29 May 1984

STRNC-ICH

MEMORANDUM FOR RECORD

SUBJECT: Human Factors Evaluation of Hydration System for Personnel in MOPP

1. At the request of Mr. Snow, the undersigned conducted a limited evaluation of the Fluid Intake Suction Tubing (FIST) Hydration System with Flexible (FLEX) Canteen. The purpose of the evaluation was to assess the compatibility of the FIST/FLEX System with CP clothing and other personal equipment items.

2. The FIST consists of a rubber bulb connected to coiled, flexible tubing. A coupling at the end of the bulb is used to connect the bulb to the drinking tube of the M17A1 mask and a coupling at the end of the t bing is used to connect the tubing to the canteen cap. The FLEX canteen is outfitted with an internal tube which is connected to the canteen cap. When the FIST bulb is squeezed, water is drawn from the canteen up into the drinking tube. The drinking tube portion of the standard M17A1 mask is modified slightly to accommodate the FIST coupling and the standard M6A2 hood is modified to accommodate the FIST Bulb. The hood modification consists of the addition of a piece of butyl and a zipper to the front, throat area of the hood. Thus, there are two layers of material at the front of the hood, each layer having a zipper. The FIST bulb lies between these two layers.

3. Findings from this limited evaluation of FIST/FLEX were as follows:

a. FLEX Canteen.

(1) The FLEX canteen has a capacity of 900 ml, while the standard canteen has a capacity of 1000 ml. When the FLEX was filled to capacity with water and the water was pumped through the drinking tube by using the bulb, 700 ml of water were drawn out of the canteen before pumping resulted in air, rather than water, being delivered through the drinking tube. Therefore, the FLEX has a useable capacity of 700 ml.

(2) The configuration of the FLEX canteen was compatible with the canteen cup and the canteen cover.

(3) It was difficult at times to secure the connector at the end of the FIST tubing to the canteen cap. The difficulty lay in pushing the connector through the rubber gasket on the cap. This problem was encountered when the gasket was dry, but not when it was wet.

b. FIST Tubing

(1) The coiled, flexible tubing running between the canteen and the rubber bulb can be compressed, stopping the flow of water. Use of another material, which cannot be compressed, should be considered.

(2) Users may find that the tubing snags or catches on other pieces of equipment, brush, etc. The tubing can be kept in place to some extent by passing it under the suspenders on the fighting load. However, it may still be an annoyance.

c. FIST Bulb

(1) The bulb could be located readily and operated with one hand.

(2) The bulb did not appear to interfere with head movements nor was it annoying at its location by the throat.

d. Compatibility with Clothing and Equipment

(1) During this evaluation, the CP mask with hood and FIST attached was donned as a unit and then the FIST tubing was attached to the canteen which was worn at the waist with the other items comprising the fighting load. Donning the mask, hood, and FIST and attaching the tubing to the canteen could be accomplished while wearing the standard, butyl CP gloves.

(2) Donning was impeded somewhat by the neck cord on the hood. The cord was not long enough to accommodate the FIST bulb and still pass easily over the head.

(3) The modifications made to the hood to accommodate the FIST bulb resulted in the extra layer of butyl being tight around the throat and other portions of the hood being tight around the shoulders or lying close to the neck. It is recommended that the hood be made fuller.

(4) The FIST did not interfere with wearing the fighting load. The FIST did not interfere with head movements while wearing the PASGT vest. Head movements were limited by the CP mask impinging upon the vest collar, rather than by the FIST device itself impinging upon the vest.

(5) The chin strap of the PASGT helmet cannot be secured when the FIST is worn. However, the strap cannot be properly secured when the standard mask and hood are worn.

3. Based upon this limited evaluation, it appears that the FIST/FLEX is a worthwhile concept to pursue as a hydration system for use with CP clothing. If FIST/FLEX devices are to be released to the TRADOC community and their feedback solicited, it is recommended that the hood be made fuller before the devices are released. In this way, negative reactions due to problems with the hood, rather than problems with the FIST/FLEX concept, may be avoided.

Carolyn K. Bensel, Ph.D.
Chief, Human Factors Group

CF: P. Snow, Chem Sec
A/C, Chem Sec
C, LSCS&E Br
C, LSS Div

DEPARTMENT OF THE ARMY
UNITED STATES ARMY INFANTRY SCHOOL
FORT BENNING, GEORGIA 31905

IN REPLY REFER TO

22 AUG 1984

ATSH-CD-MLS-C

SUBJECT: Informal Evaluation of Fist Flex Hydration System

Commander
US Army Natick Research and
Development Center
ATTN: STRNC-ICCC (Mr. Snow)
Natick, Massachusetts 01760-5019

1. Attached at Enclosure 1 is information obtained from an informal appraisal/evaluation conducted by members of the Chemical, Biological, Radiological and Individual Equipment Branch, Directorate of Combat Developments, this headquarters.

2. Point of Contact for this action is Mr. Bill Thetford, AV 835-3087.

FOR THE COMMANDANT:

Robert O'Neil DAC, x.o.
for THOMAS K. SEYBOLD
Colonel, Infantry
Director, Combat Developments

1 Encl
as

Infantry School
Evaluation

INFORMAL EVALUATION
FIST FLEX HYDRATION SYSTEM

1. Personnel conducting the appraisal of the Fist Flex Hydration System were Infantrymen or civilian equipment specialists with an Infantry background. The "pump concept" used by the system has merit and possible application for military use. The system appears to be more applicable to motorized, mechanized and aviation type units. The only real advantage for the Infantryman over the present system is that the protective mask and canteen are already connected.

2. The following problems were noted:

a. The field jacket and PASGT vest need no modification in that the NBC overgarment will be worn as the outer garment at all levels of MOPP.

b. The internal tube/pump developed an air leak.

c. All water could not be pumped from the Flex Canteen without leaning or tilting the canteen.

d. The system required two hands in order to place the drinking tube into the mouth and actuate the hand pump.

e. Although no failures developed, the tubing stem and filtering screen in the Flex Canteen appear flimsy and could be a problem area.

3. Recommendations:

a. That Natick Labs continue to evaluate the Fist Flex Hydration System.

b. That copies of the system be sent to US Army Aviation Center and the US Army Chemical School for their appraisal and comments.

DEPARTMENT OF THE ARMY
US ARMY CHEMICAL SCHOOL
FORT MCCLELLAN ALABAMA 36205-5020

REPLY TO ATTENTION OF

ATZN-CM-CS

29 OCT 1985

SUBJECT: Improved Mask Hydration System

SEE DISTRIBUTION

1. Attached is the Chemical School's analysis of the current Mask Hydration System deficiencies and a proposed position on the Fluid Intake Suction Tubing (FIST) hydration technology development.

2. Request you review this analysis and provide your organization's concurrence/nonconcurrence or comments on this action NLT 24 Nov 85.

3. USACMLS POC'S are CPT Ishmael or MSG Williams, AUTOVON 865-3877/3906.

FOR THE COMMANDANT:

GARY EIFRIED
Colonel, CM
Director of Combat Developments

Encl

DISTRIBUTION:

Cdr, USASSC NCR, ATTN: ATZI-NRC-SI/ATZI-NCR-PM, Alexandria, VA 22332
Cdr, CRDC, ATTN: SMCCR-OPP, Aberdeen Proving Ground, MD 21010
✓Cdr, USACAC, ATTN: ATZL-TIE-O, Ft Leavenworth, KS 66026
Cdr, AHS, ATTN: HSHA-CDM, Ft Sam Houston, TX 78234
Comdt, USAIS, ATTN: ATSH-CD, Ft Benning, GA 31905
Comdt, USAARMS, ATTN: ATSB-CD, Ft Knox, KY 40121
Comdt, USAAVNS, ATTN: ATZQ-CD, Ft Rucker, AL 36362
Cdr, TRADOC, ATTN: ATCD-SE, Ft Monroe, VA 23651
Cdr, USANRDC, ATTN: STRNC-WS, Natick, MA 01760

Psychology

Commanders must always be aware of the psychological effects soldiers encounter while wearing the protective clothing. History shows that 10 percent of the casualties on the battlefield are caused by psychological factors. In an NBC environment, 25 percent of the casualties may be psychological in origin. Symptoms may include claustrophobia, apprehension, paranoia, disorientation, distorted bodily sensations, hallucinations, confusion, and panic.

Prevent many of the described symptoms by continually reinforcing NBC training and by educating soldiers on NBC survival measures. During peacetime, soldiers should receive extensive concurrent training while wearing full MOPP gear. This allows soldiers to become more confident in the equipment. It also increases the time that MOPP gear can be worn without serious effects.

Food Contamination

The ability of troops to eat in an NBC environment depends on the type and extent of contamination. Some of the available options follows:

o If the troops are in a contaminated area where there is also a vapor hazard, move them into a collective protection facility. Since collective protection facilities have a limited capacity, commanders must rotate small groups through these facilities.

o If the troops are in a contaminated area with no collective protection available, they must relocate to a safe area for feeding. This is done by rotating small portions of the unit or by entire unit replacement. The rotational method selected depends largely on the situation, distance from the safe area, and availability of uncontaminated areas.

o If the troops are in a contaminated area with no detectable vapor hazard or in a clean area where they are under constant threat of NBC attack, use a rotating basis for feeding about 25 percent at any one time. Take care at all times to prevent contaminating the food.

Water Supply

The human body is highly dependent on water to cool itself in a hot environment. Soldiers in MOPP4 may lose more than 1 quart of water each hour. These losses must be replaced on a continual basis.

An approximate recommended replenishment should be based on work rate and temperature. For example with a moderate-to-heavy work rate and temperatures below 80 degrees Fahrenheit (27 degrees Celsius) 1 quart of water should be consumed every 3 hours. With the same work rate, but temperatures above 80 degrees Fahrenheit (27 degrees Celsius) the water consumption will increase to 1 quart every 2 hours. Otherwise, soldiers will suffer rapid rise in body heat and heart beat, decrease in ability and motivation to work, and eventually heat exhaustion, if water intake is neglected.

DISPOSITION FORM

For use of this form, see AR 340-15; the proponent agency is TAGO.

REFERENCE OR OFFICE SYMBOL	SUBJECT
ATZN-CM-CS	Improved Mask Hydration System - ACTION DF

TO THRU C, MLSD FROM PHY PROT BR DATE 29 OCT 1985 CMT 1

MSG Williams/ah/3877

TO D, DCD

1. Purpose. To determine if there is a need to develop a system which supplies water through the mask directly from the canteen, specifically a system similar to the Fluid Intake Suction Tubing (FIST) hydration system developed by the Wesleyan Company.

2. Discussion.

a. This analysis reviews only a concept and is not meant to endorse the Wesleyan manufactured system. This analysis reviews the current system to determine if deficiencies exist and compare the current system to the FIST system to determine if deficiencies could be corrected by this technology.

b. Technology available allows water intake while masked by drawing water directly from the canteen by use of hydraulics. This system uses tubing which connects the mask directly to the canteen. The system has check valves, quick disconnects, a squeeze bulb and a flexible canteen.

c. Currently water is consumed while masked using procedures outlined at Tab A.

d. There is no identified MAA deficiency which specifically identifies a need to improve the rate of water flow or human factors aspects of water intake through the mask. Tab B.

e. IAW FM 3-4, dated December 1984, for temperatures less than 80 degrees Fahrenheit, soldiers should consume one quart of water every 3 hours. In a worse case situation with temperatures over 80 degrees Fahrenheit, soldiers would have to consume one quart of water every 2 hours. Tab C.

f. Criterion to evaluate the advantages of the FIST technology over the current system and a discussion of each is as follows:

(1) Time savings. Tab D.

(2) Risk of consuming contamination. Tab E.

(3) Ability to conduct other tasks concurrently while drinking. Tab F.

(4) Ease of use/human factor. Tab G.

g. While there is no specific MAA deficiency directed toward the current drink system, analysis identifies shortcomings relative to the amount of time required to consume the amount of water required in an NBC environment. Additionally, procedures used are difficult and present a risk of consuming contamination.

h. Best estimates show that about 15% ± 5% of time in MOPP will be required to consume the required amounts of water. Cold weather and optimal conditions such as daylight, non-cramped environment, will tend toward the 10%. Hot weather, darkness, cramped conditions will tend toward 20%.

0810

-CM-CS
SUBJECT: Improved Mask Hydration System - ACTION DF

i. The current procedures are time consuming and difficult to perform. Soldiers in stress environments have been found to become frustrated and stop drinking the required amount of water. The FIST concept allows the materiel developer to design out the shortcomings of the drink system rather than having to train out the problems.

j. The soldier depends on correctly following the established procedures to prevent contaminant transfer to the water. These procedures are time consuming and difficult to perform in less than ideal environments such as darkness, and cramped quarters.

k. The FIST concept allows drinking with the use of one hand. This has great merit to the pilot

l. Limitations with the concept are that it costs money, adds weight and bulk and it takes up space on the LBE.

m. In conclusion, the current system has major shortcomings and FIST technology provides the following advantages:

(1) Eliminates excessive time (15%) required for the drink function.

(2) Eliminates difficult/time consuming procedures and ensures a safe drink.

(3) Enhances ability to drink in less than optimum conditions such as darkness, cramped quarters, such as a tank.

(4) Allows drinking with one hand while performing tasks such as those of a pilot.

(5) Enhances motivation for a soldier to drink water in MOPP.

3. Recommendation. That technology similar to FIST be developed and be provided as an ~~optional~~ mandatory accessory to the mask.

TERRELL R. WILLIAMS
MSG, USA
Project NBCo

7 Encls

APPROVED _____
DISAPPROVED _____

KEY EVENTS IN THE US ARMY FIELD WATER PROGRAM: USARIEM'S ROLE

1974- Discussions on the logistical and operational causes of heat stroke casualties held between Col Shlomo Shibolet (IDF) and Dr Hubbard, Tel Aviv, Israel.

1977- Heat Research Division (HRD) participates in Brave Shield XVI, MCB 29 Palms, CA.

1978- An analysis of current doctrine in use (USA vs IDF) for the prevention and treatment of heat casualties, pp1-40 (Dr Hubbard).

1979- A brief analysis of Soviet hot weather operations doctrine, pp 1-12 (Dr Hubbard).

1980- HRD participates in USMC Combined Arms Exercise 8-80, MCB 29 Palms, CA.

1980- Deficiencies in current field water capability described in a Report to the Commander: "Water as a Tactical Weapon", pp 1-25.

1981- Recommendations on "Water as a Tactical Weapon" presented to the Defense Science Board, Water Support Task Force, pp 1-17, Pentagon, 22 Jan 81 (Dr Hubbard).

1981- Briefing to the Surgeon General (LtG Pixley) on the need for Small Mobile Chillers (Dr Hubbard).

1981- Briefing to the Superintendent, A. H. S. (MG Q. T. Becker) on heat casualty prevention (Dr Hubbard).

1981- Briefing to the CO & HQ Staff (MG Kingston), RDJTF on field water and heat casualty prevention, MacDill AFB, FL (Dr Hubbard).

1981- Briefing to the Water Resources Management Action Group #1 (WRMAG) on "Heat Illness: Problems and Solutions" (Dr Hubbard). Taskings #: 5- Water discipline policy; #11- Cooling unit; 2.r.1- Water flavorants; 3.n.1- Issue Provisional Heat Doctrine (W/R cycles, water consumption); 3.n.4- Anticonvulsant therapy; 3.n.5- Heat casualty cooling.

1983- HRD participates in Bright Star 83, Cairo West, Egypt.

1985- HRD participates in Bright Star 85, Cairo West, Egypt.

1985- Briefing to WRMAG # 8 on water flavorants (NRDEC & USARIEM). Briefing on FIST/FLEX: Drinking water in a NBC environment (Sponsor: USARIEM). BG Pigaty, TROSCOM recommends FIST/FLEX be evaluated for drinking with troops in MOPP IV.

1986- Briefing to WRMAG #10: An assessment of the FIST/FLEX type system. Subsequent Tasking # 25 "Evaluate and test a system for the individual soldier to drink water from a canteen in an NBC environment". Responsible agency: AMC; Coordinating with TRADOC, NRDEC, & USARIEM.

1992

5-9 Sept -I attended the Sodium Pump Conference in Woods' Hole
10 Sept- Return to mail and Pat's protocol
11 Sept- Spoke to LTC Glenn about SPC Criss's assignment to HRD. He said he would see that he was detailed immediately.

SGRD-UE-HR 11 Sept 1990

MEMORANDUM FOR COMMANDER

SUBJECT: Telephone Memo's and Follow-up Actions

1. I received a call from Wesley Schneider of Marden-Kane Marketing Consultants on the Fist-Flex Thru Mask Drinking System. Mr. Schneider was one of the original developers of this aid to drinking designed to replace the current system. Fist/Flex is a one time connect/disconnect flexible conduit from the canteen to the face mask. It delivers water when a hydraulic hand-bulb is squeezed. USARIEM has evaluated it and found it superior to the current system in many ways. Mr. Schneider was concerned that current tests conducted with agent were not successful but the results and design were not released as yet. He said that he had heard that a type-classification meeting would be held on 9/27/90 but that PMCIE would suggest that a new developmental program for this type of item be begun (5-7 years?). Given the current military situation and some quick fixes possible in Fist/Flex his concern is probably real enough.

2. The Surgeon has no vote in these matters and COL Schnakenburg is addressing this by helping to revise the pertinent regulation. I called COL S to inform him of the scheduled Type-Classification meeting on 9/27/90 so he could seek input (probably MAJ Broadwater at OTSG).

3. I asked COL S to forward any confirmed heat casualty rates or estimates from Desert Shield as soon as they were available at OTSG. I sugggested that CENTCOM set up a tri-service heat data base as soon as practical.

4. I reviewed the current formulation for an Oral-Rehydration package and found it consistent with WHO recommendations (attached).

CF: Dep Cdr ROGER HUBBARD, Ph.D.
LTC Burr
CAPT Eisenmann

12 Sept Spc Criss reports to SGT Thomas for duty (SGT Sharp is acting 1st SGT)

1990

Mask Drinking System - Interim (MDS-I)
Protection Factor (PF) Test
With M17 Mask and M40 Mask

Mask leakage with fitted CS

CRDEC

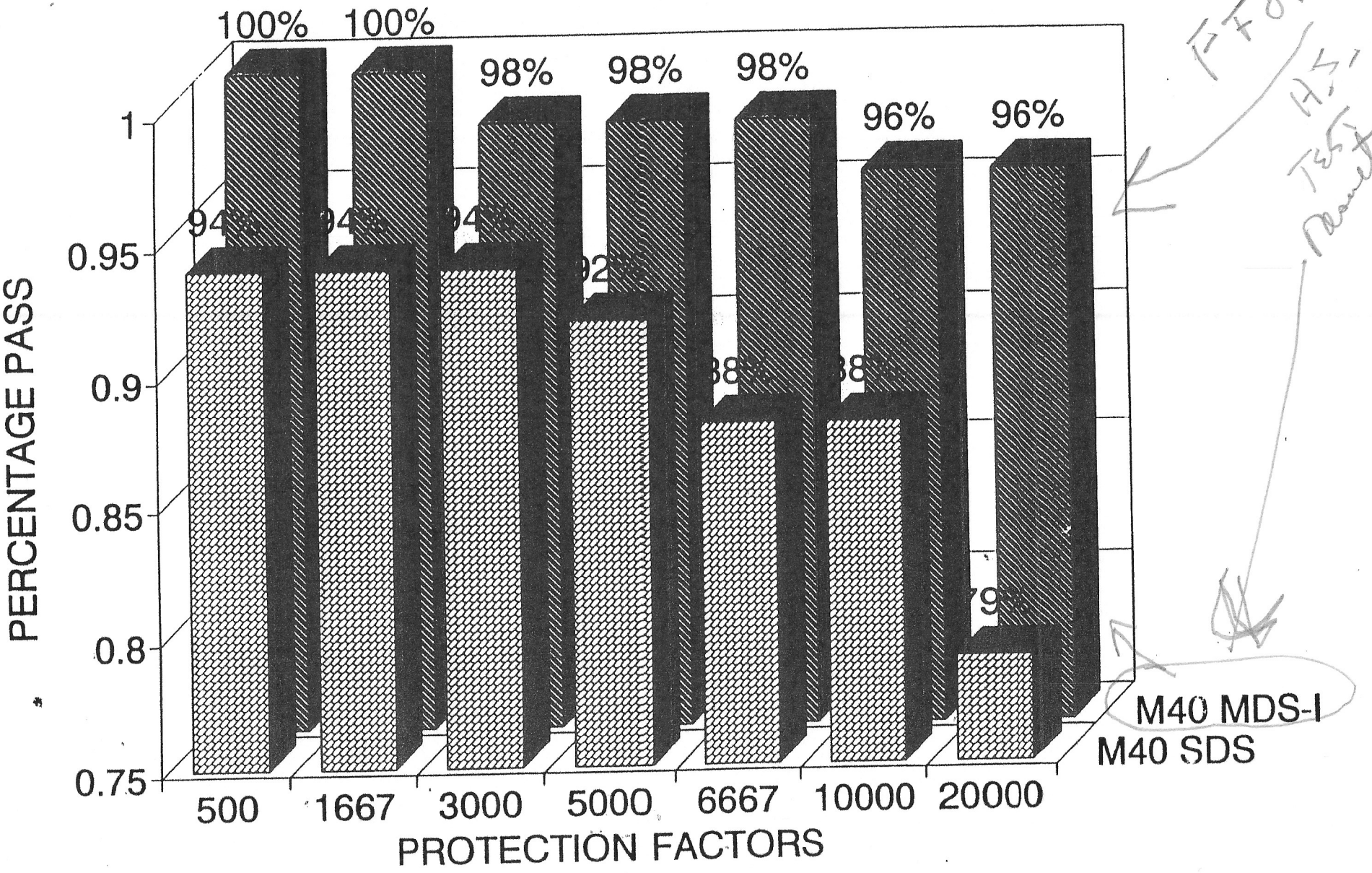
Chemical Research, Development, and Engineering Center

Physical Protection Directorate

Individual Protection Division

RANGED PROTECTION FACTORS

M40 WITH SDS VS. MDS-I



90

Mask Drinking System - Interim (MDS-I)

Test Results

Results:

- **M17 Mask with/without MDS-I**

  Showed no significant difference in protection

- **M40 Mask with/without MDS-I**

  M40 Mask with MDS-I performed 10% better than M40 Mask with SDS

Rationale:

- **M40 Mask with/without MDS-I**

  Difference is due to the shorter drink tube of the M40 mask as compared to the M17

  Shorter drink tube promoted tugging on the M40 mask and caused mask faceseal leakage when connecting to the SDS and when drinking.

1990