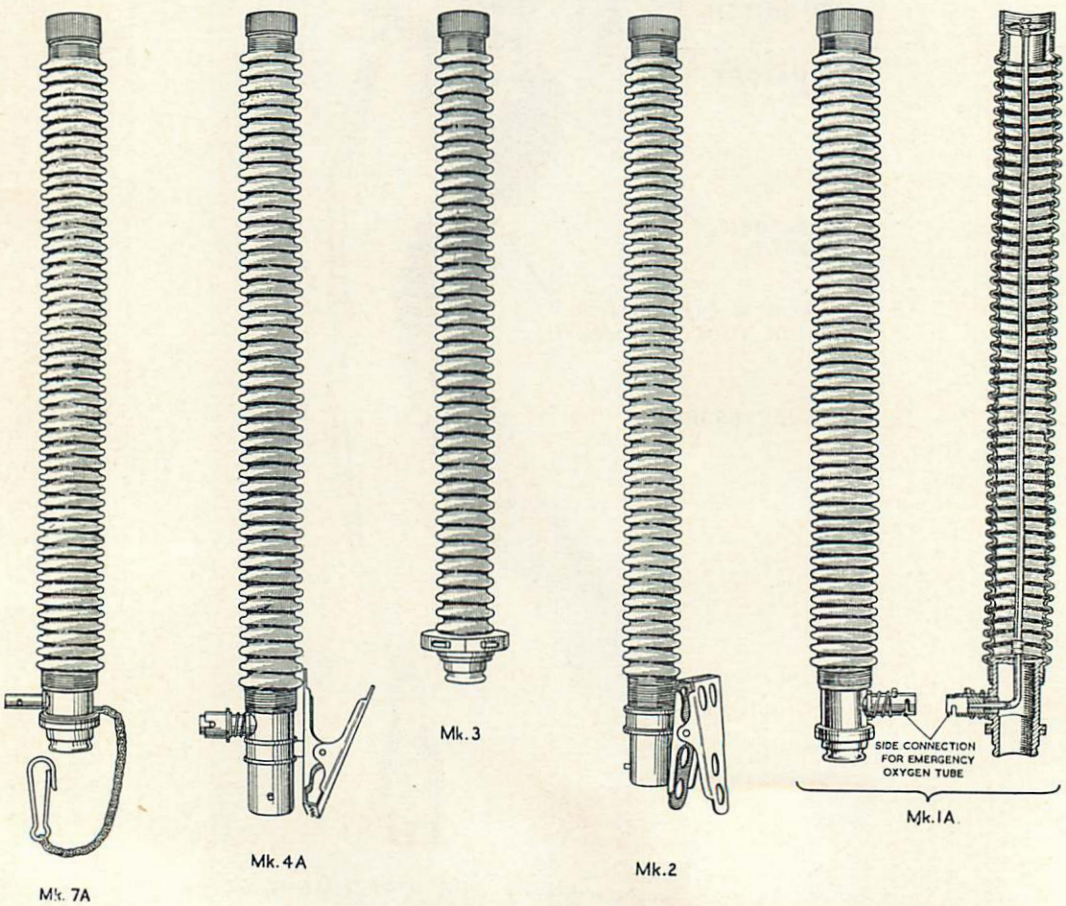

Fig. 2. Mask Tube Assemblies.

5. The standard types of oxygen masks are :—

(*a*) *Type H.* This is used with the direct flow economizer system. The Type H has twin outlet valves, and to enable the wearer to breathe air as well as oxygen an inlet valve is fitted in the side of the face-piece.

(*b*) *Type J.* This version is used with pressure-breathing equipment (see Chapter 3). The Type M is replacing this mask.

(*c*) *Types A.13A and A.13A/1.* These are for use with the automatic pressure-demand system (see Chapter 4). An improved mask (possibly the Type N) is being developed to replace these models.

(*d*) *Type L.* This mask is for passenger use It is lightly constructed, carries no microphone and is discarded after use.

Note.—As the mask moulds its shape to the face of the wearer, it is important that it is not worn by anyone but the person to whom it is issued.

Mask Tube Assemblies

6. Several types of mask tube assemblies are available :—

(*a*) Mk. 1A for fighter and P.R. aircraft fitted with fixed seats and emergency oxygen equipment.

(*b*) Mk. 2 for bomber and transport aircraft not fitted with emergency oxygen equipment.

(*c*) Mk. 3 for fighter aircraft not fitted with emergency oxygen equipment.

(*d*) Mk. 4A for high-flying bomber aircraft fitted with emergency oxygen equipment but without ejection seats.

(*e*) Mk. 5 and Mk. 6 for use with passenger mask Type L.

(*f*) Mk. 7A for all aircraft equipped with a direct-flow economizer system and fitted with ejection seats and emergency oxygen equipment. A short chain with a spring clip is attached to take the load on disconnection of the oxygen supply from the mask tube assembly when leaving the seat after ejection.

(*g*) Masks Type J, M, A.13A, and A.13A/1, used with pressure-breathing and automatic pressure-demand systems, are all fitted with integral tube assemblies.

7. The Mks. 1A, 4A, 7A, and those with integral tube assemblies, are constructed with an additional small tube running through the centre of the main tubing to convey oxygen from the emergency oxygen equipment to the mask. Emergency oxygen must be connected during flight above 10,000 feet, or, alternatively, a plug must be fitted to the connection to blank it off ; the blanking plug is not used with Types A.13A and A.13A/1 masks. The Mks. 1A, 3, and 7A have a quick-release, and the Mks. 2 and 4A have a bayonet attachment at the inlet end.

Aircraft Oxygen Cylinders and Line Valves

8. **Oxygen Cylinders.** Oxygen is stored in high-pressure cylinders of 750- and 2,250-litres capacity which are charged *in situ* to 1,800 lbs./sq. in.

9. **Line Valves.** A line valve cuts off the supply of oxygen to the regulator. The type of aircraft and regulator used determine whether or not line valves are to be fitted, as shown below :—

(*a*) *Mk.* 11 *and Mk.* 16 *Series Regulators.* No line valve is fitted for three oxygen cylinders or less. When a line valve is fitted it is wired fully open.

(*b*) *Mk.* 10*A*, *Mk.* 10*A**, *and Mk.* 10*B Regulators.* A line valve is used and is wired fully open.

(*c*) *Mk.* 17 *Demand Regulators.* No line valve is fitted for fighter aircraft but a stop valve on the regulator is wired fully open. On bomber aircraft, in addition to the stop valve on the regulator, a line valve is fitted and is wired fully open.

Walk-Around Oxygen Sets

10. The necessity for using walk-around oxygen sets when moving about an aircraft at altitude cannot be over-stressed, as the tendency not to bother about oxygen supply is strong and the realization of oxygen lack may not be apparent until it is too late.

11. There are two types of walk-around oxygen sets in service. These are :—

(*a*) *Mk.* 1*B*. This consists of a small, high-pressure cylinder with a regulator screwed into the neck. The mask tube is connected to the regulator by an adaptor tube. The regulator has an ON/OFF valve, a reducing valve, and a fixed metering jet. The flow cannot be regulated, the valve being either open or shut. The endurance of a full cylinder is 10 minutes, and the available supply is shown on a gauge graduated in minutes. As the set does not incorporate a breathing bag or economizer, it should not be used at cabin altitudes above 25,000 feet unless a pressure-breathing waistcoat is used with the mask pressure valve set at HIGH. Above 37,000 feet, all physical movement should be restricted to a minimum and no attempt made to move between crew stations.

(*b*) *Mk.* 3. This set has a longer endurance and is for use in transport aircraft below 30,000 feet. It comprises a 150-litre cylinder, a regulator, a breathing bag, an outlet connection, a charging connection, and a light metal case. The flow is adjustable for height and exertion, and the set has an endurance of about 55 minutes at 20,000 feet. With this type, the mask tube is plugged directly into the outlet socket in the metal case, no adaptor being necessary. Arrangements may be made for the set to be recharged in flight from the main oxygen supply.

Fig. 3.

Walk-Around Oxygen Set, Mk. 1B.

Fig. 4.

Walk-Around Oxygen Set, Mk. 3.

Emergency Oxygen Sets

12. Emergency oxygen sets may be attached to the parachute harness or dinghy pack. They provide the user with a supply of oxygen if the aircraft system fails, or when baling out at high altitude.

13. The following five types are available :—

(*a*) *Mk.* 1. This set is for pilot use and is carried in a pocket in the K-type dinghy pack.

(*b*) *Mk.* 2. This model, also for pilot use, is replacing the Mk. 1 set as standard equipment in some non-ejection seat aircraft. The Mk. 2 set is carried in a bag attached to the belt of the parachute harness.

(*c*) *Mk.* 3. This version is designed for use by flying personnel other than pilots. It is carried in a bag attached to the parachute back pad.

(*d*) *Mk.* 4. This set is for use in ejection-seat aircraft. It operates automatically when the seat is ejected, and can also be operated by hand if necessary. It is otherwise similar to the other marks.

(*e*) *Mk.* 5. This set is for use in R.A.F. Sabre aircraft.

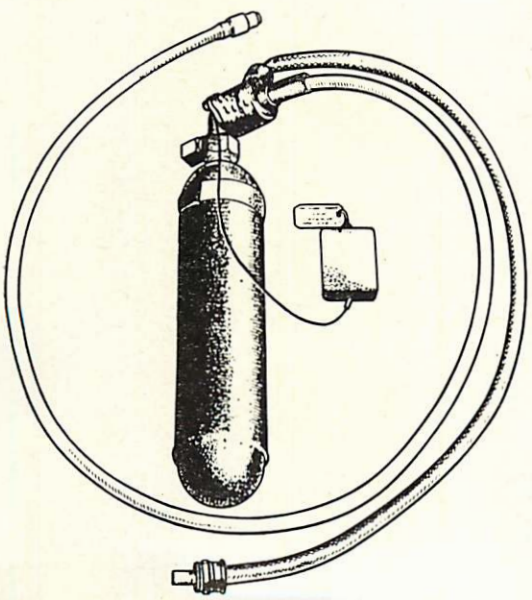

Fig. 5. Emergency Oxygen Set, Mk. 4.

14. In each case the set comprises a 55-litre steel cylinder and a simple regulator. The latter contains no reducing valve, the flow being controlled by a fixed jet in the form of a capillary tube. Thus the flow is high when the cylinder is full and falls off as the cylinder empties. The duration is about 10 minutes.

15. Emergency oxygen sets are fitted with a safety pin to prevent inadvertent operation during servicing, and a "tell tale" wire attachment is so arranged that when the ring or knob is operated, the wire is broken or bent. Before flight, a check should be made to ensure that the safety pin has been removed and that the "tell tale" wire is intact.

16. The regulator is turned on by pulling a ring or knob. This operation causes a "break-off" tube (which seals the regulator) to be broken. The oxygen is then fed to the user's mask tube assembly regardless of whether or not the mask tube is connected to the aircraft supply. With automatic pressure-demand systems the mask tube should be disconnected from the main supply to prevent pressure build-up.

17. To ensure that the oxygen mask will not be wrenched off, the emergency oxygen supply tube should be disconnected from the mask tube assembly before ditching, crash landing, or on any other occasion when the user requires to divest himself of his parachute or dinghy pack. During a parachute descent, the tube should be disconnected as soon as convenient below 10,000 feet, and in any case before reaching the ground.

Use of Oxygen—Captain's Responsibilities

18. The responsibilities of an aircraft captain, regarding the use of oxygen equipment, are detailed in Air Ministry Flying Order No. 370.

Prevention of Moisture Entry

19. When the supply dial indicates in the red sector, the pilot should descend below 10,000 feet if practicable. The regulator should be turned off before the pointer reaches EMPTY, to prevent the entry of moisture into the system.

Oxygen Test Rig

20. The oxygen test rig (Fig. 6) enables aircrew to check that their masks, as fitted, are sufficiently air-tight to operate an economizer. It also gives aircrew a better understanding of their oxygen system and its operation, and increases confidence in the equipment.

Care of Oxygen Equipment

21. Since at high altitude life depends on oxygen equipment, great care must be taken in handling it. When not in use, oxygen equipment should be protected from direct sunlight and heat. The inside of the mask should be sponged out occasionally with a weak solution of disinfectant, preferably with the microphone removed. The mask tube should be removed and immersed in the solution then allowed to dry without the use of heat.

Fig. 6. Oxygen Mask Test Rig.

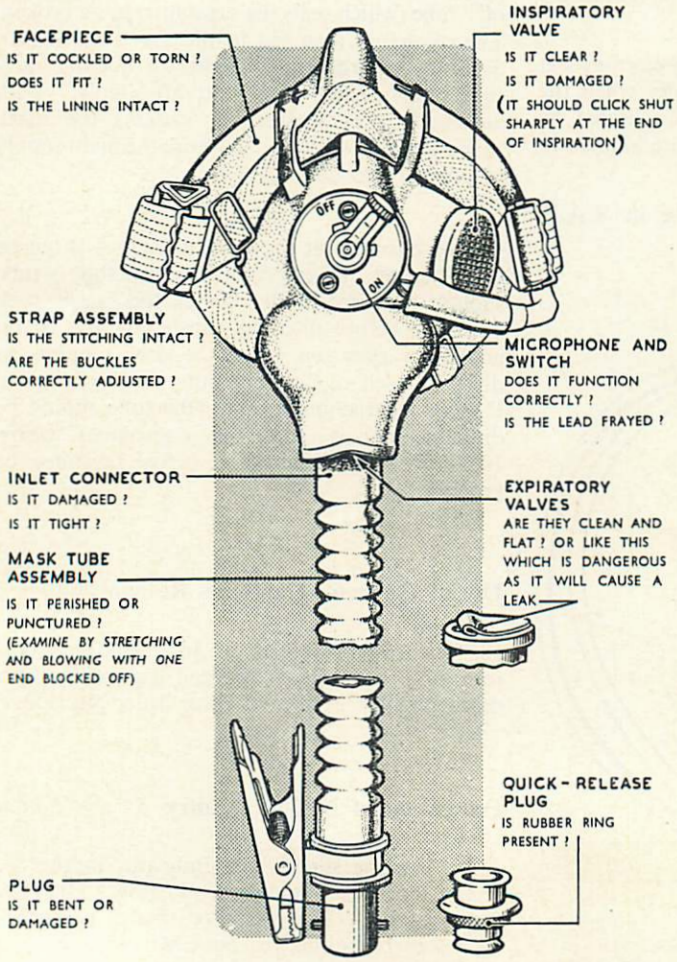

Fig. 7. Points to be Observed when Servicing the Mask.

22. Pressure-breathing waistcoats and masks must be checked monthly for serviceability, in accordance with A.P. 1182E, Volume 1, Section 4, Chapter 4, and whenever a component has been replaced, or if the serviceability of any component is suspect.