

CONTINENTAL MOTORS® AIRCRAFT ENGINE
SERVICE INFORMATION DIRECTIVE

CATEGORY 4
SID05-1B

Compliance Will Enhance Safety, Maintenance or Economy of Operation

Supersedes SID05-1A
TECHNICAL PORTIONS
FAA APPROVED

SUBJECT: Inspection Guidelines for CM Camshafts and Hydraulic Lifters

PURPOSE: To provide service information on the basic material, inspection criteria and maintenance of the camshaft and hydraulic lifters. To explain the warranty policy guidelines if warranty issues are assessed on CM camshafts and lifters.

COMPLIANCE: CM recommends inspection described only if the indications defined are found. In the absence of such indications, no action is needed or recommended.

MODELS

AFFECTED: All new and rebuilt CM AVGAS engines.

I. Scope

This Service Document contains the instructions for Continued Airworthiness to inspect hydraulic lifters and their associated camshaft lobes on in-service AVGAS engines. It also explains the criteria and indications to determine if a detailed inspection is required.

NOTE: CM lifters are a 100% replacement item at overhaul.

II. Background

In CM engines, the camshaft is located below the crankshaft and is driven by a gear set from the crankshaft at one-half the speed of the crankshaft. The **camshaft lobes** on a camshaft control individual **valve** lift and duration. The links between the camshaft and the valves are the **hydraulic lifter**, the **push rod** and the **rocker arm**.

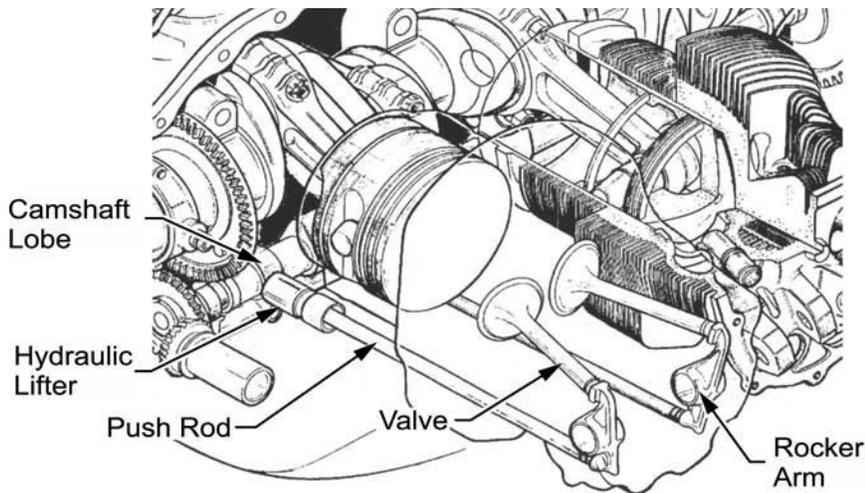


Figure 1. Illustration

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A. Operation, Hydraulic Lifter

The hydraulic lifter performs two functions. The hydraulic lifter's main function is to take up clearance in the valve train. The clearance between the lifter body and the plunger is a precision fit that allows a specified amount of oil to bleed off around the plunger when it is compressed.

Secondly, it provides an interface between the camshaft lobe and the remaining valve train. This allows conversion of the cam lobe profile into a linear movement for actuation of the intake and exhaust valves.

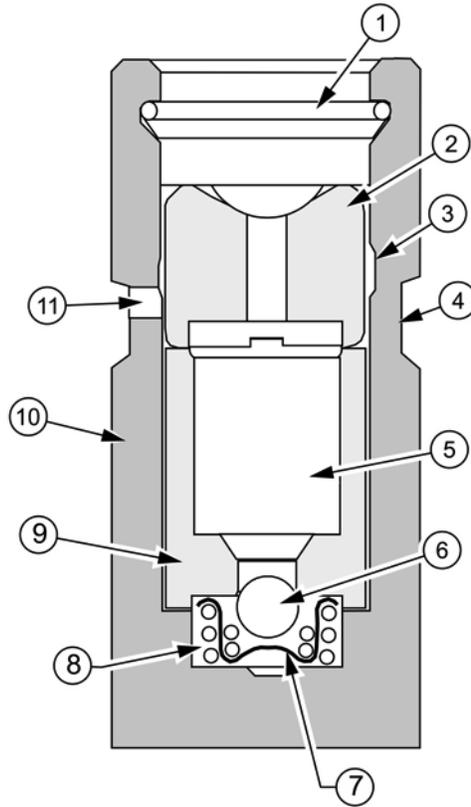


Figure 2. Hydraulic Lifter Cross Section

1	Retaining Ring	5	Oil Reservoir	9	Plunger
2	Push Rod End Socket	6	Check Ball Valve	10	Steel Body
3	Interior Body Groove	7	Expanding Spring	11	Oil Inlet Hole
4	Outside Groove	8	Check Valve Housing/Assembly		

B. Materials

The material of the camshaft is aircraft quality steel with the cam lobes treated by carburizing for additional hardness and wear resistance. The lifter body is made of cast iron with the face being “chilled” during casting to provide an extremely hard wear-resistant material. During manufacture, the lifter face and cam lobes are also coated with a manganese phosphate coating to resist rust and lower friction during the initial hours of engine operation (see Figure 3).



Figure 3. Camshaft and Lifter Interface, typical

C. Wear Factors

The interface between a cam lobe and lifter will experience normal wear as the engine operates. Normal wear may take the form of a bright shiny uniform wear surface, with a circular pattern visible on the lifter face. Minimal “wear material” will be collected by the oil and trapped in the oil filter element or screen. Localized areas may show minor signs of galling or spalling under normal service due to various operating conditions.

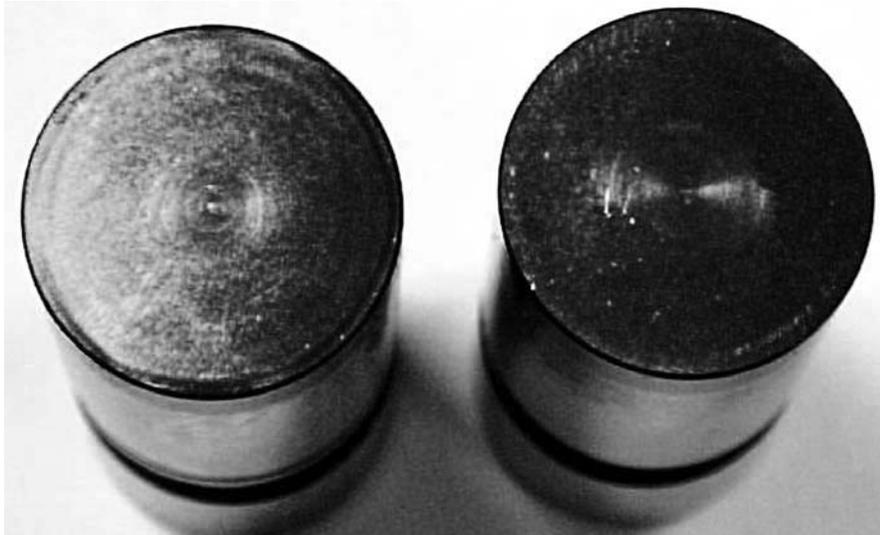


Figure 4. Typical Lifter Faces from Service

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1. Galling

Galling results from a breakdown in lubrication allowing bare metal to metal contact. Bonding of one of the materials to the other can result, transferring a small amount of material.

2. Spalling

Spall wear initially appears in small areas on the lifter face that have begun to separate, leaving shallow pits. Because the camshaft is constructed from steel and the lifter body from iron; rust and corrosion are the most common cause of spalling.

3. Foreign Materials

Foreign material between the cam lobe and lifter can result in very high local loads on the surfaces and break down a local area of the lifter. Foreign material may also stop a lifter from rotating in the bore. This results in one area being loaded constantly and can also lead to spalling.

D. Wear Effects on Cam Lifter

The cam lobe/lifter interface is designed to undergo normal wear during service life allowing the lifter and cam lobes to “break in” together; similar to piston rings in a cylinder bore. Such wear is normal as are circular wear patterns on the face of the lifter and polishing of the cam lobes. Circular scratches may also result from hard particle passage and will not effect operation.

Normal minor spalling caused from corrosion or other factors will not affect operation as the loads are redistributed to the surrounding material. Minor spalling will appear as separated spalled areas with polished contact patterns on the remainder of the face (see Figure 5).

NOTE: The hydraulic feature of the lifter continuously adjusts for normal wear.

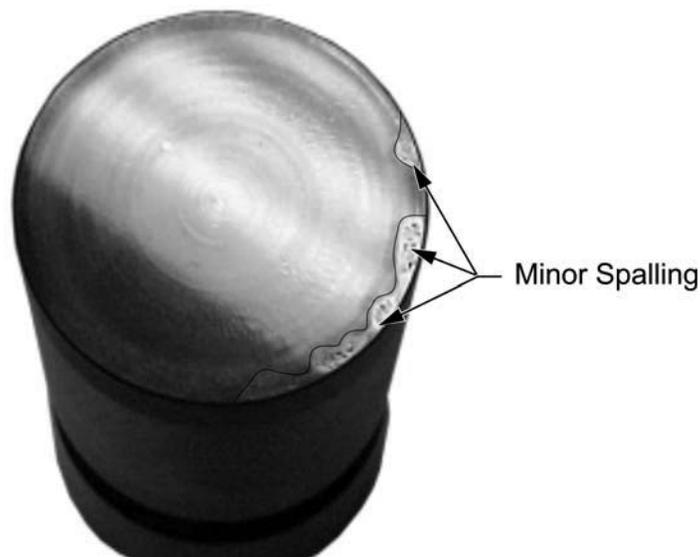


Figure 5. Indications of Minor Spalling

Major spalling that involves much of the face will usually have no effect on operation and will frequently “heal over”; reestablishing a stable surface for the cam interface. The short-term effect on the cam is generally insignificant. The discarded material from spalling will be minimal and deposit in the filter element or screen.

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In infrequent cases, lifter deterioration will cause significant wear to the cam lobe and the lift of the valve may be reduced. Extreme corrosion leads to reduced power performance in the affected cylinder. The hydraulic lifter also has a limited range of adjustment and can run out of travel indicated by an audible tapping noise from the engine.

In some cases, significant spalling may result in some damage to the cam lobe apex. This level of damage is very rare, but will manifest itself as surface cracks on the nose with moderate depth. Corrosion/rust will also cause cam lobe distress. See steps 5 through 8, “Perform visual inspection of cam lobe using an inspection light.” on page 8. for detailed information.

NOTE: The appearance of the cam lobe apex may vary normally, and only if such cracks are present should the camshaft be considered a candidate for replacement.

III. Distress Detection

As with other wearing parts in the engine, the normal means of detecting excessive wear are through examination of the oil filter element or screen at each oil change. Extreme wear may also be detected by audible noise from the valve train indicating a lifter that is not pumping up properly. *In the absence of such indications, no action is needed until the next engine overhaul.*

If material is observed in the filter and believed to be from the lifters, perform an inspection according to the instructions in (see Section IV, “Inspection Criteria and Maintenance,” on page 6).



Figure 6. Full Face Spalling

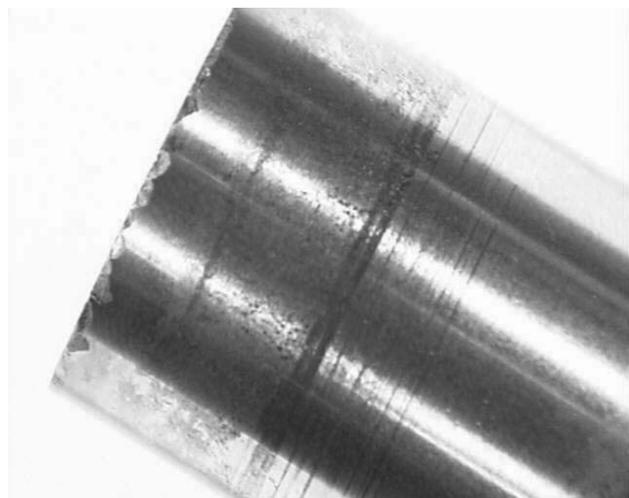


Figure 7. Corrosion Etching On Lifter Body

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A. Tips to Avoid Distress

1. Monitor Engine Usage, Flight Frequency, Oil Quality, and Oil Changes

CAUTION: Infrequently flown aircraft must have frequent oil changes to reduce wear distress. Compliance with the latest revision of M-0, Standard Practice Maintenance Manual and your applicable Engine Maintenance and Overhaul Manual is required.

Distress issues can be reduced by sustaining frequent flight operations under normal oil temperatures. A minimum 30 minute cruise flight is required (oil temperatures are stable at 170°F to 200°F range). This function assists the removal of moisture and acids from the system. As a result of such frequent operation, fleet operators rarely experience excessive corrosion or distress.

CM requires that aircraft that are not flown on a regular basis have the oil and filter changed at least four times a year. Adhere to the latest revision of M-0, Standard Practice Maintenance Manual for corrosion prevention.

2. Cold Weather Operations

Pre-heating using crankcase heaters is an effective means of warming an engine. However, the warming and cooling process can also condense moisture into the oil aggravating corrosion issues. See the latest revision of M-0, Standard Practice Maintenance Manual for more information on this subject.

3. Use Only Approved Oil

Use only approved lubricants as specified in the latest revision of M-0, Standard Practice Maintenance Manual.

IV. Inspection Criteria and Maintenance

If materials are detected from an examination of the oil filter element or screen, oil suction screen or drain plug, or if an audible noise from the valve train is detected, **the lifters and cam lobes must be examined as described below.** *No in-service examination is needed in the absence of such indicators or audible noise from the valves.*

1. Using the airframe manufacturer's maintenance instructions remove engine cowlings and cooling baffles as necessary to gain access to the cylinders for valve cover removal.
2. Using the appropriate engine overhaul or maintenance manual, remove the lifters as follows:

WARNING

Verify master switch is in the "OFF" position. Verify magneto switches are connected to the magnetos and in the "OFF" position. Verify "P" leads are grounded while working in close proximity to the propeller.

CAUTION: Mark all removed parts for reinstalling in the same position from which they were removed.

- a. Remove valve covers from the cylinders.
- b. Position the crankshaft so that the matching valve for each cylinder is fully closed.

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- c. Remove rocker shaft retaining hardware, rocker shafts, rocker arms and thrust washers (as required). Discard tab lock washers (where used). Mark the removed parts for reinstalling in the position from which they were removed.

NOTE: Some engine configurations allow removal of the push rod housing through the cylinder head flange. These configurations may be identified by the presence of two push rod housing washers on either side of the push rod housing seal in the cylinder head. After removal of the push rod housing seals and washers the push rod tube may then be removed through the cylinder head.

NOTE: Removal of induction system components may be required to facilitate push rod tube removal.

- d. Remove the push rods. Mark each removed push rod (and it's installed orientation) for reinstalling in the position from which it is removed.
 - e. Compress the push rod housing against the spring until the outboard end is clear. Carefully lower the cylinder flange-end of the push rod housing until it is clear of the cylinder.
 - f. Remove the push rod housing from the crankcase.
 - g. Remove the hydraulic lifter assemblies from the lifter bores. Mark the lifters for reinstalling into the position from which they were removed.
3. Inspect and replace lifters with severe face or lifter body wear signatures or spalling that exceeds 10% of the surface area. Lifters associated with noise indicating excessive valve lash should also be replaced regardless of face condition.
 4. If the lifter inspection only reveals normal signatures and there is no positive indication of any distress, continue with an inspection of cam lobes in steps 5 through 8, on page 8.

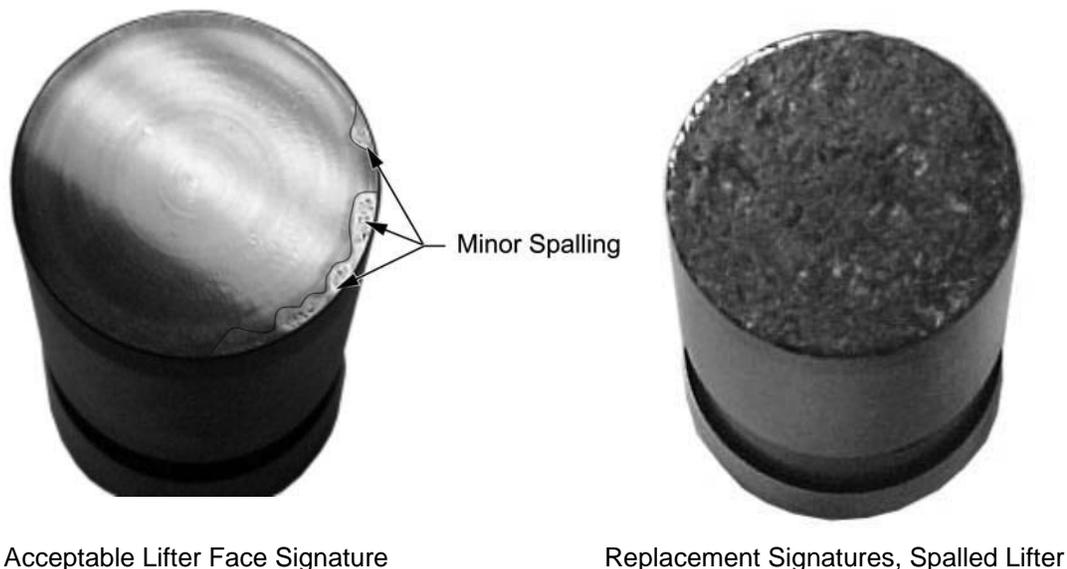


Figure 8. Example Replacement Signature, Hydraulic Lifter

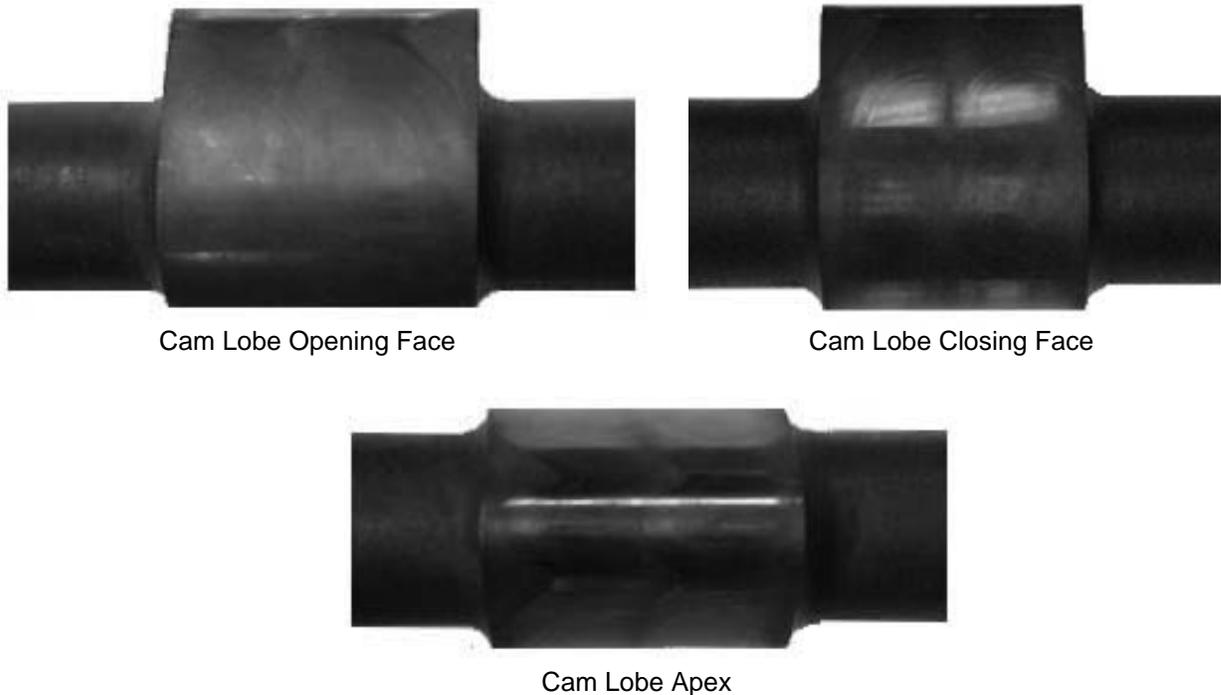
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5. Turn engine so that the apex of the cam lobe is visible through the lifter bore in the crankcase (see Figure 9).
6. Perform visual inspection of cam lobe using an inspection light.
7. Repeat Steps 5 and 6 to examine all camshaft lobes.
 - a. If the surface is smooth and shiny with only small areas of rough appearance, *no further action is required.*



Normal Wear Signature Shown

Figure 9. Cam Lobe Apex in Inspection Location



Cam Lobe Opening Face

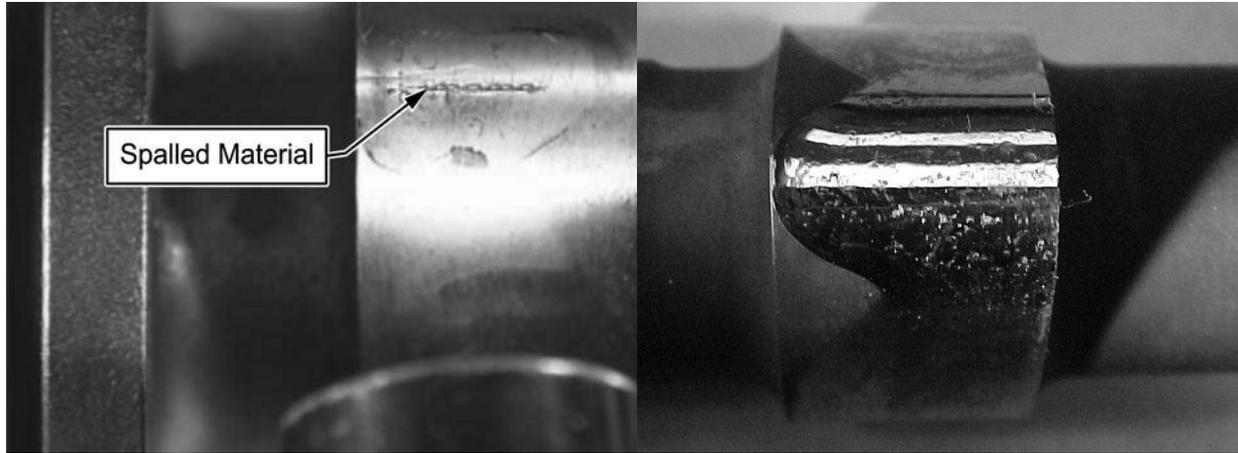
Cam Lobe Closing Face

Cam Lobe Apex

Figure 10. Typical Cam Lobe Wear Signatures

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8. If the visual cam lobe inspection reveals the presence of indentions or crack like features in the surface along the cam lobe apex, use a sharp pick or awl and lightly move it's tip over the suspect surface area. If the suspect feature has any depth, the pick tip will repeatedly catch in the groove or pits.
 - 1) If the indentation or crack is determined to have depth, the cam must be examined by a CM service representative to determine any additional steps required.



Spalled Cam Lobe

Corrosion Pitted Cam Lobe

Figure 11. Suspect Cam Lobe Wear Signatures

- 2) If the cam lobe inspection only reveals normal signatures and there is no positive indication of any distress depth, coat the serviceable lifters with Dow-Corning® G-N paste and reinstall in the same location as removed. *No further action is required.*

9. Reinstall items removed in steps 2.a. through 2.g. (using new tab washers as applicable) using the latest revision of the appropriate maintenance or overhaul manual and the latest revision of M-0, Standard Practice Maintenance Manual.

For minor distress, the camshaft may be continued in service and re-examined upon the accumulation of 100 hours operation or 12 months, whichever occurs first. If the CM representative determines the camshaft should be replaced, the engine should be removed for repair.

V. WARRANTY

For warranty information and coverage, refer to the Warranty supplied with your engine or contact CM Service Department. CM may require inspections or repair to be performed at facilities selected by CM. CM warranty will cover replacement of lifters and cam where unacceptable distress is found, in accordance with the applicable warranty policy in effect on the engine at the date of occurrence, except as noted below:

1. due to distress originating from lack of lubrication.
2. inspection for such conditions in the absence of the indications described in this service document.
3. unless authorized by a CM Service Representative prior to the work being done.

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