

to effectively
stop structural
exfoliation specify...

hi-koteTM 1

a protective coating
for titanium alloy
and corrosion
resistant
steel fasteners

- *inhibits structural corrosion*
- *reduces need for sealants*
- *meets all NAS 4006 requirements*

speeds production

safeguards structures

protects fasteners



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NOW...for truly effective aluminum exfoliation pr

Problems of structural exfoliation have been of increasing concern to the aerospace industry. As generally recognized, this type of corrosion is due to galvanic action and occurs in aluminum structures using high strength steel and titanium alloy fasteners.

Ultimately, this corrosion can result in severe reduction of the structural integrity of aluminum assemblies.

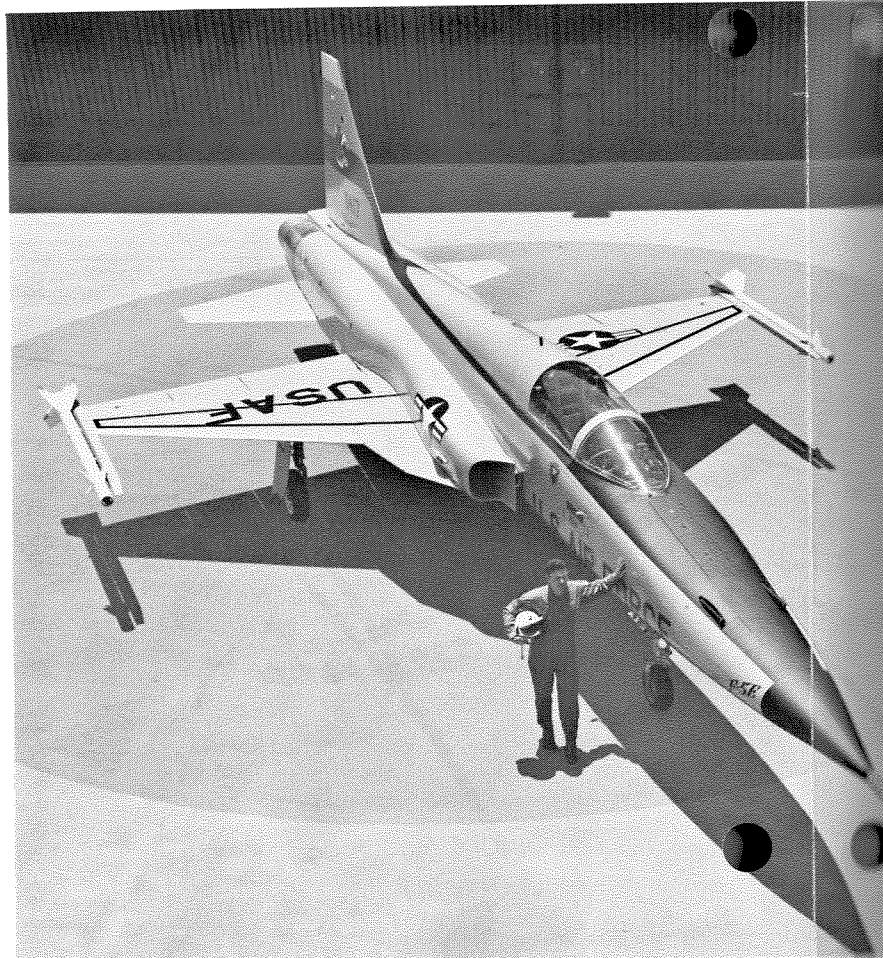
In an effort to counter galvanic corrosion, manufacturers employ various materials, processes and assembly methods. These include:

- plating fasteners using cadmium or aluminum
- coating fasteners with organic or inorganic coatings
- using wet primers or elastomeric sealants during installation
- coating the fasteners and/or structural members with zinc chromate type coatings

Hi-Shear Corporation's continuing involvement with all aspects of aircraft production programs has resulted in an acute recognition of the exfoliation problem. More importantly, it led to the development of Hi-Kote 1, an organic base formulation for overcoming exfoliation or aluminum structural corrosion.

Hi-Kote 1 yields a permanent bonded, corrosion resistant film on titanium and steel fasteners and fully meets the stringent requirements of National Aerospace Standard 4006. In addition, the coating provides excellent lubricity qualities for interference fit fasteners; resistance to hydraulic fluids, fuels, paint strippers and cleaning solvents; plus no evidence of fastener stress cracking frequently encountered with cadmium plated fasteners.

Hi-Kote 1 is currently being applied to Hi-Lok titanium fasteners that are being installed on the Northrop F-5E twin-jet supersonic fighter in production for the U.S. Air Force and allied nations.



Northrop Corporation's F-5E International Fighter for the U.S. Air Force

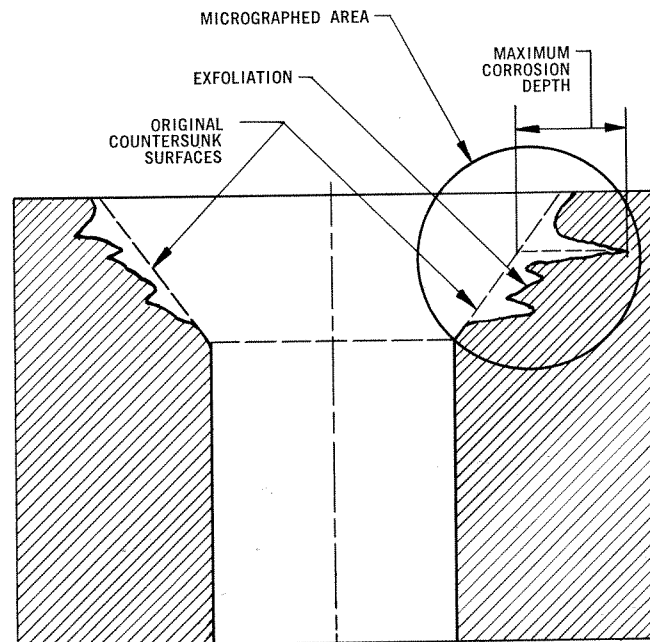
PERFORMANCE PROOF-TESTED

As part of its development, Hi-Kote 1 was subjected to a comprehensive, comparative analysis with 30 or more different coatings by Hi-Shear engineers. Hi-Kote 1 and competitive coatings were evaluated physically, metallurgically and electrochemically. Twelve separate laboratory tests were conducted to confirm performance criteria.

In each test category, Hi-Kote 1 exhibited superior characteristics as related to competitive coatings. For the critical salt immersion test, which most closely simulates the operational galvanic corrosive process, only Hi-Kote 1 of all coatings tested emerged with no evidence of corrosion in the aluminum structure or fastener—even after 1,000 test hours of exposure. Corrosion was induced using alternate salt water immersion method. A cross section of the countersink area to orient metallography is shown at right.


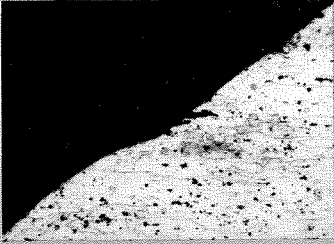
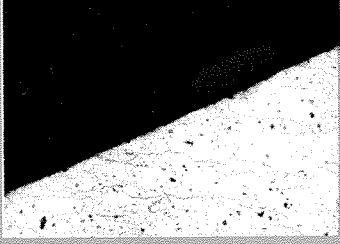

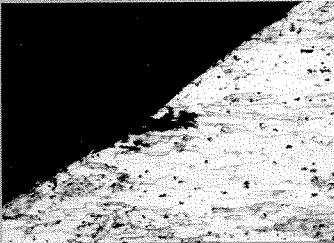
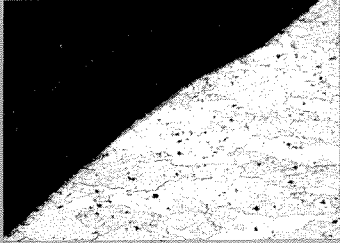
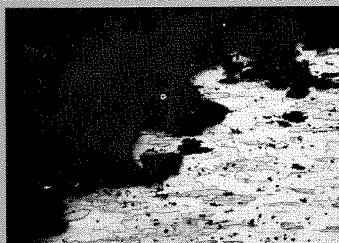
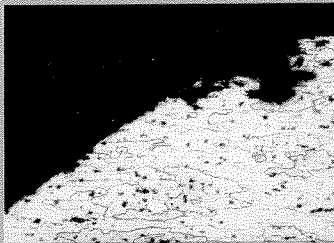
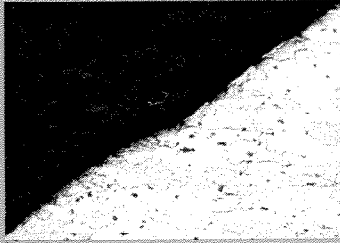
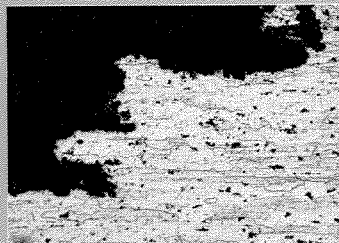
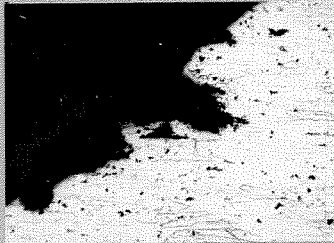
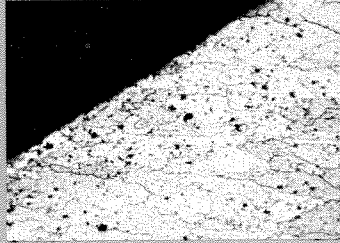
For results and evaluation of Hi-Kote 1 performance compared to other protective coating processes, write for Hi-Shear Corporation Engineering Report No. 2-1360.

Orientation Diagram Showing Area of Metallography



ction... *hi-kote*TM 1

TEST HOURS

	UNCOATED	CADMIUM PLATE (QQ-P-416)	HI-KOTE 1
250	 (.0075 inch)	 (.0025 inch)	 (None)
500	 (.010 inch)	 (.0045 inch)	 (None)
750	 (.011 inch)	 (.008 inch)	 (None)
1000	 (.012 inch)	 (.008 inch)	 (None)

Photomicrographs showing periodic effects of corrosion attack in countersink areas of 7075-T6 aluminum alloy test blocks in which three types of titanium fasteners were installed — uncoated, coated with cadmium plate and coated with Hi-Kote 1. Measurements in parenthesis under individual photographs indicate maximum corrosion depth.

SUMMARY OF HI-KOTETM 1 PERFORMANCE CHARACTERISTICS

CORROSION PROTECTION — Adopting industry-accepted methods to simulate corrosive environmental conditions, fasteners coated with Hi-Kote 1 were subjected to extensive salt spray, salt immersion and an Acetic-Acid-Salt Spray test. All tests conclusively established Hi-Kote 1 as an outstanding corrosion inhibitor coating.

STRESS EMBRITTLEMENT — This evaluation required Hi-Kote 1 coated titanium alloy fasteners be installed in an aluminum block with a .002-.004 inch interference fit. The fasteners are then torqued to 80% of

their rated ultimate load and exposed at 400°F ± 10°F for 72 hours. Tests of Hi-Kote 1 coated fasteners following this exposure revealed no cracks, structural abnormalities, or evidences of deterioration due to stress.

LUBRICITY — Tests of interference fit fasteners (diametral interference levels of .0045-.0050 inch) coated with Hi-Kote 1 established the minimal force required to install the fasteners in 3/4 inch structures. When tested under dynamic conditions with a pneumatic air gun, Hi-Kote 1 fasteners also exhibited excellent driving characteristics.

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SUMMARY OF HI-KOTE™ 1 PERFORMANCE CHARACTERISTICS (continued)

EFFECT ON FASTENER MECHANICAL PROPERTIES

— Tests were conducted on Hi-Kote 1 coated fasteners, per MIL-STD-1312, evaluating such properties as tensile, double shear and fatigue strengths. No changes were noted in the Hi-Kote 1 coated fastener properties when compared to identical uncoated parts similarly tested. Also, tests of torque-tension relationships revealed no mechanical differences compared to uncoated fasteners.

FLUID RESISTANCE — Following extensive usage, Hi-Kote 1 shows no evidence of blistering, softening or loss of adhesion when exposed to such fluids as phosphate ester hydraulic fluids; MIL-R-81294 paint stripper; and methyl-ethyl-ketone solvent.

HEAT RESISTANCE — Hi-Kote 1 withstands temperature exposure up to 450°F without suffering loss of adhesion or cracking.

COMPATIBLE WITH OTHER COATINGS

While developed for primary corrosion protection, Hi-Kote 1 is formulated to be completely compatible with other coating processes and systems — and may be used as a supplementary protection system if existing manufacturing or military procedures require use of wet primers or elastomeric sealants used under fastener head during installation.

ELECTRO-DEPOSITED CADMIUM PLATE — A COMPARISON

The general acceptance and current usage of cadmium plate in the aircraft industry as a means of controlling corrosion led to a number of tests comparing this type of protection against Hi-Kote 1. In every comparison, Hi-Kote 1 demonstrated comparable or superior performance characteristics.

Hi-Kote 1 and cadmium plated fasteners were compared following the accelerated Acetic-Acid-Salt Spray Test per ASTM B-287. This test was conducted over a period of 14 days and used fasteners of the same size, alloy and heat treatment. Test parts were first assembled to ¾ inch thick aluminum blocks and, following their exposure, all fasteners were removed from the holes.

Photomicrographs taken of the comparable fastener heads and the countersink areas (see right) reveal that Hi-Kote 1 provides much better corrosion protection than cadmium plate.

OTHER APPLICATIONS

While the development of Hi-Kote 1 is the direct result of galvanic action harmful to aircraft structures, the exceptional coating qualities of the formulation suggests numerous other industrial and commercial applications. These would include products associated with harsh liquid environments wherein prolonged exposure of parts can affect product life or serviceability. Hi-Shear engineering and metallurgical specialists are available for consultation with regard to customer inquiries.

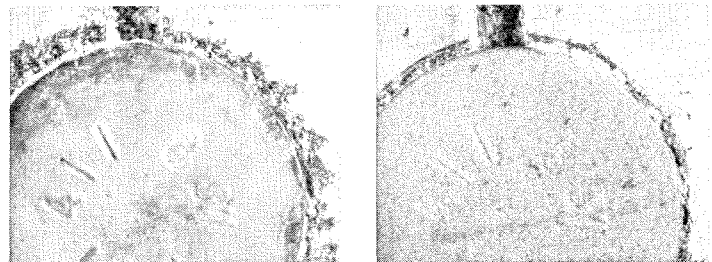
ADHESION — Hi-Kote 1 demonstrates high adherence to fastener metal substrates. When subjected to abrasion and adhesion tests, the coating exhibits high resistance to cracking, peeling or separation from the base metal.

APPEARANCE — When applied to fasteners, Hi-Kote 1 surfaces are aluminized, uniform and matte in appearance. Gold in color for easy recognition, Hi-Kote 1 coverage is smooth, free from pin holes, blisters, pits and other harmful imperfections.

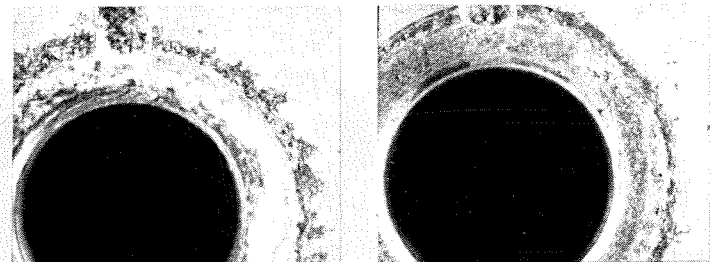
EASE OF APPLICATION, COATING THICKNESS — Application of Hi-Kote 1 is accomplished economically and requires only standard surface treatments prior to coating application. Coating thickness of .0002 to .0005 inch on all visible surfaces is easily controlled.

CADMIUM PLATE

HI-KOTE 1



FASTENER HEADS



STRUCTURAL COUNTERSINK AREAS (after removing fasteners)

Photomicrographs of Hi-Kote 1 and cadmium plated fastener test blocks following 14-day acetic acid-salt spray test. Note extensive corrosion attack of countersink area of cadmium plated fastener assembly compared to countersink areas of Hi-Kote 1 fastener assembly.

ORDERING DATA

Hi-Kote 1 is available from Hi-Shear Corporation as a coating for all types of its high strength titanium alloy and corrosion resistant steel fasteners. Minimal in cost, it can be applied to most of Hi-Shear Corporation's fastening systems by so specifying at time of fastener purchase.

Hi-Kote 1 can be applied to many types of fasteners and products other than those manufactured at Hi-Shear Corporation. Such application services can be obtained by contacting Hi-Shear Corporation, 2600 Skypark Drive, Torrance, California 90509; phone 213/326-8633.