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CHEMICAL FUNDAMENTALS OF CORROSION

CORROSION

Corrosion is:
the electrochemical deterioration of a metal because of its chemical reaction with the surrounding environment.

Corrosion:
- have many different forms
- the resistance of aircraft materials to corrosion drastically change with only a small environmental change.

Corrosion is most often thought of as a :
slow process of material deterioration, taking place over a significant period of time

Other forms of corrosion degradation can :
occur very quickly, in days or even hours, with catastrophic results.

These forms such as:
1, stress corrosion cracking
2, environmental embrittlement
3, corrosion fatigue
depend on both the chemical and mechanical aspects of the environment and cause catastrophic structural failure without warning

corrosion prevention and control program (CPCP)
- is a systematic approach for controlling corrosion in the airplane's primary structure

The type and aggressiveness of the corrosion prevention and control program depends on the:

- operational environment of the aircraft.

Aircraft exposed to

1, salt air
2, heavy atmospheric industrial pollution
3, over water operations

- will require a:

more stringent corrosion prevention and control program than an aircraft that is operated in a dry environment.

COMMON CORROSIVE AGENTS

Substances that cause corrosion of metals are called : corrosive agents

The most common corrosive agents are:

1, acids
2, alkalies
3, salts

the two most common media for these agents may also act as corrosive agents:

1, atmosphere
2, water

COMMON CORROSIVE AGENTS

1, Acids moderately

- strong acids severely corrode most of the alloys used in airframes
- The most destructive are sulfuric acid (battery acid), halogen acids hydrochloric, hydrofluoric, hydrobromic, nitrous oxide compounds And organic acids found in the wastes of humans and animals.

2, Alkalies as a group

- alkalies are not as corrosive as acids.
- Aluminum and magnesium alloys are exceedingly :

prone to corrosive attack by many alkaline solutions unless the solutions contain a corrosion inhibitor.

- Substances particularly corrosive to aluminum are :

1, washing soda
2, potash (wood ashes)
3, lime cement dust

- Ammonia, an alkali, is an exception because aluminum alloys are highly resistant to it.

3, Salts—

- most salt solutions are good electrolytes and can promote corrosive attack.
- Some stainless steel alloys are resistant to attack by salt solutions but aluminum alloy, magnesium alloys, and other steels are extremely vulnerable.
- Exposure of airframe materials to salts or their solutions is extremely undesirable.

4, Atmosphere

- the major atmospheric corrosive agents are oxygen and airborne moisture
- Corrosion often results from the direct action of atmospheric oxygen and moisture on metal, and the presence of additional moisture often accelerates corrosive attack, particularly on ferrous alloys.
- However, the atmosphere may also contain other corrosive gases and contaminants, particularly industrial and marine salt spray.

5, Water

- corrosiveness of water depends on the :

1, type and quantity of dissolved mineral and
2, organic impurities
3, dissolved gasses (particularly oxygen) in the water.

- One characteristic of water that determines its corrosiveness is the:

1, conductivity or ability to act as an electrolyte and conduct a current.

- Physical factors, such as : water temperature and velocity, also have a direct bearing on its corrosiveness.

CORROSION FORMATION

Corrosion is a natural occurrence that attacks metal by:

1, chemical or electrochemical action
2, converts it back to a non-metallic compound.

Four conditions must exist before electrochemical corrosion can occur:

1, A metal subject to corrosion (Anode)
2, A dissimilar conductive material (Cathode)
3, Presence of a continuous, conductive liquid path (Electrolyte)
4, Electrical contact between the anode and the cathode

- Elimination of any one of these 4 conditions will stop electrochemical corrosion.

Paint

Paint can : mask the initial stages of corrosion.
(corrosion hidden under the paint)

Due to that painted surfaces should be inspected often for irregularities such as :

1, blisters
2, flakes
3, chips
4, lumps.

Some factors that influence metal corrosion and the rate of corrosion are:

1, Type of metal
2, Heat treatment and grain direction
3, Presence of a dissimilar, less corrodible metal
4, Anodic and cathodic surface areas (in galvanic corrosion)
5, Temperature
6, Presence of electrolytes (hard water, salt water, battery fluids, etc.)

General information

Most alloys are made up entirely of small crystalline regions, called :grains

Corrosion can :

- occur on surfaces of those regions which are less resistant and also at boundaries between regions,
- resulting in the formation of pits and intergranular corrosion

The most active metals, (those which lose electrons easily), such as:

- magnesium
- aluminum
- corrode easily

The most noble metals (those which do not lose electrons easily), such as

- gold
- silver

do not corrode easily

read and Explain

Corrosion is quickened by high temperature environments that accelerate chemical reactions and increase the concentration of water vapor in the air. Electrolytes (electrically conducting solutions) form on surfaces when condensation, salt spray, rain, or rinse water accumulate. Dirt, salt, acidic gases, and engine exhaust gases can dissolve on wet surfaces, increasing the electrical conductivity of the electrolyte, thereby increasing the rate of corrosion. When some of the electrolyte on a

MICROBIOLOGICAL CORROSION

Bacteria may be either:

- aerobic
- anaerobic

Aerobic bacteria :

- require oxygen to live
- They accelerate corrosion by oxidizing sulfur to produce sulfuric acid

Anaerobic bacteria,

- can survive only when free oxygen is not present

Fungi

Fungi are the microorganisms that feed on organic materials.

- low humidity does not kill microbes, it slows their growth and may prevent corrosion damage

Ideal growth conditions for most microorganisms are temperatures from :

- 20-40°C
- relative humidity from 85 to 100 percent.

Microbial growth must be removed completely to avoid corrosion.

Microbial growth should be removed by :

- hand with a firm non-metallic bristle brush and water.
- Removal of microbial growth is easier if the growth is kept wet with water
- Microbial growth may also be removed with steam at 100 psi
- Protective clothing must be used when using steam for removing microbial growth.

(STUDY IF YOU WANT
YOUR CHOICE)

TYPES OF CORROSION AND THEIR IDENTIFICATION

important

TYPES OF CORROSION AND THEIR IDENTIFICATION

1, GENERAL SURFACE CORROSION

General surface corrosion also referred to as :

Uniform Etch or Uniform Attack Corrosion:

- is the most common form of corrosion

results from :

- direct chemical attack on a metal surface and involves only the metal surface.

General surface corrosion usually occurs over a :

- wide area
- more or less equal in dispersion

if allowed to continue, the surface becomes:

- rough
- possibly frosted in appearance

The discoloration or general dulling of metal created by:

- exposure to elevated temperatures is not to be considered general surface corrosion. Meaning:

لا يعتبر تغير اللون أو التبلل العام للمعدن الناتج عن التعرض لدرجات حرارة مرتفعة تآكلا سطحيا عاما.

Sometimes corrosion spreads under the surface coating and can not be recognized :

- can not be recognized by either the roughening of the surface or a frosted appearance

- closer inspection reveals the paint or plating is lifted off the surface in small blisters that result from the pressure of the underlying accumulation of corrosion products

2, PITTING CORROSION

Pitting corrosion is one of the: most destructive and intense forms of corrosion.

It can occur in any: metal

but is most common on :

- metals that form protective oxide films, such as:

1, aluminum
2, magnesium alloys

It is first noticeable is:

- white or gray powdery deposit, similar to dust, which blotches the surface

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When the deposit is cleaned away:

- tiny holes or pits can be seen in the surface.

These small surface openings may:

- penetrate deeply into structural members and cause damage completely

3, CONCENTRATION CELL CORROSION

Concentration cell corrosion, (also known as crevice corrosion)

corrosion of metals in a :

- metal to metal joint

Metal ion concentration cells and oxygen concentration cells and active passive are :

three general types of concentration cell corrosion

3.1, Metal Ion Concentration Cells

The solution may consist of 2 things :

- water
- ions of the metal which is in contact with water

high concentration of the metal ions will normally exist :

under faying surfaces

where the solution is stagnant, and a low concentration of metal ions will exist adjacent to the crevice which is created by the faying surface.

An electrical potential will exist between the two points:

1, area of the metal in contact with the low concentration of metal ions will be anodic and corrode

2, the area in contact with the high metal ion concentration will be cathodic and not show signs of corrosion.

3.2, Oxygen Concentration Cells

oxygen cell can develop at any point:

1, the oxygen in the air is not allowed to diffuse into the solution

2, creating a diff rence in oxygen concentration between two points

Typical locations of oxygen concentration cells are under:

- gaskets
- wood
- rubber
- other materials in contact with the metal surface.

Corrosion will occur at the area of:

- low oxygen concentration (anode)

Alloys that are particularly susceptible to this type of crevice corrosion:

- stainless steel

3.3, Active Passive Cells

Metals which depend on a tightly adhering passive film, usually an oxide, for corrosion protection are:

- prone to rapid corrosive attack by active passive cells

Active passive cells are often referred to as a type of :

- concentration cell corrosion

the active passive cell is actually two forms of corrosion working in conjunction:

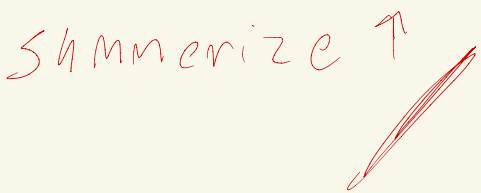
1, The corrosive action usually starts as an oxygen concentration cell.

2, becomes crystal by water

As an example (Active Passive Cells)

1, salt deposits on the metal surface in the presence of water containing oxygen can: create the oxygen cell
2, The passive film will: be broken beneath the salt crystals
3, Once the passive film is broken: the active metal beneath the film will be exposed to corrosive attack.

Rapid pitting of the active metal will result. This reaction can become locally intense due to several factors. First the reaction is augmented by the aff cted area, since the proportion of the exposed base metal is small compared to the surrounding nonreactive metal. This effectively concentrates the focal point of the reaction, often resulting in deep pits in a short time and a greater rate of corrosion.



4, FILIFORM CORROSION

Fi l iform cor rosion is a:

- special l form of oxygen concentration cell
- which occurs on metal surfaces having an organic coating system

It is recognized by its characteristic :

- worm like trace of corrosion products beneath the paint film.

Polyurethane finishes:

- are especially susceptible to filiform corrosion.

Filiform occurs when the:

- relative humidity of the air is between 78 to 90 percent
- the surface is slightly acidic.

This corrosion usually attacks :

- steel and aluminum surfaces
- The traces never cross on steel,
- but they will on aluminum which makes the damage deeper and more severe for aluminum.

- the area treated, and a protective finish applied;

If the corrosion is not removed the area treated, and a protective finish applied;

- the corrosion can lead to intergranular corrosion, especially around fasteners and seams.

Filiform corrosion can be removed using :

- glass bead blasting material
- with abrasive blasting equipment or sanding

Filiform can be prevented by :

- storing aircraft in an environment with a relative humidity below 70 percent

5, INTERGRANULAR CORROSION

Intergranular corrosion is an:

- attack on the grain boundaries of a metal

highly magnified cross section of any commercial alloy:

- shows the granular structure of the metal.

It consists of quantities of :

- individual grains,
- each of these tiny grains has a clearly defined boundary which chemically differs from the metal within the grain.

The grain boundary and the grain center can react with each other as :

- anode and cathode
- when in contact with an electrolyte

Rapid selective corrosion of the grain boundaries can occur:

- High strength aluminum alloys such as 2014 and 7075 are more susceptible to intergranular corrosion

if

- they have been improperly heat treated and then exposed to a corrosive environment

6, EXFOLIATION CORROSION

- is an advanced form of intergranular corrosion

shows itself by :

- lifting up the surface grains of a metal by the force of expanding corrosion products occurring at the grain
- boundaries just below the surface

is visible evidence of intergranular corrosion

is most often seen on :

extruded sections where grain thickness are usually less than in rolled forms.

This type of corrosion is:

- difficult to detect in its initial state.

Extruded components such as :

- spars can be subject to this type of corrosion.

Ultrasonic and eddy current inspection methods are being used to:

- detect early signs of exfoliation with a great deal of success.

7, GALVANIC CORROSION

Galvanic corrosion occurs when:

- two dissimi lar metals make contact in the presence of an electrolyte

The rate which corrosion occurs depends on :

- the diff rence in activities
- The greater the diff rence in activity:
- the faster the corrosion occurs

The rate of galvanic corrosion also depends on :

- the size of the parts in contact.

If the surface area of the corroding metal is smaller than the surface area of the less active metal:

- corrosion is rapid and severe

When the corroding metal is larger than the less active metal:

- corrosion is slow and superfi ial.

Galvanic corrosion is created by dissimilar metals being in contact with each other.

8, STRESS CORROSION CRACKING

This form of corrosion involves a:

- constant or cyclic stress

The cycle stress acting in conjunction with a:

- damaging chemical environment

The stress may be caused by:

- internal or external loading

Internal stress may be:

- trapped in a part of structure during manufacturing processes such as:
- cold working or by unequal cooling from high temperatures

Most manufacturers follow these processes with a stress relief operation. Even so, sometimes stress remains trapped.

The stress may be externally introduced in part structure by :

- riveting
- welding
- bolting
- clamping
- press fit,

If a slight mismatch occurs or a fastener is over torqued:

- internal stress is present

Internal stress is more important than design stress, because:

- stress corrosion is difficult to recognize before it has overcome the design safety factor.

The level of stress varies from point to point within the metal.

Stresses near the yield strength are generally necessary to promote stress corrosion cracking However, failures may occur at lower stresses.

Specific environments have been identified that cause stress corrosion cracking of certain alloys:

1. Salt solutions and sea water cause stress corrosion cracking of :
- high strength
- heat treated steel
- aluminum alloys

2. Methyl alcohol hydrochloric acid solutions cause stress corrosion cracking of :
- some titanium alloys.

3. Magnesium alloys may stress corrode in : moist air.

Stress corrosion may be reduced by:
- applying protective coatings
- stress relief heat treatments
- using corrosion inhibitors,
- controlling the environment

Shot peening a metal surface :
- increases resistance to stress corrosion cracking by:
- creating compressive stresses on the surface
- which should be overcome by applied tensile stress before the surface sees any tension load.
- Th refore, the threshold stress level is increased.

9, FATIGUE CORROSION

Fatigue corrosion involves:

- cyclic stress and a corrosive environment.

Metals may withstand cyclic stress for an infinite number of cycles so long as the stress is below the endurance limit of the metal. Once the limit has been exceeded, the metal will eventually crack and fail from metal fatigue.

However, when the part or structure undergoing cyclic stress is also exposed to

- a corrosive environment,
- the stress level for failure may be reduced many times.

Thus, failure occurs at stress levels that can be dangerously low depending on the number of cycles assigned to the life limited part.

Fatigue corrosion failure occurs in two stages:

First stage;

During the first stage :

- the combined action of :

1, corrosion

And

2, cyclic stress

- damages the metal by pitting and crack formations to such a degree that fracture by cyclic stress will occur,
- even if the corrosive environment is completely removed.

Second stage;

The second stage is essentially a fatigue stage in which:

- failure proceeds by propagation of the crack (often from a corrosion pit or pits).

It is controlled primarily by:

- stress concentration effects and the physical properties of the metal.

Fracture of a metal part due to fatigue corrosion, generally occurs at a :

- stress level far below the fatigue limit of an uncorroded part, even though the amount of corrosion is relatively small

10, FRETTING CORROSION

Fretting corrosion is a particularly damaging form of: corrosive attack that occurs when :

- two mating surfaces normally at rest with respect to one another are subject to slight relative motion.

It is characterized by:

- pitting of the surfaces and the generation of considerable quantities of finely divided debris

Since the restricted movements of the two surfaces prevent the debris from easily escaping:

- an extremely localized abrasion occurs

The presence of water vapor greatly increases this type of deterioration.

If the contact areas are small and sharp, deep grooves resembling brinell markings or pressure indentations may be worn into the rubbing surface.

this type of corrosion on bearing surfaces has also been called false brinelling.

example of fretting corrosion is the :

- smoking rivet found on engine cowlings and wing skins.

This is one corrosion reaction that is not driven by an electrolyte, and in fact moisture may inhibit the reaction.

smoking rivet is identified by a black ring around the rivet.

CAUSES OF CORROSION

The degree of severity, the cause, and the type of corrosion depend on many factors, including the:

- size or thickness of the part
- the material
- heat treatment of the material
- protective finishes
- environmental conditions
- preventative measures
- design

Thick structural sections are generally more susceptible to :

- corrosive attack

because of :

- variations in their composition, particularly if the sections are heat treated during fabrication.

When large sections are machined or chem-milled after heat treatment, the corrosion characteristics of thinner sections may be:

- diff rent from those of thicker areas

In service stresses and field repairs may:

- affect the rates and types of corrosion

Aircraft structure under high cyclic stresses, such as helicopter main rotors, are particularly subject to:

- stress corrosion cracking

areas adjacent to weld repaired items often have corrosion due to :

- insufficient removal of the weld flux,
- for some steels,
- buildup of a magnetic field

Areas such as these should be :

- closely inspected for signs of corrosion
- when found, proper treatment is done

Since corrosion is : the deterioration of metals resulting from reaction between metals and their environment

some corrosion control or means to minimize corrosion when the aircraft enters operational service should be introduced during the design phase:
to reduce the rate of corrosive attack by corrosion control measures introduced early in design

The nature of the material is a :

- fundamental factor in corrosion.

High strength, heat treatable aluminum and magnesium alloys are very:

- susceptible to corrosion.

while titanium and some stainless steel alloys are:

- less susceptible in atmospheric environment.

The aircraft manufacturer selects material for the aircraft based on:

1, material strength
2, weight
3, cost
4, while corrosion resistance is often a secondary consideration

However (for point 4)

- corrosion control should be considered as early as possible during the preliminary design phase.

The use of more corrosion resistant materials in any design normally involves:

- additional weight to achieve required strength.

Since weight consideration is a major factor in the construction of airframes

the primary means of preventing corrosion is by use of:

- protective coatings and proper maintenance procedures.

The use of corrosion resistant alloys is:
not a cure all for corrosion prevention.

common mistake is to: replace a corroded part with a corrosion resistant alloy only to find that the corrosion has now shifted to another part and increased in severity.

The problem of protection against corrosion is minimized if the material to be: protected is intrinsically resistant to corrosion.

Aluminum copper alloys are known to have:

- better stress corrosion resistance
- better fatigue strength properties than aluminum zinc alloys
- ; therefore, they are often used as the primary structural materials

Protective finishes

Protective finishes are divided into 2 separate categories:

1, sacrificial
2, non-sacrificial

Sacrificial coatings include:

1, cadmium
2, zinc
3, aluminum.

Non-sacrificial coatings include:

1, hard plating (chromium and nickel)
2, chemical conversion coatings
3, sealant
4, primers
5, top coat.

- Aircraft systems exposed to

1, marine atmospheres,
2, moisture
3, acid rain
4, tropical temperature conditions
5, industr ia l chemical
6, soi ls and dust in the atmosphere

- can simply be disadvantaged by:

geographic or environmental factors

Moisture is present in the air as:

- gas (water vapor)

or as

- divided droplets of liquid (mist or fog) and often contains contaminants such as:

1, chlorides
2, sulfates
3, nitrates

which increase its corrosive eff cts.

Condensed moisture which evaporates will : leave its contaminants behind

Condensed moisture and its contaminants can also be:

1, trapped in close fitting
2, wettable joints such as : faying surfaces and be drawn along poor bond lines bicapillary action

Salt particles, when dissolved in water, form: strong electrolytes

Normal sea winds carry:

- dissolved salt which makes coastal environments highly corrosive

Industrial pollutants such as

1, carbon
2, nitrates
3, ozone
4, sulfur dioxide
5, sulfates

contribute to the deterioration of :

1, nonmetallic materials
2, can cause severe corrosion of metals.

Things that accelerates corrosion: (environmental factors normally found in tropical climates)

1, Warm
2, moist air
3, normally found in tropical climates

reduces corrosion by:

1, cold and dry air :

- normally found in arctic climates

Proper heat treatment of materials is a vital factor in :

- maximizing resistance to corrosion.

MATERIAL TYPES

- Corrosion occurs in many different materials
- The look and characteristics of corrosion varies with each metal.

In the fol lowing section, common metals and environmental conditions found in aerospace are discussed.

1, ALUMINUM AND ALUMINUM ALLOYS

1, ALUMINUM AND ALUMINUM ALLOYS

Aluminum is:

- high in the electro chemical series of elements
- corrodes very easily.

the formation of a tightly adhering oxide film off rs :

- increased resistance under most corrosive conditions.

Most metals in contact with aluminum :

- form couples that undergo galvanic corrosion attack. meaning :
- (most materials in contact with aluminum galvanic corrosion will occur)

The alloys of aluminum are subject to:

- pitting corrosion
- intergranular corrosion
- intergranular stress corrosion cracking

In some cases:

- the corrosion products of metal in contact with aluminum are corrosive to aluminum.

aluminum and its alloys must be cleaned and protected.

Corrosion on aluminum surfaces is usually:

- quite obvious
- the products of corrosion are white
- the products of corrosion are : more voluminous than the original base metal

Even in its early stages, aluminum corrosion is evident as:

- general etching
- pitting
- roughness of the aluminum surfaces

Aluminum alloys commonly form a :

- smooth surface oxidation that is from 0.001" to 0.0025" thick.
- not considered detrimental.
- coating provides a :hard shell barrier to the introduction of corrosive elements.

General surface attack of aluminum penetrates is:

- relatively slowly
- but speeds up in the presence of dissolved salts.

Considerable attack can usually take place before serious loss of structural strength develops.

three forms of attack on aluminum alloys are particularly serious:

1, the penetrating pit type corrosion through the walls of aluminum tubing

2, stress corrosion cracking of materials under sustained stress

3, intergranular corrosion, which is characteristic of certain improperly heat treated aluminum alloys

2, MAGNESIUM AND MAGNESIUM ALLOYS

Magnesium and magnesium al loys are:

- the most chemical ly active of the metals used in aircraft construction and are the most difficult to protect

corrosion on magnesium surfaces is probably :

- the easiest to detect in its early stages

Since magnesium corrosion products

- occupy several times the volume of the original magnesium metal destroyed,

initial signs show a :

- lifting of the paint films and white spots on the magnesium surface.

These rapidly develop into:

- snow like mounds or even white whiskers

The prompt and complete correction of the coating failure is imperative if serious structural damage is to be avoided. Meaning:

يعد التصحيح الفوري والكامل لفشل الطلاء أمرا ضروريا إذا كان يجب تجنب الأضرار الهيكلية الخطيرة.

3, FERROUS METALS

One of the most familiar types of corrosion is :

- ferrous oxide (rust)
- generally resulting from: atmospheric oxidation of steel surfaces.

Some metal oxides:

- protect the underlying base metal

but

- rust is not a protective coating in any sense of the word

Rust presence actually promotes:

- additional attack by :

- attracting moisture from the air and acting as a catalyst for additional corrosion

If complete control of the corrosive attack is to be realized:

- all rust must be removed from steel surfaces.

Rust first appears on:

- bolt heads
- hold down nuts
- or other unprotected aircraft hardware

Its presence in these areas is generally :

- not dangerous
- has no immediate eff ct on the structural strength of any major components.

The residue from the rust may also :

- contaminate other ferrous components
- promoting corrosion of those parts.

قد تلوث بقايا الصدأ أيضا المكونات الحديدية الأخرى، مما يعزز تآكل تلك الأجزاء.

The rust is indicative of a need for maintenance and of possible corrosive attack in more critical areas.

When :

1, paint failures occur or

2, mechanical damage exposes highly stressed steel surfaces to the atmosphere, even the smallest amount of rusting :

- is potentially dangerous in these areas and must be removed and controlled

- Rust removal from structural components

followed by :

- an inspection and damage assessment, must be done as soon as feasible

4, NOBLE METALS

The noble metals :

1, silver

2, platinum

3, gold

are used in aircraft assemblies because of their resistance to:

- ordinary surface attack
- their improved electrical or heat conductivity
- brown or black sulfide tarnish may occur that is normally

(not cleaned in the field by the technician.)

Copper and copper alloys are also:

relatively corrosion resistant.

Attacks on copper components are usually limited to

- staining
- tarnish

Such change in surface condition:

- is not dangerous and should ordinarily have no eff ct on the function of the part

Serious copper corrosion is evident by the accumulation of :

- green to blue copper salts on the corroded part
- These are typically mechanically removed then the area is treated with a chromic acid solution.

5, CHROMIUM AND NICKEL PLATED PARTS

Nickel and chromium platings are used extensively as:

- protective and wear resistant coatings over high strength steel parts (landing gear journals, shock strut pistons)

Chromium and nickel plate provide protection by :

- forming a somewhat impervious physical coat over the underlying base metal

When breaks occur in the surface:
the protection is destroyed.

6, CADMIUM AND ZINC PLATED PARTS

Cadmium plating is used extensively in aircraft construction as a :

- protective finish over both steel and copper alloys.

Protection is provided by a:
sacrificial process :
in which the cadmium is attacked rather than the underlying base material.

Properly functioning cadmium surface coatings may show:

- mottling: ranging from white to brown to black spots on their surfaces

- These show the sacrificial protection being off red by the cadmium coat, and under no condition should such spotting be removed merely for appearance sake

cadmium will continue to protect even when :

- actual breaks in the coating develop and bare steel or exposed copper surfaces appear.

7, TITANIUM AND TITANIUM ALLOYS

- Attack on titanium surfaces is generally difficult to detect.
- Titanium is, by nature, highly corrosion resistant

but:

It may show deterioration (تدهور) from the: presence of salt deposits and metal impurities, particularly at high temperatures.

Therefore the use of :

- steel wool
- iron scrapers,
- steel brushes

-for cleaning or for the removal of corrosion from titanium parts is prohibited

If titanium surfaces require cleaning:

- hand polishing with aluminum polish Or
- mild abrasive is permissible if fiber brushes only are used and if the surface is treated following cleaning with a suitable solution of sodium dichromate.

- Wipe the treated surface with dry cloths to remove excess solution, but do not use a water rinse

AREAS SUSCEPTIBILITY TO CORROSION (CORROSION PRONE AREAS)

Corrosion prone areas should be

- cleaned
- inspected
- treated more frequently than less corrosion prone areas.

1, EXHAUST TRAIL AREAS

jet and reciprocating engine exhaust deposits are very corrosive

give particular trouble where :

- gaps
- seams
- hinges
- fairings are located downstream from the exhaust pipes or nozzles

Deposits may be :

- trapped and not reached by normal cleaning methods

Pay special attention to areas around:

- rivet heads
- in skin lap joints and other crevices

Remove and inspect :

fairings and access plates in the exhaust areas.

لا تتجاهل

Do not overlook exhaust deposit buildup in remote areas such as:

- empennage surfaces

- Buildup in these areas is slower and may not be noticed until corrosive damage has begun.

2, BATTERY COMPARTMENTS AND BATTERY VENT OPENINGS

In spite of protective paint systems and extensive sealing and venting provisions, battery compartments continue to be ; corrosion problem areas

Fumes from overheated battery electrolyte are :

- difficult to contain
- will spread to internal structure

Unprotected surfaces will be subjected to corrosive attack.

lead acid batteries:

- frequent cleaning
- neutralization of acid deposits with sodium bicarbonate solution

will minimize corrosion.

If the battery installation includes:

- external vent openings on the aircraft skin:

- these areas should be included in the inspection and maintenance procedure

If aircraft batteries with electrolytes of either sulfuric acid or potassium hydroxide are in use:

- their leakage will cause corrosion.

Cleaning of nickel cadmium compartments should be done with:

- ammonia or boric acid solution
- allowed to dry thoroughly
- then painted with an alkali resistant varnish

3, LAVATORIES, BUFFETS, AND GALLEYS

These areas:

- particularly deck areas behind lavatories
- sinks
- ranges

where spilled food and waste products may collect if not kept clean, are potential trouble spots.

- Pay attention to bilge areas located under galleys and lavatories.
- Clean these areas frequently and maintain the protective sealant and paint fin shes

4, BILGE AREAS

bilge is a : natural sump or collection point for waste hydraulic fluids, water, dirt, loose fasteners, drill chips, and other odds and ends of debris.

Residual oil quite often masks small quantities of water which settle to the bottom and set up a hidden potential corrosion cell.

keeping bilge areas free of all extraneous material including water and oil will insure the best protection against corrosion

How to clean: good vacuum cleaner and clean wiping cloths are necessary to clean such areas.

5, WHEEL WELLS AND LANDING GEAR

It is exposed to : mud, water, salt, gravel, and other flying debris from runways during flight operations

Frequent cleaning, lubrication and paint touch up are needed on aircraft wheels and on wheel well areas

complete coverage with a protective paint film is difficult to attain because:

- complicated shapes, assemblies, and fittings in the area,

Because of the heat generated from braking, preservative coatings cannot be used on aircraft landing gear wheels.

During inspection of this area, particular attention should be given to the following trouble spots:

- High strength steel.
- Exposed surfaces of struts, oleos, arms, links, and attaching hardware (bolts, pins, etc.).
- Axle interiors.
- Exposed position indicator switches and other electrical equipment.
- Crevices between stiff ners, ribs, and lower skin surfaces which are typical water and debris traps.
- Magnesium wheels, particularly around bolt heads, lugs, and wheel web areas.
- Exposed rigid tubing, especially at "B" nuts and ferrules under clamps and tubing identification tapes.

6, EXTERNAL SKIN AREAS

Refer to the book page 4.16,4.17

7, WATER ENTRAPMENT AREAS

the plugging of a single drain hole or the altering of the level of the aircraft can result in a :
corrosion problem if water becomes entrapped in one of these "bathtub" areas. Daily inspection of low point drains is a recommended practice.

8, ENGINE FRONTAL AREAS AND COOLING AIR VENTS

Have Constant abrasion by

- airborne dirt and dust
- bits of gravel from runways
- rain tends to remove the protective surfaces from these areas

due to the requirement for heat dissipation, may not be painted

Inspection of such areas should include all sections in the cooling air path with special attention to obstructions and crevices where salt deposits may build up during marine operations