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CONVAIR ASTRONAUTICS

CONVAIR DIVISION OF GENERAL DYNAMICS CORPORATION

MAINTENANCE STUDY

ATLAS SERIES "D" ENGINE CHANGES

QUICK ENGINE CHANGE CONCEPT

AZM-27-344

REVISION A

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FOREWORD

This report presents the results of a study to define the configuration of kits required to effect "Quick Engine Changes" on the Atlas "D" Series Missile at the Squadron Maintenance Area.

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1.0 INTRODUCTION

1.1 Reason For Study

The study was conducted in response to a request from E. B. Doll, Program Director, Atlas Weapon System, Space Technology Lab. to C. J. Dunn, Senior Project Engineer, Atlas Project Office, Convair Astronautics by TWX dated 29 June 1959 and revised per request by TWX dated 1 February 1960.

1.2 Objective of Study

The study was conducted to identify the parts that must be added to the NAA engines to make up Quick Engine Change Kits and to identify parts required to mate the Kits to the missile.

1.3 Ground Rules For Study

- 1.3.1 Subsystem Replacements/Build-Ups are to be accomplished at the SMA.
- 1.3.2 Subsystem Replacements are to be accomplished in as short a time as possible.
- 1.3.3 Only currently provisioned IOC equipment shall be utilized to accomplish the subsystem replacements or build-ups.
- 1.3.4 The kit configurations are to be for any IOC missile, EID No. 27-0002-13 & on (33D & on).
- 1.3.5 The QEC study is a coordinated Convair and Rocketdyne effort prepared and published by Convair.

2.0 BACKGROUND

2.1 Current Air Force Provisioning Status

Three Jettisonable Sections have been provisioned (complete with the Rocketdyne Engine and the Convairst furnished sub-systems installed) under the following part numbers:

<u>Qty</u>	<u>Part No.</u>	<u>Effectivity</u>	<u>Complex</u>
1	27-23001-809	4D, 8D, 13D, 21D	576A
1	27-23001-805	23D, 25D	576B
1	27-23001-865	33D & on	

NOTE: P/N 27-04304-3 valve is not delivered with the jettisonable section. This valve should be installed immediately prior to shipping the missile to the launcher. (Ref. Para 3.4.3).

2.2 Quick Engine Change Definition

- 2.2.1 The quick engine change concept developed for piston engines is defined as that part of the aircraft which is located forward of the nacelle firewall. The firewall serves as a distinct separation point for sub-system and engine mount bolt connections. The concept further defined by the QEC is built up as a separate entity on the assembly line and mated to the airplane as outlined on the manufacturing sequence flow chart. The ICBM rocket engines are not built up as separate entities on the assembly line. There are no distinct separation points comparable to the aircraft firewall. The engines as received from the engine manufacturer are installed on the missile tank and booster section. Thereafter the sub-system components, tubing, brackets and clamps are installed as required by the manufacturing sequence station and flow chart. No problems are anticipated in applying the QEC concept to the booster and sustainer engine system. The vernier engine system tubing will probably require some adjustment of attachment clamps to mate with the existing tubing on the tank section when changing an engine.

3.0 QEC REQUIREMENTS

3.1 Sustainer Engine QEC

The sustainer QEC consist of the NAA Engine P/N 100106 engine assembly, sustainer, plus the parts listed in Kit A and Kit B. The parts listed in Kit A may be installed on the NAA engine prior to installing the engine on the sustainer tank section. The parts listed in Kit B are required to connect the engine to the sustainer sub-systems. The NAA parts delivered with the sustainer engine as loose equipment should be replaced with the engine assembly at the 42 months cycle engine change.

NOTE

No engine mount bolts are required to attach the sustainer engine to the tank section thrust cone. The gimbal plate incorporates the clamping arrangement used for engine attachment. Reference Figure 1.

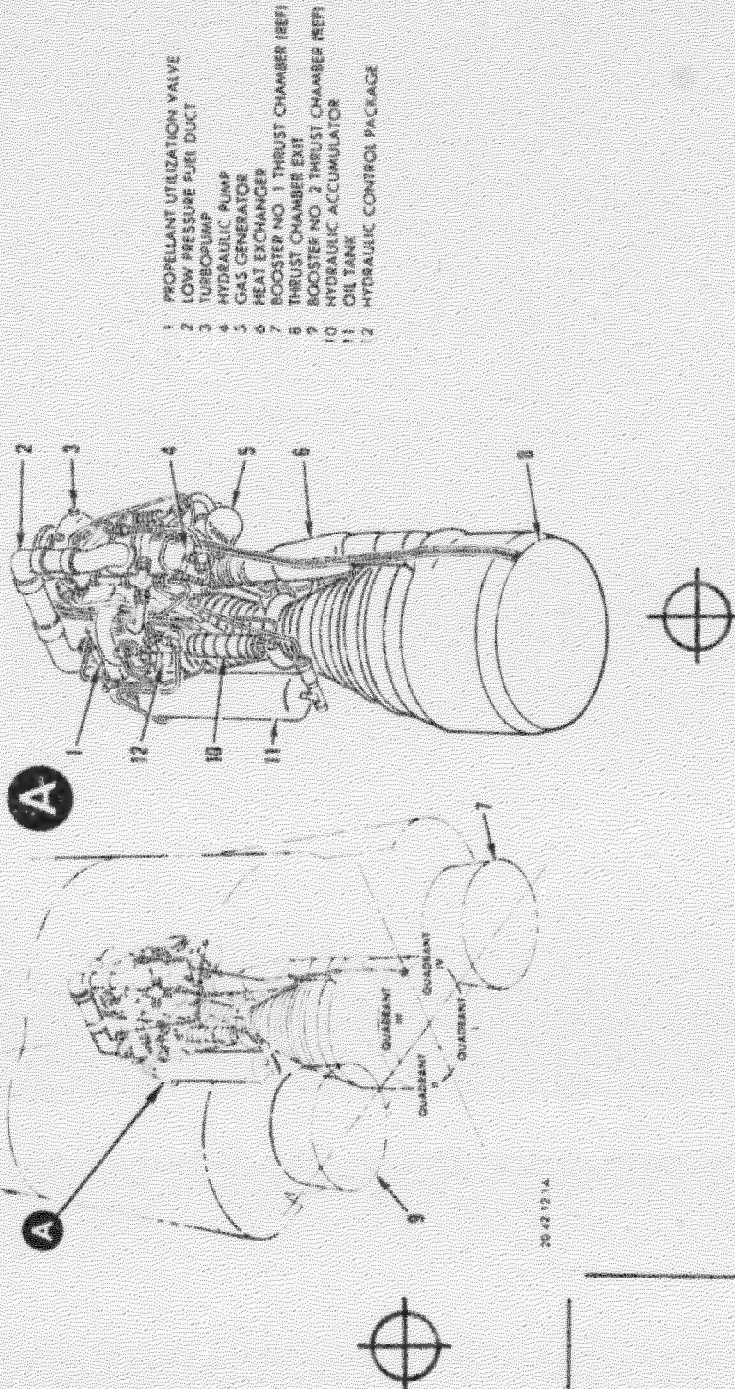


Figure 1. Sustainer Engine

3.1.1 Tools & Equipment Required For Sustainer QEC

<u>Qty</u>	<u>Part No.</u>	<u>Nomenclature</u>
1	4930-247-3669	Grease Gun
1	7829-42845	Wrench Torque
1	904496	Sling, Guided Missile Maintenance, Sustainer (G4010)
1	105332	Trailer, Transportation (Model 1210 Air Logistics Corp)
1	105986	Adapter, Sustainer And Vernier Engines (Model 2094 Air Logistics Corp)
1	106080	Mobil Tainer (Model 2900 Air Logistics Corp)
1	904101	Closure Assembly, Oxydizer And Fuel Pump Inlet, Sustainer
1	908230	Closure Assembly, Thrust Chamber Exit, Sustainer
1	908241	Cover, Thrust Chamber Skirt Sustainer
1	903505	Adapter Assembly, Dehydrator Plug, Sustainer
2	903504	Adapter Assembly, Dehydrator Plug, Sustainer
1	903501	Adapter, Dehydrator Plug, Helium (Inlet), Sustainer
1	903502	Adapter, Dehydrator Plug, Helium (Outlet), Sustainer
1	904505	Support, Sustainer Rocket Eng. (G4007)

3.1.2 Kit A

Parts Required For Sustainer Engine Build-Up

<u>Qty</u>	<u>Part No.</u>	<u>Nomenclature</u>	<u>Vendor Code</u>
1	27-85007-189	Tube	05342
1	27-85007-193	Tube	05342
1	27-85007-195	"	"
1	27-85007-197	"	"
1	27-85007-199	"	"
1	27-85007-201	"	"
1	27-85007-207	"	"
1	27-85007-413	"	"
1	27-85007-415	"	"
1	27-85007-417	"	"
1	27-80005-85	"	"
1	27-80005-87	"	"
1	27-85314-803	Servo Cyl. Assy.	"

3.1.2 Kit A (Con't)

<u>Qty</u>	<u>Part No.</u>	<u>Nomenclature</u>	<u>Vendor Code</u>
1	27-85314-805	Servo Cyl. Assy	05342
1	27-08590-1 (AA60401L2)	Pump	62983
1	27-08558-1 (K1216-2)	Check Valve	34199
1	27-08560-1 (K1247-10)	Check Valve	34199
1	27-08568-5 (12860)	Valve Assy	99643
2	27-85344-7	Tee	
1	AN832-10D	Union	
1	AN832-12D	Union	
1	AN919-15D	Reducer	
2	AN743-12	Bracket	
8	AN520-10R8	Screw	
1	AN520-10R20	Screw	
9	AN363-1032	Nut	
1	AN960D1416	Washer	
1	AN960D1716	Washer	
1	MS21919H6	Clamp	
2	MS21919H10	Clamp	
5	MS21919H12	Clamp	
1	MS21919H14	Clamp	
1	MS21919H16	Clamp	
2	MS21919H18	Clamp	
1	AN6291-10	Ring	
1	AN6291-12	Ring	
1	AN6289D10	Nut	
1	AN6289D12	Nut	
1	101106	Engine Assembly Sustainer	43999
1	301901	Valve Assy	"
1	551720	Control Assy	"
1	304327	Oxydizer Start System Assy	"
1	301786	Tank Assy, Fuel Start & Vernier Feed	"
1	650334-21	Igniter Detector Assy	"
1	650580	Igniter Thrust Chamber	"
1	500220-11	Box Assy-Engine Relay	"
2	650183	Igniter Assy-Gas Gen.	43999

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3.1.3 Kit B.

Parts Required For Sustainer Engine Installation

<u>Qty</u>	<u>Part No.</u>	<u>Nomenclature</u>	<u>Vendor Code</u>
Liquid Oxygen System Installation Drawing No. 27-20201 "AJ"			
1	27-23518-1	Gasket	05342
3	AN 5-14A	Bolt	
5	AN 5-15A	Bolt	
8	AN 363-524	Nut	
8	AN 960-516	Washer	
Fuel System Installation Drawing No. 27-20200 "BB"			
1	27-23520-7	Gasket	05342
8	AN 5-14A	Bolt	
8	AN 363-524	Nut	
8	AN 960-516	Washer	

3.2 Vernier Engine QEC

The vernier engine QEC is made to suit the respective engine position, that is, No. 1 located between Quadrant III and Quadrant IV and No. 2 located between Quadrant I and Quadrant II.

The difference between the two configurations consist in the routing of the hydraulic and propulsion system tubing. The No. 1 engine tubing is routed to clear the main fuel tank drain boss. The No. 2 engine tubing is routed to clear the auxiliary power supply ducting. Major rework to the tubing installation would be required to make the two engines interchangeable. The NAA parts delivered with the vernier engines as loose equipment should be replaced with the engine assembly at the 42 months cycle engine change. The vernier QEC consist of the NAA engine P/N 350350 vernier engine assembly plus the parts called out in Kit C and Kit D. The kit parts may be installed on the NAA engine prior to or after the engine is installed on the missile. The parts listed in Kit E are required to attach the engine to the sustainer tank section. Figure 2, indicates the recommended engine mount disconnect points.

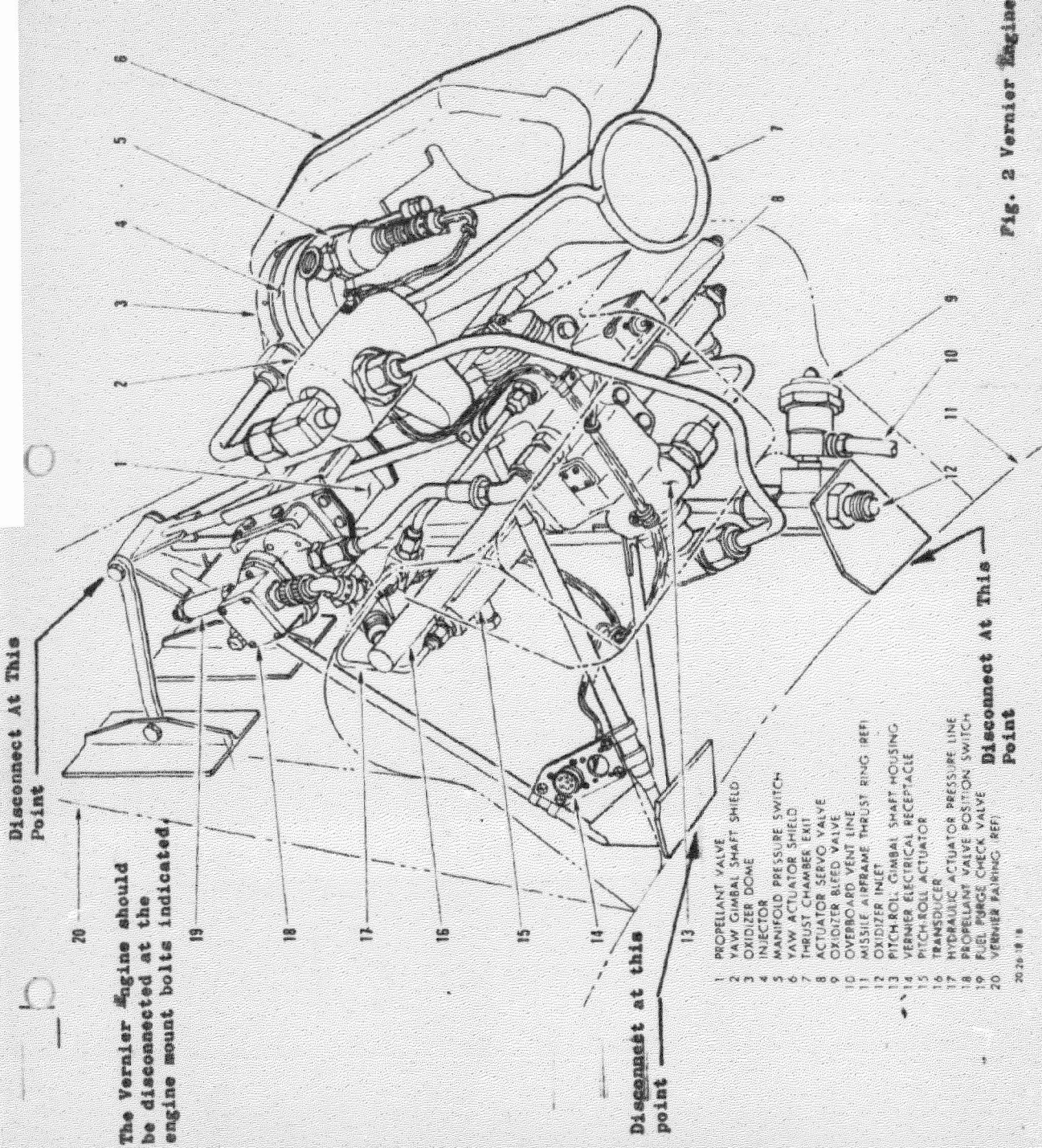


Fig. 2 Vernier Engine

3.2.1 Tools & Equipment Required For Vernier QEC

<u>Qty</u>	<u>Part No.</u>	<u>Nomenclature</u>
1	5120-595-9073	Torque Wrench
1	5120-221-7944	Torque Wrench
1	G4004 (HLU-11/E	Sling, Vernier Rocket
1	105986	Engine Lifting Adapter; Sustainer & Vernier Engine

3.2.2 Kit C.

Parts Required For Build Up Of Vernier Engine No. 1.
Located Between Quadrant III And Quadrant IV

<u>Qty</u>	<u>Part No.</u>	<u>Nomenclature</u>	<u>Vendor Code</u>
1	27-85017-7	Fairing Assy	05342
1	27-85321-1	Clip Assy	"
1	27-85321-3	Clip Assy	"
1	27-85321-13	Fairing Half	"
2	27-04206-1	Flowlimiter	"
4	7-08282	Shim	"
1	27-85311-5	Servocylinder Assy	"
1	27-85312-803	Servocylinder Assy	"
1	27-20400-133	Tube	"
1	27-20400-135	"	"
1	27-20400-153	Tube	"
1	27-20900-263	Tube	"
1	-267	"	"
1	-265	"	"
1	27-20900-269	"	"
1	27-85007-267	"	"
1	-269	"	"
1	-271	"	"
1	-273	"	"
1	-275	"	"
1	-277	"	"
1	-279	"	"
1	-281	"	"
1	27-85007-283	"	"
1	27-85007-285	Tube	"
1	-405	"	"
1	-407	"	"
1	-409	"	"
1	27-85328-1	Manifold	"

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3.2.2 Kit C. (Con't)

Qty	Part No.	Nomenclature	Vendor Code
1	27-22116-7	Tee	05342
1	27-02111-1	Check Valve	"
1	27-08564-5	Filter	"
1	27-85342-7	Tee	"
1	27-85337-7	Cross	"
4	27-85324-7	Washer	"
1	AN815-4	Union	
7	AN815-4 D	Union	
1	AN804D4	Tee BHD	
1	AN919-6D	Reducer	
1	AN6289D4	Nut	
1	AN6291-4	Ring	
10	86-10900-006	Packing	
1	86-10900-007	Packing	
7	MS21919H4	Clamp	
3	MS21919H8	Clamp	
1	MS21919H14	Clamp	
1	MS21919H16	Clamp	
1	MS21919H18	Clamp	
1	AN743-12	Bracket	
3	AN3-6A	Bolt	
4	AN173-5A	Bolt	
1	AN173-10A	Bolt	
2	AN173-11A	Bolt	
5	AN520-10R8	Screw	
3	AN520-10R12	Screw	
1	AN520-10R20	Screw	
4	AN509-10R11	Screw	
4	AN509-10R13	Screw	
20	AN363-1032	Nut	
3	AN960-10L	Washer	
4	AN960-10	Washer	
1	AN960D716	Washer	
3	NAS43DP3-18	Spacer	
1	NAS43D08-48	Spacer	
1	380350	Vernier Engine Assy	43999
1	650291	Igniter Assy	43999
1	650277	Cable Assy	43999

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3.2.3 Kit D

Parts Required For Build Up of Vernier Engine No. 2
Located between Quadrant I and Quadrant II

Qty	Part No.	Nomenclature	Vendor Code
1	27-85017-7	Fairing Assy	05342
1	27-85321-1	Clip Assy	"
1	27-85321-3	Clip Assy	"
1	27-85321-13	Fairing Half	"
2	27-04206-1	Flowlimiter	"
4	7-08282	Shim	"
1	27-85311-5	Servocylinder Assy	"
1	27-85312-803	Servocylinder Assy	"
1	27-20400-143	Tube	"
1	" -145	"	"
1	" -133	"	"
1	27-20900-263	"	"
1	" -259	"	"
1	" -261	"	"
1	27-85007-269	"	"
1	" -271	"	"
1	" -273	"	"
1	" -275	"	"
1	" -277	"	"
1	" -279	"	"
1	" -281	"	"
1	" -283	"	"
1	" -285	"	"
1	" -287	"	"
1	" -289	"	"
1	27-85328-1	Manifold	"
1	27-22116-1	Tee	"
1	27-02111-1	Check Valve	"
1	27-85337-7	Cross	"
1	27-08564-5	Filter	"
1	27-85342-7	Tee	"
4	27-85324-7	Washer	"
1	AN815-4	Union	"
9	AN815-4D	Union	"
1	AN804-D4	Tee BHO	"
1	AN919-6D	Reducer	"
1	AN6289D4	Nut	"
1	AN6291-4	Ring	"
10	86-10900-006	Packing	"
1	86-10900-007	Packing	"
5	MS21919H4	Clamp	"
3	MS21919H8	Clamp	"
1	M S21919H16	Clamp	"

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3.2.3 Kit D (Con't)

Qty	Part No.	Nomenclature	Vendor Code
1	MS21919H18	Clamp	
1	AN743-12	Bracket	
3	AN3-6A	Bolt	
4	AN173-5A	Bolt	
1	AN173-10A	Bolt	
2	AN173-11A	Bolt	
6	AN520-10R8	Screw	
1	AN520-10R24	Screw	
4	AN509-10R11	Screw	
4	AN509-10R13	Screw	
18	AN363-1032	Nut	
3	AN960-10L	Washer	
4	AN960-10	Washer	
1	AN960D716	Washer	
3	NAS43DD3-16	Spacer	
1	NAS43DD3-64	Spacer	
1	350350	Vernier Eng. Assy	43999
1	650291	Igniter Assy	43999
1	650277	Cable Assy	43999

3.2.4 Kit E

Parts Required For Vernier Engine Installation (Ref. Dwg No. 27-22107)

Qty/Dash No.	Part No.	Nomenclature	Vendor Code
-3 -5 -801			
2	1	AN6-32A	Bolt
	1	AN6-25A	Bolt
4	4	MS20004-8	Bolt
2	2	AN365-624	Nut
4	4	96-37525-003	Nut
6	6	AN960-416	Washer
	1	AN6-34A	Bolt
		Effectivity	
	-3	(59D and on	
	-5	(33D)	
	-801	(34D thru 58D)	

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3.3 Booster Engine QEC

The booster engine QEC consist of NAA P/N 100142 engine assembly, booster. This includes P/N 200351 thrust chamber assembly- Number I, P/N 200352 thrust chamber assembly- Number II, No number power package, engine. The power package, engine consist of the following installations:

<u>Dwg No.</u>	<u>Nomenclature</u>
300454	Exhaust System Installation
550321	Lube System Installation
550320	Electrical and Pneumatic System Installation
300453	Gas Generator System Installation
431002	Turbo Pump Installation

The booster section hydraulic pump P/N 27-08566-1 may be installed on the turbo pump accessory drive pad prior to installing the turbo pump in the jettisonable section. The parts delivered with the booster engine assembly as loose equipment should be replaced with the engine assembly at the 42 months cycle engine change.

Assuming the missile is demated, nacelles and fire-shield removed, the following general procedure may be used to R/R a booster engine installation:

1. Propellant lines, (LO₂ & fuel lines from each turbo pump to each thrust chamber) removed.
2. Exhaust nozzle mounting bolts removed.
3. Main propellant supply lines disconnected.
4. a) Power package handling fixture installed.
b) Power package removed.
5. "New" hydraulic pump installed on "New" power package.
6. Servo cylinders removed.
7. a) Thrust chamber handling fixture installed
b) Thrust chamber removed.

Installation is the reverse procedure of removal.

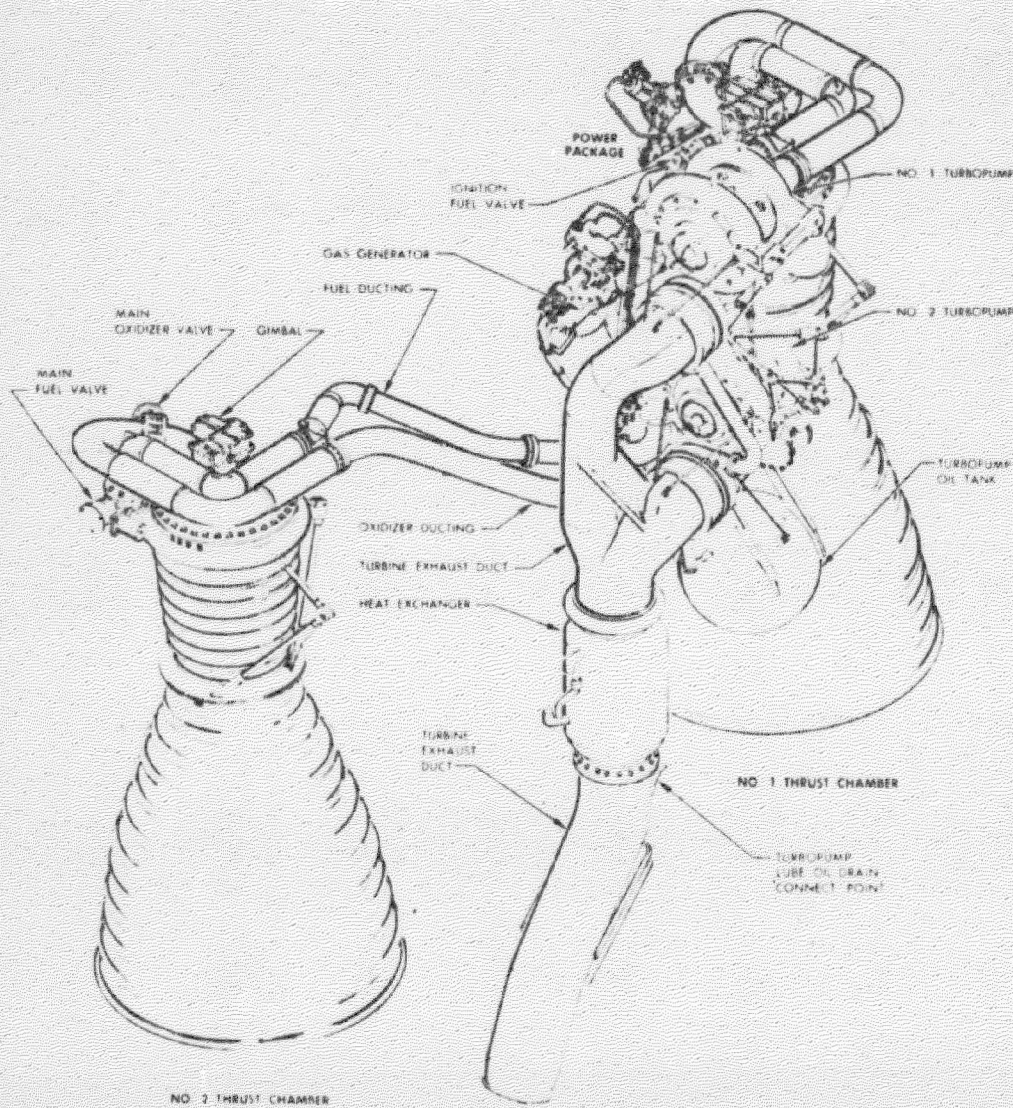


Figure 3. Booster Engine



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3.3.1 Tools & Equipment Required For Booster Engine Change

3.3.1.1 Booster Thrust Chambers

<u>Qty</u>	<u>Part No.</u>	<u>Nomenclature</u>
2	Model 1210	Trailer (Air Logistics)
2	105985	Adapter
2	G4008	Support Rocket Engine Thrust Chamber
1	27-23100-501	Sling Rocket Engine Thrust Chamber
1	27-51062-1	Thrust Chamber Alignment Fixture
2	902905	Closure-Thrust Chamber Exit
2	904226	Closure-Oxidizer & Fuel Pump Inlet
2	904227	Closure-Thrust Chamber Fuel Inlet
2	904228	Closure-Thrust Chamber LO ₂ Inlet

3.3.1.2 Turbo Pumps

<u>Qty</u>	<u>Part No.</u>	<u>Nomenclature</u>
1	Model 1210	Trailer (Air Logistics)
1	105983	Adapter
1	G4009	Sling Assy-Booster
1	904230-21	Closure Turbine Exhaust
1	905740	Closure-Turbine Exhaust

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3.3.2 Kit F.

Parts required for booster engine installation in the booster structure. No build up is required.

Qty	Part No.	Nomenclature	Vendor Code
1	100142	Engine Assy-Booster	43999
1	200351	Thrust Chamber Assy #1	"
1	200352	Thrust Chamber Assy #2	"
1	400027	Duct Assy	"
1	400035	Duct Assy	"
1	9529-48017	Duct Assy	"
1	9529-48022	Duct Assy	"
1	305385	Nozzle	"
3	MS29513-239	Packing	-
2	R4-9J	Gasket	43999
1	MS29513-242	Packing	-
38	MS20004-20	Bolt	-
10	MS20004-24	Bolt	-
5	MS20004-22	Bolt	-
59	MS20004-18	Bolt	-
133	NAS679A4W	Nut	-
133	MS20002C4	Washer	-
84	2W18-416	Washer	-
1	10-2755-1-	Gasket	43999
	PNA		
82	2W17-416	Washer	-
16	MS20004-16	Bolt	-
6	MS20004-6	Bolt	-
53	2W18-416M	Washer	-
1	2-2753-1-	Gasket	43999
	PNA		
20	0428AK10	Nut	"
20	5B30-416-	Bolt	"
	12A		
20	2W12-4	Washer	"
4	MS20006-38	Bolt	-
4	MS20002C6	Washer	-
4	MS20002-6	Washer	-
4	NAS679-A6	Nut	-
1	MS20010H18	Bolt	-
2	MS20002C10	Washer	-
4	AN960-1016L	Washer	-
1	MS20010H10	Bolt	-

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33.2 Kit F. (Con't)

Qty	Part No.	Nomenclature	Vendor Code
1	MS20002-10	Washer	-
2	AN7C-36A	Bolt	-
4	AN950-7	Washer	-
4	AN955-7	Washer	-
2	AN363C720	Nut	-
2	AN310C7	Nut	-
2	AN380-3-4	Cotter Pin	-
2	AN7C-36	Bolt	-
1	27-08566-1	Pump	05342
1	AN4047-1	Gasket	-
6	AN960-616	Washer	-
6	AN363-624	Nut	-
4	27-08550-5	Servocylinder	05342
8	AN320-9	Nut	-
8	AN380-4-4	Cotter Pin	-
8	AN960-916	Washer	-
8	AN960-916L	Washer	-
4	NAS464P9-21	Bolt	-
4	NAS464P9-29	Bolt	-
1	400566	Valve Assy-Booster	43999
		Half-disconnect fuel	
1	400565	Valve Assy-Sustainer	"
		Half disconnect fuel	
1	400857	Valve-Assy-Booster	"
		Half disconnect LO ₂	
1	401310	Valve Assy-Sustainer	"
		Half disconnect LO ₂	
2	650334-21	Igniter detector assy	"
2	650183	Igniter Assy-Gas Generator	"
2	650580	Igniter Assy-Thrust Chamber	"

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3.4 Propulsion Section Installation-Jettisonable

The jettisonable propulsion section less the booster engine instl. 27-23100-801 consist of the assemblies and installations listed in Kit G. This assembly is not presently identified by a part number.

It is not considered feasible to procure jettisonable sections that require build up in the field because the tasks involved are incompatible with the Atlas Weapons System program. Build up of jettisonable sections to the Kit G. configuration requires manufacturing capabilities that are not available at the airforce installations.

3.4.1 Tools And Equipment Required For Manufacture of Propulsion Section Installation-Jettisonable.

<u>Qty</u>	<u>Part No.</u>	<u>Nomenclature</u>
1	27-20201-501	LOFX (LO ₂ Nozzle Alignment)
1	27-80012-501	APEX (Staging Panel Alignment)
1	27-23204-B/N	LOFX (Fuel Nozzle Alignment)

NOTE

These tools are used for positioning the liquid oxygen line, fuel line and the staging disconnect panels during assembly of the propulsion section on the assembly line at Convair Astronautics. The tools are not available at the Squadron Maintenance Area.

3.4.2 Kit G.

Manufactured Kit Configuration of Propulsion Section Instl-Jettisonable Less The 27-23100-801 Booster Engine Instl.

<u>Qty</u>	<u>Part No.</u>	<u>Nomenclature</u>
1	27-78001-861	Structure Assy-Booster Section
1	27-60006-807	Harness Instl-Thrust Section
1	27-85000-875	General Arrangement-Hydraulic System
1	27-23117-801	RCC Instl-Booster & Sustainer Engines
1	27-23111-1	Support Instl
1	27-62001-1	Lanyard Instl-Staging Autopilot
1	27-62003-1	Stop Screw
1	27-11010-1	Gen. Arrangement-Inst Provision

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3.4.2 Kit G. (Con't)

<u>Qty</u>	<u>Part No.</u>	<u>Nomenclature</u>
1	27-77104-3	Shroud Instl
1	27-45400-825	Separation Instl-First Stage
1	27-80000-907	Gen. Arrangement-Pressurization Pneumatics
1	27-20900-815	Line Instl-Purge & Water Trichlor Flush System
1	27-20901-807	Vent & Drain System Instl Pro- pulsion
1	27-20902-809	Line Instl-Pressure SW CHK out
1	27-20201-847	Liquid Oxygen System Inst.
1	27-20400-811	Control System Instl. Propulsion

3.4.3 Kit H.

Parts Required For Installation of the 27-04303-3 Valve
Assy in the First Stage Separation Instl. Part Number
27-45400-801

<u>Qty</u>	<u>Part No.</u>	<u>Nomenclature</u>
1	27-04304-3	Valve Assy
4	MS29513-14	Gasket
4	AN315DD4R7	Screw
4	AN365DD440	Nut
4	MS20365-D1032	Nut

NOTE

P/N 27-04304-3 valve is not delivered with the jettisonable
section. This valve should be installed immediately prior
to shipping the missile from the SMA to the launcher.

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4.0 Summary of Findings

4.1.1 All of the following requirements must be fulfilled to obtain the capability of supporting the QEC concept:

- 4.1.1.1 Parts to support the engine changes must be available to the using organization. Kits called out in this report would fulfill this requirement.
- 4.1.1.2 Personnel must be trained to accomplish the tasks involved. Teams should be trained specifically for this task.
- 4.1.1.3 Adequate working area must be available. Squadron Maintenance Areas are inherently adequate.
- 4.1.1.4 Adequate technical instructions must be available. Currently programmed Technical Orders are not oriented specifically to support a QEC concept. Additional tech. data would be required.
- 4.1.1.5 All tools and test equipment required to accomplish the task must be available. Currently provisioned tools and test equipment appear inherently adequate.
- 4.1.1.6 Time to accomplish the task must be available. This is an unknown factor because it depends upon the operational situation.
- 4.1.1.7 Table 1 illustrates the current Air Force QEC inherent capabilities versus program requirements.

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	1. QEC Kits	2. QEC Teams	3. Facili- ties	4. Tech Data	5. Tools & Test Equip.	6. Man- Hrs.
Sustainer-Kit A	X	X	✓	X	✓	?
Sustainer-Kit B	X	X	✓	X	✓	?
Vernier #1-Kit C	X	X	✓	X	✓	?
Vernier #1-Kit E	X	X	✓	X	✓	?
Vernier #2-Kit D	X	X	✓	X	✓	?
Vernier #2-Kit E	X	X	✓	X	✓	?
Booster Eng. Kit F	X	X	✓	X	✓	?
Jettisonable Sect. -Kit G	X	X	✓	X	X	?
Jettisonable Sect. -Kit H	X	X	✓	X	✓	?

X - Requirement
✓ - Capability in being
? - Unknown

TABLE 1.

4.1.1.8 Current program planning indicates a six (6) month recycle of each missile to the SMA for periodic inspection and a forty two (42) month recycle of each engine thru a depot and/or contractors facility. Currently there are twenty one (21) calendar days "turn around" time available for the missile and engines at the SMA

NAA programming information indicates that thirty seven (37) working days or 53 calendar days are required to recycle the engine cluster through their facility. The engine cluster consist of one booster engine, one sustainer engine and two vernier engines. The recycle periods and times for both missile and engines are subject to change when the air force and contractors accumulate additional substantiating information as basis for increasing the periods between recycles and decreasing the turn around time at the factory.

4.1.1.9 The QEC concept as outlined in this report is applicable to the Atlas Weapons. However, the practicality of implementing a QEC program is questionable.

Engine changes, in an operational situation, are not compatible with the requirements of the Logistics

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4.1.1.9 (Con't)

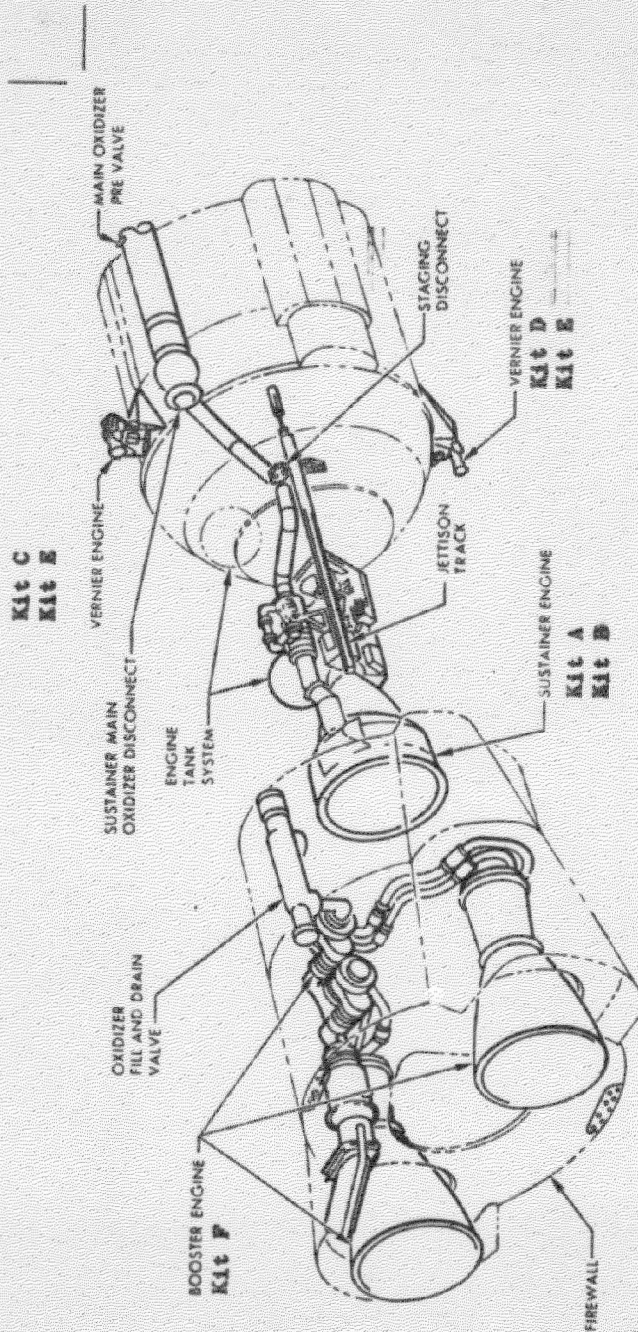
Management Code and Operational Data Summary, because the times involved are beyond programmed maintenance recovery times. Maintenance situations will presently dictate eng. changes at the 42 month re-cycle period.

5.0 Recommendations

- 3.1 That Convair be authorized to formulate a plan of implementation for a QEC program for SM65D and E series missiles. This plan would afford resolution of problem areas pointed out in this report that are additional tasks.

6.0 References

21-SM65D-1F-2-10	Rocket Propulsion System Functional Manual
21-SM65D-1J-2-11	Rocket Propulsion System Maintenance, Missile Maint. Area
Vol 1	Checkout & Trouble Shooting
Vol 2	Sustainer Engine Removal & Instl.
Vol 3	Vernier Engine Removal & Instl.
Vol 4	Component Removal & Installation
Vol 5	Servicing and Preventing Maint.
21-SM65D-2J-2-1	Booster Rocket Engine XLR89-NA-3 Maintenance
21-SM65D-2J-2-2	Vernier Rocket Engine XLR101-NA-3 Maintenance
21-SM65D-2J-2-3	Sustainer Rocket Engine XLR105-NA-3 Maintenance
21-SM65D-1J-2-1	Job Manual Missile Airframe Maint. (Booster Section R/R)
GMTR 0165-00110	Operational Data Summary
MCPTC:JEC:LAW	AMC BMO Letter Dated 8 April 1958
	Logistics Management Code For Spares And GSE End Items.
	TWX Dated 6-29-59 From E.B. Doll
	Stl to C.J. Dunn Convair Astronautics.
	TWX dated 2-1-60 from E.B. Doll stl to C. S. Ames Convair Astronautics.



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Figure 4. Engine Installation