



A Textron Company

OPERATION SAFETY NOTICE

407-19-23

24 July 2019

Revision A, 8 September 2021

TO: All owners and operators of Model 407 Helicopters

**SUBJECT: ROLLS-ROYCE M250 ENGINES - MAINTENANCE WARNING -
EXTERNAL LINES**

Revision A of this Operation Safety Notice (OSN) is to achieve complete distribution of the latest attached supplier bulletin CSL-A-6162 Revision 3 to the owners/operators currently registered on the Bell technical publications distribution list.

Refer to Chapter 11 (Placards and Markings) of the BHT-407-MM-2 Maintenance Manual for installation procedures and where the decal 23052363 is to be installed.

For any questions regarding this letter, please contact:

Bell Product Support Engineering
LIGHT Tel: 450-437-2862 / 1-800-363-8023 / productsupport@bellflight.com

ALERT COMMERCIAL SERVICE LETTER



Rolls-Royce

MAINTENANCE WARNING - EXTERNAL LINES

1. Background

Rolls-Royce continues to be involved in investigations of aircraft accidents and incidents which are attributed to improper alignment, clamping, torquing, and general condition of engine tubing during installation. Instances of twisted lines, kinked lines, and split flares have resulted from installation practices contrary to those specified in the Operation and Maintenance Manual. Compliance with the manual procedures is critical to safety of flight. In most cases, the failure of the tube assemblies can be traced to one or any combination of the following causes:

- A. Bent tubes which induce misalignment at the flare and result in cracked flares or fretting of the tube at the end of the ferrule.
- B. Tube to fitting misalignment caused by poorly aligned fittings, which result in cracked flares or fretting of the tube at the end of the ferrule.
- C. Clamps of the improper size that cause fretting wear and failure at the clamp due to stress concentration at the wear step.
- D. Incorrect clamps with cushion material that causes corrosion and eventual stress corrosion failure of the tube.
- E. Installation of chafe wrapping to correct a loose clamp. This chafe wrapping then causes corrosion and eventual stress corrosion failure of the tube.
- F. Incorrect clamp locations that do not properly dampen tube vibrations. The vibrations then lead to fatigue failure of the tube.
- G. Unauthorized clamping of other hardware to the engine tube assemblies, which induce vibratory stress that results in the tube failure.
- H. Failure to properly torque tube coupling nuts can cause leakage if under torqued, which can result in fuel or oil leaks or engine power loss. Overtorqued B-nuts result in deformed and cracked flares.
- I. Surface corrosion on the tube, especially around and under the ferrule. This can hide cracks and corrosion pits that can become initiation points for fatigue failures.

Example 1

The tube assembly P/N 6890581 failed forcing the aircraft to make a hard landing. Photographs were taken of the tube assembly and are depicted in [Figures 1-3](#). The following discrepancies were noted during the examination of the tube:

- A. The tube is bent in an area that is not a principal bend, a region that should be straight. See [Figure 1](#).
- B. Severe fretting was found under the ferrule sleeve caused by misalignment of the tube to fitting joint. See [Figure 2](#).
- C. The flared tube was found cracked 270° circumferentially in the area of ferrule fretting. The crack and fretting were likely caused by misalignment of the tube to fitting joint. See [Figure 3](#).

November 15, 1990

Revision 3

July 26, 2021

M250-C18 Series	CSL-A-169	M250-B15G	TP	CSL-A-101
M250-C20 Series	CSL-A-1166	M250-B17 Series	TP	CSL-A-1121
M250-C28 Series	CSL-A-2113	M250-B17F Series	TP	CSL-A-2019
M250-C30 Series	CSL-A-3117	M250-C40B		CSL-A-5153
M250-C20R Series	CSL-A-4036	M250-C47 Series		CSL-A-6162

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Example 2

P/N 23033896 tube assembly was removed from a Model C20R Series engine. Photographs were taken of the deformations in the tube assembly and are indicated in [Figure 4](#). The following discrepancies were noted during the examination of the tube assembly:

- A. The deformations were caused by attempting to use Model C20R Series single engine designated clamping on a multi-engine configuration tube.
- B. The previously mentioned clamp hid the large dent. Only removal of the tube assembly allowed discovery of the extent of damage to the tube.

Example 3

P/N 23051141 tube assembly was removed from a C20J engine after experiencing an in-flight power loss, followed by a hard landing. Photographs were taken of the tube while installed and after being removed as shown in [figures 9](#) through [11](#). The following discrepancies were noted during the examination of the tube assembly:

- A. The tube was corroded at both ends near and underneath the ferrules.
- B. The tube was installed backwards. The word "FILTER" is etched on the tube to indicate the end that should be adjacent to the Pc filter when installed.
- C. The separation between the tube's fracture surface and the B-nut attached to the filter indicates the tube was under stress due to misalignment.
- D. This aircraft had spent several years in a coastal environment, which likely contributed to the corrosion seen on the tube.

2. Recommendations

In the interest of flight safety, Rolls-Royce recommends the following maintenance practices when handling any pneumatic control system, lubrication system, or fuel system tube assemblies on the Model 250 engine.

- A. Use only genuine Rolls-Royce tube assemblies of the correct part number.
- B. Consult the appropriate engine Operation and Maintenance Manual for tube to fitting alignment procedures, correct torque values, and installation/tightening recommendations.
- C. Always use a torque reaction wrench when tightening tube assembly B-nuts.
- D. Tube assemblies must fit and be aligned with the mating flare tube fittings to the degree that at both ends of the assembly, the flares shall be uniformly seated in a free state on the cones of the mating fittings. The fitting shall be without distortions or stretching of the tube assembly, and to the degree that the nuts can be fully engaged up to the final one-half turn with light finger pressure. See [Figures 5](#) and [6](#).
- E. In the event that a tube does not align with the mating fittings, re-position the mating fittings to the degree that proper alignment may be attached. Final tightening of these fitting lock nuts must be accomplished before the tube assembly is torqued.

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M250-C20R Series	CSL-A-4036	M250-C47 Series		CSL-A-6162

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CAUTION: THE PRACTICE OF TIGHTENING FITTING LOCK NUTS WITH TUBE ASSEMBLIES INSTALLED CAN RESULT IN DAMAGE TO THE TUBE, WITH POSSIBLE FAILURE OF THE TUBE AND ENGINE.

- F. If proper alignment cannot be attained by re-positioning the mating flare tube fittings, bend the tube to provide alignment in the free state as specified. Accomplish all bending with the tube removed from the engine. Adjustment of the fit may be accomplished by bending by hand at principal bends.

CAUTION: TO PREVENT FLATTENING OF TUBE AT THE BEND RADIUS, EXTREME CAUTION MUST BE OBSERVED WHILE HAND BENDING PREVIOUSLY FORMED TUBES.

- G. In the event that the tube cannot be bent by hand, the tube must be clamped in a fixture or device which will not scratch, indent, crimp or mark the surface of the tube during the bending operation. The flattened effect of the cross section of the tube, as a result of the reforming operation, must not exceed fifteen percent of the tube OD.
- H. When proper free-state alignment is attained, complete the tubing installation by simultaneously securing the coupling nuts.
- I. After properly torquing the B-nut, a slippage mark of a contrasting color shall be applied by a continuous stripe approximately 0.0625 in. (1.588 mm) wide, minimum, that extends down the side of the B-nut and onto the fitting.
- J. The B-nuts shall be inspected for indications of slippage at regular 100 hour maintenance intervals.
- K. Old slippage marks (torque paint) must be completely removed and renewed each time the B-nut is retorqued. Reference applicable Operations and Maintenance Manual for proper removal procedures and slippage mark remover solvent.
- L. Clamp the tube assemblies as shown in the appropriate Illustrated Parts Catalogs and/or Commercial Engine Bulletins.
- M. Do not install unauthorized clamps, hardware, fittings, chafe material, etc., on the engine tube assemblies. See [Figure 7](#) for a correct cushion material example.
- N. Visually inspect tube assemblies before each installation for the following items: cracked flares, nicks, dents, severe fretting in the area of clamps and end ferrules, corrosion, bent or malformed tubing, correct part number, and proper clamping. Failure to meet acceptable criteria is cause for rejection of the tube assembly.
- O. Perform detailed visual inspection of the tube assemblies each time the tubes are removed in the completion of maintenance procedures. For example, if the fuel control unit is removed from the engine, all tube assemblies connected to the fuel control unit should be visually inspected.
- P. Assure that the tube to fitting alignment is acceptable per the appropriate Operation and Maintenance Manual. It will be the maintenance facility's responsibility to assure conformance with the proper alignment and torquing of the tubing.
- Q. Maintain installation of warning placards for fuel, oil, and air tubes. Consult the Airframe Manufactures installation instructions for placard installation details. Should replacement placards P/N 23052363 be required, they can be procured from a Rolls-Royce Model 250 distributor. See [Figure 8](#).

November 15, 1990	M250-C18 Series	CSL-A-169	M250-B15G	TP	CSL-A-101
Revision 3	M250-C20 Series	CSL-A-1166	M250-B17 Series	TP	CSL-A-1121
July 26, 2021	M250-C28 Series	CSL-A-2113	M250-B17F Series	TP	CSL-A-2019
	M250-C30 Series	CSL-A-3117	M250-C40B		CSL-A-5153
	M250-C20R Series	CSL-A-4036	M250-C47 Series		CSL-A-6162

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R. Ensure proper orientation of tubes during installation. Several tubes are marked either on the tube itself or the B-Nut to indicate proper orientation. These include:

- 23051141 and 23054628 Series II Scroll-to-Pc filter (Figure 15)
- 23037410 and 23038235 Series IV pressure oil tube from #6/7 bearing tee to the #8 bearing fitting (Figure 12)
- 23064620 Series IV anti-ice solenoid-to-actuator (Figure 17).

Many tubes are not marked at either end, and can be installed either way. When fitting these tubes, loose fit the tube both ways before you determine the best fit. Make sure there is no contact with the other tubes. These tubes include:

- 6848471 Series II oil check valve-to-fire shield
- 6890584 Series IV accumulator-to-PTG
- 23057782 Series IV FCU heater tube
- 23039785 Series IV Py tube from FCU-to-PTG

Two tubes can fit either way, but one way results in contact with another tube. In this case, one must ensure that the orientation with the largest clearance from other tubes is selected. These tubes are:

- 6844169 Series II FCU-to-fire shield (Figure 13)
- 6890580 Series III/IV FCU-to-fire shield (Figure 14).

If there are any other tubes that warrant special highlighting in this CSL, then feel free to contact us at helocustsupp@rolls-royce.com with your suggestions.

3. Summary

Failure of a pneumatic, lubrication, or fuel system tube assembly can cause the engine to cease operation, resulting in an in-flight shutdown or a forced landing. Properly maintained engine tubing will greatly lessen the possibility of an in-flight shutdown or forced landing.

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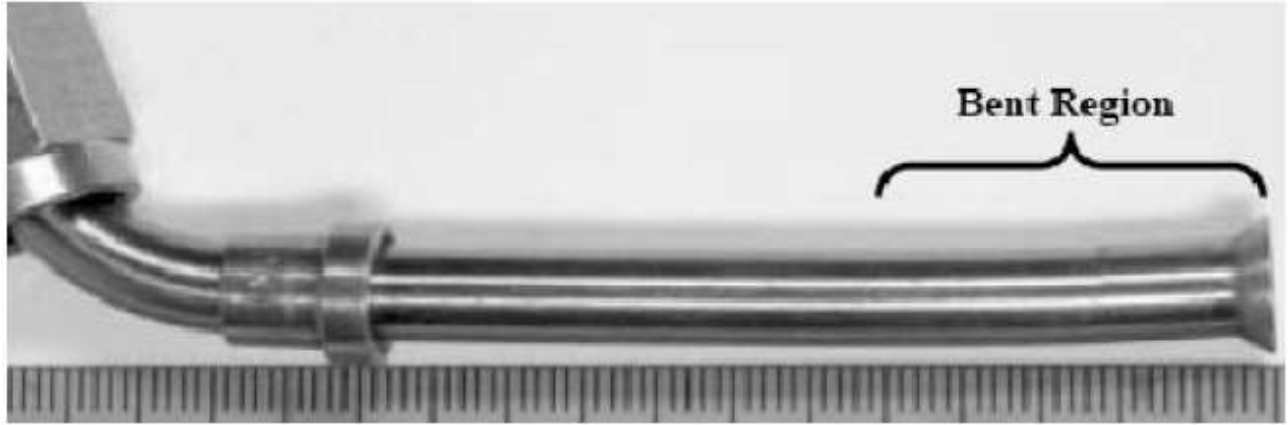
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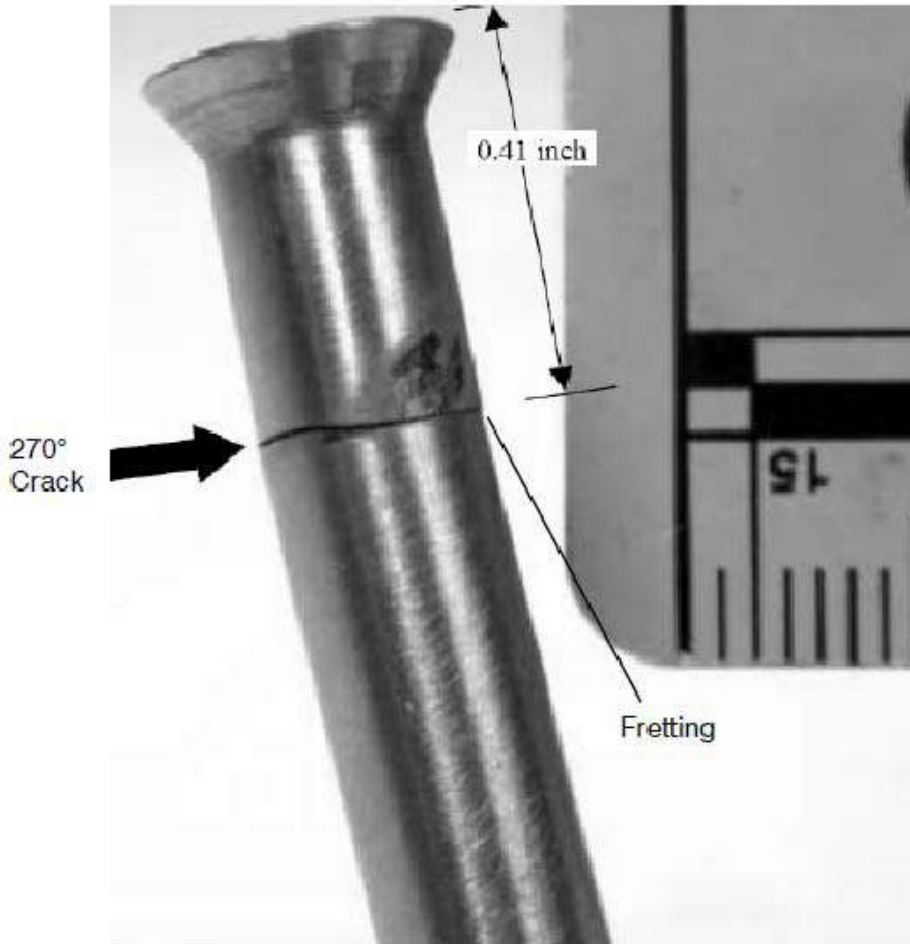
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Tube Assembly, P/N 6890581
FIG. 1



Tube Assembly, P/N 6890581
FIG. 2

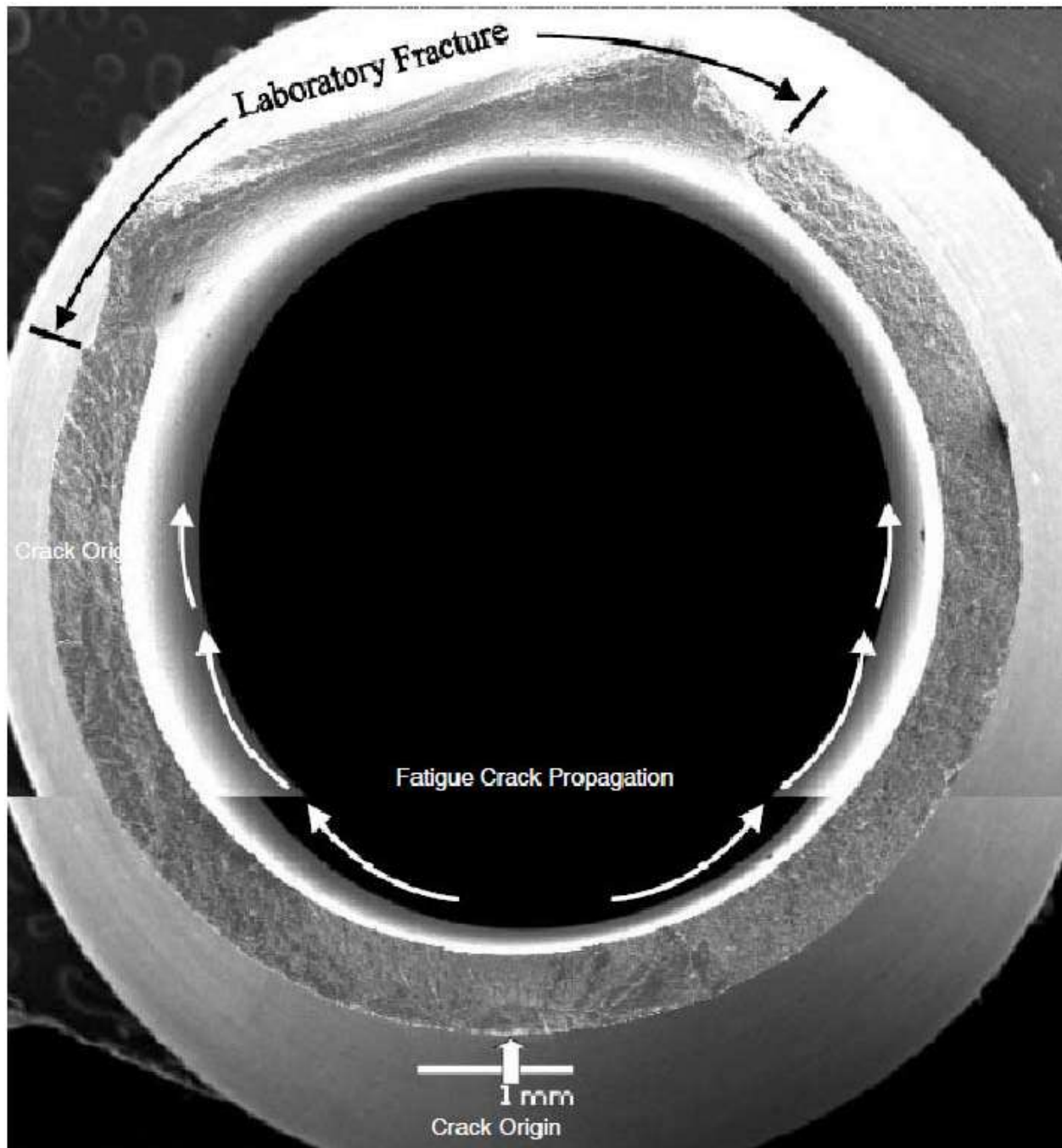
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Tube Assembly, P/N 6890581 Surface of Fracture

FIG. 3

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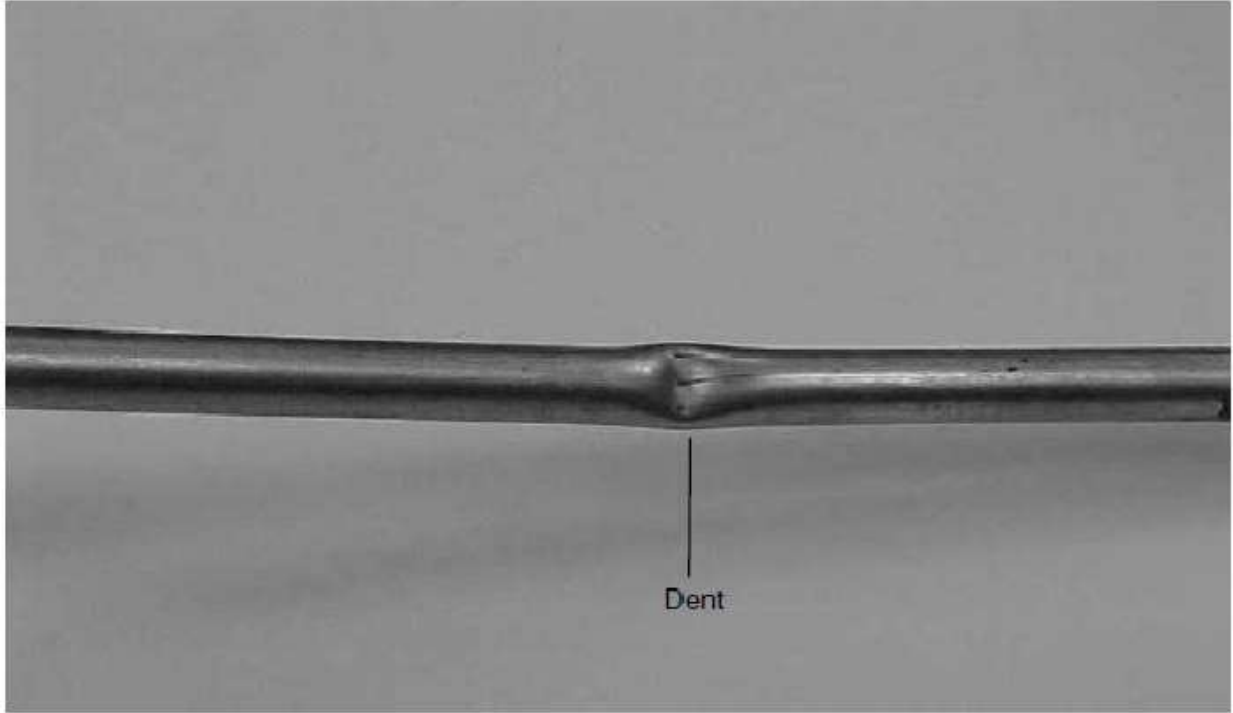
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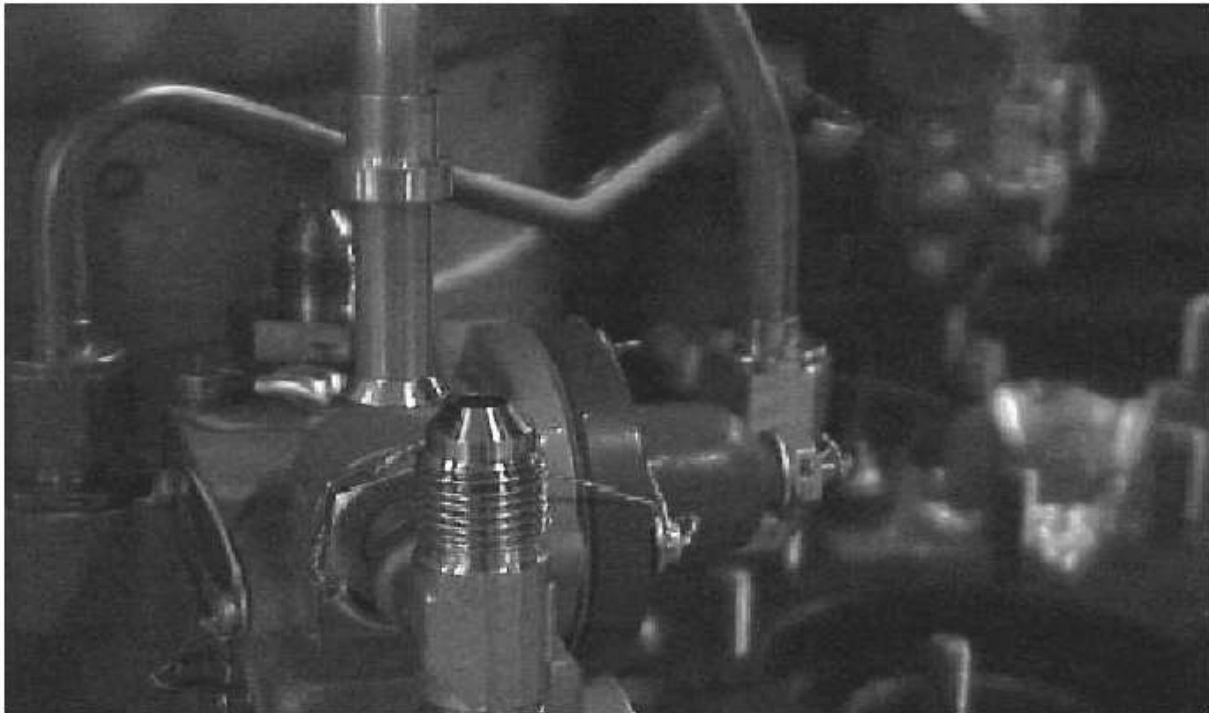
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Tube Assembly, P/N 23033896
FIG. 4



Misaligned Tube
FIG. 5

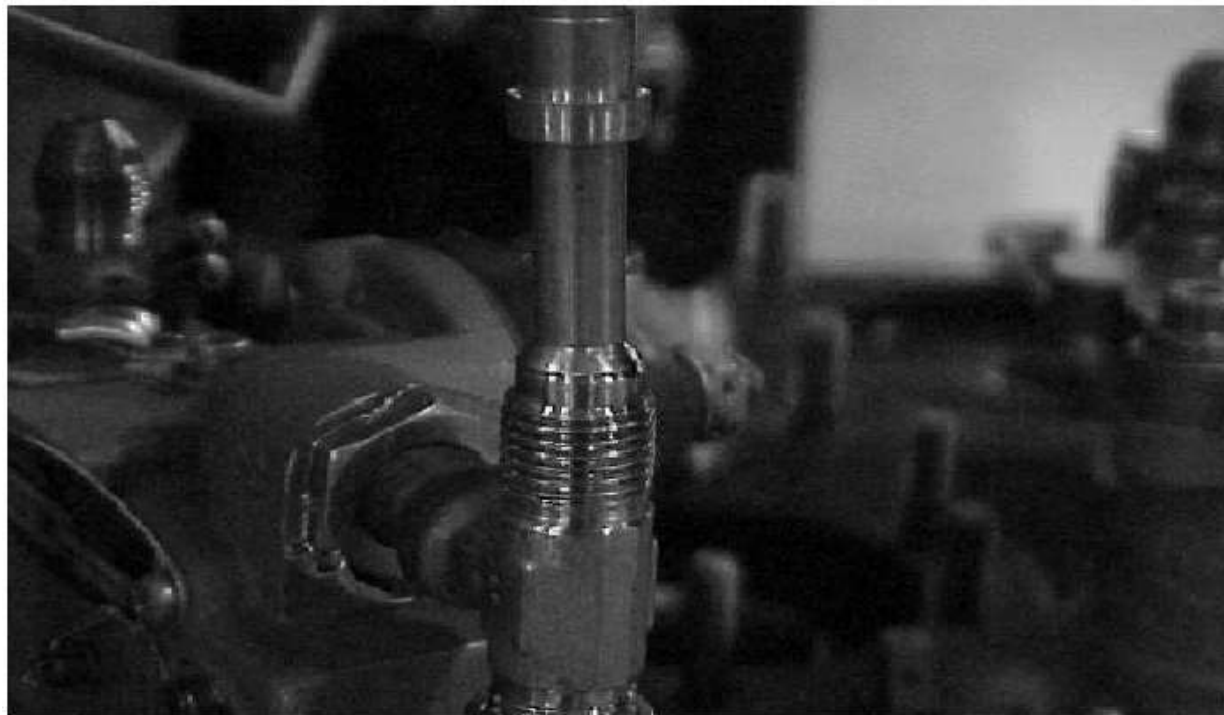
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M250-C20R Series	CSL-A-4036	M250-C47 Series		CSL-A-6162

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Properly Aligned Tube
FIG. 6



Correct Cushion Material
FIG. 7

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M250-C20 Series	CSL-A-1166	M250-B17 Series	TP	CSL-A-1121
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M250-C20R Series	CSL-A-4036	M250-C47 Series		CSL-A-6162

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"B" Nut Warning Placard P/N 23052363
FIG. 8

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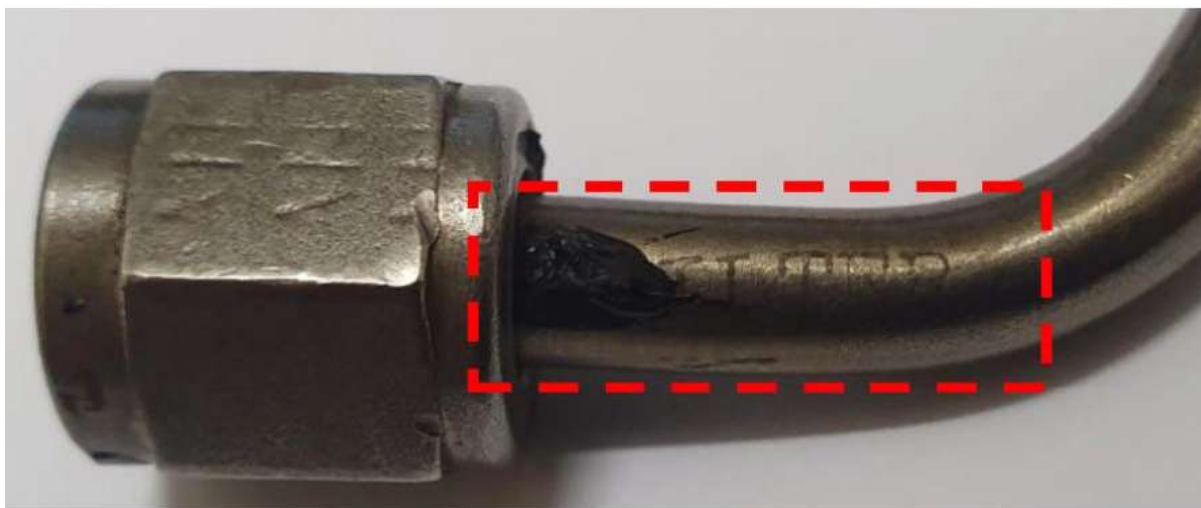
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M250-C30 Series	CSL-A-3117	M250-C40B		CSL-A-5153
M250-C20R Series	CSL-A-4036	M250-C47 Series		CSL-A-6162

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Orientation Mark
FIG. 9



Broken Tubing Showing Corrosion on Tube Under Ferrule
FIG. 10

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M250-C20 Series	CSL-A-1166	M250-B17 Series	TP CSL-A-1121
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Broken Tubing with Gap Indicative of Misalignment
FIG. 11



23037410 and 23038235 Series IV Pressure Oil Tubes
FIG. 12

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M250-C18 Series	CSL-A-169	M250-B15G	TP CSL-A-101
M250-C20 Series	CSL-A-1166	M250-B17 Series	TP CSL-A-1121
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Correct Installation
FIG. 12A



Incorrect Installation
FIG. 12B

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M250-C18 Series	CSL-A-169	M250-B15G	TP	CSL-A-101
M250-C20 Series	CSL-A-1166	M250-B17 Series	TP	CSL-A-1121
M250-C28 Series	CSL-A-2113	M250-B17F Series	TP	CSL-A-2019
M250-C30 Series	CSL-A-3117	M250-C40B		CSL-A-5153
M250-C20R Series	CSL-A-4036	M250-C47 Series		CSL-A-6162

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6844169 FCU to Fire Shield Series II
FIG. 13

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M250-C20 Series	CSL-A-1166	M250-B17 Series	TP	CSL-A-1121
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Correct Installation
FIG. 13A

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M250-C20 Series	CSL-A-1166	M250-B17 Series	TP CSL-A-1121
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Incorrect Installation
FIG. 13B



6890580 FCU to Fire Shield Series II
FIG. 14

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M250-C20 Series	CSL-A-1166	M250-B17 Series	TP CSL-A-1121
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Correct Installation
FIG. 14A

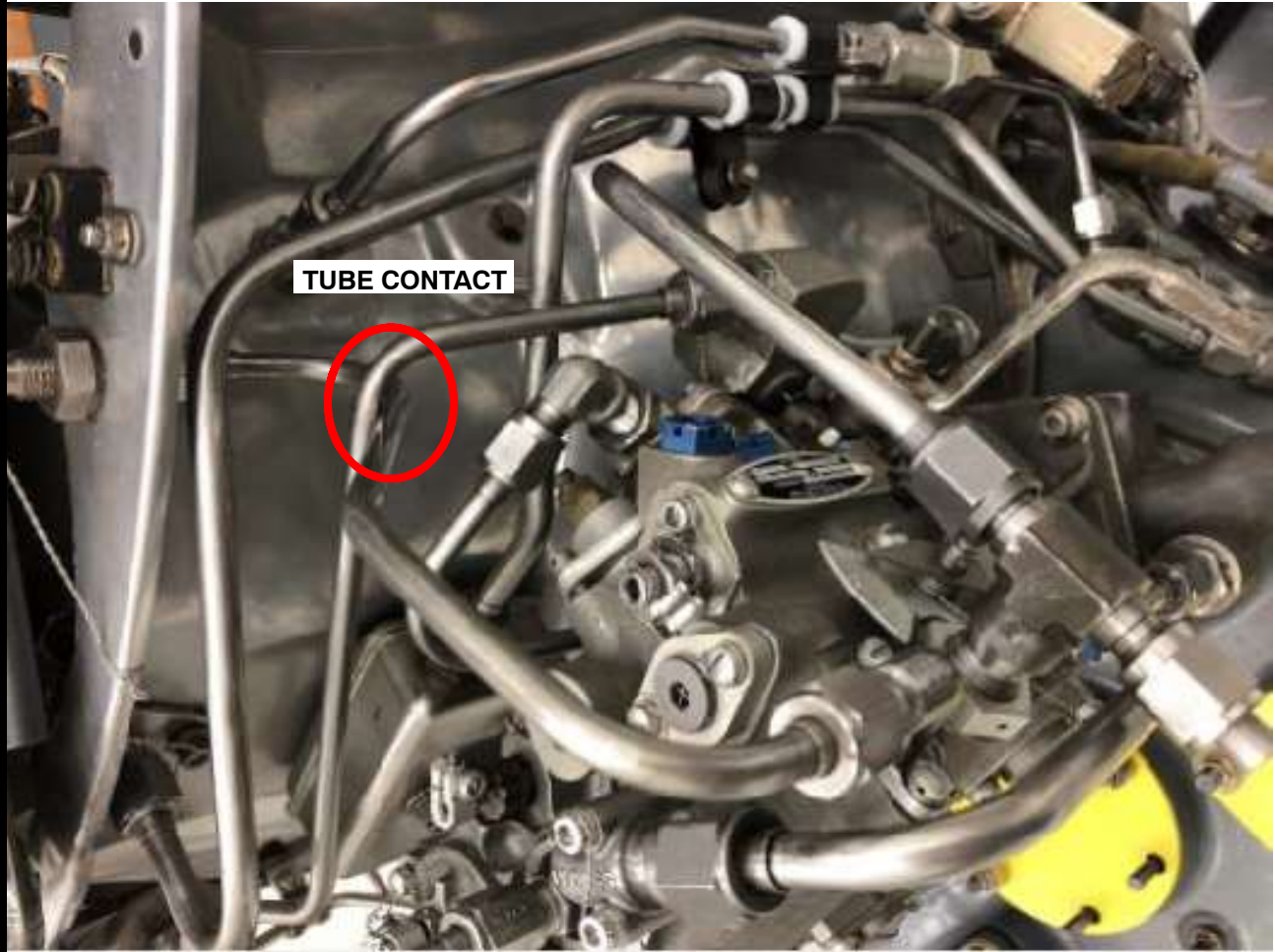
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Incorrect Installation
FIG. 14B

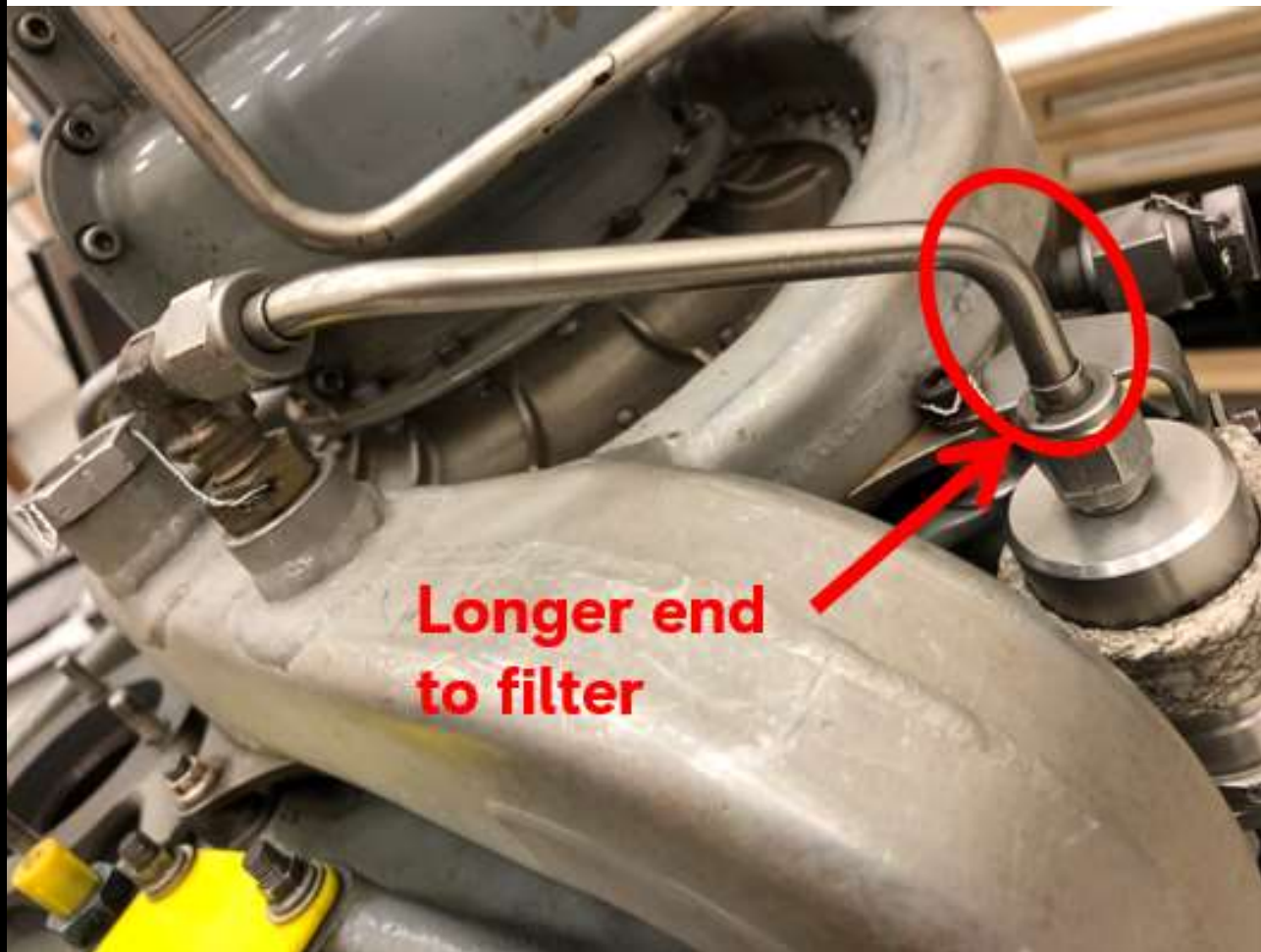
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23054628 Series II Scroll to Pc Filter - Correct Orientation
FIG. 15

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M250-C20 Series	CSL-A-1166	M250-B17 Series	TP CSL-A-1121
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23054628 Series II Scroll to Pc Filter - Incorrect Orientation
FIG. 15A

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23051141



23054628



Tube End Marking
FIG. 16

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M250-C20 Series	CSL-A-1166	M250-B17 Series	TP	CSL-A-1121
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23064620 Anti-ice Valve Series IV Marked with SOL for Solenoid End
FIG. 17

November 15, 1990
Revision 3
July 26, 2021

M250-C18 Series	CSL-A-169	M250-B15G	TP	CSL-A-101
M250-C20 Series	CSL-A-1166	M250-B17 Series	TP	CSL-A-1121
M250-C28 Series	CSL-A-2113	M250-B17F Series	TP	CSL-A-2019
M250-C30 Series	CSL-A-3117	M250-C40B		CSL-A-5153
M250-C20R Series	CSL-A-4036	M250-C47 Series		CSL-A-6162