NAVY EXPERIMENTAL DIVING UNIT
WASHINGTON NAVY YARD
WASHINGTON, D.C. 20390

KMB-8 BAND MASK EVALUATION
INTERIM REPORT
LETTER REPORT 4-70

by

DONALD R. CHANDLER

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Submitted
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Med. Admin/Supply Officer

Approved
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Officer in Charge
From: Officer in Charge, Navy Experimental Diving Unit
To: Supervisor of Diving, U. S. Navy
Ref: (a) NAVSHIPSYSCOM ltr 3960/3 Ser OOC-1153 of 27 Feb 70
Encl: (1) Results of subjective evaluation of the Kirby Morgan KMB-8 Band Mask
(2) Photographs of old and new KMB-8 Band Mask
(3) Description of test set-up
(4) Surface Test Results and Estimated Flow Rates at Depth

1. By reference (a), NAVXDIVINGU was tasked with evaluating the subject mask. The subjective portion of the evaluation was performed at this activity between 2 March 1970 and 17 March 1970, and a summary of the results is forwarded as enclosure (1). The objective portion, consisting of flow rate and breathing resistance measurements will be performed at the Naval Medical Research Institute during late December 1970. It is estimated that all testing will be complete and a final report submitted by 22 January 1971.

2. In addition to the work listed above, comparative flow measurements were conducted on two band masks during the week of 5 October 1970. The masks were similar except for differences in the design of the gas flow control barrels. The barrel on one mask was of the original design characterized by a shallow knurled hand wheel. The barrel on the second mask was of a newer design characterized by a deep knurled hand wheel and a 1/4 turn ball valve on the emergency gas supply (see enclosure (2)).

3. The tests on both masks were conducted under identical conditions and showed that the newer designed barrel passed only about 78% as much flow as did the original designed barrel. The detailed test results and a schematic of the test set-up are presented as enclosures (3) and (4). Estimated maximum flow rates at 100 psi over bottom pressure at a depth of 200 fsw were also calculated from the 20 psi over bottom test conditions at the surface and found to be 59 and 46 lpm measured at depth for

the original and newer designed barrels respectively. Since the test conditions were identical for each mask, the observed flow ratios should be valid for all conditions.

4. During the subjective evaluation periods many of the divers had difficulty in obtaining a good face seal and oral-nasal seal at the same time. Several divers also reported that the oral-nasal mask was uncomfortable and irritated the bridge of their nose. Additionally the divers reported that air sometimes became trapped inside the hood causing it to become uncomfortably buoyant. These facts are substantiated by information contained in enclosure (1).

5. It is therefore recommended that:

a. A series of standard sizes of oral-nasal masks and face seals be developed.

b. The oral-nasal mask be made of a more pliable material, and the edge of the mask, where it contacts the bridge of the diver's nose, be rounded or otherwise modified in such a manner to reduce skin irritation.

c. The hood be modified to permit trapped gas to escape.

d. The original barrel assembly (or equivalent) be required on all masks submitted for service approval.

J. H. BOYD, JR.
RESULTS OF SUBJECTIVE EVALUATION
OF THE KIRBY MORGAN KMB-8 BAND MASK

NAVY EXPERIMENTAL DIVING UNIT
2 MARCH 1970 - 16 MARCH 1970

1. Dives Conducted

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>DEPTH/TIME</th>
<th>OVERBOTTOM PRESSURE</th>
<th>MEDIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>100/60</td>
<td>100 psi</td>
<td>Air</td>
</tr>
<tr>
<td>10</td>
<td>150/30</td>
<td>100 psi</td>
<td>Air</td>
</tr>
<tr>
<td>10</td>
<td>190/20</td>
<td>100 psi</td>
<td>Air</td>
</tr>
<tr>
<td>2</td>
<td>1000/60</td>
<td>300 psi</td>
<td>He02</td>
</tr>
</tbody>
</table>

2. Questionnaire Results: The questions are listed exactly as they appeared on the questionnaires. All significant written comments to each question were tabulated, and they are reproduced below. There is no significance to the number of comments to each question or to their order. (i.e. Comment (a) on question (1) was not necessarily made by the same diver who made comment (a) on question (2)). The responses of the divers who swam the mask at 1000 feet are identified with asterisks.

(1) Can the helmet with all its accessories be donned by the diver without assistance?

   Yes-15/2*  No-0

Comments:

a. More flexible Spider needed.
b. Spider (Jack Brown type) hard to adjust properly.
c. The sponge rubber hood is pliable and offers no resistance to donning.
d. Have a better adjustable spider.

(2) Comment on the out-of-the-water comfort and fit of the helmet.

a. Feels heavy but is not uncomfortable.
b. Not too bad.
c. Too top heavy.
d. Good.
e. Good.

f. Mask as is, is hard to fit comfortably - should fit good when seal and O/N cup is cut to fit individual.
g. Good.
h. Good.
i. Very good.
j. Tends to pull the head forward out of water.
k. Good fit; a little heavy.
l. Helmet out of the water slightly heavy forward, but once in the water not noticeable.

Enclosure (1)
Would you rate it as:

<table>
<thead>
<tr>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/2*</td>
<td>8</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

(3) Comment on the in-the-water comfort of the helmet. Include comments on the helmet buoyancy.

a. I never did have a good seal.
b. Helmet, once properly adjusted, is comfortable, but buoyant (about 3 lbs.). A 3 lb. weight under the top spider strap helps greatly. Makes the mask about neutral.
c. Very good.
d. Oral-nasal rubber cover too stiff; hurts around bridge of nose and cheek bones.
e. Generally good - oral-nasal cup needs fitting by individual before it will make a seal. For me it was very bad; no seal and rubbed nose raw; need holes/valve in hood for air exit.
f. Comfortable in water. Hat slightly buoyant, needs holes in top of the head.
g. Good after hole was cut in top of hood to let air escape. Possibly install a flutter valve to vent air off.
h. Helmet buoyancy is good.
i. Improper fit on face piece; tends to rise off your head; gets air pocket in top piece of hood.
j. Comfort is excellent except that after about 1 hour the face seal starts to become uncomfortable.
k. Oral-nasal mask does not seal to face - this increases the dead space since one can intake gas for the upper part of the mask.
l. Feels real buoyant, but tends to strain the back of your neck while working in a leaned-over position.
m. Helmet in the water slightly buoyant but does not interfere with work.
ν. Helmet buoyancy is negligible. Very comfortable in water.
o. No problem.*
p. Very good.*

Would you rate it as:

<table>
<thead>
<tr>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/2*</td>
<td>7</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Enclosure (1)
(4) Comments on the arrangement of internal fittings and any special features:

a. Without weight it is very difficult to look down towards one's stomach, much easier with it. Also it tended to make my jaw hurt. Too much pressure on the chin.

b. All feels good; think it would be even better with custom fit.

c. Good except for need of individual fit.

d. Good.

e. Oral-nasal package is hard to keep snug without really cinching down on head harness.

f. Oral-nasal improper fit; face piece improper fit.

g. Very good - no problems noted.

h. Open circuit put in upper part - tends to direct air into eyes - maybe only leaving holes facing the faceplate would be a help.

i. Good.

j. All easily accessible inside and out.*

k. All accessible very nice.*

(5) Comments on the noise level in the helmet from air helmet exhaust.

a. The exhaust causes hearing problems with the communications.

b. Very low on demand; on open circuit, noise from exhaust bubbles is severe.

c. Vibrates quite a bit during vent.

d. Not too excessive.

e. Good.

f. Noise level is comfortable.

g. Good.

h. Had difficulty hearing during vent.

i. Open circuit hard to hear.

j. Inlet sometimes causes slight interference when ventilating.

k. Good.

l. Noise level moderate.

m. Noise level creates hearing difficulty when on open circuit.

n. On free flow high noise level drowns out communication especially when bubbles flow past ear.*

o. Free flow, it too high, drowns out speech especially when bubbles flow past ears.*

Does it interfere with communication?

Yes-4

No-3

Yes, but only during a vent - 7

a. Not on demand, topside to diver communications are almost wiped out by exhaust noise on open circuit.
b. Phones have to be next to ear in order to hear well-again, individual fit of hood.
c. Only when ventilating.
d. If phones are not firmly against ears communication is bad. Communications overall good.
e. Yes, if receivers are not against your ears firmly.
f. Good enough to do most any work.

(6) Are the helmet air inlet and exhaust valves easily accessible and operable?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>15/2*</td>
<td>0</td>
</tr>
</tbody>
</table>

Comments:

a. Easily accessible but not easily operable - too many turns on demand valve control valve.

(7) Comment on the visibility from the helmet.

a. Top, front, sides excellent; toward stomach poor.
b. Fair in comparison with full helmets like Clark, etc.
c. Good.
d. Very good.
e. Not too good; only straight ahead with small field of vision.
f. Good enough to do most any work.

Would you rate it as:

<table>
<thead>
<tr>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>12/2*</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

(8) Can the helmet be easily cleared of water?

Yes - 11/2* No - 0

Comments:

a. Very quick to clear.
b. Just push purge button or open supply valve.
c. No water in it.

(9) List and discuss any features of the helmet especially liked:

a. Controls easy to operate.
b. Easy to clear ears.
c. Plenty air circulation.
d. Water proof comm set up! Easily understood even under full air flow.
e. I think it's an all around good piece of diving gear and would like to see it replace some Navy gear.
f. Weight, ease of operation—simple to operate, transport and repair.
g. I like the weight which gives good mobility also visibility.
h. Weight is good in any work condition.
i. No weight problem in or out of water.
j. Neoprene hood tended to fill with air—a vent in the top would prevent this and also prevent trapped air from lifting the earphones away from one's ears.
k. Easy to move about. I found I could clear my ears real good on descent.
l. Light weight and sturdy.
m. Weight and ease of motion.
n. Light, easy to get on and off, plenty of gas.*
o. Plenty of air—light* (Note over bottom pressure on 1000 foot dive was 300 psi).

(10) List and discuss any features of the helmet especially disliked:

a. The spider should be changed to a more comfortable spider with the holes closer together. The oral-nasal mask should be fitted to each individual diver. The outer seal around the face should be changed.
b. Buoyant.
c. Oral-nasal; small hand wheels on controls; too many turns on demand control valve.
d. Ill fit of oral-nasal cup.
e. Oral-nasal cup and face seal—make oral-nasal seal of some soft, wider material such as neoprene foam.
f. To keep oral-nasal package sealed you have to really keep a strain on head harness, which on a long dive gets very uncomfortable.
g. Harness (head) not right one.
h. Face seal became uncomfortable after approximately 1 hour.
i. CO2 line must be moored or deleted, but I believe that once a diver uses it a few times it won't bother his neck very much.
j. Dislike ventilating with helmet because of bouncing on face, particularly forehead.

(11) What is your overall evaluation of the helmet?

a. With changes mentioned above (10a) it would be an excellent rig. It is just a fair rig now.
b. Appears to be a good, comfortable helmet if carefully put on. Tends to irritate bridge of nose and make jaw hurt if not properly fitted.
c. Very good.
d. Outstanding.
e. Without oral-nasal problem a good piece of gear.
f. No complaints.
g. Very good rig—especially on demand.
Comments:

a. Weighting of the helmet appears desirable. Wants to lift off diver's face.

b. High rearward pressure on diver's chin makes jaw hurt.

c. Topside to diver communications are very bad when on open circuit.

d. Demand mode of operation made dive very comfortable even while at hard work.

e. Would like to see it replace Jack Brown rig - multi-use feature, better cold water protection, ease of operation and repair.

f. Do not use more than 1/4 and 1/2 turn because too much flow dries and causes a burning sensation in the eyes.

g. Don't need free flow, can work using only demand. Free flow increases comfort. Used only 1/4 to 1/2 turn open.

h. Do not use free flow! Because when gas is on too high, it will dry your eyes and they will burn. You only need demand. On free flow use only 1/4 to 1/2 turn.
OLD (#1) AND NEW (#2) GAS FLOW
CONTROL BARRELS SHOWN SIDE BY SIDE
OLD (ORIGINAL) GAS FLOW CONTROL BARREL

NEW GAS FLOW CONTROL BARREL

Enclosure (2)
Test Set-up Used in Comparative Flow Study of 2-KMB-8 Band Masks

Regulator Supply Set of 20 PS.I

Dry Gasometer

Helmet Testing Box
SURFACE TEST RESULTS AND ESTIMATED FLOW RATES AT DEPTH

RESULTS

<table>
<thead>
<tr>
<th>Run</th>
<th>Old Helmet</th>
<th>New Helmet</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 minute run #1</td>
<td>66.8 SLPM</td>
<td>53.2 SLPM</td>
<td>.796</td>
</tr>
<tr>
<td>5 minute run #2</td>
<td>70.4 SLPM</td>
<td>56.0 SLPM</td>
<td>.795</td>
</tr>
<tr>
<td>10 minute run #1</td>
<td>72.9 SLPM</td>
<td>56.8 SLPM</td>
<td>.779</td>
</tr>
<tr>
<td>10 minute run #2</td>
<td>79.0 SLPM</td>
<td>55.0 SLPM</td>
<td>.743</td>
</tr>
<tr>
<td>Average</td>
<td>71.02 SLPM</td>
<td>55.25 SLPM</td>
<td>.778</td>
</tr>
</tbody>
</table>

Flows calculated
@ 100 psi overbottom
pressure at a depth of

100 FSW  80.2 ALPM  62.4 ALPM
200 FSW  59.2 ALPM  46 ALPM

SAMPLE CALCULATION

Estimated Flow = \frac{\text{Observed Flow} \times (\text{depth (psi)} + 114.7\text{psi}) \times 1}{\text{(SLPM)} \times \frac{20 \text{ (psi)}}{14.7 \text{ (psi)}} \times \text{Depth (ata)}}
KMB-8 BAND MASK EVALUATION, INTERIM REPORT

Interim Report

Donald R. Chandler, LT, USN

21 December 1970

Letter Report 4-70

None

Naval Ships System Command
Washington, D.C. 20360

Thirty-two manned test dives were made using the Kirby Morgan KMB-8 Band Mask; 30 on air at depths to 190 feet of sea water, 2 on He02 to 1000 feet of sea water. Comparative maximum flow tests were also run on both the original KMB-8 and on a newer model currently being supplied by the manufacturer. The tests showed that the mask performed satisfactorily under the conditions tested although some minor modifications are recommended. Also the maximum flow capability of the newer KMB-8 model was found to be significantly lower than that of the original mask.
<table>
<thead>
<tr>
<th>KEY WORDS</th>
<th>LINK A</th>
<th>LINK B</th>
<th>LINK C</th>
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<tbody>
<tr>
<td></td>
<td>ROLE</td>
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<tr>
<td>Diver Life Support</td>
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