ESPE
UNIVERSIDAD DE LAS FUERZAS ARMADAS
INNOVACIÓN PARA LA EXCELENCIA

UNIDAD DE GESTIÓN DE TECNOLOGÍAS

DEPARTAMENTO DE CIENCIAS ESPACIALES

CARRERA DE TECNOLOGÍA EN MECÁNICA AERONÁUTICA MENCIÓN AVIONES

MONOGRAFÍA: PREVIO A LA OBTENCIÓN DEL TÍTULO DE TECNÓLOGO EN MECÁNICA AERONÁUTICA MENCIÓN AVIONES

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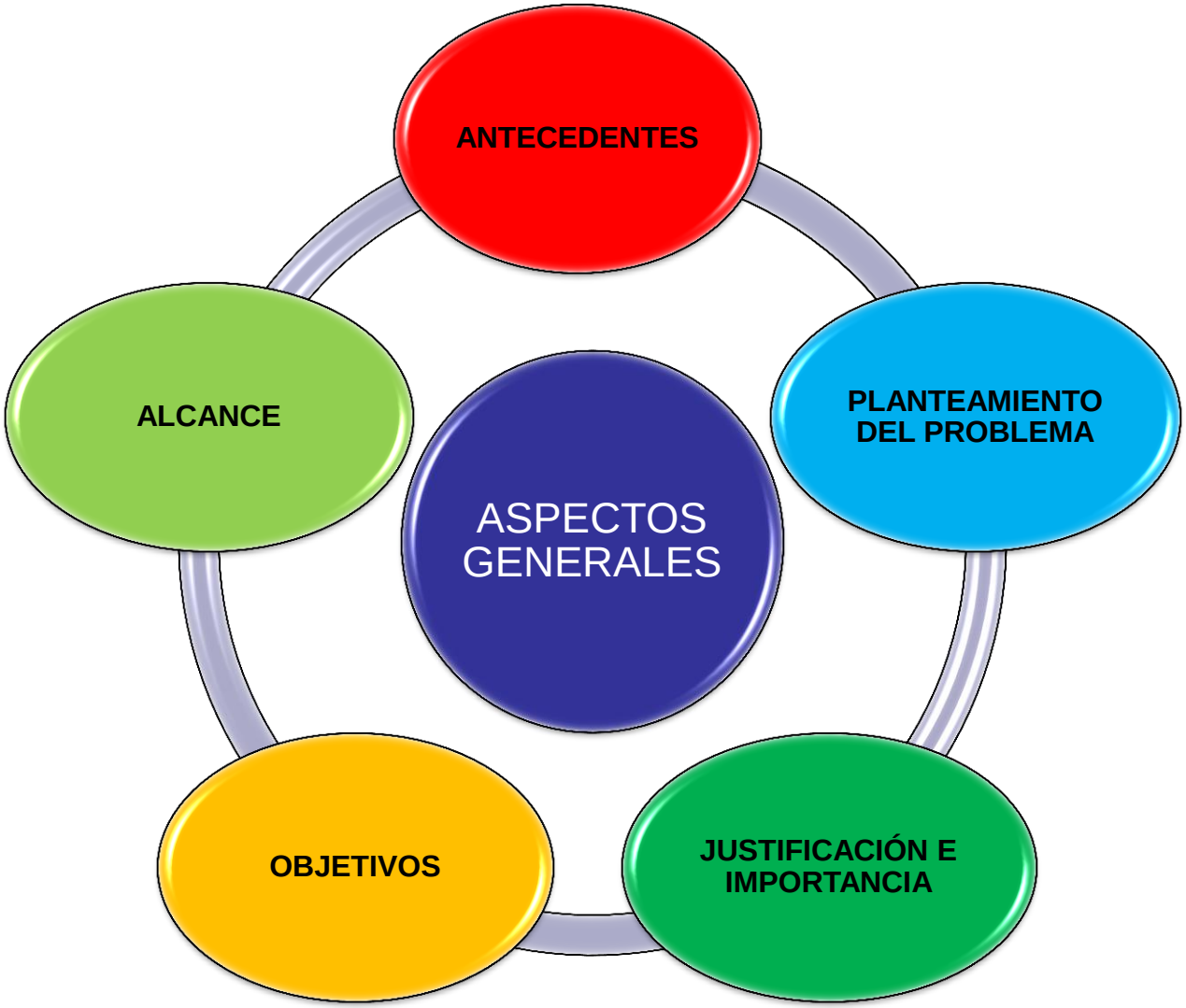
TEMA: REPARACIÓN DE LA PIEL DEL CONJUNTO DE CUBIERTAS INFERIORES DEL FUSELAJE UBICADOS ENTRE LAS ESTACIONES 12 Y 16, DE ACUERDO A LOS PROCEDIMIENTOS APLICABLES A LAS TAREAS DE MANTENIMIENTO DE LA AERONAVE HAWKER SIDDLEY 125-400, PERTENECIENTE A LA UNIDAD DE GESTIÓN DE TECNOLOGÍAS-ESPE

INTRODUCCIÓN

Volar, es una de las formas de demostrar la libertad a su máxima expresión a través del mundo, siendo las aves voladoras las más dichosas, que al extender sus alas y con un pequeño impulso manifiestan su libertad envidiable ante los ojos del hombre codicioso el cual, sintiéndose inconforme con el vasto mar y las grandes extensiones de tierra, se ha empeñado desde tiempos remotos conquistar el inmenso cielo azul experimentando y aventurándose a lo inciertamente posible.

CAPÍTULO I


ANTECEDENTES
PLANTEAMIENTO DEL PROBLEMA
JUSTIFICACIÓN E IMPORTANCIA
OBJETIVOS
ALCANCE
ASPECTOS GENERALES

ANTECEDENTES

La Unidad de Gestión de Tecnologías cuenta con aviones escuela, y una de las mas recientes es la aeronave HAWKER SIDDLEY 125-400.

- **Primeras aeronaves**
- **Aeronaves durante las guerras**
- **Avion escuela HAWKER SIDDLEY 125-400.**

Planteamiento del problema

- Necesario para el aprendizaje.
- Deterioro del avión escuela.
- Efectos y consecuencias.

JUSTIFICACIÓN E IMPORTANCIA

REALIZAR TRABAJOS DE MANTENIMIENTO AL AVIÓN ESCUELA

PROPÓSITO DE LA REPARACIÓN DE LAS CUBIERTAS INFERIORES DEL FUSELAJE

FACTIBILIDAD DE LA REPARACIÓN

OBJETIVOS

- GENERAL
- ESPECÍFICOS

ALCANCE

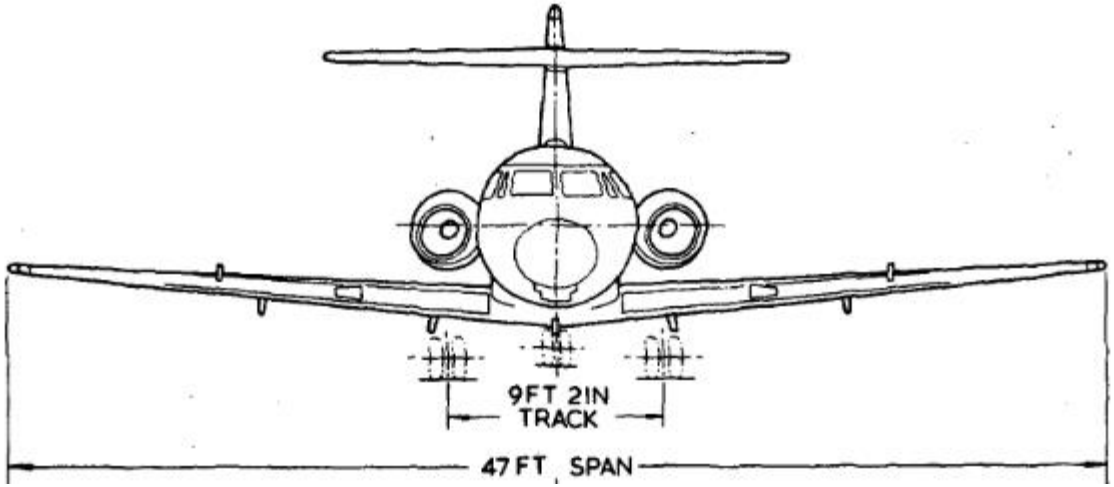

MANTENER EN ÓPTIMAS CONDICIONES
MEJORAR EL RENDIMIENTO ACADÉMICO
DESEMPEÑO PROFESIONAL

CAPÍTULO II


DESCRIPCIÓN
TIPOS DE MANTENIMIENTO
MATERIALES AERONÁUTICOS
MARCO TEÓRICO
HERRAMIENTAS PARA LA REPARACIÓN
UNIONES ESTRUCTURALES
CORROSIÓN

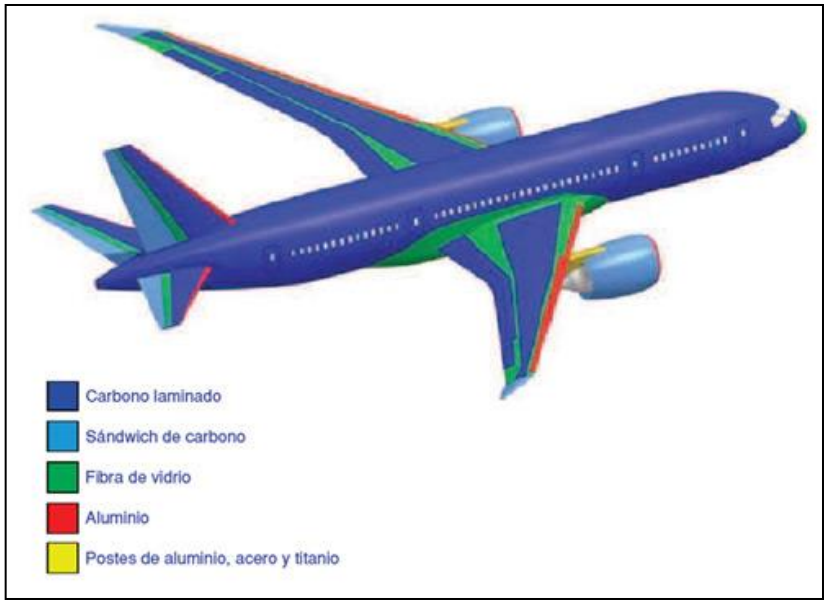
DESCRIPCIÓN

AERONAVE HAWKER SIDDLEY 125-400



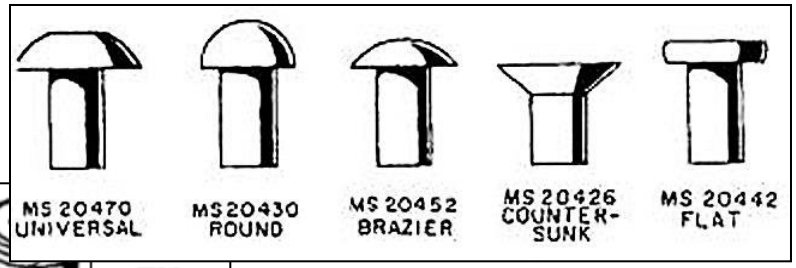
MATERIALES AERONÁUTICOS

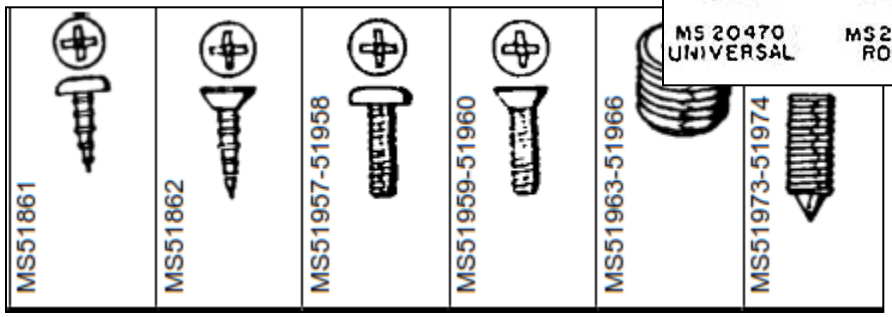
- PROPIEDADES DE LOS METALES
- ALEACIONES FERROSAS
  - ACEROS
- ALECIONES NO FERROSAS
  - ALEACIONES DE ALUMINIO
  - ALEACIONES DE TITANIO
  - ALEACIONES DE MAGNESIO

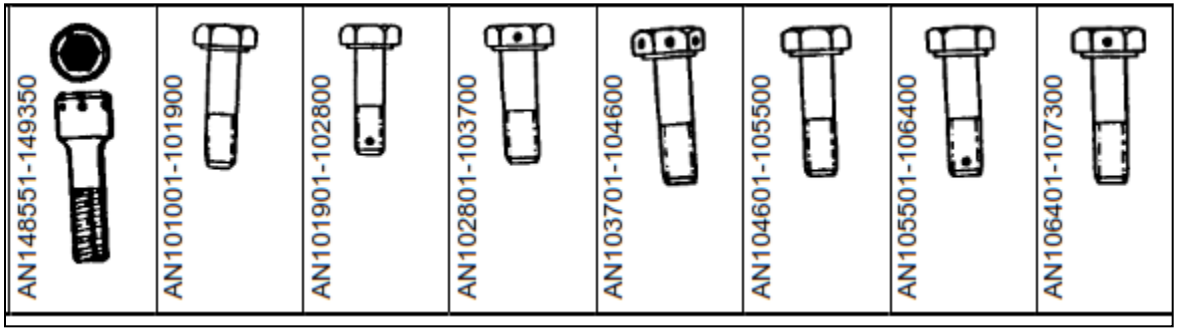


UNIONES ESTRUCTURALES

- REMACHES Y TIPOS DE REMACHES
- TORNILLOS
- PERNOS

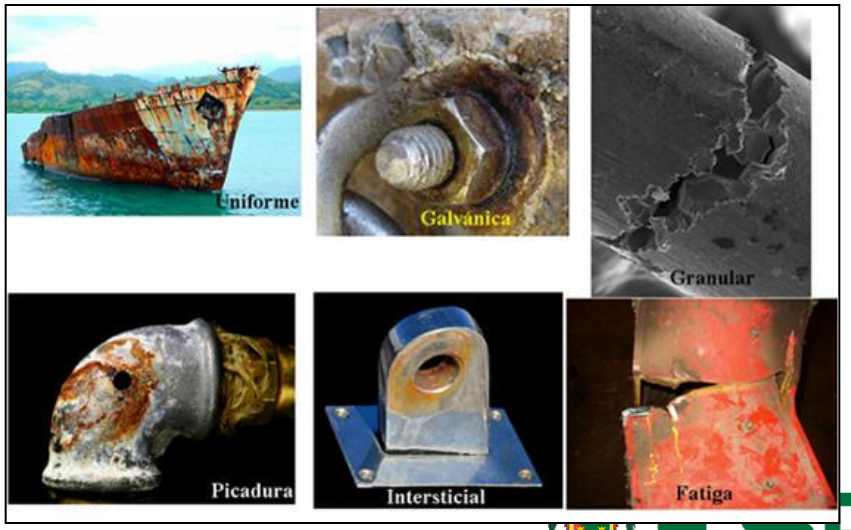






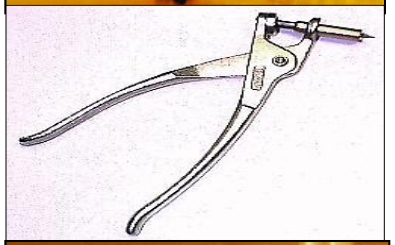
CORROSIÓN

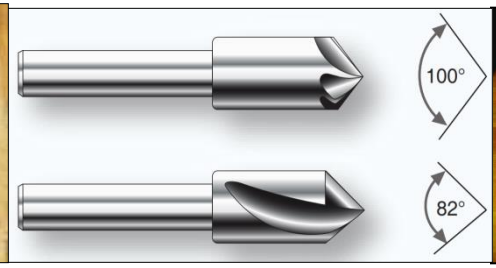
- TIPOS DE AGENTES CORROSIVOS
- TIPOS DE CORROSIÓN
- MEDIDAS DE PROTECCIÓN CONTRA LA CORROSIÓN
- MANTENIMIENTO PREVENTIVO DE CORROSIÓN
- PROCESO DE REMISIÓN DE CORROSIÓN



HERRAMIENTAS PARA LA REPARACIÓN

- TALADRO NEUMÁTICO
- CLECOS Y PORTA CLECOS
- CORTADOR DE REMACHES
- BARRA DE TRONZADO
- REMACHADORA NEUMÁTICA
- AVELLANADOR
- BUTEROLAS





TIPOS DE MANTENIMIENTO

MANTENIMIENTO PREVENTIVO

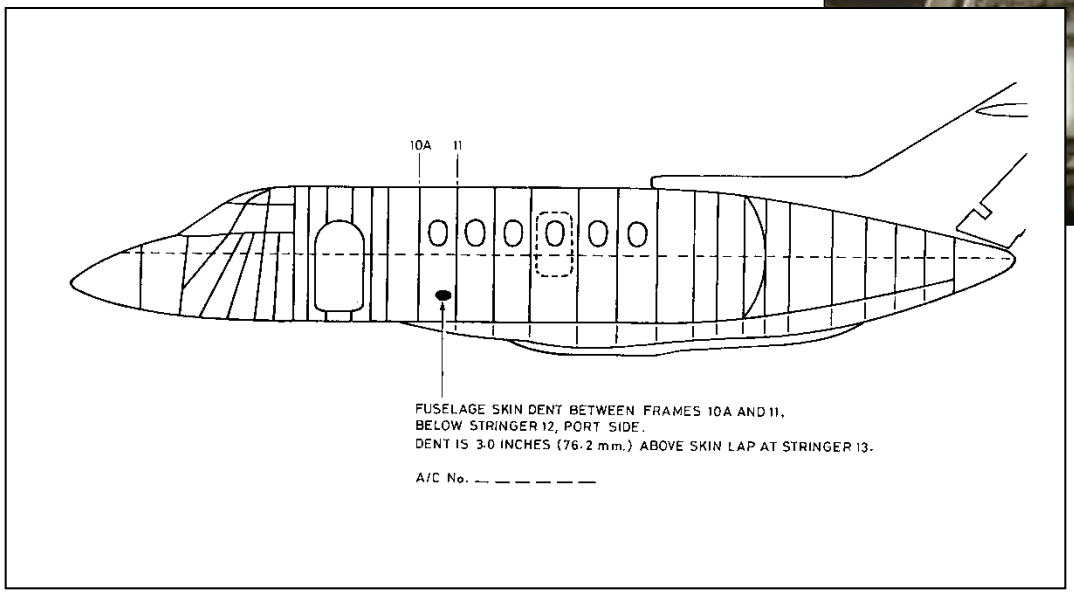
MANTENIMIENTO CORRECTIVO

MANTENIMIENTO RESTAURATIVO

CAPÍTULO III

- INTRODUCCIÓN
- MEDIDAS DE SEGURIDAD
- PLANIFICACIÓN DE TAREAS
- SIMBOLOS DE DIAGRAMA DE FLUJO
- ANALISIS ECONÓMICO

INTRODUCCIÓN



MEDIDAS DE SEGURIDAD

EPP

- Overol
- Guantes de nitrilo
- Zapatos punta de acero
- Gafas de protección
- Protector de oídos
- Mascarilla

HERRAMIENTAS

- Manuales
- Mesa para las herramientas
- Destornilladores
- Tela pañal
- Brocha
- Espátula o scraper
- Remachadora neumática
- Taladro neumático
- Limas plana y redonda

PLANIFICACIÓN DE TAREAS

- PLANIFICACIÓN INICIAL
- DETERMINACIÓN DE LOS DAÑOS PERMISIBLES

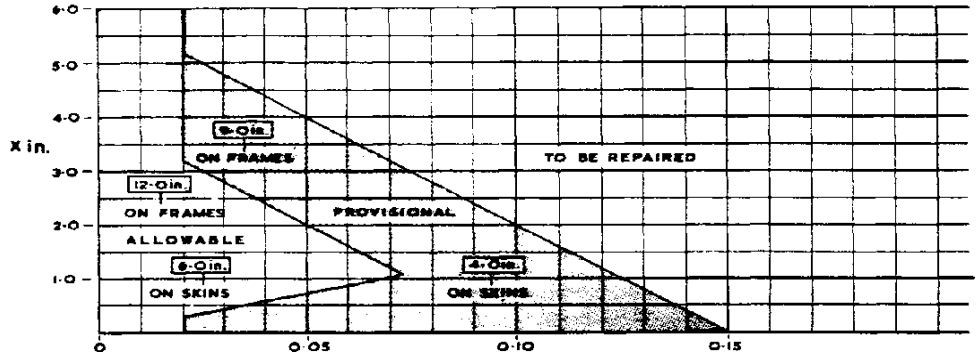
  (ver ANEXO A)
- DESIGNACIÓN DE LOS LUGARES DONDE SE REALIZARÁ LA REPARACIÓN
- COMPRA DE LOS MATERIALES PARA LA TAREA DE REPARACIÓN
- REPARACIÓN DE LAS CUBIERTAS
- ACABADOS
- PRUEBAS DE ACEPTACIÓN DE TAREAS

PLANIFICACIÓN INICIAL

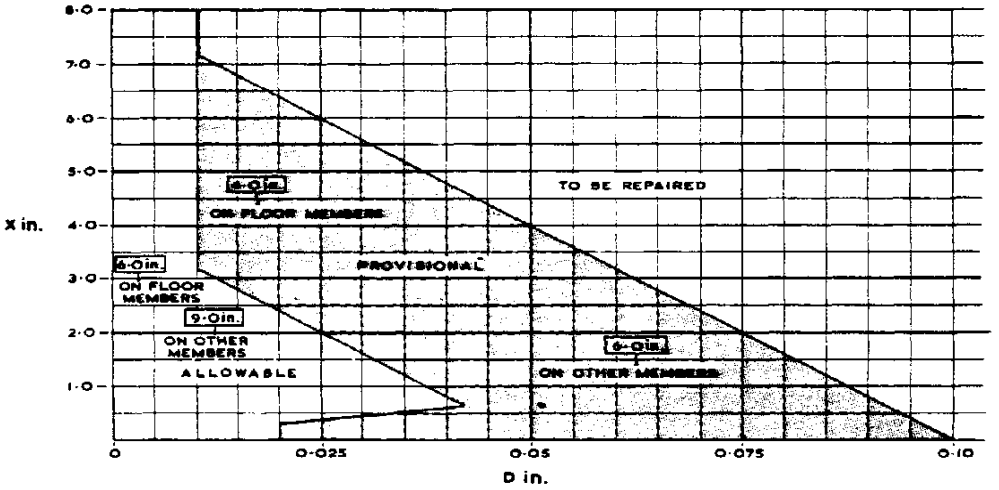
AERONAVE HAWKER SIDDLEY 125-400

DETERMINACIÓN DE LOS DAÑOS PERMISIBLES

ANEXO A



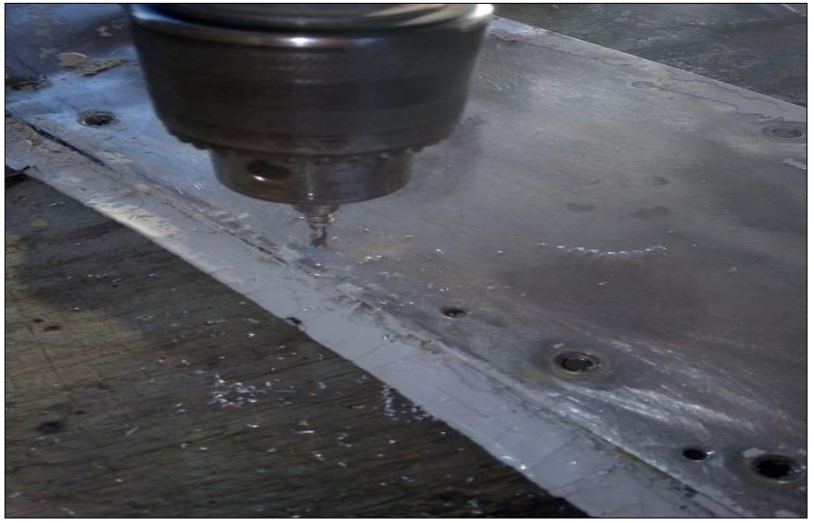
A



B — LAP STRINGERS – LONGITUDINALLY – EXCLUDING FLANGE AT A SKIN LAP
STRINGERS – LONGITUDINALLY ONLY
INTERCOSTALS
FLOOR STIFFENERS

NOTE : TO BE CLASSIFIED AS PROVISIONAL OR ALLOWABLE, DAMAGE MUST ALSO BE NOT LESS THAN THE RELEVANT "BOXED IN" DIMENSION FROM OTHER DAMAGE TO THE SAME MEMBER
REFER TO PRECEDING INSTRUCTIONS FOR USE OF EITHER CHART A OR B

LUGARES DONDE SE REALIZARÁ LA REPARACIÓN



COMPRA DE LOS MATERIALES PARA LA TAREA DE REPARACIÓN

Se consideró principalmente la lámina de aleación de aluminio para la piel nueva, remaches de 1/8 de pulgadas, pernos de 5/32 pulgadas, sellos, MEK, primer y pintura para los acabados.

REPARACIÓN DE LAS CUBIERTAS

- REMOSIÓN DE LAS CUBIERTAS
- DETERMINACIÓN DEL MÉTODO DE REPARACIÓN.
  -Se utiliza el AC43.13-1b (ver ANEXO B)
- DECAPADO DE LAS CUBIERTAS
- REMOCIÓN DE LOS REMACHES
- TIPOS DE CORROSIÓN ENCONTRADOS EN LAS CUBIERTAS
- REMOSIÓN Y/O ELIMINACIÓN DE LA CORROSIÓN
- MOLDEO DE LAS LÁMINAS DE ALEACIÓN DE ALUMINIO
- TALADRADO Y PREPARACIÓN DE LOS AGUJEROS PARA EL REMACHADO
- TRATAMIENTO TÉRMICO DE ALEACIÓN DE ALUMINIO 2024T3
- APLICACIÓN DE MATERIALES ANTICORROSIVOS
- PROCESO DE REMACHADO

REMOSIÓN DE LAS CUBIERTAS

DETERMINACIÓN DEL MÉTODO DE REPARACIÓN

Se utiliza el AC43.13-1b (ver **ANEXO B**)

SECTION 7. BASIC CORROSION REMOVAL TECHNIQUES

GENERAL. **When active corrosion is found, a positive inspection and rework program is necessary to prevent any further deterioration. The following methods of assessing corrosion damage and procedures for rework of corroded areas could be used during cleanup programs. In general, any rework would involve the cleaning and stripping of all finish from the corroded area, removal of corrosion products, and restoration of surface protective film.**

Repair of corrosion damage includes removal of all corrosion and corrosion products. When the corrosion damage is severe and exceeds the damage limits set by the aircraft or parts manufacturer, the part must be replaced.

If manufacturer information and limits are not available, then a DER must be consulted before the aircraft or part is returned to service.

PREPARATIONS FOR REWORK. **All corrosion products should be removed completely when corroded structures are reworked. Before starting rework of corroded areas, carry out the following:**

Document corrosion damage.

Position the aircraft in a wash rack or provide washing apparatus for rapid rinsing of all surfaces.

Connect a static ground line from the aircraft to a grounding point.

Prepare the aircraft for safe ground maintenance.

Remove battery(s), liquid oxygen generator container (if installed), and external hydraulic and electric power.

Install all applicable safety pins, flags, and jury struts.

Protect the pitot-static ports, louvers, airscoops, engine opening, wheels, tires, magnesium skin panels, and airplane interior from moisture and chemical brightening agents.

Protect the surfaces adjacent to rework areas from chemical paint strippers, corrosion removal agents, and surface treatment materials.

FAIRING OR BLENDING REWORKED AREAS. **All depressions resulting from corrosion rework should be faired or blended with the surrounding surface. Fairing can be accomplished as follows:**

Remove rough edges and all corrosion from the damaged area. All dish-outs should be elliptically shaped with the major axis running spanwise on wings and horizontal stabilizers, longitudinally on fuselages, and vertically on vertical stabilizers. (Select the proper abrasive for fairing operations from table 6-1.)

In critical and highly stressed areas, all pits remaining after the removal of corrosion products should be blended out to prevent stress risers that may cause stress corrosion cracking. (See figure 6-14.) On a non-critical structure, it is not necessary to blend out pits remaining after removal of corrosion products by abrasive blasting, since this results in unnecessary metal removal.

DECAPADO DE LAS CUBIERTAS

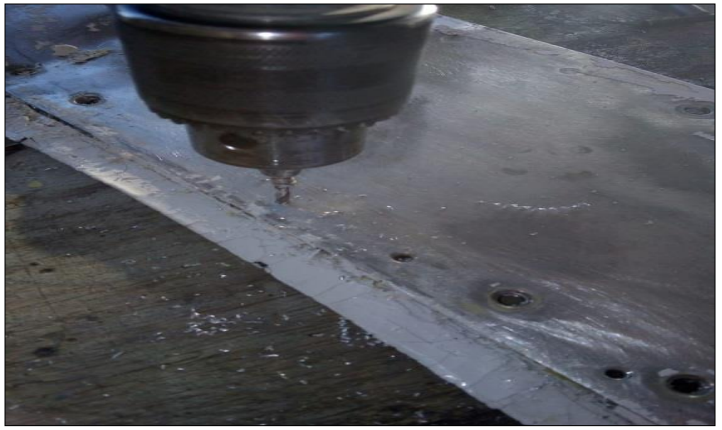
Se utilizó removedor de pintura EFS-2500, hay que esperar por lo menos 24 horas.

Con un scraper o espátula de nylon se retira toda la pintura.

REMOCIÓN DE REMACHES

PROCEDIMIENTO:

- Seleccionar una broca (0.003 pulgadas más pequeño)
- Taladre en el centro exacto de la cabeza del remache
- Retire la cabeza rompiéndola. Use un golpe como palanca.
- Saque la caña. **(Ver ANEXO C)**



ANEXO C

Occasionally, during an aircraft structural repair, it is wise to examine adjacent parts to determine the true condition of neighboring rivets. In doing so, it may be necessary to remove the paint. The presence of chipped or cracked paint around the heads may indicate shifted or loose rivets. Look for tipped or loose rivet heads. If the heads are tipped or if rivets are loose, they show up in groups of several consecutive rivets and probably tipped in the same direction. If heads that appear to be tipped are not in groups and are not tipped in the same direction, tipping may have occurred during some previous installation.

Inspect rivets known to have been critically loaded, but that show no visible distortion, by drilling off the head and carefully punching out the shank. If, upon examination, the shank appears joggled and the holes in the sheet misaligned, the rivet has failed in shear. In that case, try to determine what is causing the shearing stress and take the necessary corrective action. Flush rivets that show head slippage within the countersink or dimple, indicating either sheet bearing failure or rivet shear failure, must be removed for inspection and replacement.

Joggles in removed rivet shanks indicate partial shear failure. Replace these rivets with the next larger size. Also, if the rivet holes show elongation, replace the rivets with the next larger size. Sheet failures such as tear-outs, cracks between rivets, and the like usually indicate damaged rivets. The complete repair of the joint may require replacement of the rivets with the next larger size.

The general practice of replacing a rivet with the next larger size (1/32-inch greater diameter) is necessary to obtain the proper joint strength of rivet and sheet when the original rivet hole is enlarged. If the rivet in an elongated hole is replaced by a rivet of the same size, its ability to carry its share of the shear load is impaired and joint weakness results.

Removal of Rivets

When a rivet has to be replaced, remove it carefully to retain the rivet hole's original size and shape. If removed correctly, the rivet does not need to be replaced with one of the next larger size. Also, if the rivet is not removed properly, the strength of the joint may be weakened and the replacement of rivets made more difficult.

When removing a rivet, work on the manufactured head. It is more symmetrical about the shank than the shop head, and there is less chance of damaging the rivet hole or the material around it. To remove rivets, use hand tools, a power drill, or a combination of both.

The procedure for universal or protruding head rivet removal is as follows:

1. File a flat area on the head of the rivet and center punch the flat surface for drilling.

   NOTE: On thin metal, back up the rivet on the upset head when center punching to avoid depressing the metal.

2. Use a drill bit one size smaller than the rivet shank to drill out the rivet head.

   NOTE: When using a power drill, set the drill on the rivet and rotate the chuck several revolutions by hand before turning on the power. This procedure helps the drill cut a good starting spot and eliminates the chance of the drill slipping off and tracking across the metal.

3. Drill the rivet to the depth of its head, while holding the drill at a 90° angle. Do not drill too deeply, as the rivet shank will then turn with the drill and tear the surrounding metal.

   NOTE: The rivet head often breaks away and climbs the drill, which is a signal to withdraw the drill.

4. If the rivet head does not come loose of its own accord, insert a drift punch into the hole and twist slightly to either side until the head comes off.

5. Drive the remaining rivet shank out with a drift punch slightly smaller than the shank diameter.

On thin metal or unsupported structures, support the sheet with a bucking bar while driving out the shank. If the shank is unusually tight after the rivet head is removed, drill the rivet about two-thirds through the thickness of the material and then drive the rest of it out with a drift punch. *Figure 4-98* shows the preferred procedure for removing universal rivets.

The procedure for the removal of countersunk rivets is the same as described above except no filing is necessary. Be careful to avoid elongation of the dimpled or the countersunk holes. The rivet head should be drilled to approximately one-half the thickness of the top sheet. The dimple in 2117–T rivets usually eliminates the necessity of filing and center punching the rivet head.

To remove a countersunk or flush head rivet, you must:

1. Select a drill about 0.003-inch smaller than the rivet shank diameter.
2. Drill into the exact center of the rivet head to the approximate depth of the head.

ANEXO C

Rivet Removal

Remove rivets by drilling off the head and punching out the shank as illustrated.

1. File a flat area on the manufactured head of non-flush rivets.
2. Place a block of wood or a bucking bar under both flush and nonflush rivets when center punching the manufactured head.
3. Use a drill that is 1/32 (0.0312) inch smaller than the rivet shank to drill through the head of the rivet. Ensure the drilling operation does not damage the skin or cut the sides of the rivet hole.
4. Insert a drift punch into the hole drilled in the rivet and tilt the punch to break off the rivet head.
5. Using a drift punch and hammer, drive out the rivet shank. Support the opposite side of the structure to prevent structural damage.

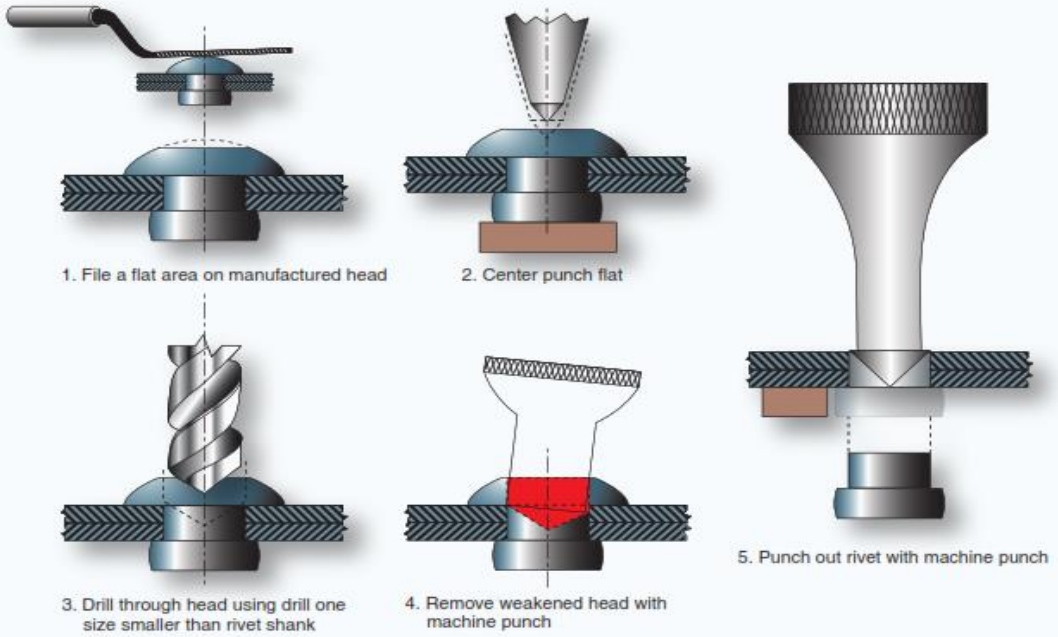


Figure 4-98. *Rivet removal.*

3. Remove the head by breaking it off. Use a punch as a lever.
4. Punch out the shank. Use a suitable backup, preferably wood (or equivalent), or a dedicated backup block. If the shank does not come out easily, use a small drill and drill through the shank. Be careful not to elongate the hole.

Replacing Rivets

Replace rivets with those of the same size and strength whenever possible. If the rivet hole becomes enlarged, deformed, or otherwise damaged, drill or ream the hole for the next larger size rivet. Do not replace a rivet with a type having lower strength properties, unless the lower strength is adequately compensated by an increase in size or a greater number of rivets. It is acceptable to replace 2017 rivets of 1/16-inch diameter or less, and 2024 rivets of 1/32-inch diameter or less with 2117 rivets for general repairs, provided the replacement rivets are 1/32-inch greater in diameter than the rivets they replace.

National Advisory Committee for Aeronautics (NACA) Method of Double Flush Riveting

A rivet installation technique known as the National Advisory Committee for Aeronautics (NACA) method has primary applications in fuel tank areas. *[Figure 4-99]* To make a NACA rivet installation, the shank is upset into a 82° countersink. In driving, the gun may be used on either the

TIPOS DE CORROSIÓN ENCONTRADOS EN LAS CUBIERTAS

REMOCIÓN DE LA CORROSIÓN

PROCEDIMIENTO DEL AC:

1.Identifique positivamente el metal como aluminio.

2.Limpie el área a retrabajar. Decape la pintura si es necesario.

3.Determinar la extensión del daño por corrosión.

4.Remueva la corrosión leve a moderada con uno de los siguientes:

a) Remoción de corrosión sin motor.

b) Remoción de corrosión química.

c) Remoción de corrosión accionada

5.Inspeccione el área por corrosión remanente. Repita el procedimiento si queda corrosión.

REMOCIÓN DE LA CORROSIÓN

Nota: si la corrosión permanece después del segundo intento, use un método más fuerte, por ejemplo, químico a mecánico.

6. Usar papel abrasivo de grano número 400

7. Limpie el área retrabajada con solventes de limpieza en seco.

9. Aplique el recubrimiento de conversión química, MIL-C-81706, inmediatamente después de retrabajar.

Nota: no se debe permitir que estas soluciones entren en contacto con magnesio o aceros de alta resistencia (180,000 psi). No permita que soluciones o materiales entren en contacto con diluyentes de pintura, acetona u otro material combustible: puede resultar en incendio.

10. Aplique acabados de pintura al área. **(Ver ANEXO D)**

ANEXO D

CORROSION REMOVAL AROUND COUNTERSUNK FASTENERS IN ALUMINUM ALLOY. **Intergranular corrosion in aluminum alloys often originates at countersunk areas where steel fasteners are used.**

When corrosion is found around a fixed fastener head, the fastener must be removed to ensure corrosion removal. All corrosion must be removed to prevent further corrosion and loss of structural strength. To reduce the recurrence of corrosion, the panel should receive a chemical conversion coating, be primed, and have the fasteners installed wet with sealant.

Each time removable steel fasteners are removed from access panels, they should be inspected for condition of the plating. If mechanical or plating damage is evident, replace the fastener. One of the following fastener installation methods should be used:

Brush a corrosion-preventive compound on the substructure around and in the fastener hole, start the fastener, apply a bead of sealant to the fastener countersink, set and torque the fastener within the working time of the sealant (this is the preferred method).

Apply the corrosion preventive compound to the substructure and fastener, set and torque the fastener.

Apply a coating of primer to the fastener, and while wet with primer, set and torque the fastener.

EXAMPLES OF REMOVING CORROSION FROM ALUMINUM AND ALUMINUM ALLOYS.

Positively identify the metal as aluminum.

Clean the area to be reworked. Strip paint if required.

Determine extent of corrosion damage.

Remove light to moderate corrosion with one of the following.

Non-Powered Corrosion Removal.

The removal of corrosion products by hand can be accomplished by use of aluminum grit and silicon carbide abrasive, such as non-woven, non-metallic, abrasive mat (Spec. MIL-A-9962), abrasive cloth, and paper. Aluminum wool, fiber bristle brushes, and pumice powder are also acceptable methods.

Stainless steel brush (Spec. H-B-178, type III, class 2) may be used as long as the bristles do not exceed 0.010 inch in diameter. After use of this brush the surface should be polished with 60 grit aluminum oxide abrasive paper, then with 400 grit aluminum oxide paper. Care should be exercised in any cleaning process to avoid breaking the protective film.

Steel wool, emery cloth, steel wire brushes (except stainless steel brush) copper alloy brushes, rotary wire brushes, or severe abrasive materials should not be used on any aluminum surface.

Chemical Corrosion Removal.

The corrosion removal compound aluminum pretreatment MIL-C-38334, an acid material, may be used to remove corrosion products from aluminum alloy materials or items (e.g., skins, stringer, ribs in wings, tubing, or ducts). MIL-C-38334 is available in two types:

Type I Liquid concentrate materials should be diluted in accordance with the

ANEXO D

Inspect the area for remaining corrosion. Repeat procedure if any corrosion remains.

NOTE: If corrosion remains after the second attempt, use a stronger method, e.g., chemical to mechanical.

Using a blend ratio of 20:1 (length to depth) blend and finish the corrosion rework area with progressively finer abrasive paper until 400-grit paper is used.

Clean reworked area using dry cleaning solvent. Do not use kerosene or any other petroleum base fuel as a cleaning solvent.

Determine depth of faired depressions to ensure that rework limits have not been exceeded.

Apply chemical conversion coating, MIL-C-81706, immediately after reworking. If 48 hours or more have elapsed since the conversion coating was first applied and the primer or final paint system has not yet been applied, then reapply the conversion coating before continuing.

NOTE: These solutions should not be allowed to come in contact with magnesium or high-strength steels (180,000 psi). Do not permit solutions or materials to contact paint thinner, acetone or other combustible material: FIRE MAY RESULT.

Apply paint finish to area.

6-137.—6-147. [RESERVED.]

MOLDEO DE LAS LÁMINAS QUE CONFORMAN LA NUEVA PIEL

Se realiza el moldeo de las láminas para la nueva piel utilizando como molde la lámina de la piel vieja.

Con la ayuda de los clecos se retuvo ambas laminas y con una lima se dio la forma adecuada a los bordes y esquinas.

TALADRADO Y PREPARACIÓN DE LOS AGUJEROS PARA EL REMACHADO

TALADRADO:

1.Asegúrese de que la broca tenga el tamaño y la forma correctos.

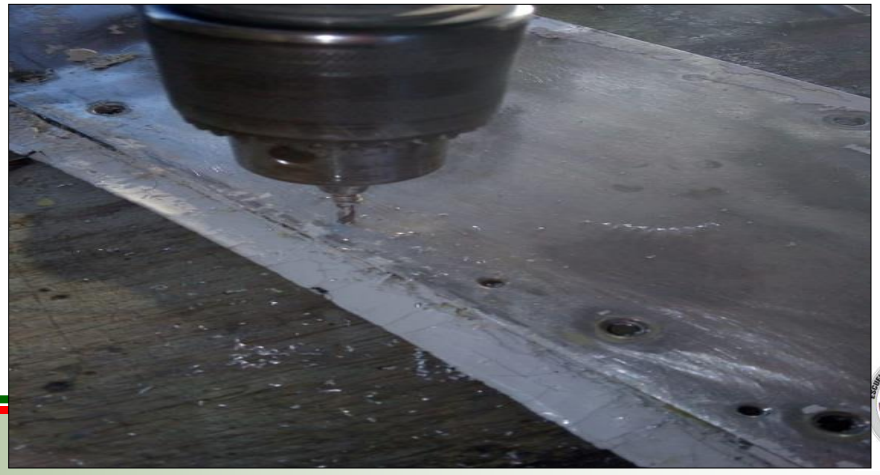
2.Coloque el taladro en la marca perforada central.

3.Mientras perfora, sostenga siempre la broca en un ángulo de 90° con respecto al trabajo o la curvatura del material.

4.Evite una presión excesiva, deje que la broca haga el corte y nunca empuje la broca a través del material.

5.Remueva todas las rebabas con un avellanador de metal o una lima.

6.Limpie todas las virutas de perforación. **(Ver ANEXO E)**



Adjustments should always be made first on scrap material. When correctly adjusted, the microshaver leaves a small round dot about the size of a pinhead on the microshaved rivet. It may occasionally be necessary to shave rivets, normally restricted to MS20426 head rivets, after driving to obtain the required flushness. Shear head rivets should never be shaved.

Riveting Procedure

The riveting procedure consists of transferring and preparing the hole, drilling, and driving the rivets.

Hole Transfer

Accomplish transfer of holes from a drilled part to another part by placing the second part over first and using established holes as a guide. Using an alternate method, scribe hole location through from drilled part onto part to be drilled, spot with a center punch, and drill.

Hole Preparation

It is very important that the rivet hole be of the correct size and shape and free from burrs. If the hole is too small, the protective coating is scratched from the rivet when the rivet is driven through the hole. If the hole is too large, the rivet does not fill the hole completely. When it is bucked, the joint does not develop its full strength, and structural failure may occur at that spot.

If countersinking is required, consider the thickness of the metal and adopt the countersinking method recommended for that thickness. If dimpling is required, keep hammer blows or dimpling pressures to a minimum so that no undue work hardening occurs in the surrounding area.

Drilling

Rivet holes in repair may be drilled with either a light power drill or a hand drill. The standard shank twist drill is most commonly used. Drill bit sizes for rivet holes should be the smallest size that permits easy insertion of the rivet, approximately 0.003-inch greater than the largest tolerance of the shank diameter. The recommended clearance drill bits for the common rivet diameters are shown in *Figure 4-90*.

Rivet Diameter (in)	Drill Size	
	Pilot	Final
3/32	3/32 (0.0937)	#40 (0.098)
1/8	1/8 (0.125)	#30 (0.1285)
5/32	5/32 (0.1562)	#21 (0.159)
3/16	3/16 (0.1875)	#11 (0.191)
1/4	1/4 (0.250)	F (0.257)

Figure 4-90. *Drill sizes for standard rivets.*

Hole sizes for other fasteners are normally found on work documents, prints, or in manuals.

Before drilling, center punch all rivet locations. The center punch mark should be large enough to prevent the drill from slipping out of position, yet it must not dent the surface surrounding the center punch mark. Place a bucking bar behind the metal during punching to help prevent denting. To make a rivet hole the correct size, first drill a slightly undersized hole (pilot hole). Ream the pilot hole with a twist drill of the appropriate size to obtain the required dimension.

To drill, proceed as follows:

1. Ensure the drill bit is the correct size and shape.
2. Place the drill in the center-punched mark. When using a power drill, rotate the bit a few turns before starting the motor.
3. While drilling, always hold the drill at a 90° angle to the work or the curvature of the material.
4. Avoid excessive pressure, let the drill bit do the cutting, and never push the drill bit through stock.
5. Remove all burrs with a metal countersink or a file.
6. Clean away all drill chips.

When holes are drilled through sheet metal, small burrs are formed around the edge of the hole. This is especially true when using a hand drill because the drill speed is slow and there is a tendency to apply more pressure per drill revolution. Remove all burrs with a burr remover or larger size drill bit before riveting.

Driving the Rivet

Although riveting equipment can be either stationary or portable, portable riveting equipment is the most common type of riveting equipment used to drive solid shank rivets in airframe repair work.

Before driving any rivets into the sheet metal parts, be sure all holes line up perfectly, all shavings and burrs have been removed, and the parts to be riveted are securely fastened with temporary fasteners. Depending on the job, the riveting process may require one or two people. In solo riveting, the riveter holds a bucking bar with one hand and operates a riveting gun with the other.

If the job requires two aircraft technicians, a shooter, or gunner, and a bucker work together as a team to install rivets. An important component of team riveting is an efficient signaling system that communicates the status of the riveting process. This signaling system usually consists of tapping the bucking bar against the work and is often called the tap

ANEXO E

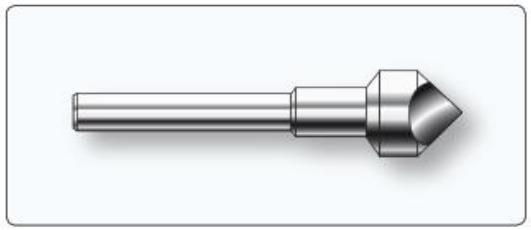


Figure 4-92. *Single-flute countersink.*

The microstop countersink is the preferred countersinking tool. *[Figure 4-85]* It has an adjustable-sleeve cage that functions as a limit stop and holds the revolving countersink in a vertical position. Its threaded and replaceable cutters may have either a removable or an integral pilot that keeps the cutter centered in the hole. The pilot should be approximately 0.002-inch smaller than the hole size. It is recommended to test adjustments on a piece of scrap material before countersinking repair or replacement parts.

Freehand countersinking is needed where a microstop countersink cannot fit. This method should be practiced on scrap material to develop the required skill. Holding the drill motor steady and perpendicular is as critical during this operation as when drilling.

Chattering is the most common problem encountered when countersinking. Some precautions that may eliminate or minimize chatter include:

- Use sharp tooling.
- Use a slow speed and steady firm pressure.
- Use a piloted countersink with a pilot approximately 0.002-inch smaller than the hole.
- Use back-up material to hold the pilot steady when countersinking thin sheet material.
- Use a cutter with a different number of flutes.
- Pilot drill an undersized hole, countersink, and then enlarge the hole to final size.

Dimpling

Dimpling is the process of making an indentation or a dimple around a rivet hole to make the top of the head of a countersunk rivet flush with the surface of the metal. Dimpling is done with a male and female die, or forms, often called punch and die set. The male die has a guide the size of the rivet hole and is beveled to correspond to the degree of countersink of the rivet head. The female die has a hole into which the male guide fits and is beveled to a corresponding degree of countersink.

When dimpling, rest the female die on a solid surface. Then, place the material to be dimpled on the female die. Insert the male die in the hole to be dimpled and, with a hammer, strike the male die until the dimple is formed. Two or three solid hammer blows should be sufficient. A separate set of dies is necessary for each size of rivet and shape of rivet head. An alternate method is to use a countersunk head rivet instead of the regular male punch die, and a draw set instead of the female die, and hammer the rivet until the dimple is formed.

Dimpling dies for light work can be used in portable pneumatic or hand squeezers. *[Figure 4-93]* If the dies are used with a squeezer, they must be adjusted accurately to the thickness of the sheet being dimpled. A table riveter is also used for dimpling thin skin material and installing rivets. *[Figure 4-94]*

Coin Dimpling

The coin dimpling, or coin pressing, method uses a countersink rivet as the male dimpling die. Place the female die in the usual position and back it with a bucking bar. Place the rivet of the required type into the hole and strike the rivet with a pneumatic riveting hammer. Coin dimpling should be used only when the regular male die is broken or not available. Coin pressing has the distinct disadvantage of the

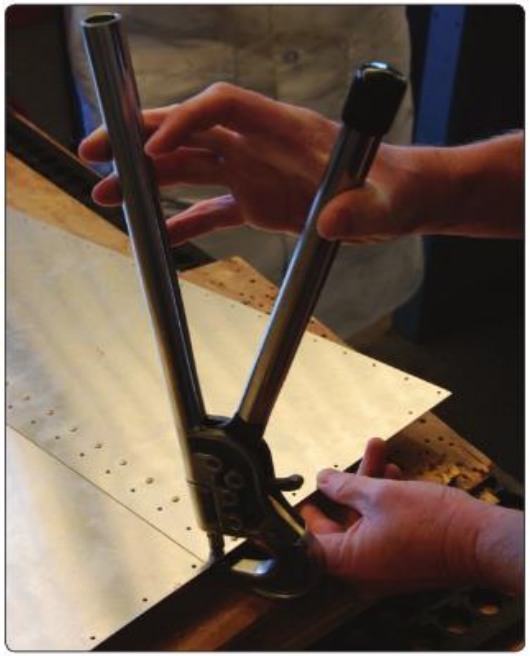


Figure 4-93. *Hand squeezers.*

ANEXO E

TALADRADO Y PREPARACIÓN DE LOS AGUJEROS PARA EL REMACHADO

AVELLANADO:

1.Use herramientas afiladas.

2.Use una velocidad lenta y una presión firme y constante.

3.Use un avellanado piloto con un piloto aproximadamente de 0.002 pulgadas más pequeño que el agujero.

4.Use material de respaldo para mantener el piloto estable cuando avellane el material de hoja delgada.

5.Use un cortador con un número diferente de estrías.

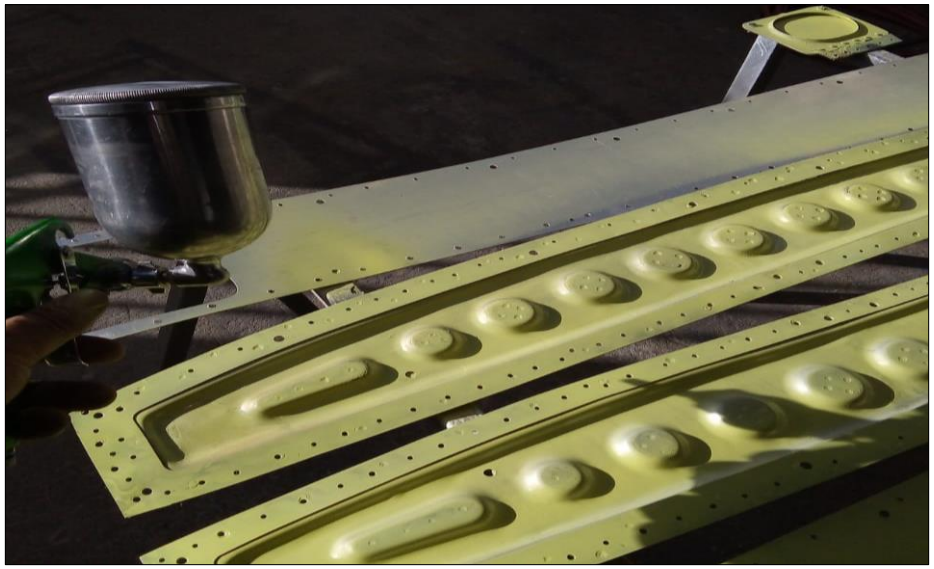
6.Haga un taladro piloto en un agujero de menor tamaño, avellane y luego agrande el agujero al tamaño final. **(Ver ANEXO E)**

TRATAMIENTO TÉRMICO DE ALEACIÓN DE ALUMINIO 2024T3

Varias partes de la aeronave necesitan tratamientos térmicos y las más comunes son las aleaciones de aluminio.

Debido a las dimensiones de las cubiertas que superaban al del horno, se procedió a realizar el tratamiento térmico a una probeta de la misma aleación y espesor.

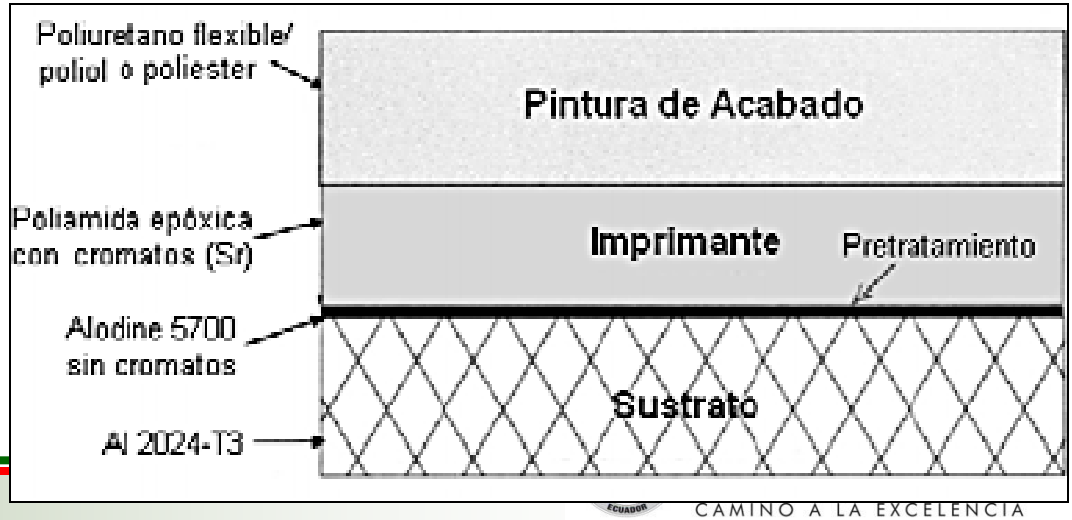
APLICACIÓN DE MATERIALES ANTICORROSIVOS



Se limpió todas las superficies de las láminas con MEK.

Se aplicó una película de Alodine.

Una vez seco las superficies se aplica primer el cual inhibe la corrosión del metal y hace que las capas de acabado se adhiera a los componentes.



PROCESO DE REMACHADO

Es importante considerar que es necesario trabajar con 2 o 3 personas como máximo.

Para determinar la longitud total del remache se sumó la longitud total de agarre más la cantidad de vástago del remache necesaria para formar una cabeza taller adecuada.

The size of the formed head is the visual standard of a proper rivet installation. The minimum and maximum sizes, as well as the ideal size, are shown in *Figure 4-76*.

Installation of Rivets

Repair Layout

Repair layout involves determining the number of rivets required, the proper size and style of rivets to be used, their material, temper condition and strength, the size of the holes, the distances between the holes, and the distance between the holes and the edges of the patch. Distances are measured in terms of rivet diameter.

Rivet Length

To determine the total length of a rivet to be installed, the combined thickness of the materials to be joined must first be known. This measurement is known as the grip length. The total length of the rivet equals the grip length plus the amount of rivet shank needed to form a proper shop head. The latter equals one and a half times the diameter of the rivet shank. Where A is total rivet length, B is grip length, and C is the length of the material needed to form a shop head, this formula can be represented as A = B + C. *[Figure 4-76]*

Rivet Strength

For structural applications, the strength of the replacement rivets is of primary importance. *[Figure 4-77]* Rivets made of material that is lower in strength should not be used as replacements unless the shortfall is made up by using a larger rivet. For example, a rivet of 2024-T4 aluminum alloy should not be replaced with one of 2117-T4 or 2017-T4 aluminum alloy unless the next larger size is used.

The 2117-T rivet is used for general repair work, since it requires no heat treatment, is fairly soft and strong, and is highly corrosion resistant when used with most types of alloys. Always consult the maintenance manual for correct rivet type and material. The type of rivet head to select for a particular repair job can be determined by referring to the type used within the surrounding area by the manufacturer.

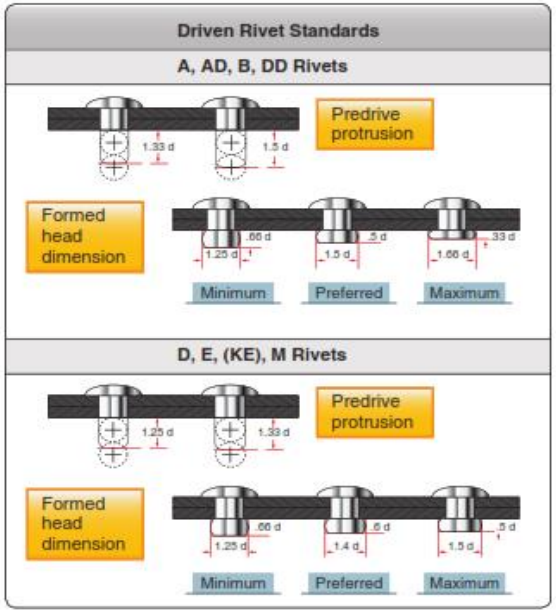


Figure 4-76. *Rivet formed head dimensions.*

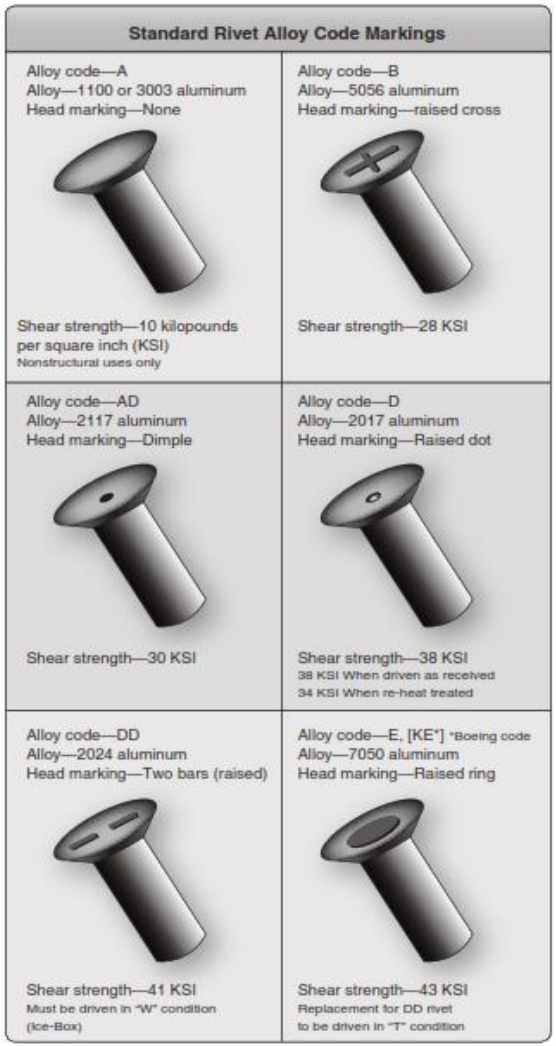
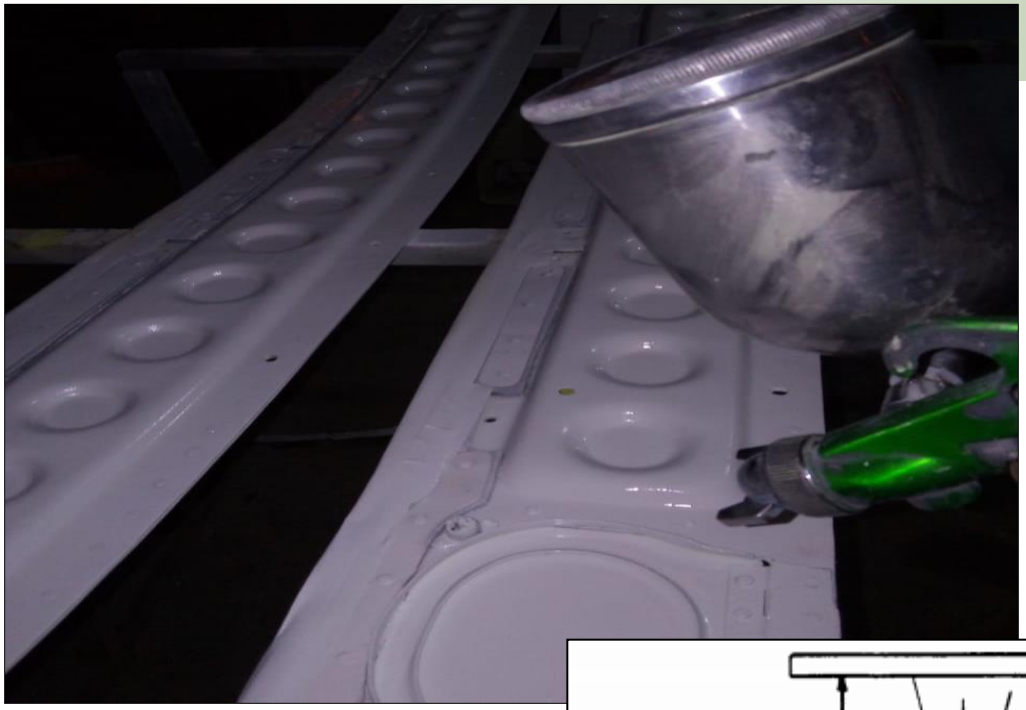


Figure 4-77. *Rivet alloy strength.*

ANEXO F

ACABADOS



Una vez terminado el proceso de remachado se empezó con el proceso de pintado, para el cual se utilizó pintura blanca.

Es de suma importancia utilizar el equipo de protección personal.

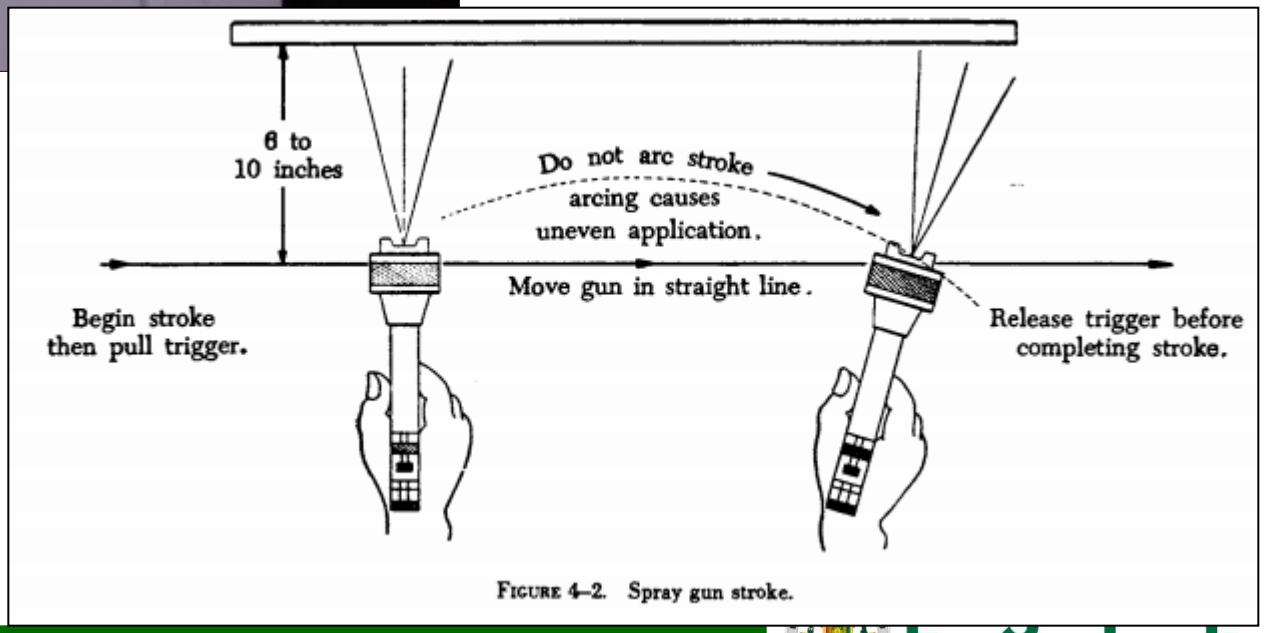
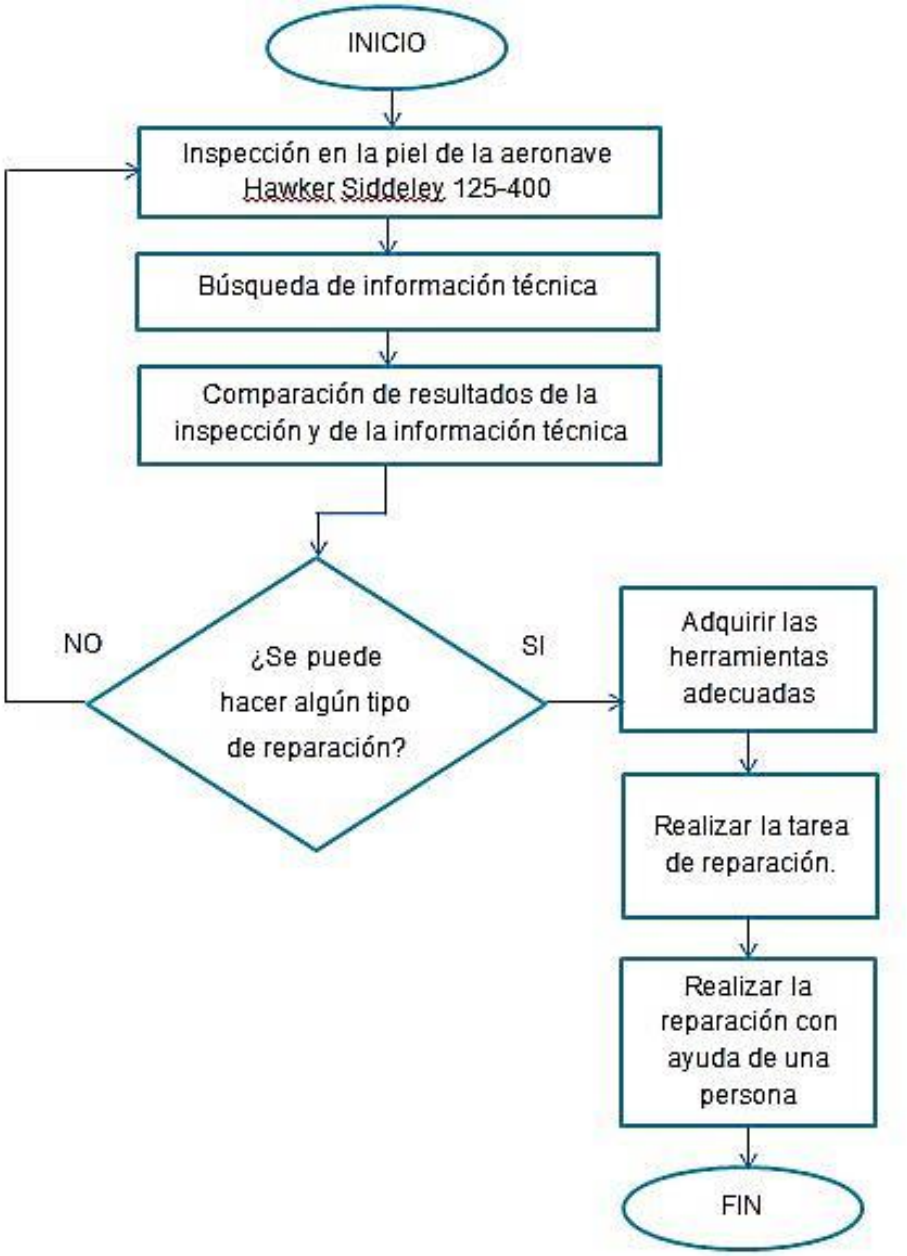


FIGURE 4–2. Spray gun stroke.

PRUEBAS DE ACEPTACIÓN DE TAREAS

PRUEBAS DE ACEPTACIÓN DE TAREAS		
Indicadores	**Favorable**	**Desfavorable**
Los acabados presentan una forma aerodinámica.	X	
Muestra rigidez y firmeza	X	
Es similar en apariencia al diseño original de fábrica.	X	
Ocupa el área adecuadamente	X	

SÍMBOLOS DE DIAGRAMA DE FLUJO



ANÁLISIS ECONÓMICO

- COSTOS PRIMARIOS
- COSTOS SECUNDARIOS
- COSTO TOTAL

COSTOS PRIMARIOS

Descripción	Cantidad	Valor unitario (USD)	Valor toral (USD)
Equipo de tratamiento térmico (horno)	1	1600	1600
Láminas de aleación de aluminio de 0.036 de espesor de 2x2.40 m	2	15	30
Remaches 1/8	1/2 lb	0.08	5
Pernos 3/32	20	0.15	3
Pernos de 5/32	18	0.30	5.40
Pernos 1/8 cabeza avellanada	4	0.10	0.40
Sellante	1/2 lt	20	20
Sello	5m	3	15
Pintura	2lt	10	20
Primer	2tl	15	30
Mek	2tl	10	20
Tela pañal 1x1 m	1	2	2
Brocha ¾	1	1.50	1.50
Láminas de choba	5	3	15
Cinta metálica	1	8	8
Brocas de 3/32	3	2.50	7.50
Brocas de 5/32	2	3	6
Brocas de 1/8	2	2.40	4.80
Removedor de pintura	1lt	15	15
TOTAL	----------	----------	1808.60

COSTOS SECUNDARIOS

N°	Detalle	Valor total (USD)
1	Tramites de solicitudes de graduación	30
2	Elaboración de textos	200
3	Viáticos	100
	TOTAL	330.00

COSTO TOTAL

N°	Detalle	Valor total (USD)
1	Costos primarios	1808.60
2	Costos secundarios	330.00
	TOTAL	2138.60

CAPÍTULO IV

- CONCLUSIONES
- RECOMENDACIONES

CONCLUSIONES

- Se realizó la tarea de reparación de la piel de las compuertas inferiores del fuselaje central, de acuerdo con los procedimientos especificados en el manual de reparación estructural y en gran parte se utilizó los procedimientos del documento AC43.13-1b, por motivo de que los manuales de mantenimiento no especifican el proceso de reparación de esos componentes en específico.
- El tratamiento térmico a los componentes de aleación de aluminio facilita el trabajo de reparación, y el uso del equipo para tratamiento térmico es una buena opción para el material que se utilizó en la reparación en las cubiertas de aleación de aluminio 2024-T3 de 0.036 pulgadas de espesor. Debido a que la longitud de las cubiertas reparadas superó las dimensiones del horno, se realizó el tratamiento térmico a una probeta de la misma aleación y espesor, a una temperatura de 400°C por 1 hora y enfriado lentamente.

CONCLUSIONES

- En el manual de reparación estructural del Hawker Siddeley 125-400 se encuentran los procedimientos que se puede considerar para la reparación de componentes específicos o similares, pero debido al estado de deterioro de las cubiertas superó los daños permisibles del SRM 53-00 página 102 figura 101, y se tuvo que recurrir al documento AC43.13-1b de la Administración Federal de Aviación para realizar adecuadamente el trabajo de titulación.

RECOMENDACIONES

- Se debe recopilar toda la información técnica que sea necesaria antes de realizar cualquier tipo de reparación, con el fin de establecer las respectivas medidas de seguridad tanto para los componentes y del usuario, así como los equipos y herramientas adecuadas que se utilizaran en los trabajos de mantenimiento.

- Utilizar los equipos de protección personal para trabajar con el horno de tratamiento térmico, los guantes son indispensable para manipular materiales o probetas que se hayan utilizado para dar el respectivo tratamiento térmico.

RECOMENDACIONES

- Hay que tener en cuenta que todos los manuales de la aeronave presentan información técnica relevante y se debe considerar la más idónea para el trabajo de reparación, también hay que considerar los procedimiento del documento AC43.13-1b en el caso que el fabricante de la aeronave no haya especificado los lineamientos para la reparación de un componente considerado como piel secundaria.

Gracias por su Atención

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