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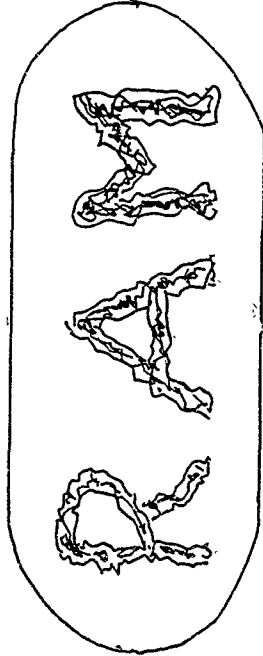
DRAFT VIEW GRAPHS

CECOM CORROSION PREVENTION & CONTROL

(CCPC)

TRAINING COURSE

DTIC
ELECTE
APR 18 1989
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INTRODUCTION

GENERAL:

DEFINITION OF CORROSION
IMPACT ON ARMY/CECOM
QUALITY CONTROL ASPECTS

SCOPE:

CECOM CORROSION
DARCOM R 702-24
CECOM SUPPLEMENT UPDATE
CECOM PAM 702-XX
APPLICATION GUIDE

COURSE OUTLINE:

Accession For	
NTIS CRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	<i>pe/ste</i>
Distribution/	
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CCPC: DEFINITION OF CORROSION

- UNDESIRABLE DETERIORATION OF METALS
- RESULTS FROM REACTIONS OF METALS WITH THE ENVIRONMENT
- ELEMENTS OF CORROSION:
 - = MOISTURE
 - = CONTAMINANT
 - = METAL OR METALS
 - = EMF'S (VOLTAGE POTENTIAL)

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CCFC: IMPACT ON ARMY/CECOM

- CORROSION: MAJOR CAUSE OF EQUIPMENT FAILURES
- OVERALL ANNUAL LOSSES IN THE HUNDRED OF MILLION DOLLARS
- MAJOR CAUSES OF:

LOW EQUIPMENT AVAILABILITY

HIGH MAINTENANCE COSTS

LOW RELIABILITY

LOW SERVICE LIFE

5

CCPC: QUALITY CONTROL ASPECTS

- SPECIFICATIONS & STANDARDS LAG TECHNOLOGY
- MATERIAL SELECTION, PARTS CONTROL, DESIGN DECISIONS ACCOMPLISHED WITHOUT ADEQUATELY CONSIDERING CORROSION IMPACT.
- LACK OF A SPECIFIC CORROSION TEST APPLICABLE TO ELECTRONICS
- COSTLY FAILURE ANALYSIS, VISUAL PASS/FAIL CRITERIA
- LIMITED VISUAL INSPECTIONS
- LACK OF A STANDARD MEASUREMENT CRITERIA FOR ELECTRONIC EFFECT
- MINUTE CORROSION INCIDENCE GENERALLY CONSIDERED HARMLESS
- LACK OF CORROSION PREVENTION TRAINING
- ELECTRONIC CORROSION NOT A CURRENT TECHNICAL FIELD OR DISCIPLINE

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CECOM CORROSION

- CORROSION INSPECTIONS OCCUR ONLY IN VISIBLE ELECTRONIC HARDWARE
- NOT A WELL-DEFINED FIELD
- MINIMAL DATA SOURCES
- ITEMS:

ANTENNAS

WAVEGUIDES

CONNECTORS, PINS, SOCKETS

RELAYS

SWITCHES

CASE HARDWARE, GASKETTED ENCLOSURES

PARTS, LEADWIRES, ELEMENT BONDS

TRANSISTORS, HEADERS, PINS

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CECOM CORROSION (CONT'D)

KOVAR-GLASS SEALS

PLASTIC ENCAPSULATED TRANSISTORS, IC'S, MICROMODULES
PRINTED CIRCUIT ASSEMBLIES, CONNECTORS, PRINTED LINES
SOLDERED-THRU-HOLES, LEADWIRES, TABS
GROUND CONNECTIONS, SOLDERING JOINTS

- ITEM FAILURES I.E. OPEN CIRCUIT, SHORTS, MALFUNCTION; USUALLY NOT
INVESTIGATED FOR ROOT CAUSE

DARCOM R 702-24

(CECOM SUPPLEMENT #1)

- DARCOM REG. 702-24, DATED OCTOBER 1979
MATERIEL DETERIORATION PREVENTION & CONTROL (MADPAC)

ESTABLISHES REQUIREMENTS, RESPONSIBILITIES, & ACTION
PROGRAMS REQUIRED FOR ALL DARCOM MATERIEL AND MAJOR
SUBORDINATE COMMANDS.

9.
DARCOM R 702-24 (CONT'D)

- CECOM SUPPLEMENT #1, DATED 22 FEBRUARY 1984
FURTHER SUPPLEMENTS 702-24 BY; DELINEATING THE FOLLOWING:

DIRECTOR OF PA&T, CECOM WILL IMPLEMENT THE PROGRAM
ESTABLISH A CECOM DETERIORATION PREVENTION AND CONTROL

OFFICE (DPAO)

MANAGE THE OVERALL MADPAC PROGRAM

CALLS UPON PM'S AND CHIEF OF DEVELOPMENT CENTERS TO PROVIDE
PARTICIPATION IN A CECOM DETERIORATION PREVENTION TECHNICAL
WORKING GROUP

INSURE THAT ALL CONCERNED PERSONNEL ARE INSTRUCTED AS TO
CAUSE, EFFECTS, AND TECHNIQUES FOR CORROSION PREVENTION

CECOM PAMPHLET 702-XX

DEVELOP A FORMAT AND PROCEDURES FOR:

- ANALYSIS OF DATA FROM ALL SOURCES
- DEVELOP TECHNOLOGY NEEDS PROPOSALS (TNP)
- SUBMISSION OF TNP TO ARMY MATERIALS & MECHANICS RESEARCH CENTER

CECOM APPLICATIONS GUIDE

- PROVIDE CORROSION PREVENTION AND CONTROL INFORMATION AND GUIDANCE TO DESIGN ENGINEERS, QUALITY CONTROL, INSPECTORS AND PROCUREMENT AND CONTRACTUAL PERSONNEL, WHO ARE INVOLVED IN THE DEVELOPMENT, TESTING AND ACQUISITION OF CECOM ELECTRONICS AND COMMUNICATION EQUIPMENTS.

INCLUDES:

TUTORIAL SECTION
LISTING OF FAILURE TYPES
PREVENTION AND QUALITY CONTROL MEASURES
CONTRACTUAL STANDARD PARAGRAPHS
WARRENTY PARAGRAPHS
DO'S & DON'T'S
REFERENCES

COURSE OUTLINE

CECOM CORROSION PREVENTION & CONTROL (CCPC)
TRAINING PROGRAM

BASIC CORROSION MECHANISMS

RATE FACTORS

SPECIFIC FORMS OF CORROSION IN ELECTRONICS

CORROSION PREVENTION

ENVIRONMENTAL TESTING

CCPC PLAN

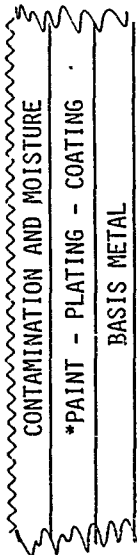
SUMMARY

BASIC CORROSION MECHANISMS

- DIRECT CHEMICAL CORROSION
- GALVANIC CELL CORROSION

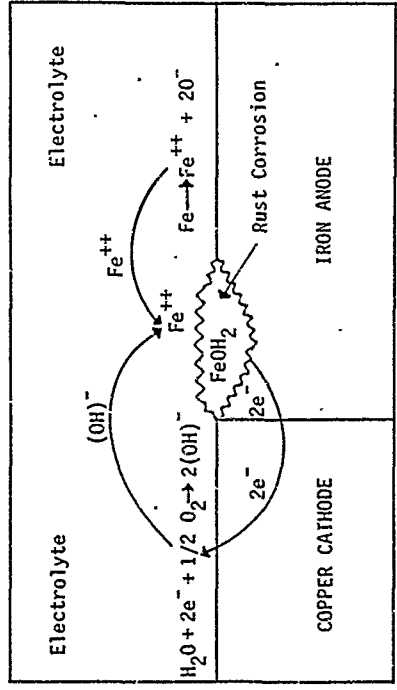
DIRECT CHEMICAL CORROSION

HIGH HUMIDITY



*PAINT, PLATING, COATING ACTS AS PROTECTIVE BARRIER FOR THE BASIS METAL. ANY HOLIDAY OR LACK OF THIS PROTECTIVE LAYER WILL ALLOW THE CONTAMINANT TO ATTACK AND CORRODE THE METAL. THE PROTECTIVE FILM CAN BLISTER, PEEL, LIFT, CRACK, BE ABRADED AND BECOME POROUS AND THUS CAUSE CORROSION OF THE BASIS METAL.

GALVANIC CELL CORROSION
TYPICAL GALVANIC CORROSION CELL



-0.20 VOLTS EMF -0.70 VOLTS

$FeOH_2$ = YELLOW RUST
ELECTROLYTE = WATER AND CONTAMINANT

GALVANIC CELL CORROSION

GALVANIC CORROSION OCCURS WHEN TWO DISSIMILAR METALS ARE COUPLED TOGETHER IN AN ELECTROLYTE. FOR EXAMPLE, IF A PART MADE OF IRON AND COPPER IS EXPOSED TO A SALT (SODIUM CHLORIDE) SOLUTION, CURRENT WILL FLOW BETWEEN THE IRON (ANODE) AND COPPER (CATHODE) AS SHOWN. THE REACTION PRODUCTS, FERROUS CHLORIDE AT THE ANODE AND SODIUM HYDROXIDE AT THE CATHODE, MEET IN THE MIDDLE TO FORM FERROUS HYDROXIDE WHICH ABSORBS FURTHER OXYGEN AND PRODUCES HYDRATED FERRIC OXIDE OR YELLOW RUST (FROM CORROSION HANDBOOK).

CORROSION RATE FACTORS

- TEMPERATURE
- TIME
- MOISTURE
- CONTAMINANTS
- POLARITY
- CORROSION BY-PRODUCTS
- EMF
- CONTACT AREA

TEMPERATURE

- CORROSION RATES DOUBLE EVERY 18°F INCREASE
- INCREASE IN TEMPERATURE IN AN OPEN CASE DRIES THE INTERIOR AND REDUCES CORROSION RATE
- INCREASE OF TEMPERATURE IN A DAMP BUT CLOSED OR SEALED CASE ACCELERATES CORROSION RATE
- CYCLING TEMPERATURE CAUSES CONDENSATION CORROSION

TIME

	<u>JUNGLE</u>		<u>SHORE</u>	
	<u>NUMBER OF JUNGLE</u>		<u>NUMBER OF SHORE</u>	
	<u>FAILURES FOR EACH</u>	<u>EXPOSURE, MONTHS</u>	<u>FAILURES FOR EACH</u>	<u>EXPOSURE, MONTHS</u>
<u>CORROSION FAILURES</u>	Z	<u>24</u>	Z	<u>24</u>
<u>FAILURE MECHANISM</u>		<u>36</u>		<u>36</u>
END SEAL MIGRATION (ESM)	0	1	0	9
ELEMENT CORROSION (EC)	0	0	1	4
ELECTROLYTIC CORROSION (ELC)	0	0	0	1
SOLDER CORROSION (SC)	0	0	0	4
SILVER MIGRATION (SM)	0	0	0	2
CASE CORROSION (CC)	0	1	0	1

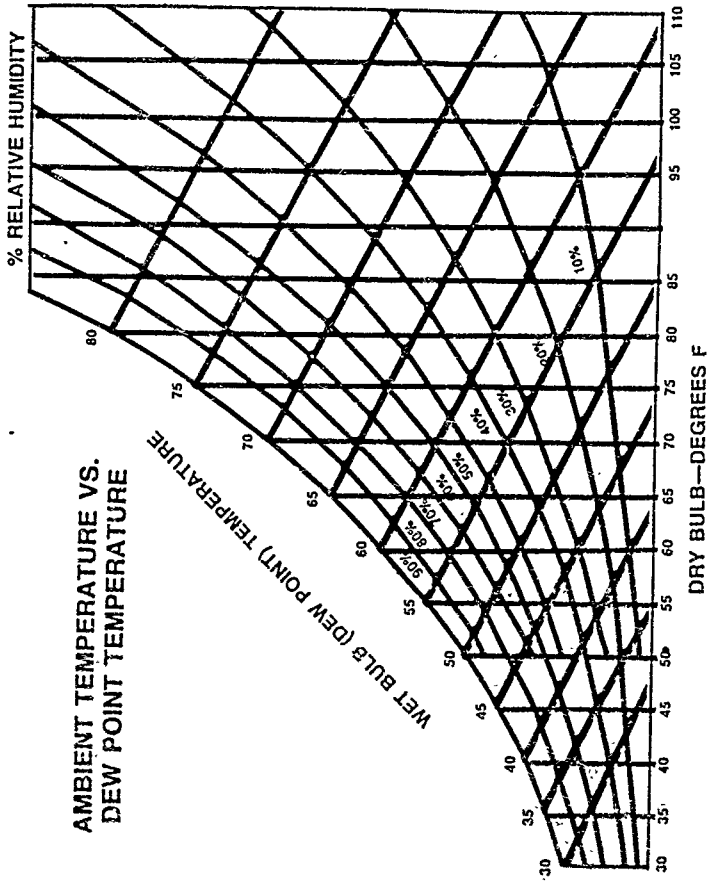
THE ABOVE DATA SHOWS CORROSION FAILURES CAN OCCUR IN THE JUNGLE 24 MONTHS AND AFTER, WHILE AT THE SHORE, CORROSION FAILURES CAN OCCUR 7 MONTHS AND AFTER.

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MOISTURE

- MEASURED AS RELATIVE HUMIDITY WHEN PRESENT IN AIR.
- MOISTURE IS A NECESSARY INGREDIENT IN ELECTROLYTE, NECESSARY FOR CORROSION.
- MOISTURE CAUSES:
 - SWELLING OF MATERIALS
 - LOSS OF PHYSICAL STRENGTH
 - DEGRADES INSULATING MATERIALS
 - ELECTRICAL SHORTS
 - BINDING OF MOVING PARTS
 - OXIDATION
 - ACCELERATES CHEMICAL REACTIONS
 - CONDENSATION OF MOISTURE DROPLETS ON SURFACES CREATING GALVANIC CORROSION CELL

AMBIENT TEMPERATURE VS. DEW POINT TEMPERATURE

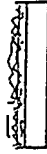


MOISTURE EFFECTS (CONT'D)

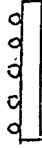
- MOISTURE ABSORPTION - POROSITY



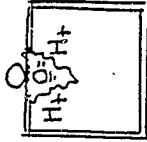
- MOISTURE ADSORPTION - CONTAMINATED SURFACE



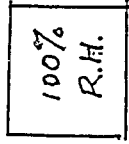
- MOISTURE CONDENSATION - DROPLETS



- CONDENSATION CELLS



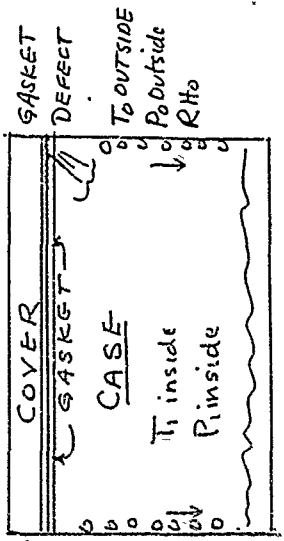
- MOISTURE SATURATION - 100% RH
A SLIGHT DROP IN TEMPERATURE CAUSES
FOG, RAIN, CONDENSATION



MOISTURE (CONT'D):

EFFECT OF DEFECTIVE GASKET

<u>STEPS</u>	<u>EFFECT</u>
1	T_0 RISES
2	RH_0 RISES
3	P_0 RISES
4	P_0 INJECTS WET AIR INTO CASE THROUGH PINHOLE
5	RH_1 RISES
6	T_0 DROPS
7	CASE WALL GETS COLD
8	RH_1 CONDENSES DROPLETS ON COLD WALL
9	CONDENSED DROPLETS DRIP DOWN TO BOTTOM
10	RH_1 REMAINS AT 100%



$T =$ TEMPERATURE

$P =$ PRESSURE

$RH =$ RELATIVE Humidity

CONTAMINANTS

- PROCESSING VAPOURS
- PLASTIC OUTGASSING
- RESIDUAL INGREDIENTS
 - ACIDIC COMPOUNDS
 - HANDLING
 - DUSTS
- FLORA-FAUNA
 - FUNGUS
 - SALT
- PROCESSING RESIDUALS

EMF - POLARITY

- EMF POTENTIAL OF EACH METAL TO GO INTO SOLUTION (GALVANIC COUPLES)
- STRAY INTERCIRCUIT EMFS
- EFFECTS OF POOR CONTACTS, GROUNDC
- STRAY EMFS BETWEEN VARIOUS GROUND PLANES
- SPURIOUS SNEAK CIRCUITS

CORROSION BY-PRODUCTS

ALUMINUM

CHEMICAL TREATMENT
CREATES ALUMINUM
OXIDE: WHICH IS
THIN, TOUGH,
ADHERENT.

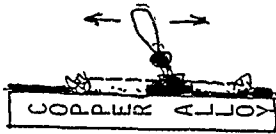
~~CADMIUM OR ZINC PLATING~~
STEEL

CADMIUM
OR ZINC
PLATING

SOFT, FLUFFY, FLAKY
WHICH IS EASILY
SHAKEN OFF.

METAL B
METAL A

HYDROGEN GAS CANNOT
ESCAPE. FORMS AN
INSULATING LAYER.

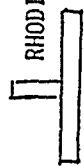

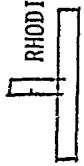
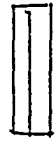
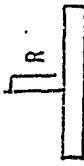
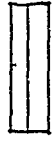
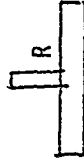
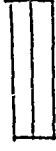
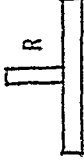
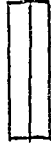


MOVEMENT OF CONTACT
OR VIBRATION WEARS
PLATING, HEATS UP ANY
PLASTIC OUTGASSING,
POLYMERIZES TO A
SOLID.

EMF (CONT'D.): EFFECT OF EMF AND CONTACT AREA

EMF & SMALL CONTACT AREA

LARGER CONTACT AREA

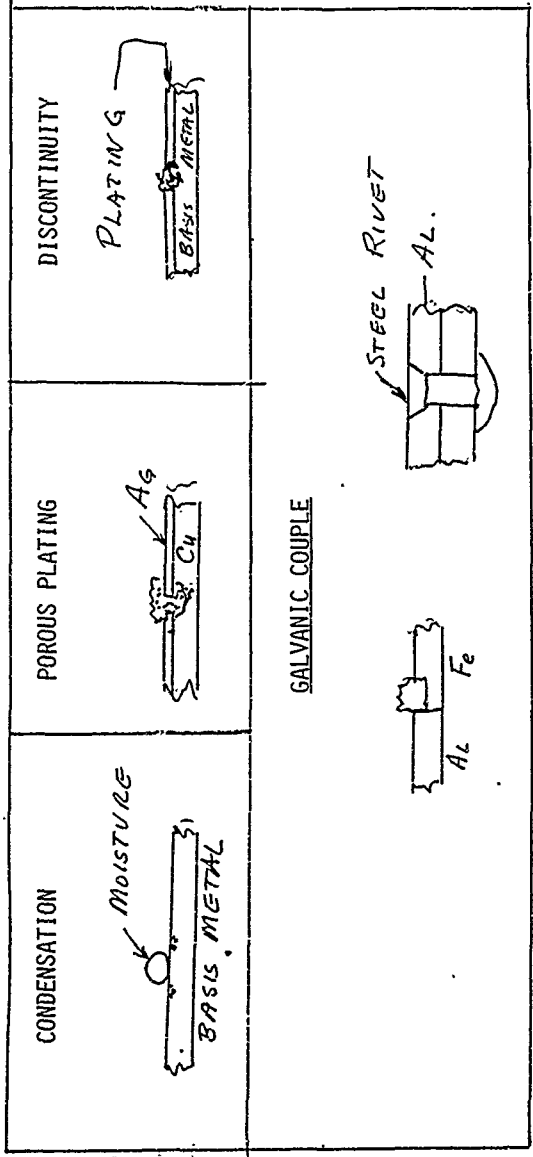
<p>RHODIUM SILVER</p>  <p>+ .05 EMF</p>	
<p>RHODIUM NICKEL</p>  <p>0 COMPATIBLE</p>	
<p>R Cu</p>  <p>-.20 NOT COMPATIBLE</p>	 <p>COMPATIBLE</p>
<p>R Al</p>  <p>-.45 NOT COMPATIBLE*</p>	 <p>NOT COMPATIBLE</p>
<p>R Mg</p>  <p>-1.45 NOT COMPATIBLE</p>	 <p>NOT COMPATIBLE</p>

* AS INDICATED IN MIL-F-14072

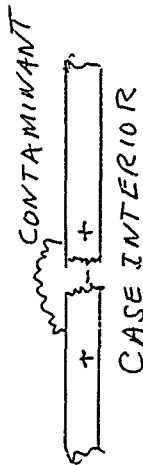
ELECTRONIC FORMS OF CORROSION

- CORROSION CELL
 - GALVANIC COUPLE
 - PITTING
 - STRESS CORROSION, HYDROGEN EMBRITTLEMENT
 - SILVER MIGRATION
 - INTERGRANULAR CORROSION
 - EXFOLIATION CORROSION
 - PURPLE PLAGUE
 - FILIFORM CORROSION
 - FRETTING CORROSION
 - DIRECT CHEMICAL
 - WHISKER GROWTH

CORROSION CELL

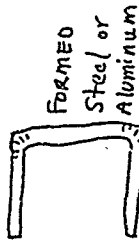


PITTING



PITTING CAN OCCUR WITH OR WITHOUT A PROTECTIVE BUT POROUS COATING/PLATING. THE BOTTOM OF THE PITS BECOME ANODES IN SMALL CORROSION CELLS WITH SURROUNDING SURFACES ACTING AS CATHODES. IF THE CORROSION PRODUCT IS NOT PROTECTIVE, CORROSION CAN CONTINUE UNTIL A HOLE OCCURS WHICH CAUSES MOIST AIR TO BREATHE INTO THE OTHERWISE SEALED CASE.

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STRESS CORROSION CRACKING
(HYDROGEN EMBRITTLEMENT)



FORMED
Steel or
Aluminum

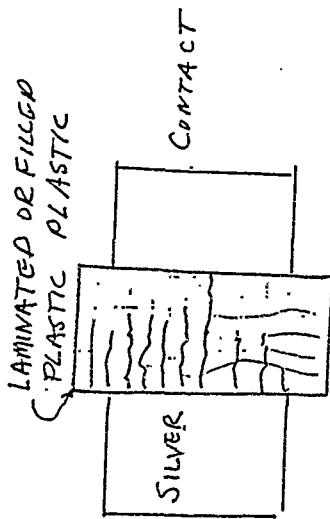


Spring

HIGH STRENGTH ALUMINUM OR STEEL

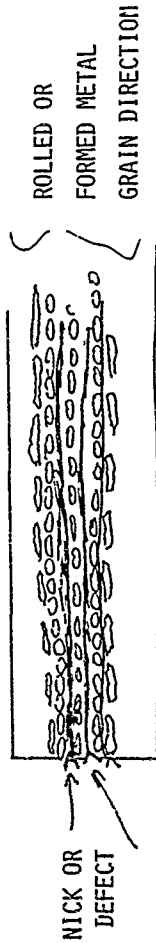
ALLOYS UNDER HIGH TENSILE STRESS ARE SUSCEPTIBLE TO CORROSION STARTING ON THE SURFACE WHICH PROPAGATES THROUGH LATTICE STRUCTURE. STRESS CAN BE RESIDUAL FROM COLD WORKING AND FORMING OR RESULT OF EXTERNAL FORCES; AS IN SPRINGS, ETC. THIS PHENOMENA HAS ALSO BEEN DEFINED AS HYDROGEN EMBRITTLEMENT WHEN HYDROGEN OR HYDROGEN SULFIDE CHEMICALS ARE PRESENT.

SILVER MIGRATION



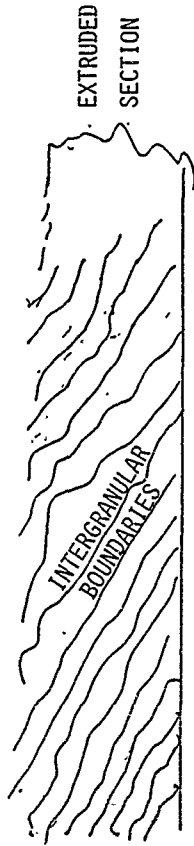
SILVER, USED AS CONTACTS, WITH FILLED PLASTICS AS INSULATORS BETWEEN D.C. POTENTIALS WILL MIGRATE AND FORM SILVER FINGERS, STRANDS WHICH WILL MIGRATE IN THE FILLED PLASTIC INTERSTICES TO THE OPPOSITE CONTACT CAUSING SHORTS.

34.
INTERGRANULAR CORROSION



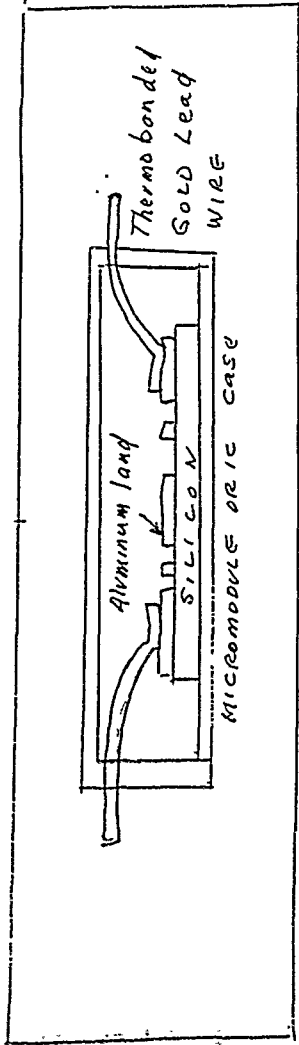
INTERGRANULAR CORROSION IS THE PREFERENTIAL CORROSION AT GRAIN BOUNDARIES OF ALUMINUM-COPPER ALLOYS, STAINLESS STEELS AND HIGH NICKEL ALLOYS. POOR QUENCHING MAY FORM ANODIC (COPPER DEPLETION) ZONES; ALONG WHICH INTERGRANULAR ATTACK WILL OCCUR.

EXFOLIATION CORROSION



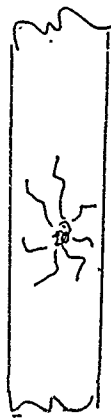
WHEN ELONGATED GRAIN STRUCTURE IS SLIGHTLY PARALLEL TO A SURFACE, THE EXPANSIVE FORCE OF INTERGRANULAR CORROSION PRODUCTS WILL EXPAND AND FORCE GRAIN BOUNDARIES APART AND CREATE A LAMINAR OR LAYER CORROSION KNOWN AS EXFOLIATION CORROSION.

PURPLE PLAGUE



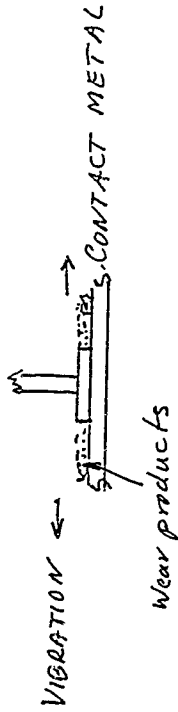
GOLD-ALUMINUM INTERMETALLIC COMPOUND FORMATION - GOLD-ALUMINUM INTERMETALLIC COMPOUND FORMATION (PURPLE PLAGUE) HAS BEEN STUDIED FOR YEARS. THESE COMPOUNDS WILL OCCUR BETWEEN GOLD WIRE BONDED TO ALUMINUM METALLIZATION DEPENDING UPON THE TEMPERATURE-TIME PRODUCT DURING BONDING. CUNNINGHAM AND BROWING DETERMINED THAT INTERMETALLIC COMPOUNDS AS A RESULT OF EACH METAL DIFFUSING INTO EACH OTHER, AND PRODUCED VOIDS WHICH CAUSED EITHER MECHANICAL BOND FAILURES, HIGH RESISTANCE CONTACTS OR OPEN CIRCUITS. THIS TYPE OF FAILURE CAN BE AVOIDED BY CONTROLLING THE BOND CHARACTERISTICS AND THE TEMPERATURE-TIME PRODUCT.

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FILIFORM CORROSION



FILIFORM CORROSION IS A SPECIAL FORM OF OXYGEN-CELL CORROSION OCCURRING BENEATH ORGANIC OR METALLIC COATINGS ON STEELS, ZINC, ALUMINUM, OR MAGNESIUM. THE ATTACK RESULTS IN A FINE NETWORK OF RANDOM "THREADS" OF CORROSION PRODUCTS DEVELOPED BENEATH THE COATING MATERIAL WITH SHALLOW GROOVING OF THE METAL SURFACE.








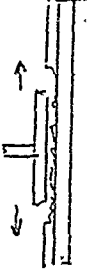
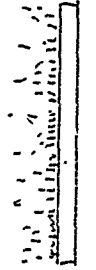
FRETTING CORROSION



FRETTING CORROSION IS DEFINED AS METAL DETERIORATION CAUSED BY REPETITIVE SLIP AT THE INTERFACE BETWEEN TWO SURFACES IN CONTACT. THE INTERFACE MUST BE UNDER LOAD WITH VIBRATORY OR OSCILLATING MOTION IN SMALL AMPLITUDE. RESULTS ARE:

- METAL LOSS IN AREA OF CONTACT
- PRODUCTION OF OXIDE DEBRIS
- GALLING, SEIZING, FATIGUING OR CRACKING OF METAL CONTACT
- LOSS OF DIMENSIONAL TOLERANCES
- LOOSENING OF ATTACHMENTS
- CORROSION OF CONTACT SURFACES

DIRECT CHEMICAL CORROSION

<p>BARE METAL</p>  <p>BASIS METAL</p>	<p>PROTECTED</p> 	<p>POOR PAINT ADHESION</p> 
<p>PAINT/PLATING HOLIDAY</p> 	<p>PAINT AFTER DRILLING</p> 	<p>POROUS COATING</p> 
<p>BLISTERING</p> 	<p>ABRASION</p> 	<p>LOOSE, FLUFFY COATING</p> 

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WHISKER GROWTH

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CORROSION PREVENTION

MISSION PROFILE OPERATIONAL MODE

PLATFORM - MANPACK, FIELD PORTABLE, OR SHELTERED
TACTICAL USE - TRANSPORTATION, ENVIRONMENTS

MATERIAL SELECTION

METALS,

FINISHES, COATINGS, PLATINGS, SURFACE TREATMENTS
PLASTICS,

LUBRICANTS, SEALS, GASKETS, HARDWARE

DESIGN FACTORS

CASE DESIGN, SEAL, GALVANIC COUPLE CONTROL

PARTS CONTROL, NON-STANDARD USAGE

LRU, MODULE PROTECTION

CLEANABILITY, DRIABILITY, DECONTAMINATEABILITY

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CORROSION PREVENTION

INSPECTION & TEST

INCOMING INSPECTION, FINISHES, COATINGS, PLATING
CLEANLINESS TESTS
PLANT PROCESS CONTROLS
DT-II, FAT, GROUP C ENVIRONMENTAL TESTS

PROCESS CONTROLS

METAL FORMING - CLEANING
FINISHES, COATINGS, PLATINGS
SOLDERING, JOINING, WELDING
HANDLING, CLEAN AIR CONTROLS
PLASTIC TESTING, CURING
ASSEMBLY CLEANING, CLEANLINESS TESTS
STORAGE OF IN-PRODUCTION PROCESS SUBASSEMBLIES

CORROSION PREVENTION

PACKAGING, TRANSPORTATION & STORAGE

SERVICE STORAGE STANDARD

PACKAGING

TRANSIT CASES

DESSICANT, VAPOUR SEAL PACKAGING

STORAGE CONDITIONS

PERIODIC INSPECTION, TESTING, VISUALS

CORROSION PREVENTION

- MISSION PROFILE - PLATFORM
- MATERIAL SELECTION
- PROCESS CONTROLS
- DESIGN FACTORS
- INSPECTION & TEST
- PACKAGING, TRANSPORTATION & STORAGE, SSS
- FIELD MAINTENANCE
- OVERHAUL
- FIELD USAGE

ENVIRONMENTAL TESTING

MIL-STD-810

- 0 RAIN, METHOD 506.2
- 0 HUMIDITY, METHOD 507.2, PROCEDURE III
- 0 FUNGUS, METHOD 508.3
- 0 SALT FOG, METHOD 509.2
- 0 LEAKAGE, IMMERSION, METHOD 512.2
- 0 FAILURE ANALYSIS
- 0 PASS/FAILURE CRITERIA
- 0 FIELD CORRELATION, BATHTUB CURVE

ENVIRONMENTAL TESTING (CONT'D)

MIL-STD-810-TEST

PASS/FAILURE CRITERIA (P/F/C)

- | | | |
|---|---|--|
| 0 | METHOD 506.2 RAIN
FOR NON-SHELTERED ITEMS ONLY | ENTRAPPED EXCESS MOISTURE SHALL BE CAUSE
FOR FAILURE |
| 0 | METHOD 507.2-3 HUMIDITY
PROCEDURE III AGGRAVATED 10 CYCLES
- EXPOSE GASKET SEALED EQUIPMENT
OPEN | PROCEDURE III AGGRAVATED, 10 CYCLES
SEALED EQUIPMENTS:
CHECK FOR CORROSION WITH A 5 POWER
AMPLIFICATION. ANY EVIDENCE OF
CORROSION SHALL BE CAUSE FOR
FAILURE. ALSO, CHECK ALL MOVING
PARTS, SWITCHES, CONTROLS, ETC.

CHECK FOR MOISTURE ACCUMULATIONS
AND CORROSION. ANY EVIDENCE OF
CORROSION AND/OR LIFTING, PEELING,
BLISTERING OF PAINTS, COATINGS OR
PLATINGS SHALL BE CAUSE FOR FAILURE. |
| - | OPEN NON-SEALED | |

ENVIRONMENTAL TESTING (CONT'D)

MIL-STD-810-TEST

PASS/FAILURE CRITERIA (P/FC)

- | | | |
|---|--|---|
| 0 | METHOD 508.3 FUNGUS
OPEN ALL GASKET SEALED ASSEMBLIES.
CONDUCT FOR 28-DAY PERIOD OF
EXPOSURE. | INSPECT FOR CORROSION WITH A 5 POWER
LOUPE. CHECK ALL MOVING ITEMS FOR
BINDING AND ANY LIFTING, PEELING,
BLISTERING OF PAINTS, COATINGS OR
PLATINGS SHALL BE CAUSE FOR FAILURE. |
| 0 | METHOD 509.2 SALT FOG
BEFORE WASHING OR CLEANING THE
EQUIPMENT, CONDUCT INSPECTION. | (SAME AS ABOVE) |
| 0 | METHOD 512.2 LEAKAGE IMMERSION | BEFORE IMMERSION, WEIGH CLOSED CASE AFTER
DRYING. AFTER IMMERSION, DRY CLOSED CASE
FOR 2 HOURS AT ROOM TEMPERATURE AND
REWEIGH CLOSED CASE. OPEN CASE AND LOOK
FOR TRAPPED WATER IN CASE OR CONDENSATION.
ANY GAIN IN WEIGHT SHOULD BE CAUSE FOR
FAILURE. |

FAILURE ANALYSIS

VISUAL

- EYEBALL

5 POWER LOUPE

MICROSCOPIC

OBSERVATIONS

- FORM OF CORROSION

LOCATION

CORROSION BY-PRODUCT - COLOR, TEXTURE, LOCATION

AREA/VOLUME COVERED, SHAPE

- METALLIC COUPLES INVOLVED

BASIS METAL

PROTECTIVE FINISH

FINISH ADHESION

CONTAMINANT

FAILURE IMPACT - OPEN CIRCUIT, SHORT CIRCUIT, LOSS OF SEAL

CIRCUIT LOCATION - PWA, POWER SUPPLY, RT CASE GASKET, CONNECTOR, PART

PASS/FAIL CRITERIA

<u>TYPE</u>	<u>EFFECT</u>
LOCAL OR EXTENSIVE AREAS	COSMETIC OR FUNCTIONAL
FUNCTIONAL LOCATION	
CRITICALITY OF ELECTRONIC FUNCTION	FUNCTIONAL FAILURE
I.E., PWA, CONNECTOR PINS	
CRITICALITY OF MECHANIC FUNCTION	MECHANICAL FAILURE
LOOSE CORROSION PRODUCT	FUNCTIONAL FAILURE
GALVANIC CORROSION	MECHANICAL OR FUNCTIONAL

CURRENTLY, THERE IS NO ESTABLISHED PASS/FAIL CRITERIA APPLICABLE TO CECOM ELECTRONICS, THIS IS A TNP. THE ABOVE LISTED FACTORS OF A CORROSION INCIDENT SHOULD BE CAREFULLY EVALUATED FOR EACH INDIVIDUAL INSTANCE OF CORROSION. EACH INITIATION OF A CORROSION INCIDENT WILL CONTINUE TO DEVELOP UNTIL FAILURE OCCURS OR A COSMETIC DEGRADATION OCCURS. IN EACH CASE, THAT PART OR LRU SHOULD BE FAILED AND REPLACED. IF A SUMMARY DECISION CANNOT BE REACHED, THEN THE PART OR LRU SHOULD BE SAMPLED AND TESTED PER THE SALT FOG TEST TO FURTHER DETERMINE POTENTIAL FOR FAILURE.

5.2

FIELD MAINTENANCE (OPERATOR)

CLEANING

DRYING

TRANSIT CASE USAGE

MAINTENANCE MANUAL DESCRIPTION OF ABOVE

FIELD USAGE (OPERATOR)

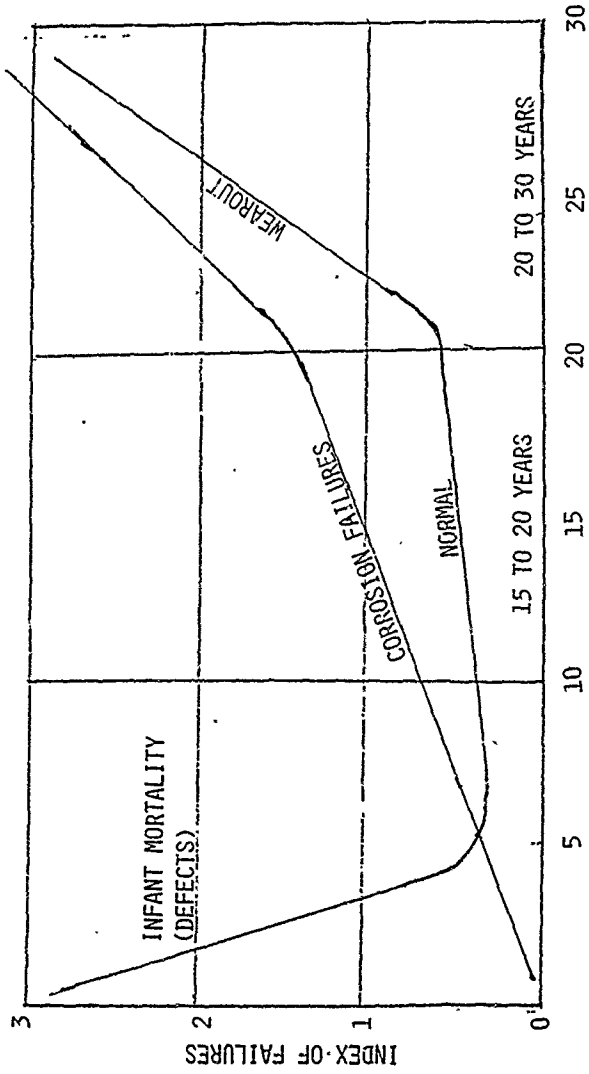
OPERATING, NON-OPERATING EFFECTS

TRANSIT CASES

RIVER FORDING

CLEANING, DRYING

ENVIRONMENTAL TESTING
BATHTUB CURVE



INFANT MORTALITY INCLUDES DESIGN AND WORKMANSHIP DEFECTS WHICH CAN
LEAD TO CORROSION.

5.2

CORROSION PREVENTION & CONTROL PLAN (CPCP)

CONTRACTUAL SOWS FOR EACH ACQUISITION & FIELDING PHASE

CONCEPT EXPLORATION

ROC, MISSION PROFILE, OPERATIONAL MODE

PLATFORM CATEGORY, FIELD ENVIRONMENT PROFILE

DEMONSTRATION & VALIDATION

DRAFT CPC PLAN (OUTLINE)

TEMP = ENVIRONMENTAL TESTS, RELIABILITY CRITICAL ITEMS

FIELDING

MONITOR WARRANTY PLAN

PARTICIPATE IN FIELDED SURVEYS

MONITOR SSS PROGRAM

CPCP: CONCEPT EXPLORATION (CE)

VARIOUS CONCEPTS AND APPROACHES ARE EXPLORED.

CE: REQUIRED OPERATIONAL CAPABILITY (ROC)

- DESCRIBES: MISSION PROFILE (MP)
OPERATIONAL MODE (OM)
BEST OPERATIONAL CAPABILITY (BOC)

- DEVELOP: PLATFORM CAPABILITY

- I.E. MANPACK?
- FIELD PORTABLE?
- VEHICULAR?

FIELD ENVIRONMENT PROFILE

- I.E. TROPICAL?
- MARINE?
- ARCTIC?

FIELD SERVICE LIFE

- I.E. 10 YEARS?
- 20 YEARS?

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CPCP: DEMONSTRATION & VALIDATION (D&V)

D&V: CANDIDATE DESIGNS ARE STUDIED
TRADE-OFF DESIGNS, DESIGN PLANS ESTABLISHED
TEMP OUTLINE DEVELOPED

PARTICIPATE: DESIGN DECISIONS
SYSTEM PACKAGING
PROTECTIVE MEASURES?
CASE DESIGNS?
CRITICAL CIRCUITS PROTECTED?

TEMP: CORRECT ENVIRONMENTAL TESTS?
FAILURE ANALYSIS?
CORROSION-PASS/FAIL CRITERIA?

CPCP: DEMONSTRATION & VALIDATION (D&V) (CONT'D)

DRAFT CPCP

- COMPARE TO CECOM SUPPLEMENT OF DARCOM-R-702-24
- CHECK MANAGEMENT
- PROTECTION PLANNED
- MAINTENANCE PLANNED
- CLEANABILITY, DECONTAMINATEABILITY REQUIREMENTS
- PARTS, MATERIALS, PROCESS CONTROLS, MIL-P-11268, MIL-F-14076,
MIL-STD-454
- WARRANTY PLANS

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CPCP FULL SCALE DEVELOPMENT (FSD)

IN FSD, FULL SCALE ENGINEERING MODELS ARE TESTED FOR OPERATION,
COMPLIANCE WITH SPECIFICATIONS AND RESISTANCE TO DETERIORATION
IN THE FIELD.

FSD MODEL DESIGN

REVIEW FOR CORROSION RESISTANCE DESIGN

- MATERIALS?
- PROTECTIVE COATINGS, PLATINGS, FINISHES?
- PROTECTED RELIABILITY CRITICAL LRUS?
- CLEAN, CLEANLINESS, CLEANABILITY?
- DECONTAMINATEABILITY?

REVIEW DT/OT-II ENVIRONMENTAL TEST RESULTS

- ANY VISIBLE CORROSION?
- MALFUNCTION MOVING PARTS?
- FAILURE ANALYSIS CONDUCTED?
- TNP's?
- CORRECTIVE MEASURES?

UPDATED CPCP?

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CPCP PRODUCTION

PREPRODUCTION AND/OR FIRST ARTICLE TESTS (FAT) ARE CONDUCTED ON PRODUCTION QUALITY MODELS. ALSO, GROUP C PERIODIC SAMPLING TESTS ARE CONDUCTED.

MONITOR CPC PLAN:

QUALITY CONTROL OF MATERIALS, PARTS, LRUS
FINISHES, COATINGS, PLATINGS?

REVIEW RESULTS OF FAT AND GROUP C TESTS

ANY CORROSION FAILURES?

FAILURE ANALYSIS?

CORRECTIVE ACTION?

REVEIN ECPS

EFFECT ON CORROSION RESISTANCE?

CPCP PRODUCTION (CONT'D)

REVIEW SSS

- PACKAGING TYPE, QUALITY?
- RH INDICATOR?
- PERIODIC TESTING?
- STORAGE CONDITIONS?

FINAL WARRANTY CONDITIONS

- SERVE ON CORROSION REVIEW GROUP
- FAILURE ANALYSIS?
- CORRECTIVE ACTION? TNP?

FIELD MANUALS

- ADEQUATE?
- CONTAIN CLEANING & DRYING INSTRUCTIONS?
- PREVENTIVE MANUALS CONTAIN CORROSION PREVENTION RULES?

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CPCP: FIELDING

FOR A SPECIFIED NUMBER OF YEARS, THE WARRANTY PLAN WILL BE IN EFFECT, HOWEVER, AFTER THAT, ORGANIC MAINTENANCE WILL CONTINUE. IT HAS BEEN TRADITIONALLY DIFFICULT TO ACQUIRE FIELD CORROSION FAILURE DATA. DEPOTS PERFORM OVERHAUL AND REPAIR, AND ALSO CONTROL STORAGE.

MONITOR WARRANTY PLAN

SERVE ON WARRANTY CONTROL BOARD
IDENTIFY CORROSION FAILURES
PROCESS TNPS
COLLECT CORROSION FAILURE DATA

PARTICIPATE IN FIELDED SURVEYS

COLLECT CORROSION FAILURE DATA
PROCESS TNPS
UPGRADE MAINTENANCE MANUALS

MONITOR SSS

CHECK STORAGE
ADEQUACY OF PACKAGING
TNPS

SUMMARY

- THE MISSION PROFILE, MODE OF OPERATION, LIFE CYCLE ENVIRONMENTAL PROFILE AND PLANNED PLATFORM USE SHALL BE USED TO DEVELOP DEGREE OF CORROSION PREVENTION AND CONTROL REQUIRED.
- CORROSION PREVENTION AND CONTROL IS ACHIEVABLE BY REQUIRING AND ENFORCING CURRENTLY AVAILABLE CECOM SPECIFICATIONS AND STANDARDS; WHICH, BECAUSE OF RAPIDLY CHANGING TECHNOLOGIES, NEED TO BE CONTINUALLY UPGRADED.
- A CPC PLAN SHOULD BE GENERATED IN THE ADVANCED DEVELOPMENT ACQUISITION PHASE AND UPDATED IN EVERY ONGOING PHASE.
- ALL DESIGN DECISIONS AND MATERIALS SELECTION, INCLUDING ECPs, SHOULD BE REVIEWED FOR IMPACT ON CORROSION RESISTANCE.
- SSSs SHOULD INCLUDE REQUIREMENTS FOR PROTECTIVE STORAGE AND PERIODIC INSPECTIONS FOR CORROSION AND VISUAL RH INDICATORS.

SUMMARY (CONT'D)

- MAINTENANCE MANUALS SHOULD DESCRIBE CLEANING PROCESSES, NON-CORROSIVE CLEANING FLUIDS AND SUITABLE DRYING PROCEDURES.
- ANY SIGN OF CORROSION, AFTER TEST OR IN THE FIELD SHOULD REQUIRE CORRECTION, SINCE CORROSION ONCE STARTED IS PROGRESSIVE AND DOES NOT REVERSE.
- ALL ELECTRONIC OR MECHANICAL FAILURES SHOULD BE SUBJECT TO FAILURE ANALYSIS TO DETERMINE IF ROOT CAUSE OF FAILURE IS CORROSION.
- WARRANTIES SHOULD SPECIFICALLY INSURE AGAINST CORROSION FAILURES.
- ENVIRONMENTAL TESTS, WITH PROPER SEVERITY, WILL DISCLOSE CORROSIVE POTENTIALS. (FR)