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LOCKWIRE AND LOCKCLIP - MAINTENANCE PRACTICES

1. General

A. This procedure has the maintenance practices for lockwire and lockclips. This procedure includes:

- Removal of lockwire and lockclips
- Installation of lockwire and lockclips
- Aileron tension regulator lockwire procedure.

B. Lockwire and lockclips are used to safely attach parts and prevent these parts from becoming loose.

C. Lockwire is used on:

- electrical connectors
- turnbuckles
- swaged cable terminals
- clevis fittings
- nuts
- bolts
- pipe fittings
- clamps
- emergency equipment switch covers.

D. Always use new safety wire of the specified type and diameter.

WARNING

DO NOT USE LOCKWIRE, SAFETY CABLES OR COTTER PINS IN THE FUEL TANKS OR FOR HARDWARE RETENTION OF COMPONENTS OR EQUIPMENT INSTALLED IN FUEL TANKS. STATIC DISCHARGES FROM THE LOCKWIRE, SAFETY CABLES OR COTTER PINS CAN CAUSE FIRES OR EXPLOSIONS. LOCKWIRE, SAFETY CABLES AND COTTER PINS CAN BE USED IF THEY ARE CONTAINED INSIDE THE HOUSING OF AN EXPLOSION PROOF, TANK MOUNTED COMPONENT, AND MUST BE INSTALLED ACCORDING TO THE APPLICABLE BOEING DESIGN, REPAIR AND MAINTENANCE DOCUMENTATION. THIS WILL HELP PREVENT INJURY TO PERSONS AND DAMAGE TO THE AIRCRAFT.

(1) Do not install the lockwire or cotter pins in the fuel tanks. The components or the equipment installed in the fuel tanks must not use lockwire or cotter pins to hold equipment. You can use the lockwire and cotter pins in the housing of an explosion proof, tank installed LRU. You must install the lockwire and cotter pins with the applicable Boeing design, repair, or maintenance documentation.

NOTE : The above warning is a Critical Design Configuration Control Limitation (CDCCL) procedure. For important information on CDCCLs, refer to Airworthiness Limitation Precautions (Ref. AIRWORTHINESS LIMITATIONS PRECAUTIONS, TASK 28-00-00-840-801).

E. Lockwire must be tight after installation and must have approximately 8-10 twists for each 1.0 in. (25.4 mm). The lockwire must not have kinks, cuts or sharp edges at the ends. (Ref. LOCKWIRE AND LOCKCLIP - MAINTENANCE PRACTICES, 20-20-05/201)

F. Twist the lockwire clockwise on connectors, nuts and bolts that tighten clockwise. Twist the lockwire counterclockwise on connectors, nuts and bolts that tightencounterclockwise. (Ref. LOCKWIRE AND LOCKCLIP - MAINTENANCE PRACTICES, 20-20-05/201)

TASK 20-20-05-000-801

2. LOCKWIRE AND LOCKCLIP REMOVAL

A. Tools/Equipment

Reference	Description
STD-3904	Goggles - Safety

B. Procedure - Lockwire and Lockclip Removal

SUBTASK 20-20-05-030-001

(1) Remove lockwire as follows:

WARNING

USE SAFETY GOGGLES WHEN YOU INSTALL OR REMOVE LOCKWIRE. PIECES OF LOCKWIRE THAT BECOME AIRBORNE CAN CAUSE INJURY TO PERSONS.

(a) Use the STD-3904 safety goggles to prevent injury to your eyes from the lockwire.

(b) Always cut lockwire at the loop adjacent to the hole in a fastener or the connector with diagonal cutter pliers. Do not bend the lockwire to break it. This practice can cause damage to the fastener or the connector. (Ref. LOCKWIRE AND LOCKCLIP - MAINTENANCE PRACTICES, 20-20-05/201)

(c) Remove the cut lockwire from the fastener or the connector with lockwire flat pliers. (Ref. LOCKWIRE AND LOCKCLIP - MAINTENANCE PRACTICES, 20-20-05/201)

(d) Hold components that can move easily (conduits, cables, tubes, etc.) as close as possible to the lockwire. This will help prevent damage to the component.

SUBTASK 20-20-05-030-003

(2) Remove safety lockclips from the turnbuckle as follows: (Ref. Figure 201)

(a) Put a thin flat screwdriver into the barrel hole.

(b) Push and bend the lockclip hook lip, then pull on the hook shoulder of the lockclip until it goes out of the barrel hole.

(c) Pull on the end loop of the lockclip (1) and out of the barrel slot and fitting slot.

(d) Remove the other lockclip.

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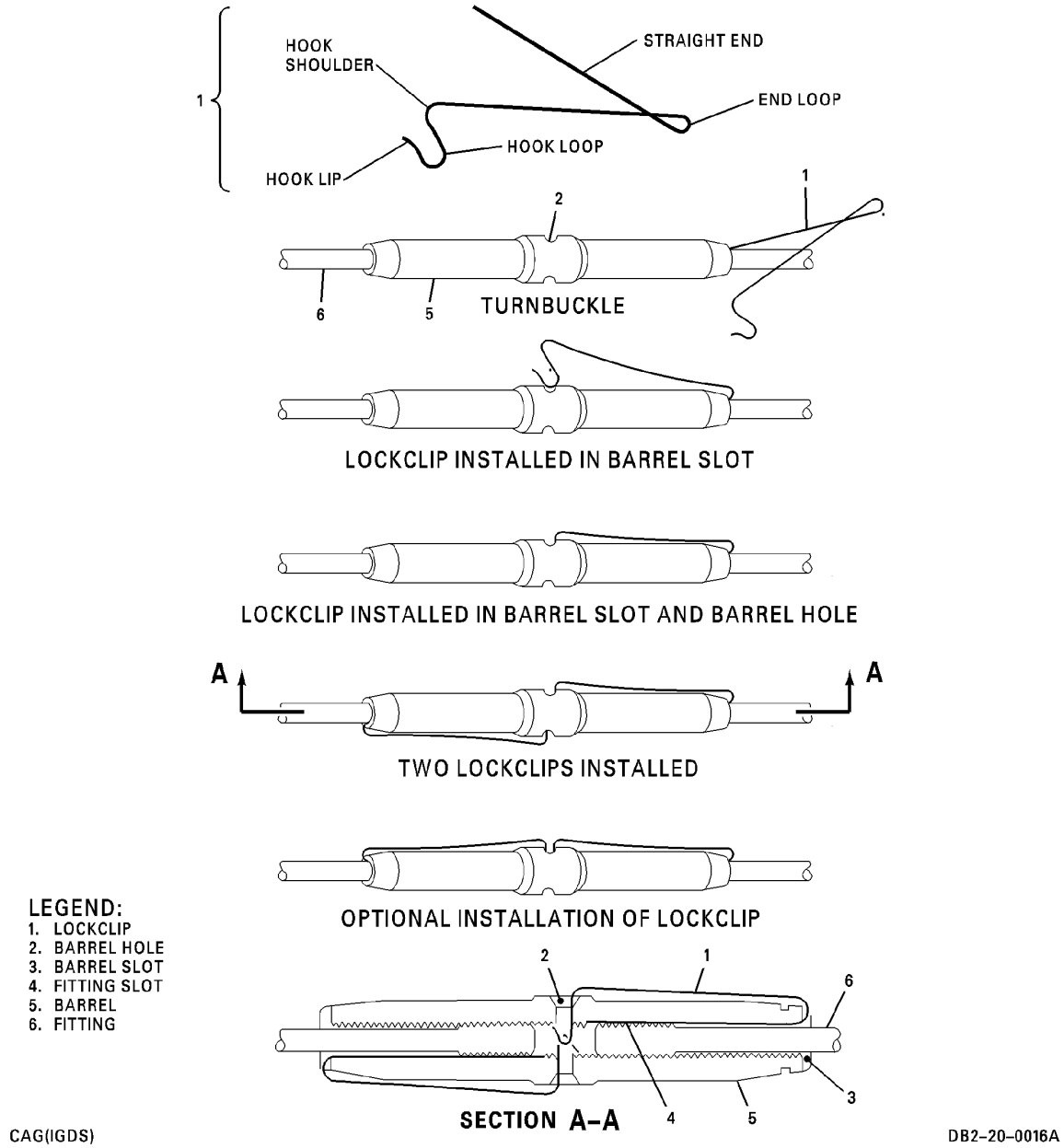

Figure 201. Turnbuckle Lockclips - Removal/Installation
(Sheet 1)

TASK 20-20-05-400-801 

3. LOCKWIRE AND LOCKCLIP INSTALLATION

A. Lockwire - Alternate Materials

(1) An alternate lockwire material is permitted only as follows:

(a) The NASM20995C (CRES Lockwire) cannot be installed as an alternate to NASM20995N (Inconel Lockwire) in the areas that follow:

1) All uses in and on the Engine, Engine Nacelle and Pylon.

2) All uses in and on the engine to pylon, pylon to wing or pylon to fuselage areas.

3) All uses in APU compartment.

4) All uses in and on the Landing gear brakes.

(b) The NASM20995C (CRES Lockwire) can be installed as an alternate to NASM20995N (Inconel Lockwire) in all areas, systems, or components not listed in the above step.

Standard Lockwire Sizes

STANDARD LOCKWIRE SIZES	
DPM 684 INCONEL (NASM20995N) (MS20995N) (INCHES)	DPM 5865 Ref. *[1] CORROSION RESISTANT STEEL (NASM20995C) (INCHES)
0.020	0.020
0.032	0.032
0.040	0.041
0.051	0.047
0.091	0.091

*[1]
Use Corrosion Resistant Steel (CRES) safety wire only where specified above.

B. Tools/Equipment

Reference	Description
STD-3904	Goggles - Safety

C. Procedure - Lockwire and Lockclip Installation

SUBTASK 20-20-05-800-001 

WARNING

USE SAFETY GOGGLES WHEN YOU INSTALL OR REMOVE LOCKWIRE. PIECES OF LOCKWIRE THAT BECOME AIRBORNE CAN CAUSE INJURY TO PERSONS.

(1) Use the STD-3904 safety goggles to prevent injury to your eyes from the lockwire.

SUBTASK 20-20-05-430-001

(2) Safety bolts with lockwire as follows: (Ref. Figure 202)(Ref. LOCKWIRE AND LOCKCLIP - MAINTENANCE PRACTICES, 20-20-05/201)

(a) Tighten and torque the bolts as necessary.

(b) Put one-half of the lockwire length through the hole in the bolt head.

(c) Bend the lockwire around the head of the bolt in a tighten direction.

(d) Twist the lockwire clockwise to the hole on the other bolt head.

(e) Put the top wire of the twist through the hole on the bolt head and pull the wire tight.

(f) Bend the other around the bolt head in a tighten direction.

(g) Twist the lockwire counterclockwise.

(h) Leave approximately six twists.

(i) Cut the unwanted length of lockwire with diagonal cutter pliers and bend the twisted lockwire end toward of the hardware.

SUBTASK 20-20-05-430-002

(3) Safety turnbuckles with lockwire as follows: (Ref. Figure 203) (Ref. LOCKWIRE AND LOCKCLIP - MAINTENANCE PRACTICES, 20-20-05/201)

NOTE : Check that not more than three threads of turnbuckle end fittings are exposed. End fitting shanks may be threaded into barrel to any depth, with no threads visible, provided enough room is left on shanks for wrapping lockwire.

(a) Cut two pieces of lockwire, each four times the length of the turnbuckle.

(b) Put one-half the length of the lockwire through the barrel hole. Bend the lockwire ends to the opposite sides of the turnbuckle.

(c) Put one-half the length of the other lockwire through the barrel hole. Bend the ends to the opposite sides of the turnbuckle and to the opposite direction of the first lockwire.

(d) Put the lockwire through the clevis and bend it 180°. Pull the lockwire tight.

(e) Wind one lockwire near to the clevis fitting on top of the other lockwire.

(f) On the same end, wind the lockwire in the opposite direction of the first lockwire.

(g) Safety the other end of the turnbuckle.

SUBTASK 20-20-05-430-007

(4) Single wire - double wrap safety lockwiring method as follows: (Ref. Figure 204)(Ref. LOCKWIRE AND LOCKCLIP - MAINTENANCE PRACTICES, 20-20-05/201)

(a) Cut the specified lockwire (2) sufficiently long so that each end will wrap at least four times around the shank (4) after lockwiring.

(b) Pass the lockwire (2) through the hole (3) in the turnbuckle (1) see step 1. Loop the lockwire (2), 1/2 turn around the barrel and pass through the hole (3), a second time, see step 2. Pull the loop

up tight. Cross the lockwire (2) over each other and pass the ends through the cable fitting from opposite sides, See Step 3.

(c) Bend both end of lockwire (2) back toward the turnbuckle (1), and wrap one end of the wire (2) over the shank (4) and the other end four times. See Step 4.

(d) Wrap second end of lockwire (2) four times around shank (4) in direction opposite to wrap of first end. See Step 4.

(e) Clip both ends of lockwire (2) and bend them closely in place.

(f) safety the other end of the turnbuckle.

SUBTASK 20-20-05-430-003

(5) Safety turnbuckles with lockclips as follows: (Ref. Figure 201)(Ref. LOCKWIRE AND LOCKCLIP - MAINTENANCE PRACTICES, 20-20-05/201)

(a) Adjust the barrel on the fitting until the cable tension is correct.

(b) Make sure the fitting is installed correctly in the barrel.

(c) Align the barrel slot and the fitting slot.

NOTE : Make sure the threaded-end fittings are installed equally in length into the turnbuckle barrel.

(d) Put the straight-end of the lockclip into the barrel slot and the fitting slot. Make sure the loop is aligned with the barrel hole.

(e) Push on the hook-shoulder until the hook-lip is locked in the barrel hole.

(f) Pull on the hook-shoulder to make sure the hook-lip is locked in the barrel hole.

(g) Install the other lockclip on the other end of the barrel.

SUBTASK 20-20-05-430-004

(6) Safety swaged cable terminals as follows: (Ref. Figure 205) (Ref. LOCKWIRE AND LOCKCLIP - MAINTENANCE PRACTICES, 20-20-05/201)

(a) On swage type I, put one-half of the lockwire through the hole.

(b) Put the lockwire over the swage retainer to the opposite hole.

(c) Put the opposite end of the lockwire over the swage retainer and through the opposite hole.

(d) Pull the lockwire tight and make approximately six twists at the end of the lockwire.

(e) Cut the unwanted length of lockwire with diagonal cutter pliers.

(f) On swage type II, put one-half of the lockwire through the holes on the edge of the pulley. Make sure it is also on top of the swaged cable terminals.

NOTE : Make sure the mechanism operated by the pulley is adjusted.

(g) Pull the lockwire through the holes on the other edge of the pulley and pull tight.

(h) Make approximately six twists at the end of the lockwire.

(i) Cut the unwanted length of lockwire with the diagonal cutter pliers.

(j) Bend the twisted end of lockwire to the side of the pulley.

NOTE : Make sure the twisted end of the wire on the pulley is away from the adjacent mechanism. Make sure it does not prevent the operation of the pulley.

(k) On the swage type III, use the safety clip procedure when specified.

SUBTASK 20-20-05-430-005

WARNING

DANGEROUSLY HIGH VOLTAGES ARE FOUND IN THE AIRCRAFT ELECTRICAL POWER CENTER. MAKE SURE ALL AIRCRAFT POWER SOURCES ARE OFF AND ALL EXTERNAL POWER IS DISCONNECTED BEFORE YOU DO MAINTENANCE IN THIS AREA. HIGH VOLTAGE CAN CAUSE DEATH OR SERIOUS INJURY TO PERSONS.

(7) Safety electrical connectors with lockwire as follows: (Ref. Figure 206) (Figure 207) (Ref. LOCKWIRE AND LOCKCLIP - MAINTENANCE PRACTICES, 20-20-05/201)

(a) Make sure the pins of the connector are straight and there is no damage to the wires.

(b) Make sure the connector is engaged correctly.

(c) Put the lockwire through the hole in the coupling ring and pull half of the length of the lockwire.

(d) Twist the lockwire clockwise to the hole on the screw at the bottom of the connector.

(e) Put one of the lockwire ends through the hole on the screw at the bottom of the connector.

(f) Make approximately six twists at the end of the lockwire.

(g) Cut the unwanted length of the lockwire with diagonal cutter pliers.

(h) Bend the twisted end of the lockwire to the side of the screw at the bottom of the connector.

SUBTASK 20-20-05-430-006

(8) Safety the conduit clamp, the saddle clamp and the clevis fitting with lockwire. (Ref. Figure 208) (Ref. LOCKWIRE AND LOCKCLIP - MAINTENANCE PRACTICES, 20-20-05/201)

D. Job Close-up - Lockwire and Lockclip Installation

SUBTASK 20-20-05-942-001

(1) Remove all tools and equipment from the work area. Make sure that the area is clean.

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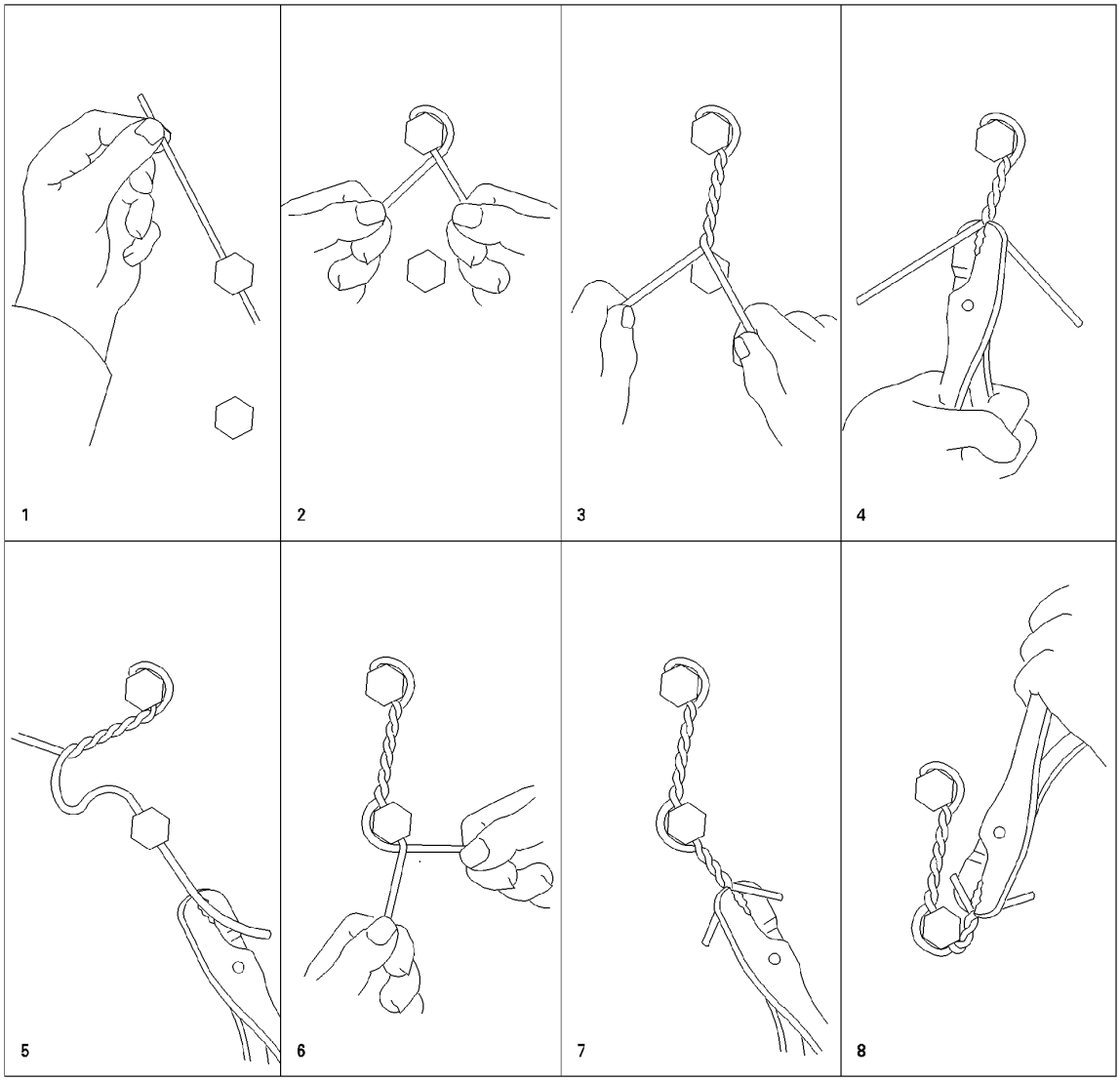

Figure 202. Lockwire Installation - Bolt
(Sheet 1)

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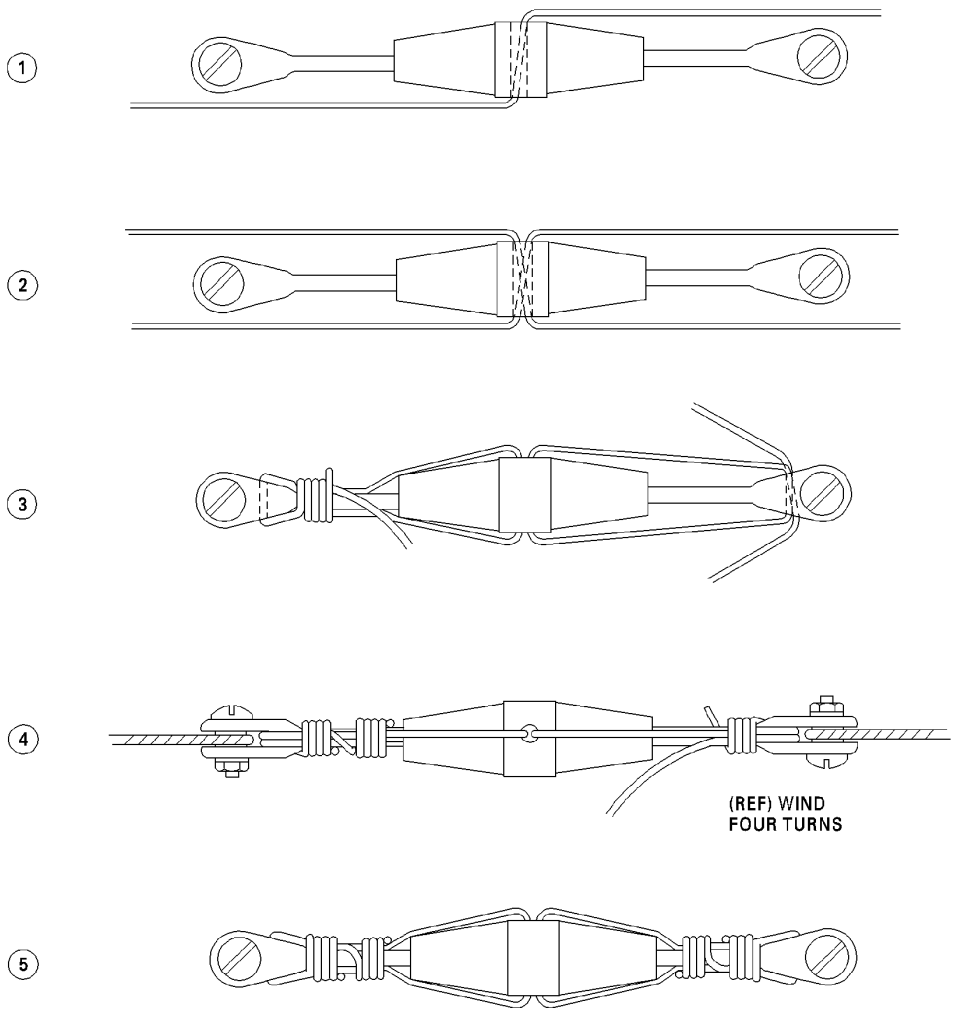

Figure 203. Lockwire Installation - Turnbuckle
(Sheet 1)

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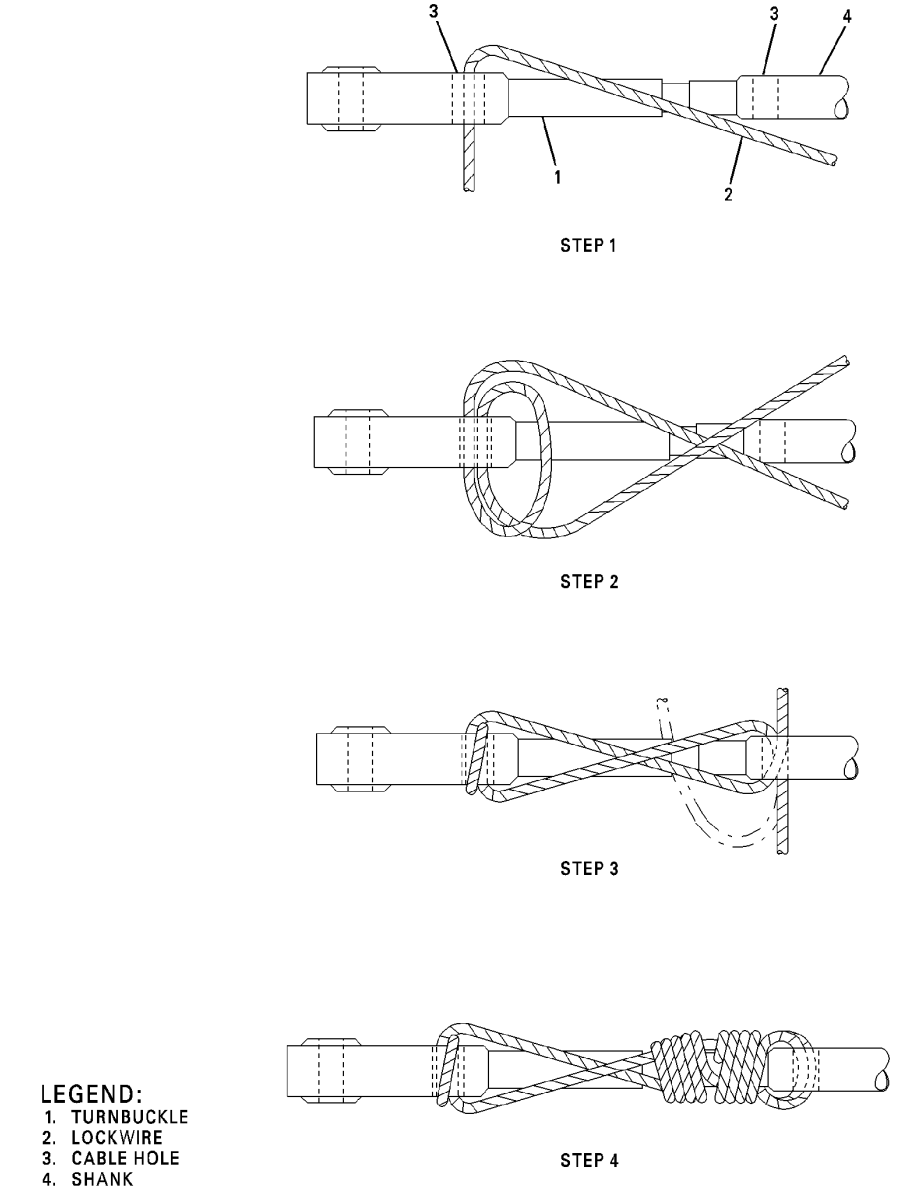

Figure 204. Single Wire - Double Wrap Safety Lockwiring Method
(Sheet 1)

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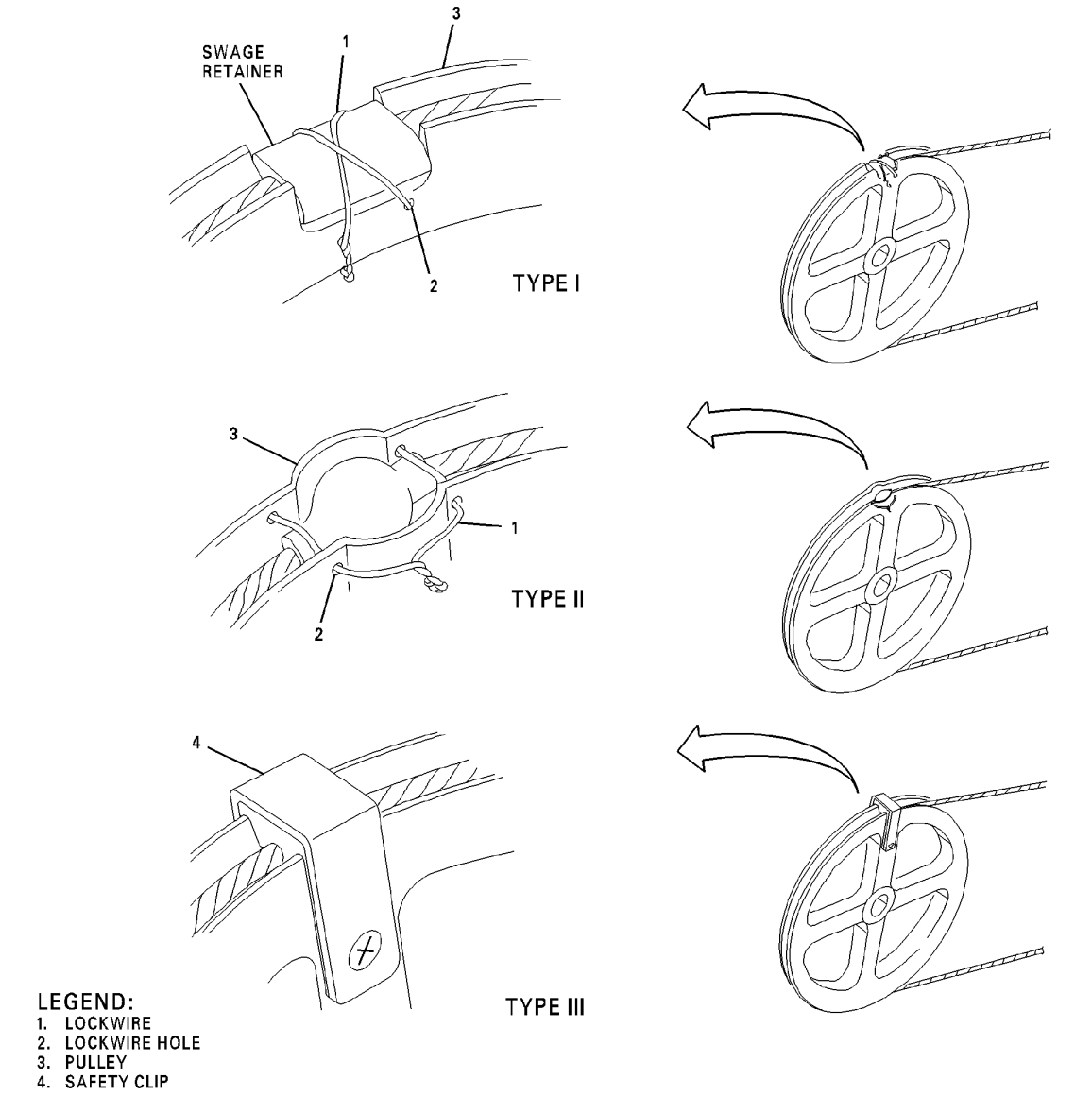

Figure 205. Swaged Cable Terminal Safety - Installation
(Sheet 1)

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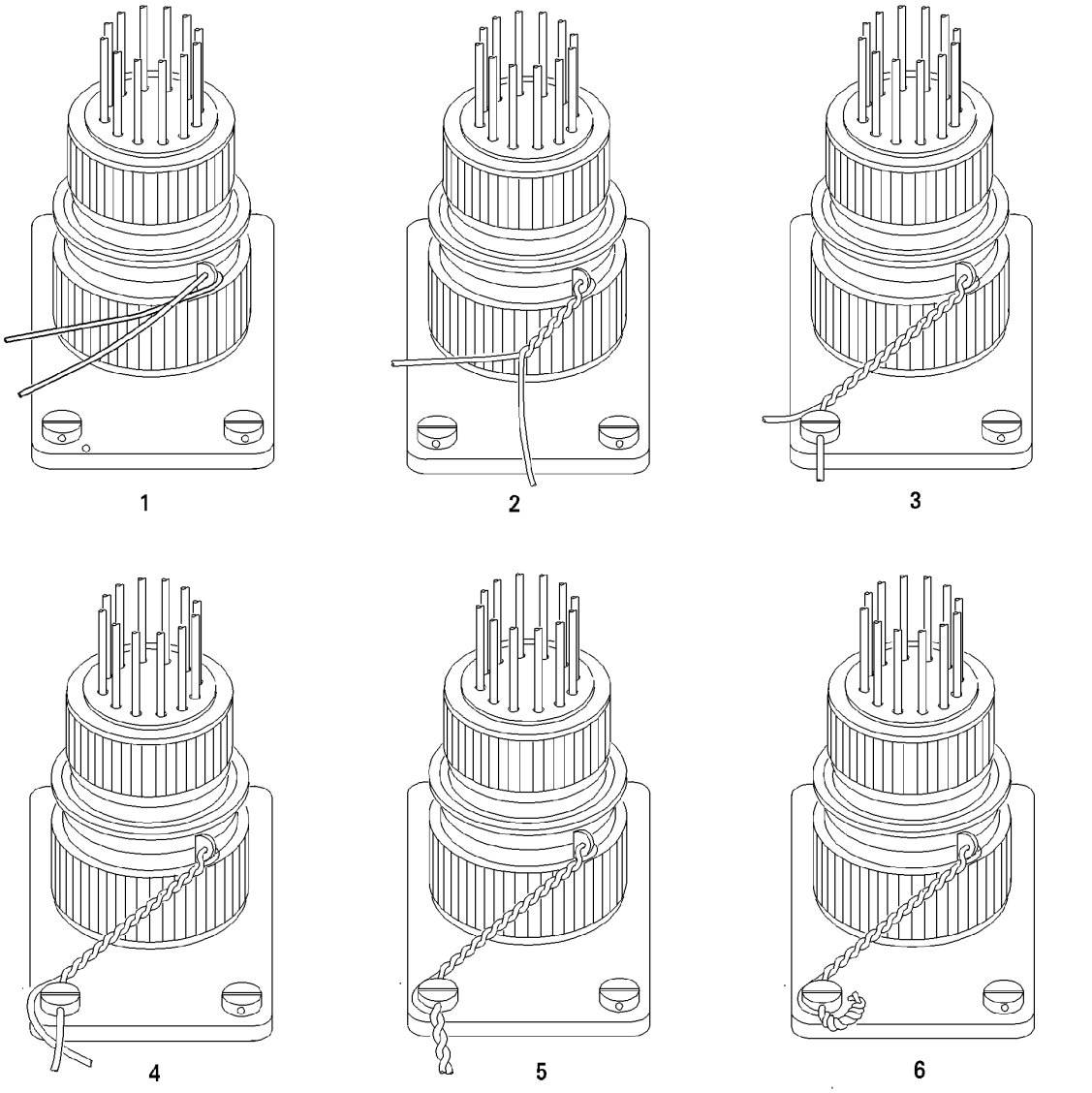

Figure 206. Lockwire Installation - Electrical Connectors
(Sheet 1)

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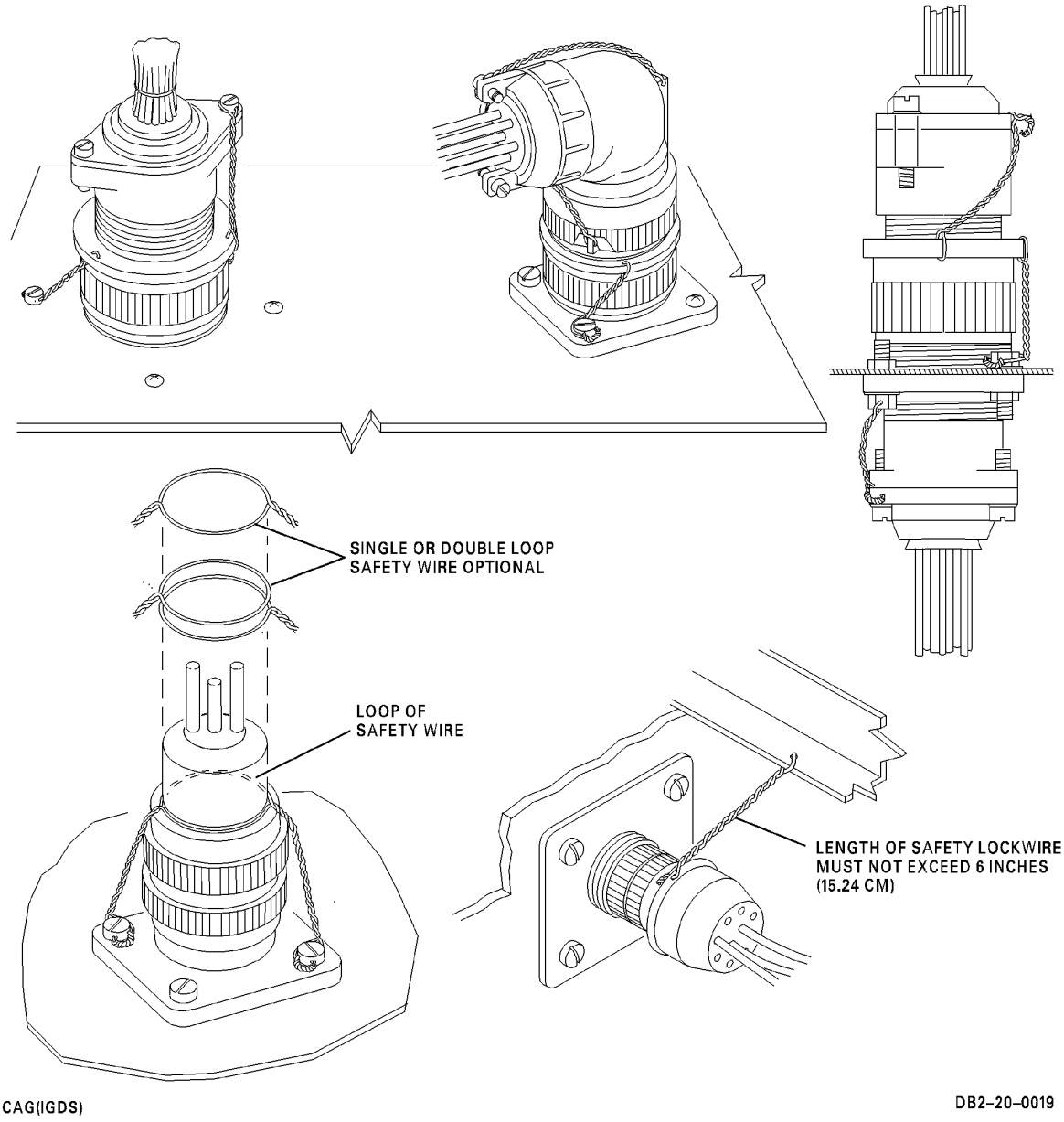

Figure 207. Lockwire Installation - Electrical Connectors
(Sheet 1)

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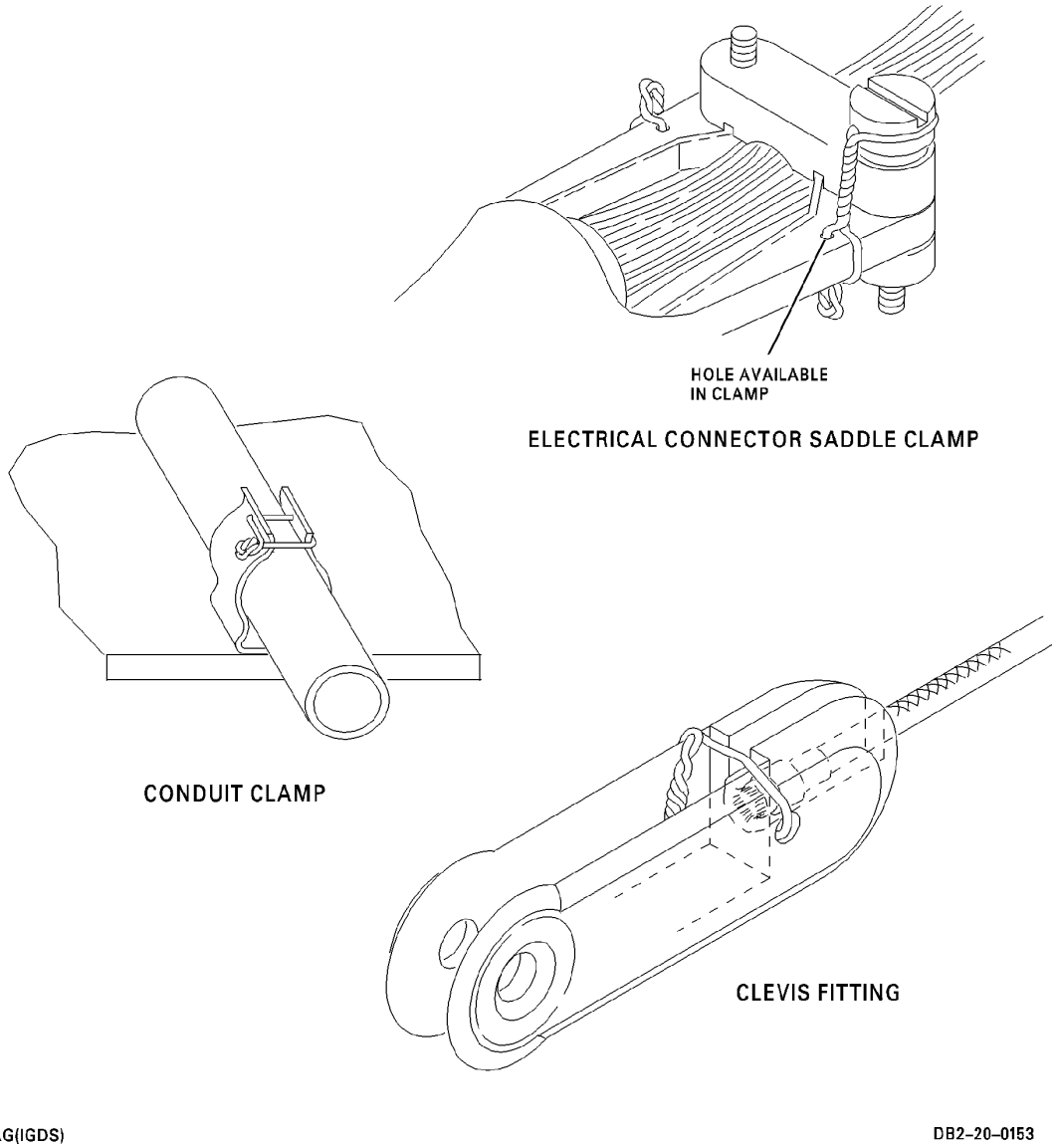

Figure 208. Lockwire - Conduit Clamp, Saddle Clamp and Clevis Fitting (Sheet 1)

TASK 20-20-05-910-801

4. AILERON TENSION REGULATOR LOCKWIRE PROCEDURE

A. Consumable Materials

(1) Consumable Materials

NOTE : Equivalent replacements are permitted for the items that follow.

Table 201.

REFERENCE	DESIGNATION
NASM20995N20, DPM 684	Inconel Lockwire 0.020 in
MS20995N20, DPM 667	Inconel Lockwire 0.020 in
NASM20995C20, DPM 5865	Corrosion Resistant Steel Lockwire 0.020 in
NASM20995N32, DPM 684	Inconel Lockwire 0.032 in
NASM20995C32, DPM 5865	Corrosion Resistant Steel Lockwire 0.032 in
NASM20995N40, DPM 684	Inconel Lockwire 0.040 in
NASM20995C41, DPM 5865	Corrosion Resistant Steel Lockwire 0.041 in
NASM20995N51, DPM 684	Inconel Lockwire 0.051 in
NASM20995C47, DPM 5865	Corrosion Resistant Steel Lockwire 0.047 in
NASM20995N91, DPM 684	Inconel Lockwire 0.091 in
NASM20995C91, DPM 5865	Corrosion Resistant Steel Lockwire 0.091 in

B. Procedure - Aileron Tension Regulator Lockwire Procedure

SUBTASK 20-20-05-910-001

(1) Safety the aileron tension Regulator as follows: (Ref. Figure 209) (Figure 210) (Ref. LOCKWIRE AND LOCKCLIP - MAINTENANCE PRACTICES, 20-20-05/201)

(a) Put one-half of the lockwire through the second hole from the end of each sector half. Pull the lockwire across the top of control cable and through the opposite hole.

CAUTION

WHEN YOU SAFETY THE SECTOR HALF WITH LOCKWIRE, MAKE SURE THE LOCKWIRE IS NOT ON TOP OF THE EDGE OR RIM. AFTER THE SAFETY PROCEDURE IS COMPLETE, MAKE SURE THERE IS NO OVERLAP OF LOCKWIRE ON THE OUTER EDGE OR RIM AREA. THE LOCKWIRE ALSO CANNOT TOUCH THE GUARD PINS WHEN THE SECTOR HALF MOVES. IF THE SECTOR HALF IS SAFETIED INCORRECTLY, DAMAGE TO THE AIRCRAFT CAN OCCUR.

(b) Put the lockwire around the end of each sector half and pull tight at each end. Make sure the lockwire is not on top of the outer edge or rim of the sector half.

(c) Twist the end of the lockwire approximately six twist.

(d) Cut the twisted end of the lockwire with diagonal cutters.

(e) Bend the twisted end of lockwire to the side of the sector half.

C. Job Close-up - Aileron Tension Regulator Lockwire Procedure

SUBTASK 20-20-05-942-002

(1) Remove all tools and equipment from the work area. Make sure that the area is clean.

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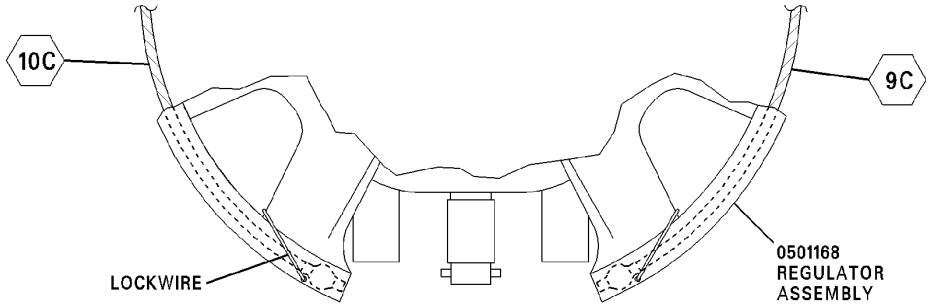
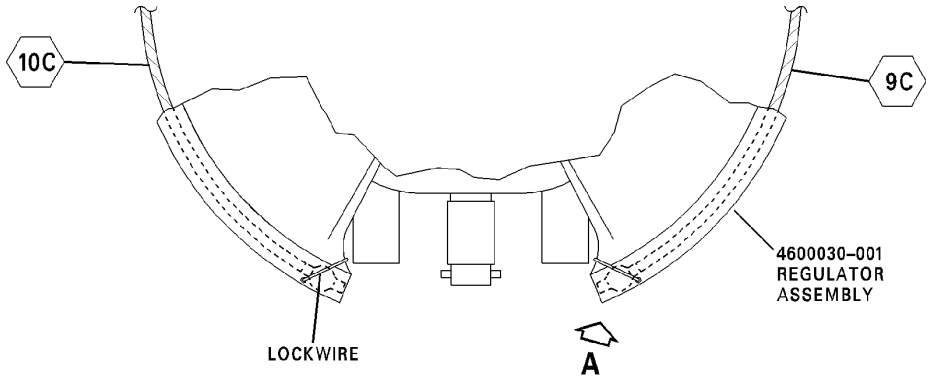


ACCEPTABLE SAFETY WIRE METHOD FOR
PACIFIC SCIENTIFIC AILERON TENSION REGULATOR



ACCEPTABLE SAFETY WIRE METHOD FOR
PACIFIC SCIENTIFIC AND MORSE CONTROLS AILERON TENSION REGULATOR

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Figure 209. Aileron Tension Regulator Lockwire Procedure
(Sheet 1)

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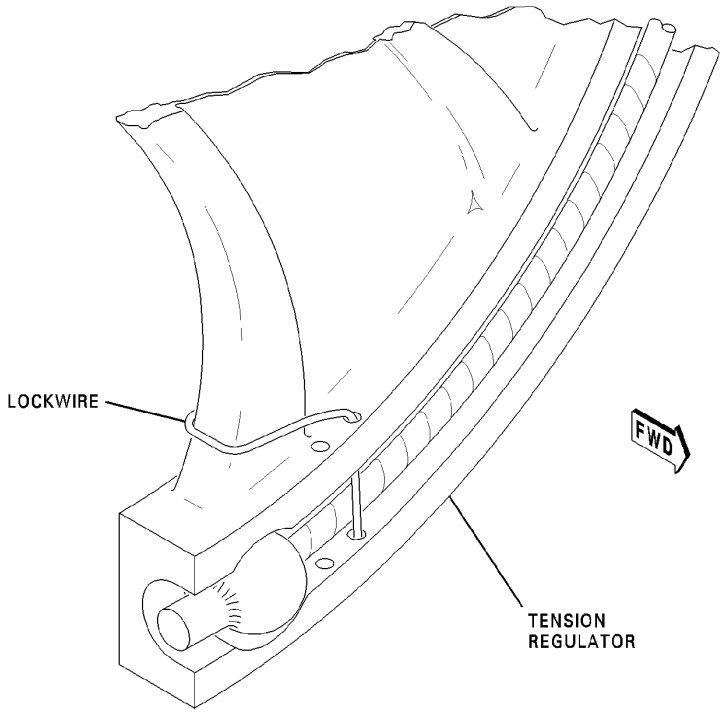

Figure 210. Aileron Tension Regulator Lockwire Procedure
(Sheet 1)