Redesign of the Field Dental Bag to Accommodate Dental Instruments, Supplies, and the Battery Operated Dental Handpiece.

Charles R. Paschal, Jr.

Robert R. Brewer

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U S ARMY BIOMEDICAL RESEARCH & DEVELPMENT LABORATORY

Fort Detrick

Frederick, MD 21702-5010

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Redesign of the Field Dental Bag to Accommodate Dental Instruments, Supplies, and the Battery Operated Dental Handpiece.

Paschal, Charles R., Jr., and Brewer, Robert R.

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Field Dental Bag, Dental Bag, Battery Operated Dental Handpiece.

It is United States Marine Corps (USMC) policy for the corpsman to use the M-3 aid bag as an emergency dental kit. The USMC incorporated a dental handpiece into the kit, which mandated the design of a new dental bag. A prototype was designed by the U.S. Army Biomedical Research and Development Laboratory, which accommodates the handpiece and ancillary supplies. In addition, it has two pouches: one for exploratory instruments and one for surgical instruments. All metal fixtures and zippers were replaced with plastic ones, the position of the carrying strap was moved to improve stability, and short handles were added to the sides. This design was accepted by the USMC, and a technical drawing package was furnished to them.
TABLE OF CONTENTS

INTRODUCTION................................................................. 1

METHODS AND MATERIALS.................................................. 2

RESULTS.............................................................................. 3
  Dimensions................................................................. 3
  Materials................................................................. 3
  Organization of the Interior................................. 5
  Second Prototype................................................. 5

SUMMARY................................................................. 7

REFERENCES............................................................... 8

ILLUSTRATIONS

Figure 1. Sketch of the M-3 Aid Bag (NSN 6545-00-912-9870) showing the trifold design............ 9

Figure 2. Stability and the Axis of Lift in the M-3 aid bag........................................ 9

Figure 3. Sketch of the Compartment Layout of the First Prototype Field Dental Bag.......... 10

Figure 4. Sketch of the Foldout Pouch of the First Prototype Field Dental Bag................ 11

Figure 5. Dimensions of the Exploratory and Surgical Instrument Pouches in the Prototype Field Dental Bag......................... 11

Figure 6. The Final Prototype Field Dental Kit..................... 12

TABLES

Table 1. U.S. Marine Corps Recommendations as provided in Memorandum 6700 DEN00 (27 November 1989)........ 13

Table 2. Components of the Field Emergency Treatment Dental Instrument and Supply Set........ 14

Table 3. List of Materials to Construct New Dental Kit..... 13

Introduction

It is United States Marine Corps (USMC) policy for the corpsman to use the M-3 aid bag (NSN 6545-00-912-9870) as an emergency dental kit. The official nomenclature for the M-3 is "Case, Medical Instrument and Supply Set". No significant changes have been made to the M-3 aid bag in twenty years. It is made of nylon fabric with metal hardware as illustrated in Figure 1. Its basic three pocket, trifold design is familiar to combat life support personnel serving over the last three decades.

The USMC incorporated a battery operated dental handpiece (NSN #6520-01-239-4696) as well as additional expendables into their emergency dental instrument and supply set. The handpiece has an approximate volume of 138 in$^3$. The approximate volume of the M-3 Aid Bag is 340 in$^3$. This 40 percent increase in required volume mandated the design of a new dental bag specific to the needs of the USMC.

A November 27, 1989, memorandum from the Commandant of the Marine Corps (see Appendix) requested that the United States Army Biomedical Research and Development Laboratory (USABRDL) design a new dental bag to accommodate the additional accessories and incorporate the recommendations listed in Table 1. This technical report describes efforts in development of the dental case to meet the USMC criteria.
Methods and Materials

A market survey was conducted to determine the availability of various types of equipment cases, trauma bags, and paramedic kits with particular interest being directed toward a containment system for emergency treatment equipment. Fifteen potential manufacturers were identified in the market survey, but none of the available products met USMC requirements. Therefore, a development effort was initiated to make a prototype and provide the USMC with a technical drawing package.

The first step in prototype development was to categorize the dental set contents according to purpose: exploratory, surgical, and medications. Table 2 lists the dental components packed into the M-3 Aid Bag; categorized by the compartments in which they are usually stored. The USMC revised this list, deleting the 53R tooth extracting forceps and adding the dental handpiece and five packages of burrs.

The second step in development was the choice of materials used in construction of the bag. The outer shell material should be tough, and the instrument pouch material should be puncture resistant and sterilizable. Lift point hardware should be rugged, and all materials should meet or exceed the standards set forth for the M-3 aid bag (MIL-C-36856).
Results

Dimensions

The largest component in the set is the dental handpiece box, which measures 2.0 by 6.3 by 11.0 inches. The second largest item is the mixing pad of parchment paper, with dimensions of 0.25 by 6.0 by 8.0 inches. Taking into account the probability of putting the mixing pad in incorrectly and the advantage of additional volume for accessories, a length of 12.0 inches and a height of 8.0 inches were selected. The M-3 aid bag had a width of 4.25 inches. An additional 2.0 inches for the handpiece box and 1.25 inches for a folding instrument pouch gave a final depth of 7.5 inches. The dimensions 12.0 by 8.0 by 7.5 inches give a volume of 720.0 cubic inches.

Materials

The nylon fabric of the M-3 is adequate, but new and better materials have been developed since the M-3 was introduced. The market investigation revealed most emergency treatment bags are made of Cordura nylon. Although more expensive, Cordura is tough, water resistant, and will neither rot nor mildew, and for these reasons Cordura Plus nylon fabric was chosen as the outer shell material for the dental bag. The puncture resistant material selected for the pouches was a water proof, vinyl coated nylon called Herculite. It was chosen because of durability, stability to heat, and cleaning characteristics.

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In the M-3, the lift point hardware, zippers, and fasteners are made of metal. Advances have also been made in polymer technology, and plastic hardware was chosen because it is lightweight, rugged, and does not rust. The lift point hardware for the attachment of the shoulder strap was replaced with DuPont Delrin hardware consisting of a tri-ring, retainer, and hook. Plastic coil style zippers were chosen because they were found to be superior in strength to tooth style zippers. Compartments did not move relative to one another, so snaps or Velcro fasteners were not necessary. A small amount of Velcro was used to secure the flaps of the roll up pouches. Table 3 contains a list of materials used to construct the new dental kit.

The shoulder strap on an aid bag attach to two lifting points. The axis passing through these points (the axis of lift) is a reference line about which the bag rotates when acted upon by nonaxial forces (see Figure 2). The weight of the bag is a resultant force acting at the center of gravity of the bag. This resultant force has a radial and tangential component relative to the axis of lift. The tangential component causes rotation and, therefore, dictates stability.

If the bag has equal weight distribution, the center of gravity corresponds to the geometric center of the bag. An unequal weight distribution of packed materials can cause small

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Manchester, New Hampshire.
shifts in the center of gravity from the geometric center. Because contents and packing procedures vary widely, aid bags should be designed around the concept that the center of gravity is generally at the geometric center. Viewed from above, the axis of lift of the M-3 aid bag is not centered, making the bag awkward to handle (see Figure 2).

In the prototype dental bags, the lift points were centered to ensure that the axis of lift passes above the geometric center of the bag. The lift points were also raised relative to the geometric center, which lowered the center of gravity and increased stability.

**Organization of the interior**

In the first prototype, the interior was divided into four compartments (see Figure 3). The rigid mixing pad in compartment 2, and the dental handpiece box in compartment 3 combined to provide structural support to the bag. Compartment 2 contained the disposables and smaller accessories. All exploratory and surgical instruments were located in pockets within a roll up pouch secured to the base of compartment 3 (see Figure 4). Velcro fasteners were used to hold the pouch in the folded position.

**Second Prototype**

In May 1990, the first prototype was presented to USMC representatives, and, in June 1990, it was presented to the Joint Services Dental Materiel Coordinating Group of the Defense Medical Standardization Board (DMSB). Suggested modifications
are listed in Table 4. All suggestions, except those involving
the instrument pouches were readily incorporated into the design
of the second prototype.

As recommended, instruments were categorized as exploratory
or surgical, and two separate pouches were designed to accom-
modate the different instruments (see Figure 5). Whereas
suggestion 2 called for a puncture proof material, there is no
suitable material that is thin and flexible and completely
resistant to the pressure generated at the point of a sharp
instrument. Puncture resistant materials can be punctured, but
the hole in the fabric does not propagate. The puncture
resistant material selected for the pouches was Herculite.

In order to answer the question of sterilizability of the
Herculite pouches, two test pouches were designed and fabricated:
one was made entirely of Herculite, and the other was made of
Cordura reinforced with Herculite. They were tested by placing
sterilization assurance strips in the bottoms of each of the
pockets and subjected to steam at 250°F for ten minutes. All
strips recovered from the pockets of both types of pouches were
sterilized. To maintain simplicity of design and reduce cost,
pouches made entirely of Herculite were selected.

To accommodate instrument pouches, an additional fabric
panel was added to the inner divider of compartment 3. It was
tacked in the middle to form two pockets where the roll-up
pouches would be secured (see Figure 6).
Summary

A field dental bag was designed by the U.S. Army Biomedical Research and Development Laboratory, which accommodates the hand-piece and ancillary supplies. In addition, it has two pouches: one for exploratory instruments and one for surgical instruments. Metal fixtures and zippers were replaced with plastic ones, the position of the carrying strap was moved to improve stability, and short handles were added to the sides. The final prototype was accepted by the USMC in November 1990, and a technical drawing package was furnished and accepted in February 1991.
REFERENCES

Memo: 6700 DEN00 27 NOV 89 From: Commandant of the Marine Corps To: Commander, U.S. Army Biomedical Research and Development Laboratory, Fort Detrick, Frederick, MD 21701-5012. Subject: Redesign of the Dental Instrument and Supply Set, Emergency Medical Treatment, Field, (Unit 2).


Figure 1. Sketch of the M-3 aid bag (NSN 6545-00-912-9870) showing the trifold design.

Figure 2. Stability and the Axis of Lift in the M-3 Aid Bag
Figure 3. Sketch of the Compartment Layout of the First Prototype Field Dental Bag.

Figure 4. Sketch of the Fold Out Pouch of the First Prototype Field Dental Bag.
Figure 5. Dimensions of the Exploratory and Surgical Instrument Pouches in the Prototype Field Dental Bag.
Figure 6. The Final Prototype Field Dental Kit.
Table 1.
U.S. Marine Corps Recommendations as provided in Memorandum 6700 DEN00 (27 November 1989)

1. Change the position of the carrying strap to improve stability.
2. Replace the metal closures with velcro fasteners.
3. Determine whether or not the dental instruments should be packed in metal or plastic cases.
4. Any other improvements that you may determine are appropriate, including the contents of the set.
5. Consider infection control requirements.

Table 3.
List of Materials to Construct New Dental Kit

| ITEM                  | DESCRIPTION                                      | NSN/NAME/NUMBER        | COLOR
|-----------------------|--------------------------------------------------|------------------------|-------
| Thread                | 301 Stitch type 3/8 in. nylon single plain weave Polyest, zs twist | 8310-00-988-1300      | O.D.  |
| Overedge              | Stitch type                                       | 8300-SS1-1             | O.D.  |
| Fabric                | Cordsa Plus™ Nylon                               | 1000/280 piece dyed   |       |
| Shoulder strap        | 1 1/2 in. nylon tape                             | 8305-00-263-2472      | O.D.  |
| Zipper tabs           | 3/8 in. nylon tape                               | 8315-00-176-8083      | O.D.  |
| Zipper pulls          | 3/4 in. nylon tape                               | 8315-00-176-8083      | O.D.  |
| Zipper slider         | No. 10 size, single tab non-locking, Triglide™ Mfg. | TK101SBK              | Blk.  |
| Zipper                | No. 10 Tooth nonseparating roll                   | TK101SBK              | Blk.  |
| Tri-ring Retainer     | made by Fastex™ Delrin™                         | SN 1 1/2"             | Blk.  |
| Hook                  | size 1 1/2 inches                                | TK1 1/2"              | Blk.  |
| Strap Slider          | Triglide™, 3 bar slide                           | TG 1 1/2"             | Blk.  |
| Velcro™               | Fastener tape, Hook and Loop, synthetic, 106 L.C. Loop # 80 Loop # 8000 | MIL-P-21840G Type II  |       |
Table 2.
Components of the Field Emergency Treatment
Dental Instrument and Supply Set

<table>
<thead>
<tr>
<th>STOCK NUMBER</th>
<th>NOMENCLATURE</th>
<th>UNIT</th>
<th>QUANTITY</th>
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<tr>
<td>6545-00-912-9870</td>
<td>Case, Medical Instrument and Supply Set, Nylon, Non-Rigid, 10&quot; X 4.25&quot; X 8&quot;.</td>
<td>ea.</td>
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<tr>
<td>6515-00-341-7200</td>
<td>Holder, Suture Needle.</td>
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<td>6515-00-344-7600</td>
<td>Handle, Surgical Knife, Detachable, Carbon Steel.</td>
<td>pg.</td>
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<td>6515-00-365-2468</td>
<td>Blade, Surgical Knife, Detachable, Carbon Steel.</td>
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<td>2</td>
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<td>6520-00-299-9671</td>
<td>Forceps, Tooth Extracting, Dental Ivory, 38 g.</td>
<td>ea.</td>
<td>1</td>
</tr>
<tr>
<td>6520-00-532-0150</td>
<td>Forceps, Tooth Extracting, No. 53R.</td>
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<tr>
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<td>ea.</td>
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</tr>
<tr>
<td>6510-00-153-8379</td>
<td>Eugenol, USP, 1 oz.</td>
<td>bt.</td>
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<tr>
<td>6505-00-118-1948</td>
<td>Aspirin Tablets, USP, .324 g.</td>
<td>bx.</td>
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</tr>
<tr>
<td>6510-00-181-7732</td>
<td>Cement Zinc Oxide and Eugenol.</td>
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<tr>
<td>6520-00-524-2550</td>
<td>Elevator, Root, No. 34-S.</td>
<td>ea.</td>
<td>1</td>
</tr>
<tr>
<td>6520-00-524-3050</td>
<td>Elevator, Root, No. 301.</td>
<td>ea.</td>
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</tr>
<tr>
<td>6510-00-576-0842</td>
<td>Lidocaine Hydrochloride Injection, with Epinephrine 1:100000, Cartridge 1.0 m1.</td>
<td>cn.</td>
<td>1</td>
</tr>
<tr>
<td>6520-00-536-5405</td>
<td>Plugger, Plastic Filling, Dental, Woodson, No. 2</td>
<td>ea.</td>
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</tr>
<tr>
<td>6520-00-536-5405</td>
<td>Scaler, Dental, Jacquette #1.</td>
<td>ea.</td>
<td>1</td>
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<tr>
<td>6520-00-536-5405</td>
<td>Sponge, Surgical, Gauze, compressed 2&quot; X 2&quot;.</td>
<td>pg.</td>
<td>1</td>
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<tr>
<td>6520-00-536-5405</td>
<td>Needle, Hypodermic, Disposable, Cartridge Type, 27 gauge.</td>
<td>bx.</td>
<td>50/100</td>
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<td>6520-00-536-5405</td>
<td>Syringe, Cartridge, Aspirating, ea.</td>
<td>thumb ring handle.</td>
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<tr>
<td>6520-00-536-5405</td>
<td>Forceps, Tooth Extracting, #17.</td>
<td>ea.</td>
<td>1</td>
</tr>
<tr>
<td>6520-00-536-5405</td>
<td>Forceps, Tooth Extracting, #53L</td>
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</tr>
<tr>
<td>6520-00-536-5405</td>
<td>Forceps, Tooth Extracting, #150</td>
<td>ea.</td>
<td>1</td>
</tr>
<tr>
<td>6520-00-536-5405</td>
<td>Forceps, Tooth Extracting, #151</td>
<td>ea.</td>
<td>1</td>
</tr>
<tr>
<td>6105-00-299-8591</td>
<td>Bag, Plastic, Button and String hd.</td>
<td>closure, 11.5&quot; X 3.5&quot;.</td>
<td>1/100</td>
</tr>
</tbody>
</table>
Table 4.

U.S. Marine Corps Recommendations (20 June 1990)

Pouch Changes:

1. Two Separate Removable Instrument Pouches.
   a. Exploratory Instruments.
   b. Surgical Instruments.

2. Puncture Proof Material for Pouches.

3. Internal Holding Pocket for Pouches.

Other Changes:

4. Zipper moved from interior panel to the exterior of the bag for external access to inner compartment.

5. The shoulder strap attachment point nylon tape should be continuous along the bottom of the bag.

6. A short handle should be added to each side.
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U.S. Army Medical Research and Development Command
ATTN: SGRD-RMI-S
Fort Detrick
Frederick, MD 21702-5012

1
Commander
U.S. Army Medical Materiel Development Activity
Bldg. T-622
Fort Detrick
Frederick, MD 21702-5009

1
Commander
U.S. Army Medical Materiel Development Activity
ATTN: SGRD-UMA
Bldg. T-622
Fort Detrick
Frederick, MD 21702-5009

1
Commander
U.S. Army Medical Materiel Agency
Bldg. 1423
Fort Detrick
Frederick, MD 21702-5001

1
Commander
U.S. Army Medical Materiel Agency
ATTN: SGMMA-RA
Bldg. 1423
Fort Detrick
Frederick, MD 21702-5001

1
Deputy Staff Director
Defense Medical Standardization Board
Bldg. 1423
Fort Detrick
Frederick, MD 21702-5009

2
Commander
U.S. Army Biomedical Research and Development Laboratory
ATTN: SGRD-UBZ-IL
Fort Detrick
Frederick, MD 21702-5010