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DEFENCE AND CIVIL INST OF ENVIRONMENTAL MEDICINE DOW--ETC F/G 6/11
EVALUATION OF UK PQ OXYGEN MASK FOR USE IN CF AIRCRAFT, (U)
SEP 79 D F LEBEN

UNCLASSIFIED

DCIEM-79-R-39

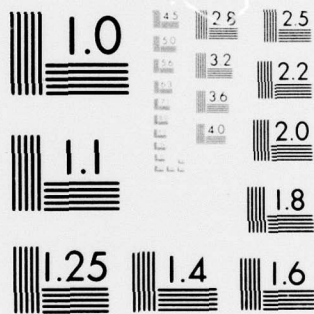
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Defence and Civil Institute of Environmental Medicine

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DCIEM Report No. 79-R-39

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EVALUATION OF UK PQ OXYGEN MASK
FOR USE IN CF AIRCRAFT

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Capt D.F. Leben

✓ MLSD Division
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1133 Sheppard Avenue West, P.O. Box 2000
Downsview, Ontario M3M 3B9

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DEPARTMENT OF NATIONAL DEFENCE - CANADA

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AB

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BACKGROUND

As part of a project to develop adequate life support equipment for the New Fighter Aircraft (NFA), evaluation of the Royal Air Force (RAF) P/Q oxygen mask by DCIEM indicated that the RAF P/Q mask is the only mask capable of holding the necessary 70-80 mm of pressure of the "get-me-down" requirement of the life support ensemble. Subsequently, DCIEM was asked by DAES (DAES Project Number 438015 - Annex A) to "evaluate the suitability of the P/Q mask as a direct replacement for the A13A mask (also known as the MS22001) for general use with the present series of aircrew helmets" (i.e., the DH 41-2 jet aircrew helmet). The A13A oxygen mask currently in use in the CAF Air Operations has a number of deficiencies (e.g., slippage under G). Additionally, the A13A is not suited for use in the NFA (i.e., it cannot seal against the requisite positive breathing pressures for high altitude). This report documents the result of this evaluation. → p. 10

LABORATORY EVALUATION

At the time of the original tasking, DCIEM's inventory of P/Q masks consisted of four masks acquired on loan through a Test Project Agreement (TPA 704-61) with the Royal Air Force under the auspices of the Air Standardization Co-ordinating Committee, Working Party 61. These masks had been exposed repeatedly in the hypobaric chamber at altitudes up to 80,000 ft and to working pressures up to 80 mm. In addition, probe holes had been introduced through the exoskeleton to enable oral-nasal cavity pressures to be monitored. Therefore, 25 new masks were acquired, 10 for replacement of the experimental masks, and 15 for flight trials. IAM Farnborough, UK, graciously agreed to perform quality assurance checks on the purchased masks. As a result of their tests, the first shipment was rejected. A subsequent shipment proved satisfactory and was forwarded to DCIEM.

In the RAF, the P/Q mask is mated to the MK3 helmet by means of a hook and "bicycle" chain arrangement. The chain was not provided with the masks and therefore a fine copper chain was utilized. A means of attaching the P/Q mask to a DH 41-2 helmet was devised. It consisted of two female portions of lift-the-dot fasteners mounted on a small metal plate. The fasteners were spaced the same distance apart as the male fasteners on the cheek flap of the DH 41-2 inner helmet. A hook was manufactured and attached to the plate. Tension adjustment was provided by threading the end of the hook and providing an adjustment screw (Fig. 1).



Figure 1: Attachment hook to mate the P/Q mask with the DH41-2 helmet.

The field of vision of four subjects was determined using a Baush and Lomb projection perimeter. While the subject was focusing on a point directly in front, a 3-mm dot was rotated through the field of view at a distance of 0.3 m. Using binocular vision, the subject noted the disappearance of the dot in his peripheral vision and notified the operator. The P/Q mask caused no reduction of the field of view in the lateral or superior aspects in addition to the limits imposed by the DH 41-2. An improvement of approximately 30% was noted in the inferior aspect (P/Q mask over the A13A mask and Pate suspension). The mating of the visors and the P/Q mask proved very acceptable (Fig. 2, 3, 4, 5, and 6).



Figure 2: DH41-2 helmet with current issue A13A oxygen mask and Pate suspension.



Figure 3: DH41-2 helmet with P/Q mask.

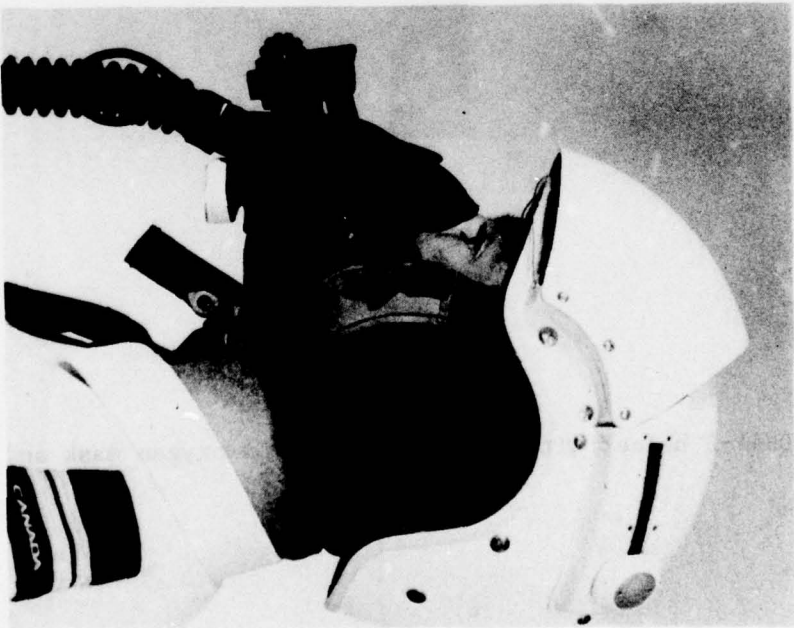


Figure 4: DH41-2 helmet with AL3A mask and Pate Suspension.

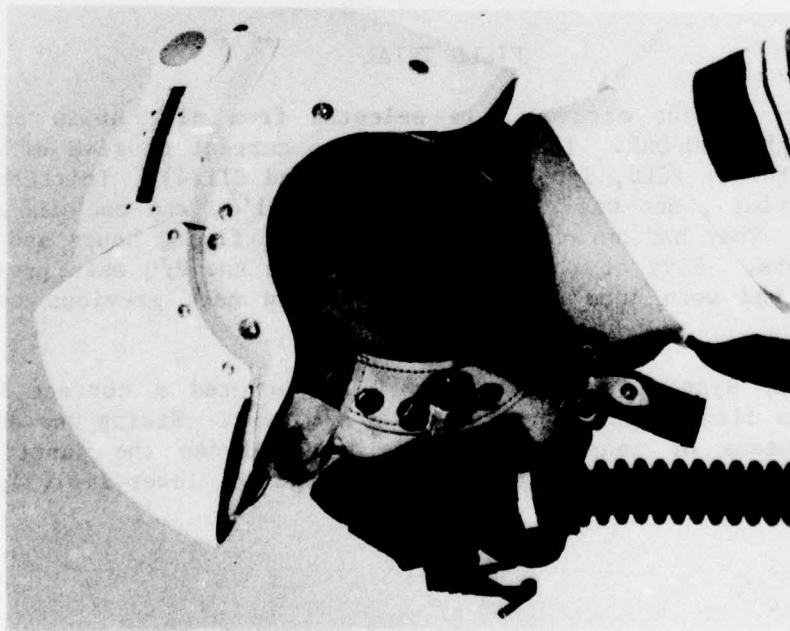


Figure 5: DH41-2 helmet with P/Q mask (Note toggle in "up or normal" position).

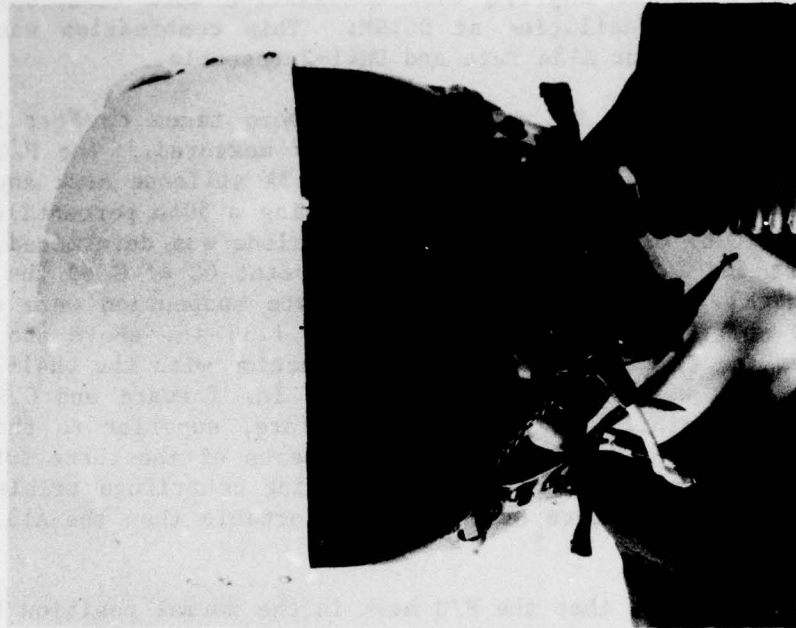


Figure 6: DH41-2 helmet and P/Q oxygen mask.

The DH41-2 helmet and P/Q mask combination were windblasted to Mach 1.0 using the facilities at DCIEM. This combination was more stable than the current Al3A Pate and DH41-2 ensemble.

The DH41-2 helmet, P/Q and Al3A mask were taken to Fort Rucker Alabama and the centre of gravity (C of G) measured. The P/Q mask weighed 515 g, 60 g less than a "trimmed" Al3A silicone mask and 94 g less than a "trimmed" Al3A rubber mask. Using a 50th percentile head and neck, the C of G for the DH41-2 helmet alone was determined to be 0.22 in. aft and 2.53 in. above the datum point (C of G of the "bare head" and neck). When the Al3A mask and Pate suspension were added, the C of G shifted to 1.3 in. forward and 1.36 in. above the datum point. When the P/Q mask was used in conjunction with the DH41-2 helmet, the C of G was determined to be 0.75 in. forward and 0.90 in. above the datum point. The P/Q was, therefore, superior to the Al3A and Pate in this test. The subjective comments of the three subjects who wore the P/Q mask and DH41-2 helmet during centrifuge trials to 5 G reported that it was more stable and comfortable than the Al3A with Pate suspension.

It was determined that the P/Q mask in the normal position (i.e., toggle up) could hold at least 30 mm of pressure (the maximum capability of the Al3A mask) and could do so while not being held as tight to the face. In the toggle down or emergency position, the P/Q mask has demonstrated a capability of holding 80 mm of pressure (using human subject in a hypobaric chamber at 80,000 ft).

FIELD TRIAL

Fifteen current aircrew were selected from nine units on five bases through NDHQ/DAR. These aircrew were current on five different types of aircraft (CF5, T-33, CF101, CF104 and CT114). Thirteen were qualified pilots, one was a navigator on CF101's, and one was a student pilot. They had an average of 2,840 total flying hours and 2,150 hours on jets. Five of the subjects had worn the P/Q mask previously. Eight had worn some other type of oxygen mask previous to this trial.

A Safety System Technician from DCIEM ensured a correct helmet fit and then fitted each subject with a P/Q mask. Sizing was accomplished by means of measuring the distance between the junction of frontal and nasal bone, and the inferior margin of lower lip (Fig. 7).



Figure 7: Method of determining correct mask size.

If the distance is less than 3.75 in., then a Q size mask is used. If more than 3.75 in., then a P size mask is used - hence the designation "P/Q".

The trial directive (Annex A) stated that the period of the trial was 90 days from the date of issue and requested that a monthly questionnaire be completed and forwarded to DCIEM (Annex C). A total of 23 completed questionnaires were received.

All subjects responded that hearing protection was apparently not affected by the replacement of the A13A mask and Pate suspension with the P/Q mask nor was helmet comfort. All respondents described the P/Q mask as being an improvement over the A13A and Pate combination

but several desired more screw adjustment. All described the P/Q as slipping less under G than the current mask ("... doesn't move under G"; "little or no slippage under G and better visibility"; "... superb in ACM even though mask was not uncomfortably tight"; "... little or no slippage under high G even with a wet face.").

Virtually all subjects experienced some telecommunications problem. Since the microphone was not compatible with CF aircraft systems, the mike cord was modified to incorporate a resistance pad to reduce the voltage by 75% (a 220 ohm resistor in series and a 56 ohm resistor in parallel) (Fig. 8).

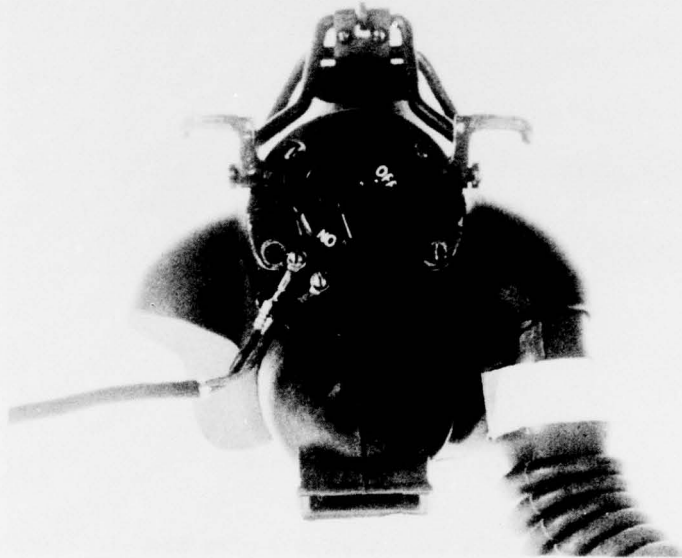


Figure 8: Placement of resistors on P/Q mask.

This pad was incorporated in the microphone wire near the mask. Additionally, the mask-mounted ON/OFF switch was modified to make it permanently "hot". Shortly after the trial commenced, DCIEM was advised that the microphones were intermittent and that the wires were breaking near the mask - probably due to flexing. Some subjects had difficulty with the chains dropping off and it is suspected that this put

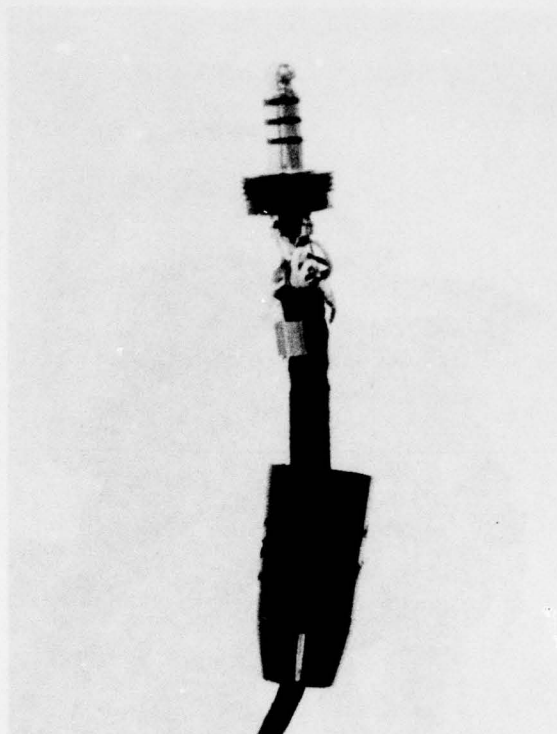


Figure 9: Placement of resistors in the helmet telecom cord.

additional stress on the wires. DCIEM produced replacement microphone wires which incorporated the resistor in the helmet/aircraft connector. Some improvement was noted but the telecommunication problems were still judged unsatisfactory (Fig. 9).

Only one subject experienced a skin problem with the P/Q mask - "a small rash under and to the side of his lip". Two had encountered rashes with the rubber version of the A13A but none had experienced skin disorders with the silicone version of the A13A.

The four subjects who commented on eye glasses reported that their glasses seemed to be positioned better when wearing the P/Q mask (Fig. 10). With the A13A, their glasses were either too close to the face causing fogging or slid too far forward causing focusing problems.

The chain/hook arrangement was commented on in that while attempting to connect the second chain, the first one often came off. Some subjects resorted to crimping the chain on one side.



Figure 10: Aircrew corrective lenses worn in conjunction with P/Q mask. (note toggle in "down" or "emergency" position).

Other comments included: "Having the microphone further away from the mouth is more comfortable." "... mask is cooler in hot weather ..." and "... better downward visibility ...".

A voice recognition problem was reported by a CF101 pilot. Voice recognition is important in air defence operations when "spoof jamming" is encountered. The CF101 aircrew also experienced a significant time delay while attempting to respond to the 5-minute scramble commitment. The difficulty was experienced in attaching the chain mechanism.

CONCLUSIONS

- 1) The P/Q is superior to all other oxygen masks available in that it is the only mask which can hold the 70-80 mm of pressure deemed necessary for the "get-me-down" capability of

- the New Fighter Aircraft. In comparison, the A13A mask with Pate suspension can hold only 30 mm. ←
- 2) The P/Q mask virtually eliminates the "slippage-under-G" problem experienced with the current oxygen mask. This is because of the reduced weight, the repositioned C of G, and the type of suspension.
 - 3) The telecommunication problems experienced must be solved prior to introduction of the P/Q mask into general service in the Canadian Armed Forces.
 - 4) An alternative method of attaching the P/Q mask to the helmet should be developed to eliminate difficulty experienced in donning the mask.

NEW DEVELOPMENTS

DCIEM has recently acquired an improved version of the P/Q mask. It is the result of co-operative research and development between the USAF School of Aviation Medicine at Brooks AFB and the RAF Institute

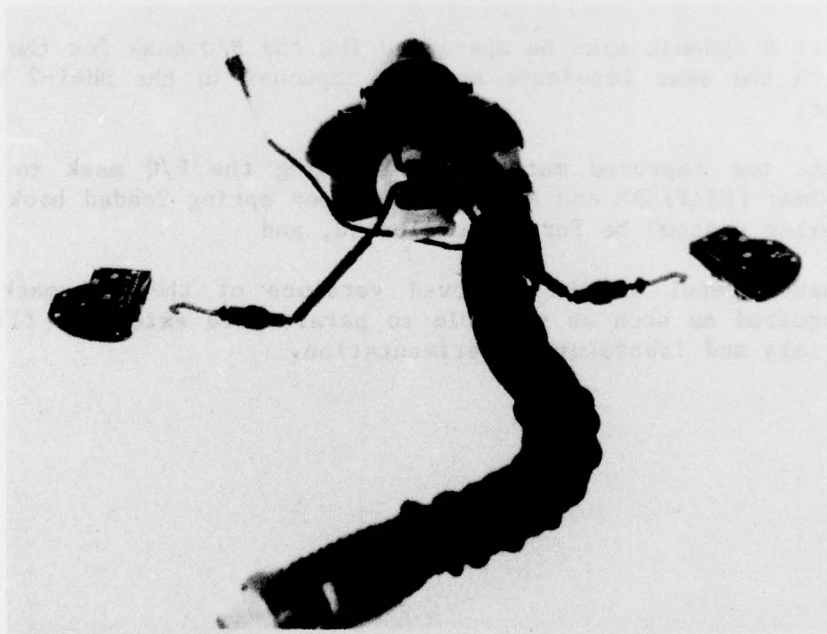


Figure 11: Improved P/Q mask with new method of attaching mask to helmet.

of Aviation Medicine at Farnborough, England. This improved mask features an improved method of attaching the mask to the helmet in that a spring loaded hook (Fig. 11) and roller system is used. A microphone compatible with U.S. telecommunications systems (and hence CF systems) is incorporated in the same location as the trial P/Q mask. The mask is fabricated in silicone and apparently will be less expensive than the current RAF mask - the model tested in this field trial. Being silicone, it should solve the skin rash problem and also have a longer service life.

The new silicone P/Q demonstrated a capability of witholding 80 mm of pressure in tests at DCIEM. Telecommunication compatibility has been confirmed using a standard CF headset testing unit, and a CT114 aircraft.

The mask will be flight tested at CFB Cold Lake.

RECOMMENDATIONS

The following recommendations are made:

- a) that the P/Q mask be adopted by the Canadian Armed Forces for replacement of the current Al3A mask and Pate suspension;
- b) that a dynamic mike be specified for the P/Q mask for the CAF with the same impedance as the earphones in the DH41-2 helmet;
- c) that the improved method of attaching the P/Q mask to the helmet (USAF/SAM and RAF/IAM developed spring loaded hook and roller system) be further evaluated, and
- d) that several of the improved versions of the P/Q mask be acquired as soon as possible to permit more extensive flight trials and laboratory experimentation.

ACKNOWLEDGMENTS

Appreciation is expressed to the ALSEO's and the Safety Systems Technicians who assisted the field trials. The appreciation is also expressed to those aircrew who volunteered as subjects for this trial. The comments made in their questionnaires and letters were invaluable.

Special mention is made of the valuable assistance provided by Sgt G.A. Green and MCpl J.C. Steffler of DCIEM who provided positive comments and suggestions, and technical assistance during the planning stages of this trial and who personally conducted the fitting of the helmets and masks of the trial subjects.

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UNCLAS DAES 4907

DCIEM FOR MLSD, AIRCOM FOR DCOS OPS

SUBJ: PROJECT TASKING - OPERATIONAL EVALUATION OF BRITISH PQ MASK

1. PROJECT NUMBER: DAES 438015
2. TITLE: OPERATIONAL EVALUATION OF BRITISH PQ MASK
3. TYPE: EVALUATION
4. PRIORITY: ESSENTIAL
5. TARGET DATE: 1 SEP 78
6. REFS: A. DAR 3008 071805Z FEB 77
B. DCOS OPS 181 101700Z MAR 77
7. SITUATION: MLSD HAS CONFIRMED THAT PROCUREMENT OF A QUANTITY OF THE SUBJECT MASKS HAS BEEN EFFECTED. IT IS REQUESTED THAT THE OPS EVAL BE COMMENCED IMMEDIATELY. REF A PARA 4 DETAILS THE PERSONNEL AND UNITS DAR FELT SHOULD BE INVOLVED IN THE TRIAL. PERSONNEL CHANGES HAVE OCCURRED SINCE ISSUE OF THE MESSAGE, DAR WILL ADDRESS BY SEPARATE CORRESPONDENCE PERSONNEL AND UNITS TO PARTICIPATE IN THE TRIAL.

8. OBJECTIVE: TO DETERMINE THE SUITABILITY OF THE PQ MASK AS A DIRECT REPLACEMENT FOR THE A13A MASK FOR GENERAL USE WITH THE PRESENT SERIES OF AIRCREW HELMETS.

9. TASK:

A. TO DEMONSTRATE THE PQ MASK SUSPENSION ASSEMBLY IS CAPABLE OF OVERCOMING THE RECOGNIZED WEIGHT DIFFICULTIES EXPERIENCED WITH THE PATE SUSPENSION.

B. TO PROVE THE PQ MASKS ABILITY TO PROVIDE SAFE, PRESSURE HOLDING SERVICE FOR THE EXTENDED OPERATIONAL PARAMETERS ENCOUNTERED IN NFA OPS.

C. CONDUCT DESIGN REVIEW WITH DAR/DAES OF RECOMMENDED CONFIGURATION PROPOSED FOR USER TRIAL. DRAFT USER TRIAL QUESTIONNAIRE WILL BE REVIEWED AT THIS TIME.

D. COORDINATE THE ARRANGEMENTS WITH THE INDIVIDUALS DETAILED BY DAR FOR FITTINGS, BRIEFINGS AND CHAMBER RUNS PRIOR TO TRIAL USE OF THE MASK.

10. METHOD: ACCOMPLISHMENT OF THIS PROJECT IS TO BE IN ACCORDANCE WITH A TEST PLAN PROPOSED BY MLSD AND APPROVED BY DAES 4.

11. SPECIAL INSTRUCTIONS:

A. FLIGHT SAFETY IS NOT TO BE COMPRISED DURING THE EVALUATION

B. ENSURE USER TRIAL REPORTS ARE SUBMITTED TO DCIEM/MLSD

12. SECURITY CLASSIFICATION: UNCLASSIFIED

13. NDHQ PROJECT OFFICER: WO PJ VANDERBURG, DAES 4-3-3, 993-2000

14. PROJECT REPORT: INTERIM REPORT DETAILING FINDINGS, RECOMMENDATIONS, EQUIPMENT MODIFICATIONS, PHOTOS/SKETCHES AND DETAIL

FOR ADOPTION INTO SERVICE, AS DEEMED NECESSARY BY MLSD

15. DCIEM ACTION: BY 28 APR 78 FORWARD ACCEPTANCE COMMENTS BT.

3614F-10 (DAR)

Distribution List**USER TRIAL DIRECTIVE - DAR
78/LETTER OF ASSIGNMENT****Project Number:** DAES 438015**Classification:** Unclassified**References:** A. DAES 4907 301835Z Mar 78
B. DAR 3001 172000Z Mar 78
C. DCIEM/MLSD 58 311330Z May 78**Title:** User Trial Directive - P/Q Oxygen Mask

1. Project DAR/78 as described in Enclosure 1, is assigned for execution with Priority.

S.P. Gulyas
Colonel
Director Air Requirements
for Chief of the Defence Staff

Enclosure: 1 - Details of Directive**Distribution List** (see overleaf)

DISTRIBUTION LISTAction

425 Squadron (ALSEO)

433 Squadron (ALSEO)

416 Squadron (ALSEO)

CFB Moose Jaw (ALSEO)

419 Squadron (ALSEO)

417 Squadron (ALSEO)

AETE (ALSEO)

Information

AIRCOM HQ (for COS OPS)

CFB Bagotville (ALSEO)

CFB Chatham (ALSEO)

CFB Comox (ALSEO)

CFB Cold Lake (ALSEO)

USER TRIAL DIRECTIVE DAR/78AIM

1. The aim of this User Trial is to evaluate whether the P/Q mask suspension assembly is capable of overcoming the recognized weight difficulties and to determine the compatibility of the P/Q mask with the current aircrew helmet.

METHOD AND SCOPE

- a. Aircrew selected by DAR will be issued a P/Q mask in lieu of the A13A mask.
- b. These aircrew will wear the P/Q mask assembly in normal flying operations for a period of 90 days from date of issue.
- c. At monthly intervals, the participating aircrew will complete the attached questionnaire and forward it to DCIEM/MLSD.
- d. At the end of the evaluation period the masks will be returned to DCIEM (Attn: MLSD) where additional laboratory tests will be carried out.

DESCRIPTION

The P/Q mask assembly being trialed is the model currently in use in the RAF and RN. The microphone has been modified to make it compatible with CAF intercom systems. The mask is attached to the 41-2 Helmet by means of the support chain and DCIEM-developed pull-the-dot attachment points. These fasteners are snapped onto the inner helmet on the existing pull-the-dot fasteners.

The P/Q mask/41-2 combination has been tested in DCIEM laboratories and has demonstrated stability under G in the centrifuge, stability when windblasted and an ability to hold adequate oxygen pressure under pressure breathing conditions.

SPECIAL INSTRUCTION

- a. Flight Safety - If any circumstances arise with the P/Q mask which could be considered a flight safety hazard, the trial is to be halted immediately and DCIEM notified of full details.

- b. Cleaning - The P/Q mask is to be cleaned, by the individual user. To clean, swab the facepiece using a lint-free cloth which has been moistened with Savolon mixture (available from Safety Systems Shop). Dry swab the mask and allow to air dry for at least three hours prior to use.
- c. Inspections - All inspections to be carried out by individual, paying special attention for any unserviceabilities.

ISSUE OF EQUIPMENT

DCIEM Safety Systems Technicians will personally fit each subject. The helmet fit will be adjusted as necessary prior to fitting the P/Q mask.

ADMINISTRATION

- Sponsor - NDHQ/DAES 4-3-3 WO P.J. Vanderburg
- NDHQ/DAR 3
- DCIEM/MLSD Capt D.F. Leben

Units - ALSEO

COMMANDS AND UNITS RESPONSIBLE

As detailed in Distribution List

DURATION OF TRIAL

90 days from date of issue.

CONTROL

The ALSEO of each unit will be the Trial Officer. The Trial Officer will be responsible for the conduct of the trial, maintenance of trial records and a submission of questionnaires.

SECURITY

All aspects of the trial are Unclassified.

REPORTS

Each Trial Officer will ensure the questionnaires are completed and submitted to DCIEM/MLSD. DCIEM will evaluate the questionnaires, the returned equipment and laboratory tests and submit a report to NDHQ (DAES and DAR).

P/Q Mask Evaluation

QUESTIONNAIRE

For Month Of: _____

INSTRUCTIONS:

Please fill out one per month, and mail on the last working day of the month to:

Defence and Civil Institute of Environmental Medicine
1133 Sheppard Avenue West
P.O. Box 2000
Downsview, Ontario
M3M 3B9

Attention: Captain D.F. Leben (MLSD)

IDENTIFICATION

1. Name: _____
2. Rank: _____
3. Unit: _____
4. Helmet Size: S M L XL
5. Liner Size: S M L XL (Special Fit)
6. Mask Size: P Q

EXPERIENCE

1. Total Flying Time _____
2. Jet Time _____
3. Have you ever used the P/Q Mask before? Yes No
If yes, describe _____

4. Have you used any oxygen mask other than CF/RCAF/RCN standard issue? Yes No
If yes, describe _____

DETAILS:

1. What types of aircraft are you now current on? _____

2. What types of aircraft have you flown in the past month using this P/Q mask? _____

3. What was the average length of mission from time of donning mask until mask removal? _____

4. Did this mask assembly affect the hearing protection afforded by the Helmet? Yes No

If yes, was the protection increased or decreased?

Comments: _____

5. Did this mask affect the comfort of the Helmet? Yes No

If yes, was it more or less comfortable?

Comments: _____

6. Did you like the mask? Yes No

7. What single improvement would you make to the Mask Assembly to improve comfort?

Comments: _____

8. What single improvement would you make to the mask assembly to improve its' operation?

Comments: _____

9. After the mask was fitted by DCIEM personnel, were any adjustments required? Yes No

If yes, what adjustments?

By whom? _____

10. Describe mask slippage under G.

P/Q slipped more than current mask.

P/Q slipped less than current mask.

No difference noted.

Comments: _____

11. Have you experienced a skin disorder/rash wearing:

- the old rubber mask? Yes No

- the old silicone mask? Yes No

- this P/Q mask? Yes No

Describe: _____
