

Survey of life expired in-use oxygen mask KM-32

Wg Cdr V N Jha* Wg Cdr S Chowdhary[†] Wg Cdr SC Banerjee[‡]

During the inspection of flying clothing of the aircrew of a MIG-21 squadron, it was revealed that eight out of ten 'in-use' oxygen masks were manufactured more than 2 years back. The mean age of the masks was 5 years and six out of eight masks needed an immediate change for reasons/defects such as deformed inspiratory diaphragm, torn and separated chamois leather on the reflected edge, tackyness of the rubber of the reflected edge and the tear of the reflected edge, which peeled-off effortlessly. Some of the other findings were that of the cracks on the compensatory pressure tubes and black staining of the contact surface due to the tackyness of the reflected edge. None of the pilots used the occipital bag hence it was not available for inspection. Subsequently, the KM-32 masks of four different squadrons also showed a similar findings.

The reason for the extended use of the life expired and unserviceable oxygen masks were largely an ignorance on part of the user. The short supply of the store has complicated the issue and their lack of faith in the indigenous microphone has given a feeling that if substituted, the indigenous replacement may even prove to be worse.

Replacement of all these masks at once is bound to create a logistic problem. Knowing the complexities of procedural delay in import, an alternate arrangement may be desirable. The paper brings out the startling facts of the poor state of in-use oxygen mask.

Keywords: Flying clothing, aircrew care.

The natural rubber exposed to the atmosphere and the climatic vagaries tend to deteriorate in quality and strength with time. It is for this reason that the pressure breathing oxygen mask made of natural rubber has a limited shelf life. This life in the Indian context is 1½ yr for ABEU mask and 2 yrs for the non-medicated grade British masks P & Q [1]. In the case of the Russian KM-32 mask made of natural rubber, there is no instruction available with the peripheral units about its shelf-life. As a result a large number of the old and apparently life expired masks are still in use.

Of the several components of the pressure breathing oxygen mask KM-32, the face piece, the inspiratory hose, the compensatory pressure tube and the inspiratory, expiratory and the compensatory pressure diaphragms are made of rubber. Where as the former three are made of natural rubber, the latter three are made of especially developed latex rubber which is very thin and can even loose its shape and contour which in turn will make the mask unserviceable.

* Classified Specialist (Av Med), 45 Wing AF c/o 56 APO

† Classified Specialist (Av Med), 35 Wing AF

‡ Classified Specialist (Av Med), 34 Wing AF

Many of the oxygen masks that had visibly deteriorated, still finds its application due to acute shortage. Rejection of all the life expired masks at once, was considered impractical as it would have created a logistic crisis of immediate replacement due to its short supply. Also a large number of the pilots would have become ineffective for want of a suitable replacement. Hence a logical approach was made to replace the malfunctioning ones the first. Even this approach was difficult as a particular size mask was scarce in all stores.

Aim

This study was aimed at surveying all the in-use pressure breathing oxygen mask KM-32 and find out if there was any impact of a long shelf-life upon any of its components.

Material and method

Five air force squadrons operating under the semi-desert environmental condition of an operational air command, where temperatures vary from 0.2 deg to 48 deg and the humidity from 68% to 100%, were included in the survey, the following method were adopted for the study.

- Inspection of all in-use oxygen masks by a specialist.
- Interview of the pilots for reasons of its extended use.
- Defect analyses of the life expired masks.
- Stock of the life expired masks held in the logistics.
- Check on the policy letter from manufacturer on shelf-life and maintenance.
- Review of instances when revalidation of life were sought.

Result

Analysis of the data received from all the squadrons reveal that a total of 79 pressure breathing oxygen masks KM-32 were surveyed out of which 3 had incomplete data, hence discarded. The mean age of the masks were 5.3 yrs of which the mean 'in-use' age was only 10.4 months. Only 28% of the masks were within 2 yrs of its age and the rest were 2-14 yrs old with 48% being 4-8 yrs. 10.5% masks were issued in < 2 months, 7.8% in > 1 yr and 2.6% in > 1½ yrs. Rest all the masks were issued within 2-12 months. Table 1 gives the details of its age since its manufacture, length of use and some of the defects seen.

Table 1. Age related parameters of the mask KM-32 (n=76)

Age yrs	Number n (%)	Length of use in months	Tachyness present n (%)	Damage to reflected n (%)	Inspiratory diaphragm deformed n (%)
< 2	22 (28)	7	3 (13.6)	2 (9.1)	4 (18.1)
2-4	3 (3.9)	11	1 (33.3)	nil	1 (33.3)
4-6	30 (39.4)	10	8 (26.6)	3 (10)	9 (30)
6-8	10 (13.1)	13	6 (60)	nil	4 (40)
8-10	8 (10.5)	13	4 (50)	4 (50)	1 (12.5)
10-12	nil	nil	nil	nil	nil
12-14	3 (3.9)	15	2 (66.6)	nil	nil
Total	76	mean=10.4	24 (31.2)	9 (11.8)	19 (24.9)

The tachynes of the rubber when present, was visible only over the reflected edge of the mask. It was evident in about 30% of the mask of > 2 yrs age and approximately 60% of the mask > 6 yrs age. The extent of tachyness ranged from being sticky to erosion of the rubber. Even the stain of the tachy surface were coming out on to the examining hands. Some of the masks having tachyness had developed tears and cracks on its reflected edge. The inspiratory diaphragm was found deformed in 27.6% of the masks. The deformity ranged from slight separation from the brim of the inspiratory valve to complete crumbling. Functional testing of the diaphragm was done by creating a suction through the inspiratory hose during which the diaphragm failed to close the valve. Inspection of the expiratory & compensatory pressure diaphragms of some of the masks made cat E during the survey show that no visible deterioration had taken place.

The chamois leather covering of the reflected edge revealed various grades of shrinkage by virtue of which the rubber surface underneath was exposed (Table 2). The extent of the exposed surface ranged from partial shrinking of the leather to complete exposure of the reflected edge. In the case of the

complete exposure, the chamois leather had completely peeled off and the strength of the adhesive was extremely poor.

Interview with the pilots using the life expired masks reveal that they were not aware of any shelf-life of the mask. Those using the defective masks expressed their fear that their masks would get exchanged with an indigenous one, the reliability of which is poor. Specific questions brought out that it was the indigenous microphone and the inner helmet that they were concerned with. Many of the aircrew were not aware with the implication that the deformed inspiratory diaphragm could have. They were happy with it as long as there was no breathing problem. None of them reported of contact dermatitis with the mask having bare/tachy contact surface.

A check on the mask issue/expense regular register revealed that at two stations a total of 27 masks were exchanged by the pilots in one year with a total of 37 aircrew strength. Of these only masks were issued to new pilots posted to the squadrons. A survey of the store showed that against a total holding of the masks, approximately 60% were > 2

Table 2. Chamois leather covering of the reflected edge (n=76)

Age in yrs	No. n	Area under coverage			Adhesive strength		
		full n	partial n	exposed n	good n	poor n	peeling n
<2	22	10 45.4%	8 36.3%	4 18.1%	10 45.4%	7 31.8%	5 22.7%
2-4	3	2 66.6%	1 33.3%	nil	2 66.6%	1 33.3%	nil
4-6	30	16 53.3%	11 36.6%	3 10%	16 53.3%	9 30%	5 16.6%
6-8	10	1 10%	6 60%	3 30%	2 20%	5 50%	3 30%
8-10	8	2 25%	3 37.5%	3 37.5%	2 25%	4 50%	2 25%
10-12	nil	nil	nil	nil	nil	nil	nil
12-14	3	1 33.3%	2 66.6%	nil	1 33.3%	2 66.6%	nil

yr and 40% > 4 yrs old. However, even the oldest mask in store which was of year 1980 make, showed no evidence of tachyness. All these masks though procured time unknown, have been received by the units within a period of 1-2 yrs.

Discussion

The survey of the oxygen mask KM-32 reveal that a large number of 'in-use' masks were having some or other defect. If the figure of < 2 yrs of permissible shelf life for natural rubber is taken as a yard stick (in the absence of the manufacturer's directive), a large proportion of the mask (71.1%) could be considered as life expired. Mask of even 12-14 yrs old make find use as these were issued to the pilots as late as mid 1996.

Of the 7 months average service provided, > 50% of the masks of year 1995 manufacture shows deterioration. The area of major concern has been poor adhesive strength, shrinkage and peeling off of the chamois leather. The reflected edge and its chamois leather covering show that the leather started shrinking as early as 2 months of use. The number of the masks showing the shrinkage, either partial or complete, are rather large. There however, is no shrinking while under storage or left-out after partial use. This signifies a role of sweat or aqua savlon on possibly an inappropriate adhesive which is unable to withstand them. A poor standard of cleanliness achieved, occasional contact dermatitis reported and the damage caused to the adhesive or the chamois leather by aqua savlon calls for reviewing the policy on mask cleaning. Dry cleaning with a suitable substance i.e. Acetone may be studied as a substitute.

A high percentage of deformation of the inspiratory diaphragm which is made of latex rubber and is expected to have longer life, is intriguing. What-

ever be the cause, use of these masks with deformed inspiratory diaphragm is a safety hazard [2]. Since most of the sorties are performed below 3 km cabin altitude, no significant problem has been encountered by the pilots flying with these masks. Tachyness of the reflected edge on the other hand, is evident in the masks above 4 yrs age. It is a common finding among 'in-use' masks of > 6 yrs age, attributable to the effects of environment. Thus it is apparent that the poor temperature and humidity control of the flying clothing room is causing the damage as the shelf-life alone shows no deterioration. Survey also shows that there is no dearth of airconditioner in the unit, but the flying clothing room does not have one. Presently the guidelines on the maintenance of the flying clothing only advises to avoid exposure to sun for drying and is mum on providing environmental control. This also brings in the fore a need to review our maintenance procedure. Guideline needs to be formed to ensure environmental control.

Since the face piece and the inspiratory diaphragm are the components most vulnerable to early deterioration, replacement of these might sound feasible to avoid undue loss or shortage. However, since an effort to revalidate 46 number of life expired KM-32 mask did not succeed [3], another alternative needs to be found.

Conclusion

A survey of the in-use oxygen masks KM-32 reveals that:

- a. 72% masks were > 2 yrs old. Its shelf-life is not known.
- b. Reflected edge and the inspiratory diaphragm showed high rate of damage attributable to uncontrolled environment.

- c. Quality of adhesive for chamois leather is inappropriate to withstand sweat and aqua savlon. A substitute for aqua savlon as a cleaning material is required to be found.
- d. Tachyness of the rubber was shown on reflected edge with increasing age.
- e. Awareness among the aircrew upon the functioning of the mask is required where they can discard an unserviceable mask.

References

1. AB&U specification 1 & 2 prepared by Defence Bioengineering and Electromedical laboratory, Bangalore, 1968.
2. Aviation medicine, 2nd edn. Edited by Air Commodore John Ernsting, Air Vice Marshal Peter King, 1988, 96.
3. Report on test of life expired masks KM-32, DEBEL, Bangalore, 1996.