DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

26 OCT 1995

FROM: HQ AFCESA/CES
139 Barnes Drive
Tyndall AFB FL 32403-5319

SUBJECT: **Engineering Technical Letter (ETL) 95-3: Planning Guide for Installation of Ultra-High-Molecular-Weight (UHMW) Polyethylene Panels Under Aircraft Arresting System Cables (CONUS Installations)**

1. Purpose. This ETL provides a planning guide for installation of UHMW polyethylene panels under aircraft arresting system cables. It includes panel specifications, and installation and inspection guidelines.

2. Application. Requirements of this ETL are mandatory for new construction. Designers should also consider thickened slabs under UHMW panels for new construction. Installation of UHMW panels is the preferred method of repair for existing pavements. Other repair options may be justified based on economy or mission. Requirements of this ETL are mandatory for all UHMW panel installations within the Air Force.

NOTE: Use of "will" indicates a mandatory requirement. "May" or "should" indicates a nonmandatory action or condition.

2.1. Authority: AFPD 32-10, *Air Force Installations and Facilities.*

2.2. Effective Date: Immediately. Expires five years from date of issue.

NOTE: The following issue of this ETL will present measurements with metric equivalents.

3. Referenced Publications.

3.1. AFI 32-1043, *Management of Aircraft Arresting Systems.*

4. Definitions.

4.1. *EPH*: effective pendant height. The clearance between an aircraft arresting system cable and the projected surface (plane) of adjacent pavement [approximately 2 inches. Refer to AFI 32-1043, Paragraph 1.3.11 for procedures for measuring EPH.

5. Specific Requirements. Aircraft arresting system cables impact underlying pavement, eroding grooves in the pavement; the rubber disks supporting the cable sink

into the grooves, lowering the cable. When the EPH is below 1-1/2 inches, the aircraft tailhook may miss the cable. These areas must be repaired to maintain a uniform pavement surface and the proper EPH to ensure reliability of the arresting system.

5.1. Criteria for Repairs:

- Materials must (1) install easily; (2) not warp or erode.
- Method must be cost-effective.

5.2. Options for Repair.

5.2.1. Bonded Partial Depth Inlays. The Air Force has used numerous cementitious-, epoxy-, and polyurethane-based materials under arresting system cables. Performance varies from satisfactory to very poor, even with the same material. Most of these repairs have been costly and/or eroded quickly.

5.2.2. Preformed Panels. The Air Force has tested non-UHMW preformed panels with only limited success: panels warp and panel edges protrude above the adjacent runway pavement, causing the aircraft arresting hook to skip the cable. It is absolutely critical to keep panels flush, or preferably slightly recessed (1/16 to 1/8 inch) below the adjacent pavement surface. Thermal compatibility of the panel material, the anchoring system, and the adjacent pavement is extremely important.

5.2.3. UHMW Polyethylene Panels. UHMW panels have proven effective for several years at European air bases at Bremgarten, Lahr, Wildenrath, and Laarbruch. The Air Force has installed test panels at RAF Lakenheath (1992), Holloman AFB (1992), and Elmendorf AFB (1993), and full-runway-width panels at Incirlik AB (1994). UHMW panels show great promise as a successful method of pavement repair.

5.3. Guidelines for Panel Sizing and Preparation.

5.3.1. Panel Dimensions: Uncut panel stock is 48 inches wide by 10 feet long by 1-1/2 inches thick. Size panels to avoid material waste.

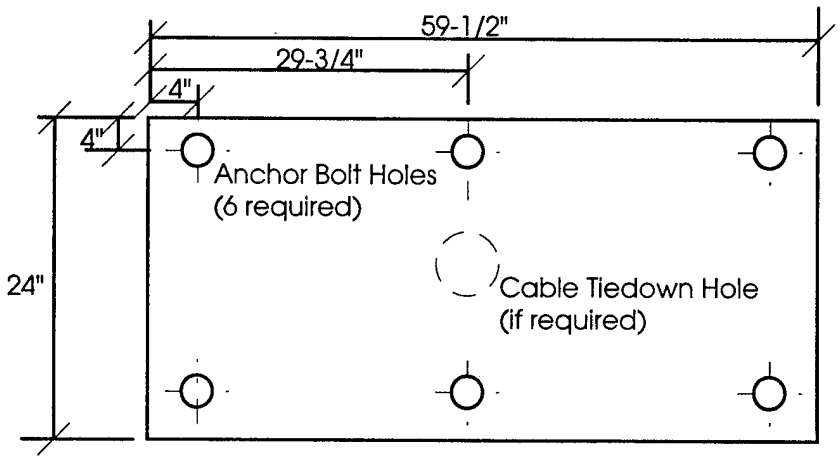
5.3.1.1. Length. Cut panels to allow joints between panels to line up with runway pavement joints. For runways with 20-foot or 25-foot longitudinal paving lane joint spacing, panels should be 4 feet, 11-1/2 inches long. (Two panels can be cut from the 10-foot-long stock with minimal waste.) Panels may be shorter, but must never exceed 5 feet.

NOTE: Recommended joint space between panels is 1/2 inch.

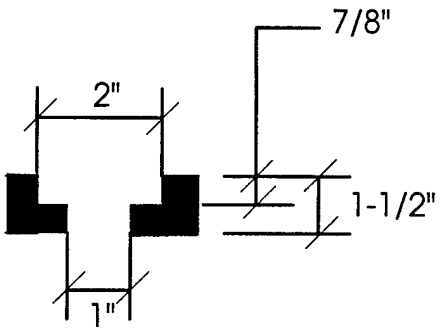
5.3.1.2. Width: To reduce panel warping and damage to joints from cable impact, panels should be a nominal 24 inches wide for all installations.

5.3.1.3. Thickness: Panel thickness should not be less than 1-7/16 inches nor more than 1-1/2 inches.

5.3.2. Panel Finishing. The panel supplier should predrill holes in panels (for anchor stud installation) IAW Figure 1.



Panel Dimensions and Anchor Hole Locations



Detail of Anchor Hole

NOTE: The MAJCOM aircraft arresting system engineer will specify the required number and spacing of tiedown anchors. If cable tiedown anchors will be used, the supplier should predrill panel centers with 4 inch diameter holes to allow anchor installation.

Figure 1. Cable Tiedown, Anchor Hole Locations and Detail.

5.4. Guidelines for Pavement Preparation and UHMW Panel Installation. The procedure to install UHMW panels under arresting system cables involves the following major steps:

- preparing the receiving slot.
- placing a cementitious setting bed.
- installing the UHMW panels.
- installing panel anchor studs.

- installing new cable tiedown anchors (if required).
- sealing the joints.

5.4.1. Preparing the Receiving Slot.

5.4.1.1. Remove Concrete.

5.4.1.1.1. Area Dimensions. Dimensions of the area of concrete removed depend upon the number of panels installed.

Example:

Given: Each panel is 59-1/2 inches long by 24 inches wide; the gap between panels is 1/2 inch.

For an inlay of 8 panels, 40 feet across the runway (20 feet on each side of the runway centerline), the saw cut area must be:

- 40 feet, 1/2 inches long
- 25 inches wide
- at least 2-1/2 inches deep.

An installation extending completely across an 150-foot wide runway requires 30 panels.

5.4.1.1.2. Perimeter Cuts. Perimeter saw cuts must be 3 inches deep and overlap at least 3 inches to ensure corners are perfectly square when pavement is removed. Remove all loose, unsound concrete within the area. Additional saw cuts inside the perimeter will make removing concrete easier (using chipping hammers), and result in a more uniform concrete profile.

5.4.1.2. Inspect Receiving Slot Following Concrete Removal. With a notched board (Figure 2), check the depth of the concrete within the recessed setting bed. Use a chipping hammer to remove any portions less than 2-1/2 inches from the surface of the adjacent pavement. Then check the concrete visually; sound it with a steel rod to identify any unsound portions; and remove all unsound concrete.

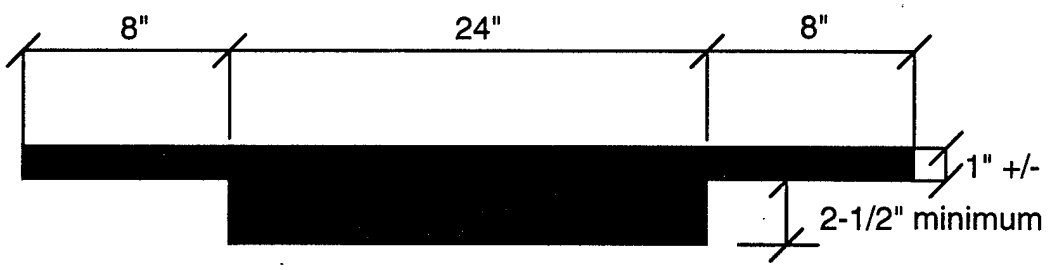


Figure 2. Notched Board for Checking Minimum Depth (2-1/2 Inches) of Concrete Within the Receiving Bed.

5.4.1.3. Remove Existing Tiedown Anchors. Cut existing aircraft arresting system cable tiedown anchors flush with the bottom of the concrete substrate before placing the setting bed.

5.4.1.4. Clean Concrete Substrate. Clean the saw-cut side walls and floor of the excavation before laying the setting bed. Sandblast or use wire brushes, followed by compressed air.

5.4.2. Placing a Setting Bed. Place a cementitious setting bed under the panels and allow the bed to cure before drilling and anchoring the panel anchor studs. Use ordinary Portland cement concrete, airfield strength (5,000 psi compression/ 650 psi flexural strength in 28 days) when several hours' cure time is available. As a suggested mix, use:

- a lean 7-bag mix with 3/8-inch maximum size aggregate
- water-to-cement ratio not to exceed 0.3:1
- platicizer admixture
- substitute fly ash for -50 sieve size sand as required

This will allow drilling within 18 to 24 hours. For short-cure-time applications, a prepackaged material such as Rapid Set Concrete Mix is satisfactory. Rapid Set Concrete Mix is packaged in 60-pound bags which will yield approximately 1/2 cubic foot of concrete when mixed with water (refer to Attachment 4 for ordering information). Placing a small test sample in a disposable pail the same depth as the setting bed may also serve as a helpful tool in determining adequate cure time for drilling operations.

5.4.2.1. Mixing Equipment Placement. Position two mechanical mortar or concrete mixers approximately 20 feet from the prepared inlay near the center of the runway. Transport mixed mortar in a wheelbarrow. Mortar mixers are preferred. Depending upon the type material used, drum mixers may not agitate material enough to produce the desired workability when the recommended amount of water is used.

5.4.2.2. Mixing and Placing Procedure for Rapid Set Concrete Mix:

- Place three to four quarts of water in the mixer. In hot climates, the setting time of the mix can be extended by using cold water. In cold climates, the setting time may be shortened by using hot water and heating the substrate.
- Add one bag of Rapid Set Concrete Mix and mix for two to three minutes.
- Place the material within ten minutes after mixing. If temperature is above freezing, wet the substrate first. If below freezing, do not wet the substrate.
- Finish the material from the center of the bed to the edges to achieve proper bonding along the side walls of the excavation.
- After initial set, when the surface becomes hard to the touch, fog or spray mist cure with water for one hour.

NOTE: This mix "wets" slowly. Do not add more water until the full mixing time is elapsed. Overwatering will weaken the final mix.

5.4.2.3. Leveling Setting Bed.

- Mechanically vibrate or jitterbug the concrete before screeding to consolidate the mass.
- Level the concrete to the proper depth in the setting bed using a notched screed board (Figure 3). Strike the screed periodically to ensure proper depth and uniform surface. The 1-9/16 inch depth of the screed board is based upon a panel thickness of 1-1/2 inches. Measure the actual panel thickness to establish the screed dimensions.
- Extend existing pavement joints through the setting bed by saw-cutting or using an expansion board. The saw cut should be a single blade-width and extend completely through the setting bed. Expansion board must be set the full depth of the setting bed.

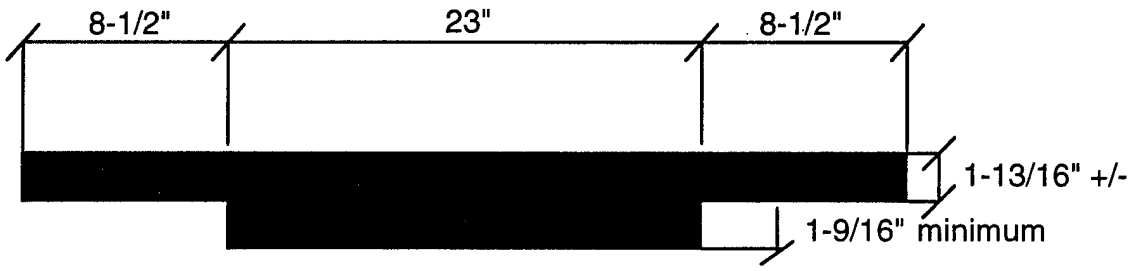


Figure 3. Notched Screed Board.

5.4.3. Installing UHMW Panels. Install panels IAW the following:

- Allow setting bed to harden (approximately 4 hours, depending on the type bed used) to the minimum psi which allows drilling without spalls.
- Lay the panels in place.
- Grind the bedding material or panel edges as necessary so that the panel surface is slightly recessed (1/16 to 1/8 inch) below the adjacent pavement surface. Panel height is especially critical in center half of runway.
- Set spacing between panels using a 1/2-inch thick board.
- Secure all panels in place with wood wedges (minimum four sets per panel) to prevent panels' shifting during drilling of anchor stud holes.

5.4.4. Installing Panel Anchor Studs. Refer to Attachment 3 for a list of tools and equipment.

5.4.4.1. Drill Holes.

- Position locally fabricated alignment tool (Figure 4) over predrilled hole in panel.
- Drill 7/8 inch diameter holes in setting bed. Not all anchor studs are consistent in length as ordered, so check actual anchor stud lengths and drill to accommodate the longest stud. The hole depth is critical. If it is not deep enough, the stud will protrude above the panel surface and require

excessive grinding. If it is too deep, the adhesive capsule will be positioned below the stud and not provide adequate coverage.

- Thoroughly clean debris from drilled hole with round wire brush and compressed air. A 3/8- to 1/2-inch diameter tube attached to the compressed air line is necessary to remove all fines from the holes. Insert tubing to bottom of hole to ensure all particles are removed.

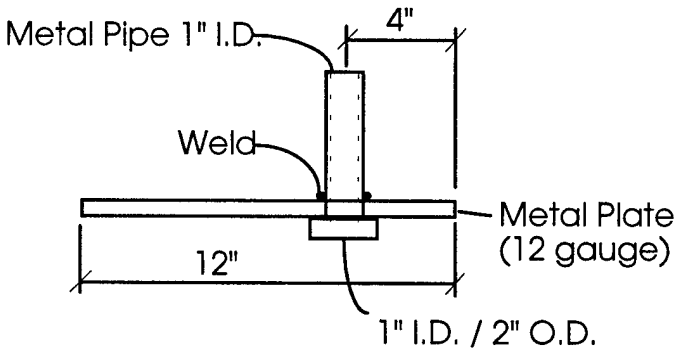


Figure 4. Alignment Tool.

NOTE: Use a drill-mounted depth gage rod or mark a position on the drill bit shaft the length of the stud plus the depth of the alignment tool to ensure proper hole depth when drilling.

5.4.4.2. Install Anchor Studs.

- Insert adhesive capsule into hole with rounded end facing hole bottom.
- Screw cap nut or other manufacturer provided adapter onto end of anchor bolt and attach unit to heavy-duty drill (or rotary impact hammer).
- Insert flat washer onto threaded stud just below adapter, or position the washer over the panel hole inside the countersink.
- Drive anchor stud to end of hole; continue rotating stud in hole for at least 3 seconds to mix adhesive.
- Allow adhesive to cure (approximately 1 hour or as recommended by the manufacturer) to the point where the cap nut can be removed without disturbing the stud position.
- Remove cap nut and flat washer; seal around stud with silicone sealant; reinsert flat washer; attach lock washer and nut to top of anchor stud.
- Allow adhesive to fully cure according to manufacturer's instructions.
- Torque nuts to 60 ft-lbs.
- Grind off portion of stud that protrudes above panel surface.

NOTE: To avoid work stoppage while adhesive cures, have at least 12 cap nuts available.

5.4.5. Installing New Cable Tiedown Anchors. The MAJCOM aircraft arresting system engineer will prescribe the number and spacing of cable tiedown anchors required.

Each cable tiedown anchor hole will be located in the center of the appropriate installed panel. Depending on the location of existing runway pavement joints in relation to the runway centerline and the longitudinal joint spacing, UHMW panels may be installed with a panel joint or panel center falling on the runway centerline. Figures 5 through 8 depict recommended cable anchor tiedown locations when installing standard 5-foot panels. Use 8-point tiedown configurations for F-16 aircraft operations. Use 4-point configurations for all other aircraft operations.

NOTE: This requirement does not apply where tiedown anchors are not used.

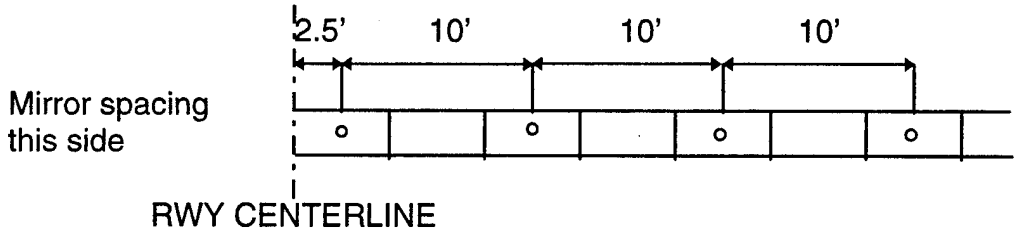


Figure 5. 8-Point Cable Tiedown Locations - Panel Joint on Runway Centerline.

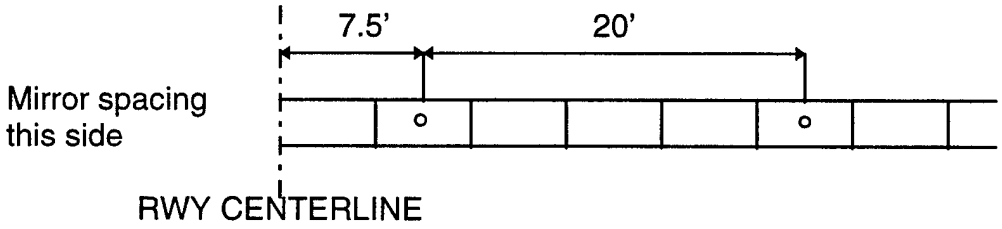


Figure 6. 4-Point Cable Tiedown Locations - Panel Joint on Runway Centerline.

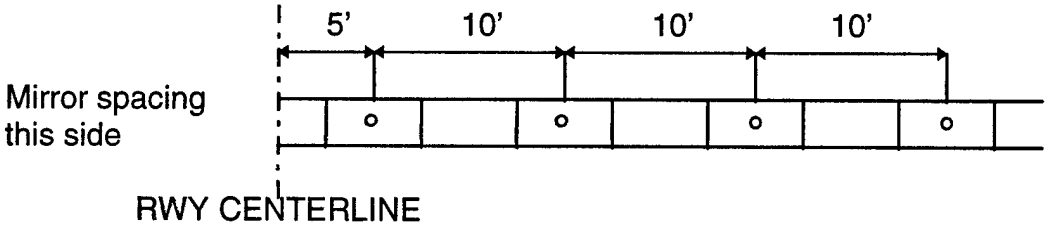


Figure 7. 8-Point Cable Tiedown Locations - Panel Center on Runway Centerline.

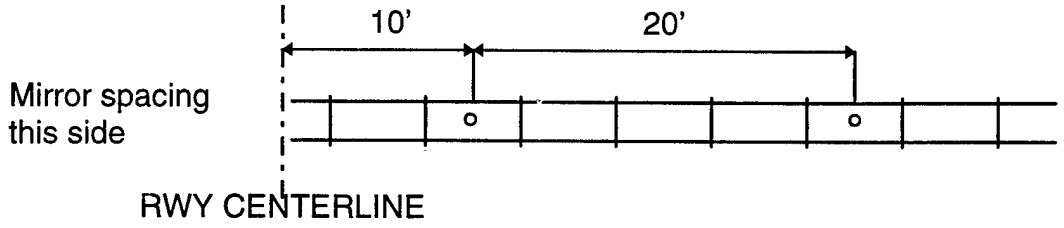


Figure 8. 4-Point Cable Tiedown Locations - Panel Center on Runway Centerline.

5.4.6. Sealing Joints. Apply joint sealant in spacing between and around panel edges, recessed 1/8-inch below the panel top surface. Joint sealants do not adhere well to UHMW panels and joints should be inspected frequently.

NOTE: Joints should be resealed just prior to onset of cold weather to prevent moisture accumulation and freezing below panels. Freezing below panels may result in panel failure, anchor failure, or excessive panel warping.

5.5. Guidelines for Inspection. Bases should establish formal procedures to ensure satisfactory performance of UHMW panels. UHMW panels should be inspected daily and monthly for effects of aircraft traffic and thermal movement (expansion/ contraction/warping) IAW the following.

5.5.1. Daily Inspection. Panel inspection should be added to the daily arresting system inspection by power production personnel. Visually check for panel buckling, warping, and surface variations.

5.5.2. Weekly Inspection. Check for panel buckling, warping, and surface variations by placing a steel straight edge on top of each panel parallel to the runway centerline at:

- each joint between panels;
- at least two locations within each panel; and
- any other location that appears raised or irregular.

The straight edge must be long enough to overlap the pavement on each side of the panel by a minimum of 12 inches. Immediately report raised edges or high spots exceeding 1/8-inch above the plane of the adjacent runway to the base pavements engineer and to the MAJCOM arresting systems engineer for further evaluation. Take color slides or photographs to document findings.

5.5.3. Monthly Inspection. The base pavements engineer should participate once each month in the daily inspections with the power production personnel. Record all panel conditions, including (but not limited to):

- erosion/EPH,
- distresses,

- warping/curling,
- soundness,
- delamination,
- anchor stud effectiveness,
- joint seal performance, and
- spalling.

NOTE: Anchor stud nuts may be over-torqued if done repeatedly. Consider using a thread locking or seizing compound such as Loc-Tite on nuts that continually loosen. Report any significant deterioration or problem to the MAJCOM immediately for further evaluation.

6. Point of Contact: Mr. Cliff Sander, HQ ACC CES/ESO, DSN 574-9337; CMSgt Richard Smith, HQ AFCESA/CESC, DSN 523-6429, commercial (904) 283-6429, or FAX 523-6219.

WILLIAM G. SCHAUZ, Colonel
Director of Technical Support

6 Atch
1. Distribution List
2. ETL Index
3. Typical Tools and Equipment
4. Material Cost and Source
5. Typical Schedule of Events
6. Technical Specifications for Ultra-High-Molecular-Weight (UHMW) Polyethylene Barrier Panels

DISTRIBUTION LIST

DEPARTMENT OF DEFENSE

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Lackland AFB TX 78236-5000

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Dallas TX 75266-0320

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Alexandria VA 22034-6145

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IHS (A.A. DeSimone) (1)
1990 M Street NW, Suite 400
Washington DC 20036

Construction Criteria Database (1)
National Institute of Bldg Sciences
1201 L Street NW, Suite 400
Washington DC 20005

ENGINEERING TECHNICAL LETTERS (ETL)

SECTION A - CURRENT ETLs

ETL Number	Title	Date Issued
83-1	Design of Control Systems for HVAC	16 Feb 83
	Change No. 1 to ETL 83-1, U.S. Air Force Standardized Heating, Ventilating & Air Conditioning (HVAC) Control Systems	22 Jul 87
83-3	Interior Wiring Systems, AFM 88-15, Para 7-3	2 Mar 83
83-4	EMCS Data Transmission Media (DTM) Considerations	3 Apr 83
83-7	Plumbing, AFM 88-8, Chapter 4	30 Aug 83
83-8	Use of Air-to-Air Unitary Heat Pumps	15 Sep 83
83-9	Insulation	14 Nov 83
84-7	MCP Energy Conservation Investment Program (ECIP)	13 Jun 84
84-10	Air Force Building Construction and the Use of Termiticides	1 Aug 84
86-2	Energy Management and Control Systems (EMCS)	5 Feb 86
86-4	Paints and Protective Coatings	12 May 86
86-5	Fuels Use Criteria for Air Force Construction	22 May 86
86-8	Aqueous Film Forming Foam Waste Discharge Retention and Disposal	4 Jun 86
86-9	Lodging Facility Design Guide	4 Jun 86
86-10	Antiterrorism Planning and Design Guidance	13 Jun 86
86-14	Solar Applications	15 Oct 86
86-16	Direct Digital Control Heating, Ventilation, and Air Conditioning Systems	9 Dec 86
87-1	Lead Ban Requirements of Drinking Water	15 Jan 87
87-2	Volatile Organic Compounds	4 Mar 87
87-9	Prewiring	21 Oct 87
88-2	Photovoltaic Applications	21 Jan 88
88-3	Design Standards for Critical Facilities	15 Jun 88
88-4	Reliability & Maintainability (R&M) Design Checklist	24 Jun 88
88-6	Heat Distribution Systems Outside of Buildings	1 Aug 88
88-9	Radon Reduction in New Facility Construction	7 Oct 88
88-10	Prewired Workstations Guide Specification	29 Dec 88
89-2	Standard Guidelines for Submission of Facility Operating and Maintenance Manuals	23 May 89
89-4	Systems Furniture Guide Specification	6 Jul 89
89-6	Power Conditioning and Continuation Interfacing Equipment (PCCIE) in the Military Construction Program (MCP)	7 Sep 89
89-7	Design of Air Force Courtrooms	29 Sep 89

ENGINEERING TECHNICAL LETTERS (ETL)

SECTION A - CURRENT ETLs

ETL Number	Title	Date Issued
90-1	Built-Up Roof (BUR) Repair/Replacement Guide Specification	23 Jan 90
90-2	General Policy for Prewired Workstations and Systems Furniture	26 Jan 90
90-3	TEMPEST Protection for Facilities Change 1 Ref: HQ USAF/LEEDE Ltr dated 20 April 90, Same Subject	23 Mar 90
90-5	Fuel and Lube Oil Bulk Storage Capacity for Emergency Generators	26 Jul 90
90-6	Electrical System Grounding, Static Grounding and Lightning Protection	3 Oct 90
90-7	Air Force Interior Design Policy	12 Oct 90
90-8	Guide Specifications for Ethylene Propylene Diene Monomer (EPDM) Roofing	17 Oct 90
90-9	Fire Protection Engineering Criteria for Aircraft Maintenance, Servicing, and Storage Facilities	2 Nov 90
90-10	Commissioning of Heating, Ventilating, and Air Conditioning (HVAC) Systems Guide Specification	17 Oct 90
91-1	Fire Protection Engineering Criteria Testing Halon Fire Suppression Systems	2 Jan 91
91-2	High Altitude Electromagnetic Pulse (HEMP) Hardening in Facilities	4 Mar 91
91-4	Site Selection Criteria for Fire Protection Training Areas	14 Jun 91
91-6	Cathodic Protection	3 Jul 91
91-7	Chlorofluorocarbon (CFC) Limitation in \Heating, Ventilating and Air-Conditioning (HVAC) Systems	21 Aug 91
93-1	Construction Signs	11 Mar 93
93-2	Dormitory Criteria for Humid Areas	13 Jul 93
93-3	Inventory, Screening, Prioritization, and Evaluation of Existing Buildings for Seismic Risk	18 Aug 93
93-4	Fire Protection Engineering Criteria - Automatic Sprinkler Systems in Military Family Housing (MFH)	11 Aug 93

ENGINEERING TECHNICAL LETTERS (ETL)

SECTION A - CURRENT ETLs

ETL Number	Title	Date Issued
93-5	Fire Protection Engineering Criteria - Electronic Equipment Installations	22 Dec 93
94-1	Standard Airfield Pavement Marking Schemes	5 Apr 94
94-2	Utility Meters in New and Renovated Facilities	10 Jun 94
94-3	Air Force Carpet Standard	10 Jun 94
94-4	Energy Usage Criteria for Facilities in the Military Construction Program	19 Aug 94
94-5	Fire Protection Engineering Criteria and Technical Guidance - Emergency Lighting and Marking of Exits	8 Nov 94
94-6	Fire Protection Engineering Criteria and Technical Guidance - Removal of Halogenated Agent Fire Suppression Systems	5 Dec 94
94-7	Affirmative Procurement Requirements for Construction and Other Civil Engineering Specifications	14 Dec 94
94-8	Design in Metric	14 Dec 94
94-9	Silicone Joint Sealants for Pavements	14 Dec 94
95-1	Halon 1301 Management Planning Guidance	12 May 95
95-2	Preparation of Requirements and Management Plan (RAMP) Packages for Military Construction (MILCON) Program Projects	26 Oct 95
95-3	Planning Guide for Installation of Ultra-High-Molecular-Weight (UHMW) Polyethylene Panels Under Aircraft Arresting System Cables (CONUS Installations)	26 Oct 95

ENGINEERING TECHNICAL LETTERS (ETL)

SECTION B - OBSOLETE ETLs

ETL Number	Date	Status
82-1	10 Nov 82	Superseded by ETLs 83-10, 86-1, 87-4
82-2	10 Nov 82	Superseded by AFEPPM 88-10
82-3	10 Nov 82	Superseded by ETLs 83-5, 84-2
82-4	10 Nov 82	Superseded by ETL 84-7
82-5	10 Nov 82	Superseded by ETLs 84-1, 86-13, 86-14
82-6	30 Dec 82	Cancelled
82-7	30 Nov 82	Cancelled
83-2	16 Feb 83	Superseded by ETL 84-3
83-5	5 May 83	Superseded by ETL 84-2
83-6	24 May 83	Cancelled
83-10	28 Nov 83	Superseded by ETL 86-1
84-1	18 Jan 84	Superseded by ETL 86-14
84-2	27 Mar 84	Superseded by ETL 94-4
84-3	21 Mar 84	Cancelled
84-4	10 Apr 84	Superseded by ETLs 86-7, 86-15, 87-5
84-5	7 May 84	Superseded by ETLs 84-8, 86-11, 86-18, 88-6
84-6	Not Issued	Cancelled/Not Used
84-8	19 Jun 84	Superseded by ETL 86-11
84-9	5 Jul 84	Superseded by ETL 88-7
88-5	2 Aug 88	Superseded by ETL 91-6
86-1	3 Feb 86	Superseded by ETL 87-7
86-3	21 Feb 86	Superseded by ETL 86-4
86-6	3 Jun 86	Superseded by ETLs 86-11, 86-18, 88-6
86-7	3 Jun 86	Superseded by ETL 86-15
86-11	3 Jul 86	Superseded by ETL 88-6
86-12	3 Jul 86	Superseded by ETL 90-2
86-13	18 Aug 86	Superseded by ETL 86-14
86-15	13 Nov 86	Superseded by ETL 87-5
86-17	17 Dec 86	Superseded by ETL 89-6
86-18	18 Dec 86	Superseded by ETL 88-6
87-3	12 Mar 87	Superseded by ETLs 87-6, ETL 88-5
87-4	13 Mar 87	Superseded by ETL 94-4
87-5	13 July 87	Superseded by ETL 94-2
87-6	21 Aug 87	Superseded by ETL-88-5
87-7	14 Oct 87	Superseded by ETL 89-1
87-8	19 Oct 87	Superseded by ETL 90-1
88-1	5 Jan 88	Superseded by ETL 89-2
88-5	2 Aug 88	Superseded by ETL 91-6
88-7	24 Aug 88	Superseded by ETLs 90-3, 91-2
88-8	4 Oct 88	Superseded by ETL 91-7

ENGINEERING TECHNICAL LETTERS (ETL)

SECTION B - OBSOLETE ETLs

ETL Number	Date	Status
89-1	6 Feb 89	Superseded by ETL 90-4
89-3	9 Jun 89	Superseded by ETL 93-5
89-5		Issued as ETL 90-7
90-4	24 May 90	Cancelled
91-8	24 Sep 91	Cancelled
91-3	14 Jun 91	Superseded by MIL HDBK 1008B, Jan 94
91-5	18 Jun 91	Superseded by ETL 94-5

CONSTRUCTION TECHNICAL LETTERS (CTL)

SECTION C - CURRENT CTLs

CTL Number	Title	Date Issued
88-2	DD Form 1354 Checklist	6 Jan 88
88-7	Constructibility Review Checklist	1 Nov 88
89-1	Thirty-Percent Design Submittal	10 Apr 89
89-2	MAJCOM Construction Management	30 May 89
89-3	Warranty and Guarantee Program	22 Sep 89
90-1	Management of the MILCON Planning and Execution Process	6 Mar 90
90-2	Definitions for Design Milestones	13 Mar 90
91-5	Fire Protection Engineering Criteria - Emergency Lighting and Marking of Exits	18 Jun 91

SECTION D - OBSOLETE CTLs

CTL Number	Status
87-1	Superseded by CTL 88-3
88-1	Superseded by CTL 90-1
88-3	Superseded by ETL
88-4	Replaced by Electronic Data File and Documentation in PDC/WIMS
88-5	Superseded by CTL 90-2
88-6	Issuance Cancelled

TYPICAL TOOLS AND EQUIPMENT

Quantity	Unit	Description
1	each	Concrete saw, self propelled
1	each	Hand-held portable saw
2	each	Saw blades
1	each	Water distributor
50	LF	Expansion board, asphalt impregnated, 4" x 1/2"
3	each	Mortar mixer, 4 cubic feet (2 for use, 1 spare)
1	each	Sand blast unit for air compressor
3	each	Jackhammer, 90 lb, with chisel and spade bits
1	each	Heavy -duty disc-type electric grinder
2	each	1.25 gal containers for mixing water
3	each	Electric generators (1 per drill)
3	tons	Pea gravel (clean, washed gravel, 3/8-inch)
150	bags	Rapid Set Concrete Mix Repair Material
4	buckets	5 gal size, for measuring aggregate
1	board	Notched screed, 2" x 4" x 40"
1	board	Notched depth gauge, 2" x 4" x 40"
30	panels	UHMW polyethylene, 24 inches wide, 59-1/2 inches long, 1-1/2 inches thick, predrilled with six 1-inch diameter anchor holes and 2-inch diameter countersinks
192	each	Anchor studs, 3/4-inch diameter, 9-5/8 inches long, fully threaded, with nuts, flat washers and vinyl ester resin vials. (6 per panel plus spares)
12(min)	each	Cap nuts, 3/4-inch, 10 UNC
2	each	Magnesium floats
1	pair	Vice grips for cap nut removal
1	each	Screwdriver to help with cap nut removal
1	each	Concrete vibrator, small size
2	each	Steel trowels
4	each	Shovels, square point
1	each	Electric drill, 13-millimeter (1/2-inch) drive

1	each	Torque wrench to apply 81 N·m (60 ft-lb) torque
1	each	Tymco Airfield sweeper
1	each	Air compressor
1	each	Front end loader
2	each	Dump trucks
2	each	Wheelbarrow, 4 cubic foot
2	each	Knives
1	each	Pickup truck
2	each	Hammer
2	each	Steel chisel, hand-held
1	each	Joint seal kettle with SS-S-1401 joint seal. NOTE: Silicone joint seal is also recommended and preferred. A recommended silicone joint seal is Dow Corning 890SL in 29-ounce tubes (96 tubes required) and a caulking gun for 29-ounce caulk tubes.
3	each	Electric impact drill (Hilti HE72 or equal) with 7/8-inch diameter by 21-inch long masonry bits.
1	each	Goose neck wrecking bar, 4 feet long, minimum
1	each	Pick for debris breakout and removal
2	each	Wire brushes for slot cleaning
1	each	Roll of heavy cloth or plastic tape for marking drill bits for depth of drilling
2	each	Alignment tools for drilling holes vertically
As req'd		Wood wedges to secure panels in position, at least eight tapered wood wedges per panel
As req'd		Safety equipment including, but not limited to, dust masks, goggles, ear protectors, work gloves, and safety shoes *Ensure an eye wash is available.
As req'd		Wood spacers, 1/2-inch thick by 4 inches) by approximately 3 inches, used to maintain spacing between panels during panel installation
As req'd		String line, spray paint, straight edge board, and a 100-foot tape to measure and mark for saw cuts

MATERIAL COST & SOURCE

NOTE: Costs do not include shipping. Suggestion of vendors is provided to assist in locating sources and does not constitute an endorsement of products from these companies.

Quantity	Item	Suggested Source	Approximate Cost
30 each	UHMW polyethylene panels, predrilled with six countersunk anchor holes	Roechling Engineered Plastics PO Box 2729 Gastonia, NC 28053 Phone: (704) 922-7814 or Ultra Poly 2926 South Steele Tacoma, WA 98409 Phone: (800) 872-8469	$10,000
192 each	Anchor studs, 3/4-inch diameter, 9-5/8 inches long, full-threaded (Hilti PN 686691) with vinyl ester bonding vials (Hilti PN 668129), nuts, and flat washers (Hilti HVA Adhesive Anchor System with HEA 3/4-inch capsule and HAS 3/4-inch rod)	Hilti Fastening Systems PO Box 21148 Tulsa, OK 74121 Phone: (800) 879-8000 or Williams Form Engineering Corporation 1448 College Grand Rapids, MI 49507 Phone: (616) 452-3107	$1,000
4 each	Drive sockets	Hilti Fastening Systems	$36
4 each	Drive socket shafts	Hilti Fastening Systems	$160
4 each	Masonry drill bits, 7/8-inch diameter, 21-inches long	Hilti Fastening Systems	$360

25 each	Cap nuts, 3/4-inch diameter, 10 UNC (P/N 91875A036)	McMaster-Carr PO Box 440, New Brunswick, NJ 08903-0440 Phone: (908) 329-3200	$80
150 bags	Rapid Set Concrete Mix	Rapid Set Products Midwestern Regional Office 1211 South 6th Street St. Charles, IL 60174 Phone: (312) 773-4949 or (800) 929-3030	$2,550
96 tubes	Silicone joint seal (Dow Corning 890-SL)	The Fred R. Hiller Company 2696 Peachtree Square Road Atlanta, GA 30360 Phone: (404) 451-4661	$1,800

TYPICAL SCHEDULE OF EVENTS
(For Installation of 8 Panels)

Date	Times	Event Description
24 Jun	1800-2200	Perimeter saw cutting, Runway 33. Crew size 2 men. Saw cuts 3 inches deep.
25 Jun	1500-1745	Excavation starts on Runway 33 inlay. Crew size 9 men. Concrete removed using three 90-pound jackhammers and one cold milling cutter drum on a "Bobcat 843" skid-steer loader. Debris loaded into a dump truck using a front end loader. Large rubble removed by hand and shovel; small debris removed using the suction wand of the "Tymco" airfield sweeper.
25 Jun	1745-1915	Excavation is complete. Slot cleaned with high pressure air. Substrate sounded and delaminated (unsound, hollow) material removed. Approximate final slot size: 100 feet long by 25 inches wide by 3 inches deep. Notched depth gauge board used to check depth in the center 40-foot area where panels are to be installed.
25 Jun	1915-2000	Final slot inspection. Loose hollow-sounding areas removed with jackhammer and pick. (Hand-held hammer and steel chisel may also be used.) Slot side walls cleaned with wire brushes. Slot cleaned and dried with high pressure air.
25 Jun	2000-2230	Mixing and placing of the setting bed begins. Both concrete mixers used. Ten-person crew is used. No bonding agent used or needed. Notched board used to keep the setting bed at the correct level below the surrounding pavement surface.
25 Jun	2030-2242	Curing compound applied periodically as the setting bed is placed.
25 Jun	2242-2300	Cleanup accomplished and runway cleared. Approximately 90 bags of mortar placed.
26 Jun	0855-1030	Joints and cracks saw-cut through the mortar patches, both flush and recessed patch areas. Hand-held portable saw used for recessed setting bed cracks/joints and self-propelled pavement saw used for flush patches.
26 Jun	1015-1045	Panel placement begins. Panels positioned and tightly wedged into place using wood spacers and wood shims (wedges). Panels as ordered for the job have predrilled bolt holes.
26 Jun	1050-1130	Drilling bolt holes begins. Three heavy-duty electric impact drills (two Hilti HE72, one Milwaukee) used and work well. Three

		minutes drilling time per hole required. Portable drill alignment tool used to keep drill bit positioned vertically to start hole. Drill bits marked with tape to control hole depth. Long slender tube inserted completely to bottom of bolt holes delivers compressed air to thoroughly clean holes. Recommended wire brushing of holes is not accomplished.
26 Jun	1130-1345	Panel anchor studs set in position using electric drill with adapter attachment. Anchor studs anchored into pavement with adhesive capsule inserted before inserting anchor stud in hole. Installation of anchors is delayed during first hour while new adapter is fabricated locally for anchor installation. After first adapter is tried and proven, two more adapters are fabricated. Anchor stud installation then progresses rapidly with most anchor studs installed in last hour. Applying oil on ends of studs aids adapter removal after stud installation.
26 Jun	1340-1400	Shims removed. Site cleaned with compressed air to remove all particles before sealing around panels with joint sealant.
26 Jun	1710-1730	Studs torqued to 60 foot-pounds with torque wrenches. All studs torqued adequately, but several stud ends protrude above panel surface.
26 Jun	1810-1820	High studs ground down flush with surface using a heavy-duty disc-type electric grinder.
26 Jun	1720-1820	Sealant applied to joints around panels using kettle with hot applied single component non-jet fuel resistant sealant (SS-S-1401). Job complete.
26 Jun	1820-1830	Final inspection and job site cleanup completed.

TECHNICAL SPECIFICATION FOR ULTRA-HIGH-MOLECULAR-WEIGHT (UHMW) POLYETHYLENE BARRIER PANELS

A1. Scope. This specification covers ultra-high-molecular-weight (UHMW) polyethylene panels to be installed under barrier cables.

A2. Referenced Documents. ASTM Standards:

D 256, *Test Methods for Impact Resistance of Plastics and Electrical Insulating Materials*, Test Method A.

D 638, *Test Method for Tensile Properties of Plastics*

D 696, *Test Method for Linear Thermal Expansion of Plastics*

D 1505, *Test Method for Density of Plastics by the Density-Gradient Technique*

D 3028, *Test Method for Kinetic Coefficient of Friction of Plastic Solids*

D 2240, *Test Method for Rubber Property - Durometer Hardness*

A3. Panel Dimensions and Anchor Stud Locations.

A3.1. Panel Dimensions. The UHMW polyethylene panel will be 59-1/2 by 24 by 1-1/2 inches. Tolerance on panel length and width will be +0/-1/8 inch. Panel thickness will not be greater than 1-1/2 inch or less than 1-7/16 inch.

A3.2. Anchor Stud Hole Locations and Dimensions. Each panel will have 6 anchor stud holes centered 4 inches from the edge of the panel. The anchor stud hole will be 1 inch for the through hole and 2 inches for the countersink hole. The countersink hole will be 7/8-inch deep with square shoulders for a flat washer to lay firmly against. Figure 1 shows dimensions and drilling details. Tolerances on dimensions for locations and diameters of anchor holes shall be ±1/16-inch.

A3.3. Holes for Cable Tiedown Anchors. The agency ordering panels will specify if cable tiedown anchor holes are required and will specify the number of panels which will be furnished with cable tiedown anchor holes. The cable tiedown anchor hole will be 4 inches in diameter and will be drilled completely through the panel. Cable tiedown anchor holes will be located in the center of the panel. The location of the cable tiedown anchor hole is shown in Figure 1. The number of tiedown anchors required should be provided by the MAJCOM aircraft arresting system engineer.

A4. Material.

A4.1. The panels will be fabricated from virgin UHMW polyethylene and will be black in color and be UV-stabilized. An antistatic additive will be added to the UHMW polyethylene.

A4.2. The UHMW polyethylene will meet the physical requirements of Table 1.

Table A1. Physical Requirement of UHMW Polyethylene.

Property	Test Method	Requirement
Density	ASTM D 1505	0.92 - 0.94 g/cm
Tensile elongation at break	ASTM D 638	400 - 500%
Tensile yield strength	ASTM D 638	2,800 - 4,000 psi
Shore hardness "D"	ASTM	60 - 70
Coefficient of Friction	ASTM D 3028	0.2
Izod impact strength	ASTM D 256, Method A*	>20 ft-lb/inch

*The test specimens shall have two (2) opposing 15-degree notches.