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Engine Manual

Gas Turbine Engine

Part Number	Model No.	CAGE
3800708-1	131-9[A]	99193

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TRANSMITTAL INFORMATION

TO HOLDERS OF GAS TURBINE ENGINE EM ATA NO. 49-27-29 ISSUED FOR USE IN SUPPORT OF THE FOLLOWING:

Table TI-1 shows the applicable components.

Table TI-1. Applicable Components

Engine/ Component PN	Engine Model No.	Aircraft Application
3800708-1	131-9[A]	A319/A320/A321

Revision History

Table TI-2 shows the revision history of this EM.

Table TI-2. Revision History

Revision Number	Revision Date
0	30 Apr 1998
1	30 Sep 2000
2	25 Jan 2005
3	31 Aug 2005
4	17 Nov 2006
5	17 Nov 2008
6	14 Sep 2009
7	31 Dec 2011
8	23 Aug 2013
9	13 May 2015
10	12 Jan 2017
11	25 Oct 2017
12	14 Aug 2018
13	21 Nov 2019
14	8 Jun 2020
15	23 Oct 2020
16	5 May 2021
17	18 Mar 2022
18	20 Apr 2022

This revision is a full replacement. All changed pages have a new date, as identified in the List of Effective Pages. Revision bars identify the changed data. See Transmittal information for history of revisions to this EM.

Remove and discard all pages of the manual and replace them with the attached pages. Write the revision number, revision date, and replacement date on the Record of Revisions page.

Revision bars mark the technical data that changed in this revision; those changes are described in the Table of Highlights. Editorial changes are not marked with a revision bar.

The table of highlights tells users what has changed as a result of the revision. The table consists of three columns.

The Task/Page column identifies the blocks of changed information, such as a task, subtask, graphic, or parts list, and the page on which that block starts. The block of information often includes the MTOSS code. Revision marks, when provided, identify the location of the change within the block.

The Description of Change column tells about the change or changes within each block. The description of change is often preceded by a paragraph or figure reference that applies to the block of information.

The Effectivity column tells the user the part number(s) to which the block of information applies. The default value for this column is "All." "All" means that the block applies to all parts.

Table of Highlights

Task/Page	**Description of Change**	**Effectivity**
TRANSMITTAL INFORMATION	Global Change: Changed the content and format to agree with the Honeywell processes in effect at the time of the release of this revision.	All
TRANSMITTAL INFORMATION	Global Change: The editorial changes and data that were moved or reformatted are not idencgmied with revision bars.	All
49-00-00 INTRODUCTION	Paragraph 1.A. Updated overhauled definition.	All

RECORD OF REVISIONS

For each revision, write the revision number, revision date, date put in the manual, and your initials in the applicable column.

NOTE: Refer to the Revision History in the TRANSMITTAL INFORMATION section for revision data.

Revision Number	Revision Date	Date Put In Manual	By		Revision Number	Revision Date	Date Put In Manual	By

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RECORD OF TEMPORARY REVISIONS

Instructions on each page of a temporary revision tell you where to put the pages in your manual. Remove the temporary revision pages only when discard instructions are given. For each temporary revision, put the applicable data in the record columns on this page.

Definition of Status column: A TR can be active, incorporated, or deleted. “Active” is entered by the holder of the manual. “Incorporated” means a TR has been incorporated into the manual and includes the revision number of the manual when the TR was incorporated. “Deleted” means a TR has been replaced by another TR, a TR number will not be issued, or a TR has been deleted.

Temporary Revision Number	Status	Page Number	Issue Date	Date Put In Manual	By	Date Removed From Manual	By
49-1	INC Rev 1		29 Aug 1998				
49-2	INC Rev 1		29 Aug 1998				
49-3	INC Rev 1		29 Aug 1998				
49-4	INC Rev 1		16 Nov 1998				
49-5	INC Rev 1		16 Nov 1998				
49-6	INC Rev 1		16 Nov 1998				
49-7	INC Rev 1		13 Aug 1999				
49-8	INC Rev 1		20 Aug 1999				
49-9	INC Rev 1		20 Aug 1999				
49-10	INC Rev 1		11 Nov 1999				
49-11	INC Rev 1		3 Mar 2000				
49-12			18 Nov 2002		(Replaced by TR 49-22)		
49-13			18 Nov 2002		(Replaced by TR 49-21)		
49-14	INC Rev 2		22 Nov 2002				
49-15	INC Rev 2		22 Nov 2002				
49-16	INC Rev 2		22 Nov 2002				
49-17	INC Rev 2		22 Nov 2002				
49-18	INC Rev 2		22 Nov 2002				
49-19	INC Rev 2		22 Nov 2002				
49-20	INC Rev 2		22 Nov 2002				
49-21	INC Rev 2		22 Nov 2002				
49-22	INC Rev 2		22 Nov 2002				
49-23	INC Rev 2		22 Nov 2002				
49-24	INC Rev 2		22 Nov 2002				
49-25	INC Rev 2		22 Nov 2002				

Temporary Revision Number	Status	Page Number	Issue Date	Date Put In Manual	By	Date Removed From Manual	By
49-26	INC Rev 2		7 Jan 2004				
49-27	INC Rev 3		18 Apr 2005				
49-28	INC Rev 3		18 Apr 2005				
49-29	INC Rev 3		18 Apr 2005				
49-30	INC Rev 4		30 Nov 2005				
49-31	INC Rev 4		30 Nov 2005				
49-32	INC Rev 4		30 Nov 2005				
49-33	INC Rev 4		30 Nov 2005				
49-34	INC Rev 4		30 Nov 2005				
49-35			11 Jan 2006		(Replaced by TR 49-36)		
49-36	INC Rev 4		30 Jan 2006				
49-37	INC Rev 4		26 Jul 2006				
49-38	INC Rev 5		27 Jul 2007				
49-39	INC Rev 5		21 Sep 2007				
49-40	INC Rev 5		21 Sep 2007				
49-41	INC Rev 5		21 Sep 2007				
49-42	INC Rev 5		21 Sep 2007				
49-43	INC Rev 5		21 Sep 2007				
49-44	INC Rev 5		21 Sep 2007				
49-45	INC Rev 5		5 Nov 2007				
49-46	INC Rev 7		9 Jun 2011				
49-47	INC Rev 7		9 Jun 2011		(Replaced by TR 49-52)		
49-48	INC Rev 7		10 Jun 2011				
49-49	INC Rev 7		30 Sep 2011				
49-50	INC Rev 7		10 Oct 2011				
49-51	INC Rev 7		14 Oct 2011				
49-52	INC Rev 7		19 Dec 2011				
49-53	INC Rev 8		14 Jun 2012				
49-54	INC Rev 8		30 Jul 2012				
49-55	INC Rev 8		10 Sep 2012				
49-56	INC Rev 8		16 Jan 2013				
49-57	INC Rev 8		26 Jul 2013				
49-58	INC Rev 8		26 Jul 2013				

Temporary Revision Number	Status	Page Number	Issue Date	Date Put In Manual	By	Date Removed From Manual	By
49-59	INC Rev 8		23 Oct 2013				
49-60	INC Rev 9		27 Jan 2014				
49-61	INC Rev 9		23 Jan 2014				
49-62	INC Rev 9		5 Sep 2014				
49-63	INC Rev 9		2 Dec 2014				
49-64	INC Rev 10		17 Jul 2015				
49-65	INC Rev 10		4 Sep 2015				
49-66	INC Rev 10		24 Sep 2015				
49-67	INC Rev 11		3 Feb 2017				
49-68	INC Rev 11		19 Apr 2017				
49-69	INC Rev 13		24 Oct 2018				

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SERVICE BULLETIN LIST

Service Bulletin/ Revision Number	Title	Modification	Date Put in Manual
131-49-7469	Remove and Replace Stud, Part No. 682-557-2416 with Part No. 682-557-2418.		30 Sep 2000
131-49-7562, R1	Replace Turbine Seal Gasket, Part No. 3844707-1 with Part No. 3844707-2.		30 Sep 2000
131-49-7600	Rework/Replace the Turbine Stator Support Assembly, Part No. 3844797-15/-16 to/with Part No. 3844797-19/-20, by Reworking Containment Ring, Part No. 3844587-3 to Part No. 3844587-4 and Replacing First Stage Stator Support, Part No. 3844683-8 with Part No. 3844908-2.		No Effect
131-49-7601	Replace Electronic Control Box, Part No. 3888394-120201 with Part No. 3888394-121202 or Part No. 3888394-221202.		Refer to ATA No. 49-27-27
3888394-49-7602, R1	Electronic Control Box (ECB), Modification of Part No. 3888394-120201 to 3888394-121202.		Refer to ATA No. 49-27-27
131-49-7606, R1	Rework and/or Replace Power Section, Part No. 3801300-1 to/with Part No. 3801300-2 and Plumbing and Electrical Assembly, Part No. 3617170-1 to/with Part No. 3617170-2.		17 Nov 2006
131-49-7668	Incorporate Combustor Case Drain Plug Lockwire Feature on Engine Assembly Part No. 3800708-1.		31 Aug 2005
131-49-7687	Replace Fuel Control Unit (FCU), Part No. 441921-4 with Part No. 441921-5.		Refer to ATA No. 49-27-27
131-49-7712, R1	Rework or Replace Surge Duct, PN 3884974-1 to/with PN 3885084-1, on the 131-9[A] APU.		Refer to ATA No. 49-27-27
131-49-7716	Replace Compressor Discharge Duct, Part No. 3885007-1 with Part No. 3885007-2.		Refer to ATA No. 49-27-27
131-49-7718	Replace Engine Compressor Shroud, Part No. 3827322-3 with Part No. 3827504-3.		Refer to ATA No. 49-27-27
131-49-7739	Replace Fuel Flow Divider, Part No. 3883830-1 with Part No. 3879005-1 and Fitting, Part No. MS24392J4 with Part No. 3879006-1.		31 Aug 2005
131-49-7741, R1	Replace Fuel Control Unit (FCU) Clamp, Part No. 234-591-3030 with Part No. 234-511-9059.		17 Nov 2006
131-49-7744	Replace/Rework First Stage Stator Support Assembly, Part No. 3844797-19/-20 or Part No. 3844797-15/-16 with/to Part No. 3844797-21/-22.		31 Aug 2005
131-49-7764	Replace Cooling Fan Inlet Duct, Part No. 3810929-2 with 3810929-3.		Refer to ATA No. 49-27-27

Service Bulletin/ Revision Number	Title	Modification	Date Put in Manual
131-49-7765	Replace Cooling Fan Exit Duct, Part No. 3810900-3 with 3810900-4.		Refer to ATA No. 49-27-27
131-49-7777, R1	Replace/Return for Rework First Stage Turbine Wheel Assembly, Part No. 3840160-5 with/to Part No. 3840303-1.		Refer to ATA No. 49-27-27
131-49-7778, R1	Replace/Rework First Stage Stator Support Assembly, Part No. 3844797-15/-16/-19/-20/-21/-22 with/to Part No. 3844797-17.		Refer to ATA No. 49-27-27
131-49-7789	Replace Electronic Control Box, Part No. 3888394-121202 or Part No. 3888394-221202 with Part No. 3888394-221203.		Refer to ATA No. 49-27-27
3888394-49-7790	Electronic Control Box (ECB) Modification of Part No. 3888394-121202 to Part No. 3888394-121203 and Part No. 3888394-221202 to Part No. 3888394-221203.		No Effect
131-49-7791, R5	Re-Initialization of Data Memory Module, Part No. 3876287-1.		No Effect
131-49-7843	Replace Surge Duct, Part No. 3884974-1 or 3885084-1 with Part No. 3885084-2.		Refer to ATA No. 49-27-27
131-49-7845	Replace Rear Bearing Seal, Part No. 3844561-1 with Rear Bearing Seal, Part No. 3844561-3.		Refer to ATA No. 49-27-27
131-49-7846	Replace/Return for rework First Stage Rotor Assembly, Part No. 3840303-1, to First Stage Turbine Rotor Assembly, Part No. 3840160-7.		Refer to ATA No. 49-27-27
131-49-7856	Replace First Stage Turbine Rotor Assembly, Part No. 3840303-1, with First Stage Turbine Rotor Assembly, Part No. 3840160-8, Replace/Rework First Stage Turbine Rotor Assembly, Part No. 3840160-5, with First Stage Turbine Rotor Assembly, Part No. 3840160-8.		Refer to ATA No. 49-27-27
131-49-7898	Replace Electronic Control Box, Part No. 3888394-120201 or Part No. 3888394-121202 or Part No. 3888394-121203 or Part No. 3888394-221202 or Part No. 3888394-221203 with Part No. 3888394-121204 or Part No. 3888394-221204.		No Effect
3616140-49-8246, R1	AIRBORNE AUXILIARY POWER - GAS TURBINE ENGINE - Rework the Fan Assembly PN 3616140-10 to PN 3616140- 11 for the 131-9[A] Auxiliary Power Unit (APU).		No Effect
3888394-49-7899, R3	Rework Electronic Control Box 3888394-121202 to 3888394-121204, 3888394-221202 to 3888394-221204, 3888394-121203 to 3888394-121204, 3888394-221203 to 3888394-221204.		No Effect
131-49-7900, R3	Modification of APU Performance Adjustments in Data Memory Module, PN 3876287-1, on the 131-9[A].		No Effect
49-7933, R8	Oil - General - Approved Oils.		17 Nov 2008

Service Bulletin/ Revision Number	Title	Modification	Date Put in Manual
131-49-7944, R1	Replace the Scavenge Tube, PN 3881826-1 with PN 3881826-2 and Incorporate Gasket, PN AS4824N06, on the 131-9[A] Auxiliary Power Unit (APU).		No Effect
131-49-7946	Remove Oil Heater, Part Number 3876145-1 and Install Heater Pad Cover, Part Number 3618244-1.		No Effect
131-49-7947	Replace Oil Stationary Seal, Part Number 3827350-3 with Air/Oil Stationary Seal, Part Number 3827608-3 and Seal Rotor, Part Number 3822418-1 with Part Number 3822635-2.		No Effect
131-49-7965	Install Oil Heater, Part Number 3876145-1 on the APU.		14 Sep 2009
131-49-7971, R5	Replace First Stage Turbine Assembly, PN 3840160-5, -7, -8 or PN 3840303-1, and Stationary Seal Assembly, PN 3844738-5, with First Stage Turbine Assembly, PN 3840310-3 and Stationary Seal Assembly, PN 3844738-6, on the 131-9[B] APU.		Refer to ATA No. 49-27-27
131-49-7989	Replace Turbine Seal Gasket, PN 3844705-1 with PN 3844705-2.		No Effect
49-7997, R5	Standard Storage and Preservation Guidelines.		31 Dec 2011
131-49-8000	Replace Cooling Fan Exit Duct, PN 3810900-4 with PN 70720156-1.		No Effect
131-49-8001	Replace the Fuel Supply Tube Assembly, PN 3883954-1 with PN 3883954-2.		No Effect
131-49-8002	Replace the Surge Control Valve (SCV) Drain Tube Assembly, PN 3883945-1 with PN 3883945-2.		No Effect
131-49-8003	Replace the Inlet Guide Vane (IGV) Drain Tube Assembly, PN 3883958-1 with PN 3883958-2.		No Effect
131-49-8005, R1	Replace the Starter Motor, PN 2704506-2 with PN 2704506-3.		No Effect
131-49-8006	Replace the Fan Assembly, PN 3616140-7 with PN 3616140-10.		No Effect
131-49-8015	Replace Duplex Ball Bearing Assembly, Matched Set, PN 3822478-1, with PN 3822666-2, Compressor Bearing Housing, PN 3827265-4, with PN 3827265-8, Compressor Bearing Retainer Plate, PN 3827385-1, with PN 3827385-2, and Compression Spring Washer, PN 3827075-1, with PN 791-548-9301. Remove Bearing Damper Ring, PN 3827173-3, and Spring Retainer, PN 3827074-4.		31 Dec 2011
3616140-49-8018	Rework the Fan Assembly, PN 3616140-7 to PN 3616140-10.		No Effect
131-49-8026	Replace the Inlet Guide Vane Actuator, PN 3886188-2 with PN 3886188-3.		No Effect

Service Bulletin/ Revision Number	Title	Modification	Date Put in Manual
49-8028, R2	Standard Storage and Preservation Guidelines for Airbus Auxiliary Power Units.		No Effect
131-49-8030	Inspect and Replace the Fuel Supply Tube Assembly, PN 3883954-2.		No Effect
131-49-8050	Replace the Starter Motor, PN 2704506-3 with PN 2704506-2.		No Effect
131-49-8053	Replacement of the Life Limited Second Stage Turbine Rotor Assembly, PN 3840165-4.		No Effect
131-49-8055, R1	Replace the Fuel Supply Tube Assembly, PN 3883954-2.		No Effect
131-49-8063, R1	Replace First Stage Turbine Assembly, PN 3840160-5, PN 3840160-7, PN 3840160-8 or PN 3840303-1, and Stationary Seal Assembly, PN 3844738-5, with First Stage Turbine Assembly, PN 3840310-3 and Stationary Seal Assembly, PN 3844738-6.		No Effect
131-49-8078	Replacement of Discrepant Data Memory Module (DMM), PN 3876287-1.		No Effect
131-49-8089, R2	Remove and Inspect the Second Stage Turbine Rotor Assembly, PN 3840165-4, for Linear Indications.		No Effect
131-49-8097	Replacement of the Bearing Set (Turbine Roller Bearing), PN 3840242-1, with the Incorrect Rolling Element Material.		No Effect
131-49-8103, R1	Install New Clamps to Prevent Contact Between the Turbine Bearing Return Tube and Secondary Fuel Manifold.		No Effect
131-49-8104	Replace Electronic Control Box, PN 3888394-121202 thru 121204 or PN 3888394-221202 thru 221204 with Electronic Control Box, PN 3888394-121205 or PN 3888394-221205.		No Effect
131-49-8105	Replace Abradable Coated Load Compressor Case, PN 3827152-3 With A Bare Metal Load Compressor Case, PN 3827505-2.		12 Jan 2017
131-49-8106	Replace the Compressor Discharge Duct, PN 3885007-2 with PN 70721411-1, (Compressor Discharge Duct Material Change).		No Effect
3888394-49-8107, R3	Electronic Control Box (ECB) modification of software.		No Effect
131-49-8110	Replace Load Control Valve, PN 3291432-1 with PN 3291432-2.		No Effect
131-49-8112, R2	Replace the Compound Idler Gear Assembly PN 3870205-1 with PN 3870205-3 on the 131-9[A] Auxiliary Power Unit (APU)		No Effect
131-49-8117, R2	Replace the Starter Motor, PN 2704506-2 or -3 with PN 2704506-4, on 131-9[A] Engine.		No Effect

Service Bulletin/ Revision Number	Title	Modification	Date Put in Manual
131-49-8126	Replace Oil Stationary Seal, PN 3827350–3 with Air/ Oil Stationary Seal, PN 3827608-3 and Seal Rotor, PN 3822418-1 or 3822635-2 with PN 3822635-3.		No Effect
131-49-8127, R1	Approve the Use of Ignition Unit, PN 3888058-5, in Place of Ignition Unit, PN 3888058-7, for the 131-9[A] Auxiliary Power Unit (APU).		No Effect
49-8185, R2	Approved Fuels for Airbus Applications.		25 Oct 2017
131-49-8205	Replace/Rework Oil Cooler Return Tube Assembly, PN 3881763-1 with PN 3881763-2, and Oil Cooler Supply Tube Assembly, PN 3881764-1 with PN 3881764-2, and Add Gearbox Tube Retainer, PN 70722243-1, Oil Cooler Tube Retainer, PN 70722244-1, Loop Clamps, PN 211-592-9010, Nuts, PN MS21043-3, Bolts, PN MS9556-05 and PN MS9556-14, Bracket, PN MS9552-005, and Spacer, PN NAS43HT3-40A, on the 131-9[A] APU.		25 Oct 2017
131-49-8217	Replace Stationary Air Seal, PN 3844738-6 with PN 3844738-7, on the 131-9[A] APU.		No Effect
131-49-8225	Replace First Stage Dual-Alloy Turbine (DAT) Rotor, PN 3840310-3 with PN 3840310-4, for the 131-9[A] Auxiliary Power Unit (APU).		No Effect
131-49-8196, R1	Replace Electronic Control Box (ECB), PN 3888394-121202 thru -121205 or PN 3888394-221202 thru -221205, with ECB, PN 3888394-321206, on the 131-9[A] APU.		No Effect
131-49-8244, R1	AIRBORNE AUXILIARY POWER - GAS TURBINE ENGINE - Replace the Fan Assembly PN 3616140-10 with PN 3616140-11 on the 131-9[A] Auxiliary Power Unit (APU).		No Effect
131-49-8245, R1	Load Compressor Scroll Housing, PN 3827426-3, Lift Mount Pad Insert Enhancement on the 131-9[A] Auxiliary Power Unit (APU).		No Effect
131-49-8254, R2	AIRBORNE AUXILIARY POWER - GAS TURBINE ENGINE - INSTALL SECOND STAGE TURBINE WHEEL, PN 3840165-9, IN REPLACEMENT OF PN 3840165-4		No Effect
131-49-8257, R1	Remove and Replace Procedure for Electronic Control Box (ECB), PN 3888394-121202 thru 121205 or PN 3888394-321206, with ECB PN 3888579-201, on the 131-9[A] Auxiliary Power Unit (APU).		No Effect
131-49-8266	Replacement of Discrepant Fuel Control Unit, PN 441921-5.		No Effect

Service Bulletin/ Revision Number	Title	Modification	Date Put in Manual
131-49-8289, R1	AIRBORNE AUXILIARY POWER - GAS TURBINE ENGINE - Replace the Fuel Control Unit, PN 441921-5, with PN 70722365-2 for the 131-9A Auxiliary Power Unit (APU)		No Effect
131-49-8313	AIRBORNE AUXILIARY POWER - GAS TURBINE ENGINE - REPLACE THE ENGINE COMPRESSOR DIFFUSER, PN 3827325-3 WITH PN 70721640-2, ON THE 131-9[A] AUXILIARY POWER UNIT (APU)		No Effect
131-49-8314	AIRBORNE AUXILIARY POWER - GAS TURBINE ENGINE - MODIFICATION OF APU PERFORMANCE ADJUSTMENTS IN DATA MEMORY MODULE, PN 3876287-1, ON THE 131-9[A] FOR HIGH EFFICIENCY ENGINE COMPRESSOR DIFFUSER		No Effect
131-49-8315	AIRBORNE AUXILIARY POWER - GAS TURBINE ENGINE - Replace the DC Starter Motor, PN 2704506-4, with PN 2704506-5 for the 131-9A Auxiliary Power Unit (APU)		No Effect
131-49-8320	AIRBORNE AUXILIARY POWER - GAS TURBINE ENGINE - REPLACE THE CONTAINMENT RING, PN 3844587-4 WITH PN 70721926-1, ON THE 131-9[A] AUXILIARY POWER UNIT (APU)		No Effect
131-49-8326	AIRBORNE AUXILIARY POWER - GAS TURBINE ENGINE – REPLACE OIL DRAIN TRANSFER TUBE, PN 3863152-1 WITH PN 3863152-2, ON THE 131-9[A] AUXILIARY POWER UNIT (APU)		No Effect
131-49-8334	AIRBORNE AUXILIARY POWER - GAS TURBINE ENGINE - REMOVE AND REPLACE PROCEDURE FOR ELECTRONIC CONTROL BOX (ECB), PN 3888394-121202 THRU -121205 OR PN 3888394-221202 THRU -221205 OR PN 3888394-321206 OR PN 3888579-201 WITH ECB, PN 3888579-202, ON THE 131-9[A] AUXILIARY POWER UNIT (APU)		No Effect
131-49-8339	AIRBORNE AUXILIARY POWER - GAS TURBINE ENGINE - REPLACE THE FAN ASSEMBLY, PN 3616140-11 WITH PN 70723947-1, ON THE 131-9[A] AUXILIARY POWER UNIT (APU)		No Effect
131-49-8351	AIRBORNE AUXILIARY POWER - GAS TURBINE ENGINE - REPLACE THE AIR OIL SEPARATOR (AOS) GEAR ASSEMBLY PN 3870205-3 WITH PN 3870205-4 OR REWORK PN 3870205-3 TO PN 3870205-4 FOR THE 131-9A AUXILIARY POWER UNIT (APU)		No Effect

Service Bulletin/ Revision Number	Title	Modification	Date Put in Manual
131-49-8352	AIRBORNE AUXILIARY POWER - GAS TURBINE ENGINE - REPLACE THE AIR OIL SEPARATOR (AOS) CARBON SEAL PN 3863104-1 WITH PN 70723510-1 FOR THE 131-9A AUXILIARY POWER UNIT (APU)		No Effect
131-49-8353	AIRBORNE AUXILIARY POWER - GAS TURBINE ENGINE - INSTALLAIR OIL SEPARATOR (AOS) CARBON SEAL J-TUBE PN 70723600-1, O-RINGS PN M83248/1-011 AND REPLACE AOS ADAPTOR HOUSING PN 3863406-1 WITH PN 70723602-1 AND PLUG AN814-2D WITH UNION PN 70723601-1 FOR THE 131-9A AUXILIARY POWER UNIT (APU)		18 Mar 2022

Spare Parts Bulletin	Title	Modification	Date Put in Manual
131-GTE1165	Authorize the use of Stud, Part No. 682-534-9701 in place of Part No. 3844728-1.		Refer to ATA No. 49-27-27
131-GTE1172	Authorize the use of Fuel Control Unit Inlet Adapter Fitting, Part No. 3617300-2 for Part No. 3617300-1.		Refer to ATA No. 49-27-27
131-GTE1177	Authorize the use of Cooling Fan, Part No. 3616140-7 in place of Part No. 3616140-6.		Refer to ATA No. 49-27-27
131-GTE1190	Authorize the use of Ignition Unit, Part No. 3888058-7 as an alternate to Part No. 3888058-5.		Refer to ATA No. 49-27-27
131-GTE1192	Authorize the use of Second Stage Stator, Part No. 3844864-1 in place of Part No. 3844762-2.		Refer to ATA No. 49-27-27
131-GTE1218	Authorize the use of Electronic Control Box (ECB), Part No. 3888394-221202 in place of Part No. 3888394-121202.		Refer to ATA No. 49-27-27
131-GTE1219	Authorize the use of Oil Pickup Tube, Part No. 3863541-2 in place of Part No. 3863344-3.		Refer to ATA No. 49-27-27
131-GTE1220	Authorize the use of Sightglass, Part No. 421-529-9102 in place of Part No. 421-529-9004.		Refer to ATA No. 49-27-27
131-GTE1231, R1	Authorize the use of Annular Combustion Chamber, Part No. 3830461-6 in place of Part No. 3830461-5.		Refer to ATA No. 49-27-27
131-GTE1236	Authorize the use of Pneumatic Duct Clamp, Part No. 234-591-9300 and Pneumatic Duct Clamp, Part No. AS 895/4-350 in place of Part No. 234-591-9350.		Refer to ATA No. 49-27-27
131-GTE1280	Authorize the use of Second Stage Stationary Air Seal, Part No. 3844582-2 in place of Part No. 3844582-1.		Refer to ATA No. 49-27-27
131-GTE1285	Authorize the use of Electronic Control Box (ECB), Part No. 3888394-121203 in place of Part No. 3888394-221203.		Refer to ATA No. 49-27-27
D201609000056	Authorize the use of bleed duct clamp, PN 234-607-9001, as an alternate for PN AS1895/4-300, and bleed duct clamp, PN 234-607-9002, as an alternate for PN AS1895/4-350.		No Effect
D201707000045	Oil Scavenge Tube - PN 3881826-3 Oil Scavenge Tube Replaces PN 3881826-2		No Effect
D201808000026	Fuel Supply Tube - PN 3883954-3 Fuel Supply Tube Replaces PN 3883954-2		No Effect

LIST OF EFFECTIVE PAGES

* Indicates a changed or added page.
F Indicates a foldout page.

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INTRODUCTION

1. How to Use This Manual

A. General

(1) This manual has been structured to support the on-condition maintenance concept by providing a total data package arranged for easy extraction of information in task-oriented units that can be tailored to different concepts and capabilities. This manual supports maintenance of the engine "off-aircraft."

(2) Each page has certain consistent features controlling information on that page. Understanding these features is essential to proper application of the information.

(3) Refer to Table INTRO-2 for equipment identification data.

(a) The configuration of the equipment is shown by the part number, dash number, series number, and change number stamped on the identification plate. Compare this data with the data shown in Table INTRO-2.

(b) A part number, a service bulletin number (Pre SB, Post SB), or an effectivity code symbol identifies the special procedures or illustrations necessary for each configuration. The procedures and illustrations not identified are applicable to all the configurations of the equipment.

(c) The effectivity coding system identifies the differences between unit configurations.

1 Modifications to the basic unit make it necessary to re-identify the unit. For example: PN 123456-1 becomes PN 123456-2.

2 Each different part number and dash number has its own effectivity code.

3 In the text, if no effectivity codes or part numbers are shown, then the procedures are applicable to all the configurations of the unit.

4 In the text, if one or more effectivity codes or part numbers are shown, then the procedures are applicable only to the related configuration of the unit.

Table INTRO-1. Effectivity Code List

Engine Model No.	Engine PN	Effectivity Code
131-9[A]	3800708-1	-

Table INTRO-2. Equipment Identification List for 131-9[A], PN 3800708-1

Code Symbol	Series No.	Change No.	Description	Service Bulletin
-	1	-	Original configuration.	-
	2		Series 1 with the changes that follow:	
			Improve terminal lug retention. Part No. 2704506-2 Series 2 Starter Motor replaces Part No. 2704506-2 Series 1 Starter Motor.	AES 49-2368

Table INTRO-2. Equipment Identification List for 131-9[A], PN 3800708-1 (Cont)

Code Symbol	Series No.	Change No.	Description	Service Bulletin
	3		Series 2 with the changes that follow:	
		1	Prevent HOC and leakage. Part No. 3844707-2 Turbine Seal Gasket replaces Part No. 3844707-1 Turbine Seal Gasket.	131-49-7562
	4	2	Series 3 with the changes that follow:	
			Provide cost reduction. Part No. 3801300-2 Power Section Assembly replaces Part No. 3801300-1 Power Section Assembly. Part No. 3617170-2 Plumbing and Electrical Assembly replaces Part No. 3617170-1 Plumbing and Electrical Assembly.	131-49-7606
	5	3	Series 4 with the changes that follow:	
			Provide additional retention. Part No. AS9902-6 Plug and Part No. AS5169J6L Plug replaces Part No. MS9901-6 Plug. Added Part No. MS20995C32 Lockwire.	131-49-7668
	6	4	Series 5 with the changes that follow:	
			Prevent delamination, reduce cost and to enhance productivity and life cycle costs. Part No. 3827504-3 Case Cent Compressor replaces Part No. 3827322-3 Case Cent Compressor.	131-49-7718
		5	Part No. 3885007-2 Discharge Duct replaces Part No. 3885007-1 Discharge Duct.	131-49-7716
		6	Part No. 441921-5 Fuel Control Unit replaces Part No. 441921-4 Fuel Control Unit.	131-49-7687
		7	Part No. 3844797-21 Stator Assembly replaces Part No. 3844797-19 Stator Assembly. Part No. 3844797-22 Stator Assembly replaces Part No. 3844797-20 Stator Assembly.	131-49-7744
		8	Part No. 3617170-3 Plumbing and Electrical Assembly replaces Part No. 3617170-2 Plumbing and Electrical Assembly.	131-49-7739
		9	Part No. 234-511-9059 Clamp replaces Part No. 234-591-3030 Clamp.	131-49-7741
	No series	10	Provide ID for incorporation of Field Evaluation of Hydropad Seal, 3827608-3 and Rotor 3822635-2.	
	7	-	Series 6.	
			Series 7 assigned to document production transition from Raunheim, GE to Phoenix, AZ, USA.	-
	8	11	Series 6 with the changes that follow:	

Table INTRO-2. Equipment Identification List for 131-9[A], PN 3800708-1 (Cont)

Code Symbol	Series No.	Change No.	Description	Service Bulletin
			Cost reduction of Cooling Fan Exit Duct and Cooling Fan Inlet. Part No. 3810900-4 Exit Duct replaces Part No. 3810900-3 Exit Duct.	131-49-7765
		12	Part No. 3810929-3 Inlet Duct replaces Part No. 3810929-2 Inlet Duct.	131-49-7764
		13	Part No. 3822505-8 Rotating Group replaces Part No. 3822505-7 Rotating Group.	131-49-7777
		14	Part No. 3844797-18 Stator Assembly and Part No. 3844797-17 Stator Assembly replaces Part No. 3844797-21 Stator Assembly and Part No. 3844797-22 Stator Assembly.	131-49-7778
	9	15	Series 8 with the changes that follow:	
			Part No. 3885084-1 Surge Duct replaces Part No. 3884974-1 Surge Duct.	131-49-7712
	10	16	Series 9 with the changes that follow:	
			Part No. 3822505-12 Rotating Group replaces Part No. 3822505-8 Rotating Group.	131-49-7856
		17	Part No. 3844561-3 Turbine Seal replaces Part No. 3844561-1 Turbine Seal.	131-49-7845
		18	Part No. 3885084-2 Surge Duct replaces Part No. 3885084-1 Surge Duct. Part No. NAS1149C0332R Washer replaces Part No. NAS1149C0332R Washer.	131-49-7843
		19	Provide Rotating Group Assembly Part No. 3822505-11 for Aftermarket use only.	131-49-7846
		20	For field evaluation of Duplex Ceramic Bearing Part No. 3822666-2. For Aftermarket use only.	49-7837
	11		Series 10 with the changes that follow:	
		21	3801300-3 Power Section Assembly replaces 3801300-2 Power Section Assembly.	131-49-7944
		22	3801300-3 Power Section Assembly replaces 3801300-2 Power Section Assembly.	131-49-7947
		23	Parts Deleted: 3876145-1 Heater Oil MS9556-06 Bolt Parts Added: 3618244-1 Cover Heater Pads	131-49-7946
		24	Add Oil Heater Part No. 3876145-1 on APU’s without Oil Heater.	131-49-7965
	12		Series 11 with the changes that follow:	

Table INTRO-2. Equipment Identification List for 131-9[A], PN 3800708-1 (Cont)

Code Symbol	Series No.	Change No.	Description	Service Bulletin
		26	Part No. 3844705-2 Aft Cover Gasket replaces Part No. 3844705-1 Aft Cover Gasket.	131-49-7989
		27	Part No. 70720156-1 Cooling Fan Exit Duct replaces Part No. 3810900-4 Cooling Fan Exit Duct.	131-49-8000
		28	Part No. 3883954-2 Fuel Supply Tube Assy replaces Part No. 3883954-1 Fuel Supply Tube Assy.	131-49-8001
		29	Part No. 3883945-2 SCV Drain Tube Assy replaces Part No. 3883945-1 SCV Drain Tube Assy.	131-49-8002
		30	Part No. 3883958-2 IGV Drain Tube Assy and Part No. MS9556-07 Bolt Assy replace Part No. 3883958-1 IGV Drain Tube Assy.	131-49-8003
		32	Part No. 2704506-3 Starter Motor Assembly replaces Part No. 2704506-2 Starter Motor Assembly. (Not Recommended)	131-49-8005
		33	Part No. 3616140-10 Cooling Fan replaces Part No. 3616140-7 Cooling Fan.	131-49-8006
			Part No. 3624129-1 Fan Stator Vane replaces Part No. 3616142-1 Fan Stator Vane.	3616140- 49-8018
	13		Series 12 with the changes that follow:	
		34	Part No. 3886188-3 IGV Actuator replaces Part No. 3886188-2.	131-49-8026
	14		Series 13 with the changes that follow:	
		20	Replace Duplex Ball Bearing Assembly, Matched Set, PN 3822478-1, with PN 3822666-2, Compressor Bearing Housing, PN 3827265-4, with PN 3827265-8, Compressor Bearing Retainer Plate, PN 3827385-1, with PN 3827385-2, and Compression Spring Washer, PN 3827075-1, with PN 791-548-9301. Remove Bearing Damper Ring, PN 3827173-3, and Spring Retainer, PN 3827074-4.	131-49-8015
	15		Series 14 with the changes that follow:	
		35	Replace the Starter Motor, PN 2704506-3 with PN 2704506-2.	131-49-8050
	16		Series 15 with the changes that follow:	
		25	Replace First Stage Turbine Assembly, PN 3840160-5, PN 3840160-7, PN 3840160-8 or PN 3840303-1, and Stationary Seal Assembly, PN 3844738-5, with First Stage Turbine Assembly, PN 3840310-3 and Stationary Seal Assembly, PN 3844738-6.	131-49-8063
	17		Series 16 with the changes that follow:	

Table INTRO-2. Equipment Identification List for 131-9[A], PN 3800708-1 (Cont)

Code Symbol	Series No.	Change No.	Description	Service Bulletin
		36	Replace Load Control Valve Assembly PN 3291432-1 with Load Control Valve Assembly PN 3291432-2.	131-49-8110
	18		Series 17 with the changes that follow:	
		37	Replace Compressor Disc Duct PN 3885007-02 with Compressor Disc Duct PN 70721411-1.	131-49-8106
		38	Replace Load Compressor Shroud PN 3827505-3 with Load Compressor Shroud PN 3827505-2.	131-49-8105
		39	Replace P&E Assembly PN 3617170-4 with P&E Assembly PN 3617170-5.	131-49-8103
		39	Replace Power Section Assy PN 3801300-7 with Power Section Assy PN 3801300-8.	131-49-8103
	19		Series 18 with the changes that follow:	
		40	Starter Assembly PN 2704506-4 is alternate to Starter Assembly PN 2704506-2.	131-49-8117
	20		Series 19 with the changes that follow:	
		41	Replace Stationary Air Seal PN 3844738-6 with Stationary Air Seal PN 3844738-7.	131-49-8217
		42	Replace Oil Cooler Return Tube Assy PN 3881763-1 with Oil Cooler Return Tube Assy PN 3881763-2.	131-49-8205
			Replace Oil Cooler Supply Tube Assy PN 3881764-1 with Oil Cooler Supply Tube Assy PN 3881764-2.	
			Add Gearbox Tube Retainer PN 70722243-1.	
			Add Oil Tube Retainer PN 70722244-1.	
	21		Series 20 with the changes that follow:	
		43	Replace First Stage Turbine Wheel PN 3840310-3 with First Stage Turbine Wheel PN 3840310-4.	131-49-8225
			Replace Rotating Group PN 70720252-1 with Rotating Group PN 70720252-4.	
			Replace Power Section PL PN 3801300-8 with Power Section PL PN 3801300-9.	
		44	Clamp PN 234-607-9001 3” added as an alternate to Clamp PN AS1895/4-300 3”.	D201609000056
			Clamp PN 234-607-9002 3.5” added as an alternate to Clamp PN AS1895/4-350 3.5”.	
	22		Series 21 with changes 45 and 46:	
		45	3870205-3 compound idler gear 1 required replaces 3870205-1 compound idler gear 1 required.	131-49-8112

Table INTRO-2. Equipment Identification List for 131-9[A], PN 3800708-1 (Cont)

Code Symbol	Series No.	Change No.	Description	Service Bulletin
		46	3616140 - 11 cooling fan replaces 3616140 - 10 cooling fan.	131-49-8244
	23		Series 22 with changes 47, 48, 49, and 50:	
		47	3822635-3 L/C (enhanced) hydropad seal rotor 1 required replaces 3822635-2 L/C (enhanced) hydropad seal rotor 1 required.	131-49-8126
		48	3883954-3 fuel supply tube acorn fitting 1 required replaces 3883954-2 fuel supply tube acorn fitting 1 required.	D201808000026
		49	3881826-3 oil scavenge tube 1 required replaces 3881826-2 oil scavenge tube 1 required.	D201707000045
		50	3827426-4 L/C scroll housing 1 required replaces 3827426-3 L/C scroll housing 1 required.	131-49-8245
	24		Series 23 with changes 51 and 52:	
		51	3840165-9 turbine rotor second stage 1 required replaces 3840165-4 turbine rotor second stage 1 required.	131-49-8254
		52	70722365-2 fuel control unit 1 required replaces 441921-5 fuel control unit 1 required.	131-49-8289
	25		Series 24 with changes 53, 54, 55 and 57:	
		53	2704506-5 starter motor unit replaces 2704506-4 starter motor unit.	131-49-8315
		54	3863152-2.oil transfer tube replaces 3863152-1 oil transfer tube.	131-49-8326
		55	70721926-1 containment ring replaces 3844587-4 containment ring.	131-49-8320
		57	70721640-2 engine compressor diffuser replaces 3827325-3 engine compressor diffuser.	131-49-8313
	26		Series 25 with changes 58, 59, 60 and 61:	
		58	70723510-1 air oil separator carbon seal replaces 3863104-1 air oil separator carbon seal.	131-49-8352
		59	Replace the Air Oil Separator (AOS) Gear Assembly PN 3870205-3 with PN 3870205-4.	131-49-8351
		60	Install Air Oil Separator (AOS) Carbon Seal J-Tube PN 70723600-1, O-Rings PN M83248/1-011 and Replace AOS Adaptor Housing PN 3863406-1 with PN 70723602-1 and Plug AN814-2D with Union PN 70723601-1.	131-49-8353
		61	70723947-1 fan assembly replaces 3616140-11 fan assembly.	131-49-8339

(4) Standard maintenance procedures that technicians must know are not given in this manual.

(5) This publication is written in agreement with the ATA Specification.

(6) Refer to the Special Tools, Fixtures, and Equipment and Consumables tables in each section before the start of maintenance or repair procedures.

(7) Warnings, cautions, and notes in this manual give the data that follows:

- A WARNING gives a condition or tells personnel what part of an operation or maintenance procedure, which if not obeyed, can cause injury or death
- A CAUTION gives a condition or tells personnel what part of an operation or maintenance procedure, which if not obeyed, can cause damage to the equipment
- A NOTE gives data, not commands. The NOTE helps personnel when they do the related instruction.

(8) Warnings and cautions go before the applicable paragraph or step. Notes follow the applicable paragraph or step.

2. Standard Definitions

A. "OVERHAULED"

(1) Load/driven compressor, engine compressor and turbine section fully disassembled.

(2) Compressor impellers/rotors, turbine rotors/disks and tie shaft inspected per IRM Zero-time Check.

(3) Gearbox repaired as necessary.

(4) LRUs (components) repaired as necessary.

(5) APU tested to highest performance standard.

B. "REPAIRED" (applicable to end unit, as noted on Regulatory Airworthiness Tag/8130): Considered continue-time. Any visit NOT an overhaul. Exposed parts checked to the CONTINUE-TIME CHECK section, repaired as necessary to continue-time check limits or REPAIR section limits where applicable, and tested to Light/Medium Repair (continue-time) criteria.

C. "CORE": Primary module(s) of an end unit (less gearbox assembly, accessories, and externals). Check of core parts to zero-time criteria constitutes a minimum Heavy Repair ("overhauled" on Regulatory Airworthiness Tag /8130 form).

D. "END UNIT" - Term applied to assemblies at the aircraft level; i.e., engines, APU, and LRUs that are shipped and installed as assemblies on the airplane. End units have functional (bench) test requirements (see definition of functional/bench test and operational test).

E. "LINE-REPLACEABLE UNIT (LRU)": Component replaceable at the aircraft level (i.e., has aircraft maintenance manual removal/installation instructions). For engines and APUs, typically refers to control system components that are replaced without removing the engine/APU.

F. "MAJOR REPAIR" (FAA definition): Repair that if improperly performed might affect end-unit weight, balance, structural strength, performance, operation, flight characteristics, or other qualities affecting airworthiness.

G. "MINOR REPAIR" (FAA definition): Repair other than a major repair. Can be acceptable if performed by acceptable practices or elementary operations. Cannot change, modify, or alter configuration/part number, dash number and serial number.

H. "REPAIR" (FAA definition): Work performed that does not have to completely conform to applicable manuals, drawings, specifications, etc.

I. "REWORK" (FAA definition): Work performed that completely conforms to applicable manuals, drawings, specifications, etc.

J. "REFURBISHED": Term reserved for bearings only, indicating a bearing has been inspected and reworked by an approved certified bearing restoration facility, thus returning the bearing to "zero-time" condition.

K. "ZERO-TIME": Maintenance action necessary to qualify for Heavy Repair ("Overhauled" on Regulatory Airworthiness Tag /8130). Provides function and service life equivalent to a new unit (except for time-controlled or life-limited parts). End units with the core parts zero-timed are referred to as "Heavy Repair". TSO reset to zero hours. End unit Regulatory Airworthiness Tag /8130 Tag Block 12 noted "Overhauled". Any part not zero-timed is considered continue-time.

L. "CONTINUE-TIME": Maintenance action necessary to provide function and service life adequate for an acceptable future period. End units which are not zero-time are considered continue-time and are referred to as "Light" or "Medium Repair". TSO hours continued and TSR reset to zero. End unit Regulatory Airworthiness Tag /8130 Tag Block 12 noted "Repaired" or "Inspected". Allows unit to use remaining service life.

M. "INSPECTION" (detail part): Examinations/measurements requiring a certified quality inspector. Unless specified otherwise, visual/dimensional/NDT examinations in this document are intended to be "checks" rather than “inspections".

N. "CHECK" (detail part): Examinations not required by a certified quality inspector. Unless specified otherwise, visual/dimensional/NDT examinations in this document are intended to be "checks" rather than "inspections".

O. "REPAIR LIMIT" (detail part): Post-repair limit. Provides acceptance criteria for a part after repair/rework. Dimensional limits in REPAIR section only apply after repair of a part.

P. "REPAIRABLE LIMIT" (detail part): Pre-repair limit contained in the CHECK or REPAIR section of manual. Point beyond which a detail part cannot be restored to serviceable condition.

Q. "SERVICEABLE LIMIT" (detail part): Not used in this manual. Replaced by "Zero-time Limits" and "Continue-time Limits", either of which can make a part or end unit serviceable. Serviceability form (Regulatory Airworthiness Tag/ 8130) can be attached to detail parts meeting zero-time limits ("Overhauled" in Block 12) or to detail parts meeting continue-time limits ("Repaired" in Block 12).

R. "DEPTH OF REPAIR" (end unit or module): Light, Medium or Heavy Repair. Refer to applicable end unit shop manual for specific product definitions.

S. "NEW" or "NEWLY-OVERHAULED" (end unit): New: Never operated, zero hours (no additional operating time since leaving the Honeywell production quality system). Newly-overhauled: Never operated since last shop visit where the unit/part received Heavy Repair ("overhauled").

T. "USED": Any unit/part not new or newly-overhauled.

U. "NORMAL LIGHT" (as in wear, etc): Wear, scoring, fretting, corrosion, erosion, etc that is commonly observed and known not to affect part or end unit function, structural integrity, build/assembly, or test.

V. "LIGHT/MEDIUM/HEAVY REPAIR": Depth of repair at end unit level. Refer to applicable end unit CMM/EM for specific product definitions.

W. "HARD-TIME": Fixed interval (hour or cycles) of service life which the end unit cannot exceed on-wing and cannot be shipped as serviceable without resetting the interval. Requires end-unit removal from the aircraft at or prior to achieving the maximum hours or cycles.

X. "SOFT-TIME": Fixed interval (hour or cycles) of service life which applies only when the end unit is received into a repair facility, but once received cannot be shipped without resetting the interval by the prescribed maintenance action without operator approval.

Y. "ON-CONDITION": Maintenance philosophy based on repetitive checks/tests to determine the condition of the end unit with regard to continued serviceability (corrective action taken as determined by the end unit condition).

Z. "RUN TO FAILURE": Maintenance process whereby the unit has no on-condition program or specified maintenance intervals.

AA. “PRIMARY FAILURE": Shop finding that caused the end unit to be removed and returned to the shop.

AB. "SECONDARY FAILURE": Shop finding that did not relate to the end unit reason for removal/return.

AC. "VISUAL CHECK": Check without the aid of a microscope or non-destructive test (FPI, magnetic resonance, radiographic, eddy current, etc). Up to 10X magnification is optional.

AD. "COSMETIC DEFECT": Defect found that would not affect end unit build, test, or in-service operation.

AE. "FUNCTIONAL DEFECT": Defect found that would affect end unit build, test, or in-service operation.

AF. “FUNCTIONAL (BENCH) TEST”: Term applied to components/LRUs of an engine/APU to indicate testing conducted on a test bench (i.e., not on the engine/APU) to verify function as stipulated by the end unit CMM or next higher assembly CMM or IRM. Successful completion of testing indicates unit serviceability (“inspected”, “adjusted”, “repaired”, or “overhauled” depending on work accomplished).

AG. "OPERATIONAL TEST": Term applied to components/LRUs of an engine/APU to indicate testing conducted on the engine/APU. Successful completion of testing indicates component/unit serviceability for continue-time on the next higher assembly it was tested on (only).

AH. "PREDICTIVE (PERFORMANCE) TREND MONITORING (PTM)": On-wing data collection to assess engine/APU condition and trended to determine if engine/APU should be removed prior to being inoperative. Considered a "scheduled" removal.

AI. "HAIRLINE (CLOSED OR SURFACE) CRACK": Crack or indication with no visible open width with 10X or less magnification.

AJ. "OPEN CRACK": Crack wide enough to allow observation of inside crack surfaces with 10X or less magnification.

AK. "UNNECESSARY": Any shop maintenance activity not required by customer or regulatory rules that does not directly benefit the customer.

3. Rotating Group Life-Limited Components

A. Check Requirements and Interval.

(1) Refer to Table INTRO-3 for check requirements and check requirement intervals.

(2) This section contains information on rotating group life-limited components, which includes cycle definition, cycle monitoring and component marking.

Table INTRO-3. Rotating Group Life-Limited Components

First Stage Axial Turbine Disk			
Disk Part No.	**Ref. Turbine Rotor Assy Part No.**	**Disk Life-Limit (Cycles)***	**Remarks**
3840161-1	3840160-5	30,000	
	3840160-8		
3840302-1	3840160-7	30,000	
	3840303-1		
First Stage Turbine Rotor			
Rotor Part No.		**Rotor Life-Limit (Cycles)**	**Remarks**
3840310-3	N/A	30,000	
3840310-4	N/A	30,000	
Second Stage Turbine Rotor			
Rotor Part No.		**Rotor Life-Limit (Cycles)***	**Remarks**
3840165-4	N/A	10,000	Refer to SB 131-49-8053 for serial numbers.
3840165-4	N/A	30,000	The 30,000 cycle limit applies to 3840165-4 turbine rotors not listed in SB 131-49-8053.
3840165-9	N/A	30,000	
Turbine Shaft			
Shaft Part No.		**Shaft Life-Limit (Cycles)***	**Remarks**
3822504-3	N/A	30,000	
Engine Compressor Impeller			
Impeller Part No.		**Impeller Life-Limit Cycles)***	**Remarks**
3822391-6	N/A	30,000	

*All above parts are serialized.

B. Cycle Definition.

(1) One cycle equals an attempted start reaching 95 percent (RPM) and subsequent shutdown.

C. Recording Cycles.

(1) Accurate engine records, log books and LLP cards should be used for tracking cycles on Life-Limited Parts.

(2) Some Life-Limited Parts can have operating cycles marked on the part using the format below. This procedure is no longer recommended.

Example:

A part that has been through repair twice since new, once at 800 cycles and once again at an additional 1,700 cycles will be marked “X.8.17.” The total accumulated cycles are 2,500. At the next repair after 1,500 additional cycles of service, the part will be identified with another 15, for a complete cycles code marking of “X.8.17.15.”

(3) To prevent confusion with proper cycle tracking on parts, cycles marked on a part should either match the actual accumulated cycles documented in the engine records (LLP Card) or be obscured using the process shown in Step (3)(a).

(a) Obscure the area using Electrochemical Etch per AS478, Type 7A1 or Standard Practices Manual (SPM) 20-00-02/70-00-01. A complete masking of the area or the use of standard type (i.e. XXXXX) is recommended.

4. Organization of Manual

A. General.

This publication uses the three-element breakdown numbering method (Chapter-Section- Subject) designed to provide a modular physical concept. By this method, an individual part has a separate Chapter-Section-Subject assigned and contains detailed procedures covering all of the work functions that can apply to the individual part. Refer to Figure INTRO-1.

B. Chapter-Section-Subject Number Identification.

(1) The ATA Specification 2200, 3-element (6-digit) numbering system is used in this manual to identify the system/chapter (element one), the APU module or major assembly (element two) and the unit/subject or detail piece parts (element three). Refer to Figure INTRO-2.

(2) Element coverage. (Example 49-20-00)

(a) The first element (first two digits - 49) identifies the ATA chapter coverage of related engine data for this and all supporting/supplementary publications. Chapter 49 is the only chapter used in this publication.

(b) The second element (second two digits - 20) identifies the coverage of the APU modules or major assemblies. The major sections used in this publication are as follows:

Section Number	Section Designation
-20	Engine Assembly
-21	Gearbox Assembly
-22	Power Section Assembly

(c) The third element (third two digits - 00, 01, 02, 03, etc.) identifies the individual subjects or units (sub-assemblies, piece parts, etc.) within the second element section number.

When double zero (-00) is used as the third element, it indicates coverage of a complete APU module or major assembly.

When numbers -01 and up are used as the third element, it indicates coverage of a part of the major assembly identified by the second element section number.

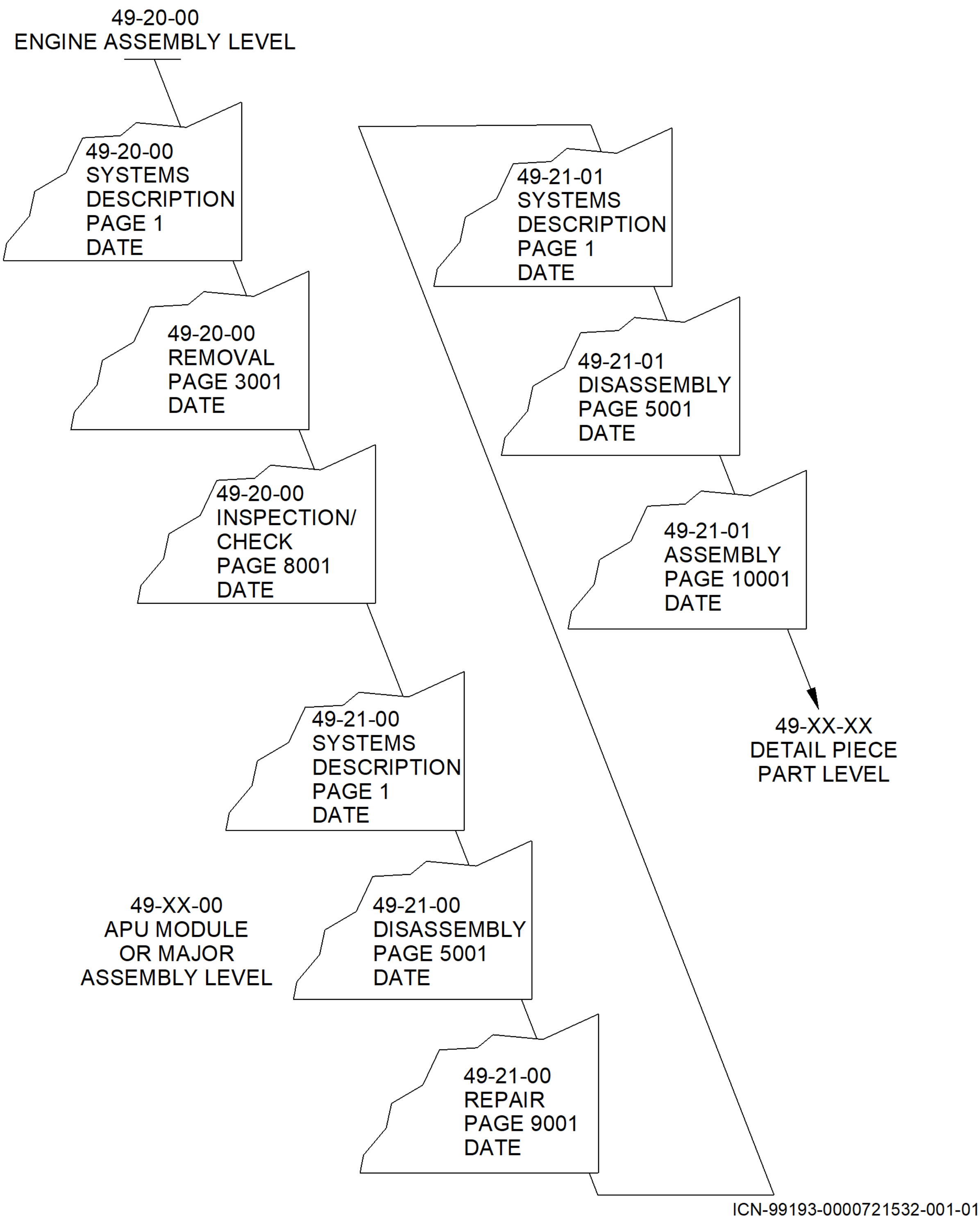

Figure INTRO-1. APU Manual ATA Numbering Sequence

C. Page Numbering.

(1) Within each Chapter-Section-Subject area, blocks of page numbers are assigned to separate the subjects into functions. The pages are numbered consecutively starting

with the first page number in the page block. The page blocks used in this publication are as follows:

Function	Page Block
Systems Description	1 - 99
Fault Isolation	1001 - 1999
Special Procedures	2001 -2999
Removal	3001 - 3999
Installation	4001 - 4999
Disassembly	5001 - 5999
Cleaning	6001 - 6999
Inspection/Check	8001 - 8999
Repair	9001 - 9999
Assembly	10001 - 10999
Servicing	11001 - 11999
Storage	12001 - 12999
Testing	13001 - 13999

(2) Function Designation.

(a) The function designation is used to further subdivide material to clearly define a complete individual procedure. This minimizes the length and complexity of certain procedures.

(b) The function designation is made by adding a numerical suffix to the affected function. For example: Removal 01, Removal 02, Check 01, Check 02, etc. Within each Chapter-Section-Subject area, the function designation assignments can be reused starting with 01.

(c) When the function designation changes, the page numbers start again at the first page number in the page block.

(3) The Chapter-Section-Subject, function designation, page number and date will be placed in the lower right hand corner of the page as follows:

49-20-00	REMOVAL 01	49-20-00	REMOVAL 02
	Page 3001		Page 3001
	Date		Date

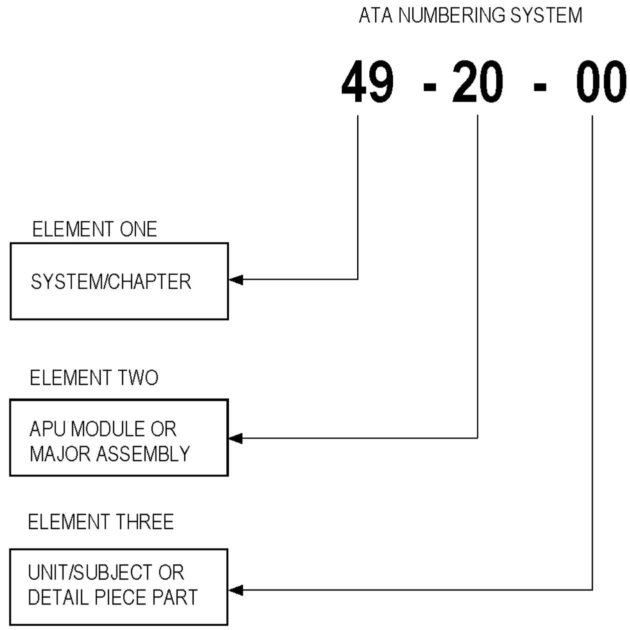

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Figure INTRO-2. ATA Numbering System (3-Element)

D. Figure Numbering.

(1) All illustrations are assigned figure numbers within each page block. Figure numbers are assigned consecutively, starting with the same number as the first page number in the page block. For example, if the section starts with Page 3001, the first figure number will be 3001.

E. Table Numbering.

(1) All tables are assigned numbers within each page block. These numbers are then identified as table numbers. Table numbers are assigned consecutively, starting with the same number as the first page number in the page block. For example, if the section starts with Page 3001, the first table number will be Table 3001.

F. Reference to Standard Practices.

(1) Standard processes or procedures that are used many times will be found in the Appendixes in the back of this publication and in Standard Practices Manual (SPM) 20-00-02/70-00-01. References will be made in the text to the specific Appendix that should be used.

5. ATA - JEMTOSS TASK and SUBTASK Numbering System

A. Maintenance Task Number Standard

(1) In agreement with ATA Specification 100, this publication uses a Maintenance Task Number Standard which makes the maintenance procedures in this manual more compatible with an automated shop environment.

B. Task and Subtask Number Assignments

(1) All procedures in this publication are assigned Task and Subtask numbers at key data retrieval points. The numbers provide the following:

(a) Identification of the hardware (part or parts) primary to the TASK.

(b) Identification of the maintenance function applied to the part or parts.

(c) A unique identifier for a set of instructions (known as a Task or Subtask).

(d) Identification of alternate methods and configuration differences that can change the procedure applied to the TASK.

(e) Identification of airline changes to a Task or Subtask.

(2) The Task and Subtask numbers, once assigned, cannot be changed or reused.

(3) TASK is a complete set of instructions needed to complete a total work assignment, i.e., REPAIR 01. The TASK will usually be composed of supporting SUBTASKS necessary to perform that procedure.

(4) SUBTASK level assignments are individual steps necessary to complete the particular work assignment(s) defined by the TASK.

C. Composition and Elements of TASK and SUBTASK Numbers.

(1) The numbering system is an expansion of the ATA three element numbering system. The number has seven elements. The first five elements are necessary for each TASK or SUBTASK. The sixth and seventh elements are applied only when necessary. Refer to Figure INTRO-3

(2) Each element of the TASK or SUBTASK number will be separate from the next by a dash (-). One space will be used between the word TASK or SUBTASK and the following elements.

(a) Elements 1, 2 and 3 will identify the ATA Chapter-Section-Subject number of the page block that is to be tasked out.

(b) Element 4 defines the maintenance function being performed. This element is a three position element. The third position is zero filled when further definition is not required. If required, the manufacturer will use the numbers 1 through 9 or letters A through Z, excluding the letters I and O. Refer to Step C and Step D for a complete list and description of all functions.

(c) Element 5 provides a unique identification for each TASK or SUBTASK number which are similarly numbered through the first four elements.

1 TASKS must be numbered from 801 through 999.

2 SUBTASKS must be numbered from 001 through 800.

(d) Element 6 is a three position alphanumeric element used for identification of differences in configurations, methods, or techniques.

(e) Element 7 is reserved for airline use to relate their own locally generated instructions.

ATA NUMBERING SYSTEM

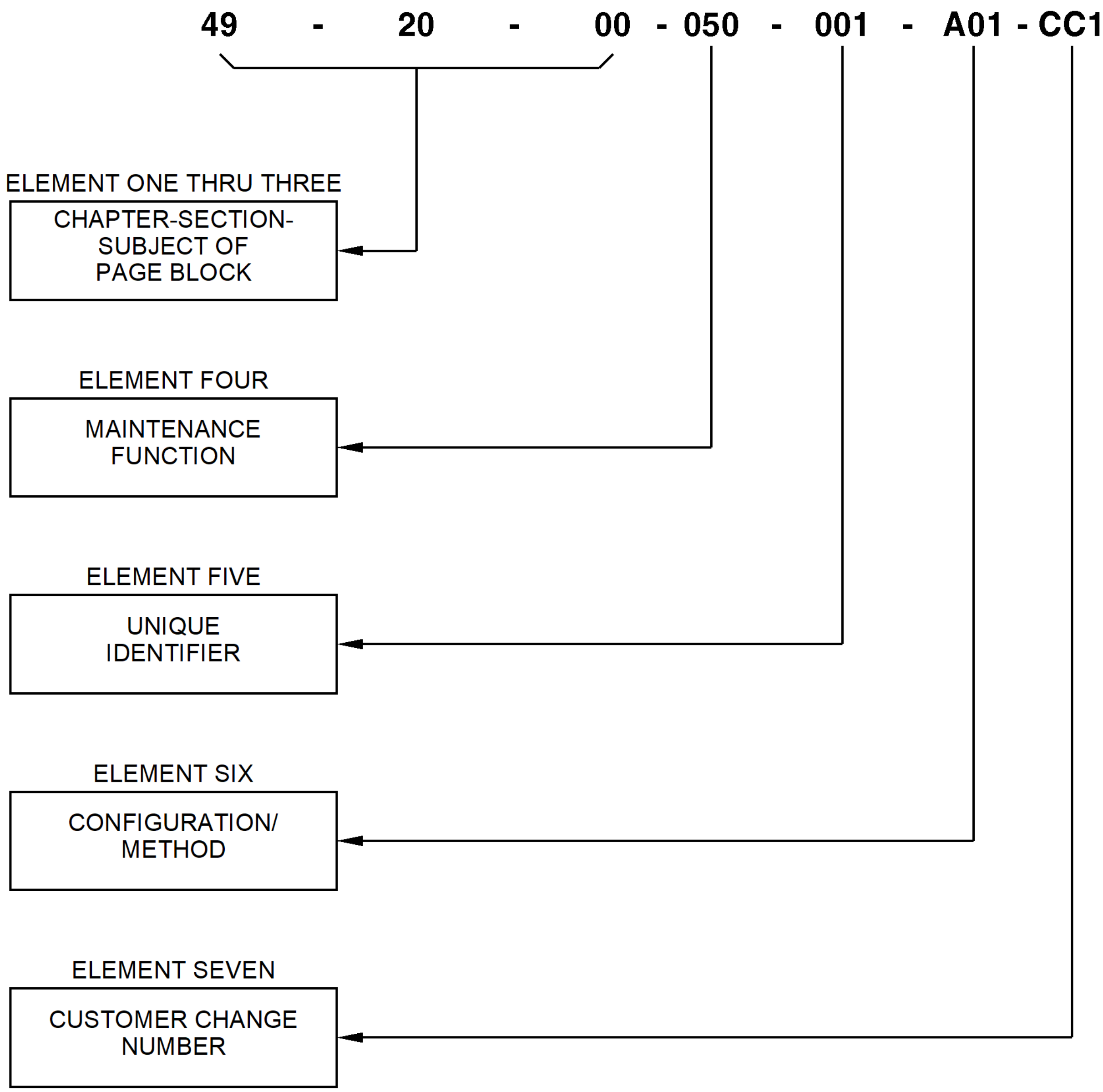

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Figure INTRO-3. Elements of a TASK or SUBTASK Number

D. TASK and SUBTASK Function Codes

(1) Table INTRO-4 shows the function codes, titles, and definitions.

Table INTRO-4. Task and Subtask Function Codes and Definitions

Function Code	Function Title	Function Definition

Table INTRO-4. Task and Subtask Function Codes and Definitions (Cont)

Function Code	Function Title	Function Definition
000	Removal And Disassembly	Functional Block
010	APU Removal	The removal of an APU from a work stand, transport dolly, test stand, etc. It also applies to the removal of an APU from an aircraft.
020	Remove APU Modular Sections	This is the first echelon of APU disassembly, which includes the sectionalization of the APU into primary modular sections. Modular sections are identified by the third element of the ATA number.
030	Disassemble APU Modular Sections	This is the second echelon of APU disassembly, which includes the disassembly of APU modular sections into subassemblies after the modular sections have been removed from the APU. Modular section are identified by the second element of the ATA number.
040	Disassemble APU Subassemblies	This is the third echelon of disassembly, which includes the disassembly of subassemblies to the piece part level. The subassemblies are identified by the third element of the ATA number.
050	Remove Accessory/Power Plant Components	The removal of individual accessory/power plant components from either installed or uninstalled APUs.
060	Disassemble Accessory	The disassembly of accessories into subassemblies.
070	Disassemble Accessory Subassembly	The disassembly of accessory subassemblies into piece parts.
080	Remove APU Test Equipment	The removal of the equipment and instrumentation after the test of an APU.
090	Disassemble Support Equipment	The disassembly of support equipment applies to any disassembly required to maintain support equipment.
100	Cleaning	Functional Block

Table INTRO-4. Task and Subtask Function Codes and Definitions (Cont)

Function Code	Function Title	Function Definition
110	Chemical	The removal of surface deposits from a part by use of a chemical cleaning agent. The chemical agent dissolves or loosens the deposit which is washed or rinsed away after a soak period. This includes a power flush with a chemical agent.
120	Abrasive	The removal of surface deposits from a part by wet or dry particle impingement.
130	Ultrasonic	The removal of surface deposits and entrapped material by use of high frequency sound waves to produce cavitation at the surface of the part. Cleaning is done in a liquid bath that transmits the sound energy and keeps the removed material in suspension.
140	Mechanical	The use of a brush, felt bob, sandpaper, or other hand (or machine) action to remove surface deposits from a part.
150	Unassigned	--
160	Miscellaneous	The removal of deposits from small passages with a compressed air blast, miscellaneous hand cleaning, and various combinations of cleaning procedures.
170	Foam/Water Wash	The removal of post-emulsified fluorescent penetrant by an agitated water wash, automatic spray rinse, or an aqueous remover, aerated to produce a foam.
180	Testing of Solutions	The identification of materials by the determination if there are or if there are not known electrochemical elements.
190	Unassigned	--
200	Inspection	Functional Block

Table INTRO-4. Task and Subtask Function Codes and Definitions (Cont)

Function Code	Function Title	Function Definition
210	Check	A complete visual examination of APUs, APU systems, subsystems, components, and/or parts, to find structural failure, deterioration. or damage; and to find the need for maintenance or repair. For example: APU exterior surfaces, rotor and stator assemblies, blades and vanes, control systems, linkages, accessory components, plumbing and tubes, electrical wiring and connections, safety wire, fasteners, clamps, etc., are inspected to make sure of the existence of correct conditions and the acceptability for continued service. Check TASKS are usually done with the APU in the static state and can include the use of borescope equipment. The check function for an APU application is equivalent to the periodic visual inspections done on APU-airframe combinations.
220	Visual/Dimensional/Grading	A comparison of the dimensions and material conditions of parts, subassemblies, or assemblies with the specifications given in technical manuals and/or blueprints, to find deviations from specified standard and limits; and to find if the item is satisfactory for continued service, if it is necessary to repair the item, or if it is necessary to discard the item. A visual/dimensional inspection function code is also required to make sure that the correct maintenance has been done. Although there are visual/dimensional inspection TASKS or SUBTASKS that cannot require measurements, the complete spectrum of visual/dimensional TASKS or SUBTASKS requires a variety of precision measurement equipment to find runout, concentricity, flatness, parallelism, hardness, squareness, thickness, clearness, angularity, diameters, radii, depth, etc.
230	Penetrant	The fluorescent penetrant inspection of parts to find surface cracks.
240	Magnetic	The magnetic particle inspection of parts to find surface cracks in magnetic materials.
250	Eddy Current	The inspection for subsurface cracks, porosity, inclusions, or other non-homogeneous material structure by use of high frequency electromagnetic wave equipment. Parts have a scan done and are compared to similar parts or test specimens with known material defects.

Table INTRO-4. Task and Subtask Function Codes and Definitions (Cont)

Function Code	Function Title	Function Definition
260	X-Ray	The inspection for subsurface cracks, porosity, inclusions, or other non-homogeneous material structure by the passing of X-rays through a part and the recording of an image on photographic film.
270	Ultrasonic	The inspection for subsurface cracks, porosity or other non-homogeneous material structure by use of contact-pulse, echo, ultrasonic techniques.
280	Special	Special inspections required as a result of abnormal operation, a special inspection to determine integrity for continued operation in service, or a qualitative analysis.
290	Unassigned	--
300	Repair	Functional Block
310	Welding and Brazing	When you bond, attach, or connect components together by a fusion weld, resistance weld, spot weld, furnace braze, torch braze, induction braze, solder, electron beam weld, plasma arc weld, etc. This category includes hard facing.
320	Machining	When you get a necessary shape or finish by grinding, lathe turning, boring, reaming, broaching, milling, machine drilling, machine lapping, honing, sizing, machine polishing, machine buffing, machine cutting, electrochemical machining (ECM), electrodischarge machining (EDM), roll forming, stamping, machine punching, blanking, etc.
330	Stripping and Plating	When you remove or apply a metallic layer on the surface of a part by mechanical, chemical, or electrical means. The plating of chromium, cadmium, tin, nickel, silver, etc., to build up the size of a part or to give the surface protection. The masking or waxing before plating and an anodize are included.

Table INTRO-4. Task and Subtask Function Codes and Definitions (Cont)

Function Code	Function Title	Function Definition
340	Plasma and Flame Spray	When you apply a layer to a part by the introduction of a powder into an ionized gas stream. The powder is melted and propelled onto the surface to be laminated. Flame spray uses a fuel-oxygen flame to melt and propel metal onto the surface of parts to build up the size or to give the surface protection.
350	Miscellaneous Repairs	When you repair parts with a hand cut, hand drill, hand polish, hand grind, hand lap, hand rivet, blend, cut or rout out materials by hand, cut and fit patches, burring, planishing, hand sand, hand saw, scrape, emery cloth, hand recamber vanes, stop drill, hand tap, install helical coil inserts, heat and/or chill parts, etc. This function is also used to identify miscellaneous disassembly and assembly procedures required to accomplish repairs.
360	Bonding and Molding	When you bond, attach, or connect parts with an adhesive, cementing material or fusible material. This includes silicone rubber bond and molding, adhesive bond, fiberglass, rubber molding, and curing of bond and molding materials.
370	Heat Treat	When you heat and/or chill a material to get the necessary physical property. This includes annealing, tempering, quenching, stress relief, solution heat treat, etc.
380	Surface Treat	When you apply paint, varnish, graphite varnish, aluminizing, a layer of Fel-Pro, SermeTel, or Teflon, zinc chromate priming, or do a tumble finish, or shot or glass bead peen, etc., as a treatment for a surface of a material. This includes the baking of surface treating materials.
390	Machine Riveting and Flaring	When you attach or connect parts by the insertion of a rivet through matching holes in parts, and deform or flare the plain end to form another head to lock the members together.
400	Assembly and Installation	Functional Block
410	APU Installation	The installation of an APU into a work stand, transport dolly, test stand, etc. It also applies to the installation of an APU in an aircraft.

Table INTRO-4. Task and Subtask Function Codes and Definitions (Cont)

Function Code	Function Title	Function Definition
420	Install APU Modular Sections	This is the third echelon of APU assembly, which includes assembly of the modular sections into a complete APU assembly. Modular sections are identified by the third element of the ATA number.
430	Assemble APU Modular Sections	This is the second echelon of APU assembly, which includes assembly of subassemblies into modular sections. Modular sections are identified by the second element of the ATA number.
440	Assemble APU Subassemblies	This is the first echelon of assembly, which includes the maximum assembly of the piece parts to the subassembly level required to assemble modular sections. The subassemblies are identified by the third element of the ATA number.
450	Install Accessory/Power Plant Components	The installation of individual accessory/power plant components on either installed or uninstalled APUs.
460	Assemble Accessory	The assembly of accessory components.
470	Assemble Accessory Subassembly	The assembly of accessory component subassemblies.
480	Install APU Test Equipment	The installation of equipment and instrumentation required for APU test.
490	Assemble Support Equipment	The assembly required for the maintenance of support equipment.
500	Material Handling	Functional Block
510	Shipping	The movement of any part, subassembly, assembly, modular section, or APU from the time it is packaged, until it reaches its intended destination.
520	Receiving	The receipt activity for any incoming part, subassembly, assembly, modular section, or APU.

Table INTRO-4. Task and Subtask Function Codes and Definitions (Cont)

Function Code	Function Title	Function Definition
530	Packing	The installation of parts, subassemblies, modules, modular sections, or APUs in shipment containers.
540	Unpacking	The removal of parts, subassemblies, modules, modular sections, or APUs from shipment containers.
550	Storage	The safekeeping of any part, subassembly, module, modular section, or APU until required for use.
560	Marshalling/Positioning	Marshalling is the collection of individual parts, subassemblies, modular sections, and accessories before release for assembly. Positioning is the movement from one fixed state to another.
570	APU Ferry/Pod Maintenance	When you do the necessary preparations before and after the transportation of an APU by aircraft ferry method.
580	Unassigned	--
590	Unassigned	--
600	Servicing / Preservation / Lubrication	Functional Block
610	Servicing	The maintenance actions required to keep the correct operation of a unit or system.
620	Preservation	When you prepare a part, subassembly, APU modular section, or APU to prevent decomposition or deterioration. This includes when you apply a preservative layer to, and desiccants in, APU hardware for storage.
630	Depreservation	The removal of the preservative layer and/or desiccants from the part, subassembly, assembly, APU modular section, or APU in preparation for installation or operation.
640	Lubrication	When you apply oil, grease, or dry-film-type lubricant on parts that move to reduce friction or wear, or to cool the part.

Table INTRO-4. Task and Subtask Function Codes and Definitions (Cont)

Function Code	Function Title	Function Definition
650	Unassigned	--
660	Unassigned	--
670	Unassigned	--
680	Unassigned	--
690	Unassigned	--
700	Functional Test	Functional Block
710	Oil Flow	The measurement of the flow of oil through APU components under specific conditions.
720	Air Flow	The measurement of the flow of air through an APU component or compartment under specific conditions.
730	Fuel Flow	The function checks and flow measurements of the part or system during a test.
740	Water Flow	The functional checks and flow measurements through the part, component, or system during a test.
750	Electrical	The functional checks of the electrical system or components as well as the measurement of systems parameters such as resistance or power drain.
760	APU	The operation of an APU to make sure of the function or operation of the systems under specific conditions to measure performance.
770	Accessory	The test of an accessory to make sure of its correct operation or function.

Table INTRO-4. Task and Subtask Function Codes and Definitions (Cont)

Function Code	Function Title	Function Definition
780	Pressure Check	The test of a normally pressurized component or system to make sure of its correct operation.
790	Leak Check	The test of a component or system to make sure of its ability to operate without leaks.
800	Miscellaneous	Functional Block
810	Fault Isolation	Fault isolation includes these procedures: – Operation of an APU at constant thrust lever or identical EPR to locate the prime suspect deficient system; – Operation of an incorrectly functioning system or component in order to locate the cause of malfunction; – The performance of a series of approved checks to isolate a failed part or component.
820	Adjustment, Alignment, Calibration	A physical correction to make sure of the correct placement or operation/test of a system or component.
830	Rigging	The hook-up, arrangement, or adjustment of the linkage of a component or accessory for correct system operation.
840	Service Bulletin Incorporation	Do the work specified in the manufacturer's service bulletin. This lets you identify the modification tasks at the task level with SUBTASKs to identify any functional changes (e.g., chemical, visual / dimensional, cleaning, machining, etc.) necessary to include the service bulletin.
850	Part Number Change/Re-Identification	The change of a part number, application of part number by transfer, engrave repair number, etc.
860	Unassigned	--
870	Unassigned	--
880	Approved Vendor Processes	The approved process can be proprietary and controlled by the applicable manufacturer or be nonproprietary and used by approved vendors.

Table INTRO-4. Task and Subtask Function Codes and Definitions (Cont)

Function Code	Function Title	Function Definition
890	Airline Maintenance Program (Customer Use)	For customer use only.
900	Unassigned	--
910	Special Equipment Maintenance	The identification of the necessary tasks for the maintenance of special support equipment.
920	Standard Equipment Maintenance	The identification the maintenance of standard support equipment.
930	Tool Fabrication	The fabrication of any tool that has procedures to make it included in the Engine Manual.
940	Unassigned	--
950	Unassigned	--
960	Unassigned	--
970	Unassigned	--
980	Unassigned	--
990	Illustrations, Tables, and Front Matter	A unique number for data retrieval which cannot be gotten by a TASK or SUBTASK number.

6. Customer Support

A. Honeywell Aerospace Online Technical Publications Website

(1) Go to the Honeywell Online Technical Publications Website at (https://aerospace.honeywell.com).

- To download or see publications online
- To order a publication
- To tell Honeywell of a possible data error in a publication.

B. Honeywell Aerospace Contact Team

(1) If you do not have access to the Honeywell Technical Publications Website, or if you need to speak to personnel about non-Technical Publication matters, the Honeywell Aerospace Contact Team gives 24/7 customer service to Air Transport & Regional, Business & General Aviation, and Defense & Space customers around the globe.

- Telephone: 800-601-3099 (Toll Free U.S.A./Canada)
- Telephone: 602-365-3099 (International).

7. References

A. Honeywell/Vendor Publications

(1) The publication title or model number, part number, publication number, and type of publications applicable to the unit are shown in Table INTRO-5.

Table INTRO-5. Applicable Publications List

Nomenclature	PN	Publication Number	Type
Pneumatic and Shaft Power	3800708-1	49-26-85	IRM
Gas Turbine Engine		49-27-27	IPC
		49-27-31	MM
Standard Practices Manual	-	20-00-02/70-00-01	SPM
Engine Wiring Harness Assembly	3888438-1	49-11-13 (Fokker Elmo) 49-11-09 (Griffith Enterprises, Inc.)	CMM/IPL
Model CU-C1 Auxiliary Power Unit Fuel Control	441921-4/-5	49-30-99	CMM/IPL
Ignition Exciter	3888058-5 3888058-7	49-41-09 49-41-01	CMM/IPL
Ignition Cable Assembly	3876132-13	49-41-19	CMM/IPL
Direct Current Motor	2704506-2/-3/-4/-5	49-41-20	CMM/IPL
IGV Actuator	3886188-3	49-50-07	CMM/IPL
Oil Cooling Fan Assembly	3616140-6/-7/-10	49-51-07	CMM/IPL
3.0 Inch Diameter Surge Control Valve	3291238-2	49-52-31	CMM/IPL
3.50 Inch Diameter Load Control Valve	3291432-1	49-52-35	CMM/IPL
Data Memory Module	3876287-1	49-60-65	CMM/IPL
Electronic Control Box	3888394-120201	49-63-50	CMM/IPL
Electronic Control Box	3888394-121202 3888394-121203 3888394-121204 3888394-121205	49-63-70	CMM/IPL

Table INTRO-5. Applicable Publications List (Cont)

Nomenclature	PN	Publication Number	Type
	3888394-221202		
	3888394-221203		
	3888394-221204		
	3888394-221205		
	3888394-321206		
Lube Module	4131020-4	49-90-57	CMM/IPL
Oil Cooler	160494-1	49-94-34	CMM/IPL

B. **Other Publications**

(1) These publications are standard references. Check for latest version of publication.

- The United States GPO Style Manual (available at http://www.gpo.gov/fdsys/pkg/GPOSTYLEMANUAL- 2008/content-detail.html)
- IEEE Std 260.1, Standard Letter Symbols for Units of Measurement (available from the American National Standards Institute at http://www.ansi.org)
- ASME Y14.38, Abbreviations for Use on Drawings and Related Documents (available from the American National Standards Institute at http://www.ansi.org)
- ASME Y14.5, Dimensioning and Tolerancing (available from the American National Standards Institute at http://www.ansi.org)
- ANSI/IEEE Std 91, Graphic Symbols for Logic Functions (available from the American National Standards Institute at http://www.ansi.org)
- CAGE codes and manufacturers' addresses are available at https://cage.dla.mil
- IEEE 315/ANSI Y32.2, Graphic Symbols for Electrical and Electronics Diagrams (available from the American National Standards Institute at http://www.ansi.org)
- MIL-HDBK-263, Electrostatic Discharge Control Handbook for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices) (Metric) (available from any military standards database)
- MIL-STD-1686, Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices) (Metric) (available from any military standards database).

8. Acronyms and Abbreviations

A. **General**

(1) The abbreviations are used in agreement with ASME Y14.38.

(2) Acronyms and non-standard abbreviations used in this publication are shown in Table INTRO-6.

Table INTRO-6. List of Acronyms and Abbreviations

Term	Full Term
ac	alternating current
Assy	assembly
ATA	Air Transport Association
ANSI	American National Standards Institute
APU	auxiliary power unit
ASME	American Society of Mechanical Engineers
BITE	built-in-test equipment
C	Celsius
cc	cubic centimeter
CAGE	commercial and government entity
CPU	central processing unit
CMM	component maintenance manual
dc	direct current
DMM	data memory module
DP	delta pressure
E/C	engine compressor
ECB	electronic control box
ECS	environmental control system
EGT	exhaust gas temperature
F	Fahrenheit
FCU	fuel control unit
IEEE	Institute of Electrical and Electronics Engineers
IGVA	inlet guide vane actuator
in-lb	inch per pound
IPC	illustrated parts catalog
IPL	illustrated parts list
IRM	inspection repair manual
JEMTOSS	jet engine maintenance task oriented support system
kg	kilogram
kPa	kilopascal
lb	pound
L/C	load compressor
LCV	load control valve
LOL	low oil level

Table INTRO-6. List of Acronyms and Abbreviations (Cont)

Term	Full Term
LOP	low oil pressure
MDCU	multipurpose cockpit control display unit
MES	main engine starting
MM	maintenance manual
Nm	Newton meter
PN	part number
PSIG	pounds per square inch - gage
PT	total pressure transducer
P2	inlet pressure transducer
RPM	revolutions per minute
RTL	ready-to-load
SB	service bulletin
SCV	surge control valve
SPM	standard practices manual
T/M	torque motor
TR	temporary revision
T2	inlet temperature sensor
VAC	volts alternating current
VDC	volts direct current

9. Process Verification

A. Verification Data

(1) Honeywell does a verification of these technical instructions by performance or by simulation of the necessary procedures. Performance shows that the procedures were checked by the use of the manual. Simulation shows that the applicable personnel looked at the procedure in the manual and that the procedure is technically correct. The dates of verification for this manual are given in Table INTRO-7.

Table INTRO-7. Verification Data

Section	Method	Date
Testing	Simulation	30 Apr 1998
Fault Isolation	Simulation	30 Apr 1998
Disassembly	Simulation	30 Apr 1998
Assembly	Simulation	30 Apr 1998
Removal	Simulation	30 Apr 1998
Installation	Simulation	30 Apr 1998

10. Geometric Tolerance

A. Symbols

(1) The symbols and special characters are in agreement with IEEE Publication 260 and IEC Publication 27. Special characters in text are spelled out.

(2) The signal mnemonics, unit control designators, and test designators are shown in capital letters.

(3) The signal names followed by an “*” show an active low signal.

(4) Some figures in this manual incorporate standard geometric characteristic symbols. Refer to Figure INTRO-4 for the geometric characteristic symbols.

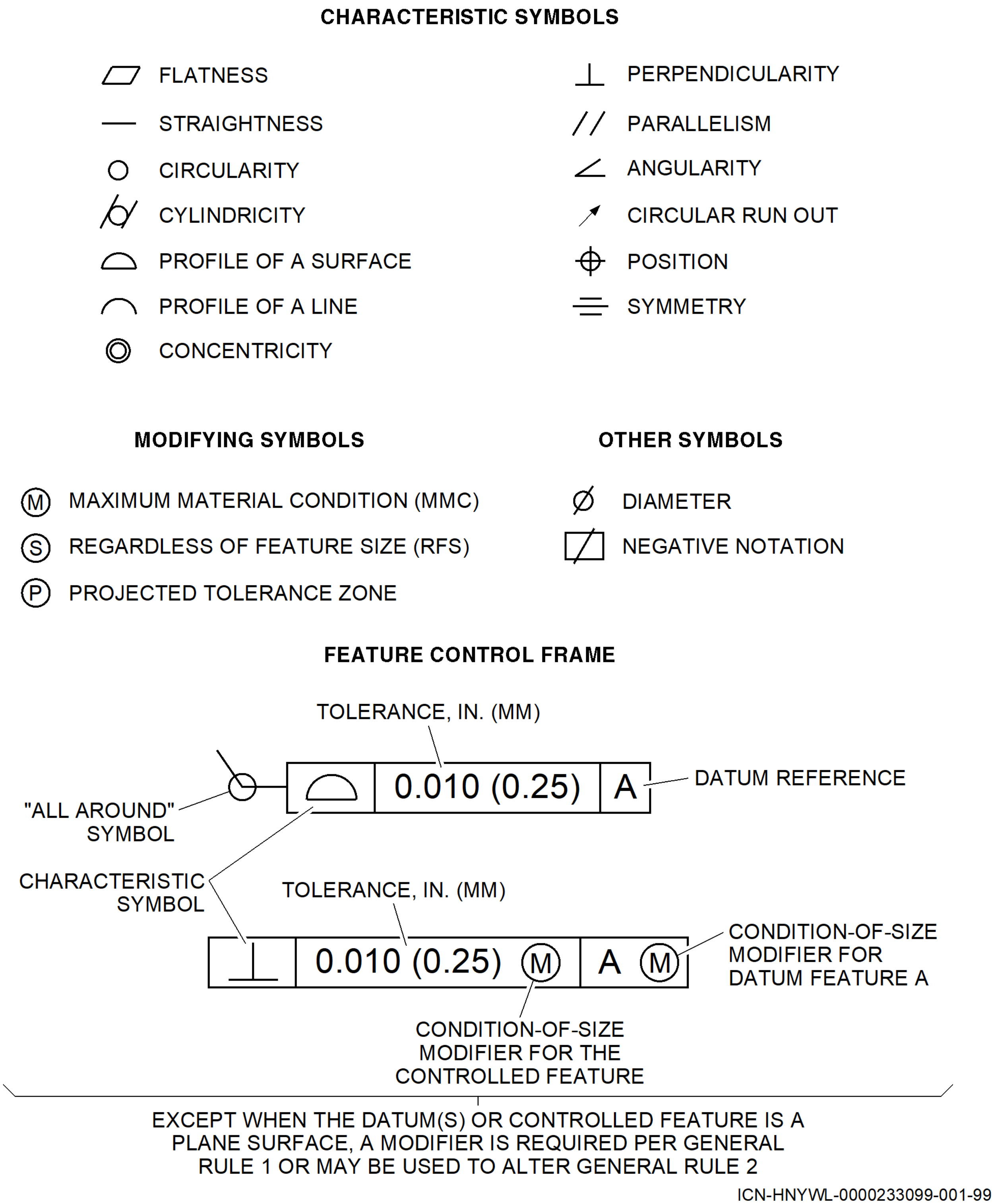

Figure INTRO-4. (Sheet 1 of 2) Geometric Tolerance Symbols

GENERAL RULES

1. POSITION (⌖) TOLERANCES AND THEIR RELATED DATUMS APPLY AT MMC OR RFS AS SPECIFIED IN THE FEATURE CONTROL FRAME.
2. EXCEPT FOR POSITION (⌖), ALL TOLERANCES AND THEIR RELATED DATUMS APPLY RFS UNLESS OTHERWISE SPECIFIED.
3. ALL GEOMETRIC TOLERANCES ARE SPECIFIED AS TOTAL VALUES (TOTAL DIAMETER, TOTAL THICKNESS, TOTAL WIDTH, OR TOTAL ON RADIUS).
4. WHEN TWO DATUM FEATURES ARE REFERENCED IN HYPHENATED FORM, | A-B |, A SINGLE DATUM IS ESTABLISHED BY THE TWO FEATURES.
5. WHEN TWO OR THREE DATUMS ARE REFERENCED IN SUCCEEDING FRAMES, | A | B | C |, THE ORDER OF PRECEDENCE IS LEFT TO RIGHT.

SAMPLE INTERPRETATIONS

-A-	THIS IS DATUM FEATURE A WHICH IS USED TO CREATE DATUM A IN THE PROCESSING EQUIPMENT.
▱ | 0.010 (0.25)	THIS SURFACE MUST BE FLAT WITHIN 0.010 IN. (0.25 MM) TOTAL (MEETING EITHER SYSTEM WILL ACCEPT THE PART).
// | 0.010 (0.25) | B -C-	THIS IS DATUM FEATURE C AND, RFS MUST BE PARALLEL TO DATUM B, RFS, WITHIN 0.010 IN. (0.25 MM) TOTAL.
↗ | 0.0005 (0.013) | A-B	EACH CIRCULAR ELEMENT OF THIS FEATURE, RFS, MUST NOT RUN OUT MORE THAN 0.0005 IN. (0.013 MM) FIM, WITH RESPECT TO THE DATUM ESTABLISHED BY FEATURES A AND B, BOTH RFS.
⌖ | Ø 0.010 (0.25) Ⓜ | A | B Ⓜ | C Ⓜ	THE AXIS OF THIS FEATURE, WHEN THIS FEATURE IS AT MMC, MUST BE LOCATED WITHIN 0.010 IN. (0.25 MM) DIAMETER OF THE TRUE (BASIC) LOCATION ESTABLISHED IN RELATION TO THE PRIMARY SURFACE DATUM A, SECONDARY DATUM B AT MMC, AND TERTIARY DATUM C AT MMC.
⊥ | Ø 0.010 (0.25) Ⓜ | A 0.500 (12.7) Ⓟ	THE AXIS OF THIS FEATURE, WHEN THIS FEATURE IS AT MMC, MUST BE PERPENDICULAR TO DATUM A, RFS, WITHIN A 0.010 IN. (0.25 MM) DIAMETER TOLERANCE ZONE PROJECTED 0.500 IN. (12.7 MM) ABOVE THE SURFACE.
∠ | ⍁	THE ANGULAR ORIENTATION OF THIS FEATURE NEED NOT BE CONTROLLED WITH RESPECT TO ANY OTHER FEATURE.

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Figure INTRO-4. (Sheet 2 of 2) Geometric Tolerance Symbols

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LIST OF EFFECTIVE PAGES

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LIST OF EFFECTIVE PAGES (Cont)

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13024	20 Apr 2022		
13025	20 Apr 2022		
13026	20 Apr 2022		
13027	20 Apr 2022		
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CHAPTER - 49 (Cont)

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SYSTEMS DESCRIPTION SECTION

1. Introduction

The gas turbine auxiliary power unit (APU) is a self-contained power unit. The APU is controlled by a system of automatic, pneumatic and electromechanical controls. The APU is designed to function as a combination shaft and pneumatic power source. Power output is ready for use while the aircraft is on the ground or in-flight.

2. General Description

The physical operational characteristics of the engine are listed in Table 1. Approved lubricating oil is found in Table 2. Approved fuel is found in Table 3.

Table 1. Leading Particulars

Total APU Weight	360.89 lb (163.7 kg)
Rated Output Shaft Power	131 HP (continuous)
Rated Shaft Speed	48800 RPM
Maximum Turbine Exhaust Gas	
Temperature at Rated Output	1185°F (641°C) with an ambient temperature of 100°F (38°C) at sea level
Maximum Allowable Speed	51728 RPM
Maximum Oil Consumption Rate (New Engine)	0.007 quart (6.6 cc) an hour
Oil Pressure Limits	67.5 ±7.5 PSIG (465 ±52 kPa) (nominal) 30 to 40 PSIG (207 to 276 kPa) (automatic LOP shutdown)
Usable Oil Capacity	Total sump capacity 6.6 quarts (6.25 liters) Approximately 1.74 quarts (1.65 liters) depletion to minimum oil quantity signal. Approximately 3.09 quarts (2.92 liters) depletion to automatic shutdown.
Frequency of Oil Change	No oil change required.
Frequency of Oil Filter Change	Delta P switches on the filter elements will send a message to the ECB when an oil filter change is required. The ECB receives this message and stores it in the form of a maintenance message.
Oil	Synthetic-base. Lubricating oil MIL-PRF-7808 and MIL-PRF-23699. (Refer to Table 2)
Fuel	Refer to Table 3 for list of acceptable fuels.
Minimum Fuel Inlet Pressure	10 PSI (20.36 in.Hg) for starting and operation.
Fuel Filter	25 micron filter
APU (Starter)	28 VDC, 30 amperes (max.)
ECB Power Supply	28 VDC, 8 amperes (max.)

Table 2. Approved Lubricating Oils

Refer to Honeywell Service Bulletin 49-7933.

Table 3. Approved Fuels

Refer to Honeywell Service Bulletin 49-8185.

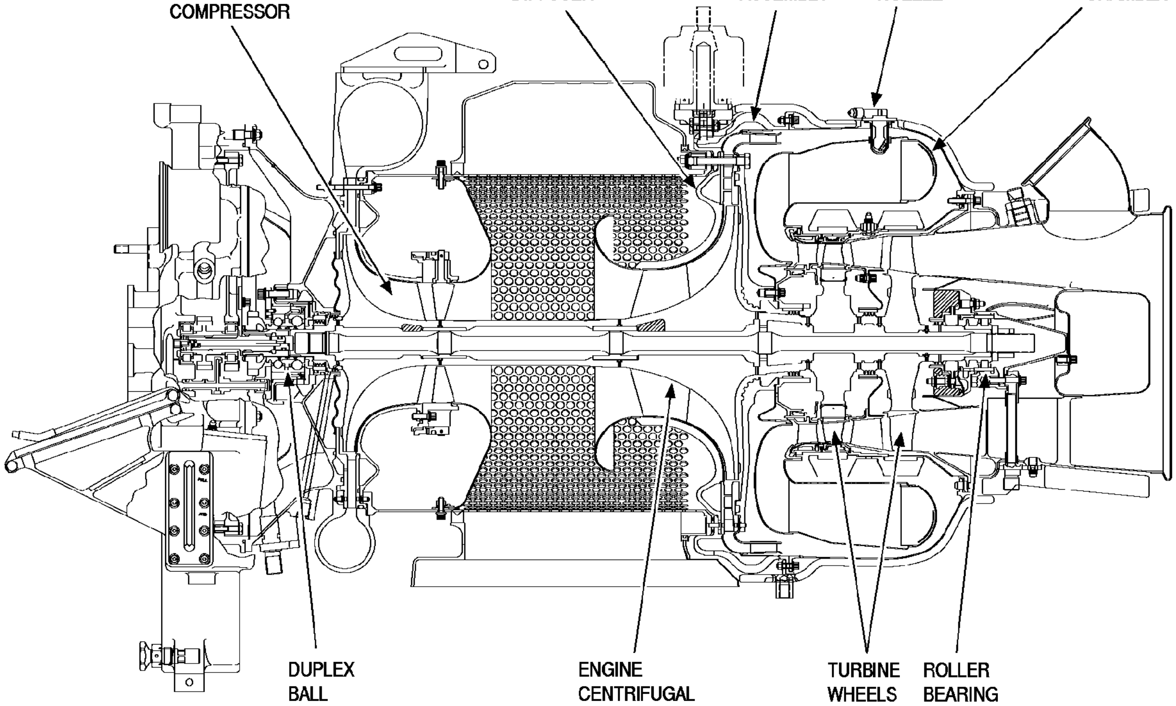

Figure 1. APU Internal Features (Typical)

The APU is of a two module design that consists of three major sections.

- Power section and load compressor module:
    - The power section,
    - The load compressor.
- Accessory gearbox with electrical generator module:
    - A gearbox with accessories.

The APU uses a single-shaft gas turbine power section that directly turns the load compressor and provides power to the gearbox. The power section and load compressor are mounted together on a single shaft supported by two bearing assemblies as shown in Figure 1.

It also incorporates accessories required to start, control, protect and perform functions that permit the APU to deliver energy with the required parameters. A remotely mounted, digital electronic control box (ECB) provides necessary control functions and signals to the APU, while transmitting and receiving signals to and from the aircraft.

The APU has been designed to be a Category I, Essential APU, which will supply the aircraft with:

- Ground power
    - Compressed air supply for environmental control system (ECS) operation,
    - Electrical power supply to the aircraft systems,
    - Compressed air supply for main engine starting (MES).
- In flight power
    - Electrical power supply to the aircraft systems,
    - Compressed air supply for ECS operation.

Figure 2 shows detailed APU external components and their locations.

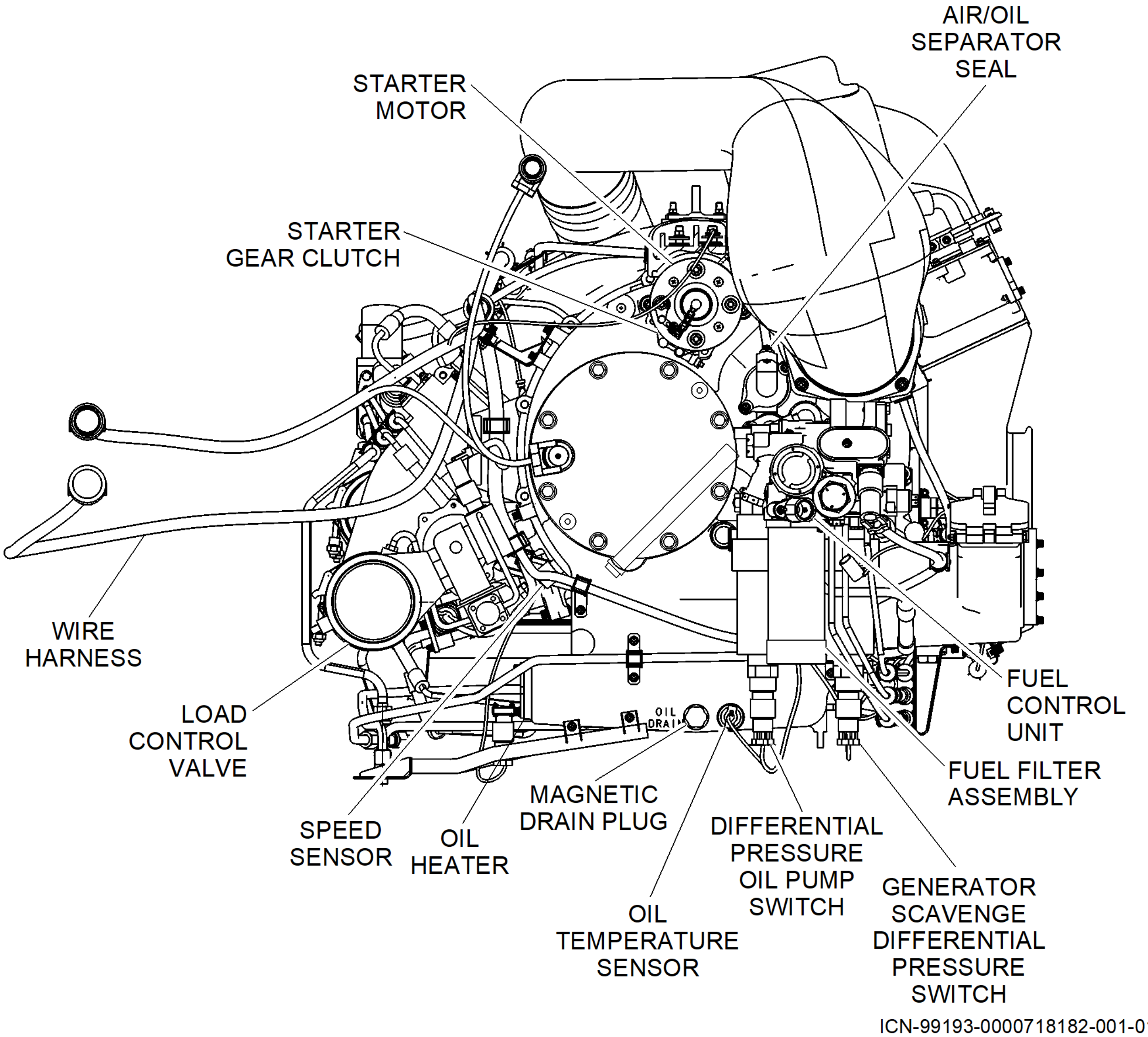

Figure 2. APU External Features

The APU has external components that are easy to service, remove and replace at line level. These components include:

- Air/oil separator seal,
- APU wiring harness,
- Data memory module,
- De-oil solenoid valve,
- Differential pressure transducer (DP),
- Dual-orifice fuel atomizer,
- Electronic control box,
- Exhaust gas temperature thermocouples,
- Fuel control unit,
- Fuel filter assembly,
- Fuel flow divider,
- Fuel flow divider solenoid valve,
- Fuel manifold (primary),
- Fuel manifold (secondary),
- Generator scavenge differential pressure switch,
- Ignition lead,
- Igniter plug,
- Ignition unit,
- Inlet guide vane actuator,
- Inlet pressure transducer (P2),
- Inlet temperature sensor (T2),
- Load control valve,
- Low oil pressure switch,
- Low oil level switch,
- Oil pump assembly/lube module with filters,
- Magnetic drain plug,
- Oil cooler,
- Oil cooling fan assembly,
- Oil heater,
- Oil pump differential pressure switch,
- Oil temperature sensor,
- Speed sensor (monopole),
- Starter gear/clutch,

- Starter motor,
- Surge control valve,
- Total pressure probe,
- Total pressure transducer (PT).

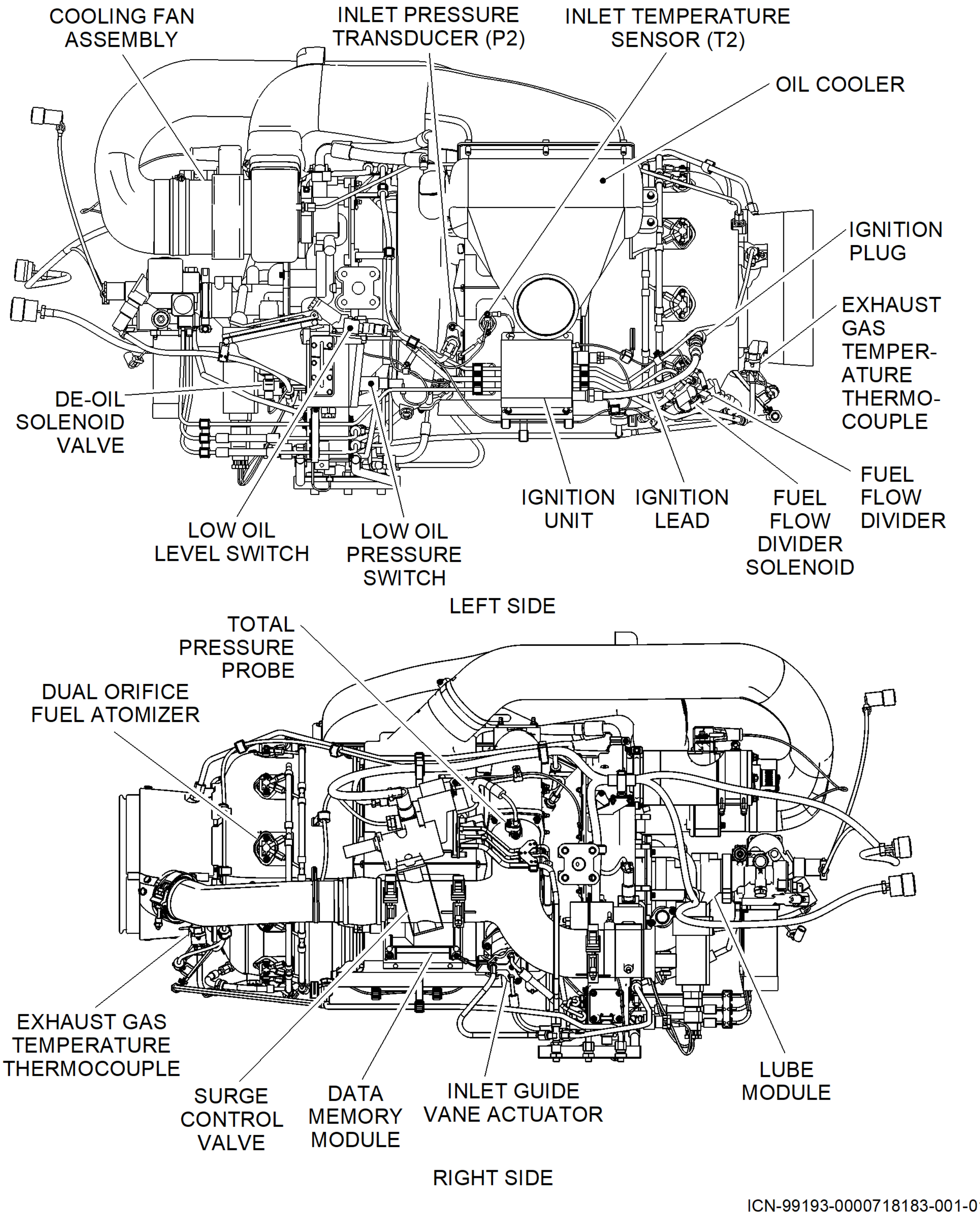

Figure 3. (Sheet 1 of 2) APU External Features

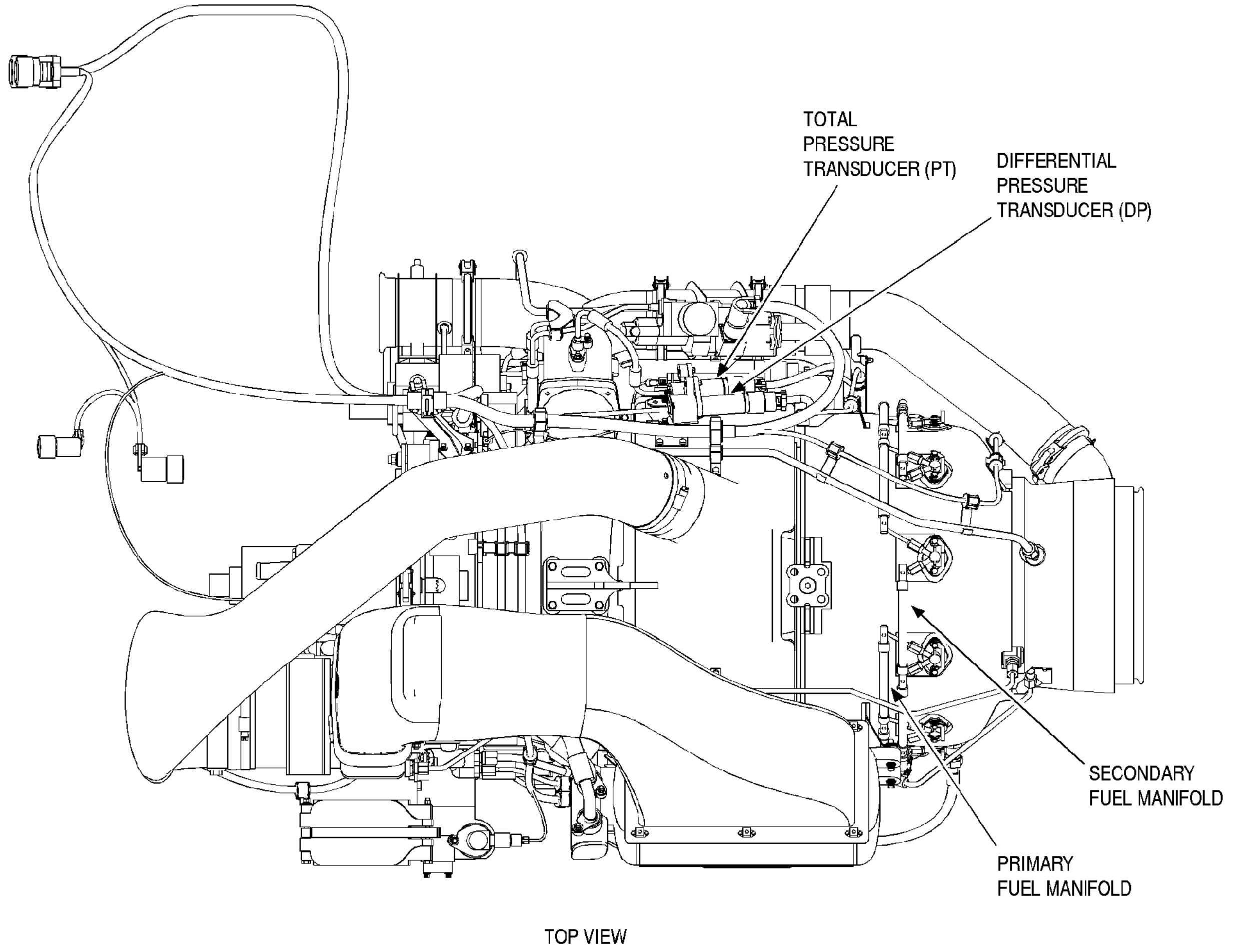

Figure 3. (Sheet 2 of 2) APU External Features

Power Section

The APU power section is shown in Figure 4.

The power section comprises a single-stage centrifugal engine compressor (E/C), a reverse flow annular combustor and a two-stage axial turbine. Shaft power to drive the load compressor, gearbox and accessories and electrical generator is generated in the following manner:

- Outside air is drawn into the APU through a series of aircraft intake ducts. The air enters radially into the APU inlet plenum and is immediately drawn into the centrifugal E/C where is compressed.
- After exiting the centrifugal E/C, the compressed air is diffused and its swirl angle decreased by means of a deswirl vane assembly. The air then flows into the reverse-flow annular combustion chamber (combustor) of an effusion-cooled design.
- Fuel is atomized and sprayed into the combustor where the fuel/compressed air mixture is burned.
- Energy provided by the combustor gas discharge is converted to mechanical shaft power by expansion through the turbine. This power is used to drive the E/C, load compressor (L/C) and gearbox and accessories, which includes the electrical generator.
- After expansion, the hot combustor gas is discharged through the primary exhaust nozzle and out through an aircraft exhaust muffler.

The APU main shaft, which ties the L/C, E/C and turbine together, is supported by two bearings: a forward duplex ball bearing and an aft roller bearing. Benefits derived from using a single shaft include a simplified rotating group assembly, fewer static structure components and minimization of the bearing problems typically associated with the output of shaft horsepower (shp). The centrifugal engine compressor provides the extra benefit of increased resistance to foreign object damage (FOD).

Load Compressor

The L/C, is a single-stage centrifugal configuration that delivers compressed air to the aircraft pneumatic system. The L/C directly attached to the power section shaft and is driven at the power section rotational speed. L/C output is regulated by variable inlet guide vanes (IGVs) located upstream of the L/C. Output is a function of aircraft system demand for ECS, MES or duct pressurization mode, as indicated by a demand signal from the aircraft to the APU ECB. The IGVs are moved to the position defined by the ECB by a hydraulic (fuel driven) IGV actuator.

Inlet air to the L/C is drawn from the inlet plenum (shared by the engine compressor) through the variable IGVs. Following discharge from the L/C, the air passes through a diffuser scroll to the compressor discharge duct, through the APU provided load control valve (LCV), to the aircraft bleed duct. A surge control system disposes of bleed air that exceeds the aircraft demand. This excess air is ducted through a modulating surge control valve (SCV) attached to the compressor discharge duct and dumped into the APU exhaust.

Gearbox

The gearbox is a modular assembly that interfaces with the L/C section and incorporates drive pads for the APU-driven accessories, direct current (dc) starter, including provisions for a 24,000 rpm oil-cooled alternating current (ac) generator. The gearbox incorporates a wet sump lubrication system where the oil is stored in the gearbox rather than in an external reservoir. The following items are mounted on the gearbox:

- Fuel control unit (FCU),
- Low oil pressure switch,

- Low oil level switch,
- Lubrication module,
- Oil cooling fan assembly,
- Oil-cooled generator (optional),
- Oil heater,
- Oil temperature sensor,
- Starter motor.

Other gearbox features are:

- A gearbox vent with air-oil separation is provided. The vent line is routed to the APU exhaust eliminating a customer interface and a separate overboard drain.
- The gravity fill port is an integral part of the gearbox housing. The port is located on the gearbox housing to minimize the possibility of over-servicing. A direct-reading sight glass, included to provide a clear indication of the full and add oil level marks, is installed to the rear of the gearbox.
- The self-closing combination drain plug and chip collector magnetically attracts ferrous alloy chips for visual detection. The option for an additional magnetic chip collector is also provided on the gearbox to isolate the aft turbine bearing sump return for enhanced fault isolation.
- Provisions for pressure fill port are provided on the front of the gearbox to facilitate pressurized servicing. In addition, an oil overfill port is located above the fill port to prevent gearbox over-servicing.

3. Operation

Start Sequencing

The APU is started by a Master Switch to ON signal, followed by a momentary START signal, transmitted from the aircraft to the Electronic Control Box (ECB) from the APU start switch. The ECB then energizes its internal power supply and commands the APU inlet door to open.

During the time it takes for the APU inlet door to open, the ECB performs an automatic prestart built-in-test equipment (BITE) check and also monitors all input commands.

After the BITE check is completed and receipt of the APU DOOR OPEN signal from the position switch, the ECB transmits a signal and applies 28 VDC to the starter. The ignition unit causes the igniter to spark at a rate necessary to ignite the atomized fuel being delivered by the FCU. The starter applies torque to the gear train, which in turn increases the speed of the APU rotating group.

As the APU shaft begins to turn, both speed signals generated by the dual-circuited speed sensor are transmitted to the ECB.

When the APU has reached 7-percent speed, the ECB energizes the fuel solenoid valve and commands the fuel control unit (FCU) torque motor (T/M) to deliver fuel flow for ignition. When light off occurs the FCU T/M signal is switched from light-off schedule to the timed-acceleration speed control loop.

At APU light off, two thermocouple assemblies positioned in the combustion exhaust gas path see a temperature rise and send these values to the ECB on a continuous basis. After light off, the ECB continues to monitor APU speed and inlet air and exhaust gas temperatures and limits fuel delivery to keep operation at safe turbine temperatures under all inlet temperature and altitude conditions.

After ignition, the starter continues to accelerate the APU faster than the reference ramp. During this time, a minimum fuel flow keeps a continuous combustion. When the actual APU acceleration rate slows to become equal to the reference ramp acceleration, then the integrator is reset so that the reference speed equals the actual speed, which gives a smooth transition from starter assistance to combustion power.

When combustion becomes the primary source of power, APU speed is controlled through fuel flow rate feedback from the resolver flow meter in the FCU. Governing action occurs when the actual speed (N) is compared against the speed reference set point (NREF): if N is less than the reference, the resulting error is amplified and added to the T/M current to increase APU speed. The ECB de-energizes the starter at 50 percent APU speed.

The speed reference increases according to the speed reference ramp schedule. This schedule varies with altitude so that the APU starts in the specified time at high altitudes and starts faster at low-altitude and normal-ambient conditions where turbine inlet temperature (T4) is moderate. The speed reference also increases more quickly at higher APU speeds, where the APU is capable of faster acceleration with reduced turbine inlet temperature.

At 95 percent speed, the timed-acceleration logic is no longer used and the on-speed governor control loop assumes control of APU speed. The "easy-up" logic permits a smooth transition of the APU from 95 to 100 percent speed. Two seconds after speed exceeds 95 percent, the ECB sends the APU ready-to-load (RTL) signals to the aircraft, indicating that generator and pneumatic power are available.

The on-speed governor loop keeps a constant APU speed under varying load conditions. Governing is electronically made by the digital APU ECB. The ECB uses proportional-plus-integral (P+I) logic to prevent steady-state speed errors and keep transient speed changes inside specification limits. The ECB gives closed-loop APU speed control at governed speed by monitoring speed and modulating fuel flow. Speed is sensed by one speed sensor and two speed-conditioning circuits, with fail-safe logic contained in the ECB. The single sensor gives two redundant speed signals. Speed is compared with a governed speed set point reference and the error signal is acted on by the P+I control logic. The governed speed setpoint without pneumatic load is 100 percent speed. Under certain ambient conditions in ECS, the speed setpoint becomes 99 percent. The output of this logic is limited by maximum and minimum schedules that prevent power section surge and combustor blowout, respectively, subsequent to large step changes in generator load. The control current to the FCU T/M is updated every 20 milliseconds. Closed-loop control of fuel flow is active. It increases the speed of response of fuel flow during generator loading and unloading and helps apply the minimum and maximum fuel flow limits more accurately.

<u>Shutdown</u>

Normal APU shutdown is specified in the following sequence of events.

a) A normal APU shutdown is started from the cockpit by switching the APU master switch to the OFF position.

b) If the APU master switch OFF signal is received while the LCV is "Open", the ECB begins pneumatic unloading by closing the inlet guide vanes (IGV) and the LCV and opening the surge control valve (SCV) and starts the 60-second cool-down time delay. The APU then continues to complete the entire cool-down cycle. If the APU master switch OFF signal is received after the completion of the cool-down timer started in b) above, the APU is shutdown immediately. If the APU master switch OFF signal is received before completion of the time delay started in a) above, the APU will shutdown at completion of the cool-down time delay in progress.

c) At the end of the cool-down cycle, the ECB supplies a frequency input to the overspeed shutdown circuitry to simulate a overspeed condition. In response, the fuel solenoid closes and the APU shuts down as it would for and actual overspeed shutdown. In this mode, however, no overspeed shutdown is recorded by the APU. After the overspeed protection circuit is checked, the ECB attempts to keep speed at 100 percent by modulating the fuel flow. If the ECB is able to keep speed at 100 percent, it would indicate that the fuel solenoid failed in the open position. If the ECB sees a fuel solenoid failure in this manner, it will reduce the FCU T/M current to zero to make sure the APU is shutdown.

d) During APU rolldown, the ECB continues to function and keep signals to the aircraft circuits. The IGVs are positioned at the RTL position until the APU has rolled down to 20 percent, at which point the IGVs are closed to 15 degrees. An APU restart can be given at any time, however the starter will not be engaged until after speed has dropped below 7 percent.

Inlet Guide Vane (IGV) Control System

The load compressor inlet guide vane (IGV) control system positions the load compressor IGVs to meet necessary aircraft pneumatic loads, protect the APU from overtemperature and limit bleed duct pressure in situations where the APU could make more than maximum permissible duct pressure. Aircraft demand logic commands the IGV position. The IGV position is set by means of the hydraulic actuator.

Two outer loops limit EGT (T5) trim and bleed-pressure, in this sequence. The logic for these two outer loops can reduce the IGV position set point if T5 or bleed pressure becomes greater than each of their set points. If an electrical overload occurs, the IGVs are immediately closed to prevent generator under frequency, then slowly and continuously permitted to return to their original position. During an APU start, the IGVs are held at 15 degrees open to remove pneumatic load from the load compressor.

Surge Control System

The foundation of the surge control system is a hydraulically actuated (fuel powered) electrically piloted surge control valve (SCV) with a two-stage servovalve and a linear variable differential transformer (LVDT) that gives feedback on valve position.

The surge control system prevents load compressor surge for all service modes, altitudes, inlet temperatures and aircraft airflows. The system keeps a minimum load compressor discharge corrected flow (W_c) by opening the surge control valve (SCV) when little or no airflow is necessary for the aircraft. Surge is prevented by control of the load compressor W_c to keep it at or above a limit, or set point. The W_c set point is a function of inlet temperature (T2), IGV position and aircraft selected mode.

The ECB commands the SCV position loop to keep W_c at or above the set point. W_c is measured by a total pressure (PT) probe at the scroll discharge and static pressure (PS) ports in the load compressor diffuser. The signals for PT and PS are transmitted to the ECB by sensors. The flow sensor gives a Delta P/PT signal that is a function of W_c. A lookup table in the ECB uses the known characteristics of the flow sensor to convert Delta P/PT back into W_c. The control logic generates the W_c error by subtracting the measured W_c from W_c setpoint. A lead-lag filter and P+I controller then act on the W_c error to command the SCV position. The P+I controller provides zero steady-state flow error. The surge control logic is updated every 5 milliseconds.

The SCV position control loop is an inner loop in the airflow control loop. The SCV position command comes from the airflow control loop software. The proportional controller for the SCV position loop is a analog electronics device, and controls the current to a T/M. The T/M controls the flow of high pressure fuel to the hydraulic cylinder, which, through a mechanical linkage, drives the SCV butterfly. A linear variable differential transformer (LVDT) senses the position of the butterfly shaft, which provides the position measurement for the controller.

Electronic Control Box (ECB)

The APU ECB is a full-authority digital electronic control that gives complete APU speed and temperature control during start and on-speed operation. The ECB is capable of power interrupts up to 0.5 seconds when the secondary power supply is active. The secondary supply at 115 VAC is taken off one phase of the APU generator. Without this supply, the power interrupt capability is 0.2 second. The ECB has key software tests that give nearly perfect fault detection and isolation to the LRU level. Fault information and APU status data are available on the multipurpose cockpit control display unit (MCDU) in the cockpit.

The ECB contains the necessary electronic hardware and software to operate the 131-9[A] APU in the aircraft. This operation includes APU start, run and load order of succession, as well as modifications of these modes that results from aircraft parameters that change. In addition, proven protective and diagnostic methods are used to make safe, reliable operation. The ECB microprocessor uses a clock speed of 20 MHz to allow for real-time margin greater than 20 percent when executing all code for ECB operation.

The ECB features BITE technology as follows:

- Open-and short-circuit and signal-invalid tests on all speed, temperature, position and pressure signals.
- Voltage, current and overcurrent signals on all outputs to detect open, short, or failed ECB drivers on any ECB output.
- Various internal self-test and monitoring features to detect and isolate ECB and LRU faults. These tests are as follows:

  + Central processor unit (CPU) instruction test.
  + Temporary results and computational storage memory (RAM) sum test.
  + Nonvolatile memory for storage of shutdown and fault records (EEPROM) voting logic test.
  + Monitoring of power-supply-voltage hardware.
  + CPU monitoring of power-supply and reference voltages using logic tests to isolate faults.
  + Self-test of internal and external CPU watchdog timers.
  + Self-test of hardware overspeed circuit, conducted during alternate APU shutdowns.
  + Transmitter-to-receiver wraparound test of the ARINC 429 data bus.
  + CPU self-test to determine execution time of foreground and background tasks.
  + Extensive LRU fault isolation.

4. Training Information Points

A. The APU oil cooler air inlet side should always be kept clean to make sure air can pass through to keep the oil within temperature limits.

B. The drain mast is checked for leakage. If leakage is found, the tell-tail witness drains are opened to isolate the leakage source. Refer to Figure 7.

C. Approved oil is added to the gearbox oil sump through the oil filler housing.

D. The oil level sight glass is visually checked to see the oil level in the gearbox oil sump.

E. The magnetic chip collector is checked for metal pieces to see if there is possible engine damage.

F. The magnetic chip collector and plug are removed to drain oil from the gearbox oil sump.

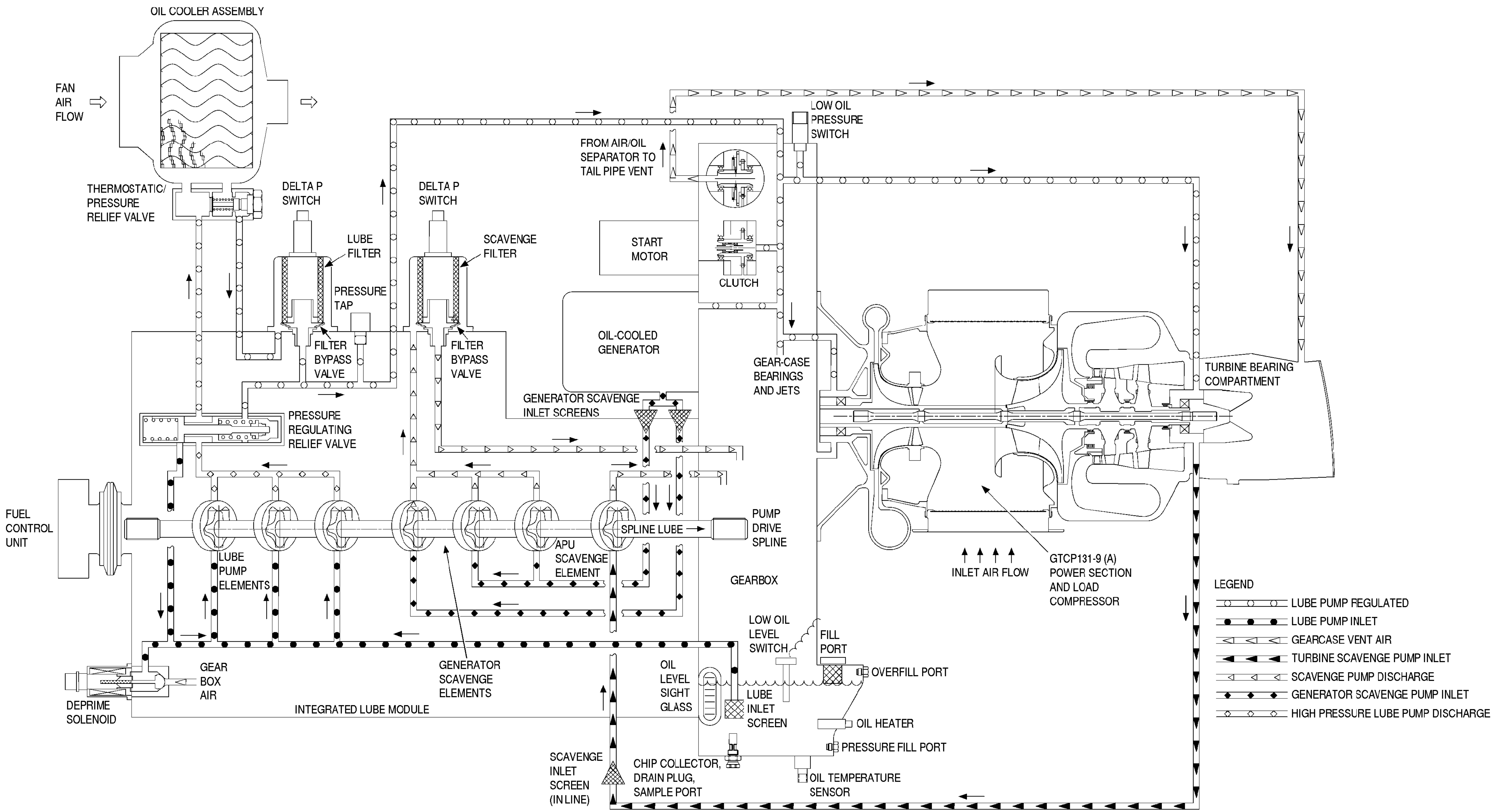

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Figure 4. Lubrication System Schematic

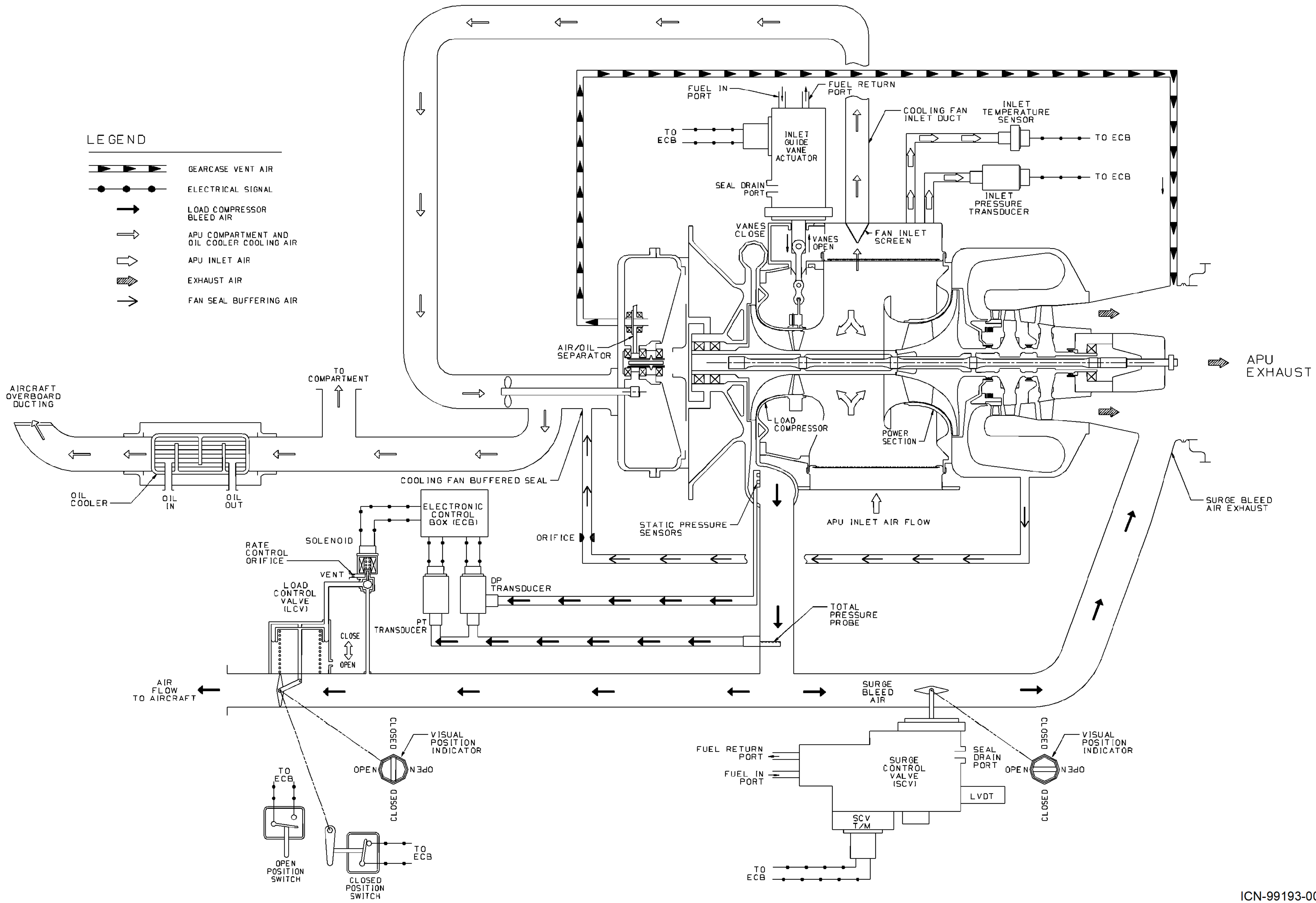

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Figure 5. Pneumatic System Schematic

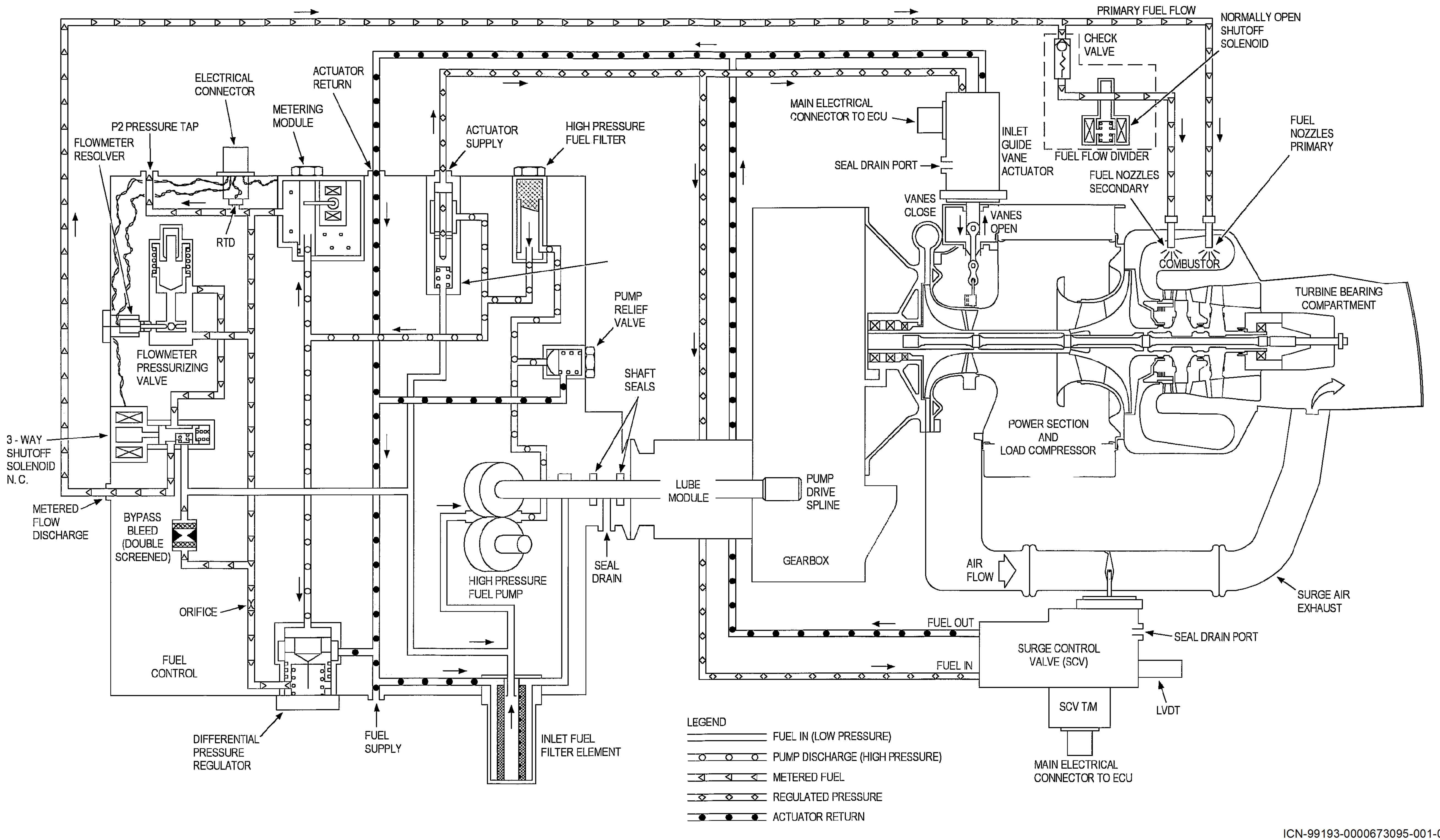

Figure 6. Fuel System Schematic

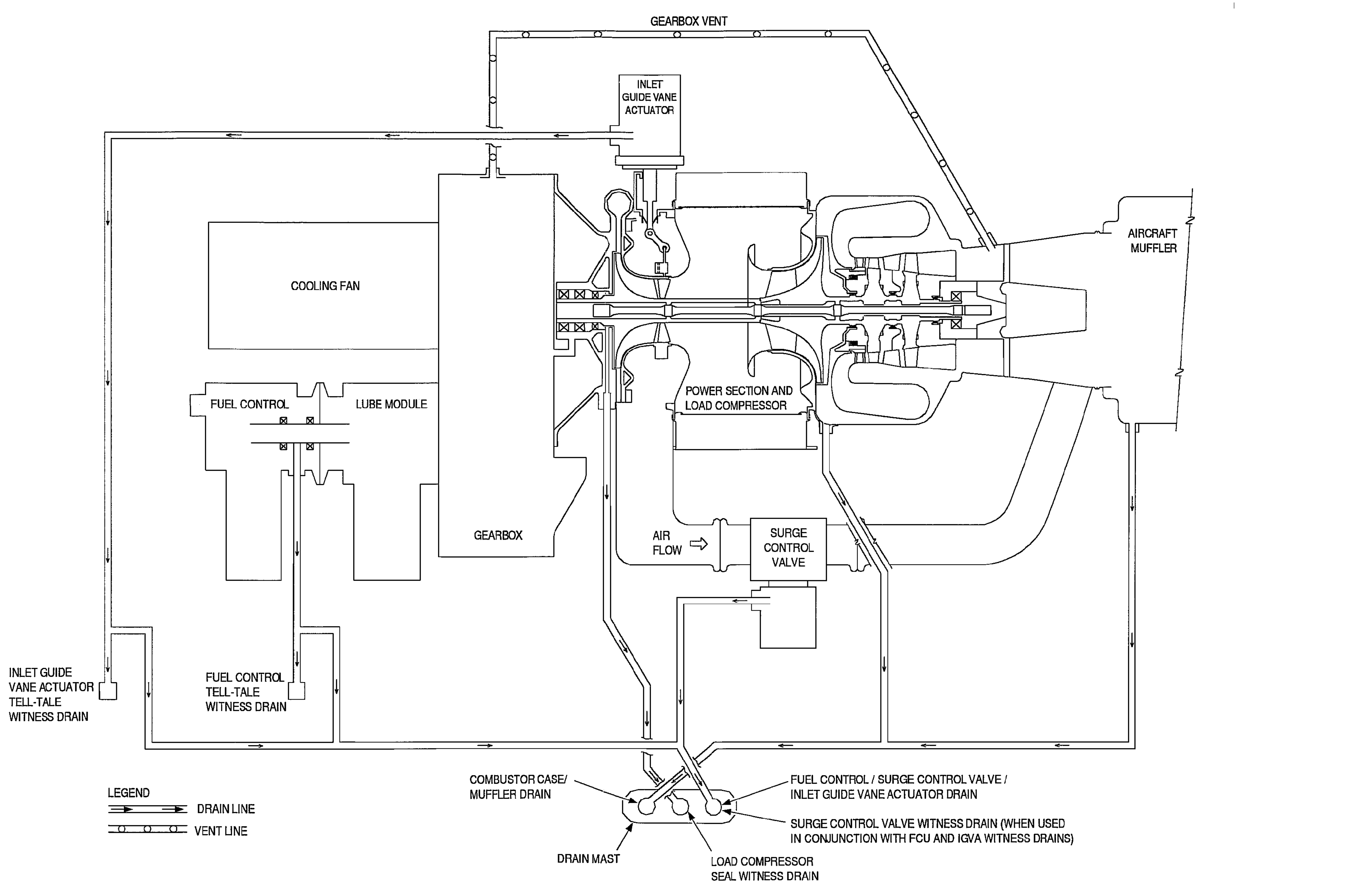

Figure 7. Vent and Drain System Schematic

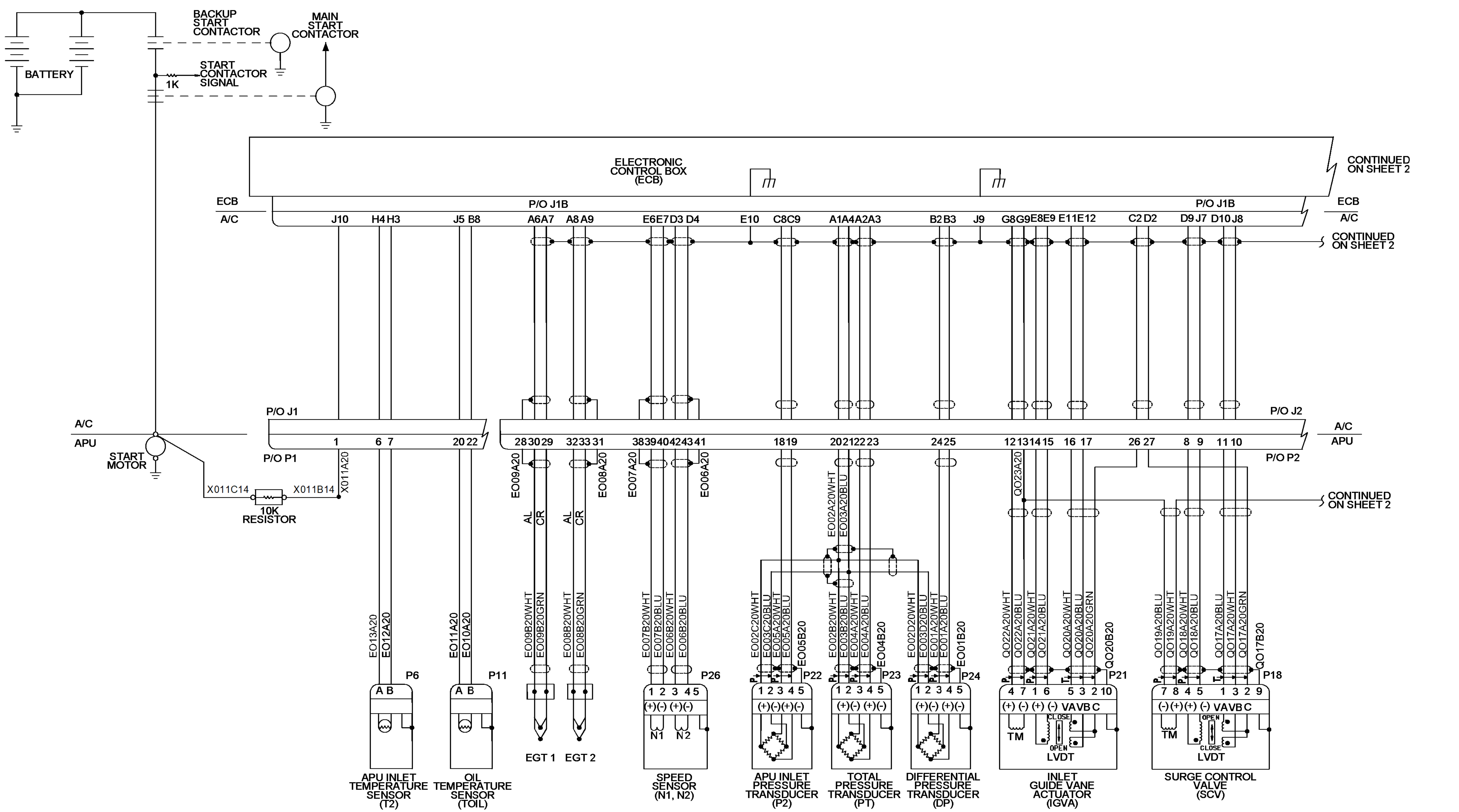

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Figure 8. (Sheet 1 of 2) Wiring Diagram Schematic

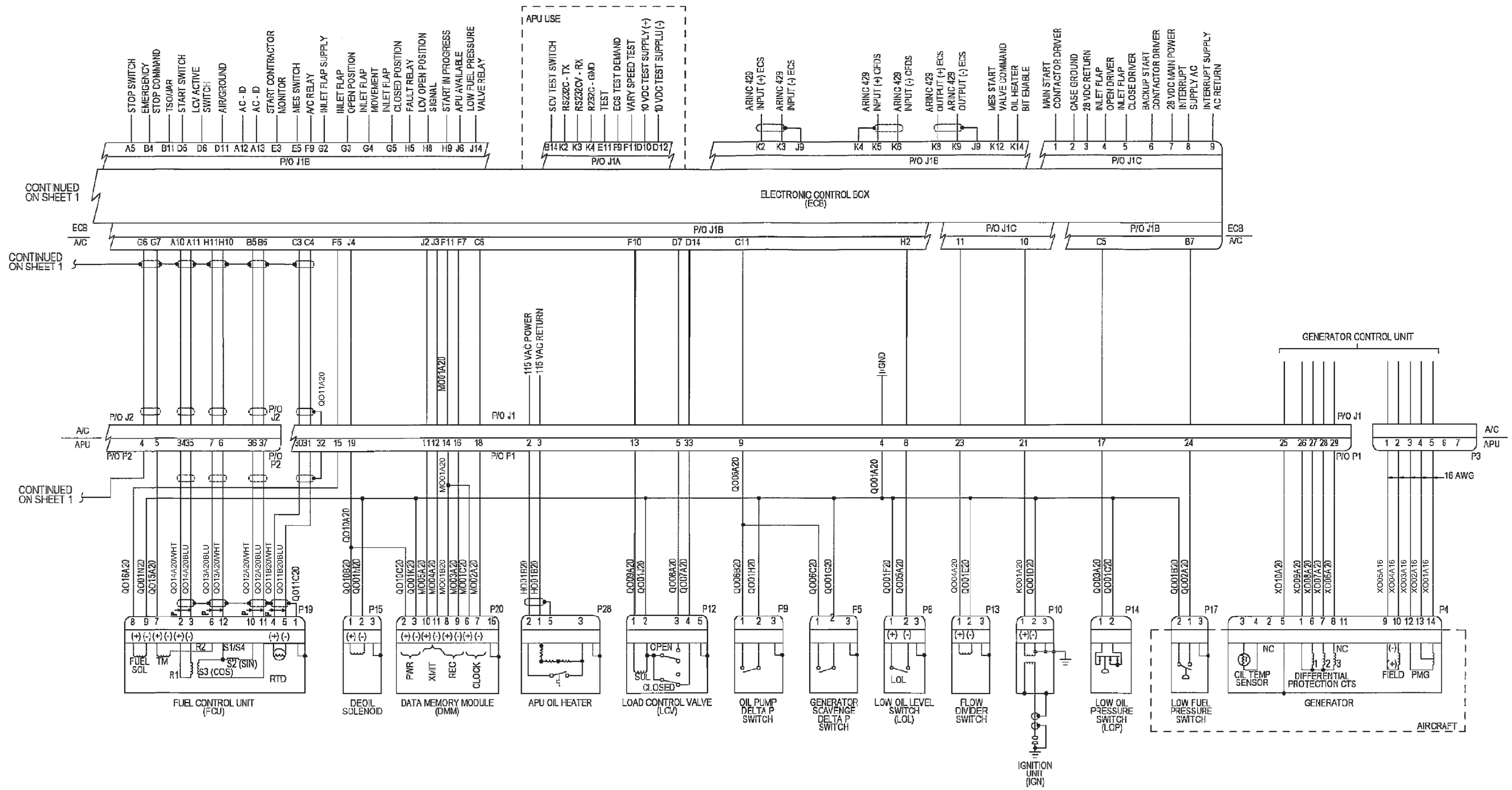

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Figure 8. (Sheet 2 of 2) Wiring Diagram Schematic

APU - FAULT ISOLATION

TASK 49-20-00-810-801

1. General

A. Electronic Control Box (ECB).

The electronic control box (ECB) is a full-authority digital controller. It has full authority over APU starts, acceleration, governed speed load conditions, temperature limits and normal and protective shutdowns. The electronic control box (ECB) also has BITE capability designed to reduce time in troubleshooting problems the APU can have.

The electronic control box (ECB) includes control-related features as follows:

- full-authority fuel control operation,
- software-computed inlet guide vane positioning with direct hardware closed-loop vane control,
- software-computed surge control valve positioning with direct hardware closed-loop valve control.

B. Built-In-Test-Equipment (BITE).

The APU BITE includes hardware and software that finds and sends fault data of the APU system and interfacing aircraft systems. The primary purpose of BITE is to be an aid to maintenance troubleshooting and planning. Faults are sent to the test cell PC monitor.

Each of the possible faults that can be found has a unique name and corresponds to a specific symptom. The test cell PC monitor shows the symptom and fault that was found.

C. Fault Detection.

Each fault has detection logic to make sure that the specified limits for a specified time are met. The detection logic is executed continuously for most faults.

Not all BITE faults can be found all the time. There will be times when a BITE fault can only be found in one of the BITE modes that follow:

- Continuous - when the electronic control box (ECB) is powered,
- Power-up - immediately after electronic control box (ECB) power-up,
- Power-down - immediately before electronic control box (ECB) power-down,
- Test - during the test mode which follows power-up and rolldown to 7 percent speed,
- Start - during APU start-up,
- Onspeed - during onspeed operation,
- Shutdown - during APU rolldown.

D. Fault Clearing.

The electronic control box (ECB) continuously transmits the condition of all the possible BITE faults to the PC monitor. The electronic control box (ECB) keeps a record on the condition of all BITE faults even after power is removed and applied again. After the cause of the fault has been repaired or replaced, the fault can be removed by running the APU in the mode that the fault was initially found in.

After an LRU has been replaced, an APU start, bleed load applied and a shutdown should be done. Refer to Paragraph 4 (Subtask 49-20-00-810-001). Then check the PC monitor to make sure the fault has been removed.

E. Fault Tolerance and Alternate Values.

Each BITE fault can cause other control logic to use different values for unsatisfactory sensors or special control procedures that must be done.

F. ECAM Messages.

Some faults cause one or more displays to be shown on the ECAM APU page. These displays supply dispatchability data to the flight crew.

G. Auto Shutdowns.

The APU will be shutdown automatically if a hazardous condition is found by the electronic control box (ECB). Like the BITE faults, some of these hazardous conditions can only be found during certain modes. If an autoshutdown is found before the APU is started, the start will be prevented. An autoshutdown can be removed when the APU Master switch is turned to the OFF position.

2. Special Tools, Fixtures and Equipment

A. Table 1001 shows the necessary special tools, fixtures and equipment for fault isolation.

Table 1001. Special Tools, Fixtures and Equipment

Nomenclature	Use	Part No.
NOTE: Equivalent tools, fixtures and equipment can be used.		
Electronic Control Box (ECB)	(Pre SB 131-49-7898) To monitor the APU operation and generates fuel metering valve position commands for APU acceleration and on-speed governing.	3888394-120201
Electronic Control Box (ECB)	(Post SB 131-49-7898) To monitor the APU operation and generates fuel metering valve position commands for APU acceleration and on-speed governing.	3888394-120204
Test cell		Commercially available
Test cell APU master control panel		Commercially available
Test cell APU PC monitor		Commercially available

3. Equipment and Materials

A. Not applicable.

4. Procedure

SUBTASK 49-20-00-810-001

A. Fault Isolation.

Off-wing fault isolation starts with a review of the aircraft log, a full check of the operating and non-operating APU, and an inspection of the PC monitor for APU faults.

For APU fault isolation procedures, use Airbus Aircraft APU Fault Isolation Manual for corrective procedures.

Anytime the Airbus Fault Isolation Manual refers to troubleshooting procedures other than APU troubleshooting, the test cell technician should refer to test cell systems schematics and troubleshoot the test cell for related problems.

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GENERAL
REMOVAL-01

TASK 49-20-00-000-801

1. General

A. This section contains procedures to prepare the APU for the removal of accessory components and the separation of the modules.

B. Perform the removal procedures in a dry, bright, clean room.

C. Be careful to prevent damage to parts that can be used again.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

D. Apply lubricating oil to parts and put them in a protective container to prevent corrosion until the parts can be cleaned and checked.

E. Remove all protective caps, plugs and closures before removal of the unit.

F. Make a record of the quantities and thickness of the shims and washers. This will help when the part is installed.

2. Special Tools, Fixtures and Equipment

A. Table 3001 shows the necessary special tools, fixtures and equipment for preparation of the APU accessory components.

Table 3001. Special Tools, Fixtures and Equipment

Nomenclature	Use	Part No.
NOTE: Equivalent tools, fixtures and equipment can be used.		
Portable Engine Stand/Cart	Build and test cart for APU. Component of PN 834991-1.	834990-1
Cart Assembly	Includes PN 834990-1 engine stand/cart, PN 834991-2 rear vertical frame, PN 834991-3 and PN 834991-4 driven support arm.	834991-1
Rear Vertical Frame	Support APU on top side on cart. Component of PN 834991-1.	834991-2
Driven Support Arm	Adapt engine mount (left mount) to transport cart. Component of PN 834991-1.	834991-3
Driven Support Arm	Adapt engine mount (right mount) to transport cart. Component of PN 834991-1.	834991-4
Lifting Adapter	Used with hoist to lift the APU out of shipping carton and place into portable engine stand/cart.	833431-1

3. Equipment and Materials

None

4. Procedure

SUBTASK 49-20-00-540-001

A. Remove the APU from the shipping container.

(1) Remove hardware that attaches the APU to the shipping container, crate, skid or other support.

(2) Attach 833431-1 lifting adapter to the APU lifting bracket.

(3) Remove the APU from the shipping container with 833431-1 lifting adapter.

SUBTASK 49-20-00-410-001

B. Install the APU in the PN 834991-1 cart assembly.

(1) Install PN 834991-4 driven support arm on the APU right mount.

(2) Install PN 834991-3 driven support arm on the APU left mount.

(3) Install the APU in PN 834990-1 portable engine stand/cart as follows:

(a) Position the APU in PN 834990-1 portable engine stand/cart with the right side next to the hand crank on the portable engine stand/cart.

(b) Attach the APU to the PN 834990-1 portable engine stand/cart.

(c) Install PN 834991-2 rear vertical frame on PN 834990-1 portable engine stand/cart.

(d) Attach PN 834990-1 portable engine stand/cart turnbuckle to PN 834991-2 rear vertical frame and the top of the rear mount on the APU.

(4) Remove 833431-1 lifting adapter from the APU.

(5) Use a protractor mounted on the DMM mount pad to adjust the APU forward end down by 6.0 degrees.

SUBTASK 49-20-00-600-001

C. Drain the oil if necessary. Refer to SERVICING 01.

PLUMBING AND ELECTRICAL INSTALLATION REMOVAL-02

TASK 49-20-00-050-801

1. General

A. This section contains procedures for removal of the plumbing and electrical installation.

B. Perform the removal procedures in a dry, bright, clean room.

C. Be careful to prevent damage to parts that can be used again.

D. Make a record of the quantities and thickness of the washers. This will help when the part is installed.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

None

4. Procedure

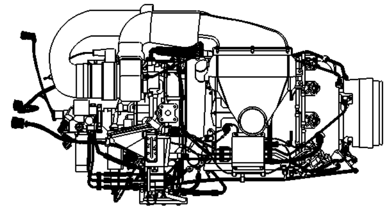
SUBTASK 49-20-00-050-002

A. Remove the plumbing and electrical installation.

WARNING: THE OUTPUT VOLTAGE OF THE IGNITION UNIT IS DANGEROUS AND COULD BE LETHAL. IT IS A CAPACITOR DISCHARGE-TYPE AND CAN KEEP HIGH VOLTAGE. MAKE SURE IT IS DE-ENERGIZED AND GROUNDED BEFORE THE INPUT AND OUTPUT LEADS ARE DISCONNECTED. DO NOT TOUCH THE CENTER CONTACT OF OUTPUT TERMINAL.

(1) Remove components of plumbing and electrical installation (Figure 3001 thru Figure 3009) and replace as necessary in accordance with good shop practice. During removal, write the routing of wiring, tubing and hoses and manner of attaching clamps for reference at reassembly. Plumbing fittings, lines and wiring harness connectors and terminals, must be tagged as removed to help in reassembly.

B. Refer to ATA No. 49-11-13 for repair of the APU wiring harness.



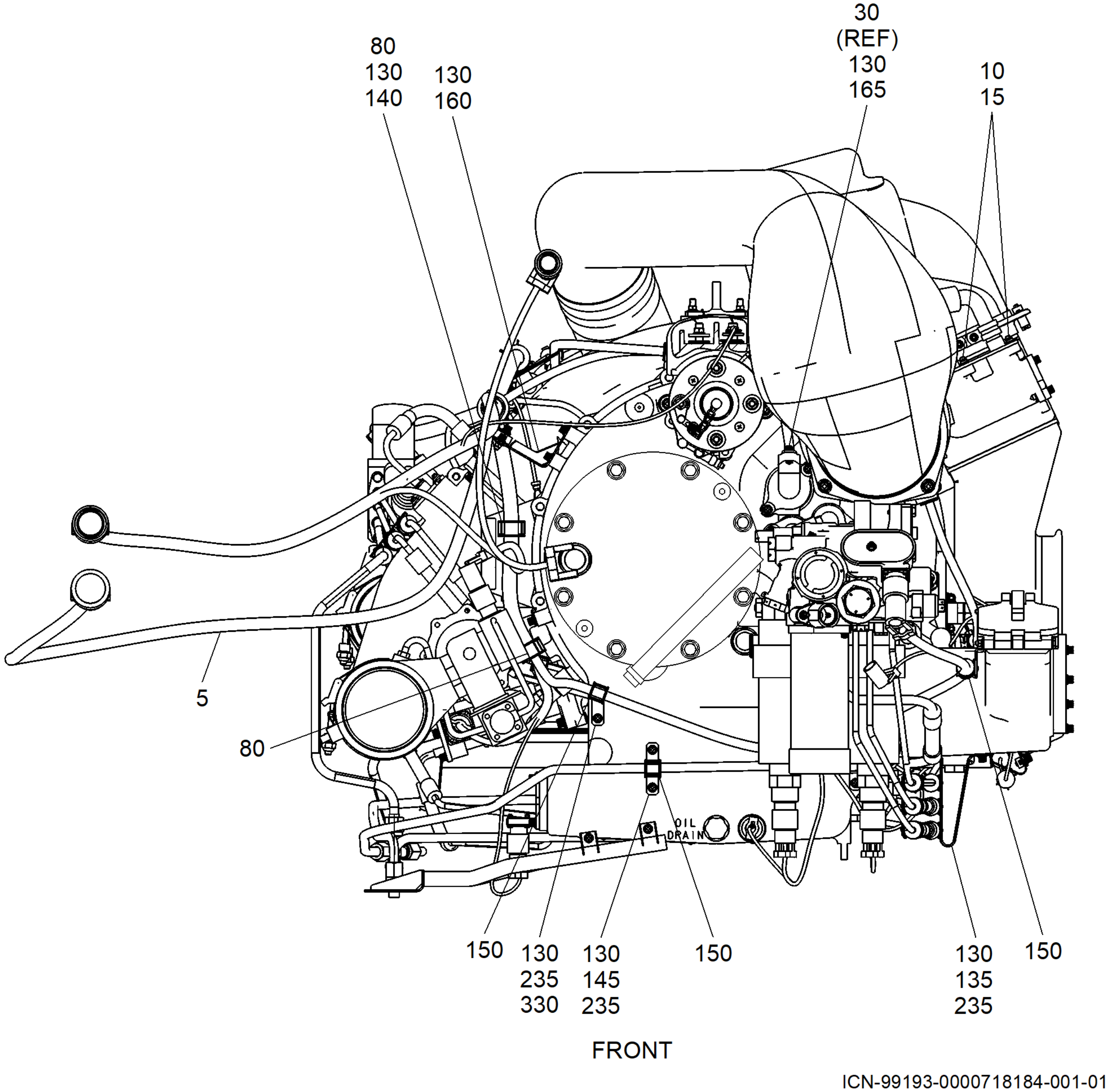


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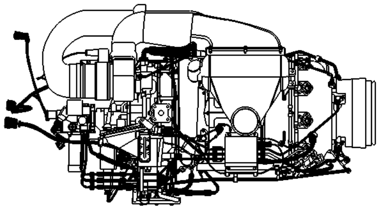
Figure 3001. Disassemble the Plumbing and Electrical Installation (Partial Breakdown)

Key to Figure 3001

5. WIRING HARNESS-BRANCHED (IPC, FIG. 2)
10. NUT-ATTACHED WASHER
15. PACKING
30. GEARBOX VENT TUBE ASSY
80. GROMMET
130. BOLT
135. TUBE GEARBOX BRACKET
140. HARNESS BRACKET
145. TUBE GEARBOX BRACKET
150. GROMMET
160. HARNESS BRACKET
165. PACKING
235. WASHER
330. HARNESS GEARBOX BRACKET



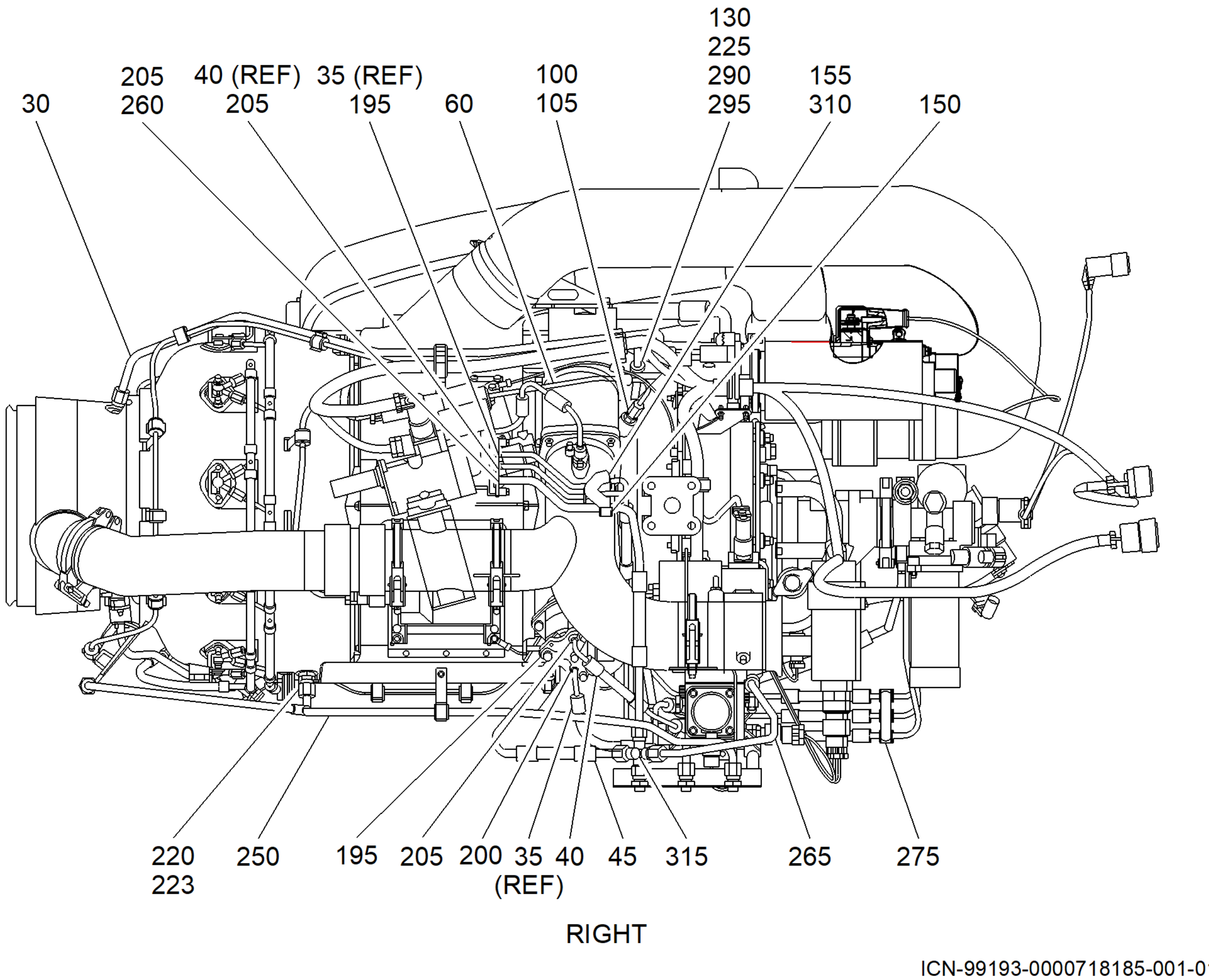
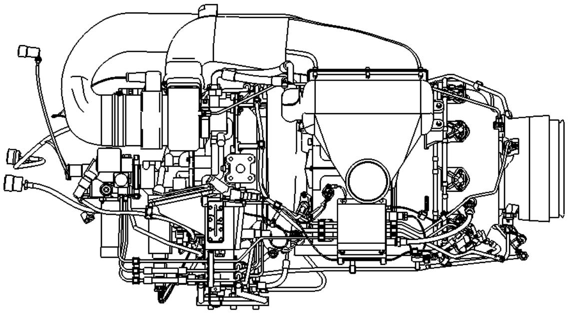


Figure 3002. (Pre SB 131-49-8002 and SB 131-49-8003) Disassemble the Plumbing and Electrical Installation (Partial Breakdown)

Key to Figure 3002

30. TUBE-GEARBOX VENT
35. SCV IGV SUPPLY TUBE
40. SCV IGV RETURN TUBE
45. IGV DR TUBE
60. PS TUBE
100. UNION
105. PACKING
130. BOLT
150. GROMMET
155. GROMMET
195. PACKING
200. PACKING
205. PACKING
220. ORIFICED ADAPTER
223. GASKET
225. NUT
250. TURBINE DRAIN TUBE
260. SCV DRAIN TUBE
265. FCU DRAIN TUBE
275. THREE TUBE SUPPLY BRACKET
290. CLAMP
295. CLAMP
310. UP TUBE SPACER BRACKET
315. CROSS UNION



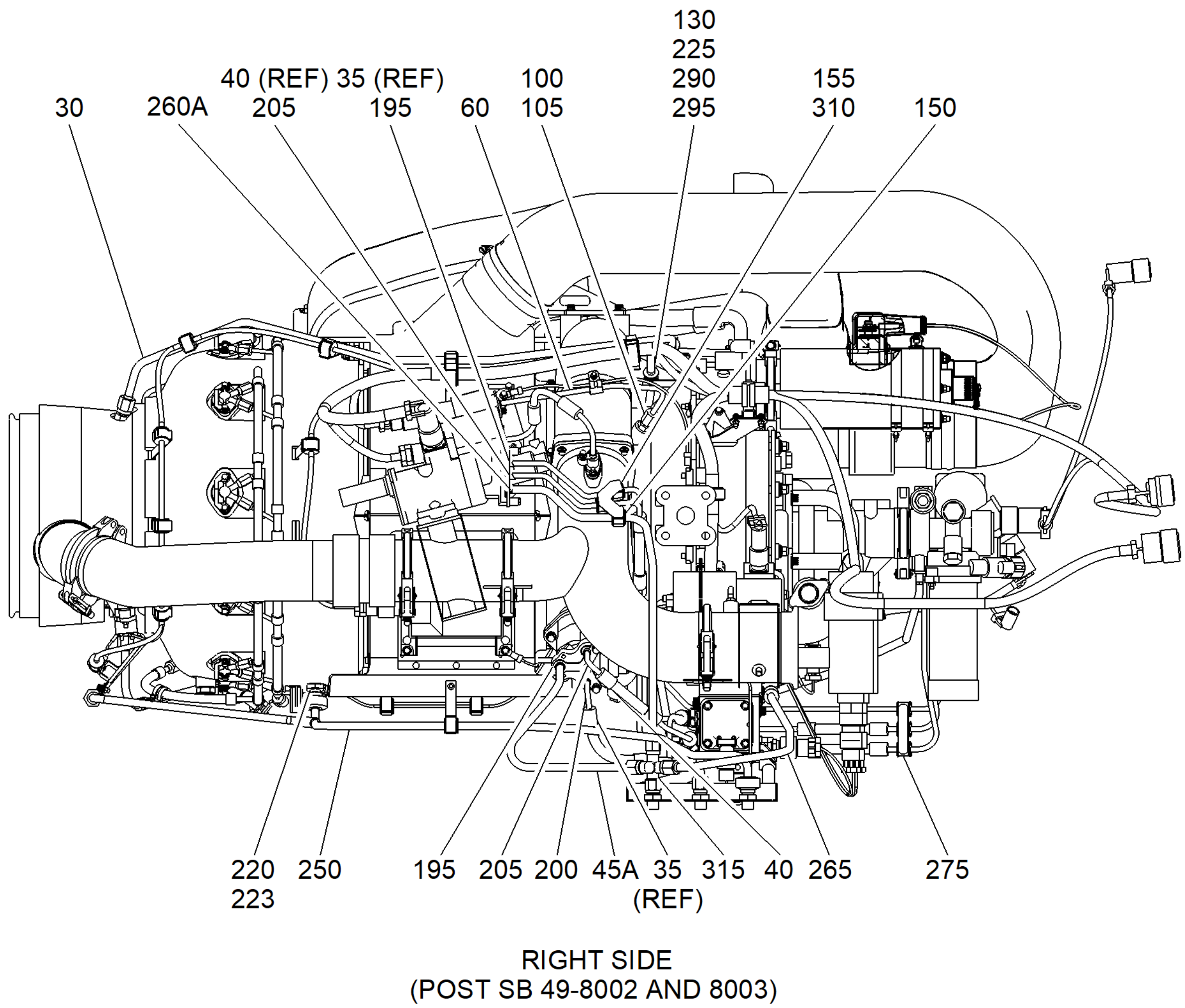


Figure 3003. (Post SB 131-49-8002 and SB 131-49-8003) Disassemble the Plumbing and Electrical Installation (Partial Breakdown)

Key to Figure 3003

30. TUBE-GEARBOX VENT
35. SCV IGV SUPPLY TUBE
40. SCV IGV RETURN TUBE
45A. IGV DR TUBE (POST SB 131-49-8003)
60. PS TUBE
100. UNION
105. PACKING
130. BOLT
150. GROMMET
155. GROMMET
195. PACKING
200. PACKING
205. PACKING
220. ORIFICED ADAPTER
223. GASKET
225. NUT
250. TURBINE DRAIN TUBE
260A. SCV DRAIN TUBE (POST SB 131-49-8002)
265. FCU DRAIN TUBE
275. THREE TUBE SUPPLY BRACKET
290. CLAMP
295. CLAMP
310. UP TUBE SPACER BRACKET
315. CROSS UNION

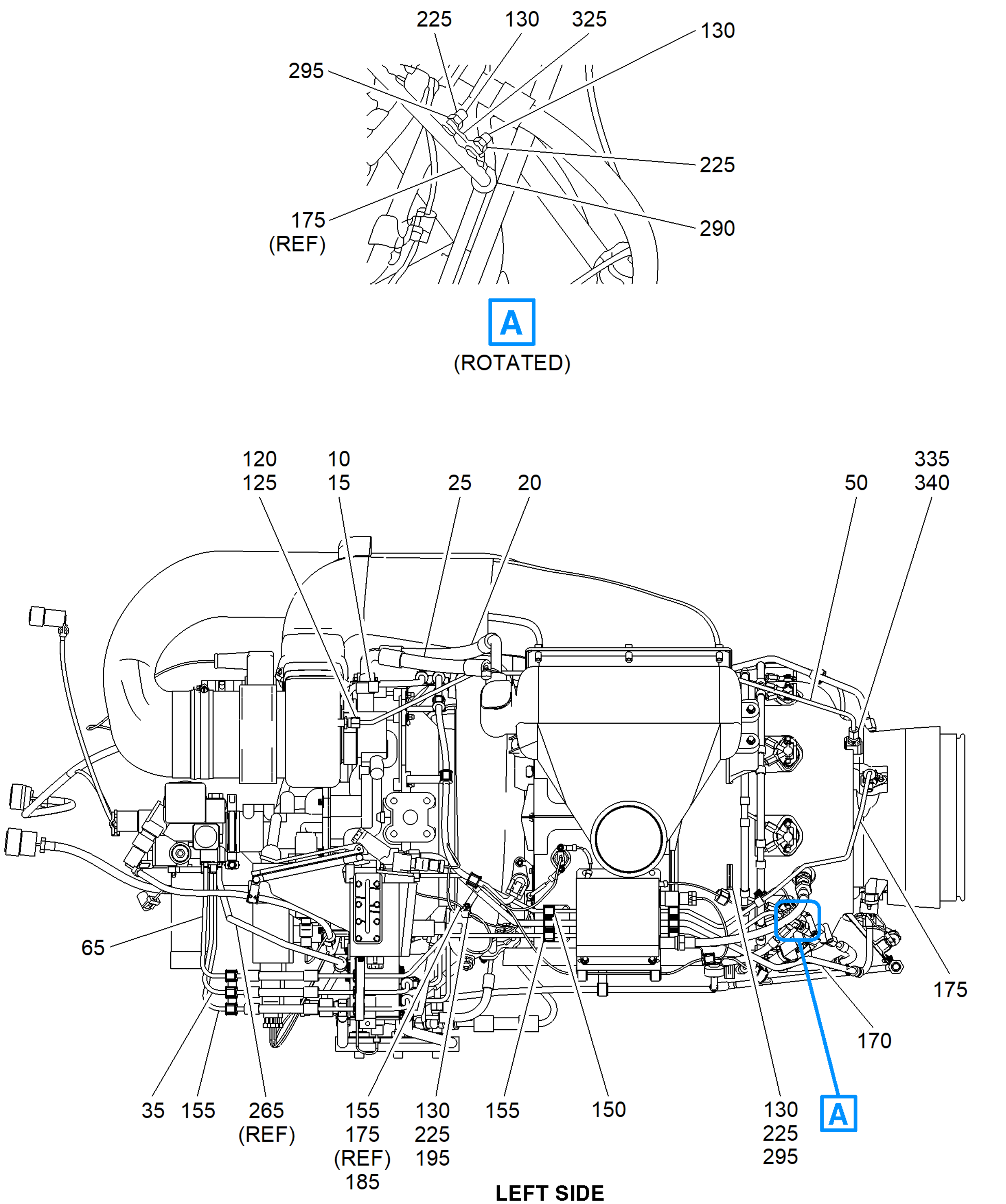


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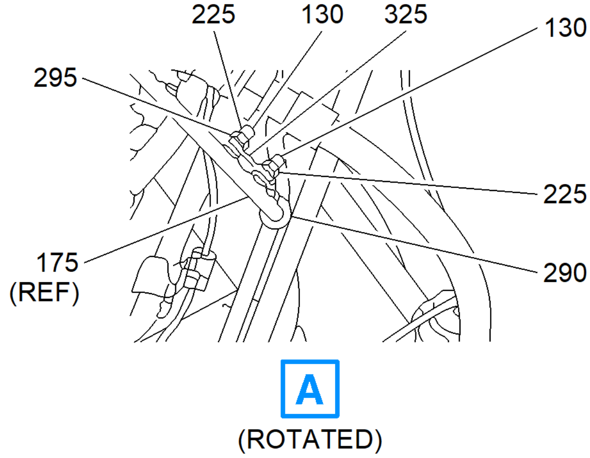
Figure 3004. (Pre SB 131-49-8001) Disassemble the Plumbing and Electrical Installation (Partial Breakdown)

Key to Figure 3004

10.	NUT-ATTACHED WASHER (IPC, FIG. 2)	-170A.	TURBINE BEARING RETURN TUBE (POST SB 131-49-7606)
15.	PACKING	175.	TURBINE BEARING SUPPLY TUBE (PRE SB 131-49-7606)
20.	OIL RETURN TUBE	-175A.	TURBINE BEARING SUPPLY TUBE (POST SB 131-49-7606)
25.	OIL SUPPLY TUBE	185.	TUBE CLAMP
35.	SCV IGV SUPPLY TUBE	195.	PACKING
50.	PCD TUBE	225.	NUT
65.	FUEL SUPPLY TUBE	265.	FCU DRAIN TUBE (PRE SB 131-49-8001)
120.	FITTING ASSEMBLY	290.	CLAMP
125.	PACKING	295.	CLAMP
130.	BOLT	325.	PLATE
150.	GROMMET	335.	UNION
155.	GROMMET	340.	GASKET
170.	TURBINE BEARING RETURN TUBE (PRE SB 131-49-7606)	-.	ITEM NOT ILLUSTRATED



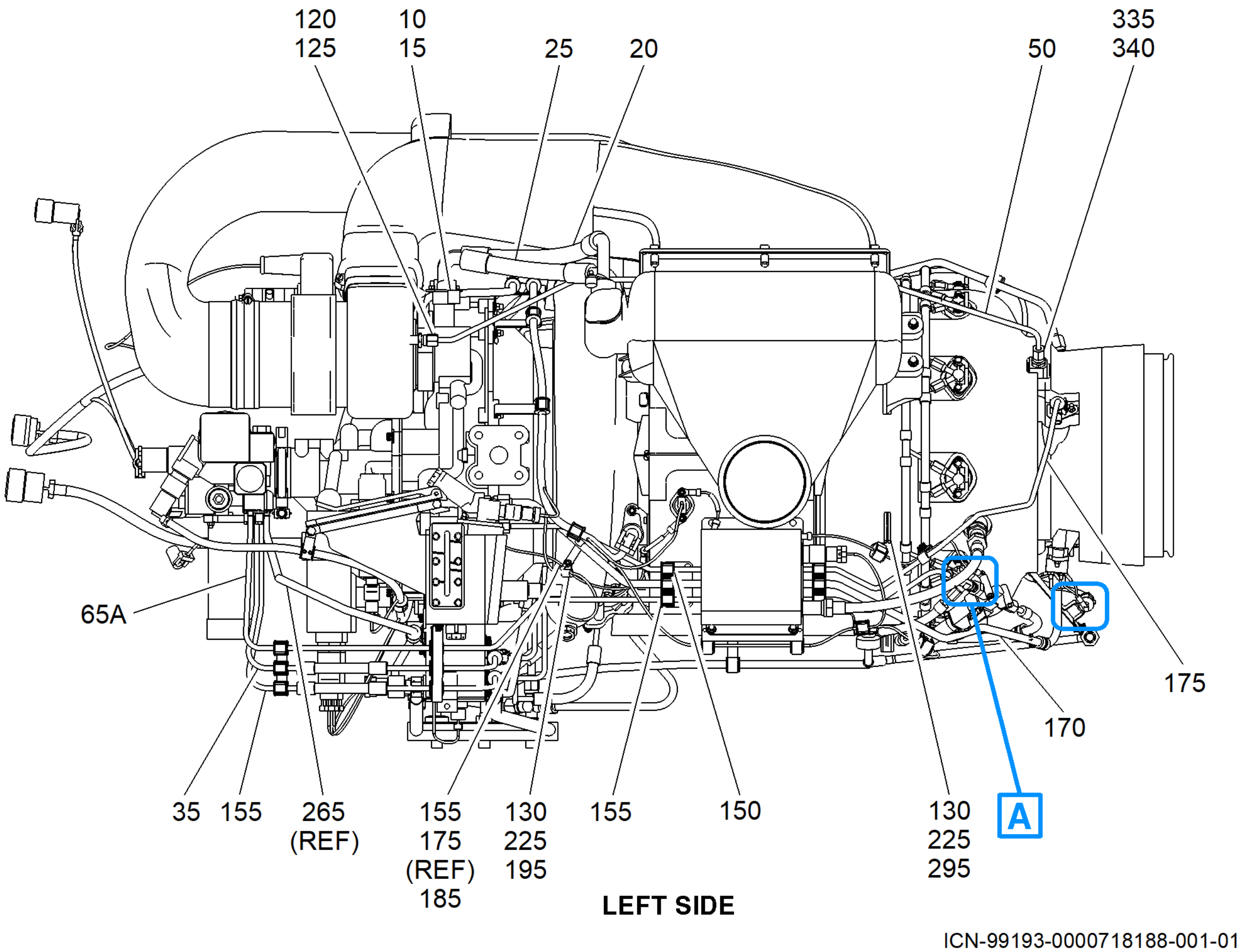
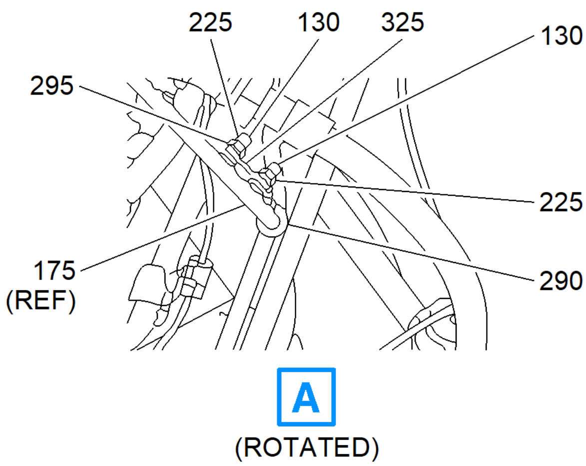


Figure 3005. (Post SB 131-49-8001) Disassemble the Plumbing and Electrical Installation (Partial Breakdown)

Key to Figure 3005

- 10. NUT-ATTACHED WASHER (IPC, FIG. 2)
- 15. PACKING
- 20. OIL RETURN TUBE
- 25. OIL SUPPLY TUBE
- 35. SCV IGV SUPPLY TUBE
- 50. PCD TUBE
- 65A. FUEL SUPPLY TUBE (POST SB 131-49-8001)
- 120. FITTING ASSEMBLY
- 65A. FUEL SUPPLY TUBE (POST SB 131-49-8001)
- 120. FITTING ASSEMBLY
- 125. PACKING
- 130. BOLT
- 150. GROMMET
- 155. GROMMET
- 170. TURBINE BEARING RETURN TUBE (PRE SB 131-49-7606)
- -170A. TURBINE BEARING RETURN TUBE (POST SB 131-49-7606)
- 175. TURBINE BEARING SUPPLY TUBE (PRE SB 131-49-7606)
- -175A. TURBINE BEARING SUPPLY TUBE (POST SB 131-49-7606)
- 185. TUBE CLAMP
- 195. PACKING
- 225. NUT
- 265. FCU DRAIN TUBE
- 290. CLAMP
- 295. CLAMP
- 325. PLATE
- 335. UNION
- 340. GASKET
- -. ITEM NOT ILLUSTRATED



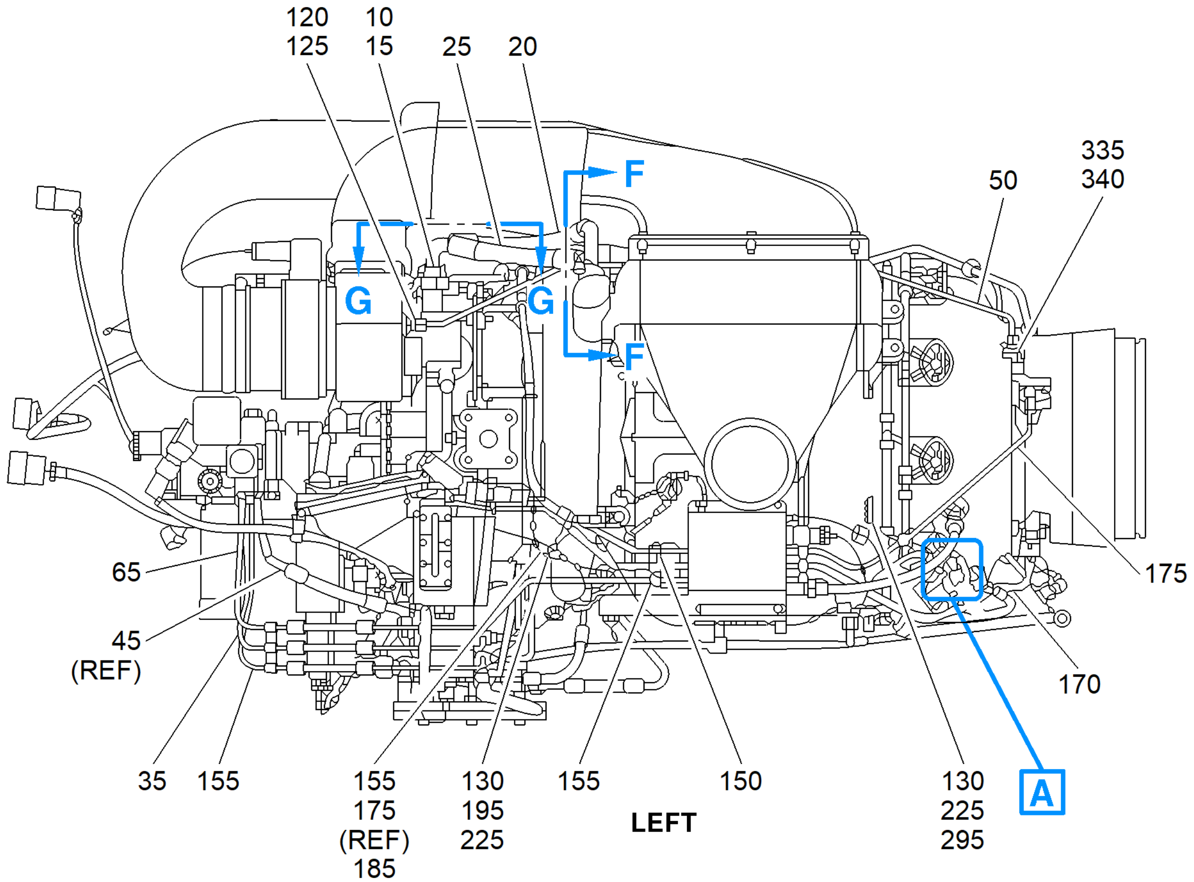


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Figure 3006. (Sheet 1 of 2) (Post SB 131-49-8205) Disassemble the Plumbing and Electrical Installation (Partial Breakdown)

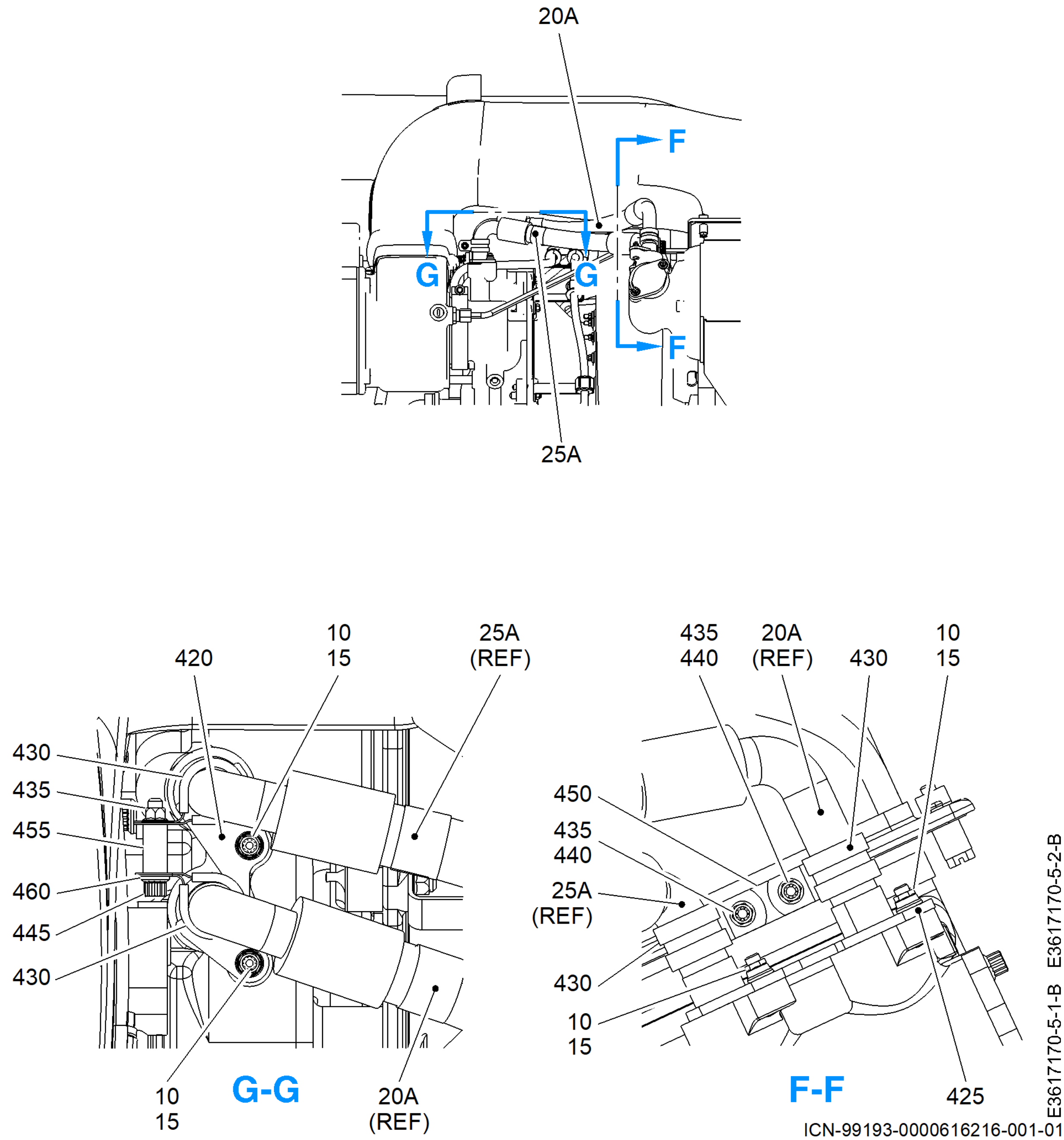


Figure 3006. (Sheet 2 of 2) (Post SB 131-49-8205) Disassemble the Plumbing and Electrical Installation (Partial Breakdown)

Key to Figure 3006

10.	NUT-ATTACHED WASHER (IPC, FIG. 2)	185.	TUBE CLAMP
15.	PACKING	195.	PACKING
20.	OIL RETURN TUBE (POST SB 131-49-8205)	225.	NUT
20A.	OIL RETURN TUBE (POST SB 131-49-8205)	-265.	FCU DRAIN TUBE
25.	OIL SUPPLY TUBE (POST SB 131-49-8205)	290.	CLAMP
25A.	OIL SUPPLY TUBE (POST SB 131-49-8205)	295.	CLAMP
35.	SCV IGV SUPPLY TUBE	325.	PLATE
45.	IGV TUBE ASSY	335.	UNION
50.	PCD TUBE	340.	GASKET
65.	FUEL SUPPLY TUBE (PRE SB-131-49-8001)	420.	RETAINER GEARBOX TUBE (POST SB 131-49-8205)
-65A.	FUEL SUPPLY TUBE (POST SB 131-49-8001)	425.	RETAINER OIL COOLER TUBE (POST SB 131-49-8205)
120.	FITTING ASSEMBLY	430.	CLAMP LOOP (POST SB 131-49-8205)
125.	PACKING	435.	NUT (POST SB 131-49-8205)
130.	BOLT	440.	BOLT (POST SB 131-49-8205)
150.	GROMMET	445.	BOLT (POST SB 131-49-8205)
155.	GROMMET	450.	BRACKET (POST SB 131-49-8205)
170.	TURBINE BEARING RETURN TUBE (PRE SB 131-49-7606)	455.	SPACER (POST SB 131-49-8205)
-170A.	TURBINE BEARING RETURN TUBE (POST SB 131-49-7606)	460.	PACKING
175.	TURBINE BEARING SUPPLY TUBE (PRE SB 131-49-7606)	-.	ITEM NOT ILLUSTRATED
-175A.	TURBINE BEARING SUPPLY TUBE (POST SB 131-49-7606)		

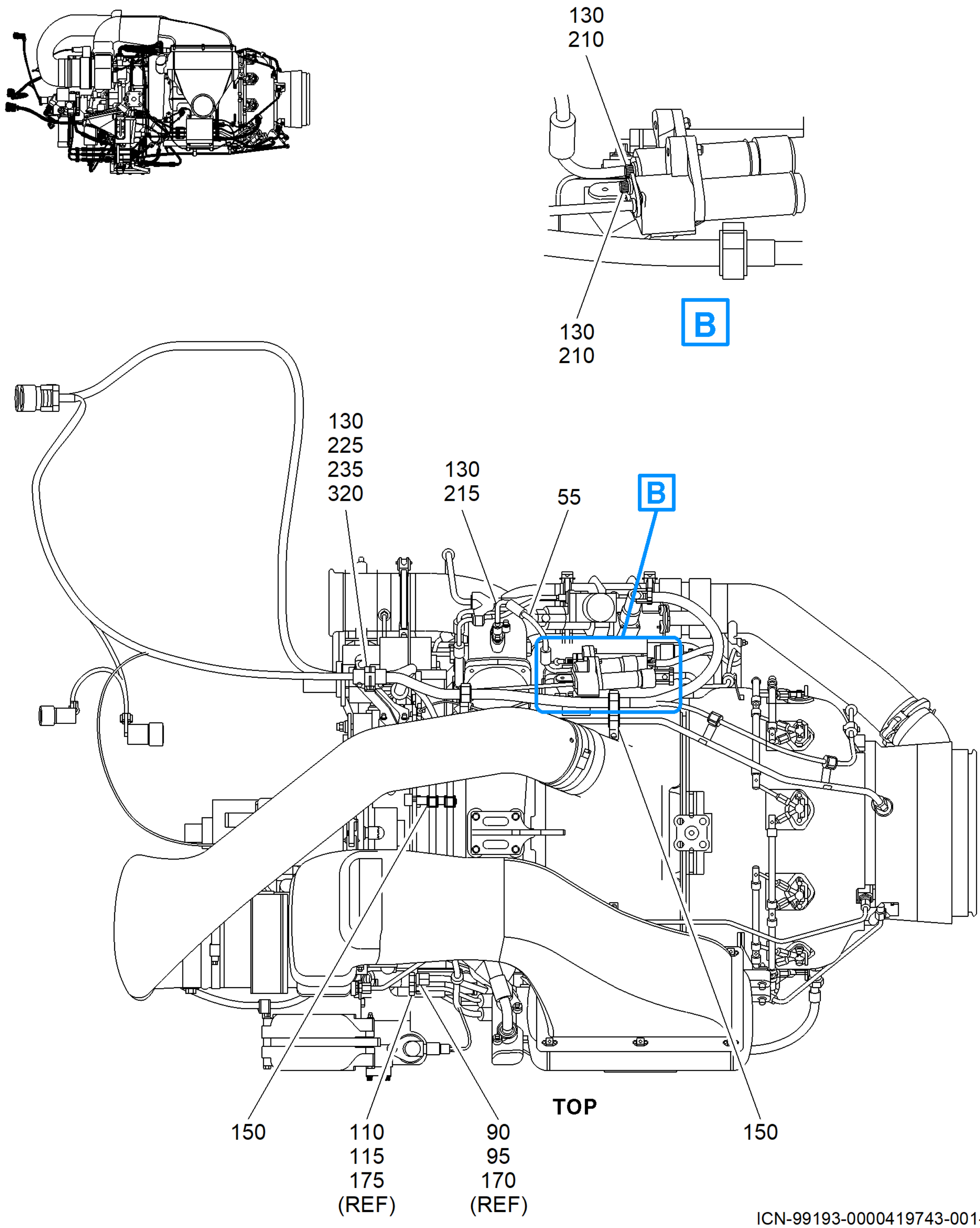


Figure 3007. Disassemble the Plumbing and Electrical Installation (Partial Breakdown)

Key to Figure 3007

55. PT TUBE	170. TURBINE BRG RETAINER TUBE
90. UNION	175. TURBINE BRG SUPPLY TUBE
95. PACKING	210. PACKING
110. UNION	215. PACKING
115. PACKING	225. NUT
130. BOLT	235. WASHER
150. GROMMET	320. CLAMP

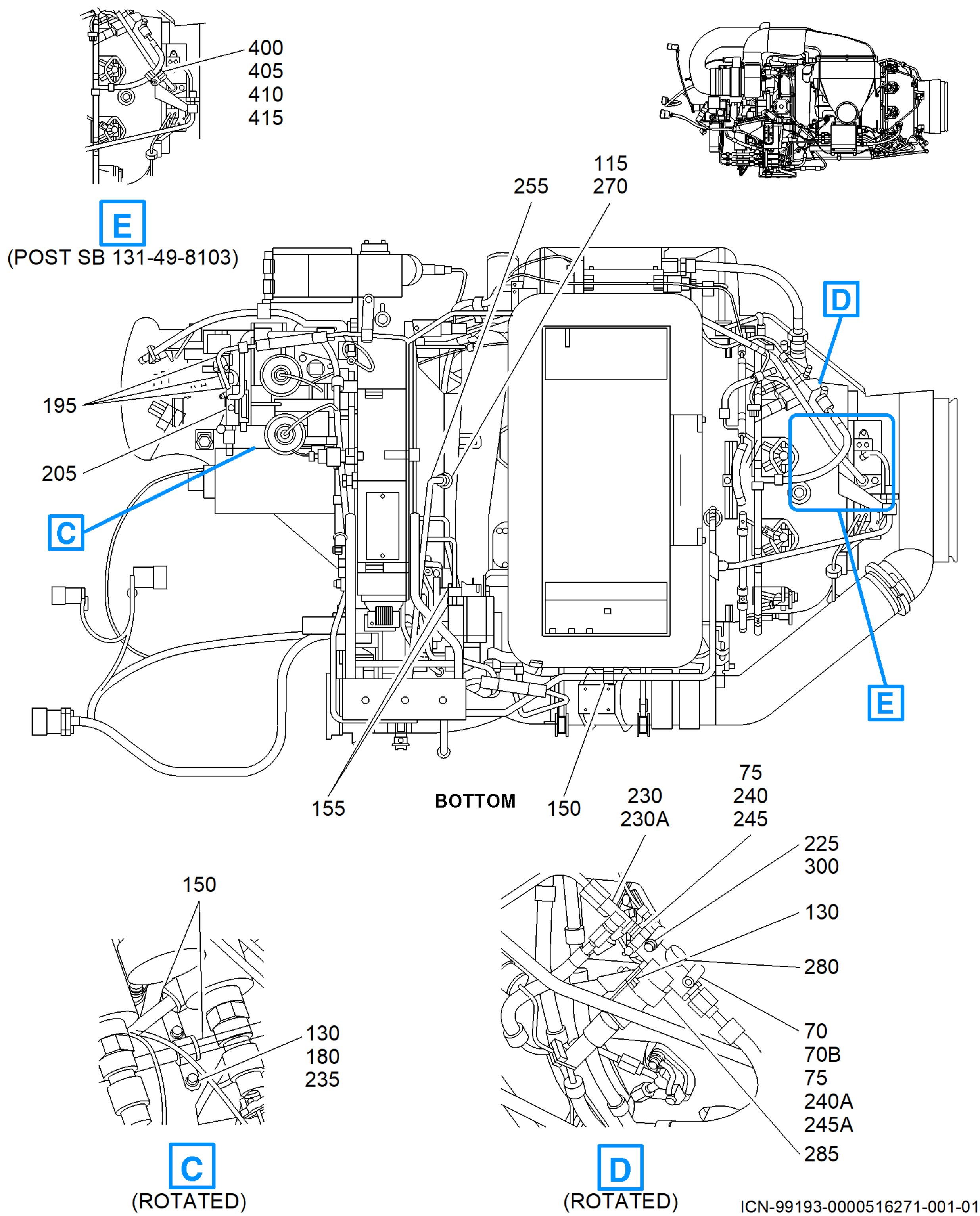


Figure 3008. Disassemble the Plumbing and Electrical Installation (Partial Breakdown)

Key to Figure 3008

70. UNION
70B. CHECK VALVE (POST SB 131-49-7739)
75. PACKING
115. PACKING
130. BOLT
150. GROMMET
155. GROMMET
180. TUBE GEARBOX BRACKET
195. PACKING
205. PACKING
225. NUT
230. FLOW DIVIDER
230A. FITTING (POST SB 131-49-7739)
235. FLAT WASHER
240. NUT TUBE
240A. NUT TUBE (POST SB 131-49-7739)
245. RETAINER PACKING
245A. RETAINER PACKING (POST SB 131-49-7739)
255. LC DRAIN TUBE
270. ORIFICE FITTING
280. SOLENOID VALVE
285. CLAMP
300. BOLT
400. NUT
405. BOLT
410. CLAMP
415. CLAMP

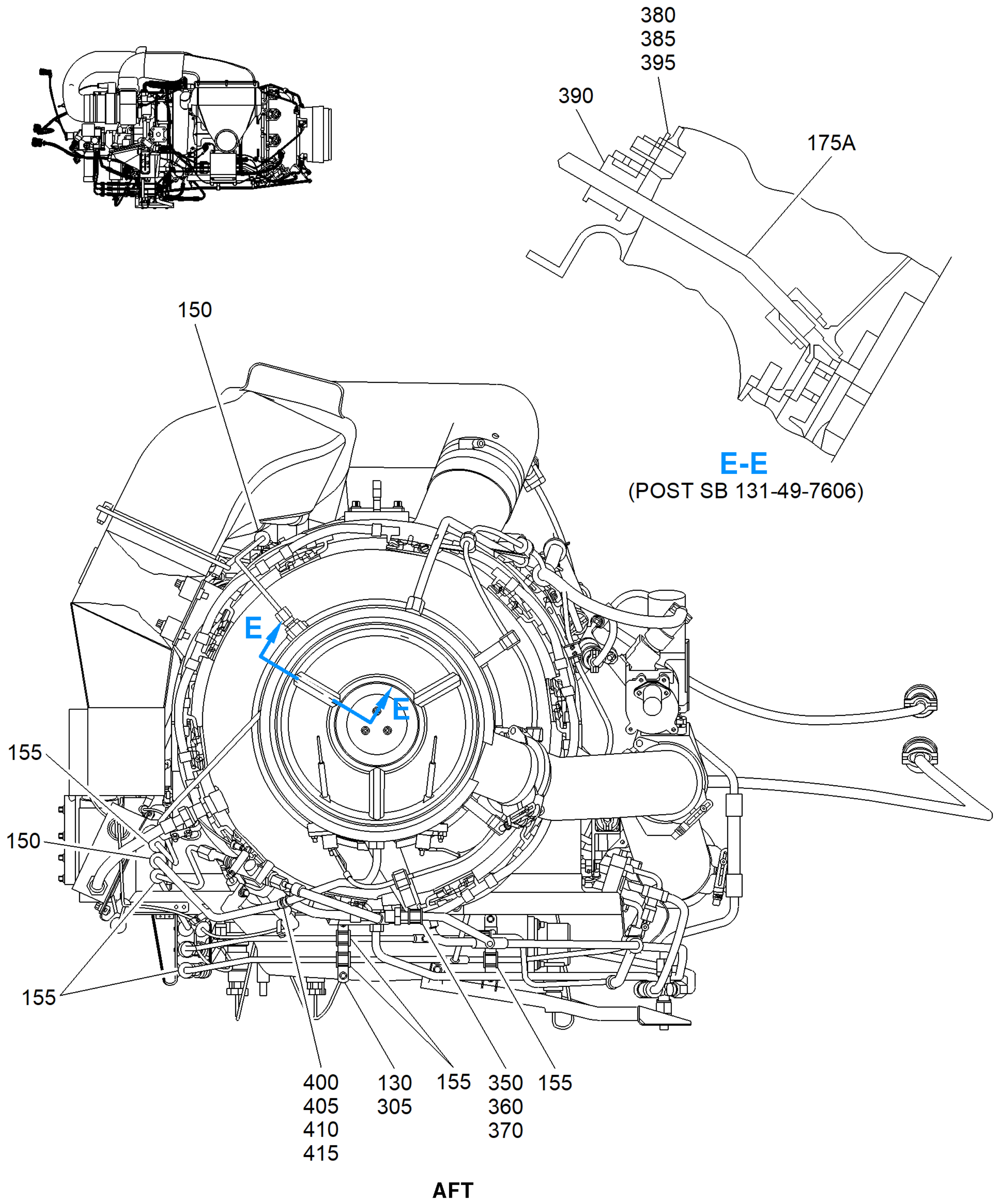


Figure 3009. Disassemble the Plumbing and Electrical Installation (Partial Breakdown)

Key to Figure 3009

130. BOLT (IPC, FIG. 2)
150. GROMMET
155. GROMMET
175A. TURBINE BEARING SUPPLY TUBE (POST SB 131-49-7606)
305. TUBE LOWER GEARBOX BRACKET
350. NUT
360. BOLT
370. CLAMP
380. NUT (POST SB 131-49-7606)
385. BRACKET (POST SB 131-49-7606)
390. GROMMET (POST SB 131-49-7606)
395. WASHER (POST SB 131-49-7607)
400. NUT
405. BOLT
410. CLAMP
415. CLAMP

STARTER
REMOVAL-03

TASK 49-20-00-050-802

1. General

A. This section contains procedures for removal of the starter.

B. Perform the removal procedures in a dry, bright, clean room.

C. Be careful to prevent damage to parts that can be used again.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

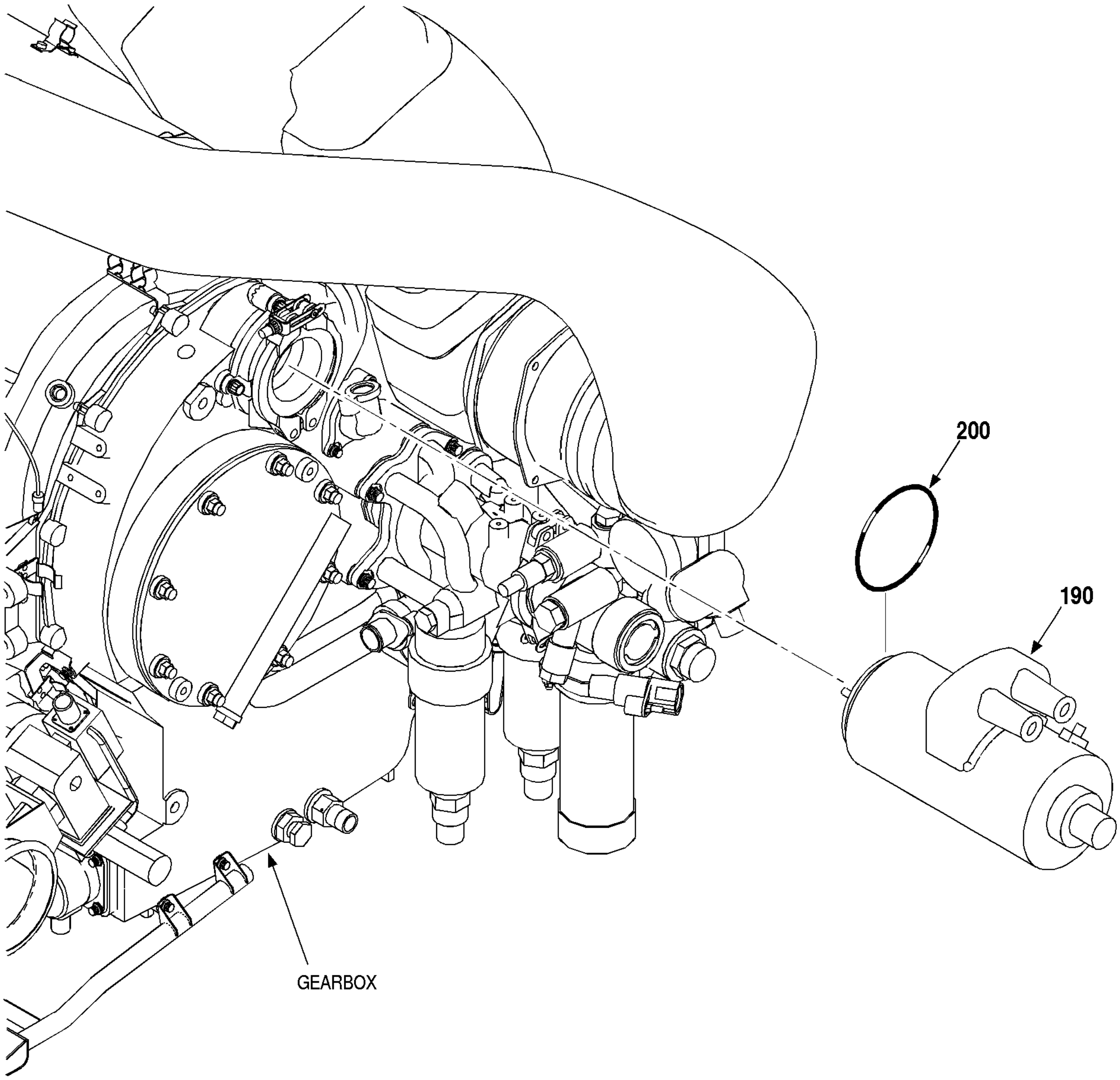
D. Apply lubricating oil to parts and put them in a protective container to prevent corrosion until the parts can be cleaned and checked.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

None



ICN-99193-0000673099-001-01

Figure 3001. Removal of Starter

Key to Figure 3001

190. STARTER MOTOR (IPC FIG. 3)
200. PACKING

4. Procedure

SUBTASK 49-20-00-050-003

A. Turn-off all electrical power to the starter.

B. Disconnect electrical connectors and cables from the starter. Separate and insulate bare lead-ends from touching each other.

C. Remove the starter. Refer to Figure 3001.

   (1) Disconnect the coupling clamp that attaches starter motor (190) to the gearbox assembly.

   (2) Remove starter motor (190) and packing (200) from the gearbox assembly. Discard packing.

D. Refer to ATA No. 49-41-20 for overhaul and repair of starter.

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LOW OIL PRESSURE (LOP) SWITCH
REMOVAL-04

TASK 49-20-00-050-803

1. General

A. This section contains procedures for removal of the LOP switch.

B. Perform the removal procedures in a dry, bright, clean room.

C. Be careful to prevent damage to parts that can be used again.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

D. Apply lubricating oil to parts and put them in a protective container to prevent corrosion until the parts can be cleaned and checked.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

None

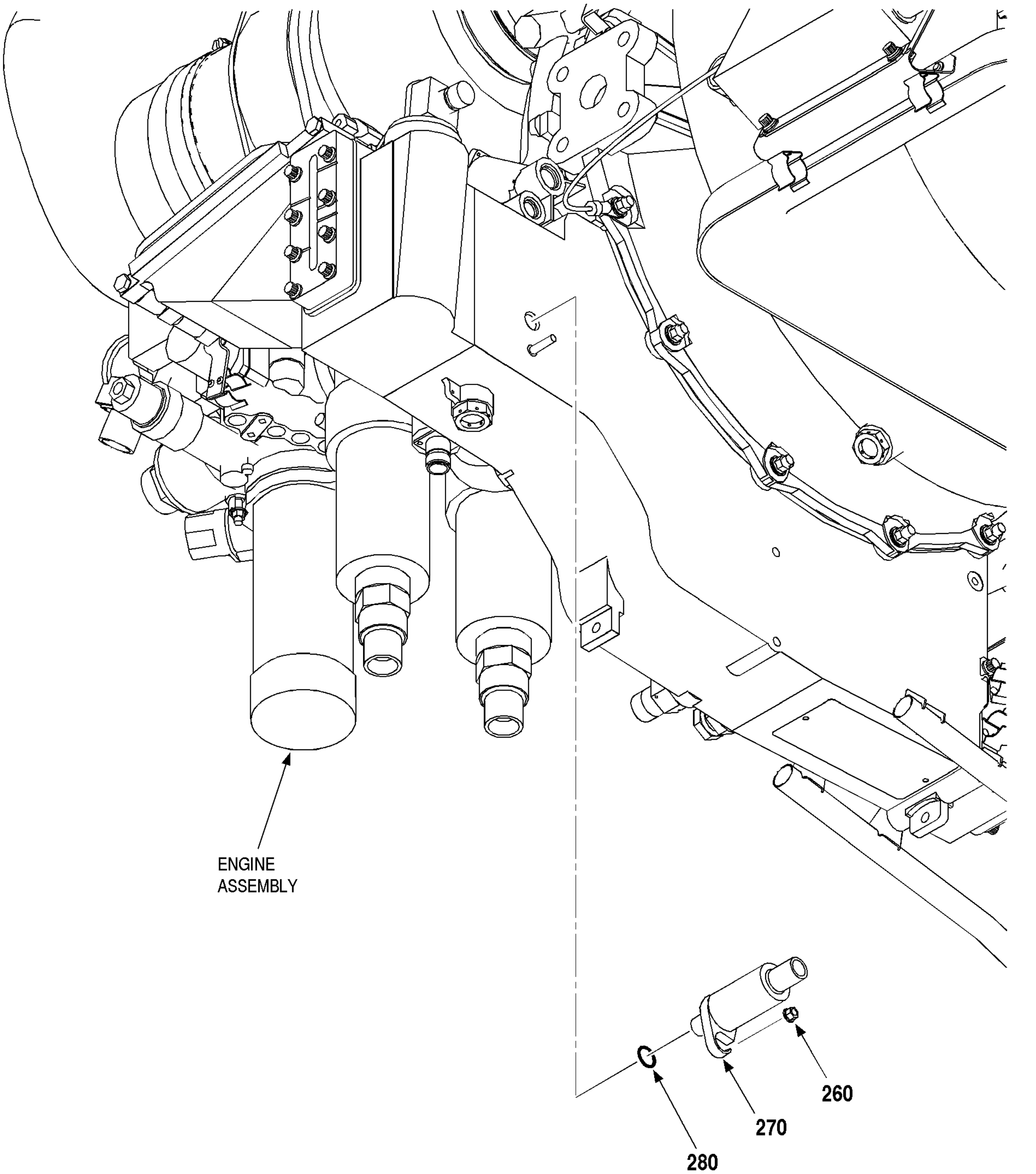

Figure 3001. Removal of Low Oil Pressure Switch

Key to Figure 3001

260. NUT (IPC FIG. 6)
270. LOP SWITCH
280. PACKING

---

4. **Procedure**

SUBTASK 49-20-00-050-004

A. Remove the LOP switch. Refer to Figure 3001.

(1) Remove nut (260) and turn LOP switch (270) clockwise to disengage mounting stud.

(2) Remove LOP switch (270) with packing (280) from the engine assembly. Discard packing.

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LOW OIL LEVEL SWITCH
REMOVAL-05

TASK 49-20-00-050-804

1. **General**

   A. This section contains procedures for removal of the low oil level switch.

   B. Perform the removal procedures in a dry, bright, clean room.

   C. Be careful to prevent damage to parts that can be used again.

   WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

   D. Apply lubricating oil to parts and put them in a protective container to prevent corrosion until the parts can be cleaned and checked.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   None

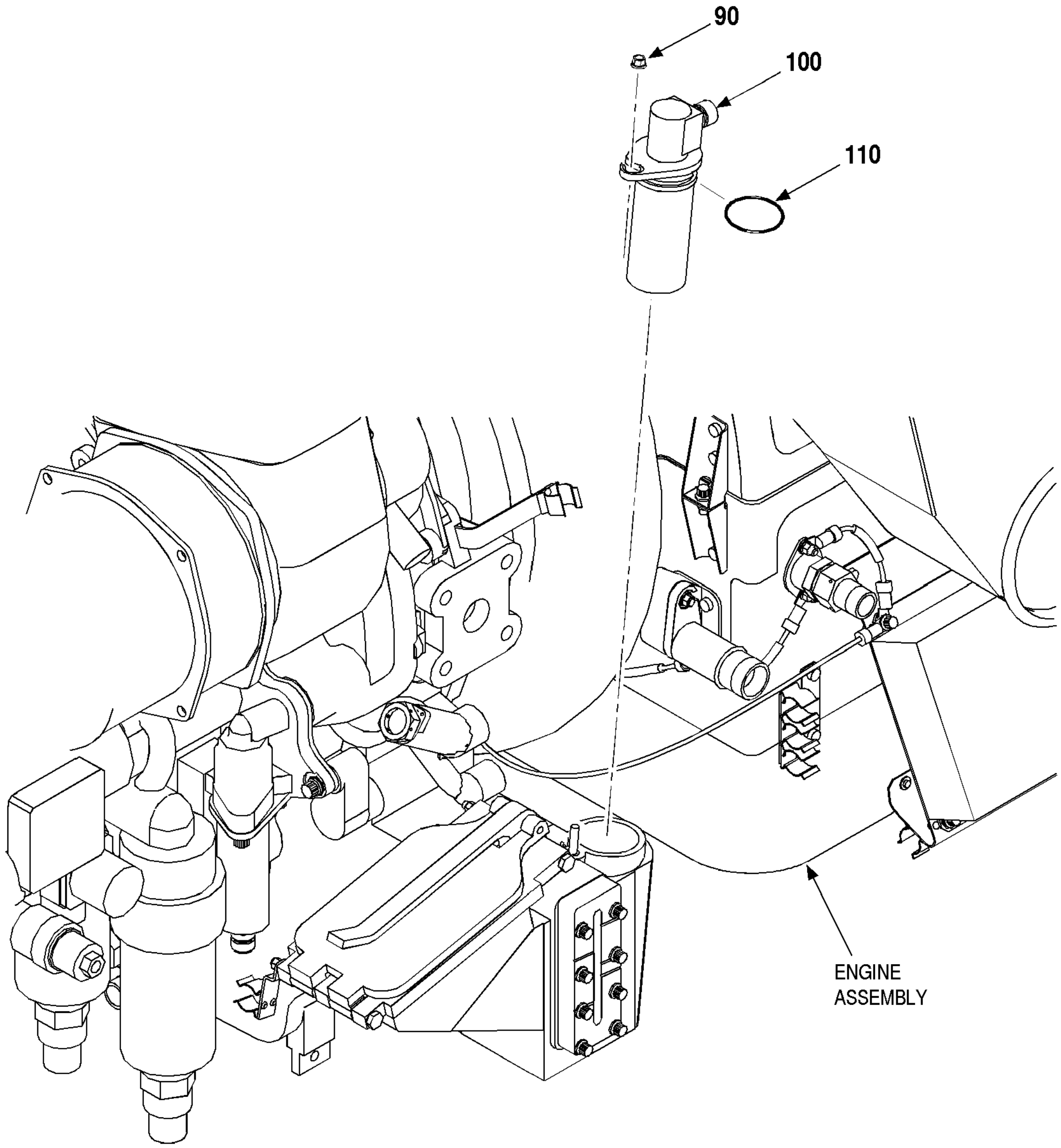

Figure 3001. Removal of Low Oil Level Switch

Key to Figure 3001

90. NUT (IPC FIG. 4)
100. LOW OIL LEVEL SWITCH
110. PACKING

4. Procedure

SUBTASK 49-20-00-050-005

A. Remove the low oil level switch. Refer to Figure 3001.

(1) Remove nut (90) and turn the low oil level switch counterclockwise to disengage mounting stud.

(2) Remove low oil level switch (100) with packing (110) from the engine assembly. Discard packing.

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FUEL CONTROL UNIT (FCU)
REMOVAL-06

TASK 49-20-00-050-805

1. General

A. This section contains procedures for removal of the FCU.

B. Perform the removal procedures in a dry, bright, clean room.

C. Be careful to prevent damage to parts that can be used again.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

D. Apply lubricating oil to parts and put them in a protective container to prevent corrosion until the parts can be cleaned and checked.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

None

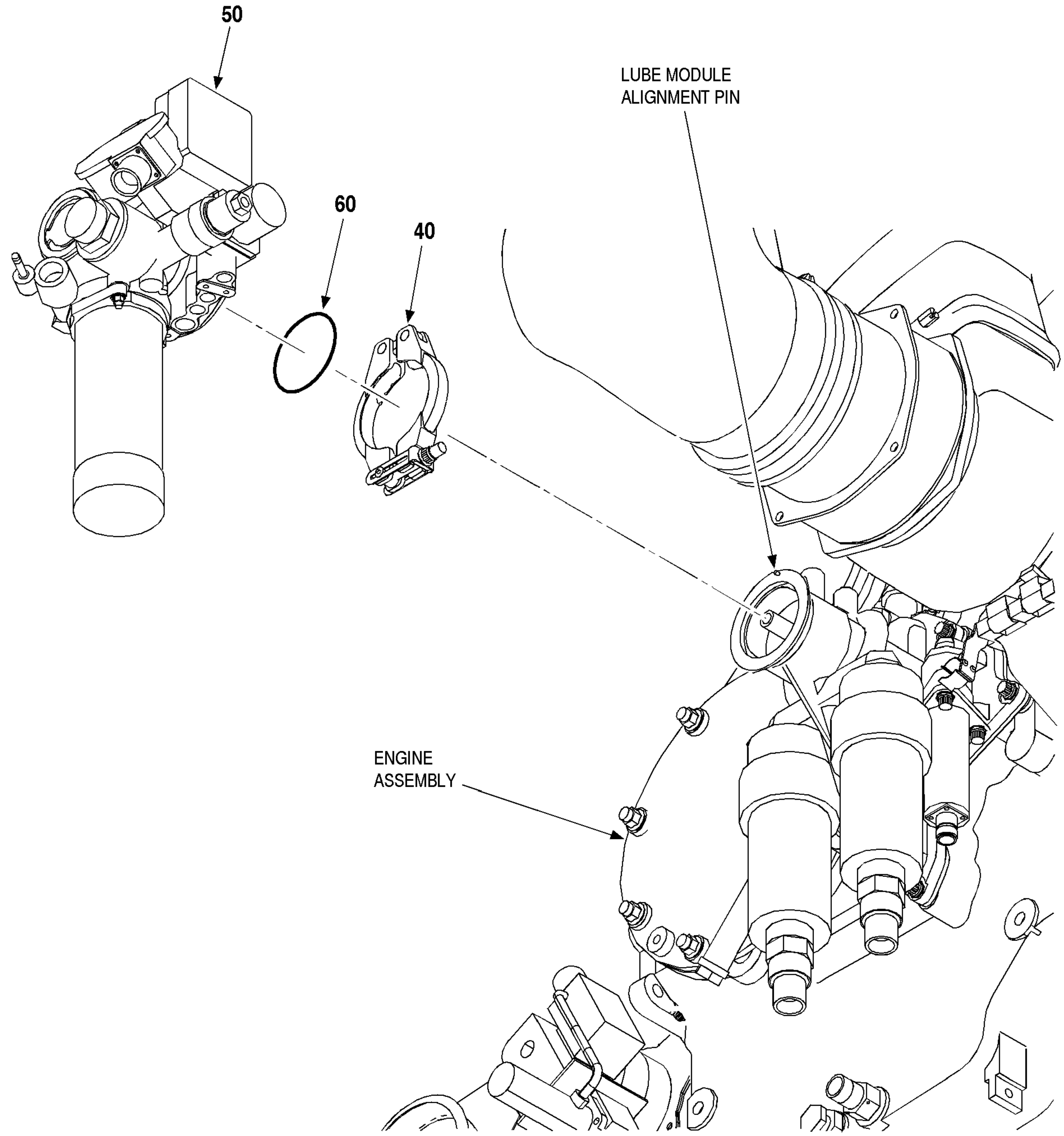

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Figure 3001. Removal of Fuel Control Unit

Key to Figure 3001

40. COUPLING CLAMP (IPC FIG. 4)
50. FCU
60. PACKING

---

4. Procedure

SUBTASK 49-20-00-050-006

A. Remove the FCU. Refer to Figure 3001.

(1) Put a 2 gallon (8 L) container below the FCU (50).

(2) Remove the coupling clamp (40) from FCU (50).

WARNING: USE THE CORRECT PERSONAL PROTECTION. FUEL CAN CAUSE SKIN, EYE, AND LUNG DAMAGE.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

(3) Remove FCU (50) with packing (60) from the engine assembly. Discard packing.

NOTE: During removal of the FCU, oil from the lube module cavity can drain.

B. Refer to ATA No. 49-30-99 for overhaul and repair of the FCU.

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LUBE MODULE
REMOVAL-07

TASK 49-20-00-050-806

1. **General**

   A. This section contains procedures for removal of the lube module.

   B. Perform the removal procedures in a dry, bright, clean room.

   C. Be careful to prevent damage to parts that can be used again.

   WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

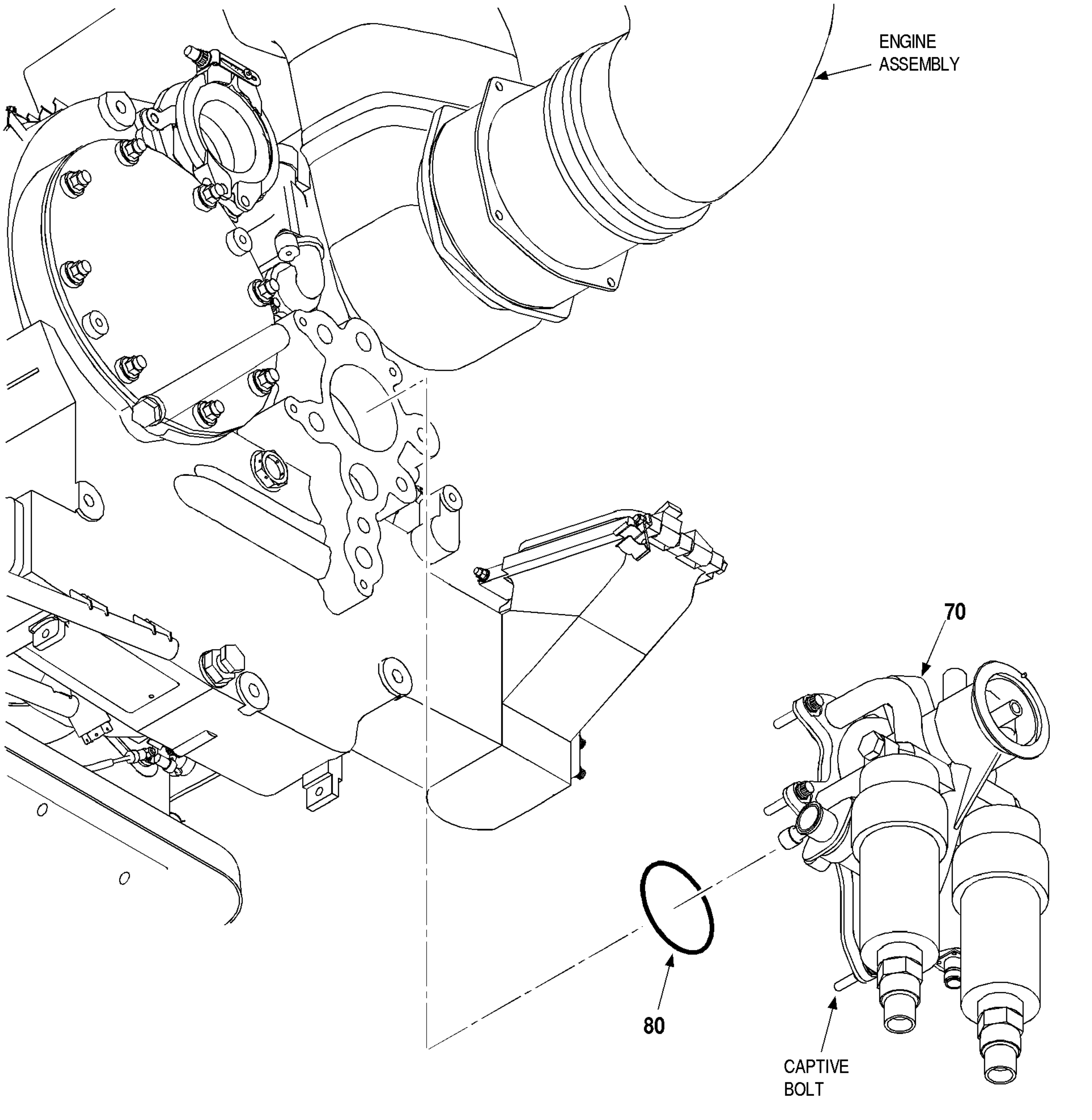
   D. Apply lubricating oil to parts and put them in a protective container to prevent corrosion until the parts can be cleaned and checked.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   None



ICN-99193-0000673103-001-01

Figure 3001. Removal of Lube Module

Key to Figure 3001

70. LUBE MODULE (IPC FIG. 4)

80. PACKING

4. Procedure

SUBTASK 49-20-00-050-007

A. Remove the lube module. Refer to Figure 3001.

(1) Put a 2 gallon (8 L) container below lube module (70).

(2) Remove the fuel control unit (FCU). Refer to REMOVAL 06.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT, IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN. USE CARE WHEN ENGINE OIL IS DRAINED. HOT OIL CAN CAUSE BAD BURNS.

CAUTION: THE LUBE MODULE IS A TIGHT FIT. DURING REMOVAL, PULL THE LUBE MODULE CAREFULLY TO PREVENT DAMAGE TO THE LUBE MODULE DRIVE SHAFT.

(3) Loosen the captive bolts and remove lube module (70) with packing (80) from the engine assembly.

(4) Remove packing (80) from lube module (70). Discard packing.

B. Refer to ATA No. 49-90-57 for overhaul and repair of the lube module.

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DATA MEMORY MODULE (DMM) REMOVAL-08

TASK 49-20-00-050-807

1. **General**

   A. This section contains procedures for removal of the DMM.

   B. Perform the removal procedures in a dry, bright, clean room.

   C. Be careful to prevent damage to parts that can be used again.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   None

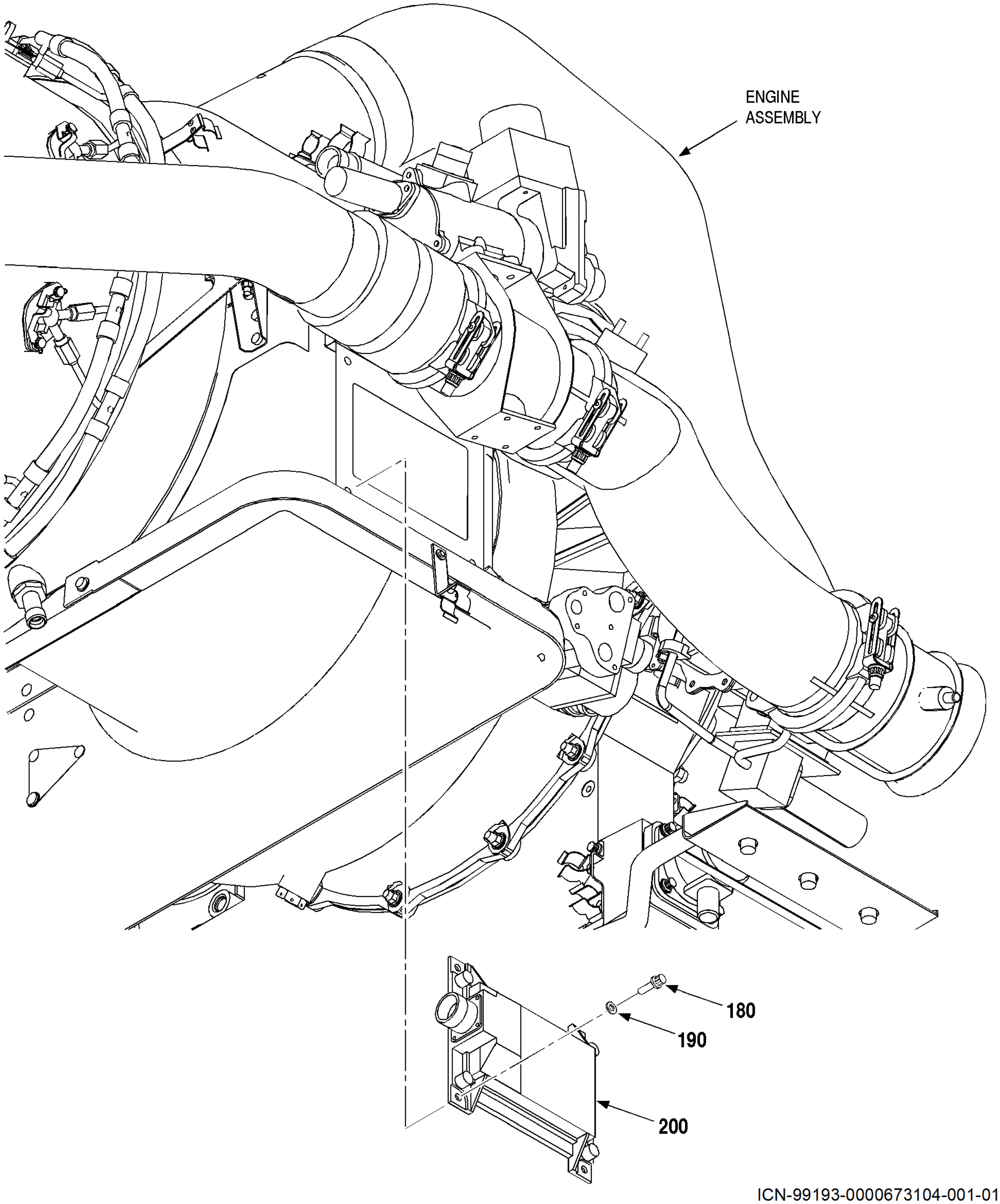

Figure 3001. Removal of Data Memory Module

Key to Figure 3001

180. BOLT (IPC FIG. 5)	200. DMM
190. WASHER	

4. Procedure

SUBTASK 49-20-00-050-008

A. Remove the DMM. Refer to Figure 3001.

(1) Remove bolts (180) and washers (190).

(2) Remove the DMM (200) from the engine assembly.

B. Refer to ATA No. 49-60-65 for overhaul and repair of the data memory module.

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OIL COOLING FAN ASSEMBLY
REMOVAL-09

TASK 49-20-00-050-808

1. General

A. This section contains procedures for removal of the oil cooling fan assembly.

B. Perform the removal procedures in a dry, bright, clean room.

C. Be careful to prevent damage to parts that can be used again.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

None

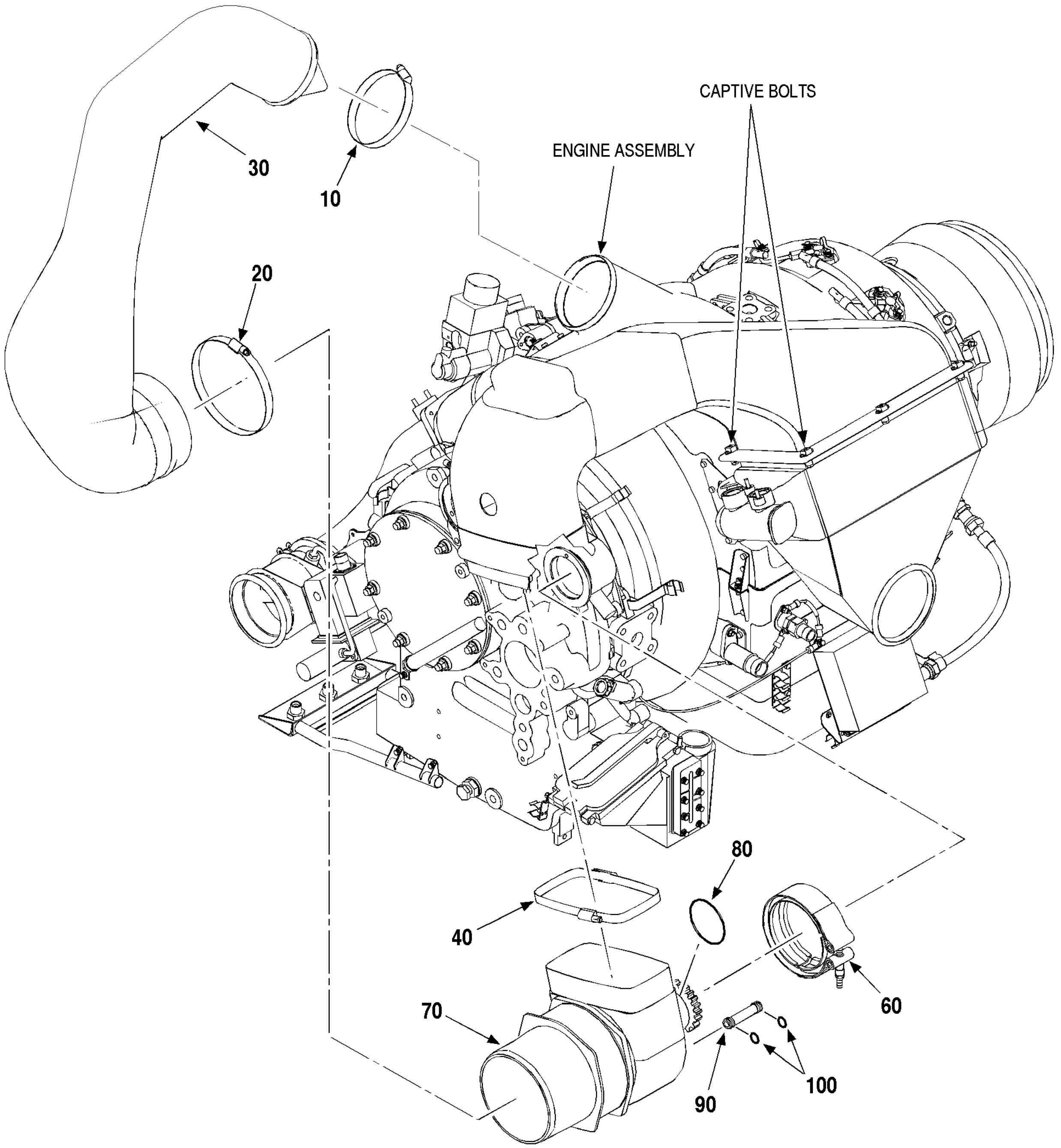

Figure 3001. Removal of Oil Cooling Fan Assembly

Key to Figure 3001

10. HOSE CLAMP (IPC FIG. 3)
20. HOSE CLAMP
30. INLET FAN DUCT
40. HOSE CLAMP
60. COUPLING CLAMP
70. OIL COOLING FAN ASSY
80. PACKING
90. TRANSFER TUBE
100. PACKING

4. Procedure

SUBTASK 49-20-00-050-009

A. Remove the oil cooling fan assembly. Refer to Figure 3001.

(1) Remove hose clamps (10, 20) and inlet fan duct (30) from the engine assembly.

(2) Remove hose clamp (40) and loosen the two forward captive bolts on the oil cooler.

(3) Remove coupling clamp (60), oil cooling fan assembly (70) and packing (80) from the engine assembly. Discard packing.

(4) Remove transfer tube (90) and packings (100). Discard packings.

B. Refer to ATA No. 49-51-07 for overhaul and repair of the oil cooling fan assembly.

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LOAD CONTROL VALVE (LCV)
REMOVAL-10

TASK 49-20-00-050-809

1. **General**

   A. This section contains procedures for removal of the LCV.

   B. Perform the removal procedures in a dry, bright, clean room.

   C. Be careful to prevent damage to parts that can be used again.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   None

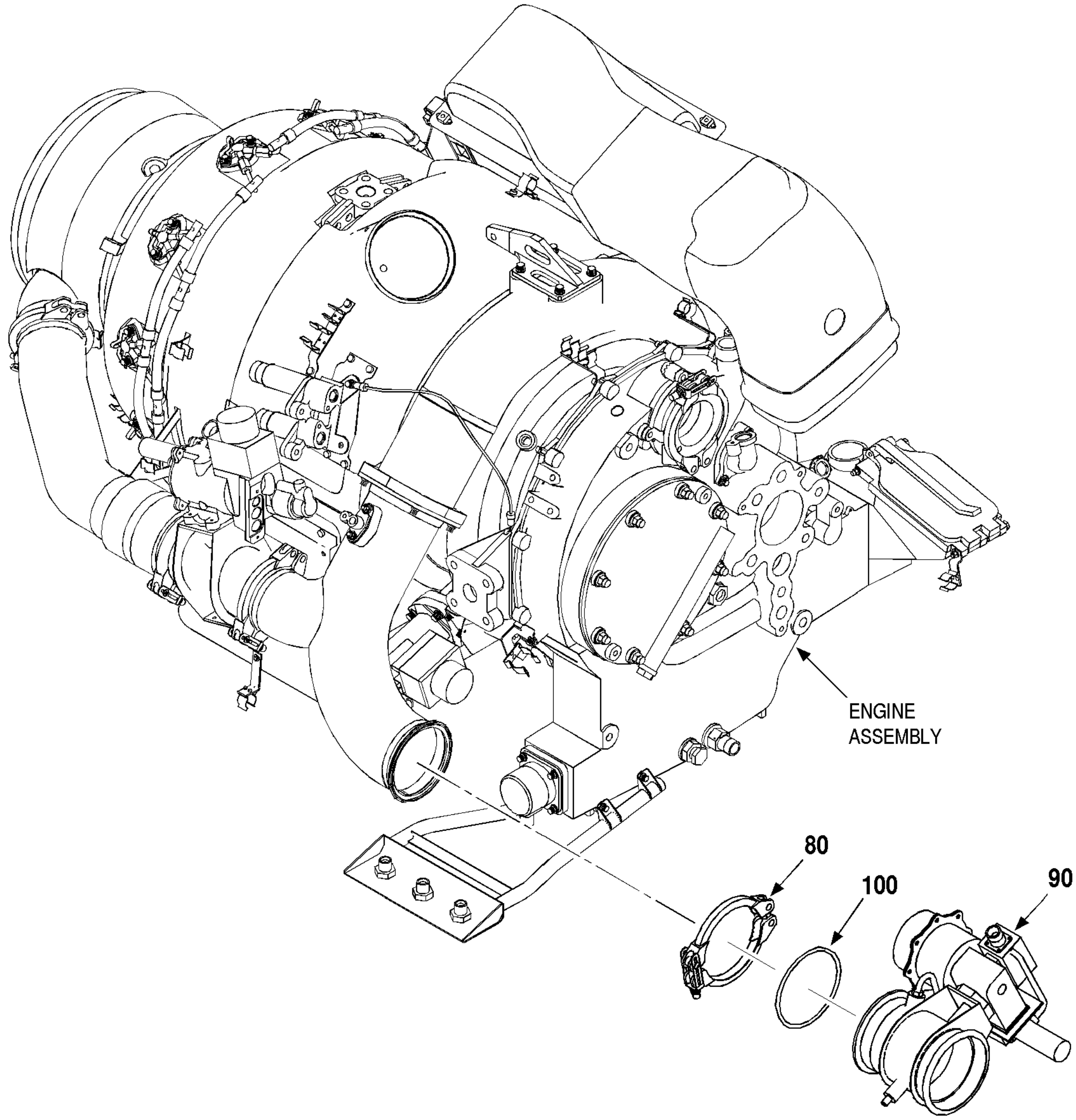

Figure 3001. Removal of Load Control Valve

Key to Figure 3001

80. CLAMP (IPC FIG. 5)
90. LOAD CONTROL VALVE
100. SEAL

---

4. **Procedure**

SUBTASK 49-20-00-050-010

A. Remove the LCV. Refer to Figure 3001.

(1) Remove clamp (80), load control valve (90) and seal (100) from the engine assembly.

B. Refer to ATA No. 49-52-35 for overhaul and repair of the LCV.

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TOTAL PRESSURE PROBE ASSEMBLY
REMOVAL-11

TASK 49-20-00-050-810

1. General

A. This section contains procedures for removal of the total pressure probe assembly.

B. Perform the removal procedures in a dry, bright, clean room.

C. Be careful to prevent damage to parts that can be used again.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

D. Apply lubricating oil to parts and put them in a protective container to prevent corrosion until the parts can be cleaned and checked.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

None

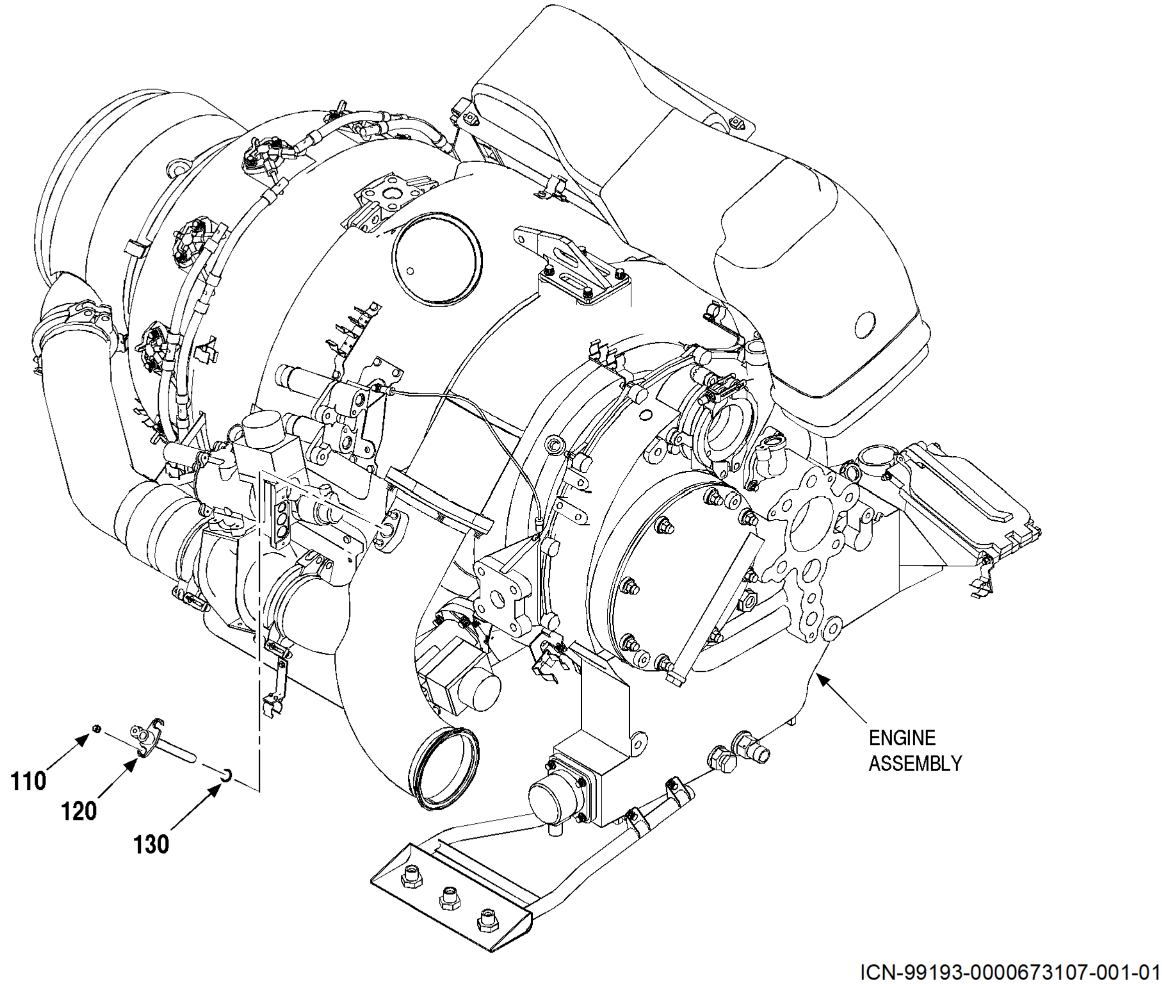

Figure 3001. Removal of Total Pressure Probe Assembly

Key to Figure 3001

110. NUT (IPC FIG. 5)
120. TOTAL PRESSURE PROBE ASSY
130. PACKING

4. Procedure

SUBTASK 49-20-00-050-011

A. Remove the total pressure probe assembly. Refer to Figure 3001.

(1) Loosen nut (110) and turn total pressure probe assembly (120) counterclockwise to disengage mounting studs.

(2) Remove total pressure probe assembly (120) with packing (130) from the engine assembly. Discard packing.

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COMPRESSOR DISCHARGE DUCT
REMOVAL-12

TASK 49-20-00-050-811

1. **General**

   A. This section contains procedures for removal of the compressor discharge duct.

   B. Perform the removal procedures in a dry, bright, clean room.

   C. Be careful to prevent damage to parts that can be used again.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   None

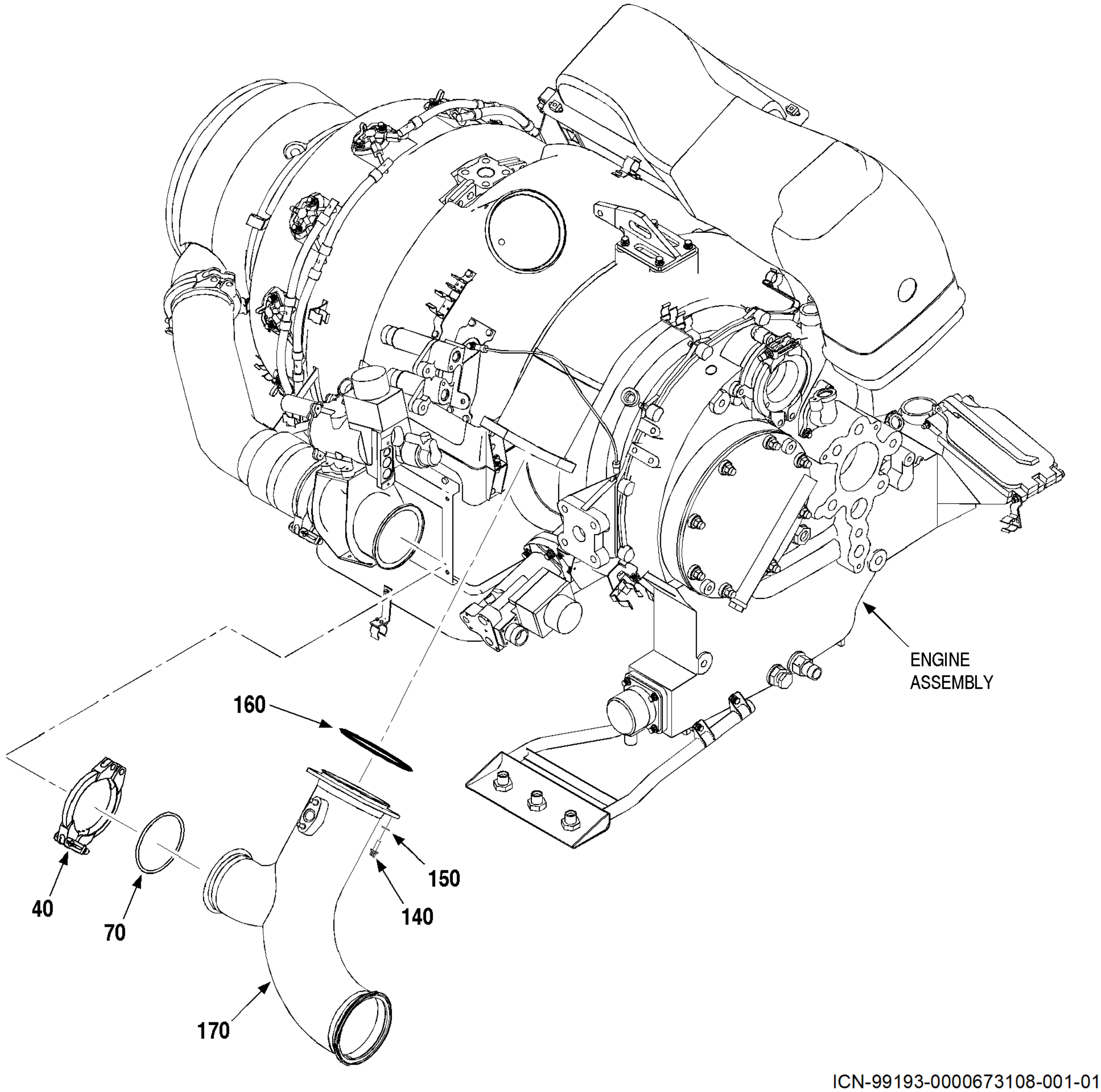

Figure 3001. Removal of Compressor Discharge Duct

Key to Figure 3001

40.	CLAMP (IPC FIG. 5)	150.	WASHER
70.	SEAL	160.	AIR PACKING
140.	BOLT	170.	COMPRESSOR DISCHARGE DUCT

4. <u>Procedure</u>

SUBTASK 49-20-00-050-012

A. Remove the compressor discharge duct. Refer to Figure 3001.

(1) Remove the load control valve. Refer to REMOVAL 10.

(2) Remove clamp (40).

(3) Remove bolts (140) and washers (150) from the engine assembly.

(4) Remove compressor discharge duct (170) with air packing (160) and attached total pressure probe assembly from the engine assembly. Discard air packing.

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SURGE CONTROL VALVE (SCV)
REMOVAL-13

TASK 49-20-00-050-812

1. **General**

   A. This section contains procedures for removal of the SCV.

   B. Perform the removal procedures in a dry, bright, clean room.

   C. Be careful to prevent damage to parts that can be used again.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   None

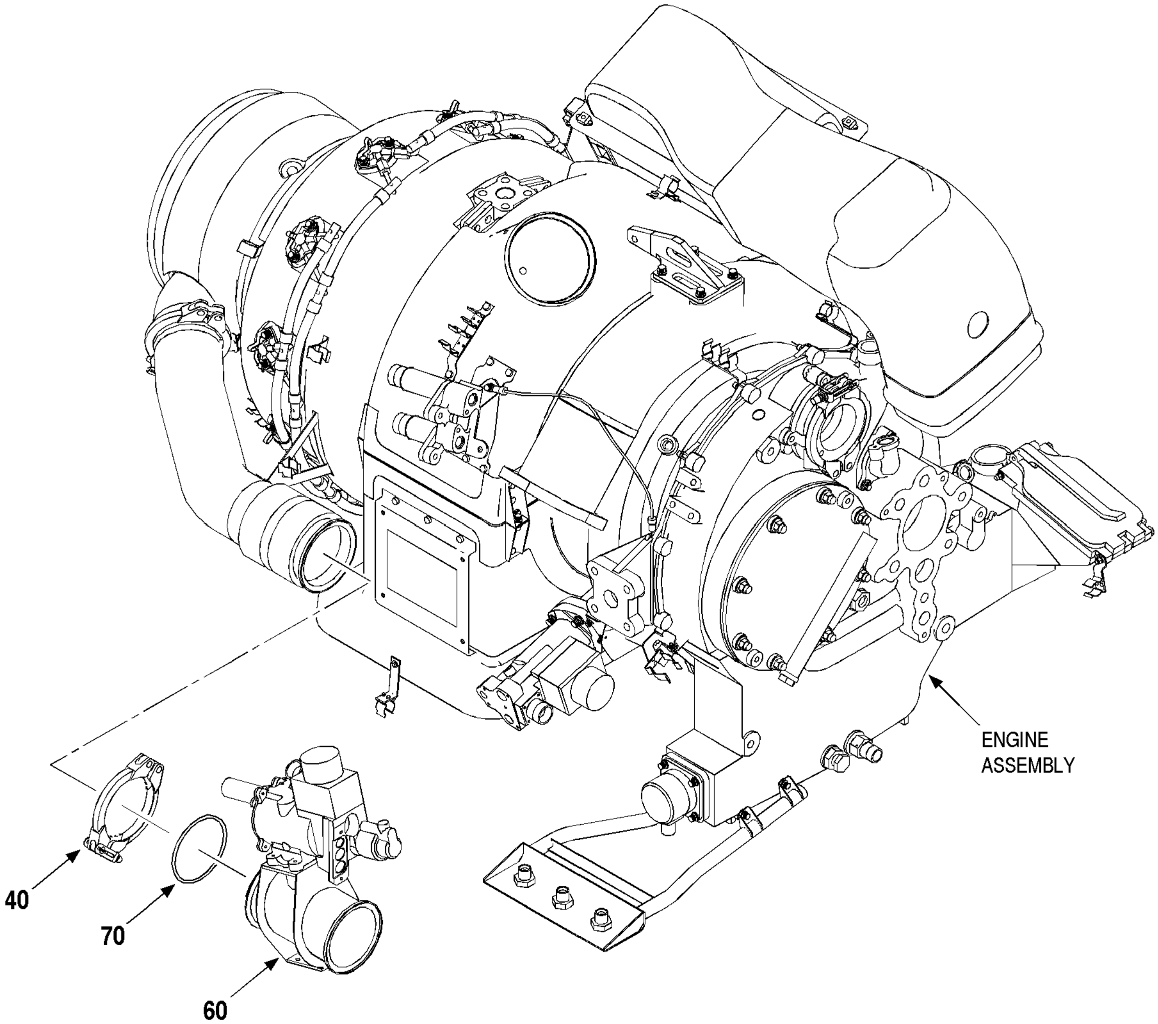

Figure 3001. Removal of Surge Control Valve

Key to Figure 3001

40. CLAMP (IPC FIG. 5)
60. SURGE CONTROL VALVE
70. SEAL

---

4. **Procedure**

SUBTASK 49-20-00-050-013

A. Remove the SCV. Refer to Figure 3001.

(1) Remove clamps (40).

(2) Remove SCV (60) from the engine assembly.

(3) Remove seals (70) from the SCV (60).

B. Refer to ATA No. 49-52-31 for overhaul and repair of the SCV.

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SURGE DUCT
REMOVAL-14

TASK 49-20-00-050-813

1. **General**

   A. This section contains procedures for removal of the surge duct.

   B. Perform the removal procedures in a dry, bright, clean room.

   C. Be careful to prevent damage to parts that can be used again.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   None

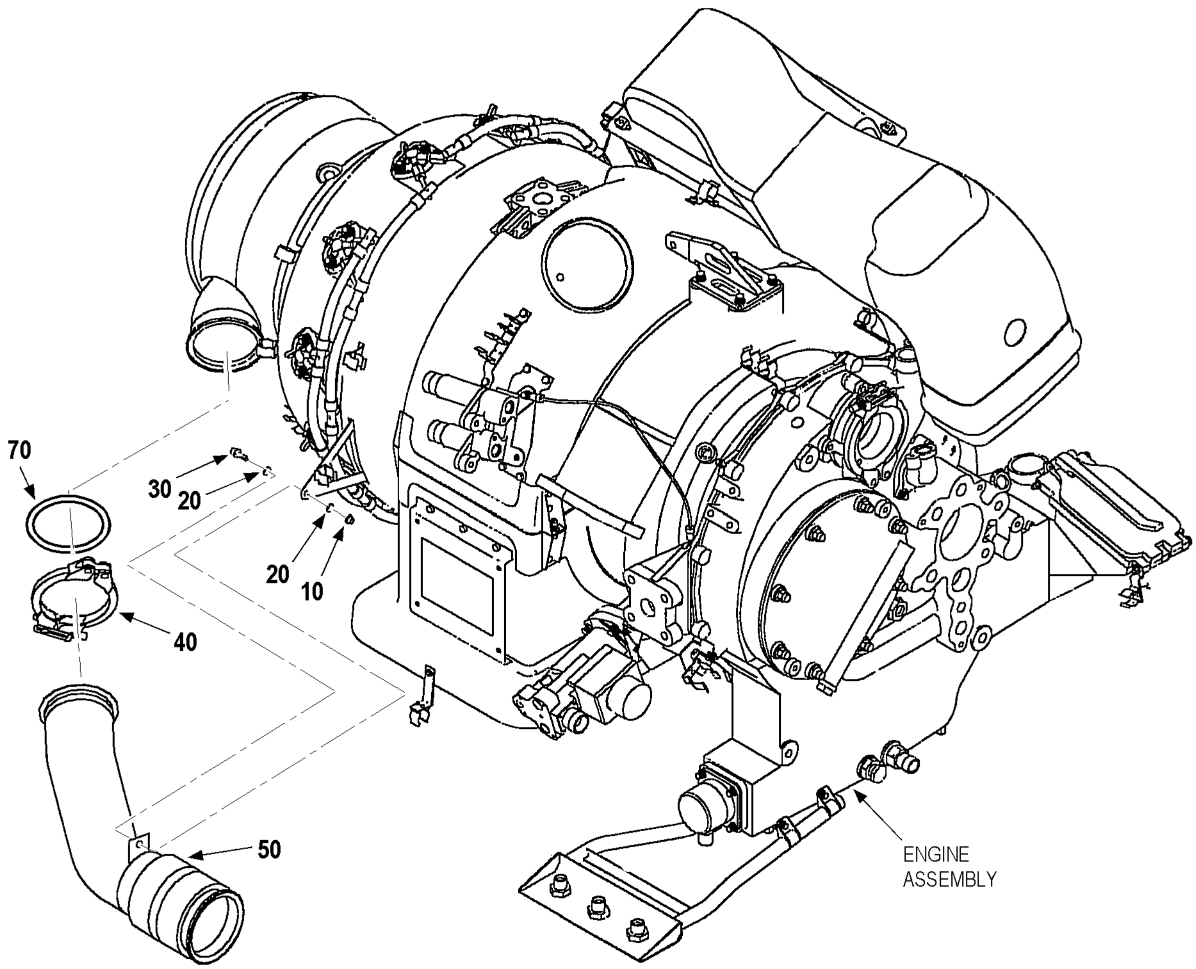

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Figure 3001. Removal of Surge Duct

Key to Figure 3001

10. NUT (IPC FIG. 5)	40. CLAMP
20. WASHER	50. SURGE DUCT
30. BOLT	70. SEAL

4. Procedure

SUBTASK 49-20-00-050-014

A. Remove the surge duct. Refer to Figure 3001.

(1) Remove nut (10), bolt (30) and washers (20).

(2) Remove clamp (40) from the engine assembly.

(3) Remove surge duct (50) and seal (70) from the engine assembly.

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SPEED SENSOR
REMOVAL-15

TASK 49-20-00-050-814

1. **General**

   A. This section contains procedures for removal of the speed sensor.

   B. Perform the removal procedures in a dry, bright, clean room.

   C. Be careful to prevent damage to parts that can be used again.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   None

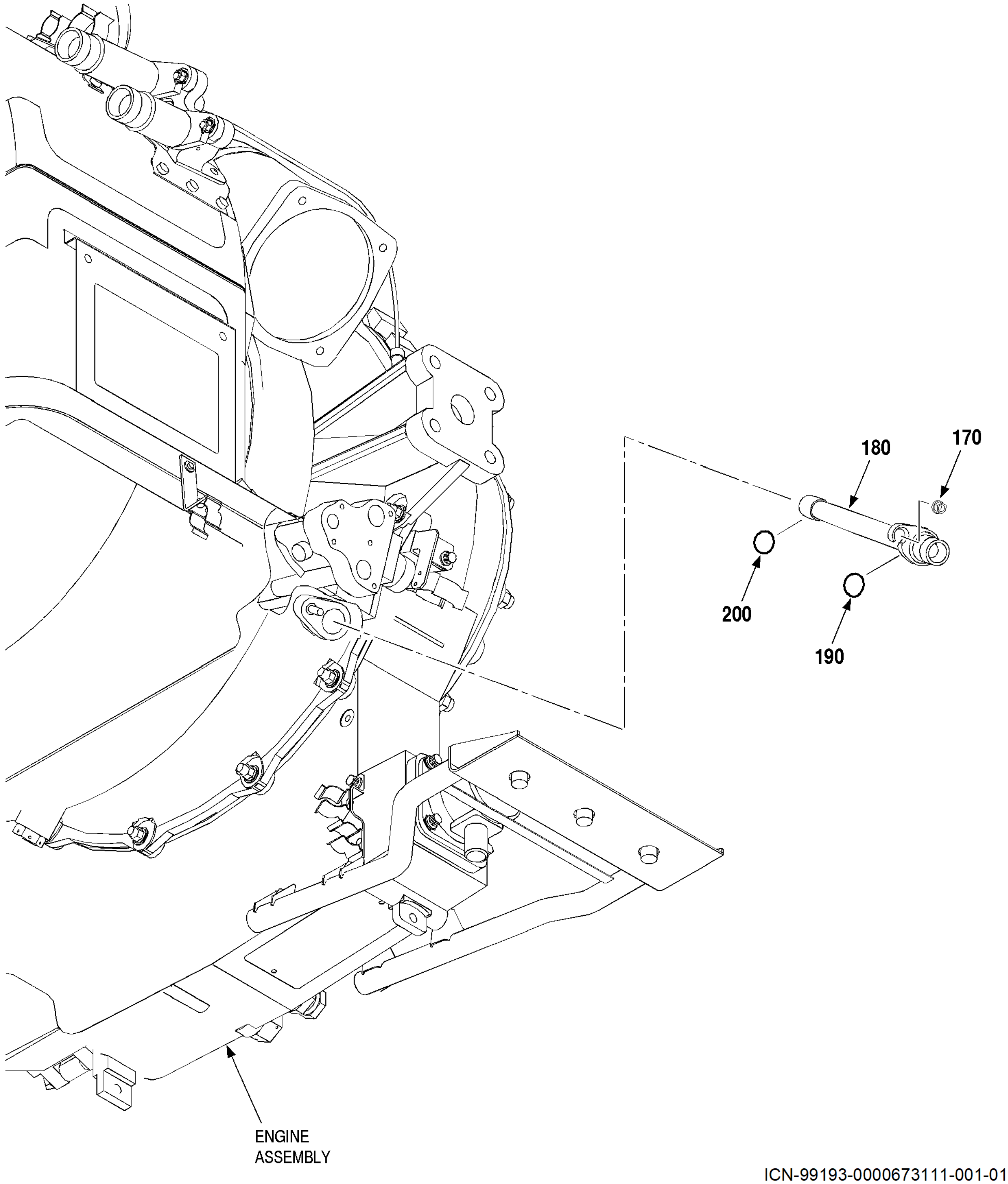

Figure 3001. Removal of Speed Sensor

Key to Figure 3001

170. NUT (IPC FIG. 6)	190. PACKING
180. SPEED SENSOR	200. PACKING

4. Procedure

SUBTASK 49-20-00-050-015

CAUTION: THIS UNIT CONTAINS ELECTROSTATICALLY SENSITIVE PARTS. USE THE BEST PRACTICES AND PROCEDURES ESTABLISHED FOR YOUR FACILITY TO HANDLE AND TEST THESE PARTS (REFER TO MIL-HDBK-263 AND MIL-STD-1686).

A. Remove speed sensor. Refer to Figure 3001.

(1) Remove nut (170) and turn speed sensor (180) clockwise to disengage mounting studs.

(2) Remove speed sensor (180) with packings (190, 200) from the engine assembly. Discard packings.

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INLET PRESSURE TRANSDUCER (P2) REMOVAL-16

TASK 49-20-00-050-815

1. General

A. This section contains procedures for removal of the inlet pressure transducer.

B. Perform the removal procedures in a dry, bright, clean room.

C. Be careful to prevent damage to parts that can be used again.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

D. Apply lubricating oil to parts and put them in a protective container to prevent corrosion until the parts can be cleaned and checked.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

None

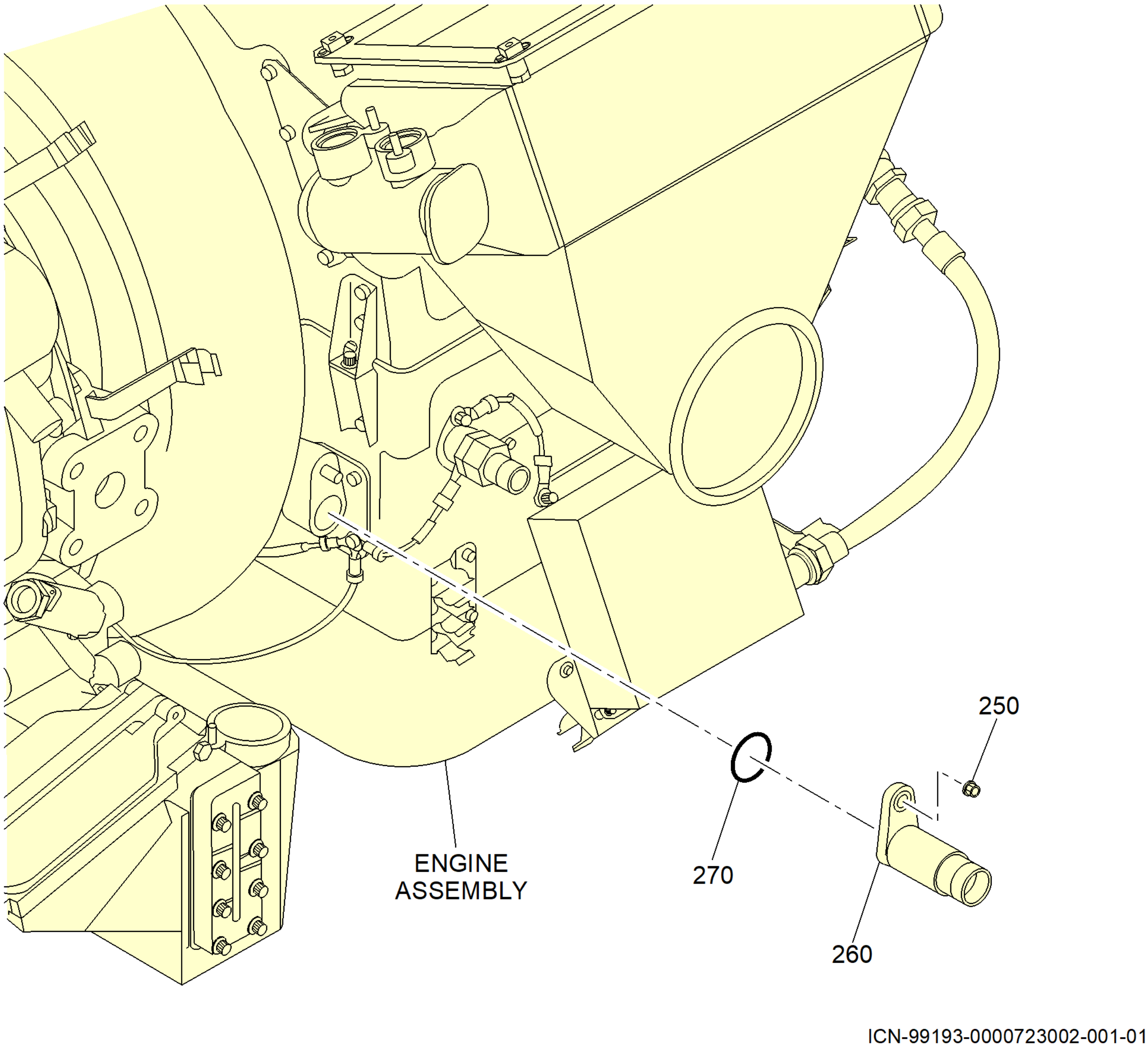

Figure 3001. Removal of Inlet Pressure Transducer

Key to Figure 3001

250. NUT (IPC FIG. 4)

260. INLET PRESSURE TRANSDUCER

270. PACKING

4. Procedure

SUBTASK 49-20-00-050-016

A. Remove inlet pressure transducer. Refer to Figure 3001.

(1) Remove nut (250) and turn inlet pressure transducer (260) counterclockwise to disengage mounting stud.

(2) Remove inlet pressure transducer (260) with packing (270) from the engine assembly. Discard packing.

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TOTAL PRESSURE TRANSDUCER (PT)
REMOVAL-17

TASK 49-20-00-050-816

1. **General**

   A. This section contains procedures for removal of the total pressure transducer.

   B. Perform the removal procedures in a dry, bright, clean room.

   C. Be careful to prevent damage to parts that can be used again.

   WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

   D. Apply lubricating oil to parts and put them in a protective container to prevent corrosion until the parts can be cleaned and checked.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   None

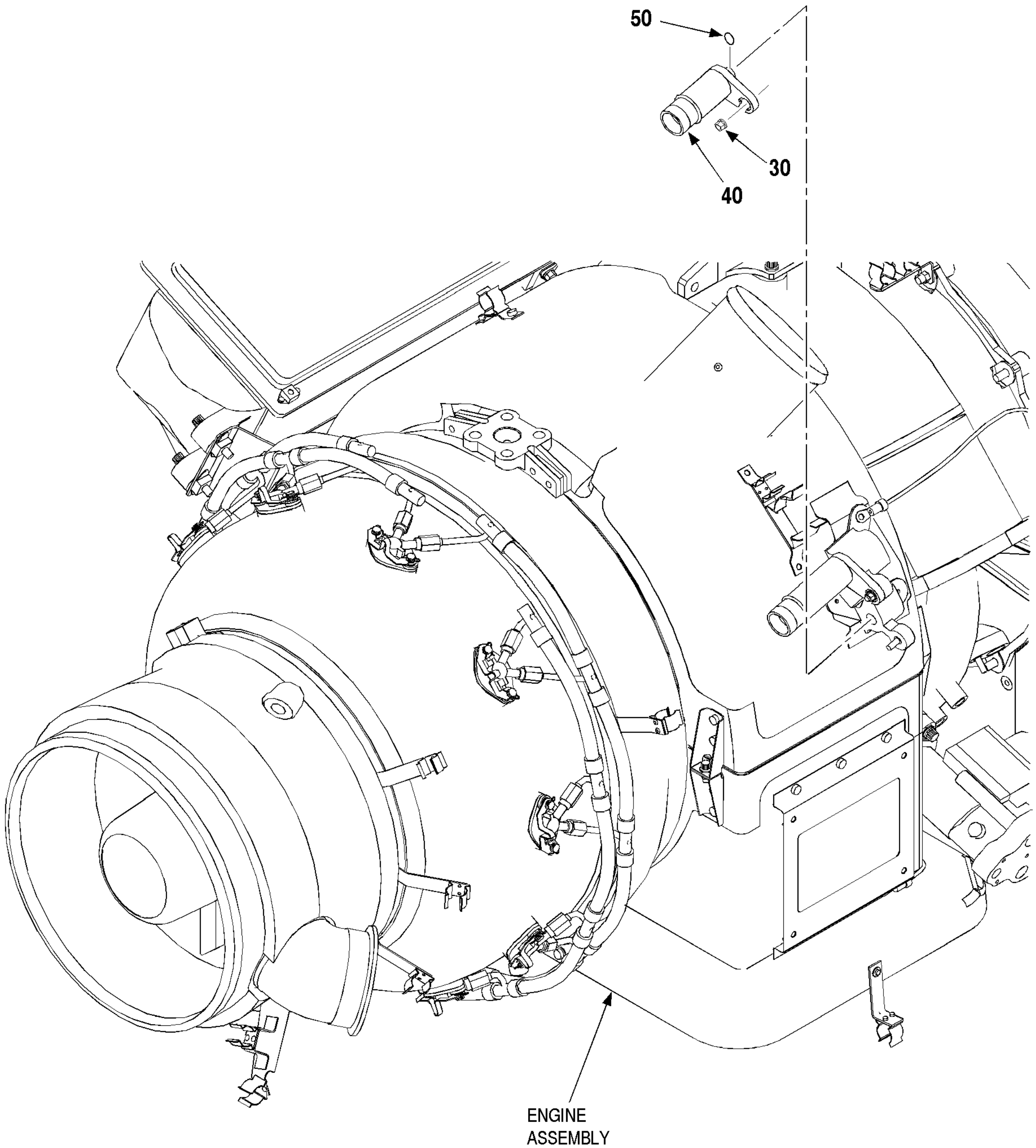

Figure 3001. Removal of Total Pressure Transducer

Key to Figure 3001

30. NUT (IPC FIG. 8)
40. TOTAL PRESSURE TRANSDUCER
50. PACKING

---

4. **Procedure**

SUBTASK 49-20-00-050-017

A. Remove total pressure transducer. Refer to Figure 3001.

(1) Remove nut (30) and turn total pressure transducer (40) counterclockwise to disengage mounting stud.

(2) Remove total pressure transducer (40) with packing (50) from the engine assembly. Discard packing.

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DIFFERENTIAL PRESSURE TRANSDUCER (DP) REMOVAL-18

TASK 49-20-00-050-817

1. General

A. This section contains procedures for removal of the differential pressure transducer.

B. Perform the removal procedures in a dry, bright, clean room.

C. Be careful to prevent damage to parts that can be used again.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

D. Apply lubricating oil to parts and put them in a protective container to prevent corrosion until the parts can be cleaned and checked.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

None

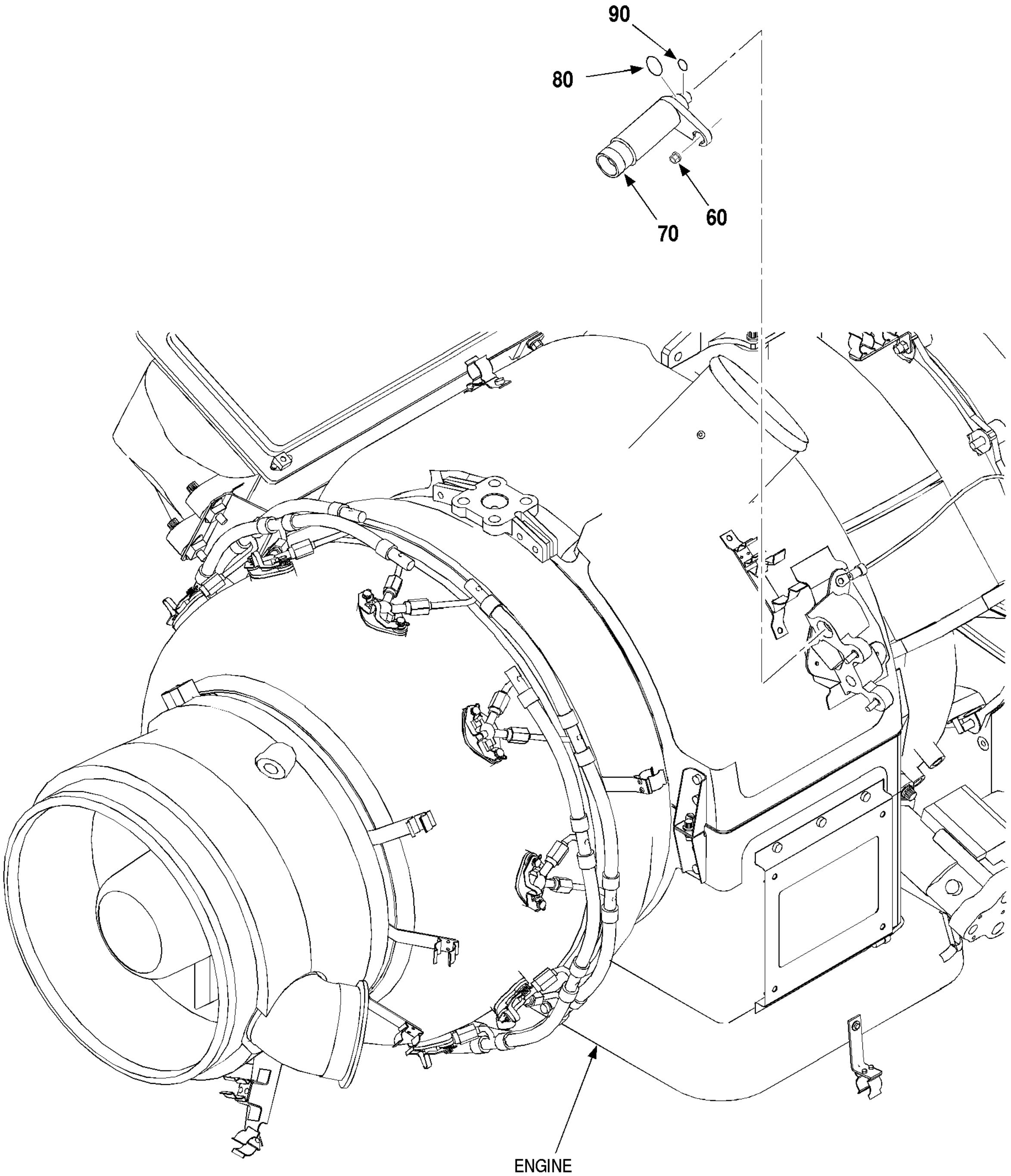

Figure 3001. Removal of Differential Pressure Transducer

Key to Figure 3001

60. NUT (IPC FIG. 8)
70. DIFFERENTIAL PRESSURE TRANSDUCER
80. PACKING
90. PACKING

---

4. Procedure

SUBTASK 49-20-00-050-018

A. Remove differential pressure transducer. Refer to Figure 3001.

(1) Remove nut (60) and turn differential pressure transducer (70) counterclockwise to disengage mounting stud.

(2) Remove differential pressure transducer (70) with packings (80, 90) from the engine assembly. Discard packings.

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INLET TEMPERATURE SENSOR (T2)
REMOVAL-19

TASK 49-20-00-050-818

1. **General**

   A. This section contains procedures for removal of the inlet temperature sensor.

   B. Perform the removal procedures in a dry, bright, clean room.

   C. Be careful to prevent damage to parts that can be used again.

   WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

   D. Apply lubricating oil to parts and put them in a protective container to prevent corrosion until the parts can be cleaned and checked.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   None

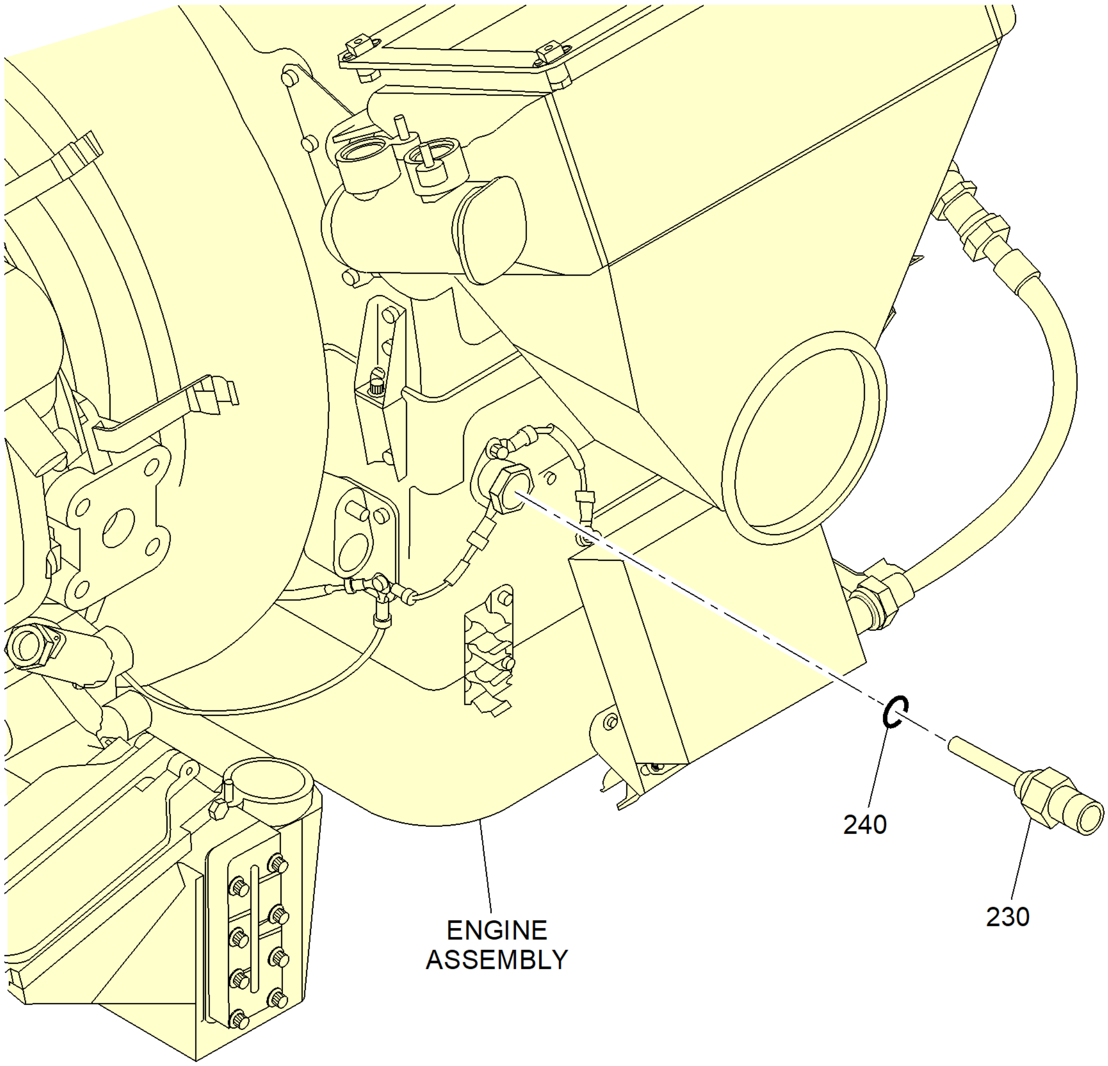

Figure 3001. Removal of Inlet Temperature Sensor (T2)

Key to Figure 3001

230. INLET TEMPERATURE SENSOR (IPC FIG. 4)

240. GASKET

4. **Procedure**

SUBTASK 49-20-00-050-019

A. Remove the inlet temperature sensor. Refer to Figure 3001.

(1) Remove inlet temperature sensor (230) with gasket (240) from the engine assembly. Discard gasket.

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IGNITER PLUG
REMOVAL-20

TASK 49-20-00-050-819

1. **General**

   A. This section contains procedures for removal of the igniter plug.

   B. Perform the removal procedures in a dry, bright, clean room.

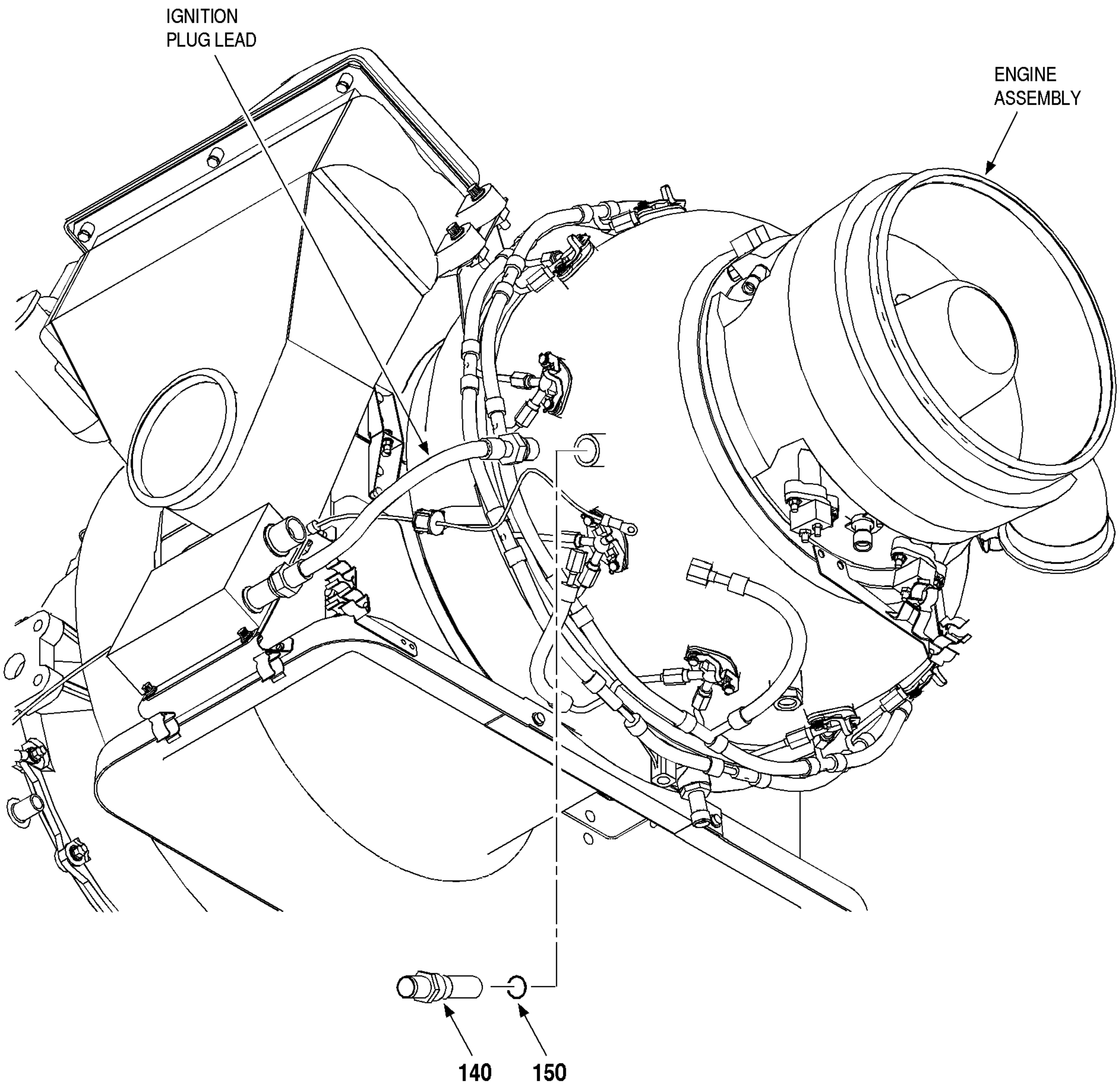
   C. Be careful to prevent damage to parts that can be used again.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   None



ICN-99193-0000673116-001-01

Figure 3001. Removal of Igniter Plug

Key to Figure 3001

140. IGNITER PLUG (IPC FIG. 4)	150. GASKET

4. Procedure

SUBTASK 49-20-00-050-020

WARNING: THE OUTPUT VOLTAGE OF THE IGNITION UNIT IS DANGEROUS AND COULD BE LETHAL. IT IS A CAPACITOR DISCHARGE-TYPE AND CAN KEEP HIGH VOLTAGE. MAKE SURE IT IS DE-ENERGIZED AND GROUNDED BEFORE THE INPUT AND OUTPUT LEADS ARE DISCONNECTED. DO NOT TOUCH THE CENTER CONTACT OF OUTPUT TERMINAL.

A. Remove the power input connector, if not already removed, from the ignition unit.

B. Remove igniter plug. Refer to Figure 3001.

(1) Remove ignition plug lead from the igniter plug (140).

(2) Remove igniter plug (140) with gasket (150) from the engine assembly. Discard gasket.

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IGNITION PLUG LEAD
REMOVAL-21

TASK 49-20-00-050-820

1. **General**

A. This section contains procedures for removal of the ignition plug lead.

B. Perform the removal procedures in a dry, bright, clean room.

C. Be careful to prevent damage to parts that can be used again.

2. **Special Tools, Fixtures and Equipment**

None

3. **Equipment and Materials**

None

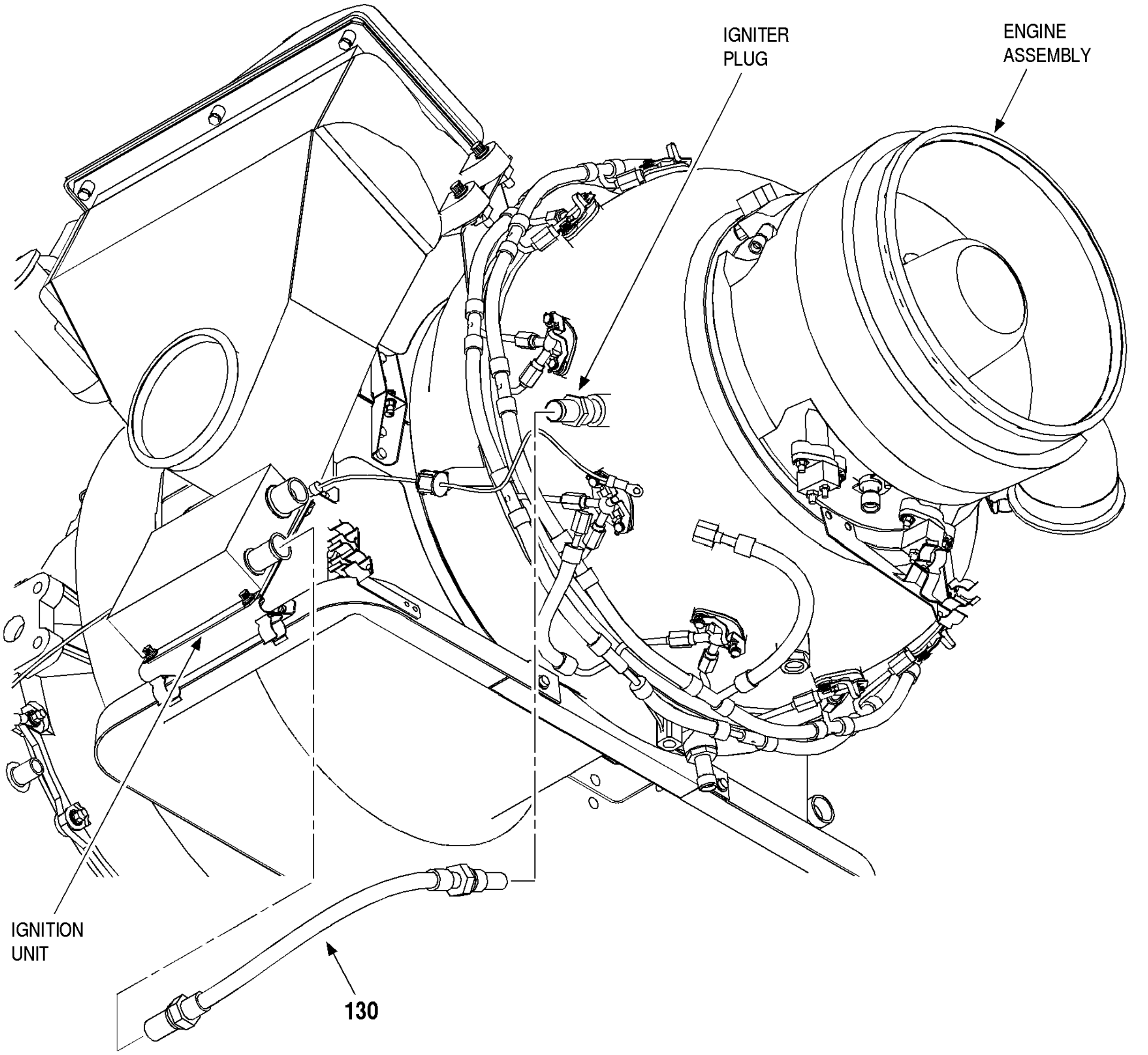

Figure 3001. Removal of Ignition Plug Lead

Key to Figure 3001

130. IGNITION PLUG LEAD (IPC FIG. 4)

4. Procedure

SUBTASK 49-20-00-050-021

WARNING: THE OUTPUT VOLTAGE OF THE IGNITION UNIT IS DANGEROUS AND COULD BE LETHAL. IT IS A CAPACITOR DISCHARGE-TYPE AND CAN KEEP HIGH VOLTAGE. MAKE SURE IT IS DE-ENERGIZED AND GROUNDED BEFORE THE INPUT AND OUTPUT LEADS ARE DISCONNECTED. DO NOT TOUCH THE CENTER CONTACT OF OUTPUT TERMINAL.

A. Remove the power input connector, if not already removed, from the ignition unit.

B. Remove ignition plug lead. Refer to Figure 3001.

(1) Remove ignition plug lead (130) from the ignition unit on the engine assembly.

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IGNITION UNIT
REMOVAL-22

TASK 49-20-00-050-821

1. **General**

    A. This section contains procedures for removal of the ignition unit.

    B. Perform the removal procedures in a dry, bright, clean room.

    C. Be careful to prevent damage to parts that can be used again.

2. **Special Tools, Fixtures and Equipment**

    None

3. **Equipment and Materials**

    None

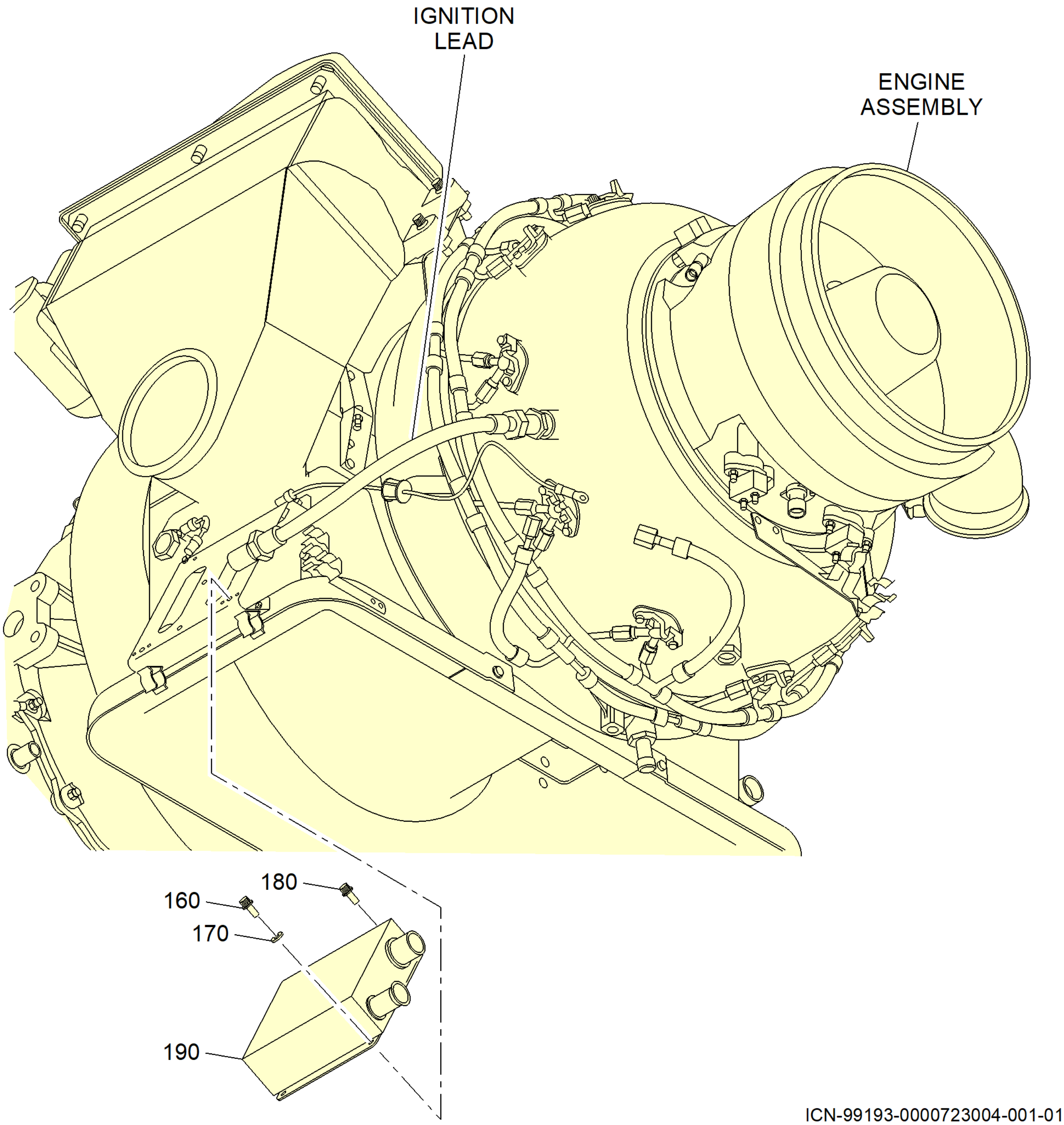

Figure 3001. Removal of Ignition Unit

Key to Figure 3001

160. BOLT (IPC FIG. 4)	180. BOLT
170. WASHER	190. IGNITION UNIT

4. Procedure

SUBTASK 49-20-00-050-022

WARNING: THE OUTPUT VOLTAGE OF THE IGNITION UNIT IS DANGEROUS AND COULD BE LETHAL. IT IS A CAPACITOR DISCHARGE-TYPE AND CAN KEEP HIGH VOLTAGE. MAKE SURE IT IS DE-ENERGIZED AND GROUNDED BEFORE THE INPUT AND OUTPUT LEADS ARE DISCONNECTED. DO NOT TOUCH THE CENTER CONTACT OF OUTPUT TERMINAL.

A. Remove the power input connector, if not already removed, from ignition unit (190).

B. Remove ignition unit. Refer to Figure 3001.

(1) Remove bolts (160, 180) and washers (170) that attach ignition unit (190) to the engine assembly.

(2) Remove ignition unit (190) from the engine assembly.

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EXHAUST GAS TEMPERATURE (EGT) THERMOCOUPLE REMOVAL-23

TASK 49-20-00-050-822

1. **General**

   A. This section contains procedures for removal of the EGT thermocouples.

   B. Perform the removal procedures in a dry, bright, clean room.

   C. Be careful to prevent damage to parts that can be used again.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   None

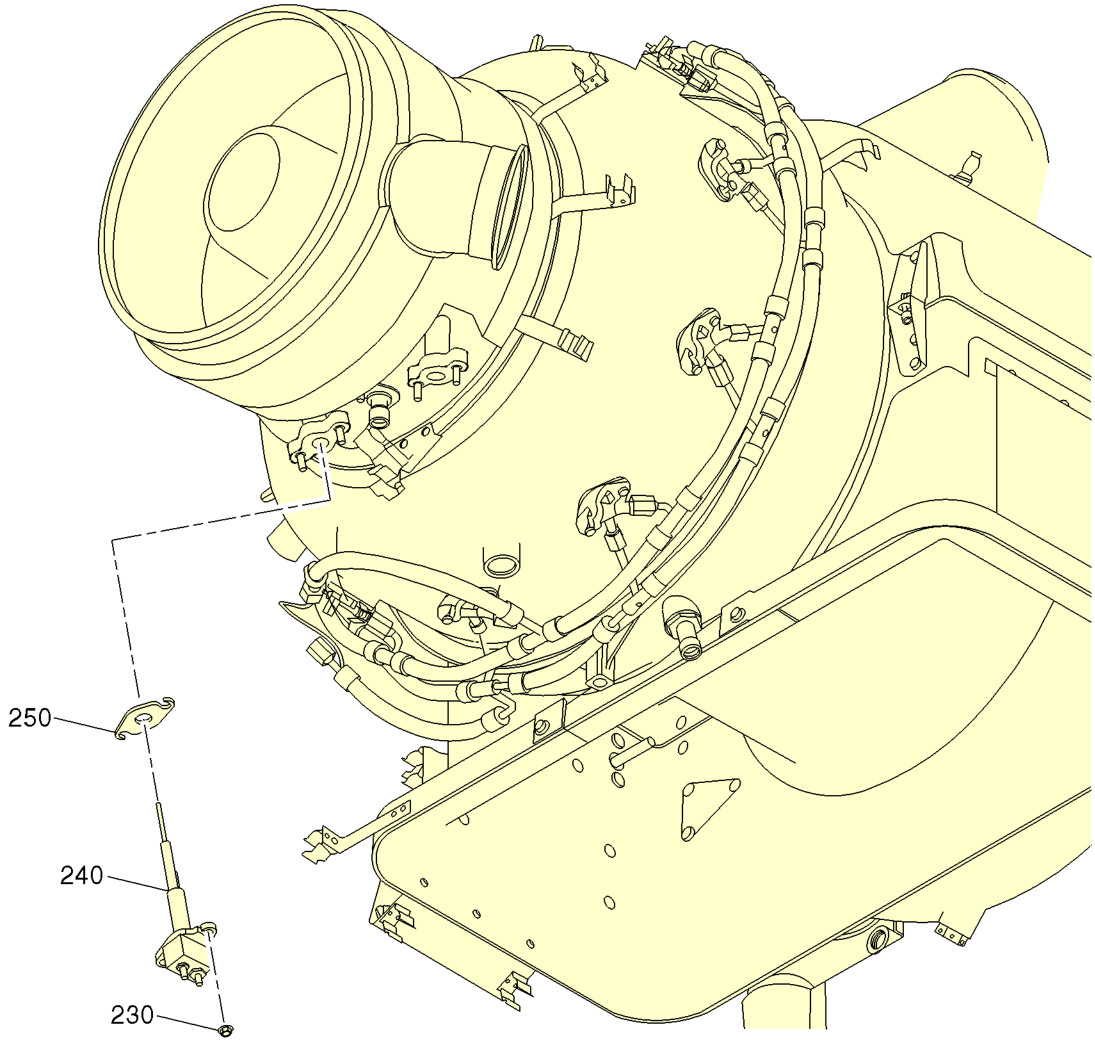

Figure 3001. Removal of Exhaust Gas Temperature Thermocouples

Key to Figure 3001

230. NUT (IPC FIG. 6)	250. GASKET
240. EGT THERMOCOUPLE	

4. **Procedure**

SUBTASK 49-20-00-050-023

A. Remove EGT thermocouples. Refer to Figure 3001.

(1) Remove nuts (230) and turn EGT thermocouples (240) clockwise to disengage mounting stud.

(2) Remove EGT thermocouples (240) with gasket (250) from the engine assembly. Discard gasket.

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ORIFICE FITTING ASSEMBLY (COMBUSTOR DRAIN) REMOVAL-24

TASK 49-20-00-050-823

1. General

A. This section contains procedures for removal of the orifice fitting assembly.

B. Perform the removal procedures in a dry, bright, clean room.

C. Be careful to prevent damage to parts that can be used again.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

None

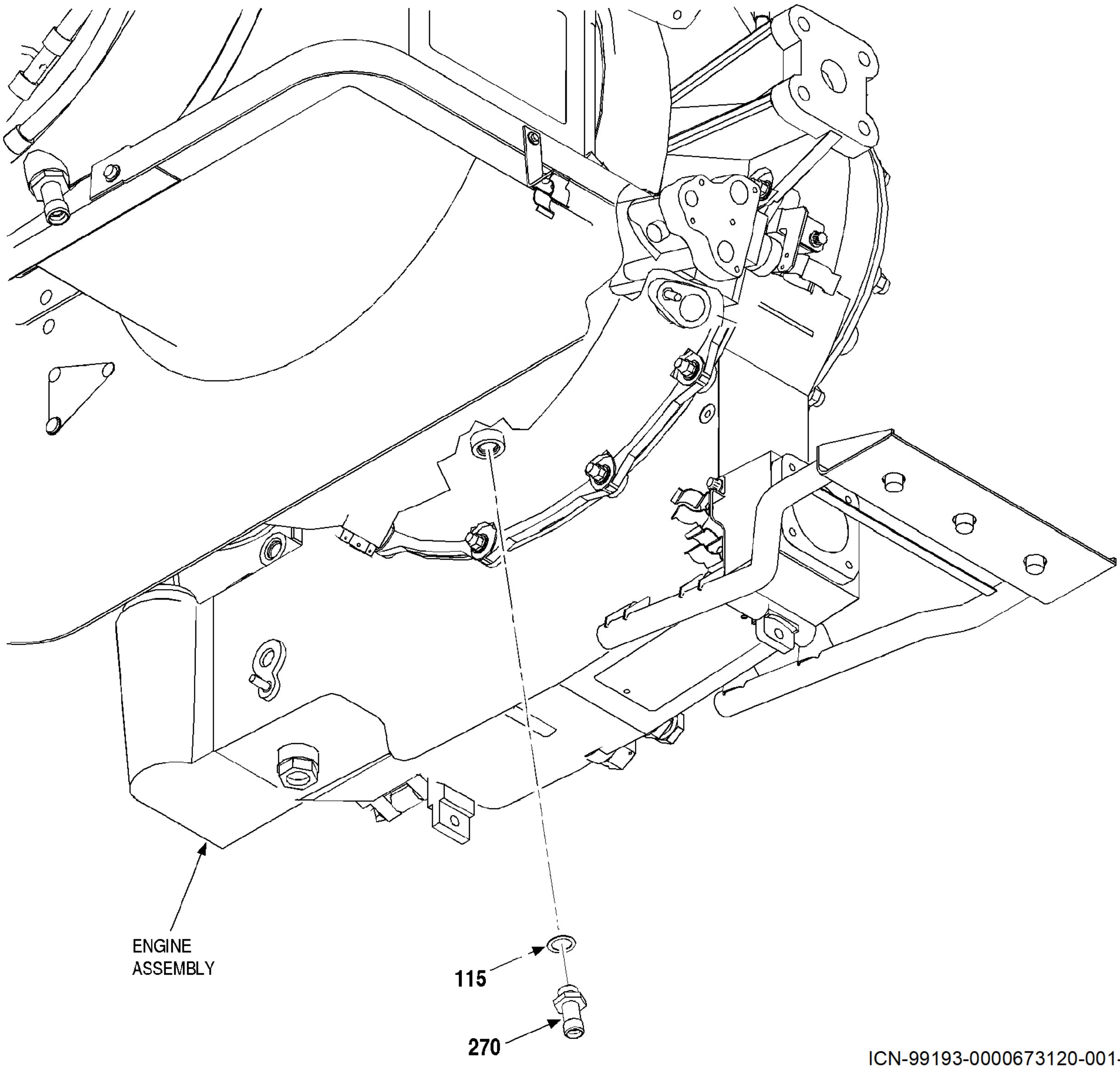

Figure 3001. Removal of Orifice Fitting Assembly

Key to Figure 3001

115. PACKING (IPC FIG. 2)	270. ORIFICE FITTING ASSEMBLY

4. <u>Procedure</u>

SUBTASK 49-20-00-050-024

A. Remove the orifice fitting assembly. Refer to Figure 3001.

(1) Remove orifice fitting assembly (270) with packing (115) from the engine assembly. Discard packing.

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INLET GUIDE VANE ACTUATOR (IGVA) REMOVAL-25

TASK 49-20-00-050-824

1. General

A. This section contains procedures for removal of the inlet guide vane actuator.

B. Perform the removal procedures in a dry, bright, clean room.

C. Be careful to prevent damage to parts that can be used again.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

D. Apply lubricating oil to parts and put them in a protective container to prevent corrosion until the parts can be cleaned and checked.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

None

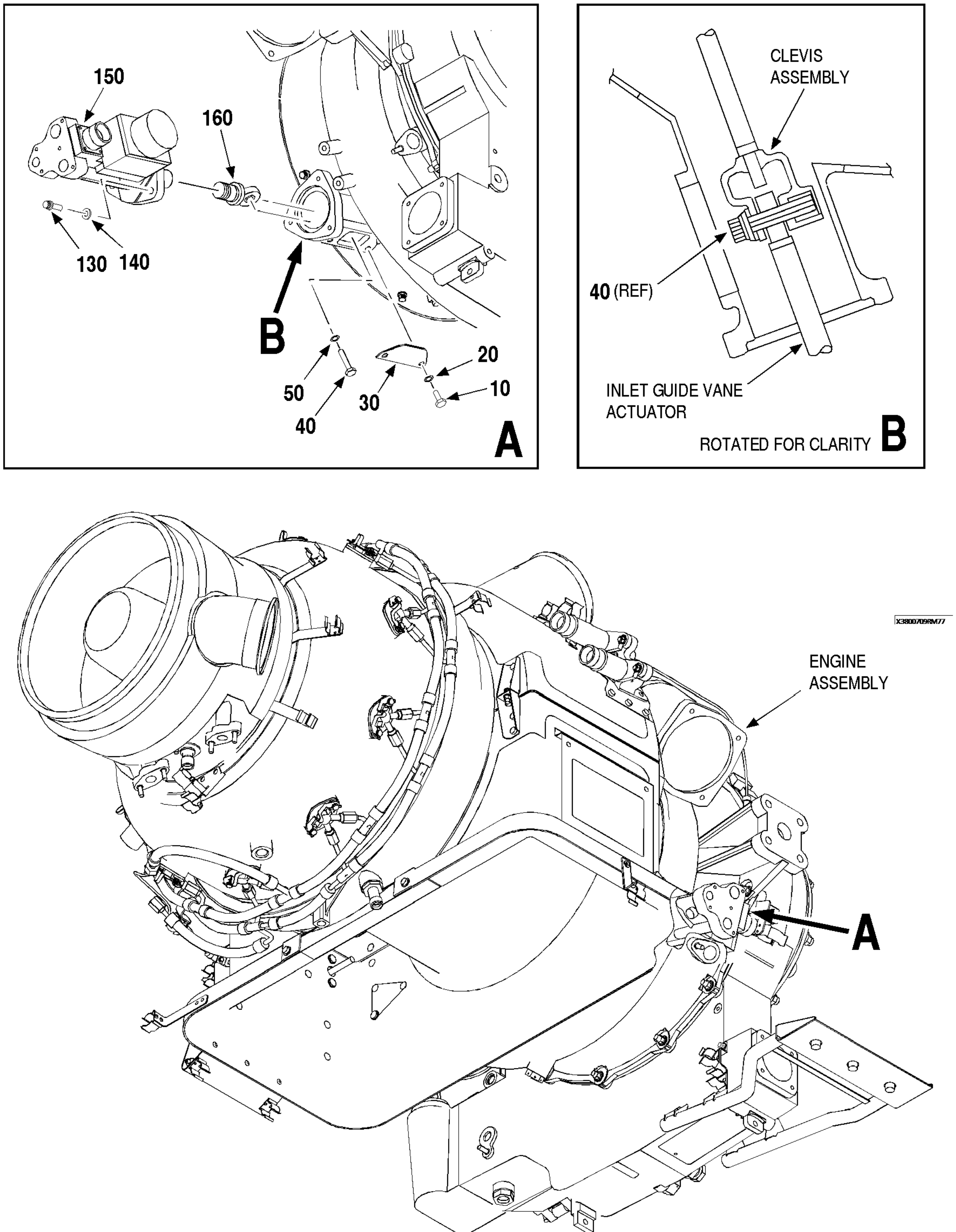

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Figure 3001. Removal of Inlet Guide Vane Assembly

Key to Figure 3001

10. BOLT (IPC FIG. 22)
20. WASHER
30. COVER
40. BOLT
50. WASHER
130. BOLT (IPC FIG. 6)
140. WASHER
150. INLET GUIDE VANE ACTUATOR
160. ROD END

---

4. **Procedure**

SUBTASK 49-20-00-050-025

A. Remove the IGVA. Refer to Figure 3001.

(1) Remove bolts (10), washers (20) and cover (30) to show clevis assembly.

(2) Remove bolt (40) and washer (50) on clevis assembly to free rod end (160). Refer to View A.

(3) Remove bolts (130) and washers (140) from the engine assembly.

(4) Remove IGVA (150) from the engine assembly.

(5) Remove rod end (160) from IGVA (150).

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IDENTIFICATION PLATE
REMOVAL-26

TASK 49-20-00-050-826

1. **General**

   A. This section contains procedures for removal of the identification plate.

   B. Perform the removal procedures in a dry, bright, clean room.

   C. Be careful to prevent damage to parts that can be used again.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   None

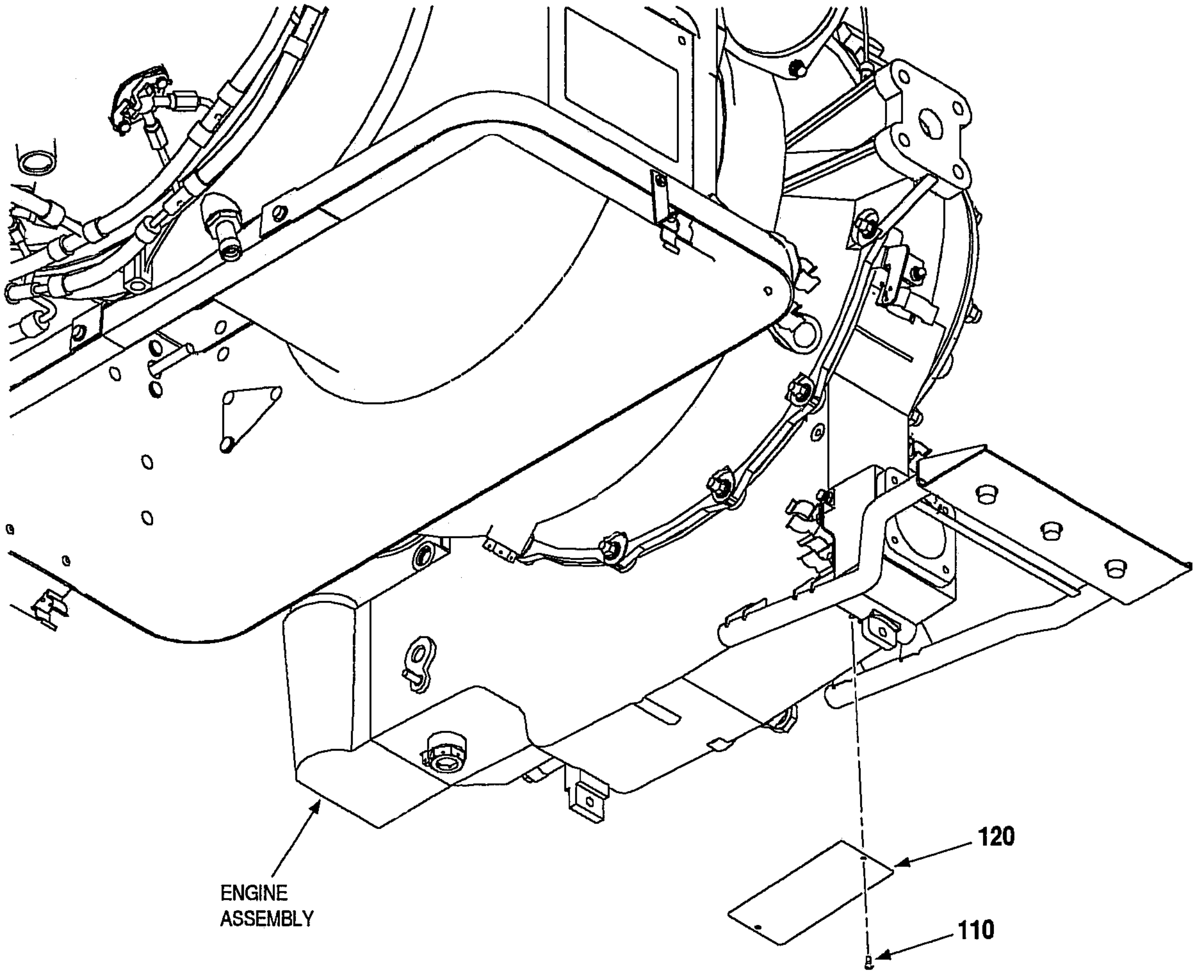

Figure 3001. Removal of Identification Plate

Key to Figure 3001

110. SCREW (IPC FIG. 6)	120. IDENTIFICATION PLATE

4. Procedure

SUBTASK 49-20-00-050-027

A. Remove the identification plate. Refer to Figure 3001.

(1) Remove screws (110) and identification plate (120) from the engine assembly.

NOTE: Do not remove the identification plate unless it is damaged or unreadable.

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FUEL MANIFOLD ASSEMBLY
REMOVAL-27

TASK 49-20-00-050-827

1. **General**

   A. This section contains procedures for removal of the fuel manifold assemblies.

   B. Perform the removal procedures in a dry, bright, clean room.

   C. Be careful to prevent damage to parts that can be used again.

   WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

   D. Apply lubricating oil to parts and put them in a protective container to prevent corrosion until the parts can be cleaned and checked.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   None

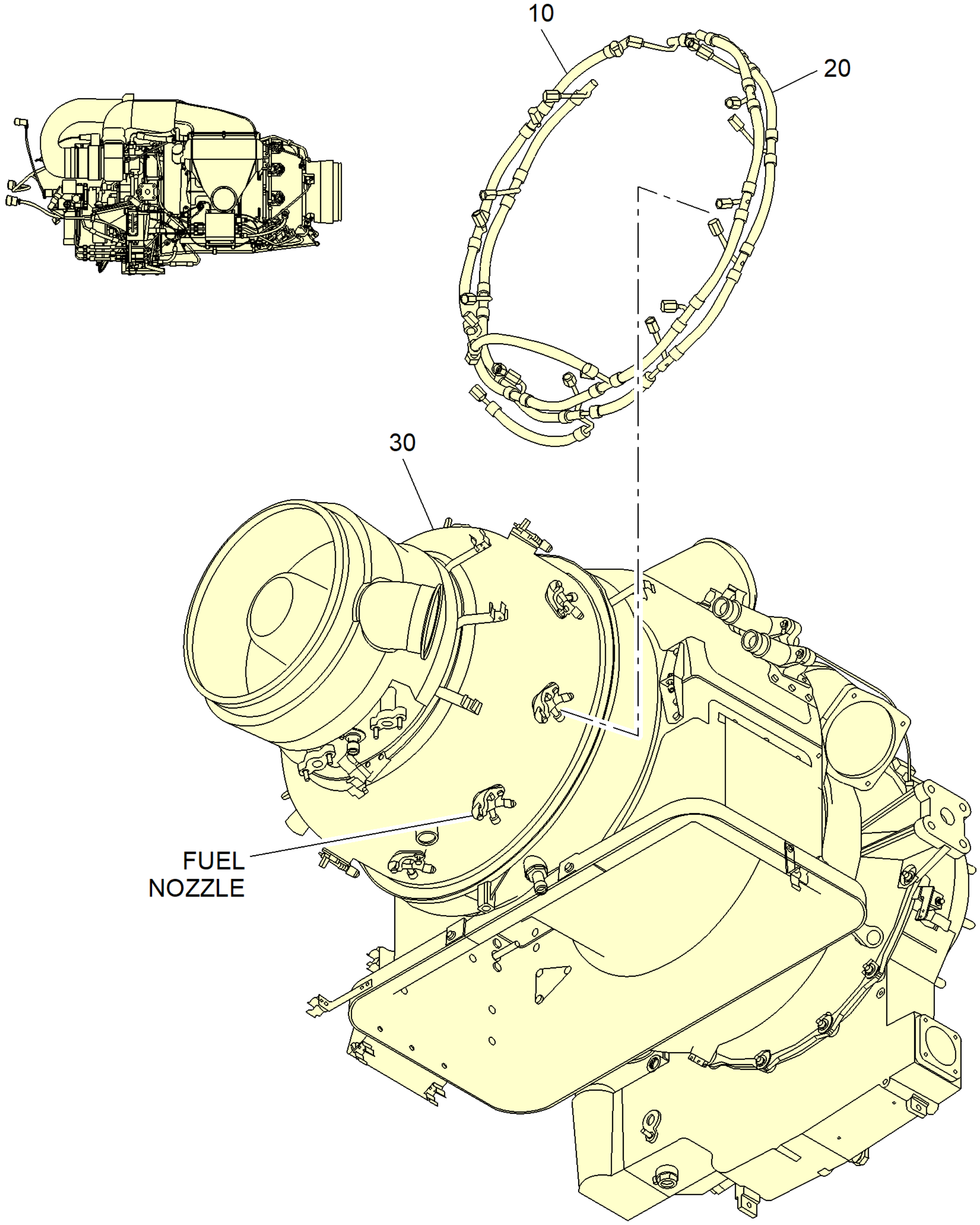

Figure 3001. Removal of Fuel Manifold Assemblies

Key to Figure 3001

10. SECONDARY FUEL MANIFOLD ASSY (IPC FIG. 7)
20. PRIMARY FUEL MANIFOLD ASSY
30. ENGINE ASSY

4. Procedure

SUBTASK 49-20-00-050-028

A. Remove the fuel manifold assemblies. Refer to Figure 3001.

(1) Disconnect secondary fuel manifold assembly (10) and primary fuel manifold assembly (20) from fuel nozzles on the engine assembly (30).

(2) Remove secondary fuel manifold assembly (10) and primary fuel manifold assembly (20) from the engine assembly (30).

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OIL COOLER
REMOVAL-28

TASK 49-20-00-050-828

1. **General**

   A. This section contains procedures for removal of the oil cooler.

   B. Perform the removal procedures in a dry, bright, clean room.

   C. Be careful to prevent damage to parts that can be used again.

   WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

   D. Apply lubricating oil to parts and put them in a protective container to prevent corrosion until the parts can be cleaned and checked.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   None

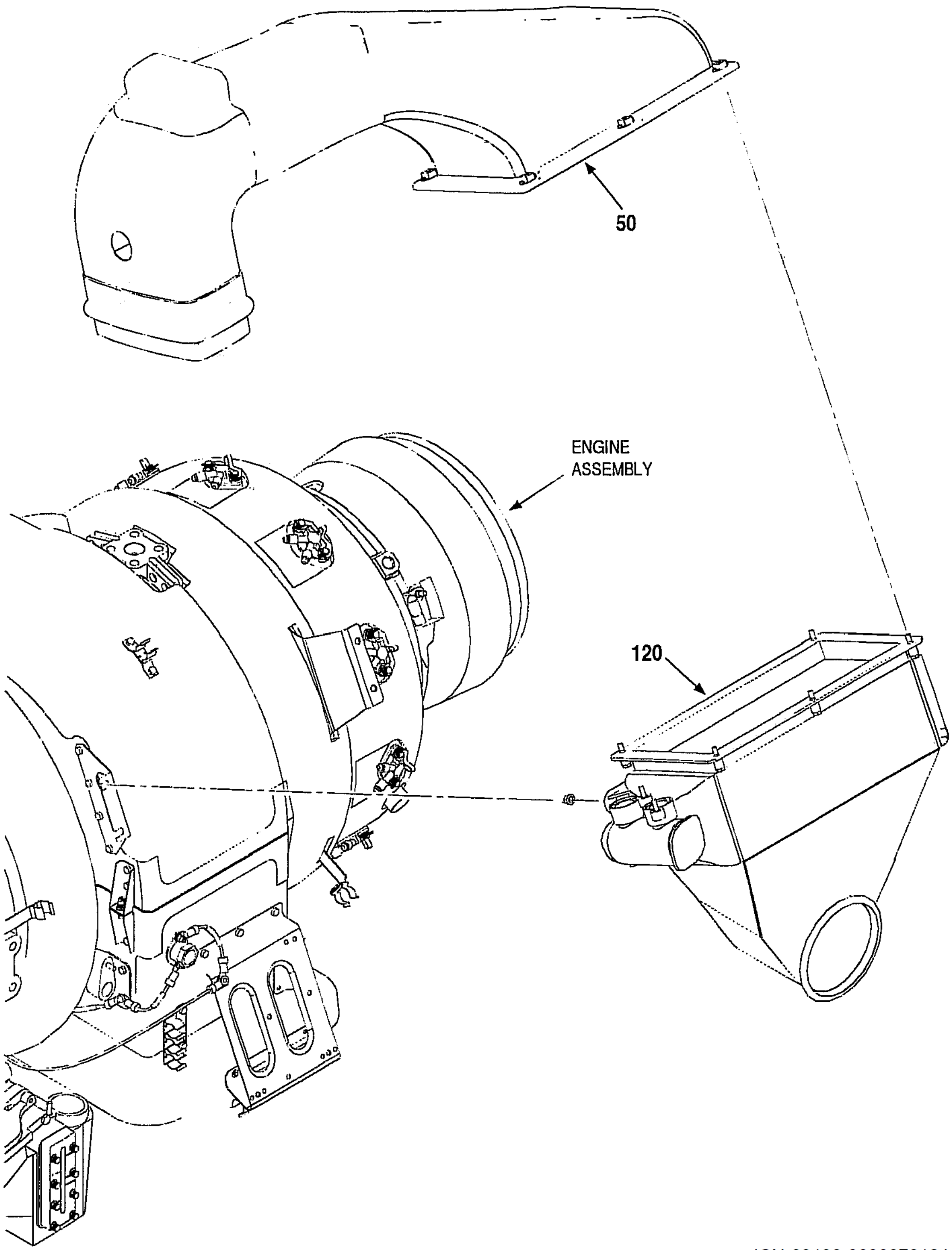

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Figure 3001. Removal of Oil Cooler

Key to Figure 3001

50. EXIT FAN DUCT ASSY (IPC FIG. 3)	120. OIL COOLER (IPC FIG. 4)

4. Procedure

SUBTASK 49-20-00-050-029

A. Remove the oil cooler. Refer to Figure 3001.

(1) Loosen the captive bolts that attach the exit fan duct assembly (50) to oil cooler (120).

(2) Remove the exit fan duct assembly (50) from oil cooler (120).

(3) Loosen the two captive nuts on the left side of the oil cooler (120).

(4) Remove the two mounting bolts on the right side of the oil cooler (120).

(5) Move the oil cooler (120) to the left and remove it from the engine assembly.

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DRAIN MAST BRACKET
REMOVAL-29

TASK 49-20-00-050-829

1. **General**

   A. This section contains procedures for removal of the drain mast bracket.

   B. Perform the removal procedures in a dry, bright, clean room.

   C. Be careful to prevent damage to parts that can be used again.

   WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

   D. Apply lubricating oil to parts and put them in a protective container to prevent corrosion until the parts can be cleaned and checked.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   None

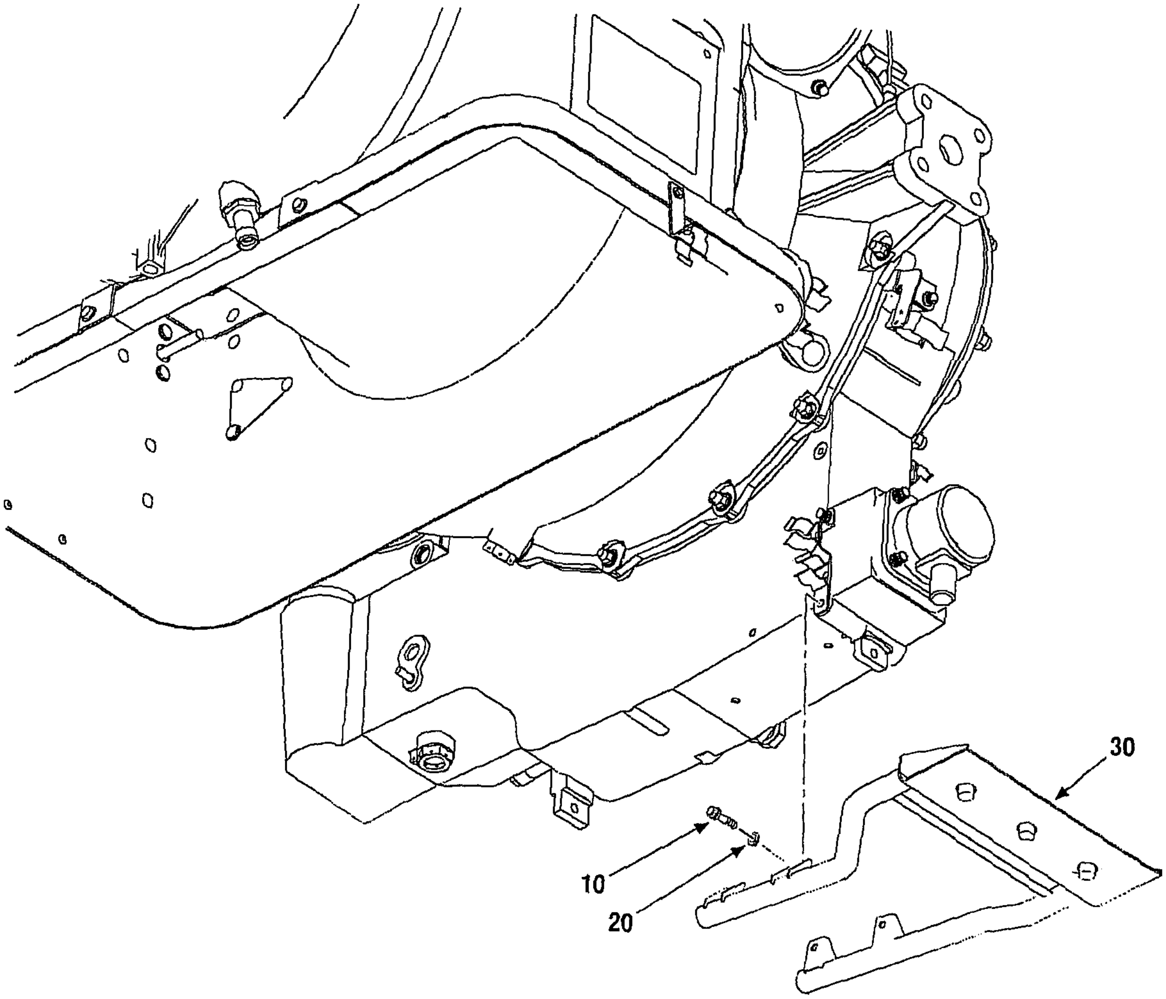

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Figure 3001. Removal of Drain Mast Bracket

Key to Figure 3001

10. BOLT (IPC FIG. 6)
20. WASHER
30. DRAIN MAST BRACKET

4. Procedure

SUBTASK 49-20-00-050-030

A. Remove the drain mast bracket. Refer to Figure 3001.

(1) Remove bolts (10) and washers (20) that attach drain mast bracket (30) to the gearbox.

(2) Remove drain mast bracket (30) from the gearbox.

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OIL HEATER
REMOVAL-30

TASK 49-20-00-050-830

1. General

A. This section contains procedures for removal of the oil heater.

B. Perform the removal procedures in a dry, bright, clean room.

C. Be careful to prevent damage to parts that can be used again.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

D. Apply lubricating oil to parts and put them in a protective container to prevent corrosion until the parts can be cleaned and checked.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

None

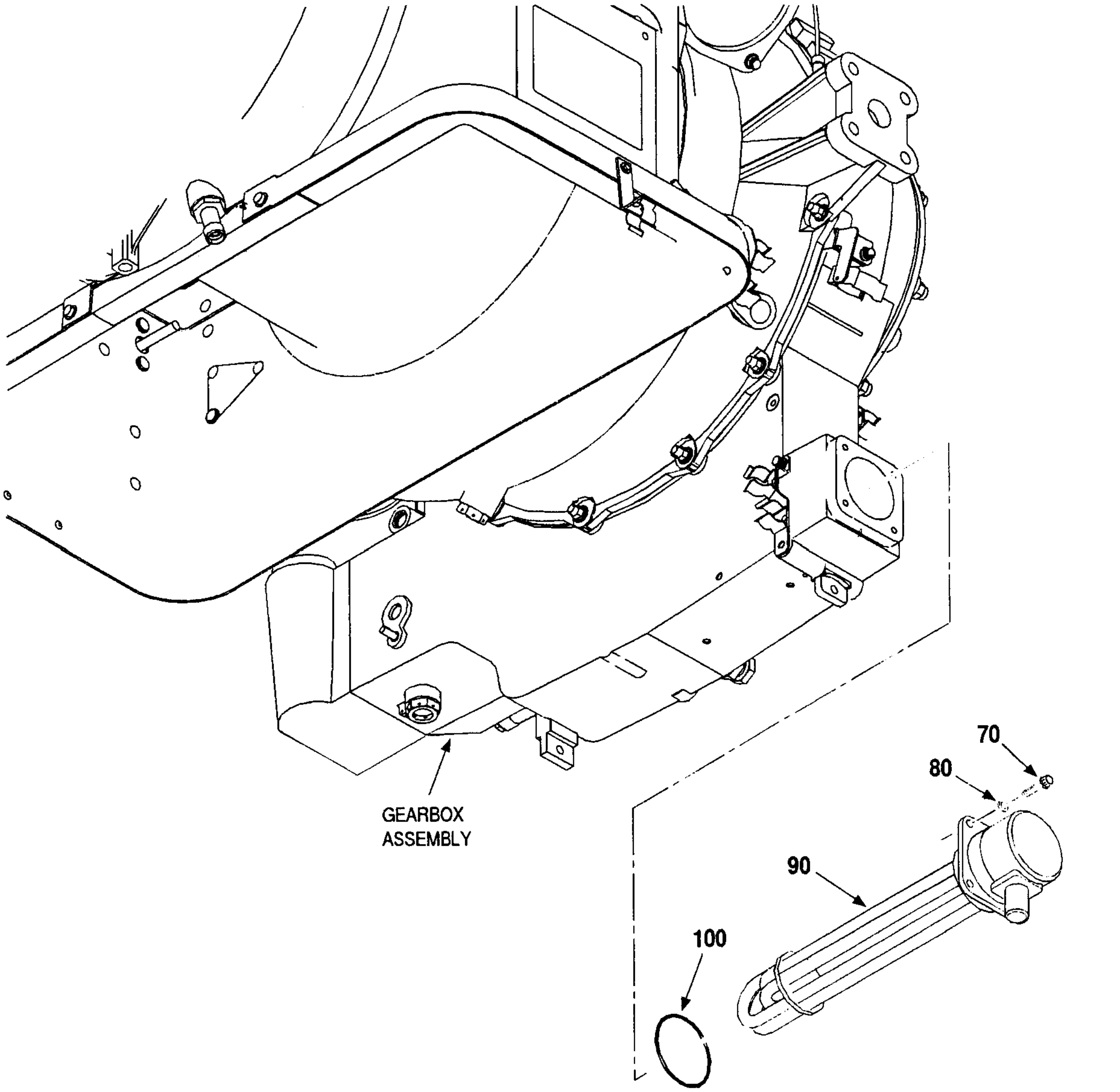

Figure 3001. Removal of Oil Heater

Key to Figure 3001

70.	BOLT (IPC FIG. 6)	- 90A.	HEATER PAD COVER
80.	WASHER	100.	PACKING
90.	OIL HEATER	-.	ITEM NOT ILLUSTRATED

4. Procedure

SUBTASK 49-20-00-050-031

A. (Pre SB 131-49-7946) Remove the oil heater. Refer to Figure 3001.

(1) Remove bolts (70) and washers (80) from oil heater (90).

(2) Remove oil heater (90) with packing (100) from the gearbox.

(3) Remove packing (100) from oil heater (90). Discard packing.

B. (Post SB 131-49-7946) Remove the heater pad cover. Refer to Figure 3001.

(1) Remove bolts (70) and washers (80) from heater pad cover (90A).

(2) Remove heater pad cover (90A) with packing (100) from the gearbox.

(3) Remove packing (100) from heater pad cover (90A). Discard packing.

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UPPER AND LOWER INLET DUCT
REMOVAL-31

TASK 49-20-00-050-831

1. General

A. This section contains procedures for removal of the upper and lower inlet ducts.

B. Perform the removal procedures in a dry, bright, clean room.

C. Be careful to prevent damage to parts that can be used again.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

None

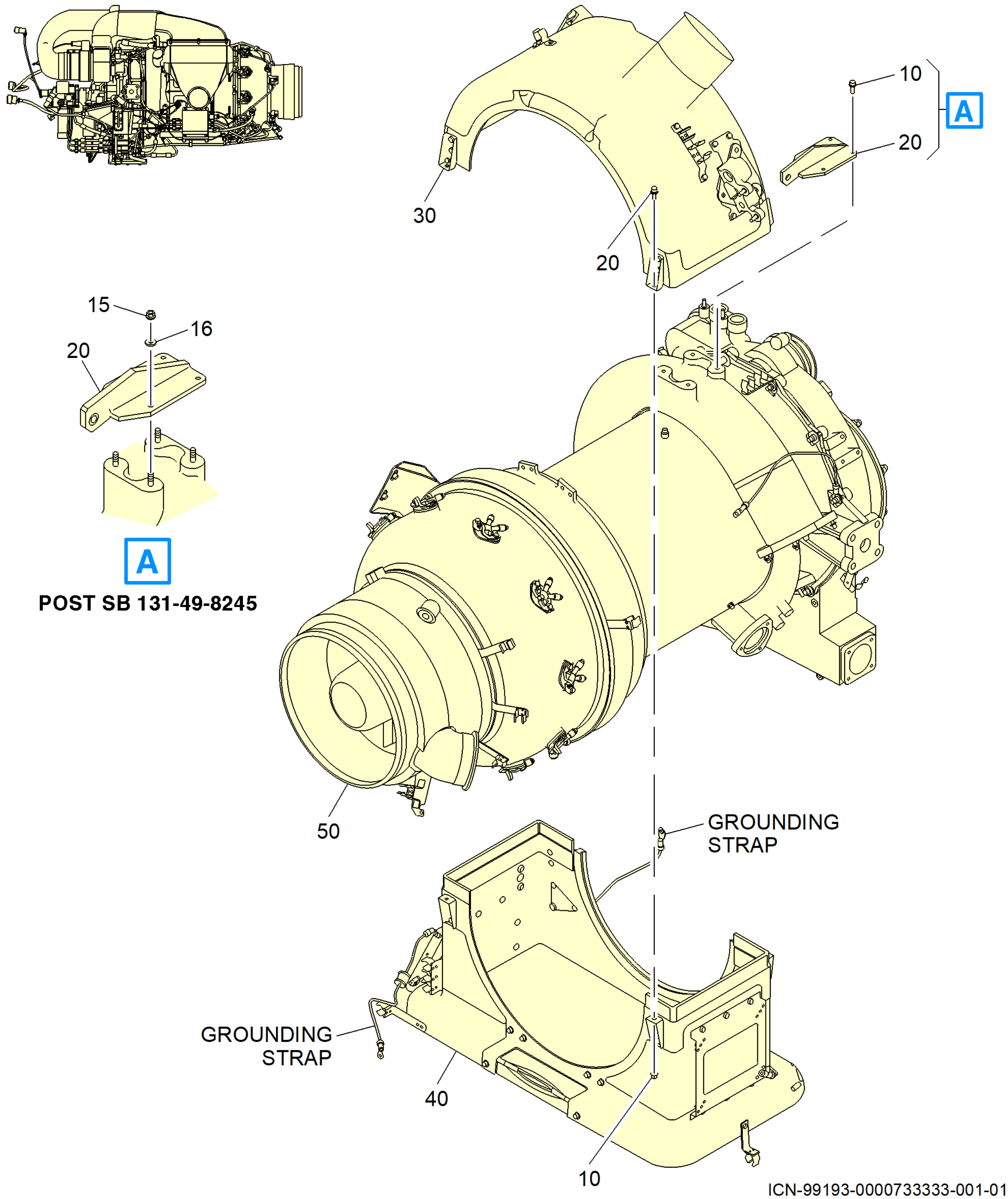

Figure 3001. Removal of Upper and Lower Inlet Duct

Key to Figure 3001

10. BOLT (IPC FIG. 8)	20. BOLT
20. HOIST BRACKET (IPC FIG. 8)	30. UPPER INLET DUCT
10. NUT (IPC FIG. 9)	40. LOWER INLET DUCT
15. NUT	50. ENGINE ASSEMBLY
16. WASHER	

4. Procedure

SUBTASK 49-20-00-050-032

A. Remove the upper and lower inlet ducts. Refer to Figure 3001.

(1) Disconnect retaining straps and remove nut (10) and bolt (20).

(2) Remove upper inlet duct (30) and lower inlet duct (40) from the engine assembly.

B. Disassemble hoist bracket from engine assembly (50).

(1) (Pre SB 131-49-8245) Remove bolts (10) from hoist bracket (20).

(2) (POST SB 131-49-8245) Remove nuts (15) and washers(16) from hoist bracket (20).

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GEARBOX ASSEMBLY
REMOVAL-32

TASK 49-20-00-020-832

1. General

A. This section contains procedures for removal of the gearbox assembly.

B. Perform the removal procedures in a dry, bright, clean room.

C. Be careful to prevent damage to parts that can be used again.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

D. Apply lubricating oil to parts and put them in a protective container to prevent corrosion until the parts can be cleaned and checked.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

None

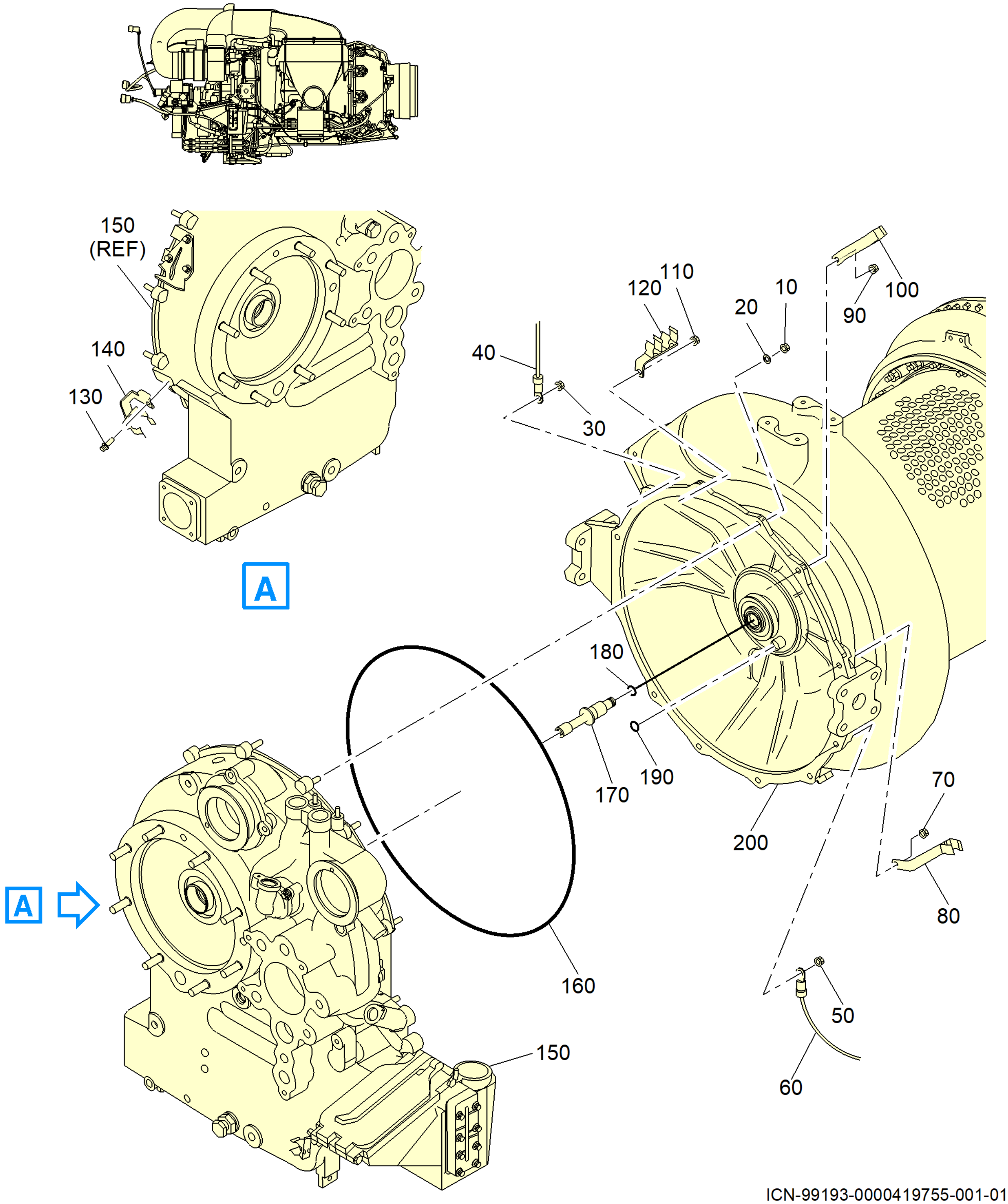

Figure 3001. Removal of Gearbox Assembly

Key to Figure 3001

10. NUT (IPC FIG. 10)	110. NUT
20. WASHER	120. BRACKET
30. NUT	130. BOLT
40. GROUNDING STRAP	140. BRACKET
50. NUT	150. GEARBOX ASSY
60. GROUNDING STRAP	160. PACKING
70. NUT	170. QUILL SHAFT
80. BRACKET	180. PACKING
90. NUT	190. PACKING
100. BRACKET	200. POWER SECTION ASSEMBLY

4. Procedure

SUBTASK 49-20-00-020-033

A. Remove the gearbox assembly. Refer to Figure 3001.

(1) Remove nuts (10) and washers (20).

(2) Remove nuts (30, 50) and grounding straps (40, 60).

(3) Remove nuts (70, 90, 110) and brackets (80, 100, 120).

(4) Remove bolt (130) and bracket (140).

(5) Remove the gearbox assembly (150) with packing (160) from the power section assembly. Discard packing.

(6) Remove quill shaft (170) and packing (180). Discard packing.

(7) Remove packing (190) from the lubricating nozzle assembly. Discard packing.

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GENERAL
INSTALLATION-01

TASK 49-20-00-400-801

1. General

A. This section contains general procedures for installation of accessory components and modules on the APU.

B. For most of the installation procedures, the APU will be supported by PN 834991-1 cart assembly.

2. Special Tools, Fixtures and Equipment

A. Table 4001 shows the necessary special tools, fixtures and equipment for installation.

Table 4001. Special Tools, Fixtures and Equipment

Nomenclature	Use	Part No.
NOTE: Equivalent tools, fixtures and equipment can be used.		
Portable Engine Stand/Cart	Build and test cart for APU. Component of PN 834991-1.	834990-1
Cart Assembly	Includes PN 834990-1 engine stand/cart, PN 834991-2 rear vertical frame, PN 834991-3 and PN 834991-4 driven support arm.	834991-1
Rear Vertical Frame	Support APU on top side on cart. Component of PN 834991-1.	834991-2
Driven Support Arm	Adapt engine mount (left mount) to transport cart. Component of PN 834991-1.	834991-3
Driven Support Arm	Adapt engine mount (right mount) to transport cart. Component of PN 834991-1.	834991-4

3. Equipment and Materials

A. Table 4002 shows the necessary equipment and materials for installation.

Table 4002. Equipment and Materials

Equipment/Materials	Description/Manufacturer
NOTE: Equivalent equipment/materials can be used.	
Anti-seize compound (C5-A Copper Based)	CAGE: 5BAM3
Anti-seize lubricant (Liqui-Moly, Brand NV Thread Compound) (MIL-PRF-907)	CAGE: 98112

Table 4002. Equipment and Materials (Cont)

Equipment/Materials	Description/Manufacturer
Corrosion-preventive compound (Braycote 248) (MIL-C-11796, Class 3)	CAGE: 4RRP4
Oil (MIL-PRF-7808 or MIL-PRF-23699)	Commercially available

4. Expendable Parts

None

5. Procedure

SUBTASK 49-20-00-410-001

A. Install the APU on the PN 834991-1 cart assembly.

(1) Install PN 834991-4 driven support arm on the APU right mount.

(2) Install PN 834991-3 driven support arm on the APU left mount.

(3) Install the APU in PN 834990-1 portable engine stand/cart as follows:

(a) Position the APU in PN 834990-1 portable engine stand/cart with the right side next to the hand crank on the portable engine stand/cart.

(b) Attach the APU to the PN 834990-1 portable engine stand/cart.

(c) Install PN 834991-2 rear vertical frame on PN 834990-1 portable engine stand/cart.

(d) Attach PN 834990-1 portable engine stand/cart turnbuckle to PN 834991-2 rear vertical frame and the top of the rear mount on the APU.

(4) Remove lifting adapter from the APU.

FUEL MANIFOLD ASSEMBLY INSTALLATION-02

TASK 49-20-00-450-802

1. General

A. This section contains procedures for installation of the fuel manifold assemblies.

B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

None

4. Expendable Parts

None

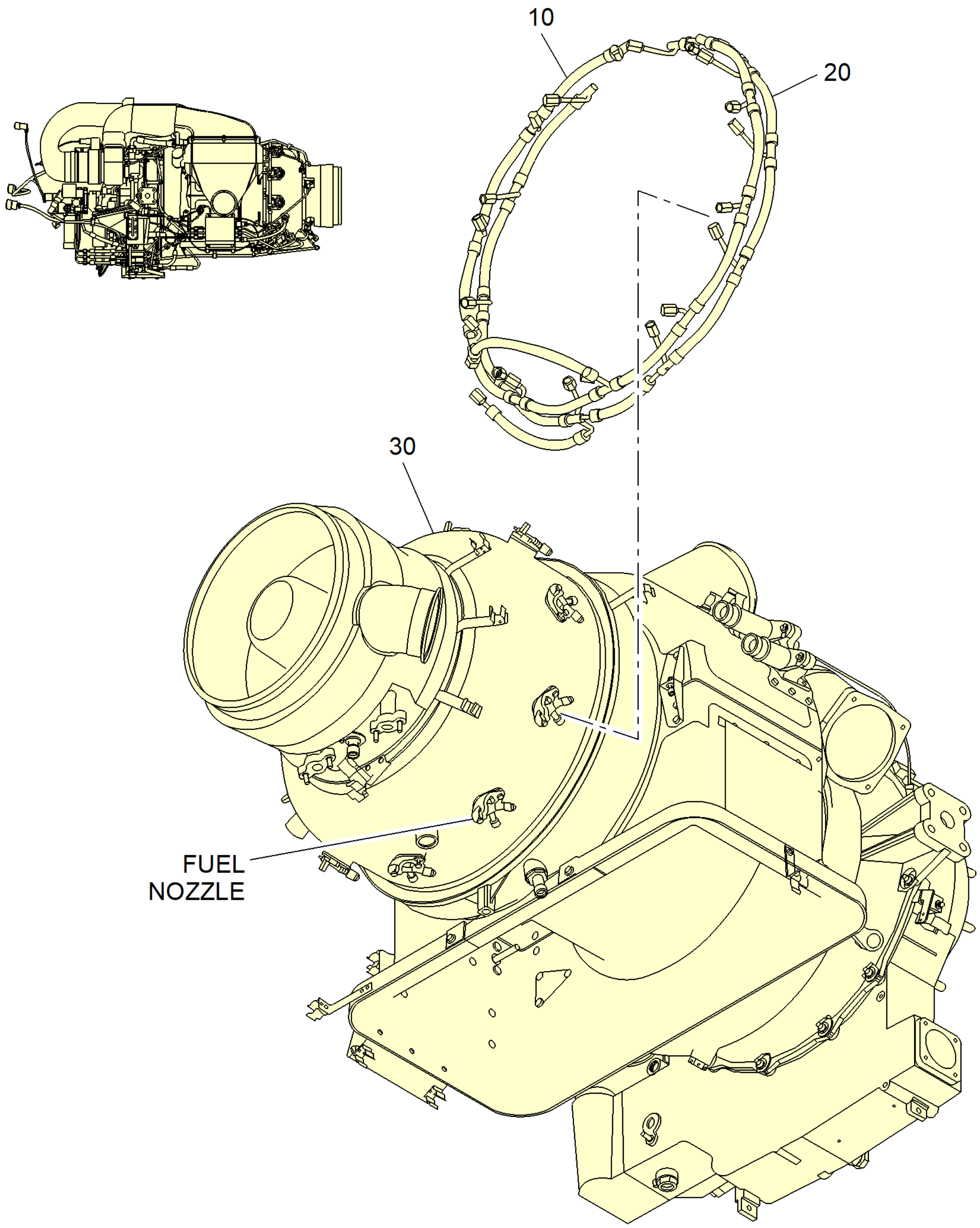

Figure 4001. Installation of Fuel Manifold Assemblies

Key to Figure 4001

10. SECONDARY FUEL MANIFOLD ASSY (IPC FIG. 7)
20. PRIMARY FUEL MANIFOLD ASSY
30. ENGINE ASSY

5. **Procedure**

SUBTASK 49-20-00-450-002

A. Install the fuel manifold assemblies. Refer to Figure 4001.

(1) Install the secondary and primary fuel manifold assemblies (10, 20) on the engine assembly (30).

(2) Connect the secondary and primary fuel manifold assemblies (10, 20) to the fuel nozzles on the engine assembly (30). Tighten fittings to a torque value of 120 in-lb (13.56 Nm).

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GEARBOX ASSEMBLY INSTALLATION-03

TASK 49-20-00-450-803

1. **General**

   A. This section contains procedures for installation of the gearbox assembly.

   B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

   C. All the nuts, bolts and screws must be tightened to a standard torque and tolerance unless the torque is specified in the text. Refer to Standard Practices Manual (SPM) 20-00-02/70-00-01 for the standard torque.

   D. When screws or bolts are too long or too short, a longer or shorter standard screw or bolt can be used if there is a minimum of one full thread more than the face of the threaded part or nut.

   NOTE: There are no alternate screw or bolt lengths permitted for blind hole applications.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   A. Table 4001 shows the necessary equipment and materials for installation.

Table 4001. Equipment and Materials

Equipment/Materials	Description/Manufacturer
NOTE: Equivalent equipment/materials can be used.	
Corrosion-preventive compound (Braycote 248) (MIL-C-11796, Class 3)	CAGE: 4RRP4
HYLOMAR Advance Formulation HV (Alternate to Braycote 248 for packing 160)	CAGE: 98112
Oil (MIL-PRF-7808 or MIL-PRF-23699)	Commercially available

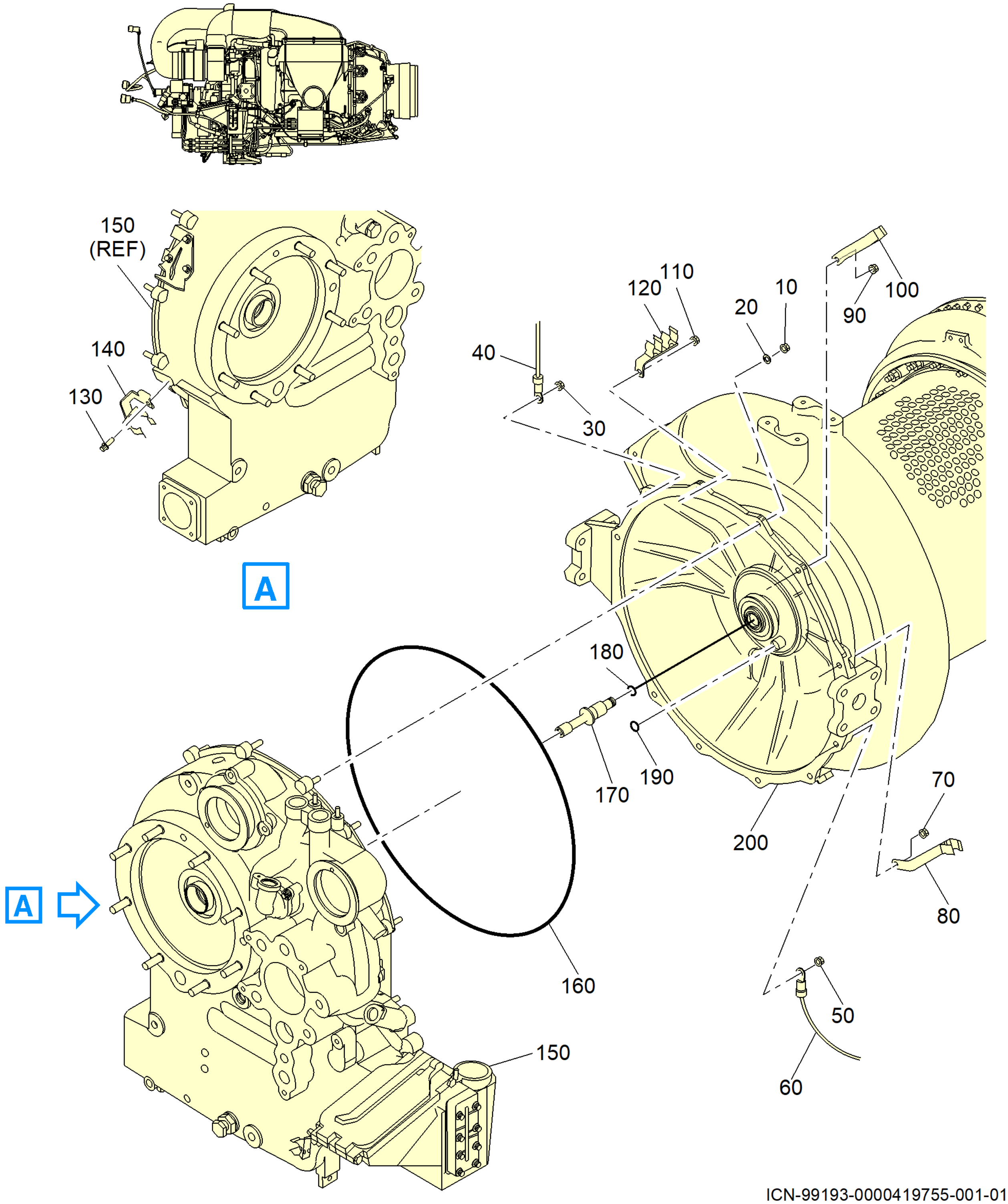


Figure 4001. Installation of Gearbox Assembly

Key to Figure 4001

10. NUT (IPC FIG. 10)
20. WASHER
30. NUT
40. GROUNDING STRAP
50. NUT
60. GROUNDING STRAP
70. NUT
80. BRACKET
90. NUT
100. BRACKET
110. NUT
120. BRACKET
130. BOLT
140. BRACKET
150. GEARBOX ASSY
160. PACKING
170. QUILL SHAFT
180. PACKING
190. PACKING
200. POWER SECTION ASSEMBLY

4. Expendable Parts

A. Honeywell recommends that the parts shown in Table 4002 must be replaced at each installation. However, actual replacement of parts can be done on in-service experience.

Table 4002. Parts to be Replaced at Each Installation

Figure No.	Item No.	Nomenclature	Quantity
Figure 4001	160	Packing	1
	180	Packing	1
	190	Packing	1

5. Procedure

SUBTASK 49-20-00-450-003

A. Install the gearbox assembly. Refer to Figure 4001.

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

(1) Lubricate new packing (190) with MIL-PRF-7808 or MIL-PRF-23699 oil.

(2) Install packing (190) on the lubricating nozzle assembly in the gearbox assembly.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

(3) Lubricate new packing (180) with MIL-PRF-7808 or MIL-PRF-23699 oil.

(4) Install packing (180) on quill shaft (170).

(5) Install quill shaft (170) with packing in the engine assembly.

WARNING: **USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.**

(6) Lubricate new packing (160) with corrosion-preventive compound or HYLOMAR advance formulation HV .

(7) Install packing (160) on gearbox assembly (150).

(8) Install gearbox assembly (150) with packing (160) on the engine assembly. Turn the starter as necessary to align gears during installation.

NOTE: Pre-oil engine duplex bearing before installation of gearbox assembly.

(9) Install washers (20) and nuts (10). Tighten nuts (10) to a torque value of 100 in-lb (11.30 Nm).

(10) Attach bracket (140) to the engine assembly with bolt (130). Refer to View A.

(11) Attach brackets (80, 100, 120) to the engine assembly with nuts (70, 90, 110). Tighten nuts (70, 90, 110) to a torque value of 100 in-lb (11.30 Nm).

(12) Attach grounding straps (40, 60) to the engine assembly with nuts (30, 50). Tighten nuts (30, 50) to a torque value of 100 in-lb (11.30 Nm).

INLET GUIDE VANE ACTUATOR (IGVA) INSTALLATION-04

TASK 49-20-00-450-804

1. **General**

   A. This section contains procedures for installation of the inlet guide vane actuator.

   B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

   C. All the nuts, bolts and screws must be tightened to a standard torque and tolerance unless the torque is specified in the text. Refer to Standard Practices Manual (SPM) 20-00-02/70-00-01 for the standard torque.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

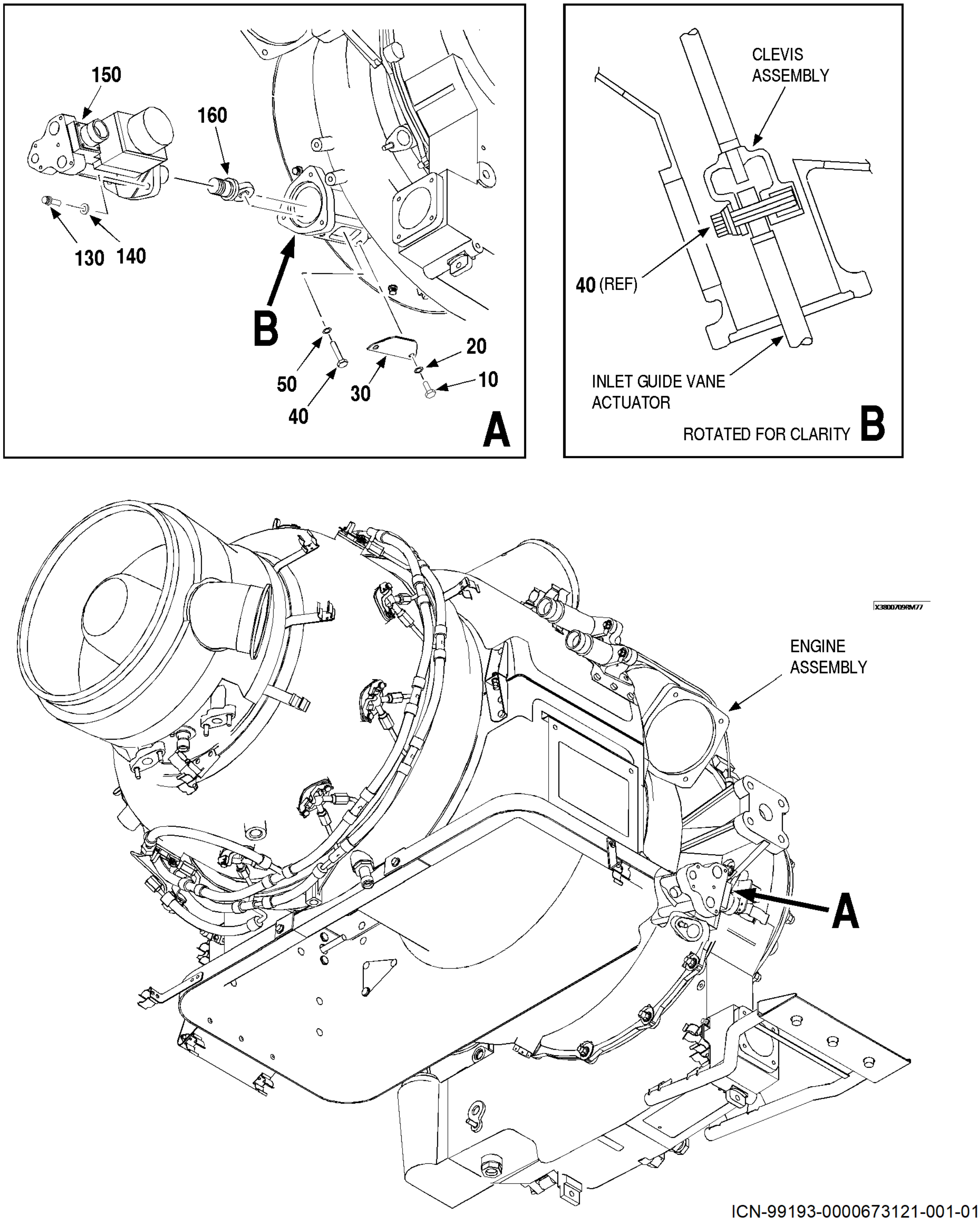
   A. Table 4001 shows the necessary equipment and materials for installation.

Table 4001. Equipment and Materials

Equipment/Materials	Description/Manufacturer
NOTE: Equivalent equipment/materials can be used.	
Oil (MIL-PRF-7808 or MIL-PRF-23699)	Commercially available

4. **Expendable Parts**

   None



ICN-99193-0000673121-001-01

Figure 4001. Installation of Inlet Guide Vane Actuator

Key to Figure 4001

10. BOLT (IPC FIG. 22)
20. WASHER
30. COVER
40. BOLT
50. WASHER
130. BOLT (IPC FIG. 6)
140. WASHER
150. INLET GUIDE VANE ACTUATOR
160. ROD END

---

5. Procedure

SUBTASK 49-20-00-450-004

A. Install the IGVA. Refer to Figure 4001.

(1) Install rod end (160) on the IGVA (150). Tighten rod end to a torque value of 30 in-lb (3.39 Nm).

(2) Put IGVA (150) into the engine assembly and attach to the clevis assembly with bolt (40) and washer (50). Tighten bolt to a torque value of 50 in-lb (5.65 Nm). Refer to Views A and B.

(3) Push IGVA (150) onto the engine assembly and attach with bolts (130) and washers (140). Tighten bolts to a torque value of 120 in-lb (13.56 Nm).

(4) Install IGVA clevis access cover (30) with bolts (10) and washers (20). Tighten both bolts to a torque value of 50 in-lb (5.65 Nm).

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UPPER AND LOWER INLET DUCT INSTALLATION-05

TASK 49-20-00-450-805

1. **General**

   A. This section contains procedures for installation of the upper and lower inlet ducts.

   B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   None

4. **Expendable Parts**

   None

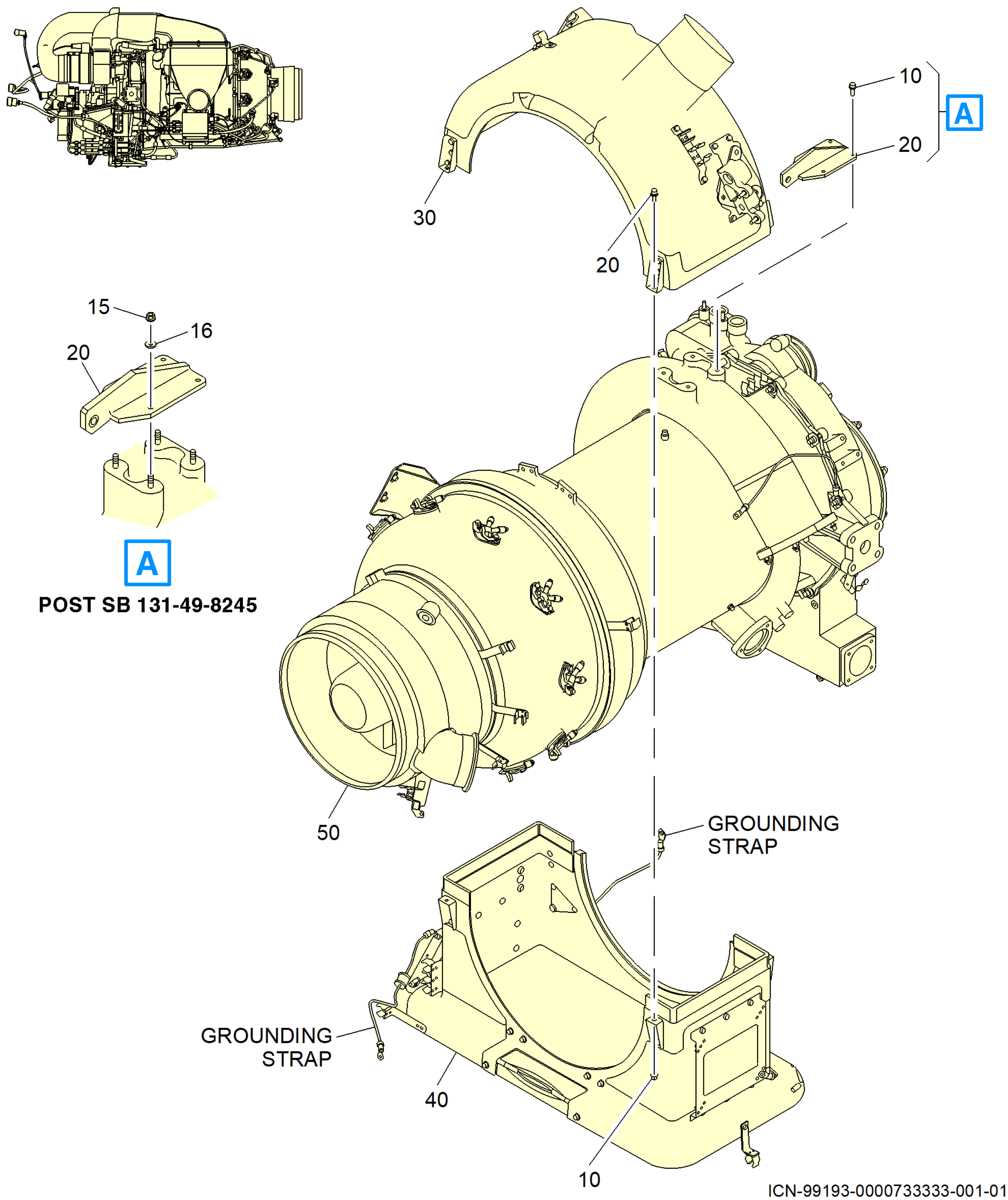

Figure 4001. Installation of Upper and Lower Inlet Duct

Key to Figure 4001

10. BOLT (IPC FIG. 8)	20. BOLT
20. HOIST BRACKET (IPC FIG. 8)	30. UPPER INLET DUCT
10. NUT (IPC FIG. 9)	40. LOWER INLET DUCT
15. NUT	50. ENGINE ASSEMBLY
16. WASHER	

5. Procedure

SUBTASK 49-20-00-450-005

A. Install the upper and lower inlet ducts. Refer to Figure 4001.

CAUTION: MAKE SURE RUBBER SEAL ALIGNS ON AFT SECTION OF ENGINE.

(1) Install upper and lower inlet ducts (30, 40) on the engine assembly.

(2) Attach upper inlet duct (30) to the lower inlet duct (40) with bolts (20) and nuts (10). Tighten nuts to a torque value of 15 in-lb (1.69 Nm).

(3) (PRE SB 131-49-8245) Install hoist bracket (20) on engine assembly with bolts (10). Tighten bolts to a torque value of 40 in-lb (4.52 Nm).

(4) (POST SB 131-49-8245) Install hoist bracket (20) on engine assembly with washers (16) and nuts (15). Tighten nuts to a torque value of 40 in-lb (4.52 Nm).

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DIFFERENTIAL PRESSURE TRANSDUCER (DP) INSTALLATION-06

TASK 49-20-00-450-806

1. **General**

   A. This section contains procedures for installation of the differential pressure transducer.

   B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

   C. All the nuts, bolts and screws must be tightened to a standard torque and tolerance unless the torque is specified in the text. Refer to Standard Practices Manual (SPM) 20-00-02/70-00-01 for the standard torque.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   A. Table 4001 shows the necessary equipment and materials for installation.

Table 4001. Equipment and Materials

Equipment/Materials	Description/Manufacturer
NOTE: Equivalent equipment/materials can be used.	
Oil (MIL-PRF-7808 or MIL-PRF-23699)	Commercially available

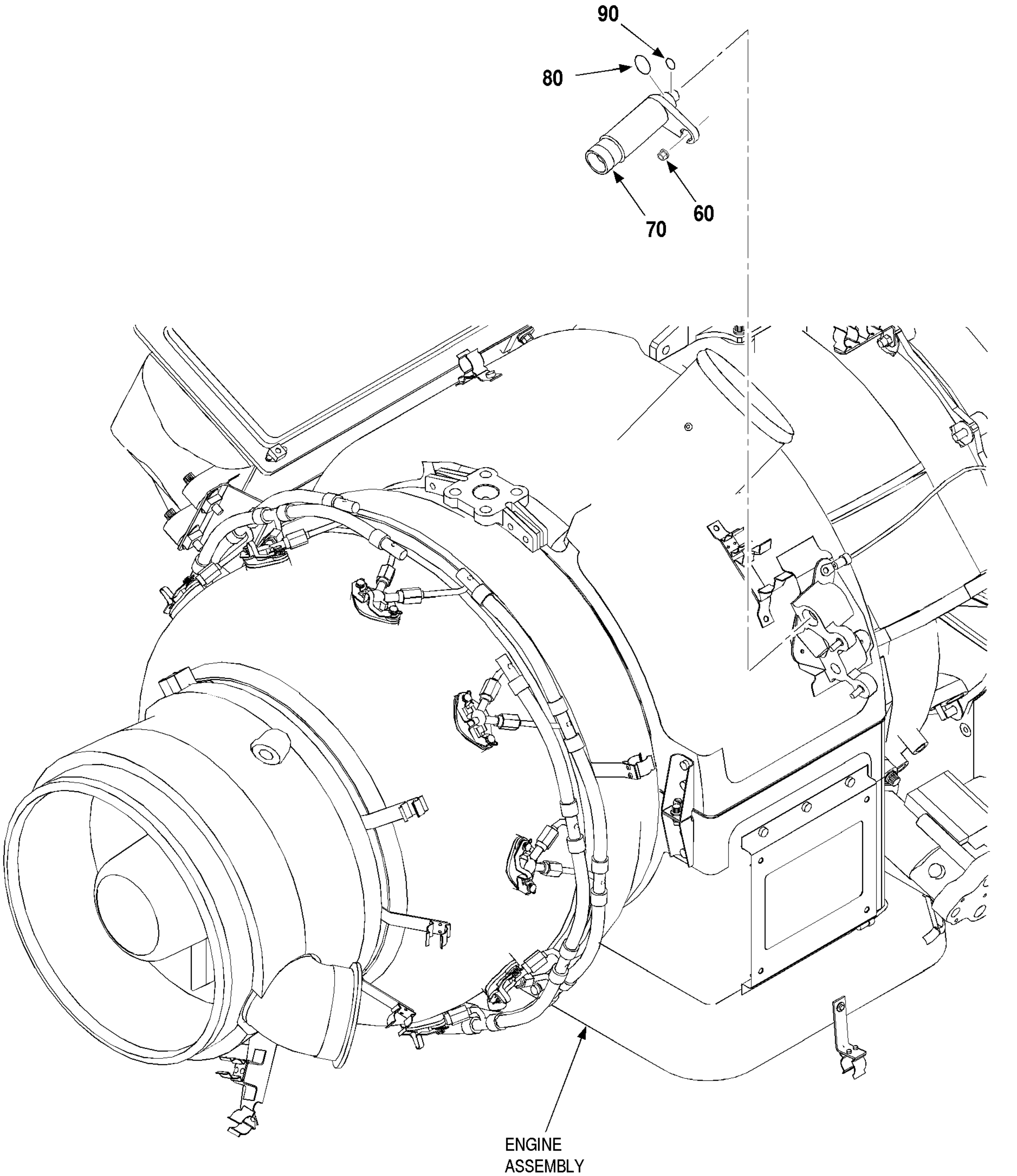

Figure 4001. Installation of Differential Pressure Transducer

Key to Figure 4001

60. NUT (IPC FIG. 8)
70. DIFFERENTIAL PRESSURE TRANSDUCER
80. PACKING
90. PACKING

4. Expendable Parts

A. Honeywell recommends that the parts shown in Table 4002 must be replaced at each installation. However, actual replacement of parts can be done on in-service experience.

Table 4002. Parts to be Replaced at Each Installation

Figure No.	Item No.	Nomenclature	Quantity
Figure 4001	80	Packing	1
	90	Packing	1

5. Procedure

SUBTASK 49-20-00-450-006

A. Install differential pressure transducer. Refer to Figure 4001.

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

(1) Lubricate new packings (80, 90) with MIL-PRF-7808 or MIL-PRF-23699 oil.

(2) Put packings (80, 90) on the differential pressure transducer (70).

(3) Install differential pressure transducer (70) with packings (80, 90) on the engine assembly.

(a) Attach differential pressure transducer (70) to engine assembly with nut (60). Tighten nut to a torque value of 40 in-lb (4.52 Nm).

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TOTAL PRESSURE TRANSDUCER (PT) INSTALLATION-07

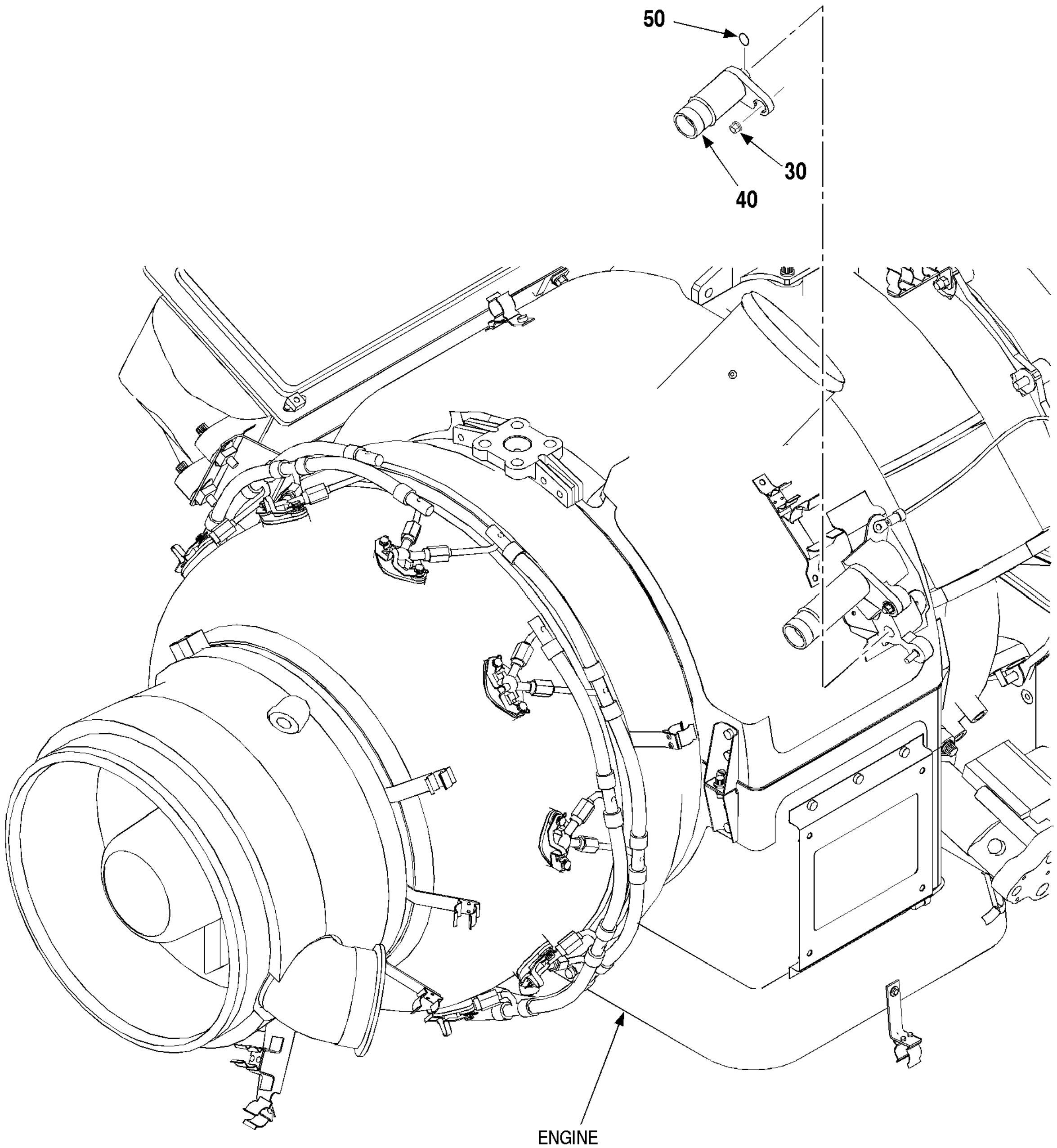
TASK 49-20-00-450-807

1. **General**
   - A. This section contains procedures for installation of the total pressure transducer.
   - B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.
   - C. All the nuts, bolts and screws must be tightened to a standard torque and tolerance unless the torque is specified in the text. Refer to Standard Practices Manual (SPM) 20-00-02/70-00-01 for the standard torque.
2. **Special Tools, Fixtures and Equipment**

   None
3. **Equipment and Materials**
   - A. Table 4001 shows the necessary equipment and materials for installation.

Table 4001. Equipment and Materials

Equipment/Materials	Description/Manufacturer
NOTE: Equivalent equipment/materials can be used.	
Oil (MIL-PRF-7808 or MIL-PRF-23699)	Commercially available



ICN-99193-0000673113-001-01

Figure 4001. Installation of Total Pressure Transducer

Key to Figure 4001

30. NUT (IPC FIG. 8)
40. TOTAL PRESSURE TRANSDUCER
50. PACKING

4. Expendable Parts

A. Honeywell recommends that the parts shown in Table 4002 must be replaced at each installation. However, actual replacement of parts can be done on in-service experience.

Table 4002. Parts to be Replaced at Each Installation

Figure No.	Item No.	Nomenclature	Quantity
Figure 4001	50	Packing	1

5. Procedure

SUBTASK 49-20-00-450-007

A. Install total pressure transducer. Refer to Figure 4001.

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

(1) Lubricate new packing (50) with MIL-PRF-7808 or MIL-PRF-23699 oil.

(2) Put packing (50) on the total pressure transducer (40).

(3) Install total pressure transducer (40) with packing (50) on the engine assembly.

(a) Attach total pressure transducer (40) to engine assembly with nut (30). Tighten nut to a torque value of 40 in-lb (4.52 Nm).

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INLET PRESSURE TRANSDUCER (P2) INSTALLATION-08

TASK 49-20-00-450-808

1. **General**

   A. This section contains procedures for installation of the inlet pressure transducer.

   B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

   C. All the nuts, bolts and screws must be tightened to a standard torque and tolerance unless the torque is specified in the text. Refer to Standard Practices Manual (SPM) 20-00-02/70-00-01 for the standard torque.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   A. Table 4001 shows the necessary equipment and materials for installation.

Table 4001. Equipment and Materials

Equipment/Materials	Description/Manufacturer
NOTE: Equivalent equipment/materials can be used.	
Oil (MIL-PRF-7808 or MIL-PRF-23699)	Commercially available

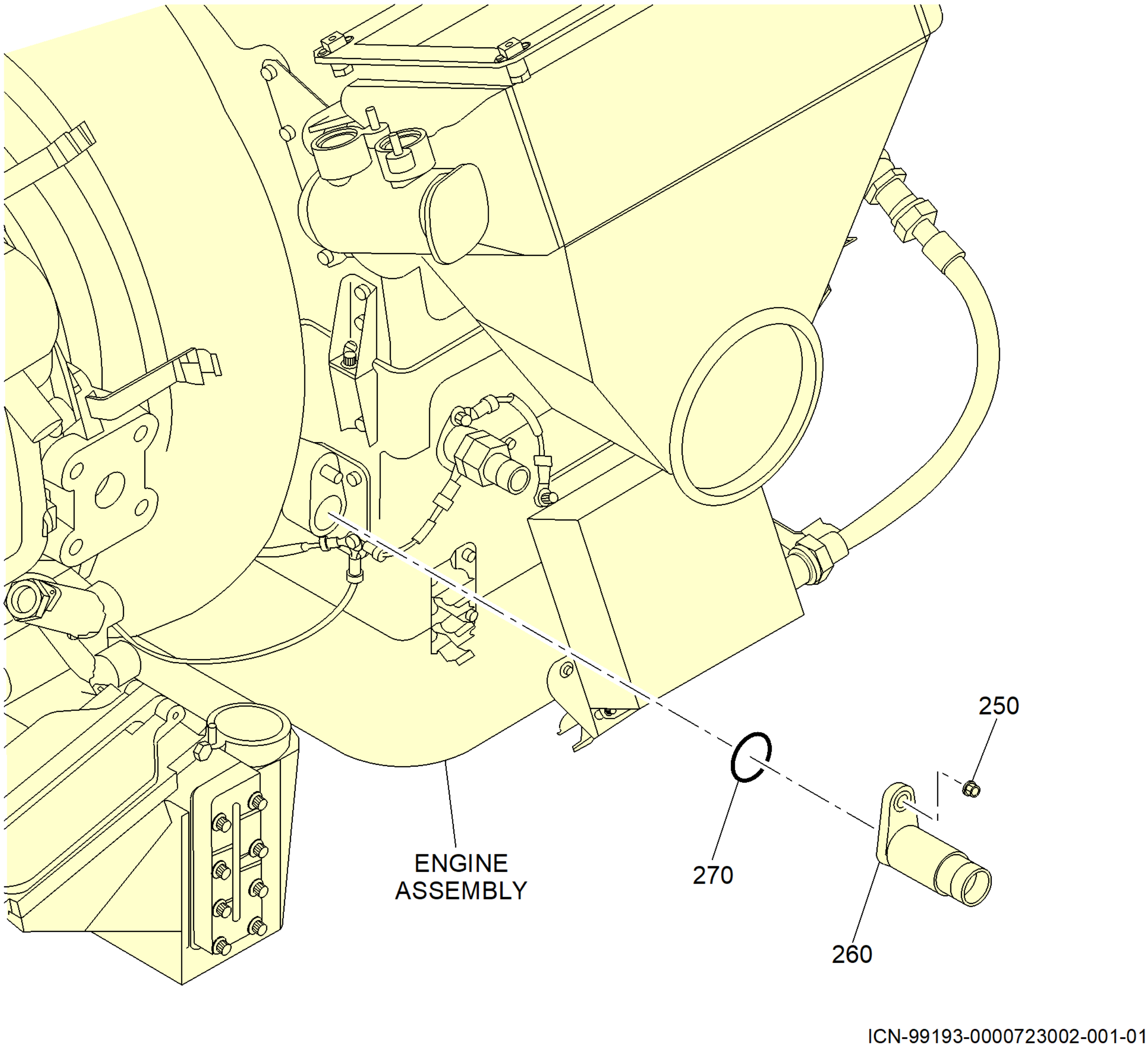

Figure 4001. Installation of Inlet Pressure Transducer

Key to Figure 4001

250. NUT (IPC FIG. 4)

260. INLET PRESSURE TRANSDUCER

270. PACKING

4. Expendable Parts

A. Honeywell recommends that the parts shown in Table 4002 must be replaced at each installation. However, actual replacement of parts can be done on in-service experience.

Table 4002. Parts to be Replaced at Each Installation

Figure No.	Item No.	Nomenclature	Quantity
Figure 4001	270	Packing	1

5. Procedure

SUBTASK 49-20-00-450-008

A. Install inlet pressure transducer. Refer to Figure 4001.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

(1) Lubricate new packing (270) with MIL-PRF-7808 or MIL-PRF-23699 oil.

(2) Put packing (270) on the inlet pressure transducer (260).

(3) Install inlet pressure transducer (260) with packing (270) on the engine assembly.

(a) Attach inlet pressure transducer (260) to engine assembly with nut (250). Tighten nut to a torque value of 40 in-lb (4.52 Nm).

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INLET TEMPERATURE SENSOR (T2) INSTALLATION-09

TASK 49-20-00-450-809

1. **General**

   A. This section contains procedures for installation of the inlet temperature sensor.

   B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   None

4. **Expendable Parts**

   A. Honeywell recommends that the parts shown in Table 4001 must be replaced at each installation. However, actual replacement of parts can be done on in-service experience.

Table 4001. Parts to be Replaced at Each Installation

Figure No.	Item No.	Nomenclature	Quantity
Figure 4001	240	Gasket	1

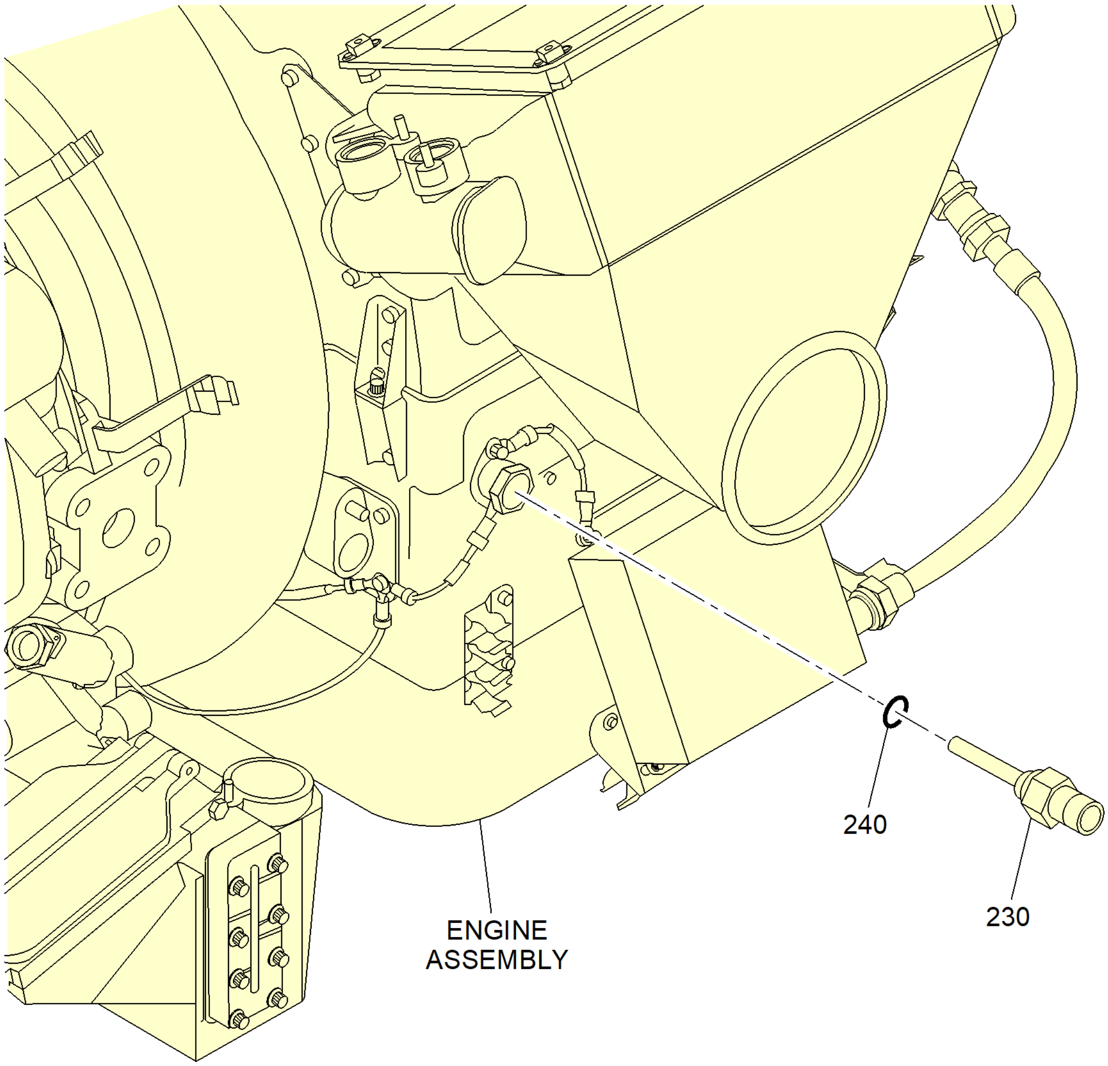

Figure 4001. Installation of Inlet Temperature Sensor (T2)

Key to Figure 4001

230. INLET TEMPERATURE SENSOR (IPC FIG. 4)	240. GASKET

5. Procedure

SUBTASK 49-20-00-450-009

A. Install the inlet temperature sensor. Refer to Figure 4001.

(1) Install gasket (240) on inlet temperature sensor (230).

(2) Install inlet temperature sensor (230) with gasket (240) on the engine assembly. Tighten inlet temperature sensor to a torque value of 230 in-lb (25.99 Nm).

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SPEED SENSOR
INSTALLATION-10

TASK 49-20-00-450-810

1. **General**

   A. This section contains procedures for installation of the speed sensor.

   B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

   C. All the nuts, bolts and screws must be tightened to a standard torque and tolerance unless the torque is specified in the text. Refer to Standard Practices Manual (SPM) 20-00-02/70-00-01 for the standard torque.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   A. Table 4001 shows the necessary equipment and materials for installation.

Table 4001. Equipment and Materials

Equipment/Materials	Description/Manufacturer
NOTE: Equivalent equipment/materials can be used.	
Oil (MIL-PRF-7808 or MIL-PRF-23699)	Commercially available

4. **Expendable Parts**

   A. Honeywell recommends that the parts shown in Table 4002 must be replaced at each installation. However, actual replacement of parts can be done on in-service experience.

Table 4002. Parts to be Replaced at Each Installation

Figure No.	Item No.	Nomenclature	Quantity
Figure 4001	190	Packing	1
	200	Packing	1

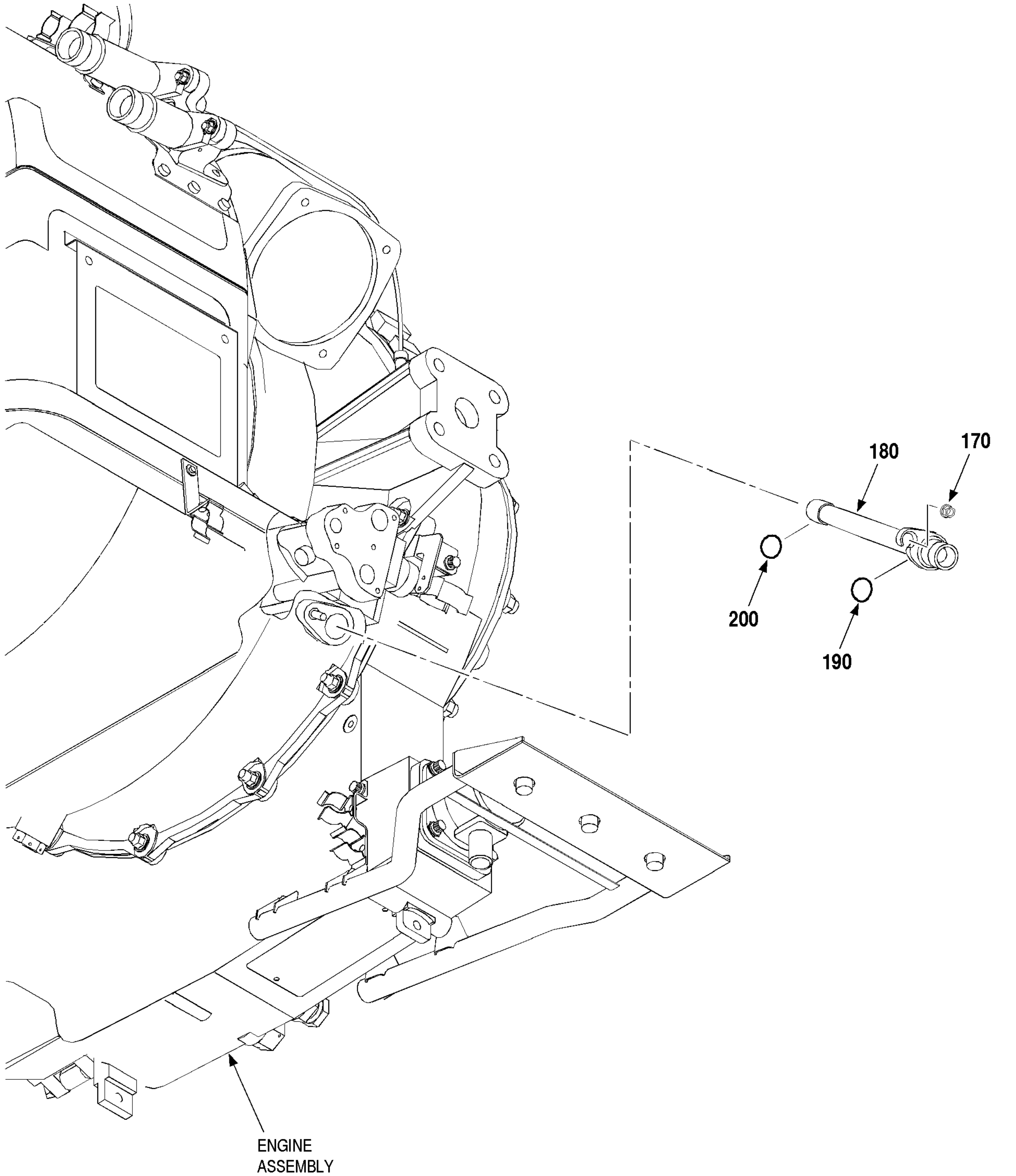

Figure 4001. Installation of Speed Sensor

Key to Figure 4001

170. NUT (IPC FIG. 6)	190. PACKING
180. SPEED SENSOR	200. PACKING

5. **Procedure**

SUBTASK 49-20-00-450-010

A. Install speed sensor. Refer to Figure 4001.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

(1) Apply a thin layer of MIL-PRF-7808 or MIL-PRF-23699 oil to packings (190, 200).

(2) Install packings (190, 200) on the speed sensor (180).

(3) Install speed sensor (180) with packings (190, 200) on the engine assembly.

(a) Attach speed sensor (180) to the engine assembly with nut (170). Tighten nut to a torque value of 40 in-lb (4.52 Nm).

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OIL COOLER
INSTALLATION-11

TASK 49-20-00-450-811

1. **General**

   A. This section contains procedures for installation of the oil cooler.

   B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

   C. All the nuts, bolts and screws must be tightened to a standard torque and tolerance unless the torque is specified in the text. Refer to Standard Practices Manual (SPM) 20-00-02/70-00-01 for the standard torque.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   None

4. **Expendable Parts**

   None

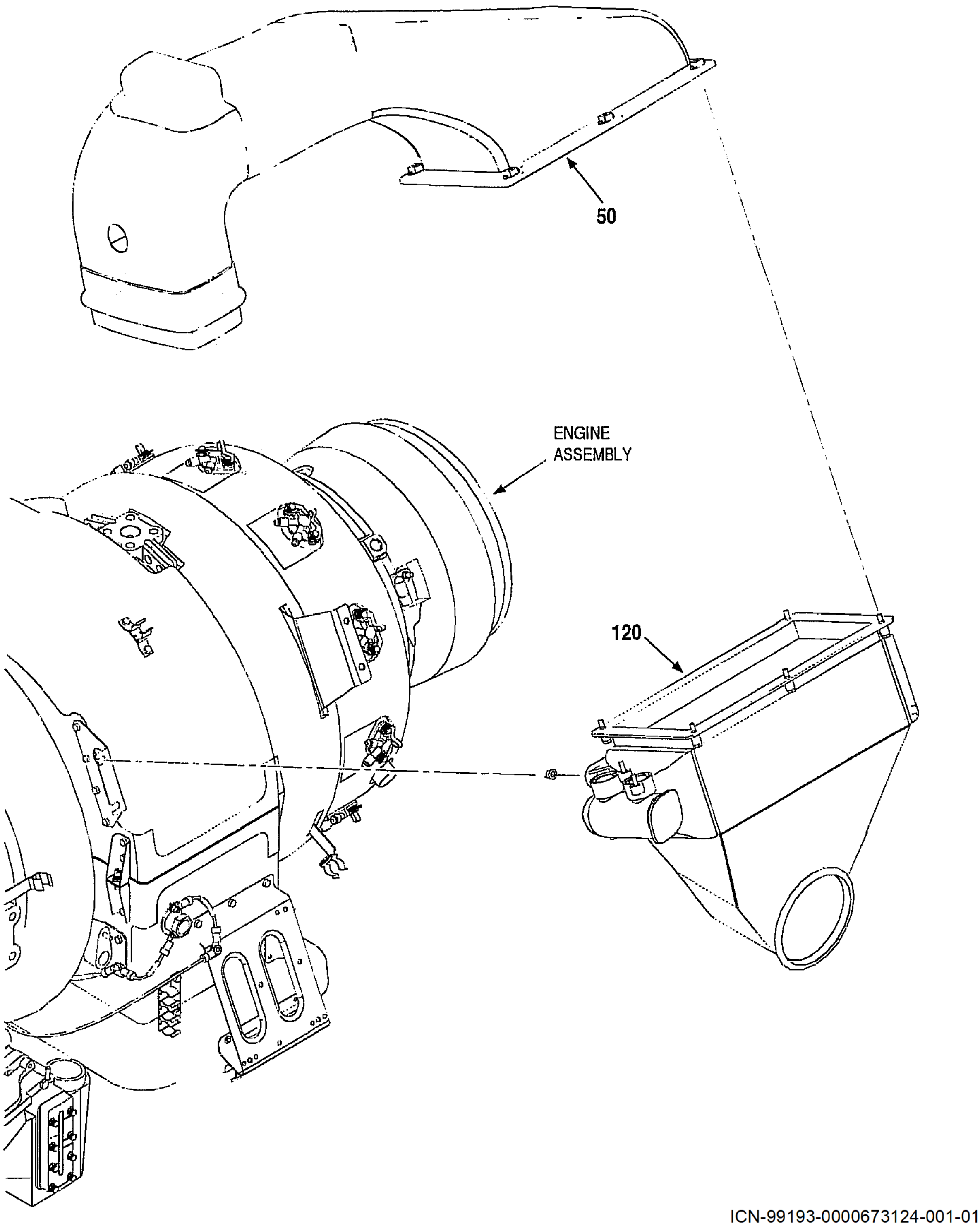

Figure 4001. Installation of Oil Cooler

Key to Figure 4001

50. EXIT FAN DUCT ASSY (IPC FIG. 3)	120. OIL COOLER (IPC FIG. 4)

5. Procedure

SUBTASK 49-20-00-450-011

A. Install the oil cooler. Refer to Figure 4001.

(1) Install oil cooler (120) on the engine assembly and tighten oil cooler captive mounting bolts. Tighten captive bolts to a torque value of 50 in-lb (5.65 Nm).

(2) Tighten captive nuts on oil cooler (120). Tighten captive nuts to a torque value of 100 in-lb (11.30 Nm).

(3) Attach exit fan duct assembly (50) to oil cooler (120) with captive bolts. Tighten bolts to a torque value of 20 in-lb (2.26 Nm).

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EXHAUST GAS TEMPERATURE (EGT) THERMOCOUPLE INSTALLATION-12

TASK 49-20-00-450-812

1. General

A. This section contains procedures for installation of the EGT thermocouples.

B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

C. All the nuts, bolts and screws must be tightened to a standard torque and tolerance unless the torque is specified in the text. Refer to Standard Practices Manual (SPM) 20-00-02/70-00-01 for the standard torque.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

None

4. Expendable Parts

A. Honeywell recommends that the parts shown in Table 4001 must be replaced at each installation. However, actual replacement of parts can be done on in-service experience.

Table 4001. Parts to be Replaced at Each Installation

Figure No.	Item No.	Nomenclature	Quantity
Figure 4001	250	Gasket	1

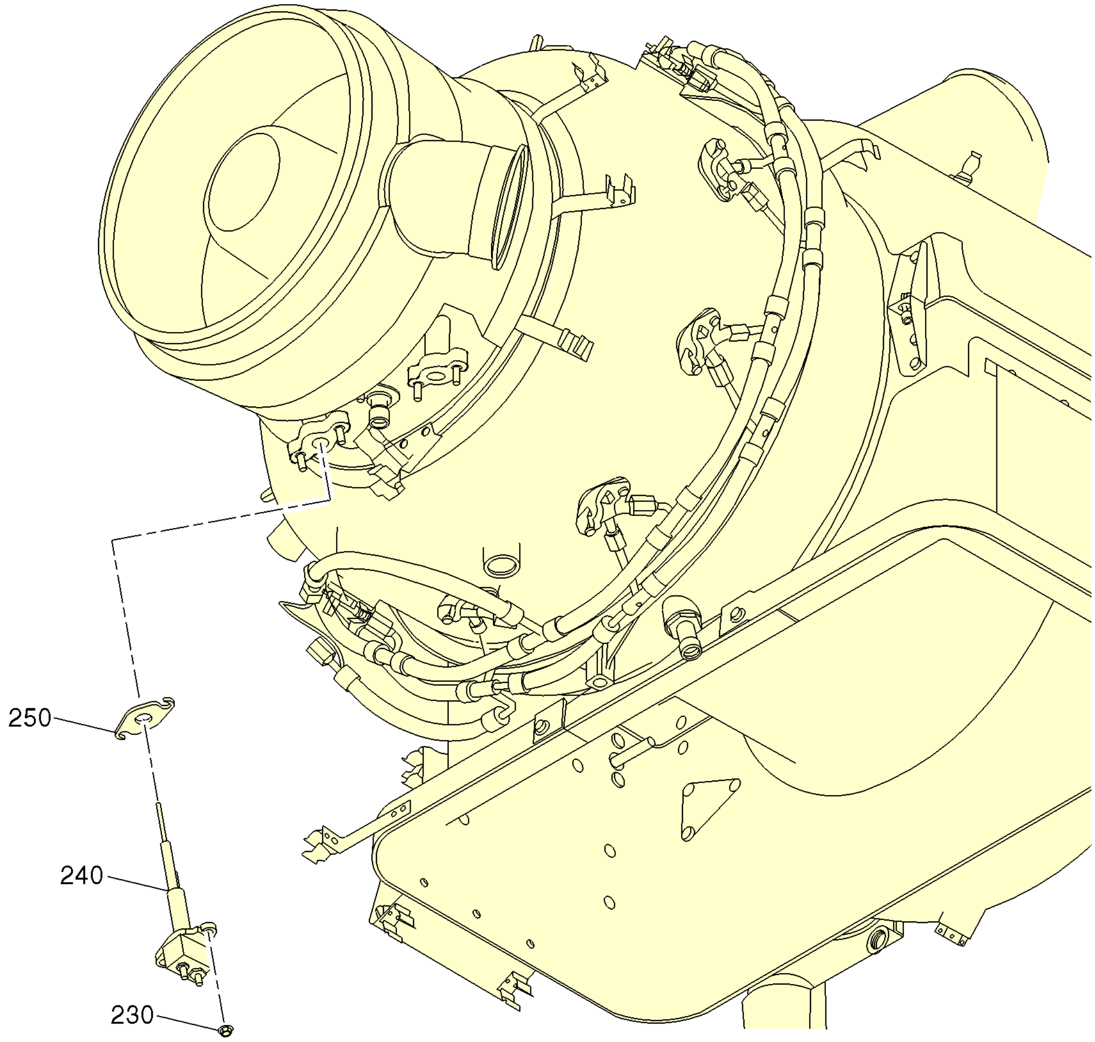

Figure 4001. Installation of Exhaust Gas Temperature Thermocouples

Key to Figure 4001

230. NUT (IPC FIG. 6)

240. EGT THERMOCOUPLE

250. GASKET

---

5. Procedure

SUBTASK 49-20-00-450-012

A. Install EGT thermocouples. Refer to Figure 4001.

(1) Install gasket (250) on the EGT thermocouple (240).

(2) Install EGT thermocouple (240) with gasket (250) on the engine assembly.

(3) Attach EGT thermocouple (240) to the engine assembly with nuts (230). Tighten nuts to a torque value of 40 in-lb (4.52 Nm).

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OIL HEATER
INSTALLATION-13

TASK 49-20-00-450-813

1. **General**

   A. This section contains procedures for installation of the oil heater.

   B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

   C. All the nuts, bolts and screws must be tightened to a standard torque and tolerance unless the torque is specified in the text. Refer to Standard Practices Manual (SPM) 20-00-02/70-00-01 for the standard torque.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   A. Table 4001 shows the necessary equipment and materials for installation.

Table 4001. Equipment and Materials

Equipment/Materials	Description/Manufacturer
NOTE: Equivalent equipment/materials can be used.	
Oil (MIL-PRF-7808 or MIL-PRF-23699)	Commercially available

4. **Expendable Parts**

   A. Honeywell recommends that the parts shown in Table 4002 must be replaced at each installation. However, actual replacement of parts can be done on in-service experience.

Table 4002. Parts to be Replaced at Each Installation

Figure No.	Item No.	Nomenclature	Quantity
Figure 4001	100	Packing	1

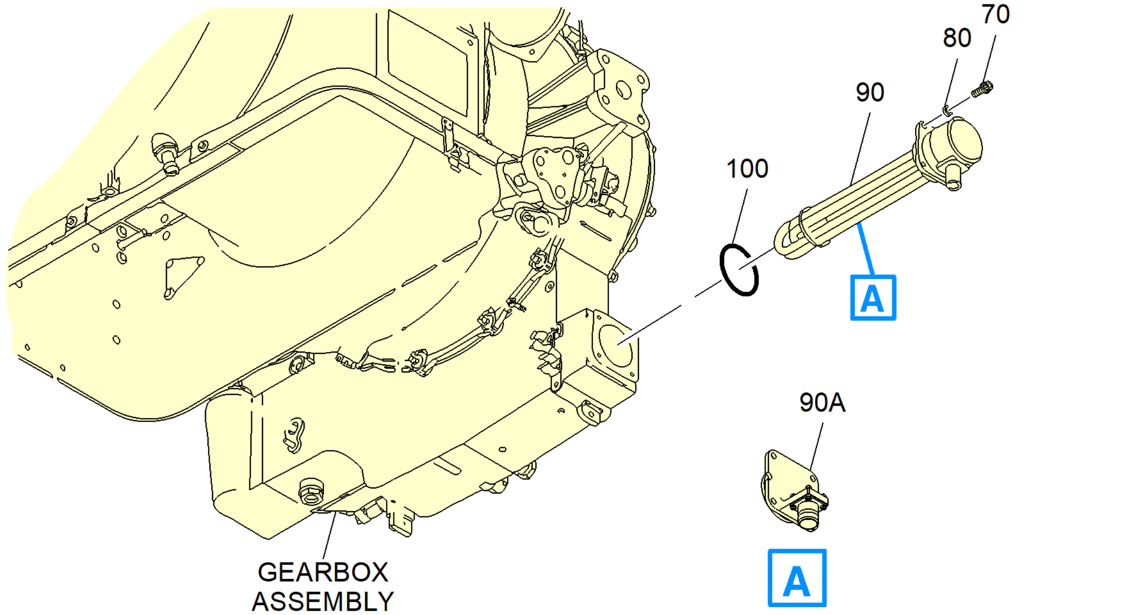

Figure 4001. Installation of Oil Heater

Key to Figure 4001

70. BOLT (IPC FIG. 6)
80. WASHER
90. OIL HEATER
90A. HEATER PAD COVER
100. PACKING

5. Procedure

SUBTASK 49-20-00-450-013

A. (Pre SB 131-49-7946) Install the oil heater. Refer to Figure 4001.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

(1) Lubricate new packing (100) with MIL-PRF-7808 or MIL-PRF-23699 oil.

(2) Install new packing (100) on oil heater (90).

(3) Install oil heater (90) with packing (100) on the gearbox.

(4) Install bolts (70) with washers (80) on oil heater (90).

(5) Tighten bolts (70) to a torque value of 40 in-lb (4.52 Nm).

B. (Post SB 131-49-7946) Install the heater pad cover.

(1) Install the heater pad cover.

(a) Lubricate the new packing (100) with MIL-PRF-7808 or MIL-PRF-23699 oil.

(b) Install the packing (100) on the heater pad cover (90A).

(c) Install the heater pad cover (90A) with the packing (100) on gearbox with the bolts (70) and washers (80).

(d) Tighten bolts (70) to a torque value of 40 in-lb (4.52 Nm).

(e) Connect the oil heater electrical connector to the heater pad cover.

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LUBE MODULE
INSTALLATION-14

TASK 49-20-00-450-814

1. **General**

   A. This section contains procedures for installation of the lube module.

   B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

   C. All the nuts, bolts and screws must be tightened to a standard torque and tolerance unless the torque is specified in the text. Refer to Standard Practices Manual (SPM) 20-00-02/70-00-01 for the standard torque.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   A. Table 4001 shows the necessary equipment and materials for installation.

Table 4001. Equipment and Materials

Equipment/Materials	Description/Manufacturer
NOTE: Equivalent equipment/materials can be used.	
Oil (MIL-PRF-7808 or MIL-PRF-23699)	Commercially available

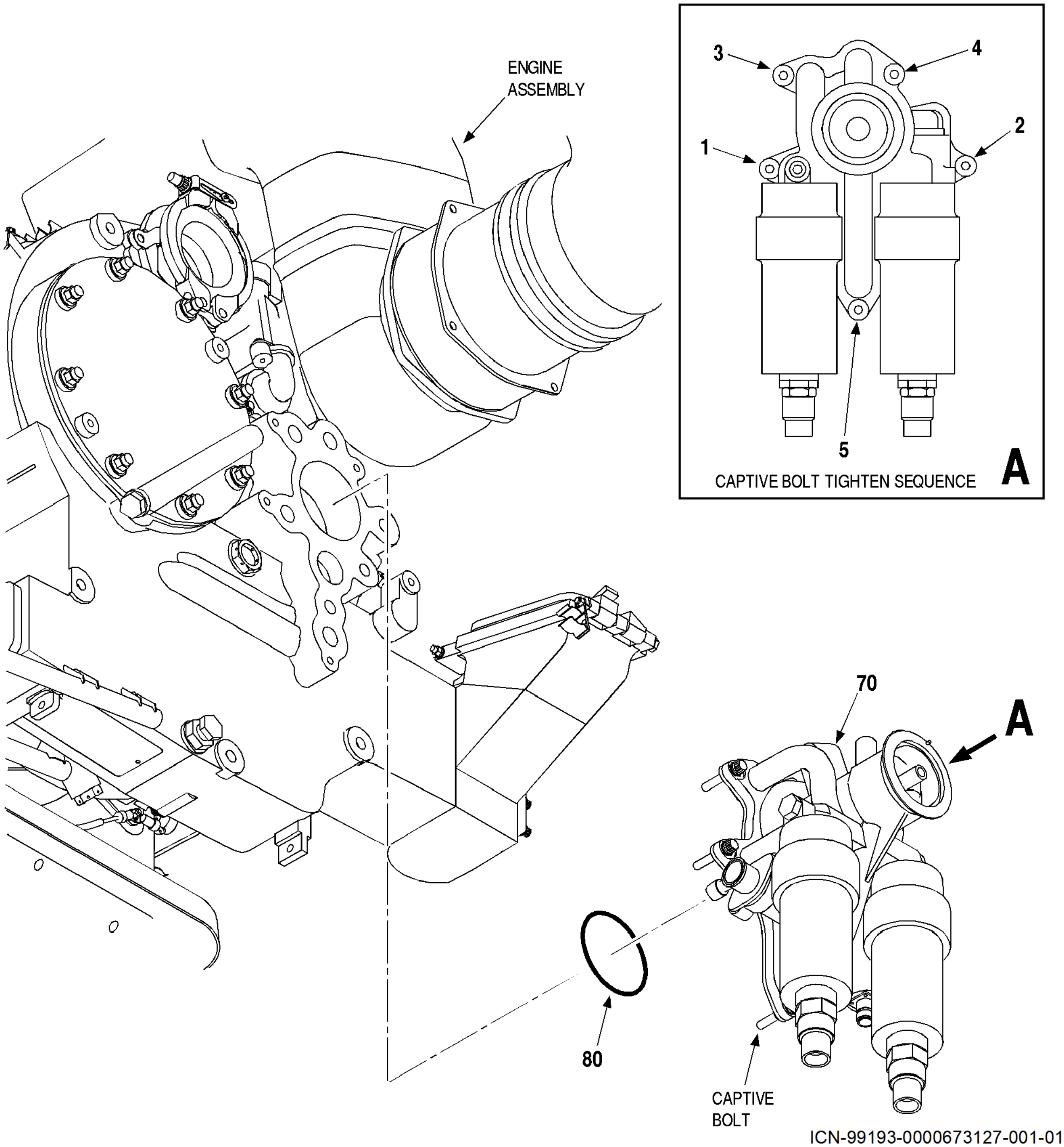

Figure 4001. Installation of Lube Module

Key to Figure 4001

70. LUBE MODULE (IPC FIG. 4)
80. PACKING

4. Expendable Parts

A. Honeywell recommends that the parts shown in Table 4002 must be replaced at each installation. However, actual replacement of parts can be done on in-service experience.

Table 4002. Parts to be Replaced at Each Installation

Figure No.	Item No.	Nomenclature	Quantity
Figure 4001	80	Packing	1

5. Procedure

SUBTASK 49-20-00-450-014

A. Install the lube module. Refer to Figure 4001.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

(1) Lubricate new packing (80) with MIL-PRF-7808 or MIL-PRF-23699 oil.

(2) Tighten seal plate screws on the lube module to a torque value of 17 to 20 in-lb (1.92 to 2.26 Nm).

(3) Install packing (80) on the lube module (70).

WARNING: OIL LEAKAGE MAY OCCUR BETWEEN LUBE MODULE AND GEARBOX, IF LUBE MODULE CAPTIVE BOLTS ARE NOT TIGHTENED IN CORRECT SEQUENCE.

(4) Install lube module (70) with packing (80) on the engine assembly and tighten captive bolts in sequence, as shown in View A, to 120 in-lb (13.56 Nm).

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OIL COOLING FAN ASSEMBLY
INSTALLATION-15

TASK 49-20-00-450-815

1. General

A. This section contains procedures for installation of the oil cooling fan assembly.

B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

C. All the nuts, bolts and screws must be tightened to a standard torque and tolerance unless the torque is specified in the text. Refer to Standard Practices Manual (SPM) 20-00-02/70-00-01 for the standard torque.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

A. Table 4001 shows the necessary equipment and materials for installation.

Table 4001. Equipment and Materials

Equipment/Materials	Description/Manufacturer
NOTE: Equivalent equipment/materials can be used.	
Oil (MIL-PRF-7808 or MIL-PRF-23699)	Commercially available

4. Expendable Parts

A. Honeywell recommends that the parts shown in Table 4002 be replaced at each removal. However, actual replacement of parts can be done on in-service experience.

Table 4002. Parts to be Replaced at Each Removal

Figure No.	Item No.	Nomenclature	Quantity
Figure 4001	80	Packing	1
	100	Packing	2

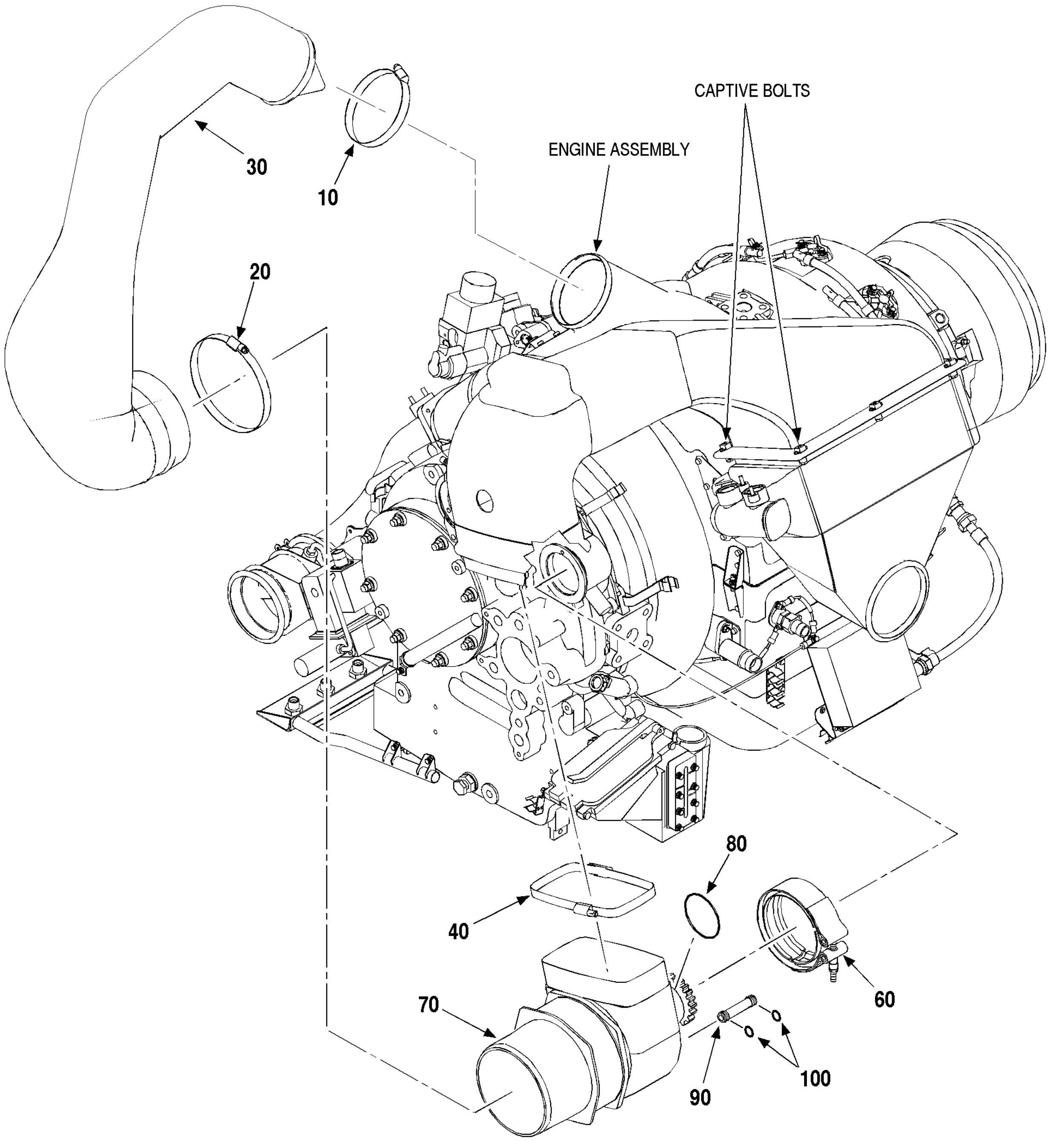

Figure 4001. Installation of Oil Cooling Fan Assembly

Key to Figure 4001

10. HOSE CLAMP (IPC FIG. 3)
20. HOSE CLAMP
30. INLET FAN DUCT
40. HOSE CLAMP
60. COUPLING CLAMP
70. OIL COOLING FAN ASSY
80. PACKING
90. TRANSFER TUBE
100. PACKING

5. Procedure

SUBTASK 49-20-00-450-015

A. Install the oil cooling fan assembly. Refer to Figure 4001.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

(1) Lubricate packings (80, 100) with MIL-PRF-7808 or MIL-PRF-23699 oil.

(2) Install packings (100) on transfer tube (90).

(3) Install transfer tube (90) with packings (100) on oil cooling fan assembly (70).

(4) Install packing (80) on oil cooling fan assembly (70).

CAUTION: CARE MUST BE TAKEN DURING INSTALLATION OF COOLING FAN TO AVOID CUTTING THE PACKINGS (80, 100).

(5) Attach oil cooling fan assembly (70) with packing (80) to the engine assembly with coupling clamp (60). Tighten nut on coupling clamp (60) to a torque value of 60 in-lb (6.78 Nm).

(6) Attach inlet fan duct (30) with hose clamps (10, 20) to oil cooling fan assembly (70) and the engine assembly. Tighten nut on hose clamps to a torque value of 30 in-lb (3.39 Nm).

(7) Install hose clamp (40) with duct and tighten the captive bolts on the oil cooler. Tighten nut on hose clamp to a torque value of 30 in-lb (3.39 Nm). Tighten captive bolts on oil cooler to a torque value of 20 in-lb (2.26 Nm).

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LOW OIL LEVEL SWITCH INSTALLATION-16

TASK 49-20-00-450-816

1. **General**

   A. This section contains procedures for installation of the low oil level switch.

   B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

   C. All the nuts, bolts and screws must be tightened to a standard torque and tolerance unless the torque is specified in the text. Refer to Standard Practices Manual (SPM) 20-00-02/70-00-01 for the standard torque.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   A. Table 4001 shows the necessary equipment and materials for installation.

Table 4001. Equipment and Materials

Equipment/Materials	Description/Manufacturer
NOTE: Equivalent equipment/materials can be used.	
Oil (MIL-PRF-7808 or MIL-PRF-23699)	Commercially available

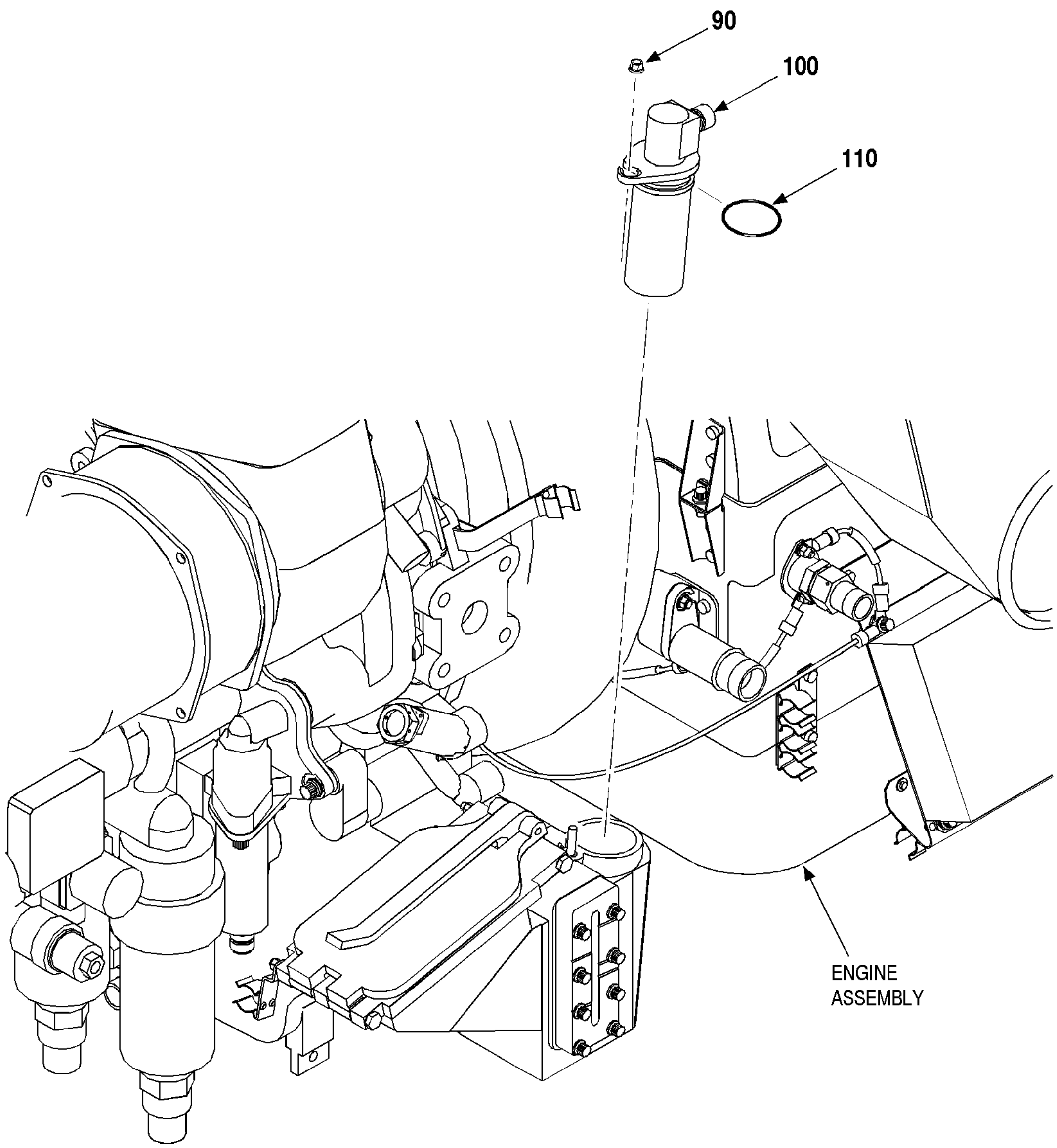

Figure 4001. Installation of Low Oil Level Switch

Key to Figure 4001

90. NUT (IPC FIG. 4)
100. LOW OIL LEVEL SWITCH
110. PACKING

4. Expendable Parts

A. Honeywell recommends that the parts shown in Table 4002 must be replaced at each installation. However, actual replacement of parts can be done on in-service experience.

Table 4002. Parts to be Replaced at Each Installation

Figure No.	Item No.	Nomenclature	Quantity
Figure 4001	110	Packing	1

5. Procedure

SUBTASK 49-20-00-450-016

A. Install the low oil level switch. Refer to Figure 4001.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

(1) Lubricate new packing (110) with MIL-PRF-7808 or MIL-PRF-23699 oil.

(2) Put packing (110) on low oil level switch (100).

(3) Put low oil level switch (100) with packing on the engine assembly.

(4) Install nut (90) and tighten to a torque value of 40 in-lb (4.52 Nm).

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LOW OIL PRESSURE (LOP) SWITCH INSTALLATION-17

TASK 49-20-00-450-817

1. General

A. This section contains procedures for installation of the LOP switch.

B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

C. All the nuts, bolts and screws must be tightened to a standard torque and tolerance unless the torque is specified in the text. Refer to Standard Practices Manual (SPM) 20-00-02/70-00-01 for the standard torque.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

A. Table 4001 shows the necessary equipment and materials for installation.

Table 4001. Equipment and Materials

Equipment/Materials	Description/Manufacturer
NOTE: Equivalent equipment/materials can be used.	
Oil (MIL-PRF-7808 or MIL-PRF-23699)	Commercially available

4. Expendable Parts

A. Honeywell recommends that the parts shown in Table 4002 must be replaced at each installation. However, actual replacement of parts can be done on in-service experience.

Table 4002. Parts to be Replaced at Each Installation

Figure No.	Item No.	Nomenclature	Quantity
Figure 4001	280	Packing	1

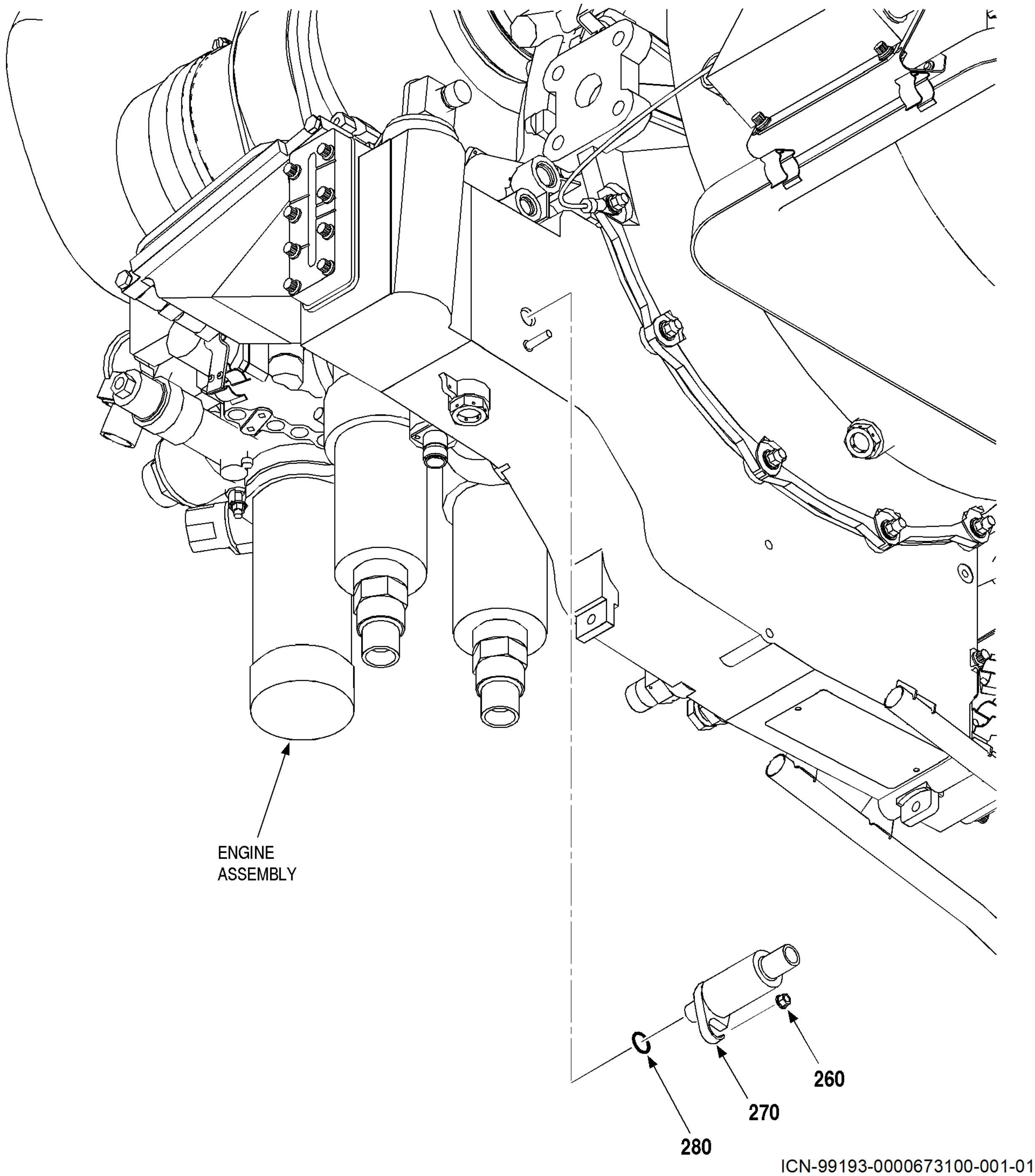

Figure 4001. Installation of Low Oil Pressure Switch

Key to Figure 4001

260. NUT (IPC FIG. 6)	280. PACKING
270. LOW OIL PRESSURE SWITCH	

5. Procedure

SUBTASK 49-20-00-450-017

A. Install the LOP switch. Refer to Figure 4001.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

(1) Lubricate new packing (280) with MIL-PRF-7808 or MIL-PRF-23699 oil.

(2) Install packing (280) on LOP switch (270).

(3) Install LOP switch (270) with packing (280) on the engine assembly and attach with captive nut (260). Tighten nut to a torque value of 40 in-lb (4.52 Nm).

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FUEL CONTROL UNIT (FCU) INSTALLATION-18

TASK 49-20-00-450-818

1. General

A. This section contains procedures for installation of the FCU.

B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

A. Table 4001 shows the necessary equipment and materials for installation.

Table 4001. Equipment and Materials

Equipment/Materials	Description/Manufacturer
NOTE: Equivalent equipment/materials can be used.	
Oil (MIL-PRF-7808 or MIL-PRF-23699)	Commercially available

4. Expendable Parts

A. Honeywell recommends that the parts shown in Table 4002 must be replaced at each installation. However, actual replacement of parts can be done on in-service experience.

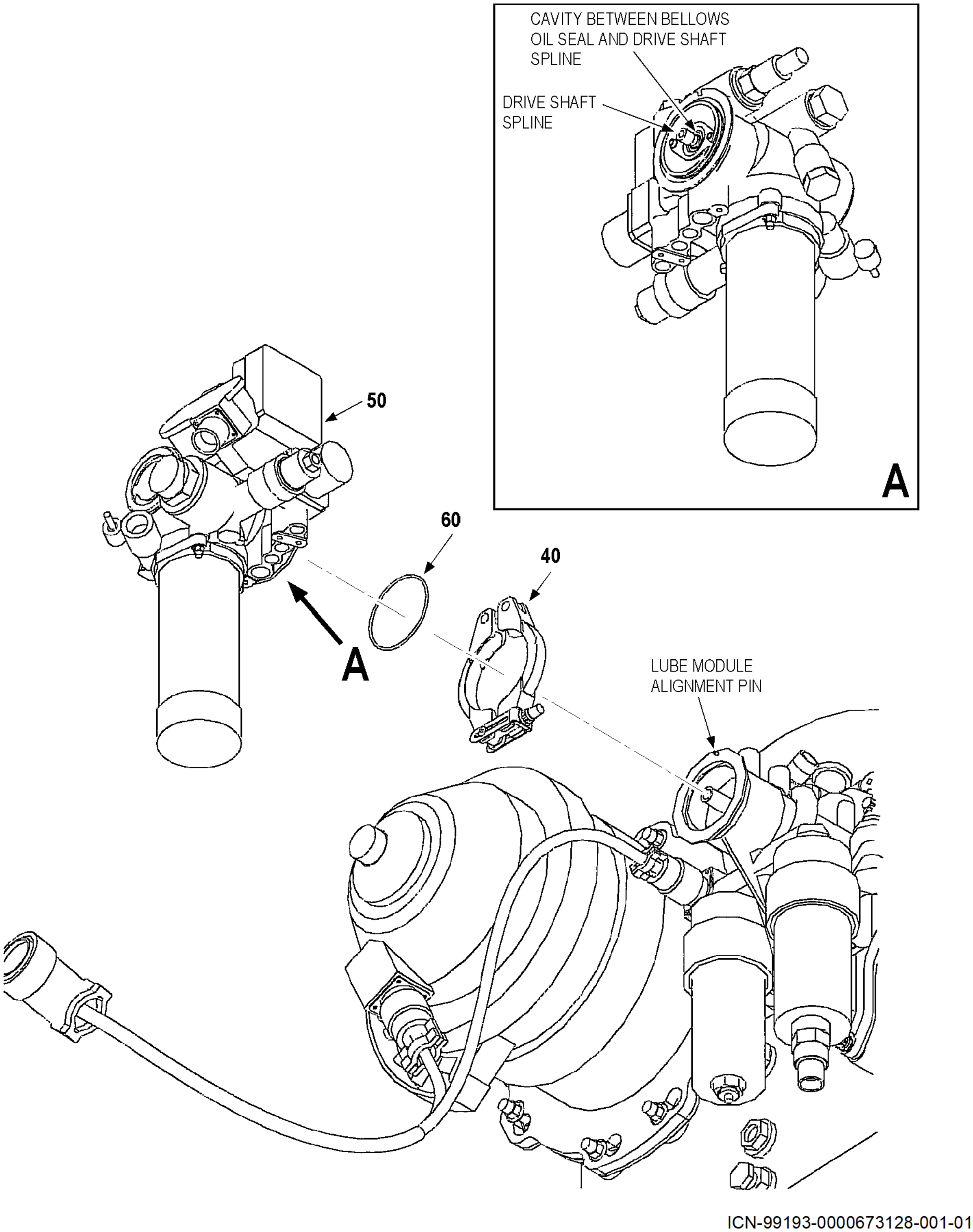

Figure 4001. Installation of Fuel Control Unit

Key to Figure 4001

40. COUPLING CLAMP (IPC FIG. 4)
50. FCU
60. PACKING

Table 4002. Parts to be Replaced at Each Installation

Figure No.	Item No.	Nomenclature	Quantity
Figure 4001	60	Packing	1

5. Procedure

SUBTASK 49-20-00-450-018

A. Install the FCU. Refer to Figure 4001.

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

(1) Apply MIL-PRF-7808 or MIL-PRF-23699 oil to the new packing (60). Install packing on the FCU (50).

(2) Install coupling clamp (40) on flange of FCU (50). Do not tighten coupling clamp.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

CAUTION: THE BELLOWS SHAFT SEAL LIFE CAN DECREASE WITHOUT LUBRICANT.

(3) Lubricate FCU (50).

(a) Make sure the FCU drive shaft points up.

(b) Fill the cavity between the FCU drive shaft and the bellows shaft seal with 2 cc or 40 drops of MIL-PRF-7808 or MIL-PRF-23699 oil.

(c) Apply 3 to 4 drops of MIL-PRF-7808 or MIL-PRF-23699 oil on the FCU drive shaft spline.

(4) Put FCU (50) over alignment pin on flange of the lube module.

(5) Put coupling clamp (40) over flanges of FCU (50) and lube module.

(6) (Pre SB 131-49-7741) Tighten nut on coupling clamp (40) to a torque value of 60 in-lb (6.78 Nm).

(Post SB 131-49-7741) Tighten nut on coupling clamp (40) to a torque value of 20 in-lb (2.26 Nm).

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STARTER
INSTALLATION-19

TASK 49-20-00-450-819

1. **General**

   A. This section contains procedures for installation of the starter.

   B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

   C. All the nuts, bolts and screws must be tightened to a standard torque and tolerance unless the torque is specified in the text. Refer to Standard Practices Manual (SPM) 20-00-02/70-00-01 for the standard torque.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   A. Table 4001 shows the necessary equipment and materials for installation.

Table 4001. Equipment and Materials

Equipment/Materials	Description/Manufacturer
NOTE: Equivalent equipment/materials can be used.	
Oil (MIL-PRF-7808 or MIL-PRF-23699)	Commercially available

4. **Expendable Parts**

   A. Honeywell recommends that the parts shown in Table 4002 be replaced at each installation. However, actual replacement of parts can be done on in-service experience.

Table 4002. Parts to be Replaced at Each Installation

Figure No.	Item No.	Nomenclature	Quantity
Figure 4001	200	Packing	1

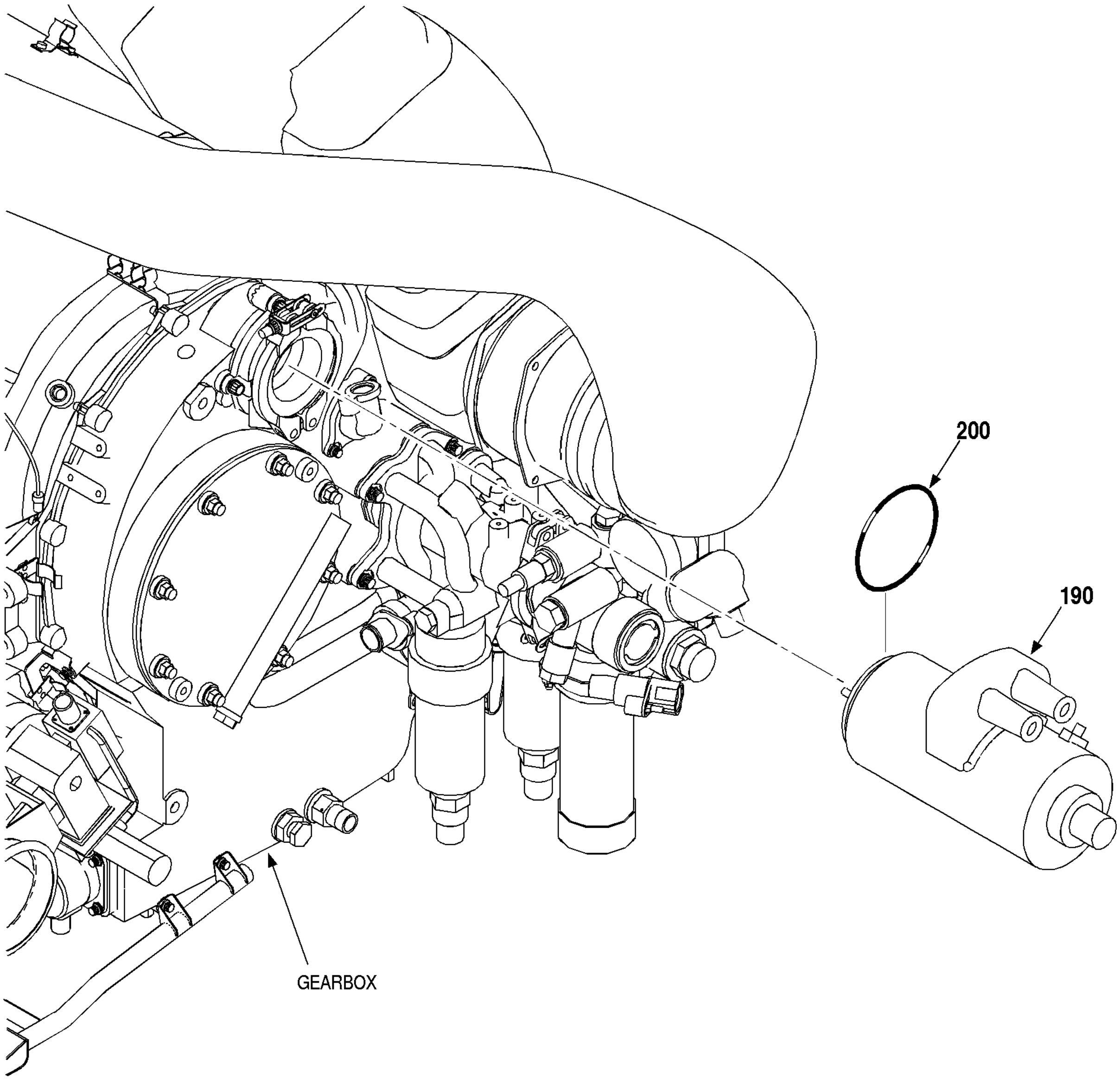

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Figure 4001. Installation of Starter

Key to Figure 4001

190. STARTER MOTOR (IPC FIG. 3)	200. PACKING

5. Procedure

SUBTASK 49-20-00-450-019

A. Install the starter. Refer to Figure 4001.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

(1) Lubricate new packing (200) with MIL-PRF-7808 or MIL-PRF-23699 oil.

(2) Install packing (200) on the starter motor (190).

(3) Attach starter motor (190) to the gearbox assembly with the coupling clamp. Tighten nut on coupling clamp to a torque value of 60 in-lb (6.78 Nm).

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DATA MEMORY MODULE (DMM) INSTALLATION-20

TASK 49-20-00-450-820

1. General

A. This section contains procedures for installation of the DMM.

B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

C. All the nuts, bolts and screws must be tightened to a standard torque and tolerance unless the torque is specified in the text. Refer to Standard Practices Manual (SPM) 20-00-02/70-00-01 for the standard torque.

D. When screws or bolts are too long or too short, a longer or shorter standard screw or bolt can be used if there is a minimum of one full thread more than the face of the threaded part or nut.

NOTE: There are no alternate screw or bolt lengths permitted for blind hole applications.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

None

4. Expendable Parts

None

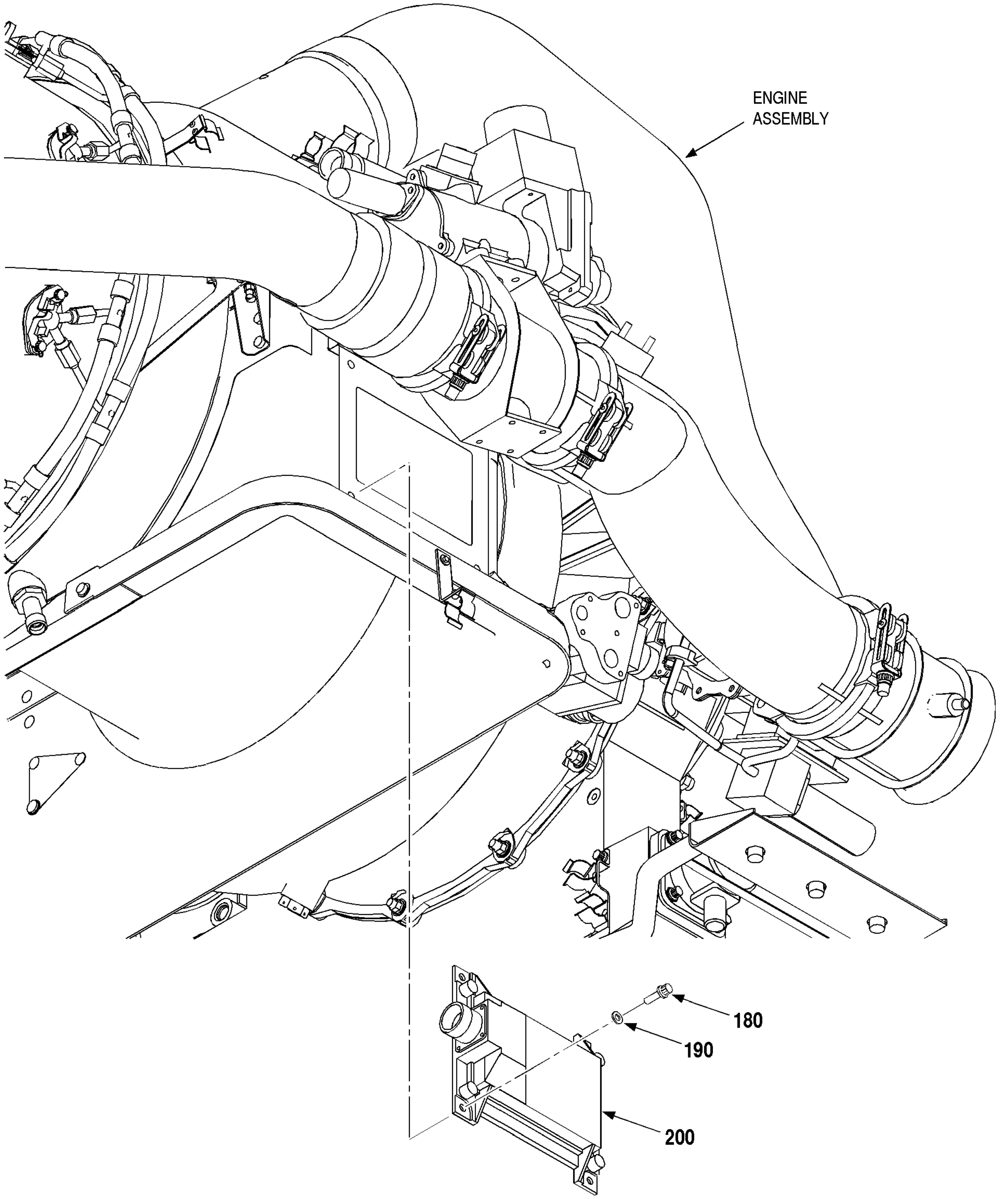

Figure 4001. Installation of Data Memory Module

Key to Figure 4001

180. BOLT (IPC FIG. 5)
190. WASHER
200. DATA MEMORY MODULE

---

5. Procedure

SUBTASK 49-20-00-450-020

A. Install the DMM. Refer to Figure 4001.

(1) Install DMM (200) on the engine assembly.

(2) Put one bolt (180) through grounding strap then through lower right hole in DMM.

(3) Attach DMM to engine assembly with three other bolts (180) and washers (190). Tighten all four bolts to a torque value of 50 in-lb (5.65 Nm).

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TOTAL PRESSURE PROBE ASSEMBLY INSTALLATION-21

TASK 49-20-00-450-821

1. **General**

   A. This section contains procedures for installation of the total pressure probe assembly.

   B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

   C. All the nuts, bolts and screws must be tightened to a standard torque and tolerance unless the torque is specified in the text. Refer to Standard Practices Manual (SPM) 20-00-02/70-00-01 for the standard torque.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   A. Table 4001 shows the necessary equipment and materials for installation.

Table 4001. Equipment and Materials

Equipment/Materials	Description/Manufacturer
NOTE: Equivalent equipment/materials can be used.	
Oil (MIL-PRF-7808 or MIL-PRF-23699)	Commercially available

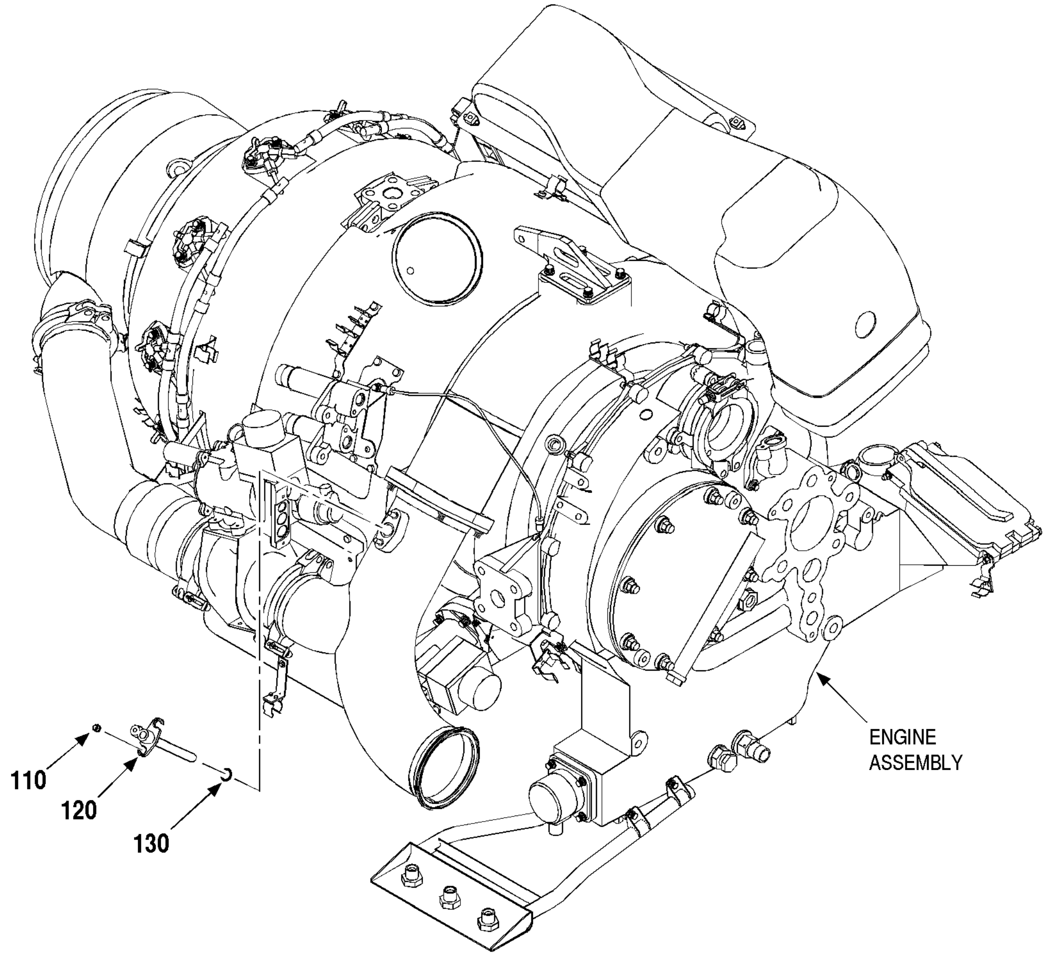

Figure 4001. Installation of Total Pressure Probe Assembly

Key to Figure 4001

110. NUT (IPC FIG. 5)
120. TOTAL PRESSURE PROBE ASSY
130. PACKING

4. Expendable Parts

A. Honeywell recommends that the parts shown in Table 4002 must be replaced at each installation. However, actual replacement of parts can be done on in-service experience.

Table 4002. Parts to be Replaced at Each Installation

Figure No.	Item No.	Nomenclature	Quantity
Figure 4001	130	Packing	1

5. Procedure

SUBTASK 49-20-00-450-021

A. Install the total pressure probe assembly. Refer to Figure 4001.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

(1) Lubricate packing (130) with MIL-PRF-7808 or MIL-PRF-23699 oil.

(2) Install packing (130) on total pressure probe assembly (120).

(3) Install total pressure probe assembly (120) on the compressor discharge duct.

(a) Attach total pressure probe assembly (120) to compressor discharge duct with nut (110). Tighten nut to a torque value of 40 in-lb (4.52 Nm).

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SURGE DUCT
INSTALLATION-22

TASK 49-20-00-450-822

1. General

A. This section contains procedures for installation of the surge duct assembly.

B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

C. All the nuts, bolts and screws must be tightened to a standard torque and tolerance unless the torque is specified in the text. Refer to Standard Practices Manual (SPM) 20-00-02/70-00-01 for the standard torque.

D. When screws or bolts are too long or too short, a longer or shorter standard screw or bolt can be used if there is a minimum of one full thread more than the face of the threaded part or nut.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

None

4. Expendable Parts

None

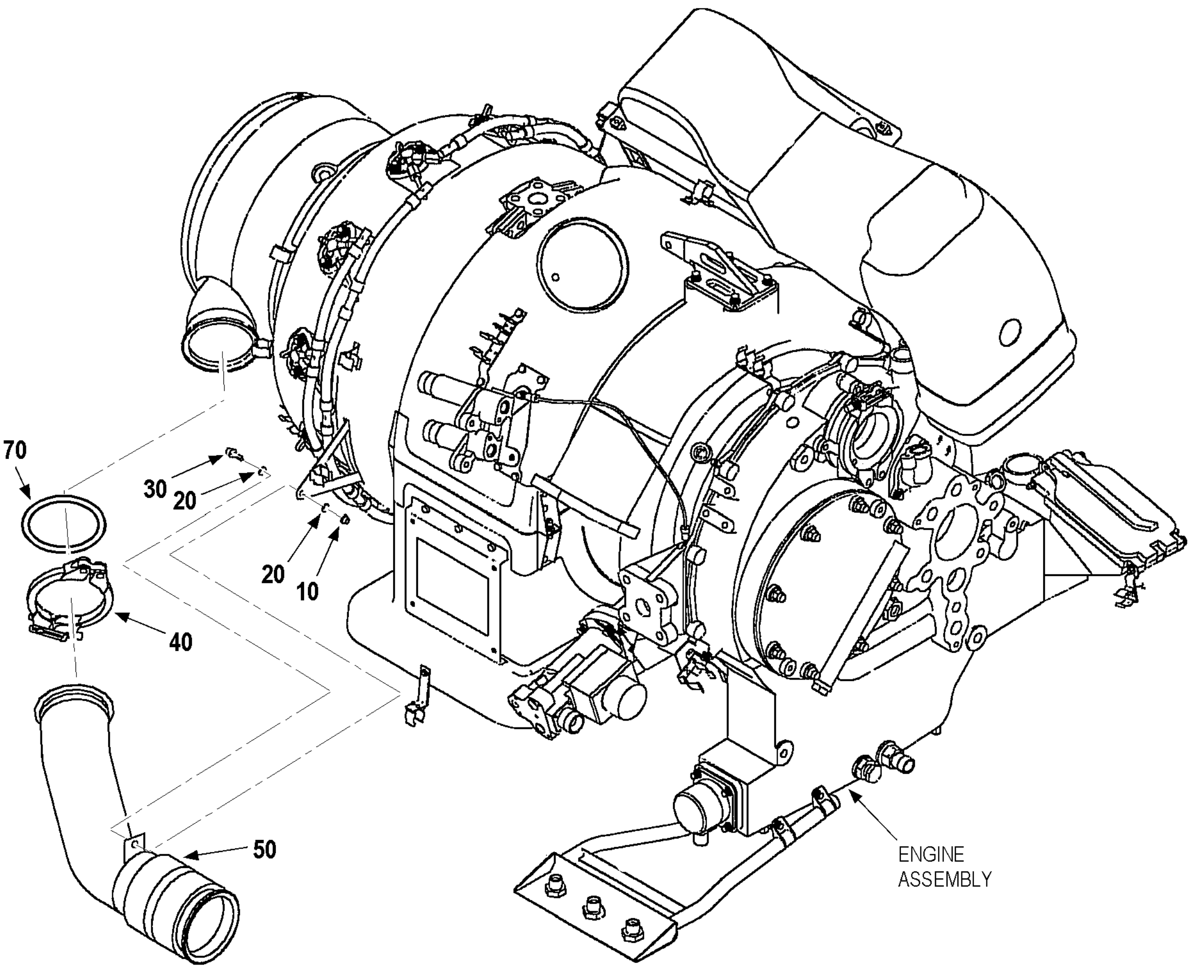

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Figure 4001. Installation of Surge Duct

Key to Figure 4001

10. NUT (IPC FIG. 5)	40. CLAMP
20. WASHER	50. SURGE DUCT
30. BOLT	70. SEAL

5. **Procedure**

SUBTASK 49-20-00-450-022

A. Install the surge duct. Refer to Figure 4001.

(1) Loosely attach both ends of surge duct (50) to the engine assembly with clamps (40) and seals (70).

(2) Attach surge duct assembly (50) to bracket on engine assembly with bolt (30), washers (20) and nut (10). Tighten nut to a torque value of 50 in-lb (5.65 Nm).

(3) Tighten clamp (40) to a torque value of 93 in-lb (10.5 Nm).

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SURGE CONTROL VALVE (SCV) INSTALLATION-23

TASK 49-20-00-450-823

1. General

A. This section contains procedures for installation of the surge control valve.

B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

None

4. Expendable Parts

None

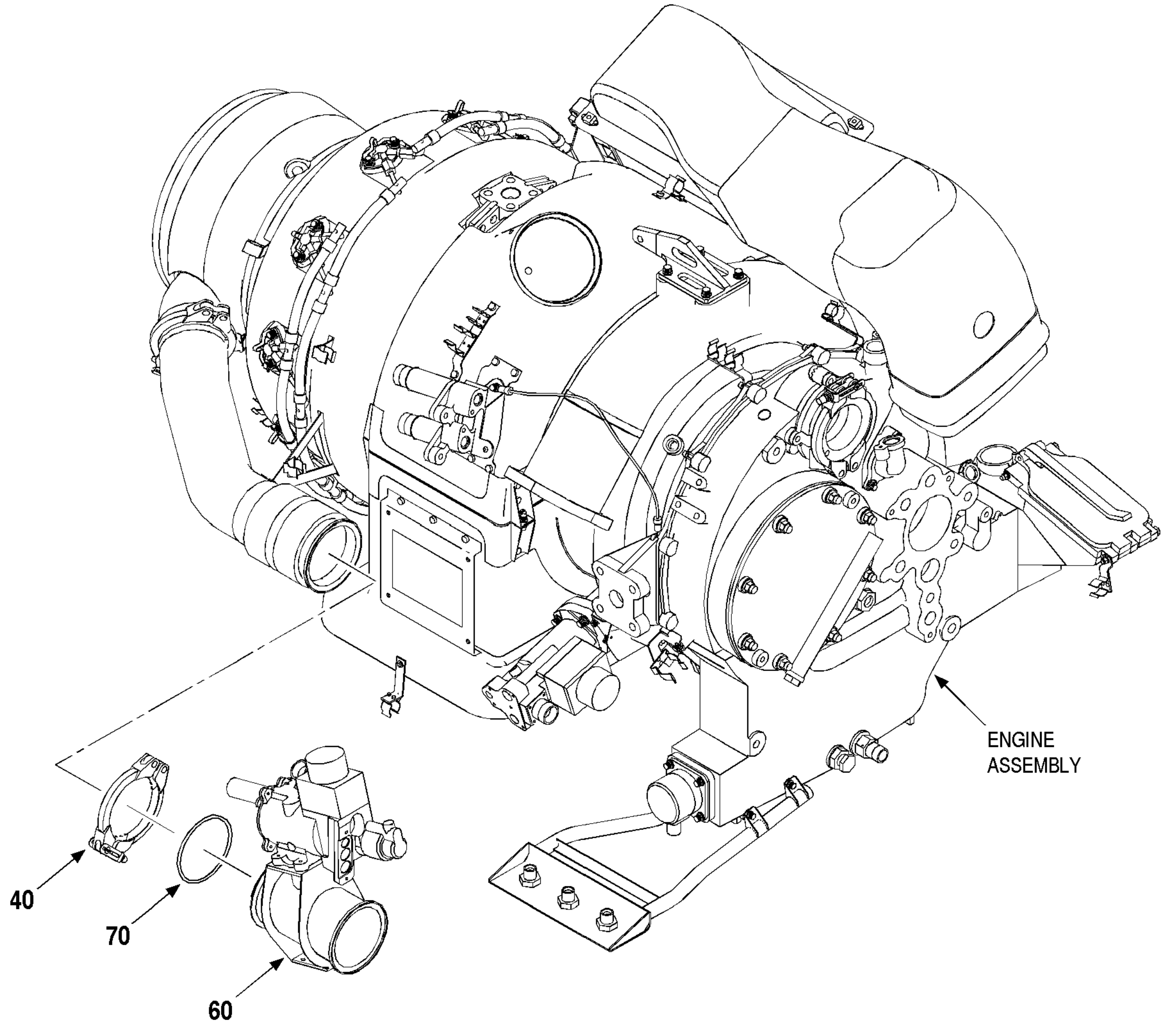

Figure 4001. Installation of Surge Control Valve

Key to Figure 4001

40. CLAMP (IPC FIG. 5)
60. SURGE CONTROL VALVE
70. SEAL

5. Procedure

SUBTASK 49-20-00-450-023

A. Install the surge control valve. Refer to Figure 4001.

(1) Install seal (70) on the compressor discharge duct.

(2) Install seal (70) on the discharge end of the surge control valve (60).

(3) Install surge control valve (60) with clamps (40) on the engine assembly.

(4) Align the alignment mark on the surge control valve (60) with the alignment mark on the compressor discharge duct.

(5) Tighten clamps (40) to a torque value of 93 in-lb (10.5 Nm).

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COMPRESSOR DISCHARGE DUCT INSTALLATION-24

TASK 49-20-00-450-824

1. **General**

   A. This section contains procedures for installation of the compressor discharge duct.

   B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

   C. All the nuts, bolts and screws must be tightened to a standard torque and tolerance unless the torque is specified in the text. Refer to Standard Practices Manual (SPM) 20-00-02/70-00-01 for the standard torque.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   None

4. **Expendable Parts**

   A. Honeywell recommends that the parts shown in Table 4001 must be replaced at each installation. However, actual replacement of parts can be done on in-service experience.

Table 4001. Parts to be Replaced at Each Installation

Figure No.	Item No.	Nomenclature	Quantity
Figure 4001	160	Air Packing	1

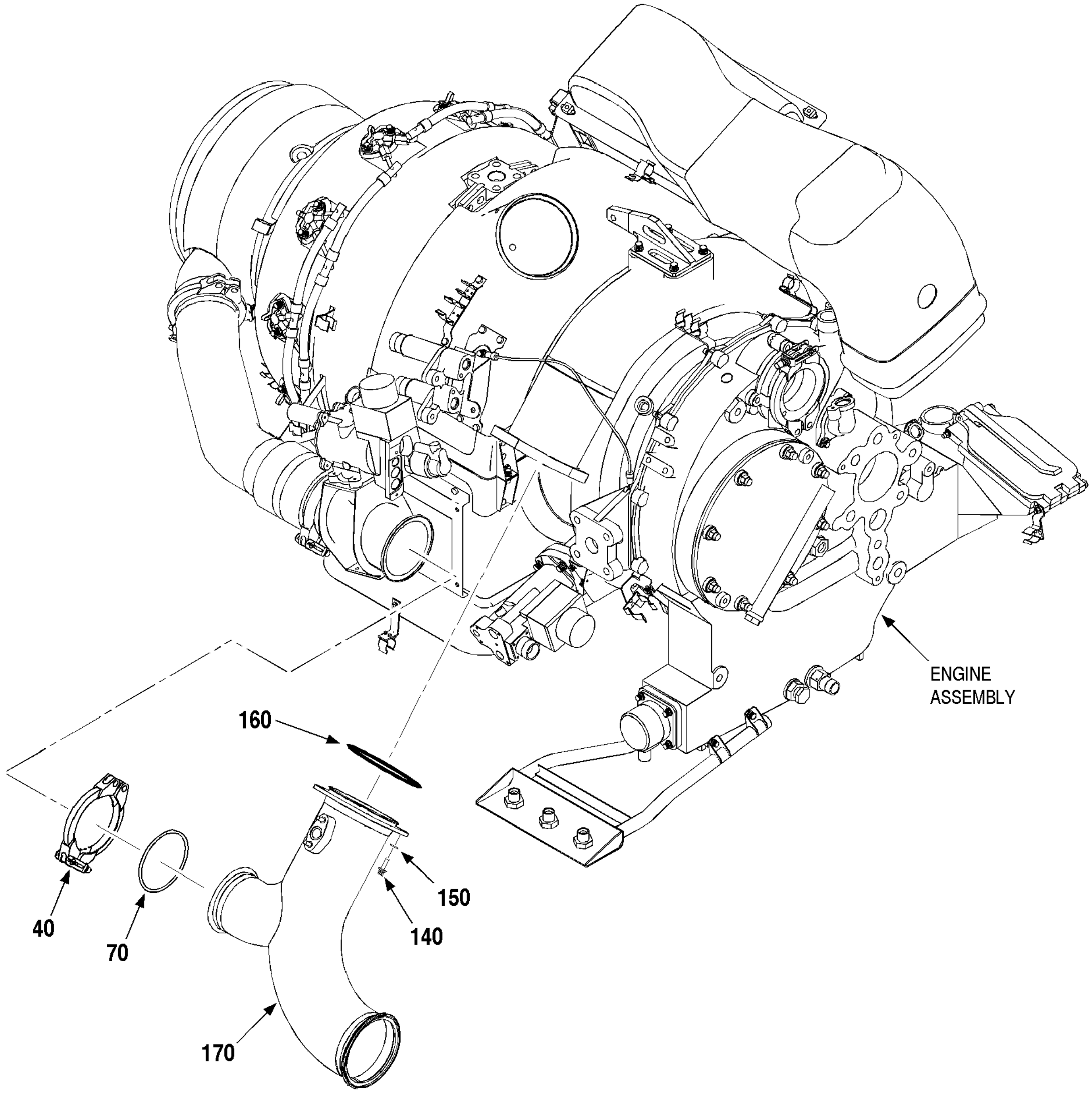

Figure 4001. Installation of Compressor Discharge Duct

Key to Figure 4001

40. CLAMP (IPC FIG. 5)	150. WASHER
70. SEAL	160. AIR PACKING
140. BOLT	170. COMPRESSOR DISCHARGE DUCT

5. Procedure

SUBTASK 49-20-00-450-024

A. Install the compressor discharge duct. Refer to Figure 4001.

(1) Install total pressure probe assembly on compressor discharge duct. Refer to INSTALLATION-21.

(2) Install air packing (160) on the compressor discharge duct (170).

(3) Attach compressor discharge duct (170) to the engine assembly with bolts (140) and washers (150). Tighten bolts to a torque value of 120 in-lb (13.56 Nm).

(4) Position seal (70) between surge control valve and compressor discharge duct (170). Connect compressor discharge duct to surge control valve with clamp (40) as below:

(a) If clamp (40) is PN 8087-300 (or) AS1895-4-300, tighten to a torque value of 93 in-lb (10.50 Nm).

(b) If clamp (40) is PN NH1010580-10, tighten to a torque value of 40 in-lb (4.52 Nm).

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LOAD CONTROL VALVE (LCV) INSTALLATION-25

TASK 49-20-00-450-825

1. **General**

   A. This section contains procedures for installation of the LCV.

   B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   None

4. **Expendable Parts**

   None

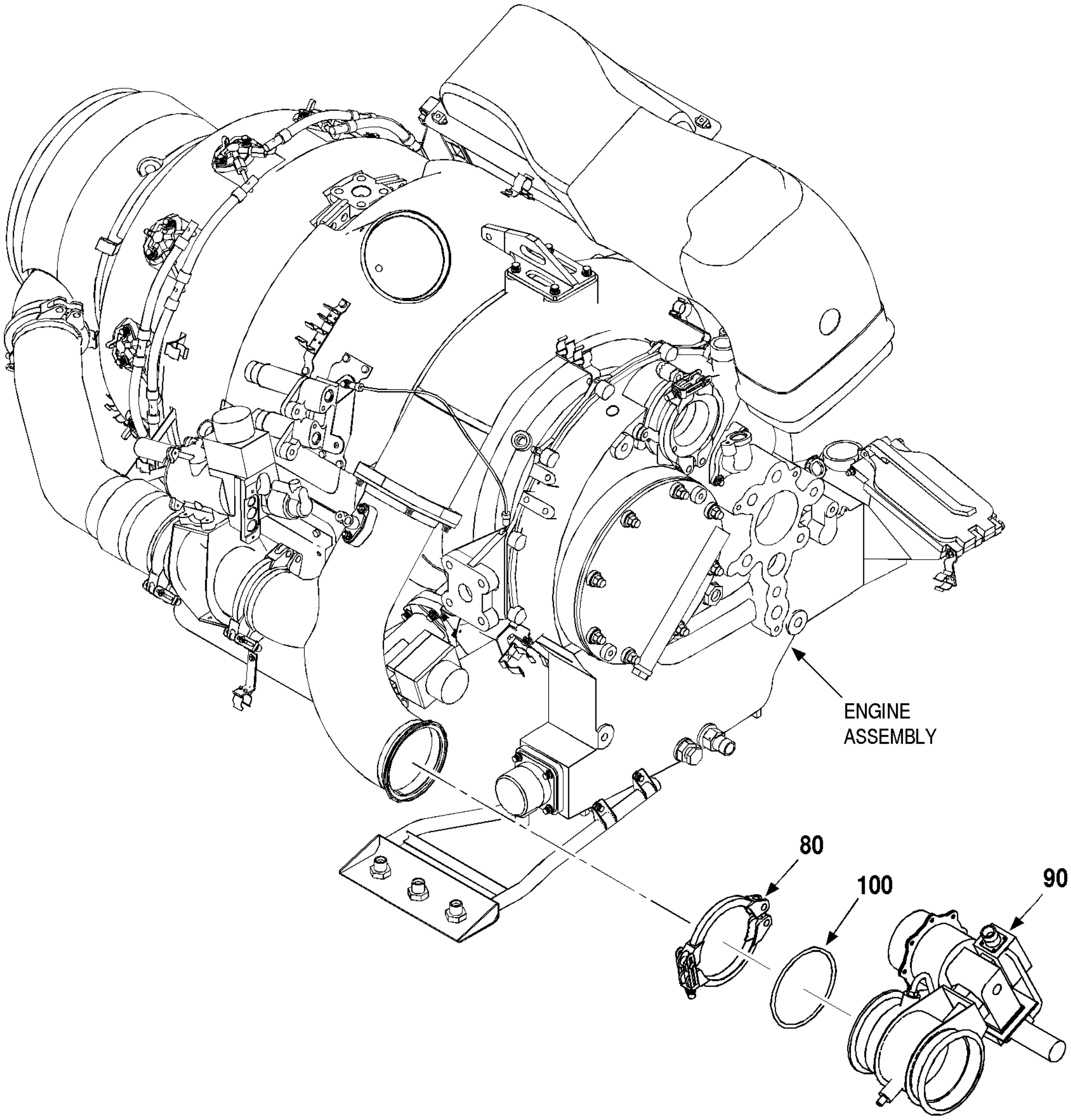

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Figure 4001. Installation of Load Control Valve

Key to Figure 4001

80. CLAMP (IPC FIG. 5)
90. LOAD CONTROL VALVE
100. SEAL

---

5. Procedure

SUBTASK 49-20-00-450-025

A. Install the LCV. Refer to Figure 4001.

(1) Put seal (100) on the compressor discharge duct.

(2) Install LCV (90) with clamp (80) on the engine assembly.

(3) Align the alignment mark on the load control valve (90) with the alignment mark on the compressor discharge duct.

(4) Tighten clamp (80) as below:

(a) If clamp (80) is PN 8087-350 (or) AS1895-4-350, tighten to a torque value of 95 to 110 in-lb (10.73 to 12.42 Nm).

(b) If clamp (80) is PN NH1010580-20, tighten to a torque value of 35 to 40 in-lb (3.95 to 4.52 Nm.)

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DRAIN MAST BRACKET INSTALLATION-26

TASK 49-20-00-450-826

1. **General**

   A. This section contains procedures for installation of the drain mast bracket.

   B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   None

4. **Expendable Parts**

   None

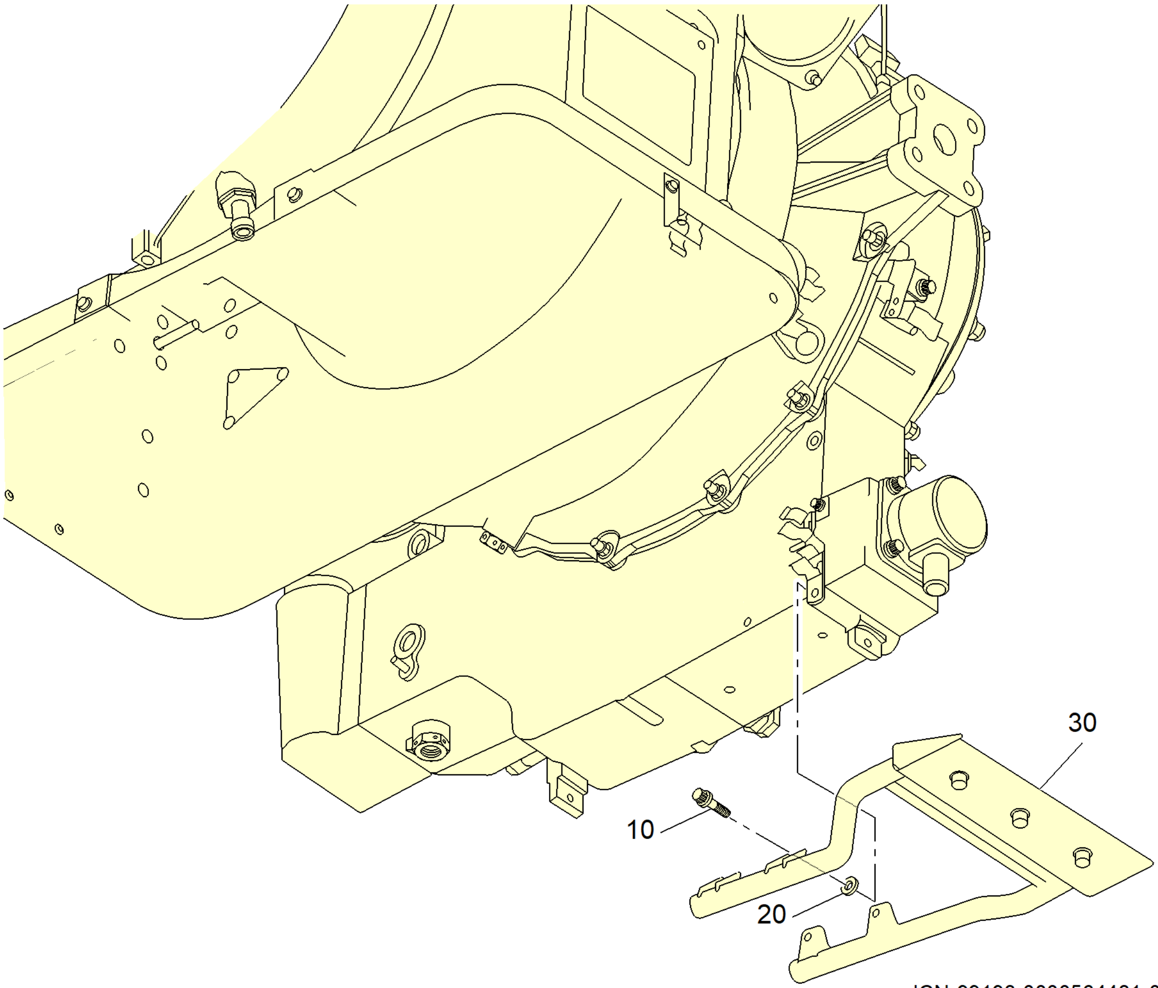

Figure 4001. Installation of Drain Mast Bracket

Key to Figure 4001

10. BOLT (IPC FIG. 6)
20. WASHER
30. DRAIN MAST BRACKET

---

5. Procedure

SUBTASK 49-20-00-450-026

A. Install the drain mast bracket. Refer to Figure 4001.

(1) Install drain mast bracket (30) on the gearbox.

(2) Install washers (20) between the gearbox and drain mast bracket (30).

(3) Align washers (20) with bolt holes and holes in drain mast bracket (30).

(4) Install bolts (10) through drain mast bracket (30) and washers (20) into the gearbox.

(5) Tighten bolts (10) to a torque value of 40 in-lb (4.52 Nm).

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IGNITER PLUG
INSTALLATION-27

TASK 49-20-00-450-827

1. **General**

   A. This section contains procedures for installation of the igniter plug.

   B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   None

4. **Expendable Parts**

   A. Honeywell recommends that the parts shown in Table 4001 must be replaced at each installation. However, actual replacement of parts can be done on in-service experience.

Table 4001. Parts to be Replaced at Each Installation

Figure No.	Item No.	Nomenclature	Quantity
Figure 4001	150	Gasket	1

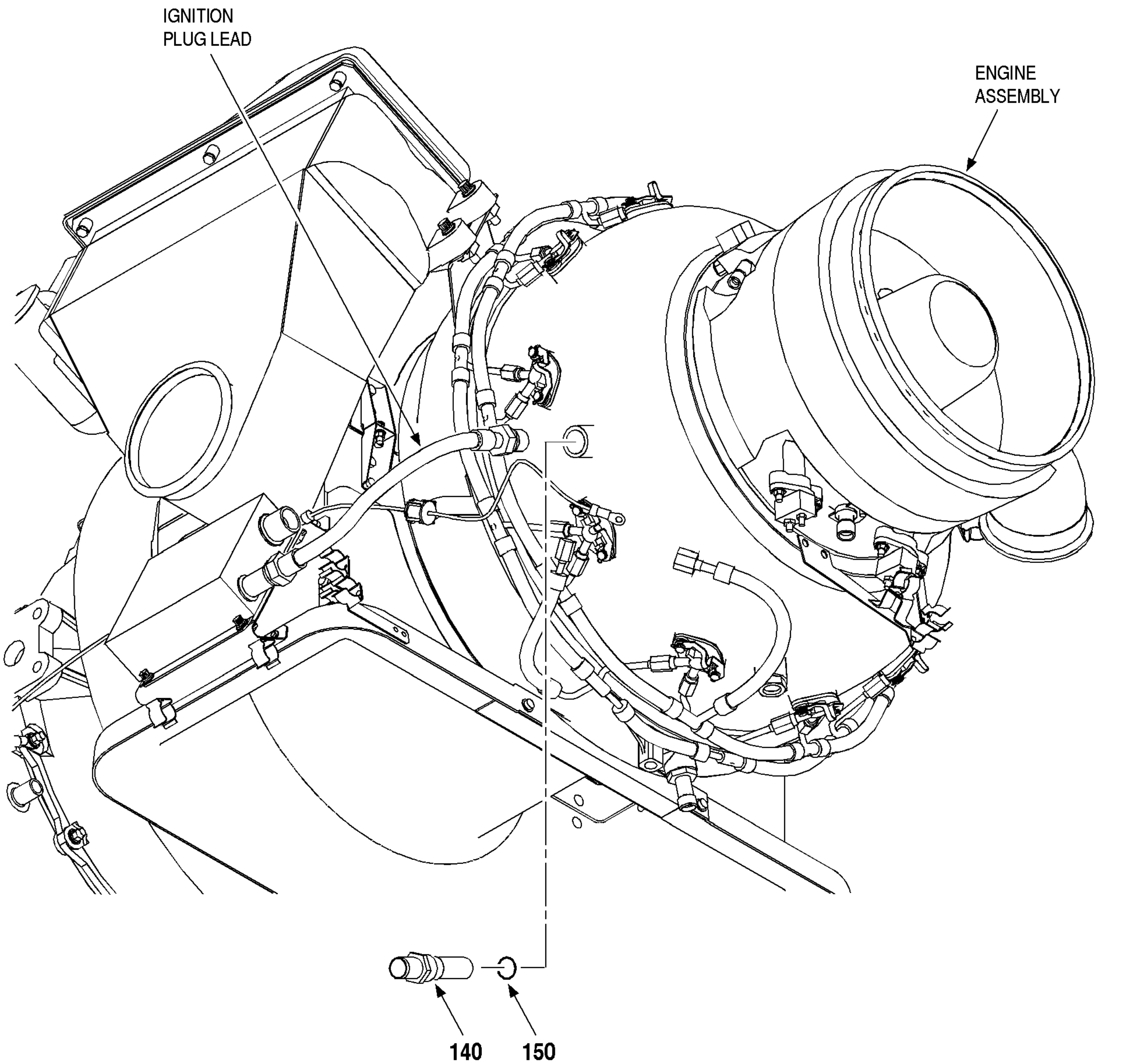

Figure 4001. Installation of Igniter Plug

Key to Figure 4001

140. IGNITER PLUG (IPC FIG. 4)	150. GASKET

5. Procedure

SUBTASK 49-20-00-450-027

A. Install igniter plug. Refer to Figure 4001.

(1) Put gasket (150) on the igniter plug (140).

(2) Install igniter plug (140) with gasket on the engine assembly. Tighten igniter plug to a torque value of 225 in-lb (25.42 Nm).

(3) Install the igniter plug lead on igniter plug (140). Refer to INSTALLATION-29.

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IGNITION UNIT
INSTALLATION-28

TASK 49-20-00-450-828

1. General

A. This section contains procedures for installation of the ignition unit.

B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

C. All the nuts, bolts and screws must be tightened to a standard torque and tolerance unless the torque is specified in the text. Refer to Standard Practices Manual (SPM) 20-00-02/70-00-01 for the standard torque.

D. When screws or bolts are too long or too short, a longer or shorter standard screw or bolt can be used if there is a minimum of one full thread more than the face of the threaded part or nut.

NOTE: There are no alternate screw or bolt lengths permitted for blind hole applications.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

None

4. Expendable Parts

None

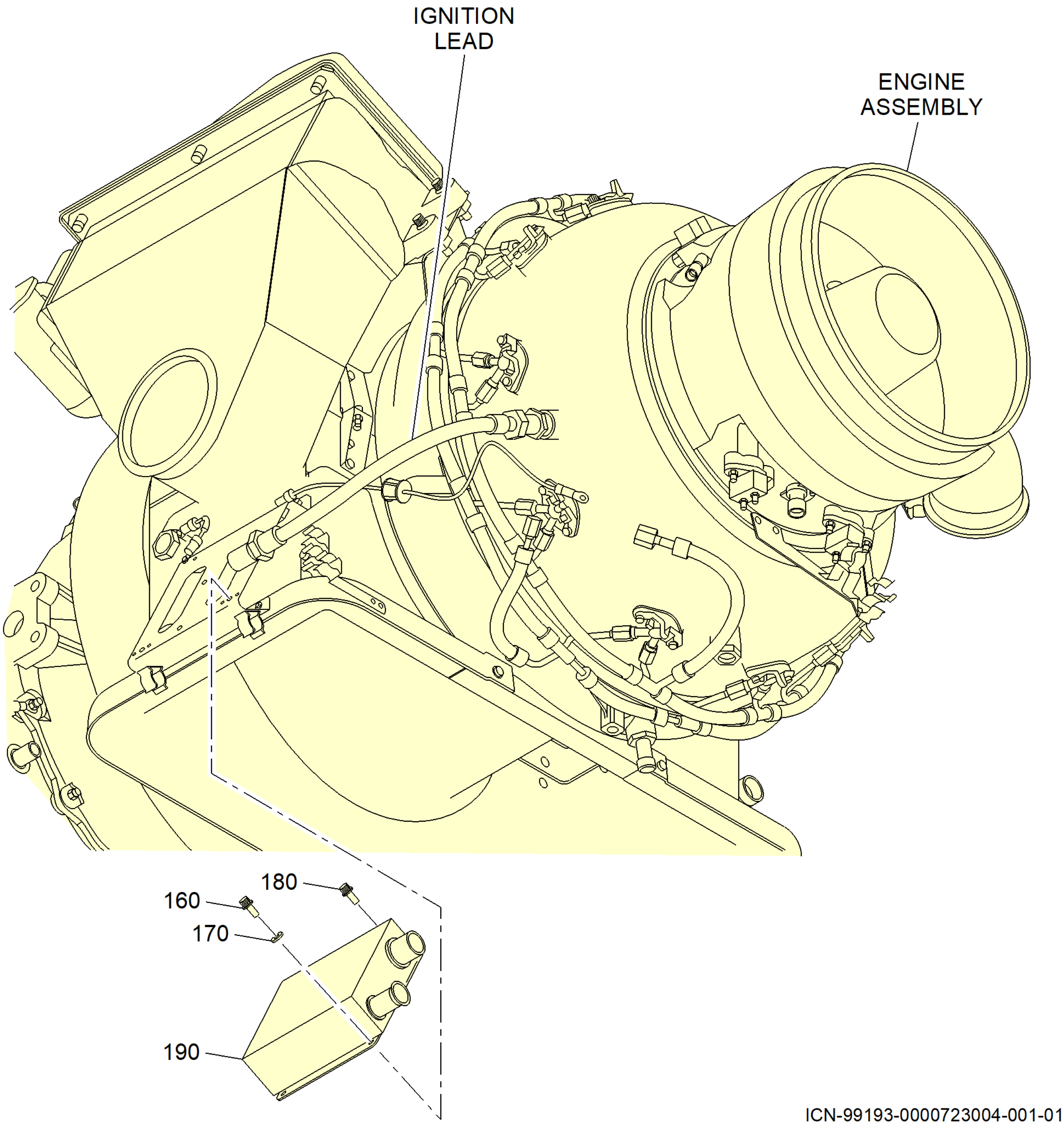

Figure 4001. Installation of Ignition Unit

Key to Figure 4001

160. BOLT (IPC FIG. 4)
170. WASHER
180. BOLT
190. IGNITION UNIT

5. Procedure

SUBTASK 49-20-00-450-028

A. Install ignition unit. Refer to Figure 4001.

(1) Install ignition unit (190) on the ignition unit bracket.

(a) Install one bolt (180) through the grounding strap in the upper left hole in ignition unit (190).

(b) Install one bolt (180) through the grounding strap and upper right hole in ignition unit (190).

(c) Attach ignition unit to ignition unit bracket with two bolts (160), washers (170) and bolts (180). Tighten bolts to a torque value of 50 in-lb (5.65 Nm).

(2) Install igniter plug lead on igniter plug and ignition unit. Refer to INSTALLATION-29.

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IGNITION PLUG LEAD
INSTALLATION-29

TASK 49-20-00-450-829

1. **General**

    A. This section contains procedures for installation of the ignition plug lead.

    B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

2. **Special Tools, Fixtures and Equipment**

    None

3. **Equipment and Materials**

    None

4. **Expendable Parts**

    None

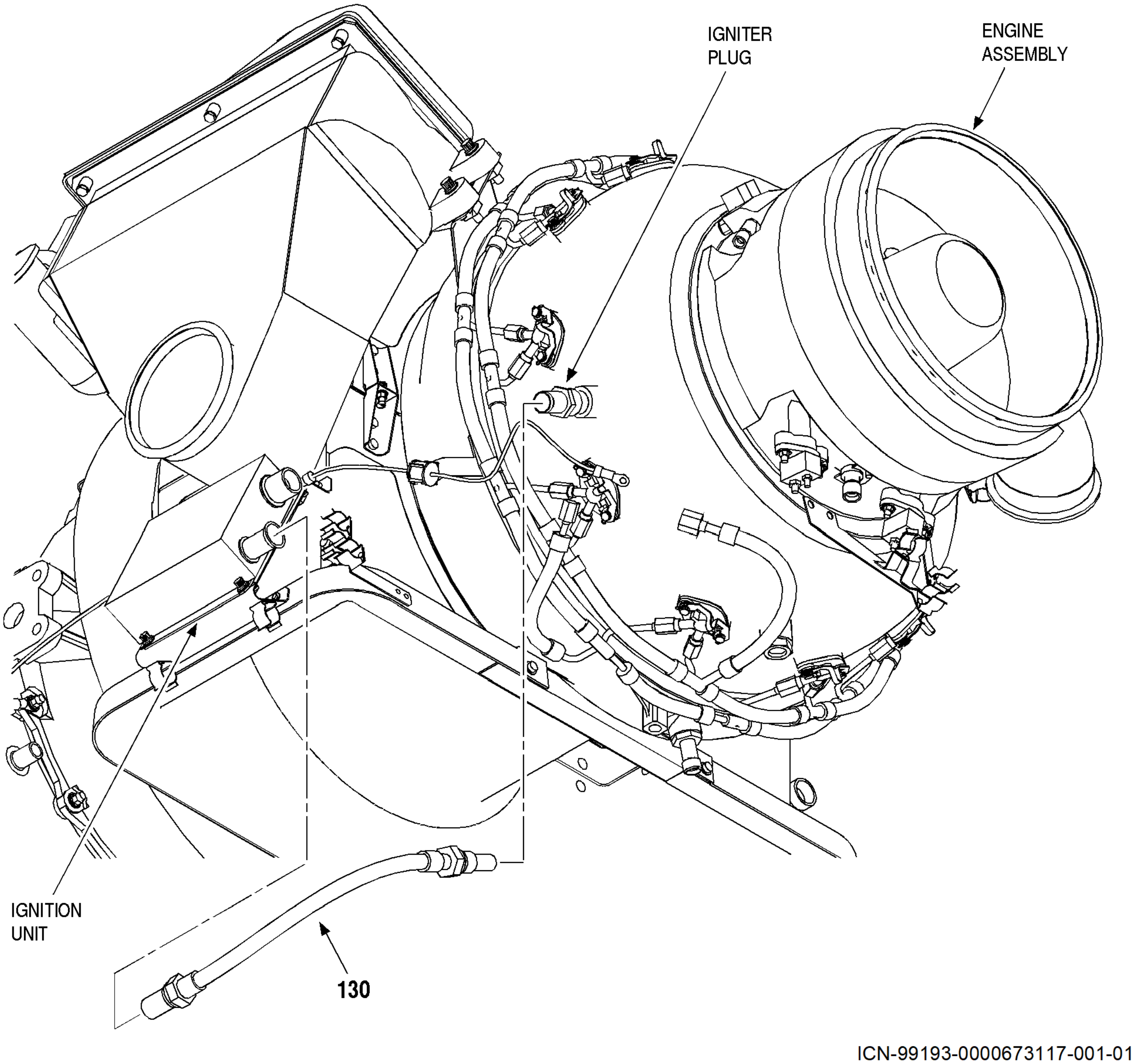

Figure 4001. Installation of Ignition Plug Lead

Key to Figure 4001

130. IGNITION PLUG LEAD (IPC FIG. 4)

5. <u>Procedure</u>

SUBTASK 49-20-00-450-029

A. Install ignition plug lead. Refer to Figure 4001.

(1) Install ignition plug lead (130) on the ignition unit and igniter plug. Tighten both ends to a torque value of 225 in-lb (25.42 Nm).

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ORIFICE FITTING ASSEMBLY (COMBUSTOR DRAIN) INSTALLATION-30

TASK 49-20-00-450-830

1. **General**

    A. This section contains procedures for installation of the orifice fitting assembly.

    B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

2. **Special Tools, Fixtures and Equipment**

    None

3. **Equipment and Materials**

    None

4. **Expendable Parts**

    A. Honeywell recommends that the parts shown in Table 4001 must be replaced at each installation. However, actual replacement of parts can be done on in-service experience.

Table 4001. Parts to be Replaced at Each Installation

Figure No.	Item No.	Nomenclature	Quantity
Figure 4001	115	Packing	1

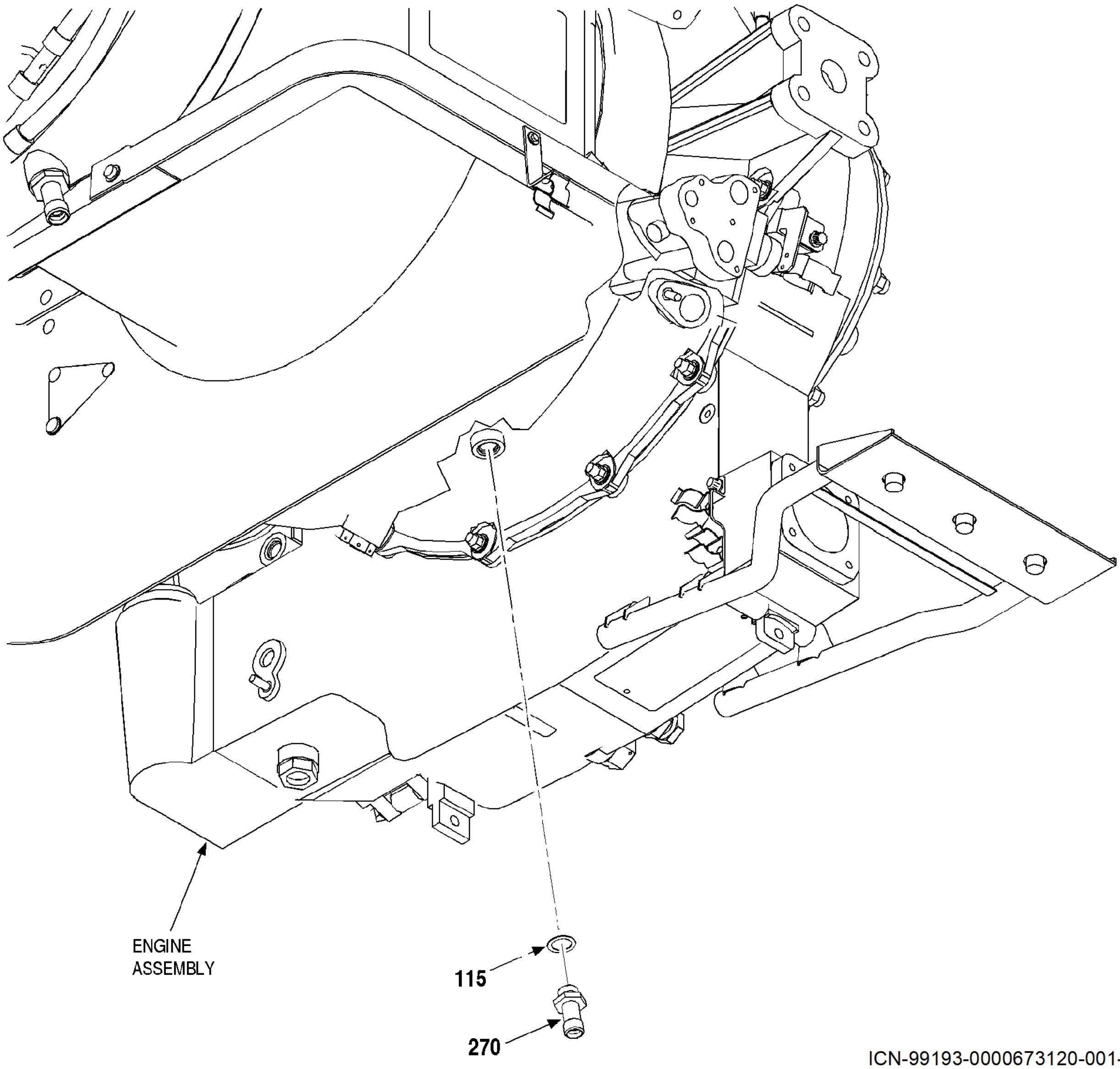

Figure 4001. Installation of Orifice Fitting Assembly

Key to Figure 4001

115. PACKING (IPC FIG. 2)
270. PLUG

5. Procedure

SUBTASK 49-20-00-450-030

A. Install orifice fitting assembly. Refer to Figure 4001.

(1) Install packing (115) on plug (270).

(2) Install plug (270) with packing on the engine assembly. Tighten plug to a torque value of 125 in-lb (14.12 Nm).

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PLUMBING AND ELECTRICAL INSTALLATION
INSTALLATION-31

TASK 49-20-00-450-831

1. General

A. This section contains procedures for installation of the plumbing and electrical installation.

B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

C. All the nuts, bolts and screws must be tightened to a standard torque and tolerance unless the torque is specified in the text. Refer to Standard Practices Manual (SPM) 20-00-02/70-00-01 for the standard torque.

D. Installation of threaded connectors.

(1) Align the key of one part with the groove or keyway of the other part to find the correct position of the connector in relation to the receptacle.

(2) Start the connector in the receptacle with a light forward pressure. Engage the threads of the coupling ring and receptacle.

CAUTION: NEVER USE FORCE TO ENGAGE CONNECTORS TO RECEPTACLES. DO NOT HAMMER A CONNECTOR INTO THE RECEPTACLE. DO NOT USE A TORQUE WRENCH OR PLIERS TO LOCK COUPLING RINGS.

(3) Carefully push in on the connector and tighten the coupling ring until the connector is seated and tight. If necessary use connector pliers to tighten coupling rings more than finger tight.

E. When screws or bolts are too long or too short, a longer or shorter standard screw or bolt can be used if there is a minimum of one full thread more than the face of the threaded part or nut.

NOTE: There are no alternate screw or bolt lengths permitted for blind hole applications.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

A. Table 4001 shows the necessary equipment and materials for installation.

Table 4001. Equipment and Materials

Equipment/Materials	Description/Manufacturer
NOTE: Equivalent equipment/materials can be used.	
Corrosion-preventive compound (Braycote 248) (MIL-C-11796, Class 3)	CAGE: 4RRP4

4. Expendable Parts

A. Honeywell recommends that the parts shown in Table 4002 be replaced at each removal. However, actual replacement of parts can be done on in-service experience.

Table 4002. Parts to be Replaced at Each Installation

Figure No.	Item No.	Nomenclature	Quantity
Figure 4001	15	Packing	4
	165	Packing	2
Figure 4002	105	Packing	1
	195	Packing	4
	200	Packing	2
	205	Packing	6
	223	Gasket	1
Figure 4005	15	Packing	2
	125	Packing	1
	340	Gasket	1
Figure 4007	95	Packing	1
	115	Packing	1
	210	Packing	4
	215	Packing	1
Figure 4008	75	Packing	2
	115	Packing	1
	195	Packing	6
	205	Packing	2
	245	Retainer	1
	245A	Retainer	1

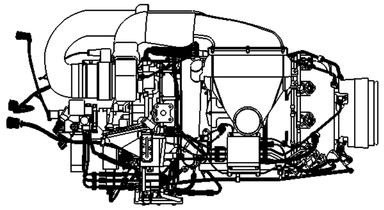
5. Procedure

SUBTASK 49-20-00-450-031

A. Install the plumbing and electrical installation.

(1) Install the APU on the engine maintenance stand assembly. Refer to INSTALLATION 01.

(2) Install the plumbing and electrical installation. Refer to Figure 4001 thru Figure 4009.



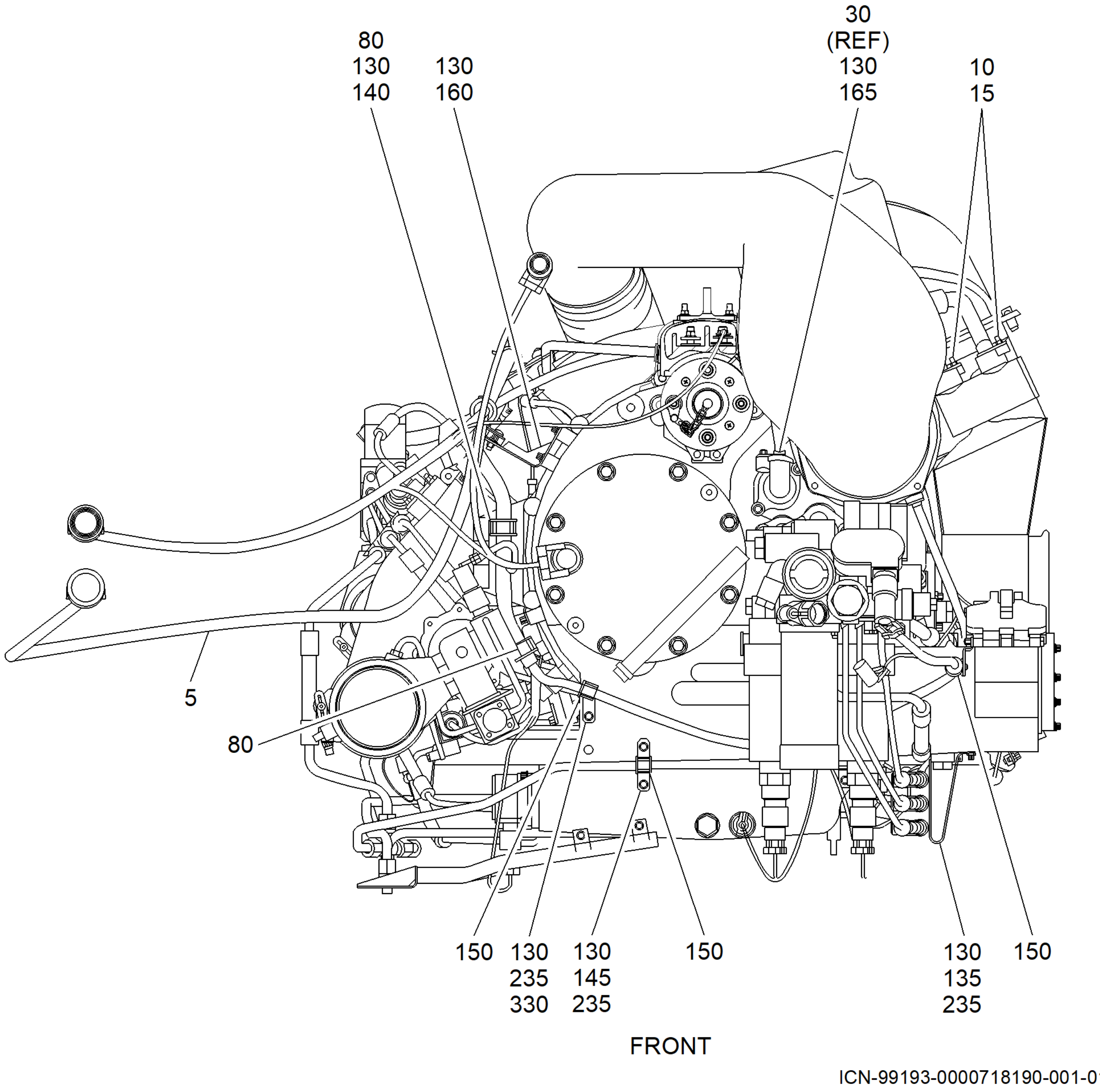
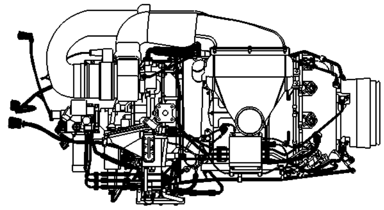


Figure 4001. Install the Plumbing and Electrical Installation (Partial Breakdown)

Key to Figure 4001

5. WIRING HARNESS-BRANCHED (IPC, FIG. 2)
10. NUT-ATTACHED WASHER
15. PACKING
30. GEARBOX VENT TUBE ASSY
80. GROMMET
130. BOLT
135. TUBE GEARBOX BRACKET
140. HARNESS BRACKET
145. TUBE GEARBOX BRACKET
150. GROMMET
160. HARNESS BRACKET
165. PACKING
235. WASHER
330. HARNESS GEARBOX BRACKET



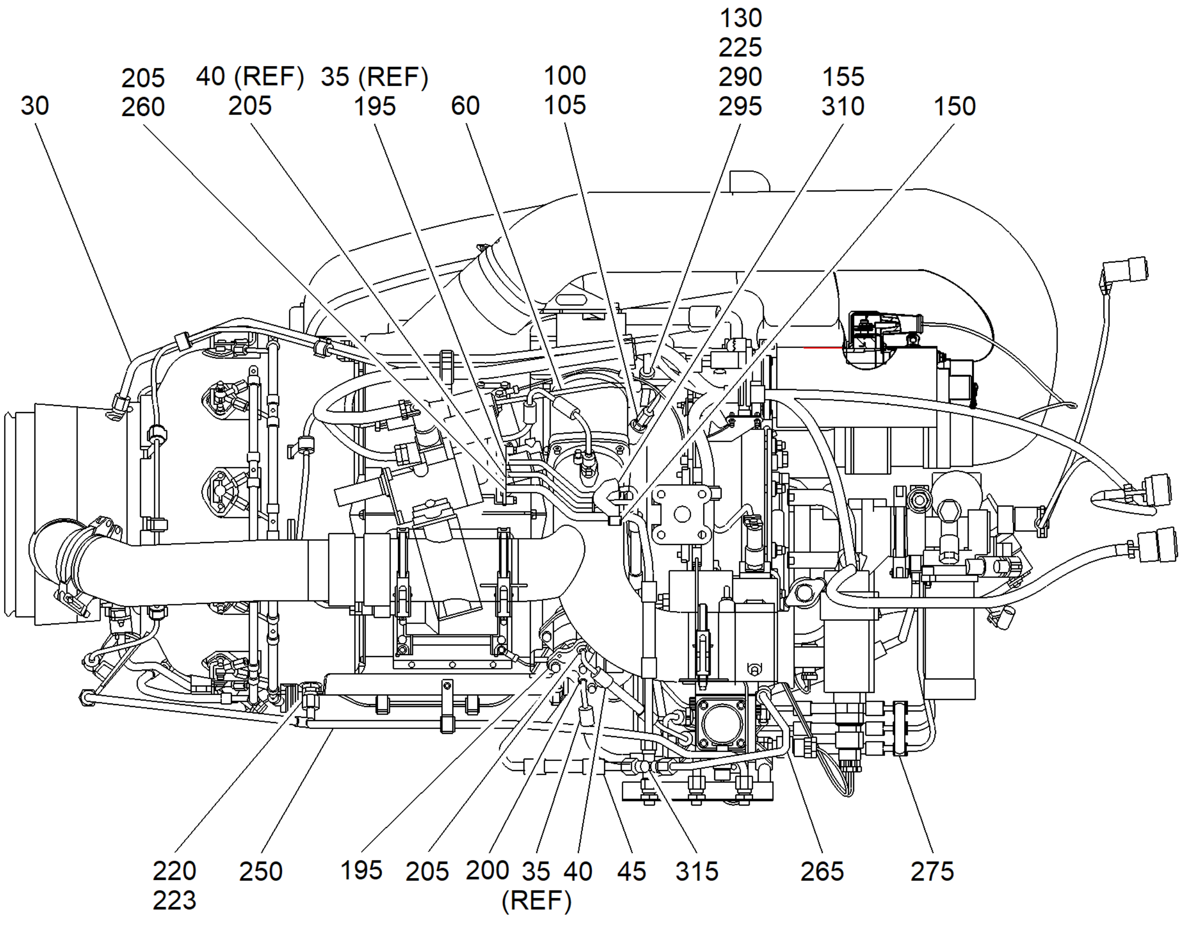


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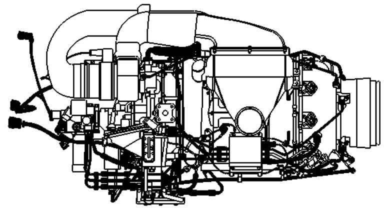
Figure 4002. (Pre SB 131-49-8002 and SB 131-49-8003) Install the Plumbing and Electrical Installation (Partial Breakdown)

Key to Figure 4002

30. TUBE-GEARBOX VENT	205. PACKING
35. SCV IGV SUPPLY TUBE	220. ORIFICED ADAPTER
40. SCV IGV RETURN TUBE	223. GASKET
45. IGV DR TUBE	225. NUT
60. PS TUBE	250. TURBINE DRAIN TUBE
100. UNION	260. SCV DRAIN TUBE
105. PACKING	265. FCU DRAIN TUBE
130. BOLT	275. THREE TUBE SUPPLY BRACKET
150. GROMMET	290. CLAMP
155. GROMMET	295. CLAMP
195. PACKING	310. UP TUBE SPACER BRACKET
200. PACKING	315. CROSS UNION



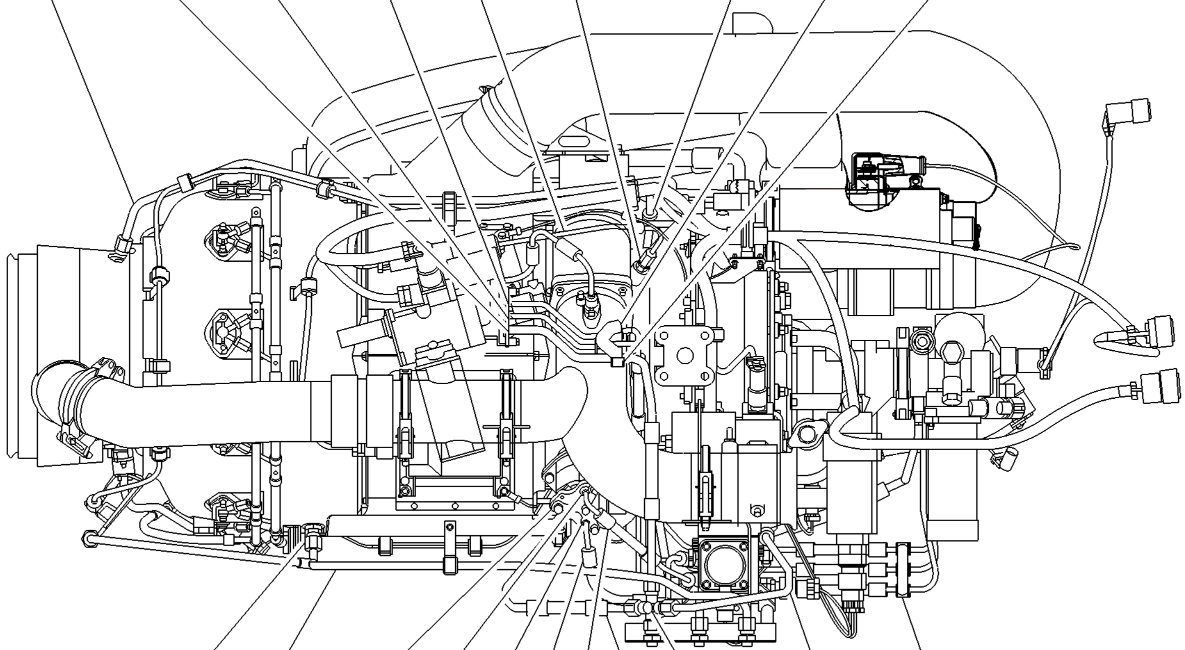


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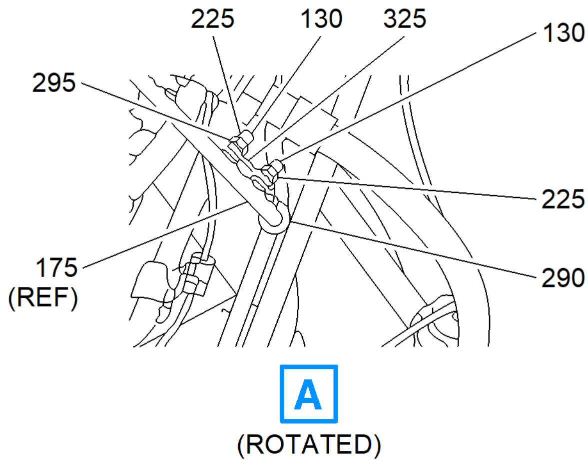
Figure 4003. (Post SB 131-49-8002 and SB 131-49-8003) Install the Plumbing and Electrical Installation (Partial Breakdown)

Key to Figure 4003

30.	TUBE-GEARBOX VENT	205.	PACKING
35.	SCV IGV SUPPLY TUBE	220.	ORIFICED ADAPTER
40.	SCV IGV RETURN TUBE	223.	GASKET
45A.	IGV DR TUBE (POST SB 131-49-8003)	225.	NUT
60.	PS TUBE	250.	TURBINE DRAIN TUBE
100.	UNION	260A.	SCV DRAIN TUBE (POST SB 131-49-8002)
105.	PACKING	265.	FCU DRAIN TUBE
130.	BOLT	275.	THREE TUBE SUPPLY BRACKET
150.	GROMMET	290.	CLAMP
155.	GROMMET	295.	CLAMP
195.	PACKING	310.	UP TUBE SPACER BRACKET
200.	PACKING	315.	CROSS UNION



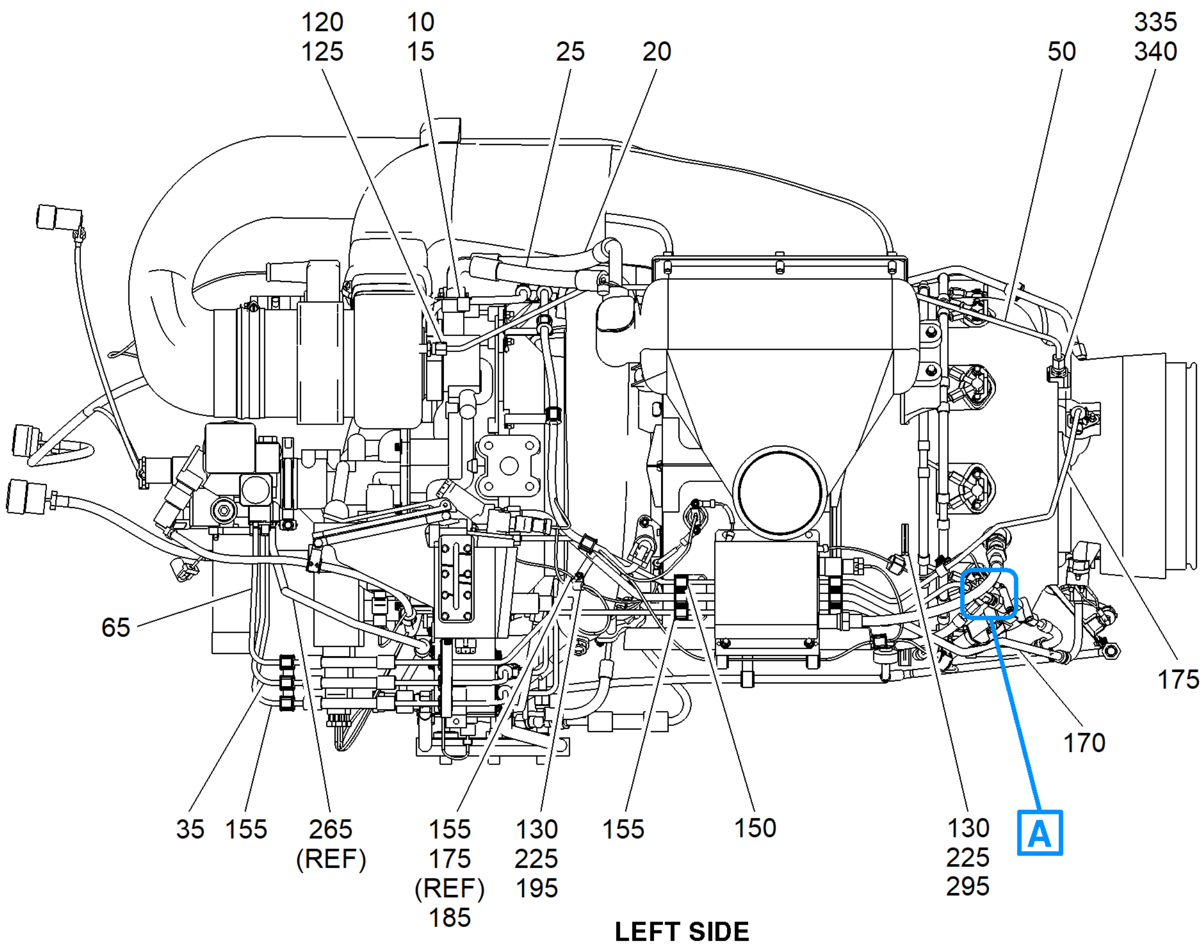


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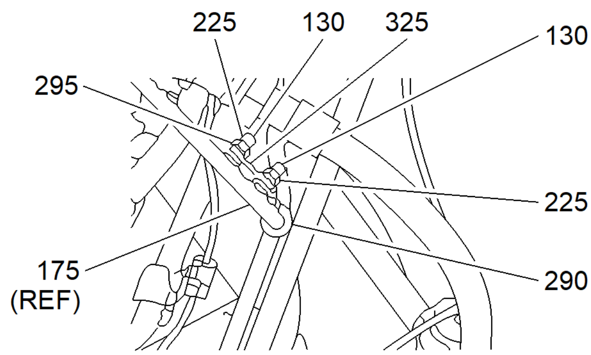
Figure 4004. (Post SB 131-49-8001) Install the Plumbing and Electrical Installation (Partial Breakdown)

Key to Figure 4004

10. NUT-ATTACHED WASHER (IPC, FIG. 2)
15. PACKING
20. OIL RETURN TUBE
25. OIL SUPPLY TUBE
35. SCV IGV SUPPLY TUBE
50. PCD TUBE
65. FUEL SUPPLY TUBE (PRE SB 131-49-8001)
-65A. FUEL SUPPLY TUBE (POST SB 131-49-8001)
120. FITTING ASSEMBLY
125. PACKING
130. BOLT
150. GROMMET
155. GROMMET
170. TURBINE BEARING RETURN TUBE (PRE SB 131-49-7606)
-170A. TURBINE BEARING RETURN TUBE (POST SB 131-49-7606)
175. TURBINE BEARING SUPPLY TUBE (PRE SB 131-49-7606)
-175A. TURBINE BEARING SUPPLY TUBE (POST SB 131-49-7606)
185. TUBE CLAMP
195. PACKING
225. NUT
265. FCU DRAIN TUBE
290. CLAMP
295. CLAMP
325. PLATE
335. UNION
340. GASKET
-. ITEM NOT ILLUSTRATED



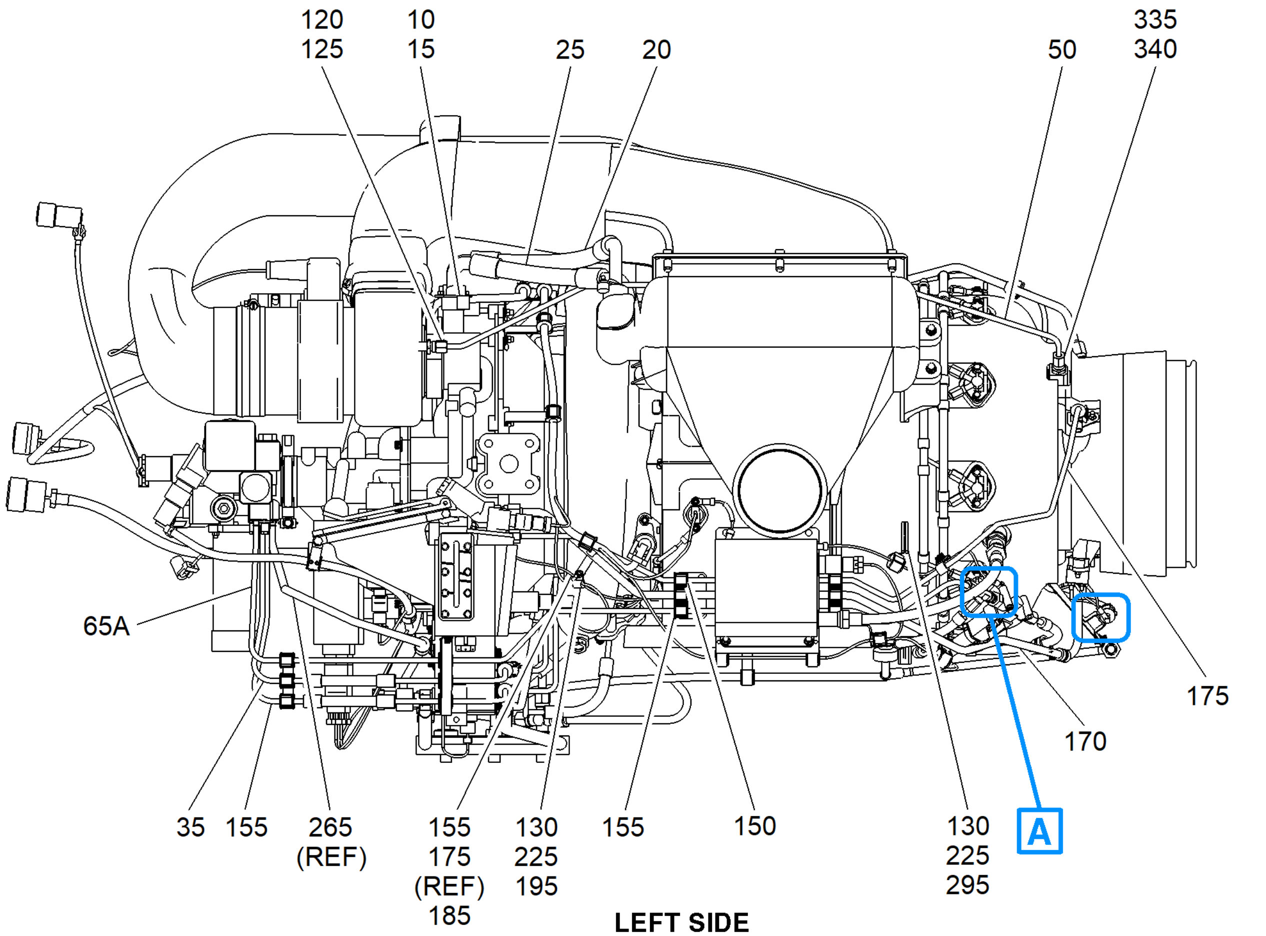


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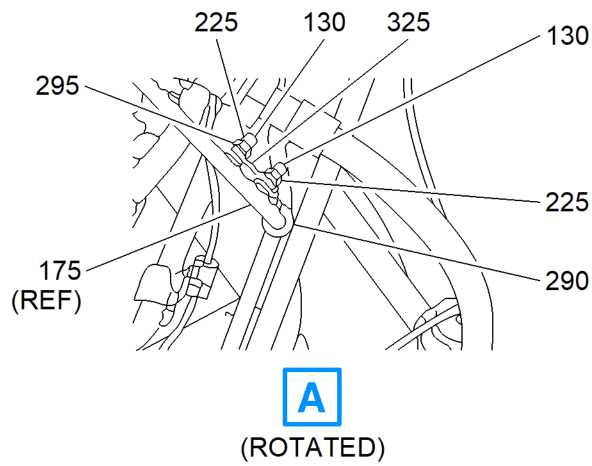
Figure 4005. (Pre SB 131-49-8001) Install the Plumbing and Electrical Installation (Partial Breakdown)

Key to Figure 4005

10. NUT-ATTACHED WASHER (IPC, FIG. 2)
15. PACKING
20. OIL RETURN TUBE
25. OIL SUPPLY TUBE
35. SCV IGV SUPPLY TUBE
50. PCD TUBE
65A. FUEL SUPPLY TUBE (POST SB 131-49-8001)
120. FITTING ASSEMBLY
125. PACKING
130. BOLT
150. GROMMET
155. GROMMET
170. TURBINE BEARING RETURN TUBE (PRE SB 131-49-7606)
-170A. TURBINE BEARING RETURN TUBE (POST SB 131-49-7606)
175. TURBINE BEARING SUPPLY TUBE (PRE SB 131-49-7606)
-175A. TURBINE BEARING SUPPLY TUBE (POST SB 131-49-7606)
185. TUBE CLAMP
195. PACKING
225. NUT
265. FCU DRAIN TUBE
290. CLAMP
295. CLAMP
325. PLATE
335. UNION
340. GASKET
-. ITEM NOT ILLUSTRATED



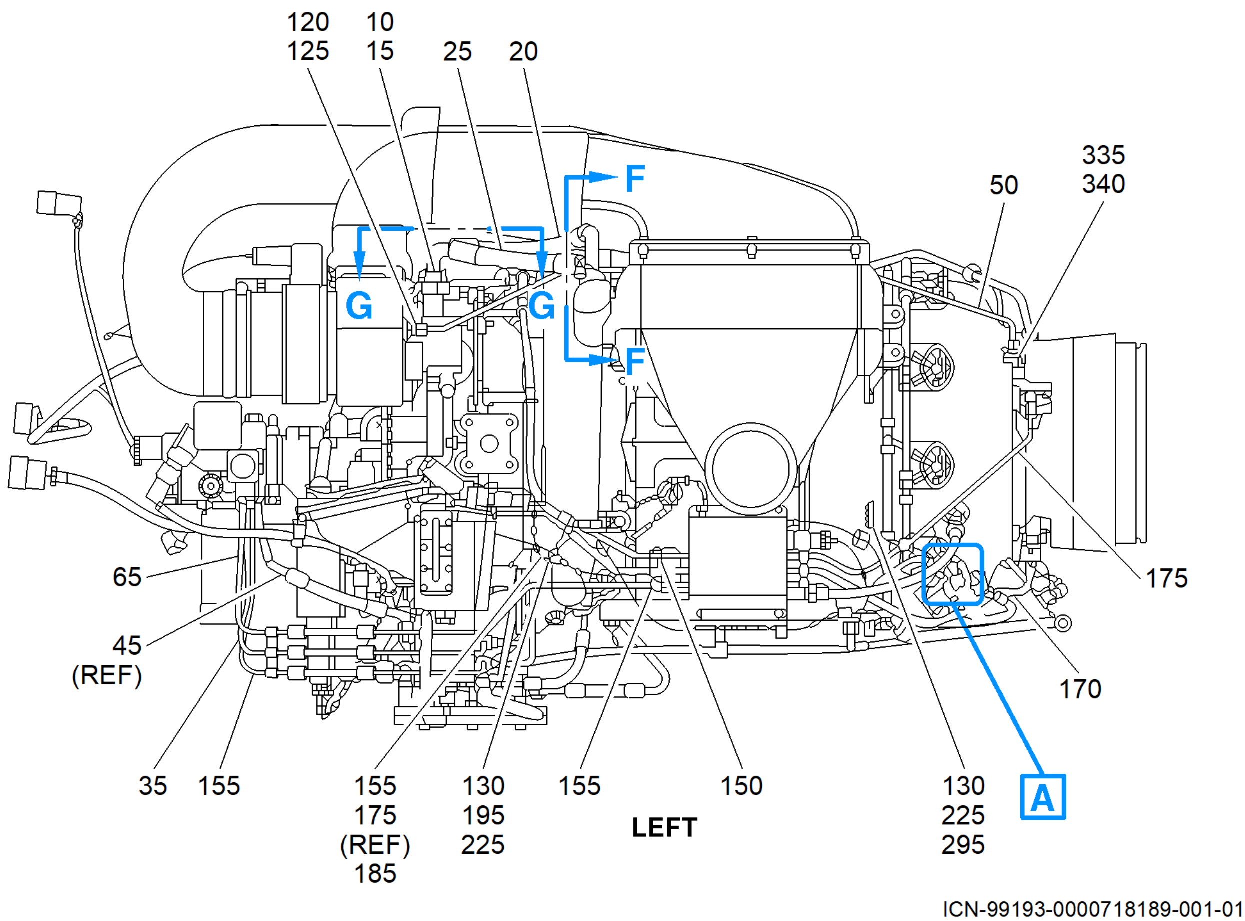


Figure 4006. (Sheet 1 of 2) (Post SB 131-49-8205) Disassemble the Plumbing and Electrical Installation (Partial Breakdown)

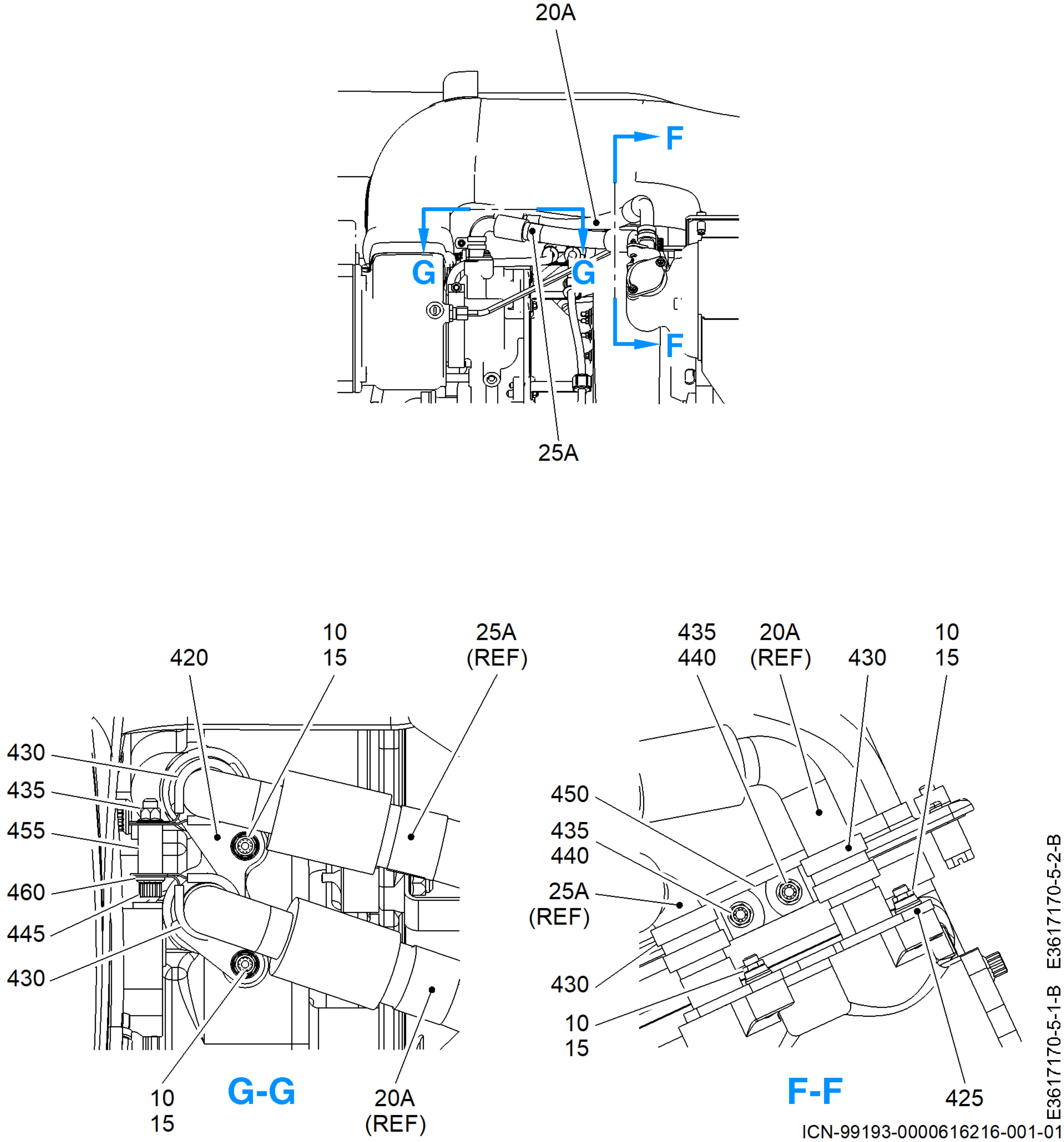


Figure 4006. (Sheet 2 of 2) (Post SB 131-49-8205) Disassemble the Plumbing and Electrical Installation (Partial Breakdown)

Key to Figure 4006

10. NUT-ATTACHED WASHER (IPC, FIG. 2)
15. PACKING
20. OIL RETURN TUBE (PRE SB 131-49-8205)
20A. OIL RETURN TUBE (POST SB 131-49-8205)
25. OIL SUPPLY TUBE (PRE SB 131-49-8205)
25A. OIL SUPPLY TUBE (POST SB 131-49-8205)
35. SCV IGV SUPPLY TUBE
45. IGVA DRAIN TUBE ASSY
50. PCD TUBE
65. FUEL SUPPLY TUBE (PRE SB 131-49-8001)
-65A. FUEL SUPPLY TUBE (POST SB 131-49-8001)
120. FITTING ASSEMBLY
125. PACKING
130. BOLT
150. GROMMET
155. GROMMET
170. TURBINE BEARING RETURN TUBE (PRE SB 131-49-7606)
-170A. TURBINE BEARING RETURN TUBE (POST SB 131-49-7606)
175. TURBINE BEARING SUPPLY TUBE (PRE SB 131-49-7606)
-175A. TURBINE BEARING SUPPLY TUBE (POST SB 131-49-7606)
185. TUBE CLAMP
195. PACKING
225. NUT
-265. FCU DRAIN TUBE
290. CLAMP
295. CLAMP
325. PLATE
335. UNION
340. GASKET
420. RETAINER GEARBOX TUBE (POST SB 131-49-8205)
425. RETAINER OIL COOLER TUBE (POST SB 131-49-8205)
430. CLAMP LOOP (POST SB 131-49-8205)
435. NUT (POST SB 131-49-8205)
440. BOLT (POST SB 131-49-8205)
445. BOLT (POST SB 131-49-8205)
450. BRACKET (POST SB 131-49-8205)
455. SPACER (POST SB 131-49-8205)
460. WASHER
-. ITEM NOT ILLUSTRATED

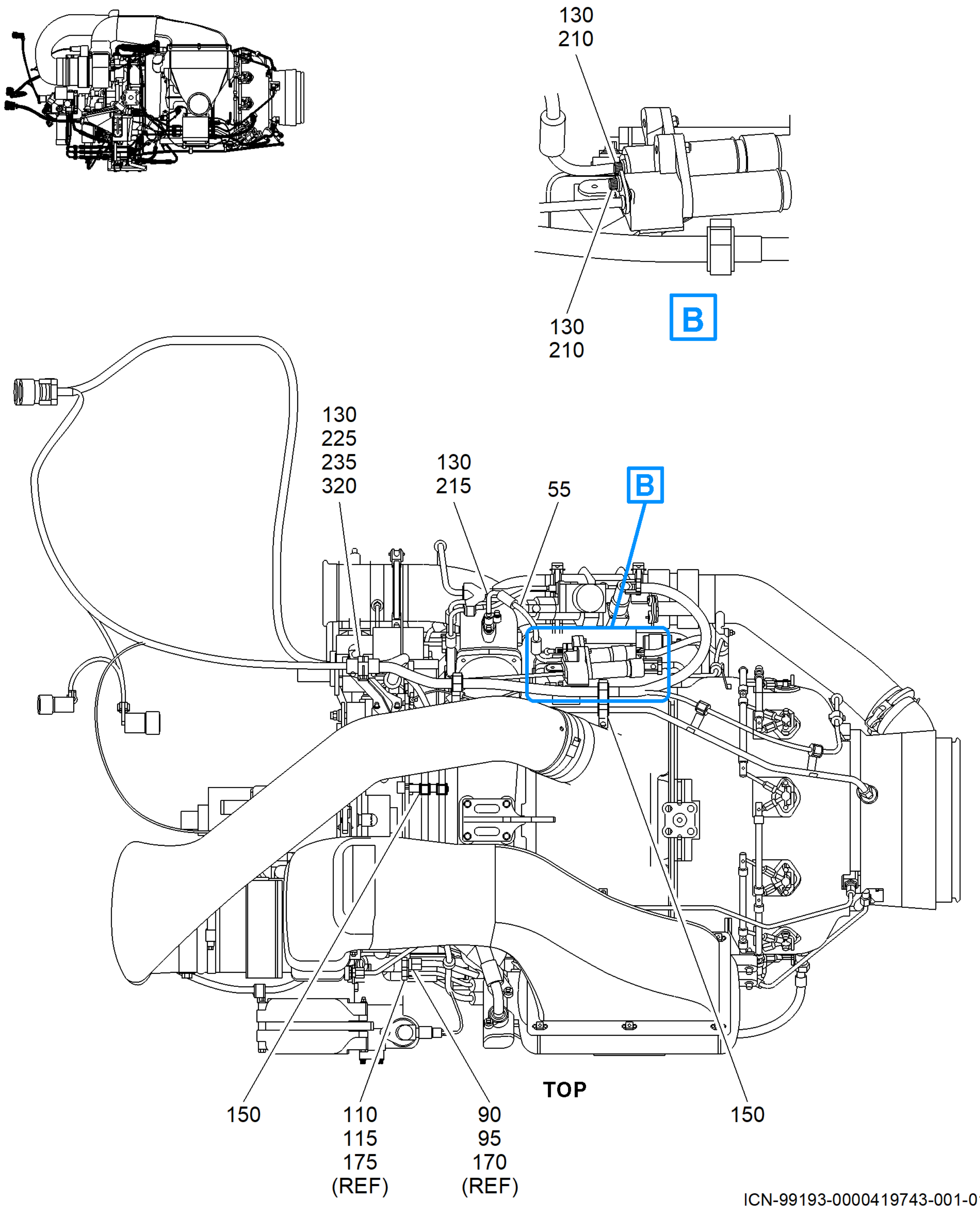


Figure 4007. Install the Plumbing and Electrical Installation (Partial Breakdown)

Key to Figure 4007

55. PT TUBE	170. TURBINE BRG RETAINER TUBE
90. UNION	175. TURBINE BRG SUPPLY TUBE
95. PACKING	210. PACKING
110. UNION	215. PACKING
115. PACKING	225. NUT
130. BOLT	235. WASHER
150. GROMMET	320. CLAMP

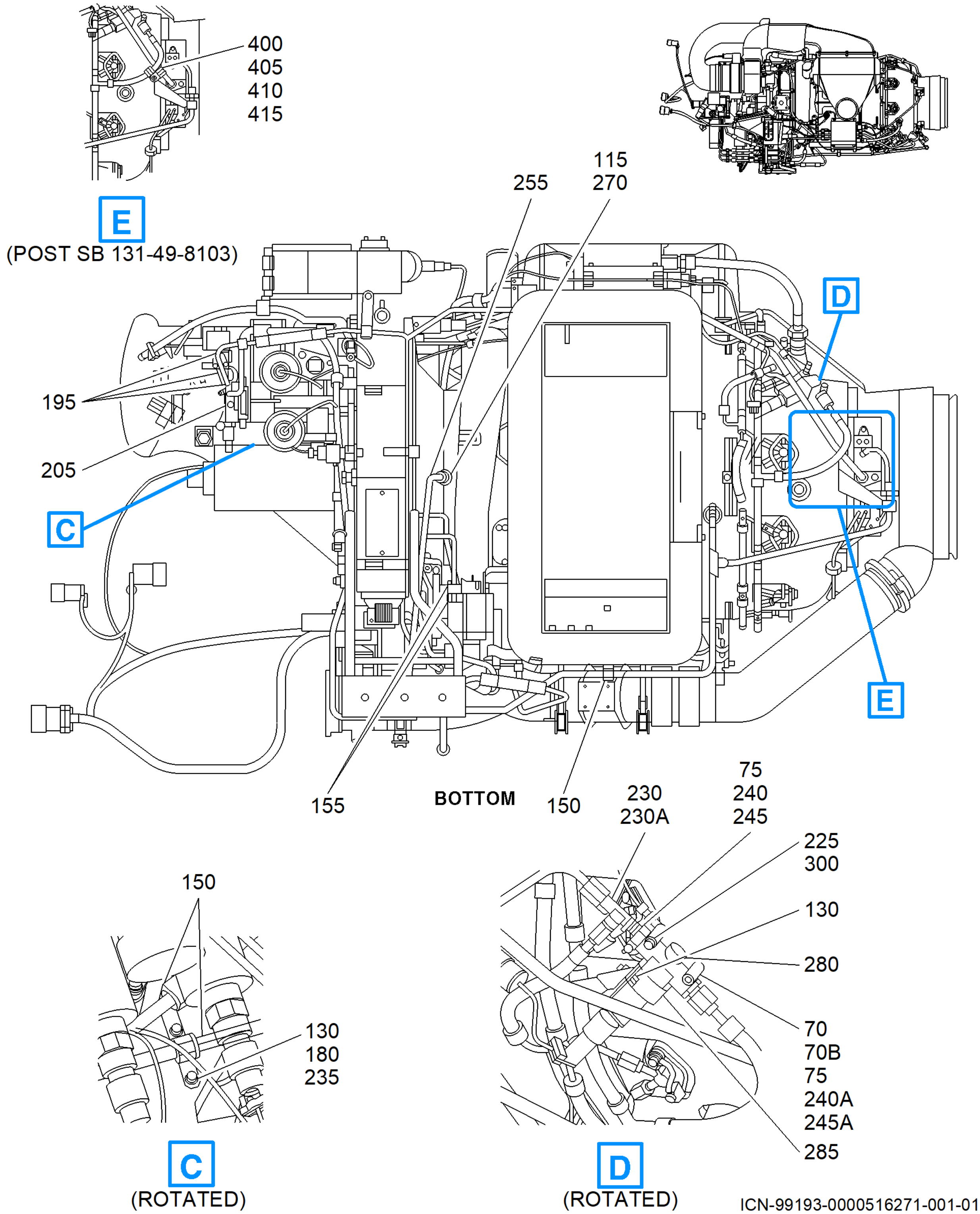


Figure 4008. Install the Plumbing and Electrical Installation (Partial Breakdown)

Key to Figure 4008

70. UNION
70B. CHECK VALVE (POST SB 131-49-7739)
75. PACKING
115. PACKING
130. BOLT
150. GROMMET
155. GROMMET
180. TUBE GEARBOX BRACKET
195. PACKING
205. PACKING
225. NUT
230. FLOW DIVIDER
230A. FITTING (POST SB 131-49-7739)
235. FLAT WASHER
240. NUT TUBE
240A. NUT TUBE (POST SB 131-49-7739)
245. RETAINER PACKING
245A. RETAINER PACKING (POST SB 131-49-7739)
255. LC DRAIN TUBE
270. ORIFICE FITTING
280. SOLENOID VALVE
285. CLAMP
300. BOLT
400. NUT
405. BOLT
410. CLAMP
415. CLAMP

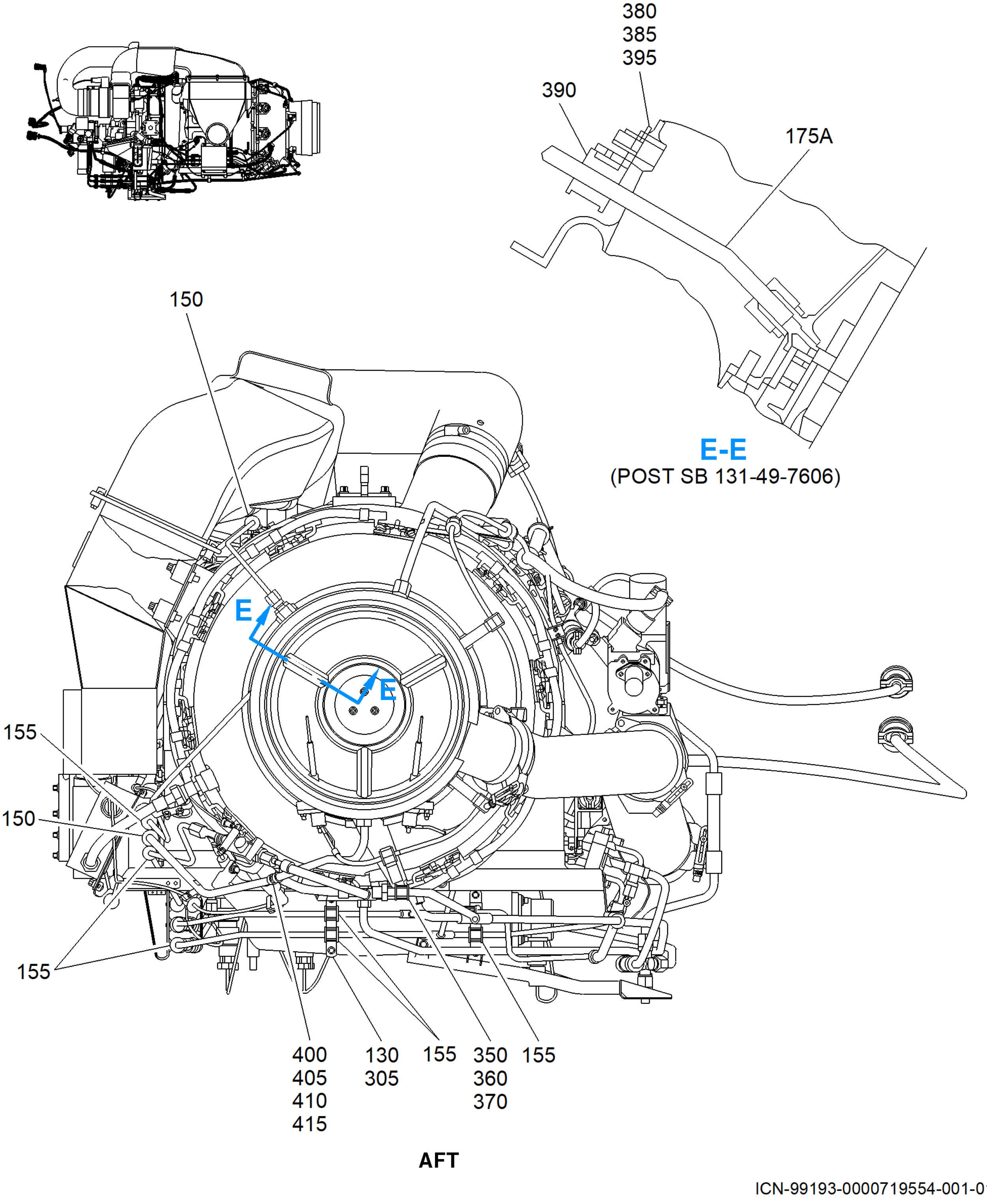


Figure 4009. Install the Plumbing and Electrical Installation (Partial Breakdown)

Key to Figure 4009

- 130. BOLT (IPC, FIG. 2)
- 150. GROMMET
- 155. GROMMET
- 175A. TURBINE BEARING SUPPLY TUBE (POST SB 131-49-7606)
- 305. TUBE LOWER GEARBOX BRACKET
- 350. NUT
- 360. BOLT
- 370. CLAMP
- 380. NUT (POST SB 131-49-7606)
- 385. BRACKET (POST SB 131-49-7606)
- 390. GROMMET (POST SB 131-49-7606)
- 395. WASHER (POST SB 131-49-7606)
- 400. NUT
- 405. BOLT
- 410. CLAMP
- 415. CLAMP

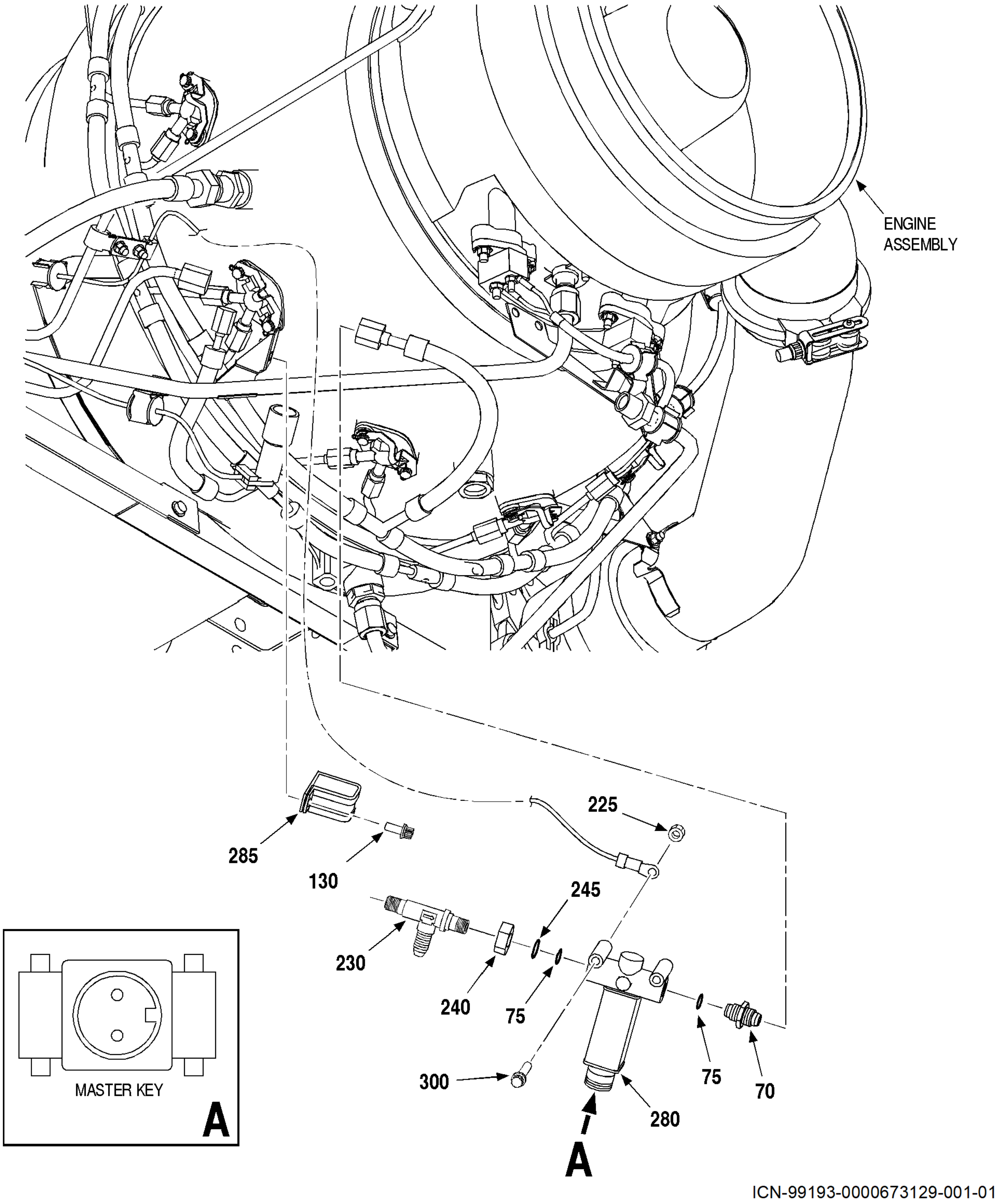


Figure 4010. (Pre SB 131-49-7739) Install the Fuel Flow Divider

Key to Figure 4010

70.	UNION (IPC, FIG. 2)	240.	TUBE NUT
75.	PACKING	245.	RETAINER
130.	BOLT	280.	SOLENOID VALVE
225.	NUT	285.	CLAMP
230.	FUEL FLOW DIVIDER	300.	BOLT

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

B. (Pre SB 131-49-7739) Install fuel flow divider solenoid valve. (Refer to Figure 4010.)

(1) Put a light layer of corrosion-preventive compound on new packing (75) and install packing on union (70).

(2) Install union (70) with attached packing (75) on the solenoid valve (280).

(3) Put a light layer of corrosion-preventive compound on new packing (75) and install packing on fuel flow divider (230) with assembled tube nut (240) and packing retainer (245).

(4) Install assembled fuel flow divider (230) on the solenoid valve (280) with master key position on the opposite side of the fuel flow divider. (Refer to Detail A.)

(5) Install fuel flow divider solenoid valve assembly on engine assembly and attach with clamp (285), bolts (130, 300) and nut (225).

(6) Tighten nut (225) and bolt (300) to 50 in-lb (5.65 Nm).

(7) Tighten tube nut (240) and union (70) to 140 in-lb (15.82 Nm).

CAUTION: IT IS RECOMMENDED TO START THE FITTINGS BY HAND FOR TWO COMPLETE TURNS.

(8) Connect fuel supply tube assembly to assembled fuel flow divider (230) and tighten fitting to 140 in-lb (15.82 Nm).

(9) Connect primary fuel manifold to assembled fuel flow divider (230) and tighten fitting to 100 in-lb (11.30 Nm).

(10) Connect secondary fuel manifold to assembled union (70) and tighten fitting to 140 in-lb (15.82 Nm).

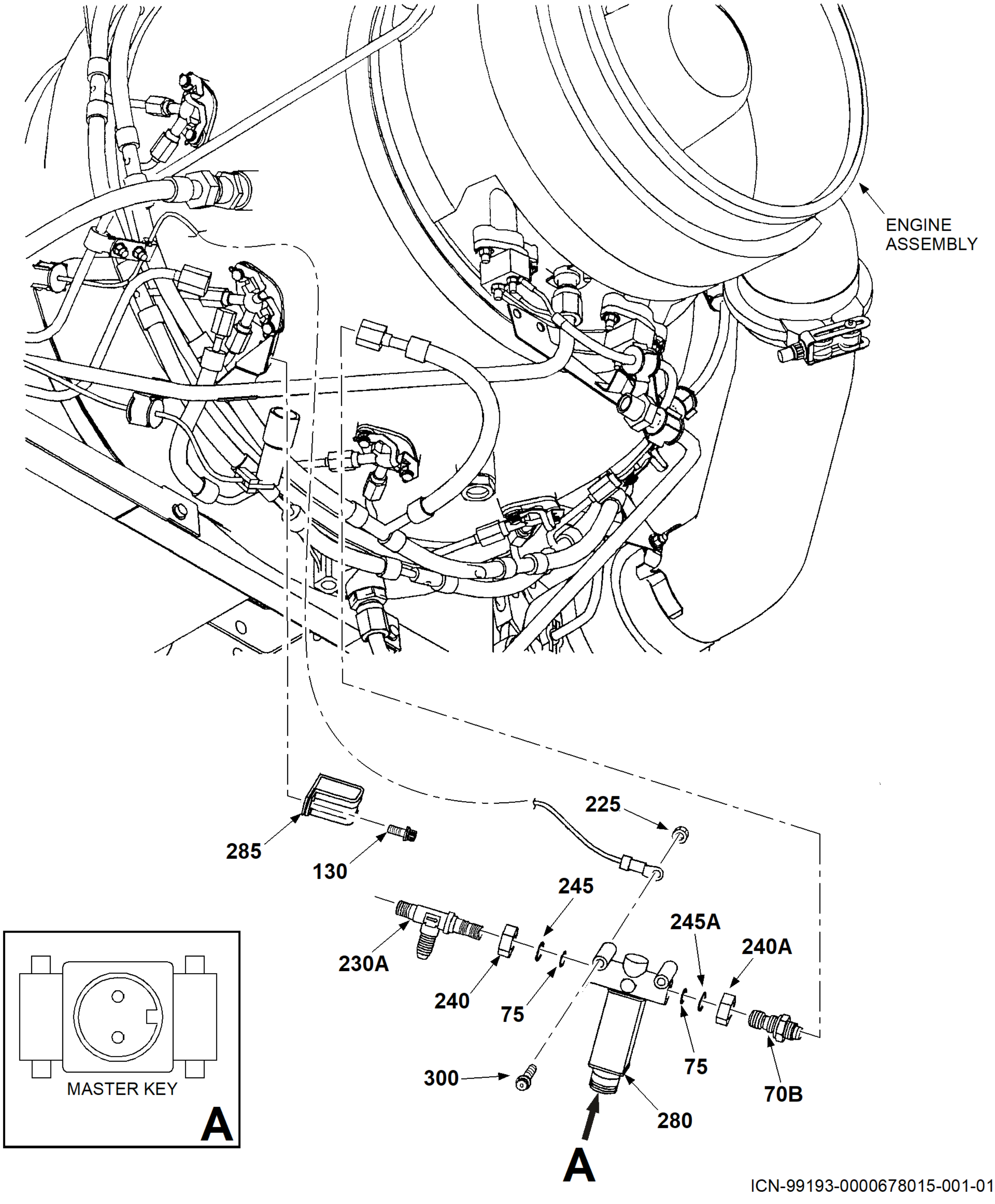


Figure 4011. (Post SB 131-49-7739) Install the Fuel Flow Divider

Key to Figure 4011

70B. CHECK VALVE (IPC, FIG. 2)	240A. TUBE NUT
75. PACKING	245. RETAINER
130. BOLT	245A. RETAINER
225. NUT	280. SOLENOID VALVE
230A. FITTING	285. CLAMP
240. TUBE NUT	300. BOLT

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

C. (Post SB 131-49-7739) Install fuel flow divider solenoid valve. (Refer to Figure 4011.)

(1) Put a light layer of corrosion-preventive compound on new packing (75) and install packing on check valve (70B) with assembled tube nut (240A) and packing retainer (245A).

(2) Install the assembled check valve (70B) on the solenoid valve (280).

(3) Put a light layer of corrosion-preventive compound on new packing (75) and install packing on fitting (230A) with assembled tube nut (240) and packing retainer (245).

(4) Install assembled fitting (230A) on the solenoid valve (280) with master key position on the opposite side of fitting (230A). (Refer to Detail A.)

(5) Install fuel flow divider solenoid valve assembly with ground wire, on engine assembly and attach with clamp (285), bolts (130, 300) and nuts (225).

(6) Tighten nut (225) and bolt (300) to 50 in-lb (5.65 Nm).

(7) Tighten tube nut (240) and fitting (230A) to 140 in-lb (15.82 Nm).

(8) Tighten tube nut (240A) and check valve (70B) to 140 in-lb (15.82 Nm).

CAUTION: IT IS RECOMMENDED TO START THE FITTINGS BY HAND FOR TWO COMPLETE TURNS.

(9) Connect fuel supply tube assembly to assembled fitting (230A) and tighten fitting to 140 in-lb (15.82 Nm).

(10) Connect primary fuel manifold to assembled fitting (230A) and tighten fitting to 100 in-lb (11.30 Nm).

(11) Connect secondary fuel manifold to assembled check valve (70B) and tighten fitting to 140 in-lb (15.82 Nm).

NOTE: The following procedure can be used to install one or both oil tubes.

D. (Pre SB 131-49-8205) Install the oil supply and oil return tubes. (Refer to Figure 4004 or Figure 4005.)

(1) Remove the blanking caps (if applicable) from the oil supply tube (25).

(2) Apply corrosion-preventive compound to the four new O-rings (15) and install on the oil supply tube (25).

CAUTION: THE OIL SUPPLY TUBE WILL INSTALL IN ONE ORIENTATION ONLY, DUE TO DIFFERENT ANGLES AT THE TUBE ENDS. THE TUBE WILL FLEX IN THE MIDDLE BUT SHOULD NOT REQUIRE ANY SIGNIFICANT FORCE OR TWISTING MOTION TO INSTALL. TYPICALLY THE METAL BAND WITH THE TUBE PART NUMBER WILL BE LOCATED AT THE GEARBOX SIDE OF THE TUBE ASSEMBLY.

(3) Align the oil supply tube (25) in the proper orientation and push the tube end into the oil cooler bypass valve inboard port identified at OIL IN and the other end into the gearbox housing outboard port.

CAUTION: MAKE SURE THAT THE TUBE IS FULLY ENGAGED INTO THE OIL PORT, THE TUBE RETAINER IS AGAINST THE TUBE SURFACE, AND TUBE RETAINER “HOOK” IS AGAINST THE THREADED STUD WHILE TIGHTENING THE NUTS.

(4) Rotate each tube retainer “hook” under the nut (10) and while holding the retainer securely against the threaded stud, lightly tighten the nuts (10) on the oil cooler bypass valve and the gearbox housing. Refer to Figure 4012.

(5) Tighten the nuts (10, Figure 4004 or Figure 4005) to a torque value of 40 to 45 in-lb (4.52 to 5.08 Nm).

(6) Remove the blanking caps (if applicable) from the oil return tube (20).

(7) Apply corrosion-preventive compound to the four new O-rings (PN M83248/1-017) and install on the oil return tube (20).

CAUTION: THE OIL RETURN TUBE WILL INSTALL IN ONE ORIENTATION ONLY, DUE TO DIFFERENT ANGLES AND LENGTHS AT THE TUBE ENDS. THE TUBE WILL FLEX IN THE MIDDLE BUT SHOULD NOT REQUIRE ANY SIGNIFICANT FORCE OR TWISTING MOTION TO INSTALL. THE LONGER TUBE END (ELBOW) INSTALLS INTO THE OIL COOLER BYPASS VALVE. TYPICALLY THE METAL BAND WITH THE TUBE PART NUMBER WILL BE LOCATED AT THE GEARBOX SIDE OF THE TUBE ASSEMBLY.

(8) Align the oil return tube (20) in the proper orientation and push the tube end into the oil cooler bypass valve inboard port identified at OIL IN and the other end into the gearbox housing outboard port.

CAUTION: MAKE SURE THAT THE TUBE IS FULLY ENGAGED INTO THE OIL PORT, THE TUBE RETAINER IS AGAINST THE TUBE SURFACE, AND TUBE RETAINER “HOOK” IS AGAINST THE THREADED STUD WHILE TIGHTENING THE NUTS.

(9) Rotate each tube retainer “hook” under the nut (10) and while holding the retainer securely against the threaded stud, lightly tighten the nuts (10) on the oil cooler bypass valve and the gearbox housing. Refer to Figure 4012.

(10) Tighten the nuts (10, Figure 4004 or Figure 4005) to a torque value of 40 to 45 in-lb (4.52 to 5.08 Nm).

E. (Post SB 131-49-8205) Install the oil supply and oil return tubes. (Refer to Figure 4006.)

(1) Apply corrosion-preventive compound to the new packings (15).

(2) Install the new oil cooler return tube assembly (20A), using new packings (15).

CAUTION: EXTREME CAUTION SHOULD BE USED TO MAKE SURE THE TUBES ARE FIRMLY AND FULLY INSTALLED INTO THE OIL COOLER OR GEARBOX MATING HOUSINGS.

(3) Apply MIL-PRF-23699, lubricating oil to the new packings (15).

(4) Install the new oil cooler supply tube assembly (25A), using new packings (15).

CAUTION: EXTREME CAUTION SHOULD BE USED TO MAKE SURE THE TUBES ARE FIRMLY AND FULLY INSTALLED INTO THE OIL COOLER OR GEARBOX MATING HOUSINGS.

(5) Install the new gearbox tube retainer (420), on top of both tubes flanges on the gearbox side and while holding the retainer in place, lightly tighten the nuts (10), on the two studs.

(6) Install the new oil cooler tube retainer (425), on top of both tubes flanges in the oil cooler side and while holding the retainer in place, lightly tighten the nuts (10), on the two studs.

(7) Torque the four nuts (10) to a torque value from 40 in-lb (4.5 Nm) to 45 in-lb (5.1 Nm).

(8) Install the four loop clamps (430) around the vertical rigid sections of both tubes at both ends.

(9) Install the bracket (450), between the two loop clamps (430) attached to both tubes at the oil cooler bypass valve end using two bolts (440), and two nuts (435). Tighten the bolts/nuts to 40 in-lb (4.52 Nm) if the nut is torqued and the bolt is held stationary or to 50 in-lb (5.65 Nm) if the bolt is torqued and the nut is held stationary.

(10) Install the spacer (455), between the two loop clamps (430) attached to both tubes at the gearbox end using the bolt (445), washer (460), and nut (435). Tighten the bolts/nuts to 40 in-lb (4.52 Nm) if the nut is torqued and the bolt is held stationary or to 50 in-lb (5.65 Nm) if the bolt is torqued and the nut is held stationary.

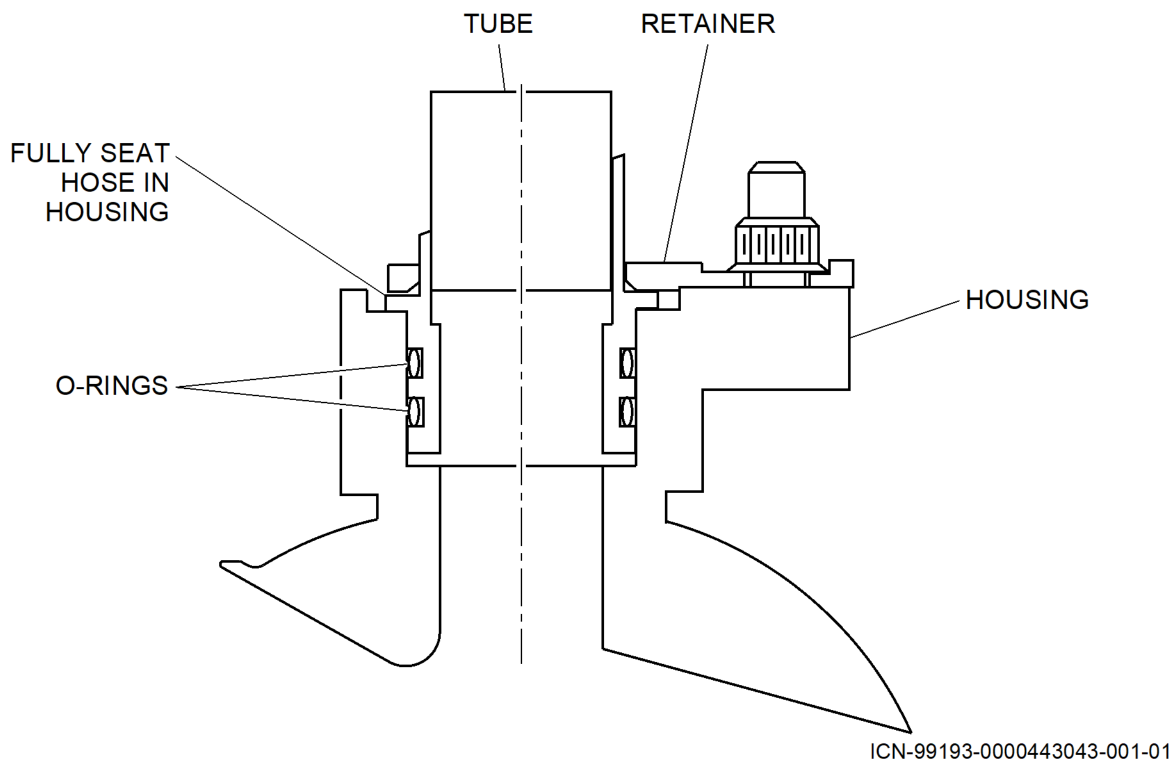


Figure 4012. Correct Installation of Tube - Housing - O-rings

IDENTIFICATION PLATE INSTALLATION-32

TASK 49-20-00-450-832

1. General

A. This section contains procedures for installation of the identification plate.

B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

C. All the nuts, bolts and screws must be tightened to a standard torque and tolerance unless the torque is specified in the text. Refer to Standard Practices Manual (SPM) 20-00-02/70-00-01 for the standard torque.

D. When screws or bolts are too long or too short, a longer or shorter standard screw or bolt can be used if there is a minimum of one full thread more than the face of the threaded part or nut.

NOTE: There are no alternate screw or bolt lengths permitted for blind hole applications.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

None

4. Expendable Parts

None

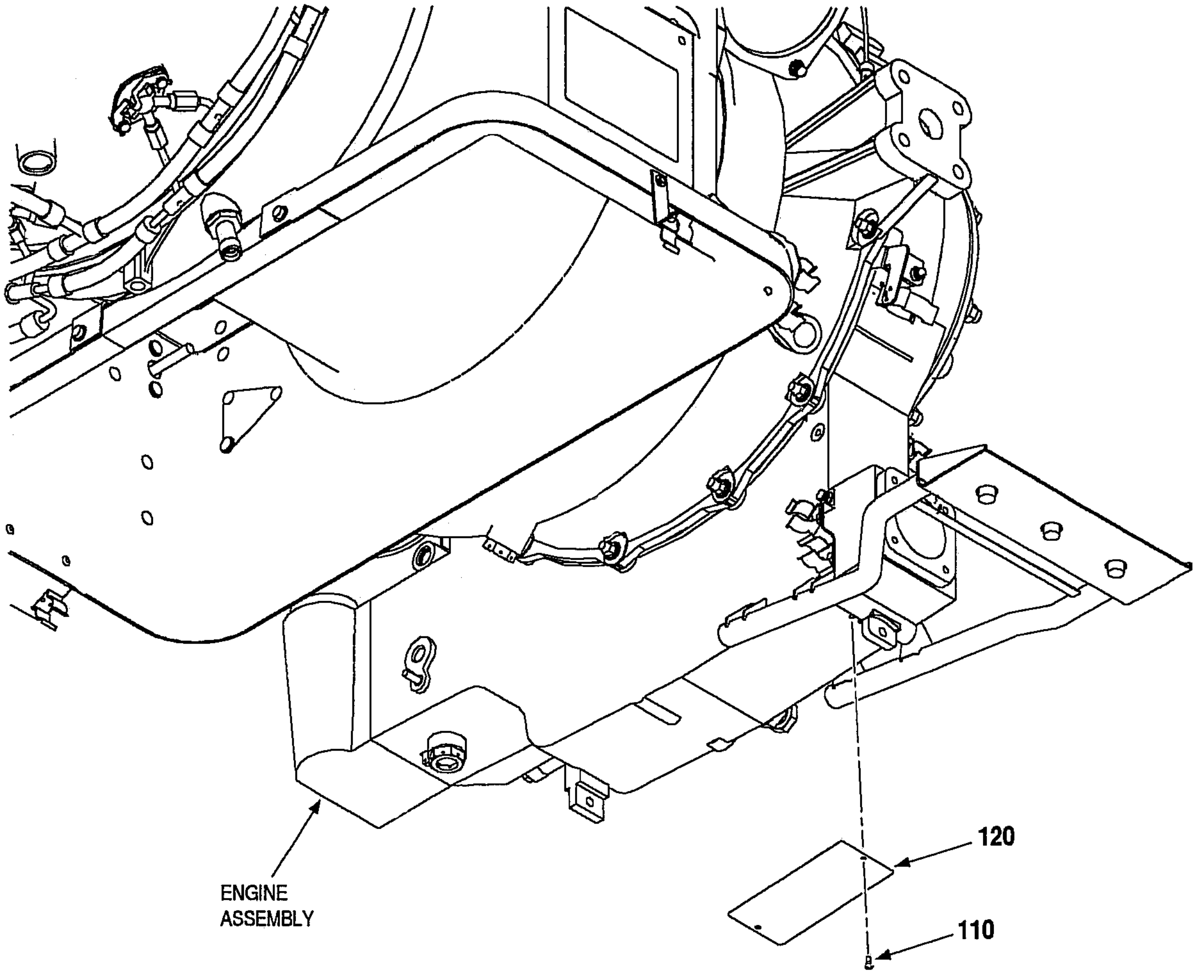


Figure 4001. Installation of Identification Plate

Key to Figure 4001

110. SCREW (IPC FIG. 6)	120. IDENTIFICATION PLATE

5. Procedure

SUBTASK 49-20-00-450-032

A. Install the identification plate. Refer to Figure 4001.

(1) Install screws (110) and identification plate (120) on the engine assembly. Tighten screws to a torque value of 10 in-lb (1.13 Nm).

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FINAL
INSTALLATION-33

TASK 49-20-00-400-802

1. General

A. This section contains recommended procedures that should be done by all users of this manual after all other installation procedures have been completed.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

None

4. Expendable Parts

None

5. Procedure

SUBTASK 49-20-00-210-001

A. Perform general final checks as follows:

(1) Check the engine identification plate for:

(a) Serial number.

(b) Series and changes.

(2) Check plumbing installation as follows:

(a) Check plumbing for damage.

(b) Check tubes for routing and tightness of clamps for chaffing.

(3) Check electrical installation as follows:

(a) Check the APU wire harness for routing and clamps for tightness and chaffing.

(b) Check electrical connectors for tightness.

SUBTASK 49-20-00-600-002

B. Service the APU with oil. Refer to SERVICING 01.

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APU
CLEANING-1

TASK 49-20-00-100-801

1. General

A. This section contains procedures for cleaning the components of the APU.

2. Cleaning Methods

A. Table 6001 shows the standard cleaning methods necessary for cleaning of the components. Refer to Standard Practices Manual (SPM) 20-00-02/70-00-01 for the cleaning procedures.

Table 6001. Cleaning Methods

IPC Figure No.	Item No.	Nomenclature	Cleaning Methods 203A	203V	203J	203M	203Q	203N	203K
All standard metallic hardware			X	X					
Plumbing and fittings						X			
Rubber, fiber or plastic parts							X		
2	5	APU wire harness	Refer to ATA No. 49-11-13						
3	190	Starter motor	Refer to ATA No. 49-41-20						
4	50	Fuel control unit	Refer to ATA No. 49-30-99						
	70	Lube module	Refer to ATA No. 49-90-57						
	120	Oil cooler	Refer to ATA No. 49-94-34						
	130	Igniter plug lead						X	
	140	Igniter plug						X	
	190	Ignition unit	Refer to ATA No. 49-41-09						
	230	Inlet temperature sensor	X	X	X				
	260	Inlet pressure transducer	X	X	X				
5	40, 80	Clamp	X	X	X				
	50	Surge duct							X
	60	Surge control valve	Refer to ATA No. 49-52-31						
	70	Seal	X	X	X				
	90	Load control valve	Refer to ATA No. 49-52-35						
	120	Total pressure probe assembly	X	X	X				
	170	Compressor discharge duct	X	X					X

Table 6001. Cleaning Methods (Cont)

IPC Figure No.	Item No.	Nomenclature	Cleaning Methods 203A	203V	203J	203M	203Q	203N	203K
6	150	Inlet guide vane actuator	Refer to ATA No. 49-50-07						
	180	Speed sensor	X						
	240	EGT thermocouple						X	
	270	LOP switch	X						
7	10	Secondary fuel manifold assembly				X			
	20	Primary fuel manifold assembly				X			
8	40	Total pressure transducer	X						
	70	Differential pressure transducer	X						
9	30	Upper inlet duct					X		
	40	Lower inlet duct					X		
10	170	Quill shaft			X				

INSPECTION/CHECK

1. Refer to INSPECTION/REPAIR Manual, ATA No. 49-26-85, for inspection/check procedures.

   NOTE: INSPECTION/REPAIR Manual, ATA No. 49-26-85, is a companion manual to this ENGINE Manual.

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REPAIR

1. Refer to INSPECTION/REPAIR Manual, ATA No. 49-26-85, for repair procedures.

   NOTE: INSPECTION/REPAIR Manual, ATA No. 49-26-85, is a companion manual to this ENGINE Manual.

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APU
SERVICING-01

TASK 49-20-00-610-801

1. General

CAUTION: USE OF NON-APPROVED OILS, OR WHEN BRANDS OR TYPES OF OILS ARE MIXED TOGETHER, CAN DAMAGE APU.

A. Lubrication system general description.

The APU gearbox is a wet sump type and is used as a reservoir for the APU lubrication system which supplies pressure lubrication for all of the APU.

Refer to Honeywell Service Bulletin 49-7933 for list of oils currently approved for use in this APU. Different brands or types of oils must not be mixed.

2. Equipment and Materials

A. Table 11001 shows the necessary equipment and materials to do servicing.

Table 11001. Equipment and Materials

Equipment/Materials	Description/Manufacturer
NOTE: Equivalent equipment/material can be used.	
Degreasing solvent (MIL-PRF-680)	Commercially available
Lockwire (MS20995C32)	Commercially available
*Oil (MIL-PRF-23699)	Commercially available
*Oil (MIL-PRF-7808)	Commercially available
*Refer to SB 49-7933 for approved lubricant brand name.	

3. Procedure

SUBTASK 49-20-00-610-001

A. Change oil. Refer to Figure 11001.

Two methods of changing the oil are available. The Drain, Flush and Fill method and the Top Off method.

The Drain, Flush and Fill method quickly replaces the current oil brand with the new oil brand. The effects of the new oil are realized immediately.

The Top Off method gives the easiest way to change oil brands in the same oil specification. This method consumes less oil, however the effects of the new oil will take more time.

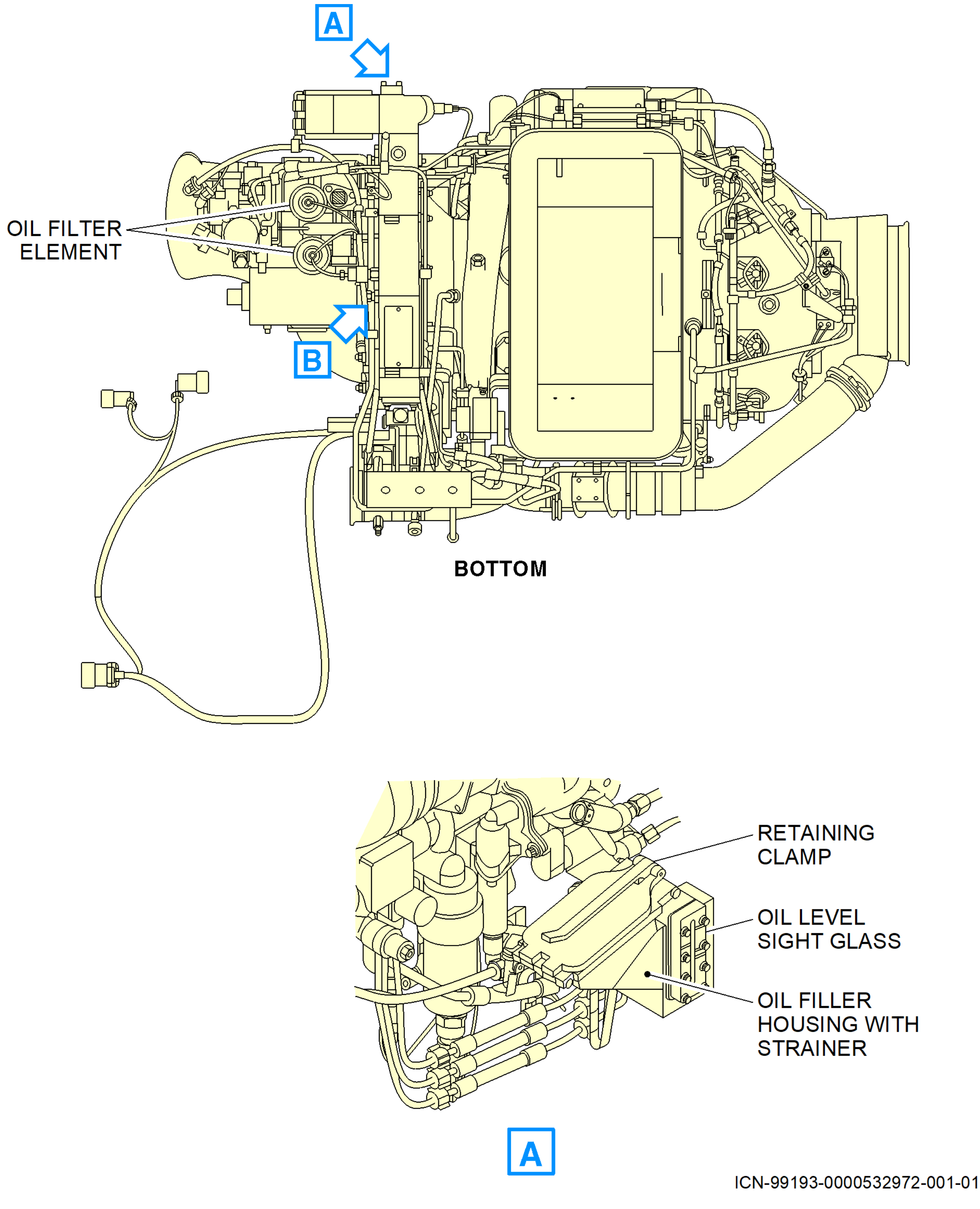

Figure 11001. (Sheet 1 of 2) APU Servicing

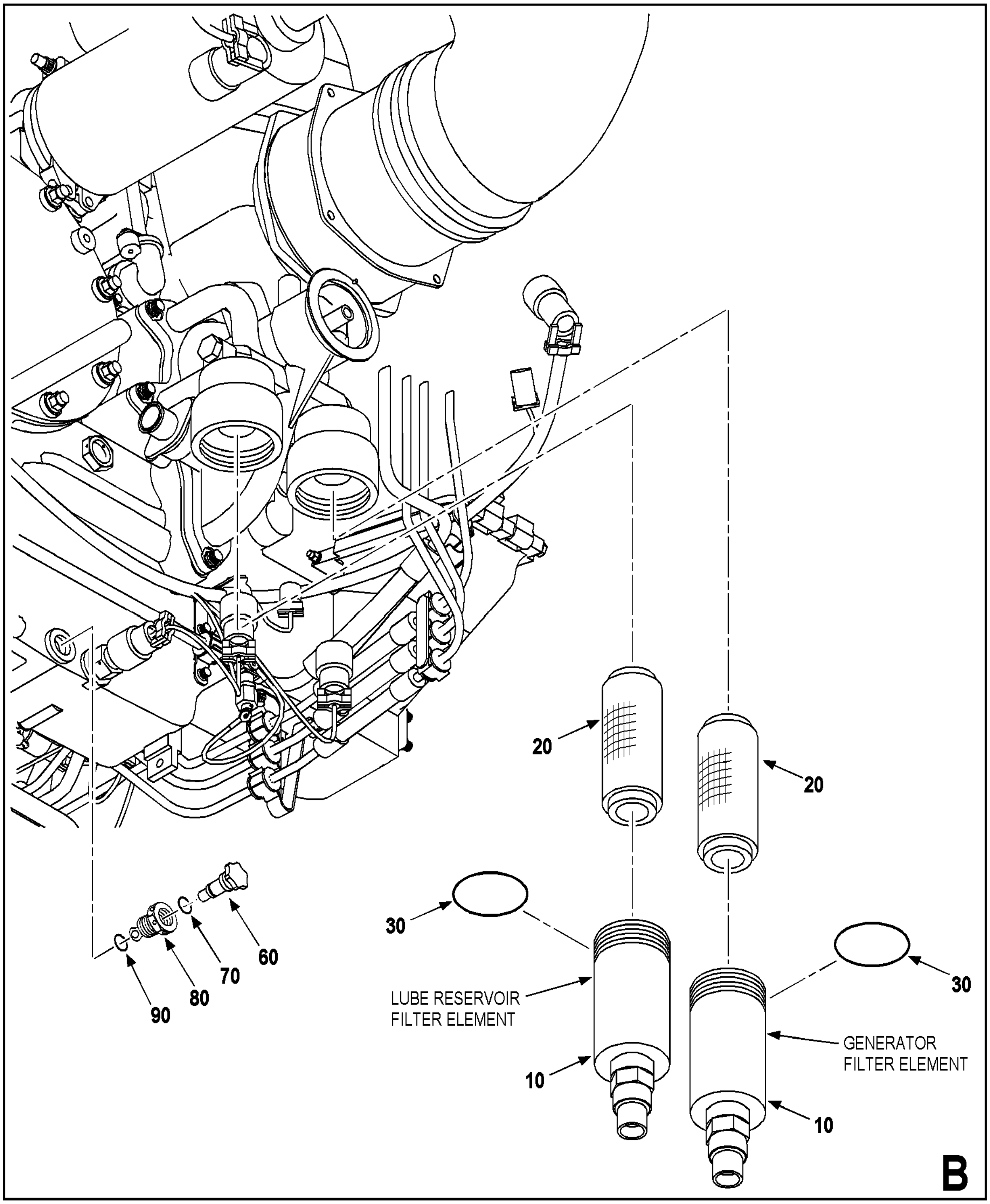

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Figure 11001. (Sheet 2 of 2) APU Servicing

Key to Figure 11001

10. FILTER HOUSING (49-90-57, IPL FIG. 1)
20. OIL FILTER ELEMENT
30. PACKING
60. MAGNETIC PLUG (IPC 49-27-27, FIG. 11)
70. PACKING
80. PLUG
90. PACKING

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(1) Drain, Flush and Refill Method.

NOTE: Use oil specified in Table 11001. These oils are the only lubricants currently approved for this engine.

Drain oil while engine is still hot from operation. If necessary, start and operate engine until oil reaches operating temperature, then shutdown engine and proceed with oil change while oil is hot.

CAUTION: DO NOT OPERATE THE STARTER MORE THAN THE STARTER DUTY CYCLE OF THREE STARTS, THEN LET COOL FOR 15 MINUTES.

(a) Put an oil resistant container (approximately 5 gallon (19 liter)) below oil drain plug. Refer to Figure 11001 (Sheet 2 of 2).

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

CAUTION: IF THE OIL LEVEL IS AT THE TOP OF THE OIL LEVEL SIGHT GLASS, THE OIL CAN FLOW OUT WHEN THE FILL CAP IS LOOSENED. THE HOT OIL CAN BURN THE SKIN.

(b) Loosen oil fill cap (refer to Figure 11001 (Sheet 1 of 2)) to vent gearbox and facilitate draining.

(c) Remove plug (80, Figure 11001 (Sheet 2 of 2)) with magnetic plug (60) and packings (70, 90). Check magnetic plug. Refer to APU TESTING.

(d) Remove filter housings (10), packings (30) and oil filter elements (20). Discard packings and oil filter elements. Refer to Step 3.A.(3).

(e) Carefully check drained oil for metal particles which can indicate internal damage to engine. If indicated, check engine to determine extent of damage and remedial procedure required.

(f) Install new oil filter elements (20). Refer to Step 3.A.(3).

(g) Install plug (80) with magnetic plug (60) and new packings (70, 90).

(h) Remove oil fill cap and fill with selected new specification/brand of oil.

(i) Install oil fill cap and motor engine for 30 seconds to prime oil pump if necessary.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

(j) Start engine and operate at no-load governed speed for approximately 5 minutes.

(k) Shut down engine and drain and refill oil in accordance with Steps 3.A.(1)(a) thru (i).

NOTE: Wait at least 1 hour after the APU is shut down to permit the oil to cool before you service the oil system. This will make sure the sight glass reading is accurate.

(l) Attach a service tag to the engine to show brand and specification oil used.

(m) Operate engine for approximately 15 minutes and monitor oil pressure and temperature. If no changes are observed, the engine can be returned to service. If either oil pressure or temperature fluctuates, repeat entire drain and fill procedure until fluctuation stops or it is determined that fluctuation is caused by some other malfunction.

SUBTASK 49-20-00-610-002

CAUTION: THIS METHOD MUST NOT BE USED WHEN CHANGING OIL TO A DIFFERENT SPECIFICATION THAN THE OIL CURRENTLY USED IN THE SYSTEM. IF OIL OF A DIFFERENT SPECIFICATION IS BEING USED, REFER TO THE DRAIN, FLUSH AND REFILL METHOD.

(2) Top Off Method.

NOTE: The oil filter elements must be replaced. Refer to Step 3.A.(3).

Use oil specified in Table 11001. These oils are the only lubricants currently approved for use in this engine.

(a) If engine oil requires service, remove oil fill cap.

NOTE: Wait at least 1 hour after the APU is shut down to permit the oil to cool before you service the oil system. This will make sure the sight glass reading is accurate.

(b) Service engine with new brand of oil.

(c) Install oil fill cap.

(d) Attach a service tag to the engine to show brand and type oil used.

(3) Remove, check and replace oil filters. (Refer to Figure 11001 (Sheet 2 of 2).)

NOTE: Change oil filters when oil with different specification or brand is used.

(a) Use an approved container to catch the engine oil drained from the oil filter elements and filter housings.

(b) Remove filter housings (10), packing (30) and oil filter elements (20) from the lube module. Discard packing.

(c) Check the oil filter elements and oil in the container for contamination.

<u>1</u> Large metal particles or pieces with machined surfaces are not permitted and an internal check of the engine is necessary.

<u>2</u> If the quantity of metal particles collected is heavy, it is an indication of unusual engine wear. Check the engine for internal wear.

<u>WARNING:</u> USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

<u>WARNING:</u> CLEAN PARTS IN AN AREA OPEN TO THE AIR, THAT HAS GOOD LIGHT AND SUFFICIENT SAFETY AND FIRE PREVENTION EQUIPMENT.

<u>WARNING:</u> ALWAYS WEAR SOLVENT-RESISTANT GLOVES, SUCH AS NEOPRENE, WHEN USING SOLVENT.

(d) Clean the filter housings (10) and mating surfaces with degreasing solvent (MIL-PRF-680).

(e) Install lube module filter assemblies.

<u>WARNING:</u> USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

<u>1</u> Lubricate packings (30) with MIL-PRF-7808 or MIL-PRF-23699 oil.

<u>2</u> Install new packings (30) on the filter housings (10).

<u>3</u> Put oil filter elements (20) in the filter housings (10) and fill with the necessary specification of approved engine oil.

NOTE: It is not necessary to service the oil system if the oil sump was not drained.

<u>4</u> Install filter housings (10) with packing (30) and oil filter elements (20) on the lube module. Hand tighten.

APU
STORAGE-01

TASK 49-20-00-620-801

1. General

A. Refer to Service Bulletin 49-8028 for Standard Preservation and Storage Guidelines.

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APU
STORAGE-02

TASK 49-20-00-550-801

1. General

A. Refer to Service Bulletin 49-8028 for Standard Preservation and Storage Guidelines.

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APU - TESTING

TASK 49-20-00-760-801

1. General

A. This test procedure describes the setup, instrumentation, necessary data, limits, and outlines the procedures to test the 131-9[A] Auxiliary Power Unit (APU). These procedures are done to make sure that the APU is repaired correctly and meets operating limits.

B. An electronic control box (ECB) is necessary to conduct this test.

C. Table 13001 and Table 13002 supply information on special tools and equipment.

D. Table 13003 supplies information on the parameters for the instrumentation. To make sure of the accuracy of the readings found during testing, it is recommended that all instrumentation be checked on a periodic basis. Any errors in the accuracy limits must be corrected before the equipment is used.

E. Table 13007 gives definitions for the symbols used in the TESTING Section.

F. Tables 13006 and 13008 gives ARINC and Transmit labels definitions and parameters.

G. A test cell or test facility applicable for high speed rotating equipment must be used for all tests. Test setup is shown in Figure 13001.

H. Instructions for data corrections are given with the use of tables and equations.

I. The APU will be tested at prevailing ambient conditions. The collected performance data will be corrected to installed, sea-level, 100°F (38°C) conditions.

J. EGT trim and shutdown schedules and inlet guide vane (IGV) trim schedules are shown in Figure 13007 and Figure 13008.

2. Special Tools, Fixtures and Equipment

A. Table 13001 shows the necessary special tools, fixtures and equipment for testing.

Table 13001. Special Tools, Fixtures and Equipment

Nomenclature/Description	Use	Part No.
NOTE: Equivalent tools, fixtures and equipment can be used.		
Bleed Duct (Lab)	Instrument with pressure and temperature	834971-1
Bleed Duct	Transition	834972-1
Exhaust Duct	To simulate aircraft APU exhaust pipe	834983-1
Portable Engine Stand/Cart	Build and test cart for APU Component of PN 834991-1	834990-1
Cart Assembly	Includes PN 834990-1 engine stand/cart, PN 834991-2 rear vertical frame, PN 834991-3 and PN 834991-4 driven support arm	834991-1
Rear Vertical Frame	Support APU on top side on cart Component of PN 834991-1	834991-2

Table 13001. Special Tools, Fixtures and Equipment (Cont)

Nomenclature/Description	Use	Part No.
Driven Support Arm	Adapt engine mount (left mount) to transport cart, Component of PN 834991-1	834991-3
Driven Support Arm	Adapt engine mount (right mount) to transport cart, Component of PN 834991-1	834991-4
Pressure Compressor Discharge (PCD) Probe Temperature Compressor Discharge (TCD) Probe	Pressure and temperature probe	834947-1
Inlet Duct Assembly	Instrument inlet per Figure 13001, provides inlet air for instrumented inlet duct assembly and APU	834976-1
Inlet Bellmouth	Adapt to the top of the inlet duct assembly (834976-1) to improve the inlet airflow profile	834979-1
Data Memory Module Reader	Interface DMM to PC (RS-232)	2024215-1/-2/-3
Electronic Control Box (ECB)	(Pre SB 131-49-7898) Electronic control box	3888394-120201
Electronic Control Box (ECB)	(Post SB 131-49-7898) Electronic control box	3888394-121204
Oil Temperature and Pressure Probe	Used for testing as per the Dress Kit PN7416670-1 for APU 131-9A.	3727419-1
Accelerometer (DCS-A/02)	Vibration sensors necessary for gearbox and turbine vibration measurement.	Commercially available.
Airflow measuring section	Necessary for bleed airflow measurement. Customer furnished.	Commercially available.
ARINC Computer	386/33 MHz or better IBM compatible with ARINC 429 communication protocol.	Commercially available.
Electrical load bank	To absorb electrical load for APU generator.	Customer furnished.
Electrical power, 28 VDC	An independent 28 VDC power supplies must be provided for both the starter and ECB control power.	Customer furnished.
Fuel flow meter	Measures the flow of fuel.	Customer furnished.
Generator 90 kVA	Necessary to apply shaft loads.	Customer furnished.
Generator control unit	Necessary to apply shaft loads.	Customer furnished.
Test cell	Test facility for APU.	Customer furnished.
Test cell APU master control panel		Commercially available.
Vibration amplifier and meter	Monitors, analyzes and measures vibration.	Commercially available.

Table 13001. Special Tools, Fixtures and Equipment (Cont)

Nomenclature/Description	Use	Part No.
Wiring	Facility, ECB, starter and generator interconnect wiring.	Customer furnished.
3094540-1	Oil Filter (PN 3094540-1) (Qty 2 ea)	Available from Air Supply, Chandler, AZ.

3. **Equipment and Materials**

A. Table 13002 shows the necessary equipment and materials for testing.

Table 13002. Equipment and Materials

Nomenclature/Description	Description/Manufacturer
NOTE: Equivalent equipment/materials can be used.	
Degreasing solvent (MIL-PRF-680)	Commercially available.
Fuel MIL-DTL-5624, Grade JP-4 or JP-5	Filtered and supplied at 110°F (43°C) maximum and 10 to 60 PSIG (70 to 415 kPa).
ASTM D-1655-75T, Jet A, A-1, or Jet B	Commercially available.
Mineral base oil (Grade 1010) (MIL-PRF-6081)	Commercially available.
Oil (MIL-PRF-7808 or MIL-PRF-23699)	Commercially available. Refer to DESCRIPTION AND OPERATION, Table 2 for approved oils.

4. Equipment and Instrumentation Check List

A. Table 13003 shows the parameters for the instrumentation.

Table 13003. Equipment and Instrumentation Check List

Parameter	Range	Data Acquisition Console	Data Acquisition Digital
Barometric pressure	12.2 to 17.2 PSIA (841 to 1186 mbar)	X[1]	X
Cell pressure	0 to 20 PSIA (0 to 1379 mbar)	X	X
Cell temperature	0 to 150°F (-18 to 66°C)	X	X
Engine speed	0 to 100,000 RPM	X	X
Generator current	0 to 500 amps	X	
Generator voltage (at generator terminals)	0 to 300 VAC	X	
Generator electrical power (at generator terminals)	0 to 150 kW	X	X
Oil pressure, lube pump outlet	0 to 100 PSIG (0 to 6.9 bar)	X	X
Oil temperature, lube pump outlet	0 to 500°F (-18 to 260°C)	X	X
Oil sump pressure	0 to 20 PSIA (0 to 1379 mbar)	X	X
Fuel inlet temperature	0 to 150°F (-18 to 66°C)		X
Fuel inlet pressure	0 to 60 PSIG (0 to 4.1 bar)	X	X
Fuel flow	0 to 1.25 gpm (0 to 4.73 lpm)	X[1]	X
APU inlet air total temperature, 12 probes	0 to 150°F (-18 to 66°C)	X	X
Orifice PT, bleed air	0 to 100 PSIA (0 to 6.9 bar)[2]	X	X
Orifice DP, bleed air	0 to 5 PSID (0 to 345 mbar)	X	X
Orifice TT, bleed air	0 to 500°F (-18 to 260°C)	X	X
Bleed air total pressure, 5 probes (minimum)	0 to 100 PSIA (0 to 6.9 bar)	X[1]	X
Bleed air total temperature, four probes (minimum)	0 to 500°F (-18 to 260°C)	X[1]	X
Compressor discharge static pressure	0 to 150 PSIG (0 to 10.3 bar)	X	X
Compressor discharge temperature	0 to 1000°F (-18 to 538°C)	X	X
EGT - lab rake, 12 probes	0 to 2000°F (-18 to 1093°C)	X	X
EGT - unit 1 and 2	0 to 2000°F (-18 to 1093°C)	X[1]	X
Exhaust static pressure, four probes	±2.5 PSIG (±172.4 mbar)		X

[1] Only if manual data is recorded.

[2] Only if cell load control valve is upstream of measuring orifice. If valve is downstream, range becomes 0 to 60 PSIA (0 to 4 bar).

Table 13003. Equipment and Instrumentation Check List (Cont)

Parameter	Range	Data Acquisition Console	Data Acquisition Digital
Vibration, gearbox, turbine and cooling fan velocity	0 to 2 in./sec (0 to 51 mm/sec)	X	X
Cell valve position	0 to 100% open	X	
32°F reference	31.6 to 32.4°F (-0.22 to 0.22°C)		X
Bleed orifice diameter	Thumbwheel	X	X
Bleed duct diameter	Thumbwheel	X	X
Fuel specific gravity	Query		X
Fuel lower heating value	Query		X
Test condition	Thumbwheel	X	X
Surge control valve (SCV) position	0 to 100 degrees	X	
IGV_POSITION (from ECB)	0 to 100 degrees	X	X
T2 (from ECB)	-100, +150°F (-73 to 66°C)	X	X
P2 (from ECB)	0 to 20 PSIA (0 to 1.4 bar)	X	X
PT (from ECB)	0 to 100 PSIA (0 to 6.9 bar)	X	X
DP (from ECB)	0 to 20 PSID (0 to 1.4 bar)	X	X
WFMES (from ECB) (called FUEL_FLOW ON ARINC)	0 to 500 lb/hr (0 to 227 kg/hr)	X	X

[1] Only if manual data is recorded.

[2] Only if cell load control valve is upstream of measuring orifice. If valve is downstream, range becomes 0 to 60 PSIA (0 to 4 bar).

5. Operating Limits

A. Table 13004 shows the operating limits for the APU.

Table 13004. Operating Limits

Type	Limit	Tolerance	Remarks
Leakage			
Fuel			
Muffler/combustor case drain	--	Refer to Remarks	Fuel leakage from the muffler/combustor case drain is permitted only after a false start or blowout
SCV/FCU/IGVA	$1/3\ cm^3$ per hour per component 1 drop/9 minute per component	Maximum	At drain

Table 13004. Operating Limits (Cont)

Type	Limit	Tolerance	Remarks
Oil, compressor seal drain	0	Maximum	At drain
Light-Off Time	10 seconds after 7% speed	Maximum	Any condition
Oil Pressure (normal)	67.5 PSIG (4.65 bar)	±7.5 PSIG (±0.52 bar)	Measured at oil pump discharge port
Oil Pressure (shutdown)	35 PSIG (2.41 bar)	±5 PSIG (±0.34 bar)	
Oil Pressure Fluctuation (under steady-state operating conditions)	±3 PSI (±0.21 bar)	Maximum	Measured at oil pump discharge port
Starter Duty Cycle	Refer to remarks	Maximum	Three starts or attempts permitted in a 1 hour period with a minimum of 1 minute off between attempts
Lube Consumption (New Engine)	6.5 cc/hr	Maximum	Verified by gearbox pressure less than 20 in H_2O (50 mbar) and visual observation
Temperature			
Inlet air	131°F (55°C)	Maximum	
Oil (shutdown)	325°F (163°C)	±10°F (±6°C)	Measured at oil temperature sensor
Maximum EGT (onspeed operation)	Refer to Figure 13007	±25°F (±14°C)	Shutdown and T5 trim limits shown
Maximum EGT (starting and acceleration)	Refer to Figure 13008	±25°F (±14°C)	Shutdown limits shown
Rotor Speed			
Continuous operation (ECS mode)	48.360 RPM	±125 RPM	For T2+14 to 86-14, =9(-10 to 30C-8,+5)
Continuous operation	48.800 RPM	±125 RPM	
Absolute maximum	51.728 RPM	±0.25%	Overspeed shutdown (106%) (hardware)
	51.728 RPM	±0.25%	Overspeed shutdown (106%) (software)
Speed variation, steady state	±125 RPM	- -	No instantaneous speed deviation will exceed the limit
	±125 RPM	- -	No amplitude modulation rate in a 1-second time will exceed the limit Repetition rate must be lower than 2 Hz
Speed variation load transients	±2100 RPM	- -	
Vibration			Refer to Figure 13001 for locations (110-2000 Hz, “z” direction)
On-speed operation			

Table 13004. Operating Limits (Cont)

Type	Limit	Tolerance	Remarks
Gearbox	0.65 in/sec (16.5 mm/sec)	Maximum	
Turbine	0.65 in/sec (16.5 mm/sec)	Maximum	If the turbine vibration exceeds 0.65 in/sec (16.5 mm/sec), but is less than 1.0 in/sec (25.4 mm/sec) and a speed sweep between 96 and 104% lowers the vibration level to below 0.65 in/sec (16.5 mm/sec), then the APU vibration is permissible
Cooling fan	0.75 in/sec (19.1 mm/sec)	Maximum	
Starting and acceleration			
Gearbox	1.0 in/sec (25.4 mm/sec)	Maximum	
Turbine	1.0 in/sec (25.4 mm/sec)	Maximum	
Cooling fan	1.5 in/sec (38.1 mm/sec)	Maximum	
Unit EGT Spread			
Temperature spread between No. 1 and No. 2 thermocouple rakes	60°F (33°C)	Maximum	On-speed operation, bleed air with SCV closed (Heavy Repair)
	80°F (44°C)	Maximum	On-speed operation, bleed air with SCV closed (Light/Medium Repair, Continue time)
Temperature spread between unit average and lab average EGT readings	30°F (17°C)	Maximum	On-speed operation, bleed air with SCV closed (Heavy Repair)
	40°F (22°C)	Maximum	On-speed operation, bleed air with SCV closed (Light/Medium Repair, Continue time)
Gearbox pressure, steady state	Ambient pressure	±20.0 in H_2O (±50 mbar)	Any condition

6. Performance Load Limits

A. Table 13005 shows the performance load limits for the APU.

Table 13005. Performance Load Limits

Step	Condition	Mode	Shaft Load Corrected SHPSL, kW	Disch. Corr.Bleed Airflow WBCDNA, lb/min (kg/min)	IGV Position,deg (Approx)	Minimum Time, minutes	Digital Data Point
8.D.(1)(f)	No load	NL	0	0	22	15	0001
8.D.(2)(d)	Generator load	RTL	98 -0, +2	0	22	10	0002
8.D.(4)(c)	Two-pack high ECS plus generator load	ECS	83 -0.0, +2.0	57.1 ±1 (25.92 ±0.48)	N/A	10	0003
8.D.(5)(g)	MES plus generator load	MES	54 -0.0, +2.0	53.0 ±1 (24.06 ±0.48)	92	10	0004
8.E.(8)	Flow sensor check	ECS	0	(SCV crack point)	90	--	0005
8.E.(11)	Flow sensor check	ECS	0	(SCV closure point)	90	--	0006
8.G.(5)	Surge margin check	ECS	0	(Figure 13006)	90	--	0007

7. **Symbol Definitions**

A. Table 13006 shows the definitions for the symbols used in the TESTING Section.

Table 13006. Symbol Definitions

Symbol	Definition
APU ΔP or PS9	Differential pressure between the APU inlet and PN 834882-1 APU test cell exhaust duct.
ECB	Electronic control box.
EGT	Exhaust gas temperature °F (°C), measured.
EGTCOR	Corrected exhaust gas temperature in °F (°C) for standard sea level condition.
ECS	Environmental control system.
IGV	Inlet guide vane.
KW	Kilowatts.
MES	Main engine start.
P_B (measured)	Bleed pressure PSIA (bar).
PBCOR	Corrected bleed air pressure in PSIA (bar) for standard sea level condition.
PBREQ	Minimum necessary bleed pressure.
PCELL	APU test cell pressure.
P_T	Flow sensor total pressure PSIA as calculated by the ECB.

Table 13006. Symbol Definitions (Cont)

Symbol	Definition
P2	Inlet air pressure. (ECB)
RTL	Ready to load.
SCV	APU surge control valve.
SHPCOR	Generator shaft load, hp, for standard sea level condition.
T2	APU inlet temperature in °F (°C). (ECB)
T_B (measured)	Bleed temperature °F (°C).
TBCOR	Corrected bleed temperature °F (°C) for standard sea level condition.
WC	Discharge corrected bleed flow as calculated by ECB.
W_B	Bleed airflow pounds per minute (kilogram per minute).
WBCDNA	Load compressor corrected discharge flow pounds per minute (kilograms per minute).
WBCOR	Corrected bleed air flow in pounds per minute (kilograms per minute) for standard sea level condition.
W_F	Fuel flow pounds per hour (kilograms per hour).
WFCOR	Corrected fuel consumption in pounds per hour (kilograms per hour) for standard sea level condition.
∆P (DP)	Flow sensor differential pressure PSID (kPa), measured.
δ (delta)	English units: P_{bar}inches Hg_{abs}/29.92 inches Hg_{abs} Metric units: P_{bar} mm Hg_{abs})/760 mm Hg_{abs}

Table 13007. ARINC Receive Label Definition

Label (SDI)	Label Name	Code	Min	Max	Bits	Range	LSB
221 (10)	ESC Demand	BNR	100	150	7	128%	1%
061 (10)	ESC Pack Value	DIS	250	500	NA	NA	NA
			Bits 25-23 = Data				
227 (01)	BITE Command Word	ISO5	120	NA	NA	NA	NA
126 (01)	Flight Phase	BNR	1000	NA	4	NA	NA
		Bits 11-3 = Data					
155	Aircraft Configuration Word	DSC	1000	NA	1	NA	NA
		Bite 11 = Data					

Table 13007. ARINC Receive Label Definition (Cont)

Label (SDI)	Label Name	Code	Min	Max	Bits	Range	LSB
260	Date	BCD	200	240	19	NA	1 Day
		Bits 29-28 Days X 10, Bits 27-24 Days, Bits 23 Months X 10, Bits 22-19 Months, Bits 18-15 Years X 10, Bits 14-11 Years					
125	Greenwich Mean Time	BCDe	1000	NA	19	NA	0.1 Min
		Bits 29-28 hours X 10, Bits 26-23 Hours, Bits 22-19 Minutes X 10, Bits 18-15 Minutes, Bits 14-11 Minutes X 0.1					
301 (00)	Aircraft Identification	ISO5	4000	NA	21	NA	NA
		Bits 31-25 3rd char, Bits 24-18 2nd char, Bits 17-11 1st char.					
302 (00)	Aircraft Identification	ISO5	4000	NA	21	NA	NA
		Bits 31-25 6th char, Bits 24-18 5th char, Bits 17-11 4th char.					
303 (00)	Aircraft Identification	ISO5	4000	NA	21	NA	NA
		Bits 31-25 NA, Bits 24-18 NA, Bits 17-11 7th char.					

Table 13008. Bits of Label transmitted to ARINC Monitor Computer

Label	Software Name	Code	Update Min	(MS) Max	SIG Bits	Word Range	Operational Range	Data Word Resolution
176	N	BNR	100	200	9	256	120% RPM	0.5% RPM
175	EGT	BNR	100	200	11	±2048	-70/+1100C	1 Deg C
110	T2	BNR	150	250	7	±128	-70/+80C	1 Deg C
112	P2	BNR	150	250	9	2048	0.1 - 1.5 Bar	0.004 Bar
123	WC	BNR	150	250	9	2048	0-2000 g/s	4 g/sec
130	IGV_POSITION	BNR	150	250	12	±180	15-100 Deg	0.044 Deg
001	IGV_STROKE _CMD	BNR	100	200	15	±120	0-100%	0.00366%
134	SCV_DEGREE _CMD	BNR	150	250	12	±180	10-90 Deg	0.044 Deg
002	SCV_DEGREE _CMD	BNR	100	200	15	±120	10-90 Deg	0.00366 Deg
166	PT	BNR	150	250	10	8192	1-5 Bar	0.880 Bar
242	WFA_MIN	BNR	150	250	11	512	0-500 lb/hr	0.25 lb/hr
243	WFM	BNR	150	250	11	512	0-500 lb/hr	0.25 lb/hr
244	WFMES	BNR	150	250	11	512	0-500 lb/hr	0.25 lb/hr
245	WFA_MAX	BNR	150	250	11	512	0-500 lb/hr	0.25 lb/hr
247	OIL_TEMP	BNR	250	500	8	256	-55/+200C	1 Deg C

Table 13008. Bits of Label transmitted to ARINC Monitor Computer (Cont)

Label	Software Name	Code	Update Min	(MS) Max	SIG Bits	Word Range	Operational Range	Data Word Resolution
132	APU_HOURS	BNR	500	1000	14	16384	NA	1 Hour
133	APU_CYCLES	BNR	500	1000	14	16384	NA	1 Cycle
120	T5MAX	BNR	100	200	11	2048	0-2000C	1 Deg C
145	FUEL_TMC	BNR	100	200	9	512	0-500 Ma	1 mA
165	DP	BNR	150	250	9	2048	0.1-1.5 Bar	0.004 Bar
121	T4	BNR	100	200	11	±2048	-70/+1204C	NA
037	DISCRETE_WRD	DIS	250	500	NA	NA	NA	NA
353	SHUTDOWN _WRD	DIS	250	500	NA	NA	NA	NA
351	LRU_WORD_1	DIS	250	500	NA	NA	NA	NA
352	LRU_WORD_2	DIS	250	500	NA	NA	NA	NA
050	APU_SER_NUM	BCD	500	1000	5 digit	79999	NA	NA
004	COOLDOWN TIME	BCD	500	1000	5 digit	79999	NA	NA
356	OMS FAULT	ISO5	50	250	NA	NA	NA	NA
250	START_TIME	BNR	500	1000	8	256	40-120	1 Sec
251	CT5ATP	BNR	500	1000	11	±2048	-70/+110C	1 Deg C
252	CT5ATP	BNR	500	1000	10	8192	1-5 Bar	0.008 Bar
253	CWFATP	BNR	500	1000	11	512	0-500 lb/hr	0.25 lb/hr
254	IGVATP	BNR	500	1000	12	±180	15-100 Deg	0.044 Deg
255	OIL_TEMP	BNR	500	1000	12	256	70-200 OHMS	0.0625 OHMS
256	T2_RAW	BNR	500	1000	12	256	70-200 OHMS	0.0625 OHMS
257	SCV_LVDT_RA-TIO	BNR	500	1000	12	0.512		0.00013
260	IGV_LVDT_RA-TIO	BNR	500	1000	12	0.512		0.00013
261	P2_RAW	BNR	500	1000	8	32	0-30 MV	0.125 mV
262	P TOTAL (PT)	BNR	500	1000	8	32	0-30 MV	0.125 mV
263	DELTA PRESS	BNR	500	1000	8	32	0-30 MV	0.125 mV
264	EGT1_RAW	BNR	500	1000	11	64	-2.699/+44.856 mV	0.031 mV
265	EGT2_RAW	BNR	500	1000	11	64	-2.699/+44.856 mV	0.031 mV
270	WF_POSITION _RAW	BNR	500	1000	11	128	20-75 Deg	0.625 Deg

Table 13008. Bits of Label transmitted to ARINC Monitor Computer (Cont)

Label	Software Name	Code	Update Min	(MS) Max	SIG Bits	Word Range	Operational Range	Data Word Resolution
271	EPEED1	BNR	500	1000	14	16384	0-12200 Hz	1 Hz
272	EPEED2	BNR	500	1000	14	16384	0-12200 Hz	1 Hz
273	FUEL_TEMP	BNR	500	1000	12	256	70-200 OHMS	0.0625 OHMS
274	DISC RETRANS	DIS	500	1000	NA	NA	NA	NA
135	APU Hours	BNR	500	1000	17	131071	NA	1 hour
136	APU Cycles	BNR	500	1000	17	131071	NA	1 cycle

Table 13009. ARINC Label 037 Definition

BIT Number	Function	BIT 1	BIT 0
1			
2			X
3	LABEL 037	X	X
4		X	X
5		X	
6		X	
7		X	
8			
9	SDI	X	X
10	SDI		

Table 13009. ARINC Label 037 Definition (Cont)

BIT Number	Function	BIT 1	BIT 0
11	LOAD_VALVE_OPEN	YES	NO
12	LOAD_VALVE_CLOSED_SW	YES	NO
13	F_LOW_VALVE_PRESSURE	YES	NO
14	FLAP_OPEN_COMPLETE	YES	NO
15	FLAP_CLOSE_COMPLETE	YES	NO
16	EGT_AT_LIMIT	YES	NO
17	PROT_SDN	YES	NO
18	EMERGENCY_SDN_RECOGNIZED	YES	NO
19	APU_AVAILABLE_CMD	YES	NO
20	F_OIL_LEVEL_LOW	YES	NO
21	MES_MODE	YES	NO
22	START_IN_PROGRESS_CMD	YES	NO
23	CLASS 2 FAULT IN LAST LEG	YES	NO
24	AIR_INTAKE_NOT_OPEN_SDN	YES	NO
25	SPARE	YES	X
26	PACK_DATA = ZERO		NO
27	SPARE		X
28	SPARE		X
29	SPARE		X
30	SSM		
31	SSM		
32	PARITY (ODD)		
NOTE: Bit 23 must be set if a Class 2 fault is present in Zone 1 with Leg Number 0.			

Table 13010. ARINC Label 353 Definition

BIT Number	Function	BIT 1	BIT 0
1		X	
2		X	
3	LABEL 353	X	X
4			
5		X	X
6			
7		X	
8		X	
9	SDI	X	X
10	SDI		

Table 13010. ARINC Label 353 Definition (Cont)

BIT Number	Function	BIT 1	BIT 0
11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29	NO_FLAME_SDN REVERSE_FLOW_SDN MAIN_POWER_INTERRUPT HIGH_OIL_TEMPERATURE CLOGGED_OIL_FILTER_SDN INLET_OVERHEAT_SDN AIR_INLET_NOT_OPEN_SDN SPARE TRUE_EMERGENCY_SDN OVRTMP_ONSPD_SDN or OVRTMP_START_SDN SENSOR_FAIL_SDN NO_ACCELERATION_SDN or NO_SPEED_SDN SPARE OVERSPEED_SDN ECB_SDN LOP_SDN LOSS_OF_SPEED_SDN SPARE UNDERSPEED_SDN	SET IF SDN FAILED	CLEAR IF NOT
30 31	SSM SSM		
32	PARITY (ODD)		
NOTE:	If an uninhibited shutdown is present, the first occurring uninhibited shutdown bit must be set, else the first occurring inhibited shutdown bit must be set.		

Table 13011. ARINC Label 351 Definition

BIT Number	Function	BIT 1	BIT 0
1		X	
2		X	
3	LABEL 351	X	X
4			
5		X	X
6			X
7			
8		X	

Table 13011. ARINC Label 351 Definition (Cont)

BIT Number	Function	BIT 1	BIT 0
9 10	SDI SDI	X	X
11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29	TOTAL PRESSURE TRANSDUCER DIFFERENTIAL PRESSURE TRANSDUCER SPEED SENSOR BLEED SHUTDOWN REVERSE FLOW BLEED SHUTDOWN T4 HIGH OIL TEMPERATURE SENSOR FUEL CONTROL UNIT SURGE CONTROL VALVE EGT RAKE 1 EGT RAKE 2 IGV ACTUATOR IGNITION UNIT DE-OIL SOLENOID IGV POSITION VS COMMAND ARINC ECS DEMAND STARTER MOTOR LOW OIL PRESSURE SWITCH INLET PRESSURE TRANSDUCER ECB	SET IF SDN FAILED	CLEAR IF NOT
30 31	SSM SSM		
32	PARITY (ODD)		

Table 13012. ARINC Label 352 Definition

BIT Number	Function	BIT 1	BIT 0
1		X	
2		X	
3	LABEL 352	X	X
4			
5		X	X
6			
7		X	X
8			
9 10	SDI SDI	X	X

Table 13012. ARINC Label 352 Definition (Cont)

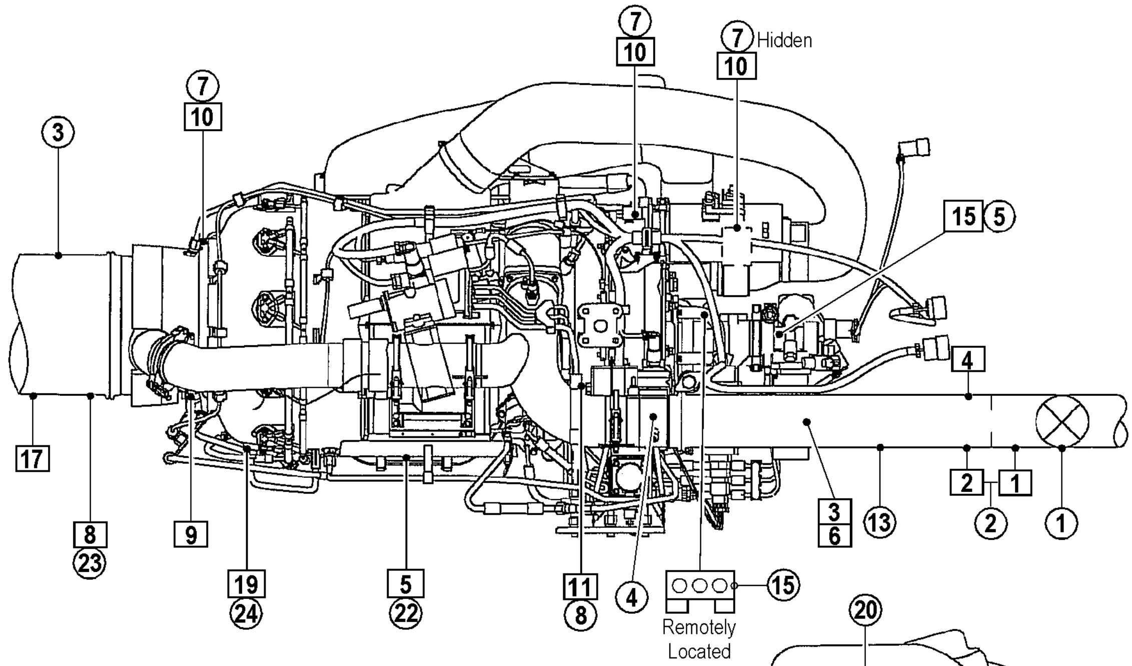
BIT Number	Function	BIT 1	BIT 0
11	OIL FILTER SWITCH		
12	LOAD CONTROL VALVE		
13	A/C PIN CODE		
14	INLET TEMPERATURE SENSOR		
15	AIRNC FAILURE (CFDS BUS)		
16	MAIN START CONTACTOR		
17	BACKUP START CONTACTOR		
18	DATA MEMORY MODULE		
19	FLOW DIVIDER		
20	AIR INTAKE FLAP ACTUATOR		
21	FUEL FLOW VS COMMAND	SET IF SDN FAILED	CLEAR IF NOT
22	LOW FLOW PRESSURE RELAY		
23	AIR INTAKE FLAP SWITCHES		
24	PRESSURE TRANSDUCER WIRING		
25	ARINC ECS PACK DATA		
26	OIL HEATER		
27	CLOGGED OIL FILTER		
28	SCV POSITION VS COMMAND		
29	SPARE		
30	SSM		
31	SSM		
32	PARITY (ODD)		

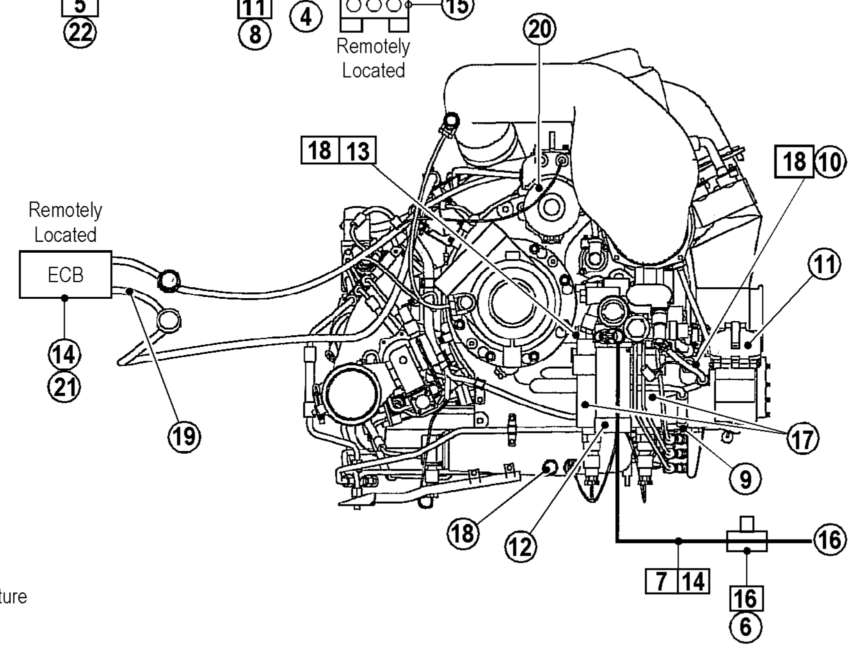
Table 13013. ARINC Label 274 Definition

BIT Number	Function	BIT 1	BIT 0
1		X	X
2			
3	LABEL 274	X	
4		X	
5		X	
6		X	X
7			X
8			
9	SDI	X	X
10	SDI		

Table 13013. ARINC Label 274 Definition (Cont)

BIT Number	Function	BIT 1	BIT 0
11	LOAD_VALVE_ACTIVATE_SW	GROUND	OPEN
12	MES_STRT_VLV_SW	28 VCD	OPEN
13	MES_SW	28 VCD	OPEN
14	START_CONTACTOR_MONITOR_V	28 VCD	OPEN
15	START_CONTACTOR_MONITOR_G	GROUND	OPEN
16	STARTER VOLTAGE MONITOR	GROUND	>4 VDC
17	IN_AIR_SW	GROUND	OPEN
18	A321_ID_1	GROUND	OPEN
19	A321_ID_2	GROUND	OPEN
20	FLAP_MOVEMENT	>16 VDC	OPEN
21	FLAP_OPEN_SW	28 VDC	GROUND
22	FLAP_CLOSED_SW	GROUND	OPEN
23	STOP_SW	GROUND	OPEN
24	EMERGENCY_SW	GROUND	OPEN
25	START_SW	28 VCD	OPEN
26	TSO	GROUND	OPEN
27	LOW_FUEL_PRESS_SW	GROUND	OPEN
28	LOW_FUEL_PRESS_BITE_ENABLE	GROUND	OPEN
29	OIL_HEATER_BITE_ENABLE	GROUND	OPEN
30	SSM		
31	SSM		
32	PARITY (ODD)		





☐ Test Parameter

1 Bleed-Air Orifice DP
2 Bleed-Air Orifice Inlet Pressure
3 Bleed-Air Total Pressure
4 Bleed-Air Orifice Inlet Temperature
5 Inlet Temperature
6 Bleed-Air Temperature
7 Fuel Inlet Temperature
8 Cell Exhaust Gas Average Temperature
9 Unit Exhaust Gas Temperature (2)
10 Unit Vibration (See Figure 4)
11 Unit Speed
12 Oil Discharge Pressure
13 Oil Discharge Temperature
14 Fuel Inlet Pressure
15 Shaft Load
16 Fuel Flow
17 Exhaust Static Pressure
18 Oil Sump Pressure
19 Compressor Discharge Pressure/Temperature

◯ Equipment Identification

1 Test Cell Manual Flow Control Valve
2 Orifice Measuring Section
3 Lab Exhaust Duct
4 Load Control Valve (Ref)
5 Generator (Ref)
6 Fuel Flowmeter
7 Lab Vibration Pickup (See Figure 4)
8 Dual-Element Speed Sensor
9 Oil Pressure Fill Port
10 Oil Pressure Overfill Port
11 Oil Gravity Fill Port
12 Fuel Filter
13 Lab Bleed-Air Duct
14 ECB
15 Lab Load Cell (Required for Generator)
16 Fuel Supply
17 Oil Filters
18 Magnetic Drain Plug
19 Electrical Harness
20 28 Vdc, 1500 amp Electrical Supply
21 28 Vdc, Control Power
22 Lab Inlet Duct
23 Lab EGT Rake
24 Lab PCD/TCD Probe

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Figure 13001. Model 131-9[A] APU General Test Setup Schematic

8. Procedure

SUBTASK 49-20-00-480-001

A. Prepare the APU for testing. Refer to Tables 13001 and 13002 for the necessary special tools and equipment.

(1) Preliminary Preparation.

(a) Install APU in PN 834943-1 portable engine stand/cart. Refer to INSTALLATION 01.

(2) Connect the test equipment as shown in the APU General Test Schematic, Figure 13001 and Figure 13002.

(3) Perform all tests at ambient temperature, barometric pressure and humidity.

(4) During all tests, monitor the operating limits in Table 13004.

(5) All necessary performance test parameters must be corrected from ambient temperature to 100.4°F (38°C) for the ECS and to 122°F (50°C) for the MES points.

(6) Complete identification data and collected data during the tests must be put on the Test Data Sheets, Figure 13009.

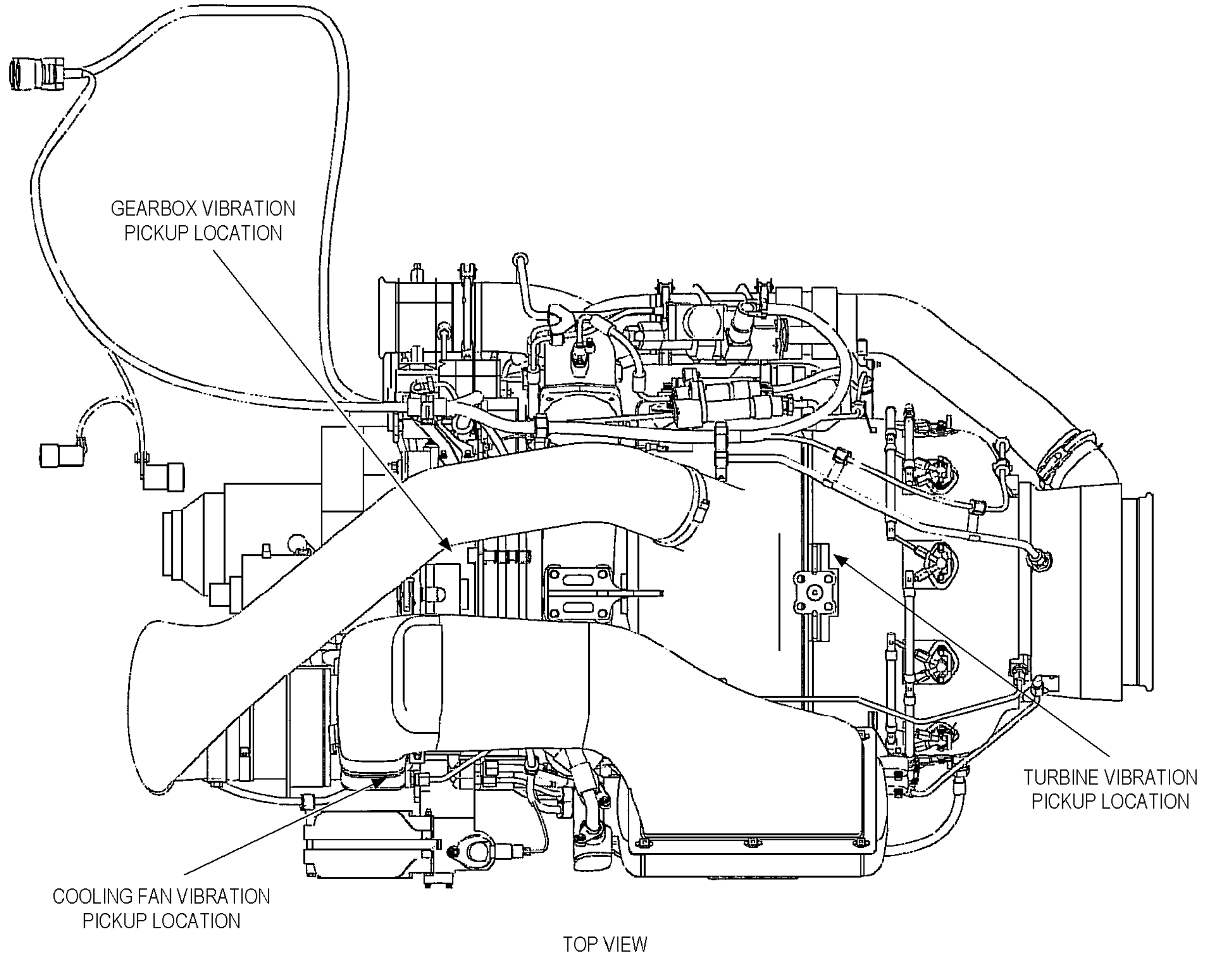

Figure 13002. APU Vibration Pickup Locations

(7) Install PN 834894-1 bleed duct support arm on to engine stand/cart and bleed duct.

(8) Connect APU to the customer furnished ECB. Refer to Figure 13003.

(9) Supply an external 28 VDC electrical power to the starter.

(10) Supply a separate 28 VDC electrical power to the ECB.

(11) Install PN 834894-1 bleed duct support arm on to engine stand/cart and bleed duct.

NOTE: The fuel supplied to the APU must be from 10 to 60 PSIG (69 to 414 kPa).

(12) Make sure that the APU is fully serviced with oil. Refer to Table 13002 for oil specifications.

(13) Check all instrumentation and plumbing connections for correct installation.

(14) Prior to powering up the master panel, make sure all master panel switches are set as follows:

Switch	Position
MASTER POWER	OFF
RUN/STOP	STOP
INHIBIT SHUTDOWNS	OFF
A/C CONFIGURATION	A319/320
INLET DOOR OPEN	OPEN
MES ENGAGE	OFF
LOAD VALVE	CLOSED
AIR/GROUND	GROUND
SCV CLOSED	OFF
T2 SELECT	NORMAL
VARISPEED DEMAND	OFF
ECS DEMAND	OFF

Potentiometer	Position
T2 SELECT	5.0
ECS DEMAND	ANY
VARISPEED	5.0

NOTE: If the AIRCRAFT CONFIGURATION switch position is changed, the master panel power must be cycled OFF and ON for the new aircraft signature to be recognized by the ECB.

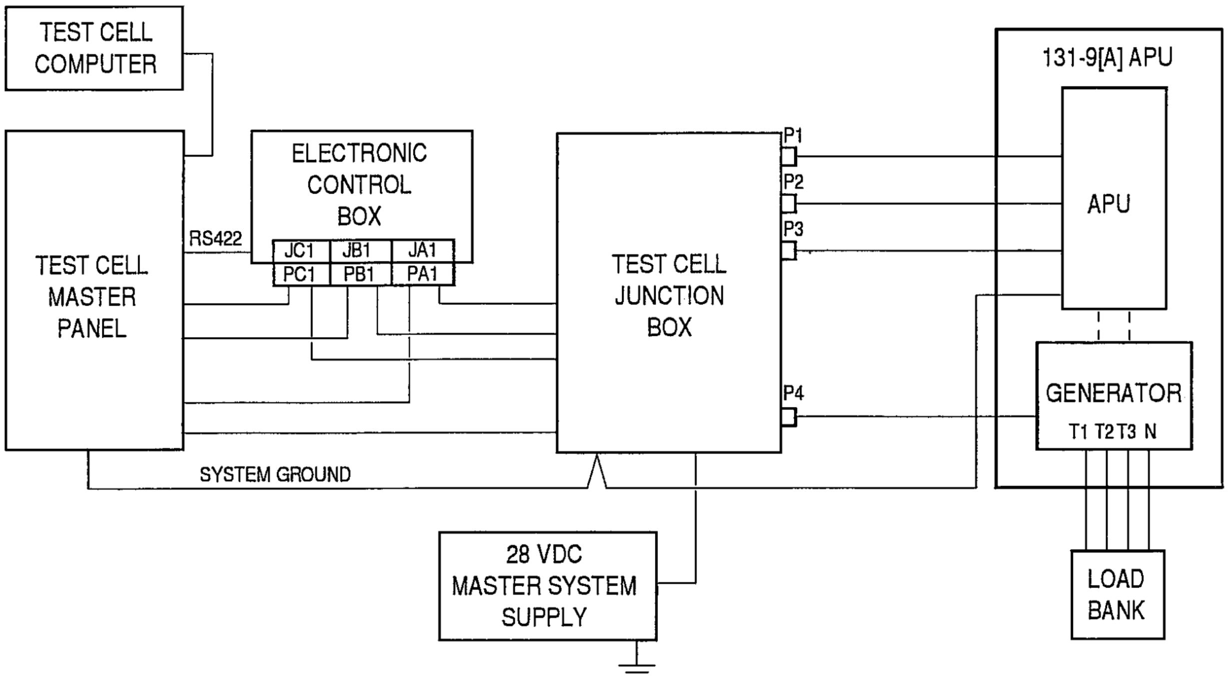

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Figure 13003. APU

SUBTASK 49-20-00-760-001

B. Perform an APU run-in procedure as follows:

NOTE: During testing make sure to evaluate Labels 351 and 352 are set at zero for Bits 11 thru 29 and Label 037, Bits 13 and 20. Use Tables 13009, 13011 and 13012 to further aid in identifying repair procedure.

(1) Motor the APU as follows:

(a) Make sure the APU test cell fuel supply valve is OFF.

WARNING: THE OUTPUT VOLTAGE OF THE IGNITION UNIT IS DANGEROUS AND COULD BE LETHAL. IT IS A CAPACITOR DISCHARGE-TYPE AND CAN KEEP HIGH VOLTAGE. MAKE SURE IT IS DE-ENERGIZED AND GROUNDED BEFORE THE INPUT AND OUTPUT LEADS ARE DISCONNECTED. DO NOT TOUCH THE CENTER CONTACT OF OUTPUT TERMINAL.

(b) Disconnect the ignition unit electrical connector.

(c) Motor the APU with the starter for 25 seconds at minimum of 8500 RPM. Refer to Paragraph P.

(d) Make sure there are no unusual noises or vibration during motoring and rolldown to zero speed.

(e) Make sure APU oil pressure reached 15 PSIG (103 kPa) minimum during motoring.

(f) Reconnect the ignition unit electrical connector.

(g) Reset the RUN/STOP switch to clear the APU fault light.

(h) Reservice the gearbox to the FULL oil level mark.

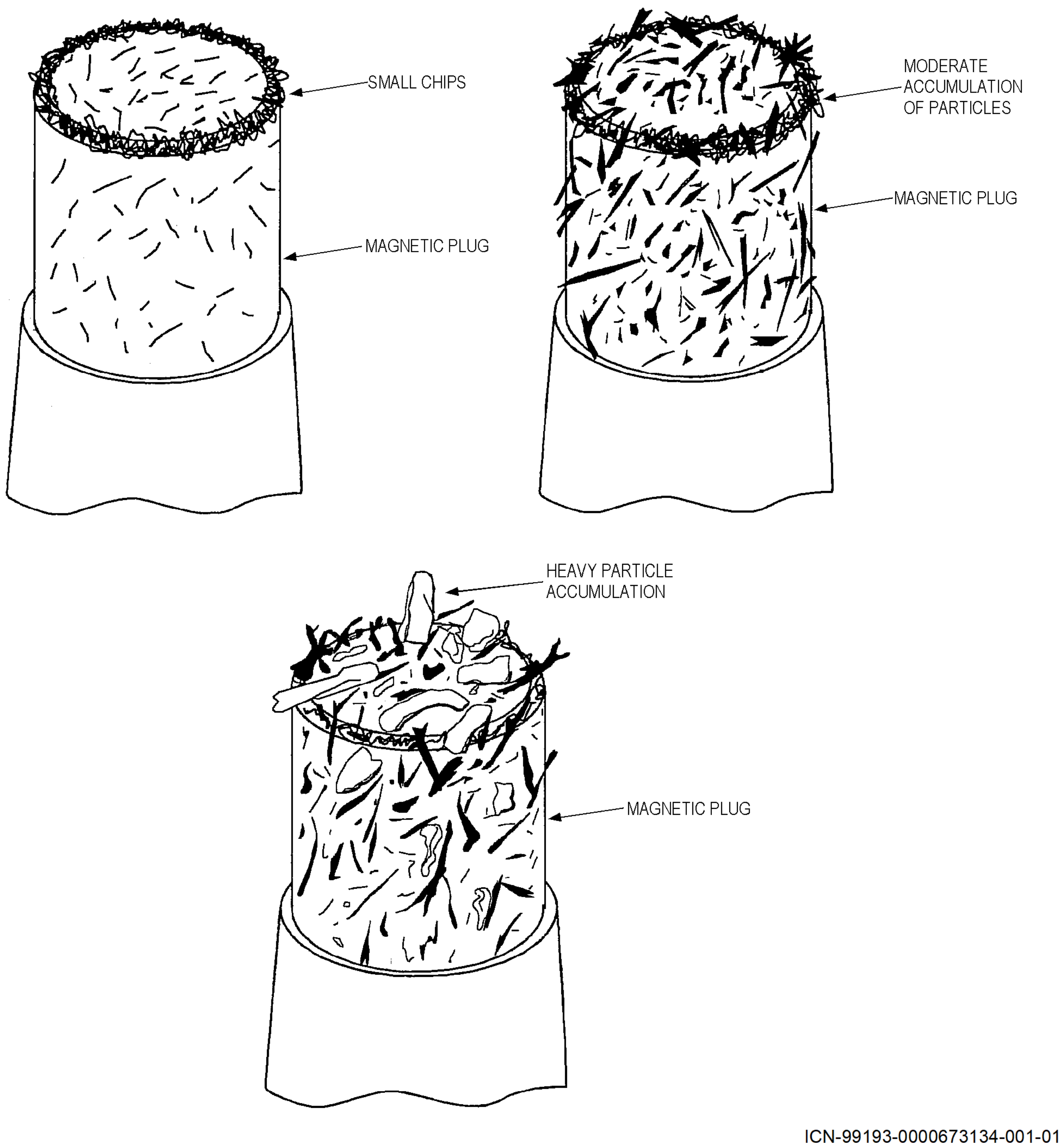


Figure 13004. Magnetic Chip Collector

(2) Start the APU. Refer to Paragraph P.

(3) Perform the following operating APU run-in steps. Make sure the APU operates in the limits in Table 13004.

(a) Operate the APU at ready to load (RTL) for 10 minutes.

(b) Operate the APU Bleed Demand and ECS switches and perform the following steps.

1 Adjust the ECS DEMAND pot to 92 degrees IGV_POSITION.

2 Close test cell valve until the discharge corrected airflow (WBCDNA) is approximately 53 lb/min (24 kg/min).

3 Apply 83 SHPSL and run the APU for 5 minutes.

4 Make sure the APU is stable in the operating limits given in Table 13004.

5 Check the APU for fuel, oil and air leaks. No leaks permitted.

(4) Stop the APU. Refer to Paragraph Q.

SUBTASK 49-20-00-210-002

C. Check the oil system. Refer to Figure 13004.

(1) Remove the magnetic plug and check for contamination as follows:

(a) Small chips on magnet.

1 Permitted: Thin slivers.

2 Not permitted: Flakes that have a silver color or large pieces of metal with definite shape.

(b) Moderate accumulation of particles (other than silver colored pieces).

1 Clean the magnetic plug and install in the APU.

2 Service the gearbox with oil. Refer to SERVICING 01.

CAUTION: DO NOT OPERATE THE ELECTRIC STARTER MOTOR MORE THAN THREE STARTS OR TRIES IN 1 HOUR MAXIMUM. MAKE SURE THE OIL SYSTEM IS FILLED BEFORE THE APU IS OPERATED.

3 Start and operate the APU for 15 minutes. Refer to Paragraph P.

4 Stop the APU. Refer to Paragraph Q.

a Permitted: No more accumulation of chips after 15 minutes of APU operation.

b Not Permitted: Continued build-up of chips on the magnetic plug. Any flake accumulation that has a silver color, i.e. bearing material.

(c) Heavy particle accumulation.

1 Not Permitted: Heavy build-up shows abnormal APU internal conditions.

(2) Make sure there is no DP fault for the filter elements.

SUBTASK 49-20-00-760-002

D. Perform performance tests as follows:

NOTE: During the performance tests make sure that all instrumentation operates correctly. Monitor the APU operating limits. The APU operating limits must not be more than given in Table 13004.

If the test cell bleed flow control valve is used to set bleed flow rates it is not necessary to shutdown the APU between each test.

(1) Put APU in a no-load mode as follows:

(a) Select Page 1 of the digital system.

(b) Make sure the AIRCRAFT CONFIGURATION switch is set to A319/A320 and the test cell flow control valve is open.

(c) Start the APU. Refer to Paragraph P.

(d) Accelerate the APU to governed speed. Make sure the laboratory cell valve is open. Make sure engine speed is 48.800 ±125 RPM.

(e) Operate the APU for 15 minutes at no-load.

(f) Record Digital Data Point 0001 with the thumbwheel TCOND=0001.

(2) Put APU in a shaft load mode as follows:

(a) With the APU operating at no-load verify VARISPEED is off.

(b) Make sure engine speed is 48.800 ±125 RPM.

(c) Apply a shaft load of 98, -0, +2/δ kW corrected to electrical load (SHPSL) for a minimum of 10 minutes.

(d) Record Digital Data Point 0002 with the thumbwheel TCOND = 0002.

(3) Perform a combination load ECS and offset adjustment as follows:

(a) With the APU operating in RTL mode, apply a generator load equivalent (SHPSL) to 83, -0, +2/δ kW.

(b) Put the T2 toggle switch up and slowly turn the T2 adjustable potentiometer to set the TENIVA (ARINC Label 110) valve equal to the APU inlet temperature lab rake T1 (average) ±1.8°F (±1°C).

(c) Operate the load valve switch and select ECS DEMAND on the master panel. Adjust the ECS Demand adjustable potentiometer to set IGVA position to 92 ±0.5. Make sure the engine speed is 48.800 ±125 RPM, use the varispeed potentiometer to adjust, if necessary.

(d) Slowly close the test cell bleed flow control valve until the discharge corrected airflow (WBCDNA) is 57.1 ±1.0 lb/min (25.90 ±0.45 kg/min), then operate the APU for a minimum of 5 minutes.

(e) Write the initial value of IGV_POSITION (ARINC Label 130) and PBCOR.

(f) If PBCOR is more than 53 PSIA (3.65 bar) use the ECS DEMAND adjust pot to close the IGVs.

(g) Continue to adjust as necessary, until PBCOR is stable and is between 51.2 and 53.0 PSIA (3.53 to 3.66 bar) with WBCDNA and SHPSL per (a).

(h) If performance is below 51.2 PSIA (3.53 bar) but equal to or more than 50.2 PSIA (3.46 bar) continue the test. Do not apply an ECS offset. Record offset as 0.

NOTE: The ECS_OFFSET is limited to an adjustment between 0 and -8.0 degrees. The ECB will not permit adjustment beyond this limit.

(i) Write the final values of IGV_POSITION, PBCOR and ECS_OFFSET in the data sheet.

NOTE: The final ECS_OFFSET value is found by subtracting the initial IGV_POSITION, written in Step (e), from the final IGV_POSITION written in Step (i).

(4) Perform a combination load, environmental control system (ECS) test.

(a) Let the APU operate for a minimum of 5 minutes at the conditions of Table 13005.

(b) Perform a Two-Pack High flow mode ECS test using left and right ECS mode. Make sure all parameter limits in Table 13014 are met. Parameters are defined as follows:

Table 13014. ECS Performance Limits

Parameter	Heavy Repair Limits	Light/Medium Repair (Continue-Time) Limits
Minimum bleed pressure, PBCOR	51.2 PSIA (3.53 bar)	50.2 PSIA (3.46 bar)
Minimum bleed airflow WBCOR	152.2 lb/min (69.0 kg/min)	148.9 lb/min (67.5 kg/min)
Maximum EGT, EGTCOR	1130°F (610°C)	1150°F (621°C)

(c) Record Digital Data Point 0003.

(d) Remove ECS bleed load.

(e) Open the test cell bleed flow control valve.

(5) Perform a MES performance test.

(a) Select MES page of the digital system.

(b) Apply a shaft load of 54, -0, +2/δ kW (SHPSL).

(c) Operate the load valve switch and select MES on the master panel. Shut off the varispeed potentiometer. Make sure the engine speed is 48.800 ±125 and IGVA position is 92 ±0.5 degrees.

(d) Slowly close the test cell load flow control valve until discharge corrected airflow (WBCDNA) is 53.0 ±1.0 lb/min (24.06 ±0.48 kg/min).

(e) Operate the APU for a minimum of 10 minutes at load.

(f) Make sure all parameter limits in Table 13015 are met.

Table 13015. MES Performance Limits

Parameter	Heavy Repair Limits	Light/Medium Repair (Continue-Time) Limits
Minimum bleed pressure, PBCOR	51.1 PSIA (3.52 bar)	50.1 PSIA (3.45 bar)
Maximum fuel consumption, WFCOR	269 lb/hr (122.0 kg/hr) (REFERENCE)	269 lb/hr (122.0 kg/hr) (REFERENCE)
Minimum bleed airflow WBCOR	N/A	N/A
Maximum EGT, EGTCOR	1125°F (607°C)	1145°F (618°C)

(g) Record Digital Data Point 0004 with the thumbwheel TCOND = 0004.

(h) Remove MES bleed load.

(i) Open the test cell bleed flow control valve.

(j) Remove the generator load from the generator.

SUBTASK 49-20-00-760-003

E. Perform a flow sensor test as follows:

(1) Make sure the test cell bleed flow control valve is open.

(2) Operate the master panel load valve switch ON and select the ECS DEMAND switch.

(3) Make sure generator load is zero.

(4) Select the ECS DEMAND switch, use the ECS DEMAND pot and adjust the IGV_POSITION to 90 ±0.5 degrees.

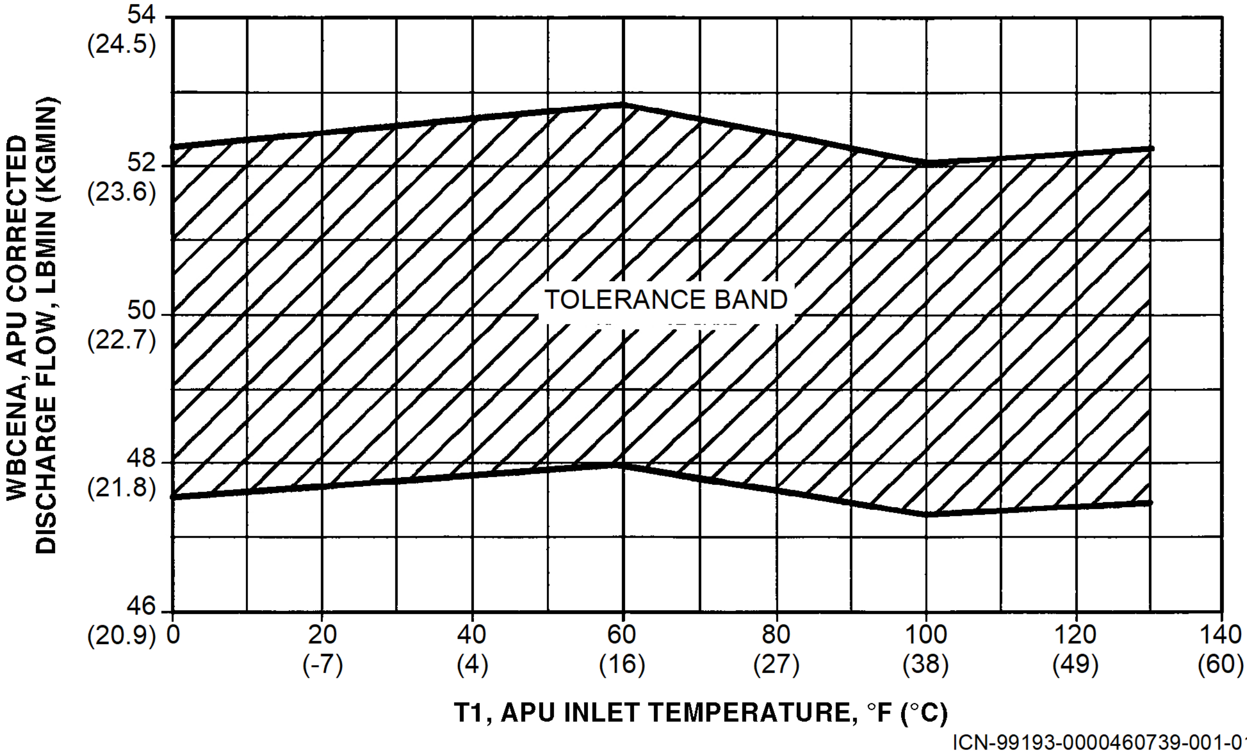


Figure 13005. Flow Sensor Tolerance Band

(a) Check the monitor to make sure (SCV_POSITION) is 88 to 92 degrees when fully closed.

(5) Readjust the T2 POT ADJ knob if necessary to make T2 ECB in degrees is equal to T1 ±1.8°F (±1°C). Make sure the engine speed is 48.800 ±125 RPM. Use the varispeed potentiometer to adjust, if necessary.

(6) Slowly close the test cell bleed flow control valve until the SCV begins to open, as seen on the ARINC parameter variable SCV_POSITION changes to a number less than written in Step (4)(a).

(7) Make sure that the load compressor discharge corrected flow (WBCDNA) is in the tolerance band given in Figure 13005.

(8) Record Digital Data Point 0005.

(9) Slowly open test cell bleed flow control valve until SCV just closes (when SCV_POSITION returns to the value written in Step (4)(a).

(10) Make sure that the load compressor discharge corrected flow (WBCDNA) is in the tolerance band given in Figure 13005.

(11) Record Digital Data Point 0006.

(12) Make sure the load compressor discharge corrected flow measured by the flow sensor (WC, from ECB monitor) is within 5 percent of that measured by the test cell measuring section (WBCDNA) on the digital monitor as follows:

(a) Write WC and WBCDNA on the data sheet.

(b) Calculate the resultant percentage using the following formula.

ENGLISH:

$$\frac{[1.006 \times (WC \times 0.1323)] - WBCDNA}{WBCDNA} \times 100 = \underline{\hspace{2cm}}$$ percent (a value between -5 and +5)

METRIC:

$$\frac{[1.006 \times WC - WBCDNA}{WBCDNA} \times 100 = \underline{\hspace{2cm}}$$ percent (a value between -5 and +5)

Write this value in the data sheet.

NOTE: If calculated resultant percentage does not fall within 5 percent, check for possible leak or failed cell transducer.

CAUTION: IF THERE IS LOAD COMPRESSOR SURGE, QUICKLY OPEN THE TEST CELL BLEED FLOW CONTROL VALVE.

(13) Close the test cell bleed flow control valve as fast as possible to make sure the load compressor does not surge.

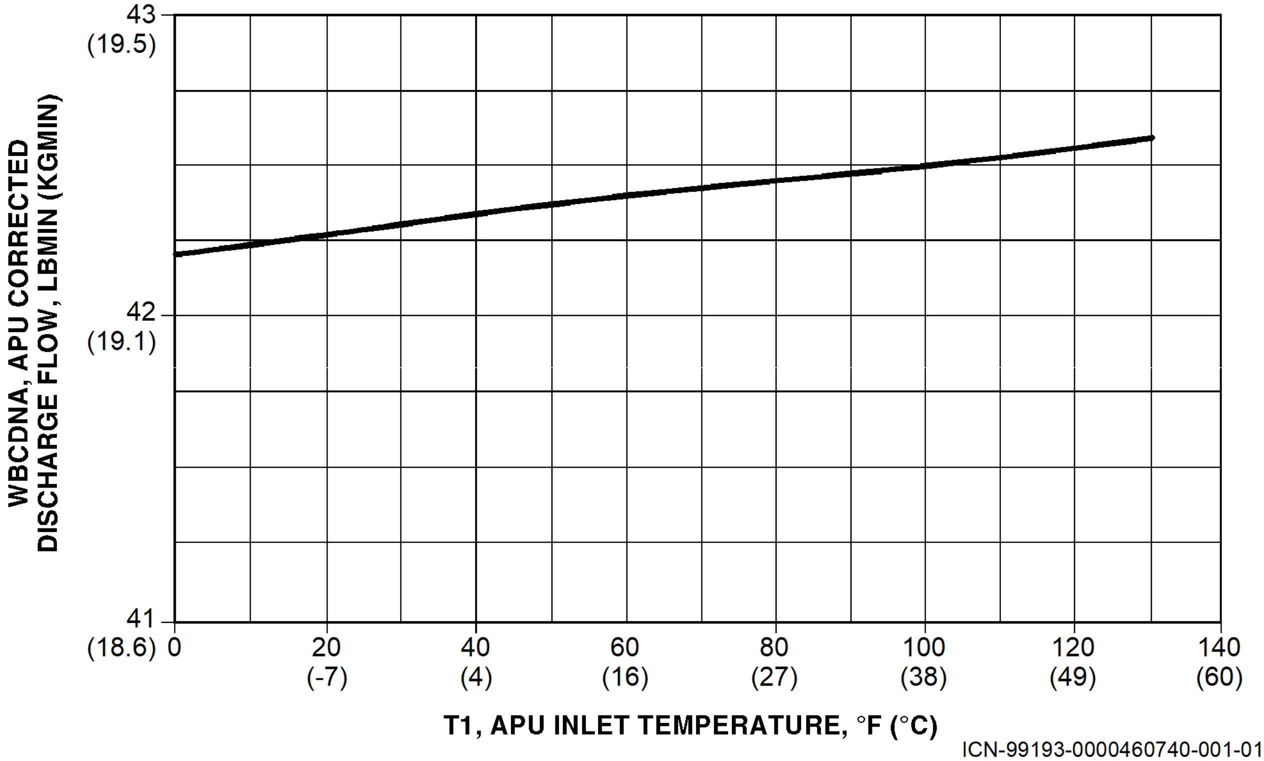


Figure 13006. Corrected Flow Limit for Surge Margin Check

(14) Open the test cell bleed flow control valve.

SUBTASK 49-20-00-760-004

F. Perform a Surge Control Valve (SCV) stability test as follows:

(1) Keep the IGVs at 90 degrees and close the test cell bleed flow control valve until the load compressor corrected discharge flow (WBCDNA) is 53 to 57 lb/min (24.04 to 25.85 kg/min). (APU is still in ECS mode, RPM is 48.800 ±125.)

(a) Make sure the SCV is not changing more than 10 degrees per second without ever becoming stable.

(2) Close the test cell bleed flow control valve completely to permit all the bleed air to go through the SCV.

(a) Make sure the SCV is not cycling over a period of at least 2 minutes.

SUBTASK 49-20-00-760-005

G. Perform a minimum surge margin test as follows:

(1) Keep the IGVs at 90 degrees and open the test cell bleed flow control valve so that WBCDNA is more than 60 lb/min (27.2 kg/min).

(2) Turn on ECS DEMAND, turn off VARISPEED switch. Turn on MES switch and make sure the engine speed is 48.800 ±125. Force the SCV closed using the “SCV closed” switch on the master panel.

(3) Use T1 (average inlet rate temperature) to find the necessary WBCDNA from Figure 13006.

CAUTION: IF THERE IS LOAD COMPRESSOR SURGE, QUICKLY OPEN THE TEST CELL BLEED FLOW CONTROL VALVE.

(4) Slowly close the test cell bleed flow control valve until WBCDNA decreases and meets the necessary airflow found in (3) ±1.0 lb/min (±0.008 kg/sec).

(5) Record Digital Data Point 0007.

(6) Return the SCV to manual control by moving the SCV CLOSED switch to the down position.

(7) Operate the master panel APU BLEED DEMAND, switches OFF to unload the APU.

(8) Stop the APU. Refer to Paragraph Q.

SUBTASK 49-20-00-760-006

CAUTION: MAKE SURE THE STARTER DUTY CYCLE STAYS IN THE OPERATING LIMITS OF TABLE 13004.

H. Perform three consecutive automatic start tests as follows:

NOTE: The automatic starts tests can be run in conjunction with other tests as long as they are not interrupted by an unsuccessful start. In that case the starts must be rerun.

(1) Perform three consecutive fully automatic starts and accelerations to governed speed. The start times must be less than 60 seconds. Refer to Paragraphs P. and Q.

(a) Write the time to governed speed for one start.

NOTE: Time to governed speed is defined as the time from initiation of APU speed as seen on the lab Daytronic system until the RTL light comes on.

(2) Stop the APU. Refer to Paragraph Q.

SUBTASK 49-20-00-760-007

I. Perform a load control valve test as follows:

(1) Set the digital data acquisition system to the RUN page.

(2) Make sure the test cell bleed valve is fully open.

(3) Activate the load valve switch on the master panel.

(4) Use the ECS DEMAND pot to adjust the IGV_POSITION to 42.0 ±0.5 degrees.

(5) Slowly close the test cell bleed valve until the bleed pressure (PBCOR) is 28 ±0.5 PSIG (193 ±3.4 kPa).

(6) Turn the load valve switch, on the master panel, to off.

(7) On the ECB monitor Main Run page, use page up/down and tab keys and locate Label 037.

(8) Make sure the Label 037, BIT 11 = 0 and BIT 12 = 1.

(9) Turn the load valve switch, on the master panel, to on.

(10) Make sure that Label 037, BIT 11 = 1 and BIT 12 = 0.

(11) Record the Label 037 status for both conditions.

(12) If the Label 037 values do not meet the criteria of Steps (8) and (9), perform a BITE check (GND SCANNING) and follow the applicable troubleshooting procedures to correct the problem.

SUBTASK 49-20-00-820-001

J. Data corrections.

(1) The performance data must be corrected as outlined below.

(a) Bleed pressure (PB), bleed airflow (WB), delta pressure across the APU (APU ΔP) and fuel flow (WF) for ambient pressure (i.e., δ correction) to simulate sea level conditions.

(b) PB, WB, bleed temperature (TB), EGT and WF for ambient temperature (i.e., lapse rate correction) to simulate 100°F (38°C) ambient for ECS data and 122°F (50°C) ambient for MES data. (The lapse rate correction also accounts for IGV scheduling effects.)

(c) EGT and WF for APU ΔP to remove the effects of laboratory inlet and exhaust ducting.

(d) PB, WB, TB, EGT and WF for aircraft installation effects.

(e) If the corrected bleed pressure (PBCOR) is more than the minimum limit, correct EGT and WF to simulate power section performance with a minimum specification load compressor.

(f) Generator loading must be corrected to sea level and also corrected for generator efficiency to indicate shaft power supplied by the APU at the output pad.

(2) Digital acquisition system.

(a) If the digital data acquisition system is available, reduce the data. Carefully review the data to make sure that the measured parameters are in the operating limits of Table 13004 and meet the ECS performance limits of Table 13014 and MES performance limits of Table 13015 when operated at the applicable performance load limits of Table 13005 conditions. Once it is certain the data are accurate and acceptable, write the values on the data sheet.

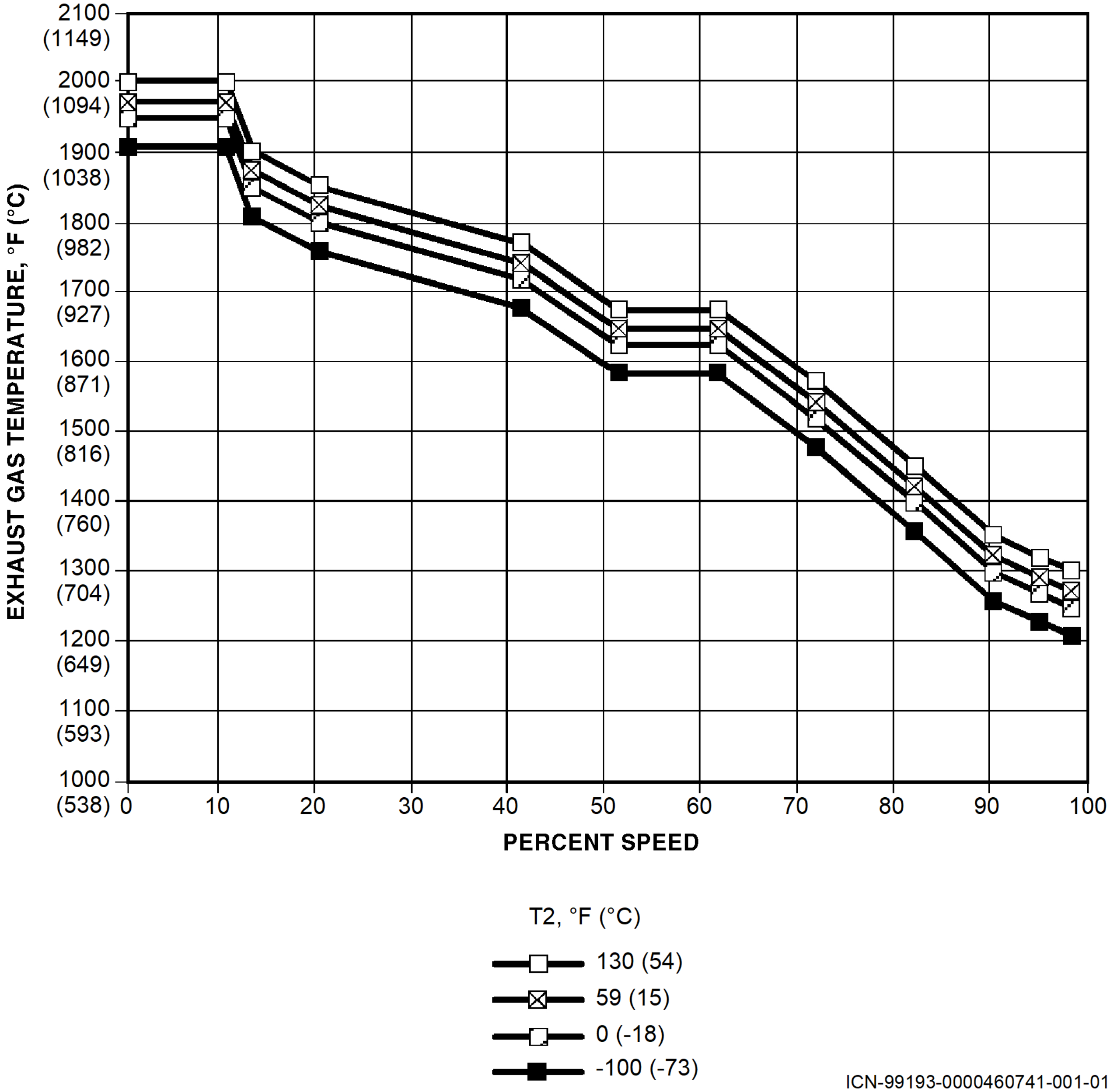
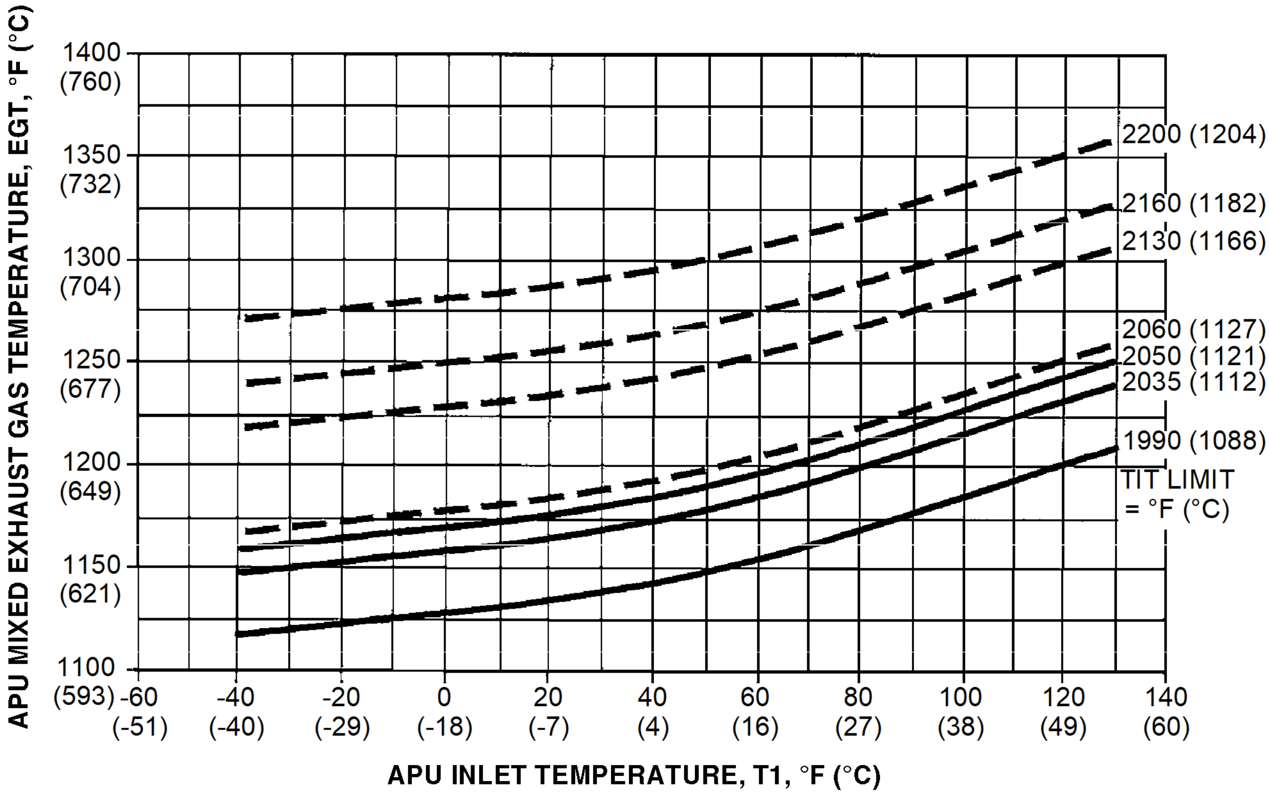


Figure 13007. EGT Shutdown Limits for Starting and Acceleration



NOTES:

1. S.L. installed APU.
2. Minimum performance.
3. PM131-9A-STATUS-961025.
4. TIT temperature trim and overtemp shutdown schedule.
   TIT = 1990 (1088) - Sea level static bleed IGV trim limit.
   TIT = 2035 (1112) - 15 KFT static bleed IGV trim limit.
   TIT = 2050 (1121) - Flight trim limit.
   TIT = 2060 (1127) - Overtemp bleed shutoff activated after 15 seconds.
   TIT = 2130 (1166) - Overtemp bleed shutoff activated after 6 seconds.
   TIT = 2160 (1182) - Overtemp bleed shutoff activated after 1 second.
   TIT = 2200 (1204) - Overtemp APU shutdown activated after 1 second.

ICN-99193-0000460742-001-01

Figure 13008. EGT Shutdown and Trim Limits for On Speed Operation

(3) Manual Correction.

(a) If necessary, the data can be manually corrected and written in the data sheet. Parameters are defined as follows:

PBmeasured	=	PB	=	bleed pressure, PSIA (bar)
WBmeasured	=	WB	=	bleed flow, lb/min (kg/sec)
TBmeasured	=	TB	=	bleed temperature, °F (°C)
EGTmeasured	=	EGT	=	exhaust gas temperature, °F (°C)
WFmeasured	=	WF	=	fuel flow, lb/hr (kg/hr)
FLHV	=	lab fuel lower heating value, BTU/lb (KJ/kg)		
WBCDNA	=	$WB\sqrt{\Theta_B}/\delta_B$, lb/min (kg/sec)		

(b) Two-Pack ECS Calculations.

English units:

PBCOR = PB / δ + DELPB (Table 13018) - 1.2

WBCOR = WB / δ + DELWB (Table 13018) - 3.5

TBCOR = TB + DELTB (Table 13018) -4.5 (PBCOR-PBREQ)

EGTCOR = EGT + DELEGT (Table 13018) + 65 * [(PCELL - PS9) / δ] +14 -11 * (PBCOR - PBREQ)

WFCOR = (WF * FLHV / δ * 18550) + DELWF (Table 13018) + 15 * [(PCELL - PS9) / δ] -2.7 -4.4 * (PBCOR - PBREQ)

SHPSL = (PWGEN / ETAGEN) / δ, where ETAGEN = 0.85

δB = PB / 14.696 ϴB = (TB + 459.67) / 518.67

δ = PAMB / 14.696

Metric units:

PBCOR = PB / δ + DELPB (Table 13019) – 0.08

WBCOR = WB / δ + DELWB (Table 13019) – 0.02

TBCOR = TB + DELTB (Table 13019) - 36.3 (PBCOR-PBREQ)

EGTCOR = EGT + DELEGT (Table 13019) + 36 * [(PCELL - PS9) / δ] +8 -89 * (PBCOR - PBREQ)

WFCOR = (WF * FLHV / δ* 43144) + DELWF (Table 13019) + 8 * [(PCELL - PS9) / δ] -1.2 - 28.9 * (PBCOR - PBREQ)

SHPSL = (PWGEN / ETAGEN) / δ, where ETAGEN = 0.85

δB = PB / 1.0132 ϴB = (TB + 273.15) / 288.15

δ = PAMB / 1.0132

(c) MES Calculations.

English units:

PBCOR = PB / δ + DELPB (Table 13016) - 1.2

WBCOR = WB / δ + DELWB (Table 13016) - 3.1

TBCOR = TB + DELTB (Table 13016) -4.5 (PBCOR-PBREQ)

EGTCOR = EGT + DELEGT (Table 13016) + 65 * [(PCELL - PS9) / δ] +14 -11 * (PBCOR - PBREQ)

WFCOR = (WF * FLHV / δ * 18550) + DELWF (Table 13016) + 15 * [(PCELL - PS9) / δ] -2.7 -4.4 * (PBCOR - PBREQ)

SHPSL = (PWGEN / ETAGEN) / δ, where ETAGEN = 0.85

δB = PB / 14.696 ϴB = (TB + 459.67) / 518.67

δ = PAMB / 14.696

Metric units:

PBCOR = PB / δ+ DELPB (Table 13017) – 0.08

WBCOR = WB / δ + DELWB (Table 13017) – 0.02

TBCOR = TB + DELTB (Table 13017) - 36.3 (PBCOR-PBREQ)

EGTCOR = EGT + DELEGT (Table 13017) + 36 * [(PCELL - PS9) / δ] +8 -89 * (PBCOR - PBREQ)

WFCOR = (WF * FLHV / δ* 43144) + DELWF (Table 13017) + 8 * [(PCELL - PS9) / δ] -1.2 - 28.9 * (PBCOR - PBREQ)

SHPSL = (PWGEN / ETAGEN) / δ, where ETAGEN = 0.85

δB = PB / 1.0132 ϴB = (TB + 273.15) / 288.15

δ = PAMB / 1.0132

SUBTASK 49-20-00-760-008

K. Perform a De-Prime check.

(1) Insure oil level is at gearbox sight glass Full mark with APU off.

(2) Start the APU and run for three minutes, then shutdown the APU.

(3) Note that the oil level returns back to the Full mark on the sight glass.

(4) Disconnect the de-prime cannon plug from the de-prime valve.

(5) Start the APU and run for three minutes and then shutdown the APU.

(6) Note that the oil level is approximately one quart low, if yes the de-prime is working correctly. If the oil level is at the Full mark the de-prime is not working correctly, replace the de-prime and/or troubleshoot the wire harness for open circuit, perform Steps (1) thru (6) again.

(7) When finished, install the de-prime cannon plug to the de-prime valve. This subtask can be performed in conjunction with other APU testing.

SUBTASK 49-20-00-790-001

L. Perform a leak check.

(1) Remove all of the test equipment and fixtures from the APU.

(2) Replace the oil filters. Refer to ATA No. 49-90-57.

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

WARNING: ALWAYS WEAR SOLVENT-RESISTANT GLOVES, SUCH AS NEOPRENE, WHEN USING SOLVENT.

(3) Wash the APU with MIL-PRF-680 degreasing solvent.

(a) Connect the preservation oil supply, MIL-L-6081, Grade 1010, or 1005 oil to the fuel supply inlet of the APU with a manual shutoff valve. The preservation oil must be pressurized at 10 to 25 PSIG (0.7 to 1.75 bar) and be a minimum of 1 gallon (3.8 L) of fluid. The fuel supply must be capable of being shut off with the APU operating and the preservation fluid then provided to the APU fuel inlet. This must be done rapidly. Leave the valve connecting the preservation fluid closed at this time.

(4) Start the APU and operate at idle for at least 5 minutes before the final leak check.

(5) Check the APU for fuel, oil or air leaks.

(6) If leaks are found, repair as necessary to correct the problem. If the APU must be shut down to repair the leaks, perform Paragraph K. again after repairs are complete.

(7) Shutdown the APU by switching RUN/STOP switch to STOP. Within 15 seconds disconnect the fuel supply and open the preservation oil shutoff valve. It is acceptable for the APU to shutdown prior to the end of the normal cooldown cycle.

SUBTASK 49-20-00-210-003

M. Check the magnetic chip collector. Refer to Figure 13004.

(1) Remove the magnetic plug and check for contamination as follows:

(a) Small chips on magnet.

1 Permitted: Thin slivers.

2 Not Permitted: Flakes that have a silver color or large pieces of metal with definite shape.

(b) Moderate accumulation of particles (other than silver).

1 Clean the magnetic plug and install in the APU.

2 Service the gearbox with oil. Refer to SERVICING 01.

CAUTION: DO NOT OPERATE THE ELECTRIC STARTER MOTOR MORE THAN THREE STARTS OR TRIES IN 1 HOUR MAXIMUM. MAKE SURE THE OIL SYSTEM IS FILLED BEFORE THE APU IS OPERATED.

3 Start and operate the APU for 15 minutes. Refer to Paragraph 8.P.

4 Stop the APU. Refer to Paragraph 8.Q.

a Permitted: No more accumulation of chips after 15 minutes of APU operation.

b Not Permitted: Continued build-up of chips on the magnetic plug. Any flake accumulation that has a silver color, i.e., bearing material.

(c) Heavy particle accumulation.

1 Not Permitted: Heavy build-up shows abnormal APU internal conditions.

SUBTASK 49-20-00-820-002

N. If the APU has been returned for overhaul/retrofit, adjust the ECS offset in the data memory module as follows:

(1) Disconnect DMM connector at the APU.

(2) Connect PN 2024215-1 or -2 or -3 DMM interface cable to DMM and a parallel port on an IBM compatible PC.

(3) Power the DMM/PC interface cable using a 12-VDC power supply (ac-dc converter is supplied with the cable).

(4) The following commands are to be input through the keyboard of the PC.

(a) Press “CONTROL Q” to exit the ARINC monitor program and to return to a listing of software.

(b) Select the number corresponding to the DMM file BATCH FILE TO RUN DMM.EXE (ALL PROGRAMS) and press <ENTER>.

(c) Select the number for the 131A.

(5) After the Honeywell copyright information has been displayed the main menu will show as follows:

DMM SERIAL NUMBER INITIALIZATION FOR 131A APU
DMM.EXE version 4.10.00 131A.FIL version 2.00.00
Ctrl Z to exit Program

MAIN MENU
1 : INITIALIZE DMM AND ENTER APU SERIAL NUMBER
2 : DOWNLOAD DMM CONTENTS TO A FILE ON DISK

3 : CHANGE SPECIFIC DMM CONTENTS
4 : ADD NEW LABEL TO DMM
5 : EXIT PROGRAM
ENTER DESIRED SELECTION (1,2,3,4 OR 5):

(6) Make sure software versions in the display are as follows:

(a) DMM.EXE version 4.00.00 or newer.

(b) 131A.FIL version 2.00.00 or newer.

(7) Press the Character 3 on the keyboard to get access to DMM variables which can be changed.

(8) The user will be prompted for the label change number. Press the Character 2 followed by <ENTER> on the keyboard.

(9) The user will be prompted for the new value of ECS_OFFSET. Press the correct ECS offset found in Step 8.D.(2)(h) followed by <ENTER> on the keyboard.

NOTE: ECS_OFFSET is limited to a value between 0 and -8 degrees.

(10) Make sure the ECS_OFFSET value to be recorded is correct. If correct, press the character Y on the keyboard. If not correct, press the Character N on the keyboard and (9) will repeat automatically.

(11) The user will be prompted whether to change an additional label. Press the Character Y on the keyboard.

(12) The user will be prompted for the label change number. Press the Character 1 followed by <ENTER> on the keyboard.

(13) The user will be prompted for the new value of SW Version. Press the Characters 00 followed by <ENTER> on the keyboard.

(14) Make sure the SW Version value to be recorded is correct. If correct, press the Character Y on the keyboard. If not correct, press the Character N and (13) will repeat automatically.

(15) The user will be prompted whether to change an additional label. Press the character N to return to the main menu.

(16) After being prompted for the desired function, press the Character 2 on the keyboard to create a file that has the DMM contents on the PC disk drive.

(17) After being prompted for the desired function, press the Character 5 to exit the program.

(18) If an error message shows or data was entered incorrectly, Steps (4) thru (17) must be repeated.

(19) Disconnect the DMM/PC interface cable from the DMM and reconnect the DMM to the APU.

O. (SB 131-49-7900) Software to permit for DMM performance adjustments.

NOTE: Make sure that hydraulic systems are depressurized (as outlined in the AMM, Task 29-00-00-864-001). Make sure that the APU is de-activated (as outlined in the AMM, Task 49-10-00-040-008).

(1) Determine the correct data to be installed in the DMM as follows:

Performance Settings			**APU _OPTIONS (numeric value)**
	A321	A320/319/318	
(1)	Standard	Standard	0
(2)	Standard	Original	80
(3)	Standard	De-rate	8
(4)	Original	Standard	2
(5)	Original	Original	82
(6)	Original	De-rate	10
(7)	De-rate	Standard	1
(8)	De-rate	Original	81
(9)	De-rate	De-rate	9

(2) Open DMU/FDIMU Circuit Breaker (5TV), AMM 31-36-34-865-058.

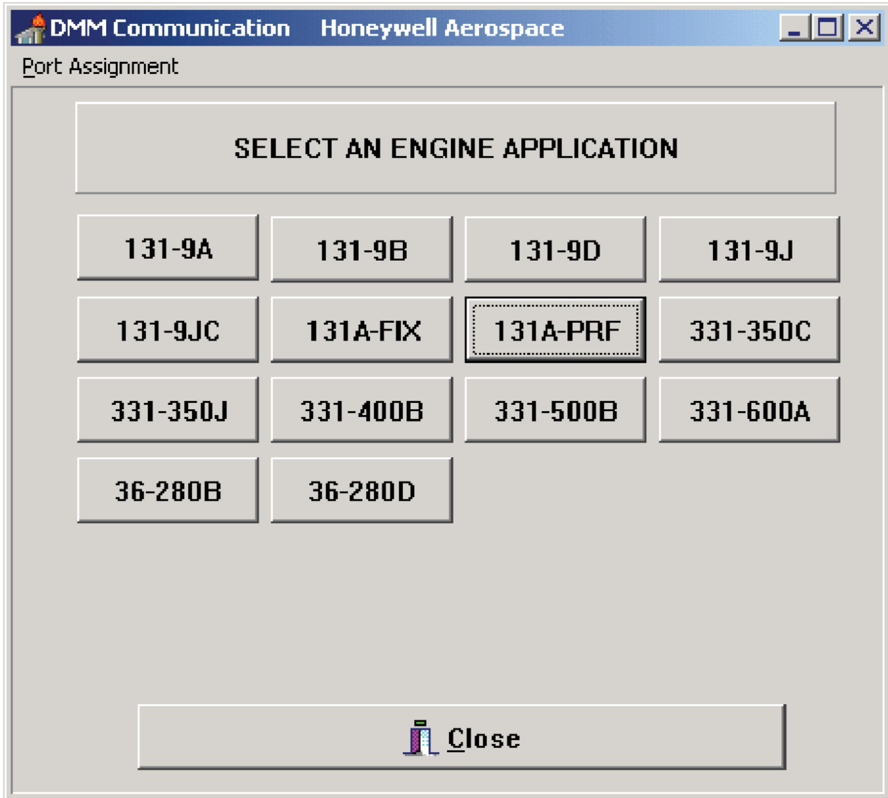
(3) Disconnect APU Harness from DMM.

(4) Connect DMM Reader, PN 2024215 with PC and DMM and make sure the DMM Reader has power.

(5) Activate the PC program by double clicking on Windmm.

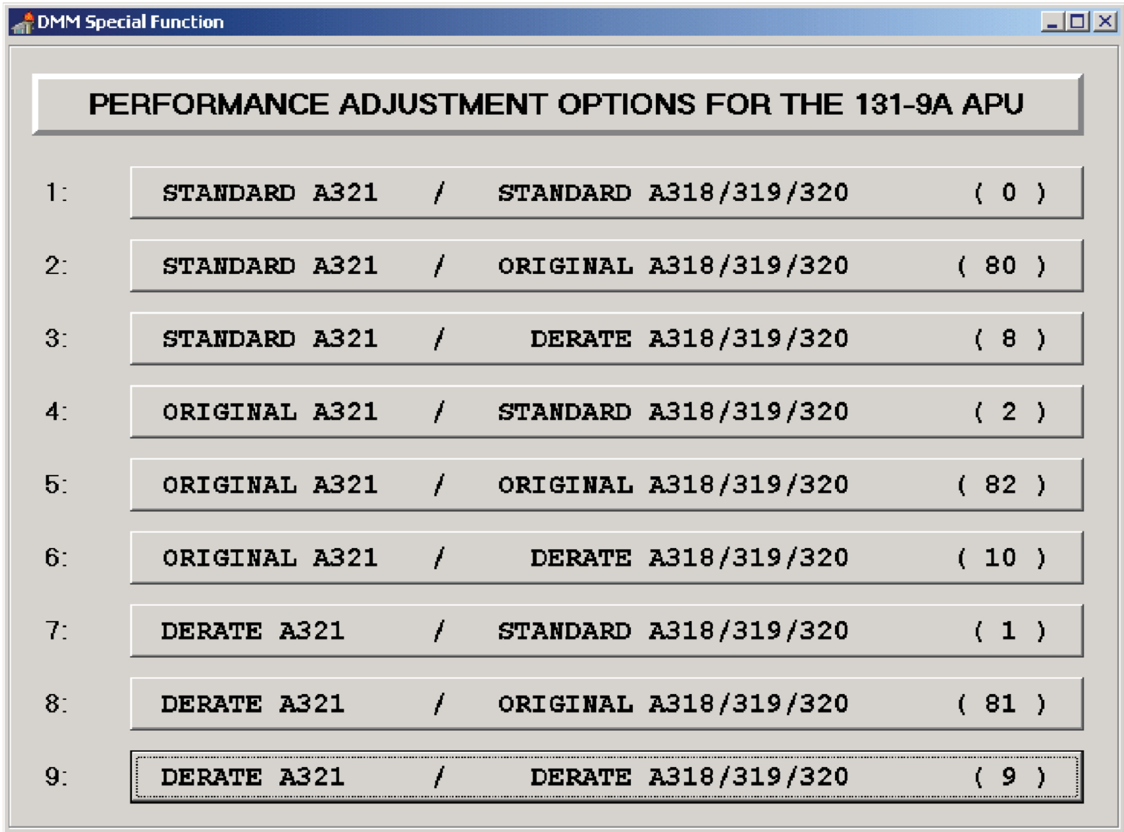
ICN-99193-0000675073-001-01

(6) A wrap and port test to determine whether the DMM Reader is properly installed will be performed. After completion of the test a menu will appear.



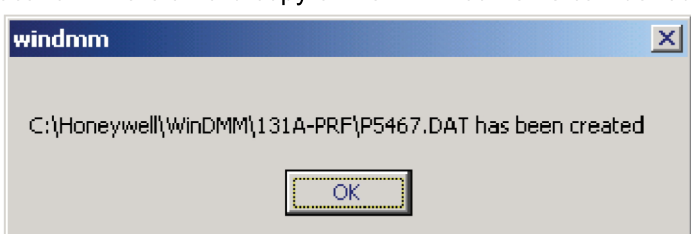
ICN-99193-0000673137-001-01

(7) Click the 131A-PRF button and the following menu will appear after a brief message window:



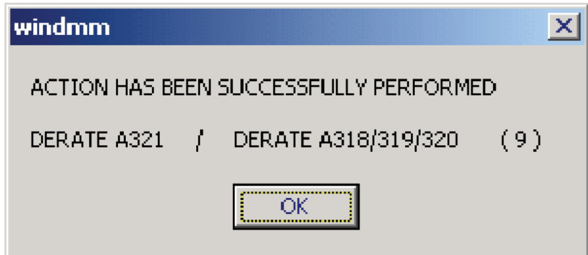
ICN-99193-0000673136-001-01

(8) Select the desired setting by “clicking” the appropriate button. The associated data will be written to the DMM. Upon completion a window will appear indicating a directory location where a hard copy of the DMM contents can be found.



ICN-99193-0000675075-001-01

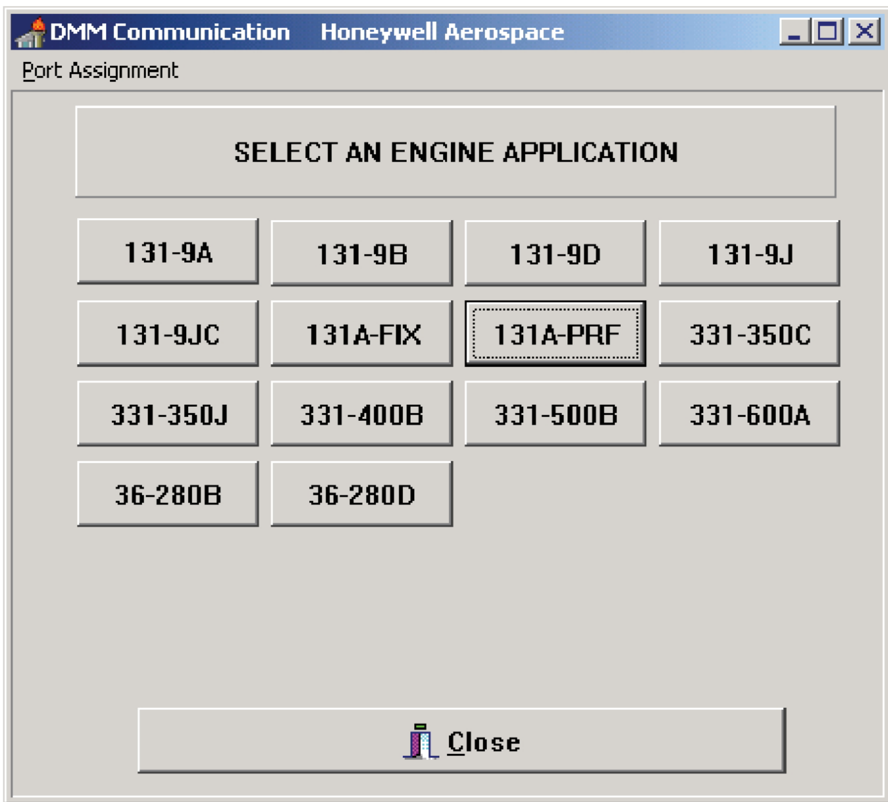
(9) “Click” OK to continue and a confirmation window of the selected APU performance setting will appear.



ICN-99193-0000675076-001-01

(10) “Click” OK and the Engine Selection Page will appear.

(11) Select “Close” to Exit the program.



ICN-99193-0000673137-001-01

(12) Disconnect the DMM Reader, PN 2024215 from the DMM and reconnect the APU harness to the DMM.

(13) Perform steps as follows:

(a) Close ECB circuit breaker (1KD), AMM 49-61-865-063.

(b) Close APU circuit breaker (2KD), AMM 49-61-34-865-063.

(c) Select the APU Master Switch to ON.

(14) After 120 seconds, check APU_OPTIONS on the MCDU.

(a) Close DMU/FDIMU Circuit Breaker (5TV), AMM 31-36-34-865-059.

(b) Push the MCDU MENU mode key to display the MCDU MENU page.

(c) Push the CFDS key to display the CFDS page.

(d) Push the SYSTEM REPORT/TEST key to display the SYSTEM REPORT/TEST page.

(e) Push the APU key to display MCDU main APU page.

(f) Push Service Data key display APU Service Data page.

(g) Push DMM key to display DMM page.

(h) Verify the APU_OPTIONS value on page 1 of the APU DMM page of the MCDU displays the correct value.

(15) Select APU Master Switch to “OFF” and permit the ECB to power down.

SUBTASK 49-20-00-760-009

P. Start the APU.

(1) Make sure APU test cell fuel valve is open.

(2) Set the Master Power switch to ON.

(3) Set the Master Panel Run/Stop switch to RUN.

SUBTASK 49-20-00-760-010

Q. Stop the APU.

(1) Set the Master Panel Run/Stop switch to STOP.

(2) Set the Master Power switch to OFF.

SUBTASK 49-20-00-760-011

R. APU Motor (electric starter motor).

WARNING: THE OUTPUT VOLTAGE OF THE IGNITION UNIT IS DANGEROUS AND COULD BE LETHAL. IT IS A CAPACITOR DISCHARGE-TYPE AND CAN KEEP HIGH VOLTAGE. MAKE SURE IT IS DE-ENERGIZED AND GROUNDED BEFORE THE INPUT AND OUTPUT LEADS ARE DISCONNECTED. DO NOT TOUCH THE CENTER CONTACT OF OUTPUT TERMINAL.

(1) Disconnect the APU wire harness connector from the ignition unit.

(2) Disconnect the APU wire harness connector from the fuel control unit.

(3) Set the Master Power switch to ON.

CAUTION: DO NOT OPERATE THE STARTER MORE THAN THREE TIMES FOLLOWED BY A 15 MINUTE WAITING PERIOD.

(4) Set the Master Panel Run/Stop switch to RUN.

(5) Set the Master Panel Run/Stop switch to STOP.

(6) Set the Master Power switch to OFF.

(7) Connect the APU wire harness connector to the ignition unit.

(8) Connect the APU wire harness connector to the fuel control unit.

Table 13016. MES LAPSE RATE (ENGLISH)

TAMB	DWB	DPB	DTB	DWF	DEGT
F	LB/MIN	PSI	F	LB/HR	F
0	-52.9	-14.6	117	-49.0	169
1	-52.4	-14.4	116	-48.4	169
2	-51.9	-14.3	115	-47.9	168
3	-51.4	-14.2	114	-47.3	167
4	-50.9	-14.0	113	-46.8	167
5	-50.5	-13.9	112	-46.3	166
6	-50.0	-13.8	111	-45.7	165
7	-49.5	-13.6	110	-45.2	165
8	-49.0	-13.5	109	-44.7	164
9	-48.5	-13.4	108	-44.1	163
10	-48.0	-13.2	107	-43.6	162
11	-47.5	-13.1	106	-43.1	162
12	-47.1	-13.0	105	-42.6	161
13	-46.6	-12.8	104	-42.1	160
14	-46.1	-12.7	103	-41.6	159

Table 13016. MES LAPSE RATE (ENGLISH) (Cont)

TAMB	DWB	DPB	DTB	DWF	DEGT
F	LB/MIN	PSI	F	LB/HR	F
15	-45.6	-12.6	102	-41.0	158
16	-45.1	-12.5	101	-40.5	157
17	-44.7	-12.3	100	-40.0	157
18	-44.2	-12.2	99	-39.5	156
19	-43.7	-12.1	98	-39.0	155
20	-43.2	-11.9	97	-38.5	154
21	-42.8	-11.8	96	-38.0	153
22	-42.3	-11.7	95	-37.5	152
23	-41.8	-11.5	95	-37.0	151
24	-41.4	-11.4	94	-36.6	150
25	-40.9	-11.3	93	-36.1	149
26	-40.4	-11.2	92	-35.6	148
27	-39.9	-11.0	91	-35.1	147
28	-39.5	-10.9	90	-34.6	147
29	-39.0	-10.8	89	-34.1	146
30	-38.6	-10.6	88	-33.7	145
31	-38.1	-10.5	87	-33.2	143
32	-37.6	-10.4	86	-32.7	142
33	-37.2	-10.3	85	-32.3	141
34	-36.7	-10.1	84	-31.8	140
35	-36.2	-10.0	83	-31.3	139
36	-35.8	-9.9	82	-30.9	138
37	-35.3	-9.8	81	-30.4	137
38	-34.9	-9.6	80	-29.9	136
39	-34.4	-9.5	79	-29.5	135
40	-34.0	-9.4	78	-29.0	134
41	-33.5	-9.3	77	-28.6	133
42	-33.1	-9.1	76	-28.1	131
43	-32.6	-9.0	75	-27.7	130
44	-32.2	-8.9	74	-27.3	129
45	-31.7	-8.8	73	-26.8	128
46	-31.3	-8.6	72	-26.4	127

Table 13016. MES LAPSE RATE (ENGLISH) (Cont)

TAMB	DWB	DPB	DTB	DWF	DEGT
F	LB/MIN	PSI	F	LB/HR	F
47	-30.8	-8.5	71	-25.9	126
48	-30.4	-8.4	70	-25.5	124
49	-29.9	-8.3	69	-25.1	123
50	-29.5	-8.1	68	-24.7	122
51	-29.0	-8.0	67	-24.2	121
52	-28.6	-7.9	66	-23.8	119
53	-28.1	-7.8	66	-23.4	118
54	-27.7	-7.7	65	-23.0	117
55	-27.3	-7.5	64	-22.5	115
56	-26.8	-7.4	63	-22.1	114
57	-26.4	-7.3	62	-21.7	113
58	-25.9	-7.2	61	-21.3	111
59	-25.5	-7.1	60	-20.9	110
60	-25.1	-6.9	59	-20.5	109
61	-24.6	-6.8	58	-20.1	107
62	-24.2	-6.7	57	-19.7	106
63	-23.8	-6.6	56	-19.3	104
64	-23.3	-6.5	55	-18.9	103
65	-22.9	-6.3	54	-18.5	102
66	-22.5	-6.2	53	-18.1	100
67	-22.1	-6.1	52	-17.7	99
68	-21.6	-6.0	51	-17.3	97
69	-21.2	-5.9	50	-17.0	96
70	-20.8	-5.8	49	-16.6	94
71	-20.4	-5.6	48	-16.2	93
72	-19.9	-5.5	47	-15.8	91
73	-19.5	-5.4	46	-15.5	90
74	-19.1	-5.3	45	-15.1	88
75	-18.7	-5.2	44	-14.7	87
76	-18.2	-5.1	43	-14.3	85
77	-17.8	-4.9	43	-14.0	84
78	-17.4	-4.8	42	-13.6	82

Table 13016. MES LAPSE RATE (ENGLISH) (Cont)

TAMB	DWB	DPB	DTB	DWF	DEGT
F	LB/MIN	PSI	F	LB/HR	F
79	-17.0	-4.7	41	-13.3	80
80	-16.6	-4.6	40	-12.9	79
81	-16.2	-4.5	39	-12.5	77
82	-15.7	-4.4	38	-12.2	75
83	-15.3	-4.2	37	-11.8	74
84	-14.9	-4.1	36	-11.5	72
85	-14.5	-4.0	35	-11.1	70
86	-14.1	-3.9	34	-10.8	69
87	-13.7	-3.8	33	-10.5	67
88	-13.3	-3.7	32	-10.1	65
89	-12.9	-3.6	31	-9.8	64
90	-12.5	-3.5	30	-9.4	62
91	-12.1	-3.3	29	-9.1	60
92	-11.7	-3.2	28	-8.8	58
93	-11.3	-3.1	27	-8.5	57
94	-10.9	-3.0	26	-8.1	55
95	-10.5	-2.9	25	-7.8	53
96	-10.1	-2.8	24	-7.5	51
97	-9.7	-2.7	24	-7.2	49
98	-9.3	-2.6	23	-6.9	48
99	-8.9	-2.5	22	-6.5	46
100	-8.5	-2.3	21	-6.2	44
101	-8.1	-2.2	20	-5.9	42
102	-7.7	-2.1	19	-5.6	40
103	-7.3	-2.0	18	-5.3	38
104	-6.9	-1.9	17	-5.0	36
105	-6.5	-1.8	16	-4.7	34
106	-6.1	-1.7	15	-4.4	33
107	-5.7	-1.6	14	-4.1	31
108	-5.3	-1.5	13	-3.8	29
109	-4.9	-1.4	12	-3.5	27
110	-4.6	-1.3	11	-3.3	25

Table 13016. MES LAPSE RATE (ENGLISH) (Cont)

TAMB	DWB	DPB	DTB	DWF	DEGT
F	LB/MIN	PSI	F	LB/HR	F
111	-4.2	-1.2	10	-3.0	23
112	-3.8	-1.1	9	-2.7	21
113	-3.4	-0.9	8	-2.4	19
114	-3.0	-0.8	8	-2.1	17
115	-2.6	-0.7	7	-1.9	15
116	-2.3	-0.6	6	-1.6	13
117	-1.9	-0.5	5	-1.3	10
118	-1.5	-0.4	4	-1.0	8
119	-1.1	-0.3	3	-0.8	6
120	-0.8	-0.2	2	-0.5	4
121	-0.4	-0.1	1	-0.3	2
122	0.0	0.0	0	0.0	0

Table 13017. MES LAPSE RATE (METRIC)

TAMB	DWB	DPB	DTB	DWF	DEGT
C	KG/SEC	BAR	C	KG/HR	C
-18	-0.40	-1.01	65	-22.3	94
-17	-0.39	-0.99	64	-21.9	94
-16	-0.39	-0.98	63	-21.4	93
-15	-0.38	-0.96	62	-21.0	92
-14	-0.37	-0.94	61	-20.6	92
-13	-0.37	-0.93	60	-20.1	91
-12	-0.36	-0.91	59	-19.7	90
-11	-0.36	-0.89	58	-19.3	89
-10	-0.35	-0.88	57	-18.9	88
-9	-0.34	-0.86	56	-18.4	88
-8	-0.34	-0.84	55	-18.0	87
-7	-0.33	-0.83	54	-17.6	86
-6	-0.32	-0.81	53	-17.2	85
-5	-0.32	-0.80	53	-16.8	84
-4	-0.31	-0.78	52	-16.4	83
-3	-0.30	-0.76	51	-16.0	82

Table 13017. MES LAPSE RATE (METRIC) (Cont)

TAMB	DWB	DPB	DTB	DWF	DEGT
C	KG/SEC	BAR	C	KG/HR	C
-2	-0.30	-0.75	50	-15.6	81
-1	-0.29	-0.73	49	-15.2	80
0	-0.28	-0.72	48	-14.8	79
1	-0.28	-0.70	47	-14.5	78
2	-0.27	-0.68	46	-14.1	77
3	-0.27	-0.67	45	-13.7	76
4	-0.26	-0.65	44	-13.3	75
5	-0.25	-0.64	43	-13.0	74
6	-0.25	-0.62	42	-12.6	73
7	-0.24	-0.61	41	-12.2	71
8	-0.23	-0.59	40	-11.9	70
9	-0.23	-0.58	39	-11.5	69
10	-0.22	-0.56	38	-11.2	68
11	-0.22	-0.55	37	-10.8	66
12	-0.21	-0.53	36	-10.5	65
13	-0.20	-0.52	35	-10.2	64
14	-0.20	-0.50	34	-9.8	62
15	-0.19	-0.49	33	-9.5	61
16	-0.19	-0.47	32	-9.2	60
17	-0.18	-0.46	31	-8.8	58
18	-0.18	-0.44	30	-8.5	57
19	-0.17	-0.43	29	-8.2	56
20	-0.16	-0.41	28	-7.9	54
21	-0.16	-0.40	27	-7.6	53
22	-0.15	-0.38	26	-7.2	51
23	-0.15	-0.37	26	-6.9	50
24	-0.14	-0.35	25	-6.6	48
25	-0.13	-0.34	24	-6.3	46
26	-0.13	-0.33	23	-6.0	45
27	-0.12	-0.31	22	-5.8	43
28	-0.12	-0.30	21	-5.5	42
29	-0.11	-0.28	20	-5.2	40

Table 13017. MES LAPSE RATE (METRIC) (Cont)

TAMB	DWB	DPB	DTB	DWF	DEGT
C	KG/SEC	BAR	C	KG/HR	C
30	-0.11	-0.27	19	-4.9	38
31	-0.10	-0.26	18	-4.6	37
32	-0.10	-0.24	17	-4.3	35
33	-0.09	-0.23	16	-4.1	33
34	-0.08	-0.21	15	-3.8	31
35	-0.08	-0.20	14	-3.5	29
36	-0.07	-0.19	13	-3.3	28
37	-0.07	-0.17	12	-3.0	26
38	-0.06	-0.16	11	-2.8	24
39	-0.06	-0.15	10	-2.5	22
40	-0.05	-0.13	9	-2.3	20
41	-0.05	-0.12	8	-2.0	18
42	-0.04	-0.11	8	-1.8	16
43	-0.04	-0.09	7	-1.6	14
44	-0.03	-0.08	6	-1.3	12
45	-0.03	-0.07	5	-1.1	10
46	-0.02	-0.05	4	-0.9	8
47	-0.02	-0.04	3	-0.6	6
48	-0.01	-0.03	2	-0.4	4
49	-0.01	-0.01	1	-0.2	2
50	0.00	0.00	0	0.0	0

Table 13018. ECS LAPSE RATE (ENGLISH)

TAMB	DWB	DPB	DTB	DWF	DEGT
F	LB/MIN	PSI	F	LB/HR	F
0	-42.0	-10.5	97	-39.8	148
1	-41.6	-10.3	96	-39.3	147
2	-41.2	-10.2	95	-38.8	146
3	-40.7	-10.1	94	-38.3	145
4	-40.3	-10.0	93	-37.8	144
5	-39.9	-9.9	92	-37.3	143
6	-39.5	-9.8	91	-36.8	142

Table 13018. ECS LAPSE RATE (ENGLISH) (Cont)

TAMB	DWB	DPB	DTB	DWF	DEGT
F	LB/MIN	PSI	F	LB/HR	F
7	-39.0	-9.7	90	-36.4	141
8	-38.6	-9.6	89	-35.9	140
9	-38.2	-9.5	88	-35.4	139
10	-37.8	-9.4	87	-34.9	138
11	-37.3	-9.3	86	-34.4	137
12	-36.9	-9.2	85	-34.0	136
13	-36.5	-9.1	84	-33.5	135
14	-36.0	-9.0	83	-33.0	134
15	-35.6	-8.9	82	-32.5	132
16	-35.2	-8.8	81	-32.1	131
17	-34.8	-8.7	80	-31.6	130
18	-34.3	-8.6	79	-31.1	129
19	-33.9	-8.5	78	-30.7	128
20	-33.5	-8.4	77	-30.2	127
21	-33.1	-8.2	76	-29.8	126
22	-32.6	-8.1	75	-29.3	125
23	-32.2	-8.0	74	-28.9	123
24	-31.8	-7.9	73	-28.4	122
25	-31.4	-7.8	72	-28.0	121
26	-30.9	-7.7	71	-27.5	120
27	-30.5	-7.6	70	-27.1	119
28	-30.1	-7.5	69	-26.6	117
29	-29.7	-7.4	69	-26.2	116
30	-29.2	-7.3	68	-25.7	115
31	-28.8	-7.2	67	-25.3	114
32	-28.4	-7.1	66	-24.9	112
33	-28.0	-7.0	65	-24.4	111
34	-27.5	-6.9	64	-24.0	110
35	-27.1	-6.8	63	-23.6	108
36	-26.7	-6.7	62	-23.1	107
37	-26.3	-6.6	61	-22.7	106
38	-25.9	-6.5	60	-22.3	104

Table 13018. ECS LAPSE RATE (ENGLISH) (Cont)

TAMB	DWB	DPB	DTB	DWF	DEGT
F	LB/MIN	PSI	F	LB/HR	F
39	-25.4	-6.4	59	-21.9	103
40	-25.0	-6.3	58	-21.5	102
41	-24.6	-6.2	57	-21.0	100
42	-24.2	-6.0	56	-20.6	99
43	-23.7	-5.9	55	-20.2	97
44	-23.3	-5.8	54	-19.8	96
45	-22.9	-5.7	53	-19.4	95
46	-22.5	-5.6	52	-19.0	93
47	-22.1	-5.5	51	-18.6	92
48	-21.6	-5.4	50	-18.2	90
49	-21.2	-5.3	49	-17.8	89
50	-20.8	-5.2	48	-17.4	87
51	-20.4	-5.1	47	-17.0	86
52	-20.0	-5.0	46	-16.6	84
53	-19.5	-4.9	45	-16.2	83
54	-19.1	-4.8	44	-15.8	81
55	-18.7	-4.7	43	-15.4	80
56	-18.3	-4.6	42	-15.0	78
57	-17.9	-4.5	41	-14.6	77
58	-17.4	-4.4	40	-14.3	75
59	-17.0	-4.3	39	-13.9	74
60	-16.6	-4.2	38	-13.5	72
61	-16.2	-4.1	37	-13.1	70
62	-15.8	-4.0	37	-12.7	69
63	-15.4	-3.9	36	-12.4	67
64	-14.9	-3.7	35	-12.0	66
65	-14.5	-3.6	34	-11.6	64
66	-14.1	-3.5	33	-11.3	62
67	-13.7	-3.4	32	-10.9	61
68	-13.3	-3.3	31	-10.5	59
69	-12.8	-3.2	30	-10.2	57
70	-12.4	-3.1	29	-9.8	56

Table 13018. ECS LAPSE RATE (ENGLISH) (Cont)

TAMB	DWB	DPB	DTB	DWF	DEGT
F	LB/MIN	PSI	F	LB/HR	F
71	-12.0	-3.0	28	-9.5	54
72	-11.6	-2.9	27	-9.1	52
73	-11.2	-2.8	26	-8.8	51
74	-10.8	-2.7	25	-8.4	49
75	-10.3	-2.6	24	-8.1	47
76	-9.9	-2.5	23	-7.7	45
77	-9.5	-2.4	22	-7.4	44
78	-9.1	-2.3	21	-7.0	42
79	-8.7	-2.2	20	-6.7	40
80	-8.3	-2.1	19	-6.3	38
81	-7.9	-2.0	18	-6.0	36
82	-7.4	-1.9	17	-5.7	35
83	-7.0	-1.8	16	-5.3	33
84	-6.6	-1.7	15	-5.0	31
85	-6.2	-1.6	14	-4.7	29
86	-5.8	-1.5	13	-4.4	27
87	-5.4	-1.4	12	-4.0	25
88	-5.0	-1.2	11	-3.7	23
89	-4.5	-1.1	11	-3.4	22
90	-4.1	-1.0	10	-3.1	20
91	-3.7	-0.9	9	-2.8	18
92	-3.3	-0.8	8	-2.4	16
93	-2.9	-0.7	7	-2.1	14
94	-2.5	-0.6	6	-1.8	12
95	-2.1	-0.5	5	-1.5	10
96	-1.6	-0.4	4	-1.2	8
97	-1.2	-0.3	3	-0.9	6
98	-0.8	-0.2	2	-0.6	4
99	-0.4	-0.1	1	-0.3	2
100	0.0	0.0	0	0.0	0
101	0.4	0.1	-1	0.3	-2
102	0.8	0.2	-2	0.6	-4

Table 13018. ECS LAPSE RATE (ENGLISH) (Cont)

TAMB	DWB	DPB	DTB	DWF	DEGT
F	LB/MIN	PSI	F	LB/HR	F
103	1.2	0.3	-3	0.9	-6
104	1.6	0.4	-4	1.2	-8
105	2.1	0.5	-5	1.5	-10
106	2.5	0.6	-6	1.7	-12
107	2.9	0.7	-7	2.0	-14
108	3.3	0.8	-8	2.3	-16
109	3.7	0.9	-9	2.6	-19
110	4.1	1.0	-10	2.9	-21
111	4.5	1.1	-10	3.1	-23
112	4.9	1.2	-11	3.4	-25
113	5.3	1.3	-12	3.7	-27
114	5.7	1.5	-13	4.0	-29
115	6.2	1.6	-14	4.2	-31
116	6.6	1.7	-15	4.5	-34
117	7.0	1.8	-16	4.8	-36
118	7.4	1.9	-17	5.0	-38
119	7.8	2.0	-18	5.3	-40
120	8.2	2.1	-19	5.5	-43
121	8.6	2.2	-20	5.8	-45
122	9.0	2.3	-21	6.0	-47

Table 13019. ECS LAPSE RATE (METRIC)

TAMB	DWB	DPB	DTB	DWF	DEGT
C	KG/SEC	BAR	C	KG/HR	C
-18	-0.32	-0.72	54	-18.1	82
-17	-0.31	-0.71	53	-17.7	81
-16	-0.31	-0.70	52	-17.3	80
-15	-0.30	-0.68	51	-16.9	79
-14	-0.30	-0.67	50	-16.5	78
-13	-0.29	-0.66	49	-16.1	77
-12	-0.28	-0.65	48	-15.7	76
-11	-0.28	-0.63	47	-15.4	75

Table 13019. ECS LAPSE RATE (METRIC) (Cont)

TAMB	DWB	DPB	DTB	DWF	DEGT
C	KG/SEC	BAR	C	KG/HR	C
-10	-0.27	-0.62	46	-15.0	74
-9	-0.27	-0.61	45	-14.6	73
-8	-0.26	-0.59	44	-14.2	72
-7	-0.26	-0.58	43	-13.8	71
-6	-0.25	-0.57	42	-13.5	70
-5	-0.24	-0.55	41	-13.1	69
-4	-0.24	-0.54	40	-12.7	67
-3	-0.23	-0.53	39	-12.4	66
-2	-0.23	-0.52	38	-12.0	65
-1	-0.22	-0.50	37	-11.6	64
0	-0.21	-0.49	36	-11.3	62
1	-0.21	-0.48	35	-10.9	61
2	-0.20	-0.46	34	-10.6	60
3	-0.20	-0.45	34	-10.2	58
4	-0.19	-0.44	33	-9.9	57
5	-0.19	-0.42	32	-9.5	56
6	-0.18	-0.41	31	-9.2	54
7	-0.17	-0.40	30	-8.9	53
8	-0.17	-0.39	29	-8.5	51
9	-0.16	-0.37	28	-8.2	50
10	-0.16	-0.36	27	-7.9	49
11	-0.15	-0.35	26	-7.6	47
12	-0.15	-0.33	25	-7.2	46
13	-0.14	-0.32	24	-6.9	44
14	-0.13	-0.31	23	-6.6	42
15	-0.13	-0.29	22	-6.3	41
16	-0.12	-0.28	21	-6.0	39
17	-0.12	-0.27	20	-5.7	38
18	-0.11	-0.26	19	-5.4	36
19	-0.11	-0.24	18	-5.1	34
20	-0.10	-0.23	17	-4.8	33
21	-0.09	-0.22	16	-4.5	31

Table 13019. ECS LAPSE RATE (METRIC) (Cont)

TAMB	DWB	DPB	DTB	DWF	DEGT
C	KG/SEC	BAR	C	KG/HR	C
22	-0.09	-0.20	15	-4.2	29
23	-0.08	-0.19	14	-3.9	28
24	-0.08	-0.18	13	-3.6	26
25	-0.07	-0.16	12	-3.3	24
26	-0.07	-0.15	11	-3.1	22
27	-0.06	-0.14	10	-2.8	21
28	-0.05	-0.13	9	-2.5	19
29	-0.05	-0.11	8	-2.2	17
30	-0.04	-0.10	7	-2.0	15
31	-0.04	-0.09	6	-1.7	13
32	-0.03	-0.07	6	-1.5	11
33	-0.03	-0.06	5	-1.2	9
34	-0.02	-0.05	4	-0.9	7
35	-0.02	-0.04	3	-0.7	6
36	-0.01	-0.02	2	-0.4	4
37	0.00	-0.01	1	-0.2	2
38	0.00	0.00	0	0.1	0
39	0.01	0.02	-1	0.3	-2
40	0.01	0.03	-2	0.5	-5
41	0.02	0.04	-3	0.8	-7
42	0.02	0.05	-4	1.0	-9
43	0.03	0.07	-5	1.2	-11
44	0.03	0.08	-6	1.5	-13
45	0.04	0.09	-7	1.7	-15
46	0.05	0.11	-8	1.9	-17
47	0.05	0.12	-9	2.1	-19
48	0.06	0.13	-10	2.3	-22
49	0.06	0.14	-11	2.5	-24
50	0.07	0.16	-12	2.7	-26

PART NO. ____________________ MODEL NO. ____________ UNIT S/N ___________ DATE ________

ECB PART NO. _________________________ UNIT S/N ___________________________

AIRFLOW MEASURING SECTION NO. ______________________

		HEAVY REPAIR LIMITS			
		2-PACK ECS - 700 HIGH + 83 KW DATA POINT 0003		MES + 54 KW DATA POINT 0004	
PARAMETER		LIMIT	ACTUAL	LIMIT	ACTUAL
PBCOR	BLEED PRESSURE, PSIA (BAR)	51.2 (3.53) MINIMUM		51.1 (3.52) MINIMUM	
WBCOR	BLEED AIRFLOW, LB/MIN (KG/MIN)	152.2 (69.0) MINIMUM		NOT APPLICABLE	
EGTCOR	EXHAUST GAS TEMPERATURE, °F (°C)	1130 (610) MAXIMUM		1125 (607) MAXIMUM	
WFCOR	FUEL CONSUMPTION, LB/HR (KG/HR)	NOT APPLICABLE		269.0 (122.1) REFERENCE	
		LIGHT/MEDIUM REPAIR (CONTINUE-TIME) LIMITS			
		2-PACK ECS - 700 HIGH + 83 KW DATA POINT 0003		MES + 54 KW DATA POINT 0004	
PARAMETER		LIMIT	ACTUAL	LIMIT	ACTUAL
PBCOR	BLEED PRESSURE, PSIA (BAR)	50.2 (3.46) MINIMUM		50.1 (3.454) MINIMUM	
WBCOR	BLEED AIRFLOW, LB/MIN (KG/MIN)	148.9 (67.5) MINIMUM		NOT APPLICABLE	
EGTCOR	EXHAUST GAS TEMPERATURE, °F (°C)	1150 (621) MAXIMUM		1145 (618) MAXIMUM	
WFCOR	FUEL CONSUMPTION, LB/HR (KG/HR)	NOT APPLICABLE		269.0 (122.1) REFERENCE	

NOTE: PERFOMANCE DATA ADJUSTED TO SEA LEVEL, 100°F/122°F (38°C/50°C), INSTALLED CONDITIONS. EGTCOR AND WFCOR ARE ALSO CORRECTED TO MINIMUM BLEED PRESSURE. WFCOR IS A REFERENCE-ONLY VALUE.

ECS OFFSET WORKSHEET (Step 8.D.(2))			
INITIAL IGV POSITION:______________________	DEGREES	INITIAL PBCOR	PSIA (BAR)
FINAL IGV POSITION:_	DEGREES	FINAL PBCOR	PSIA (BAR)
ECS_OFFSET = (FINAL IGV DEGREES - INITIAL IGV DEGREES) =			ECS OFFSET DEGREES

FLOW SENSOR TEST						
ITEM	STEP	PARAMETER	UNITS	DATA POINT	VALUE	LIMIT
FLOW SENSOR TEST	8.E.(8)	WBCDNA	LB/MIN (KG/MIN)	0005		FIGURE 1303
FLOW SENSOR TEST	8.E.(11)	WBCDNA	LB/MIN (KG/MIN)	0006		FIGURE 1303
FLOW SENSOR ACCURACY	8.E.(12)(a)	WC	--	--		+/- 5

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Figure 13009. (Sheet 1 of 4) Test Data Sheet

SCV STABILITY TEST - SCV IS STABLE: YES_______NO_________ (PARAGRAPH 8.F.)

MINIMUM SURGE MARGIN TEST - APU DID_________/DID NOT_________ SURGE (PARAGRAPH 8.G.)

DC POWER START TIME ___________SECONDS (STEP 8.H.(1)(a))

APU FAULTS SEEN: NONE____ OTHER____

TOTAL NUMBER OF APU STARTS DURING TEST _______________

TOTAL OPERATING TIME DURING TEST _______________________HOUR/MINUTE

APU STATUS: ACCEPT ____________ REJECT ____________

	SIGNATURE	DATE
TECHNICIAN		
SUPERVISOR		
QUALITY ASSURANCE		

ICN-99193-0000673139-001-01

Figure 13009. (Sheet 2 of 4) Test Data Sheet

		STEP	8.D.(4)(c)	8.D.(5)(g)	8.D.(1)(f)	8.D.(2)(d)
		DIGITAL DATA POINT NUMBER	0003	0004	0001	0002
TEST		UNITS	2 PCK-700 ECS HIGH	MES	RTL	SHAFT
PBAR	BAROMETRIC PRESSURE	PSIA (BAR)				
PCELL	CELL PRESSURE	PSIA (BAR)				
T1	T1 - APU INLET TEMPERATURE (AVG)	DEG F (C)				
TENIVA	UNIT INLET TEMPERATURE (T2)	DEG F (C)				
POIL	OIL PRESSURE - LUBE PUMP DISCHARGE	PSIG (KPA)				
TOIL	OIL TEMPERATURE - LUBE PUMP DISCHARGE	DEG F (C)				
PSGBX	GEARBOX PRESSURE - SUMP	IN H20 (MM H20)				
TOS	GEARBOX TEMPERATURE - SUMP	DEG F (C)				
TFUEL	FUEL INLET TEMPERATURE	DEG F (C)				
PFUEL	FUEL INLET PRESSURE	PSIG (KPA)				
VIBGBA	UNIT VIBRATION - GEARBOX	IN/SEC (MM/SEC)				
VIBTHA	UNIT VIBRATION - TURBINE	IN/SEC (MM/SEC)				
VIBCFA	UNIT VIBRATION - COOLING FAN	IN/SEC (MM/SEC)				
XNL	SHAFT SPEED	RPM				
PIGV	INLET GUIDE VANE POSITION	DEGREE				
PCDFD	COMPRESSOR DISCHARGE STATIC PRESSURE	PSIA (BAR)				
TCDFD	COMPRESSOR DISCHARGE TEMPERATURE	DEG F (C)				
TTDEA TTDEB	TURBINE DISCHARGE TEMPERATURE (UNIT EGT)	#1 DEG F (C) #2 DEG F (C)				
EGT	LAB EGT (AVG)	DEG F (C)				
PS9	EXHAUST STATIC PRESSURE	PSIA (BAR)				
PBORFA	BLEED AIR ORIFICE PRESSURE	PSIA (BAR)			NA	NA
TBORFA	BLEED ORIFICE TEMPERATURE (AVG)	DEG F (C)			NA	NA
PDBORA	BLEED AIR ORIFICE DELTA P	PSID (KPAD)			NA	NA
WB	BLEED AIRFLOW	LB/MIN (KG/MIN)			NA	NA
WBCDNA	CORRECTED DISCHARGE AIRFLOW	LB/MIN (KG/MIN)			NA	NA
PG	BLEED PRESSURE (AVG)	PSIA (BAR)			NA	NA
TB	BLEED TEMPERATURE (AVG)	DEG F (C)			NA	NA
WF	FUEL FLOW (AVG)	LB/HR (KG/SEC)				
PWGEN	GENERATOR LOAD - POWER FACTOR = 1.0	KW			NA	

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Figure 13009. (Sheet 3 of 4) Test Data Sheet

CALCULATIONS						SHAFT DATA
SHPSL	GENERATOR LOAD AT SEA LEVEL -- PWGEN/(PCELL/14.696	KW			NA	
	APU DELTAP/DELTA -- (PCELL - PS9)/(PCELL/14.696)	PSIA(BAR)			NA	
	BLEED PRESSURE AT SEA LEVEL -- PB/(PCELL/14.696)	PSIA (BAR)			NA	NA
DELPB	BLEED PRESSURE LAPSE RATE CORRECTION	PSIA (BAR)			NA	NA
	INSTALLATION EFFECT ON BLEED PRESSURE	PSIA (BAR)			NA	NA
PBCOR	BLEED PRESSURE CORRECTED TO SEA LEVEL, 100°F (38°C), INSTALLED	PSIA (BAR)			NA	NA
	BLEED AIRFLOW AT SEA LEVEL -- WB/(PCELL/14.696)	LB/MIN (KG/MIN)			NA	NA
DELWB	BLEED FLOW LAPSE RATE CORRECTION	LB/MIN (KG/MIN)			NA	NA
	INSTALLATION EFFECT ON WB	LB/MIN (KG/MIN)			NA	NA
WBCOR	BLEED AIRFLOW CORRECTED TO SEA LEVEL, 100°F (38°C)	LB/MIN (KG/MIN)			NA	NA
DELTB	BLEED TEMPERATURE LAPSE RATE CORRECTION	DEG F (C)			NA	NA
	EXCESS PRESSURE CORRECTION ON BLEED TEMPERATURE (-4.5*(PBCOR-PBREQ))	DEG F (C)			NA	NA
TBCOR	BLEED TEMPERATURE CORRECTED TO SEA LEVEL, 100°F (38°C), INSTALLED	DEG F (C)			NA	NA
DELEGT	EGT LAPSE RATE CORRECTION	DEG F (C)			NA	NA
	APU DELTA P CORRECTION ON EGT - (65*(PCELL-PS9)/(PCELL/14.696)	DEG F (C)			NA	NA
	INSTALLATION EFFECT ON EGT	DEG F (C)			NA	NA
	EXCESS BLEED PRESSURE CORRECTION ON EGT -- (-11*(PBCOR-PBREQ))	DEG F (C)			NA	NA
EGTCOR	EGT CORRECTED TO SEA LEVEL, 100°F (38°C), INSTALLED, AT PBREQ	DEG F(C)			NA	NA
	SEA LEVEL FUEL FLOW – (WF/PCELL/14.696)*(FLHV/18550)	LB/HR (KG/SEC)			NA	NA
DELWF	FUEL FLOW LAPSE RATE CORRECTION	LB/HR (KG/SEC)			NA	NA
	APU DELTA P CORRECTION ON WF -- (15*(PCELL-PS9)/(PCELL/14.696))	LB/HR (KG/SEC)			NA	NA
	INSTALLATION EFFECT ON WF	LB/HR (KG/SEC)			NA	NA
	EXCESS BLEED PRESSURE CORRECTION ON WF -- (-4.4*(PBCOR-PBREQ))	LB/HR (KG/SEC)			NA	NA
WFCOR	FUEL FLOW CORRECTED TO SEA LEVEL, 100°F (38°C), INSTALLED, AT PBREQ	LB/HR (KG/SEC)			NA	NA
NOTE: NA = NOT NEEDED OR APPLICABLE						

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Figure 13009. (Sheet 4 of 4) Test Data Sheet

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LIST OF EFFECTIVE PAGES

* Indicates a changed or added page.
F Indicates a foldout page.

LIST OF EFFECTIVE PAGES (Cont)

* Indicates a changed or added page.
F Indicates a foldout page.

TABLE OF CONTENTS
CHAPTER - 49

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GEARBOX ASSEMBLY
SYSTEMS DESCRIPTION SECTION

1. Introduction

The purpose of the gearbox assembly is to interface between the APU power section and the gearbox mounted lube module, fuel control and generator. The gearbox assembly also serves as the lubrication distribution system for the APU, starter and generator.

2. General Description

The gearbox is a modular assembly that interfaces with the L/C section and incorporates drive pads for the APU-driven accessories, direct current (dc) starter, including provisions for a 24,000 RPM oil-cooled alternating current (ac) generator. The gearbox incorporates a wet sump lubrication system where the oil is stored in the gearbox rather than in an external reservoir. The following items are mounted on the gearbox:

- Fuel control unit (FCU),
- Low oil pressure switch,
- Low oil level switch,
- Lubrication module,
- Oil cooling fan assembly,
- Oil-cooled generator (optional),
- Oil heater,
- Oil temperature sensor,
- Starter motor.

Other gearbox features are:

- A gearbox vent with air-oil separation is provided. The vent line is routed to the APU exhaust eliminating a customer interface and a separate overboard drain.
- The gravity fill port is an integral part of the gearbox housing. The port is located on the gearbox housing to minimize the possibility of over-servicing. A direct-reading sight glass, included to provide a clear indication of the full and add oil level marks, is installed to the rear of the gearbox.
- The self-closing combination drain plug and chip collector magnetically attracts ferrous alloy chips for visual detection. The option for an additional magnetic chip collector is also provided on the gearbox to isolate the aft turbine bearing sump return for enhanced fault isolation.
- Provisions for pressure fill port are provided on the front of the gearbox to facilitate pressurized servicing. In addition, an oil overfill port is located above the fill port to prevent gearbox over-servicing.

During APU operation, oil is drawn from the gearbox assembly oil sump through the oil sump pickup filter screen and into the lube module where it goes through a temperature control system and lube filter. The conditioned oil is distributed internally to the gearbox oil jets for lubrication of the components and externally to the starter, generator and APU power section bearings.

The gearbox assembly receives power directly from the turbine through the driven compressor shaft. The compound idler gear is meshed with the starter to receive power from the starter. The compound idler gearshaft, with integral air-oil separator, drives the oil cooling fan, meshes with the high speed pinion gear and the lube pump gear drives the lube module and fuel control unit. The generator gear is meshed with the high speed pinion gear to supply power to the generator.

Unwanted air that collects in the gearbox assembly is sent through the air-oil separator. Once air is separated from the oil, the air is sent through the gearbox vent to the APU exhaust.

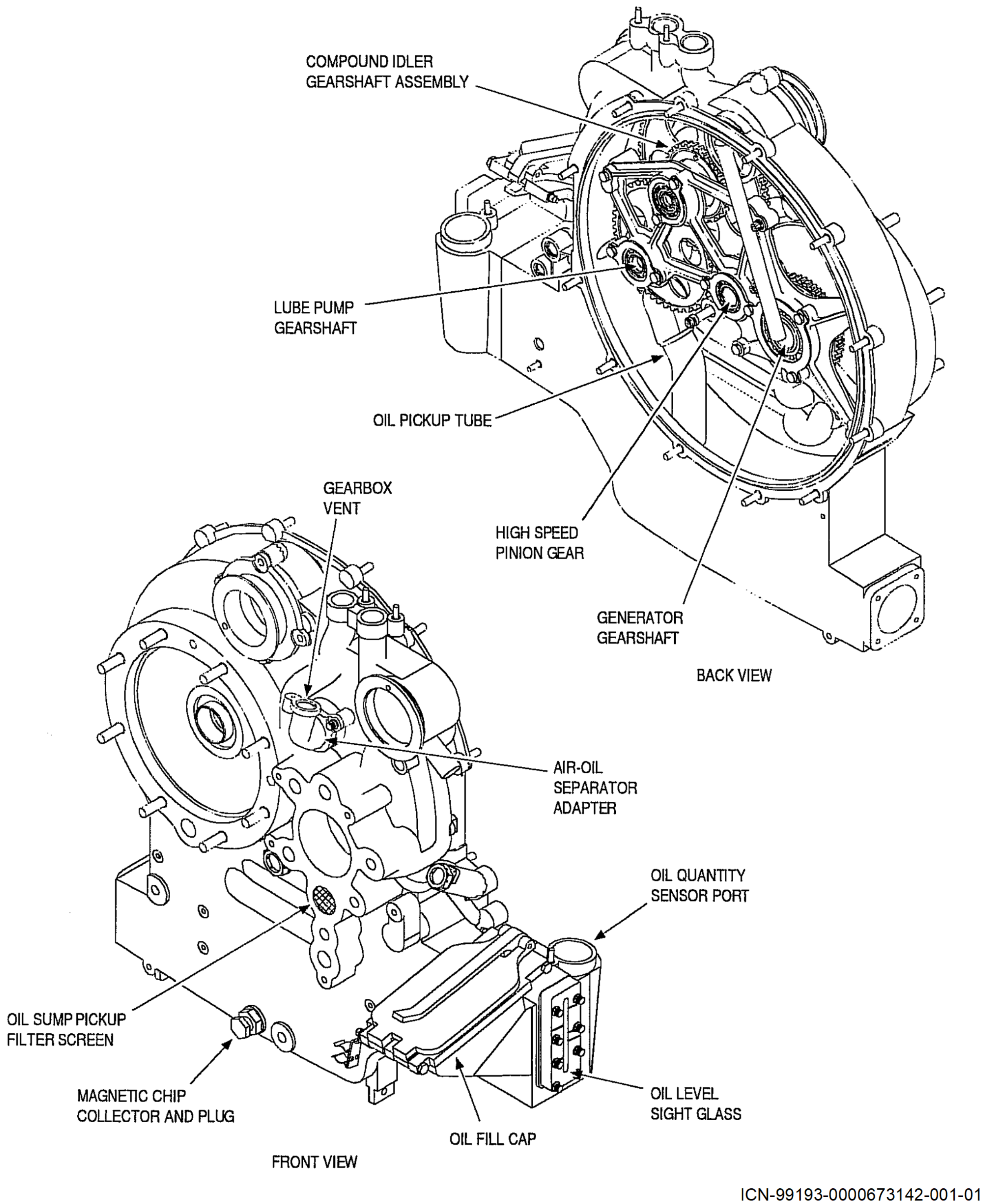

Figure 1. Gearbox Assembly

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GEARBOX ASSEMBLY
DISASSEMBLY-01

TASK 49-21-00-030-801

1. General

A. This section contains procedures for disassembly of the gearbox assembly.

B. Perform the disassembly procedures in a dry, bright, clean room.

C. Be careful to prevent damage to parts that can be used again.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

D. Apply lubricating oil to parts and put them in a protective container to prevent corrosion until the parts can be cleaned and checked.

E. Do not disassemble any staked, welded, riveted, soldered, swaged, or press fit assemblies.

F. Do not remove plates, passage hole plugs, or threaded inserts unless replacement is necessary.

G. Check all bearings for roughness, brinelling and damaged races or retainers. These conditions can be an indication of possible damage.

H. Remove all protective caps, plugs and closures before disassembly of the unit.

I. Make a write of the quantities and thickness of the shims and washers. This will help when the part is assembled.

J. Refer to Section 49-20-00, Removal 32 for removal of the gearbox assembly.

2. Special Tools, Fixtures and Equipment

A. Table 5001 shows the necessary special tools, fixtures and equipment or disassembly.

Table 5001. Special Tools, Fixtures and Equipment

Nomenclature	Use	Part No.
NOTE: Equivalent tools, fixtures and equipment can be used.		
Standard arbor press		Commercially available
Split plate adapter	Used with the step plate adapter to remove bearings from the gearshaft assembly.	834820-1
Step plate adapter	Used with the split plate adapter to remove bearings.	834822-1
Step plate adapter	Used with the split plate adapter to remove bearings.	834822-2
Step plate adapter	Used with the split plate adapter to remove bearings.	834822-3

Table 5001. Special Tools, Fixtures and Equipment (Cont)

Nomenclature	Use	Part No.
Step plate adapter	Used with the split plate adapter to remove bearings.	834822-6
Bearing removal adapter	Used to remove bearings from the starter gear spline shaft assembly.	834826-1
Seal puller	Used to remove the seal from the air-oil separator.	834829-1
Split plate adapter	Used with the step plate adapter to remove bearings from the high speed pinion gearshaft.	834928-1
Split plate adapter	Used with the step plate adapter to remove bearings from the compound idler assembly.	834929-1
Split plate adapter	Used with the step plate adapter to remove bearings from the generator gearshaft.	834930-1
Split plate adapter	Used with the step plate adapter to remove bearings from the lube module gearshaft.	834964-1

3. Equipment and Materials

A. Not applicable.

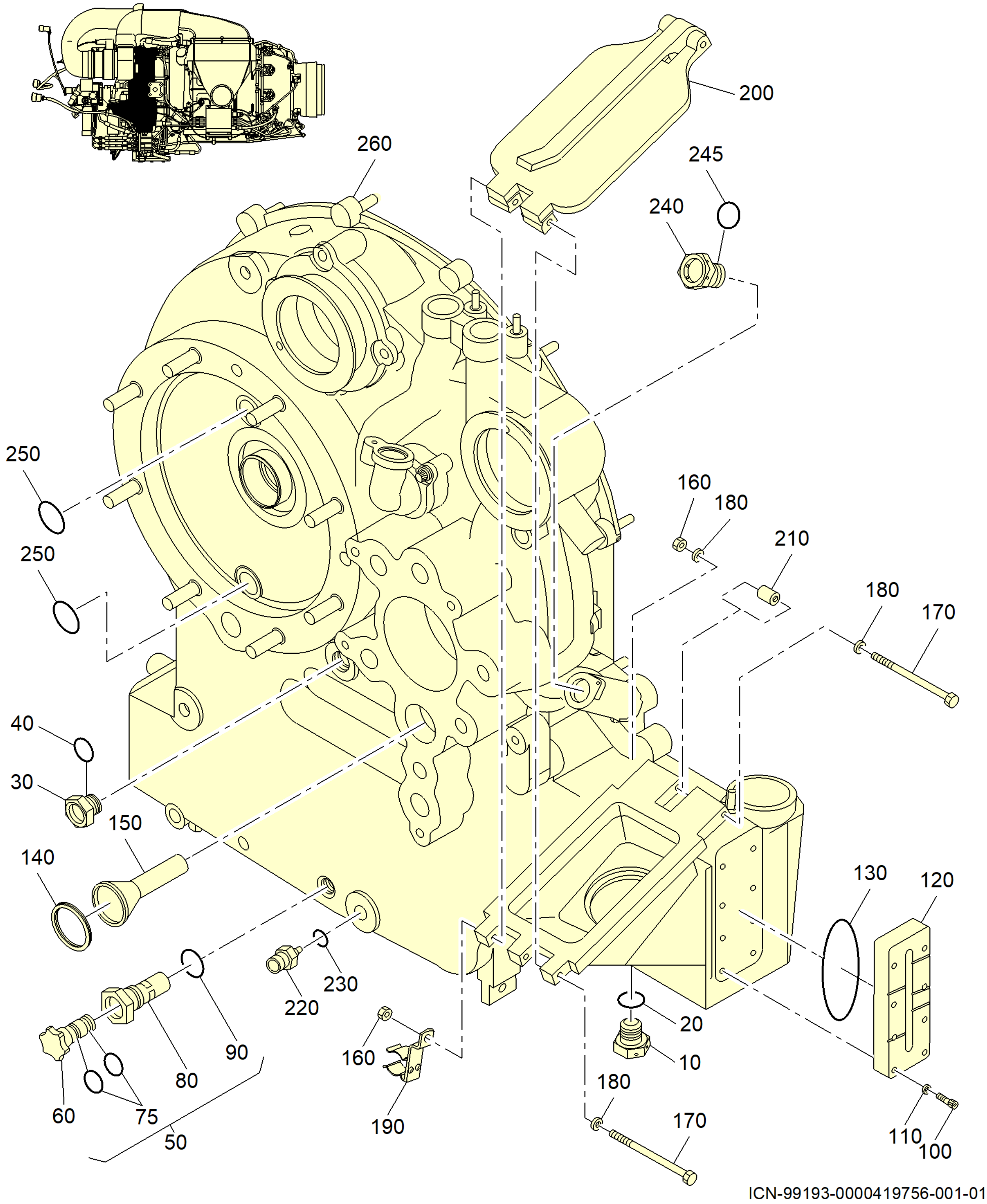

Figure 5001. Disassembly of Gearbox Assembly

Key to Figure 5001

10. PLUG (IPC FIG. 11)	150. FILTER ELEMENT
20. PACKING	160. NUT
30. PLUG	170. BOLT
40. PACKING	180. WASHER
60. MAGNETIC PLUG	190. BRACKET
50. MAGNETIC DRAIN PLUG	200. OIL FILL CAP
75. PACKING	210. OIL FILL CAP ROLLER
80. PLUG	220. OIL TEMPERATURE SENSOR
90. PACKING	230. GASKET
100. BOLT	240. PLUG
110. WASHER	245. PACKING
120. SIGHT GLASS	250. SCREEN
130. PACKING	260. GEARBOX ASSY
140. RETAINING RING	

4. Procedure

SUBTASK 49-21-00-030-001

A. Disassemble the gearbox assembly. Refer to Figure 5001.

(1) Turn the gearbox assembly (260) until the drive pads point up.

(2) Remove nuts (160), bracket (190), bolts (170), washers (180), oil fill cap (200) and oil fill cap roller (210) from the gearbox assembly (260).

(3) Remove bolts (100), washers (110), sight glass (120) and packing (130). Discard packing.

(4) Remove the plugs (10, 30) with packings (20, 40). Discard packings.

(5) Remove assembled magnetic plug (60, 80) with packings (75, 90). Discard packings.

(6) Remove oil temperature sensor (220) and gasket (230).

(7) Remove plug (240) and packing (245). Discard packing.

(8) Remove screen (250).

(9) Remove retaining ring (140) and filter element (150).

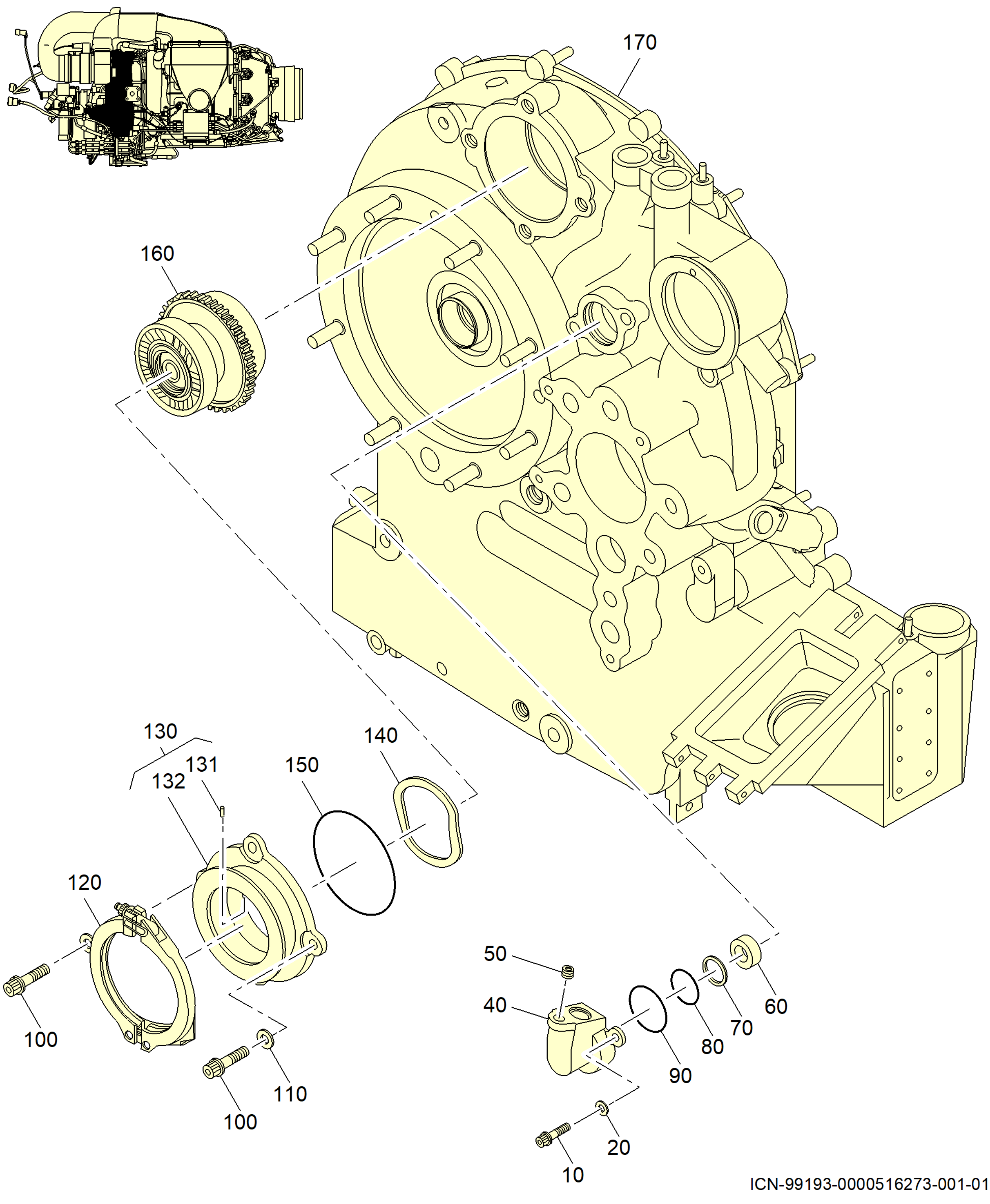

Figure 5002. Disassembly of Gearbox Assembly

Key to Figure 5002

10.	BOLT (IPC FIG. 12)	110.	WASHER
20.	WASHER	120.	CLAMP
40.	ADAPTER	130.	STARTER ADAPTER
50.	INSERT	131.	PIN
60.	STATIONARY AIR-OIL SEAL	132.	ADAPTER
70.	SHIM	140.	WAVE SPRING WASHER
80.	PACKING	150.	PACKING
90.	PACKING	160.	STARTER GEAR ASSY
100.	BOLT	170.	GEARBOX ASSY

B. (SB 131-49-8353) Remove the J-Tube. Refer to Figure 5003.

(1) Remove the J-tube captive retainer bolt (p/o 20) that install the J-tube captive retainer to the adaptor housing (60).

(2) Remove the J-tube nut (p/o 20) that install the J-tube (20) to the gearbox housing (10).

(3) Remove the O-rings (30) from the J-tube (20).

(4) Remove union (40) and the O-ring (50).

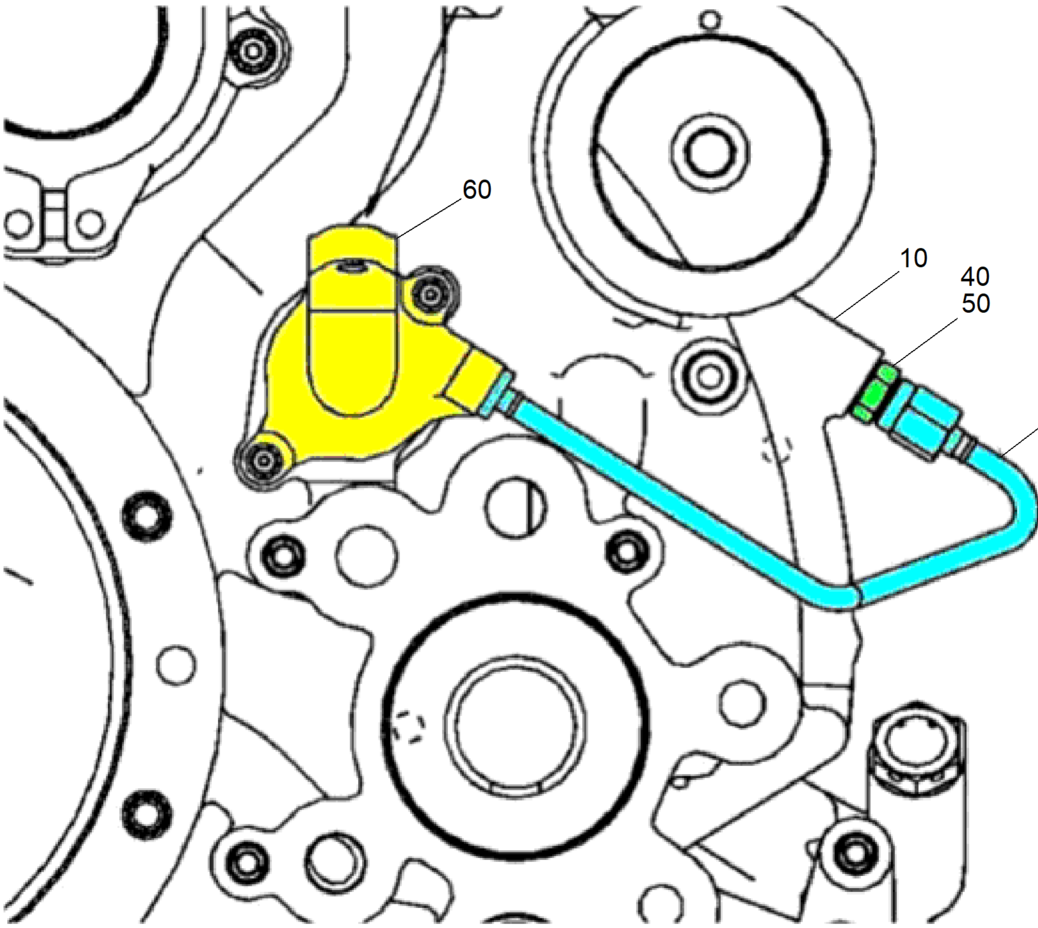

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Figure 5003. Removal of J-Tube

Key to Figure 5003

10. GEARBOX HOUSING	40. UNION
20. J-TUBE	50. O-RING
30. O-RING	60. ADAPTOR HOUSING

C. Disassemble the gearbox assembly components. Refer to Figure 5002.

(1) Remove bolts (10), washers (20) and adapter (40) with stationary air-oil seal (60), packings (80, 90) and installed quantity of shims (70) from the gearbox assembly.

(2) Disassemble the air-oil separator adapter as follows:

(a) Use a PN 834829-1 seal puller to remove stationary air-oil seal (60), from adapter (40).

(b) Remove the installed quantity of shims (70) and packings (80, 90) from adapter (40). Record the thickness of shims (70) for use during assembly. Discard packings.

(3) Remove the bolts (100), washers (110), clamp (120), starter adapter (130), wave spring washer (140), packing (150) and starter gear assembly from the gearbox assembly. Discard packings.

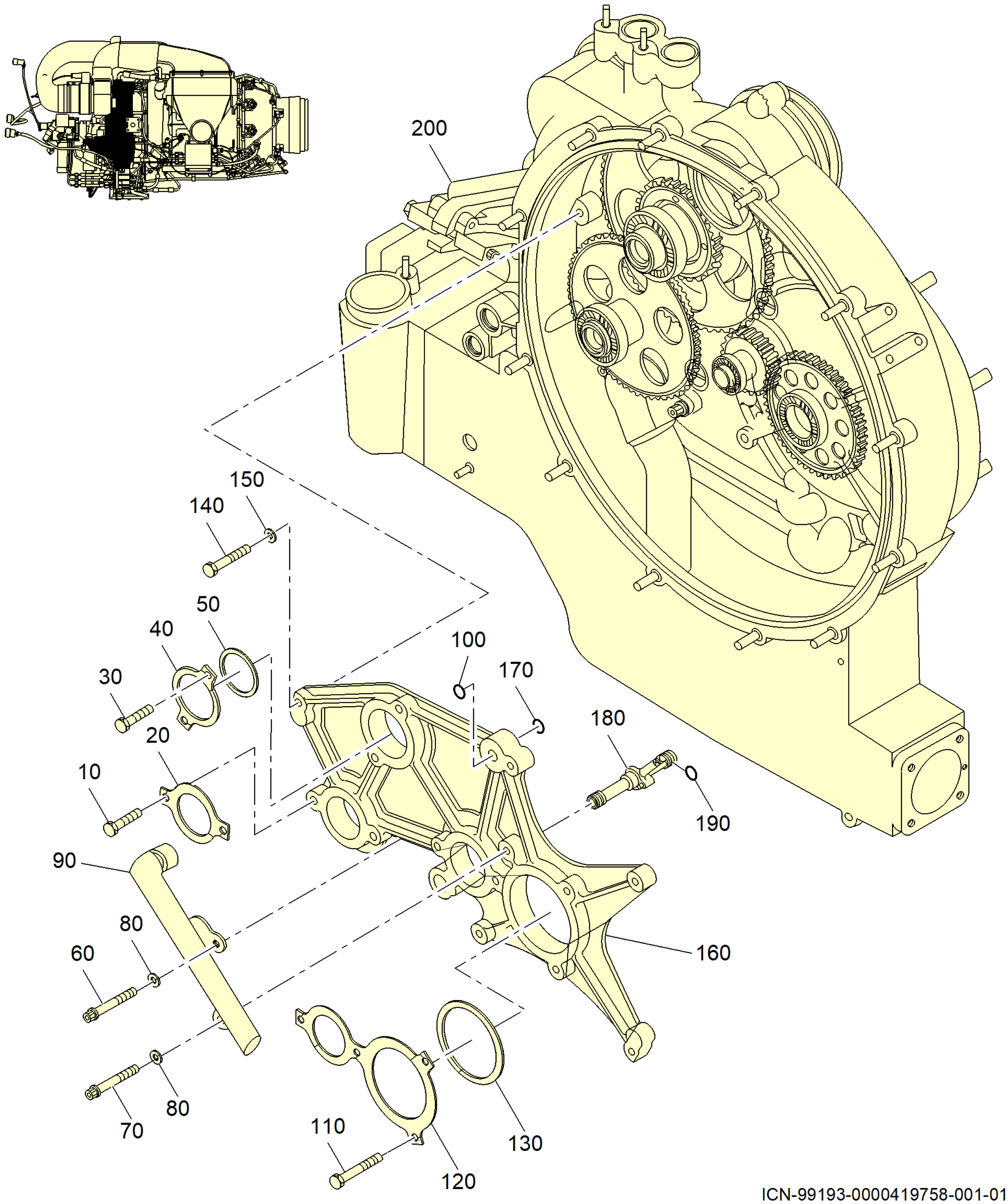

Figure 5004. Disassembly of Gearbox Assembly

Key to Figure 5004

10. BOLT (IPC FIG. 13)	120. BEARING RETAINER
20. BEARING RETAINER	130. SHIM
30. BOLT	140. BOLT
40. BEARING RETAINER	150. WASHER
50. SHIM	160. BEARING CARRIER
60. BOLT	170. PACKING
70. BOLT	180. NOZZLE ASSY
80. WASHER	190. PACKING
90. LUBE MANIFOLD	-200. PACKING (180, IPC FIG. 10)
100. PACKING	-. ITEM NOT ILLUSTRATED
110. BOLT	

D. Disassemble the gearbox assembly. Refer to Figure 5004.

(1) Turn the gearbox assembly until the drive pads point down.

(2) Remove bolts (10) and bearing retainer (20) from the gearbox assembly.

(3) Remove bolts (30) and bearing retainer (40) and installed quantity of shims (50) from the gearbox assembly. Record the thickness of shims (50) for use during assembly.

(4) Remove bolts (60, 70), washers (80), lube manifold (90) and packing (100) from the gearbox assembly. Discard packing.

(5) Remove bolts (110), bearing retainer (120) and installed quantity of shims (130) from the gearbox assembly. Record the thickness of shims (130) for use during assembly.

(6) Remove bolts (140), washers (150), bearing carrier (160), packing (170) and lubricating nozzle assembly (180) with packing (190) from the gearbox assembly. Discard packing.

(7) Remove nozzle assembly (180) with packings (190, 200) from the bearing carrier (160).

(8) Remove packings (190, 200) from the nozzle assembly (180). Discard packing.

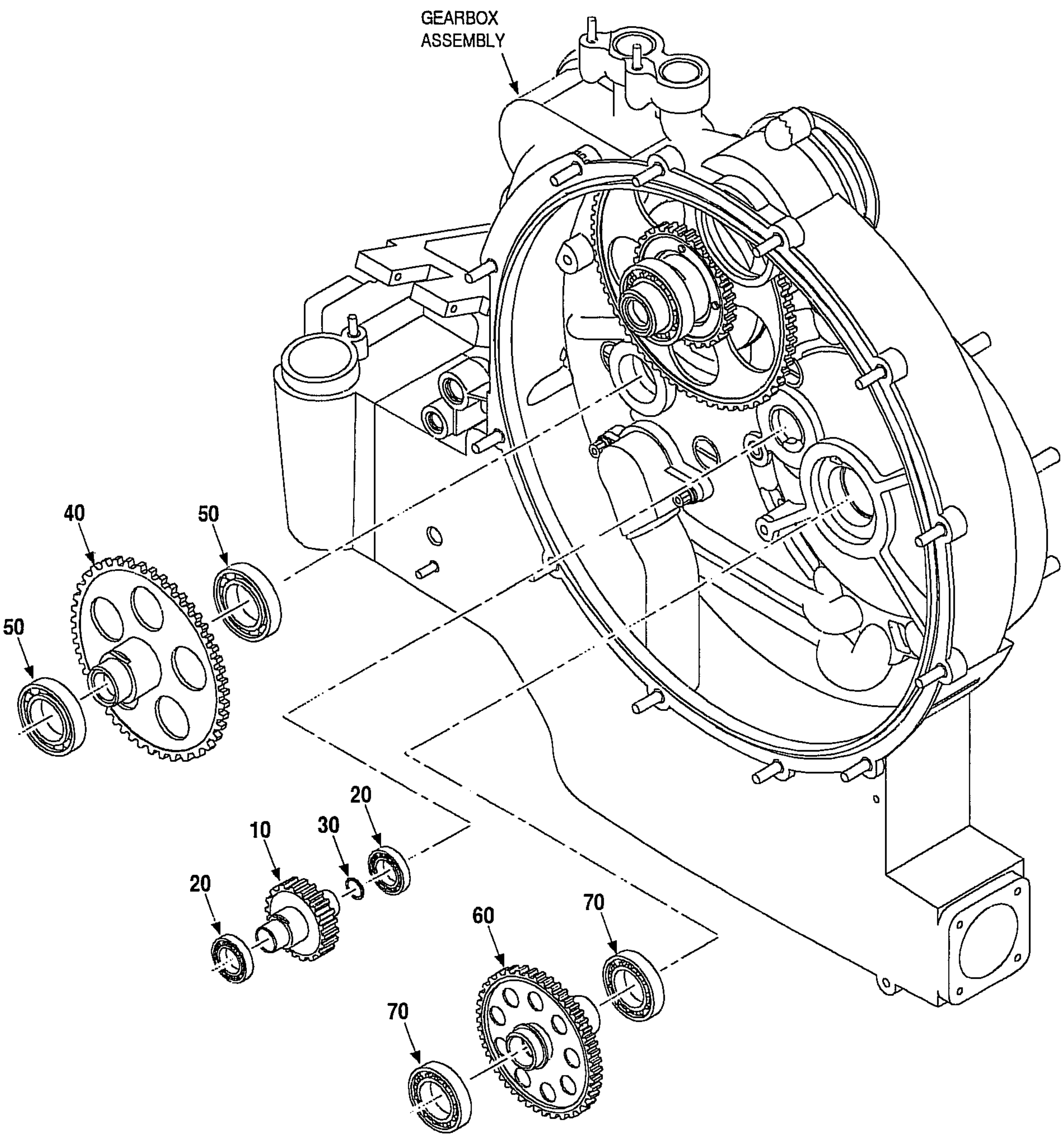

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Figure 5005. Disassembly of Gearbox Assembly

Key to Figure 5005

10. HIGH SPEED PINION GEAR (IPC FIG. 14)
20. BEARING
30. RETAINING RING
40. LUBE PUMP GEARSHAFT ASSY
50. BEARING
60. GENERATOR GEARSHAFT
70. BEARING

E. Disassemble the gearbox assembly. Refer to Figure 5005.

(1) Remove high speed pinion gear (10) with bearings (20) and retaining ring (30) from the gearbox assembly.

(2) Use a PN 834928-1 split plate adapter and a PN 834822 step plate adapter to remove bearings (20) from high speed pinion gear (10).

(3) Remove retaining ring (30).

(4) Remove lube pump gearshaft assembly (40) with bearings (50) from the gearbox assembly.

(5) Use a PN 834964-1 split plate adapter and a PN 834822 step plate adapter to remove bearings (50) from lube pump gear shaft assembly (40).

(6) Remove generator gearshaft (60) with bearings (70) from the gearbox assembly.

(7) Use a PN 834930-1 split plate adapter and a PN 834822 step plate adapter to remove bearings (70) from generator gearshaft (60).

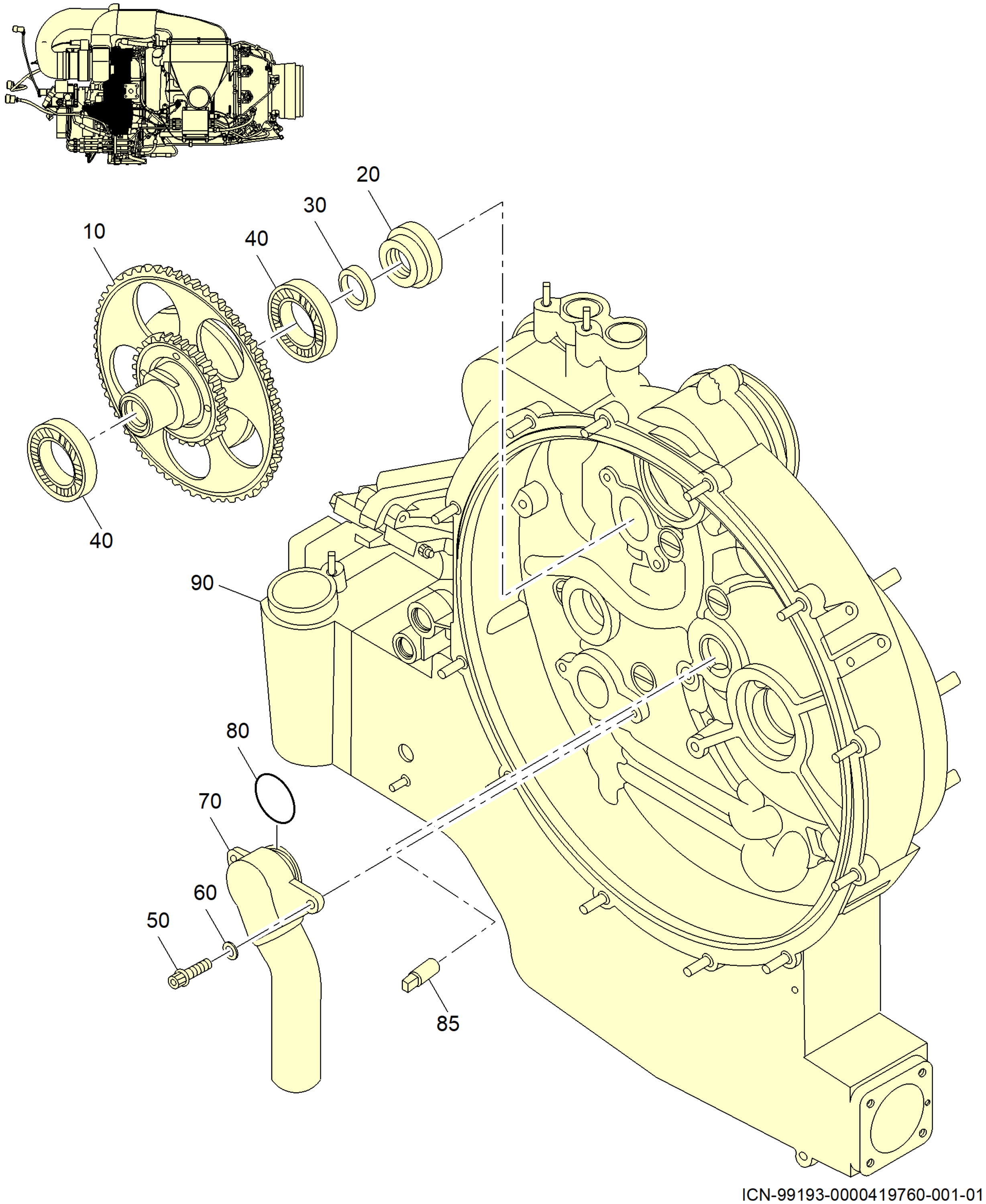

Figure 5006. Disassembly of Gearbox Assembly

Key to Figure 5006

10. COMPOUND IDLER ASSY (IPC FIG. 15)	60. WASHER
20. SEAL DISK	70. OIL PICKUP TUBE
30. SEAL RING	80. PACKING
40. BEARING	85. OIL JET
50. BOLT	90. HOUSING ASSY

F. Disassemble the gearbox assembly. Refer to Figure 5006.

(1) Remove assembled compound idler assembly (10) from the gearbox assembly.

(2) Disassemble the compound idler assembly (10) as follows:

(a) Remove seal disk (20) and seal ring (30) from compound idler assembly (10). Discard seal ring.

(b) Use a PN 834929-1 split plate adapter and a PN 834822 step plate adapter to remove bearings (40) from compound idler assembly (10).

(3) Remove bolts (50), washers (60) and oil pickup tube (70) with packing (80) from the gearbox assembly.

(4) Remove packing (80) from oil pickup tube (70). Discard packing.

(5) Remove oil jet (85) from the gearbox housing (90).

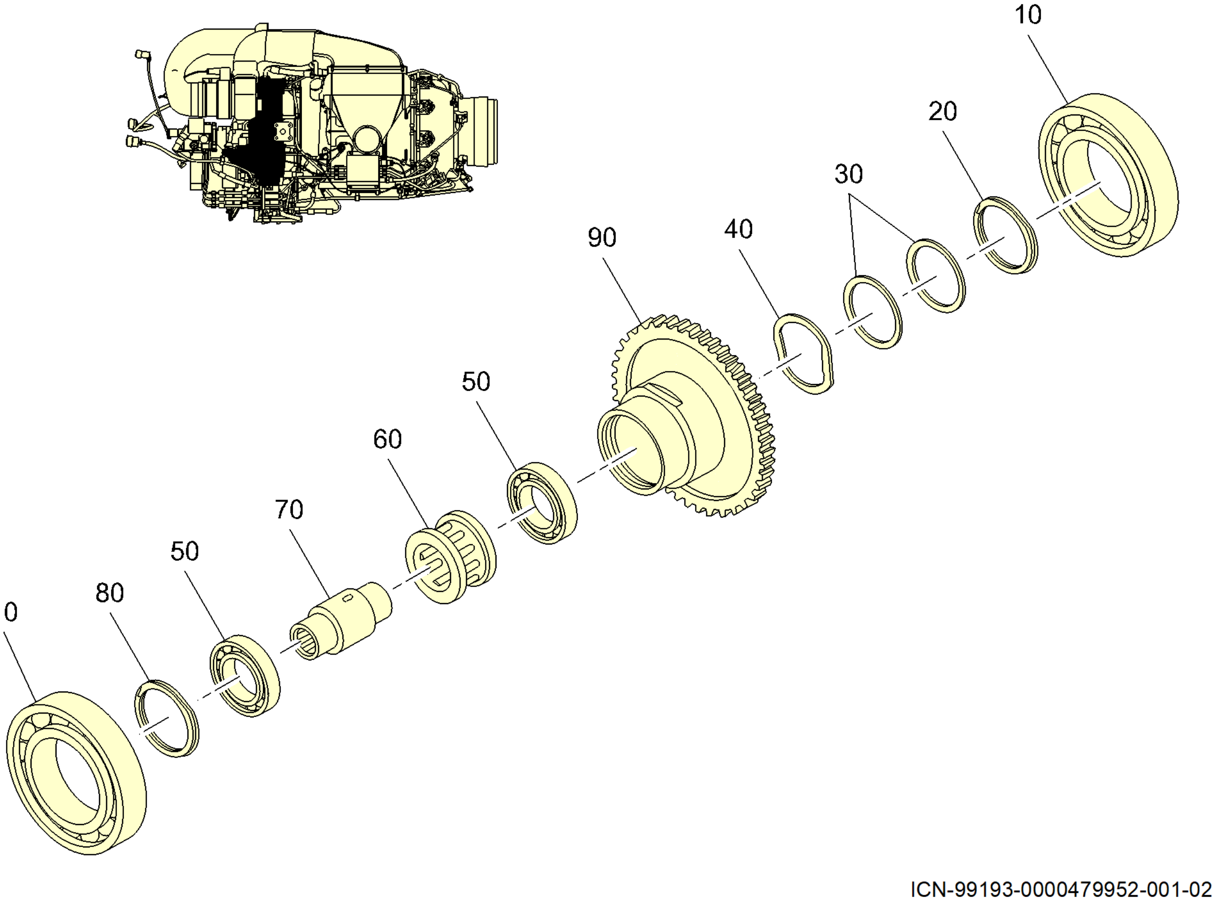

Figure 5007. Disassembly of Gearbox Assembly

Key to Figure 5007

10. BEARING (IPC FIG. 25)
20. RETAINING RING
30. SHIM
40. WAVE SPRING WASHER
50. BEARING
60. CLUTCH
70. SPLINE SHAFT ASSY
80. RETAINING RING
90. GEARSHAFT

G. Disassemble the starter gear assembly. Refer to Figure 5007.

(1) Use a PN 834820-1 split plate adapter and a PN 834822 step plate adapter to remove bearings (10) from the starter gearshaft assembly (90).

(2) Remove retaining ring (20) from the non-splined end of the starter gear assembly and remove the installed quantity of shims (30), wave spring washer (40), spline shaft assembly (70) with attached bearings (50) and clutch (60).

(3) Use a PN 834826-1 bearing removal adapter assembly to remove bearings (50) from spline shaft assembly (70).

(4) Remove clutch (60) from spline shaft assembly (70).

(5) Remove retaining ring (80) from gearshaft (90).

GEARBOX ASSEMBLY
CLEANING-1

TASK 49-21-00-100-801

1. General

A. This section contains procedures for cleaning the components of the gearbox assembly.

2. Cleaning Methods

A. Table 6001 shows the standard cleaning methods necessary for cleaning of the components. Refer to Standard Practices Manual (SPM) 20-00-02/70-00-01 for the cleaning procedures.

Table 6001. Cleaning Methods

IPC Figure No.	Item No.	Nomenclature	Cleaning Methods						
			203A	203V	203E	203F	203Q	203P	203R
All standard metallic hardware			X	X					
11	120	Sight Glass					X		
	150	Filter Element							X
	250	Screen					X		
12	30	Air/Oil Separator Adapter	X	X	X				
	60	Stationary Air/Oil Seal	X	X		X			
	120	Clamp	X	X		X			
	130	Starter Adapter	X	X		X			
	160	Starter Gear Assembly	X	X		X			
13	20, 40, 120	Retainer	X	X			X		
	50, 130	Shim	X	X		X			
	90	Lube Manifold	X	X	X	X			
	160	Bearing Carrier	X	X	X	X			
	180	Lubricating Nozzle Assembly	X	X	X	X			
14	10	High Speed Pinion Gear		X	X		X		
	20	Bearing						X	
	30	Retaining Ring	X	X		X			

Table 6001. Cleaning Methods (Cont)

IPC Figure No.	Item No.	Nomenclature	203A	203V	203E	203F	203Q	203P	203R
	40	Lube Pump Gearshaft Assembly	X	X		X			
	50	Bearing						X	
	60	Generator Gearshaft	X	X		X			
	70	Bearing						X	
15	10	Compound Idler Assembly	X	X		X			
	20	Seal Disk	X	X		X			
	40	Bearing						X	
	70	Oil Pickup Tube	X	X	X				

3. Special Procedures

A. Table 6002 shows the special cleaning methods necessary for cleaning of the components. Refer to CLEANING 2 and 3 this section for the cleaning procedures.

Table 6002. Cleaning Methods

IPL Figure No.	Item No.	Nomenclature	Cleaning Methods 2	Cleaning Methods 3
11	50	Magnetic Drain Plug	X	
15	90	Matched Set Gearbox		X

CLEAN MAGNETIC DRAIN PLUG
CLEANING-2

TASK 49-21-00-110-811

1. **Clean magnetic drain plug (50, IPC Figure 11)**

2. **Equipment and Materials**

   A. Table 6001 shows the necessary equipment and materials for cleaning.

Table 6001. Equipment and Materials

Equipment/Materials	Description/Manufacturer
NOTE: Equivalent equipment/materials can be used.	
Degreasing solvent (MIL-PRF-680)	Commercially available

3. **Procedures**

SUBTASK 49-21-00-110-011

   A. Clean the magnetic drain plug.

   WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

   (1) Put the components of the magnetic drain plug fully into the MIL-PRF-680 degreasing solvent to clean.

   WARNING: USE THE CORRECT PERSONAL PROTECTION. COMPRESSED AIR WILL CAUSE LOOSE PARTICLES THAT CAN GET IN YOUR EYES. THE AIRFLOW CAN CAUSE CUTS. DO NOT POINT IT AT YOUR SKIN.

   (2) Dry with clean compressed air.

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GEARBOX HOUSING
CLEANING-3

TASK 49-21-00-110-812

1. **Clean gearbox housing (IPC Figure 15, item 90)**

2. **Equipment and Materials**

   A. Table 6001 shows the necessary equipment and materials for cleaning.

Table 6001. Equipment and Materials

Equipment/Materials	Description/Manufacturer
NOTE: Equivalent equipment/materials can be used.	
Alkaline cleaner (Ridoline 909) (MIL-S-5002)	Henkel Surface Technologies, 32100 Stephenson Hwy., Madison Heights, MI 48071
Degreasing solvent (MIL-PRF-680)	Commercially available
Distilled water	Commercially available

3. **Procedures**

SUBTASK 49-21-00-160-001

A. Prepare alkaline cleaner solution.

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

(1) Add 4 to 6 ounces (113 to 170 g) of alkaline cleaner with sufficient water to make 1 gallon (3.8 L) of solution and mix fully.

WARNING: USE THE CORRECT PERSONAL PROTECTION. THE HEATED PARTS WILL CAUSE BURNS.

(2) Keep the solution at 130 to 180°F (54 to 82°C) in an air-agitated tank.

SUBTASK 49-21-00-110-012

B. Clean the gearbox housing.

(1) Remove the grease from the gearbox housing. Refer to Standard Practices Manual (SPM) 20-00-02/70-00-01, CLEANING Method No. 203V.

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

(2) If necessary, put the gearbox housing in an alkaline cleaner solution and clean with a soft, fiber bristled brush.

(3) Flush the gearbox housing with water at 140 to 200°F (60 to 93°C).

(4) Immediately after flushing with water, flush the gearbox housing with distilled water.

(5) Dry the gearbox housing with one of the methods as follows:

WARNING: USE THE CORRECT PERSONAL PROTECTION. THE HEATED PARTS WILL CAUSE BURNS.

(a) Put the gearbox housing in an oven at 150 to 200°F (66 to 93°C) until dry.

WARNING: USE THE CORRECT PERSONAL PROTECTION. COMPRESSED AIR WILL CAUSE LOOSE PARTICLES THAT CAN GET IN YOUR EYES. THE AIRFLOW CAN CAUSE CUTS. DO NOT POINT IT AT YOUR SKIN.

(b) Dry with clean compressed air.

REPAIR

1. Refer to ATA No. 49-26-85 for repair procedures.

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GEARBOX GEARSHAFTS
ASSEMBLY-01

TASK 49-21-00-440-801

1. **General**

   A. This section contains procedures for assembly of the gearshafts.

2. **Special Tools, Fixtures and Equipment**

   A. Table 10001 shows the necessary special tools, fixtures and equipment for installation.

Table 10001. Special Tools, Fixtures and Equipment

Nomenclature	Use	Part No.
NOTE: Equivalent tools, fixtures and equipment can be used.		
Standard arbor press		Commercially available
Shaft driver	Used to install generator gearshaft.	834702-1
Shaft driver	Used to install high speed pinion gear.	834703-1
Bearing driver	Used to install bearings on the lube pump gear and compound idler assembly.	834819-1
Shaft driver	Used to install air-oil seal adapter on compound idler assembly.	834830-1

3. **Equipment and Materials**

   A. Table 10002 shows the necessary equipment and materials for installation.

Table 10002. Equipment and Materials

Equipment/Materials	Description/Manufacturer
NOTE: Equivalent equipment/materials can be used.	
Corrosion-preventive compound (Braycote 248) (MIL-C-11796, Class 3)	CAGE: 4RRP4

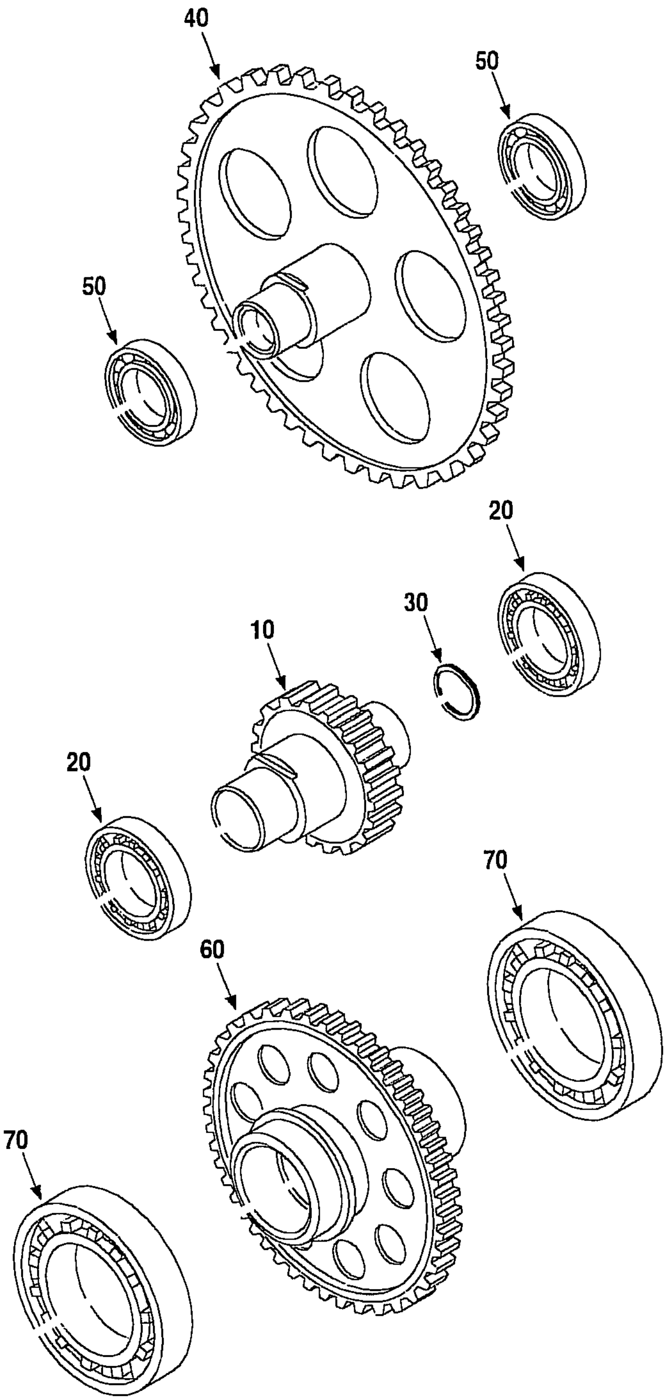

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Figure 10001. Assemble the High Speed Pinion Gear, Lube Pump Gear and Generator Gearshaft

Key to Figure 10001

10. HIGH SPEED PINION GEAR (IPC FIG. 14)
20. BEARING
30. RETAINING RING
40. LUBE PUMP GEARSHAFT ASSY
50. BEARING
60. GENERATOR GEARSHAFT
70. BEARING

4. Expendable Parts

A. Honeywell recommends that the parts shown in Table 10003 be replaced at each assembly. However, actual replacement of parts can be done on in-service experience.

Table 10003. Parts to be Replaced at Each Assembly

Figure No.	Item No.	Nomenclature	Quantity
Figure 10002	20	Seal Disk	1
	30	Seal Ring	1

5. Procedure

SUBTASK 49-21-00-440-001

A. Assemble the bearings and retaining ring on the high speed pinion gear. Refer to Figure 10001.

NOTE: When installing bearings onto gear assemblies, make sure that the THRUST marking on the outer race of the bearing is facing out. If the bearing has no THRUST marking, make sure that the part number is facing out.

(1) Put bearing (20) on one side of the high speed pinion gear (10).

(2) Push bearing (20) on high speed pinion gear (10) with PN 834703-1 shaft driver and a standard arbor press.

(3) Perform Steps (1) and (2) again for the other bearing (20).

(4) Install the retaining ring (30) in the high speed pinion gear (10).

(5) Hold assembled components (10, 20, 30) for installation into the gearbox assembly.

SUBTASK 49-21-00-440-002

B. Assemble the bearings on the lube pump gear. Refer to Figure 10001.

NOTE: When installing bearings on gear assemblies, make sure that the THRUST marking on the outer race of the bearing is pointing out. If the bearing has no THRUST marking, make sure that the part number is pointing out.

(1) Put bearing (50) on one side of the lube pump gearshaft (40).

(2) Push bearing (50) on lube pump gearshaft (40) with PN 834819-1 bearing driver and a standard arbor press.

(3) Perform Steps (1) and (2) again for the other bearing (50).

(4) Hold assembled components (40, 50) for installation into the gearbox assembly.

SUBTASK 49-21-00-440-003

C. Assemble the bearings on the generator gearshaft. Refer to Figure 10001.

NOTE: When installing bearings on gear assemblies, make sure that the THRUST marking on the outer race of the bearing is pointing out. If the bearing has no THRUST marking, make sure that the part number is pointing out.

(1) Put bearing (70) on one side of the generator gearshaft (60).

(2) Push bearing (70) on generator gearshaft (60) with PN 834702-1 shaft driver and a standard arbor press.

(3) Perform Steps (1) and (2) again for the other bearing (70).

(4) Hold assembled components (60, 70) for installation into the gearbox assembly.

SUBTASK 49-21-00-440-004

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

D. Assemble the bearings and seal disk on the compound idler assembly. Refer to Figure 10002.

NOTE: When installing bearings on gear assemblies, make sure that the THRUST marking on the outer race of the bearing is pointing out. If the bearing has no THRUST marking, make sure that the part number is pointing out.

(1) Put bearing (40) on one side of the compound idler assembly (10).

(2) Push bearing (40) on cluster gearshaft (10) with PN 834819-1 bearing driver and a standard arbor press.

(3) Perform Steps (1) and (2) again for the other bearing (40).

(4) Coat seal ring (30) with corrosion-preventive compound.

(5) Install seal ring (30) in the seal disk (20).

(6) Layer the seal disk (20) with corrosion-preventive compound and push the seal disk (20) with installed seal ring on the compound idler assembly (10) with PN 834830-1 shaft driver.

(7) Hold assembled components (10, 20, 30, 40) for installation into the gearbox assembly.

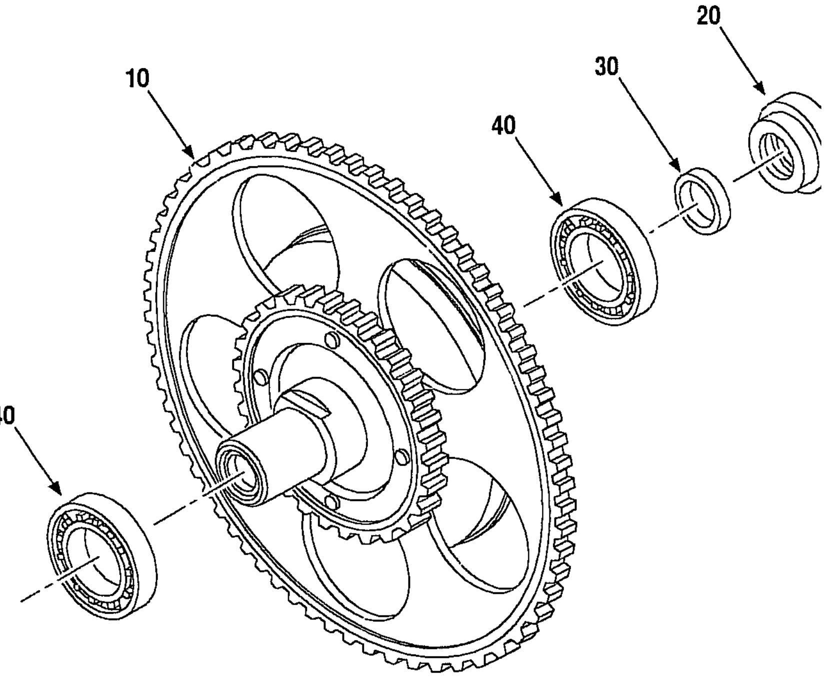


Figure 10002. Assemble the Compound Idler

Key to Figure 10002

10. COMPOUND IDLER ASSEMBLY (IPC FIG. 15)	30. SEAL RING
20. SEAL DISK	40. BEARING

GEARBOX ASSEMBLY
ASSEMBLY-02

TASK 49-21-00-430-801

1. General

A. This section contains procedures for assembly of the gearbox assembly.

2. Special Tools, Fixtures and Equipment

Table 10001. Special Tools, Fixtures and Equipment

Nomenclature	Use	Part No.
NOTE: Equivalent tools, fixtures and equipment can be used.		
Bearing driver	Used to install bearing on the gearshaft of the starter gear assembly.	834438-11
Shaft driver	Used to install stationary air-oil seal in the air-oil separator adapter.	834824-1
Sprag clutch driver	Used with an arbor press to install the clutch onto the spline shaft of the starter gear assembly. Contains PN 834827-2, PN 834827-5 and PN 834827-6.	834827-1

3. Equipment and Materials

A. Table 10002 shows the necessary equipment and materials for installation.

Table 10002. Equipment and Materials

Equipment/Materials	Description/Manufacturer
NOTE: Equivalent equipment/materials can be used.	
Corrosion-preventive compound (Braycote 248) (MIL-C-11796, Class 3)	CAGE: 4RRP4
Lockwire (MS20995C20)	Commercially available
Oil (MIL-PRF-7808 or MIL-PRF-23699)	Commercially available

4. Expendable Parts

A. Honeywell recommends that the parts shown in Table 10003 be replaced at each assembly. However, actual replacement of parts can be done on in-service experience.

Table 10003. Parts to be Replaced at Each Assembly

Figure No.	Item No.	Nomenclature	Quantity
Figure 10001	80	Packing	1

Table 10003. Parts to be Replaced at Each Assembly (Cont)

Figure No.	Item No.	Nomenclature	Quantity
Figure 10004	70	Packing	1
	100	Packing	1
	170	Packing	1
	190	Packing	1
Figure 10008	150	Packing	1
Figure 10012	80	Packing	1
	90	Packing	1
Figure 10013	20	Packing	1
	40	Packing	1
	75	Packing	1
	90	Packing	1
	130	Packing	1
	230	Gasket	1

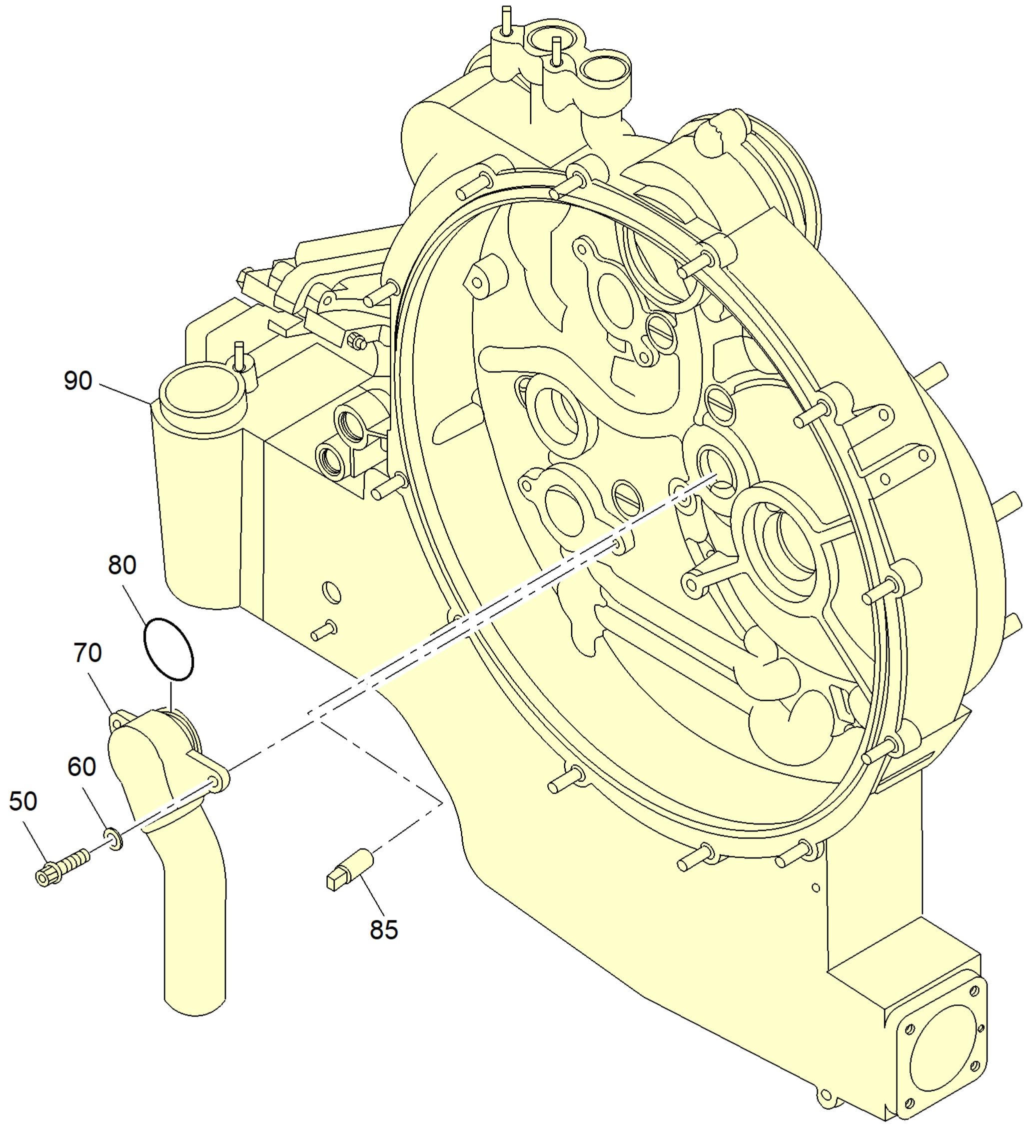


Figure 10001. Install Oil Pickup Tube and Oil Jet in Gearbox Assembly

Key to Figure 10001

50. BOLT (IPC FIG. 15)	80. PACKING
60. WASHER	85. OIL JET
70. OIL PICKUP TUBE	90. HOUSING ASSY

5. Procedure

SUBTASK 49-21-00-430-001

A. Assemble the gearbox assembly.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

(1) Install oil pickup tube on gearbox. (Refer to Figure 10001.)

(a) Lubricate new packing (80) with oil.

(b) Install packing (80) on oil pickup tube (70).

(c) Install oil pickup tube (70), with installed packing (80), in gearbox assembly (90) with bolts (50) and washers (60).

(d) Tighten bolts (50) to a torque value of 50 in-lb (5.65 Nm).

(2) Install oil jet as follows:

(a) Apply Loctite 620 at oil jet thread and install oil jet (85) on gearbox assembly (90). Maintain position as shown in Figure 10002.

(b) Punch mark in three positions to secure position of oil jet.

(3) Install gear assemblies in gearbox assembly as follows. (Refer to Figure 10003.)

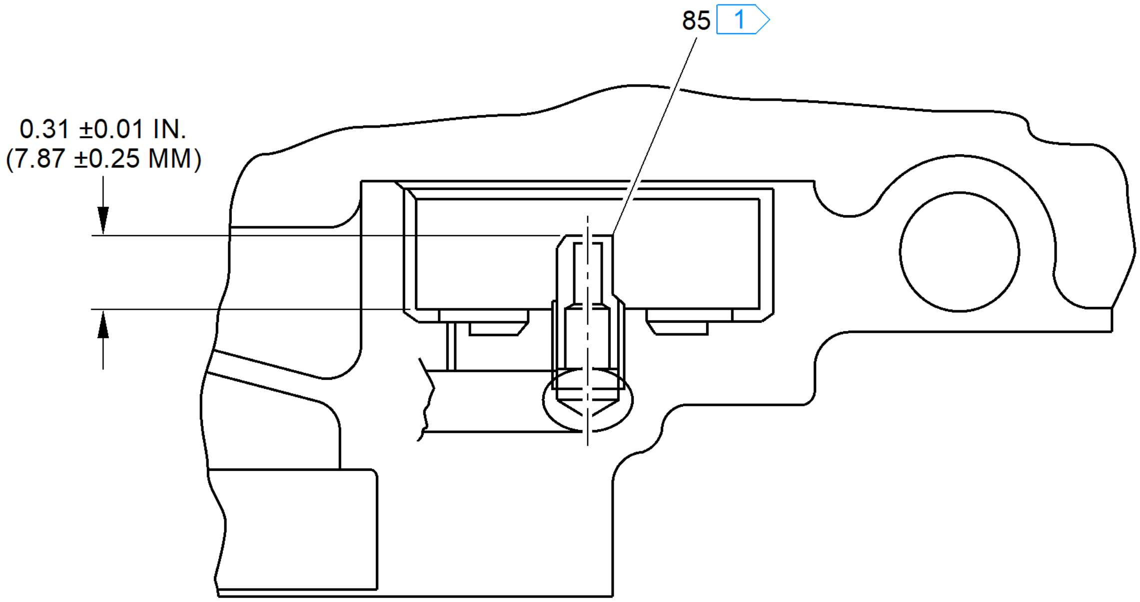
NOTE: Place gearbox assembly flat with front down when installing gear assemblies into the gearbox.

(a) Install compound idler and bearing assembly into the gearbox assembly.

(b) Install generator gearshaft and bearing assembly into the gearbox assembly.

(c) Install lube pump gearshaft and bearing assembly into the gearbox assembly.

(d) Install high speed pinion gear and bearing assembly into the gearbox assembly.



NOTE:
1 Install to depth shown, stake to secure.

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Figure 10002. Install Oil Jet

Key to Figure 10002

85. OIL JET

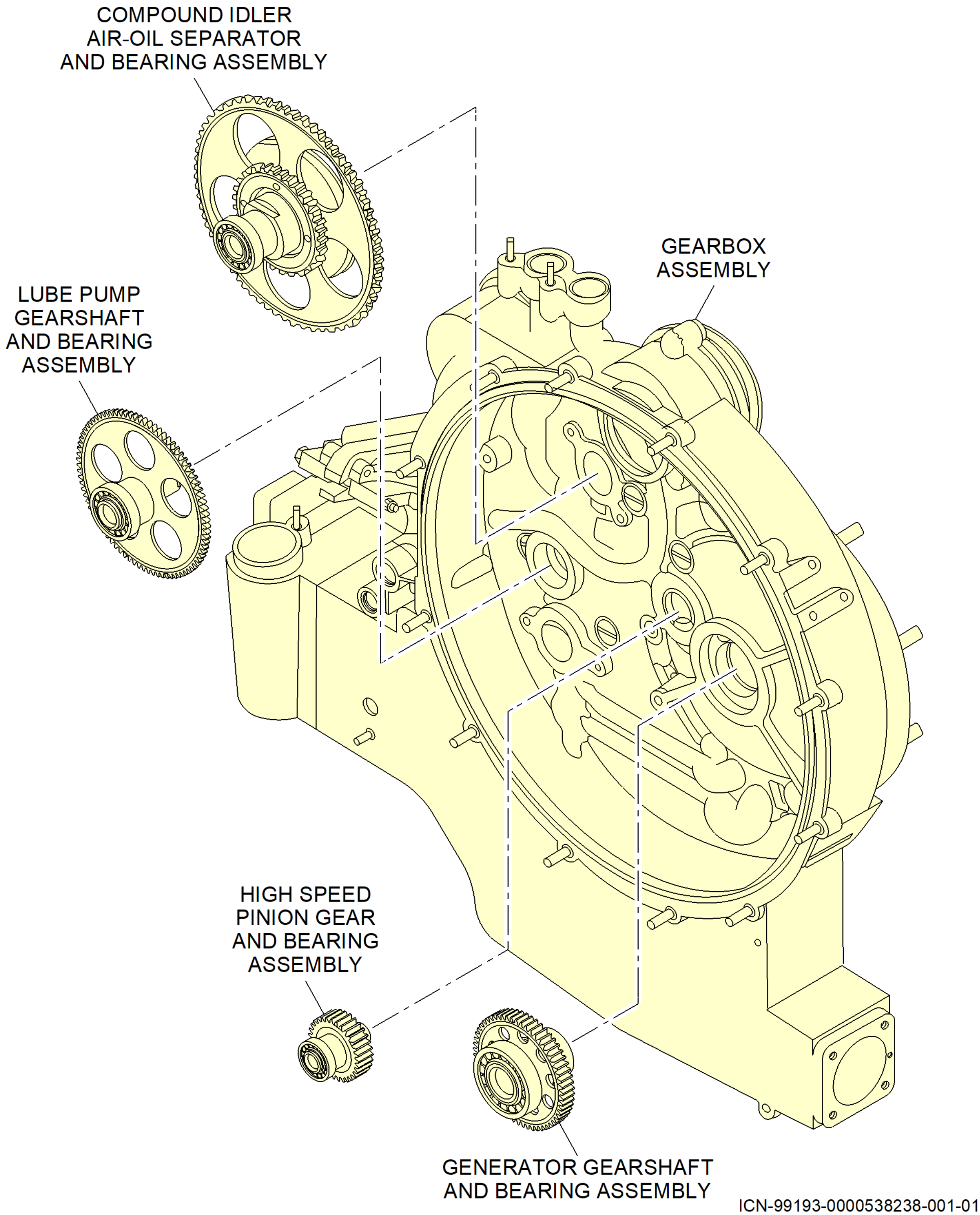

Figure 10003. Install Gear Assemblies in Gearbox Assembly

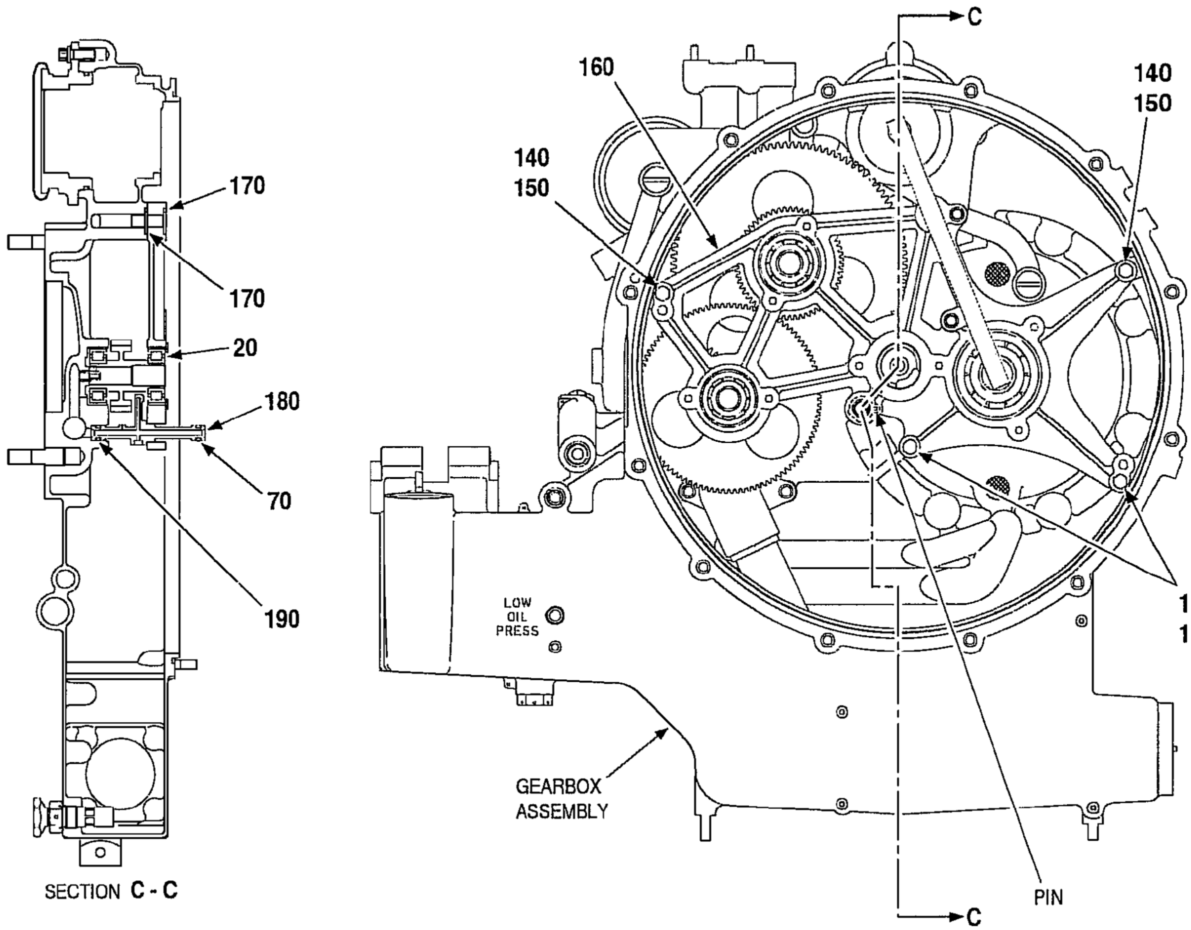

Figure 10004. Install Lubricating Nozzle Assembly, Bearing Carrier and Lube Manifold in Gearbox Assembly

Key to Figure 10004

20.	BEARING (IPC FIG. 14)	140.	BOLT
-50.	BOLT (70, IPC FIG. 13)	150.	WASHER
-60.	BOLT	160.	BEARING CARRIER
70.	PACKING (180, IPC FIG. 10)	170.	PACKING
-80.	WASHER (IPC FIG. 13)	180.	LUBRICATING NOZZLE ASSY
-90.	LUBE MANIFOLD	190.	PACKING
-100.	PACKING	-.	ITEM NOT ILLUSTRATED

(4) Install lubricating nozzle, bearing carrier and lube manifold. Refer to Figure 10004.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

(a) Lubricate packings (70, 190) with oil.

(b) Install packings (70, 190) on the lubricating nozzle assembly (180). Put oil through lubricating nozzle assembly to make sure oil passage is not closed.

(c) Put lubricating nozzle assembly (180) with installed packings (70, 190) in the gearbox assembly oil port, located near the high speed pinion bearing (20), until it is fully seated.

(d) Turn the lubricating nozzle assembly (180), approximately 90 degrees in the clockwise direction, until lubricating nozzle assembly oil jet arm is in line with the center of the high speed pinion bearing (20).

(e) Install packing (170) on the oil supply port in the gearbox assembly.

(f) Put bearing carrier (160) on the gearbox assembly and over the bearing/gear assemblies.

NOTE: Make sure index pin on the lubricating nozzle assembly (180) goes into the index hole in the bearing carrier (160) when the bearing carrier is installed on the gearbox assembly.

(g) Install bolts (140) and washers (150).

(h) Tighten bolts (140) to a torque value of 50 in-lb (5.65 Nm).

(i) Install packing (100) on oil supply port in bearing carrier (160).

(j) Put lube manifold (90) on bearing carrier (160).

(k) Attach lube manifold (90) to bearing carrier (160) with bolts (60, 70) and washers (80).

(l) Tighten bolts (60, 70) to a torque value of 50 in-lb (5.65 Nm).

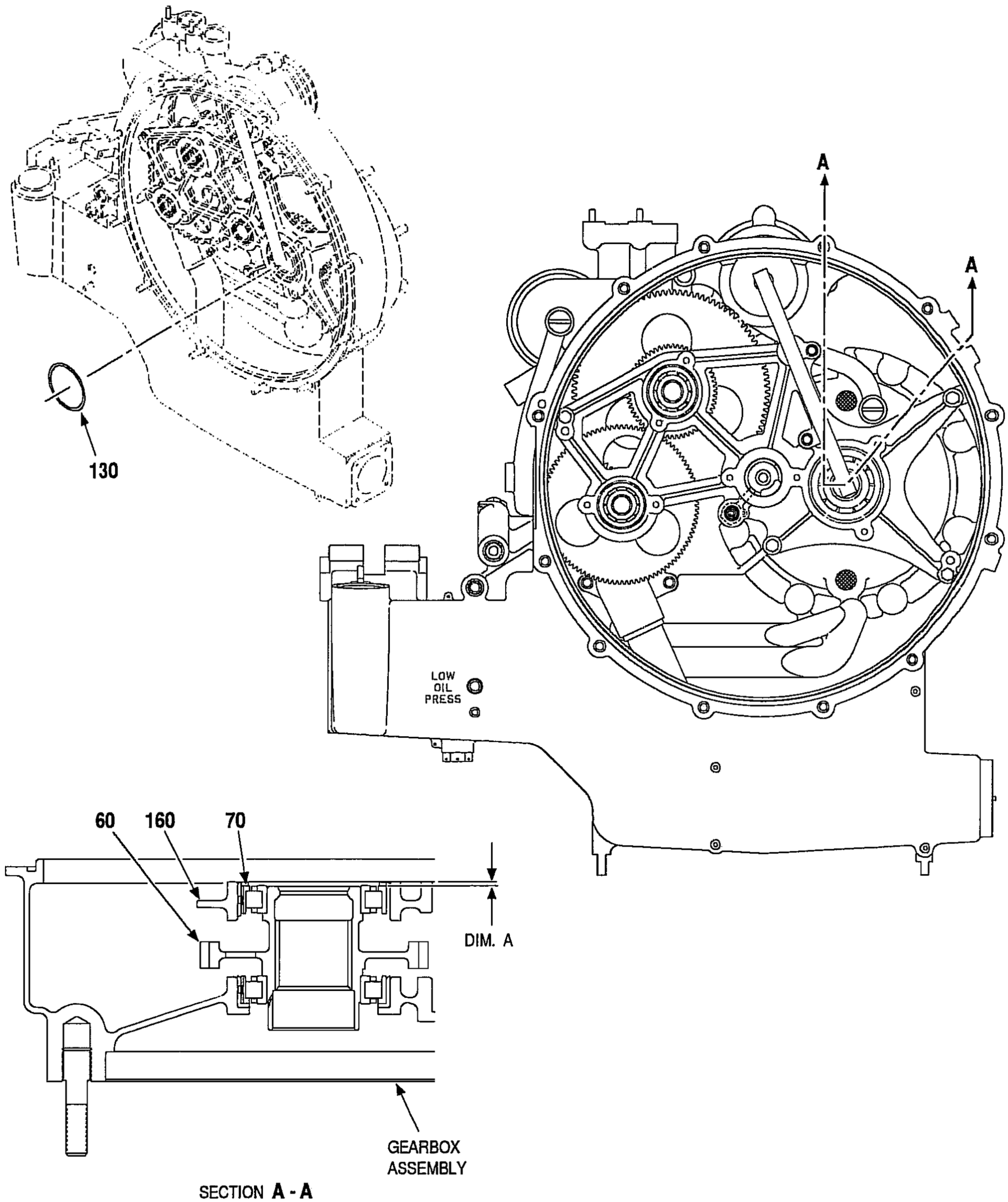

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Figure 10005. Calculate and Install Generator Gearshaft Bearing Shims

Key to Figure 10005

60. GENERATOR GEARSHAFT (IPC FIG. 14)	130. SHIM (IPC FIG. 13)
70. BEARING	160. BEARING CARRIER

(5) Calculate and install generator gearshaft bearing shims. Refer to Figure 10005.

(a) Make sure generator gearshaft (60) and assembled bearings (70) are fully engaged in gearbox assembly.

(b) Measure between top of bearing carrier (160) and top of bearing (70) outer race. Write the measurement as Dimension A.

(c) Use the following equation to calculate the correct amount of shims (130) for the generator gearshaft (60).

1 Dimension A = ______________inch (mm).

2 Correct shim pack (130) = Dimension A - 0.010 inch (0.25 mm) ±0.005 inch (±0.13 mm).

(d) Install calculated shim (130) pack on top of bearing (70) outer race.

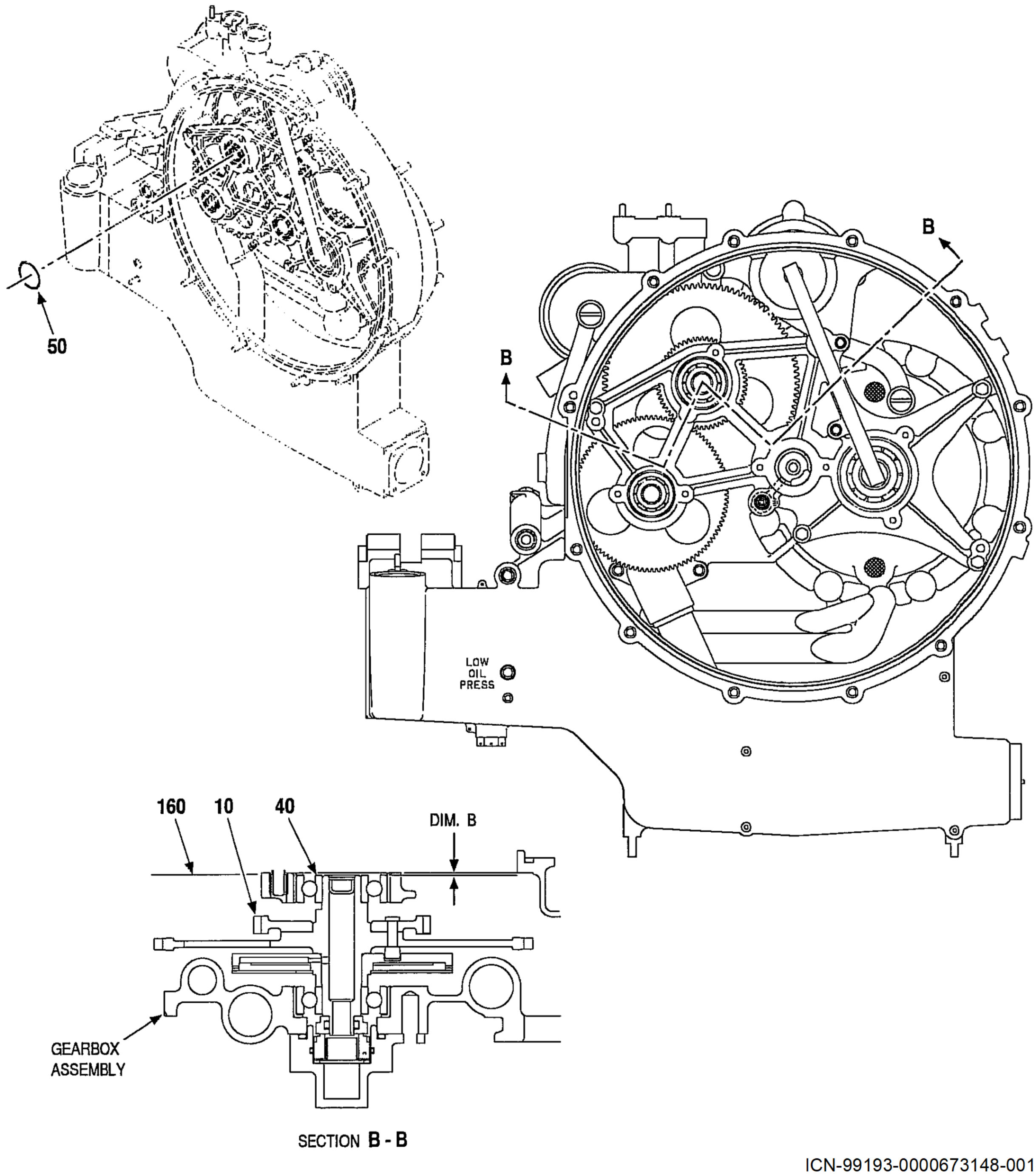

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Figure 10006. Calculate and Install Compound Idler Assembly Bearing Shims

Key to Figure 10006

10. COMPOUND IDLER ASSEMBLY (IPC FIG. 15)
40. BEARING
50. SHIM (IPC FIG. 13)
160. BEARING CARRIER

---

(6) Calculate and install compound idler assembly bearing shims. Refer to Figure 10006.

(a) Make sure compound idler assembly (10) and assembled bearings (40) are fully seated in the gearbox assembly.

(b) Measure between the top of the bearing carrier (160) and the top of the bearing (40) outer race. Write the measurement as Dimension B.

(c) Use the following equation to calculate the correct amount of shims (50) for the compound idler assembly (10).

1 Dimension B = inch (mm).

2 Correct shim pack (50) = Dimension B -0.010 inch (0.25 mm) ±0.005 inch (0.13 mm).

(d) Install calculated shim (50) pack on top of bearing (40) outer race.

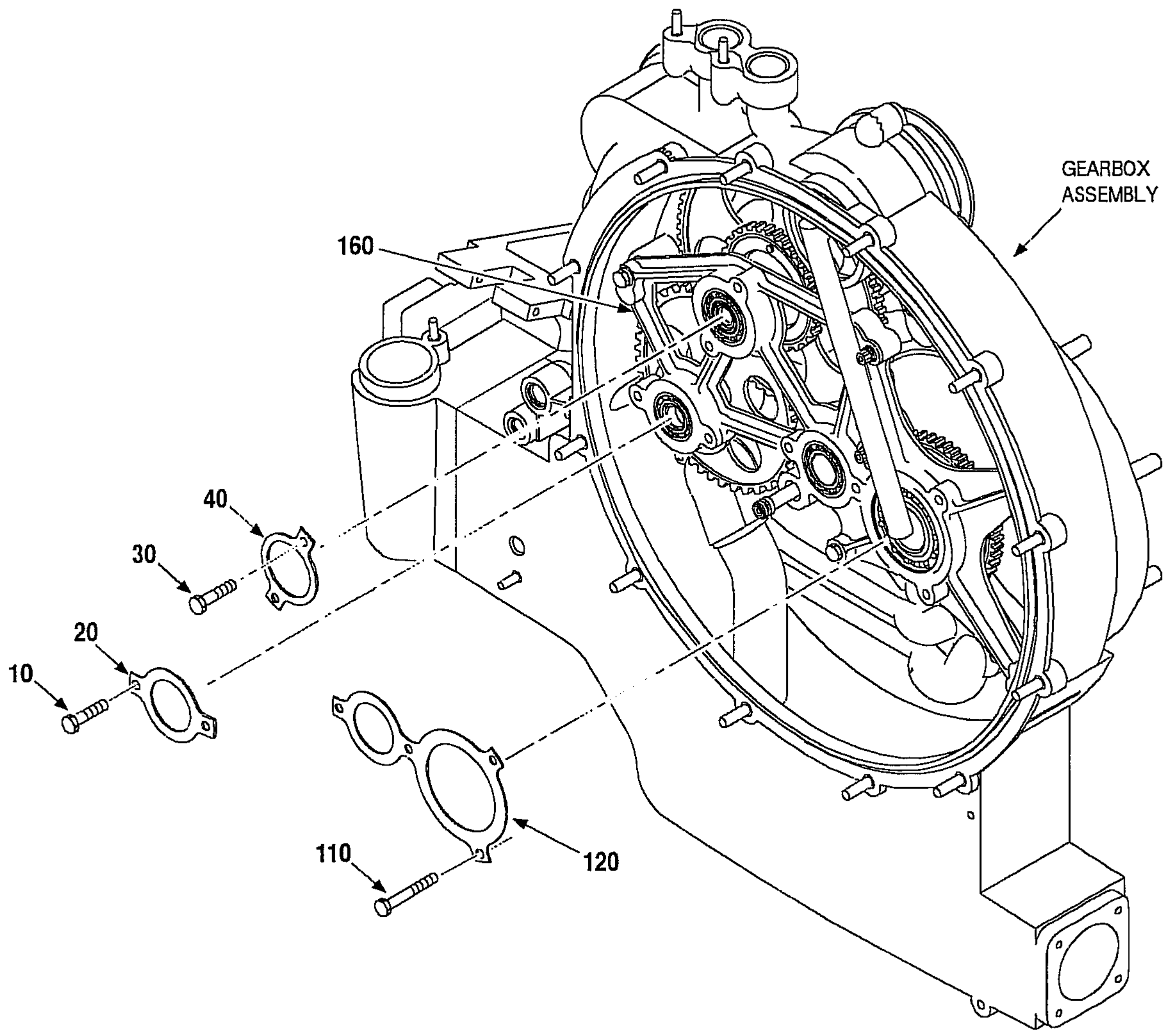

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Figure 10007. Install Bearing Retainers on Bearing Carrier

Key to Figure 10007

10. BOLT (IPC FIG. 13)
20. RETAINER
30. BOLT
40. RETAINER
110. BOLT
120. RETAINER
160. BEARING CARRIER

(7) Install bearing retainers on bearing carrier. Refer to Figure 10007.

NOTE: Make sure all gear assembly shim packs are in their correct positions on top of their related bearings.

(a) Install retainer (120) on bearing carrier (160) and attach with bolts (110).

(b) Tighten bolts (110) to a torque value of 50 in-lb (5.65 Nm).

(c) Install retainer (20) on bearing carrier (160) and attach with bolts (10).

(d) Tighten bolts (10) to a torque value of 50 in-lb (5.65 Nm).

(e) Install retainer (40) on bearing carrier (160) and attach with bolts (30).

(f) Tighten bolts (30) to a torque value of 50 in-lb (5.65 Nm).

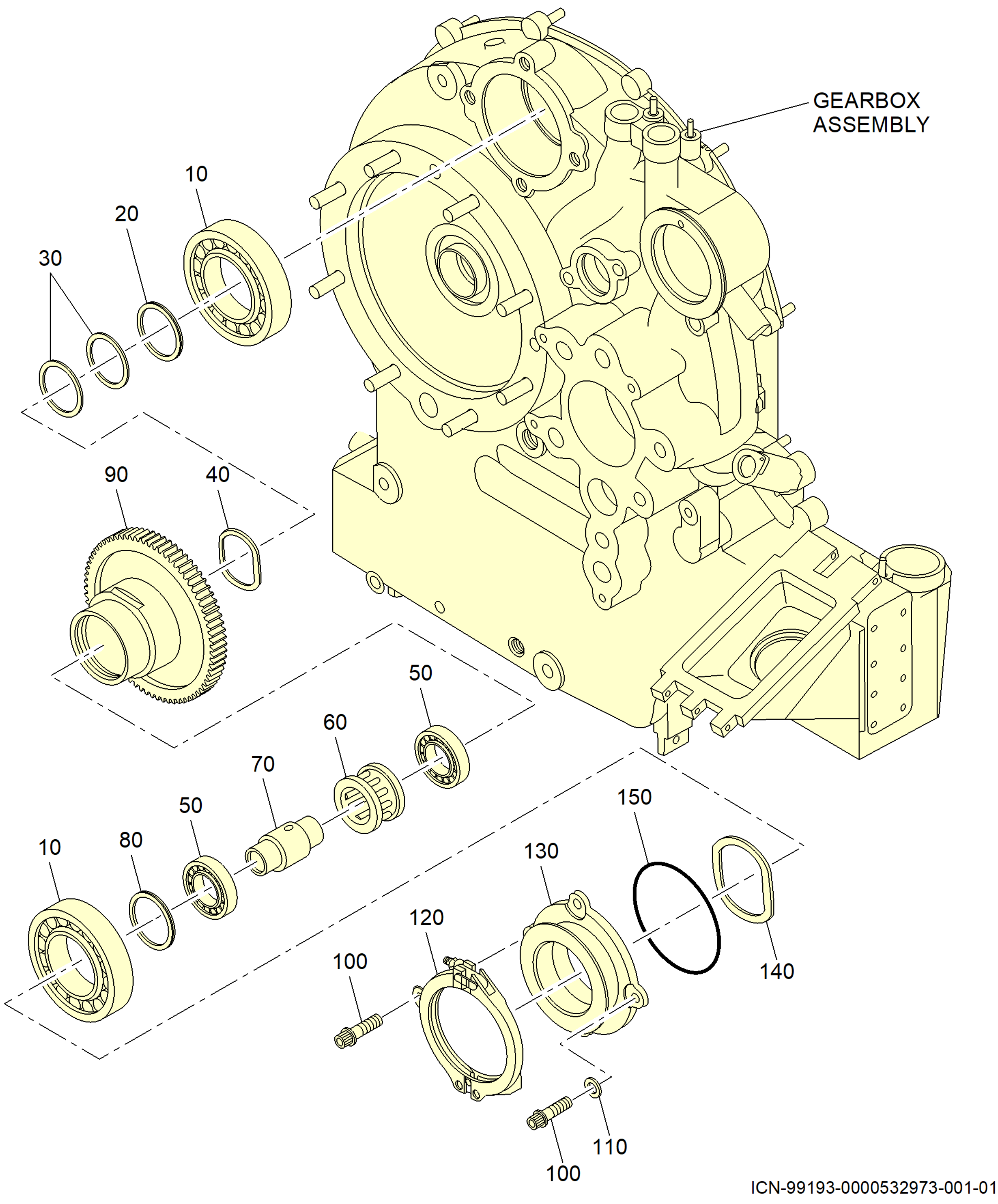

Figure 10008. Assemble Starter Gear Assembly and Install in Gearbox Housing

Key to Figure 10008

10. BEARING (IPC FIG. 25)	90. GEARSHAFT
20. RETAINING RING	100. BOLT (IPC FIG. 12)
30. SHIM	110. WASHER
40. WAVESPRING WASHER	120. CLAMP
50. BEARING	130. STARTER ADAPTER
60. CLUTCH	140. WAVE SPRING WASHER
70. SPLINED SHAFT ASSY	150. PACKING
80. RETAINING RING	

(8) Assemble starter gear assembly and install in gearbox housing. Refer to Figure 10008.

(a) Install bearings (10) on gearshaft (90) as follows. Refer to Section View A, Figure 10009.

NOTE: When bearings are installed on gear assemblies, make sure that the THRUST mark on the outer race of the bearing faces out. If the bearing has no THRUST mark, make sure that the PART number faces out.

1 Use arbor press and PN 834438-11 bearing driver to install bearings (10), with THRUST marking out, on both ends of gearshaft (90).

(b) Install clutch (60) into gearshaft (90) as follows. Refer to Section View B.

1 Push clutch (60) by hand into long end of gearshaft (90), with arrow on clutch pointed in the counterclockwise direction as viewed from the long end of the gearshaft.

2 Make sure clutch is approximately centered between retaining ring channels.

(c) Install splined shaft assembly (70) into clutch (60) as follows. Refer to Section View C.

1 Place gearshaft (90) and assembled parts (10, 60), with long end up, on PN 834827-1 sprag clutch driver (PN 834827-2 sprag clutch driver assembly stand).

2 Push by hand the PN 834827-5 sprag clutch driver bar, taper first, into long end of clutch (60) until stiff resistance is met and part of sprag clutch driver bar is still above the clutch.

3 Put the splined shaft assembly (70), with splined end up, on the PN 834827-5 sprag clutch driver bar.

4 Use the arbor press to push the spline shaft assembly (70) and the PN 834827-5 sprag clutch driver bar into the clutch (60) until the splined shaft assembly is approximately centered in the clutch.

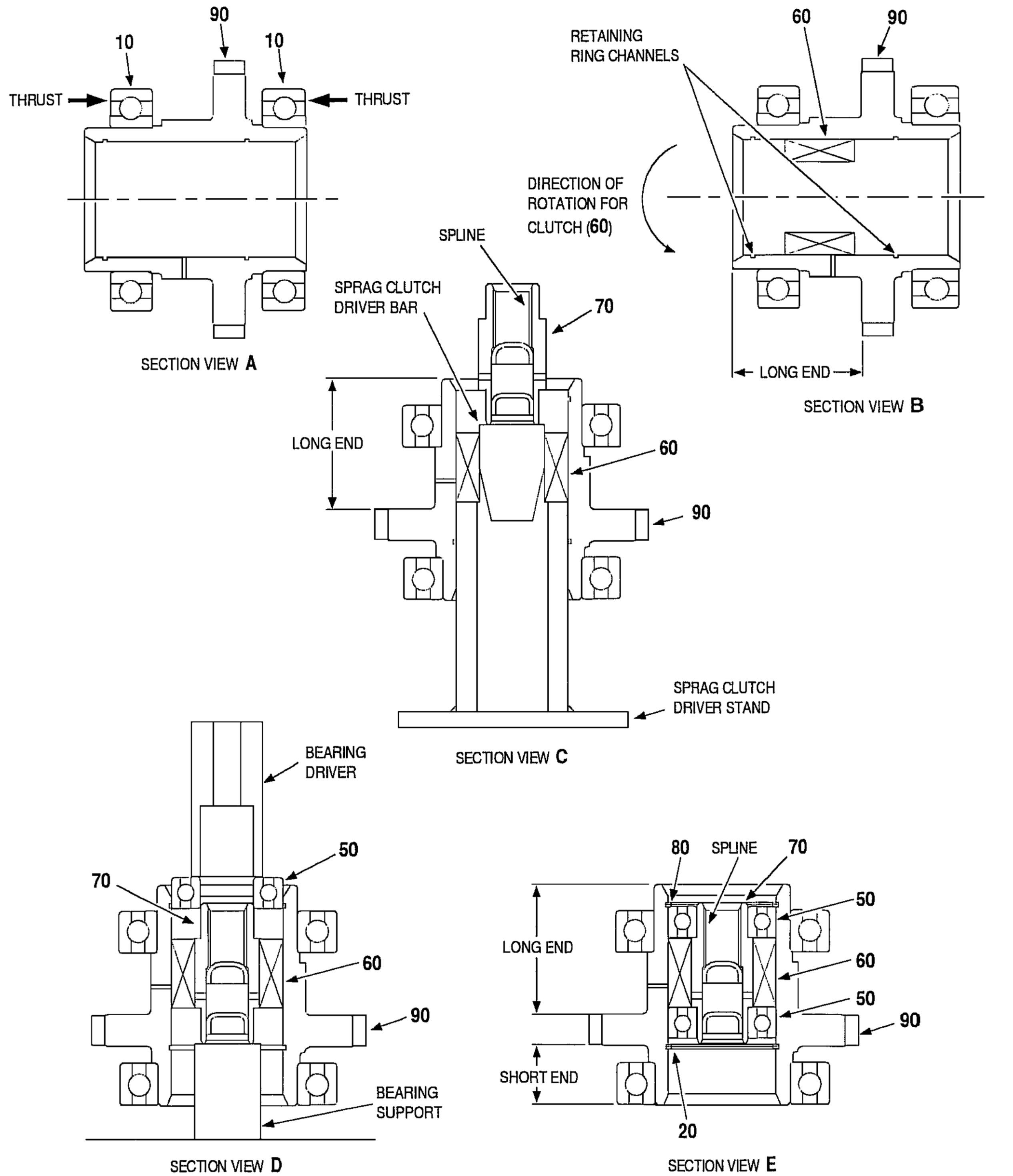

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Figure 10009. Assemble Starter Gear Assembly and Install in Gearbox Housing

Key to Figure 10009

10. BEARING (IPC FIG. 25)	60. CLUTCH
20. RETAINING RING	70. SPLINED SHAFT ASSY
-30. SHIM	80. RETAINING RING
-40. WAVESPRING WASHER	90. GEARSHAFT
50. BEARING	-. ITEM NOT ILLUSTRATED

5 Make sure the PN 834827-5 sprag clutch driver bar falls into the PN 834827-2 sprag clutch driver assembly stand.

6 Remove the gearshaft (90) and assembled parts (10, 60, 70) from PN 834827-2 sprag clutch driver assembly stand.

(d) Install bearings (50) on splined shaft assembly (70). Refer to Section View D, Figure 10009.

NOTE: When bearings are installed on gear assemblies, make sure that the THRUST mark on the outer race of the bearing faces out. if the bearing has no THRUST mark, make sure that the part number faces out.

1 Hold non-splined end of spline shaft assembly (70) so spline shaft assembly will not move in gearshaft (90).

2 Place large inside diameter end of the PN 834819-1 bearing driver against bearing (50) inner race.

3 Use an arbor press to push bearing (50), with THRUST mark or part number face out, on splined end of splined shaft assembly (70).

4 Hold splined end of spline shaft assembly (70) so spline shaft assembly will not move in gearshaft (90).

5 Place large inside diameter end of the PN 834819-1 bearing driver against bearing (50) inner race.

6 Use an arbor press to push bearing (50), with THRUST mark or part number face out, on non-splined end of splined shaft assembly (70).

(e) Install retaining rings inside of gearshaft (90). Refer to Section View E.

1 Move splined shaft assembly (70) with assembled parts (50, 60) between retaining ring channels on inside of gearshaft (90).

2 Install retaining ring (80) into retaining ring channel inside the long end of gearshaft (90).

3 Install retaining ring (20) into retaining ring channel inside the short end of gearshaft (90).

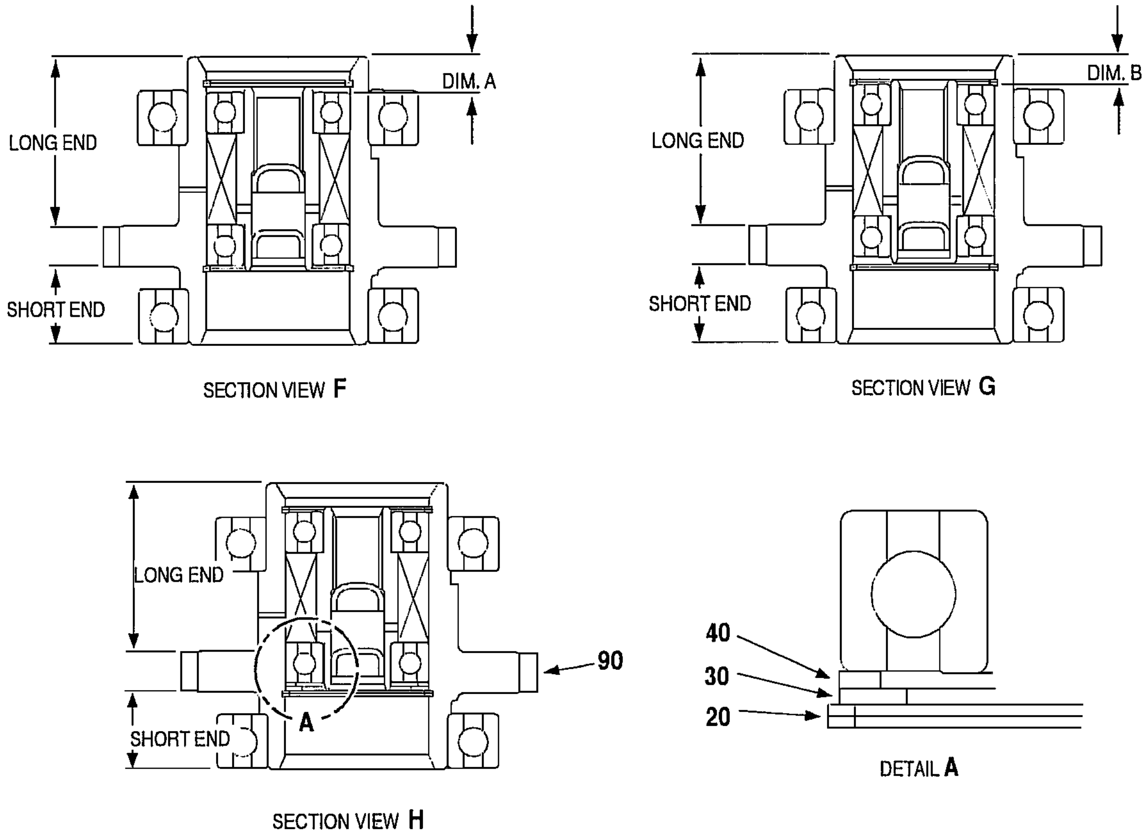

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Figure 10010. Assemble Starter Gear Assembly and Install in Gearbox Housing

Key to Figure 10010

20. RETAINING RING (IPC FIG. 25)
30. SHIM
40. WAVESPRING WASHER
90. GEARSHAFT

(f) Calculate correct shim pack (30) for clutch (60) and assembled parts (50, 70) installed in gearshaft (90), as follows. Refer to Figure 10008, Figure 10009 and Figure 10010, Section Views F and G.

1 Push clutch (60) and assembled parts (50, 70) inside gearshaft (90) until bearing (50) is against retaining ring (20).

2 Use a depth micrometer to measure from the top of the long end of gearshaft (90) to the outer race of bearing (50) mounted on the splined end of the spline shaft assembly (70). Write down the measurement as Dimension A.

3 Push clutch (60) and assembled parts (50, 70) inside gearshaft (90) until bearing (50) is against retaining ring (80). Refer to Section View G.

4 Use a depth micrometer to measure from the top of the long end of gearshaft (90) to the outer race of bearing (50) mounted on the splined end of the spline shaft assembly (70). Write down the measurement as Dimension B.

5 Use the following formula to calculate the correct thickness of shim pack (30).

a Dimension A= _________________inch (___mm).

b Dimension B= _________________inch (___mm).

c Correct shim pack (30) inch (___mm) =

Dim. A-Dim. B -0.033 ±0.002 inch (0.84 ±0.05 mm).

(g) Install wave washer (40) and calculated shim pack (30) in gearshaft (90) as follows. Refer to Figure 10010, Section View H.

1 Remove retaining ring (20) from short end of gearshaft (90).

2 Install wave washer (40) into short end of gearshaft (90).

3 Install shim pack (30), calculated in Step 5.A.(8)(f)5c, in gearshaft (90) against wave washer (40).

4 Install retaining ring (20) into gearshaft (90).

NOTE: Make sure that retaining ring (20) is properly seated in the gearshaft (90).

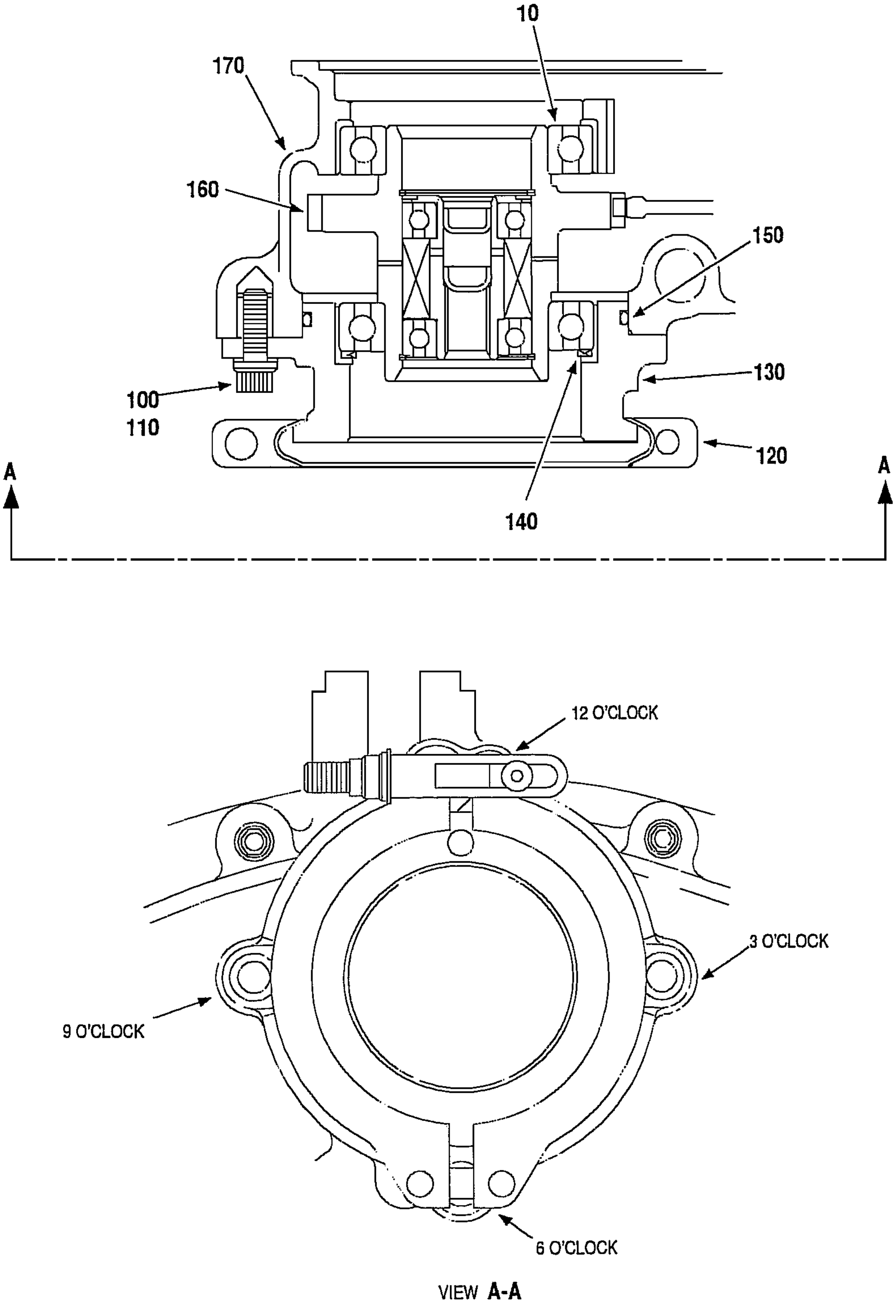

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Figure 10011. Assemble Starter Gear Assembly and Install in Gearbox Housing

Key to Figure 10011

10. BEARING (IPC FIG. 25)	140. WAVE SPRING WASHER
100. BOLT (IPC FIG. 12)	150. PACKING
110. WASHER	160. STARTER GEAR ASSEMBLY
120. CLAMP	170. GEARBOX ASSEMBLY
130. STARTER ADAPTER	

(9) Install starter gear assembly in the gearbox housing. Refer to Figure 10011.

(a) Install the starter gear assembly (160) in the front side of the gearbox housing (170). Make sure bearing (10) is correctly seated in the gearbox assembly (170).

NOTE: Make sure starter gear assembly (160) is correctly seated in the gearbox assembly (170).

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

(b) Install packing (150) on the starter adapter (130) and coat the packing with corrosion-preventive compound (Braycote 248).

(c) Place the wave spring washer (140) on the starter adapter (130) and install the starter adapter in the gearbox assembly (170).

(d) Install bolts (100) and washers (110) in the 3, 6 and 12 o’clock position on the starter adapter (130). Refer to Section View AA.

(e) Tighten bolts (100) to a torque value of 120 in-lb (13.56 Nm).

(f) Attach clamp (120) to the starter adapter in the 9 o’clock position with bolt (100). Refer to Section View AA.

(g) Tighten bolts (100) to a torque value of 120 in-lb (13.56 Nm).

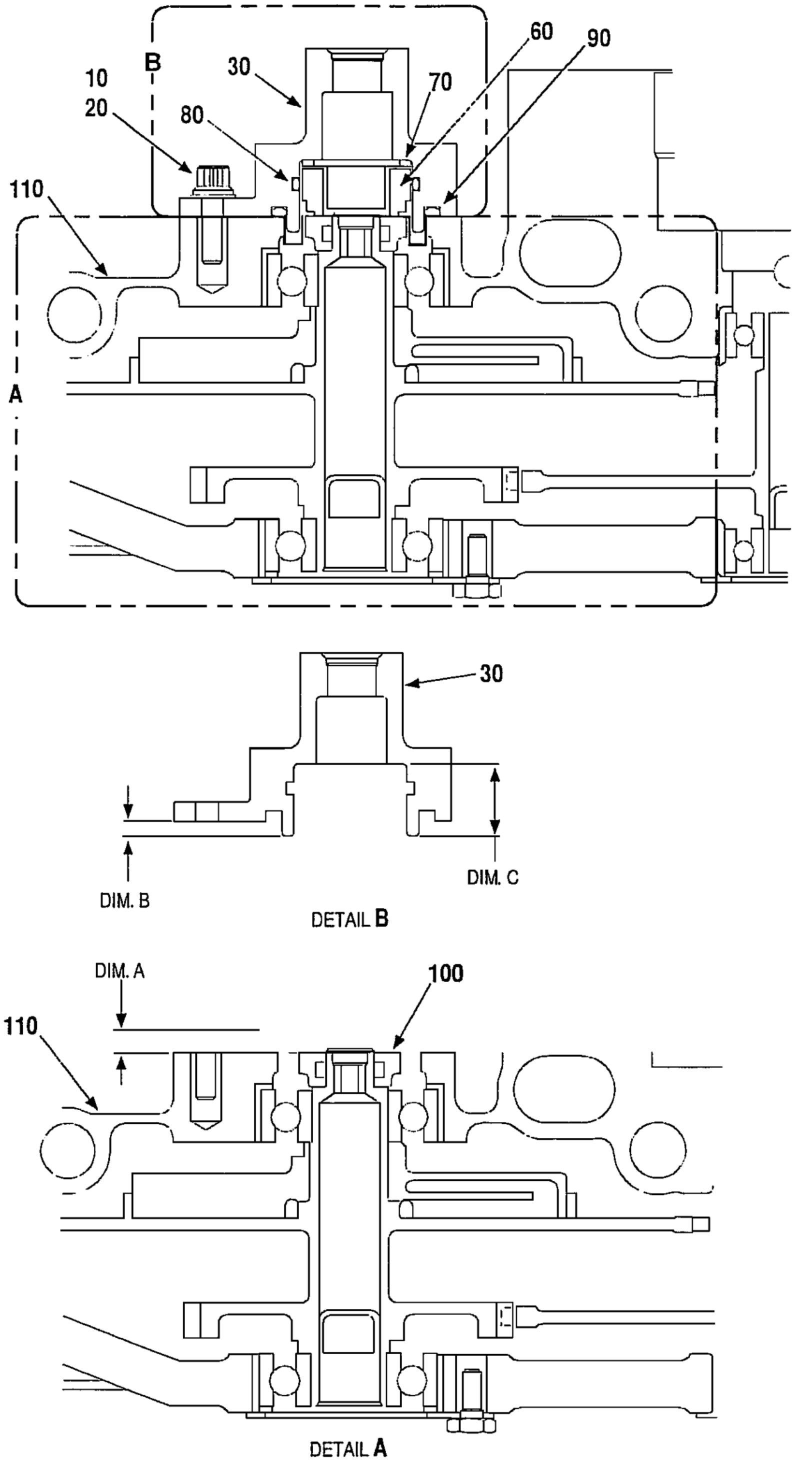

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Figure 10012. Install Air-Oil Separator Adapter in Gearbox Housing

Key to Figure 10012

10. BOLT (IPC FIG. 12)	80. PACKING
20. WASHER	90. PACKING
30. AIR-OIL SEPARATOR ADAPTER	100. SEAL DISK (20, IPC FIG. 15)
60. STATIONARY AIR-OIL SEAL	110. GEARBOX ASSY (170, IPC FIG. 12)
70. SHIM	

(10) Install air-oil separator adapter. Refer to Figure 10012.

(a) Determine the shims (70) necessary for the stationary air-oil seal (60) as follows:

1 Measure from the face of the gearbox assembly (110) to the face of the seal disk (100). Write as Dimension A. Refer to Dimension A, Detail A.

2 Measure from the top of the air-oil separator adapter (30) to the face of the air-oil separator adapter flange. Write as Dimension B. Refer to Dimension B, Detail B.

3 Measure from the top of the air-oil separator adapter (30) to the air-oil separator adapter seal land. Write as Dimension C. Refer to Dimension C, Detail B.

4 Calculate the necessary shims as follows:

a Dimension A = ____________________inch (mm).

b Dimension B = ____________________inch (mm).

c Dimension C = ____________________inch (mm).

d Necessary shim (70) pack _________inch (mm) = A-B+C-0.450 inch (11.43 mm) ±0.002 inch (±0.05 mm).

(b) Install shim (70) pack calculated in Step 5.A.(10)(a)4.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

(c) Lubricate packing (90) with oil.

(d) Install packing (90) in the air-oil separator adapter (30).

(e) Use PN 834824-1 shaft driver to install stationary air-oil seal (60) up against the installed shim (70) pack in the air-oil separator adapter (30).

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

(f) Lubricate packing (80) with oil.

(g) Install packing (80) on the air-oil separator adapter (30).

(h) Put air-oil separator adapter (30) with installed packing (80, 90), shim (70) pack and stationary air-oil seal (60) on the gearbox assembly (110) and attach the air-oil separator adapter to the gearbox assembly with bolts (10) and washers (20).

(i) Tighten bolts (10) to a torque value of 50 in-lb (5.65 Nm).

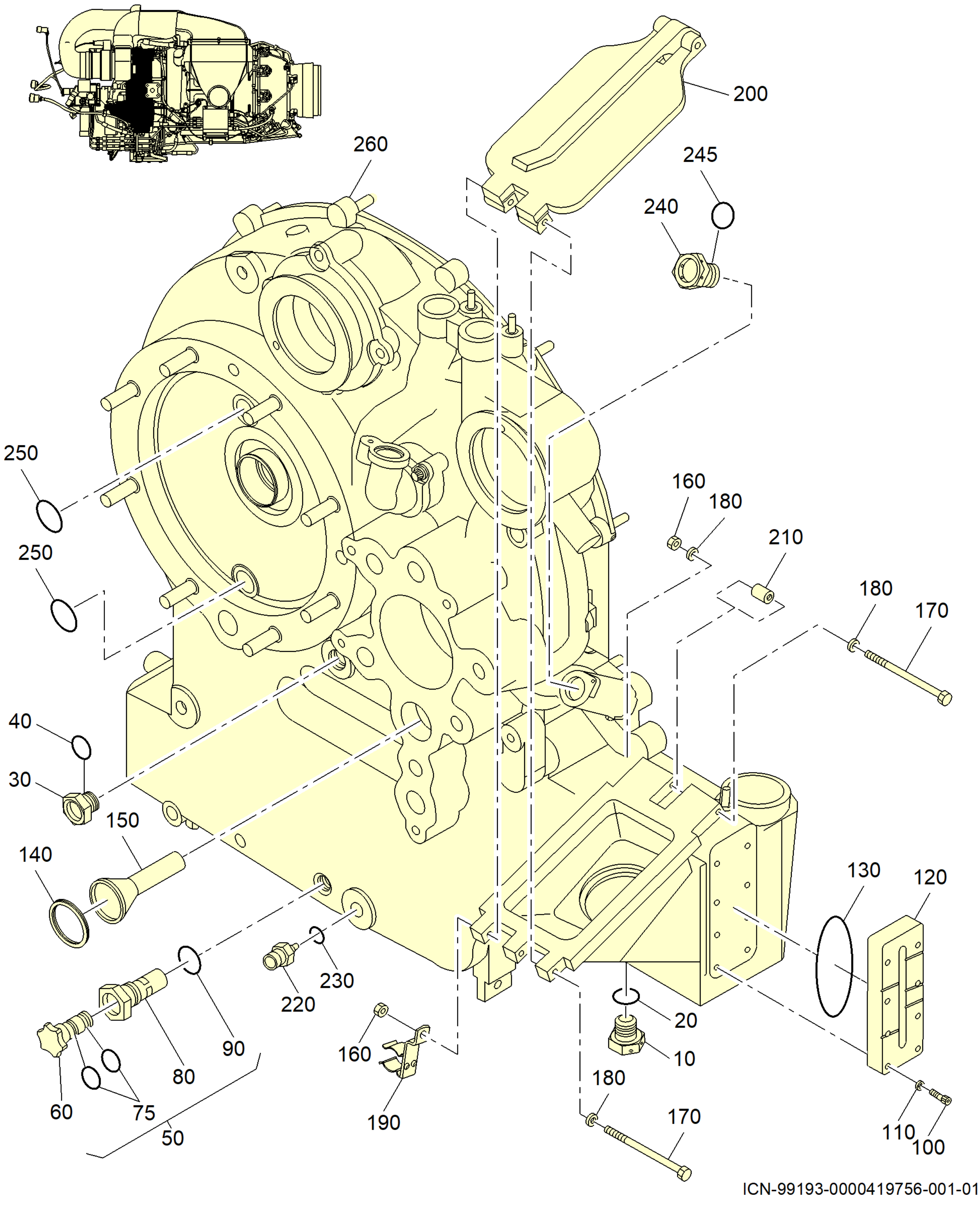

Figure 10013. Install Plugs, Filter Element and Oil Cap on Gearbox Housing

Key to Figure 10013

10. PLUG (IPC FIG. 11)
20. PACKING
30. PLUG
40. PACKING
60. MAGNETIC PLUG
50. MAGNETIC DRAIN PLUG
75. PACKING
80. PLUG
90. PACKING
100. BOLT
110. WASHER
120. SIGHT GLASS
130. PACKING
140. RETAINING RING
150. FILTER ELEMENT
160. NUT
170. BOLT
180. WASHER
190. BRACKET
200. OIL FILL CAP
210. OIL FILL CAP ROLLER
220. OIL TEMPERATURE SENSOR
230. GASKET
240. PLUG
245. PACKING
250. SCREEN
260. GEARBOX ASSEMBLY

---

(11) (SB 131-49-8353) Install J-tube. Refer to Figure 10014.

(a) Install the O-ring (50) to the union (40).

(b) Install the union (40) to the gearbox housing (10). Torque tighten the union (40) to 50 in-lb (5.65 Nm).

(c) Install the O-rings (30) to the J-tube (20).

(d) Install the J-tube (20) to the gearbox housing (10) with the the J-tube nut (p/o 20). Torque tighten the J-tube nut (p/o 20) to 140 in-lb (15.82 Nm).

(e) Install the J-tube captive retainer to the adaptor housing (60) with the J-tube captive retainer bolt (p/o 20). Tighten J-tube captive retainer bolt (p/o 20) to a torque value of 50 in-lb (5.65 Nm).

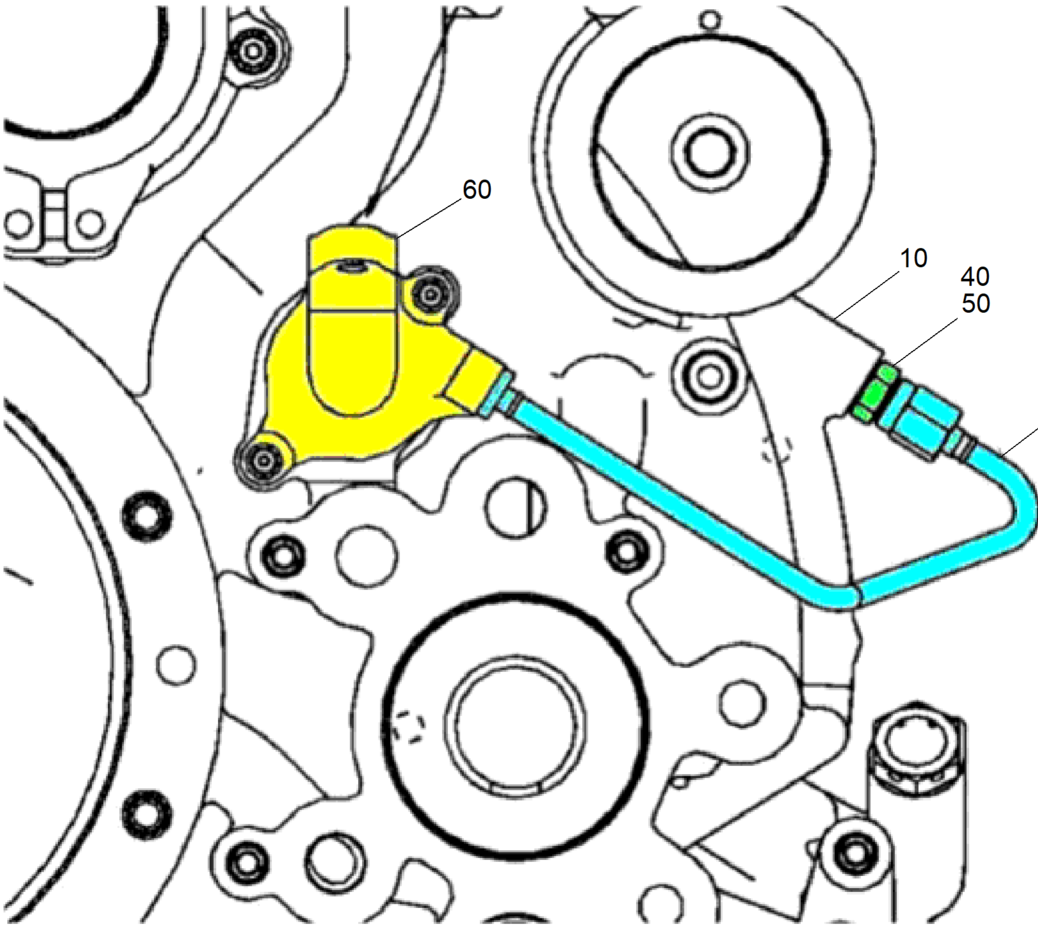

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Figure 10014. Installion of J-tube

Key to Figure 10014

10. GEARBOX HOUSING	40. UNION
20. J-TUBE	50. O-RING
30. O-RING	60. ADAPTOR HOUSING

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

(12) Install plugs, filter element and oil fill cap on gearbox assembly. Refer to Figure 10013.

(a) Install filter element (150) and retaining ring (140) in gearbox assembly (260).

(b) Lubricate packing (20) with oil.

(c) Install plug (10) with packing (20) on gearbox assembly (260).

(d) Lockwire plug (10) using MS20995C20 per NASM33540.

(e) Lubricate packing (40) with oil.

(f) Install plug (30) with packing (40) on gearbox assembly (260).

(g) Lubricate packing (90) with oil.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

(h) Install plug (80) with packing (90) on gearbox assembly (260).

(i) Lockwire plug (80) using MS20995C20 per NASM33540.

(j) Lubricate packings (75) with oil.

(k) Install magnetic plug (60) with packings (75) on installed plug (80).

(l) Lubricate packing (130) with oil.

(m) Install sight glass (120) with packing (130), washers (110) and bolts (100) on gearbox assembly (260).

(n) Install oil fill cap roller (210), oil fill cap (200) and attach to gearbox assembly (260) with bolts (170), washers (180), bracket (190) and nuts (160).

(o) Tighten nuts (160) to a torque value of 40 in-lb (4.52 Nm).

(p) Lubricate gasket (230) with oil.

(q) Install oil temperature sensor (220) with gasket (230) in gearbox assembly (260).

(r) Lubricate packing (245) with oil.

(s) Install plug (240) with packing (245) on gearbox assembly (260).

(t) Install screens (250).

GEARBOX ASSEMBLY
STORAGE-01

TASK 49-21-00-550-801

1. General

A. This section contains procedures for storage of the gearbox assembly.

NOTE: The storage/preservation procedures are guidelines only and represent best practices for the protection of stored units against damage from worst-case exposure to moisture, debris, and other environmental conditions during extended periods storage. The manual should be used as a baseline to establish what precautions should be taken at and/or after storage based on each operator's region and experience.

B. Age control for most parts today is not necessary for assemblies, silicon rubber, fluorocarbon rubber, fuel tank synthetics, or static seals used with fasteners.

C. Age Controls of Age-Sensitive Elastomeric Material for Aerospace Applications is specified in SAE ARP 5316. Refer to this standard for all military and commercial use. Assemblies that contain age-sensitive material in this specification are limited by failure rates, in service use and system life estimated by the user.

D. Bad weather conditions can cause damage to parts. Such conditions are, but not limited to:

- Moisture,
- High temperature (over 125°F (52°C)),
- Fuel or solvents that have expanded,
- Fumes that can cause corrosion,
- Mechanical stresses,
- Ultraviolet light.

E. Parts that have been in bad weather conditions must be checked for damage and replaced as necessary.

2. Equipment and Materials

A. Table 12001 shows the necessary equipment and materials for storage.

Table 12001. Equipment and Materials

Equipment/Materials	Description/Manufacturer
NOTE: Equivalent equipment/materials can be used.	
Barrier material (MIL-PRF-131H, Type 1, Class III)	Commercially available
Dehydrating agent	Commercially available
pH Neutral paper (MIL-P-17667)	Commercially available

3. Procedure

SUBTASK 49-21-00-550-001

A. Prepare the gearbox assembly for storage.

(1) Clean the external surfaces with a clean, lint-free cloth.

(2) Seal all ports.

(3) Wrap the gearbox assembly in pH neutral paper.

(4) Put cushions at the sharp corners to prevent damage to the barrier material and pack with dehydrating agent.

(5) Put the gearbox assembly in the applicable size barrier material.

SUBTASK 49-21-00-550-002

B. Monitor storage conditions.

(1) Keep the gearbox assembly in an area away from high temperatures, dust, moisture and corrosive fumes.

(2) The recommended storage temperature is less than 100°F (38°C) and must not be more than 125°F (52°C).

(3) Control the humidity to prevent moisture on the unit.

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CHAPTER - 49

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POWER SECTION ASSEMBLY
SYSTEMS DESCRIPTION SECTION

1. Introduction

The purpose of the power section assembly is to supply the necessary power during the operation of the APU.

2. General Description

The power section is a single-shaft design that includes a single-stage centrifugal compressor, a reverse flow annular combustor and a two-stage axial flow turbine. The single main shaft also ties the engine compressor and turbine to the load compressor and is supported by two bearings, a duplex ball bearing located forward of the load compressor and a roller bearing located aft of the second stage turbine. Carbon seals are used in the front and rear bearing cavities. The load compressor bearing has a bellows carbon face seal and the turbine bearing has a segmented carbon ring seal. The carbon seals are buffered with air pressure to minimize oil consumption and give additional operational redundancy.

The engine compressor has a single-stage, high-pressure-ratio impeller, followed by single-stage, radial-flow diffuser vanes and axial deswirl vanes.

The axial flow turbine design has two stages, each has a stator and turbine wheel. The first stage stator is air cooled. The first stage turbine wheel has inserted blades and the second stage turbine wheel has a diffusion-bonded blade ring.

High-energy containment is provided for the engine compressor and turbine wheels if necessary.

The load compressor section has a single-stage centrifugal compressor mounted on a common shaft with the power section rotating group. The load compressor shares a common inlet with the power section and provides compressed air to the airplane pneumatic system.

The forward end of the power section assembly has provision to attach a gearbox and supplies torque to meet the gearbox power requirements.

During operation the engine compressor supplies compressed air to the annular combustion chamber where ten dual-orificed fuel nozzles continuously inject fuel into the incoming air to sustain combustion that gives the necessary energy to power the two-stage turbine. The turbine section provides the necessary power to drive the engine compressor, load compressor and gearbox for all airplane design load applications.

The load compressor output is regulated by variable inlet guide vanes located upstream of the load compressor impeller. Output is based on airplane environmental control system, main engine start and electrical load demands as indicated by airplane signals to the APU electronic control box (ECB). The inlet guide vanes are scheduled by the ECB and are moved to the necessary position by the hydraulic actuator. The inlet guide vane assembly has 16 vanes located radially at the load compressor inlet. The vanes are supported at one end and are driven by gear segments attached to each vane. The gear segments mesh with a cylindrical rack to synchronize vane position.

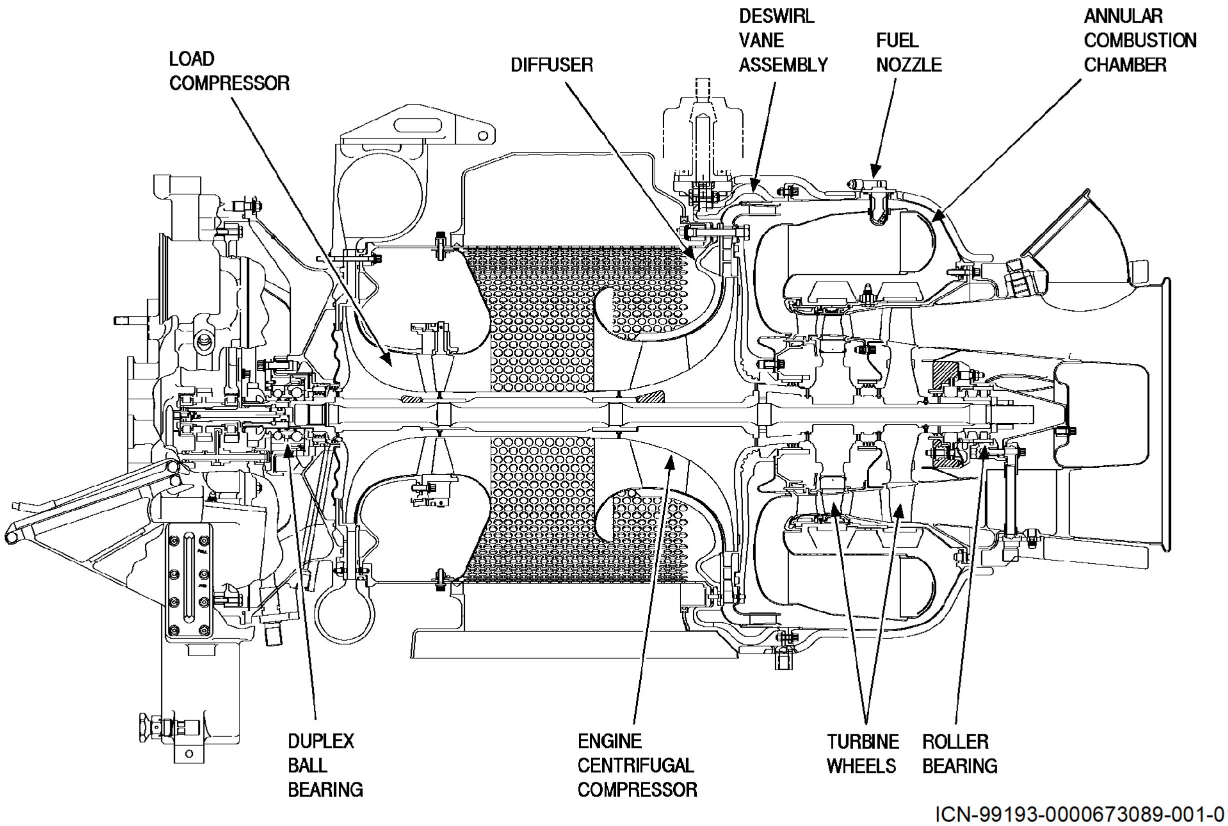


Figure 1. Power Section Assembly

POWER SECTION ASSEMBLY
DISASSEMBLY-01

TASK 49-22-00-420-801

1. General

A. This section contains procedures to install the power section assembly on the portable engine stand/cart.

B. Perform the disassembly procedures in a dry, bright, clean room.

C. Be careful to prevent damage to parts that can be used again.

2. Special Tools, Fixtures and Equipment

A. Table 5001 shows the necessary special tools, fixtures and equipment for preparation of the power section assembly for disassembly.

Table 5001. Special Tools, Fixtures and Equipment

Nomenclature	Use	Part No.
NOTE: Equivalent tools, fixtures and equipment can be used.		
Portable Engine Stand/Cart	Build and test cart for APU. Component of PN 834991-1.	834990-1
Cart Assembly	Includes PN 834990-1 engine stand/cart, PN 834991-2 rear vertical frame, PN 834991-3 and PN 834991-4 driven support arm.	834991-1
Rear Vertical Frame	Support APU on top side on cart. Component of PN 834991-1.	834991-2
Driven Support Arm	Adapt engine mount (left mount) to transport cart. Component of PN 834991-1.	834991-3
Driven Support Arm	Adapt engine mount (right mount) to transport cart. Component of PN 834991-1.	834991-4

3. Procedure

SUBTASK 49-22-00-420-001

A. Install the power section assembly on the portable engine stand/cart.

(1) Install PN 834991-4 driven support arm on the power section assembly right mount.

(2) Install PN 834991-3 driven support arm on the power section assembly left mount.

(3) Install power section assembly in PN 834990-1 portable engine stand/cart as follows:

(a) Position the power section assembly in the PN 834990-1 portable engine stand/cart with the right side next to the hand crank on the portable engine stand/cart.

(b) Attach the power section assembly to the PN 834990-1 portable engine stand/cart.

(c) Use PN 834990-1 portable engine stand/cart to rotate the power section so it is positioned aft side up.

POWER SECTION ASSEMBLY
DISASSEMBLY-02

TASK 49-22-00-030-801

1. **General**

   A. This section contains procedures for disassembly of the power section assembly.

   B. Perform the disassembly procedures in a dry, bright, clean room.

   C. Be careful to prevent damage to parts that can be used again.

   WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

   D. Apply lubricating oil to parts and put them in a protective container to prevent corrosion until the parts can be cleaned and checked.

   E. Do not disassemble any staked, welded, riveted, soldered, swaged, or press fit assemblies.

   F. Do not remove plates, passage hole plugs or threaded inserts unless replacement is necessary.

   G. Check all bearings for roughness, brinelling and damaged races or retainers. These conditions can be an indication of possible damage.

   H. Remove all protective caps, plugs and closures before disassembly of the unit.

   I. Make a write of the quantities and thickness of the shims and washers. This will help when the part is assembled.

2. **Special Tools, Fixtures and Equipment**

   A. Table 5001 shows the necessary special tools, fixtures and equipment for disassembly.

Table 5001. Special Tools, Fixtures and Equipment

Nomenclature	Use	Part No.
NOTE: Equivalent tools, fixtures and equipment can be used.		
Shaft Stretch Kit	Used with stretch shaft tool.	834740-2
Torque Adapter	Adapt torque wrench to tieshaft nut.	834801-1
Turbine Shaft Simulator	Simulate turbine rotating section when the compressor section is shimmed.	834803-1
Alignment Pin	Align combustor separation to first stage assembly.	834809-1
Bearing Remover	Remove duplex ball bearing.	834808-1
Seal Remover	Remove oil stationary seal.	834810-1
Wheel Remover Adapter	Remove turbine wheels (two required).	834812-1
Lifting Adapter	Lift power section assembly by turbine shaft.	834816-1

Table 5001. Special Tools, Fixtures and Equipment (Cont)

Nomenclature	Use	Part No.
Diffuser Puller	Remove load compressor diffuser.	834836-1
Exhaust Cap Remover	Remove exhaust cap.	834863-1
Driven Compressor Coupling Shaft Holding Fixture	Hold driven compressor coupling shaft while turbine shaft is removed.	834864-1
Bearing Puller	Remove turbine roller bearing.	834883-1
Stretch Tool	Shaft stretch tool used with shaft stretch kit.	834889-1
Portable Engine Stand/Cart	Build and test cart for APU. Component of PN 834991-1.	834990-1
Cart Assembly	Includes PN 834990-1 engine stand/cart, PN 834991-2 rear vertical frame, PN 834991-3 and PN 834991-4 driven support arm.	834991-1
Rear Vertical Frame	Support APU on top side on cart. Component of PN 834991-1.	834991-2
Driven Support Arm	Adapt engine mount (left mount) to transport cart. Component of PN 834991-1.	834991-3
Driven Support Arm	Adapt engine mount (right mount) to transport cart. Component of PN 834991-1.	834991-4

3. Equipment and Materials

None

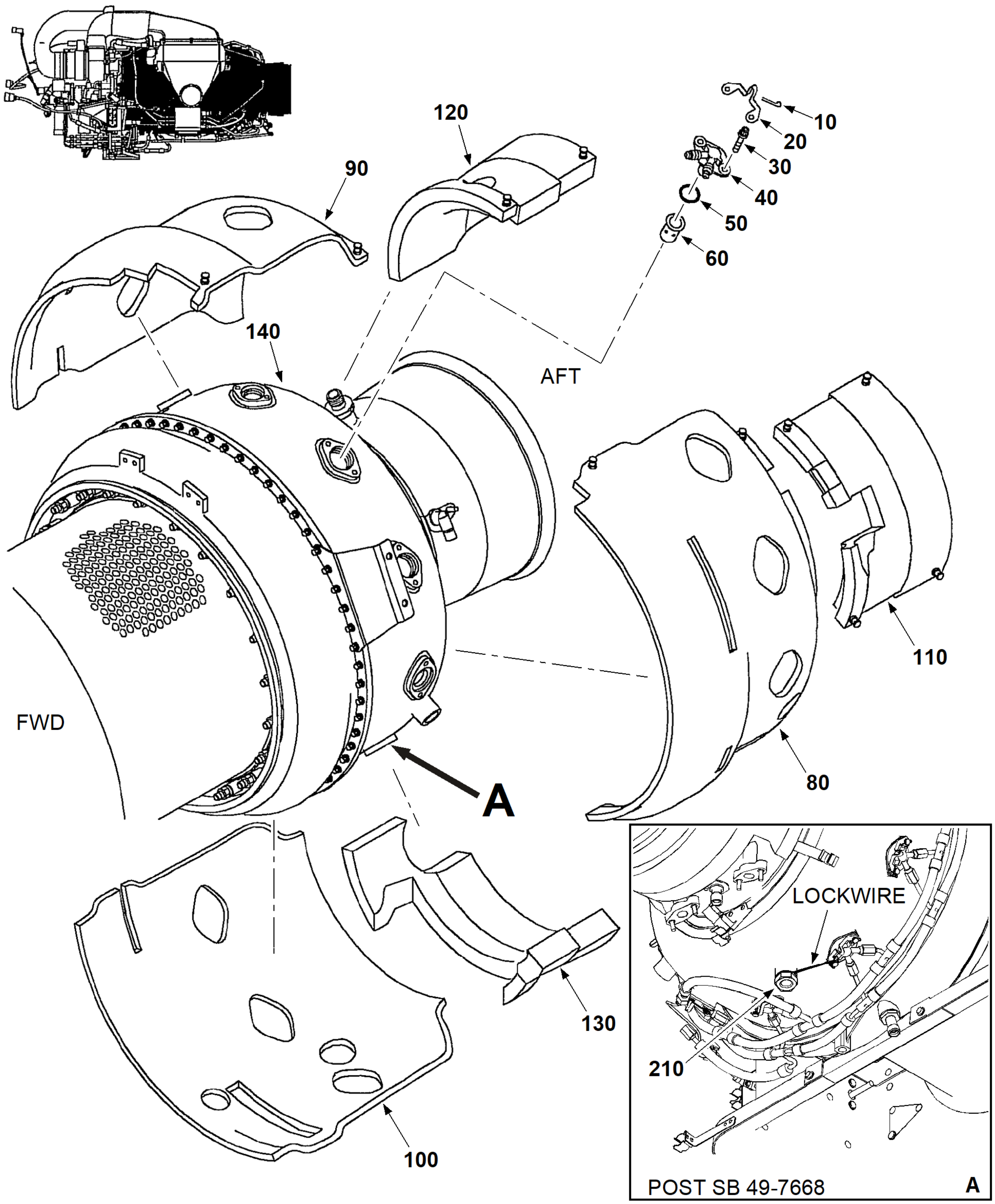


Figure 5001. Disassemble the Thermal Insulation Blanket Set from the Power Section Assembly (Partial Breakdown)

Key to Figure 5001

10. PIN (IPC FIG. 16)	90. SIDE BLANKET
20. LOCKING PLATE	100. SIDE BLANKET
30. BOLT	110. AFT SIDE BLANKET
40. FUEL NOZZLE	120. AFT SIDE BLANKET
50. GASKET	130. AFT SIDE BLANKET
60. FUEL NOZZLE AIR SHROUD	140. POWER SECTION ASSY
-70. THERMAL INSULATION BLANKET SET	210. PLUG (IPC FIG. 6)
80. SIDE BLANKET	-. ITEM NOT ILLUSTRATED

4. Procedure

SUBTASK 49-22-00-030-001

A. Disassemble the Power Section Assembly. Refer to Figure 5001.

(1) Remove fuel nozzle.

CAUTION: DO NOT REMOVE ALL FUEL NOZZLES (40) AT THE SAME TIME, UNLESS THE COMBUSTOR ASSEMBLY IS GOING TO BE REMOVED. KEEP A MINIMUM OF THREE EQUALLY SPACED NOZZLES INSTALLED UNTIL THE OTHERS HAVE BEEN REPLACED. THE FUEL NOZZLES KEEP THE CORRECT COMBUSTOR ASSEMBLY ALIGNMENT.

(a) Remove pin (10) and locking plate (20). If lockwire was used as alternative to the pin and locking plate, remove the lockwire.

(b) (Post SB 131-49-7668) Remove lockwire from plug (210) and fuel nozzle bolt (30).

(c) Remove bolts (30).

(d) Remove fuel nozzle (40), gasket (50) and fuel nozzle air shroud (60) from the engine assembly. Discard gasket.

(2) Disassemble the thermal insulation blanket set from the power section assembly.

(a) Remove lockwire that holds the side blankets (80, 90, 100) together.

(b) Remove side blankets (80, 90, 100) from the power section assembly (140).

(c) Remove lockwire that holds the aft side blankets (110, 120, 130) together.

(d) Remove aft side blankets (110, 120, 130) from the power section assembly (140).

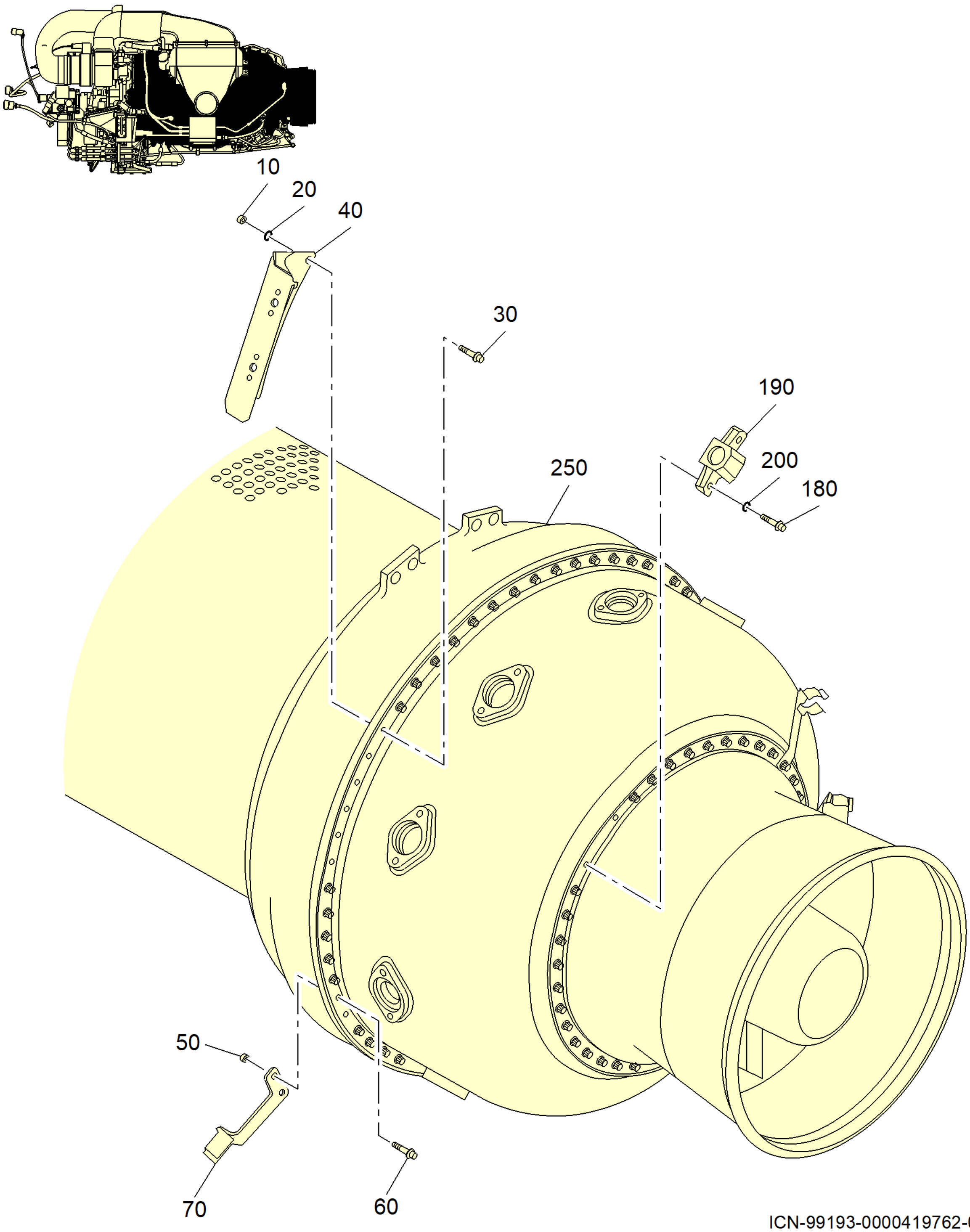


Figure 5002. Disassemble the Engine Brackets (Partial Breakdown)

Key to Figure 5002

10. NUT (IPC FIG. 17)	70. BRACKET
20. WASHER	180. BOLT
30. BOLT	190. PCD AIR ADAPTER
40. OIL COOLER BRACKET	200. ADAPTER GASKET
50. NUT	250. POWER SECTION ASSY
60. BOLT	

(3) Disassemble the engine brackets as follows. Refer to Figure 5002 and Figure 5003.

(a) Remove nuts (10), washes (20), bolts (30) and oil cooler bracket (40) from the power section assembly (250).

(b) Remove nuts (50), bolts (60) and bracket (70) from the power section assembly (250).

(c) Remove bolts (180), adapter gaskets (200) and PCD air adapter (190) from the power section assembly (250).

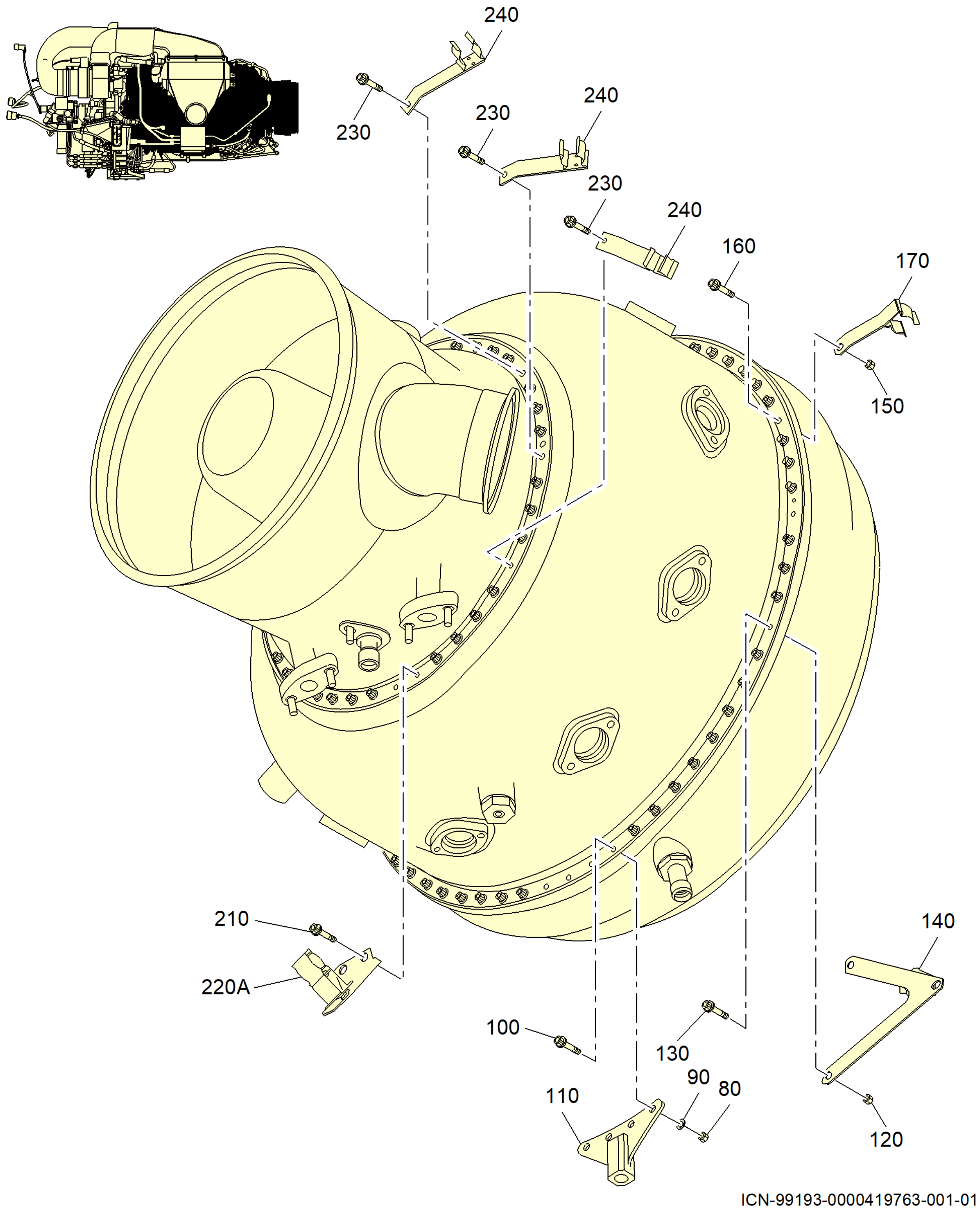


Figure 5003. Disassemble the Engine Brackets (Partial Breakdown)

Key to Figure 5003

80.	NUT (IPC FIG. 17)	160.	BOLT
90.	WASHER	170.	HARNESS BRACKET
100.	BOLT	210.	BOLT
110.	LIFTING BRACKET	220A.	EXHAUST DRAIN BRACKET
120.	NUT	230.	BOLT
130.	BOLT	240.	HARNESS BRACKET
140.	SURGE DUCT BRACKET	-250.	POWER SECTION ASSY
150.	NUT	-.	ITEM NOT ILLUSTRATED

(d) Remove nuts (80), washers (90), bolts (100) and lifting bracket (110) from the power section assembly (250).

(e) Remove nuts (120), bolts (130) and surge duct bracket (140) from the power section assembly (250).

(f) Remove nut (150), bolt (160) and harness bracket (170) from the power section assembly (250).

(g) Remove bolt (210) and exhaust drain bracket (220A) from the power section assembly (250).

(h) Remove bolts (230) and harness brackets (240) from the power section assembly (250).

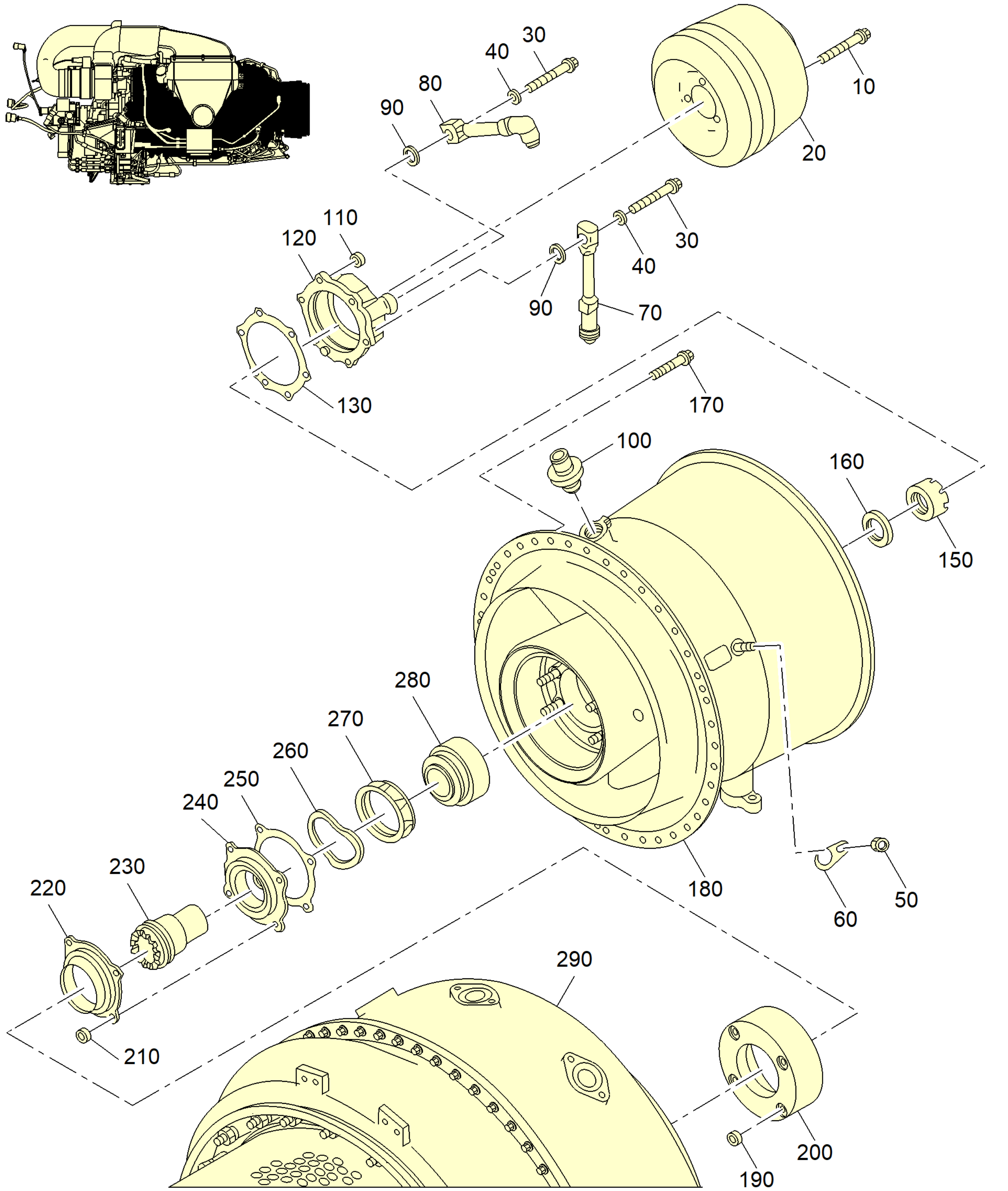


Figure 5004. (Pre SB 131-49-7606) Disassemble the Turbine Bearing Housing Section (Partial Breakdown)

Key to Figure 5004

10.	BOLT (IPC FIG. 18)	170.	BOLT
20.	EXHAUST CENTER BODY CAP	180.	TURBINE BEARING HOUSING ASSY
30.	BOLT	190.	NUT
40.	SEAL WASHER	200.	FWD TURBINE BEARING INSULATION BLANKET
50.	NUT	210.	NUT
60.	OIL TUBE RETAINER	220.	STATIONARY AIR SEAL
70.	SCAVENGE TUBE ASSY	230.	AFT BEARING SHAFT
80.	IN TUBE ASSY	240.	REAR BEARING SEAL
90.	SEAL WASHER	250.	REAR BEARING SEAL GASKET
100.	FLARELESS FITTING	260.	SPRING WASHER
110.	NUT	270.	SEAL RETAINER
120.	BEARING RETAINER ASSY	280.	BEARING SET
130.	AFT BEARING COVER GASKET	290.	POWER SECTION ASSY
150.	TIESHAFT NUT	-300.	TURBINE SHAFT (120, IPC FIG. 23)
160.	TIESHAFT WASHER	-.	ITEM NOT ILLUSTRATED

(4) Disassemble the turbine bearing housing section. Refer to Figure 5004 and Figure 5005.

(a) Remove bolts (10) and use a PN 834863-1 exhaust cap remover to remove exhaust center body cap (20) from the turbine bearing housing assembly (180).

(b) (Pre SB 131-49-7606) Remove nuts (50) and oil tube retainers (60) from the turbine bearing housing assembly (180).

(c) Remove bolts (30) and seal washers (40) from the scavenge tube assembly (70) and the in tube assembly (80).

(d) (Pre SB 131-49-7606) Remove scavenge tube assembly (70), in tube assembly (80) and seal washers (90) from the turbine bearing housing assembly (180).

(e) (Pre SB 131-49-7606) Remove bearing retainer assembly from the power section assembly as follows:

1 Remove nuts (110) from the turbine bearing housing assembly (180).

2 Remove bearing retainer assembly (120) from the turbine bearing housing assembly (180).

3 Remove aft bearing cover gasket (130) from the turbine bearing housing assembly (180). Discard the gasket.

(f) Remove bearing outer race from the bearing set (280) and turbine bearing housing (180).

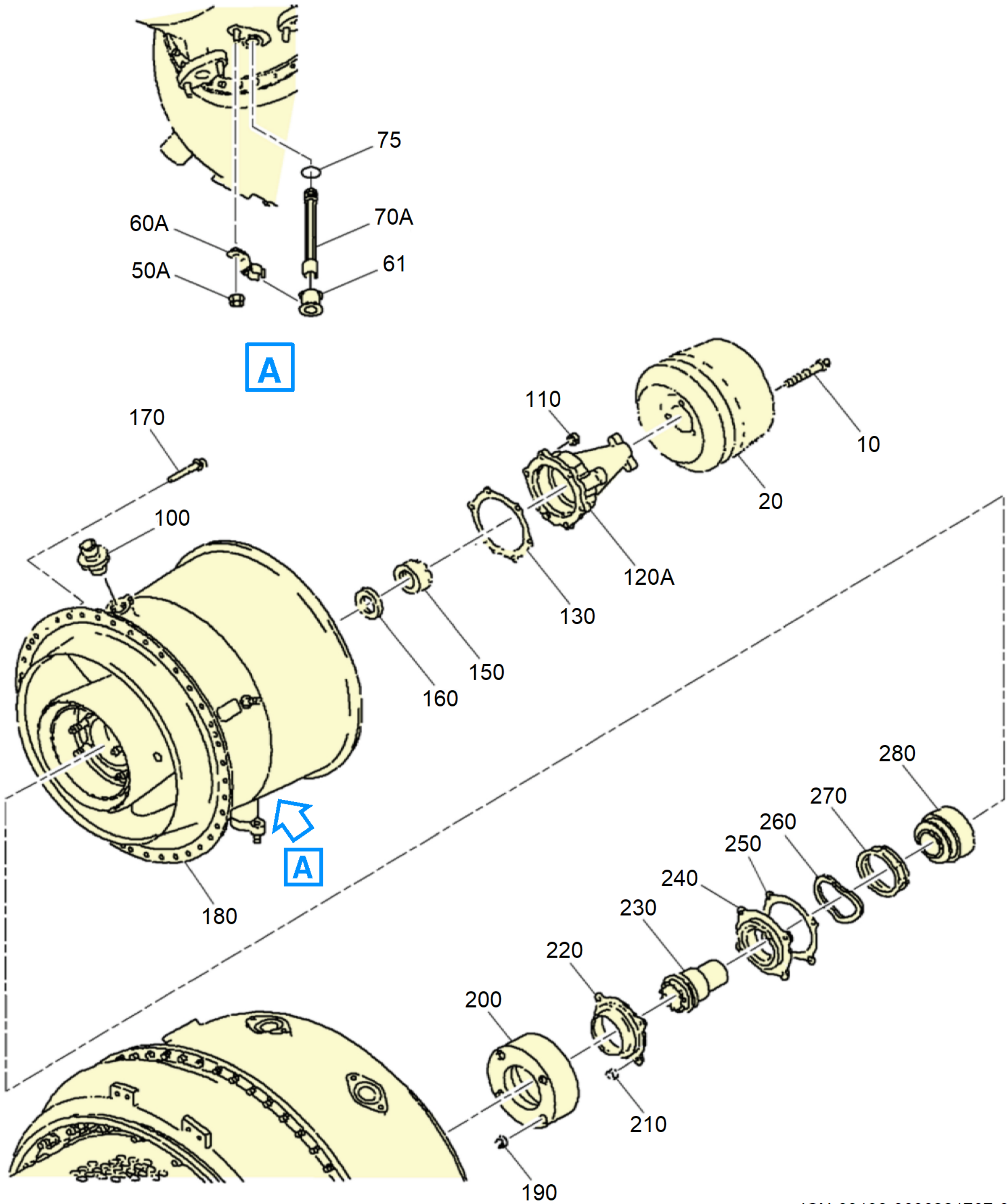


Figure 5005. (Post SB 131-49-7606) Disassemble the Turbine Bearing Housing Section (Partial Breakdown)

Key to Figure 5005

10.	BOLT (IPC FIG. 18)	180.	TURBINE BEARING HOUSING ASSY
20.	EXHAUST CENTER BODY CAP	190.	NUT
50A.	NUT	200.	FWD TURBINE BEARING INSULATION BLANKET
60A.	TUBE SUPPORT BRACKET	210.	NUT
61.	GROMMET	220.	STATIONARY AIR SEAL
70A.	SCAVENGE TUBE ASSY	230.	AFT BEARING SHAFT
-70B.	SCAVENGE TUBE ASSY	240.	REAR BEARING SEAL
75.	GASKET	250.	REAR BEARING SEAL GASKET
100.	FLARELESS FITTING	260.	SPRING WASHER
110.	NUT	270.	SEAL RETAINER
120A.	BEARING RETAINER ASSY	280.	BEARING SET
130.	AFT BEARING COVER GASKET	-290.	POWER SECTION ASSY
150.	TIESHAFT NUT	-300.	TURBINE SHAFT (120, IPC FIG. 23)
160.	TIESHAFT WASHER	-.	ITEM NOT ILLUSTRATED
170.	BOLT		

(g) (Post SB 131-49-7606) Remove nut (50A) and tube support bracket (60A) with grommet (61) from the turbine bearing housing assembly (180).

(h) (Post SB 131-49-7606, Pre SB 131-49-7944) Remove scavenge tube assembly (70A) from the bearing retainer assembly (120A).

(Post SB 131-49-7944) Remove scavenge tube assembly (70B) from the bearing retainer assembly (120A).

(Post SB 131-49-7944) Remove gasket (75) from scavenge tube assembly (70B). Discard gasket.

(i) (Post SB 131-49-7606) Remove bearing retainer assembly from the power section assembly as follows:

1 Remove nuts (110) from turbine bearing housing assembly (180).

2 Remove bearing retainer assembly (120A) from the turbine bearing housing assembly (180).

3 Remove aft bearing cover gasket (130) from the turbine bearing housing assembly (180). Discard the gasket.

(j) Remove bearing outer race from the bearing set (280) and turbine bearing housing assembly (180).

(k) Remove tieshaft nut and tieshaft washer as follows:

1 Install PN 834889-1 stretch shaft tool with PN 834740-2 shaft stretch kit on the turbine shaft (300).

NOTE: Back PN 834889-1 stretch shaft off four turns from full seat.

WARNING: USE EXTREME CAUTION WHEN WORKING WITH PRESSURIZED EQUIPMENT. PLACE UNIT UNDER TEST (UUT) BEHIND A PROTECTIVE BARRIER TO AVOID INJURY TO PERSONNEL.

2 Apply 5400 to 5600 PSIG (37232 to 38611 kPa) to the PN 834889-1 stretch shaft tool and hand loosen the tieshaft nut (150) three turns.

3 Remove PN 834889-1 shaft stretch tool and PN 834740-2 shaft stretch kit from the turbine shaft (300).

4 Remove tieshaft nut (150) and tieshaft washer (160) from the turbine shaft (300).

(l) Remove bolts (170) from the turbine bearing housing assembly (180).

(m) Remove assembled turbine bearing housing assembly (180) from the power section assembly (290).

(n) Remove nuts (190, 210), forward turbine bearing insulation blanket (20) and stationary air seal (220) from the turbine bearing housing assembly (180).

(o) Remove assembled aft bearing shaft (230) from the turbine bearing housing (180).

(p) Use PN 834883-1 bearing puller to remove bearing set (280) from the aft bearing shaft (230).

(q) Remove seal retainer (270), spring washer (260), rear bearing seal gasket (250) and rear bearing seal (240) from the aft bearing shaft (230).

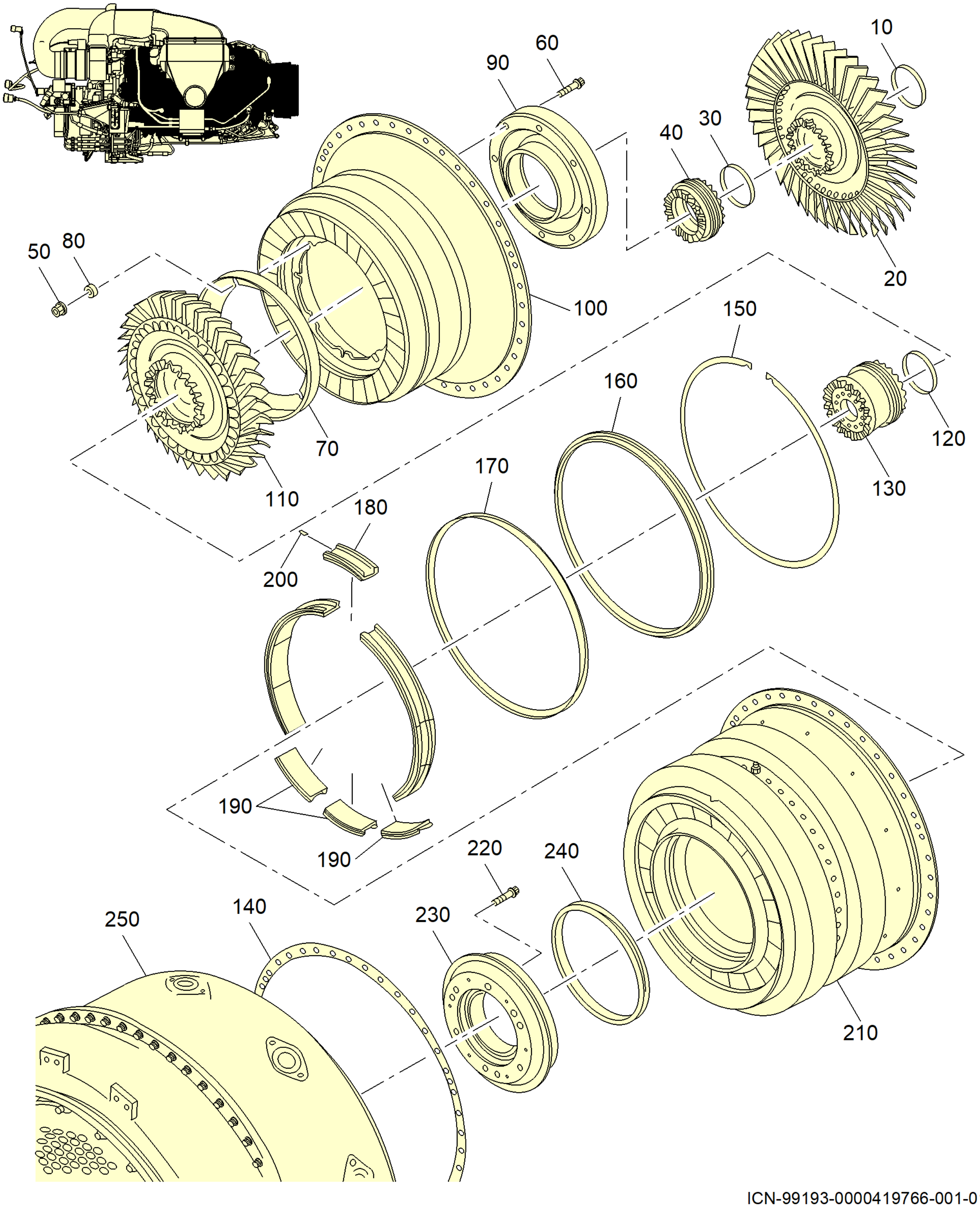


Figure 5006. (Pre SB 131-49-8063) Disassemble the First Stage Stator Section (Partial Breakdown)

Key to Figure 5006

10. RING SEAL (IPC FIG. 19)
20. SECOND STAGE TURBINE ROTOR ASSY
30. CURVIC RING SEAL
40. COUPLING SHAFT
50. NUT
60. BOLT
70. SECOND STAGE TURBINE STATOR BAFFLE
80. SLEEVE SPACER
90. SECOND STAGE STATOR SEAL WELDMENT
100. SECOND STAGE STATOR ASSY
110. FIRST STAGE TURBINE ROTOR ASSY
120. CURVIC RING SEAL
130. COUPLING SHAFT
140. TURBINE PLENUM SHIM
150. RETAINING RING
160. SHROUD SUPPORT RING
170. SHROUD SEGMENT SEAL
180. FIRST STAGE TURBINE SHROUD SEGMENT
190. FIRST STAGE TURBINE SHROUD SEGMENT
200. FEATHER SEAL
210. FIRST STAGE STATOR ASSY
220. BOLT
230. AIR SEAL
240. TURBINE SEAL
250. POWER SECTION ASSY
-250. COMPRESSOR ROTOR (10, IPC FIG. 21)
-260. TURBINE SHAFT (120, IPC FIG. 23)
-270. TIESHAFT NUT (150, IPC FIG. 18)
-280. DRIVEN COMPRESSOR BEARING HOUSING (190, IPC FIG. 24)
-290. DIFFUSER HOUSING ASSY (50, IPC FIG. 21)
-. ITEM NOT ILLUSTRATED

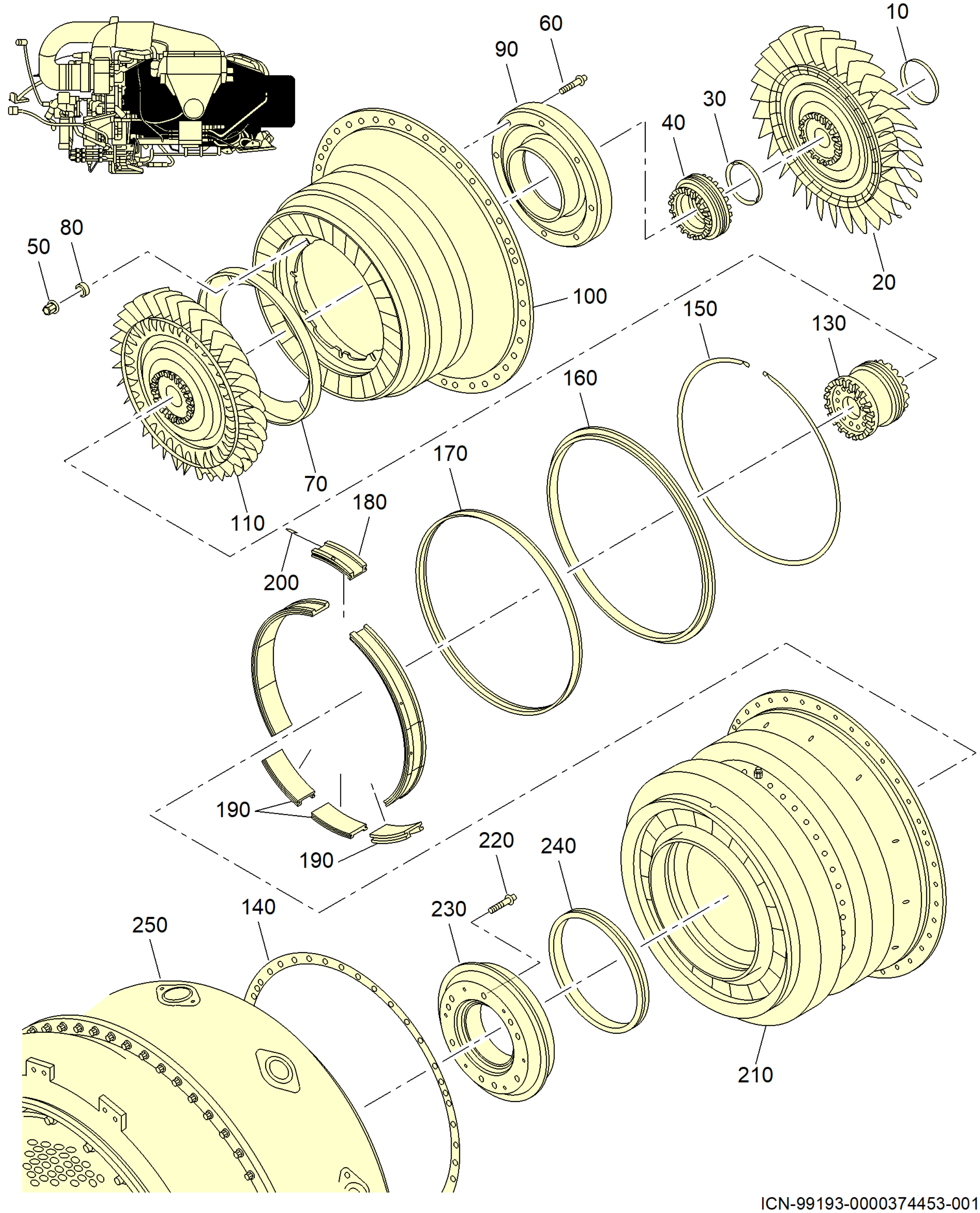


Figure 5007. (Post SB 131-49-8063) Disassemble the First Stage Stator Section (Partial Breakdown)

Key to Figure 5007

10. RING SEAL (IPC FIG. 19)	170. SHROUD SEGMENT SEAL
20. SECOND STAGE TURBINE ROTOR ASSY	180. FIRST STAGE TURBINE SHROUD SEGMENT
30. CURVIC RING SEAL	190. FIRST STAGE TURBINE SHROUD SEGMENT
40. COUPLING SHAFT	200. FEATHER SEAL
50. NUT	210. FIRST STAGE STATOR ASSY
60. BOLT	220. BOLT
70. SECOND STAGE TURBINE STATOR BAFFLE	230. AIR SEAL
80. SLEEVE SPACER	240. TURBINE SEAL
90. SECOND STAGE STATOR SEAL WELDMENT	250. POWER SECTION ASSY
100. SECOND STAGE STATOR ASSY	-250. COMPRESSOR ROTOR (10, IPC FIG. 21)
110. FIRST STAGE TURBINE ROTOR ASSY	-260. TURBINE SHAFT (120, IPC FIG. 23)
130. COUPLING SHAFT	-270. TIESHAFT NUT (150, IPC FIG. 18)
140. TURBINE PLENUM SHIM	-280. DRIVEN COMPRESSOR BEARING HOUSING (190, IPC FIG. 24)
150. RETAINING RING	-290. DIFFUSER HOUSING ASSY (50, IPC FIG. 21)
160. SHROUD SUPPORT RING	-. ITEM NOT ILLUSTRATED

(5) Disassemble the turbine section. Refer to Figure 5006 and Figure 5007.

(a) Remove ring seal (10) from the second stage turbine rotor assembly (20).

(b) Use two PN 834812-1 wheel removal adapters to remove the second stage turbine rotor assembly (20) from the coupling shaft (40).

(c) Remove curvic ring seal (30) and the coupling shaft (40) from the first stage turbine rotor assembly (110).

(d) Remove second stage stator assembly (100) from the power section assembly (250).

(e) Disassemble the second stage stator as follows:

1 Remove nuts (50), bolts (60), second stage turbine stator baffle (70), spacers (80) and second stage stator seal weldment (90) from the second stage stator assembly (100).

(f) Use two PN 834812-1 wheel removal adapters to remove the first stage turbine rotor assembly (110) from the coupling shaft (130).

(g) (Pre SB 131-49-8063) Remove curvic ring seal (120) from the coupling shaft (130).

NOTE: (Post SB 131-49-8063) Forward curvic seal (120) is deleted.

(h) Remove coupling shaft (130) from the power section assembly (250). Install plenum alignment pins PN 834809-1 to facilitate in first stage stator assembly (210) and combustor separation.

(i) Use jacking screws to remove first stage stator assembly (210) with the assembled retaining ring (150), shroud support ring (160), shroud segment seal (170), first stage turbine shroud segments (190) and feather seals (200) from the power section assembly (250).

(j) Remove installed quantity of turbine plenum shims (140) from the power section assembly (250).

(k) Remove retaining ring (150), shroud support ring (160), shroud segment seal (170), first stage turbine shroud segments (190) and feather seals (200) from the first stage stator assembly (210). Refer to DISASSEMBLY 04 for further disassembly of first stage stator assembly (210) if necessary.

(l) Remove bolts (220), air seal (230) and turbine seal (240) from the power section assembly (250).

(m) Change power section mount position in engine build stand to driven compressor bearing housing as follows:

1 Install PN 834803-1 turbine shaft simulator on the compressor rotor (250). Make sure the curvics are not stacked.

2 Install tieshaft nut (270) on the turbine shaft (260). Tighten tieshaft nut hand tight.

3 Install PN 834740-2 and PN 834889 stretch shaft tooling on the turbine shaft (260).

4 Stretch turbine shaft (260), using PN 834740-2 and PN 834889 stretch shaft tooling, to a load of 5400 to 5600 PSIG (37232 to 38611 kPa) and hand-tighten tieshaft nut (270).

5 Release pressure on PN 834740-2 ram and remove PN 834740-2 and PN 834889 stretch shaft tooling from the turbine shaft (260).

6 Install PN 834816-1 lifting adapter on the turbine shaft (260).

7 Install PN 834805-1 maintenance adapter set on the driven compressor bearing housing (280) mount pads.

8 Use hoist attached to PN 834816-1 lifting adapter to move power section assembly (250) in PN 834990-1 engine build stand. Keep power section assembly aft end up.

9 Remove PN 834991-4 and PN 834991-3 aft mount arms from the diffuser housing (290).

10 Remove PN 834816-1 lifting adapter from the turbine shaft (260).

11 Install PN 834740-2 and PN 834889 stretch shaft tooling on the turbine shaft (260), apply a load of 5400 to 5600 PSIG (37232 to 38611 kPa) and remove tieshaft nut (270).

12 Release pressure on PN 834740-2 ram and remove PN 834740-2 and PN 834889 stretch shaft tooling from the turbine shaft (260).

13 Remove PN 834803-1 turbine shaft simulator from the turbine shaft (260).

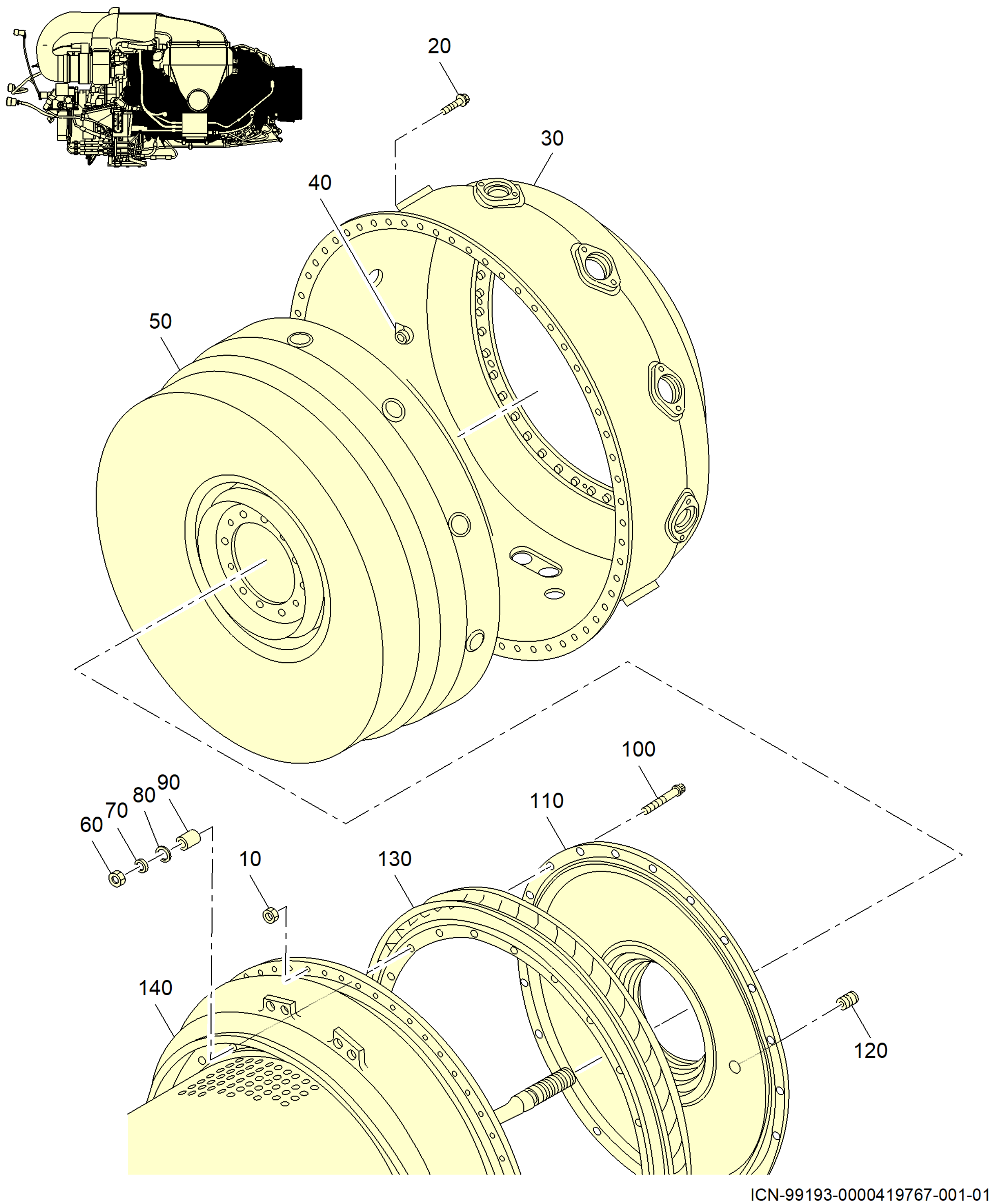


Figure 5008. Disassemble the Combustor Case and Attached Hardware (Partial Breakdown)

Key to Figure 5008

10. NUT (IPC FIG. 20)
20. BOLT
30. COMBUSTOR CASE
40. NUT
50. ANNULAR COMBUSTION CHAMBER
60. NUT
70. WASHER
80. PACKING WITH RETAINER
90. DIFFUSER SPACER
100. ENGINE COMPRESSOR DIFFUSER BOLT
110. AIR STATIONARY SEAL SUPPORT
120. INSERT
130. ENGINE COMPRESSOR DESWIRL
140. POWER SECTION ASSY

---

(6) Disassemble the combustor case and attached hardware. Refer to Figure 5008.

(a) Remove nuts (10), bolts (20) and combustor case (30) from the power section assembly (140).

(b) Remove the annular combustion chamber (50) from the power section assembly (140).

(c) Remove the nuts (60), washers (70), packing with retainers (80), diffuser spacers (90), bolts (100), air stationary seal support (110) and engine compressor deswirl (130) from the power section assembly (140).

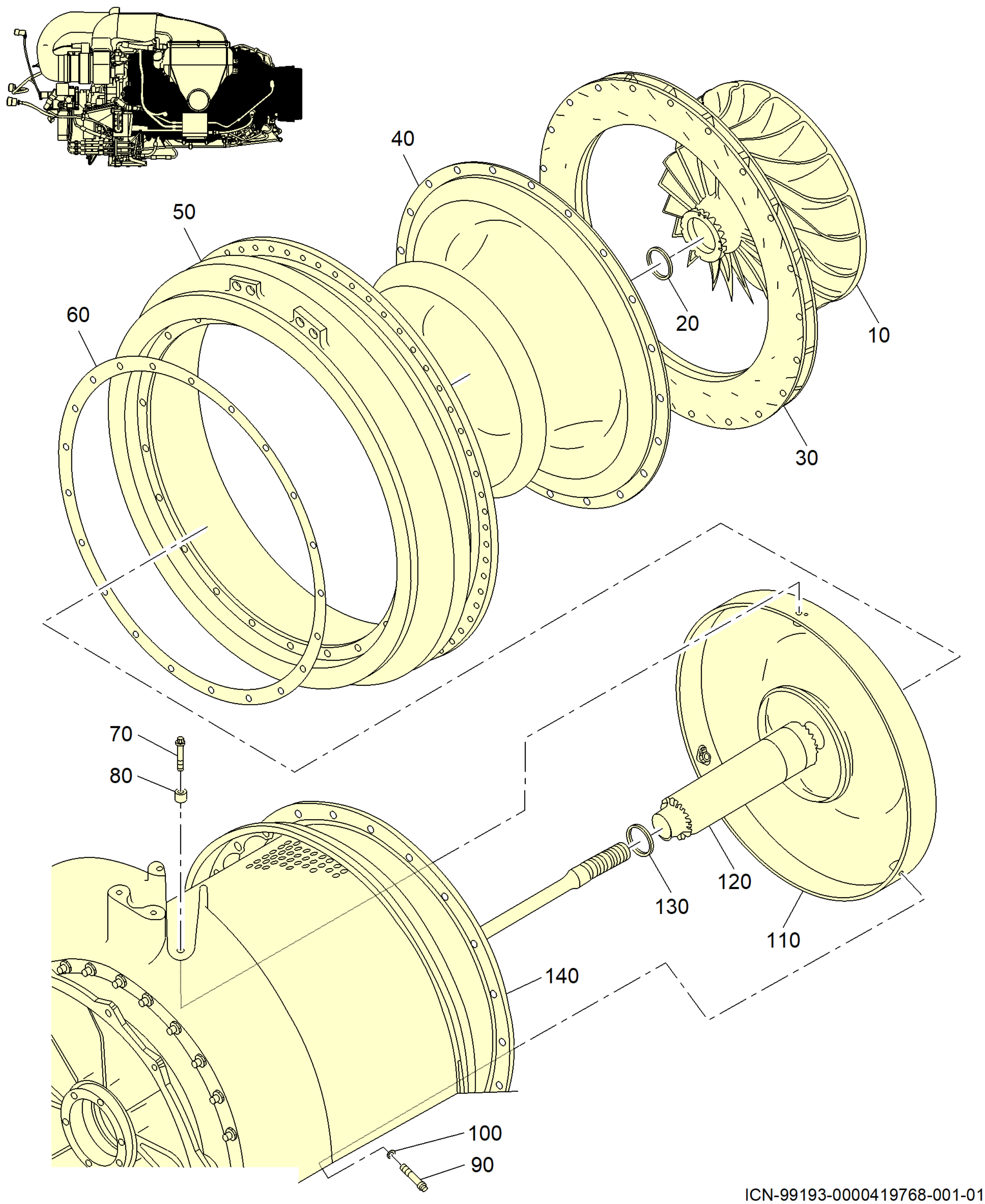


Figure 5009. Disassemble the Engine Compressor Section (Partial Breakdown)

Key to Figure 5009

10. COMPRESSOR ROTOR (IPC FIG. 21)	80. SPACER
20. CURVIC RING SEAL	90. BOLT
30. ENGINE COMPRESSOR DIFFUSER	100. WASHER
40. ENGINE COMPRESSOR SHROUD ASSY	110. INLET GUIDE VANES COVER
50. DIFFUSER HOUSING ASSY	120. SHAFT ASSY
60. INLET HOUSING SHIM	130. CURVIC RING SEAL
70. BOLT	140. POWER SECTION ASSY

(7) Disassemble the engine compressor section and remove the inlet guide vanes cover. Refer to Figure 5009.

(a) Remove compressor rotor (10) from the power section assembly (140).

(b) Remove curvic ring seal (20) from the power section assembly (140).

(c) Remove engine compressor diffuser (30) from the power section assembly (140).

(d) Remove engine compressor shroud assembly (40) from the power section assembly (140).

(e) Remove diffuser housing assembly (50) and installed quantity of inlet housing shims (60) from the power section assembly (140).

(f) Remove bolts (70, 90), spacer (80), washers (100) and inlet guide vanes cover (110) from the power section assembly (140).

(g) Remove shaft assembly (120) and curvic ring seal (130) from the power section assembly (140).

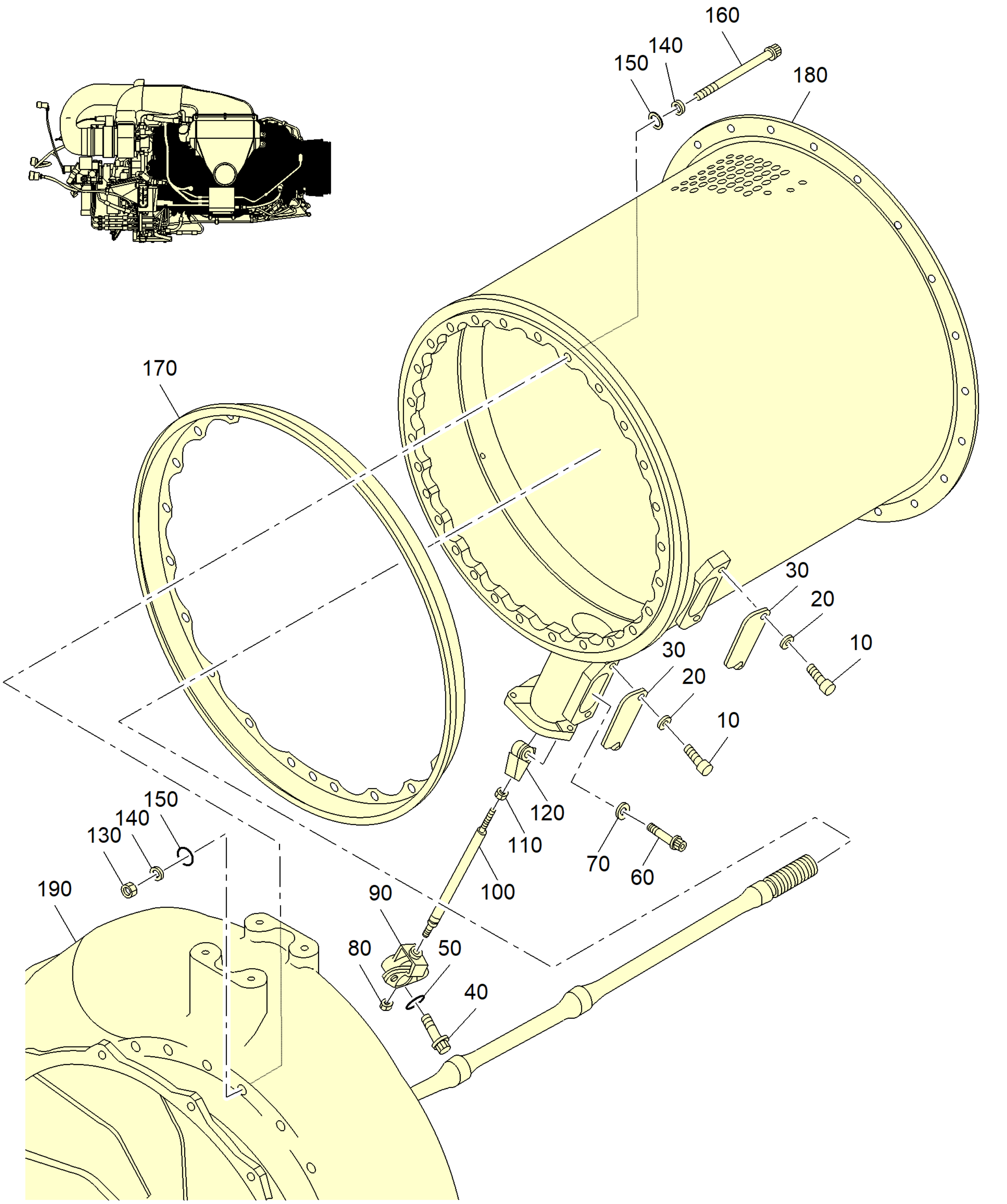


Figure 5010. Disassemble Inlet Guide Vanes Linkage and Inlet Housing from the Power Section (Partial Breakdown)

Key to Figure 5010

10. BOLT (IPC FIG. 22)	110. NUT
20. WASHER	120. ROD END BEARING
30. COVER	130. NUT
40. BOLT	140. WASHER
50. WASHER	150. PACKING WITH RETAINER
60. BOLT	160. EXT RELIEF BOLT
70. WASHER	170. INLET DUCT SUPPORT
80. NUT	180. INLET HOUSING ASSY
90. CLEVIS ASSY	190. POWER SECTION ASSY
100. ACTUATOR ROD	

(8) Disassemble inlet guide vanes linkage and inlet housing from the power section. Refer to Figure 5010.

(a) Remove bolts (10), washers (20) and covers (30) from the inlet housing assembly (180).

(b) Remove bolt (40) and washer (50) from the clevis assembly (90) and actuator rod (100).

(c) Remove bolt (60) and washer (70) on the inlet vanes assembly clevis from the rod end bearing (120).

(d) Remove the linkage from the power section assembly (190). Disassemble the inlet guide vanes linkage as follows:

1 Remove lockwire from nut (110).

2 Remove rod end bearing (120) and nut (110) from actuator rod (100).

3 Remove nut (80) and clevis assembly (90) from the actuator rod (100).

(e) Remove nuts (130), washers (140), packings with retainers (150) and ext relief bolts (160) from the power section assembly (190). Discard packings with retainers.

(f) Remove inlet housing assembly (180) from the power section assembly (190).

(g) Remove inlet duct support (170) from the inlet housing assembly (180).

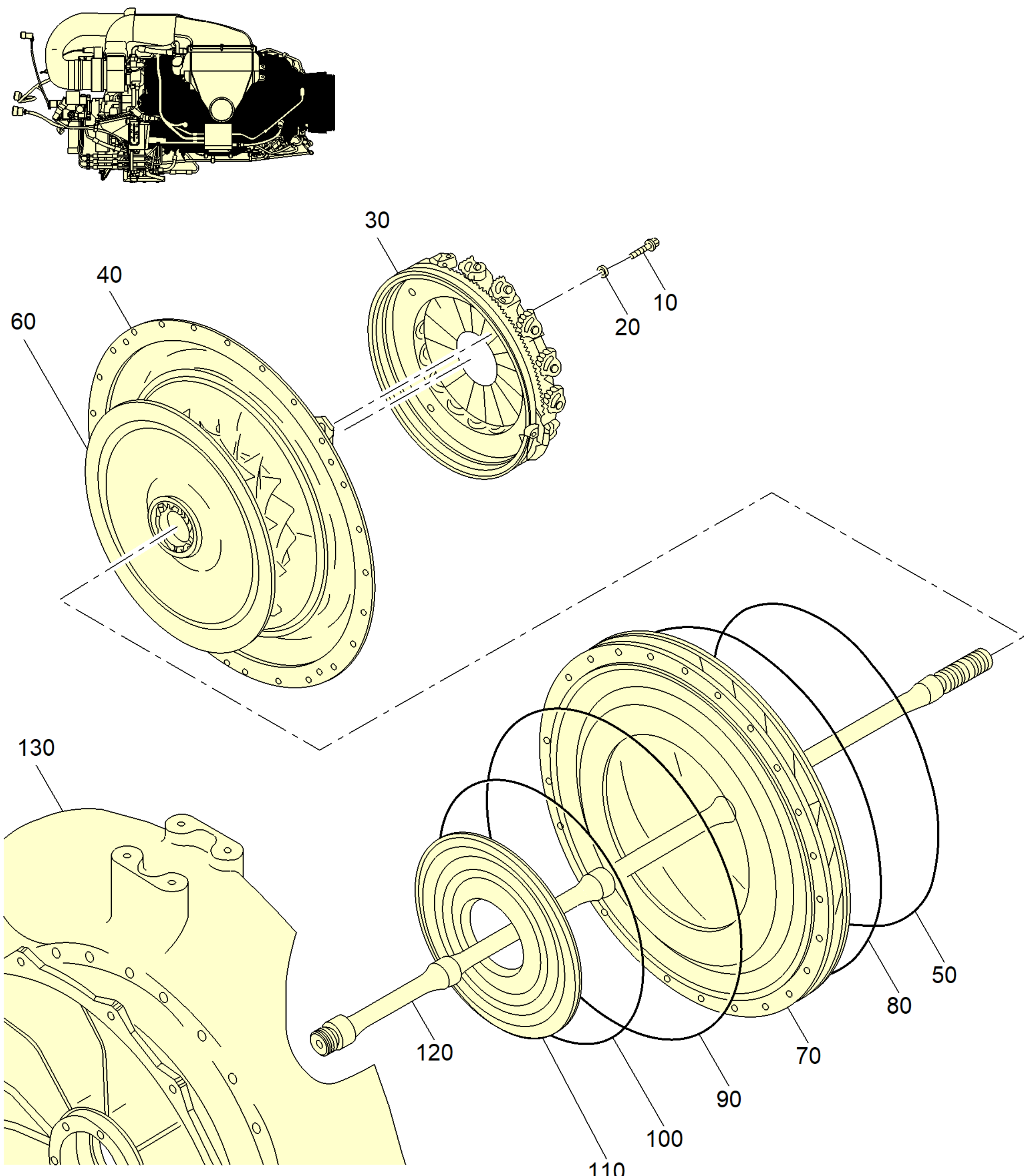


Figure 5011. Disassemble the Inlet Guide Vane Assembly and Load Compressor Section from the Power Section Assembly (Partial Breakdown)

Key to Figure 5011

10.	BOLT (IPC FIG. 23)	90.	PACKING
20.	WASHER	100.	PACKING
30.	INLET GUIDE VANE ASSY	110.	HEAT SHIELD
40.	CENTRIFUGAL CASE	120.	TURBINE SHAFT
50.	PACKING	130.	POWER SECTION ASSY
60.	COMPRESSOR ROTOR	-140.	DRIVEN COMPRESSOR COUPLING SHAFT (IPC FIG. 24)
70.	CENTRIFUGAL DIFFUSER	-.	ITEM NOT ILLUSTRATED
80.	PACKING		

(9) Disassemble the inlet guide vane assembly and load compressor section from the power section as follows. Refer to Figure 5011.

(a) Remove bolts (10), washers (20) and inlet guide vane assembly (30) from the power section assembly (130).

(b) Remove centrifugal case (40) from the power section assembly (130).

(c) Remove packing (50) from the centrifugal diffuser (70). Discard packing.

(d) Remove compressor rotor (60) from the power section assembly (130).

(e) Double nut turbine shaft (120) threaded end and use PN 834864-1 driven compressor coupling shaft holding fixture on driven compressor coupling shaft (140) to remove turbine shaft from the power section assembly (130).

(f) Use a PN 834836-1 diffuser puller to remove centrifugal diffuser (70) with packing (80) from the power section assembly (130). Discard packing.

(g) Remove packings (90, 100) from the power section assembly (130). Discard packing.

(h) Remove heat shield (110) from the power section assembly (130).

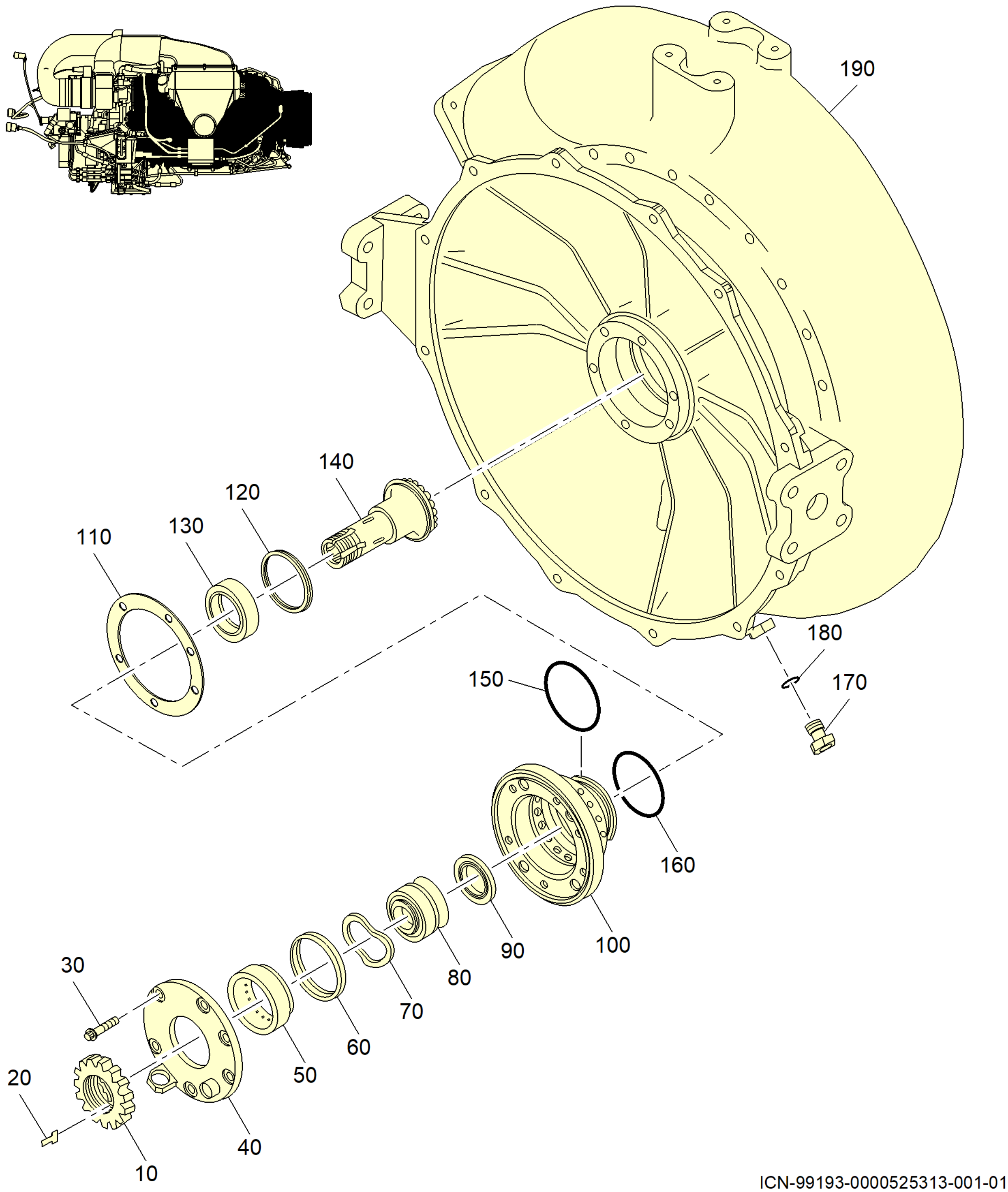


Figure 5012. (Pre SB 131-49-8015) Disassemble the Driven Compressor Bearing Housing Section (Partial Breakdown)

Key to Figure 5012

10.	COMPRESSOR BEARING NUT (IPC FIG. 24)	110.	LC BEARING SHIM
20.	NUT LOCKING KEY	120.	RETAINING RING
30.	BOLT	130.	OIL STATIONARY SEAL
40.	COMPRESSOR BEARING RETAINING PLATE	140.	DRIVEN COMPRESSOR COUPLING SHAFT
50.	BEARING DAMPER RING.	150.	PACKING
60.	SPRING RETAINER	160.	PACKING
70.	COMPRESSION SPRING WASHER	170.	PLUG
80.	MATCHED DUPLEX BALL BEARING ASSY SET	180.	PACKING
90.	SEAL ROTOR	190.	DRIVEN COMPRESSOR BEARING HOUSING
100.	COMPRESSOR BEARING HOUSING	-.	ITEM NOT ILLUSTRATED

(10) Disassemble the driven compressor bearing housing section. Refer to Figure 5012.

(a) Bend up nut locking key (20) and use PN 834801-1 torque adapter to remove compressor bearing nut (10) and nut locking key from the driven compressor coupling shaft (140).

(b) Remove bolts (30) and compressor bearing retaining plate (40) from the driven compressor bearing housing (190).

(c) (Pre SB 131-49-8015) Remove bearing damper ring (50), spring retainer (60) and compression spring washer (70) from the driven compressor bearing housing (190).

(Post SB 131-49-8015) Remove compressor spring washer (70) from the driven compressor bearing housing (190).

(d) Use PN 834808-1 bearing puller to remove matched duplex ball bearing assembly set (80) from the driven compressor coupling shaft (140).

NOTE: Driven compressor coupling shaft (140) will release when matched duplex ball bearing assembly set (80) is removed.

(e) Remove seal rotor (90) from the driven compressor coupling shaft (140).

CAUTION: MAKE SURE THE COMPRESSOR BEARING HOUSING (100) IS REMOVED EVENLY TO PRECLUDE DAMAGE TO THE DRIVEN COMPRESSOR BEARING HOUSING.

(f) Remove compressor bearing housing (100) with packings (150, 160) and installed quantity of LC bearing shims (110) from the driven compressor bearing housing (190). Discard packings.

(g) Remove retaining ring (120) and use PN 834810-1 seal removal and driver tool to remove oil stationary seal (130) from the compressor bearing housing (100).

(h) Remove plug (170) with installed packing (180) from the driven compressor bearing housing (190). Discard packing.

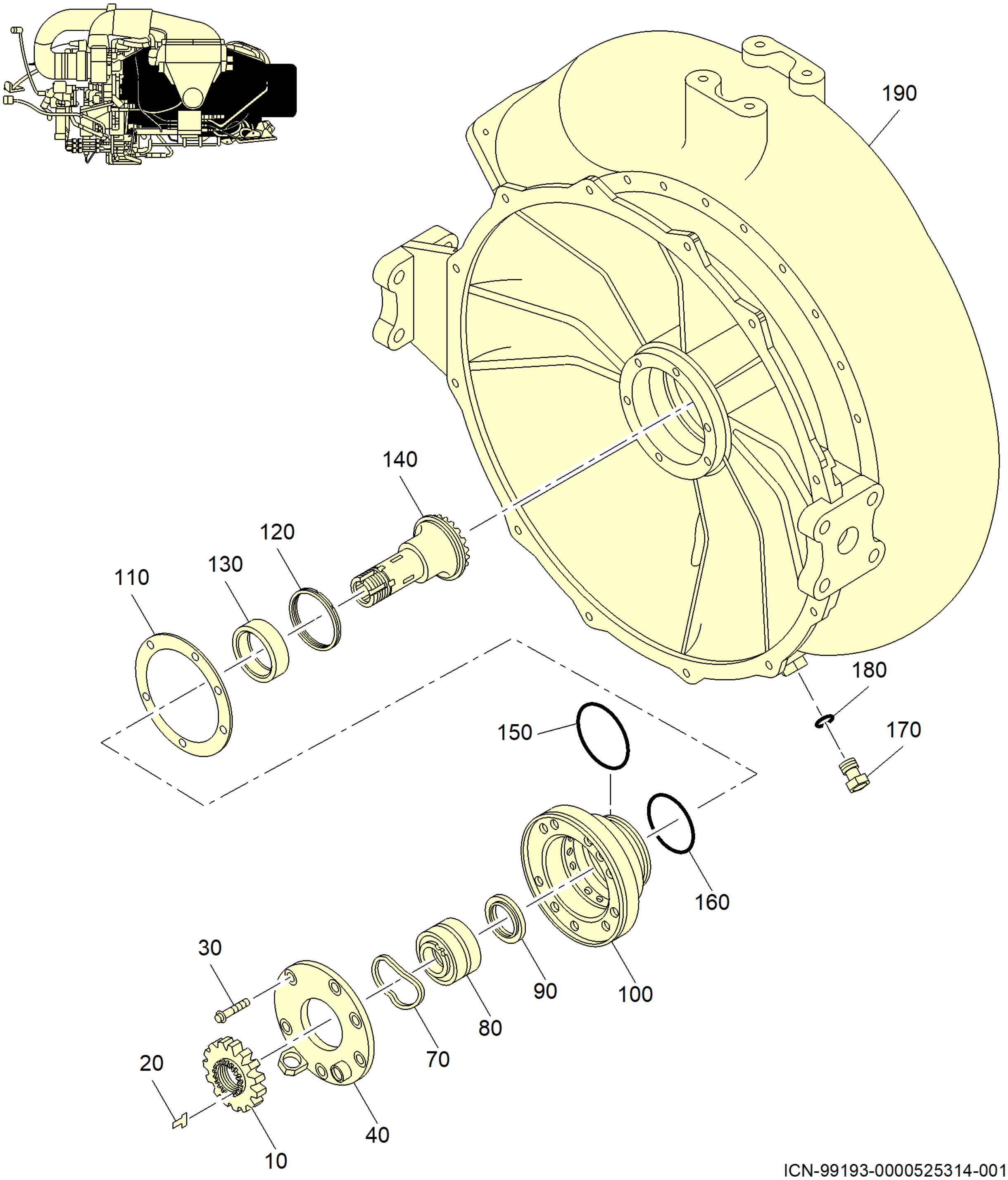


Figure 5013. (Post SB 131-49-8015) Disassemble the Driven Compressor Bearing Housing Section (Partial Breakdown)

Key to Figure 5013

10. COMPRESSOR BEARING NUT (IPC FIG. 24)
20. NUT LOCKING KEY
30. BOLT
40. COMPRESSOR BEARING RETAINING PLATE
70. COMPRESSION SPRING WASHER
80. MATCHED DUPLEX BALL BEARING ASSY SET
90. SEAL ROTOR
100. COMPRESSOR BEARING HOUSING
110. LC BEARING SHIM
120. RETAINING RING
130. OIL STATIONARY SEAL
140. DRIVEN COMPRESSOR COUPLING SHAFT
150. PACKING
160. PACKING
170. PLUG
180. PACKING
190. DRIVEN COMPRESSOR BEARING HOUSING

DIFFUSER HOUSING ASSEMBLY
DISASSEMBLY-03

TASK 49-22-00-050-801

1. **General**

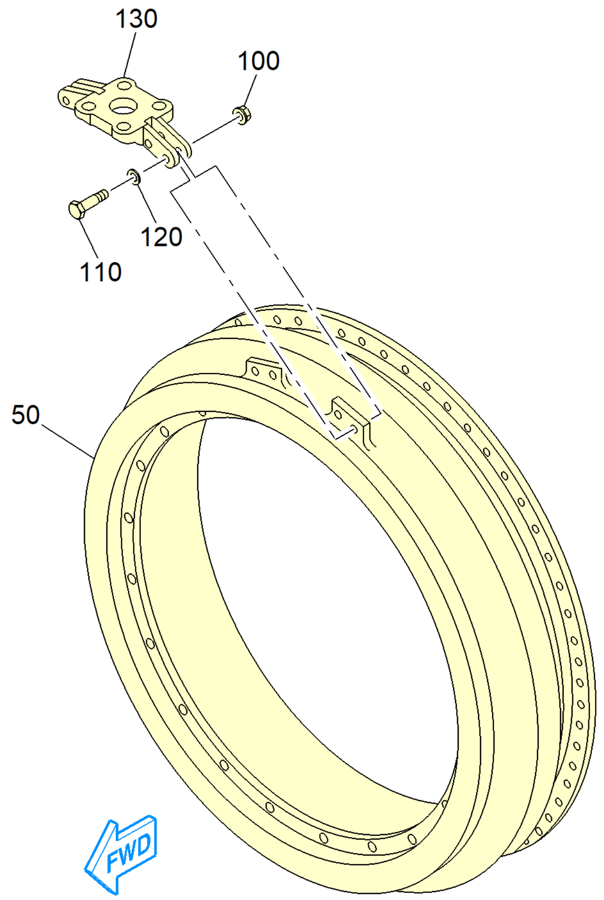
   A. This section contains procedures for disassembly of the diffuser housing assembly.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   None



ICN-99193-0000710607-001-02

Figure 5001. Disassembly of Diffuser Housing

Key to Figure 5001

50.	DIFFUSER HOUSING ASSY (IPC FIG. 21)	120.	SPACER
100.	NUT (IPC FIG. 8)	130.	TOP BRACKET
110.	BOLT		

4. <u>Procedure</u>

SUBTASK 49-22-00-040-003

A. Remove top bracket from diffuser housing. Refer to Figure 5001.

(1) Remove the bolts (110), spacers (120), nuts (100) and top bracket (130) from upper half of diffuser housing assembly (50).

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INLET GUIDE VANE ASSEMBLY DISASSEMBLY-04

TASK 49-22-00-040-801

1. General

A. This section contains procedures for disassembly of the inlet guide vane assembly.

B. Perform the disassembly procedures in a dry, bright, clean room.

C. Be careful to prevent damage to parts that can be used again.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

D. Apply lubricating oil to parts and put them in a protective container to prevent corrosion until the parts can be cleaned and checked.

E. Do not disassemble any glued assemblies.

F. Do not remove bushings unless replacement is necessary.

G. Check all bearing surfaces for roughness and wear. These conditions can be an indication of possible damage.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

None

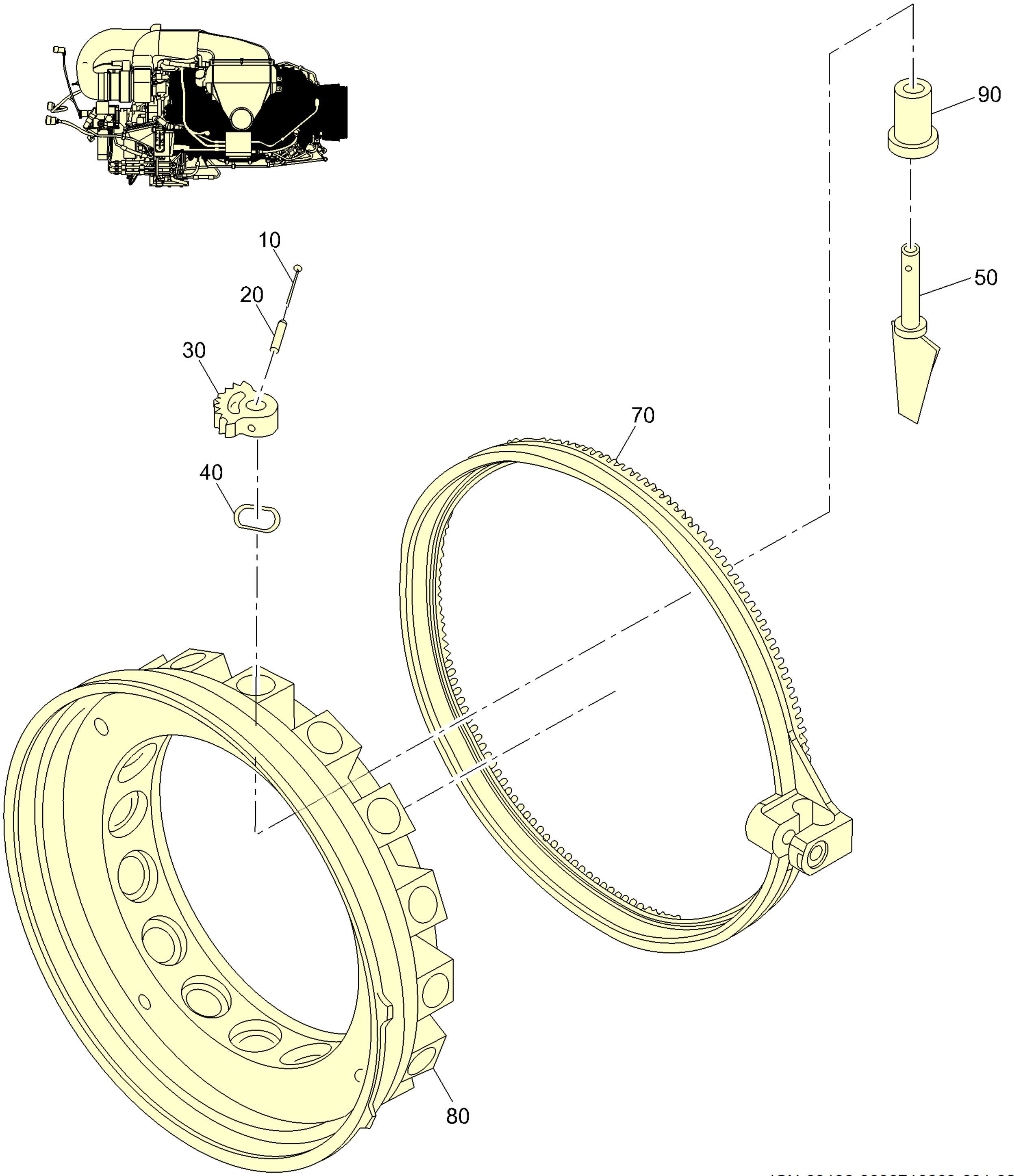

Figure 5001. Disassemble the Inlet Guide Vane Assembly

Key to Figure 5001

10. COTTER PIN (IPC FIG. 29)
20. SPRING PIN
30. SEGMENT GEAR
40. SPRING WASHER
50. INLET GUIDE VANE
90. IGV BUSHING
70. FACE GEAR
80. HOUSING

---

4. Procedure

SUBTASK 49-22-00-040-001

A. Disassemble the Inlet Guide Vane Assembly. Refer to Figure 5001.

(1) Remove cotter pins (10) from spring pins (20).

(2) Remove spring pins (20).

(3) Remove segment gears (30) from spring washers (40).

(4) Remove spring washers (40).

(5) Remove inlet guide vanes (50) from the IGV bushings (90).

NOTE: IGV bushings (90) are glued into housing (80) and should not be removed from the housing except by special machining process when replacement of the IGV bushings is necessary.

(6) Remove face gear (70) from the housing (80).

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FIRST STAGE STATOR ASSEMBLY DISASSEMBLY-05

TASK 49-22-00-040-802

1. General

A. This section contains procedures for disassembly of the first stage stator assembly.

B. Perform the disassembly procedures in a dry, bright, clean room.

C. Be careful to prevent damage to parts that can be used again.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

D. Apply lubricating oil to parts and put them in a protective container to prevent corrosion until the parts can be cleaned and checked.

E. Do not remove pins unless replacement is necessary.

2. Special Tools, Fixtures and Equipment

None

3. Equipment and Materials

None

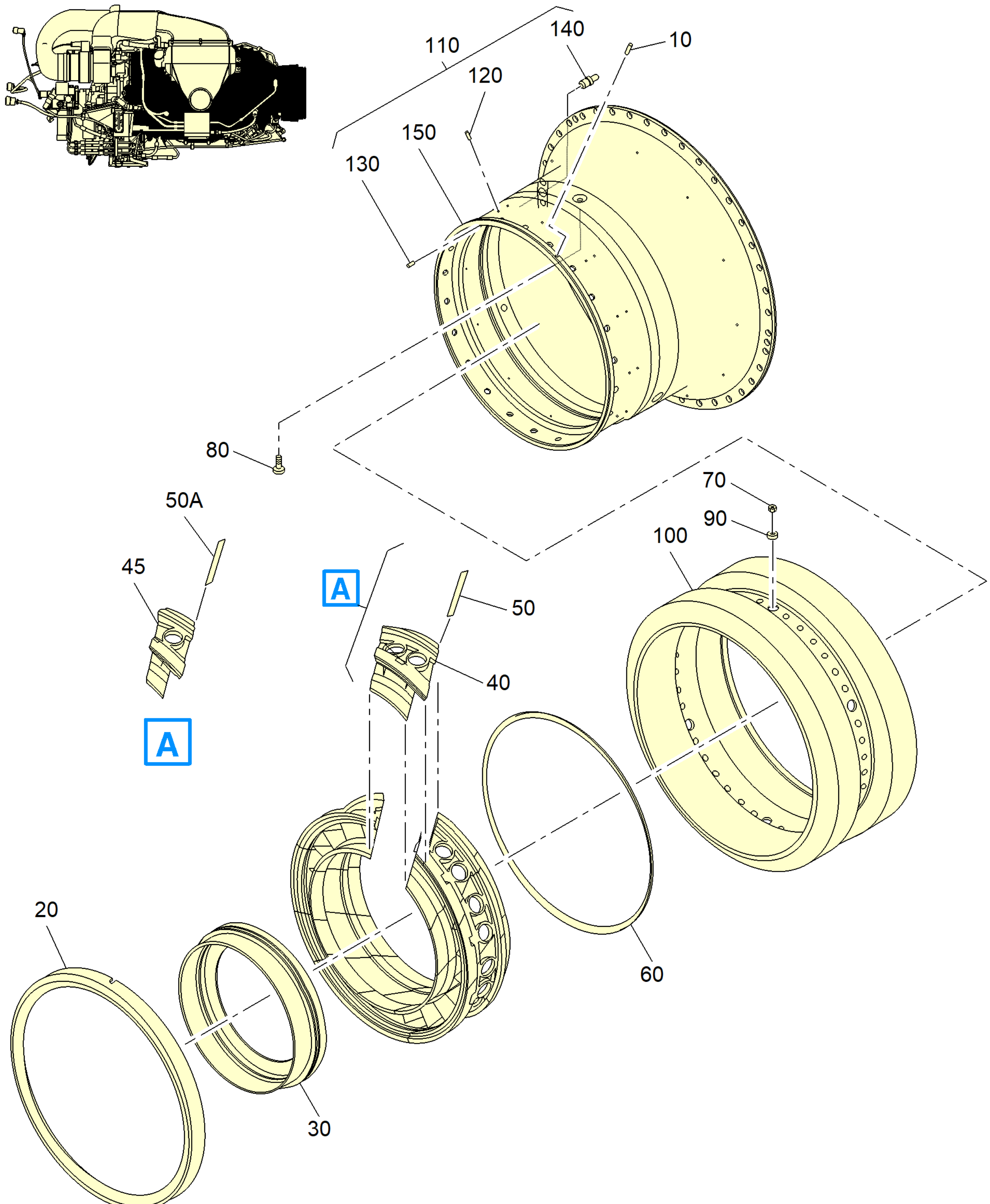

Figure 5001. Disassemble the First Stage Stator Assembly

Key to Figure 5001

10. PIN (IPC FIG. 28)
20. INNER TRANSITION LINER
30. STATOR SUPPORT RING
40. FIRST STAGE TURBINE NOZZLE SEGMENT
45. FIRST STAGE TURBINE NOZZLE SEGMENT
50. FEATHER SEAL
50A. FEATHER SEAL
60. STATOR SEAL RING
70. SELF LOCKING NUT
80. FIRST STAGE STATOR SUPPORT BOLT
90. SLEEVE SPACER
100. CONTAINMENT RING
110. SUPPORT
120. PIN
130. PIN
140. PIN
150. NOZZLE SUPPORT

4. Procedure

SUBTASK 49-22-00-040-002

A. Disassemble the First Stage Stator Assembly. Refer to Figure 5001.

WARNING: USE THE CORRECT PERSONAL PROTECTION. PROCEDURES THAT NEED GRIND/MACHINE WORK WILL CAUSE LOOSE PARTICLES THAT CAN GET IN YOUR EYES.

(1) Drill out pins (10) and remove inner transition liner (20), stator support ring (30), first stage nozzle segments (40), feather seals (50) and stator seal ring (60) from the nozzle support (150).

(2) Remove self locking nuts (70), first stage stator support bolts (80), sleeve spacers (90) and containment ring (100) from the nozzle support (150).

(3) If pins (120) are worn, drill them out from nozzle support (150).

(4) If pins (130) are worn, remove them from nozzle support (150).

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TURBINE AND COMPRESSOR ASSEMBLY
CLEANING-1

TASK 49-22-00-100-801

1. General

A. This section contains procedures for cleaning the components of the turbine and compressor assembly.

2. Cleaning Methods

A. Table 6001 shows the standard cleaning methods necessary for cleaning of the components. Refer to Standard Practices Manual (SPM) 20-00-02/70-00-01 for the cleaning procedures.

Table 6001. Cleaning Methods

IPC Figure No.	Item No.	Nomenclature	Cleaning Methods								
			203A	203V	203E	203F	203J	203Q	203N	203P	203K
All standard metallic hardware			X	X							
16	60	Fuel nozzle air shroud	X	X			X				
	80, 90, 100,	Side blanket	X	X			X				
	110, 120, 130	Aft side blanket	X	X			X				
17	110	Lifting bracket	X	X			X				
18	20	Exhaust center body cap	X	X			X				
	70, 80	Tube assembly	X	X			X				
	120	Bearing retainer assembly	X	X			X				
	180	Turbine bearing housing assembly	X	X			X				
	200	Forward turbine bearing insulation blanket	X	X			X				
	220	Stationary air seal	X	X			X				
	230	Aft bearing shaft	X	X			X				
	240	Rear bearing seal	X	X			X				

Table 6001. Cleaning Methods (Cont)

IPC Figure No.	Item No.	Nomenclature	Cleaning Methods								
			203A	203V	203E	203F	203J	203Q	203N	203P	203K
	260	Spring washer	X	X			X				
	270	Seal retainer	X	X			X				
	280	Bearing set								X	
19	10, 30, 120	Seal ring	X	X			X				
	20	Second stage turbine rotor assembly	X	X			X				
	40, 130	Coupling shaft	X	X			X				
	70	Second stage turbine stator baffle	X	X			X				
	90	Second stage stator seal weldment	X	X			X				
	100	Second stage stator assembly	X	X			X				
	140	Turbine plenum shim	X	X			X				
	150	Retaining ring	X	X			X				
	160	Shroud support ring	X	X			X				
	170	Shroud segment seal	X	X			X				
	180, 190	First stage turbine shroud segment	X	X			X				
	200	Feather seal	X	X			X				
	230	Air seal	X	X			X				
	240	Turbine seal	X	X			X				
20	30	Combustor case	X	X			X				
	50	Annular combustion chamber	X	X			X				

Table 6001. Cleaning Methods (Cont)

IPC Figure No.	Item No.	Nomenclature	Cleaning Methods 203A	203V	203E	203F	203J	203Q	203N	203P	203K
	110	Air stationary seal support	X	X			X				
	130	Engine compressor deswirl	X	X			X				
21	10	Compressor rotor									X
	30	Engine compressor diffuser	X	X			X				
	40	Engine compressor shroud assembly	X	X			X				
	50	Diffuser housing assembly	X	X			X				
	60	Inlet housing shim	X	X			X				
	110	Inlet guide vanes cover			X	X					
	120	Shaft assembly	X	X			X				
22	90	Clevis assembly	X	X			X				
	100	Actuator rod	X	X			X				
	120	Rod end bearing	X				X				
	170	Inlet duct support			X	X					
	180	Inlet housing assembly			X	X					
23	40	Centrifugal case	X	X			X				
	60	Compressor rotor									X
	70	Centrifugal diffuser	X	X			X				
	110	Heat shield	X	X			X				
	120	Turbine shaft	X	X			X				
24	10	Compressor bearing nut	X	X			X				
	40	Compressor bearing retaining plate	X	X			X				

Table 6001. Cleaning Methods (Cont)

IPC Figure No.	Item No.	Nomenclature	203A	203V	203E	203F	203J	203Q	203N	203P	203K
			Cleaning Methods								
	50*	Bearing damper ring	X	X			X				
	60*	Spring retainer	X	X			X				
	70	Compression spring washer	X	X			X				
	80	Matched duplex ball Bearing assembly set								X	
	90	Seal rotor	X	X			X				
	100	Compressor bearing housing	X	X			X				
	110	LC Bearing shim	X	X			X				
	120	Retaining ring	X	X			X				
	140	Driven compressor coupling shaft	X	X			X				
	190	Driven compressor bearing housing			X	X					
* Post SB 131-49-8015: Delete Item No. 50 Bearing Damper Ring and Item No. 60 Spring Retainer.											
26	120	Bearing carrier			X	X					
	130	Gearbox housing			X	X					
28	20	Inner transition liner	X	X			X				
	30	Stator support ring	X	X			X				
	40	First stage turbine nozzle segment	X	X			X				
	50	Feather seal	X	X			X				
	60	Stator seal ring	X	X			X				
	100	Containment ring	X	X			X				
	110	First stage nozzle support assembly	X	X			X				
29	30	Segment gear						X			
	40	Spring washer	X	X			X				
	50	Inlet guide vane			X	X					

Table 6001. Cleaning Methods (Cont)

IPC Figure No.	Item No.	Nomenclature	Cleaning Methods 203A	203V	203E	203F	203J	203Q	203N	203P	203K
	70	Face gear			X	X					
	80	Housing			X	X					
31	10	Axial turbine disk	X	X			X				
	20	Turbine rotor blade	X	X			X				
	30	Blade retainer	X	X			X				
	40	Turbine blade seal	X	X			X				

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CHECK

1. Refer to INSPECTION/REPAIR Manual, ATA No. 49-26-85, for check procedures.

   NOTE: INSPECTION/REPAIR Manual, ATA NO. 49-26-85, is a companion manual to this ENGINE Manual.

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REPAIR

1. Refer to ATA No. 49-26-85 for repair procedures.

   NOTE: INSPECTION/REPAIR Manual, ATA NO. 49-26-85, is a companion manual to this ENGINE Manual.

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INLET GUIDE VANE ASSEMBLY
ASSEMBLY-01

TASK 49-22-00-440-801

1. **General**

   A. This section contains procedures for assembly of the inlet guide vane assembly.

   B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

2. **Special Tools, Fixtures and Equipment**

   A. Table 10001 shows the necessary special tools, fixtures and equipment for installation.

Table 10001. Special Tools, Fixtures and Equipment

Nomenclature	Use	Part No.
NOTE: Equivalent tools, fixtures and equipment can be used.		
Spring Pin Installer	Install spring pins	834861-1
IGV Assembly Mount	Hold inlet guide vanes in position during assembly	834935-1
Force meter	Force meter (gives required force to move IGV vanes)	Commercially available

3. **Equipment and Materials**

Table 10002. Equipment and Materials

Equipment/Materials	Description/Manufacturer
NOTE: Equivalent equipment/material can be used.	
Contact cleaner (QD) (PN 03131 or 03132)	CAGE: 023V4
Plastic squirt bottle with siphon tube (used for cleaning parts)	Commercially available

4. **Procedure**

Table 10003. Parts to Clean Prior to Power Section Assembly

Nomenclature	IPC Figure	Item Number
Compressor Bearing Nut	24	10
Compressor Bearing Retaining Plate	24	40
Bearing Damper Ring*	24	50
Spring Retainer*	24	60
Compression Spring Washer	24	70

Table 10003. Parts to Clean Prior to Power Section Assembly (Cont)

Nomenclature	IPC Figure	Item Number
Seal Rotor	24	90
Compressor Bearing Housing	24	100
Driven Compressor Coupling Shaft	24	140
Driven Compressor Bearing Housing	24	190

* Post SB 131-49-8015: Delete Item No. 50 Bearing Damper Ring and Item No. 60 Spring Retainer.

A. Special cleaning procedures before assembly. Refer to Table 10003.

NOTE: This special cleaning procedure is done to help prevent lube system contamination in the load compressor bearing zone.

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

(1) Prepare 1.0 qt (1.0 l) plastic squirt bottle, with siphon tube, for cleaning parts as follows:

(a) Put 0.5 qt (0.5 l) contact cleaner Contact Cleaner (QD), PN 03131 or PN 03132 in squirt bottle.

(b) Shake the squirt bottle and squirt contact cleaner through the siphon tube to completely clean the siphon tube and rinse the bottle internally.

(c) Remove the cap with siphon tube from the plastic bottle and rinse and pour out remainder of contact cleaner into a collection tray.

(d) Fill squirt bottle with fresh contact cleaner and install cap with siphon tube.

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

WARNING: CLEAN THE PARTS IN AN AREA OPEN TO THE AIR, HAS GOOD LIGHT AND SUFFICIENT SAFETY AND FIRE PREVENTION EQUIPMENT.

(2) Clean the parts listed in Table 10003 as follows:

NOTE: Clean the driven compressor coupling shaft, (140, Figure 10018), after all rotating group balance and run-out procedures are completed. Make sure the alignment marks made during Step 5.D.(1) are not removed.

It is not necessary to clean the impeller air side of the compressor bearing housing, (190, Figure 10006), if the part is installed on the APU immediately after cleaning. Both sides of the housing must be cleaned if the part will not be installed immediately after cleaning.

(a) Use the squirt bottle to flush and clean the parts with contact cleaner.

1 Collect the used contact cleaner in a collection tray.

WARNING: USE THE CORRECT PERSONAL PROTECTION. COMPRESSED AIR WILL CAUSE LOOSE PARTICLES THAT CAN GET IN YOUR EYES. THE AIRFLOW CAN CAUSE CUTS. DO NOT POINT IT AT YOUR SKIN.

(b) Use filtered compressed air to dry the parts.

(c) The lube module must be cleaned as follows:

1 Remove the inboard filter housing with packing and filter from the lube module.

2 Remove the protective plastic cap from the opening of the oil passage downstream of the oil filter.

3 Use the squirt bottle to flush and clean the oil passage from the filter end with contact cleaner.

4 Use filtered compressed air to dry the oil passage.

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

WARNING: USE THE CORRECT PERSONAL PROTECTION. COMPRESSED AIR WILL CAUSE LOOSE PARTICLES THAT CAN GET IN YOUR EYES. THE AIRFLOW CAN CAUSE CUTS. DO NOT POINT IT AT YOUR SKIN.

5 Clean the plastic cap with contact cleaner.

6 Use filtered compressed air to dry the plastic cap.

7 Install the plastic cap on the lube module.

8 Install the filter and filter housing with packing on the lube module. Torque the filter housing to a torque value of 20 in-lb (2.26 Nm).

(3) If the part(s) are not installed on the APU immediately after being cleaned, perform the following:

(a) Put the cleaned part(s) in a new clean plastic bag.

(b) Fold over the open end of the plastic bag and staple closed.

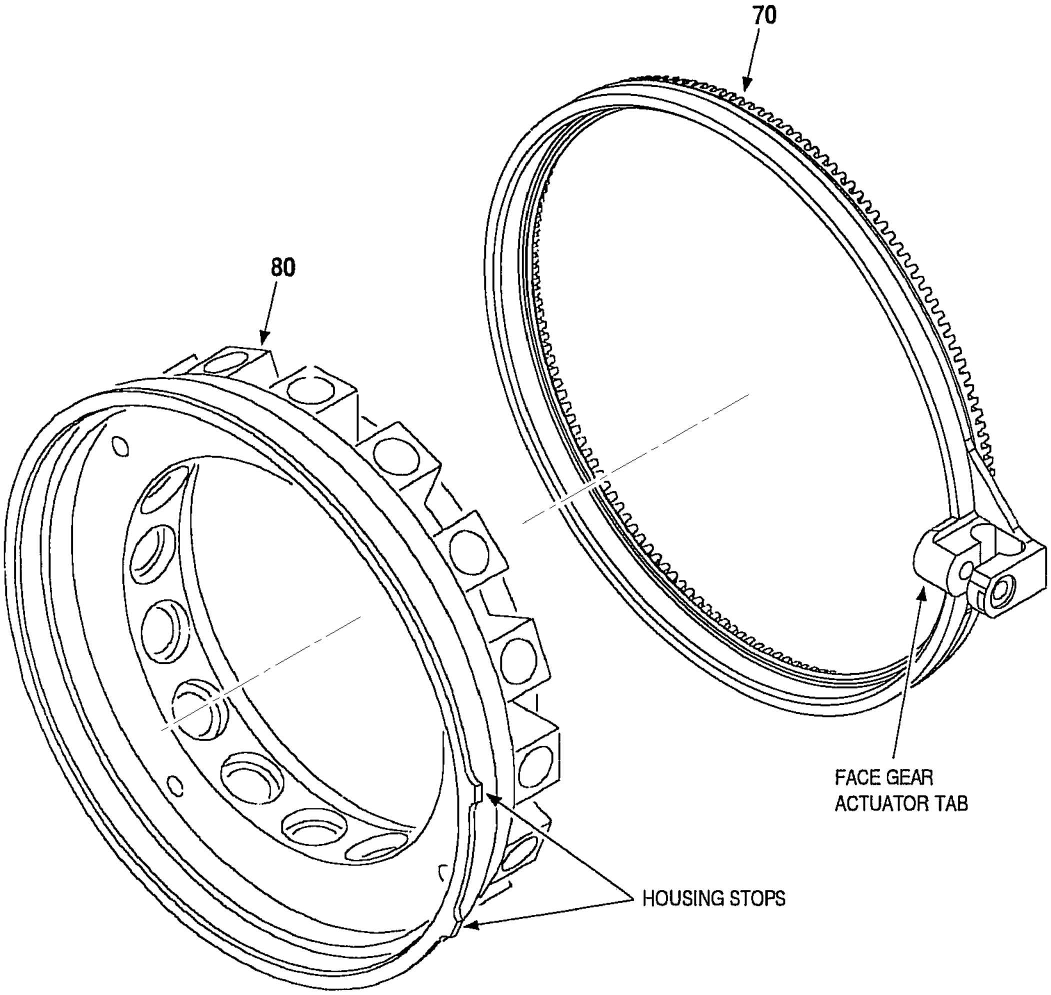

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Figure 10001. (Sheet 1 of 2) Assemble the Inlet Guide Vane Assembly

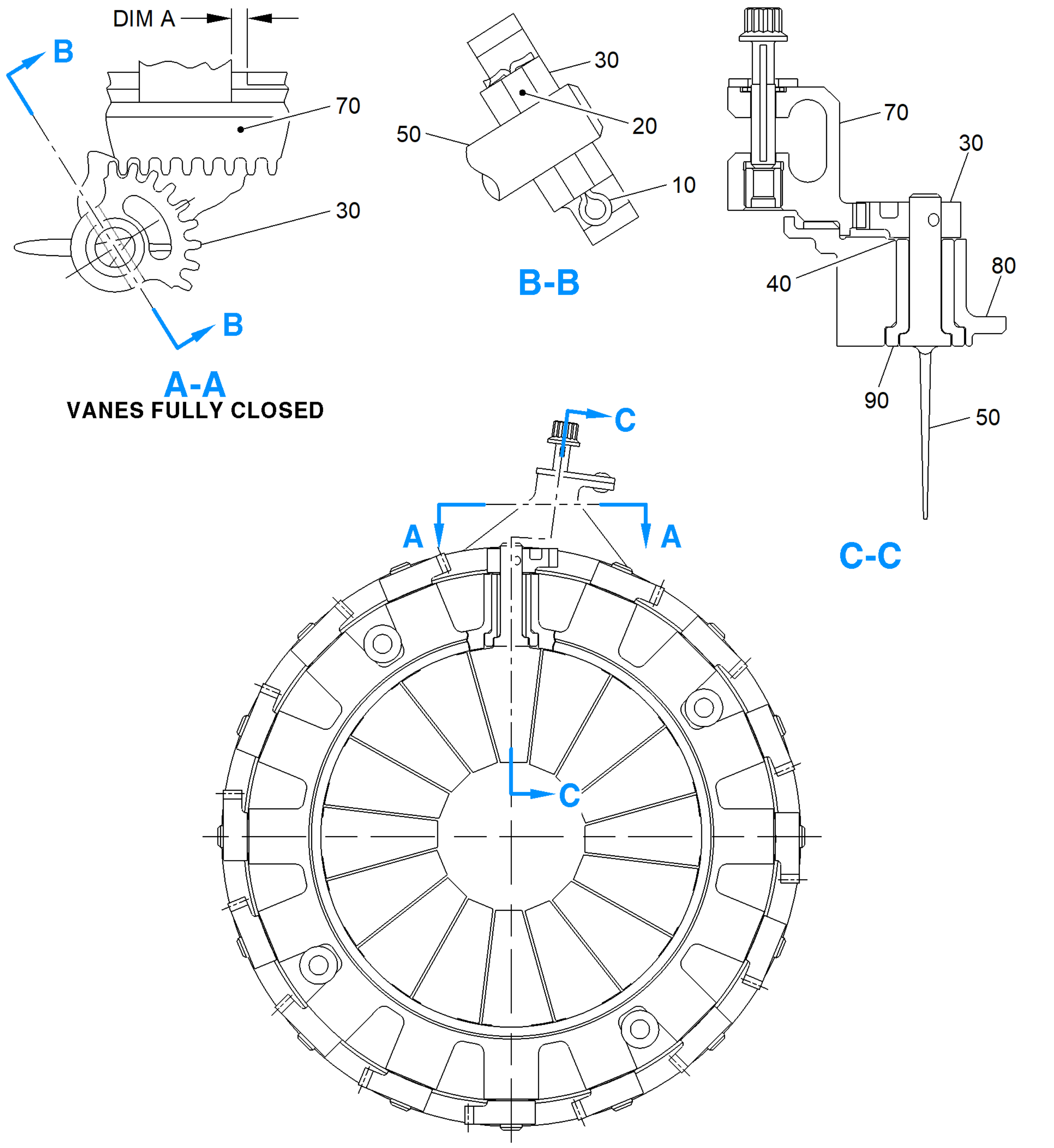


Figure 10001. (Sheet 2 of 2) Assemble the Inlet Guide Vane Assembly

Key to Figure 10001

10. COTTER PIN (IPC FIG. 29)	50. INLET GUIDE VANE
20. SPRING PIN	90. IGV BUSHING
30. SEGMENT GEAR	70. FACE GEAR
40. SPRING WASHER	80. HOUSING

SUBTASK 49-22-00-440-001

B. Assemble the Inlet Guide Vane (IGV) Assembly.

(1) Install face gear (70) on housing (80) with face gear actuator tab between housing stops. Refer to Figure 10001 (Sheet 1 of 2).

(2) Install inlet guide vanes (50) and segment gears (30) as follows. Refer to Figure 10001 (Sheet 2 of 2).

(a) Put assembled face gear (70) and housing (80) on IGV assembly mount PN 834935-1.

(b) Install inlet guide vanes (50) into housing (80).

(c) Position face gear (70) against stop in direction shown in View A-A.

(d) With inlet guide vanes (50) fully closed, install spring washers (40) and segment gears (30) on inlet guide vanes as shown in Section C-C. Make sure segment gears are aligned with V mark on inlet guide vanes and engaged with face gear (70) as shown in View A-A.

(e) Use spring pin installer PN 834861-1 to install spring pins (20) into assembled segment gears (30) and inlet guide vanes (50). Refer to Section B-B.

(f) Make sure inlet guide vanes (50) are fully close, then measure Dimension A as shown in View A-A. Dimension A must be 0.050 to 0.150 inch (1.27 to 3.81 mm).

1 If Dimension A is not in limits, repeat Steps (d) thru (f).

(g) Install cotter pins (10) into spring pins (20). Bend and trim cotter pin ends as shown in Section B-B.

(3) Move face gear (70) on housing (80) to make sure inlet guide vane assembly works smoothly. The force necessary to move the face gear on the housing must not be more than 5 pounds force (22 Newton's).

ROTATING GROUP ASSEMBLY
ASSEMBLY-02

TASK 49-22-00-820-801

1. General

A. This section contains procedures for balance and run out alignment of the rotating group assembly.

B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

2. Special Tools, Fixtures and Equipment

A. Table 10001 shows the necessary special tools, fixtures and equipment for installation.

Table 10001. Special Tools, Fixtures and Equipment

Nomenclature	Use	Part No.
NOTE: Equivalent tools, fixtures and equipment can be used.		
Balance Machine (Model HL-2B)	Balance rotating group (Model HL-2B)	CAGE: 30218
Bearing Driver	Press on bearing simulator	834701-1
Shaft Stretch Kit	Used to stretch shaft tool	834740-2
Removal Tool	Remove bearing simulator	834883-1
Button press	Support and press bearing simulator	834759-8
Rotating Group Support Assembly	Measure rotating group length	834857-1
Coupling Holder	Hold driven compressor coupling shaft when tie shaft is torqued	834864-1
Runout Checking Fixture	Check rotating group runout	285868-2-1
Stretch Shaft Tooling Coupling Nut Shaft	Stretch turbine shaft	834889-1
Torque Adapter	Adapt torque wrench to tieshaft nut	834890-1
Roller Bearing Simulator	Simulate roller bearing	834926-1

3. Equipment and Materials

A. Table 10002 shows the necessary equipment and materials for installation.

Table 10002. Equipment and Materials

Equipment/Materials	Description/Manufacturer
NOTE: Equivalent equipment/materials can be used.	
Anti-seize thread compound (Never Seez Pure Nickel Special) (MIL-PRF-907)	Bostik Inc, 211 Boston St, Middleton, MA 01949
Anti-seize thread compound (Never Seez Regular Grade) (MIL-PRF-907)	Bostik Inc, 211 Boston St, Middleton, MA 01949
Marking compound (Dykem Hi-Spot Blue or Steel Blue/Red)	ITW Dykem, P.O. Box 340, 805 E. Highway 56, Olathe, KS 66051-0340
Marking compound (Ink violet 127 1/2)	Pannier Corporation, 207 Sandursky Street, Pittsburgh, PA 1512-5823 Phone: 412-3223-4900

4. Procedure

Table 10003. Check Point Summary

Check Point	Operation	Page
10	Verify and write down Dimensions U and BU.	10007
20	Verify and write ram pressure Actual Load.	10007
30	Verify and write Dimensions BS and S.	10009
40	Verify runout is correct and within limits.	10009
50	Verify balance is correct and within limits.	10010
60	Verify assembly components have been grouped together as matched parts for the next assembly.	10011
70	Verify lot and serial numbers of noted hardware are correctly written on traceability card.	10011

SUBTASK 49-22-00-440-002

A. Assemble the Rotating Group Assembly.

(1) Install turbine shaft on driven compressor coupling shaft as follows:

(a) Put PN 834864-1 driven compressor coupling shaft holding fixture in a vice and install driven compressor coupling shaft (140) on fixture spline.

WARNING: **USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.**

(b) Lubricate threads on forward end of turbine shaft (90) with anti-seize thread compound (Never Seez Pure Nickel Special or Regular Grade) and install forward end of turbine shaft into driven compressor coupling shaft (140).

(c) Tighten turbine shaft (90) in driven compressor coupling shaft (140) to 150 in-lb (16.95 Nm) with two nuts jammed together on free end of turbine shaft.

(2) Assemble rotating elements on turbine shaft as follows: Refer to Figure 10001.

(a) Position assembled driven compressor coupling shaft (140) and turbine shaft (90) on PN 834857-1 rotating group stand.

(b) Install the compressor rotor (60), the shaft assembly (120), large diameter up and the compressor rotor (10) on the driven compressor coupling shaft (140).

NOTE: Make sure the curvic high-point mark on each curvic coupling is positioned 180 degrees from the high-point mark on the mating curvic coupling.

(c) Install the coupling shaft (130) on the compressor rotor (10).

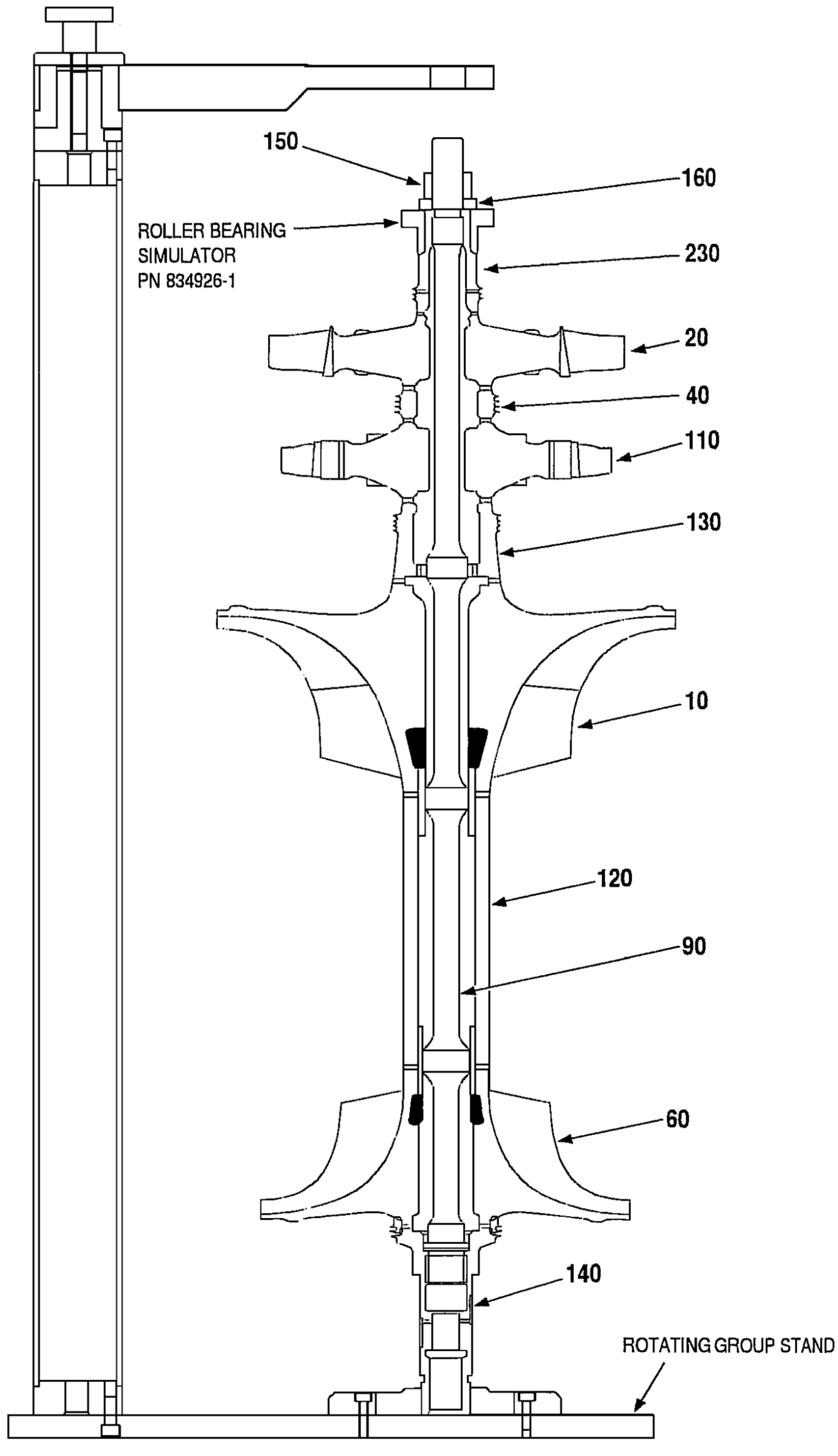
NOTE: Make sure the curvic high-point mark on each curvic coupling is positioned 180 degrees from the high-point mark on the mating curvic coupling.

Make sure curvic is clean using SPM 20-00-02/70-00-01.

(d) Install the first stage turbine rotor assembly (110), with the word "AFT" pointing up, on the coupling shaft (130).

NOTE: Make sure the curvic high-point mark on each curvic coupling is positioned 180 degrees from the high-point mark on the mating curvic coupling.

Make sure the first stage turbine rotor assembly (110) is positioned with the word "AFT" pointing up.



ICN-99193-0000673156-001-01

Figure 10001. Assemble the Rotating Group

Key to Figure 10001

10. COMPRESSOR ROTOR (IPC FIG. 21)	120. SHAFT ASSY (IPC FIG. 21)
20. SECOND STAGE TURBINE ROTOR ASSY (IPC FIG. 19)	130. COUPLING SHAFT (IPC FIG. 19)
40. COUPLING SHAFT	140. DRIVEN COMPRESSOR COUPLING SHAFT (IPC FIG. 24)
60. COMPRESSOR ROTOR (IPC FIG. 23)	150. TIESHAFT NUT (IPC FIG. 18)
90. TURBINE SHAFT (120, IPC FIG. 23)	160. TIESHAFT WASHER
110. FIRST STAGE TURBINE ROTOR ASSY (IPC FIG. 19)	230. AFT BEARING SHAFT

(e) Install the coupling shaft (40) and the second stage turbine rotor assembly (20) on the first stage turbine rotor assembly (110).

NOTE: Make sure the curvic high-point mark on each curvic coupling is positioned 180 degrees from the high-point mark on the mating curvic coupling.

(f) Press PN 834926-1 roller bearing simulator and install the roller bearing simulator on the aft bearing shaft (230).

NOTE: Use arbor press PN 834759-8 press button and PN 834701-1 bearing press tube to push on the PN 834926-1 roller bearing simulator on curvic end of the aft bearing (230).

(g) Install the aft bearing shaft (230) with installed roller bearing simulator, on the second stage turbine rotor assembly (20).

(h) Install the tieshaft washer (160).

(i) Install the tieshaft nut (150) on the turbine shaft (90).

NOTE: Make sure no curvices are stacked.

(j) Use PN 834890-1 torque adapter to tighten the tieshaft nut (150) to a torque value of 120 in-lb (13.56 Nm).

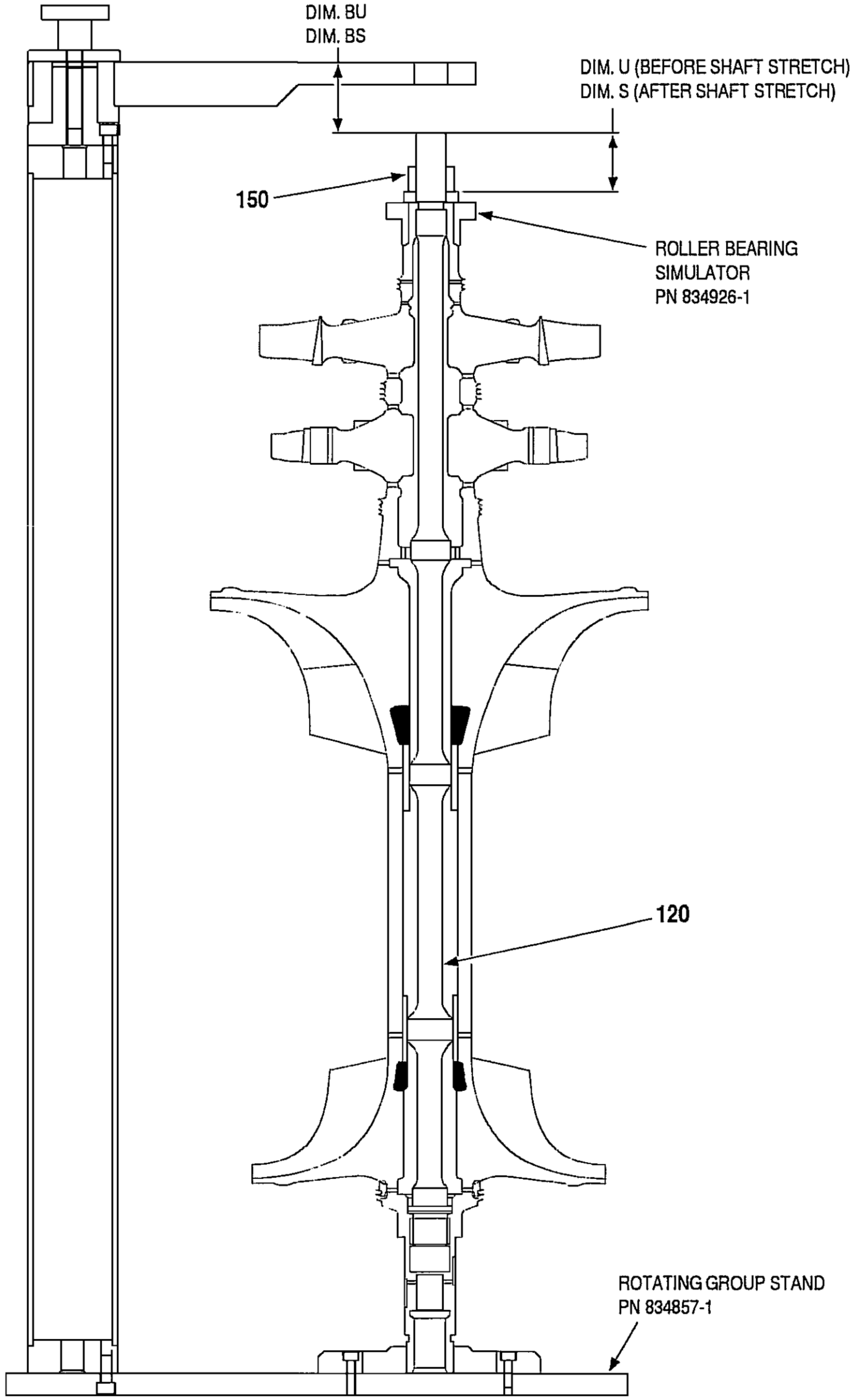


Figure 10002. Measure the Rotating Group

Key to Figure 10002

120. TURBINE SHAFT (IPC FIG. 23)   150. TIESHAFT NUT (IPC FIG. 18)

(3) Measure the rotating group. Refer to Figure 10002.

(a) Install assembled rotating group on PN 834857-1 rotating group support assembly.

(b) Measure and write unstretched Dimension U and Dimension BU as follows:

1 Measure Dimension U and write below (to be used when engine is in various build stages to make sure rotating group is not stacked).

Dimension U ____________________inch (mm)

2 Use mic stand to measure Dimension BU and record below.

Dimension BU __________________inch (mm)

Check Point 10: Verify and write down Dimensions U and BU.

(c) Measure and write down the results of the stretched Dimensions BS and S as follows:

1 Stretch the turbine shaft (120) as follows:

a Install the PN 834889-1 stretch shaft tooling.

b Stretch the turbine shaft (120) to a load of 5400 to 5600 PSIG (37,232 to 38,611 kPa) and hand tighten tieshaft nut (150). Write the actual load below.

Ram pressure Actual Load = _______________PSIG (kPa)

Check Point 20: Verify and write ram pressure Actual Load.

c Release pressure on PN 834889-1 ram.

d Remove the PN 834889-1 stretch shaft tooling.

2 Use PN 834857-1 rotating group support assembly to measure Dimension BS and record below.

Dimension BS ________________________inch (mm)

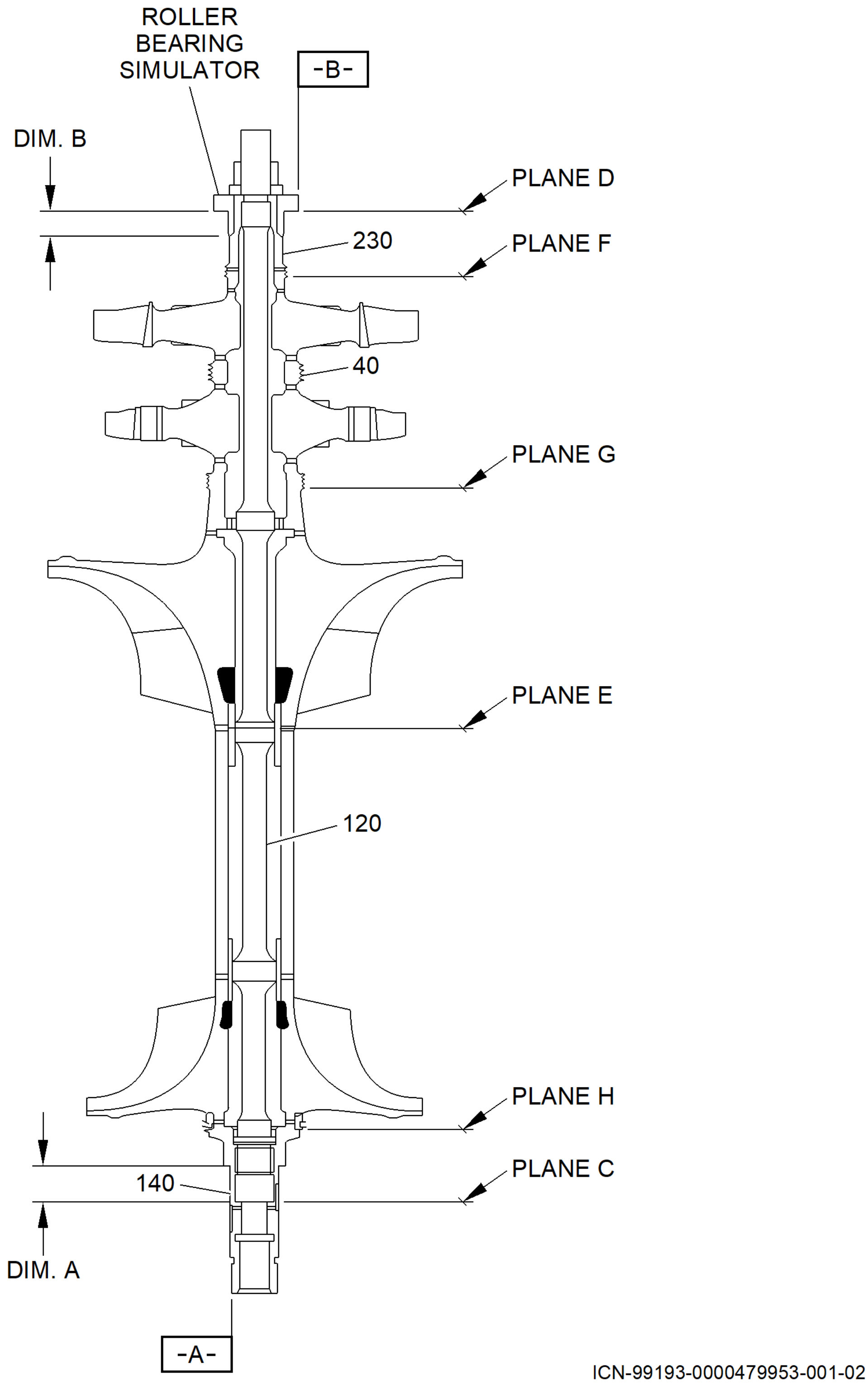


Figure 10003. Rotating Group Balance and Runout Check

Key to Figure 10003

40.	COUPLING SHAFT (IPC FIG. 19)	140.	DRIVEN COMPRESSOR COUPLING SHAFT (IPC FIG. 24)
120.	TURBINE SHAFT (IPC FIG. 21)	230.	AFT BEARING SHAFT (IPC FIG. 18)

DIM. A 0.900 IN. (22.86 MM) DIM. B 0.707 IN. (17.96 MM)

3 Use the following equation to get actual tieshaft stretch and compare to necessary actual stretch.

Actual Stretch BS = Dimension BU - Dimension BS =

______________________inch (mm)

Necessary Actual Stretch BS = 0.104 to 0.106 inch (2.64 to 2.69 mm).

NOTE: If Actual Stretch BS does not equal Necessary Stretch BS repeat Steps 4.A.(3)(C)1a thru d, adjust Actual Load to get Actual Stretch BS equal to Necessary Actual Stretch BS in limits shown.

4 Use PN 834857-1 rotating group support assembly to measure Dimension S and record below.

Dimension S ________________________inch (mm)

Check Point 30: Verify and write Dimensions BS and S.

SUBTASK 49-22-00-820-001

B. Balance the rotating group. Refer to Figure 10003.

(1) Balance the rotating group on Datums A and B and write down the results.

	BALANCE	
PLANE	LIMIT: OZ-IN (mNm)	ACTUAL OZ-IN (mNm)
C	0.070 (0.49)	____________(________)
D	0.100 (0.71)	____________(________)

NOTE: Reduce group imbalance by unstretching and restacking to index curvic high marks 90 degrees clockwise from starting position if required.

Check Point 40: Verify balance is correct and within limits.

SUBTASK 49-22-00-820-002

C. Measure rotating group runout. Refer to Figure 10003.

(1) Put the rotating group in the PN 285868-2-1 runout checking fixture on Datum A and B and measure the rotating group runout at Planes E, F, G and H.

(2) Write down the results of the run out.

	RUNOUT	
PLANE	LIMIT: INCHES (MM)	ACTUAL INCHES (MM)
F	0.002 (0.05)	_______(_______)
G	0.002 (0.05)	________(_______)
E	0.002 (0.05)	________(_______)
H	0.002 (0.05)	________(_______)

(3) If run out is not in limits perform the following:

(a) Turn each component, one at a time, in increments of 90 degrees or less until the run outs are in limits.

(b) Repeat Steps 4.B.(1) thru 4.C.(3).

Check Point 50: Verify runout is correct and within limits.

SUBTASK 49-22-00-040-001

D. Disassemble the rotating group. Refer to Figure 10003.

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

CAUTION: DO NOT USE LEAD PENCIL OR OTHER MARKER THAT CAN LEAVE CARBON RESIDUE ON THE TURBINE PART.

(1) Mark the final assembly with marking compound to show necessary alignment during actual engine assembly.

(2) Use PN 834740-2 shaft stretch kit and PN 834889-1 stretch shaft tooling to unstretch rotating group.

(3) Disassemble the rotating group as follows:

(a) At each stage of disassembly mark the turbine shaft (120) with marking compound in line with the marks made on the stack group.

NOTE: Mark coupling shaft (40) with marking compound on the aft side, as it is removed from the rotating group, with three dots to make sure the coupling is installed the same way at final assembly.

(b) Leave driven compressor coupling shaft (140) attached to turbine shaft (120).

Check Point 60: Verify assembly components have been grouped together as matched parts for the next assembly.

(4) Remove coupling and dummy bearing simulator from the aft bearing shaft (230).

Check Point 70: Verify lot and serial numbers of noted hardware are correctly written on traceability card.

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DIFFUSER HOUSING ASSEMBLY
ASSEMBLY - 03

TASK 49-22-00-440-802

1. **General**

   A. This section contains procedures for assembly of the diffuser housing assembly.

   B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

2. **Special Tools, Fixtures and Equipment**

   None

3. **Equipment and Materials**

   None

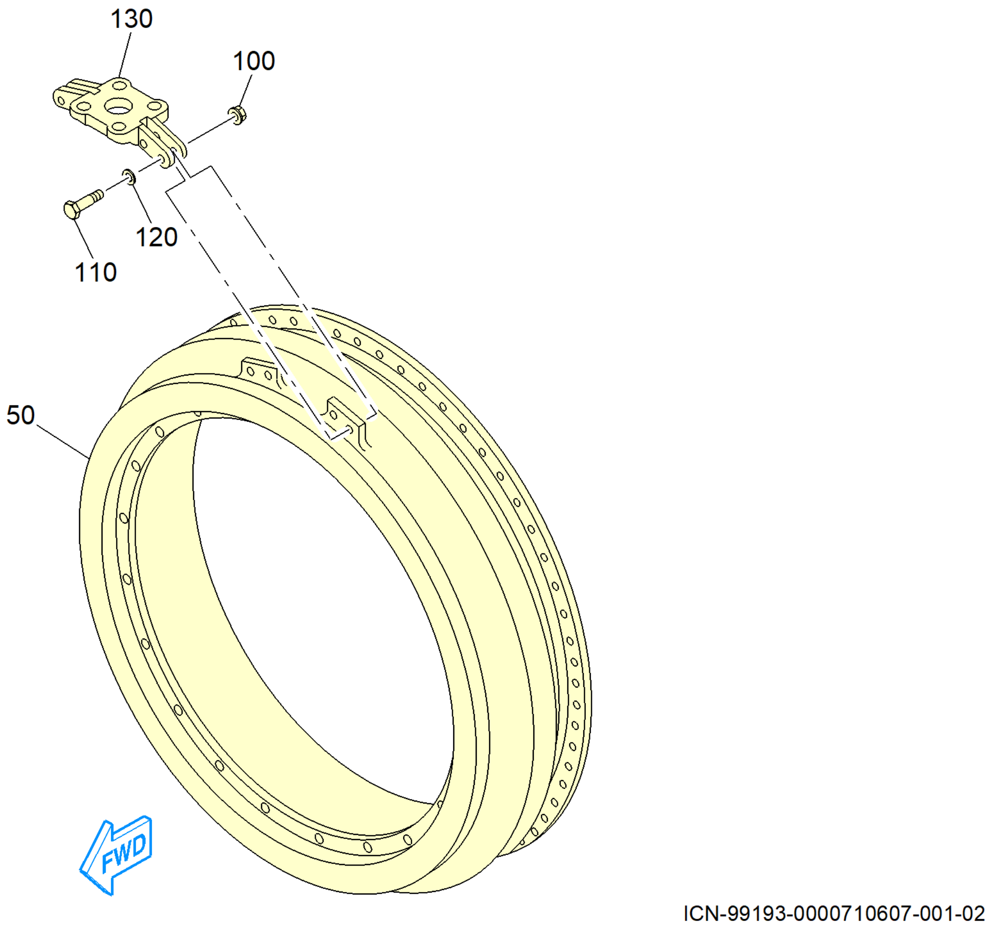

Figure 10001. Assembly of Diffuser Housing

Key to Figure 10001

50.	DIFFUSER HOUSING ASSY (IPC FIG. 21)	120.	SPACER
100.	NUT (IPC FIG. 8)	130.	TOP BRACKET
110.	BOLT		

4. Procedure

SUBTASK 49-22-00-440-003

A. Install top bracket on diffuser housing. Refer to Figure 10001.

(1) Lay diffuser housing assembly (50) aft side down flat on table.

(2) Install top bracket (130) on upper half of diffuser housing assembly (50) and attach with bolts (110), spacers (120) and nuts (100). Tighten bolts to a torque value of 40 in-lb (4.52 Nm).

(3) Tighten bolts (110) to a torque value of 40 in-lb (4.52 Nm).

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FIRST STAGE STATOR ASSEMBLY
ASSEMBLY - 04

TASK 49-22-00-440-803

1. General

A. This section contains procedures for assembly of the first stage stator assembly.

B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

2. Special Tools, Fixtures and Equipment

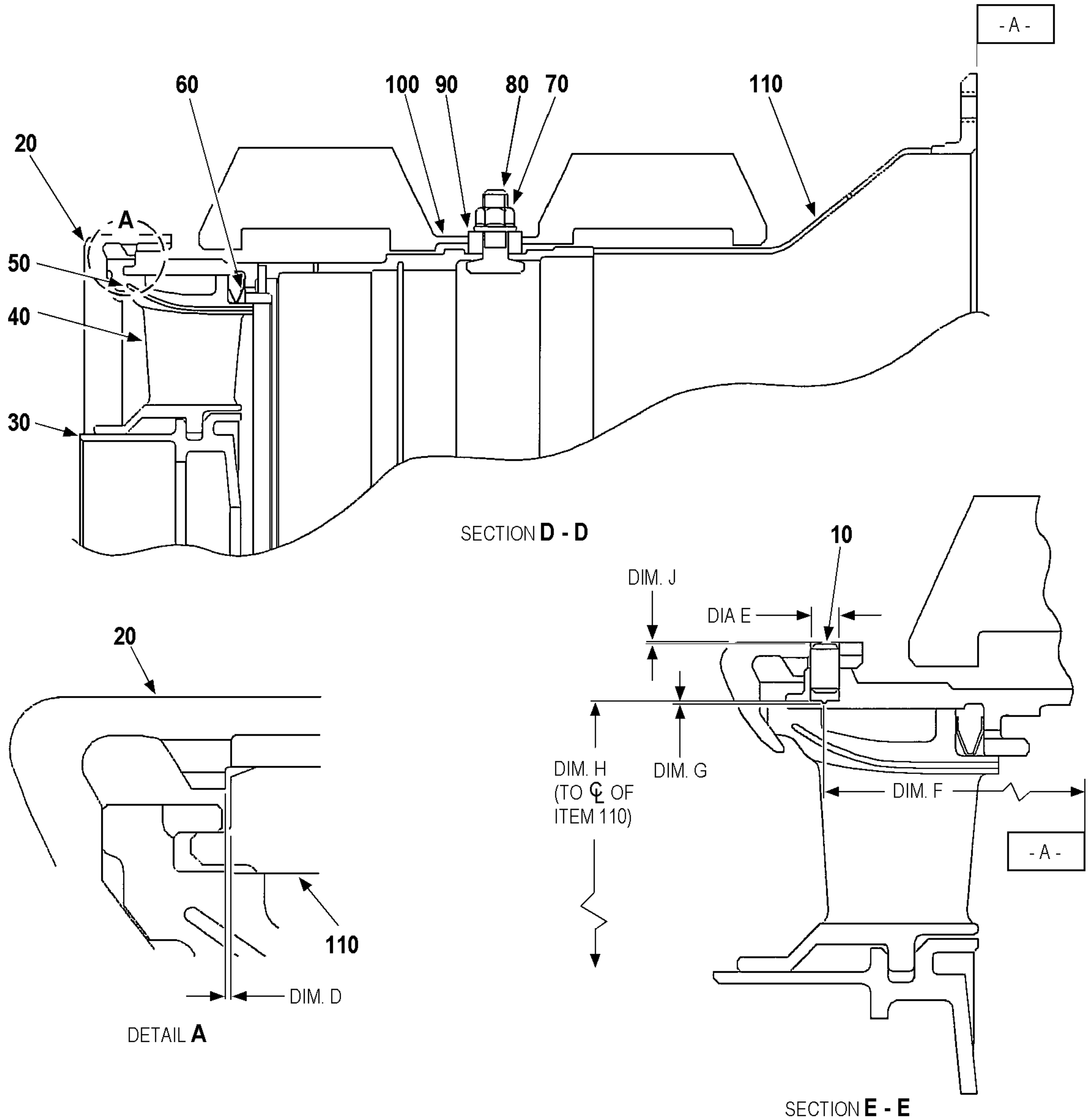
A. Table 10001 shows the necessary special tools, fixtures and equipment for installation.

Table 10001. Special Tools, Fixtures and Equipment

Nomenclature	Use	Part No.
NOTE: Equivalent tools, fixtures and equipment can be used.		
Installer	Used to aid in aligning compressor liner and first stage nozzle.	834956-1

3. Equipment and Materials

A. None



ICN-99193-0000673159-001-01

Figure 10001. Assemble the First Stage Stator Assembly

Key to Figure 10001

10. PIN (IPC FIG. 28)	70. SELF LOCKING NUT
20. INNER TRANSITION LINER	80. FIRST STAGE STATOR SUPPORT BOLT
30. STATOR SUPPORT RING	90. SLEEVE SPACER
40. FIRST STAGE TURBINE NOZZLE SEGMENT	100. CONTAINMENT RING
50. FEATHER SEAL	110. FIRST STAGE NOZZLE SUPPORT ASSY
60. STATOR SEAL RING	

DIM. D	0.001 ±0.001 IN. (0.03 ±0.03 MM)	DIM. G	0.01 IN. (0.3 MM) MAX.
DIA. E	0.1240 ±0.0002 IN. (3.150 ±0.005 MM)	DIM. H	4.00 ±0.02 IN. (101.6 ±0.5 MM)
DIM. F	6.228 IN. (158.191 MM)	DIM. J	0.01 ±0.01 IN. (0.3 ±0.3 MM)

4. Procedure

SUBTASK 49-22-00-440-004

A. Assemble First Stage Nozzle Segments in the First Stage Stator Assembly. Refer to Figure 10001 and Figure 10002.

(1) Install containment ring (100) on first stage nozzle support assembly (110) and attach with first stage stator support bolts (80), sleeve spacers (90) and self locking nuts (70). Tighten nuts to a torque value of 50 in-lb (5.65 Nm).

(2) Set the first stage nozzle support (110) aft end down.

(3) Install stator seal ring (60) into first stage nozzle support assembly (110).

(4) Install the first stage turbine nozzle segments (40) in the first stage nozzle support assembly (110) as follows:

(a) (Pre SB 131-49-7744) Assemble the first stage turbine nozzle segments (40) around the stator support ring (30) and use the inner transition liner (20) to hold them in place or (alternate) use a rubber band to hold them in place.

(Post SB 131-49-7744) Assemble the first stage turbine nozzle segments (40) adjacent to each other and located at any circumferential position in the stator support ring (30). Use the inner transition liner (20) to hold them in place or (alternate) use a rubber band to hold them in place.

(b) Install the assembled first stage turbine nozzle segments (40) and stator support ring (30) into the first stage nozzle support assembly (110) and over the installed stator seal ring (60). Make sure the slots in the first stage turbine nozzle segments (40) engage with the antirotation pins in first stage nozzle support assembly (110).

(5) Install the inner transition liner (20) on the first stage nozzle support assembly (110) as follows:

(a) Install the inner transition liner (20) to Dimension D on the first stage nozzle support assembly (110).

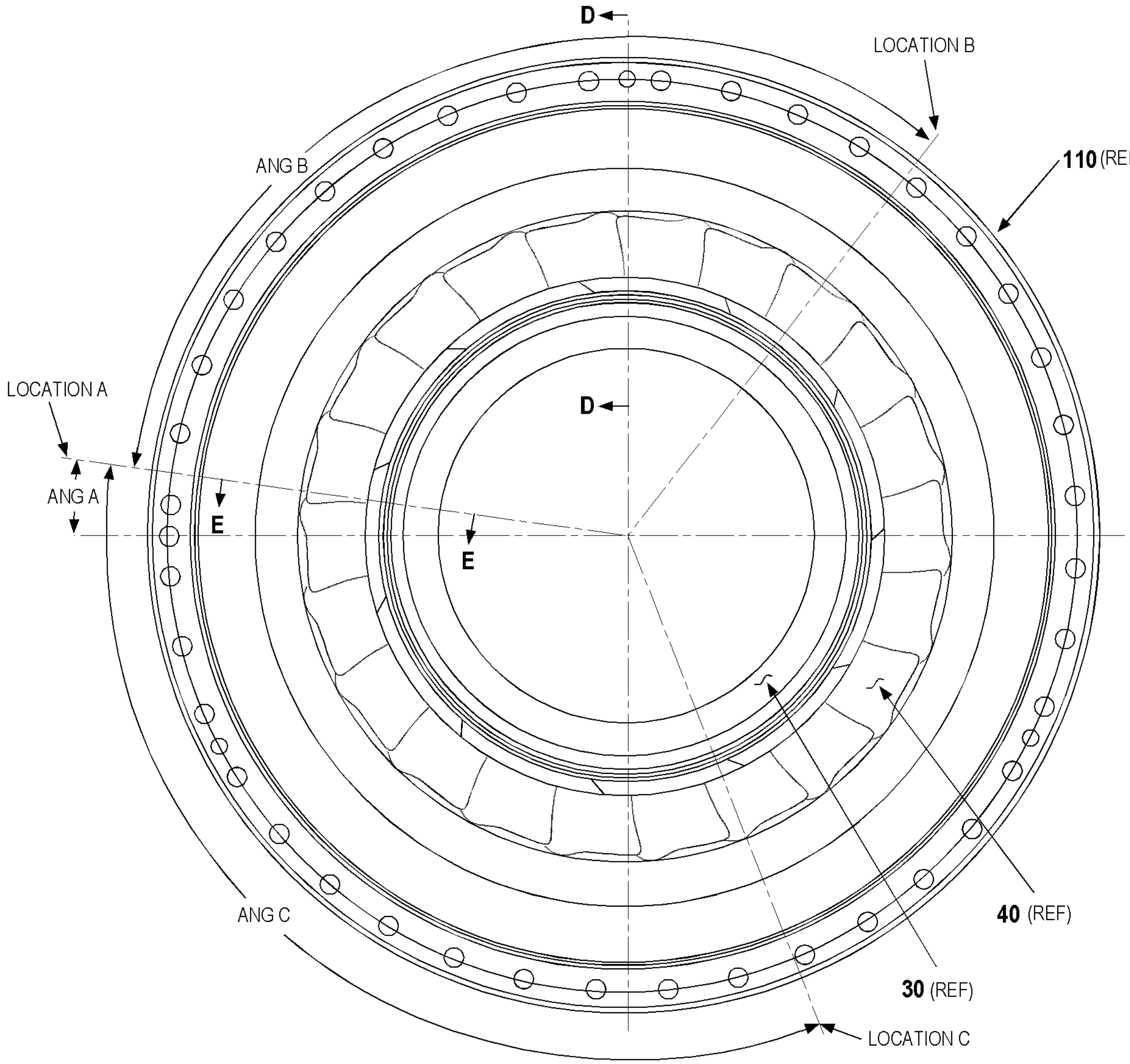


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Figure 10002. Assemble the First Stage Stator Assembly

Key to Figure 10002

30. STATOR SUPPORT RING (IPC FIG. 28)
40. FIRST STAGE TURBINE NOZZLE SEGMENT
110. FIRST STAGE NOZZLE SUPPORT ASSY

ANG A	12, 36, 60, 84 OR 108 DEGREES
ANG B	120 DEGREES
ANG C	120 DEGREES

<u>WARNING:</u> USE THE CORRECT PERSONAL PROTECTION. PROCEDURES THAT NEED GRIND/MACHINE WORK WILL CAUSE LOOSE PARTICLES THAT CAN GET IN YOUR EYES.

(b) Drill one hole at each Location A, B and C through the inner transition liner (20) and the first stage nozzle support assembly (110) to the dimensions shown. Make sure the drill point does not go more than Dimension G from Dimension H.

(c) Use PN 834956 pin installer to compress transition liner (20) and first stage nozzle support assembly (110) to align holes.

(d) Install pins (10) to a depth of Dimension J.

(6) Install the feather seals (50) from the back into the slots in between the first stage turbine nozzle segments (40).

SECOND STAGE STATOR ASSEMBLY
ASSEMBLY - 05

TASK 49-22-00-440-804

1. General

A. This section contains procedures for assembly of the second stage stator assembly.

B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

2. Special Tools, Fixtures and Equipment

A. Table 10001 shows the necessary special tools, fixtures and equipment for installation.

Table 10001. Special Tools, Fixtures and Equipment

Nomenclature	Use	Part No.
NOTE: Equivalent tools, fixtures and equipment can be used.		
Second stage stator support	Used to support stator during assembly	834949-1

3. Equipment and Materials

None

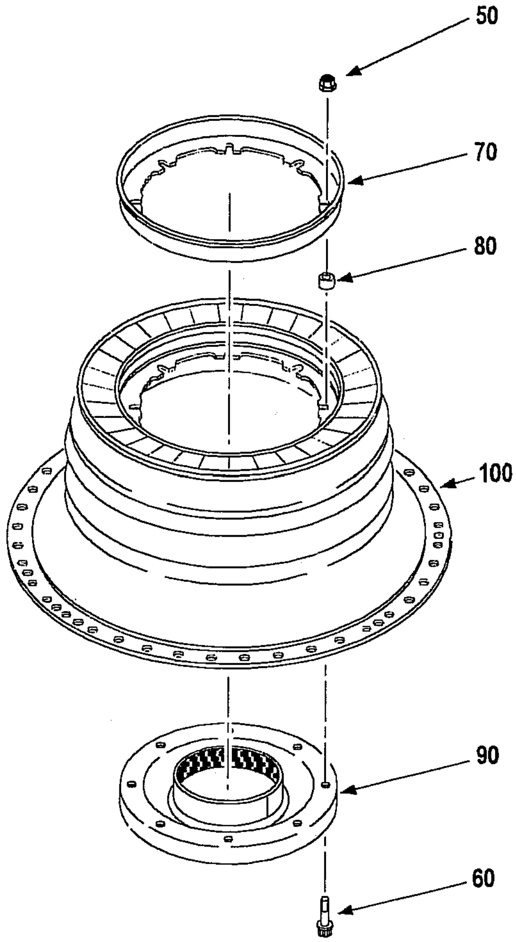

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Figure 10001. Assemble the Second Stage Stator Assembly

Key to Figure 10001

50. NUT (IPC FIG. 19)
60. BOLT
70. SECOND STAGE TURBINE STATOR BAFFLE
80. SLEEVE SPACER
90. SECOND STAGE STATOR SEAL WELDMENT
100. SECOND STAGE STATOR ASSY

4. Procedure

SUBTASK 49-22-00-440-005

A. Assemble the Second Stage Stator Assembly.

(1) Install the second stage stator seal weldment (90), sleeve spacers (80) and second stage turbine stator baffle (70) in the second stage stator assembly (100) and attach with bolts (60) and nuts (50). Do not tighten nuts at this time. (Refer to Figure 10001 and Figure 10002).

NOTE: Use PN 834949-1 second stage stator fixture to support stator assembly (100).

(2) Use four feeler gauges positioned equal distances apart to place second stage stator seal weldment (90) in the center of the second stage stator assembly (100). (Refer to Figure 10002).

NOTE: The feeler gauges are approximately 0.01 to 0.02 inch (0.25 to 0.51 mm).

(a) Adjust the feeler gauges until the measurements are equal circumferentially between the second stage stator seal weldment (90) and the second stage stator assembly (100).

(b) Tighten nuts (50) to a torque value of 40 in-lb (4.52 Nm).

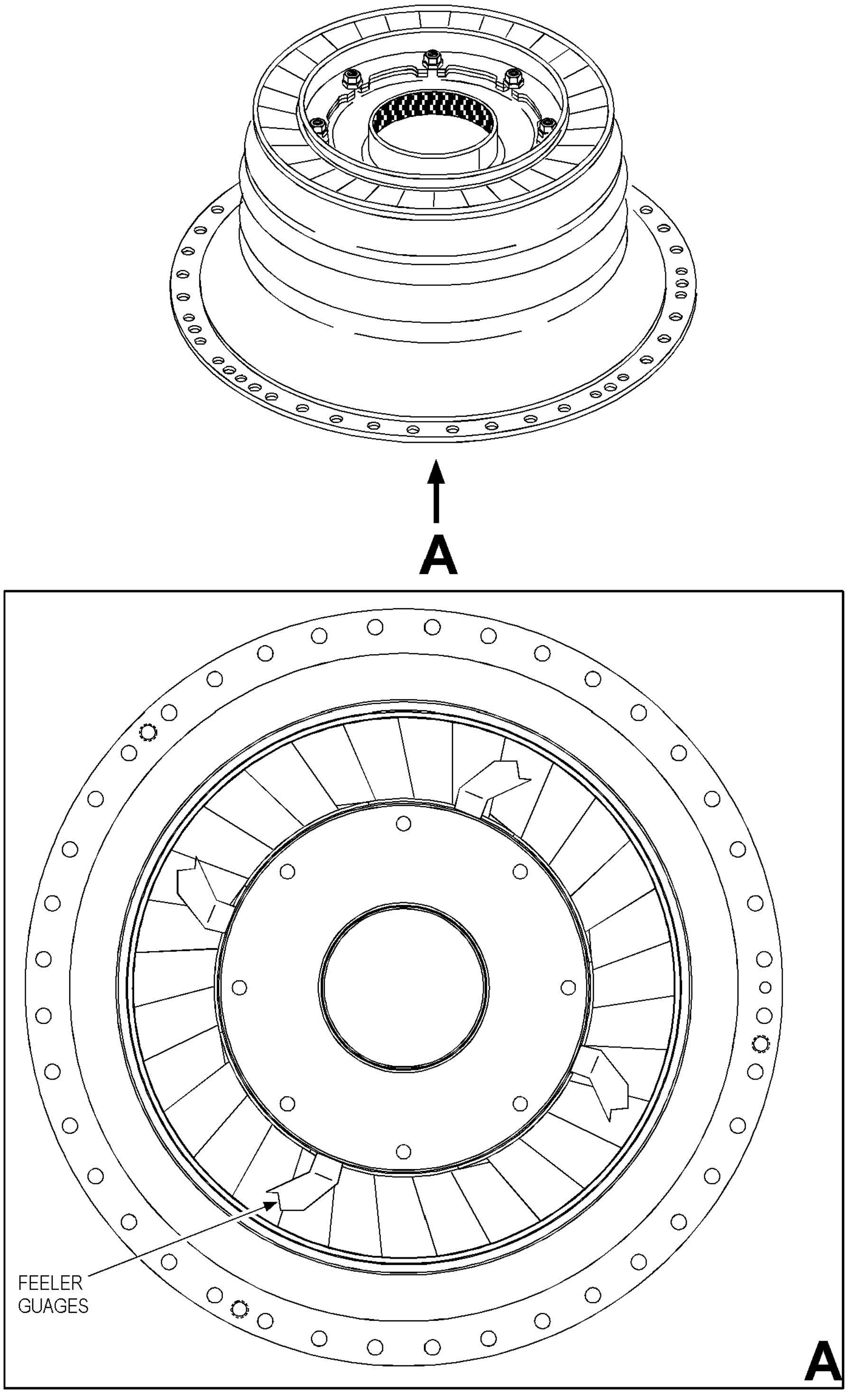

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Figure 10002. Assemble the Second Stage Stator Assembly

POWER SECTION ASSEMBLY
ASSEMBLY-06

TASK 49-22-00-430-801

1. General

A. This section contains procedures for assembly of the power section assembly.

B. Remove all corrosion-preventive compound and any contamination from the parts before assembly.

C. Refer to ASSEMBLY 01 for assembly of inlet guide vane assembly, ASSEMBLY 02 for assembly of rotating group, ASSEMBLY 03 for assembly of diffuser housing, ASSEMBLY 04 for assembly of first stage stator assembly and ASSEMBLY 05 for assembly of second stage stator assembly.

2. Special Tools, Fixtures and Equipment

A. Table 10001 shows the necessary special tools, fixtures and equipment for installation.

Table 10001. Special Tools, Fixtures and Equipment

Nomenclature	Use	Part No.
NOTE: Equivalent tools, fixtures and equipment can be used.		
Knurled Screw	Attach PN 834850-1 stand off to PN 834711 micing bar. Component of PN 834774-1.	CL-4-KHS
Bearing Driver	Install roller bearing on aft bearing shaft.	834701-1
Micing Bar	Used with two PN 834850-1 stand off for measurements. Component of PN 834774-1.	834711-2 834711-6
Press Button	Use with arbor press to install roller bearing simulator.	834759-8
Micing Bridge Set	Includes PN 834711-2 and PN 834711-6 micing. bar, two PN 834850-1 stand off and two CL-4-KHS knurled screws.	834774-1
Torque Adapter	Adapt torque wrench to tieshaft nut.	834801-1
Bearing Remover	Remove duplex ball bearing.	834808-1
Alignment Pin	Align combustor to combustor case (three necessary).	834809-1
Shaft Stretch Kit	Used with stretch shaft tool.	834740-2
Installation Seal Driver	Install stationary seal in compressor bearing housing.	834810-2
Wheel Removal Adapter	Remove turbine wheels from power section (two necessary).	834812-1
Duplex Bearing Nut Simulator	Simulate compressor bearing nut when compressor is measured for shims.	834814-1
Load Compressor Centering Tool	Support and move turbine shaft axially as required during build.	834815-1

Table 10001. Special Tools, Fixtures and Equipment (Cont)

Nomenclature	Use	Part No.
Lifting Adapter	Lift power section by turbine shaft.	834816-1
Housing Simulator	Simulate compressor bearing housing.	834818-1
Stand Off	Used with PN 834711-2 or PN 834711-6 micing bar for measurements. Component of PN 834774-1.	834850-1
Coupling Holder	Hold driven compressor coupling shaft when tie shaft is torqued.	834864-1
Aft Bearing Puller	Remove bearings from gearshafts.	834883-1
Turbine Shaft Simulator	Simulate turbine rotating section when turbine shaft is stretched.	834886-1
IGV Gauge Set	Used as slave IGV actuator during IGV linkage build dimension adjustment.	834887-1
Stretch Shaft Tooling	Stretch turbine shaft.	834889-1
Torque Adapter	Adapt torque wrench to tieshaft nut.	834890-1
Centering Bridge Adapter	Support the aft rotating section when the compressor section is shimmed.	834891-1
Roller Bearing Simulator	Simulate roller bearing during power section build.	834926-1
Alignment Pin Remover	Removes alignment pin out of combustor case.	834931-1
Portable Engine Stand/Cart	Build and test cart for APU. Component of PN 834991-1.	834990-1
Cart Assembly	Includes PN 834990-1 engine stand/cart, PN 834991-2 Frame, PN 834991-3 and PN 834991-4 driven support arm.	834991-1
Rear Vertical Frame	Support APU on top side on cart. Component of PN 834991-1.	834991-2
Driven Support Arm	Adapt engine mount (left mount) to transport cart. Component of PN 834991-1.	834991-3
Driven Support Arm	Adapt engine mount (right mount) to transport cart. Component of PN 834991-1.	834991-4
IGV Vane Setting	Aligns IGV vanes during assembly of linkage.	834948-1
Bearing Support	Used to measure compressor bearing.	834950-1
Seal Spacer	Used to aid in assembly turbine seal.	834951-1
Adapter	Install matched duplex ball bearing assembly set.	3700537-1/-2
Installation Tool	Handle matched duplex ball bearing assembly set.	3700539-1
Installation Tool	Ceramic duplex ball bearing installation tool.	70641924-1
Nut Tool	Seat bearing in matched duplex ball bearing assembly set.	3700508-1

3. **Equipment and Materials**

A. Table 10002 shows the necessary equipment and materials for installation.

Table 10002. Equipment and Materials

Equipment/Materials	Description/Manufacturer
NOTE: Equivalent equipment/materials can be used.	
Adhesive sealant (RTV 106)	General Electric Co, GE Silicones, 260 Hudson River Rd, Waterford, NY 12188
Anti-seize compound (C5-A Copper Based) (Honeywell Part No. 219-090-9002)	Henkel Loctite Corp, 1001 Trout Brook Crossing, Rocky Hill, CT 06067
Anti-seize lubricant (Liqui-Moly, Brand NV Thread Compound) (MIL-PRF-907)	Lockrey Co. Inc., P.O. Box 1269, 2517 Finlaw Ave., Merchantville, NJ 08109
Contact cleaner (QD)	CRC Industries Inc., 885 Louis Dr., Warminster, PA 18974-2869
Corrosion-preventive compound (Braycote 248) (MIL-C-11796, Class 3)	Air BP Lubricants Div., Maple Plaza II, 1 N., 6 Campus Dr., Parsippany, NJ 07054-4406
Degreasing solvent (MIL-PRF-680)	Commercially available
Dry film lubricant (MS-122DF, MS-122V, or MS-122XD)	Miller-Step henson Chemical Co, Inc, George Washington Hwy., Danbury, CT 06810
Jointing compound (Heavy) (Hylomar PL32H)	Marston Bentley Ltd, 9 Naylor St, Liverpool, L3 6DS United Kingdom
Jointing compound (Light) (Hylomar PL32L)	Marston Bentley Ltd, 9 Naylor St, Liverpool, L3 6DS United Kingdom
Jointing compound (Medium) (Hylomar PL32M)	Marston Bentley Ltd, 9 Naylor St, Liverpool, L3 6DS United Kingdom
Lockwire (PN MS20995C20)	Commercially available
Lockwire (PN MS20995C32)	Commercially available
Lubricant (Molykote Z) (AMS-M-7866)	Dow Corning Corp, P.O. Box 995, 3901 S. Saginaw Rd., Midland, MI 48640
Lubricant (Santovac OS-124 or Santovac 5)	Arch Technology Holding LLC, 8 Governor Dr, St. Charles, MO 63301
Marking compound (Dykem Hi-Spot Blue)	ITW Dykem, P.O. Box 340, 805 E. Highway 56, Olathe, KS 66051-0340
Oil (MIL-PRF-7808 or MIL-PRF-23699)	Commercially available

Table 10002. Equipment and Materials (Cont)

Equipment/Materials	Description/Manufacturer
Seal (PN S8187A)	Honeywell Consumables Solutions, P.O. Box 100473, Pasadena, CA 91198-0473, Telephone: 800-601-3099
Silver aluminum paint (TT-P-28)	Intrepid Coatings, 1910 E. Riverview Dr., Phoenix, AZ 85034

4. Expendable Parts

A. Honeywell recommends that the parts shown in Table 10003 be replaced at each assembly. However, actual replacement of parts can be done on in-service experience.

Table 10003. Parts to be Replaced at Each Assembly

Figure No.	Item No.	Nomenclature	Quantity
Figure 10006	50	Packing	1
	80	Packing	1
	90	Packing	1
	100	Packing	1
Figure 10009	150	Packing with retainer	50
Figure 10018	150	Packing	1
	160	Packing	1
Figure 10019	20	Nut locking key	1
Figure 10026	150	Packing	1
	160	Packing	1
Figure 10029	140	Packing with retainer	21
Figure 10042	240	Rear bearing seal	1
Figure 10047	40	Seal washer	2
	90	Seal washer	2
	130	Aft bearing cover gasket	1
Figure 10050	50	Gasket	8

5. Procedure

Table 10004. Check Point Summary

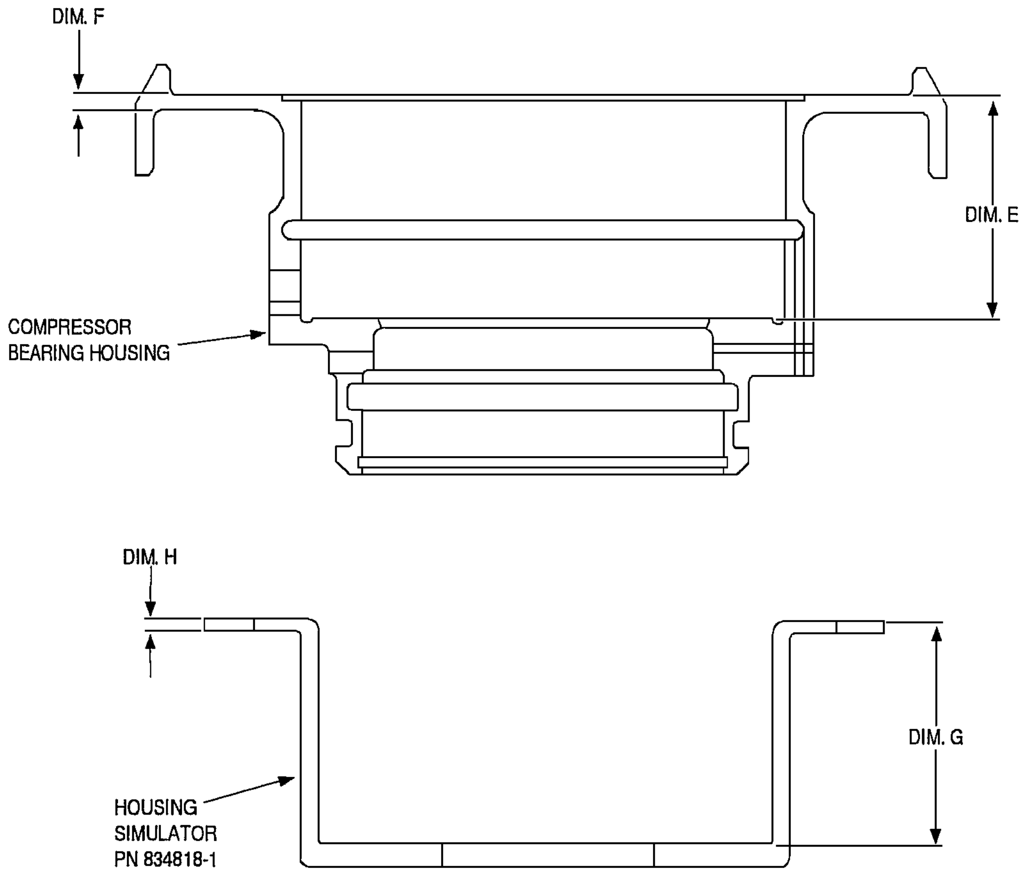
Check Point	Operation	Page
10	Make sure Dimensions A1, B, C, D, E, F, G, H and L are written down and calculated Dimension X is correctly calculated.	10010
20	Make sure Dimension C is .007 ±0.001 inch (0.18 ±0.03 mm).	10010
30	Make sure Dimension T is written.	10014

Table 10004. Check Point Summary (Cont)

Check Point	Operation	Page
40	With PN 834887-1 IGV gauge set installed make sure Dimension A is ZERO with inlet guide vanes fully closed.	10031
50	Make sure Dimensions R and S are written down.	10039
60	Make sure calculation to find L/C bearing shim (110) pack thickness is correct.	10041
70	Make sure installed L/C bearing shim (110) pack thickness is same as calculated L/C bearing shim pack thickness.	10041
90	Make sure Measured Dimension X is within +0.002/-0.001 inch (+0.05/-0.03) of Calculated Dimension X.	10047
100	Make sure compressor bearing nut (10) is tightened and seated.	10049
110	Make sure Dimensions F, D, B, A1 and X are properly measured, calculated and recorded within the limits.	10055
120	Make sure calculation to find L/C bearing shim (110) pack thickness is correct.	10061
130	Make sure install L/C bearing shim (110) pack thickness is same as calculated L/C bearing shim pack thickness.	10062
140	Make sure Measured Dimension X is within +0.002/-0.001 inch (+0.05/-0.03 mm) of Calculated Dimension X.	10068
150	Make sure compressor bearing nut (10) is tightened and seated.	10069
160	Make sure locking tab of the nut locking key (20) is bent down flat into the locking slot of the compressor bearing nut (10).	10069
170	Make sure engine compressor tip clearance is 0.079 ±0.001 inch (2.01 ±0.03 mm) for Pre SB 131-49-7718.	10074
	Make sure engine compressor tip clearance is 0.084 +0.001/-0.003 inch (2.13 +0.03/-0.08 mm) for Post SB 131-49-7718.	
180	Verify and write down Dimensions Y.	10083
190	Verify and write down Dimensions Z1.	10085
200	Verify Dimension S is same as written down during assembly of rotating group	10094
210	Verify Dimension Y (minus the thickness of the micing bar and buttons) is 1.812 ±0.001 inch (46.02 ±0.03 mm).	10094
220	Verify and write down Dimension Z2.	10099
230	Verify calculation to make sure first stage stator assembly (200) is seated is 0.000 ±0.001 inch (0.00 ±0.03 mm).	10099

Table 10004. Check Point Summary (Cont)

Check Point	Operation	Page
240	Make sure Dimension U is same as written down during assembly of rotating group.	10115
250	Make sure Dimension S is same as written down during assembly of rotating group.	10115



ICN-99193-0000673163-001-01

Figure 10001. (Pre SB 131-49-8015) Bearing Carrier Measurements

Key to Figure 10001

1. HOUSING SIMULATOR (PN 834818-1)
100. COMPRESSOR BEARING HOUSING (IPC FIG. 24)

SUBTASK 49-22-00-430-001

A. Assemble the Power Section.

(1) (Pre SB 131-49-8015) Measure compressor bearing components as follows:

(a) Measure and write the results of the bearing carrier measurements. Refer to Figure 10001.

FLANGE DEPTH

DIMENSION E = ________________ inch (mm) (Compressor Bearing Housing (100))

DIMENSION F = ________________ inch (mm) (Compressor Bearing Housing (100))

DIMENSION G = ________________ inch (mm) (Housing Simulator (1))

DIMENSION H = ________________ inch (mm) (Housing Simulator (1))

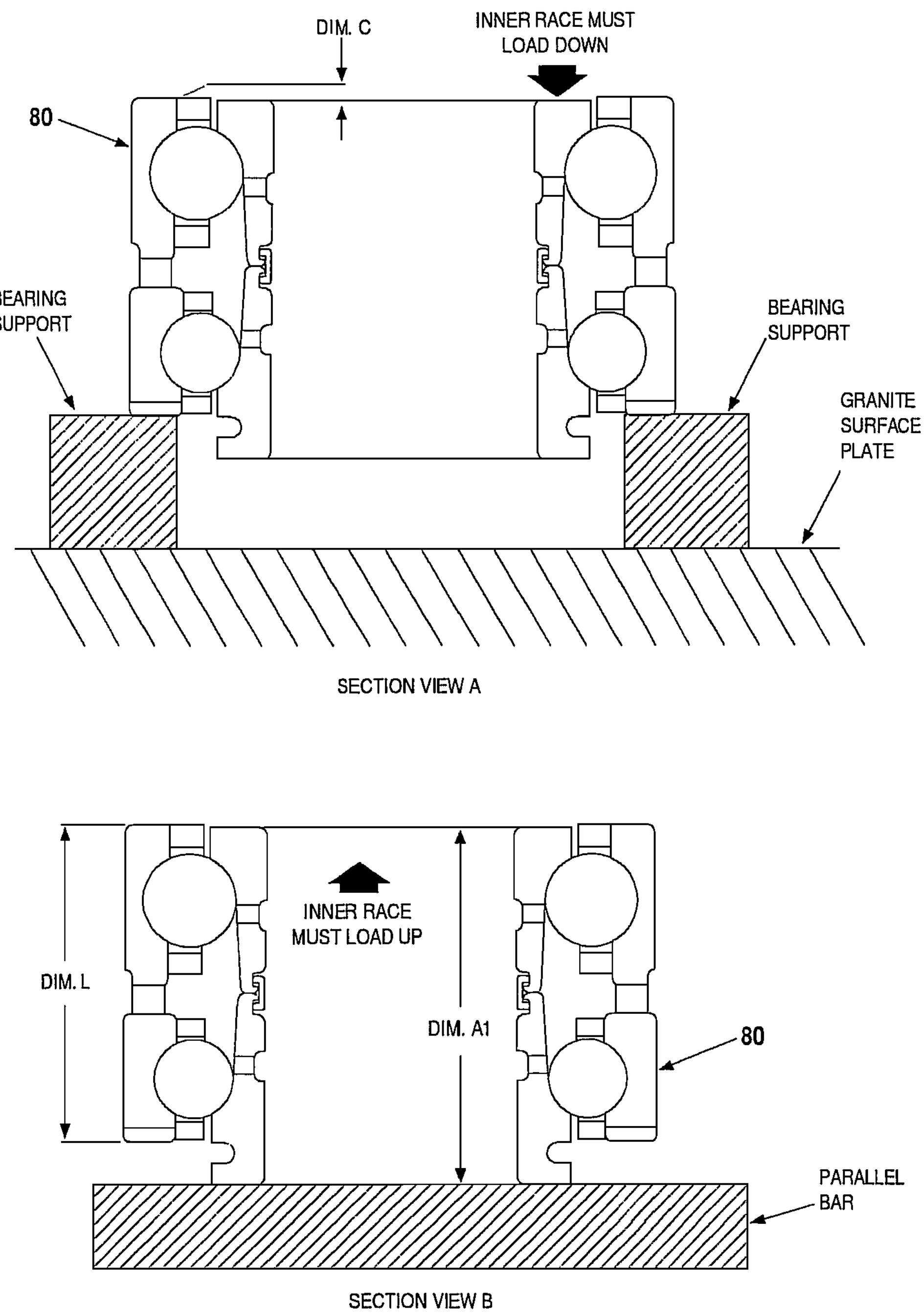


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Figure 10002. (Pre SB 13149-8015) Compressor Bearing Seat Measurements

Key to Figure 10002

(b) (Pre SB 131-49-8015) Measure and write down the results of the compressor bearing seat measurements. Use PN 834950-1 bearing support for measurement of Dimension C. Refer to Figure 10002 and Figure 10003.

CAUTION: DIMENSION C MUST BE 0.007 ±0.001 INCH (0.18 ±0.03 MM).

DIMENSION MEASUREMENTS

A1= ________ inch (mm)

B= ________ inch (mm)

*C= ________ inch (mm)

D= ________ inch (mm)

L= ________ inch (mm)

CALCULATIONS

Dimension M = E - L = ____________ inch (mm)

Calculated Dimension X = D - B - A1 = ____________ inch (mm)

NOTE: Calculated dimension x must equal measured dimension X, STEP 5.A.(11)(m), in +0.002/-0.001 inch (+0.05/-0.03 mm) to make sure bearing assembly set is not stacked.

These measurements represent the verification method for seating the duplex bearing. Also for adjusting the load compressor shim pack to account for dimensional differences between the actual bearing carrier and the bearing carrier simulator.

Check Point 10: Make sure Dimensions A1, B, C, D, E, F, G, H and L are written down and Calculated Dimension X is correctly calculated.

Check Point 20: Make sure Dimension C is 0.007 ±0.001 inch (0.18 ±0.03 mm).

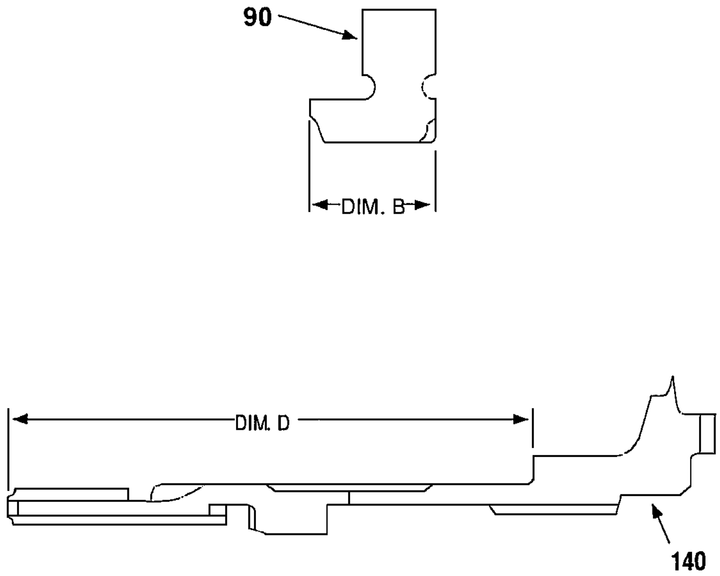

Figure 10003. (Pre SB 131-49-8015) Compressor Bearing Seat Measurements

Key to Figure 10003

90. SEAL ROTOR (IPC FIG. 24)	140. COUPLING SHAFT

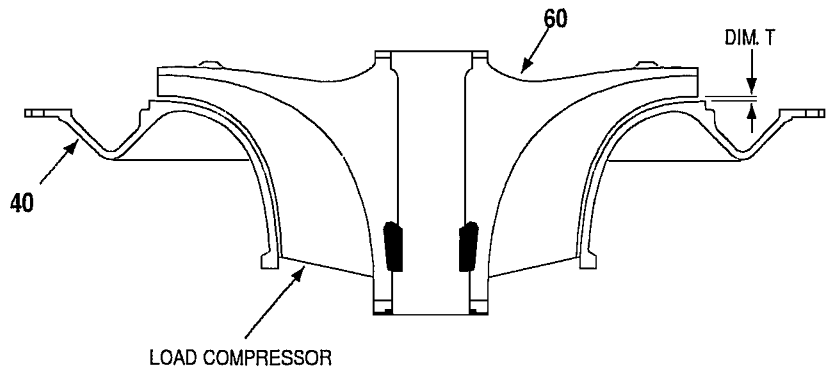

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Figure 10004. Load Compressor Rotor to Shroud Initial Tip Clearance

Key to Figure 10004

40. CENTRIFUGAL CASE	60. COMPRESSOR ROTOR (IPC FIG. 23)

(2) Measure the compressor rotor to centrifugal case initial tip clearance as follows. Refer to Figure 10004.

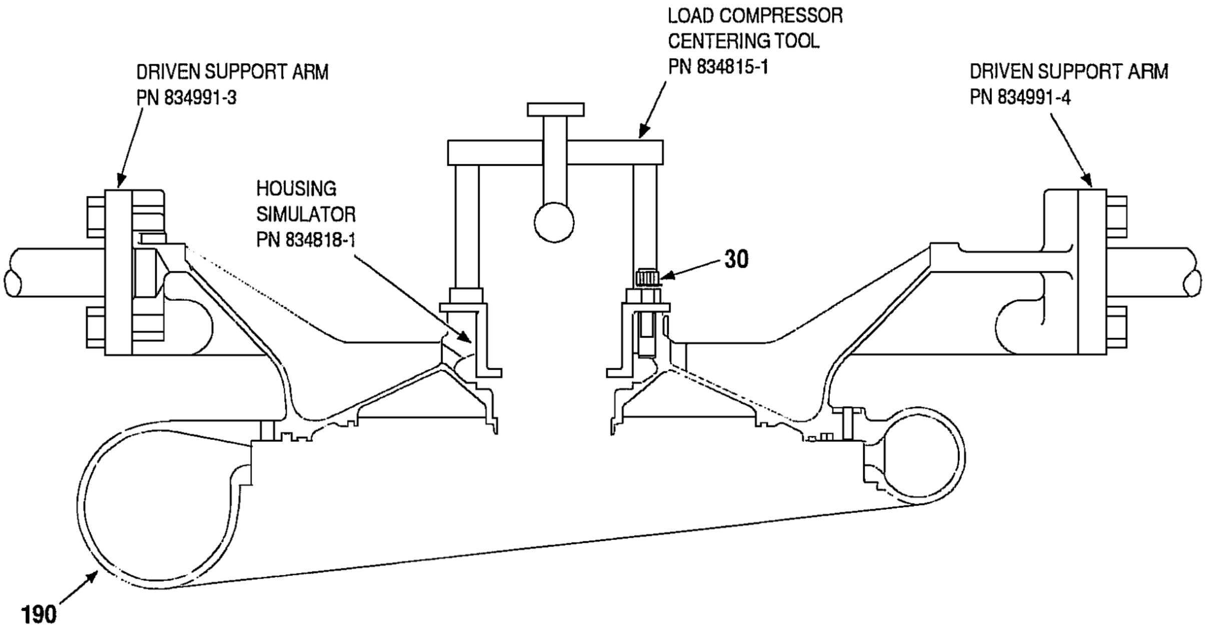
(a) Put the compressor rotor (60) into the centrifugal case (40). Measure the tip clearance in 120 degree increments to center the wheel and get equal tip measurements all the way around the wheel.

NOTE: Do not insert feeler gauge more than 0.120 inch (3.04 mm) from tip of compressor rotor (60).

LOAD COMPRESSOR (L/C) TIP CLEARANCE

Dimension T = ______________inch (mm) (Initial Tip Clearance)

Check Point 30: Make sure Dimension T is written above.



NOTE:
Housing simulator is used for Pre SB 131-49-8015 only.

ICN-99193-0000673168-001-01

Figure 10005. Build Stand Installation

Key to Figure 10005

30. BOLT (IPC FIG. 24)

190. DRIVEN COMPRESSOR BEARING HOUSING

---

(3) Install driven compressor bearing housing in build stand installation as follows: Refer to Figure 10005.

(a) Install PN 834991-4 driven support and PN 834991-3 driven support on the driven compressor bearing housing (190).

(b) Install the driven compressor bearing housing (190) and attached driven support arms on the PN 834990-1 portable engine stand/cart.

(c) Use 834990-1 portable engine stand/cart to rotate the driven compressor bearing housing (190) so it is positioned fwd side up.

(d) Line up mount holes and install PN 834818-1 housing simulator in bearing driven compressor bearing housing (190).

(e) Install PN 834815-1 load compressor centering tool on the driven compressor bearing housing (190) and attach with two bolts (30).

(f) Tighten bolts (30) to a torque value of 100 in-lb (11.30 Nm).

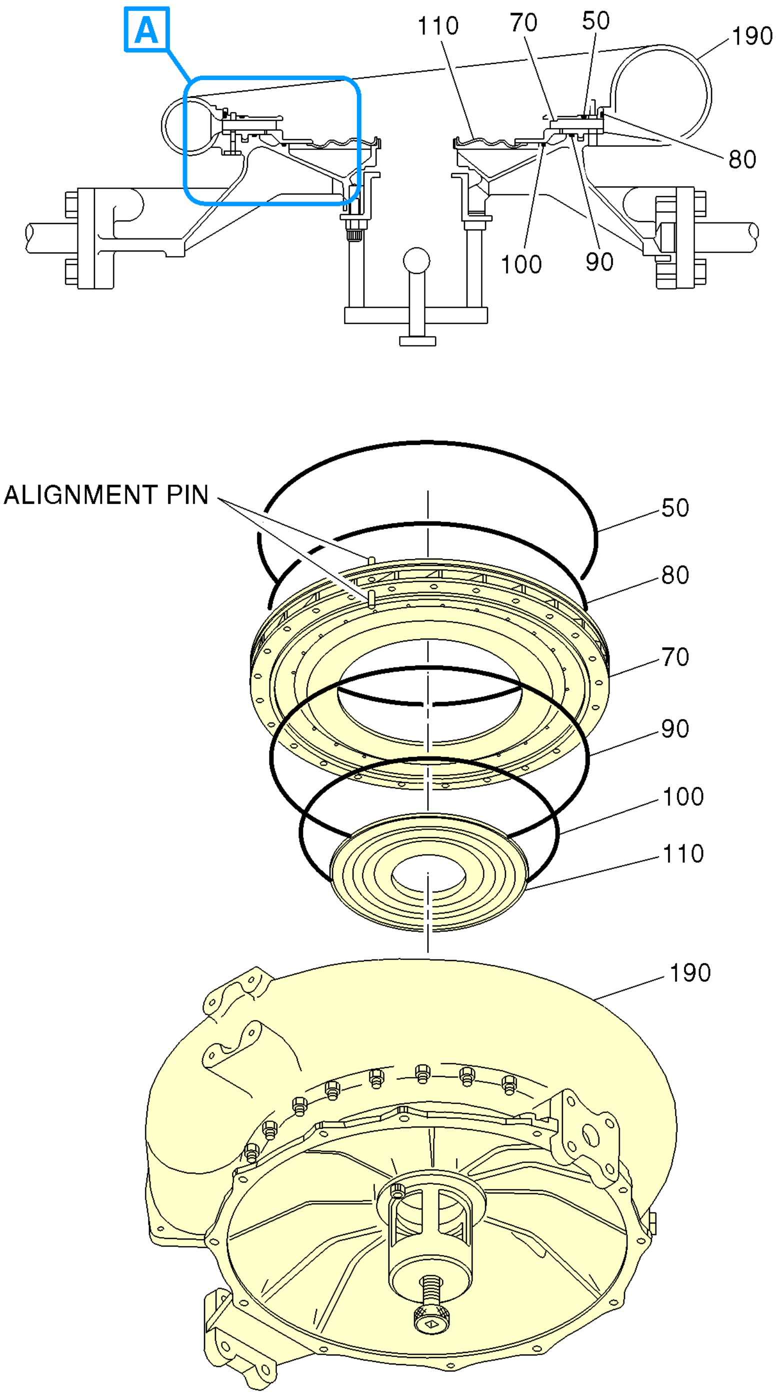


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Figure 10006. Install Centrifugal Diffuser into Driven Compressor Bearing Housing

Key to Figure 10006

50. PACKING (IPC FIG. 23)
70. CENTRIFUGAL DIFFUSER
80. PACKING
90. PACKING
100. PACKING
110. HEAT SHIELD
190. DRIVEN COMPRESSOR BEARING HOUSING (IPC FIG. 24)

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

(4) Install centrifugal diffuser into driven compressor bearing housing as follows: Refer to Figure 10006.

(a) Use 834990-1 portable engine stand/cart to rotate the driven compressor bearing housing (190) so it is positioned aft side up.

(b) Lubricate packings (90, 100) with lubricant (Santovac OS-124 or Santovac 5).

(c) Install packings (90, 100) into corresponding grooves in the driven compressor bearing housing (190).

(d) Install heat shield (110), with inner lip facing upward, into the driven compressor bearing housing (190).

(e) Layer driven compressor bearing housing (190) and centrifugal diffuser (70) mating surfaces with silver aluminum paint (TT-P-28). Refer to Figure 10007.

(f) Lubricate packing (80) with lubricant (Santovac OS-124 or Santovac 5) and install packing (80) on centrifugal diffuser (70).

(g) Install centrifugal diffuser (70) with packing (80) into the driven compressor bearing housing (190) while the silver aluminum paint (TT-P-28), from the previous step, is wet.

(h) Align centrifugal diffuser (70) alignment pin with the corresponding hole in the driven compressor bearing housing (190).

(i) Lubricate packing (50) with lubricant (Santovac OS-124 or Santovac 5).

(j) Install packing (50) on the centrifugal diffuser (70).

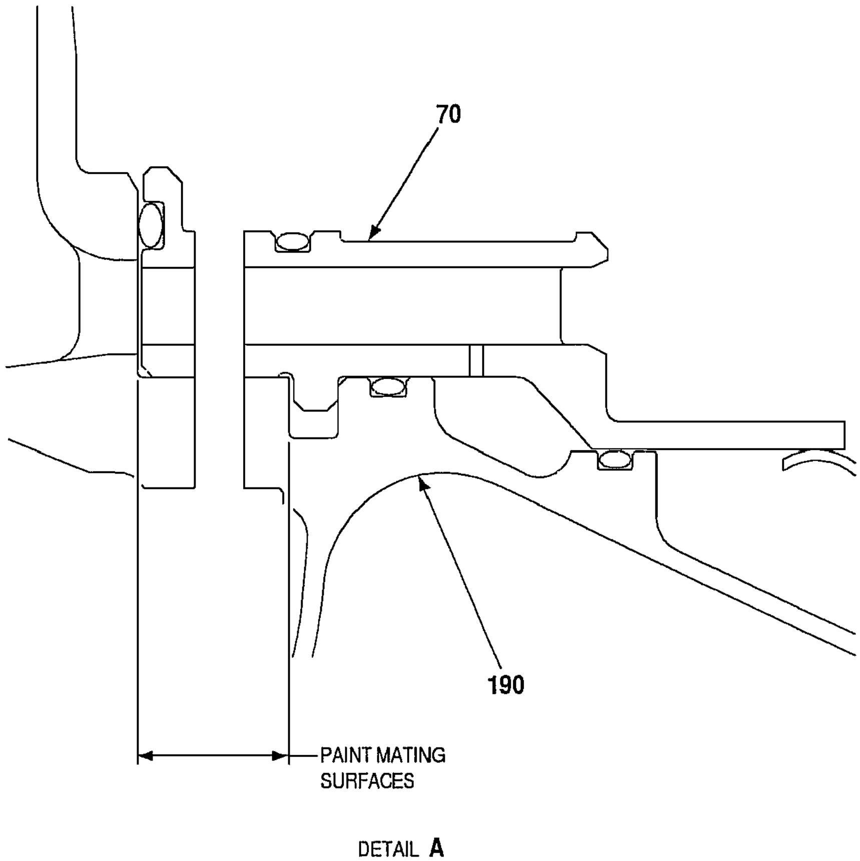

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Figure 10007. Install Centrifugal Diffuser into Driven Compressor Bearing Housing

Key to Figure 10007

70. CENTRIFUGAL DIFFUSER (IPC FIG. 23)

190. DRIVEN COMPRESSOR BEARING HOUSING (IPC FIG. 24)

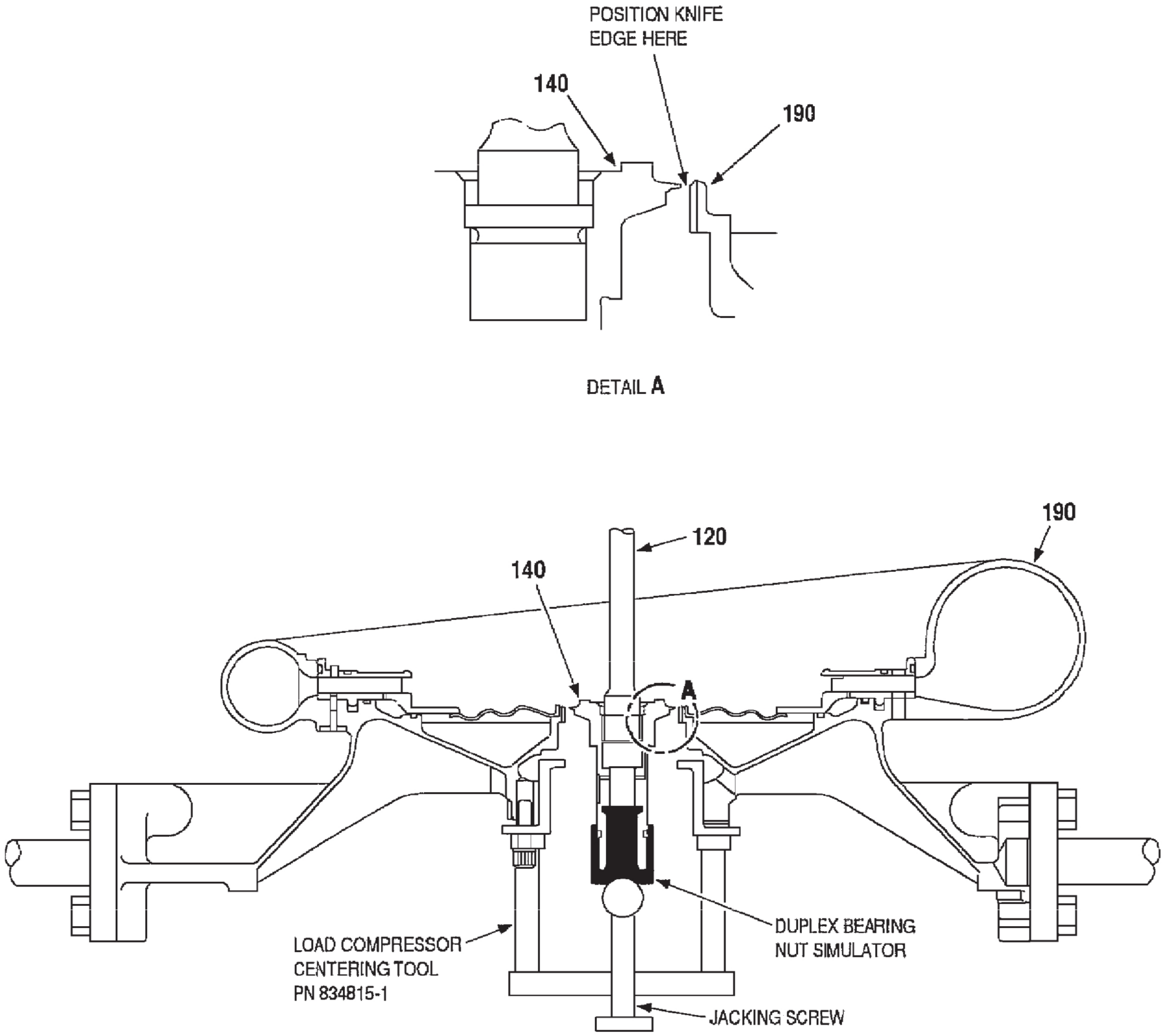

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Figure 10008. Install Turbine Shaft into Driven Compressor Bearing Housing

Key to Figure 10008

120. TURBINE SHAFT (IPC FIG. 23)

140. DRIVEN COMPRESSOR COUPLING SHAFT (IPC FIG. 24)

190. DRIVEN COMPRESSOR BEARING HOUSING

---

(5) Install turbine shaft into driven compressor bearing housing as follows. Refer to Figure 10008.

(a) Install PN 834814-1 duplex bearing nut simulator on the driven compressor coupling shaft (140) with assembled turbine shaft (120).

(b) Put driven compressor coupling shaft (140) with assembled PN 834814-1 duplex bearing nut simulator and turbine shaft (120) in the driven compressor bearing housing (190).

(c) Turn PN 834815-1 load compressor centering tool jacking screw to move driven compressor coupling shaft (140) up to a position where the knife edge is in relation to driven compressor bearing housing (190) as shown in Figure 10008, Detail A.

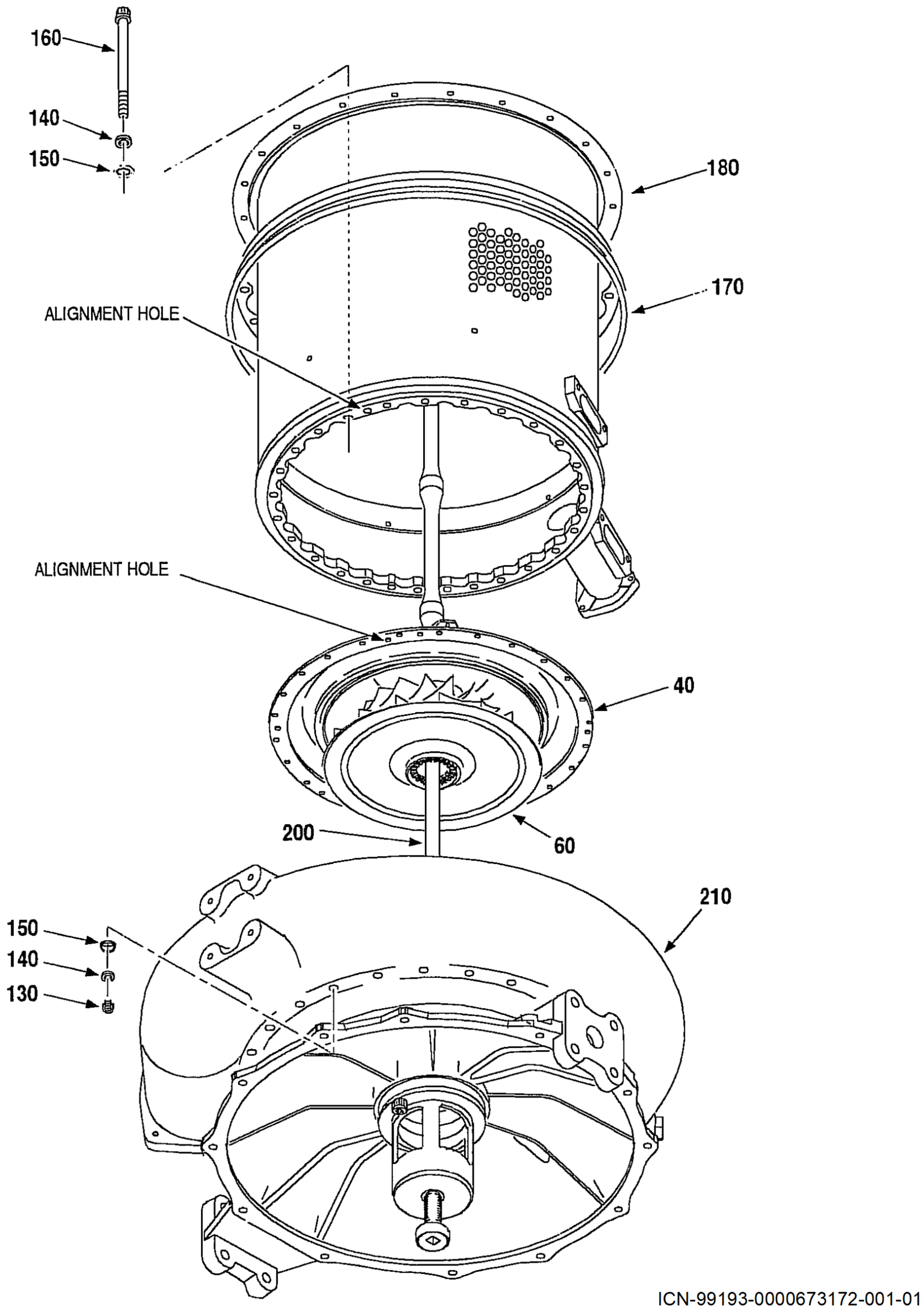

Figure 10009. Install Compressor Rotor and Inlet Housing Assembly on Driven Compressor Bearing Housing

Key to Figure 10009

40.	CENTRIFUGAL CASE (IPC FIG. 23)	170.	INLET DUCT SUPPORT
60.	COMPRESSOR ROTOR	180.	INLET HOUSING ASSY
-70.	CENTRIFUGAL DIFFUSER	-190.	DRIVEN COMPRESSOR COUPLING SHAFT (140, IPC FIG. 24)
130.	NUT (IPC FIG. 22)	200.	TURBINE SHAFT (120, IPC FIG. 23)
140.	WASHER	210.	DRIVEN COMPRESSOR BEARING HOUSING (190, IPC FIG. 24)
150.	PACKING WITH RETAINER	-.	ITEM NOT ILLUSTRATED
160.	EXT RELIEF BOLT		

(6) Install compressor rotor and inlet housing assembly on turbine shaft and driven compressor bearing housing as follows. Refer to Figure 10009.

(a) Clean curvics on the driven compressor coupling shaft (190) and the compressor rotor (60).

(b) Align balance marks and install the compressor rotor (60) on the driven compressor coupling shaft (190) curvics so that the compressor rotor backface is pointed downward.

(c) Make sure the curvics are engaged correctly and not stacked.

(d) Make sure packing (80, Figure 10006) is in place on the centrifugal diffuser (70).

(e) Install centrifugal case (40, Figure 10009) on the centrifugal diffuser (70).

NOTE: Make sure the alignment pin is engaged in the centrifugal diffuser (70) alignment hole.

(f) Rotate the turbine shaft (200) and coupled compressor rotor (60) to make sure the compressor rotor is free from centrifugal case (40) contact.

NOTE: Make sure the PN 834815-1 load compressor centering tool jacking screw is lowered slightly until the compressor rotor (60) is free from the centrifugal case (40). Make sure the curvics do not get disengaged.

CAUTION: MAKE SURE THE CURVICS DO NOT DISENGAGE ON COMPRESSOR COUPLING SHAFT.

(g) When the PN 834815-1 load compressor centering tool is lowered, make sure that the curvics on the compressor rotor (60) are still engaged with those on the driven compressor coupling shaft (190).

(h) Install the inlet support duct (170) on the inlet housing assembly (180).

(i) Install the inlet housing assembly (180) and align the pin hole with hole in the centrifugal case (40). (Refer to Figure 10009.)

1 Lubricate and install ext relief bolts (160), washers (140) and packings with retainers (150) through the inlet housing assembly (180), centrifugal case (40), centrifugal diffuser (70) and driven compressor bearing housing (210).

2 Assemble packings with retainer (150), washers (140) and nuts (130) on bolts (160).

3 Alternately tighten nuts (130) evenly until inlet housing assembly (180), centrifugal case (40) and centrifugal diffuser (70) are seated against driven compressor bearing housing (210) to a torque value of 70 in-lb (7.91 Nm) and at the same time make sure compressor rotor (60) and turbine shaft (200) rotate freely.

NOTE: If necessary, lower jacking screw on load compressor centering tool so jam between compressor rotor (60) and centrifugal case (40) does not occur while nuts (130) are tightened.

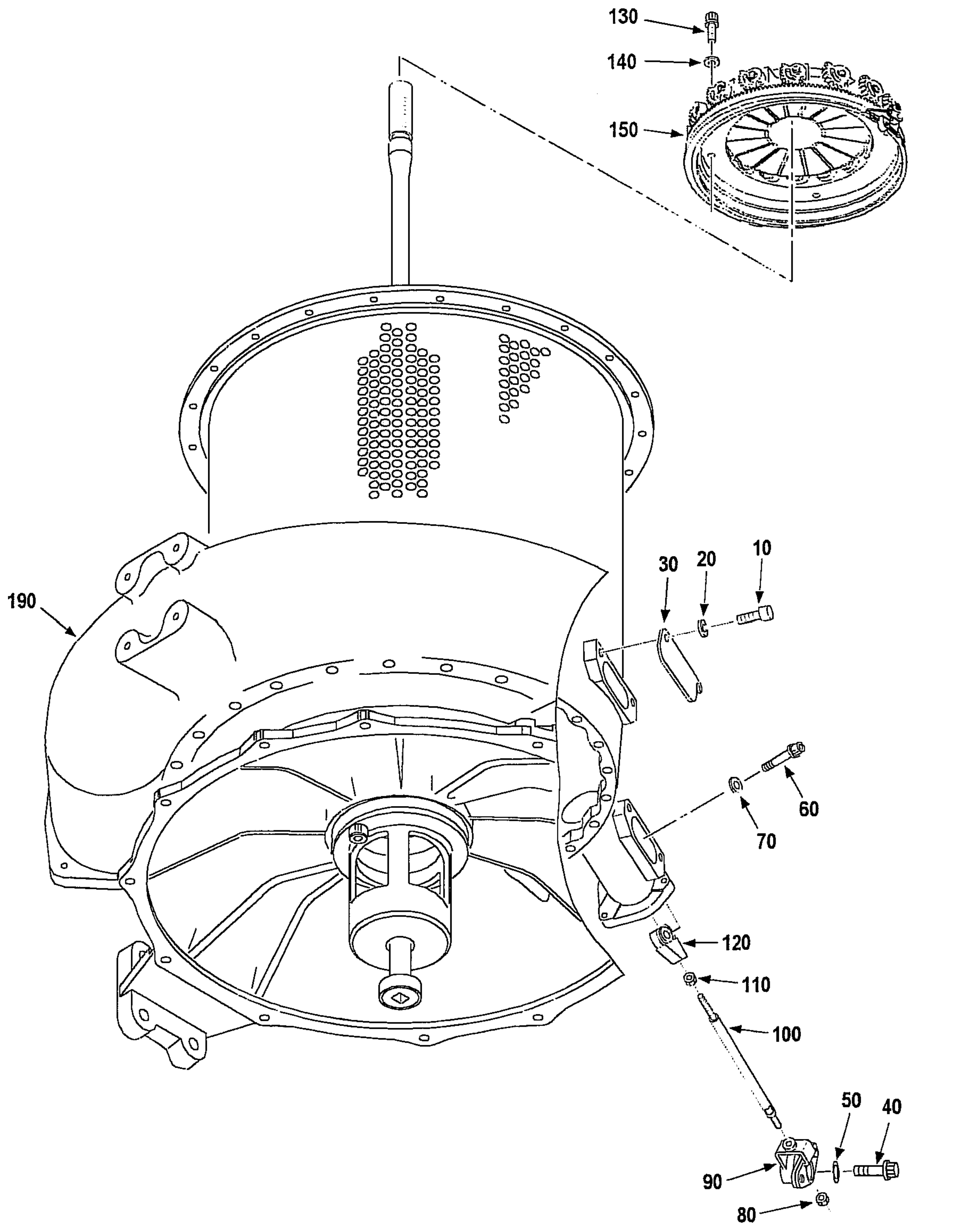

Figure 10010. Inlet Guide Vane Installation

Key to Figure 10010

10. BOLT (IPC FIG. 22)	100. ACTUATOR ROD
20. WASHER	110. NUT
30. COVER	120. ROD END BEARING
40. BOLT	130. BOLT (10, IPC FIG. 23)
50. WASHER	140. WASHER (20, IPC FIG. 23)
60. BOLT	150. INLET GUIDE VANE ASSY (30, IPC FIG. 23)
70. WASHER	-160. CENTRIFUGAL CASE (40, IPC FIG. 23)
80. NUT	190. POWER SECTION ASSY (IPC FIG. 22)
90. CLEVIS ASSY	-. ITEM NOT ILLUSTRATED

(7) Install inlet guide vane assembly into the power section as follows:

(a) Install clevis assembly (90) on actuator rod (100) and attach with nut (80). Tighten nut (80) to a torque value of 30 in-lb (3.39 Nm). Refer to Figure 10010.

NOTE: Put clevis assembly (90) on actuator rod (100) end that has two wrench flats machined in the outside diameter.

(b) Put nut (110) and rod end bearing (120) on actuator rod (100). Leave nut (110) loose at this time.

(c) Use PN 834948-1 IGV vane setting to align IGV vanes.

(d) Install the assembled IGV linkage on the inlet guide vane assembly (150) and attach the rod end bearing (120) to the inlet guide vane clevis with the inlet guide vane clevis bolt. Tighten IGV clevis bolt to a torque value of 35 in-lb (3.95 Nm).

(e) Put the inlet guide vane assembly (150), with attached IGV linkage, on the centrifugal case (160).

(f) Attach the inlet guide vane assembly (150) to the centrifugal case (160) with bolts (130) and washers (140). Tighten bolts to a torque value of 50 in-lb (5.65 Nm).

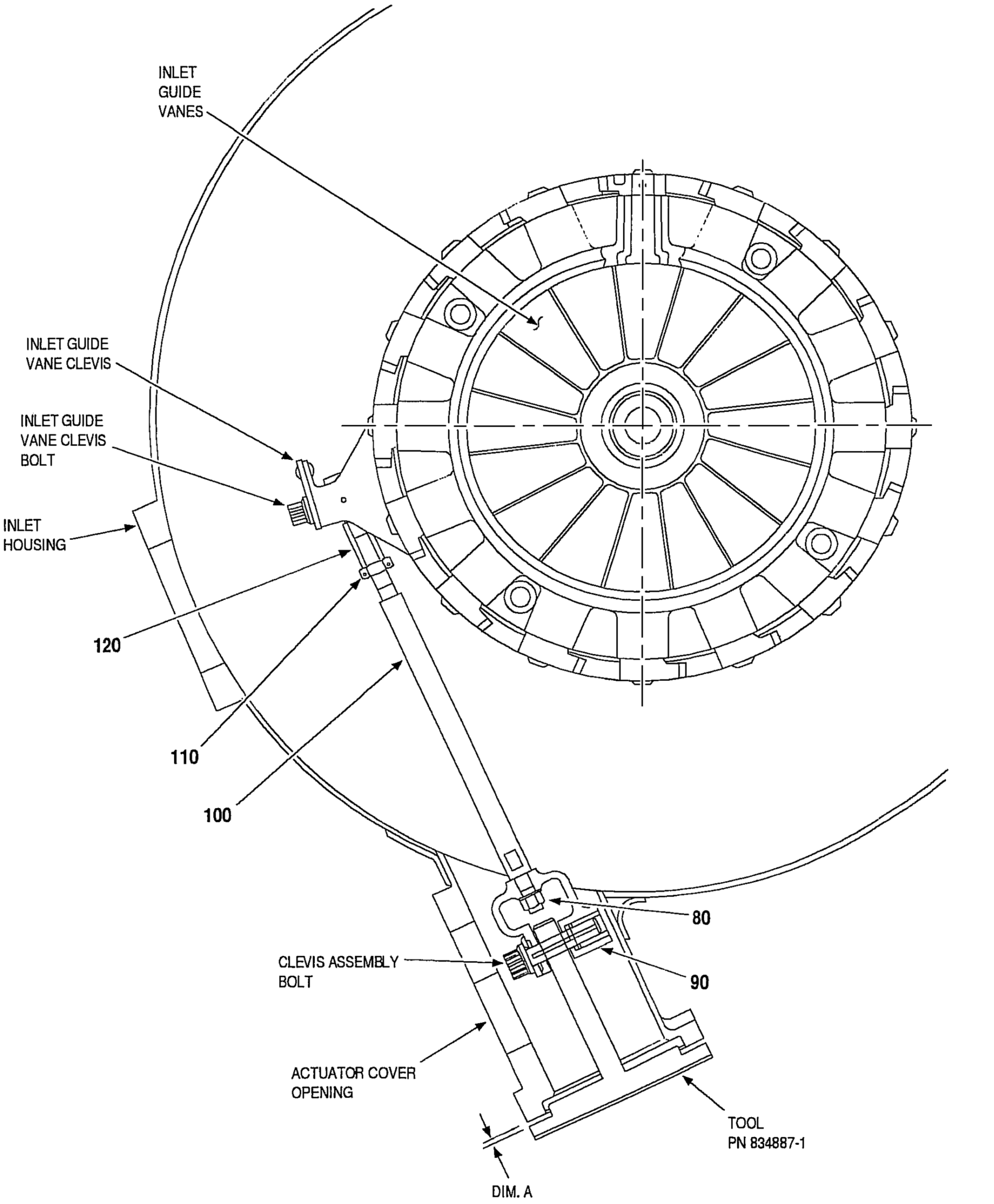

Figure 10011. Adjust Inlet Guide Vanes

Key to Figure 10011

80. NUT (IPC FIG. 22)	110. NUT
90. CLEVIS ASSY	120. ROD END BEARING
100. ACTUATOR ROD	

(g) Adjust the inlet guide vane linkage as follows. Refer to Figure 10011.

1 Install PN 834948-1 IGV vane alignment tool to IGV vane ribs.

2 Attach PN 834887-1 IGV gauge set to the clevis assembly (90) with bolt in clevis assembly.

3 Turn and push PN 834887-1 IGV gauge set as necessary until the inlet guide vanes are fully closed and Dimension A is zero.

4 Tighten nut (110) against rod end bearing (120) to a torque value of 30 in-lb (3.39 Nm).

5 Loosen inlet guide vane clevis bolt and remove IGV linkage with attached PN 834887-1 IGV gauge set.

6 Loosen clevis assembly bolt and remove PN 834887-1 IGV gauge set from clevis assembly (90).

7 Remove PN 834948-1 IGV vane alignment tool from IGV vanes.

8 Lockwire nut (110) to rod end bearing (120) with lockwire MS20995C20 per NASM33540, and install seal (PN S8187A).

9 If the clevis assembly captive bolt is not aligned with the bolt hole in the rod end bearing (120) perform the following:

a Loosen nut (80) and rotate clevis assembly (90) on actuator rod (100) until clevis assembly captive bolt is aligned with bolt hole in the rod end bearing (120).

b Tighten nut (80) to a torque value of 30 in-lb (3.39 Nm).

(h) Install assembled IGV linkage into the load compressor, with clevis assembly (90) and bolt head positioned toward actuator cover opening.

(i) Tighten inlet guide vane clevis bolt to a torque value of 35 in-lb (3.95 Nm).

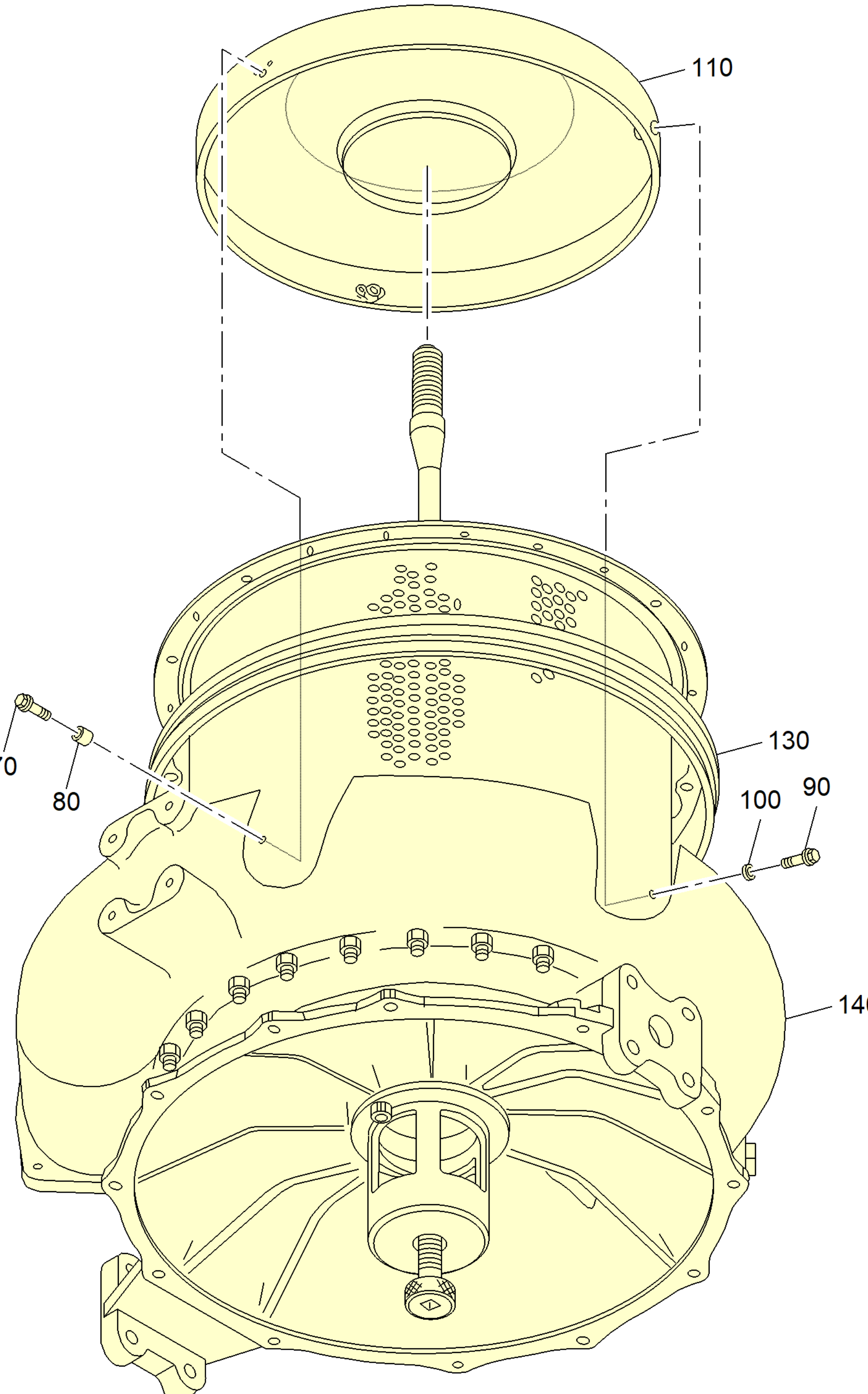

Figure 10012. Install Inlet Guide Vanes Cover

Key to Figure 10012

70. BOLT (IPC FIG. 21)
80. SPACER
90. BOLT
100. WASHER
110. INLET GUIDE VANES COVER
130. INLET DUCT SUPPORT
140. POWER SECTION ASSY

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

(j) Install PN 834887-1 IGV gauge set and attach to clevis assembly.

Check Point 40: With PN 834887-1 IGV gauge set installed make sure Dimension A is ZERO with inlet guide vanes fully closed.

(k) Remove PN 834887-1 IGV gauge set.

(l) Install cover (110) on the inlet housing and attach with bolts (90) and washers (100). Tighten bolts to a torque value of 30 in-lb (3.39 Nm). Refer to Figure 10012.

(m) Install inlet guide vanes cover as follows. Refer to Figure 10012.

1 Install inlet guide vanes cover (110) in the power section assembly (140) and make sure the inlet guide vanes cover is engaged with inlet guide vane housing.

2 Attach inlet guide vanes cover (110) to the power section assembly (140) with spacer (80), washer (100) and bolts (70, 90). Tighten bolts (70, 90) to a torque value of 40 in-lb (4.52 Nm).

3 Apply a thick layer of adhesive sealant (RTV 106) to cylindrical outside diameter of inlet guide vanes cover (110).

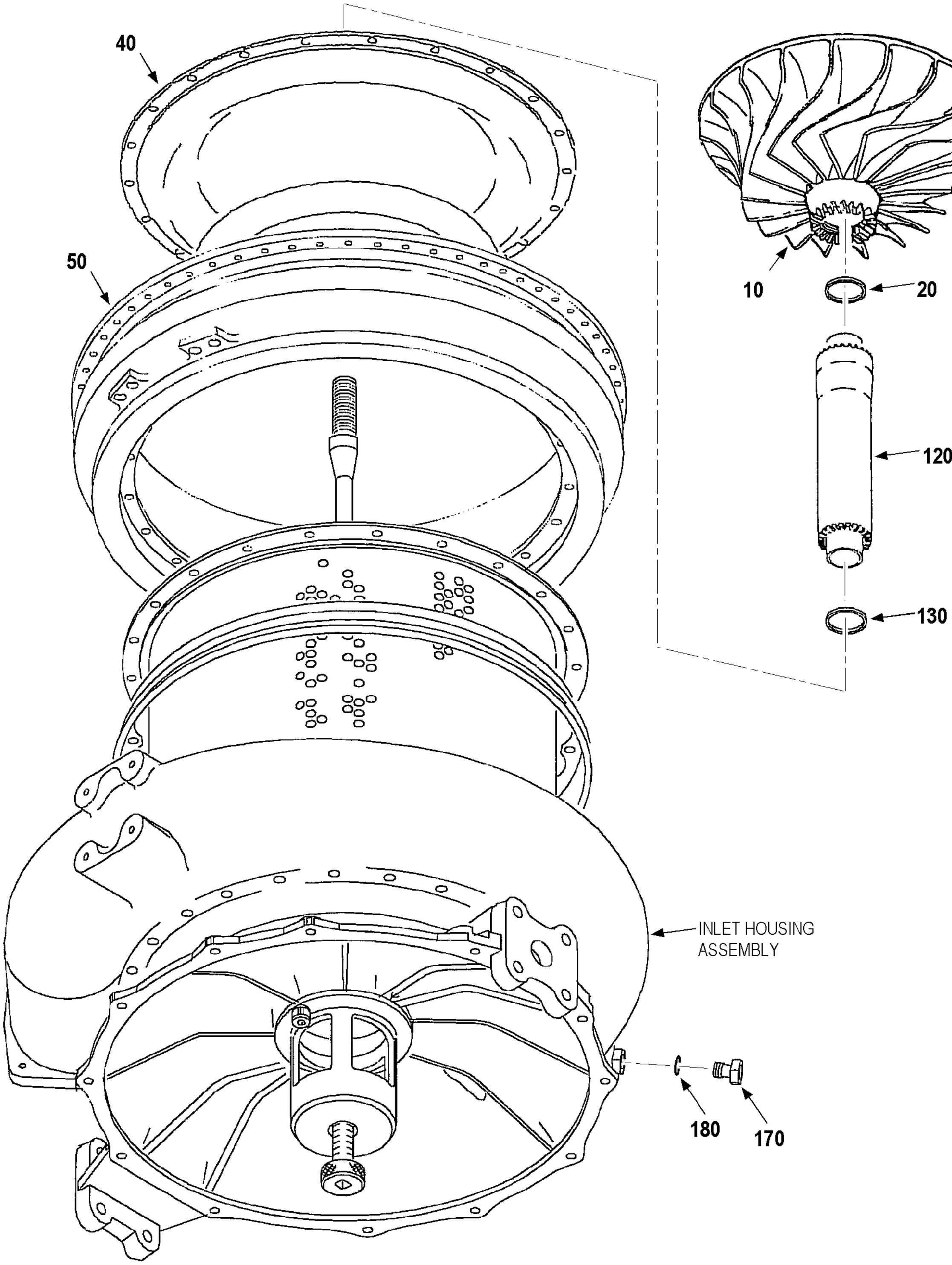

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Figure 10013. Engine Compressor Section Assembly

Key to Figure 10013

10. COMPRESSOR ROTOR (IPC FIG. 21)	120. SHAFT ASSY (IPC FIG. 21)
20. CURVIC RING SEAL	130. CURVIC RING SEAL
40. ENGINE COMPRESSOR SHROUD ASSY	170. PLUG (IPC FIG. 24)
50. DIFFUSER HOUSING ASSY	180. PACKING
-60. COMPRESSOR ROTOR (IPC FIG. 23)	-. ITEM NOT ILLUSTRATED

(8) Install engine compressor components as follows. Refer to Figure 10013.

(a) Install the diffuser housing assembly (50) and align its pin with the pin hole on the inlet housing assembly.

(b) Clean the curvics on the compressor rotor (60) and the shaft assembly (120).

(c) Install the curvic ring seal (130) into the compressor rotor (60).

(d) Install the shaft assembly (120) on the compressor rotor (60) and align the balance marks. Make sure the curvics are not stacked.

(e) Clean the curvics on the shaft assembly (120) and the compressor rotor (10).

(f) Put the curvic ring seal (20) into the shaft assembly (120).

(g) Put the engine compressor shroud assembly (40) on the diffuser housing assembly (50) and align pin hole in the engine compressor shroud assembly with pin hole in the diffuser housing assembly and inlet housing assembly and attach with seven slave bolts and nuts in equally spaced places. Tighten nuts to a torque value of 180 in-lb (20.33 Nm).

(h) Install the compressor rotor (10) on the shaft assembly (120) and align the balance marks. Make sure the curvics are not stacked.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

(i) Lubricate packing (180) with oil.

(j) Install plug (170) with packing (180) on the driven compressor bearing housing. Tighten plug to a torque value of 80 in-lb (9.04 Nm). Lockwire plug to driven compressor bearing housing using MS20995C32 in accordance with NASM33540.

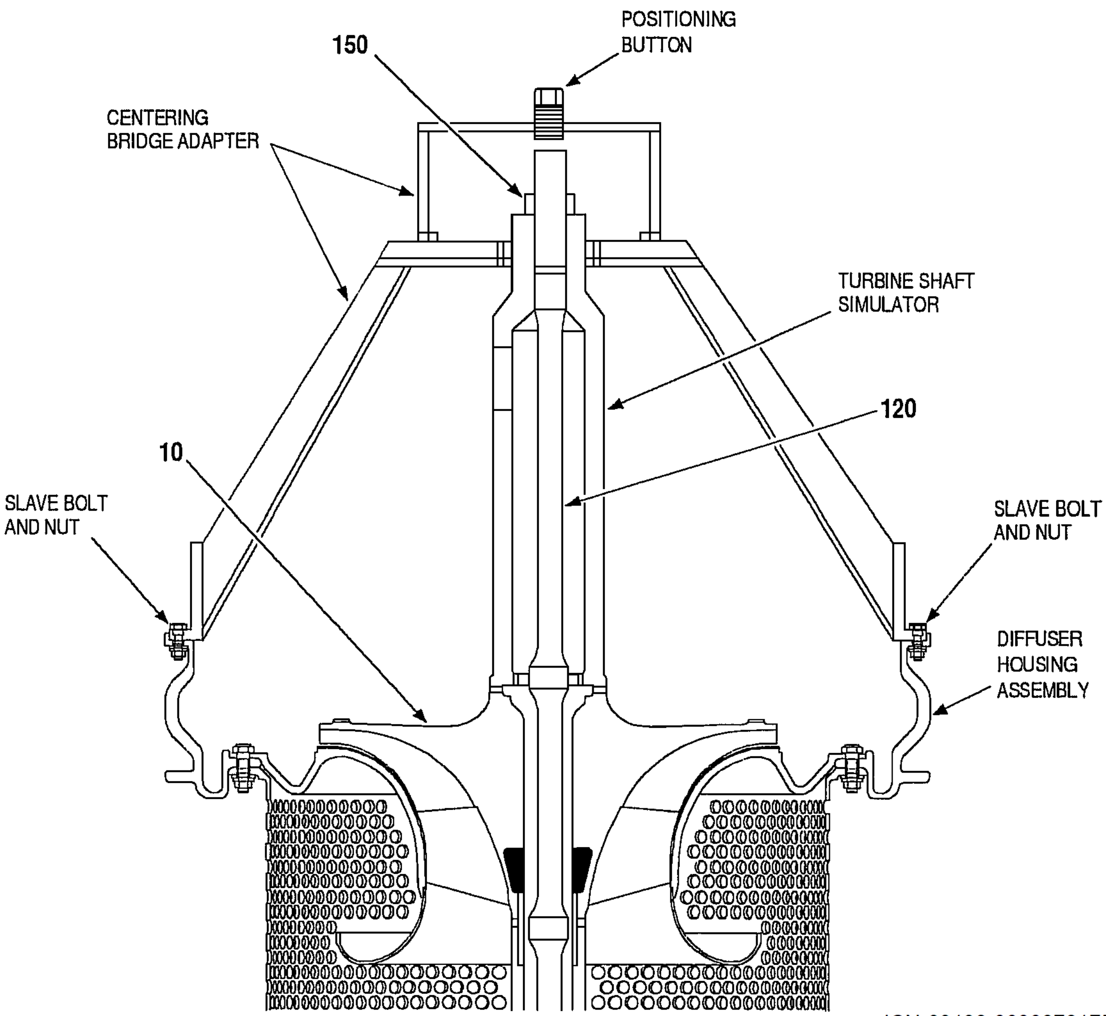


Figure 10014. Engine Compressor Section Assembly

Key to Figure 10014

10. COMPRESSOR ROTOR (IPC FIG. 21)
120. TURBINE SHAFT (IPC FIG. 23)
150. TIESHAFT NUT (IPC FIG. 18)

(9) Install turbine shaft simulator and stretch turbine shaft as follows. Refer to Figure 10014.

(a) Clean curvics on compressor rotor (10) and PN 834886-1 turbine shaft simulator.

(b) Install PN 834886-1 turbine shaft simulator on compressor rotor (10). Make sure the curvics are not stacked.

(c) Install tieshaft nut (150) on turbine shaft (120). Tighten tieshaft nut hand tight

(d) Install PN 834740-2 shaft stretch kit and PN 834889-1 stretch shaft tooling on turbine shaft (120).

(e) Stretch turbine shaft (120) to the Actual Load as written in ASSEMBLY 02, Step 4.A.(3)(c)1 b.

(f) Tighten tieshaft nut (150) hand tight.

(g) Remove PN 834740-2 shaft stretch kit and PN 834889-1 stretch shaft tooling from the turbine shaft (120).

CAUTION: MAKE SURE PN 834891-1 CENTERING BRIDGE ADAPTER ALIGNMENT HOLE IS ALIGNED WITH ALIGNMENT PIN ON DIFFUSER HOUSING ASSEMBLY.

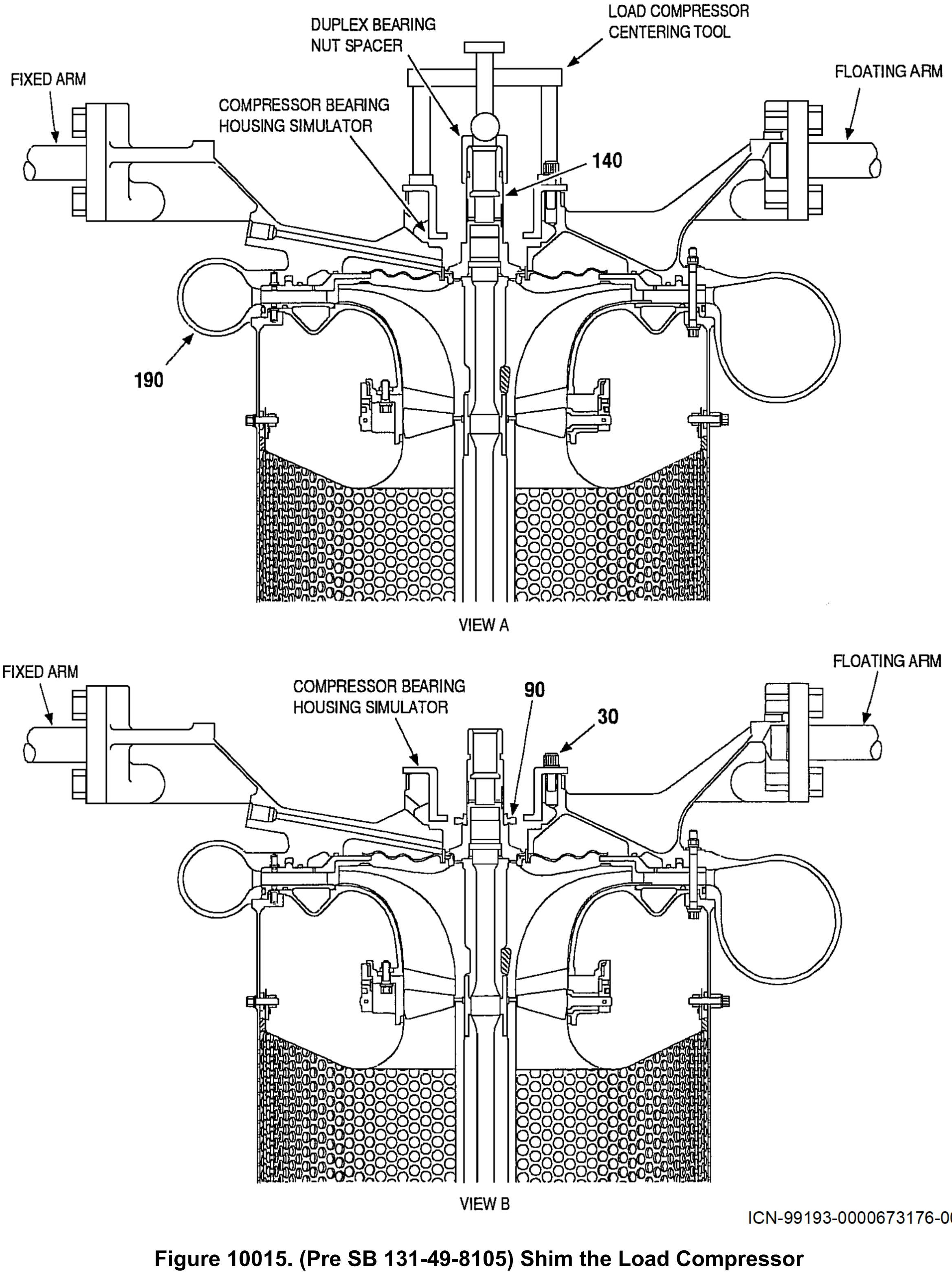
(h) Install PN 834891-1 centering bridge adapter and PN 834891-1 button tool on the diffuser housing assembly and attach with six slave bolts and nuts in equally spaced places. Tighten nuts to a torque value of 40 in-lb (4.52 Nm).

(i) Hand tighten PN 834891-1 button tool on turbine shaft (120).

CAUTION: MAKE SURE ROTATING GROUP IS AFT BEFORE POWER SECTION IS ROTATED.

(j) Rotate power section assembly to the fwd end up position.

(k) Loosen PN 834891-1 centering bridge adapter until it is one turn away from the turbine shaft (120).



ICN-99193-0000673176-001-01

Figure 10015. (Pre SB 131-49-8105) Shim the Load Compressor

Key to Figure 10015

30. BOLT (IPC FIG. 24)	140. DRIVEN COMPRESSOR COUPLING SHAFT
90. SEAL ROTOR	190. DRIVEN COMPRESSOR BEARING HOUSING

(10) (Pre SB 131-49-8105) Shim the load compressor as follows. Refer to Figure 10015.

(a) Remove bolts (30) and PN 834815-1 load compressor centering tool from the driven compressor bearing housing (190). Refer to View A.

(b) Attach PN 834818-1 compressor bearing housing simulator to driven compressor bearing housing (190) with two bolts (30). Tighten bolts to a torque value of 100 in-lb (11.30 Nm). Refer to View B.

(c) Install seal rotor (90) on the driven compressor coupling shaft (140). Make sure seal rotor is installed with inner step up as shown in View B and is fully seated.

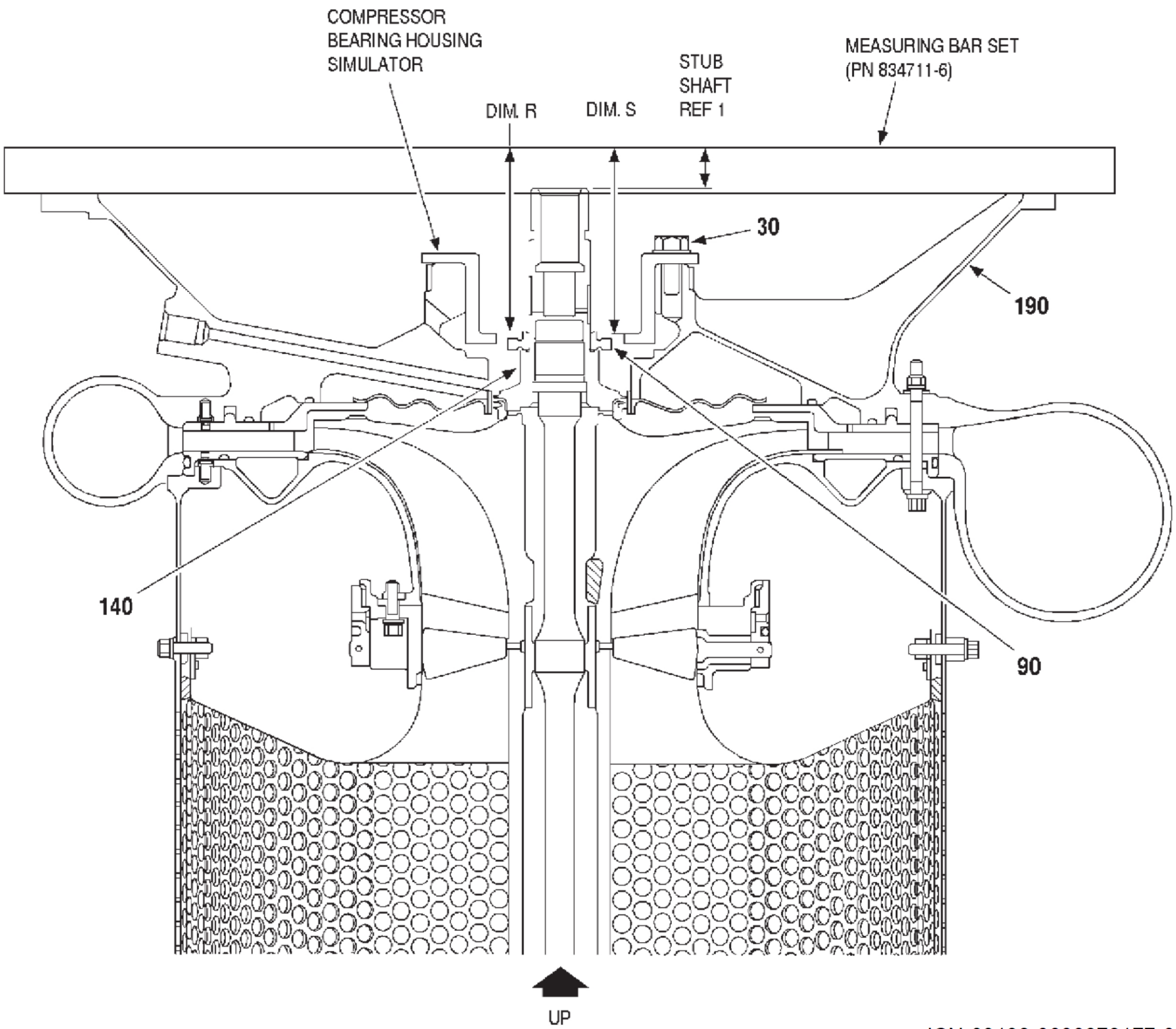


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Figure 10016. (Pre SB 131-49-8105) Shim the Load Compressor

Key to Figure 10016

30. BOLT (IPC FIG. 24)
90. SEAL ROTOR
140. DRIVEN COMPRESSOR COUPLING SHAFT
190. DRIVEN COMPRESSOR BEARING HOUSING

(d) (Pre SB 131-49-8105) Measure for compressor bearing shims as follows. Refer to Figure 10016.

1 Put PN 834711-6 micing bar on driven compressor bearing housing (190).

2 Measure from top of seal rotor (90) inner step to top of PN 834711-6 micing fixture. Write as Dimension R.

Dimension R__________________________inch (mm)

3 Measure from bottom of PN 834818-1 housing simulator to top of PN 834711-6 micing bar. Write as Dimension S.

Dimension S ____________________________inch (mm)

Check Point 50: Verify Dimensions R and S are written down.

4 Measure from end of driven compressor coupling shaft (140) to top of PN 834711-6 micing fixture. Write as Stub Shaft Ref. 1.

Stub Shaft Ref. 1___________________________inch (mm)

5 Remove seal rotor (90) from driven compressor coupling shaft (140).

6 Remove bolts (30) and PN 834818-1 housing simulator from driven compressor bearing housing (190).

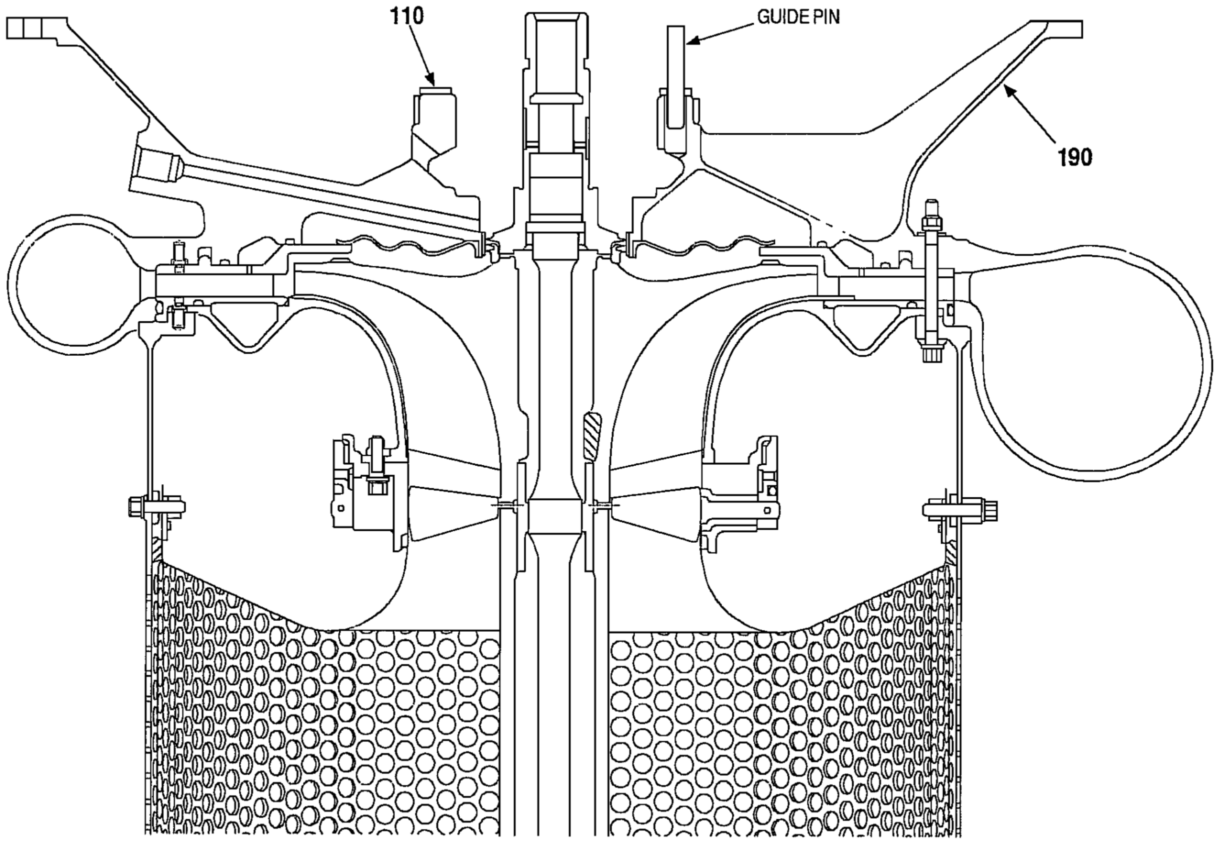

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Figure 10017. (Pre SB 131-49-8105) Shim the Load Compressor

Key to Figure 10017

110. L/C BEARING SHIM (IPC FIG. 24)	190. DRIVEN COMPRESSOR BEARING HOUSING

(e) (Pre SB 131-49-8105) Calculate and install necessary shims for load compressor as follows. Refer to Figure 10017.

1 Write the following dimensions.

Dimension C	________________	inch (mm), from Step 5.A.(1)(b)
Dimension E	________________	inch (mm), from Step 5.A.(1)(a)
Dimension F	________________	inch (mm), from Step 5.A.(1)(a)
Dimension G	________________	inch (mm), from Step 5.A.(1)(a)
Dimension H	________________	inch (mm), from Step 5.A.(1)(a)
Dimension M	________________	inch (mm), from Step 5.A.(1)(b)
Dimension R	________________	inch (mm), from Step 5.A.(10)(d)2
Dimension S	________________	inch (mm), from Step 5.A.(10)(d)3
Dimension T	________________	inch (mm), from Step 5.A.(10)(a)

2 Use dimensions in Step 1 for the following formula to calculate necessary L/C bearing shim (110) pack thickness.

Dimensions S + (E - F) - (G - H) - R - T - C - M + 0.048 inch (1.22 mm) = L/C bearing shim (110) pack thickness ________inch (mm) required +0.001/-0.001 inch (+0.025/-0.025 mm).

Check Point 60: Make sure calculation to find L/C bearing shim (110) pack thickness is correct.

3 Select two L/C bearing shims (110) maximum of each thickness to get required shim pack thickness calculated in Step (2) (Pre SB 131-49-8105). Use guide pins to install L/C bearing shim (110) pack on driven compressor bearing housing (190). Write thickness of L/C bearing shim (110) pack installed _______________inch (mm).

Check Point 70: Make sure installed L/C bearing shim (110) pack thickness is same as calculated L/C bearing shim pack thickness.

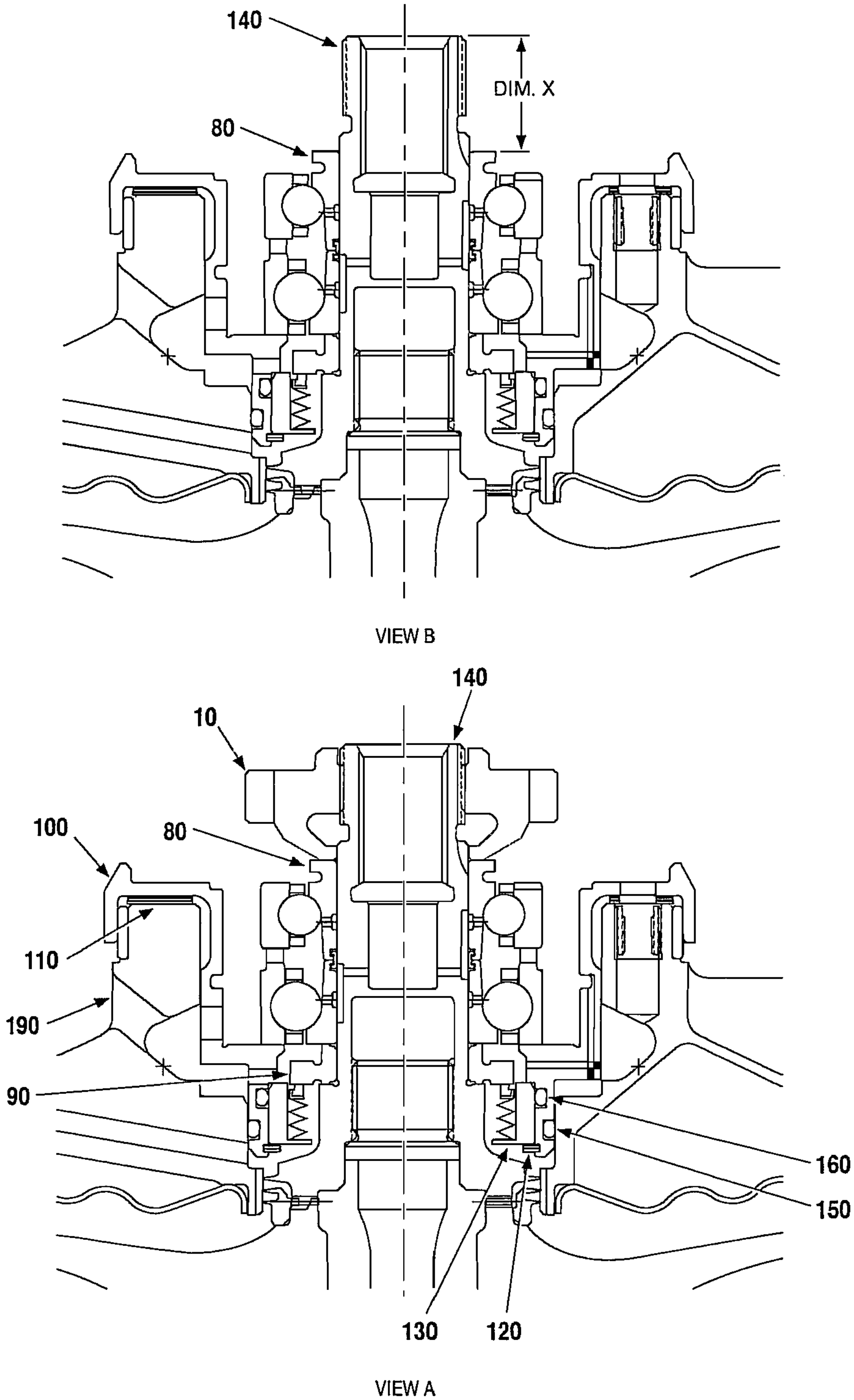

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Figure 10018. (Pre SB 131-49-8105) Shim the Load Compressor

Key to Figure 10018

10. COMPRESSOR BEARING NUT (IPC FIG. 24)
80. MATCHED DUPLEX BALL BEARING ASSY SET
90. SEAL ROTOR
100. COMPRESSOR BEARING HOUSING
110. L/C BEARING SHIM
120. RETAINING RING
130. OIL STATIONARY SEAL
140. DRIVEN COMPRESSOR COUPLING SHAFT
150. PACKING
160. PACKING
190. DRIVEN COMPRESSOR BEARING HOUSING

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(11) (Pre SB 131-49-8105) Install compressor bearing components as follows. Refer to Figure 10018.

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

(a) Lubricate packings (150, 160) with corrosion-preventive compound (Braycote 248).

(b) Install packings (150, 160) in the compressor bearing housing (100).

(c) Install and seat oil stationary seal (130) in the compressor bearing housing (100) from the aft end using PN 834810-2 installation seal drive tool.

(d) Install retaining ring (120) in the compressor bearing housing (100).

CAUTION: WHEN HEATING THE COMPRESSOR BEARING HOUSING (100) BE CAREFUL NOT TO OVERHEAT AND DAMAGE THE PACKINGS (150, 160).

(e) Heat the compressor bearing housing (100) outer flange only. Use guide pins and install compressor bearing housing (100) on the driven compressor bearing housing (190) over the L/C bearing shims (110).

NOTE: Make sure value of L/C bearing shim (110) pack on driven compressor bearing housing (190) agrees with Step 5.A.(10)(h)2.

CAUTION: LOAD ROTATING GROUP FORWARD. TIGHTEN JACK SCREW TO 10 IN-LB (1.13 NM).

(f) Install seal rotor (90) on the driven compressor coupling shaft (140).

NOTE: Make sure that the large outside diameter side of the seal rotor is installed facing aft on the driven compressor coupling shaft (140).

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

(g) Clean matched duplex ball bearing assembly set (80) with degreasing solvent (MIL-PRF-680).

WARNING: **USE THE CORRECT PERSONAL PROTECTION. COMPRESSED AIR WILL CAUSE LOOSE PARTICLES THAT CAN GET IN YOUR EYES. THE AIRFLOW CAN CAUSE CUTS. DO NOT POINT IT AT YOUR SKIN.**

CAUTION: MAKE SURE MATCHED DUPLEX BALL BEARING ASSEMBLY SET (80) IS COMPLETELY FREE OF DEGREASING SOLVENT AND DRY. DO NOT SPIN BEARING WHILE DRY.

(h) Dry matched duplex ball bearing assembly set (80) with dry compressed air.

WARNING: **USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.**

WARNING: **USE THE CORRECT PERSONAL PROTECTION. THE HEATED PARTS WILL CAUSE BURNS.**

(i) Heat matched duplex ball bearing assembly set (80) to 450 to 500°F (232 to 260°C) 20 to 30 minutes and install on driven compressor coupling shaft (140).

(j) (Preferred method) Install matched duplex ball bearing assembly set (80).

1 Install PN 3700537-1 or -2 adapter on driven compressor coupling shaft (140).

CAUTION: WHEN HANDLING MATCHED DUPLEX BALL BEARING ASSEMBLY SET (80) USE PN 3700539-1 INSTALLATION TOOL.

2 Install heated matched duplex ball bearing assembly set (80) on driven compressor coupling shaft (140) with the inner race puller groove facing up.

NOTE: Make sure that inner race puller groove is facing up.

3 Coat threads and face PN 3700508-1 nut tool with lubricant (Liqui-Moly) (AMS-M-7866).

4 Tighten PN 3700508-1 nut tool to a torque value of 800 in-lb (90.39 Nm) to seat bearing.

5 Remove nut tool and adapter.

6 Coat threads and face of compressor bearing nut (10) with lubricant (Liqui-Moly) (AMS-M-7866).

7 Install compressor bearing nut (10) and use PN 834801-1 torque adapter with a torque wrench to tighten to a torque value of 600 to 680 in-lb (67.79 to 76.83 Nm). Loosen the compressor bearing nut (10) and retighten to 600 in-lb (67.79 Nm)), continue to tighten to the first alignment of the key and then mark alignment.

(k) (Alternate Method) Install matched duplex ball bearing assembly set (80).

1 Install heated matched duplex ball bearing assembly set (80).

NOTE: Make sure that inner race puller groove is facing up.

2 Coat threads and face of compressor bearing nut (10) with lubricant (Liqui-Moly) (AMS-M-7866).

3 Install compressor bearing nut (10) and use PN 834801-1 torque adapter with a torque wrench to tighten to a torque value of 600 to 680 in-lb (67.79 to 76.83 Nm). Loosen the compressor bearing nut (10) and retighten to 600 in-lb (67.8 Nm)), continue to tighten to the first alignment of the key and then mark alignment.

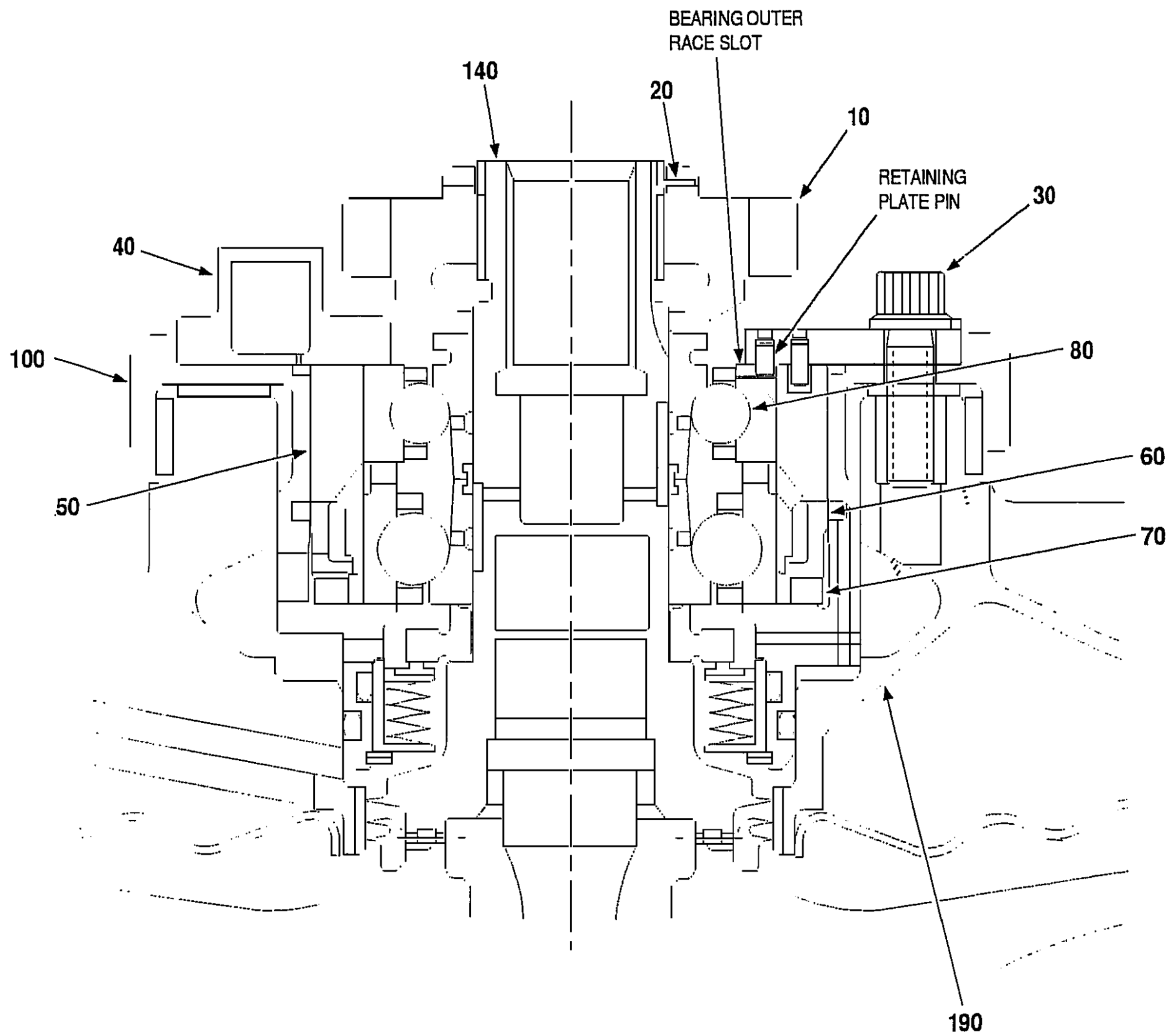

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Figure 10019. (Pre SB 131-49-8105) Shim the Load Compressor

Key to Figure 10019

10. COMPRESSOR BEARING NUT (IPC FIG. 24)
20. NUT LOCKING KEY
30. BOLT
40. COMPRESSOR BEARING RETAINING PLATE
50. BEARING DAMPER RING
60. SPRING RETAINER
70. COMPRESSION SPRING WASHER
80. MATCHED DUPLEX BALL BEARING ASSY SET
100. COMPRESSOR BEARING HOUSING
140. DRIVEN COMPRESSOR COUPLING SHAFT
190. DRIVEN COMPRESSOR BEARING HOUSING

(l) (Pre SB 131-49-8105) Remove compressor bearing nut (10) from the driven compressor coupling shaft (140).

1 Apply a generous amount of oil (MIL-PRF-7808 or MIL-PRF-23699) to the duplex ball bearing and make sure thorough lubrication. Repeat this step if the bearing requires removal.

(m) Measure and write results of Measured Dimension X. Refer to View B.

Dimension X__________inch (mm)

(n) Write Calculated Dimension X from Step 5.A.(1)(b).

Calculated Dimension X ______________inch (mm)

(o) Compare Calculated Dimension X with Measured Dimension X. Calculated Dimension X must be within +0.002/-0.001 inch (+0.05/-0.03 mm) of Measured Dimension X to make sure the bearing assembly set (80) is not stacked.

(p) If Calculated Dimension X is not within +0.002/-0.001 inch (+0.05/-0.03 mm) of Measured Dimension X, repeat Steps 5.A.(11)(g) thru (p). If necessary, use PN 834808-1 bearing puller to remove matched duplex ball bearing assembly set (80).

NOTE: Duplex ball bearing can be reassembled as necessary if separation occurs.

Check Point 90: Make sure Calculated Dimension X is within +0.002/-0.001 inch (+0.05/-0.03 mm) of Measured Dimension X.

CAUTION: LOAD ROTATING GROUP AFT. TURN JACK SCREW CCW UNTIL GAP IS SEEN.

(q) Install compression spring washer (70) in the compressor bearing housing (100). Refer to Figure 10019.

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

(r) (Pre SB 131-49-8105) Install spring retainer (60) in the compressor bearing housing (100) with small inside diameter side against compression spring washer (70).

(s) (Pre SB 131-49-8105) Install bearing damper ring (50) in the compressor bearing housing (100) with small outside diameter side against spring retainer (60).

1 Apply contact cleaner (QD) to bearing damper ring (50). Clean with a soft cloth.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMICAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

2 Apply a thin layer of lubricating oil on inner surface of damper ring (50).

3 Install bearing damper ring (50) in the compressor bearing housing (100) with small outside diameter side against spring retainer (60).

(t) Install the compressor bearing retaining plate (40) as follows:

1 Align the speed sensor hole in the compressor bearing retaining plate (40) with the speed sensor hole in the driven compressor bearing housing (190).

2 Align the slot on the matched duplex ball bearing assembly set (80) outer race with the antirotation pin on the compressor bearing retaining plate (40).

3 Install the compressor bearing retaining plate (40) on the compressor bearing housing (100) with bolts (30). Tighten bolts to a torque value of 120 in-lb (13.56 Nm).

(u) Place nut locking key (20) into the marked slot, made in Step (i), of the driven compressor coupling shaft (140). Perform a load compressor reference calculation check as follows:

1 Write Stub Shaft Ref. 1 from Step 5.A.(10)(d).

Sub Shaft Ref. 1 ____________ inch (mm)

2 Repeat Step 5.A.(10)(d) except write as:

Sub Shaft Ref. 2 ____________ inch (mm)

3 Write Dimension T from Step 5.A.(10)(h).

Dimension T = ______________ inch (mm)

4 With the measurements written in Steps (1), (2) and (3) perform the following calculation.

Stub Shaft 1 – Stub Shaft 2 + Dimension T =__________ inch (mm)

5 Calculation in Step 4 must equal 0.048 inch (1.22 mm) +0.001/-0.001 inch (+0.025/-0.025 mm).

(v) Install the compressor bearing nut (10). Bend the locking tab of the nut lock key (20) down flat into the locking slot of the compressor bearing nut (10).

Check Point 90A: Make sure locking tab of the nut lock key (20) is bent down flat into the locking slot of the compressor bearing nut (10).

(w) Tighten the compressor bearing nut (10), using PN 834801-1 torque adapter tool, to a torque value of 600 to 680 in-lb (67.79 to 76.83 Nm) to seat matched duplex ball bearing assembly set (80). Back off compressor bearing nut, then retorque to a minimum of 600 in-lb (67.79 Nm) and continue to torque in a clockwise direction until the marked alignment of the driven compressor coupling shaft (140) key slot with the compressor bearing nut (10) key slot is reached. Use PN 834990-1 portable engine stand/cart to rotate power section assembly aft side up.

Check Point 100: Make sure compressor bearing nut (10) is tightened and seated.

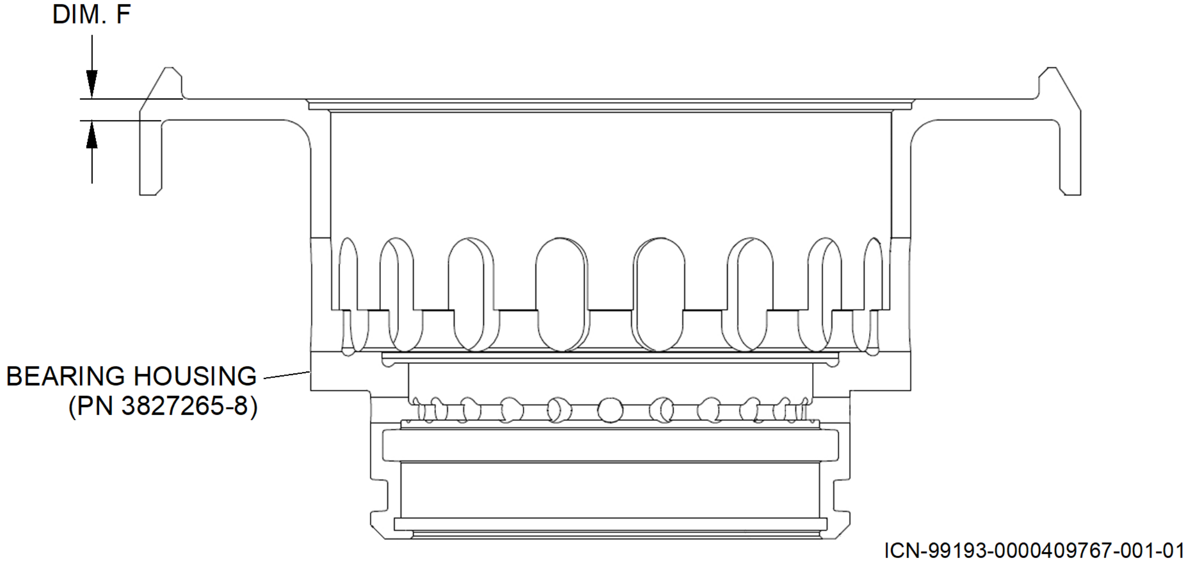

Figure 10020. (Post SB 131-49-8105) Bearing Housing Measurements

Key to Figure 10020

100A. COMPRESSOR BEARING HOUSING (PN 3827265-8)

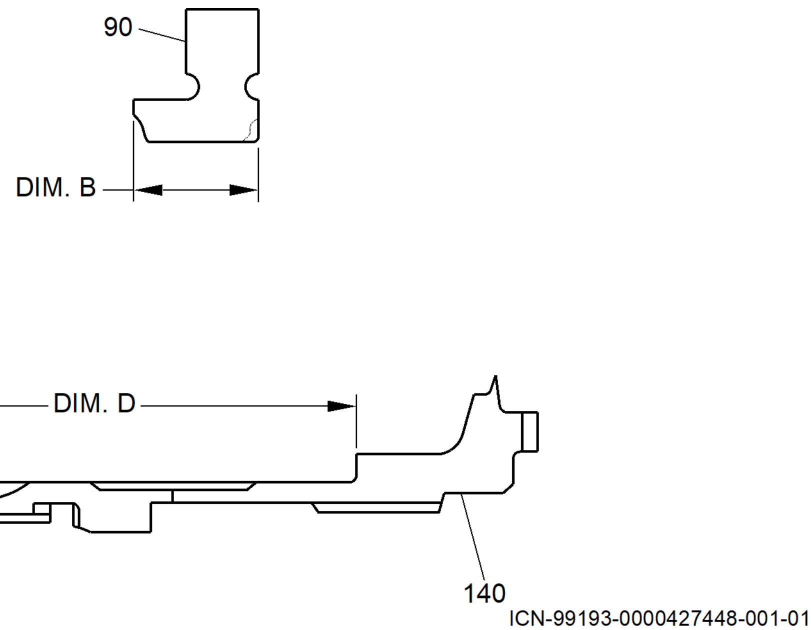

Figure 10021. (Post SB 131-49-8105) Bearing Housing Measurements

Key to Figure 10021

90. SEAL ROTOR (IPC FIG. 24)	140. COUPLING SHAFT

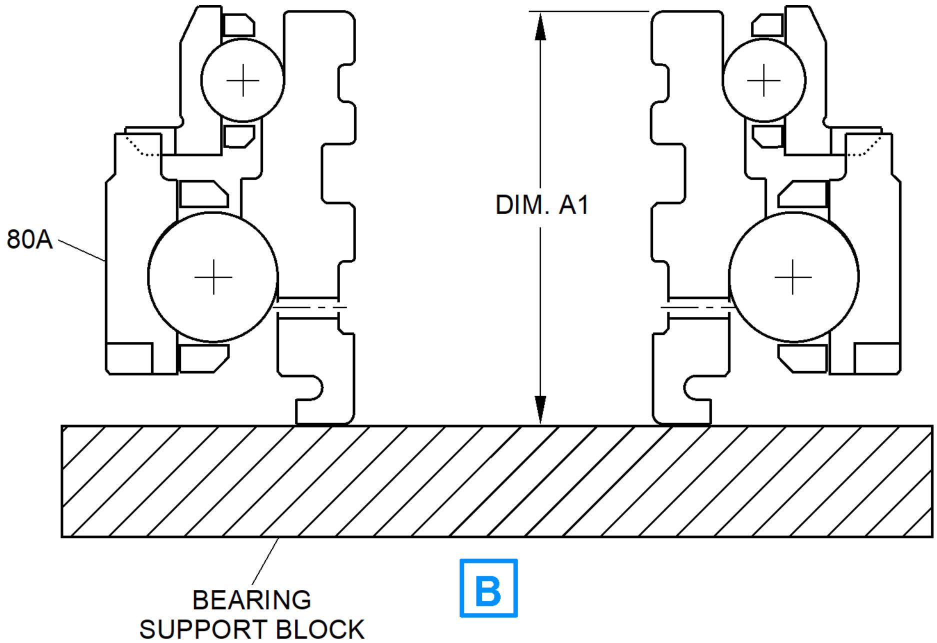

Figure 10022. (Post SB 131-49-8105) Bearing Housing Measurements

(12) (Post SB 131-49-8105) Measure compressor bearing components. Refer to Figure 10022 to Figure 10020.

(a) Measure and write the results of the bearing flange thickness (DIM. F), coupling shaft (DIM. D), seal rotor (DIM. B) and bearing inner race (DIM. A1).

DIMENSION F =______________________inch (mm)

DIMENSION D =______________________inch (mm)

DIMENSION B =______________________inch (mm)

DIMENSION A1 =_____________________inch (mm)

(b) Dimension A must be 1.233 inch (31.32 mm) or copied from the package for the duplex bearing.

NOTE: Indicate on the build sheet if dimension A is 1.233 inch (31.32 mm) or recorded from the bearing packaging.

(c) Calculate Dimension X. Refer to Step 5.A.(12)(a).

____________________________inch (mm) DIM. D (Coupling Shaft)

- ___________________________inch (mm) DIM. B (Seal Rotor)

=___________________________inch (mm) Subtotal

-___________________________inch (mm) DIM. A1 (Bearing Inner Race)

=___________________________inch (mm) DIM. X (Calculated)

Check Point 110: Make sure Dimensions F, D, B, A1, and X are properly measured, calculated and recorded within the limits.

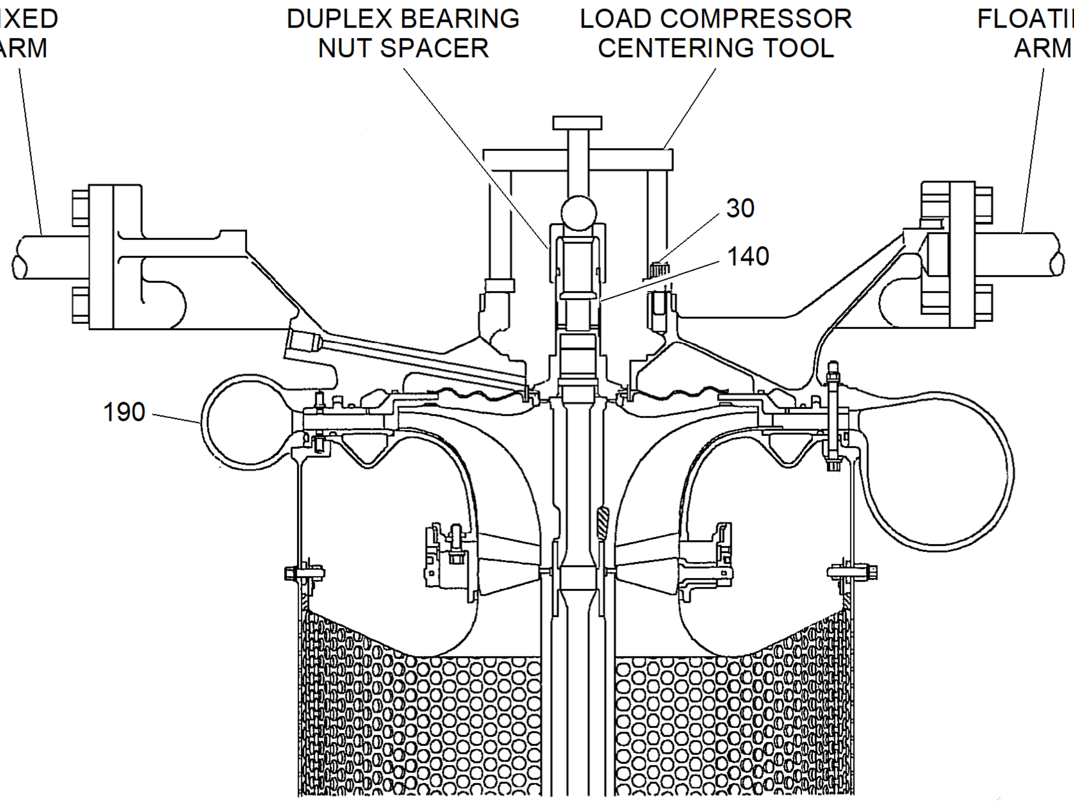

Figure 10023. (Post SB 131-49-8105) Bearing Housing Measurements

Key to Figure 10023

30. BOLT (IPC FIG. 24)

140. DRIVEN COMPRESSOR COUPLING SHAFT

190. DRIVEN COMPRESSOR BEARING HOUSING

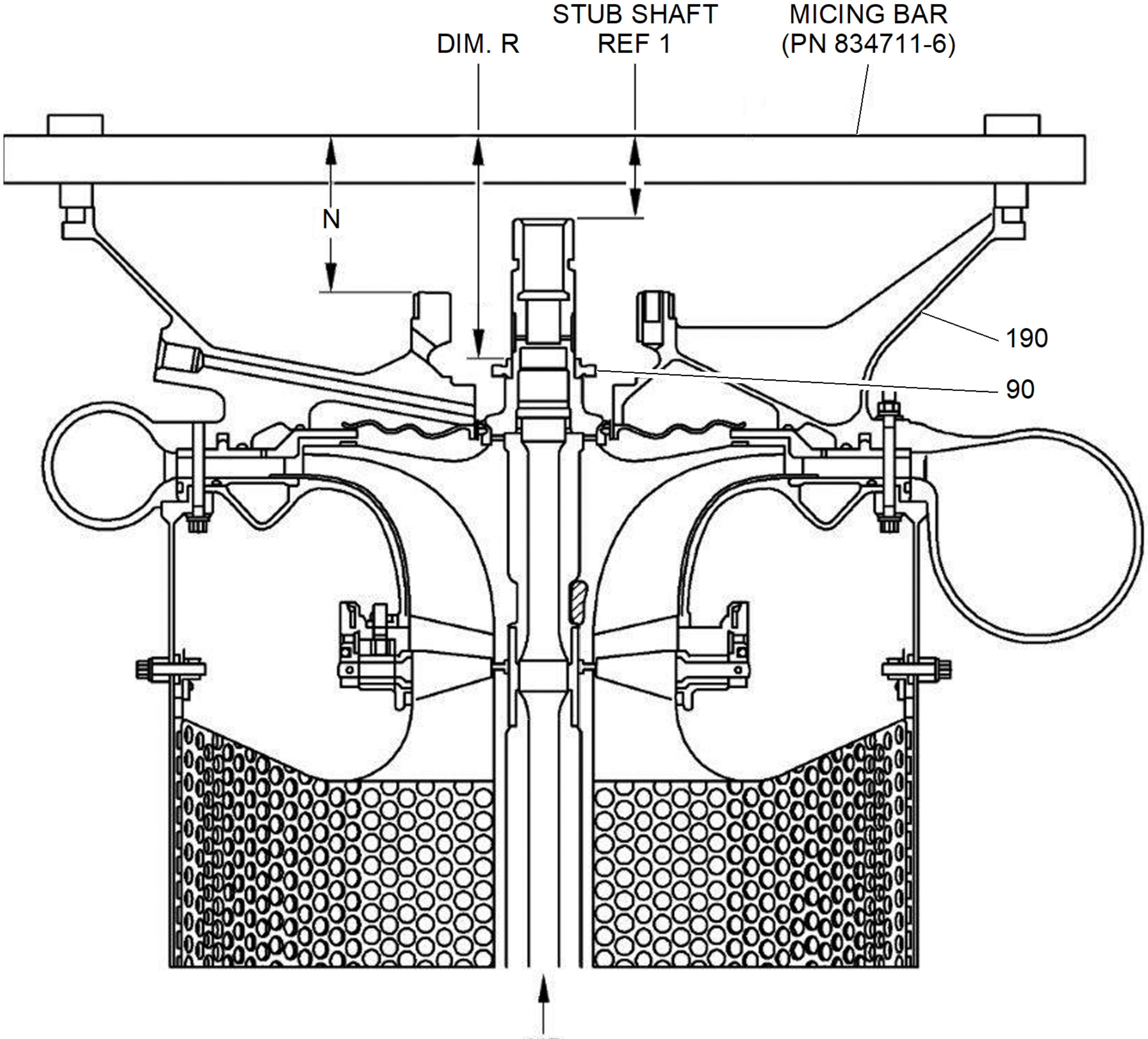

Figure 10024. (Post SB 131-49-8105) Compressor Bearing Seat Measurements

Key to Figure 10024

90. SEAL ROTOR

190. DRIVEN COMPRESSOR BEARING HOUSING

(13) (Post SB 131-49-8105) Shim the load compressor as follows. (Refer to Figures 10024 and 10025.)

(a) Remove bolts (30) and PN 834815-1 load compressor centering tool from the driven compressor bearing housing (190).

(b) Remove PN 834814-1 duplex bearing nut spacer from the coupling shaft (140).

(c) Install seal rotor (90) on the driven compressor coupling shaft (140). Make sure rotor is installed with inner step up as shown in View B and is fully seated.

(d) Measure for compressor bearing shims as follows. (Refer to Figure 10024).

1 Attach two PN 834850-1 stand off to PN 834711-6 micing bar with two CL-4-KHS knurled screws.

2 Put assembled PN 834711-6 micing bar on the driven compressor bearing housing (190).

3 Measure from top of bearing housing bore face to top of PN 834711-6 micing bar. Write as Dimension N.

Dimension N __________________inch (mm)

4 Measure from top of seal rotor (90) inner step to top of PN 834711-6 micing fixture. Write as Dimension R.

Dimension R __________________ inch (mm)

5 Measure from end of coupling shaft (140) to top of PN 834711-6 micing fixture. Write as Stub Shaft Ref. 1.

Stub Shaft Ref. 1 __________________ inch (mm)

6 Remove seal rotor (90) from driven compressor coupling shaft (140).

7 Remove assembled PN 834711-6 micing bar from driven compressor bearing housing (190).

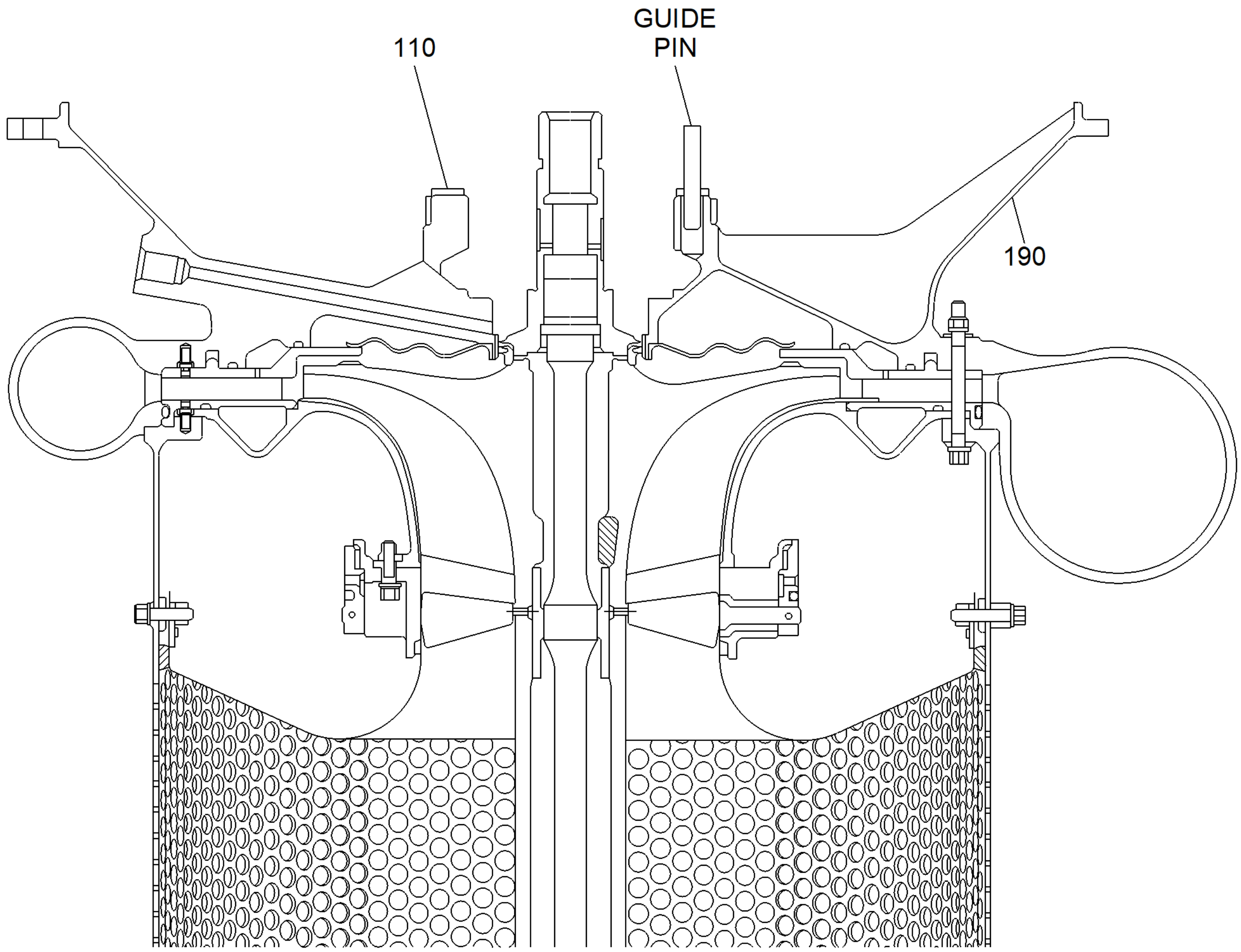

Figure 10025. (Post SB 131-49-8105) Shim the Load Compressor

Key to Figure 10025

110. L/C BEARING SHIM (IPC FIG. 24)
190. DRIVEN COMPRESSOR BEARING HOUSING

(e) (Post SB 131-49-8105) Calculate and install necessary shims for load compressor as follows. (Refer to Figure 10020, Sheet 6).

1 Write the following dimensions.

Dimension A __________________inch (mm) from Step 5.A.(12)(b)

Dimension F __________________inch (mm) from Step 5.A.(12)(a)

Dimension R __________________inch (mm) from Step 5.A.(13)(d)

Dimension N __________________inch (mm) from Step 5.A.(13)(d)

Dimension T __________________inch (mm) from Step 5.A.(2)(a)

2 Use dimensions in Step 1 for the following formula to calculate necessary L/C bearing shim (110) pack thickness.

___________________DIM. A

+ ___________________DIM. N

= ___________________Subtotal

- ___________________DIM. R

= ___________________Subtotal

- ___________________DIM. F

= ___________________Subtotal

- ___________________DIM. T

- ___0.001 inch (0.025 mm)________________ Compressor Factor

= ______________________Subtotal

+ __0.054 inch (1.37 mm)________________B/P

= ___________________Calculated Shims

Installed shims must be within +0.001/-0.001 inch (+0.025/-0.025 mm) calculated shim value.

Check Point 120: Make sure calculation to find L/C bearing shim (110) pack thickness is correct.

3 Select two L/C bearing shims (110) maximum of each thickness to get required shim pack thickness calculated in Step 2. Use guide pins to install L/C bearing shim (110) pack on driven compressor bearing housing (190). Write thickness of L/C bearing shim (110) packing installed ________ inch (mm).

Check Point 130: Make sure install L/C bearing shim (110) pack thickness is same as calculated L/C bearing shim pack thickness.

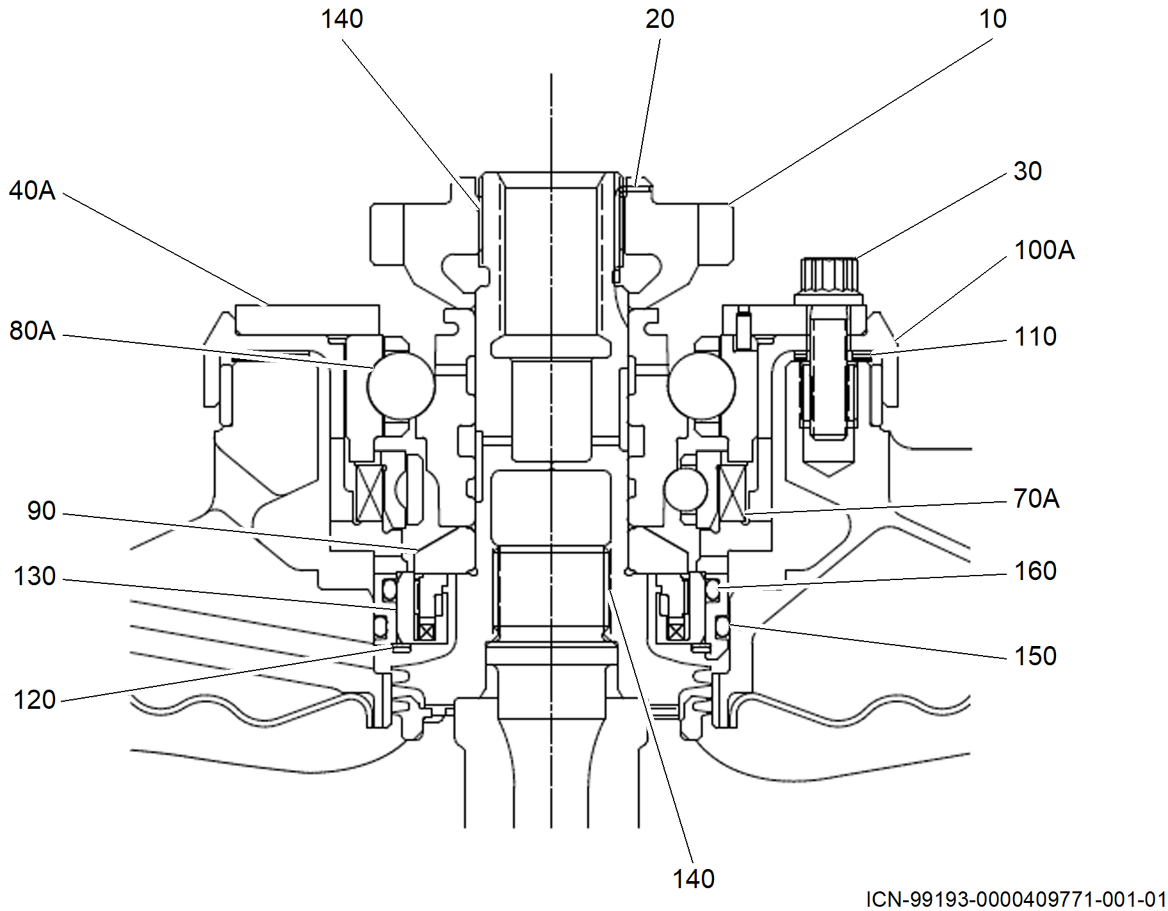

Figure 10026. (Post SB 131-49-8105) Duplex Bearing Set Installation

Key to Figure 10026

10. COMPRESSOR BEARING NUT (IPC FIG. 24)	100A. COMPRESSOR BEARING HOUSING PN 3827265-8
20. NUT LOCKING KEY	110. L/C BEARING SHIM
30. BOLT	120. RETAINING RING
40A. COMPRESSOR BEARING RETAINING PLATE PN 3827385-2	130. STATIONARY OIL SEAL
70A. COMPRESSION SPRING WASHER PN 791-548-9301	140. DRIVEN COMPRESSOR COUPLING SHAFT
80A. MATCHED DUPLEX BALL BEARING ASSY SET PN 3822666-2	150. PACKING
90. SEAL ROTOR	160. PACKING

(14) (Post SB 131-49-8105) Install compressor bearing components as follows. (Refer to Figure 10026.

(a) Lubricate packings (150, 160) with Braycote 248.

(b) Install packings (150, 160) in the compressor bearing housing (100A, PN 3827285-8).

(c) Install and seat stationary oil seal (130) in the compressor bearing housing (100A) from the aft end by hand or using PN 834810-2 installation seal drive tool.

(d) Install retaining ring (120) in the compressor bearing housing (100A).

CAUTION: WHEN HEATING THE COMPRESSOR BEARING HOUSING (100A) BE CAREFUL NOT TO OVERHEAT AND DAMAGE THE PACKINGS (150, 160).

(e) Heat the compressor bearing housing (100A) outer flange only. Use guide pins and install compressor bearing housing (100A) on the driven compressor bearing housing (230) over the L/C bearing shims (110).

NOTE: Temporarily secure compressor bearing housing (100A) with three bolts (MS9557-08) while still hot and torque to 120 in-lbs (13.6 Nm).

(f) Install seal rotor (90) on the driven compressor coupling shaft (140).

NOTE: Make sure that the large outside diameter side of the seal rotor (90) is installed facing aft on the driven compressor coupling shaft (140).

(g) Install the compression spring washer (70A) in the bearing housing (100A).

NOTE: Thrust the rotating group forward (up) by hand tightening the button on the PN 834891-1 turbine centering bridge adapter.

(h) Clean matched duplex ball bearing assembly set (80A) with degreasing solvent (MIL-PRF-680).

WARNING: USE THE CORRECT PERSONAL PROTECTION. COMPRESSED AIR WILL CAUSE LOOSE PARTICLES THAT CAN GET IN YOUR EYES. THE AIRFLOW CAN CAUSE CUTS. DO NOT POINT IT AT YOUR SKIN.

CAUTION: MAKE SURE MATCHED DUPLEX BALL BEARING ASSEMBLY SET (80A) IS COMPLETELY FREE OF SOLVENT AND DRY. DO NOT SPIN BEARING WHILE DRY.

(i) Dry matched duplex ball bearing assembly set (80A) with dry compressed air.

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

WARNING: USE THE CORRECT PERSONAL PROTECTION. THE HEATED PARTS WILL CAUSE BURNS.

(j) Heat matched duplex ball bearing assembly set (80A) to 450 to 500°F (232 to 260°C) for 20 to 30 minutes.

(k) (Preferred method) Install matched duplex ball bearing assembly set (80A).

1 Install PN 3700537-2 adapter on driven compressor coupling shaft (140).

CAUTION: WHEN HANDLING MATCHED DUPLEX BALL BEARING ASSEMBLY SET (80A), USE PN 3700539-1 INSTALLATION TOOL AND/OR PROTECTIVE EQUIPMENT.

2 Install heated matched duplex ball bearing assembly set (80A) on driven compressor coupling shaft (140) with the inner race puller groove facing up.

3 Seat ball bearing assembly set (80A) using bearing driver PN 70641924-1.

NOTE: To prevent damage to stub shaft, oil the bearing driver PN 70641924-1 threads that screw onto the stub shaft.

4 Cool bearing with compressed air then remove tool.

5 Oil bearing using oil (MIL-PRF-7808 or MIL-PRF-23699).

6 Coat threads and face of compressor bearing nut (10) with lubricant (Liqui-Moly).

7 Install compressor bearing nut (10) and use PN 834801-1 torque adapter with a torque wrench to tighten to a torque value of 600 to 680 in-lbs (67.8 to 76.8 Nm). Loose the compressor bearing nut (10) and retighten to 600 in-lbs (67.8 Nm), continue to tighten in a clockwise direction to the first alignment of the key and then mark alignment with marking compound.

(l) (Alternate method) Install matched duplex ball bearing assembly set (80A).

1 Install PN 3700537-1 or -2 adapter on driven compressor coupling shaft (140).

CAUTION: WHEN HANDLING MATCHED DUPLEX BALL BEARING ASSEMBLY SET (80A), USE PN 3700539-1 INSTALLATION.

2 Install heated matched duplex ball bearing assembly set (80A) on driven compressor coupling shaft (140) with the inner race puller groove facing up.

3 Coat threads and face of PN 3700508-1 nut tool with lubricant (Liqui-Moly).

4 Tighten PN 3700508-1 nut tool to a torque value of 800 in-lbs (90.4 Nm) to seat bearing.

5 Remove nut tool and adapter.

6 Coat threads and face of compressor bearing nut (10) with lubricant (Liqui-Moly).

7 Install compressor bearing nut (10) and use PN 834801-1 torque adapter with a torque wrench to tighten to a torque value of 600 to 680 in-lbs (67.8 to 76.8 Nm). Loosen the compressor bearing nut (10) and retighten to 600 in-lbs (67.8 Nm), continue to tighten to the first alignment of the key and then mark alignment.

(m) (Alternate Method) Install matched duplex ball bearing assembly set (80A).

1 Install heated matched duplex ball bearing assembly set (80A).

NOTE: Make sure that inner race puller groove is facing up.

2 Coat threads and face of compressor bearing nut (10) with lubricant (Molykote Z).

3 Install compressor bearing nut (10) and use PN 834801-1 torque adapter with a torque wrench to tighten to a torque value of 600 to 680 in-lb (67.8 to 76.8 Nm). Loosen the compressor bearing nut (10) and retighten to 600 in-lb (67.8 Nm), continue to tighten to the first alignment of the key and then mark alignment.

NOTE: Loosen the button on the PN 834891-1 turbine centering bridge adapter.

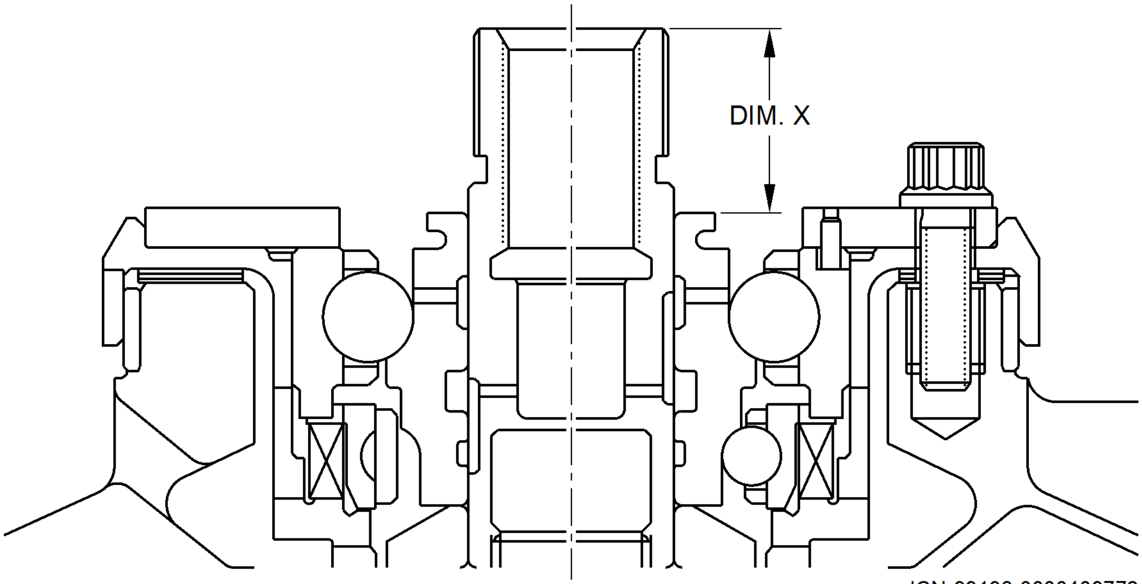

Figure 10027. (Post SB 131-49-8105) Final Dimension X Measurement

(n) Remove compressor bearing nut (10) from the driven compressor coupling shaft (140).

1 Apply a generous amount of oil (MIL-PRF-7808 or MIL-PRF-23699) to the duplex ball bearing and make sure of a thorough lubrication. Repeat this step if the bearing requires removal.

(o) Measure and write the results of Measured Dimension X. (Refer to Figure 10020.)

Dimension X ______________________ inch (mm)

(p) Write Calculated Dimension X from Step 5.A.(12)(c).

Calculated Dimension X ___________________inch (mm)

(q) Compare Calculated Dimension X with Measured Dimension X. Calculated Dimension X must be within +0.002/-0.001 inch (+0.05/-0.03 mm) of Measured Dimension X to make sure the bearing assembly set (80A) is not stacked.

(r) If Calculated Dimension X is not within +0.002/-0.001 inch (+0.05/-0.03 mm) of Measured Dimension X, repeat Steps 5.A.(14)(i) thru (p). If necessary, use PN 834808-1 bearing puller to remove matched duplex ball bearing assembly set (80A).

Check Point 140: Make sure Measured Dimension X is within +0.002/-0.001 inch (+0.05/-0.03 mm) of Calculated Dimension X.

CAUTION: LOAD ROTATING GROUP AFT. TURN JACK SCREW CCW UNTIL GAP IS SEEN.

WARNING: USE THE CORRECT PERSONAL PROTECTION. OIL CAN HAVE AN ADDITIVE CALLED TRICRESYL PHOSPHATE IN IT. THIS CHEMCIAL IS AN ASPHYXIANT; IT IS POISONOUS AND CAN BE ABSORBED THROUGH THE SKIN.

1 Align the slot on the matched duplex ball bearing assembly set (80A, Figure 10026) outer race with the anti-rotation pin on the compressor bearing retaining plate (40A).

2 Install the compressor bearing retaining plate (40A) on the compressor bearing housing (100A) with bolts (30). Tighten bolts to a torque value of 120 in-lbs (13.6 Nm).

(s) Place nut locking key (20) into the marked slot, made in Step (i), of the driven compressor coupling shaft (140).

(t) Install the compressor bearing nut (10).

(u) Tighten the compressor bearing nut (10), using PN 834801-1 torque adapter tool, to a torque value of 600 to 680 in-lbs (67.8 to 76.8 Nm) to seat matched duplex ball bearing assembly set (80A). Back off compressor bearing nut, then retorque to a minimum of 600 in-lbs (67.8 Nm) and continue to torque in a clockwise direction until the marked alignment of the driven compressor coupling shaft (140) key slot with the compressor bearing nut (10) key slot is reached.

Check Point 150: Make sure compressor bearing nut (10) is tightened and seated.

(v) Perform a load compressor reference calculation check as follows:

1 Write Stub Shaft Ref. 1 from Step 5.A.(13)(d)5.

Stub Shaft Ref. 1 inch (mm)

2 Repeat Step 5.A.(13)(d)5 except write as Stub Shaft Ref. 2.

Stub Shaft Ref. 2 inch (mm)

3 Write Dimension T from Step 5.A.(13)(e).

Dimension T inch (mm)

4 With the measurements written in Steps (1), (2) and (3) perform the following calculation.

Stub Shaft 1 – Stub Shaft 2 + Dimension T = inch (mm)

5 Calculation in Step 4 must equal 0.054 inch (1.37 mm) +0.001/-0.001 inch (+0.025/-0.025 mm).

6 If calculation in Step 4 does not equal to 0.054 inch (1.37 mm) +0.001/-0.001 inch (+0.025/-0.025 mm) adjust L/C bearing shim pack thickness as necessary to equal to 0.054 inch (1.37 mm) +0.001/-0.001 inch (+0.025/-0.025 mm) (If less than 0.053 inch (1.34 mm) then add shims, if greater than 0.055 inch (1.39 mm) then remove shims).

(w) Bend the locking tab of the nut lock key (20) down flat into the locking slot of the compressor bearing nut (10).

Check Point 160: Make sure locking tab of the nut locking key (20) is bent down flat into the locking slot of the compressor bearing nut (10).

(x) Use 834990-1 portable engine stand/cart to rotate power section assembly aft side up.

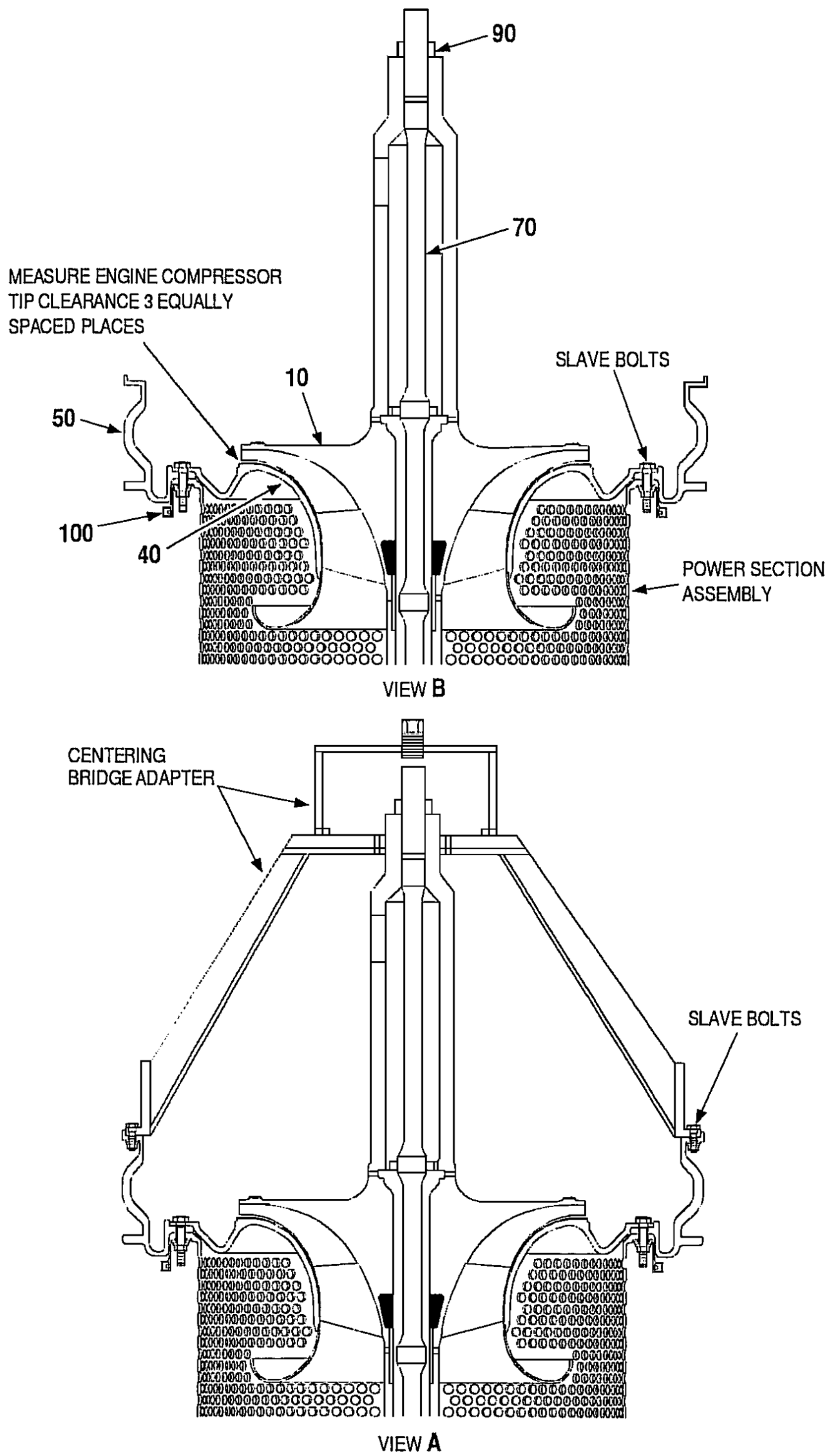

Figure 10028. Calculate and Install Engine Compressor Shims

Key to Figure 10028

10. COMPRESSOR ROTOR (IPC FIG. 21)	70. TURBINE SHAFT (120, IPC FIG. 23)
40. ENGINE COMPRESSOR SHROUD ASSY	90. TIESHAFT NUT (150, IPC FIG. 18)
50. DIFFUSER HOUSING ASSY	100. INLET DUCT SUPPORT (170, IPC FIG. 22)

(15) Install engine compressor components (Refer to Figure 10029). Use initial shim pack of approximately 0.040 inch (1.02 mm).

(a) Stretch group (refer to Steps (12)(e) and (f)). Install PN 834891-1, centering bridge adapter.

(b) Use feeler gauges or gauge pins to measure engine compressor (10) to engine compressor shroud (40) tip clearance. Measure each impeller blade to locate the highest blade (minimum clearance).

(c) Pre SB 131-49-7718 (Shroud PN 3827322-3).

Engine Compressor Tip Clearance _______ (inch) (mm) from Step 5.A.(12)(b) - (minus) 0.079 inch (2.01 mm) + initial shim pack thickness _______ inch (mm) = necessary shim (60) pack thickness _______ inch (mm).

Post SB 131-49-7718 (Shroud PN 3827504-3).

Engine Compressor Tip Clearance _______ (inch) (mm) from Step 5.A.(12)(b) - (minus) 0.084 +0.001 inch/-0.003 (2.13 +0.03/-0.08 mm) + initial shim pack thickness _______ inch (mm) = necessary shim (60) pack thickness _______ (inch) (mm).

If necessary shim pack thickness is within ±0.001 inch (0.03 mm) of initial pack thickness, no further adjustment is required.

(d) Remove the six slave bolts and PN 834891-1 centering bridge adapter from the power section assembly.

CAUTION: SAFETY COVER PN 834740-10 MUST BE IN PLACE BEFORE PRESSURE IS APPLIED TO THE STRETCH SHAFT TOOL.

(e) Install PN 834889-1 stretch shaft tool with PN 834889-1 shaft stretch kit and apply force found in Step 4.A.(3)(c)1 b and hand loosen the tieshaft nut (90) and then release pressure.

(f) Remove PN 834889-1 stretch shaft tool, PN 834889-1 shaft stretch kit, tieshaft nut (90) and PN 834886-1 turbine shaft simulator tool from the power section assembly.

CAUTION: DO NOT REMOVE CURVIC RING SEAL (20) FROM THE SHAFT ASSEMBLY (80).

(g) Remove the eight slave bolts and nuts from the power section assembly.

(h) Remove compressor rotor (10), engine compressor shroud assembly (40) and diffuser housing assembly (50) from the power section assembly.

(i) Install shims (60) calculated in Step (c) on inlet housing. Make sure all holes in the shims are lined up with holes in the inlet housing.

(j) Install diffuser housing assembly (50) on installed shims (60) and align its pin with the pin on the inlet housing assembly.

(k) Install engine compressor shroud assembly (40) in the diffuser housing (50). Align pin hole in engine compressor shroud assembly with pin in the diffuser housing.

(l) Install compressor rotor (10) on the turbine shaft (70) and align the balance marks. Make sure the curvics are not stacked.

(m) Install eight slave nuts and bolts equally spaced through the engine compressor shroud assembly (40), diffuser housing assembly (50) and inlet housing. Tighten slave nuts to a torque value of 180 in-lb (20.33 Nm).

(n) Clean curvics on compressor rotor (10) and PN 834886-1 turbine shaft simulator.

(o) Install PN 834886-1 turbine shaft simulator on compressor rotor (10). Make sure the curvics are not stacked.

(p) Install tieshaft nut (90) on turbine shaft (70). Tighten tieshaft nut hand tight.

(q) Install PN 834889-1 shaft stretch tool and PN 834889-1 stretch shaft kit on turbine shaft (70).

(r) Stretch turbine shaft (70) to the same pressure as written in ASSEMBLY 02, Step 4.A.(3)(c)1 b.

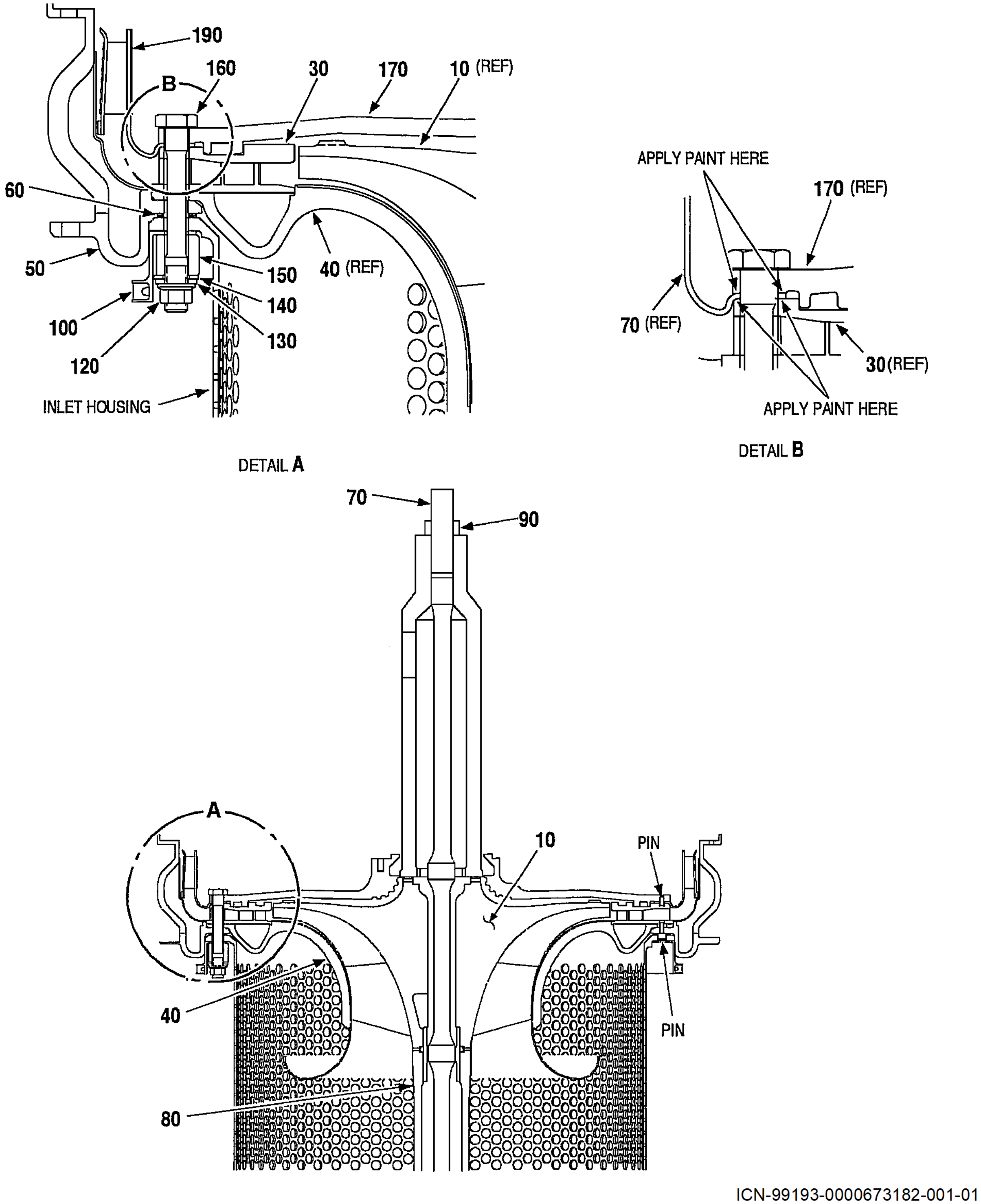

Figure 10029. Assemble the Engine Compressor

Key to Figure 10029

10. COMPRESSOR ROTOR (IPC FIG. 21)
30. ENGINE COMPRESSOR DIFFUSER
40. ENGINE COMPRESSOR SHROUD ASSY
50. DIFFUSER HOUSING ASSY
60. INLET HOUSING SHIM
70. TURBINE SHAFT (120, IPC FIG. 23)
80. SHAFT ASSY (120, IPC FIG. 21)
90. TIESHAFT NUT (150, IPC FIG. 18)
100. INLET DUCT SUPPORT (170, IPC FIG. 22)
120. NUT (60, IPC FIG. 20)
130. WASHER (70, IPC FIG. 20)
140. PACKING WITH RETAINER (80, IPC FIG. 20)
150. DIFFUSER SPACER (90, IPC FIG. 20)
160. ENGINE COMPRESSOR DIFFUSER BOLT (100, IPC FIG. 20)
170. AIR STATIONARY SEAL SUPPORT (110, IPC FIG. 20)
190. ENGINE COMPRESSOR DESWIRL (130, IPC FIG. 20)

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

(s) Tighten tieshaft nut (90, Figure 10028) hand tight.

(t) Remove PN 834889-1 shaft stretch tool and PN 834889-1 stretch shaft kit from the turbine shaft (70).

(u) Tighten turbine simulator tooling to 20 in-lb (2.26 Nm) to thrust rotating group forward.

(v) Use three feeler gauges or gauge pins to measure engine compressor rotor (10, Figure 10029) to engine compressor shroud assembly (40) tip clearance. Measure each impeller blade to locate the highest blade (minimum clearance).

(w) If tip clearance is not 0.079 ±0.001 inch (2.01 ±0.03 mm) for Pre SB 131-49-7718 (Shroud PN 3827322-3), repeat Steps (b) thru (u).

If tip clearance is not 0.084 +0.001/-0.003 inch (2.13 +0.03/-0.08 mm) for Post SB 131-49-7718 (Shroud PN 3827504-3), repeat Steps (b) thru (u).

Check Point 170: Make sure engine compressor tip clearance is 0.079 ±0.001 inch (2.01 ±0.03 mm) for Pre SB 131-49-7718.

Make sure engine compressor tip clearance is 0.084 +0.001/-0.003 inch (2.13 +0.03/-0.08 mm) for Post SB 131-49-7718.

(x) Remove the eight slave bolts and nuts from the power section assembly.

(y) Install engine compressor diffuser (30) on the power section assembly. Align the pin in the engine compressor diffuser with the hole in the engine compressor shroud assembly (40). Refer to Figure 10029.

(z) Paint engine compressor diffuser (30) and engine compressor deswirl (190) mating surfaces with silver aluminum paint (TT-P-28). Refer to Figure 10029, Detail B.

(aa) While paint from previous step is still wet install the engine compressor deswirl (190) on the power section assembly. Align the pin in the engine compressor diffuser (30) with the hole in the engine compressor deswirl.

(ab) Paint engine compressor deswirl (190) and air stationary seal support (170) mating surfaces with silver aluminum paint (TT-P-28). Refer to Figure 10029, Detail B.

(ac) While paint from previous step is still wet install the air stationary seal support (170) on the power section assembly. Align the pin in the engine compressor deswirl (190) with the hole in the air stationary seal support.

(ad) Install bolts (160), diffuser spacers (150), packings with retainer (140), washers (130) and nuts (120) on the power section assembly. Make sure chamfer end of diffuser spacers are against the diffuser housing assembly (50). Tighten nuts to a torque value of 180 in-lb (20.33 Nm).

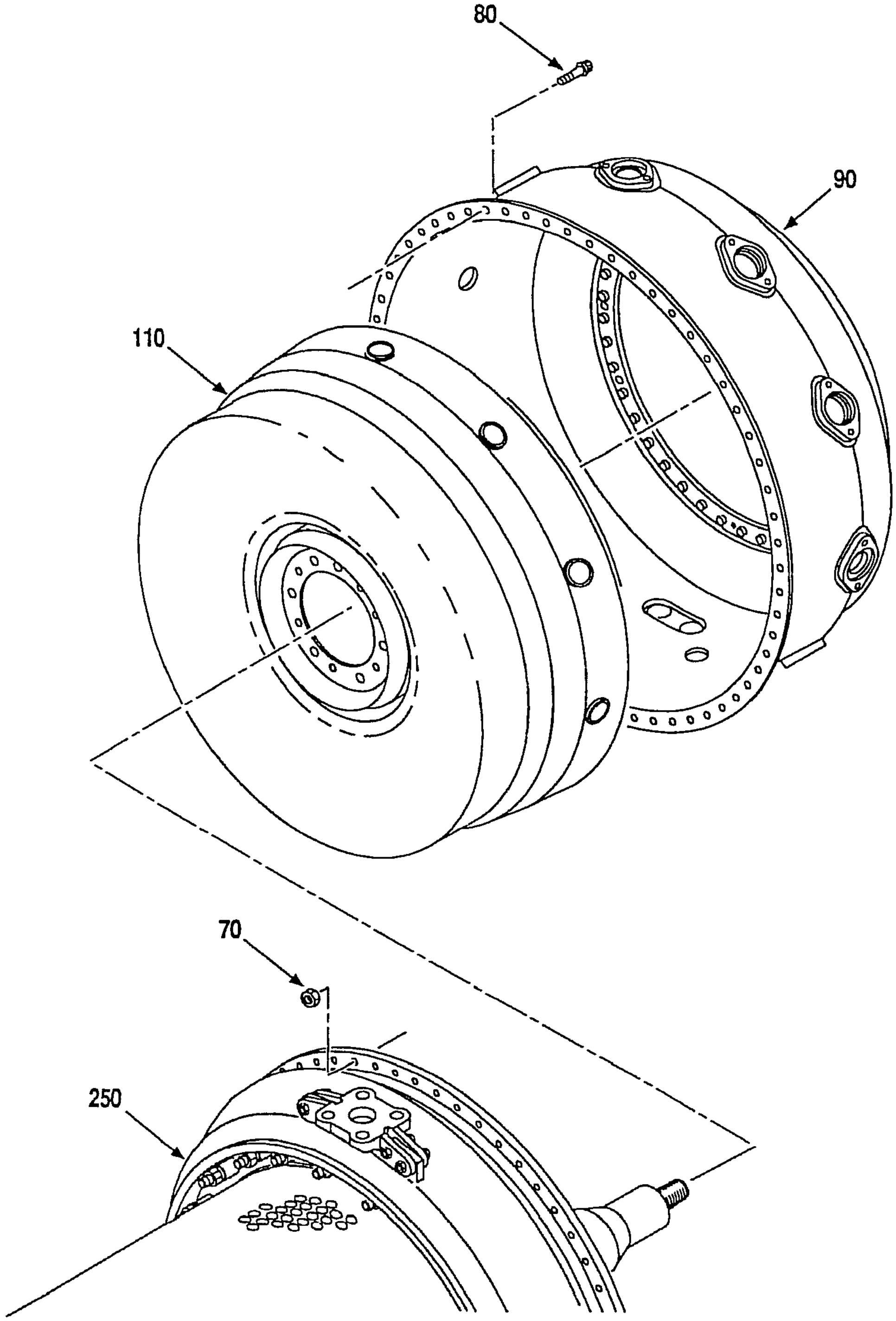

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Figure 10030. (Sheet 1 of 3) Install Combustor Elements

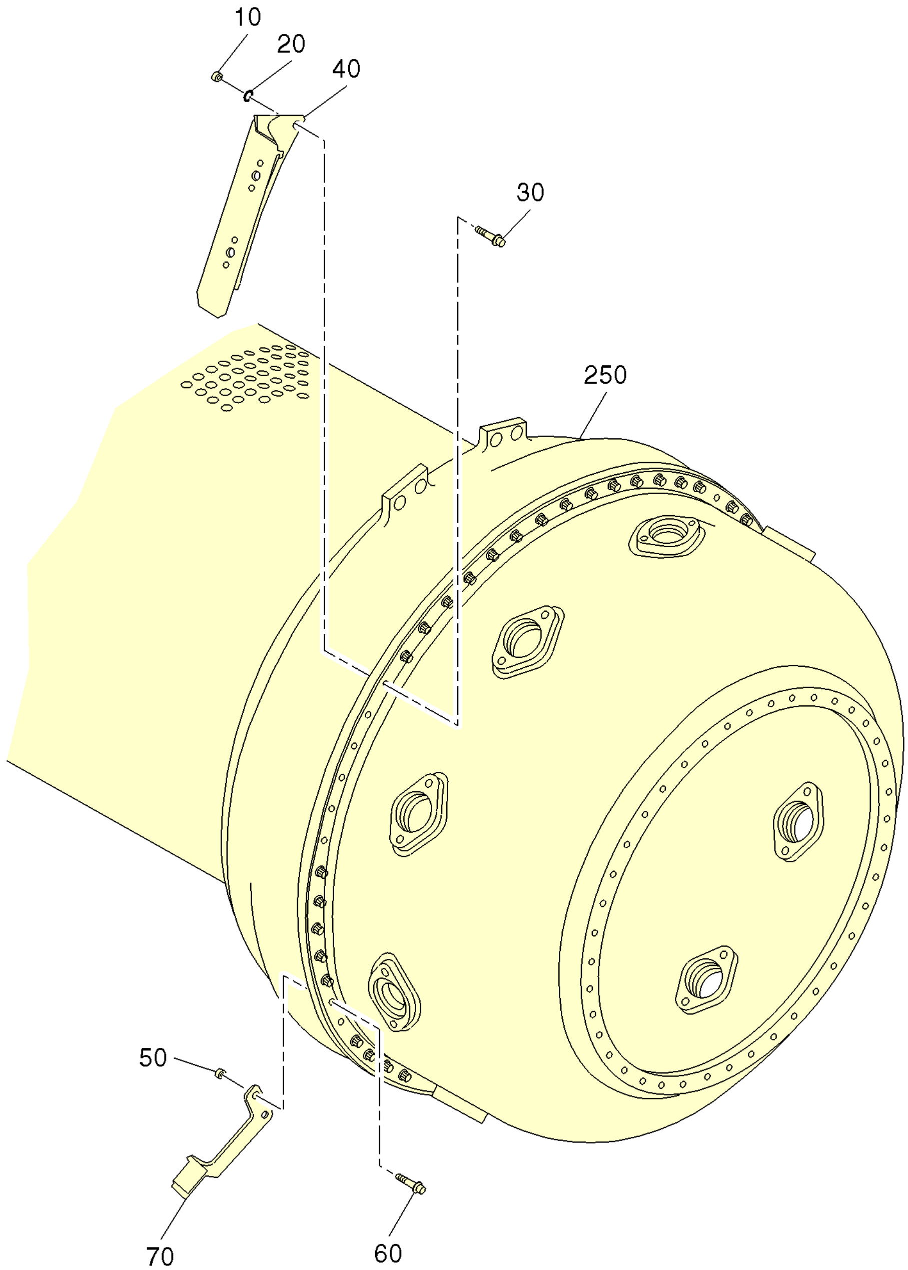

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Figure 10030. (Sheet 2 of 3) Install Combustor Elements

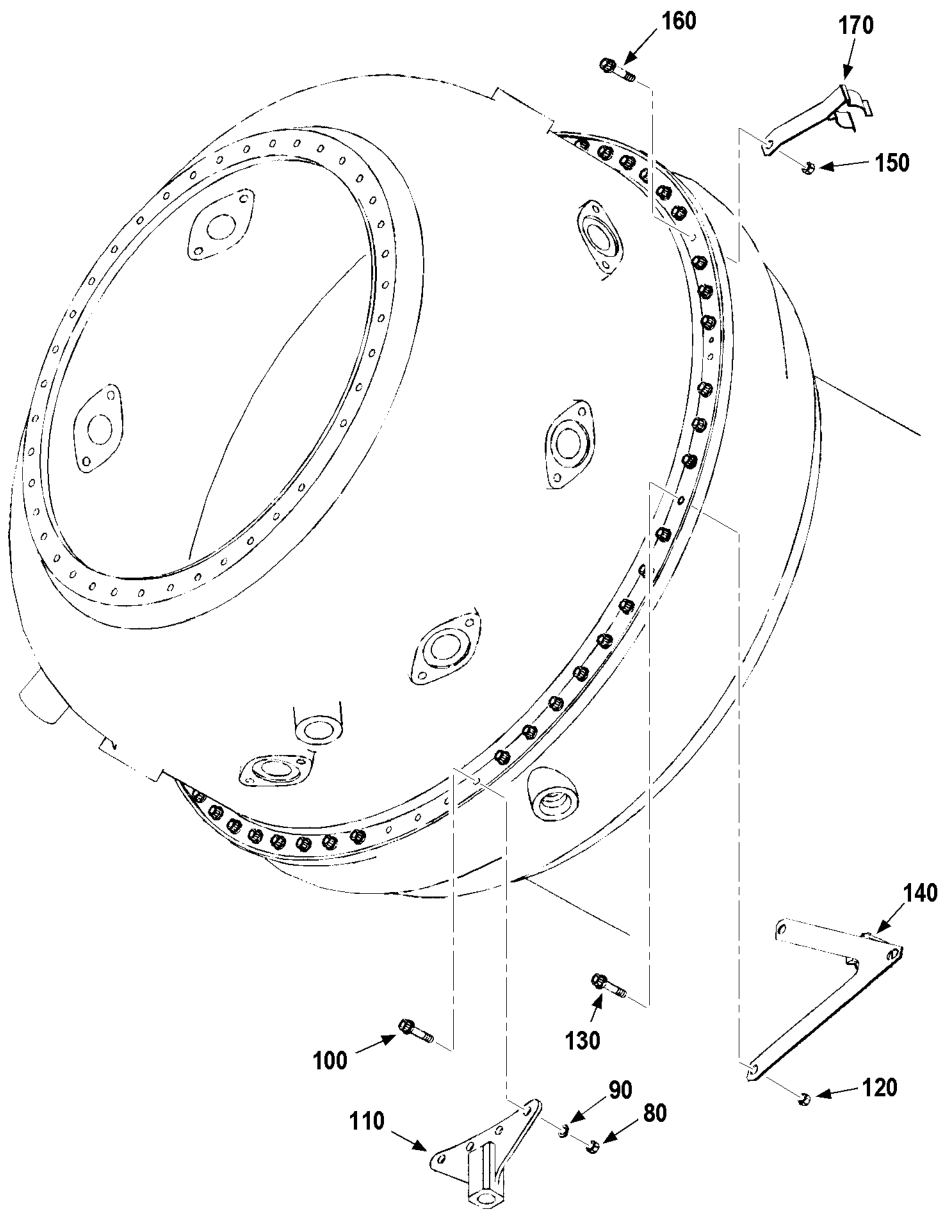

Figure 10030. (Sheet 3 of 3) Install Combustor Elements

Key to Figure 10030

10. NUT (IPC FIG. 17)	100. BOLT (IPC FIG. 17)
20. WASHER	110. LIFTING BRACKET
30. BOLT	110. ANNULAR COMBUSTION CHAMBER (50, IPC FIG. 20)
40. OIL COOLER BRACKET	120. NUT (IPC FIG. 17)
50. NUT	130. BOLT
60. BOLT	140. SURGE DUCT BRACKET
70. BRACKET	150. NUT
70. NUT (10, IPC FIG. 20)	160. BOLT
80. NUT (IPC FIG. 17)	170. HARNESS BRACKET
80. BOLT (20, IPC FIG. 20)	250. POWER SECTION ASSY (IPC FIG. 19)
90. WASHER (IPC FIG. 17)	-. ITEM NOT ILLUSTRATED
90. COMBUSTOR CASE (30, IPC FIG. 20)	

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(16) Install combustor elements as follows. Refer to Figure 10030.

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

(a) Install the annular combustion chamber (110) on the power section assembly as follows:

1 Put the combustor case (90) on the diffuser housing assembly and engage the pin on the diffuser housing assembly with the corresponding hole in the combustor case.

2 Use marking compound to mark the circumferential location of the igniter plug hole on the diffuser housing.

3 Remove the combustor case (90) from the diffuser housing.

4 Put the annular combustion chamber (110) on the air stationary seal support and align the igniter plug hole location mark on the diffuser housing, made in Step 2, with the igniter hole in the annular combustion chamber.

(b) Install the combustor case (90) and brackets on the diffuser housing assembly as follows:

1 Align the hole on the combustor case (90) flange with the corresponding pin on the diffuser housing assembly flange.

2 Use three PN 834809-1 alignment pins to align the annular combustion chamber (110) and combustor case (90) fuel nozzle holes. Make sure the igniter hole in the annular combustion chamber is aligned with the igniter hole in the combustor case.

3 Attach combustor case (90) to diffuser housing assembly with bolts (80) and nuts (70). Tighten nuts (70) to a torque value of 50 in-lb (5.65 Nm).

4 Install aft lifting bracket (110) and attach with bolts (100), washers (90) and nuts (80). Tighten nuts to a torque value of 50 in-lb (5.65 Nm).

5 Install oil cooler bracket (40), with bent tab facing aft and attach with bolts (30), washers (20) and nuts (10). Tighten nuts to a torque value of 50 in-lb (5.65 Nm).

6 Install bracket (70) with bolts (60) and nuts (50). Tighten nuts to a torque value of 50 in-lb (5.65 Nm).

7 Install surge duct bracket (140), with the word “FORWARD” facing forward and attach with bolts (130) and nuts (120). Tighten nuts to a torque value of 50 in-lb (5.65 Nm).

8 Install harness bracket (170) and attach with bolts (160) and nuts (150). Tighten nuts to a torque value of 50 in-lb (5.65 Nm).

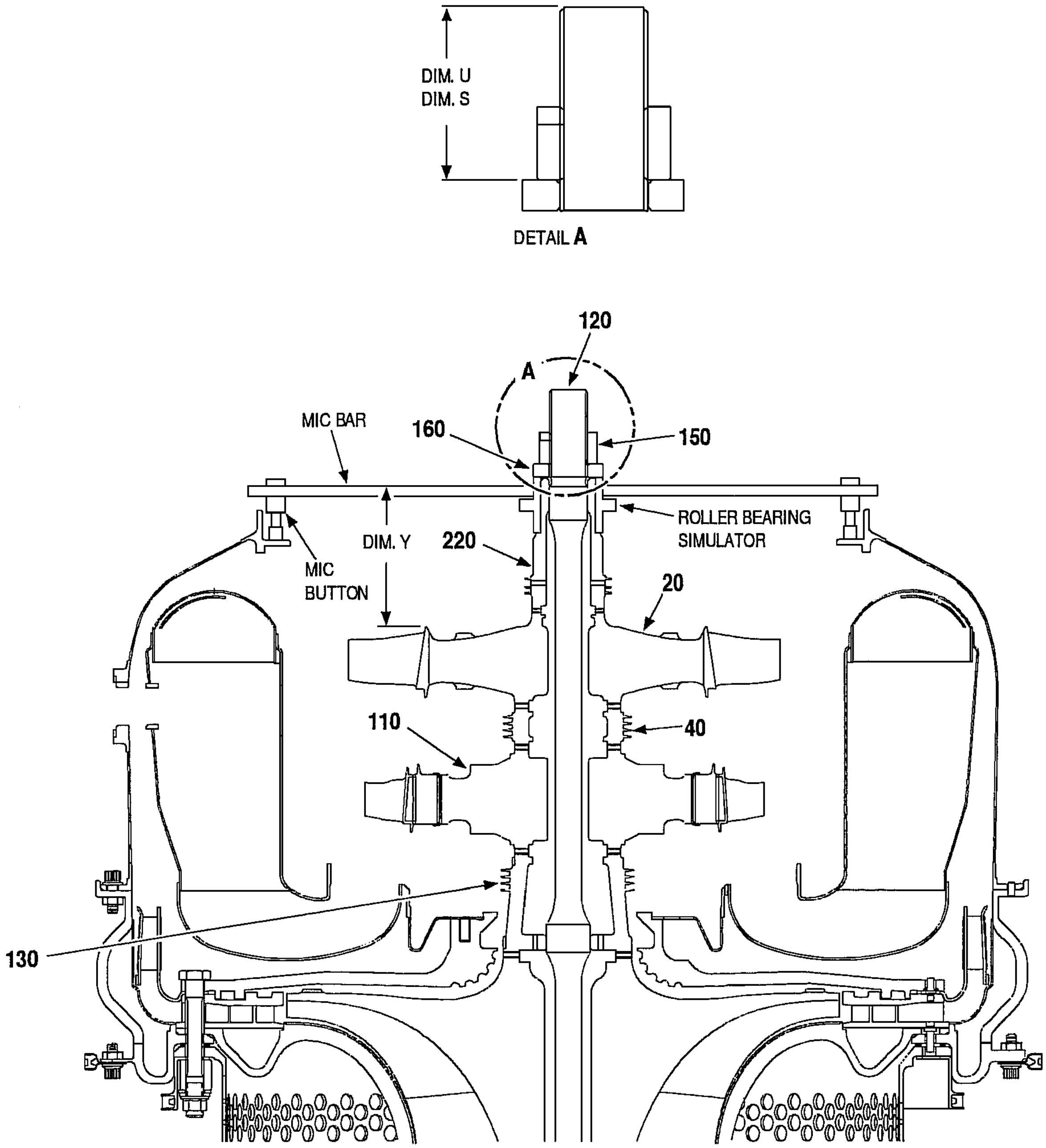

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Figure 10031. Third Rotating Group Stretch

Key to Figure 10031

20. SECOND STAGE TURBINE ROTOR ASSY (IPC FIG. 19)	130. COUPLING SHAFT (IPC FIG. 19)
40. COUPLING SHAFT	150. TIESHAFT NUT (IPC FIG. 18)
110. FIRST STAGE TURBINE ROTOR ASSY	160. TIESHAFT WASHER
120. TURBINE SHAFT (IPC FIG. 23)	220. AFT BEARING SHAFT (230, IPC FIG. 18)

(17) Perform third rotating group stretch as follows. Refer to Figure 10031.

(a) Remove PN 834886-1 turbine shaft simulator from the turbine shaft as follows:

1 Install stretch shaft tool and PN 834889-1 on the turbine shaft (120).

2 Stretch the turbine shaft to force found in ASSEMBLY- 02, Step 4.A.(3)(c)1 b remove tieshaft nut (150) and release pressure on shaft stretch tool.

3 Remove PN 834889-1 stretch shaft tool, PN 834889-1 shaft stretch kit and PN 834886-1 turbine shaft simulator tool from the turbine shaft (120).

(b) Install turbine rotors and coupling shafts on turbine shaft as follows:

1 Clean the curvics on coupling shaft (130) and install, with seal knife edges facing aft, on engine compressor rotor (10, Figure 10029). Align balance marks and make sure curvics are not stacked.

2 Clean the curvics on first stage turbine rotor assembly (110) and use two PN 834812-1 wheel removal adapters to install first stage rotor on the coupling shaft (130) with the word “AFT” on the disk facing up. Align balance marks and make sure curvics are not stacked.

3 Clean the curvics on coupling shaft (40) and install, with the three marked dots facing aft, on the first stage turbine rotor assembly (110). Align balance marks and make sure curvics are not stacked.

4 Clean the curvics on second stage turbine rotor assembly (20) and use two PN 834812-1 wheel removal adapters to install second stage rotor on the coupling shaft (40). Align balance marks and make sure curvics are not stacked.

NOTE: The second stage turbine rotor assembly (20) can be installed only in one direction due to the difference in its forward and aft curvics.

5 Install PN 834926-1 roller bearing simulator on aft bearing shaft (220).

NOTE: The PN 834926-1 roller bearing simulator can be pushed on the aft bearing shaft (220) with an arbor press, but make sure the curvic end is placed on a clean phenolic block for protection.

6 Clean the curvics on aft bearing shaft (220).

7 Install aft bearing shaft (220) on second stage rotor assembly (20). Align balance marks and make sure curvics are not stacked.

8 Install tieshaft washer (160) and tieshaft nut (150) on the turbine shaft (120).

9 Use PN 834890-1 torque adapter to tighten tieshaft nut (150) to a torque value of 120 in-lb (13.56 Nm).

(c) Measure Dimension U, Dimension S and Dimension Y as follows:

1 Measure and make sure Dimension U is same, ±0.009 inch (0.23 mm), as Dimension U from ASSEMBLY-02, Step 4.A.(3)(b)1. Refer to Figure 10031, Detail A.

2 Install stretch shaft tool and PN 834889-1. Stretch the turbine shaft (120) to actual load as written in ASSEMBLY- 02, Step 4.A.(3)(c)1 b.

3 Measure and make sure Dimension S is same, ±0.002 inch (0.05 mm), as Dimension S from ASSEMBLY-02, Step 4.A.(3)(c)4. Refer to Figure 10031, Detail A.

4 Attach two PN 834850-1 stand-offs to PN 834711-2 micing bar with two CL-4-KHS knurled screws.

5 Put assembled PN 834711-2 micing bar on the installed first stage stator assembly.

6 Use PN 834711-2 mic bar and depth mic to measure Dimension Y.

a Write Dimension Y _______________ inch (mm) measured in Step 6.

Check Point 180: Verify and write down Dimension Y.

(d) Remove turbine rotors and coupling shafts from the turbine shaft as follows:

1 Install stretch shaft tool and PN 834889-1 on the turbine shaft (120).

2 Stretch the turbine shaft force found in ASSEMBLY- 02, Step 4.A.(3)(c)1 b loosen tieshaft nut (150) and release pressure on shaft stretch tool.

3 Remove stretch shaft tool and PN 834889-1 from the turbine shaft (120).

4 Remove tieshaft nut (150), tieshaft washer (160) and aft bearing shaft (220) with roller bearing simulator from the turbine shaft (120).

5 Use two PN 834812-1 wheel removal adapters to remove second stage turbine rotor assembly (20) from the turbine shaft (120).

6 Remove coupling shaft (40) from the turbine shaft (120).

7 Use two PN 834812-1 wheel removal adapters to remove first stage turbine rotor assembly (110) from the turbine shaft (120).

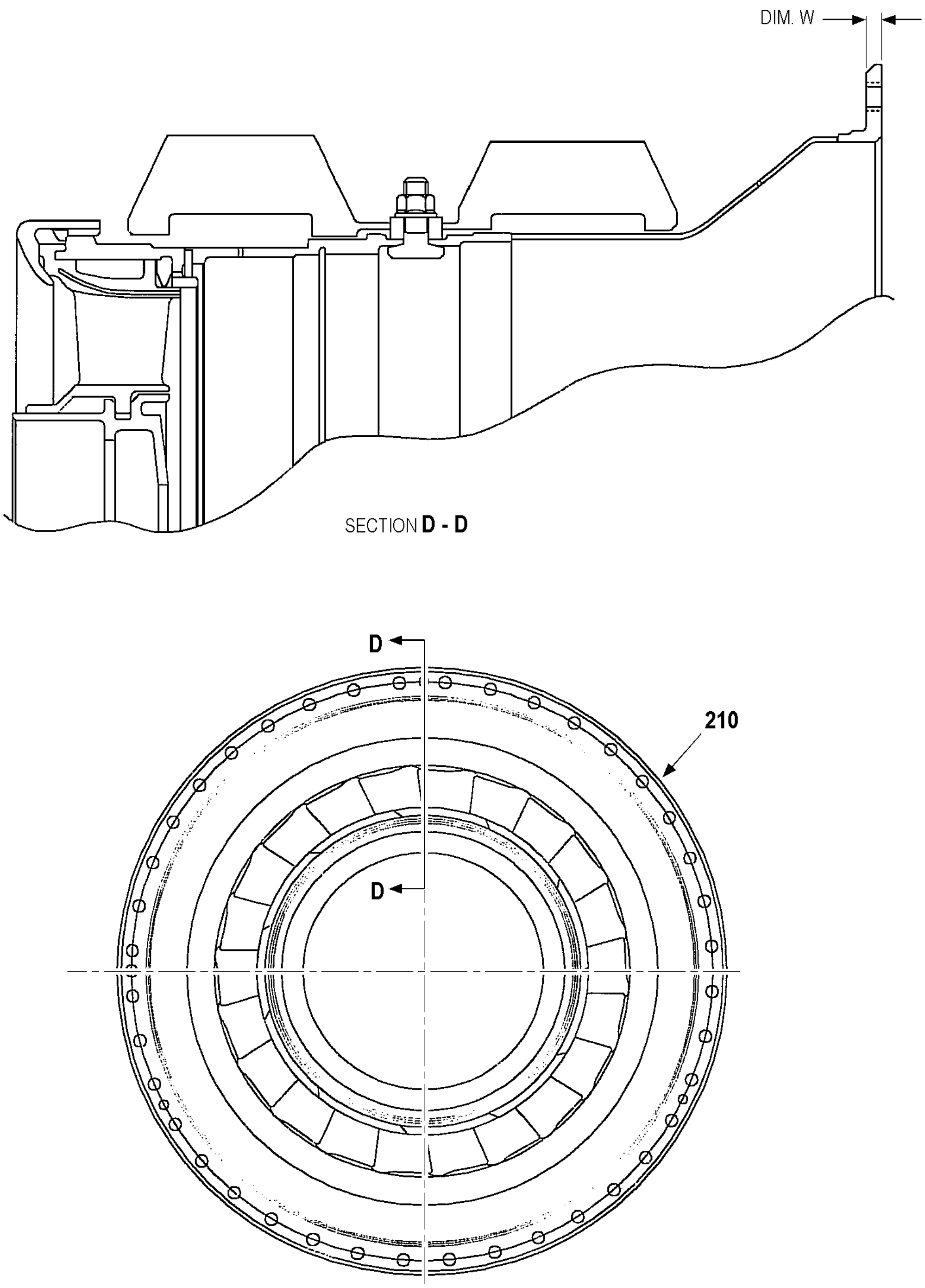

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Figure 10032. Measure Dimension W

(18) Measure Dimension W and Dimension Z1 as follows:

(a) Measure and write first stage stator assembly (210) flange thickness as Dimension W. Refer to Figure 10032.

Dimension W ___________________inch (mm)

(b) Measure and write combustor case (90) aft flange depth as Dimension Z1. Refer to Figure 10033.

Dimension Z1 ___________________inch (mm)

Check Point 190: Verify and write down Dimension Z1.

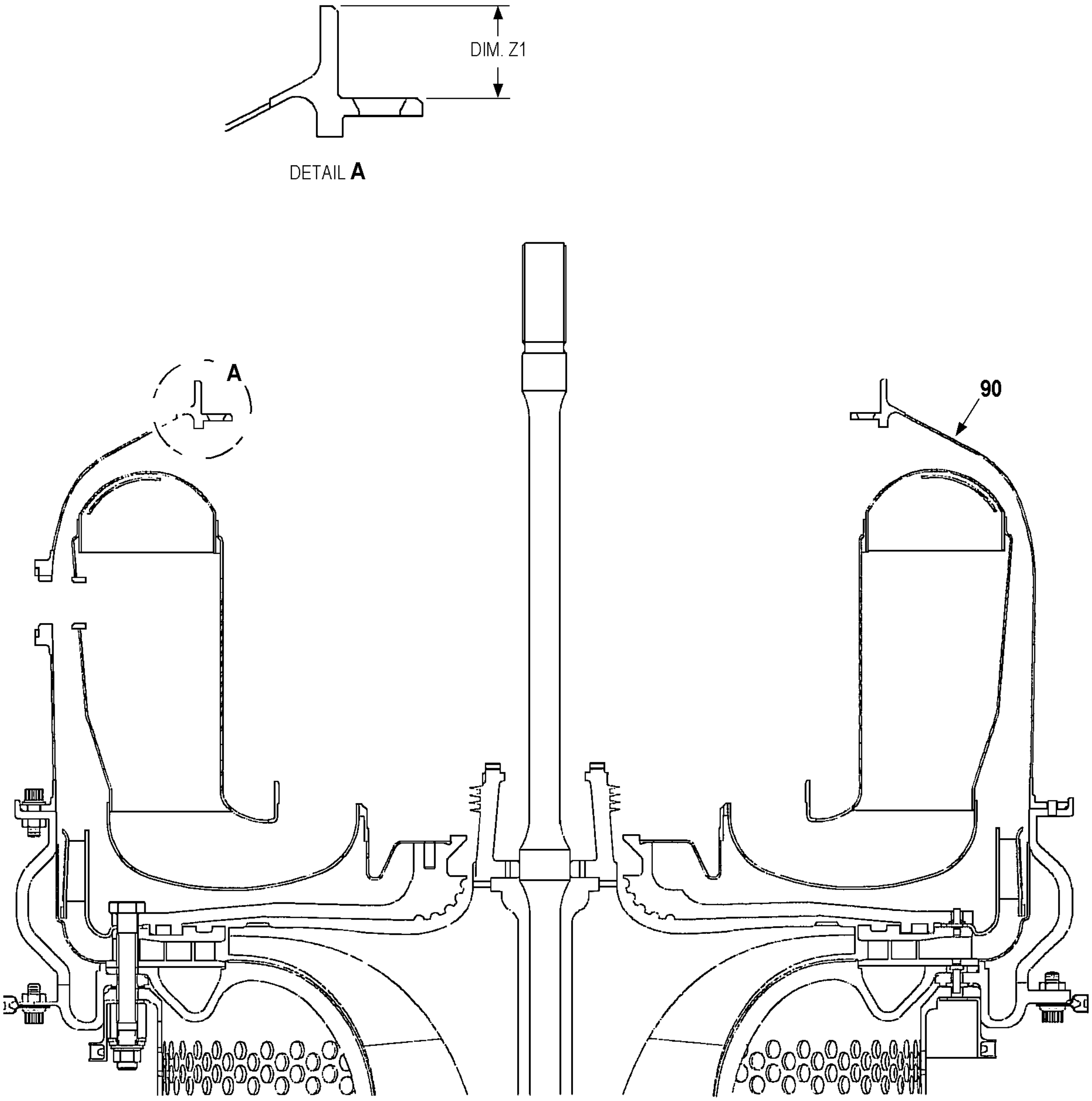

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Figure 10033. Measure Dimension Z1

Key to Figure 10033

90. COMBUSTOR CASE (30, IPC FIG. 20)

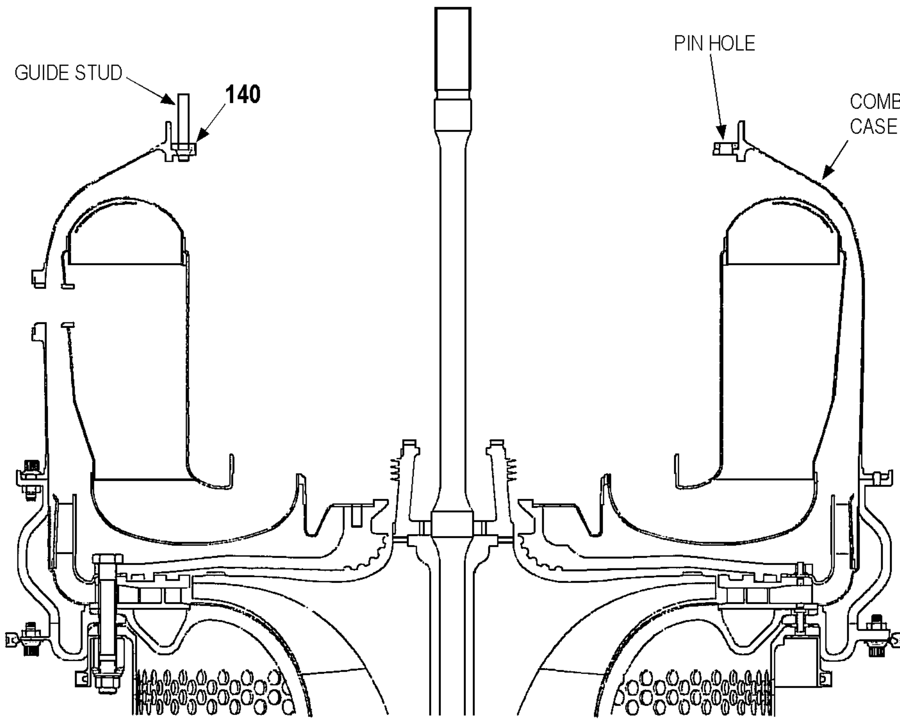

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Figure 10034. Install First Stage Stator Assembly

Key to Figure 10034

140. TURBINE PLENUM SHIM (IPC FIG. 19)

(19) Install first stage stator assembly as follows. Refer to Figure 10034 and Figure 10035.

(a) Calculate required first stage stator shims as follows:

1 Write the following dimensions.

Build Dimension ______________1.812 (46.02) inch (mm)

Mic Bar and Button thickness ______________2.000 (50.80) inch (mm)

Dimension W (from Step 5.A.(15)(a)) ______________inch (mm)

Dimension Y (from Step 5.A.(14)(c)6 a)______________inch (mm)

2 Use dimensions in Step 1 to perform the following equation to calculate required turbine plenum shims (140).

1.812 (46.02) inch (mm) + 2.000 (50.80) inch (mm) minus

Dimension W___________________ inch (mm) minus

Dimension Y ___________________ inch (mm) =

Required Shims ___________________ inch (mm)

(b) Install two guide studs in combustor case flange.

(c) Install turbine plenum shims (140) as calculated in Step 5.A.(16)(a)2 ±0.001 (0.03) inch (mm), two maximum each thickness, on the combustor case. Make sure pin hole in shim pack is aligned with pin hole in the combustor case.

1 Write installed turbine plenum shims (140) as Installed Turbine

Plenum Shims ___________________ inch (mm)

(d) Align pin in first stage stator assembly (200) flange with installed shims (140) and combustor case pin holes, then insert the first stage stator assembly (200) into the combustor case.

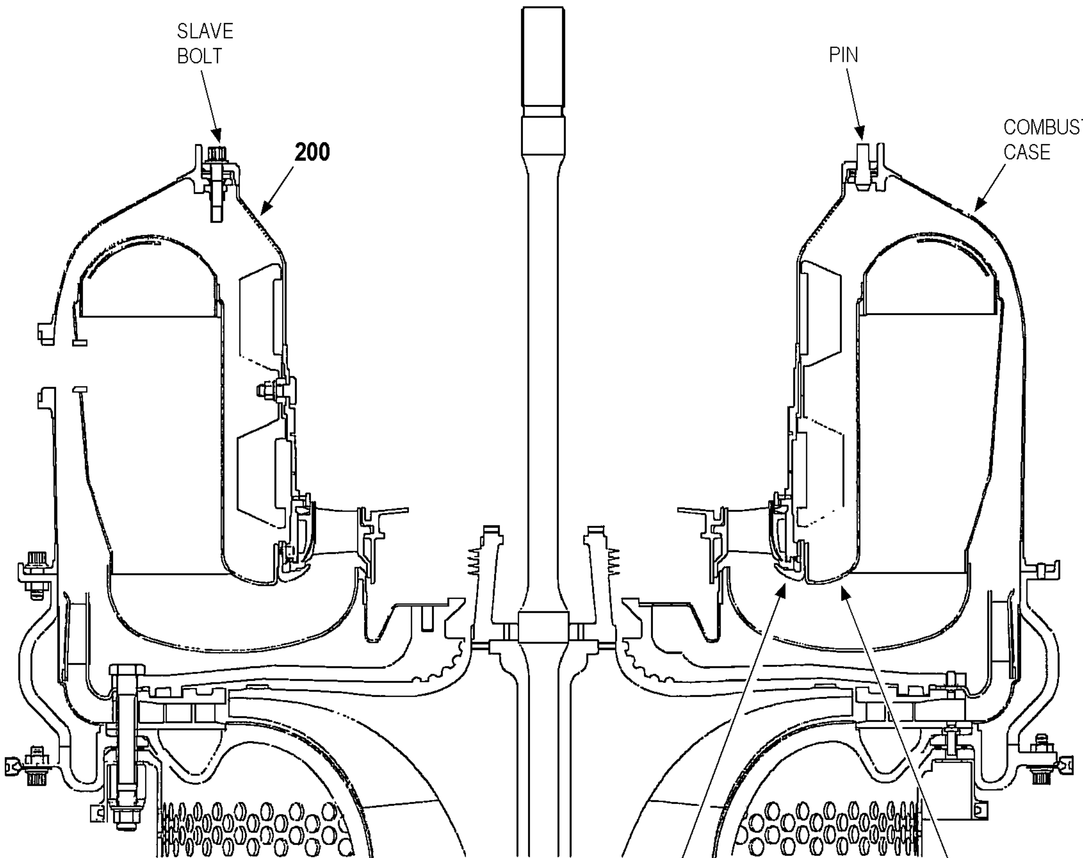

Figure 10035. Install First Stage Stator Assembly

Key to Figure 10035

200. FIRST STAGE STATOR ASSEMBLY (210, IPC FIG. 19)

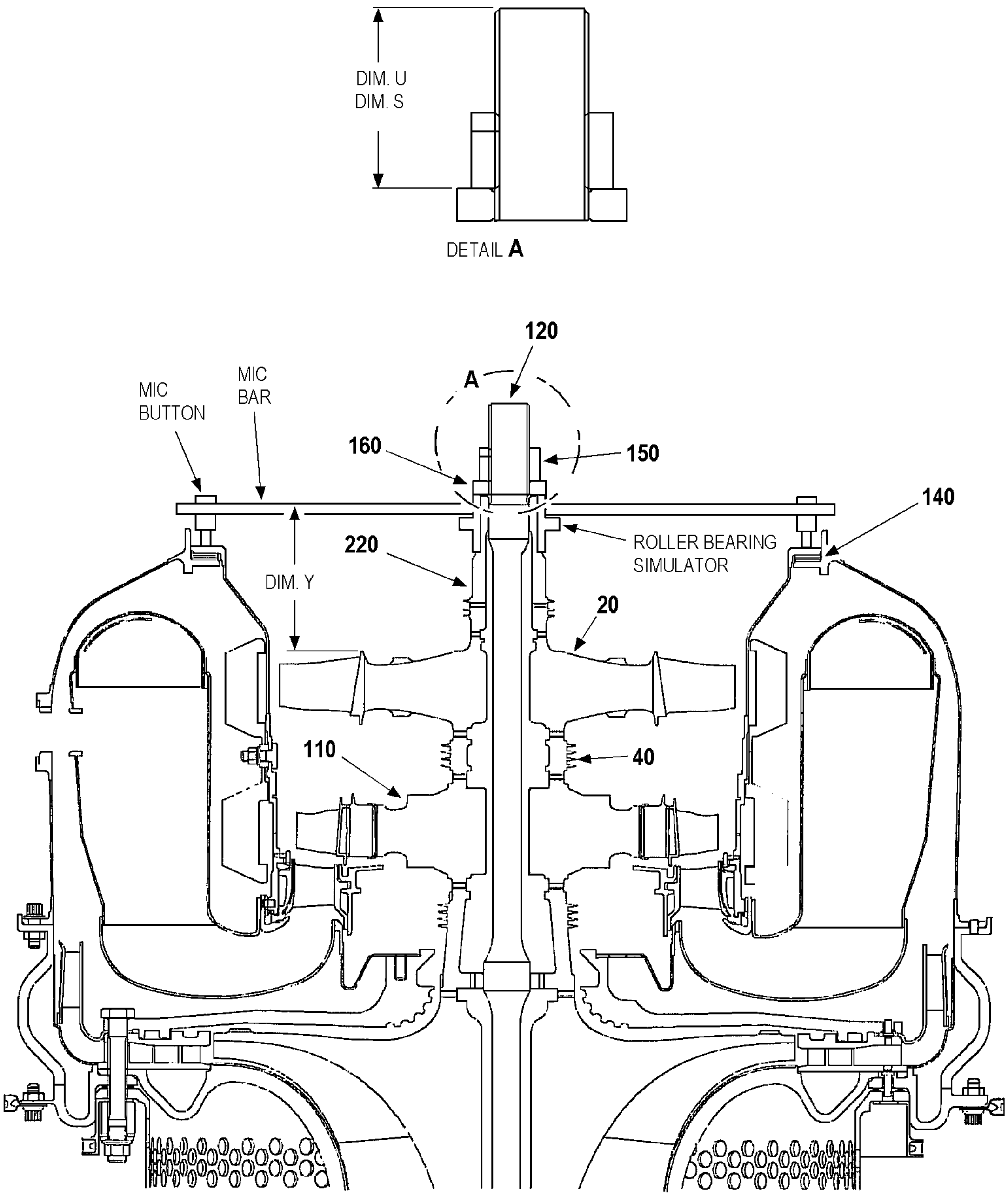

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Figure 10036. Fourth Rotating Group Stretch

Key to Figure 10036

20.	SECOND STAGE TURBINE ROTOR ASSY (IPC FIG. 19)	140.	TURBINE PLENUM SHIM
40.	COUPLING SHAFT	150.	TIESHAFT NUT (IPC FIG. 18)
110.	FIRST STAGE TURBINE ROTOR ASSY	160.	TIESHAFT WASHER
120.	TURBINE SHAFT (IPC FIG. 23)	220.	AFT BEARING SHAFT (230, IPC FIG. 18)
-130.	COUPLING SHAFT (IPC FIG. 19)	-.	ITEM NOT ILLUSTRATED

(20) Perform fourth rotating group stretch as follows. Refer to Figure 10036.

(a) Install turbine rotors and coupling shafts on turbine shaft as follows:

1 Clean the curvics on coupling shaft (130) and install, with seal knife edges facing aft, on engine compressor rotor (10, Figure 10029). Align balance marks and make sure curvics are not stacked.

2 Clean the curvics on first stage turbine rotor assembly (110, Figure 10036) and use two PN 834812-1 wheel removal adapters to install first stage rotor on the coupling shaft (130) with the word “AFT” on the disk facing up. Align balance marks and make sure curvics are not stacked.

3 Clean the curvics on coupling shaft (40) and install, with the three marked dots facing aft, on the first stage turbine rotor assembly (110). Align balance marks and make sure curvics are not stacked.

4 Clean the curvics on second stage turbine rotor assembly (20) and use two PN 834812-1 wheel removal adapters to install second stage rotor on the coupling shaft (40). Align balance marks and make sure curvics are not stacked.

NOTE: The second stage turbine rotor assembly (20) can be installed only in one direction due to the difference in its forward and aft curvics.

5 Clean the curvics on aft bearing shaft (220) install aft bearing shaft, with installed PN 834926-1 roller bearing simulator, on second stage turbine rotor assembly (20). Align balance marks and make sure curvics are not stacked.

6 Install tieshaft washer (160) and tieshaft nut (150) on the turbine shaft (120).

7 Use PN 834890-1 torque adapter to tighten tieshaft nut (150) to a torque value of 120 in-lb (13.56 Nm).

(b) Measure Dimension U, Dimension S and Dimension Y as follows. Refer to Figure 10036, Detail A.

1 Measure and make sure Dimension U is same as Dimension U from ASSEMBLY-02, Step 4.A.(3)(b)1 (±0.009 inch (0.23 mm)).

2 Install stretch shaft tool and PN 834889-1. Stretch the turbine shaft (120) to actual load as written in ASSEMBLY 02, Step 4.A.(3)(c)1 b.

3 Measure and make sure Dimension S is same as Dimension S from ASSEMBLY-02, Step 4.A.(3)(c)4 (±0.002 inch (0.05 mm)).

Check Point 200: Verify Dimension S is same as written down during assembly of rotating group.

4 Use assembled PN 834711-2 mic bar and PN 834850-1 mic buttons with a depth mic to measure Dimension Y. Refer to Figure 10036.

a Write Dimension Y_______________inch (mm)

b Measured Dimension Y (minus the thickness of the micing bar and buttons) must be 1.812 ±0.001 inch (46.02 ±0.03 mm).

Check Point 210: Verify Dimension Y (minus the thickness of the micing bar and buttons) is 1.812 ±0.001 inch (46.02 ±0.03 mm).

(c) Remove turbine rotors and coupling shafts from the turbine shaft as follows:

1 Install stretch shaft tool and PN 834889-1 on the turbine shaft (120).

2 Stretch the turbine shaft to force used in ASSEMBLY 02, Step 4.A.(3)(c)1 b loosen tieshaft nut (150) and release pressure on shaft stretch tool.

3 Remove stretch shaft tool and PN 834889-1 from the turbine shaft (120).

4 Remove tieshaft nut (150), tieshaft washer (160) and aft bearing shaft (220) with roller bearing simulator from the turbine shaft (120).

5 Use two PN 834812-1 wheel removal adapters to remove second stage turbine rotor assembly (20) from the turbine shaft (120).

6 Remove coupling shaft (40) from the turbine shaft (120).

7 Use two PN 834812-1 wheel removal adapters to remove first stage turbine rotor assembly (110) from the turbine shaft (120).

(d) Remove first stage stator assembly (110) from the power section assembly. Leave turbine plenum shim (140) pack in place on combustor case.

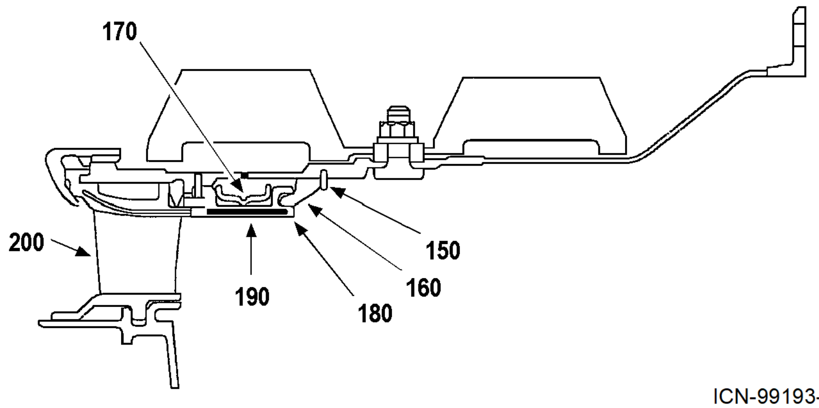

Figure 10037. Install Shroud Segments in the First Stage Stator Assembly

Key to Figure 10037

150. RETAINING RING (IPC FIG. 19)
160. SHROUD SUPPORT RING
170. SHROUD SEGMENT SEAL
180. FIRST STAGE TURBINE SHROUD SEGMENT
190. FEATHER SEAL (200, IPC FIG. 19)
200. FIRST STAGE STATOR ASSY (210, IPC FIG. 19)

---

(21) Assemble the shroud segments in the first stage stator assembly as follows. Refer to Figure 10037.

(a) Assemble the first stage turbine shroud segments (180) and feather seals (190) in the shroud segment seal (170).

(b) Install the assembled first stage turbine shroud segments (180), feather seals (190) and shroud segment seal (170) into the first stage stator assembly (200). Make sure the slot on a first stage turbine shroud segment is engaged with the pin on the first stage stator assembly.

(c) Lower and seat the shroud support ring (160) on the assembled first stage turbine shroud segments (180), feather seals (190) and shroud segment seal (170).

(d) Install the retaining ring (150) into the groove on the first stage stator assembly (200).

NOTE: The retaining ring (150) can only be installed when the assembled first stage turbine shroud segments (180), feather seals (190) and shroud segment seal (170) are seated.

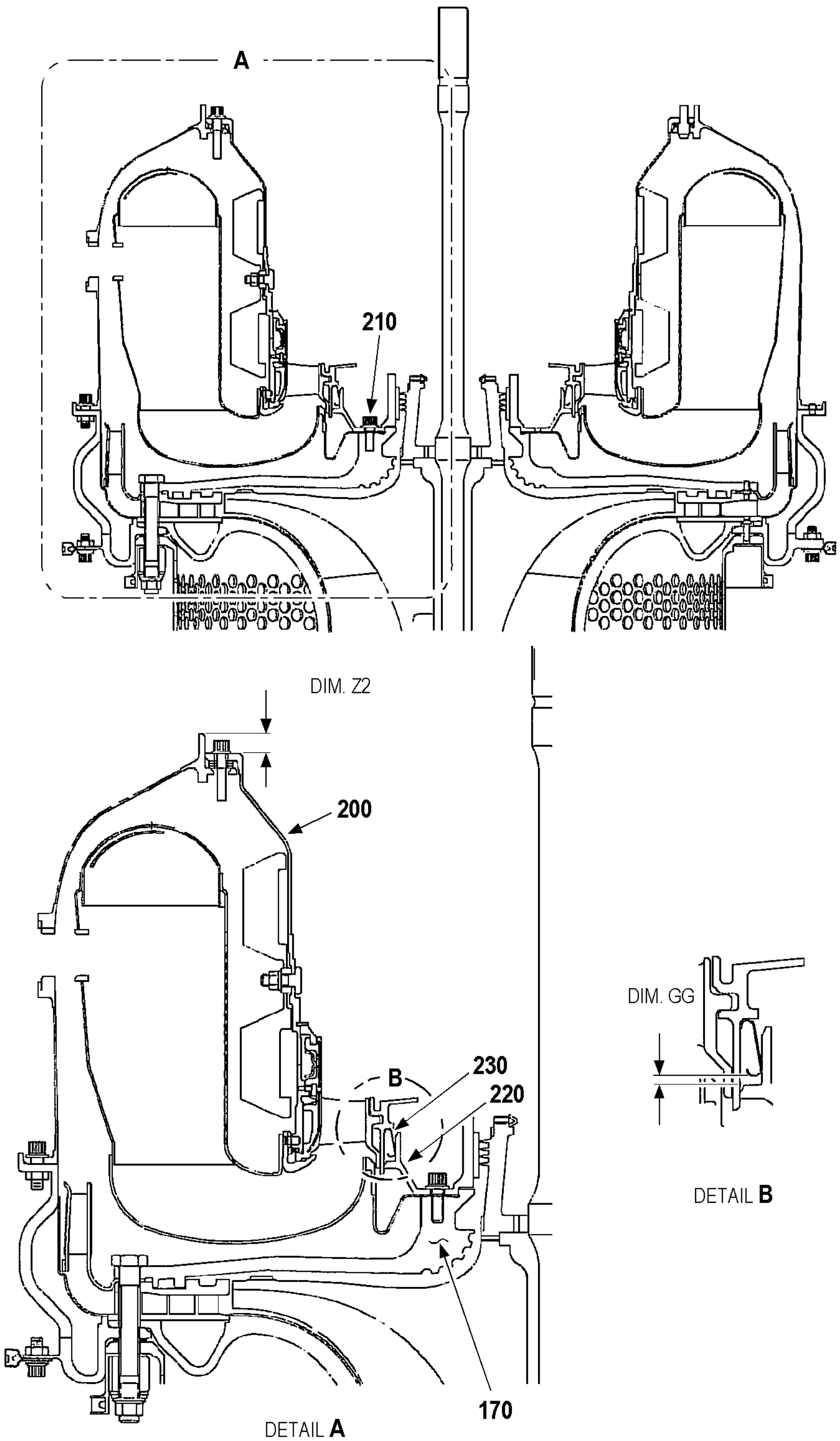

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Figure 10038. Install Air Seal and First Stage Stator Assembly

Key to Figure 10038

170. AIR STATIONARY SEAL SUPPORT (110, IPC FIG. 20)
200. FIRST STAGE STATOR ASSY (210, IPC FIG. 19)
210. BOLT (220, IPC FIG. 19)
220. AIR SEAL (230, IPC FIG. 19)
230. TURBINE SEAL (240, IPC FIG. 19)

DIM. GG	0.125 IN. (3.18 MM)

(22) Install the air seal and first stage stator assembly as follows. Refer to Figure 10038.

(a) Install turbine seal (230) on the air seal (220) as follows:

CAUTION: MAKE SURE TURBINE SEAL IS PROPERLY ORIENTATED (LARGE LIP FACING AFT) ON AIR SEAL.

1 Install the turbine seal (230) (large end of seal facing aft) on the air seal (220). Leave a 0.125 inch (3.18 mm) gap between the large lip on the turbine seal and the air seal as shown in Detail B, Dimension GG. Use PN 834951-1 turbine seal space to make sure correct gap.

(b) Install assembled air seal (220) on the air stationary seal support (170) as follows:

1 Install the air seal (220) with the installed turbine seal (230) on to the air stationary seal support (170) and align the bolt holes.

2 Attach the air seal (220) to the air stationary seal support (170) with bolts (210). Torque bolts to a torque value of 60 in-lb (6.78 Nm).

(c) Install the first stage stator assembly (200) into the combustor case as follows:

1 Align the locating pin hole in the combustor case and assembled shim pack with the pin in the first stage stator assembly (200).

2 Put the first stage stator assembly (200) on the combustor case and make sure that uniform contact is made between the first stage stator inner transition liner and combustion chamber.

3 Use eight slave bolts to pull the first stage stator assembly (200) down on the combustor case. While the slave bolts are tightened make sure that uniform contact is kept between the first stage stator inner transition liner and combustion chamber. Tighten slave bolts to a torque value of 60 in-lb (6.78 Nm).

(d) Make sure the first stage stator assembly (200) is seated as follows:

1 Write the following dimensions.

Installed Turbine Plenum Shims (140) installed (Step 5.A.(16)(c)1)

____________________________________ inch (mm)

Dimension W (from Step 5.A.(15)(a)) __________ inch (mm)

Dimension Z1 (from Step 5.A.(15)(b)) ________ inch (mm)

2 Measure and write the results of Dimension Z2.

Dimension Z2 = ________________________ inch (mm)

Check Point 220: Verify and write Dimension Z2.

3 Use the following equation to make sure first stage stator assembly (200) is seated.

Dimension Z1 ________________________ inch (mm) minus

Dimension Z2 ________________________ inch (mm) minus

Dimension W ________________________ inch (mm) minus

Installed Turbine Plenum Shims (140) used _____inch (mm)

= ________ inch (mm) (must equal 0.000 ±0.001 inch (0.00 ±0.03 mm))

Check Point 230: Verify calculation to make sure first stage stator assembly (200) is seated is 0.000 ±0.001 inch (0.00 ±0.03 mm).

NOTE: Calculation in this step must equal 0.000 ±0.001 inch (0.00 ±0.03 mm) to make sure the first stage stator assembly (200) is seated.

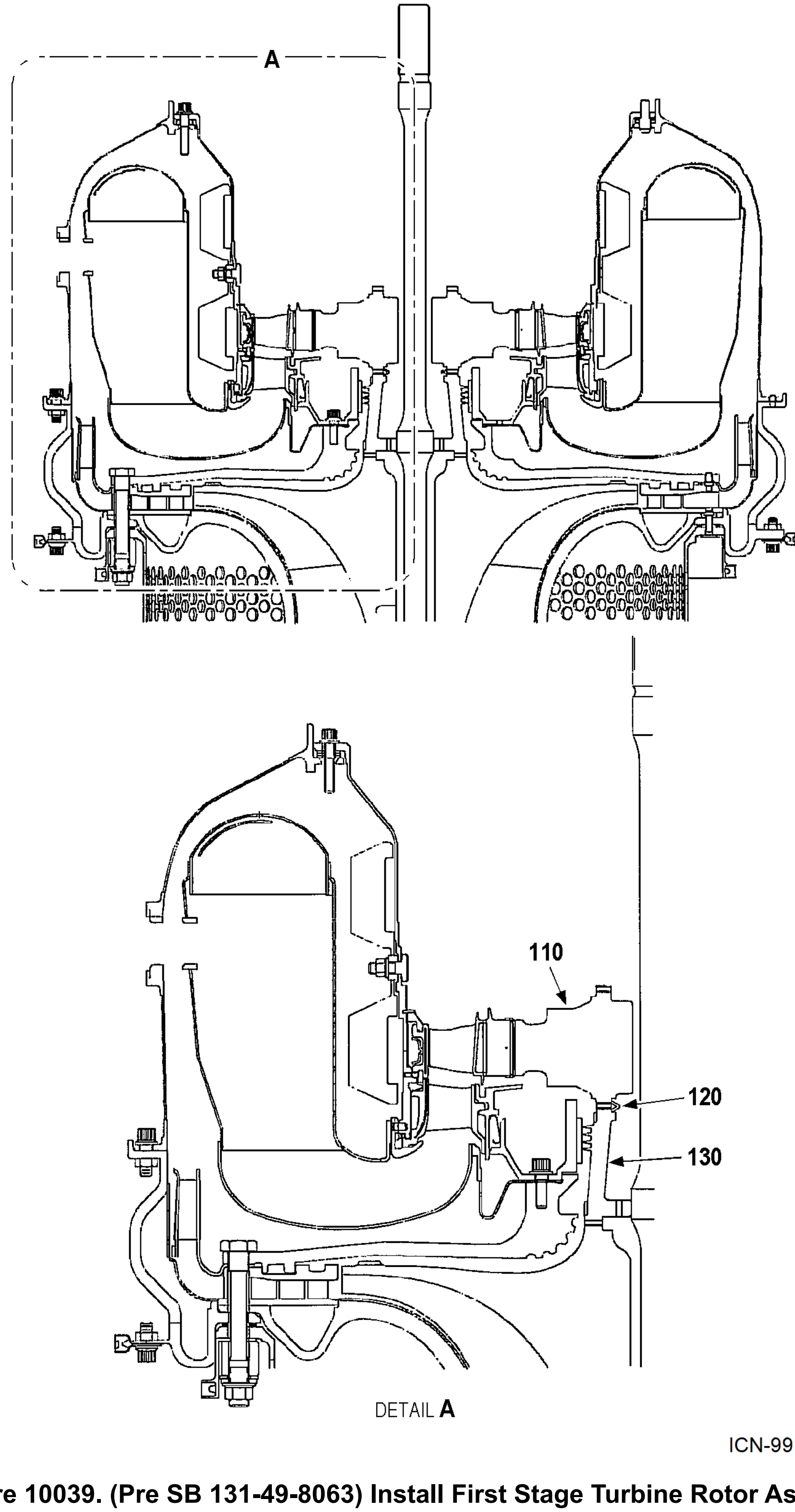

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Figure 10039. (Pre SB 131-49-8063) Install First Stage Turbine Rotor Assembly

Key to Figure 10039

110. FIRST STAGE TURBINE ROTOR ASSY (IPC FIG. 19)

120. CURVIC RING SEAL

130. COUPLING SHAFT

(23) Install turbine rotor assemblies, coupling shafts and second stage stator assembly as follows. Refer to Figure 10039.

(a) Install first stage turbine rotor as follows:

1 (Pre SB 131-49-8063) Install curvic ring seal (120) on the coupling shaft (130).

2 (Post SB 131-49-8063) First stage turbine (110), air seal (220, Figure 10038) and deletion of curvic ring seal (120) must be used together.

3 Clean the curvics on coupling shaft (130) and first stage turbine rotor assembly (110).

4 Use two PN 834812-1 wheel removal adapters to install the first stage turbine rotor assembly (110) on the coupling shaft (130). Align the balance marks and make sure curvics are not stacked.

NOTE: Make sure that the word "AFT" is visible on the first stage turbine rotor assembly (110) after it has been installed.

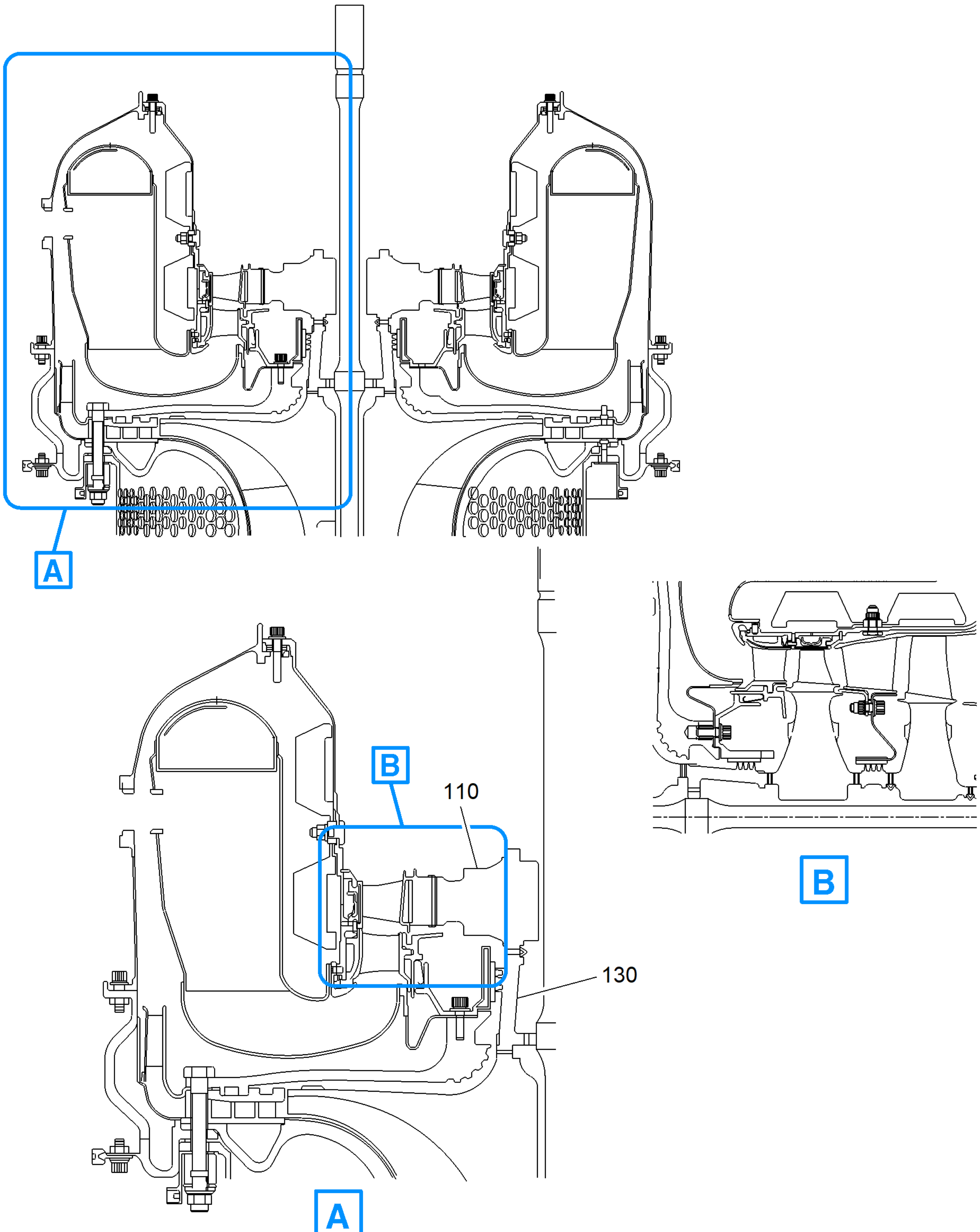

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Figure 10040. (Post SB 131-49-8063) Install First Stage Turbine Rotor Assembly

Key to Figure 10040

110. FIRST STAGE TURBINE ROTOR ASSY (IPC FIG. 19)

130. COUPLING SHAFT

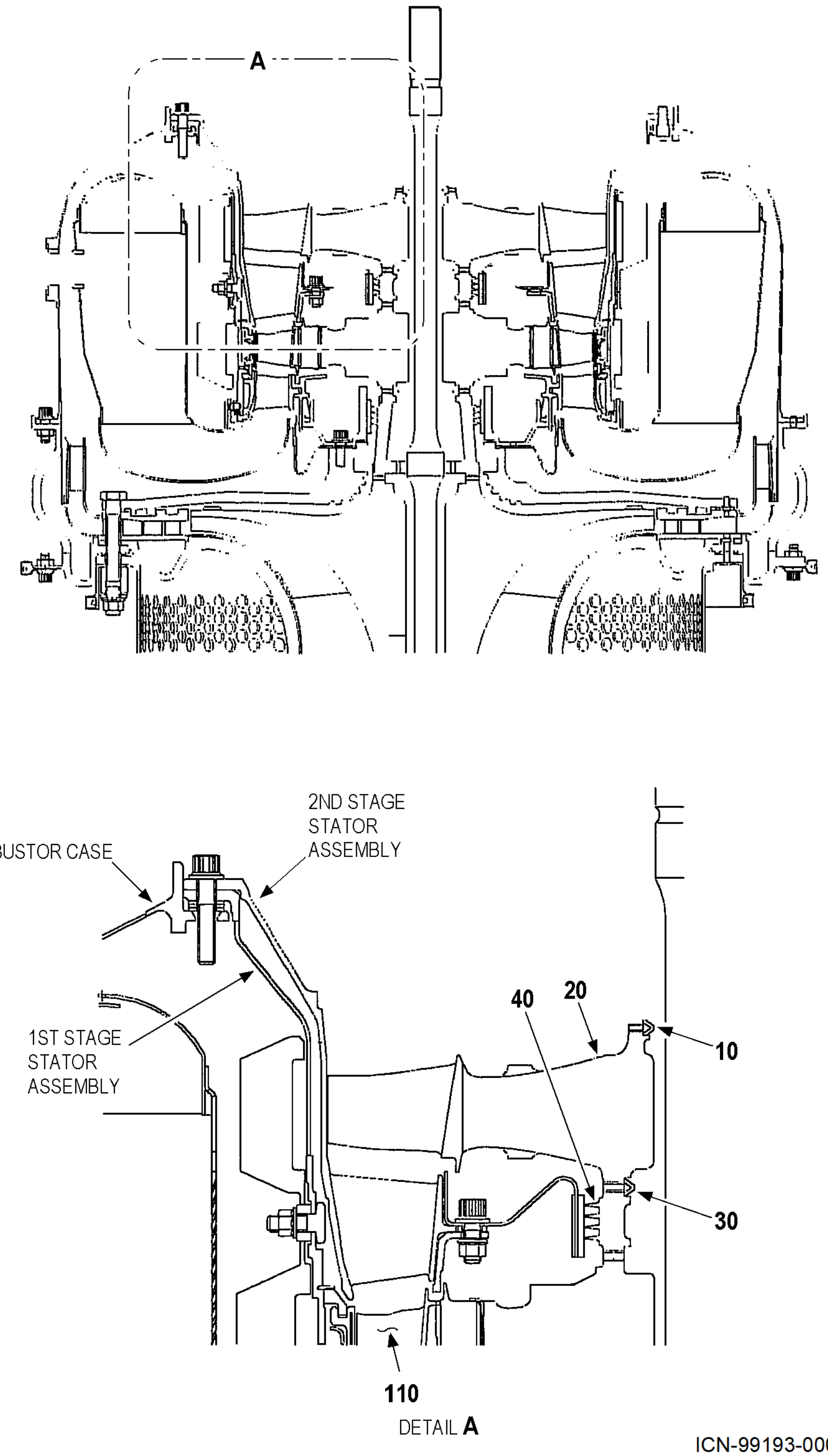

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Figure 10041. Install Second Stage Turbine Stator and Second Stage Turbine Rotor Assemblies

Key to Figure 10041

10. RING SEAL (IPC FIG. 19)	40. COUPLING SHAFT
20. SECOND STAGE TURBINE ROTOR ASSY	110. FIRST STAGE TURBINE ROTOR ASSY
30. CURVIC RING SEAL	

(b) Install second stage turbine stator assembly and second stage turbine rotor assembly as follows. Refer to Figure 10041.

1 Remove eight slave bolts that attach first stage stator to combustor case. Leave guide pins in place.

2 Install second stage stator assembly in the combustor case and align locating pin.

3 Clean curvics on the coupling shaft (40).

4 Install coupling shaft (40), with the three marked dots facing aft, on the first stage turbine rotor assembly (110). Align balance marks and make sure curvics are not stacked.

5 Put the curvic ring seal (30) into the coupling shaft (40).

6 Clean the curvics on the second stage turbine rotor assembly (20).

7 Use two PN 834812-1 wheel removal adapters to install the second stage turbine rotor assembly (20) on the coupling shaft (40). Align the balance marks and make sure curvics are not stacked.

8 Place the ring seal (10) into the curvics of the second stage rotor assembly (20).

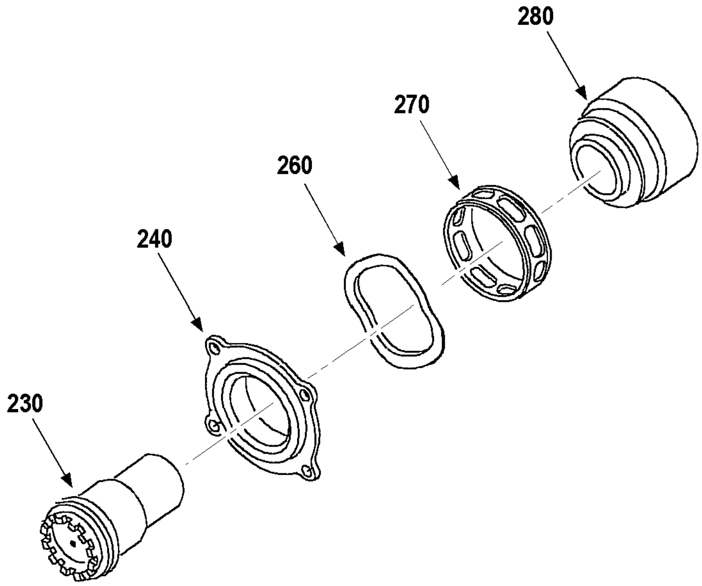

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Figure 10042. Install Roller Bearing on Aft Bearing Shaft

Key to Figure 10042

230. AFT BEARING SHAFT (IPC FIG. 18)	270. SEAL RETAINER
240. REAR BEARING SEAL	280. BEARING SET
260. SPRING WASHER	

(24) Install roller bearing in the power section assembly as follows:

(a) Assemble roller bearing on aft bearing shaft.

1 Use the PN 834883-1 aft bearing puller to remove PN 834926-1 roller bearing simulator from aft bearing shaft (230). Refer to Figure 10042.

2 Install the rear bearing seal (240) with short shoulder facing aft on the aft bearing shaft (230).

3 Install the spring washer (260) and seal retainer (270) with inner lip on spring wave washer (260) on the aft bearing shaft (230).

4 Use arbor press, PN 834759-8 press button and PN 834701-1 bearing press tube to push the bearing set (without outer race in place) (280) with the chamfer facing up (aft), on the aft bearing shaft (230). Refer to Figure 10043.

NOTE: Make sure the bearing set (280) is seated on the aft bearing shaft (230).

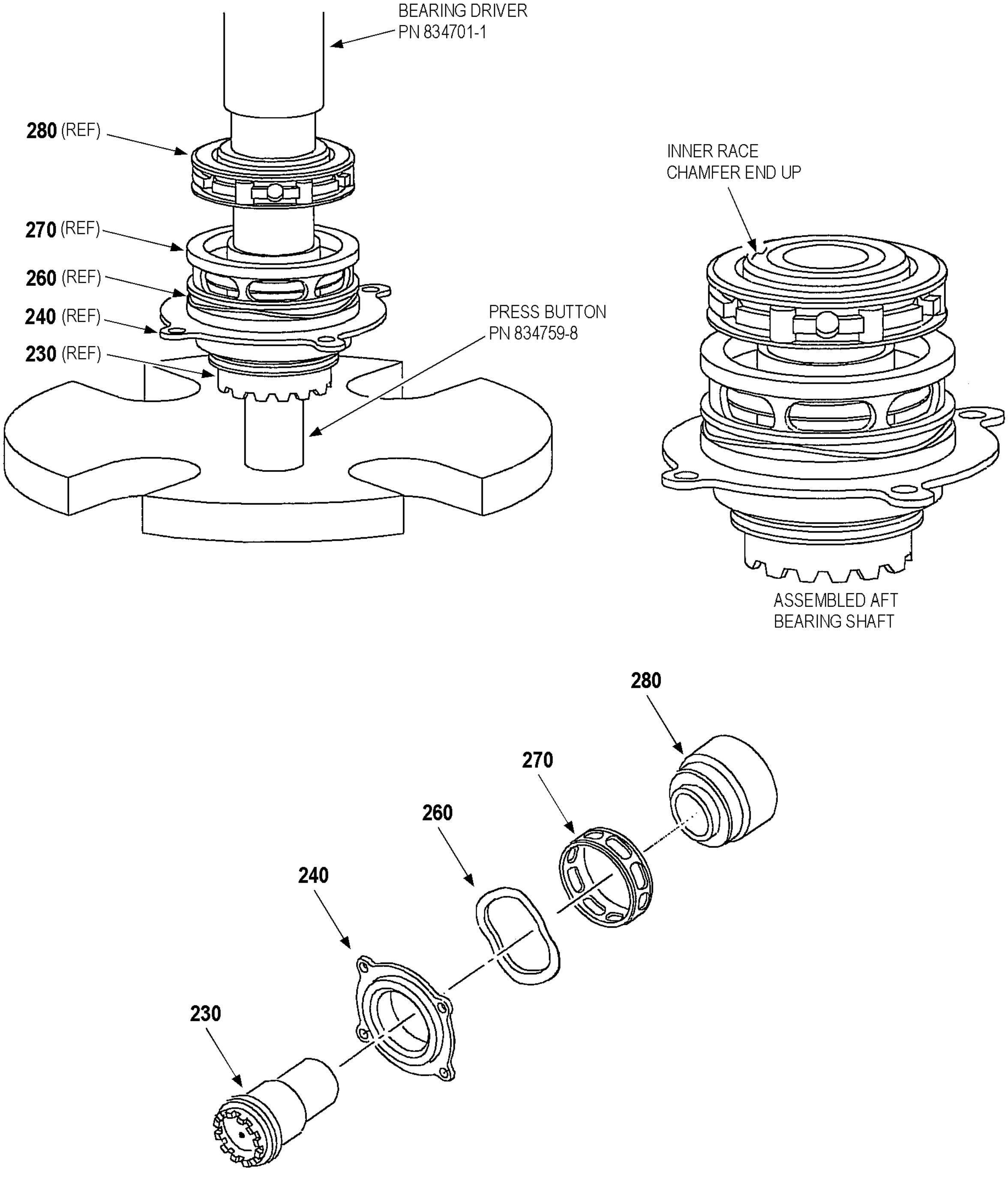

Figure 10043. Install Roller Bearing on Aft Bearing Shaft

Key to Figure 10043

230. AFT BEARING SHAFT (IPC FIG. 18)
240. REAR BEARING SEAL
260. SPRING WASHER
270. SEAL RETAINER
280. BEARING SET

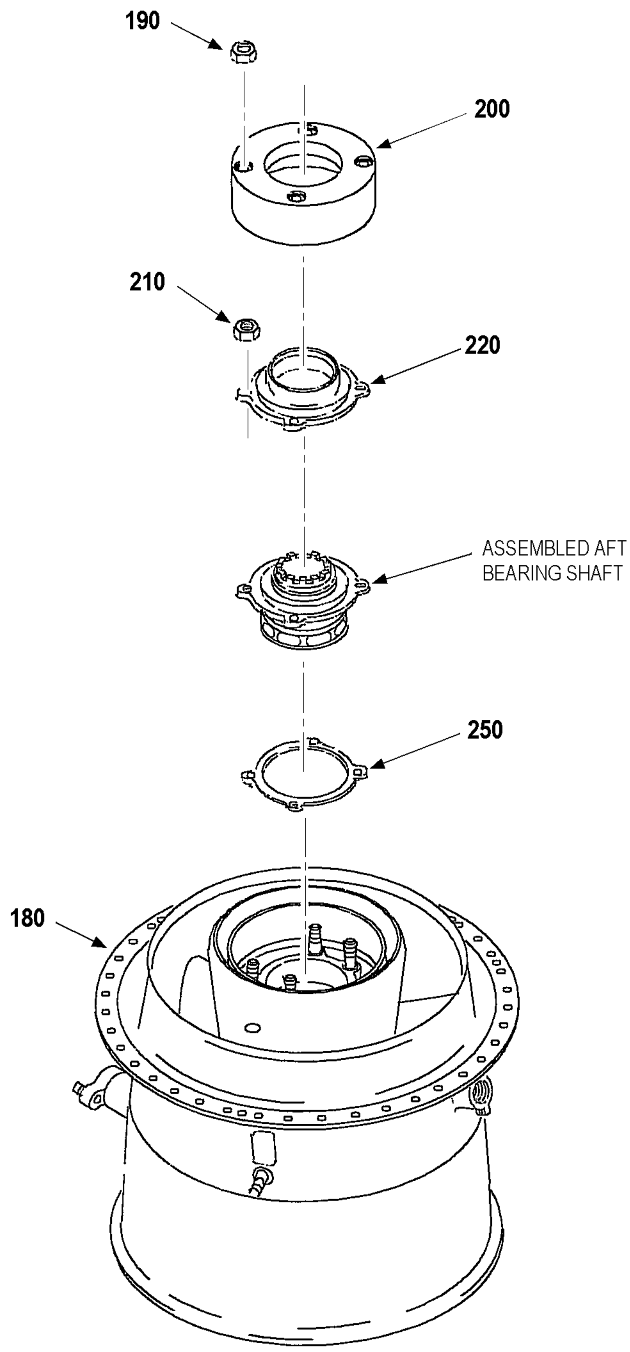

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Figure 10044. Install Assembled Roller Bearing and Aft Bearing Shaft in Turbine Bearing Housing Assembly

Key to Figure 10044

180. TURBINE BEARING HOUSING ASSY (IPC FIG. 18)
190. NUT
200. FWD TURBINE BEARING INSULATION BLANKET
210. NUT
220. STATIONARY AIR SEAL
250. REAR BEARING SEAL GASKET

(b) Install assembled aft bearing shaft in the turbine bearing housing assembly. Refer to Figure 10044.

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

1 Spray rear bearing seal gasket (250) with dry film lubricant then install on the turbine bearing housing assembly (180).

2 Install the assembled aft bearing shaft into the turbine bearing housing assembly (180).

3 Install the stationary air seal (220) on the turbine bearing housing assembly (180) and attach with nuts (210). Tighten nuts to a torque value of 50 in-lb (5.65 Nm).

4 Install the forward turbine bearing insulation blanket (200) on the turbine bearing housing assembly (180) and attach with nuts (190). Tighten nuts to a torque value of 27 in-lb (3.05 Nm).

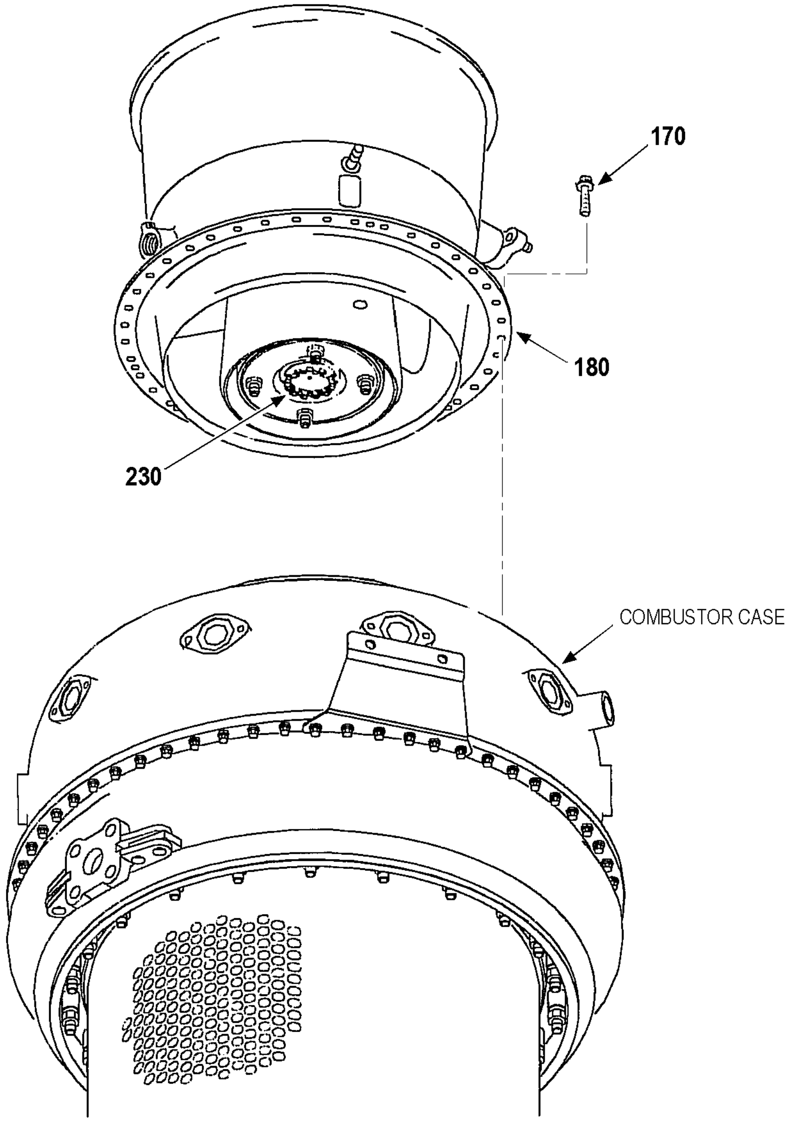

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Figure 10045. Install Assembled Turbine Bearing Housing Assembly on the Power Section Assembly

Key to Figure 10045

-20.	SECOND STAGE TURBINE ROTOR ASSY (IPC FIG. 19)	180.	TURBINE BEARING HOUSING ASSY
-100.	SECOND STAGE STATOR ASSY	230.	AFT BEARING SHAFT
170.	BOLT (IPC FIG. 18)	-.	ITEM NOT ILLUSTRATED

(c) Install assembled turbine bearing housing assembly on the power section assembly as follows. Refer to Figure 10045.

1. Clean the curvics on the second stage turbine rotor assembly (20) and the aft bearing shaft (230).

2. Align the pin hole in the turbine bearing housing assembly (180) mount flange with the pin in the combustor case and lower the assembled turbine bearing housing assembly on the second stage stator assembly (100).

3. Align the balance mark on the aft bearing shaft (230) with the balance mark on the second stage turbine rotor assembly (20) and engage the curvics. Make sure the curvics are not stacked.

4. Attach the assembled turbine bearing housing assembly (180) to the power section assembly with bolts (170). Tighten bolts to a torque value of 60 in-lb (6.78 Nm).

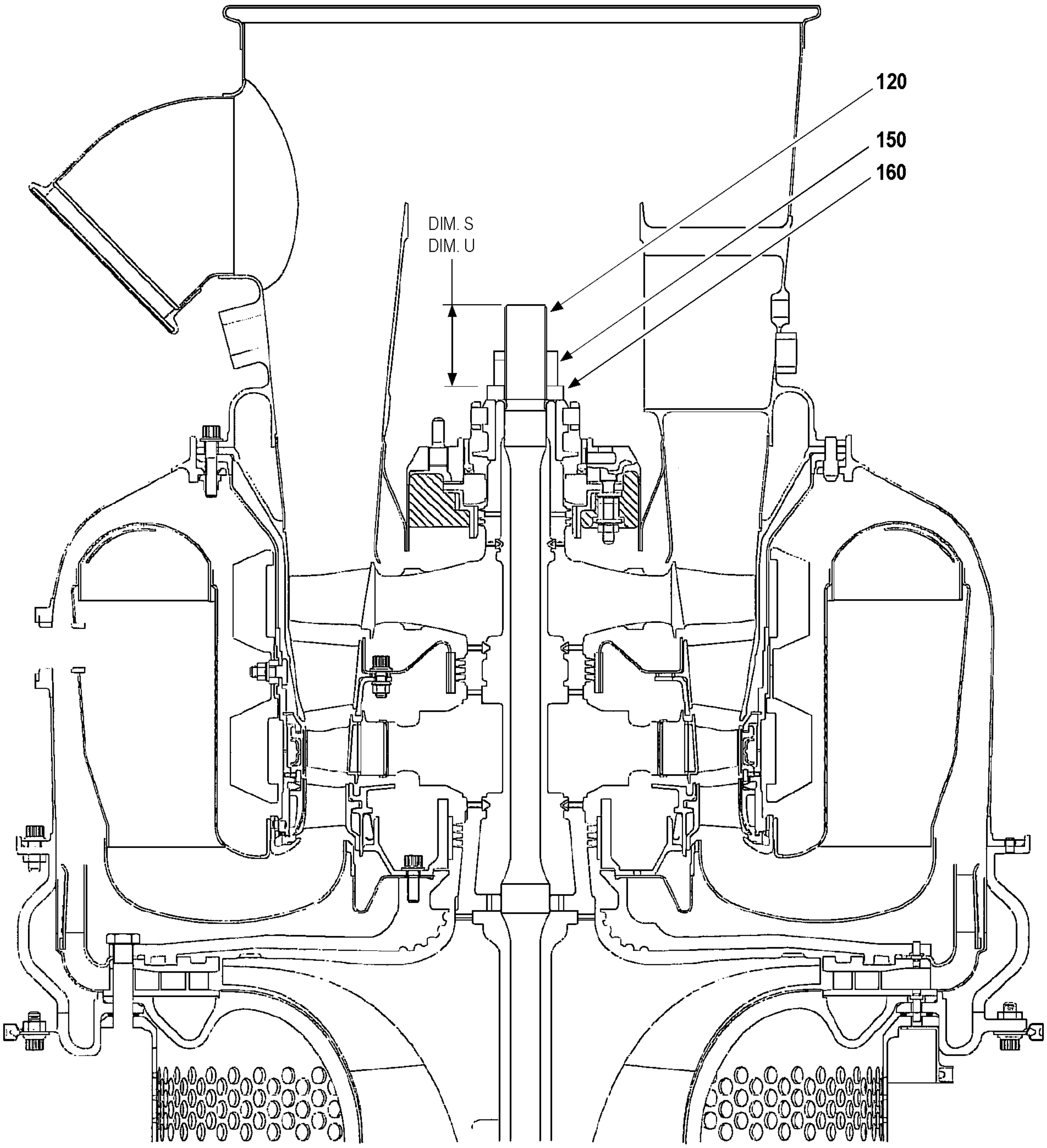

Figure 10046. Stretch Turbine Shaft

Key to Figure 10046

120. TURBINE SHAFT (IPC FIG. 23)
150. TIESHAFT NUT (IPC FIG. 18)
160. TIESHAFT WASHER

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

(d) Stretch the turbine shaft as follows. Refer to Figure 10046.

1 Install the tieshaft nut and tieshaft washer as follows:

a Put anti-seize lubricant (Liqui-Moly, Brand NV Thread Compound) (MIL-PRF-907) on the turbine shaft (120) threads and install tieshaft washer (160) and tieshaft nut (150) on the turbine shaft.

b Tighten the tieshaft nut (150) to a torque value of 120 in-lb (13.56 Nm) using PN 834890-1 adapter.

2 Use depth micrometer to measure Dimension U and make sure the unstretched value of Dimension U is in ±0.009 inch (0.23 mm) of Dimension U written in ASSEMBLY-02, Step 4.A.(3)(b)1.

Check Point 240: Make sure Dimension U is same as written during assembly of rotating group.

3 Stretch the turbine shaft as follows:

a Install stretch shaft tool and PN 834889-1. Stretch the turbine shaft (120) to actual load as written in ASSEMBLY 02, Step 4.A.(3)(c)1 b.

b Tighten tieshaft nut (150) hand tight.

c Remove stretch shaft tool and PN 834889-1.

4 Use a depth micrometer to measure Dimension S and make sure the stretched value of Dimension S is in ±0.002 inch (0.05 mm) of Dimension S written in ASSEMBLY-02, Step 4.A.(3)(c)4.

Check Point 250: Make sure Dimension S is same as written during assembly of rotating group.

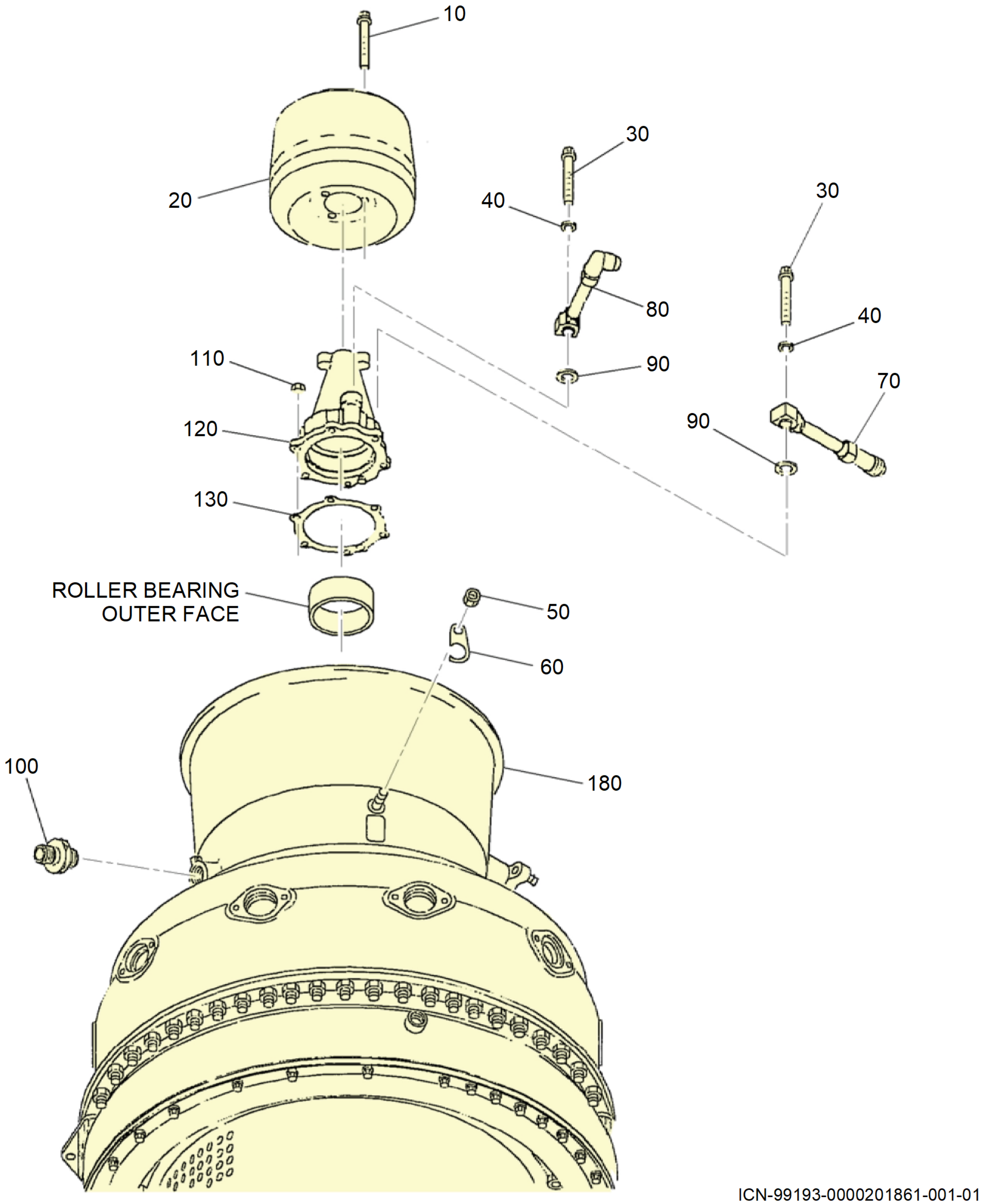

Figure 10047. (Pre SB 131-49-7606) Install Bearing Retainer Assembly and Oil Tubes

Key to Figure 10047

10. BOLT (IPC FIG. 18)	90. SEAL WASHER
20. EXHAUST CENTER BODY CAP	100. FLARELESS FITTING
30. BOLT	110. NUT
40. SEAL WASHER	120. BEARING RETAINER ASSY
50. NUT	130. AFT BEARING COVER GASKET
60. OIL TUBE RETAINER	-160. TIESHAFT WASHER
70. SCAVENGE TUBE ASSY	180. TURBINE BEARING HOUSING ASSEMBLY
-70A. SCAVENGE TUBE ASSY	-260. SPRING WASHER
-70B. SCAVENGE TUBE ASSY	-280. BEARING SET
-75. GASKET	-300. TURBINE SHAFT (120, IPC FIG. 23)
80. IN TUBE ASSY	-. ITEM NOT ILLUSTRATED

(e) Install bearing retainer assembly and oil tubes on the turbine bearing housing assembly as follows. Refer to Figure 10047.

1 Install the roller bearing outer race of bearing set (280) over the installed bearing set rollers. Make sure inside chamfer of outer race goes in first.

2 Align the hole pattern and spray aft bearing cover gasket (130) with dry film lubricant then install the aft bearing cover gasket (130) on the turbine bearing housing assembly (180).

3 Install the bearing retainer assembly on the turbine bearing housing assembly as follows:

a Align the oil scavenge and pressure ports on the bearing retainer assembly (120) with the corresponding holes on the turbine bearing housing assembly (180).

b Install the bearing retainer assembly (120) on the turbine bearing housing assembly (180).

c Attach the bearing retainer assembly (120) to the turbine bearing housing assembly (180) with nuts (110). Tighten nuts alternately and evenly to a torque value of 50 in-lb (5.65 Nm) so turbine bearing housing assembly provides even compression of the spring washer (260).

4 (Pre SB 131-49-7606) Install the oil tubes on the turbine bearing housing assembly as follows:

a Install the seal washers (90) on the bearing retainer assembly (120) oil tube bosses.

b Install the scavenge tube assembly (70) and in tube assembly (80) on the installed seal washers (90).

c Install oil tube retainers (60) and nuts (50).

d Tighten nuts (50) to a torque value of 60 in-lb (6.78 Nm).

e Attach the scavenge tube assembly (70) and in tube assembly (80) with seal washers (40) and bolts (30).

f Tighten bolts (30) to a torque value of 60 in-lb (6.78 Nm).

(Post SB 131-49-7606) Install the oil tubes on the turbine bearing housing assembly as follows:

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

g Apply jointing compound to threads on the scavenge tube assembly (70A).

h (Pre SB 131-49-7944) Install the scavenge tube assembly (70A) in the bearing retainer assembly (120A).

i (Pre SB 131-49-7944) Tighten scavenge tube assembly (70A) to a torque value of 150 in-lb (16.95 Nm).

(Post SB 131-49-7944) Apply a light film of Braycote 248 to gasket (-75) and install gasket (-75) on scavenge tube (-70B). Install the scavenge tube assembly (-70B) and supply tube assembly (refer to 49-20-00, Installation 31, Figure 4004, Sheet 3, item 175A). Tighten scavenge tube assembly to a torque value of 320 in-lb (36.16 Nm).

j Install tube support bracket (60A) and grommet (61) with nut (50).

k Tighten nut (50) to a torque value of 60 in-lb (6.78 Nm).

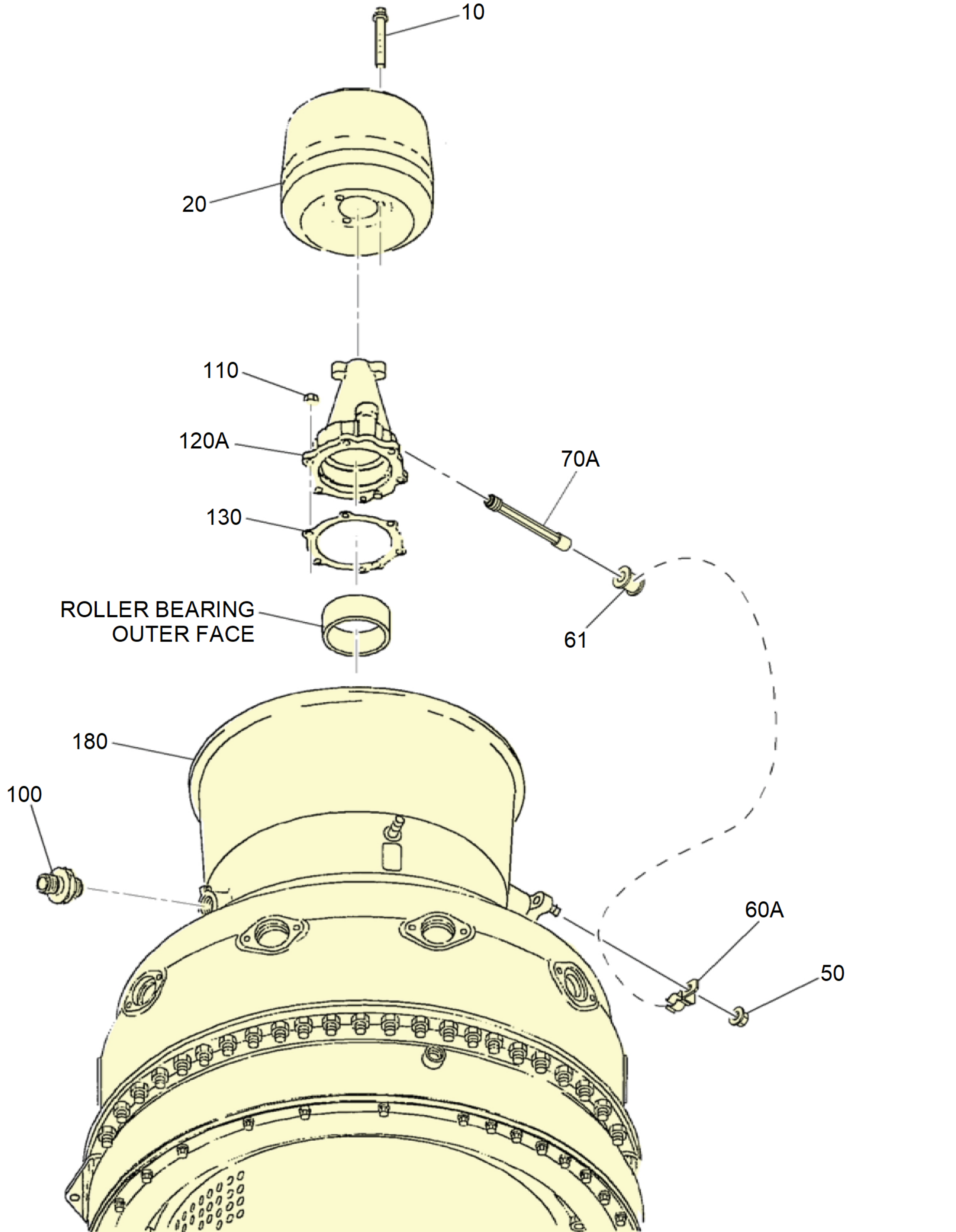

Figure 10048. (Post SB 131-49-7606) Install Bearing Retainer Assembly and Oil Tube

Key to Figure 10048

10.	BOLT (IPC FIG. 18)	120A.	BEARING RETAINER ASSY
20.	EXHAUST CENTER BODY CAP	130.	AFT BEARING COVER GASKET
50.	NUT	-160.	TIESHAFT WASHER
60A.	TUBE SUPPORT BRACKET	180.	TURBINE BEARING HOUSING ASSY
61.	GROMMET	-260.	SPRING WASHER
70A.	SCAVENGE TUBE ASSY	-280.	BEARING SET
100.	FLARELESS FITTING	-300.	TURBINE SHAFT (120, IPC FIG. 23)
110.	NUT	-.	ITEM NOT ILLUSTRATED

5 Install the exhaust cap on the turbine bearing housing assembly as follows:

a Align the hole pattern and install the exhaust center body cap (20) on the turbine bearing housing assembly (180).

b Attach the exhaust center body cap (20) with bolts (10). Tighten bolts to a torque value of 60 in-lb (6.78 Nm).

6 Install flareless fitting (100) on the turbine bearing housing assembly (180).

a Tighten flareless fitting to a torque value of 40 in-lb (4.52 Nm).

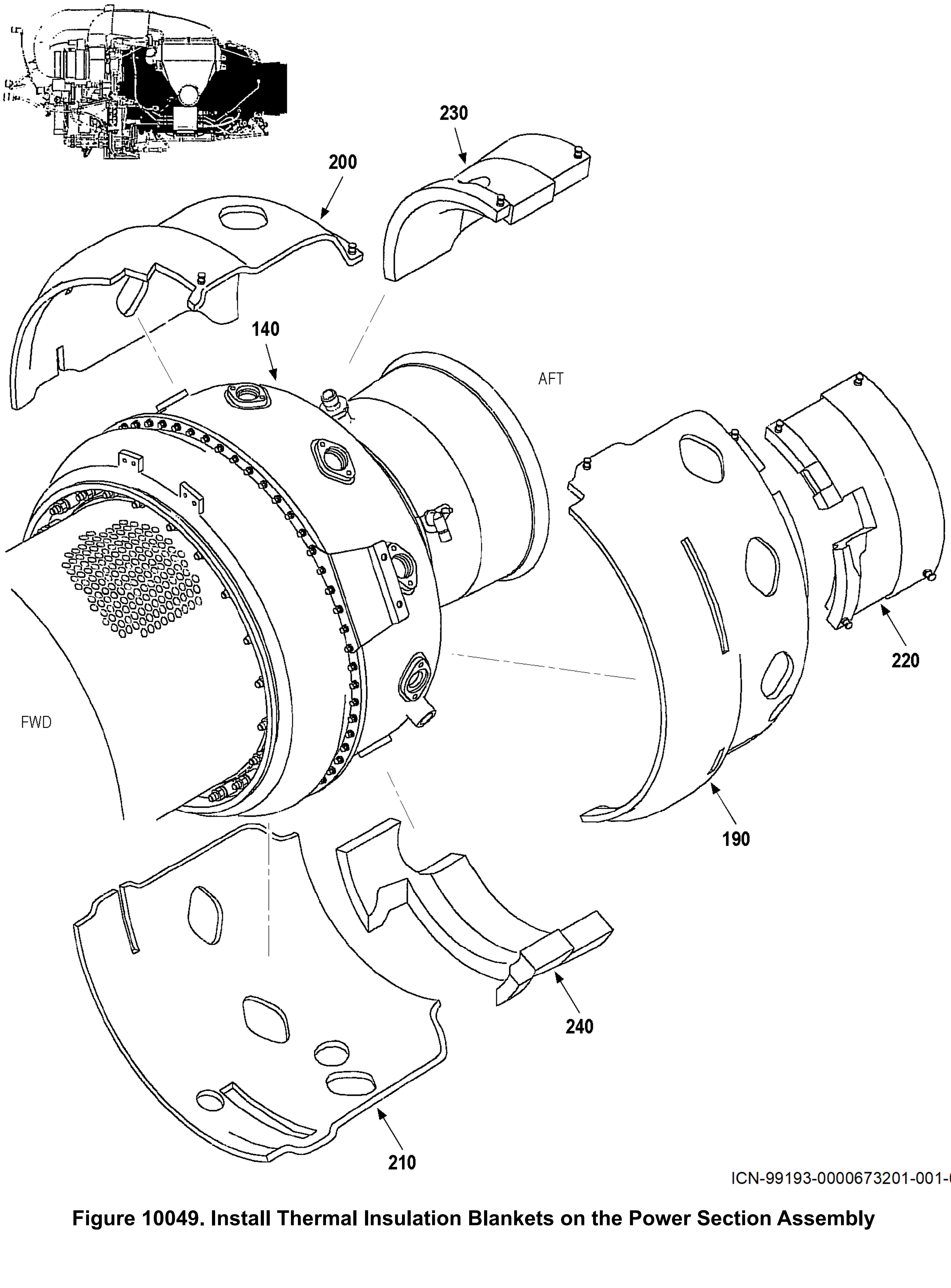

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Figure 10049. Install Thermal Insulation Blankets on the Power Section Assembly

Key to Figure 10049

140. POWER SECTION ASSEMBLY (IPC FIG. 16)
190. SIDE BLANKET (80, IPC, FIG. 16)
200. SIDE BLANKET (90, IPC, FIG. 16)
210. SIDE BLANKET (100, IPC, FIG. 16)
220. AFT SIDE BLANKET (110, IPC, FIG. 16)
230. AFT SIDE BLANKET (120, IPC, FIG. 16)
240. AFT SIDE BLANKET (130, IPC, FIG. 16)

---

(25) Install thermal insulation blankets (190 thru 240) on the power section assembly. Refer to Figure 10049.

(a) Install side blankets (190, 200, 210) on power section assembly (140).

(b) Secure side blankets (190, 200, 210) with lockwire MS20995C20 in accordance with NASM33540.

(c) Install aft side blankets (220, 230, 240) on power section assembly (140).

(d) Secure aft side blankets (220, 230, 240) with lockwire MS20995C20 in accordance with NASM33540.

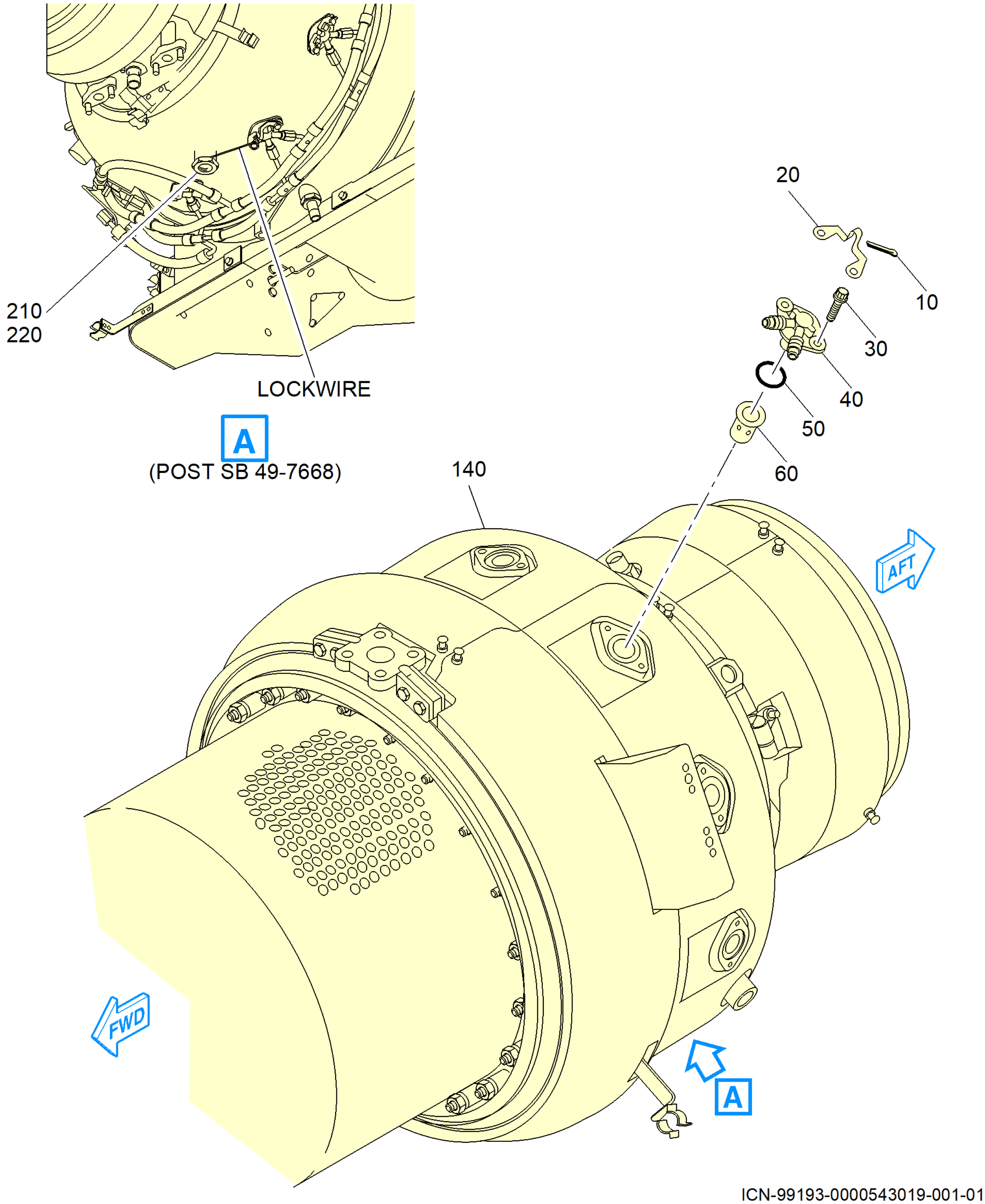

Figure 10050. Install the Fuel Nozzles on the Power Section Assembly

Key to Figure 10050

10. PIN (IPC FIG. 16)
20. LOCKING PLATE
30. BOLT
40. FUEL NOZZOLE
50. GASKET
60. FUEL NOZZOLE AIR SHROUD
140. POWER SECTION ASSEMBLY
210. PLUG (IPC FIG. 6)
220. GASKET

WARNING: USE THE CORRECT PROTECTION. THIS CHEMICAL/ SOLUTION CAN CAUSE SKIN, EYE AND LUNG DAMAGE. FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR EACH CHEMICAL.

(26) Install the fuel nozzles on the power section assembly. Refer to Figure 10050.

(a) Apply anti-seize compound (C5-A Copper Based) to threads of bolts (30).

(b) Install new gasket (50), fuel nozzle air shroud (60) and fuel nozzle (40) into the power section assembly (140).

CAUTION: MAKE SURE THAT THE ALIGNMENT HOLE IN THE NOZZLE SHROUD IS CORRECTLY CENTERED OVER THE ALIGNMENT PIN ON THE FUEL NOZZLE. IF THE NOZZLE SHROUD IS INCORRECTLY INSTALLED ON THE FUEL NOZZLE, IT WILL CAUSE POSSIBLE APU SMOKING AND ENGINE DAMAGE.

(c) Attach fuel nozzle (40) to the combustor case with bolts (30). Gradually tighten each of the two bolts (30) on the fuel nozzle assembly to apply even crush pressure on the gasket (50). Tighten bolts to 50 in-lb (5.65 Nm).

NOTE: If necessary, bolt (30) can be tightened to a torque of up to 70 in-lb (7.91 Nm) to align with pin (10) and locking plate (20).

(d) Install locking plate (20) on bolts (30) and attach with pins (10). Lockwire MS20995C32 (in accordance with NASM33540) can be used as an alternative to the locking plate and pin.

(e) (Post SB 131-49-7668) Install new plug (210) with gasket (220). Tighten plug to a torque value of 125 in-lb (14.12 Nm). Secure plug (210) with lockwire MS20995C32 to the available hole in the fuel nozzle bolt (30) (in accordance with NASM33540).

POWER SECTION ASSEMBLY
STORAGE-01

TASK 49-22-00-550-801

1. General

A. This section contains procedures for storage of the power section assembly.

NOTE: The storage/preservation procedures are guidelines only and represent best practices for the protection of stored units against damage from worst-case exposure to moisture, debris, and other environmental conditions during extended periods storage. The manual should be used as a baseline to establish what precautions should be taken at and/or after storage based on each operator's region and experience.

B. Age control for most parts today is not necessary for assemblies, silicon rubber, fluorocarbon rubber, fuel tank synthetics, or static seals used with fasteners.

C. Age Controls of Age-Sensitive Elastomeric Material for Aerospace Applications is specified in SAE ARP5316. Refer to this standard for all military and commercial use. Assemblies that contain age-sensitive material in this specification are limited by failure rates, in service use and system life estimated by the user.

D. Bad weather conditions can cause damage to parts. Such conditions are, but not limited to:

- Moisture,
- High temperature (over 125°F (52°C)),
- Fuel or solvents that have expanded,
- Fumes that can cause corrosion,
- Mechanical stresses,
- Ultraviolet light.

E. Parts that have been in bad weather conditions must be checked for damage and replaced as necessary.

2. Equipment and Materials

A. Table 12001 shows the necessary equipment and materials for storage.

Table 12001. Equipment and Materials

Equipment/Materials	Description/Manufacturer
NOTE: Equivalent equipment/materials can be used.	
Barrier material (MIL-PRF-131H, Type I, Class III)	Commercially available
Desiccant (MIL-D-3464, Type I & II)	Commercially available
Humidity indicator (MS20003)	Commercially available

3. Procedure

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A. Prepare the power section assembly for storage.

(1) Put the power section assembly in a vapor-proof barrier material bag.

(2) Put desiccant in the storage container and barrier material bag.

(3) Put a humidity indicator in the storage container and barrier material bag.

(4) Put the power section assembly in a storage container.

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B. Monitor storage conditions.

(1) Check the humidity indicator every 30 days as follows:

(a) The humidity indicator must be checked by comparison with the color comparison chart shown on (MS20003).

(b) If the inspection shows that the humidity indicator is in fully activated condition with the relative humidity less than 40 percent, no maintenance is necessary until the next inspection.

(c) If the inspection shows that the humidity indicator is 40 percent or more, an unsafe corrosive condition can exist. The bag must be opened and the power section assembly removed and checked to determine its serviceability.

1 If corrosion is found, return the power section assembly to the maintenance facility.

2 Put the power section assembly in a new vapor-proof barrier material bag.

3 Put desiccant in the storage container and barrier material bag.

4 Put a humidity indicator in the storage container and barrier material bag.

5 Put the power section assembly in a storage container.