

PRATT & WHITNEY CANADA
MAINTENANCE MANUAL
MANUAL PART NO. 3013242

LIST OF EFFECTIVE PAGES

<u>CHAPTER SECTION</u>	<u>PAGE</u>	<u>DATE</u>
LEP	1	Feb 11/2000
	2 blank	Feb 11/2000
Contents	1	Feb 11/2000
	2 blank	Feb 11/2000
72-40-00	1	Feb 11/2000
Description and Operation	2 blank	Feb 11/2000
72-40-01	1	Feb 11/2000
Description and Operation	2	Feb 11/2000
72-40-01	201	Feb 11/2000
Maintenance	202	Feb 11/2000
Practices	203	Feb 11/2000
	204	Feb 11/2000
	205	Feb 11/2000
	206	Feb 11/2000
	207	Feb 11/2000
	208	Feb 11/2000
	209	Feb 11/2000
	210	Feb 11/2000
	211	Feb 11/2000
	212	Feb 11/2000
	213	Feb 11/2000
	214	Feb 11/2000

PRATT & WHITNEY CANADA
MAINTENANCE MANUAL
MANUAL PART NO. 3013242

<u>SUBJECT</u>	<u>TABLE OF CONTENTS</u>	<u>PAGE</u>
COMBUSTION SECTION - DESCRIPTION AND OPERATION		72-40-00
1. Description and Operation		1
COMBUSTION CHAMBER LINER ASSEMBLY- DESCRIPTION AND OPERATION		72-40-01
1. Description and Operation		1
COMBUSTION CHAMBER ASSEMBLY - MAINTENANCE PRACTICES		72-40-01
1. General		201
2. Consumable Materials		201
3. Special Tools		201
4. Fixtures, Equipment and Supplier Tools		201
5. Removal/Installation		201
A. Removal of Combustion Chamber Liner		201
B. Installation of Combustion Chamber Liner		203
6. Inspection/Check		203
A. General		203
B. Acceptable Conditions, Repair Unnecessary		203
C. Acceptable Conditions, Repair Necessary		207
D. Unacceptable Conditions, No Repair Permitted		207
7. Approved Repairs		214
A. Repair of Cracks		214

PRATT & WHITNEY CANADA
MAINTENANCE MANUAL
MANUAL PART NO. 3013242

COMBUSTION SECTION - DESCRIPTION AND OPERATION

1. Description and Operation

The combustion section of the engine is contained in the front section of the gas generator case and consists of the combustion chamber liner and the small and large exit ducts. The liner is retained within the gas generator case by the two glow plugs or spark igniters and the 14 fuel manifold adapters. Compressor discharge air is directed from the diffuser section and discharges into the combustion section; air enters the liner through straight and plunged holes, mixes with fuel from the manifold and is ignited. The expanding gases flow to the rear and into the exit duct zone where the gas flow is turned 180 degrees inward to flow forward through the compressor turbine inlet guide vanes to the compressor turbine.

PRATT & WHITNEY CANADA
MAINTENANCE MANUAL
MANUAL PART NO. 3013242

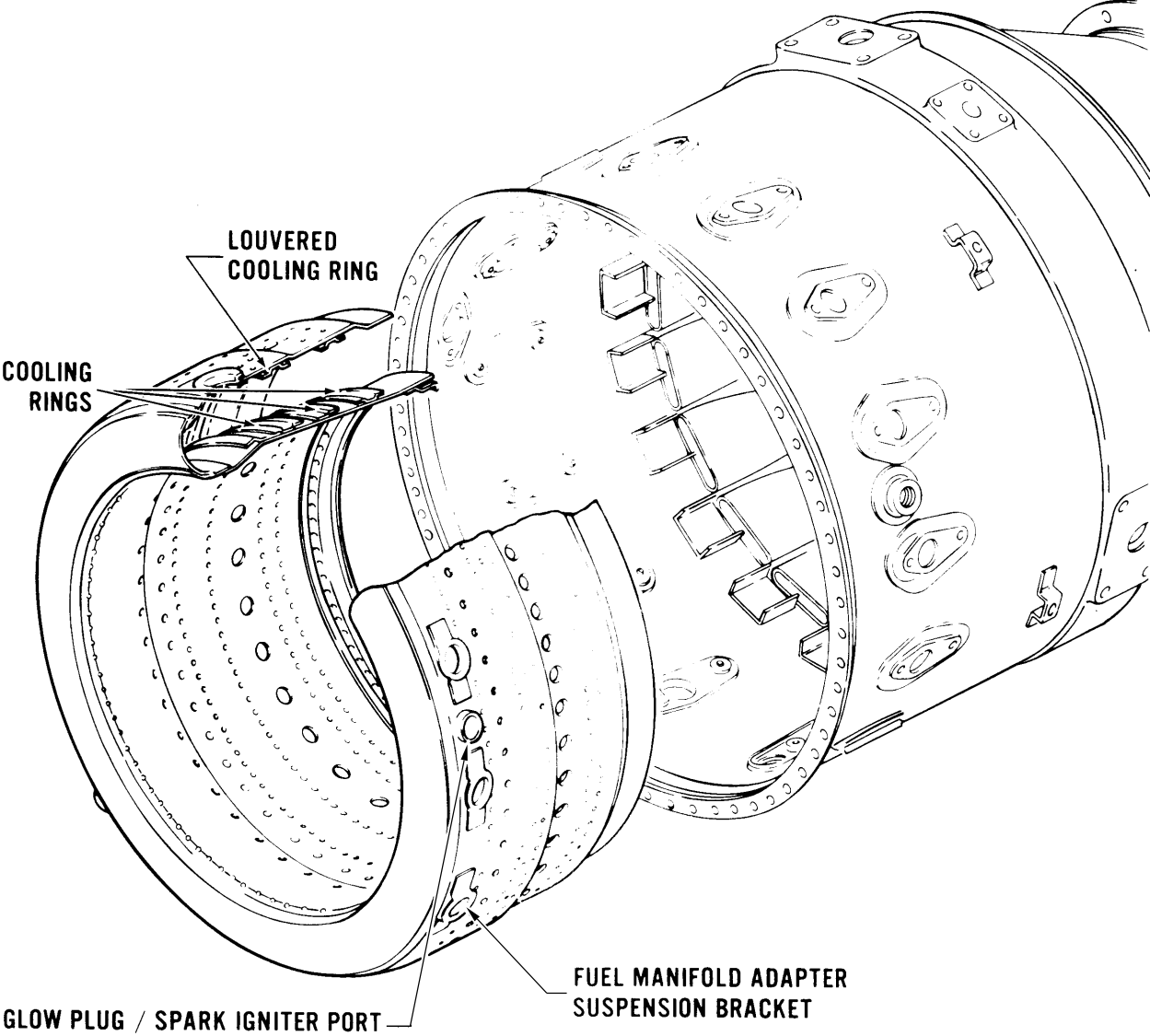
COMBUSTION CHAMBER LINER ASSEMBLY- DESCRIPTION AND OPERATION

1. Description and Operation (Ref. Fig. 1)

The combustion chamber liner is an annular, heat-resistant steel liner, open at the rear end and domed at the front end. A series of straight, plunged and shielded holes in the inner and outer walls of the liner allow compressor discharge air to enter the liner combustion zone. Two glow plugs/ igniter sleeves and 14 fuel nozzle ports, which incorporate nozzle support brackets, are located in the liner outer wall adjacent to the domed end. The shape, size and locations of the holes and shields, as well as the locations of the glow plugs/igniter sleeves, provide the best fuel/air ratios for starting and sustained combustion and form efficient primary and secondary zones within the liner combustion zone. Primary air, introduced near the fuel nozzle ports, serves to support combustion. The secondary air provides a layer of cooling air adjacent to the liner inner walls; this effectively keeps the flame away from the walls and, by mixing, ensures that the gases leaving the liner are cooled to a temperature which the compressor turbine can tolerate; it also provides additional air for the combustion process.

The domed end of the liner is supported inside the front section of the gas generator case (Ref. 72-30-04) by the 14 fuel manifold adapter sheaths (Ref. 73-10-05) while the rear end of the liner is supported by the large and small exit ducts.

**PRATT & WHITNEY CANADA
MAINTENANCE MANUAL
MANUAL PART NO. 3013242**



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Combustion Chamber Liner Assemblies
Figure 1

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MAINTENANCE MANUAL
MANUAL PART NO. 3013242

COMBUSTION CHAMBER ASSEMBLY - MAINTENANCE PRACTICES

1. General

- A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00 STANDARD PRACTICES of this manual to familiarize themselves with general procedures.
- B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.
- C. Lockwire shall comply with specification AMS 5687, heat and corrosion resistant steel wire MS9226-03, which is 0.025 inch diameter, and will not be specified in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

<u>Item No.</u>	<u>Name</u>
PWC05-151	Wire, Filler
PWC11-014	Alcohol, Isopropyl

3. Special Tools

Not Applicable

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Removal/Installation

A. Removal of Combustion Chamber Liner (Ref. Fig. 201)

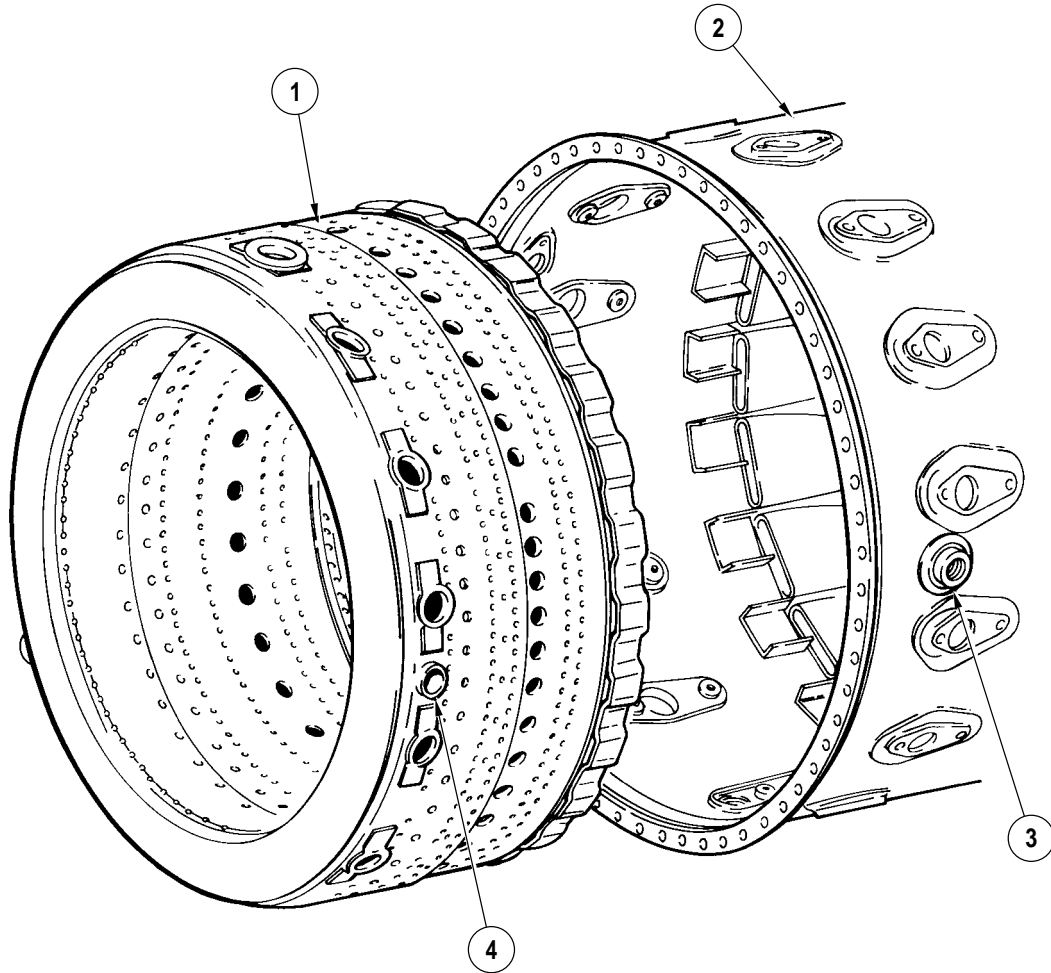
- (1) Remove the power section (Ref. 72-00-00, SERVICING).
- (2) Remove the fuel manifold adapter assemblies (Ref. 73-10-05, Removal/Installation).
- (3) Remove the ignition glow plugs (Ref. 74-20-02) or spark igniters (Ref. 74-20-04, Removal/Installation).

CAUTION: DO NOT ATTEMPT TO PRY THE LINER LOOSE WITH SHARP EDGED OR POINTED TOOLS.

- (4) Withdraw the combustion chamber liner (1) from the gas generator assembly (2).

NOTE: If difficulty is experienced in withdrawing the liner from the gas generator assembly, strike the inside wall of the liner with the palm of your hand to dislodge the liner from the small and large exit duct joints.

PRATT & WHITNEY CANADA
MAINTENANCE MANUAL
MANUAL PART NO. 3013242



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Removal/Installation of Combustion Chamber Liner
Figure 201

PRATT & WHITNEY CANADA
MAINTENANCE MANUAL
MANUAL PART NO. 3013242

Key to Figure 201

1. Combustion Chamber Liner
2. Gas Generator Assembly
3. Gas Generator Case Glow Plug/Spark Igniter Bosses
4. Combustion Chamber Liner Glow Plug/Spark Igniter Bosses

B. Installation of Combustion Chamber Liner (Ref. Fig. 201)

- (1) Install the combustion chamber liner (1) in the gas generator assembly (2), aligning the glow plug/spark igniter bosses (4) in the outer wall of the liner with the corresponding bosses (3) on the gas generator assembly.
- (2) Make sure that the rear flanges Pre-SB1434 or rear sliding joint flanges Post-SB1434 (Ref. Fig. 208) of the liner inner and outer walls engage with the corresponding flanges on the small and large exit ducts.
- (3) Install the ignition glow plugs (Ref. 74-20-02) or spark igniters (Ref. 74-20-04, Removal/Installation).
- (4) Install the fuel manifold adapter assemblies (Ref. 73-10-05, Removal/Installation).
- (5) Install the power section on the gas generator assembly (Ref. 72-00-00, SERVICING).

6. Inspection/Check

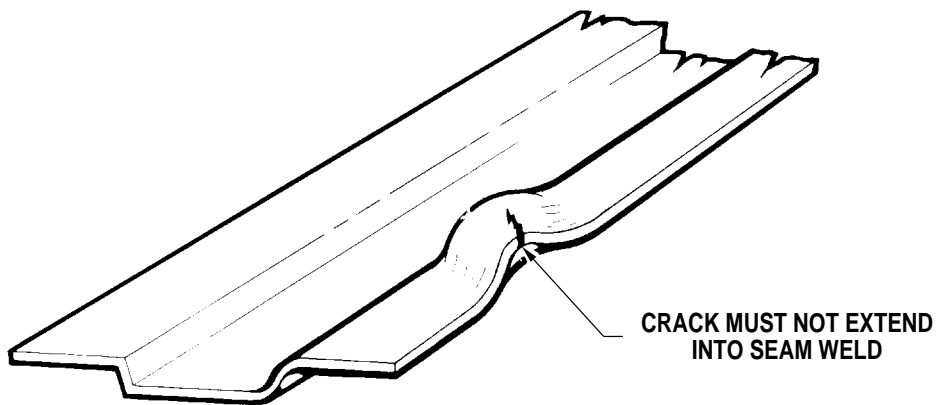
A. General

- (1) Examine the combustion chamber liners for cracks, buckling and burning. Cracks in the liner surface are usually of a stress relieving nature and are usually not serious, since the rate of growth decreases as the crack lengthens. Thermal stresses, in effect, relieve original stress conditions. It is normal to observe a given type of deterioration repeated from liner to liner in the same engine, or engines of the same model. Typical liner distress consists of buckling and cracking of the cooling rings and cracking at the inner wall of the exit duct section of the outer liner.

B. Acceptable Conditions, Repair Unnecessary

- (1) Localized buckling and/or burning of the cooling rings, except the louvered type, accompanied by cracking is acceptable provided the cracks do not extend into the seam weld (Ref. Fig. 202).
- (2) Cracks in the louvered type cooling ring (Ref. Fig. 203) are acceptable provided that circumferential cracks in the seam weld (Ref. Fig. 204) not exceeding 0.300 inch in length are stop drilled using a $\frac{1}{16}$ (0.0625) inch drill.
- (3) Straight line cracks between two adjacent cooling holes are acceptable.

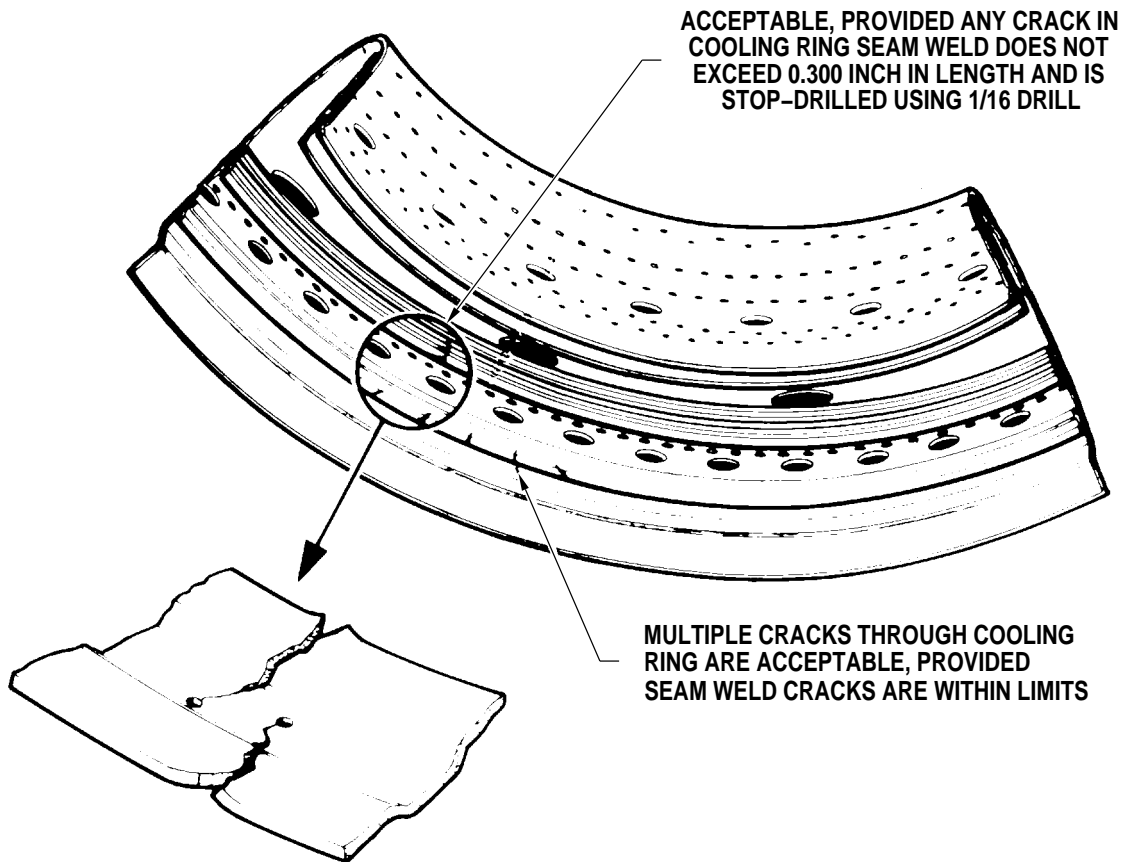
PRATT & WHITNEY CANADA
MAINTENANCE MANUAL
MANUAL PART NO. 3013242



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Acceptable Buckling and Cracking in Cooling Rings (Non-Louvered Type)
Figure 202

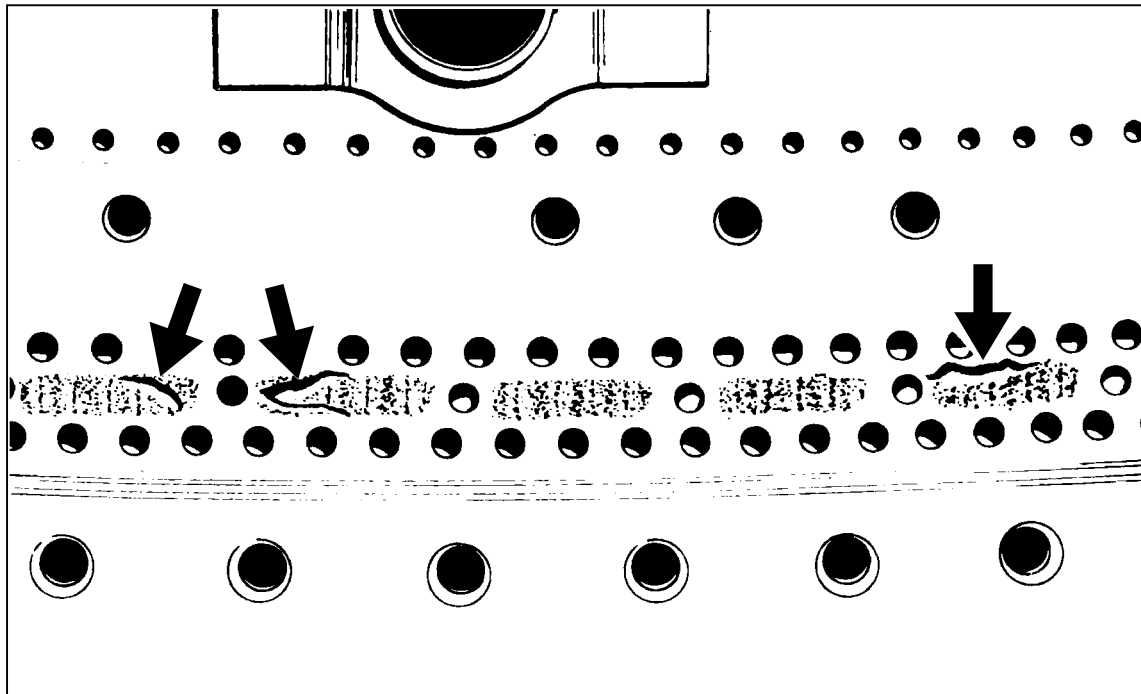
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MAINTENANCE MANUAL
MANUAL PART NO. 3013242



C224B

Acceptable Cracks in Louvered Type Cooling Ring
Figure 203

PRATT & WHITNEY CANADA
MAINTENANCE MANUAL
MANUAL PART NO. 3013242



CRACKS OF THIS NATURE ARE ACCEPTABLE, PROVIDED
THEY DO NOT EXCEED 0.300 INCH IN LENGTH AND ARE
STOP-DRILLED USING 1/16 DRILL.

C225B

Acceptable Cracks in Louvered Cooling Ring Seam Weld
Figure 204

PRATT & WHITNEY CANADA
MAINTENANCE MANUAL
MANUAL PART NO. 3013242

CAUTION: CRACKS RUNNING IN THE SAME DIRECTION, AND WHICH COULD ULTIMATELY JOIN, ARE NOT ACCEPTABLE UNLESS THEY ARE SEPARATED BY AT LEAST THREE INCHES OF PARENT METAL.

- (4) A maximum of seven cracks, each crack not exceeding one inch long, is acceptable in the inner wall of the domed end of the inner liner (Ref. Fig. 205).
- (5) Inspect convolutions (Pre-SB1434) of support strip on outer liner for wear. Wear not exceeding 50 percent of material thickness is acceptable. If convolutions worn in excess of 50 percent, ship the liner to an approved overhaul facility for repair.
- (6) Localized areas that have been heated to an extent as to cause buckling of the liner are considered acceptable provided the buckling is shallow, and it is not associated with burning, which would reduce the wall thickness and weaken the structure (Ref. Fig. 207).
- (7) The dome bulging is often associated with cooling ring buckling and reduction of cooling ring gap, and repair of the gap is necessary (Ref. Fig. 206).

C. Acceptable Conditions, Repair Necessary

- (1) Buckled cooling rings and liner dome, where the gap has been eliminated, must be reworked. Use a suitable bar to restore a uniform gap to dimensions shown (Ref. Fig. 208).
- (2) Cracks not exceeding two inches in length must be repaired (Ref. Para. 7.).
- (3) Circumferential cracks next to seam welds must be repaired (Ref. Para. 7.).

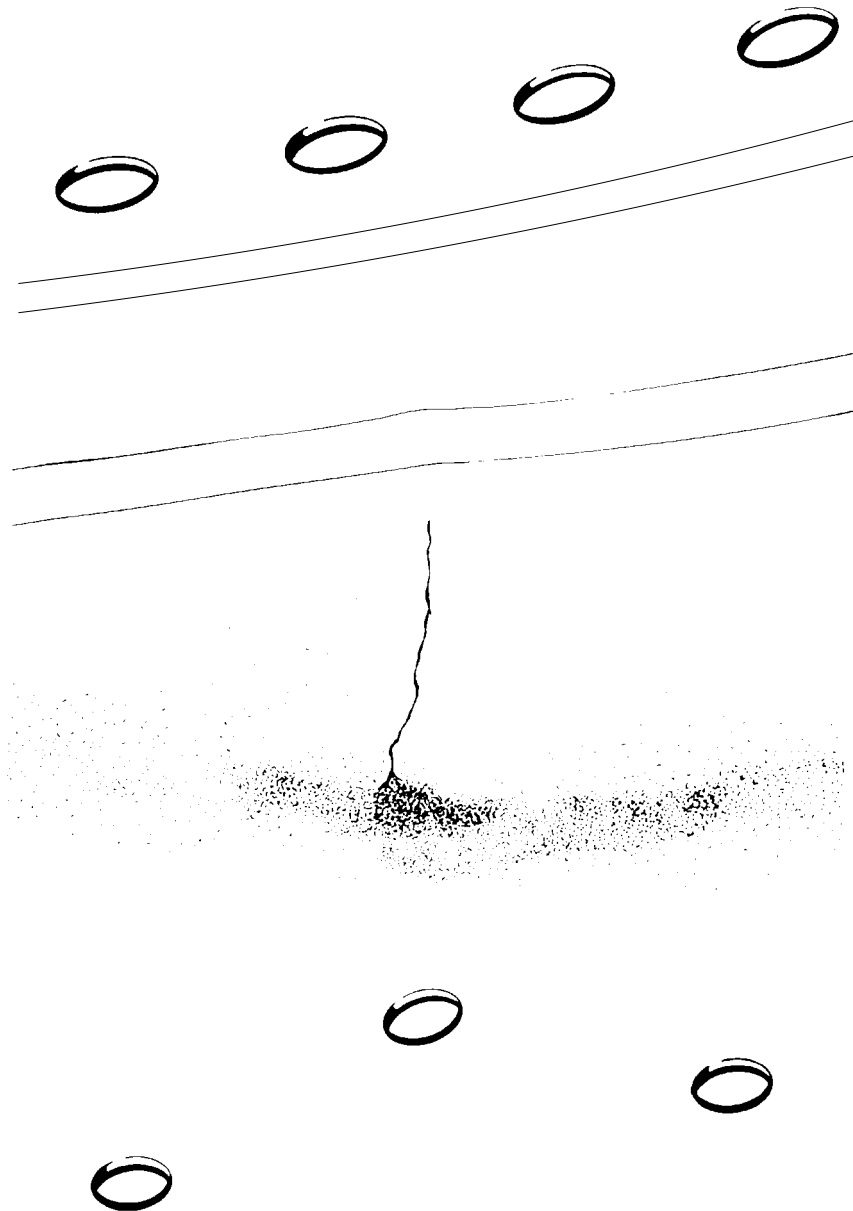
NOTE: Crack openings in excess of 0.030 inch are not repairable.

- (4) When cracks progress from a free edge so that their meeting is imminent, and could subsequently allow a piece of liner material to break loose, they must be repaired by welding (Ref. Para. 7.).

D. Unacceptable Conditions, No Repair Permitted

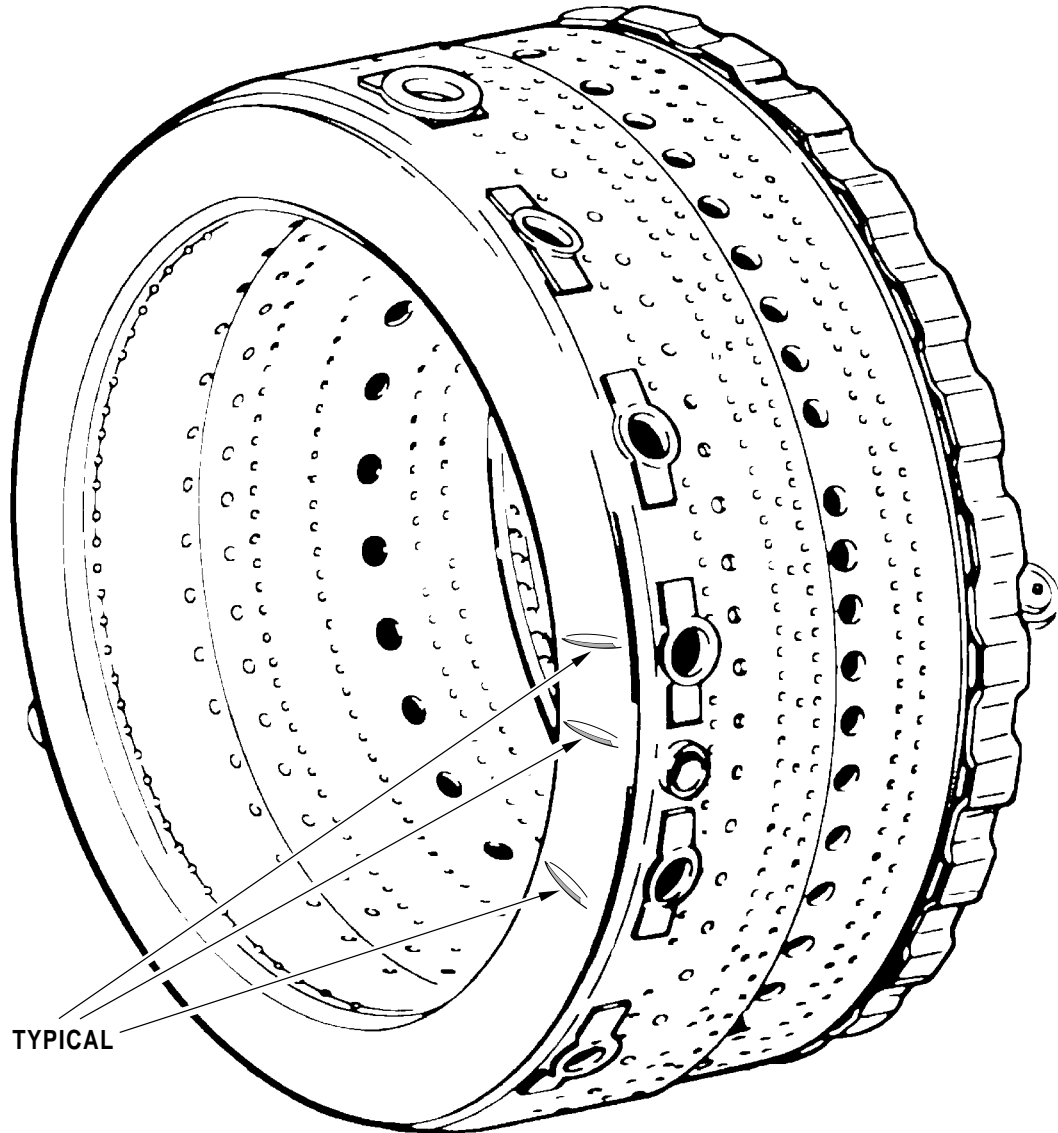
NOTE: Rejected combustion chamber inner and outer liners removed during maintenance activities should be returned to an overhaul facility for possible restoration to a usable condition. It is recommended that "run" inner and outer liners be kept together in pairs, if possible.

- (1) Severe buckling causing kinked metal (Ref. Fig. 209).
- (2) Multiple cracks are not repairable (Ref. Fig. 210).
- (3) Cracks exceeding two inches in length are not repairable.
- (4) Circumferential cracks which are opened more than 0.030 inch and are next to seam welds are not repairable.



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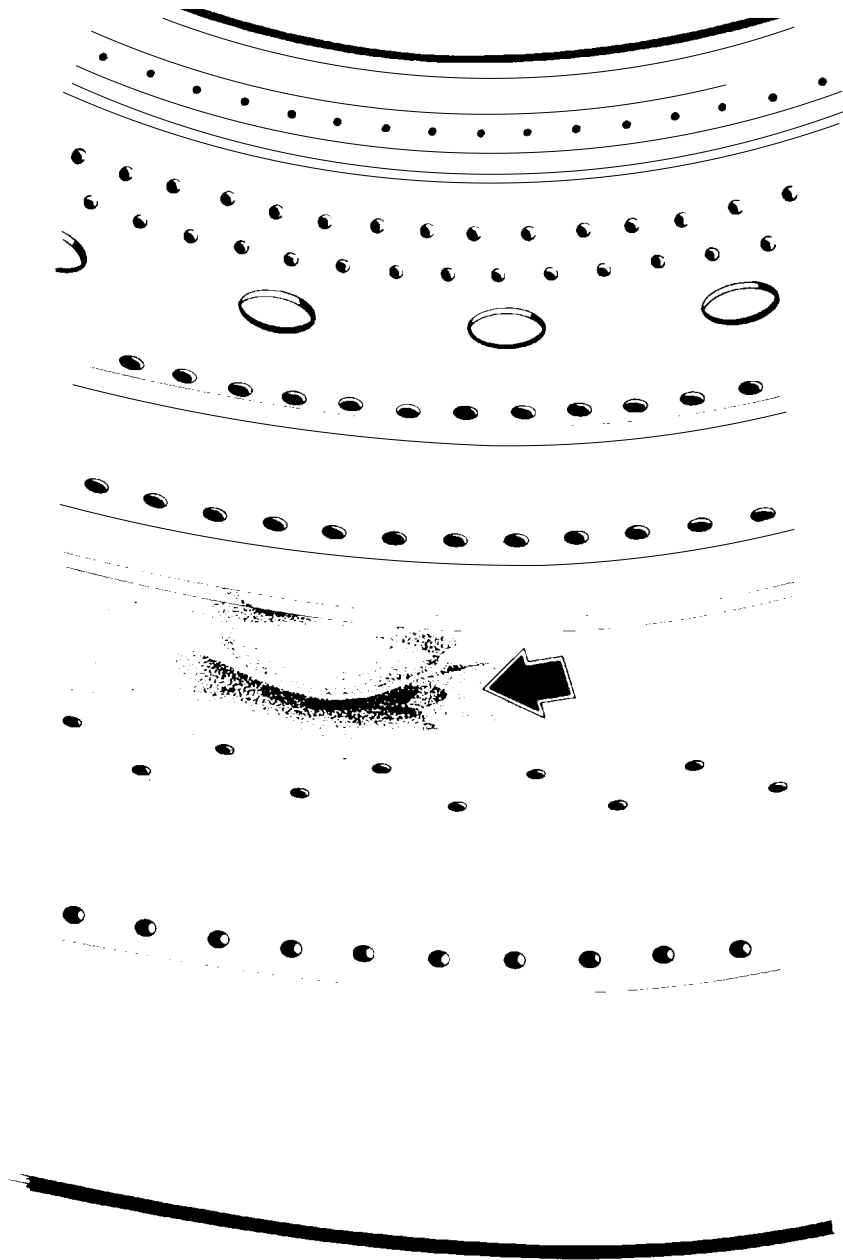
Acceptable Cracks in Inner Wall of Liner
Figure 205



TYPICAL

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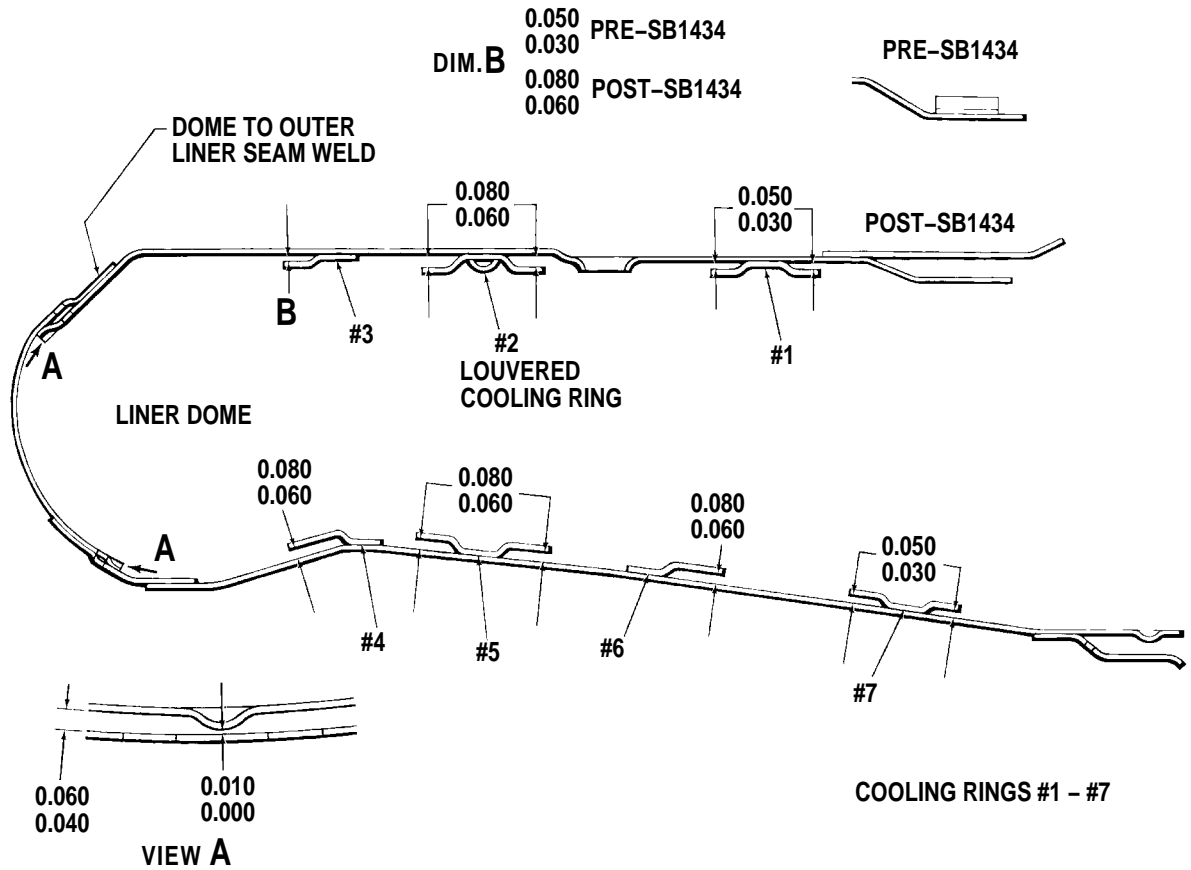
Acceptable Bulging in Liner Dome
Figure 206



C89A

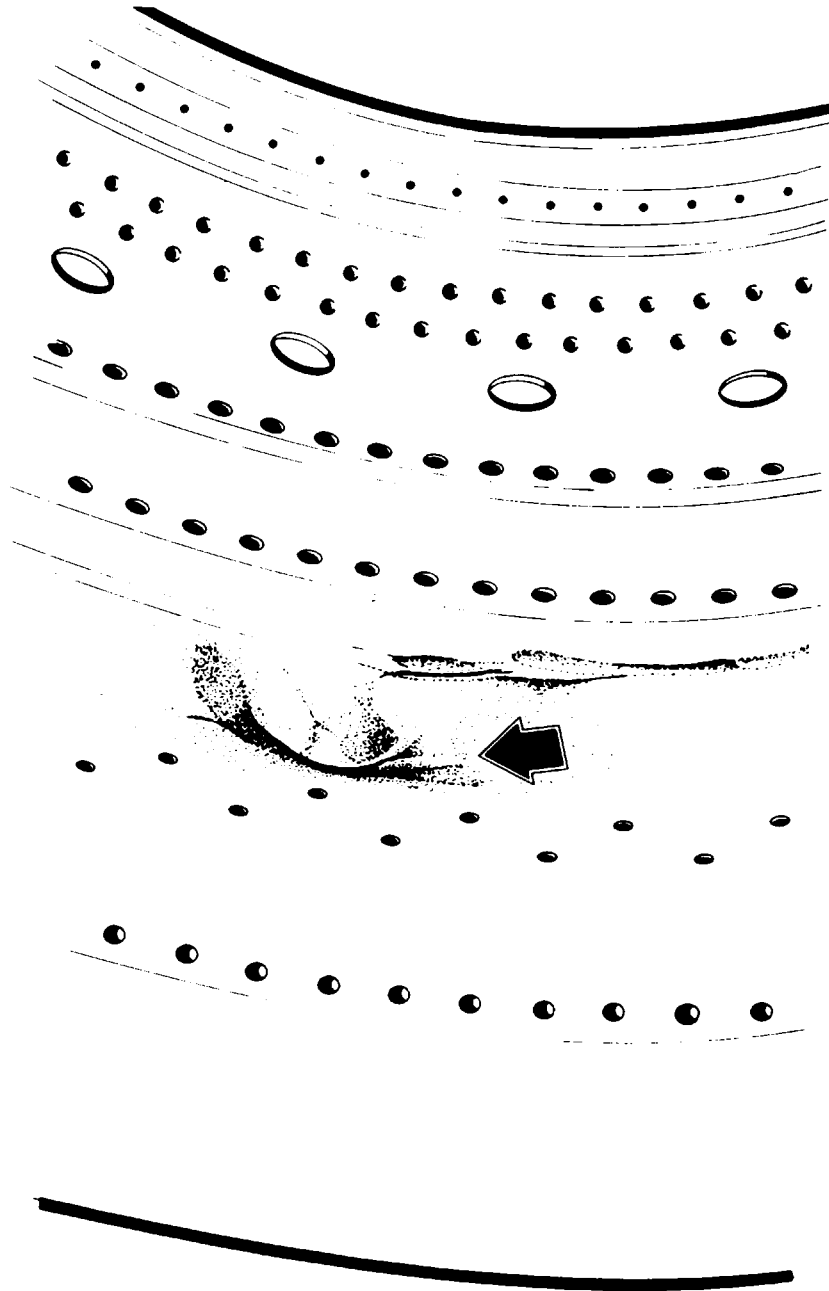
Acceptable Buckling in Liner
Figure 207

PRATT & WHITNEY CANADA
 MAINTENANCE MANUAL
 MANUAL PART NO. 3013242



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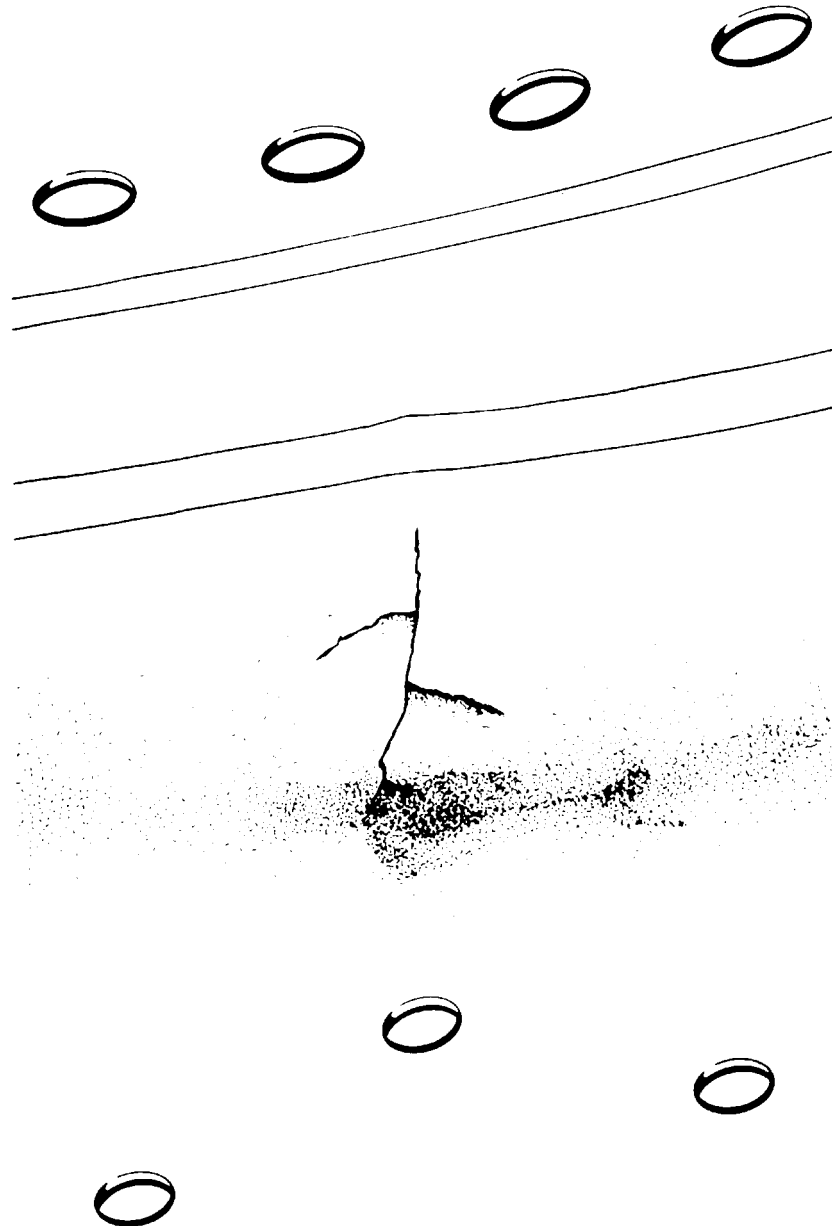
Restoration of Gaps in Liner Dome and Cooling Rings
 Figure 208



C90A

Unacceptable Buckling in Liner
Figure 209

PRATT & WHITNEY CANADA
MAINTENANCE MANUAL
MANUAL PART NO. 3013242



C91A

Unacceptable Multiple Cracks in Liner
Figure 210

PRATT & WHITNEY CANADA
MAINTENANCE MANUAL
MANUAL PART NO. 3013242

7. Approved Repairs

A. Repair of Cracks

CAUTION: HOLES THAT BECOME PLUGGED AS A RESULT OF WELDING MUST BE REDRILLED TO THE ORIGINAL SIZE AND THEN DEBURRED. CHECK THE PATTERN AND SIZE OF THE ADJACENT HOLES USING A SUITABLE DRILL GAGE. LOOSE WELD MATERIAL MUST BE REMOVED.

- (1) Stop drill the ends of a crack with a 1/16 (0.0625) inch drill. Vee out a crack using a suitable abrasive wheel.
- (2) Thoroughly wire brush the area and swab with alcohol (PWC11-014).
- (3) Weld the prepared area using tungsten inert gas (TIG) equipment (Ref. 70-00-00) and a small diameter filler rod (PWC05-151) to minimize the weld bead size. Stress relief after welding is not necessary.

NOTE: Use a copper back-up plate to reduce distortion with the addition of argon gas backup, if available.

TABLE 201, Determination of Filler Material for Crack Repairs

Combustion Chamber Liner Part No.	Filler Metal	PT6A-21	PT6A-27	PT6A-28
3014144 *	AMS 5798		X	X
3020491 *	AMS 5798		X	X
3011283 *	AMS 5798		X	X
3022535	AMS 5837		X	X
3024576	AMS 5837	X	X	X

* Pre-SB1216 and Pre-SB1220