

Controlling Corrosion in Heritage Aircraft Using ARDROX AV Corrosion Inhibiting Compounds

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The preservation of heritage aircraft is a battle against corrosion. Outdoor exhibits are particularly vulnerable. Metal structures are susceptible to condensation, moisture penetrating deeply into cracks and crevices, around fasteners, between joints, under peeling and fractured paint coatings. Corrosion Inhibiting Compounds (CIC) are used in the manufacture and during routine maintenance and overhaul of all civil and military aircraft. The increased use of CICs has considerably improved corrosion protection and extended aircraft service life.

The corrosion protection and preservation life of heritage aircraft can be considerably improved using CICs applied using appropriate equipment and techniques.



Get Rid of Moisture and Reduce Corrosion

ARDROX AV Corrosion Inhibiting Compounds work by displacing water and forming a barrier to prevent it from re-penetrating into cracks and crevices in the airframe

Corrosion is the destruction of metal by electro-chemical reaction with its environment. Corrosion occurs under the following conditions:

- Presence of an anode and a cathode, for example when two dissimilar metals are in close contact.
- Electrical contact between anode and cathode.
- Presence of an electrolyte usually moisture.

An airframe is made of various alloys of aluminium, steel, other metals and composites. If dissimilar metals or metal and composite come into contact and moisture and oxygen are present then an electro-chemical cell can be formed, this will create the pre-conditions for corrosion.

PRIMARY CORROSION PROTECTION

Metal airframe components are protected by using:

- chemical and electro-chemical conversion pre-treatments
- primer and top coat paints
- sealants - used between surfaces and in joints

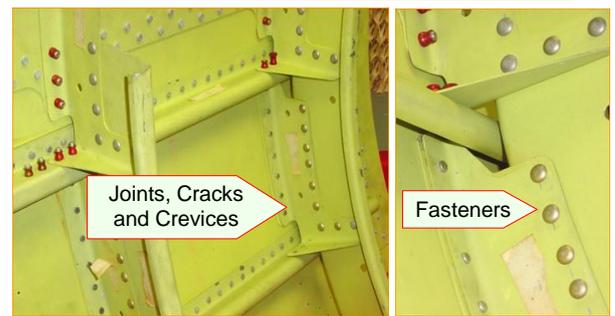
PRIMARY PROTECTION systems ensure that wherever possible moisture and oxygen are excluded from direct contact with exposed metal.

Primary Corrosion Protection Systems

- Anodizing
- Plating
- Chromating
- Phosphating
- Paints: Primers and Top Coats
- Sealants - Interfay and Wet Assembly Sealants

An airframe is a complex structure held together by bolts and rivets inserted into pre-drilled holes, in consequence there is always the possibility that Primary Corrosion Protection coatings may not give full protection and that bare metal may be exposed to oxygen, moisture and corrosion. Cracks and crevices are likely to trap moisture and this is where corrosion is likely to occur.

Airframes – Complex Structures with Moisture Traps



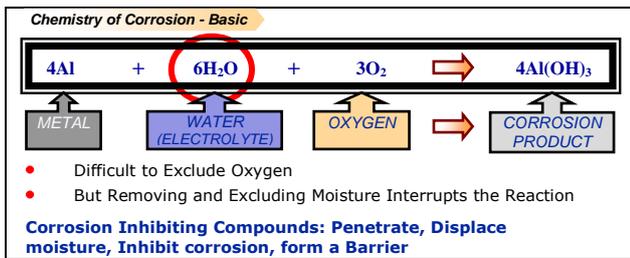
SECONDARY CORROSION PROTECTION

ARDROX AV Corrosion Inhibiting Compounds (CIC) give the airframe additional protection. They are applied during the manufacturing process, during overhaul and as part of routine maintenance procedures.

During its service life an airframe is subjected to considerable flexing and movement, joints open, exposing cracks and crevices where moisture can accumulate. Military aircraft are generally subject to more severe mechanical stresses than commercial aircraft.

ARDROX AV CICs work by penetrating into these exposed joints, cracks and crevices, displacing moisture and forming a protective barrier, by preventing moisture coming into contact with unprotected metal, the 'corrosion cycle' is interrupted reducing the possibility of corrosion.

Crevice corrosion occurs when water is trapped between exposed metal surfaces, for example under loose and flaking paint, in unsealed joints and in cracks and crevices, corrosion can quickly develop into more serious exfoliation or pitting.



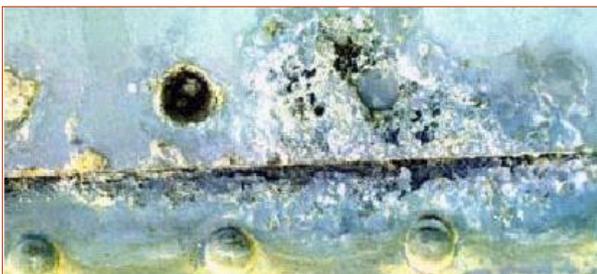
To 'break the corrosion cycle:

- It is very difficult to exclude oxygen
- More effective to displace water and create a barrier against corrosion

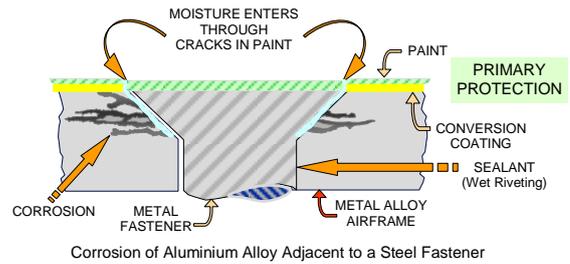
Sources of Potential Corrosion

- Bringing different metals / materials into contact
- Fabrication processes involving drilling and riveting.
- Fasteners in items painted BEFORE ASSEMBLY - joints not protected against corrosion.
- Moisture condensation is an inevitable consequence of outdoor storage
- Complex structures such as airframes will inevitably have cracks and crevices where moisture can accumulate
- PRIMARY protection systems cannot always prevent corrosion
- Large, complex structures stored outdoors are subject to moisture condensation and are particularly vulnerable to subsequent corrosion

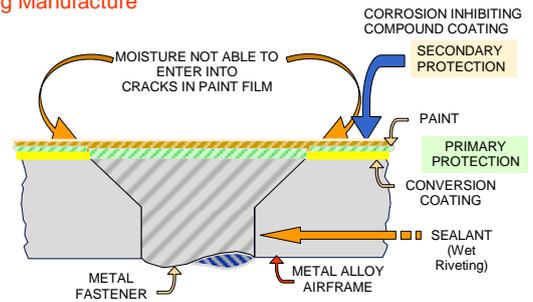
Breakdown of Primary Protection



Corrosion of: Damaged PRIMARY Protective Coatings

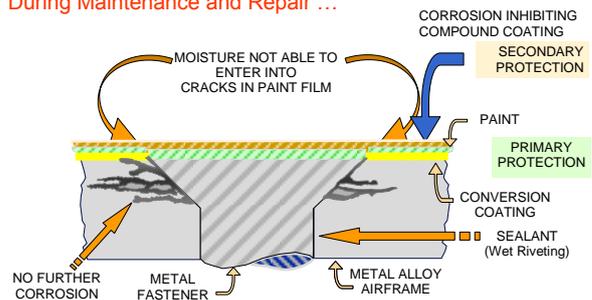


Corrosion Inhibiting Compounds Applied During Manufacture



CICs prevent moisture penetrating into the crack between fastener and airframe
NO MOISTURE - NO CORROSION!

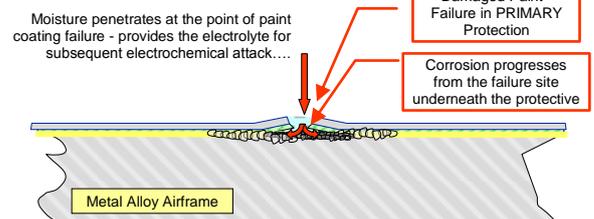
Corrosion Inhibiting Compounds Applied During Maintenance and Repair ...



CICs prevent moisture penetrating into the crack between fastener and airframe
NO MOISTURE - NO FURTHER CORROSION!

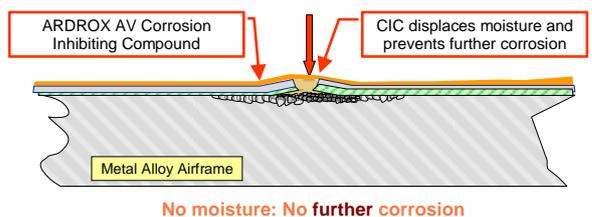
Damaged Paint:

No Corrosion Inhibiting Compound Applied



Damaged Paint:

Corrosion Inhibiting Compound Applied



ARDROX AV Corrosion Inhibiting Compounds

Penetrate into joints, cracks and crevices
Displace water (moisture)
Protective Barrier prevents water re-penetration
Give Long-term Corrosion Protection!

ARDROX AV Corrosion Inhibiting Compounds Contain

- INHIBITORS: Stop corrosion reactions
- BARRIER COATING: Forms wax based coating to protect from moisture and corrosive elements
- SPECIAL CHEMICALS: De-watering and Surface Active Agents
- ORGANIC SOLVENT: Carrier and Wetting Agent

ARDROX AV Corrosion Inhibiting Compounds (CIC)

Chemmetall manufacture and supply a range of aviation CICs used to treat all internal fuselage areas of fixed wing and rotary aircraft with the exception of the inside of integral fuel tanks. CICs are used on painted and unpainted surfaces and will protect all types of metal against corrosion.

ARDROX AV 8 — Super penetrating, water displacing, corrosion inhibiting compound. Forms a tack-free, firm film. Recommended dry film thickness is 8-microns. Can be used as the first coat in a 2-coat system in combination with either ARDROX AV 30 or AV 100D as the second 'cover coat' for increased corrosion protection. Not recommended for use on moveable components.

ARDROX AV 15 — Super penetrating, water displacing, heavy duty corrosion inhibiting compound. Forms a tack-free, firm film. Recommended dry film thickness is 15-microns. Gives 1-coat, heavy duty corrosion protection. Not recommended for use on moveable components.

ARDROX AV 30 — Penetrating, water displacing corrosion inhibiting compound. Forms an almost tack-free, waxy film. Recommended dry film thickness is 30-microns. Can be used as the second 'cover coat' in a 2-coat system with AV 8 as the 'primer coat' for increased corrosion protection. Not recommended for use on moveable components.

ARDROX AV 25 — Penetrating, water displacing, general purpose corrosion inhibiting compound. Forms a soft, waxy film. Recommended dry film thickness is 25-microns. Recommended for use on moveable components where lubrication and corrosion prevention is required for example on pulleys and control cables.

ARDROX AV 100D — Thixotropic, heavy duty, corrosion inhibiting compound, forms a firm waxy film. Recommended dry film thickness is 100-microns. Can be used as the second 'cover coat' in a 2-coat system with AV 8 as the 'primer coat' for increased corrosion protection. Used in areas such as under toilets, galleys and entrances. Not recommended for use on moveable components.

ARDROX AV 40 — Heat resistant, colourless, forms a tack-free film. Recommended dry film thickness is 40-micron. Designed for use in areas of the airframe exposed to elevated temperatures, typically on engine components, pylons and cowlings, will withstand service temperatures of up to 150°C.

QUALIFIED AND APPROVED

ARDROX AV CICs are designed to prevent corrosion within the airframe during the service life of the aircraft. Our products meet and exceed the most stringent specification requirements and are fully qualified for use by all major aircraft manufacturers including: Boeing, Airbus Industrie, Bombardier Canadair, ATR, Embraer, McDonnell Douglas, Lockheed Martin and many others.

TESTING AND QUALITY CONTROL

The performance of ARDROX AV products is evaluated using defined test methods designed to simulate the most severe corrosion environments. Each batch of material is Release Tested for quality and conformance to specification. A Release Test Certificate is issued with each batch of material supplied.

TECHNICAL PERFORMANCE

Drying Time: ARDROX CICs have been formulated to give minimum drying times but still maintain sufficient time for the effective penetration of the product into joints, cracks and crevices in the airframe.

Soft Film v Firm Film CIC Products:

The ARDROX AV range includes both firm ('hard') and soft film products. There are circumstances where soft film products such as AV 25 have to be used - specifically on moveable components where the flexibility of the dry AV 25 film must be maintained to allow for movement of the component but still retain corrosion protection. For most other applications firm film products such as AV 8, AV 15, AV 30 and AV 100D are recommended.

Advantages of Hard Film ARDROX AV CICs:

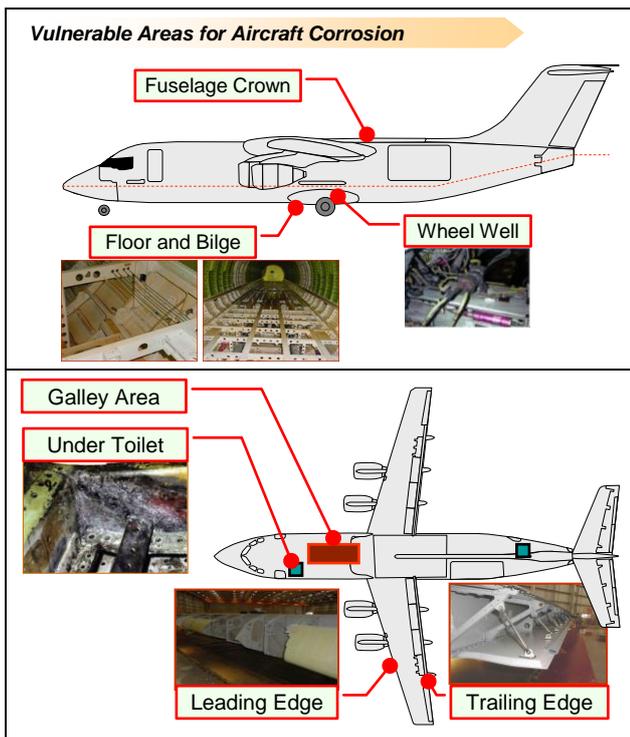
- **Tack Free and Non-transferable** when dry, they do not contaminate workers, other users or other components

- **Robust**, less susceptible to being damaged or removed by subsequent operations after application
- **Durable** give long-term corrosion protection compared to soft film products.
- **Dust Free** do not attract or retain dust and other contaminants they can be wiped or brushed clean without being damaged or removed.
- **Quick Drying** ARDROX AV 15 gives a considerable advantage it is fast drying allowing subsequent manufacturing, repair, maintenance and overhaul operations to be carried out more quickly after application.
- **Good Adhesion** to the airframe substrate ensuring continuing long-term protection in severe environments in contact with corrosive elements.

Colour and Transparency: ARDROX CICs are coloured so that treated areas can be quickly and easily identified. CIC coatings are transparent allowing inspection of the underlying airframe for any corrosion. ARDROX AV CICs will retain their transparency over the service life of the aircraft.

Removal of ARDROX CIC Films: Sometimes it is necessary to remove both firm and soft film ARDROX CICs. Our products are designed to be easily and effectively removed with specified solvents (aliphatic solvents such as naphtha solvent ['white spirit']) or by using ARDROX AV 980 CIC remover.

Applying ARDROX CIC over old CIC Films: ARDROX CICs can be applied over existing CIC treatments as long as they are clean and uncontaminated.



APPLICATION GUIDELINES

There are number of areas within the aircraft which are particularly prone to corrosion these include: under the galleys and toilets; wheel wells; leading and trailing edges of the wings; doors; and seat tracks. Additionally, the cargo area can be subjected to spillages of corrosive liquids and mechanical damage to the secondary (CIC) and primary protection systems and subsequent corrosion.

It is important to identify all corrosion prone areas of the aircraft and draw up an effective corrosion control plan - ARDROX aviation CIC treatments should be an integral part of this plan.

The airframe should be carefully prepared under toilet and galley areas: decontaminate and clean the area complete all painting and sealing operations. Apply ARDROX AV 8 as a super penetrating, water displacing CIC, after drying (40 to 60 minutes) apply ARDROX AV 100D heavy duty CIC, allow to dry (up to 6 hours) before carrying out any subsequent operations on the application site.

Under floor decks (in the lower lobe of the fuselage), on the leading and trailing edges of the wings and in the wheel wells we recommend using either a 2-coat system of ARDROX AV 8 followed by ARDROX AV 30 or using AV 15 as a single coat. The advantages of using AV 15 are that application and turn-round times are reduced and overall weight of CIC on the aircraft is minimised.

SPRAY APPLICATION OF CICs

Chemetall supply a range of custom designed application equipment, including High Pressure (airless) and Low Pressure (air mix) spray equipment complete with a range of custom designed spray wands. Using this equipment ensures that CICs to be applied efficiently and effectively to all areas of the airframe including behind stringers and frames and into difficult to access areas and cavities.

Spraying is the most effective CIC application method and ensures proper wetting of the airframe combined with maximum penetration as the CIC is driven into the joint by air pressure.

Only apply CICs by brush where penetration is not required - for example when applying AV 100D for touch-up and for maintenance and repair.

Sufficient CIC must be applied along stringers, profiles and other joints so that a 'reservoir' of material is formed which can be drawn into the cracks and crevices of the airframe and provide effective corrosion protection, a 3 to 5 mm stream of CIC is recommended

- Heavy CIC over-spray should be removed immediately, or at least whilst it is still wet, use rags or tissues to soak up excess material
- Remove excess CIC which has accumulated around drain holes and in drainage channels

- A narrow, round, telltale ring of CIC around fasteners and rivets is a good indication that sufficient CIC has been applied to these areas.
- CICs are 'working films' they are not decorative coatings.
- CIC coatings should not be compared to cover coat paint finishes where cosmetic appearance is important.
- RUNS, SAGS and DRIPS are allowed and indicate that sufficient CIC has been applied to provide effective penetration and resulting in good corrosion protection.

HOW TO ACHIEVE EFFECTIVE CIC COATINGS

- Apply CICs with a minimum distance between spray nozzle and the area or component being treated, this will ensure that sufficient CIC is applied to stringers, longerons and frames, this will ensure that the CIC coats the underside and the other hidden areas of these components.
- After application the CIC should penetrate deeply into any cracks and crevices these are corrosion vulnerable and must be thoroughly and effectively treated.
- A careful, systematic approach to the AV CIC treatment procedure will help to ensure effective corrosion protection.
- Remember that if any areas of the airframe remain partially or totally untreated by CIC then they are vulnerable to moisture penetration and eventually to corrosion.

WHERE TO START - SPRAY APPLICATION SEQUENCE

- **PLAN** the Application taking into account where the CIC needs to be applied and which areas/components need to be masked. Pay attention to the sequence of events and draw up a logical CIC application plan. Choose the correct ARDROX AV CIC for the job.
- **COMPLETE** all sealing and painting operations before beginning the CIC application.
- **PREPARE** clean and decontaminate surfaces before treating with CIC.
- **MASK AND PROTECT** areas and components which do not require treatment.
- **CHOOSE** the most appropriate application equipment for the job, spray apply the CIC wherever possible.



Using Aerosol Sprays: ARDROX AV CICs are available in aerosol spray cans, these are very effective for treating small areas, for touchup and for small scale maintenance and repair.

CIC aerosols can also be used to access small areas and cavities when conventional spray equipment is not available or not appropriate.

Chemetall supply special 600-mm extension hoses which can be attached directly to the aerosol spray can nozzle for more effective application of the CIC to difficult to reach hidden areas such as cavities and behind stringers.

Brush Application: Brushing is the least effective method of application and is not recommended for applying CICs when penetration into cracks crevices and joints is required.

APPLICATION GUIDELINES

- Attention to detail and a systematic approach are the key features in achieving effective ARDROX AV CIC treatment.
- This approach will help to eliminate missing spots and ensure that the AV CIC is successfully and effectively applied to hidden or difficult to reach areas.
- Use the recommended equipment for the application.
- Runs, drips and sags are easily removed when the ARDROX CIC is still wet but remember to allow sufficient time for the CIC to be drawn into and penetrate deeply into joints, cracks and crevices, these are the most vulnerable areas of the airframe for corrosion.

- MOP UP EXCESS ARDROX AV CIC
- INSPECT
- TOUCH-UP WHERE REQUIRED

HEALTH AND SAFETY

Before using any ARDROX AV CIC read and understand all relevant Material Safety Data Sheets and other relevant information on the products and equipment being used.

- ARDROX AV CIC Coatings contain volatile organic solvents, adequate precautions must be taken to make sure that the user is properly protected from inhaling these solvents whilst applying and as they evaporate during the CIC drying cycle.

- When using ARDROX AV CICs use the recommended personal protective equipment (PPE) including: overalls; impermeable gloves; and eye protection.