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MISCELLANEOUS PAPER S-69-22

# HISTORY OF DOW CHEMICAL EXTRUDED MEDIUM - DUTY MAT

by

D. W. White, Jr.



June 1969

Sponsored by

U. S. Army Materiel Command

Conducted by

U. S. Army Engineer Waterways Experiment Station  
CORPS OF ENGINEERS

Vicksburg, Mississippi

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## FOREWORD

The traffic tests pertinent to the mats described herein were performed at the U. S. Army Engineer Waterways Experiment Station (WES) during the period January 1965-April 1968. Engineers of the WES, Soils Division, who were actively engaged in the planning, testing, and reporting phases were Messrs. W. J. Turnbull, A. A. Maxwell, W. L. McInnis, Robert Turner, H. L. Green, D. W. White, Jr., and G. L. Carr. This report was prepared by Mr. White.

Directors of the WES during conduct of tests and the preparation of this report were COL John R. Oswalt, Jr., CE, and COL Levi A. Brown, CE. Technical Directors were Mr. J. B. Tiffany and Mr. F. R. Brown.

## SUMMARY

This report gives the history of a group of extruded aluminum alloy landing mats which were tested as medium-duty mats. These mats were developed and produced by the Dow Chemical Company, Midland, Mich. During the period January 1965-April 1968, accelerated traffic tests were conducted on several experimental versions of the mats at the U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss. A small quantity of the last version (designated XM18E1) was acquired from the 1.5 million sq ft production contract and tested at the WES. Integrated engineering and service tests were conducted at Dyess AFB, Tex., on the modified MX18-B version. This report describes the metamorphosis of the original experimental MX18-A to the present XM18 which has been type classified in the Federal Supply System.





DEPARTMENT OF THE ARMY  
WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS  
VICKSBURG, MISSISSIPPI 39180

IN REPLY REFER TO: WESSS

MEMORANDUM FOR RECORD

SUBJECT: History of Dow Chemical Extruded Medium-Duty Mat

1. Landing mats were developed to meet the requirements of World War II aircraft, and development was continued to meet the needs during the Korean conflict. With the introduction of the high performance jet aircraft, the requirement for mat surfacing became more evident.
2. The U. S. Army Materiel Command (AMC) was advised by the Air Force in a letter dated 8 October 1964 of performance requirements for landing mats to meet the Air Force's needs. These requirements closely paralleled criteria that AMC had previously furnished the WES for guidance in the mat program. The revised AMC requirements are given in appendix A (Incl 1). From the AMC criteria and Air Force requirements, a Qualitative Materiel Requirement (QMR) for airfield surfacing was approved on 14 April 1966. This QMR was subsequently revised and a new QMR was approved on 2 April 1968 (Incl 2).
3. An accelerated program was initiated in January 1965 to develop a Tri-Service landing mat compatible with the present day operational concepts of the Army, Navy, and Air Force. A landing mat for this purpose was designed and manufactured by the Metal Products Division of the Dow Chemical Company, Midland, Michigan. This mat, designated MX18-A, is a one-piece extruded section with extruded end connectors welded to each end. The side connectors are integral parts of the panel extrusion. The panel extrusion is partially hollow with 12 internal vertical ribs. The panels, which are 1-1/2 in. thick, 2 ft wide, 12 ft long, and weigh 4.4 lb per sq ft of placing area (without antiskid material) were fabricated from 6061 aluminum alloy tempered to the T6 condition. (All mat described herein is fabricated from 6061 tempered to the T6 condition, except as noted, and is 1-1/2 in. thick, 2 ft wide, and 12 ft long; half panels are 1-1/2 in. thick, 2 ft wide, and 6 ft long.)
4. Accelerated traffic tests were conducted in January 1965 (Incl 3, item 1) on the MX18-A under the conditions described for a heavy-duty

mat as given in appendix A. (In the QMR's dated 14 April 1966 and 2 April 1968, this mat is referred to as medium duty. In the QMR of 2 April 1968, requirements also have been specified for the heavy-duty mat.) This mat failed after 40 coverages due to shearing off of the end connectors from the panels. The joint between the end connectors and panels were not adequate to transfer the load from one panel to the next. The method of attaching the end connector to the panel extrusion is shown on Incl 4, Fig. A.

5. From the results of the tests on the MX18-A, Dow developed and produced test quantities of the MX18-B and MX18-C (7005-T6 aluminum alloy). These mats were similar in design; however, several changes were made from the MX18-A design. Inclosure 4, Fig. B, shows the method of attaching the end connector. The inserts in the MX18-B and MX18-C mats are 2 in. in length. Additional metal was added in the top sheet with the top sheet being scalloped and in the vertical ribs, whereas a small amount of metal was removed from the bottom sheet. The radii between the top sheet and vertical ribs were increased. The weight of the MX18-B and MX18-C mats was 4.7 and 5.1 lb per sq ft of placing area, respectively (both without antiskid material).

6. Traffic tests (Incl 3, item 2) were conducted on these mats during February-April 1965. These tests indicated that both the MX18-B and MX18-C mats met the project requirements and that the MX18-C was better than the MX18-B (270 versus 200 coverages on a 4-CBR subgrade).

7. In February 1966, WES awarded a contract, DA-22-079-eng-467 (neg), for field test quantities of the MX18-B (230,000 sq ft) and MX18-C (150,000 sq ft) mats. Prior to production of these mats, additional studies indicated that improved performance could be obtained from both these mats with minor redistribution of metal in the panel extrusion. This redistribution included the elimination of the scallop in the top sheet and increased top sheet thickness, radii between the vertical rib and sheet and vertical rib thickness. To validate these conclusions, traffic tests were conducted in March-April 1966 on the redesigned extrusions without end connectors (end connectors were not included as no problems were experienced with them during the February-April 1965 tests). The results of these tests indicated a definite improvement in the performance of both modified mats over the initial versions (400 coverages on 4-CBR subgrade). These improved versions were designated modified MX18-B and modified MX18-C.

8. The contract (DA-22-079-eng-467 neg) was changed as a result of the March-April 1966 tests to provide for procurement of the modified

mats. The manufacturer encountered difficulties that resulted in the inability to fabricate the modified MX18-C in quantity in the required time frame for the scheduled field tests. Since the tests in March-April 1966 indicated equal performance of the modified MX18-B and MX18-C mats, the modified MX18-B was accepted for the remainder of the contract except for a small quantity (20,000 sq ft) of the modified MX18-C already produced. Field testing of the modified mats began in October 1966 (Incl 3, item 3). The modified MX18-C was included in this test; however, it has been concluded that there was not enough mat of this type to make any valid conclusions. (A small quantity of the modified MX18-B (unused) mat was obtained from Dyess AFB and subjected to accelerated traffic tests (Incl 3, item 4) at WES in August 1967. (In September 1967, the modified MX18-B mat was type classified for limited production (LP) as XM18 and is shown in Supply Catalog SC 5680-97-CL-E04, "Mat Set, Landing," dated January 1968.) The mat, which weighed 4.85 lb per sq ft of placing area with anti-skid material, sustained 670 coverages with the wheel travel perpendicular to the internal ribs and 330 coverages with the wheel travel parallel to the internal ribs on a 4-CBR subgrade. Failure was attributed to tire hazards caused by curl and splits in the female side connectors at the overlap and underlap corners and vertical weld cracks at these corners that extended into the top sheet of the panel.)

9. In February 1967, WES awarded a contract, DACA39-67-C-0027 (neg), to Dow for an extruded mat similar to the modified MX18-B mat. However, this mat (designated XM20) was a heavier mat since it contained more metal in the extrusions. The external geometry and the method of attaching the end connectors to the panels were the same as for the modified MX18-B mat (2-in.-long inserts). Due to fabrication difficulties, delivery of the XM20 mat was delayed.

10. In the meantime, Contract No. DACA39-67-C-0042 (neg) was awarded to Dow for test quantities of a two-piece 2- by 12-ft (designated MX18-D) and a four-piece 4- by 4-ft (designated MX18-E) extruded mats. The MX18-D mat consisted of two 12-in.-wide extrusions welded together along the longitudinal center line to form a 2- by 12-ft panel. The method of attaching the end connectors to the panel was similar to that used with the MX18-B (Incl 4, Fig. B) except the inserts were 1-1/2 in. long. This mat weighed 5.3 lb per sq ft without antiskid material. The MX18-E consisted of four 12-in.-wide extrusions welded together to form a 4- by 4-ft panel. The end connectors were attached to the panel in the same manner as for the MX18-D mat. This mat weighed 5.86 lb per sq ft without antiskid material.



11. The decision was made to give the two- and four-piece mats higher priority than the XM20 and this also caused delay in the delivery of the XM20 mat. If these mats proved to be satisfactory, this would broaden the production base, since numerous companies have extrusion presses large enough to extrude the 12-in.-wide extrusions; whereas, only a limited number have presses large enough to extrude the 24-in.-wide mat. Also, if satisfactory, the possibility of including some of the two- and four-piece mats in the field test at Dyess AFB was considered possible.

12. In May 1967, the MX18-D (two-piece) mat was tested (Incl 3, item 5) both with the internal ribs parallel and perpendicular to the direction of the load wheel travel. The normal lay for the mat (internal ribs perpendicular to wheel travel) supported 704 coverages on a 4-CBR subgrade while the mat with internal ribs parallel to wheel travel supported 500 coverages on a 4-CBR subgrade. Results of this test indicated a weakness in the area of the female-underlap and female-overlap corners. Failure was attributed to tire hazards as result of curl and splits in the female connector at the corners mentioned and vertical weld cracks also at these corners that extended into the top sheet of the panels.

13. The MX18-E (four-piece) mat was tested during May and June 1967 both with the internal ribs parallel and perpendicular to the direction of load wheel travel. The normal lay for the mat (internal ribs perpendicular to wheel travel) supported 620 coverages on a 4-CBR subgrade while the mat with the internal ribs parallel to wheel travel supported 580 coverages on a 4-CBR subgrade. Failure was attributed to cracked welds between the 12-in. extrusions and curl of the female connector.

14. As a result of the test conducted on the MX18-D and MX18-E mats, Dow proposed that several changes be made in the XM20 design. The changes which were approved and incorporated into the mat were as follows:

a. The insert tubes were shortened to 1-1/2 in. and additional metal was added in the area of the female connector and the first cavity adjacent to this connector.

b. The method of attaching the end connectors to the panel extrusion was changed.

The latter change resulted in the welds at the corners between the panel and the end connectors being slanted. Also, the transverse

welds between the end connectors and panel on the top and bottom of the panel were offset from each other by approximately  $3/8$  in. (Incl 4, Fig. C). This change allowed the corner welds to be made more easily and the weldments did not protrude into the male or female side connectors. On the modified MX18-B and MX18-D mats, the weldment protruded into these connectors, and a routing operation was required to remove the excess weldment. This excess weldment if not removed would interfere with the connection of the panels when placed. The routing not only removed the excess weld, but also base metal from the panel was sometimes removed which created a potential stress riser. The addition of metal in the area of the female connector and the method of attaching the end connector to the panel were made in order to try to prevent failures in the XM20 mat similar to those that occurred in the modified MX18-B, MX18-D, and MX18-E mats. The XM20 weighs 6.15 lb per sq ft of placing area.

15. Accelerated traffic tests were conducted on the XM20 mat during August-October 1967 (Incl 3, item 6). This mat sustained 2290 coverages of traffic. The equivalent of this coverage on a rated 4 CBR is in excess of 5000 coverages. Failure was attributed to breaks at the female connector at the corner of the underlap and overlap ends of the panels. These breaks were in the slant leg of the female connector and in the top sheet of the panel which allowed a section of about  $2-1/2$  in. wide to curl up and become a tire hazard. No vertical weld cracks were observed.

16. In accordance with a teletype dated 30 June 1967 from the Corps of Engineers, Department of the Army, Washington, D. C., to the WES, a letter contract, DACA39-67-C-0063 (neg), was awarded to Dow in June 1967 for 1.5 million sq ft of the modified MX18-B mat. Prior to contract finalization and production of the mat under this contract, in a mutual agreement between the WES and Dow, Dow supplied a test quantity of mat (designated XM18E1) for accelerated traffic tests. This mat contained changes similar to those in the XM20. The inserts were shortened in length to  $1-1/4$  in., additional metal was added in the area of the female connector and first cavity adjacent to this connector, and the method (Incl 4, Fig. C) of attaching the end connector to the panel was changed to allow better welds. This mat weighed 4.77 lb per sq ft of placing area.

17. Prior to actual mat production under the 1.5 million sq ft contract, accelerated traffic tests were conducted on the XM18E1 mat. Results of these tests conducted during November-December 1967 indicated improvement over the modified MX18-B mat (1100 versus 670 coverages on

a 4 CBR)(Incl 3, item 7). Therefore, the changes mentioned above were incorporated into the contract for the procurement of the XML8E1 mat.

18. After production was in full-scale operation and approximately 400,000 sq ft of mat had been fabricated, a test quantity of mat was pulled from the production line and furnished to WES. Accelerated traffic tests (Incl 3, item 7) were conducted during April 1968. The coverage level dropped to 620 coverages on a 4-CBR subgrade. Analysis by WES and Dow personnel revealed two probable causes for the coverage drop off. These were irregularities in the dimensions of individual panel extrusions as well as between panels (even though these dimensions were within specified tolerances) and a brittle welding wire had been used to make the slanted welds at the corners between the end connectors and panels. Increased quality control and discontinued use of the brittle welding wire were put into effect by Dow to improve the quality of the mat.

4 Incl  
as

*Dewey W. White*  
DEWEY W. WHITE  
Engineer  
Mat Section



**HEADQUARTERS  
UNITED STATES ARMY MATERIEL COMMAND  
WASHINGTON, D.C. 20315**

IN REPLY REFER TO: AMCRD-RV-E

5 February 1965

**SUBJECT:** Requirements for Expedient Surfacing for Construction of  
Forward-Area Airfields

**TO:** SEE DISTRIBUTION


1. In response to requests from numerous industry representatives and from various offices within the military family, we have prepared a study which sets forth requirements and proposed operational concepts which must be considered in developing expedient surfacings for use in the construction of forward-area airfields.

2. A copy of this report, "Requirements for Expedient Surfacing," is furnished herewith for your information and retention. As stated in the report, "The information presented ----- should not be construed as representing official Army or Air Force doctrine, but as representing a reasonably valid assessment of the requirements in support of concepts which, in themselves, have not been solidified."

3. Any comments you wish to make regarding the content of this report would be welcomed.

FOR THE COMMANDER:

1 Incl  
as

  
**ROBERT R. PHILIPPE**  
Chief, Environmental Sciences Branch  
Research Division  
Research and Development Directorate

Incl 1 (sheet 1)

January 1965

REQUIREMENTS FOR EXPEDIENT SURFACINGS

Prepared by  
Environmental Sciences Branch, Research Division  
Hq., Army Materiel Command

A complex of airfields is an essential ingredient for the Army's concept of air mobility, as well as for similar concepts tailored for the employment of joint forces. This complex includes several levels of operational capability as required to support the various logistical and tactical air missions.

Depending on the general geographic location, the complex may exist in part; but in no area of the world are these airfields to be found in the quantity necessary to satisfy the requirements. In some cases, all aspects of the complex will be totally non-existent. As a generality the time available to bring this airfield complex to a state of sufficiency will be short, with periods of from four hours to seventy-two hours representing the maximum construction time for various facilities. Thus it becomes evident that construction of conventional rigid and flexible pavements is not feasible. Furthermore, the use of soil stabilization and similar expedients generally will prove to be not feasible both from logistic and construction time considerations. There may be isolated instances where construction of conventional pavements, use of select materials or soil stabilization could represent solutions. Information currently available indicates that these conditions will prevail infrequently, and can be considered only as special cases capable of being preplanned for specific purposes.

A partial solution to meeting the rigorous construction time requirements lies in the employment of surfacing expedients such as pre-fabricated landing mats and membranes. Here again, the severe overall logistical demand of a theater of operations controls what is feasible. The movement into a theater of the large bulk of materiel necessary to satisfy airfield surfacing requirements may, in many instances, determine the scale of the operation itself. In the rear areas of a theater, weight of the surfacing expedients generally will control their usage. As the movement of this materiel is toward the forward areas of a theater, both weight and bulk become critical. These limitations are imposed by the capabilities of the aircraft supporting an airline of communication (ALOC). Even though air delivery of surfacing materiel not always will be employed, the system has to be such that aircraft can be employed when the requirements of the operation so dictate. Furthermore, it is likely that in remote or under-developed regions of the world, as well as in the more forward areas of a theater, air delivery represents the only satisfactory delivery procedure that can be employed.

It is possible to develop a variety of surfacing expedients which will satisfy a number of operational situations. Their adoption in toto, however, becomes impractical within our complex supply system. To give a basis for comparison, landing mats which have been used, are currently in use, or are contemplated for use in the near future are shown in Table 1. Airfields whose construction is likely to be required in a theater of operations and the aircraft associated with each type of facility are shown in Table 2 along with their respective construction requirements. The information presented in this table should not be construed as representing



official Army or Air Force doctrine, but as representing a reasonably valid assessment of the requirements in support of concepts which, in themselves, have not been solidified.

A general indication of the air mission requirements presumed for each of the seven types of airfields designated in Table 2 is given in the following:

a. Heavy-Lift, Rear Area. These facilities must accept a high volume of C-141 and C-135 heavy transport aircraft carrying the strategic inter-theater tonnage from the continental United States to the theater of operations. It will be necessary that such airfields be found already in existence. Construction will be limited to extending runways, taxiways, and parking aprons. The service life is expected to range from six months to one year.

b. Medium-Lift, Rear Area. These facilities would be satellited on the heavy-lift airfield, and must support C-130 transport aircraft for initiation of the intra-theater lift. Tonnage would be transloaded from the heavy-lift aircraft to the C-130s. Probable time required for construction is estimated at one week. The service life is expected to range from six months to one year.

c. Tactical, Rear Area. These facilities must support high performance fighter aircraft (Century series and F4C) for fighting the air war, and conducting aerial mapping and reconnaissance missions. Probable time required for construction is estimated at two weeks. The service life is expected to range from six months to one year.

d. Medium-Lift, Support Area. These facilities must support the forward end of the intra-theater lift by C-130 aircraft. Probable time

required for construction is estimated to range from one to three days. The service life is estimated to be two weeks to one month.

e. Tactical, Support Area. These facilities must support high-performance fighter aircraft, such as the F4C, for providing air superiority and close tactical support for ground troops. Probable time required for construction is estimated at one week. The service life is expected to range from one to two months.

f. Light-Lift, Support Area. These facilities would be sited on medium-lift, support area airfields, and must support CV-2B and CV-7A Army light transport aircraft for the initiation of the final leg (retail delivery) of the intra-theater lift. Tonnage would be transloaded from the C-130 aircraft to the CV-2B and CV-7A aircraft. Probable time required for construction is estimated at one day. The service life is estimated to range from two to four weeks.

g. Light-Lift, Forward Area. These facilities must support CV-2B and CV-7A Army light transport aircraft for completion of the final leg of the intra-theater airlift. Probable time required for construction is estimated to range from one-fourth to one-half day. The service life is estimated to range from two to five days.

From the requirements as set forth in Table 2, it has been possible to establish general design criteria governing landing mats. It is evident that a more efficient employment of materiel can be achieved if both a light-duty mat and a heavy-duty mat are provided in the supply system. The greater flexibility provided by two mats permits maximum utilization of terrain with regard to airfield siting. General criteria governing the design of the mats may be stated as follows:

### Heavy-Duty Mat

Single-wheel load = 25,000 lbs.

Tire inflation pressures = 250 psi.

Tire contact area = 100 sq. in.

Operational life = 200 coverages.

Minimum CBR = 4.

### Light-Duty Mat

Single-wheel load = 25,000 lbs.

Tire inflation pressure = 250 psi.

Tire contact area = 100 sq. in.

Operational life = 200 coverages.

Minimum CBR = 10.

Additional requirements of major concern include maximum allowable unit weight for the mats, minimum rate of placement, and capability to withstand use of a tailhook for emergency arrested landings. For the heavy-duty mat, a maximum weight of 4.0 to 4.5 lbs. per sq. ft. is indicated. At present it appears to be technically feasible to meet the design criteria for the heavy-duty mat at a weight not in excess of 4.0 lbs/sq. ft. Even so, the 300,000 sq. ft. of mat required for the average assault airfield represents approximately 50 C-130 planeloads. For the light-duty mat, a maximum weight of 2.5 to 3.0 lbs/sq. ft. is indicated. Balancing construction forces against available construction time and total area to be surfaced indicates that minimum placement rates of 250 and 400 sq. ft. per man hour must be achieved for the heavy-duty and light-duty mats, respectively. It is desirable that these placement rates be as great as 500 and 750 sq. ft. per man hour, if practicable. At the moment the

requirements relative to use of a tailhook for arrested landings of fighter aircraft are indefinite. This is unfortunate in that the use or non-use of a tailhook has a significant impact on the design of landing mat. In fact its use may represent an increase in mat cost of as much as \$1.00 to \$1.50 per sq. ft..

When the military requirements stated above are applied to the various landing mats shown in Table 1, only the T-11 mat approaches being considered as a satisfactory heavy-duty mat. While the AM-2 mat has proven itself to be structurally adequate, insofar as the loading conditions for a heavy-duty mat are concerned, the high unit weight (6.3 lbs per sq. ft.) of AM-2 precludes further consideration of this mat for air delivery. At a unit weight of 4.7 lbs. per sq. ft. the T-11 mat probably exceeds our present capability for air delivery, particularly when sizeable operations requiring airfield construction are contemplated. Admittedly the present design of T-11 contains certain deficiencies, the most notable of which pertain to the ability of the mat to sustain operations involving employment of a tailhook for arrested landings of fighter aircraft. It appears that significant improvement in the T-11 design may be achieved by:

a. Substituting a welded joint for the riveted tongue and groove joint now used in joining the two basic extrusions comprising each panel of matting.

b. Modifying the design of the edge connectors to improve vertical alignment of the mat surface and waterproofing characteristics of the joints along the panel edges.

c. Reducing the unit weight from 4.7 lbs per sq. ft. to 4.0 lbs per sq. ft. (or less) by substituting a new higher strength aluminum

alloy for the alloy currently being used.

The current research program is not limited to modification of the T-11 mat. Contracts with industry for new designs in both steel and aluminum have been awarded with a view toward achieving a more satisfactory heavy-duty mat. These new designs include:

a. Modified T-11. An extruded aluminum design utilizing an "open" extrusion weighing 3.8 lbs per sq. ft., with a welded center joint and improved edge connector design.

b. Modified AM-2. An extruded aluminum design utilizing a "closed" extrusion weighing 4.3 lbs per sq. ft..

c. Modified "Air Dek." A fabricated steel design utilizing a cellular core and weighing 4.7 lbs per sq. ft..

d. Modified "Fenmat." An extruded aluminum design utilizing a "closed" extrusion weighing 4.7 lbs per sq. ft..

e. Modified AM-3. A fabricated aluminum design utilizing a cellular core and weighing 3.0 lbs per sq. ft..

f. Kaiser Mat. A fabricated aluminum design utilizing a honeycomb core and weighing 4.0 lbs per sq. ft..

A summary of information pertinent to these proposed new designs is presented in Table 3.

It is emphasized that the light-duty mat does not exist today. Research toward developing such a mat was initiated only within the past year. There has been no preference established as to the type of material to be employed, as long as the desired structural competency and weight restrictions are achieved. Contracts with industry for "first cut" designs of this mat have been awarded. These designs include:

a. T-100. An extruded aluminum design utilizing an "open" extrusion weighing 3.7 lbs per sq. ft. and similar in cross-section to the T-11.

b. Modified "Air Dek." An orthotropic fabricated steel design utilizing a cellular core and weighing 3.5 lbs per sq. ft..

c. Modified AM-3. This design, described previously, will be evaluated both as a heavy-duty and as a light-duty mat.

In addition to landing mats, another class of materials also is available for use as an expedient surfacing. These materials are prefabricated membranes and consist of cotton duck or nylon fabric coated with neoprene or vinyl. When used in traffic areas the membranes serve both as a waterproofer, to insure maintaining in situ soil strength, and as a dustproofer. They also may be used adjacent to the traffic areas to control dust generated from prop wash, jet engine exhaust or helicopter downwash. The membranes range in weight from 0.13 lbs per sq. ft. to 0.33 lbs per sq. ft.. Membranes currently available or under development are shown in Table 4. When conditions are favorable, the lightest of these (T-15, T-16) may be used in all areas trafficked by Army aircraft with the exception of runway ends for facilities supporting the AO-1 Mohawk. Similarly, it is anticipated that the heaviest membrane (T-17) may be used in all areas trafficked by Air Force cargo aircraft up to and including the C-130 class, and at runway ends for facilities supporting the AO-1 Mohawk. Conditions governing the employment of membranes for theater of operations airfields are shown in Table 2.

In the use of both landing mats and membranes, speed of placement is important. Minimum rates of placement now considered acceptable are:



- a. Heavy-duty mat - 250 sq. ft. per man-hour.
- b. Light-duty mat - 500 sq. ft. per man-hour.
- c. Membrane - 1000 sq. ft. per man-hour.

Current indicated average rates of placement are:

- a. Heavy-duty mat - 175 sq. ft. per man-hour.
- b. Light-duty mat - None available.
- c. Membrane - 600 sq. ft. per man-hour.

Ability to increase rates of placement is considered desirable but not critical inasmuch as the grading of earth and related preparations are the principal factors in consuming construction effort available within the time frame permissible for establishing operational airfields.

The problem of handling expedient surfacings in transport preparatory to placement also must be considered. Bundles or packages of mat and membrane must be palletized in standard sizes and weights to facilitate their being handled at the depots, supply bases and other points of transshipment. For landing mats, multiples of width, length and height of the bundles must fit the aircraft. Also, bundles should be of weights and dimensions readily handled by ground support equipment (fork-lift trucks, etc.); and, if necessary, should permit being manhandled in cases where mechanized materiel handling is limited. Of further consideration is the desirability of selecting a matting panel length such that multiples of this length form the minimum required widths for runways and taxiways. Since mat placement procedures require that the panels be staggered, some half-length panels will be required at the edges of the traffic areas. Mat bundles should contain a proper mix of half-length and full-length panels.

There is one overpowering consideration in the packaging of the light-duty mat, and that is to optimize the handling of mat bundles at Support Area and Forward Area airfields. It follows that mat bundles must be sized for fitting into light Army aircraft (such as the CV-28 and CV-7A) and for handling by troop labor. Membranes should be packaged into manageable units capable of surfacing runways and taxiways with a minimum use of field-prepared joints.

Although considerable research efforts have been directed toward developing a theoretical approach to the design of landing mats, as yet no satisfactory theoretical solution has been achieved. In developing new mat designs, contractors are permitted to employ various theories as they choose. The use of these theories, however, is not considered as proof of acceptability of a mat design. In each case, engineering evaluation of the design will require production of a quantity of mat sufficient to permit testing under full-scale rolling wheel loads. Such proof tests will be conducted by the government.

Table 1

Landing Mat Characteristics

<u>Item</u>	<u>Weight (lbs/sq. ft.)</u>	<u>Original Cost (per sq. ft.)</u>	<u>Current Cost (per sq. ft.)</u>
PSP (Steel)	5.1	\$0.35 (1945)	--
PAP (Aluminum)	2.5	\$1.13 (1945)	--
M6 (Steel)	5.4	\$0.40 (1948)	\$1.20*
M8 (Steel)	7.3	\$0.56 (1952)	\$1.65*
M9 (Aluminum)	3.1	\$1.32 (1952)	\$2.75*
T11 (Aluminum)	4.7	--	\$2.09
AM2 (Aluminum)	6.3	--	\$3.40

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\* Estimated.

Table 2

Theater of Operations Airfield Requirements

Facility	Construction Time Required	Surfacing Versus CBR		Aircraft Type	Main Gear Loading	Service Life*
		Traffic Areas	Non-Traffic Areas			
Heavy-Lift, Rear Area	2 weeks**	Heavy-Duty Mat (Min. CBR = 8)	Light-Duty Membrane or Dust Palliative	C-141, C-135	150,000 lbs, twin-tandem tires at 150 psi	6 to 12 months
Medium Lift, Rear Area	1 week	Heavy-Duty Mat (CBR = 4 to 8) Light-Duty Mat (CBR = 8 to 15) Heavy-Duty Membrane (Min. CBR = 15)	Light-Duty Membrane or Dust Palliative	C-130	65,000 lbs, single- tandem tires at 70 psi	6 to 12 months
Tactical, Rear Area	2	Heavy-Duty Mat (CBR = 4 to 12) Light-Duty Mat (Min. CBR = 12)	Light-Duty Membrane or Dust Palliative	F4C, F-105	25,000 lbs, single- tires at 250 psi	6 to 12 months
Medium-Lift, Support Area	1 to 3 days	Heavy-Duty Mat (CBR = 4 to 6) Light-Duty Mat (CBR = 6 to 10) Heavy-Duty Membrane (Min. CBR = 10)	Dust Palliative	C-130	55,000 lbs, single- tandem tires at 70 psi	2 to 4 weeks
Tactical, Support Area	1 week	Heavy-Duty Mat (CBR = 4 to 10) Light-Duty Mat (Min. CBR = 10)	Light-Duty Membrane or Dust Palliative	F4C, F-105	25,000 lbs, single- tires at 250 psi	1 to 2 months
Light-Lift Support	1 day	Light-Duty Membrane or Dust Palliative	Dust Palliative	CV-2, CV-7	15,000 lbs, twin tires at 35 psi	2 to 4 weeks
Light-Lift, Forward Area	1/4 to 1/2 day	Dust Palliative	--	CV-2, CV-7	15,000 lbs, twin tires at 35 psi	2 to 5 days

\* Estimated.

\*\* Assumes only limited construction to extend runway, taxiway or apron.

Table 3

Summary of Landing Mats Under Development

Mat Designation	Weight (lb/sq. ft.)	Cost* (\$/sq. ft)	Material	Contractor	Description
Mod. T-11	3.8	2.00	Aluminum	Alcoa	"Open" extrusion, high-strength alloy, welded joint, improved connectors.
Mod. AM-2	4.3	3.40	Aluminum	Dow. Chem. Co.	"Closed" extrusion, X-section similar to Navy AM-2 design.
HD "Air Dek"	4.7	3.60	Steel	U. S. Steel	Orthotropic design with "egg-crate" core and bonded skin sheets.
Mod "Fenmat"	4.7	3.00	Aluminum	Fenestra Corp.	"Closed" extrusion, truss-type web stiffeners.
Mod. AM-3	3.0	2.75	Aluminum	Alcoa	Orthotropic design with fabricated grid core and bonded skin sheets.
Kaiser	4.0	4.00	Aluminum	Kaiser Al. and Chem.	Orthotropic design with honey-comb core and bonded skin sheets.
LD "Air Dek"	3.5	5.00	Stainless Steel	U. S. Steel	Orthotropic design with "egg crate" core and bonded skin sheets.
T-100	3.7	1.75	Aluminum	Alcoa	"Open" extrusion, high-strength alloy, X-section similar to T-11.

\* Contractor's estimated cost for quantity production.

Table 4

Prefabricated Membrane Characteristics

<u>Item</u>	<u>Weight (lb/sq. ft.)</u>	<u>Cost (\$/sq. ft.)</u>
T-1, Vinyl coated cotton duck*	0.24	0.16
T-12, Neoprene coated nylon fabric**	0.28	0.64
T-15, Vinyl coated nylon fabric**	0.13	0.20
T-16, Neoprene coated nylon fabric**	0.13	0.26
T-17, Neoprene coated nylon fabric**	0.33	0.50

\* FSN 5680-795-7943 (3' x 300' roll)  
FSN 5680-795-7944 (55.4' x 28.5' panel)

\*\* Under development.



REVISED DEPARTMENT OF THE ARMY APPROVED  
QUALITATIVE MATERIEL REQUIREMENT  
FOR PREFABRICATED AIRFIELD SURFACINGS

Section I - Statement of Requirement

1. Statement of Requirement

Prefabricated or expedient airfield surfacings are required to provide the Army with improved capability to produce the required aircraft landing facilities, in theaters of operations, which are essential for support of air mobility concepts. Economy in logistics and costs and flexibility in design of landing facilities can best be provided by development of mats and membranes. The landing mats will provide a bearing surface capable of supporting specified aircraft loadings on low strength soils. Use of the matting will greatly reduce the time and engineer effort required to construct airfields by substantially reducing the need for subgrade preparation and by providing a surface which can be rapidly emplaced. The membranes will provide a rapid means of waterproofing and dustproofing runways and taxiways in areas where soil strength is adequate and of waterproofing subgrades beneath landing mats. Use of the membranes will enable in-situ soil strength to be maintained, reducing airfield construction and maintenance effort required, and provide dust control, reducing safety hazards to aircraft operation and airfield detection. It is desirable that these membrane requirements be met by a single membrane. All surfacings will be lightweight, consistent with meeting operational requirements, reusable without rehabilitation if undamaged, and packaged for ease of handling. The landing mats and membranes will be of such superiority to warrant replacement of current standard items. Army engineer units or groups of indigenous personnel under Army engineer supervision will use the surfacings to improve existing airfields or to construct new airfields in all areas of the world where operations require airfield support. (TF: 70) (CDOG para 639b (2)) (Approved 14 Apr 66)

Section II - Operational, Organizational and Logistical Concepts

2. Operational Concepts

a. Requirements. The proposed airfield surfacings will provide rapid means for preparing and/or improving airfields and landing areas capable of accommodating all types of aircraft in support of military operations including strategic and tactical lift (inter-theater and intra-theater), and tactical air support. The surfaces must provide all-weather operational capability and be capable of installation during all times except when the proper subgrade conditions cannot be obtained or maintained.

The landing mat must be capable of providing operational surfacing for two weeks or 500 sorties (sortie - one takeoff and one landing) without failure. A typical daily 24-hour mission for an airfield is 36 sorties. The membrane must be capable of providing operational surfacing for two weeks or 100 sorties without failure. A typical daily 24-hour mission for a membrane surfaced airfield is seven sorties. The method of construction and materials used will provide for the suppression of dust to the extent that visual detection and adverse effects on aircraft maintenance will be reduced.

b. Operational Information.

(1) Planned deployment. The proposed materiel is essential to the successful conduct of air operation within any theater of operations. The airfield surfacings may be utilized to support air operations in any land area of the world; however, primary use is expected to be in the underdeveloped areas where airfields are either nonexistent or inadequate. The surfacing will also be used to repair damage of existing airfields with like surfacings. Adoption of this materiel will provide significant reductions in logistical tonnages and manhours of installation and maintenance effort required. The proposed surfacings will be installed primarily by Army engineer combat and construction battalions or trained indigenous personnel, under supervision of Army engineers.

(2) Turnaround time. Predicted turnaround time is unknown. Turnaround time is the time needed to remove, inspect for reuse, reprovision, and install at another site.

(3) Reaction time. Reaction time is the time needed to inspect the airfield surface to determine if an aircraft can take off or land without damage. The reaction time will not exceed ten minutes per landing or takeoff. Normally, the suitability of the airfield to perform a typical 24-hour mission will be determined during a daily (1 hour essential) (30 minutes desired) visual inspection of the runway surface. The daily visual inspection will be performed from a moving ground vehicle driving up one side and down the other side of the runway with intermediate stops as necessary.

(4) Service life. The surfacing will have a service life of not less than six months or equivalent sorties with not more than a 10 percent replacement of materiel due to failures.

(5) Availability. It is desired that operational availability be at least 93 percent, with 15 percent replacement parts (AR 700-19).

(6) Reliability. The materiel shall demonstrate a Mean Time Between Failures (MTBF) of not less than two weeks or equivalent sorties. A failure is defined for the purposes of computing MTBF as a repair necessary

to restore performance to within limits indicated herein and requiring greater than 24 manhours of total effort by personnel from an Engineer Platoon of the Airmobile Divisional Engineer Battalion.

(7) Durability. Surfacing materiel shall without failure complete the following initial operations requirement of 500 sorties for mat and 100 sorties for membrane.

### 3. Organizational and Logistical Concepts

a. The size and numbers of the installing crews will be consistent with construction requirements and the time factors dictated by operational requirements.

b. The proposed surfacings will be Class IV supply items.

c. Specific quantities required will be determined after completion of the current US Army Combat Developments Command Study, Airfield Construction Requirements, Theater of Operations 1967-1970.

## Section III - Justification, Feasibility and Priority

### 4. Reason for the Requirement

The requirements for air support to ground combat operations have increased significantly and are continuing to grow. Present planning in both general and limited war situations, and for sustained ground, airborne and airmobile operations, call for an unprecedented volume of Air Force and Army aircraft for such air missions as inter-theater strategic lift, close tactical support, air assault operations, intra-theater airlift in an air line of communications (ALOC), and intra-division airlift to front line units. Additionally, the concept of total air mobility as developed by the Army Tactical Mobility Requirements Board will create many new aircraft missions within the front line division area. Current Army construction capabilities in support of these concepts are not compatible with requirements in terms of time and geographical areas of employment. Concepts dictate that airfields be readied in the early stages of troop deployment in airmobile operations and that airfields be located in proximity to the supported forces thereby ensuring that the mobility of the Army force is consistent with strategic and tactical objectives. Current airfield surfacing methods require either the selection of a site where the California Bearing Ratio (CBR) of the soil will sustain aircraft loadings or the extensive preparation of the subgrade to achieve necessary soil strengths. In many areas of the world where deployment of US airmobile forces is foreseen, required airfields do not exist, are too few in number, or cannot sustain the loadings of supporting aircraft. Also, construction materials for preparation of airfield subgrades and surface are not available

or necessitate disproportionate demands for time and effort to locate, process, transport, emplace and compact granular materials for airfield base construction. Current military systems (PSP, M6, M8, and M9 mats) due to weight and load bearing characteristics and conventional methods of constructing airfields do not permit the development of air landing facilities for airborne and airmobile forces throughout the world on a selective basis within envisioned time parameters. Without the construction capability to support airborne and airmobile forces their employment is seriously jeopardized if not totally prevented. This proposed system will facilitate the construction envisaged.

a. The time phasing of this requirement is immediate in relationship to present material and capabilities. The requirement satisfies immediate and long-range objectives.

b. The requirement for this type materiel is supported in CDOG paragraph 639b(2).

c. References which support this requirement are:

(1) US Army Tactical Mobility Requirements Board Final Report, August 1962.

(2) Final Report of Joint Exercise SWIFT STRIKE III, 20 November 1963.

(3) Army Air Mobile Evaluation, Headquarters, US Army Combat Developments Command, 15 February 1965.

## 5. Technical Feasibility

It is technically feasible, as stated Appendix I, to develop the airfield surfacings which will satisfy the requirements of this QMR.

## 6. Priority

This QMR is assigned Priority I, functional group 4 Tactical Movement, Appendix C, CDOG.

## Section IV - Characteristics

### 7. Performance Characteristics

a. It is essential that the landing mats for the various classifications:

(1) Be capable of being directly installed upon graded subgrades.

(2) Be capable of withstanding the aircraft loading conditions shown on Incls 1 and 2.

(3) Be capable of withstanding coverages and loads shown on Incls 1 and 2, with a maximum of 10 percent replacement.

(4) Be capable of:

(a) Heavy duty mats will withstand aircraft operations to include maximum takeoffs using afterburner. These mats shall withstand blast effects of 700°F for 10 seconds.

(b) Medium duty mats will withstand aircraft operations to include maximum takeoffs using afterburner. These mats shall withstand blast effects of 300°F for 5 seconds.

(c) Light duty mats shall withstand C-130 aircraft assault landings utilizing maximum wheel braking and reverse thrust procedures.

(d) Surfacing at locations of arresting cables and arresting hook impacts are subject to unusual loadings and impact effects and are considered critical areas. Special surfacing will be provided when heavy and medium duty mats do not meet the requirements listed below for critical areas of runways surfaced with heavy or medium duty mats.

1. Surfacing for critical areas of heavy duty mat surfaced runways will withstand five F4 tailhook impacts of 80 knots at equivalent 18 feet per second (FPS) sink speed at the same location without structural failure due to rupture of the top surface of the mat.

2. Surfacing for critical areas of heavy duty mat surfaced runways will withstand 20 roll-over loadings on a one inch diameter arresting cable with a 50,000-lb wheel load, having a nominal tire contact area of 200 sq in. and a tire-inflation pressure of 250 psi, without structural failure due to rupture of the top surface of the mat.

3. Surfacing for critical areas of medium duty mat surfaced runways will withstand two F4 tailhook impacts of 80 knots at equivalent 18 FPS sink speed at the same location without structural failure due to rupture of the top surface of the mat.

4. Surfacing for critical areas of medium duty mat surfaced runways will withstand 20 roll-over loadings on a one inch diameter arresting cable with a 25,000-lb wheel load, having a nominal tire-contact area of 100 sq in.

and tire-inflation pressure of 250 psi without structural failure due to rupture of the top surface of the mat.

(5) Be so designed so as to not cause damage to waterproofing or dust-proofing treatment applied to the subgrade, or desirably, inherently provide waterproofing and dustproofing of the underlying soil surface.

(6) Be capable of withstanding ambient temperature variations in accordance with paragraph 7c of AR 705-15, change 1, without deformation of such magnitude as to interfere with assembly and operations.

(7) Possess a surface which provides effective braking with a Runway Condition Reading (RCR) of 13-25 for aircraft landings and control during all ground operations, under conditions specified in AFR 60-13 and in paragraph 7a, b, and c of AR 705-15, change 1.

(8) Resist adverse effects, when installed operationally, resulting from exposure to POL spillage, downwash from helicopters, and wheel vehicle traffic.

(9) Be capable of storage and air transit under conditions stated in paragraph 7.1a, b, and d of AR 705-15, change 1: for closed storage, ten years; for open storage, five years without adverse effects upon the system components.

(10) Possess a service life of not less than six months or 6000 sorties with not more than a 10 percent replacement of material due to failures.

(11) Possess an operational availability of at least 93 percent, with 15 percent replacement parts (AR 700-19).

(12) Possess reliability that the Mean Time Between Failures (MTBF) shall be not less than two weeks or 500 sorties. A failure is defined for the purpose of computing MTBF as a repair necessary to restore performance to within limits indicated herein and requiring greater than 24 manhours of total effort by personnel from an Engineer Platoon of the Airmobile Divisional Engineer Battalion.

(13) Possess a durability which will enable the mats to sustain 500 sorties of initial operations without failure.

b. It is essential that the membranes:

(1) Be capable of being directly installed upon graded subgrades.



(2) Possess a surface which provides effective braking with a Runway Condition Reading(RCR) of 13-25 for aircraft landings and control during all ground operations, under conditions specified in AFR 60-13 and paragraph 7a, b, and c of AR 705-13, change 1.

(3) Be capable of withstanding wheel loads without destruction of waterproof properties when laid on soils capable of supporting these wheel loads, or when placed underneath landing mat, see Incl 3.

(4) Resist adverse effects, when installed operationally, resulting from exposure to POL spillage, helicopter downwash, and wheel vehicle traffic.

(5) Be capable of storage and air transit under conditions stated in paragraph 7.1a, b, and d of AR 705-15, change 1: for closed storage, five years; for open storage, three years without adverse effects upon the system components.

(6) Be capable of withstanding ambient temperature variations in accordance with paragraph 7c of AR 705-15, change 1, without elongation or contraction of such magnitude as to interfere with assembly and operations.

(7) Be readily repairable in the field under conditions as specified in paragraph 7a and b of AR 705-15, change 1.

(8) Possess a service life of not less than six months or 1200 sorties with not more than 10 percent replacement of material due to failure.

(9) Possess an operational availability of at least 93 percent assuming adequate logistical support.

(10) Possess reliability that the MTBF shall be not less than two weeks or 100 sorties. A failure is defined for the purposes of computing MTBF as a repair necessary to restore performance to within limits indicated herein and requiring greater than 24 manhours of total effort by personnel from a Engineer Platoon of an Airmobile Divisional Engineer Battalion.

(11) Possess a durability which will enable the membrane to sustain initial operations of 100 sorties without failure.

## 8. Physical Characteristics

a. It is essential that the landing mats:

- (1) Be as lightweight as possible consistent with other requirements, and weigh as shown on Incls 1 and 2.
- (2) Be capable of installation by trained personnel at the rates shown on Incl 1, Table 3.
- (3) Permit replacement of an individual mat panel within two hours essential, one hour desirable.
- (4) Be capable of placement with a minimum number of accessories and special tools.
- (5) Be provided with a simple method of transition and laying from runway to taxiway and parking aprons.
- (6) Be provided with an adequate system of anchoring runways and taxiways to prevent movement, lift, and not cause damage to aircraft tires.
- (7) Be capable of being installed directly on graded subgrades with maximum crowns of 3 percent, longitudinal grades of 5 percent, and a maximum longitudinal grade change of 2 percent in 100 ft.
- (8) Individual mats be of such size, shape, and weight to be handled by two men (desirable maximum weight - 100 lb, essential maximum weight - 120 lb).
- (9) Be packaged so as to compliment ground transportation and installation and for ease of aircraft transportation in accordance with para 5a of AR 705-35.
- (10) Be provided with a capability which will allow rapid replacement of buckled (forced together) and forced apart panels in the center of the runway from bomb or other damage.
- (11) Be provided with components which will permit joining light duty panels to medium duty panels, and medium duty panels to heavy duty panels.
- (12) (Desirable) Be provided with 45-deg transition connector panel which will allow construction of high speed taxiways.

b. It is essential that the membranes:

- (1) Be as lightweight as possible as shown on Incl 1, Table 4.
- (2) Be capable of being installed by trained personnel at the rates shown on Incl 1, Table 5.

(3) Withstand locked-wheel braking action and maximum wheel braking procedures of critical aircraft.

(4) Be packaged to facilitate hand laying so as to compliment ground transportation and installation and for ease of aircraft transportation in accordance with para 5a of AR 705-35.

(5) Be provided with suitable anchoring devices which will not damage the membrane or tires.

(6) Be capable of being installed directly on graded subgrades with maximum crowns of 3 percent, longitudinal grades of 5 percent, and a maximum longitudinal grade change of 2 percent in 100 ft.

## 9. Maintenance Characteristics

a. The mats and membranes shall be designed to minimize maintenance. It is essential that maintenance be as follows:

(1) Be designed to facilitate maintenance accessibility in the field environment at all categories so that required maintenance will be performed in the minimum practicable time with a minimum degree of skill, variety of tools, test equipment, and other supplies.

(2) Be designed towards minimization of maintenance by utilization of the most reliable components; modular construction; built-in, simple, failure indicators; and other technological advances in components and/or methods.

(3) Be designed so that individual and/or damaged sections of materials may be removed and replaced.

b. Typical maintenance to restore performance specified herein will consist of but not necessarily be restricted to the following: cleaning, inspecting for repairs, alignment, tightening of anchors, patching, replacement of damaged mat panels, and repair of nonskid surface. Maintenance performed shall not exceed 150 manhours per month by personnel from an Engineer Platoon of the Airmobile Divisional Engineer Battalion for the service life of the materials. (Subgrade failures are not included in this paragraph.)

## 10. Human Engineering Characteristics

Human factors engineering characteristics of the system will include consideration of the intellectual, physical and psychomotor capabilities of the intended user.

## **11. Priority of Characteristics**

- a. Performance**
- b. Weight**
- c. Reliability and Durability**
- d. Transportability**
- e. Maintainability**

### **Section V - Personnel and Training Considerations**

## **12. Quantitative and Qualitative Personnel Considerations**

**a.** The system will be installed primarily by Army engineer units. However, its simplicity of emplacement will require a minimum of training whereby any Army unit, or indigenous personnel, could install and maintain the system.

**b.** No new MOS will be required.

**c.** Although a savings in personnel strengths normally associated with airfield construction may not be effected, with this system the troop effort required to prepare base courses can be diverted to other tasks, and the overall airfield construction time reduced.

## **13. Training Considerations**

Training for actual installation and maintenance of this system will be negligible. Preparation of the ground for installation of this system will normally be by Army engineer units which already have this capability. Training literature on the repair and reuse of prefabricated airfield surfacing materials is required. This literature should cover the factors to be considered in evaluation of surfacing for reuse, evaluation methods and procedures, repair techniques and methods, repackaging information, and a basis of classification of prefabricated airfield surfacing materials for future use.

### **Section VI - Associated Considerations**

## **14. Training Devices**

None required. Components of the system will be utilized for training.

## 15. Related Materiel

No change in present items of supply is anticipated. Similar items of supply already in the Army supply system may still be required to support Army aircraft operations. It is not intended that this system be capable of inter-mix usage with current standard, similar items of supply, although this would be desirable if it could be done with no compromise of capability in the proposed system. Ancillary equipment and special tools to emplace, use, and maintain prefabricated airfield surfacings must be developed as required.

## 16. Concealment and Deception

Normal camouflage considerations apply; reduction in light reflectivity is required. No disguise or simulation devices are required.

## 17. Interest

This system will probably be of interest to British, Canadian, and Australian Armies.

## 18. Current Inventory Items

There are no existing items, and no items are under development by other services or allied armies which can fulfill this requirement.

## 19. Communications Security

None.

## 20. Additional Comments

a. If, during the development phase, it appears to the developing agency that the characteristics listed herein require the incorporation of certain impracticable features and/or unnecessarily expensive and complicated components or devices, costly manufacturing methods or processes, critical materials or restrictive specifications which will prove excessively expensive or serve as a detriment to the military value of the unit, such matters shall be brought to the immediate attention of the Chief of Research and Development of the Army, and Headquarters, US Army Combat Developments Command for consideration before incorporation into a final design.

b. This materiel requirement is identified by USACDC Action Control Number 7494 and supports the following:

- |     |   |   |
|-----|---|---|
| (1) | Army CD Program                                   | Army 75 (70-75)   |
| (2) | Study "Engineer 75";<br>USACDC Action Control No. | 6493  |
| (3) | Army Tasks  | <ul style="list-style-type: none"><li>1: High Intensity Conflict</li><li>2: Mid Intensity Conflict</li><li>3: Low Intensity Conflict,<br/>Type I</li><li>4: Low Intensity Conflict,<br/>Type II</li><li>6: Military Aid to US Civil<br/>Authorities</li><li>7: Complementing of Allied<br/>Land Power</li></ul> |
| (4) | Phase   | Materiel  |
| (5) | Function  | Service Support   |

3 Incl  
Tables

Table 1

<u>Mat Classification</u>	<u>Single-Wheel Load</u> lb	<u>Tire Pressure</u> psi	<u>Nominal Contact Area</u> sq in.	<u>Coverage Level</u>	<u>CBR</u>
Heavy duty	50,000	250	200	1000	4
Medium duty	25,000	250	100	1000	4
Light duty	30,000	100	300	1000	4

Table 2

<u>Mat Classification</u>	<u>Desirable Weight</u> lb per sq ft	<u>Essential Weight</u> lb per sq ft
Heavy duty	5.0	6.5
Medium duty	4.0	4.5
Light duty	2.5	3.0

Table 3

<u>Mat Classification</u>	<u>Desirable Placing Rate</u> sq ft per man-hour	<u>Essential Placing Rate</u> sq ft per man-hour
Heavy duty	400	150
Medium duty	400	250
Light duty	600	400

Table 4

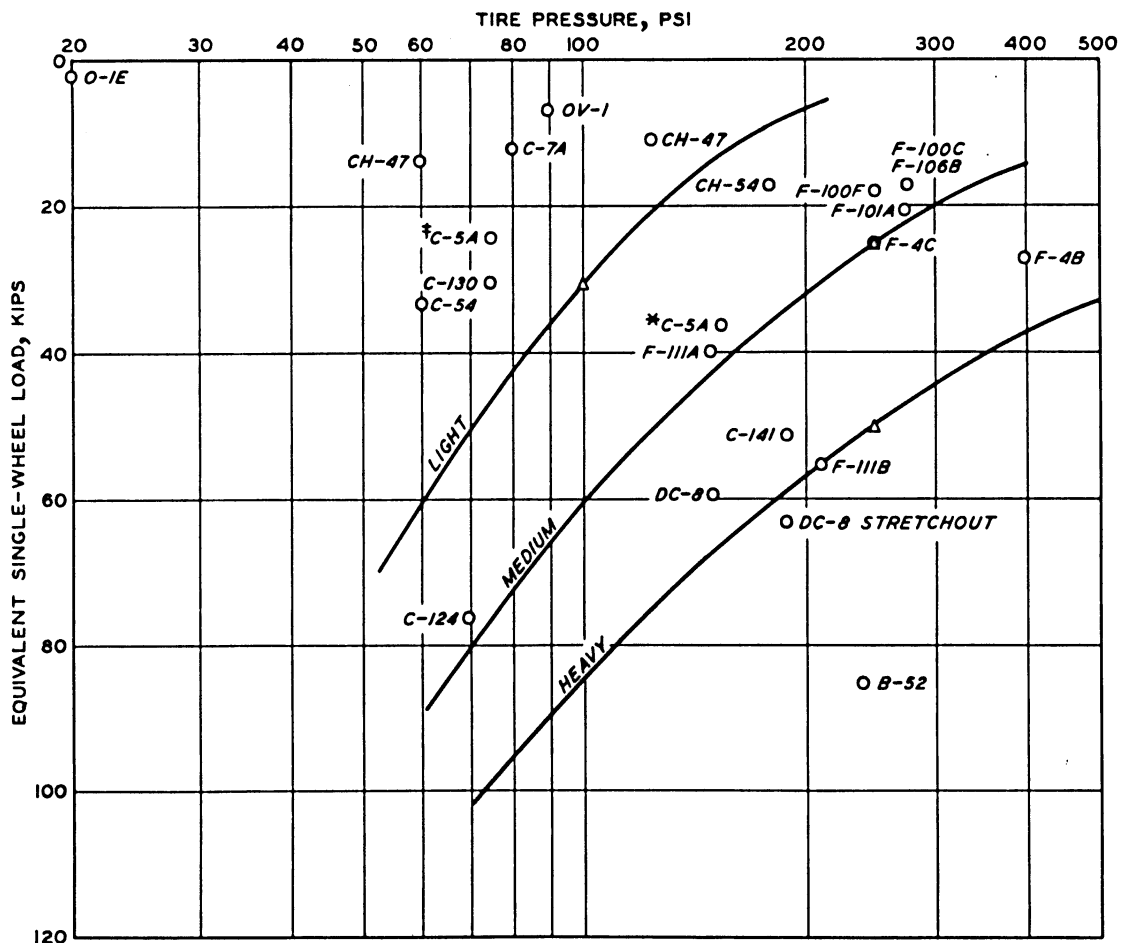
<u>Membrane Classification</u>	<u>Desirable Weight</u> lb per sq yd	<u>Essential Weight</u> lb per sq yd
Heavy duty	5.0	6.0
Medium duty	3.0	4.0
Light duty	1.0	2.0

Table 5

<u>Membrane Classification</u>	<u>Desirable Placing Rate</u> sq ft per man-hour	<u>Essential Placing Rate</u> sq ft per man-hour
Heavy duty	300	200
Medium duty	400	300
Light duty	600	400

Incl 1 to QMR

Incl 2 (sheet 13)



### LEGEND

- △ MAT CATEGORY DEFINITION
- AIRCRAFT REQUIREMENT
- \* MAXIMUM TAKEOFF WEIGHT
- † THEATER OF OPERATIONS WEIGHT

NOTE: THESE CURVES DO NOT INDICATE MAT CAPABILITY FOR ARRESTING GEAR LANDINGS WITH TAILHOOKS.

THE PURPOSE OF THIS FAMILY OF CURVES IS TO ILLUSTRATE THE APPROXIMATE LOAD-CARRYING CAPABILITY OF A PROPOSED FAMILY OF MATS WITH RESPECT TO LOADINGS OF SOME CURRENT AIRCRAFT. THE CURVES HAVE ONLY BEEN PARTIALLY VALIDATED AND SHOULD NOT BE USED FOR DESIGN PURPOSES.

EACH MAT WILL SUPPORT ALL AIRCRAFT PLOTTED IN A POSITION ABOVE THE CURVE REPRESENTING THAT MAT CATEGORY.

## PROJECTED RELATIVE LANDING MAT CAPABILITY

1000 COVERAGES 4 CBR

(SUBJECT TO REVISION)

Incl 2 to QMR



PROJECTED PERFORMANCE OF MEMBRANES FOR PERIOD OF SIX MONTHS (1200 SORTIES\*)

(This is a preliminary table subject to revision)

Aircraft	Landing	Operation			Auxiliary Use		Remarks
		Max Engine Run-Up for Takeoff	Locked- Wheel Turns	Taxiing	Locked- Wheel Braking	Waterproofing Beneath Landing Mats	
<u>Heavy-Duty Membrane (5-6 lb per sq yd)</u>							
F-111A	4	4	4	4	4	4	Performance rating scale for membranes:  1 Satisfactory 2 Borderline 3 Unsatisfactory 4 No test data available
F-111B	4	4	4	4	4	4	
F-4B	4	4	4	4	4	1	
C-141	4	4	4	4	4	1	
C-5	4	4	4	4	4	4	
C-130E	1	1	1	1	1	1	
C-7A	1	1	1	1	1	1	
CH-54	1	1	1	1	1	1	
CH-47	1	1	1	1	1	1	
UH-1	1	1	NA	1	NA	1	
OV-1	1	1	1	1	1	1	
Ol-E	1	1	1	1	1	1	
<u>Medium-Duty Membrane (3-4 lb per sq yd)</u>							
F-111A	4	4	4	4	4	4	NOTE: The purpose of this projected performance of a family of membranes is to indicate their relative capabilities for selected current aircraft and helicopters.
F-111B	4	4	4	4	4	4	
F-4B	3	3	1	4	4	1	
C-141	4	4	4	4	4	4	
C-5	4	4	4	4	4	4	
C-130E	2	2	1	1	1	1	
C-7A	1	1	1	1	1	1	
CH-54	1	1	1	1	1	1	
CH-47	1	1	1	1	1	1	
UH-1	1	1	NA	1	NA	1	
OV-1	1	1	1	1	1	1	
Ol-E	1	1	1	1	1	1	
<u>Light-Duty Membrane (1-2 lb per sq yd)</u>							
F-111A	4	4	4	4	4	4	
F-111B	4	4	4	4	4	4	
F-4B	4	4	3	1	3	1	
C-141	4	4	4	4	4	4	
C-5	4	4	4	4	4	4	
C-130E	3	3	2	1	2	1	
C-7A	3	3	2	1	2	1	
CH-54	1	1	1	1	1	1	
CH-47	1	1	1	1	1	1	
UH-1	3	3	NA	3	NA	1	
OV-1	3	3	3	1	1	1	
Ol-E	1	1	1	1	1	1	

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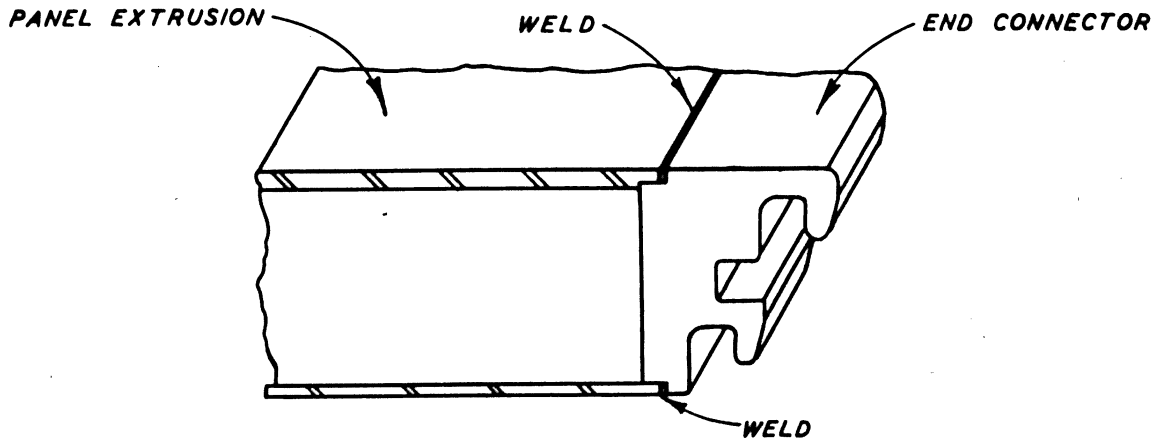


FIGURE A. MX18-A END CONNECTION

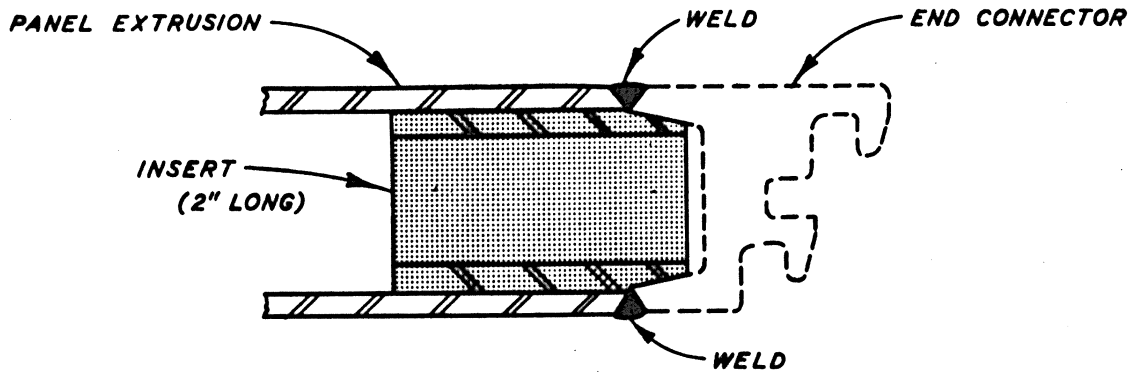


FIGURE B. MX18-B, MX18-C, MODIFIED MX18-B,  
AND MODIFIED MX18-C

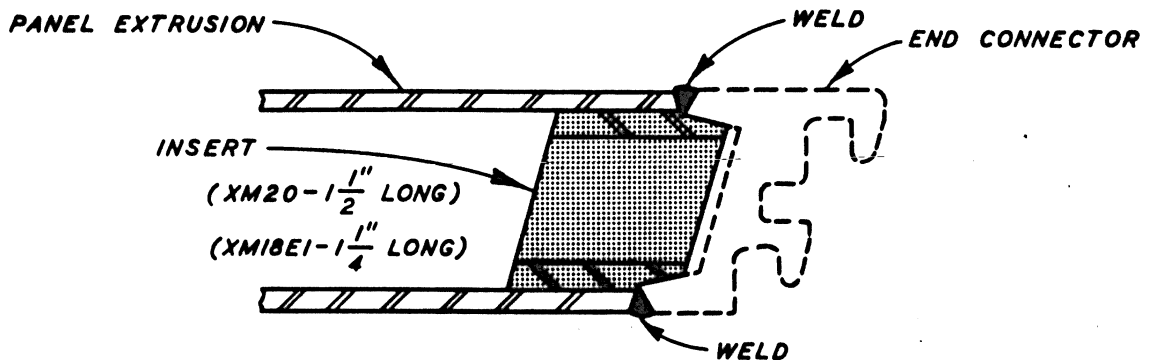


FIGURE C. XM20 AND XM18EI END CONNECTION

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<p>This report gives the history of a group of extruded aluminum alloy landing mats which were tested as medium-duty mats. These mats were developed and produced by the Dow Chemical Company, Midland, Mich. During the period January 1965-April 1968, accelerated traffic tests were conducted on several experimental versions of the mats at the U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss. A small quantity of the last version (designated XM18E1) was acquired from the 1.5 million sq ft production contract and tested at the WES. Integrated engineering and service tests were conducted at Dyess AFB, Tex., on the modified MX18-B version. This report describes the metamorphosis of the original experimental MX18-A to the present XM18 which has been type classified in the Federal Supply System.</p>		

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