

AD-A094 442

GENERAL MOTORS CORP INDIANAPOLIS IN DETROIT DIESEL A--ETC F/G 21/5
ALLISON PD370-41 DERIVATIVE TURBOPROP ENGINE.(U)

FEB 79 P STOLP

DDAD-EDR-9776A

N62269-78-C-0415

UNCLASSIFIED

NADC-80181-D-60

NL

1 of 1
AL
SCHALL

END
DATE
FILMED
2-81
DTIC

AD A094442

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

19 REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NADC-80181-D-60	2. GOVT ACCESSION NO. AD-A094 442	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Maritime Patrol Aircraft (MPA) Concept Formulation, Allison PD370-41 Derivative Turboprop Engine, 14 DDA		5. TYPE OF REPORT & PERIOD COVERED Final Report, Oct 1978 - Feb 1979,
7. AUTHOR(s) P./Stolp		8. PERFORMING ORG. REPORT NUMBER EDR-9776A
9. PERFORMING ORGANIZATION NAME AND ADDRESS Detroit Diesel Allison Division of General Motors Corporation, Box 894 Indianapolis, IN 46206		9. CONTRACT OR GRANT NUMBER(s) N62269-78-C-0415
11. CONTROLLING OFFICE NAME AND ADDRESS Naval Air Development Center Warminster, PA 18974		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 65152N A03P-03PA/001E/780880 001 Work Unit XM201
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE Feb 1979
		13. NUMBER OF PAGES 35
		15. SECURITY CLASS. (of this report) UNCLASSIFIED
16. DISTRIBUTION STATEMENT (of this Report) APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Aircraft Propulsion Turbofan Engine Derivative Engine Turboshift Engine Maritime Patrol Aircraft Turboprop Engine		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This study developed data on Detroit Diesel Allison (DDA) common core derivative engines for use in Maritime Patrol Aircraft (MPA) concept formulation studies. The study included the screening of potential DDA turboprop/turboshift engines and the preparation of technical and planning information on three of the most promising engine candidates plus an all new engine. Screening of DDA derivative candidates was performed utilizing an analytical MPA model using synthesized mission profiles to rank the candidates in terms		

DD FORM 1473
1 JAN 73EDITION OF 1 NOV 65 IS OBSOLETE
S/N 0102-LF-014-6601

UNCLASSIFIED

019200

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

of fuel consumption, weight, cost and complexity. The three turboprop engines selected for further study were as follows: a derivative of the unity size T701-AD-700 shaft power engine with rematched turbine (PD 370-37), an advanced T701 turboprop derivative with 25:1 overall pressure ratio and a scaled ATEGG demonstrated compressor (PD 370-40), an advanced T701 turboprop derivative with 17.7:1 overall pressure ratio and a scaled ATEGG demonstrated compressor (PD 370-41). Data is also presented on a new advanced turboprop engine with 30:1 overall pressure ratio which incorporates compressor, combustor, turbine, and cooling technology now under development and demonstration at DDA. The documentation consists of six separate reports prepared in the following manner. One report summarizes the engine screening analysis and describes the approach to, and the conclusions of the study. A separate report for each of the three derivative engines and for the new turboprop present estimates of performance, weight, and dimensional data. The engineering budgetary estimates of the development, acquisition, and service costs for each of the four engines are presented in a separate report.

Accession For	
NTIS GRA&I	☒
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution/	
Availability Codes	
and/or	
Special	
A	

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)



Detroit Diesel Allison
Division of General Motors Corporation
Indianapolis, Indiana 46206

TABLE OF CONTENTS

	<u>Page</u>
I. INTRODUCTION-----	1
II. ENGINE DESCRIPTION-----	2
III. WEIGHTS-----	6
IV. STEADY STATE PERFORMANCE-----	7



Detroit Diesel Allison
Division of General Motors Corporation
Indianapolis, Indiana 46206

REVISIONS

<u>Letter</u>	<u>Page</u>	<u>Revision</u>
A	4	Gearbox and total weight
A	6	Gearbox, interconnecting struts and shaft, and total weight
A	10	Additional matrix points at 0 and 25,000 feet
A	13	Additional performance
A	18	Additional performance
A	23	Additional performance
A	28	Additional performance



Detroit Diesel Allison
Division of General Motors Corporation

Indianapolis, Indiana 46206

I. INTRODUCTION

This report presents estimates of performance, weight, and dimensional data for the PD 370-41 turboprop engine. The PD 370-41 represents an advanced T701 turboprop derivative engine with 17.7:1 overall pressure ratio. It incorporates a scaled ATEGG demonstrated compressor with basic shaft, bearing and turbine arrangements from the new T701 turboshaft engine. The engine is in the 10,000 to 11,000 SHP class. The data is submitted for use in preliminary design type studies in the evaluation of turboprop systems.

The basic T701 engine is a free turbine turboshaft engine that was developed through safety demonstration testing, for the U.S. Army's HLE program. The model 570, a commercial industrial version of the T701, has undergone additional development testing, and is now in production.

The reduction gearbox for speed reduction to the prop-fan is a new simplified design, compared to the DDA T56 series of gearboxes. The new design is based upon a study into the reliability and maintenance cost history of past turboprop systems, and follows the recommendations of that study for a gearbox with high reliability, easy maintainability, and low maintenance costs.



Detroit Diesel Allison

Division of General Motors Corporation

Indianapolis, Indiana 46206

II. ENGINE DESCRIPTION

The Model PD 370-41 is an axial flow engine, having a single spool core and a free power turbine connected by shafting, and supporting structure to an offset reduction gear assembly. The general arrangement and external features of the engine are shown in Figure II-1, with principle physical characteristics listed in Table II-I. Output speed of the engine is constant at 10,600 RPM. The reduction gearbox shown in Figure II-1 has an overall gear ratio of 8.52:1, providing a propfan speed of 1244 rpm at 10,600 engine rpm. Parametric weight data is shown in Section III so that other propfan rotational speeds, and gear ratios can be analyzed. An aircraft accessory drive pad is provided on the back of the gearbox to drive an aircraft mounted accessory drive box. Power available at this pad is 500 HP at 8000 rpm. The primary engine mounts are on the gearbox with a hang mount at the rear of the engine. Engine accessories are driven by a bevel drive from the high pressure spool. The control system is integral with the prop-fan and is digital electronic. The oil system is integral to the engine and also supplies the prop-fan and reduction gearbox, but is separately filtered and monitored to isolate fault detection in each of these major modules. Engine torque is measured hydraulically from the gear thrust of the power train idler gears in the reduction gearbox.

The gearbox is shown offset, based upon DDA's experience with large turbo-prop engines. It is offset up to be consistent with current studies showing a preference to under-the-wing engine mounting. It can also be supplied in the offset-down position.

Performance ratings, sea level static, are listed in Table II-II.



Detroit Diesel Allison
Division of General Motors Corporation
Indianapolis, Indiana 46206

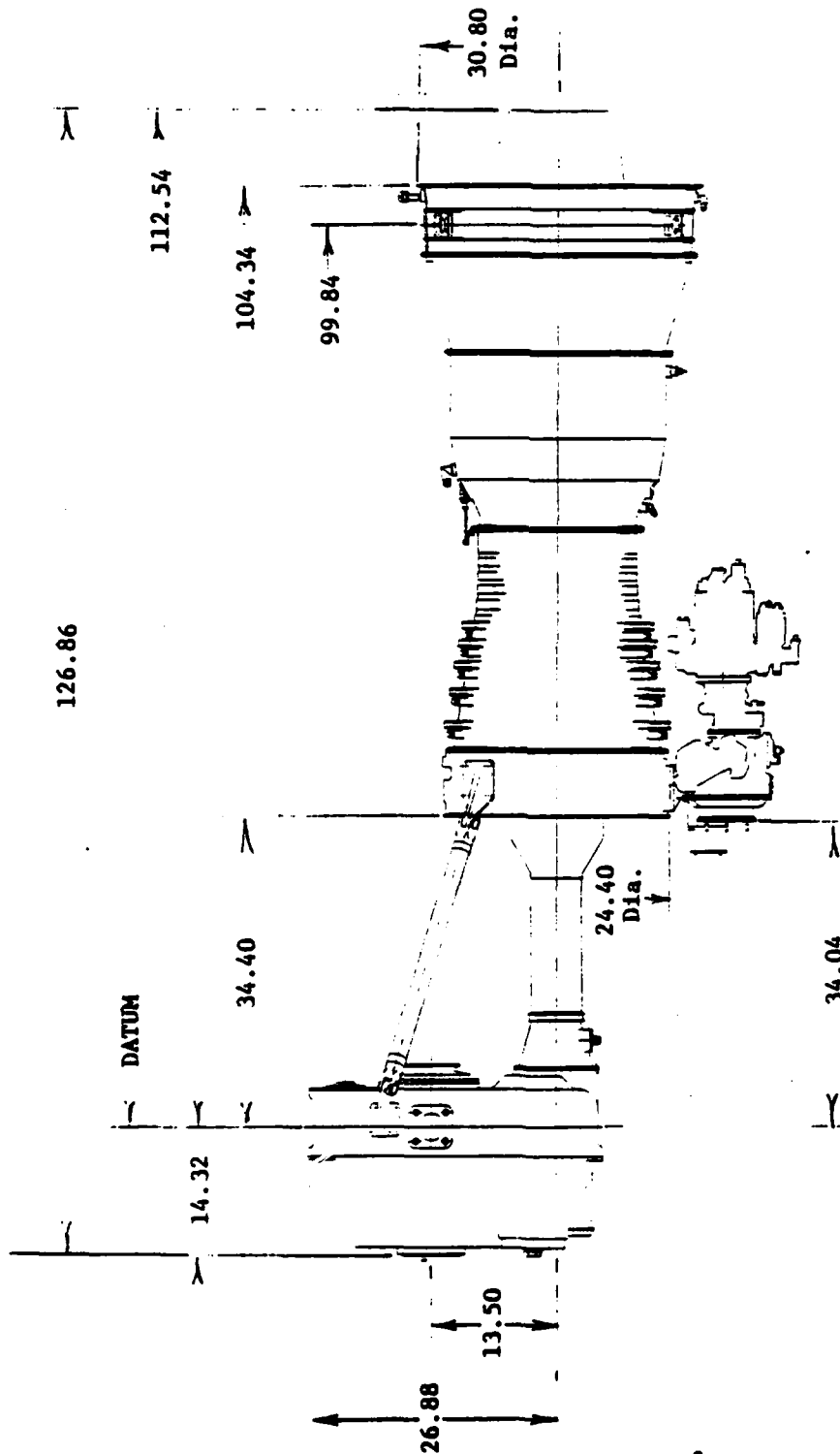


Figure II-1. PD370-41 General Arrangement



Detroit Diesel Allison
Division of General Motors Corporation
Indianapolis, Indiana 46206

TABLE II-I

PD 370-41 PHYSICAL CHARACTERISTICS

(Includes Gearbox)

Length (in)	126.86
Max. Engine Diameter (in)	30.80
Max. Gearbox Offset, upward (in)	26.88
Dry Weight, lbs	
Engine	1503
Gearbox, including interconnecting struts and shaft	634
Total	2137

For gear ratios other than 8.52:1 the reduction gearbox dimensions may be scaled as follows:

$$\text{Dimensions} = \text{Base dim.} \times \left(\frac{\text{GR}}{8.52} \right)^{0.33}$$



Detroit Diesel Allison
Division of General Motors Corporation

Indianapolis, Indiana 46206

TABLE II-II

PD370-41 PERFORMANCE SUMMARY

Sea Level, 0 kts

	<u>Standard Day</u>			<u>Hot Day, 89.8°F</u>		
	SHP	SFC	F _N	SHP	SFC	F _N
Take-Off	10,974	0.389	1,247	9,114	0.407	997
Max. Continuous	8,133	0.409	908	6,713	0.432	738



Detroit Diesel Allison

Division of General Motors Corporation

Indianapolis, Indiana 46206

III. WEIGHTS

The weight of the engine, gearbox, and the interconnecting struts and shaft are given in Table III-I. The gearbox weight is based upon a gear ratio of 8.52:1 which provides a propfan speed of 1244 rpm.

TABLE III-I

PD 370-41 WEIGHTS

	<u>Dry</u>	<u>Wet</u> [*]	<u>Installed</u>
Basic Engine, lbs	1503	1526	1526
Gearbox, lbs	598	641	641
Interconnecting Struts and Shaft, lbs	36	36	36
Total, lbs	2137	2203	2203

* Includes total amount of oil required for engine and gearbox operation.

For gear ratios other than 8.52:1, the gearbox, interconnecting strut, and shaft dry weight may be estimated as follows:

$$\text{Dry gearbox weight} = 598 \times \left(\frac{\text{GR}}{8.52} \right)^{0.4}$$

Interconnecting struts and shaft weight = 6.0% of dry gearbox weight



Detroit Diesel Allison

Division of General Motors Corporation

Indianapolis, Indiana 46206

IV. STEADY STATE PERFORMANCE

Steady state performance data is tabulated in this section for all points shown in Figure IV-1. Basic engine data is shown for the following assumptions:

- o Uninstalled engine
- o ICAO standard atmosphere except for takeoff which in addition includes an ambient temperature of 89.8°F at standard atmosphere
- o 100% inlet recovery
- o Zero accessory horsepower extraction
- o Zero customer bleed extraction
- o Zero losses due to reduction gear
- o Fuel heating value - 18,400 Btu/lb
- o Estimated average engine performance - No SHP or fuel flow guarantee factors

Sensitivity data is provided for each point so that bleed and duct losses may be estimated as required.

Nomenclature

Nomenclature used in the tabulation of performance is as follows:

MACH	Mach number
SHP	Shaft horsepower
SFC	Specific fuel consumption, lbs/hr/hp
WF	Engine fuel flow, lbs/hr
FN	Net jet thrust, lbs (jet gross thrust - ram drag)
ESHP	Equivalent shaft horsepower (energy in jet stream converted ideally to horsepower and added to SHP)
WCIN	Total inlet corrected airflow, $W\sqrt{\theta_1}/\delta_1$

where: $\theta_1 = \frac{\text{Engine inlet total temp, } ^\circ\text{R}}{518.688}$



Detroit Diesel Allison
Division of General Motors Corporation
Indianapolis, Indiana 46206

$$\delta_1 = \frac{\text{Engine inlet total pressure, psi}}{14.696}$$

TNOZ Jet nozzle total temperature, °R
PNOZ Jet nozzle total pressure, psi
RC Compressor pressure ratio
BOT Burner outlet temperature, °R
NO Point number

Sensitivity Data

Bleed:

$$\text{SHP, with bleed} = \text{SHP, no bleed} - (\text{DEL SHP})(\% \text{ bleed})$$

$$\text{WF, with bleed} = \text{WF, no bleed} - (\text{DEL WF})(\% \text{ bleed})$$

$$\text{FN, with bleed} = \text{FN, no bleed} - (\text{DEL FN})(\% \text{ bleed})$$

Inlet Recovery:

$$\eta_R = \text{Total pressure actual} / \text{Total pressure ideal}$$

$$\text{SHP, with recovery} = \text{SHP, ideal recovery} - (\text{DEL SHP})(1 - \eta_R)(100)$$

$$\text{WF, with recovery} = \text{WF, ideal recovery} (\eta_R)$$

$$\text{FN, with recovery} = \text{FN, ideal recovery} - (\text{DEL FN})(1 - \eta_R)(100)$$

Jet Nozzle Duct Loss:

To estimate thrust loss due to additional duct loss prior to the jet nozzle, use the following equation:

$$\text{FN, with loss} = \text{FN, without loss} - \text{FN, without loss} (K) \left(\frac{\Delta P}{P} \right)$$

where,

o K is obtained for each point from sensitivity data

$$o \frac{\Delta P}{P} = \frac{\text{PTOT, no loss} - \text{PTOT, total loss}}{\text{PTOT, no loss}}$$



Detroit Diesel Allison
Division of General Motors Corporation

Indianapolis, Indiana 46206

Reduction Gear Loss:

Reduction gear is 99 percent efficient.

Accessory Drive Losses:

Accessory drive power extraction is directly from the accessory drive pad on the reduction gearbox. Reduce SHP to prop-fan by amount of accessory power extraction at each point.

Nozzle Throat Area

The effective nozzle throat area is constant for all conditions at 398.4 in².



Detroit Diesel Allison
Division of General Motors Corporation
Indianapolis, Indiana 46206

Standard and Hot Day; Takeoff and Maximum Continuous

Altitude (Ft $\times 10^{-3}$)	MACH Number			
	0	.1	.2	.3
0	X	X	X	X

Standard Day; Maximum Climb, Maximum Continuous and Part Power to Idle

Altitude (Ft $\times 10^{-3}$)	MACH Number							
	.2	.3	.4	.5	.6	.7	.75	.8
0	X	X	X	X	X	X	X	X
5	X	X	X	X	X			
10	X	X	X	X	X	X	X	X
15		X	X	X	X	X	X	X
20			X	X	X	X	X	X
25			X	X	X	X	X	X
30				X	X	X	X	X
35				X	X	X	X	X
40				X	X	X	X	X
45				X	X	X	X	X

Figure IV-1. Matrix of flight conditions for performance data

DETROIT DIESEL ALLISON DIVISION
ZERO BLEED
EDR 9776
PD370-41 TURBOPROP
100 PERCENT RECOVERY
STD DAY
GENERAL MOTORS CORPORATION
ZERO POWER EXTRACTION

POWER	MACH	SHP	SFC	WF	FN	ESHP	WCIN	TNOZ	PNOZ	RC	NO
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0

T AMBIENT - 89.8° F

0 FEET ALTITUDE

DETROIT DIESEL ALLISON DIVISION

EIR 9776

PD370-41 TURBOPROP

GENERAL MOTORS CORPORATION

SENSITIVITY DATA FOR BLEED, INLET RECOVERY, AND EXHAUST DUCT LOSS

0 FEET ALTITUDE

POWER	MACH	PER-SHP-INLET-BLEED-FN	PER-SHP-PER-BLEED-FN	PER-SHP-EXHAUST-BLEED-FN	K	NO
TO 1	0.0	170.5	27.1	36.3	4.61	0001
M.C.	0.0	170.5	27.1	36.3	4.61	0002
TO 1	0.1	170.5	27.1	36.3	5.33	0003
M.C.	0.1	170.5	27.1	36.3	5.33	0004
TO 1	0.2	170.5	27.1	36.3	6.41	0005
M.C.	0.2	170.5	27.1	36.3	6.41	0006
TO 1	0.3	170.5	27.1	36.3	9.04	0007
M.C.	0.3	170.5	27.1	36.3	9.04	0008

T AMBIENT = 89.8°

0 FEET ALTITUDE

POWER	MACH	PER-SHP-INLET-BLEED-FN	PER-SHP-PER-BLEED-FN	PER-SHP-EXHAUST-BLEED-FN	K	NO
TO 1	0.0	170.5	27.1	36.3	4.61	0009
M.C.	0.0	170.5	27.1	36.3	4.61	0010
TO 1	0.1	170.5	27.1	36.3	5.33	0011
M.C.	0.1	170.5	27.1	36.3	5.33	0012
TO 1	0.2	170.5	27.1	36.3	6.41	0013
M.C.	0.2	170.5	27.1	36.3	6.41	0014
TO 1	0.3	170.5	27.1	36.3	9.04	0015
M.C.	0.3	170.5	27.1	36.3	9.04	0016

GENERAL MOTORS CORPORATION
ZERO POWER EXTRACTION

EDR 9776
PD370-41 TURBOPROP
100 PERCENT RECOVERY

DETROIT DIESEL ALLISON DIVISION
ZERO BLEED

[illegible]

DETROIT DIESEL ALLISON DIVISION
EGR 9776
PD370-41 TURBOPROP
100 PERCENT RECOVERY
ZERO BLEED
ZERO POWER EXTRACTION
GENERAL MOTORS CORPORATION
STD DAY

[illegible]

DETROIT DIESEL ALLISON DIVISION

ZERO POWER EXTRACTION

100 PERCENT RECOVERY
STD DAY

ZERO BLEED

15000 FEET ALTITUDE

[illegible]

ZERO POWER EXTRACTION

EDR 9776
PC370-41 TURBOPROP

100 PERCENT RECOVERY

STD DAY

25000 FEET ALTITUDE

DETROIT DIESEL ALLISON DIVISION

ZERO OLEO

[illegible]

GENERAL MOTORS CORPORATION
ZERO POWER EXTRACTION

EDR 9776
PD370-41 TURBOPROP
100 PERCENT RECOVERY
SID DAY

DETROIT DIESEL ALLISON DIVISION
ZERO BLEED

[illegible]

0 FEET ALTITUDE

23

DETROIT DIESEL ALLISON DIVISION

EDR 9776

PD370-41 TURBOPROP

GENERAL MOTORS CORPORATION

SENSITIVITY DATA FOR BLEED, INLET RECOVERY, AND EXHAUST DUCT LOSS

5000 FEET ALTITUDE

POWER	MACH	PER-SHP-INLET-BLEED	DEL-SHP	PER-BLEED-BLEED	DEL-FR	K	NO
CLIMB M.C.	0.00	135.9	21.4	4.8	7.2	7.0	0050
	0.05	121.6	21.4	4.8	5.1	7.0	0051
	0.10	119.7	21.4	4.8	4.4	7.0	0052
	0.15	117.8	21.4	4.8	3.7	7.0	0053
	0.20	115.9	21.4	4.8	3.0	7.0	0054
	0.25	114.0	21.4	4.8	2.3	7.0	0055
	0.30	112.1	21.4	4.8	1.6	7.0	0056
	0.35	110.2	21.4	4.8	0.9	7.0	0057
	0.40	108.3	21.4	4.8	0.2	7.0	0058
	0.45	106.4	21.4	4.8	0.0	7.0	0059
	0.50	104.5	21.4	4.8	0.0	7.0	0060
	0.55	102.6	21.4	4.8	0.0	7.0	0061
	0.60	100.7	21.4	4.8	0.0	7.0	0062
	0.65	98.8	21.4	4.8	0.0	7.0	0063
	0.70	96.9	21.4	4.8	0.0	7.0	0064
	0.75	95.0	21.4	4.8	0.0	7.0	0065
	0.80	93.1	21.4	4.8	0.0	7.0	0066
	0.85	91.2	21.4	4.8	0.0	7.0	0067
	0.90	89.3	21.4	4.8	0.0	7.0	0068
	0.95	87.4	21.4	4.8	0.0	7.0	0069
	1.00	85.5	21.4	4.8	0.0	7.0	0070
	1.05	83.6	21.4	4.8	0.0	7.0	0071
	1.10	81.7	21.4	4.8	0.0	7.0	0072
	1.15	79.8	21.4	4.8	0.0	7.0	0073
	1.20	77.9	21.4	4.8	0.0	7.0	0074
	1.25	76.0	21.4	4.8	0.0	7.0	0075
	1.30	74.1	21.4	4.8	0.0	7.0	0076
	1.35	72.2	21.4	4.8	0.0	7.0	0077
	1.40	70.3	21.4	4.8	0.0	7.0	0078
	1.45	68.4	21.4	4.8	0.0	7.0	0079
	1.50	66.5	21.4	4.8	0.0	7.0	0080
	1.55	64.6	21.4	4.8	0.0	7.0	0081
	1.60	62.7	21.4	4.8	0.0	7.0	0082
	1.65	60.8	21.4	4.8	0.0	7.0	0083
	1.70	58.9	21.4	4.8	0.0	7.0	0084
	1.75	57.0	21.4	4.8	0.0	7.0	0085
	1.80	55.1	21.4	4.8	0.0	7.0	0086
	1.85	53.2	21.4	4.8	0.0	7.0	0087
	1.90	51.3	21.4	4.8	0.0	7.0	0088
	1.95	49.4	21.4	4.8	0.0	7.0	0089
	2.00	47.5	21.4	4.8	0.0	7.0	0090
	2.05	45.6	21.4	4.8	0.0	7.0	0091
	2.10	43.7	21.4	4.8	0.0	7.0	0092
	2.15	41.8	21.4	4.8	0.0	7.0	0093
	2.20	39.9	21.4	4.8	0.0	7.0	0094
	2.25	38.0	21.4	4.8	0.0	7.0	0095
	2.30	36.1	21.4	4.8	0.0	7.0	0096
	2.35	34.2	21.4	4.8	0.0	7.0	0097
	2.40	32.3	21.4	4.8	0.0	7.0	0098
	2.45	30.4	21.4	4.8	0.0	7.0	0099
	2.50	28.5	21.4	4.8	0.0	7.0	0100

GENERAL MOTORS CORPORATION

10000 FEET ALTITUDE

[illegible]

GENERAL MOTORS CORPORATION

SENSITIVITY DATA FOR BLEED, INLET RECOVERY, AND EXHAUST DUCT LOSS

15000 FEET ALTITUDE

[illegible]

GENERAL MOTORS CORPORATION

EDR 9776

PD370-41 TURBOPROP

DETROIT DIESEL ALLISON DIVISION

SENSITIVITY DATA FOR BLEED, INLET RECOVERY, AND EXHAUST DUCT LOSS

20000 FEET ALTITUDE

[illegible]

GENERAL MOTORS CORPORATION

SENSITIVITY DATA FOR BLEED, INLET RECOVERY, AND EXHAUST DUCT LOSS 25000 FEET ALTITUDE

28

DETROIT DIESEL ALLISON DIVISION

FDR 9776

P0370-41 TURBOPROP

GENERAL MOTORS CORPORATION

SENSITIVITY DATA FOR BLEED, INLET RECOVERY, AND EXHAUST DUCT LOSS

30000 FEET ALTITUDE

POWER	MACH	PER PCI INLET REC DEL SHP INLET DEL FR	PER PCI BLEED DEL SHP BLEED DEL FR	K	NO
CLIMB M.C.	0.50	62.7	2.2	94	78
	0.55	60.8	2.8	94	99
	0.60	59.2	3.6	94	00
	0.65	57.7	4.6	94	00
	0.70	56.3	5.7	94	00
	0.75	55.0	6.9	94	00
	0.80	53.7	8.2	94	00
	0.85	52.5	9.6	94	00
	0.90	51.3	11.0	94	00
	0.95	50.1	12.5	94	00
	1.00	48.9	14.0	94	00
	1.05	47.7	15.5	94	00
	1.10	46.5	17.0	94	00
	1.15	45.3	18.5	94	00
	1.20	44.1	20.0	94	00
	1.25	42.9	21.5	94	00
	1.30	41.7	23.0	94	00
	1.35	40.5	24.5	94	00
	1.40	39.3	26.0	94	00
	1.45	38.1	27.5	94	00
	1.50	36.9	29.0	94	00
	1.55	35.7	30.5	94	00
	1.60	34.5	32.0	94	00
	1.65	33.3	33.5	94	00
	1.70	32.1	35.0	94	00
	1.75	30.9	36.5	94	00
	1.80	29.7	38.0	94	00
	1.85	28.5	39.5	94	00
	1.90	27.3	41.0	94	00
	1.95	26.1	42.5	94	00
	2.00	24.9	44.0	94	00
	2.05	23.7	45.5	94	00
	2.10	22.5	47.0	94	00
	2.15	21.3	48.5	94	00
	2.20	20.1	50.0	94	00
	2.25	18.9	51.5	94	00
	2.30	17.7	53.0	94	00
	2.35	16.5	54.5	94	00
	2.40	15.3	56.0	94	00
	2.45	14.1	57.5	94	00
	2.50	12.9	59.0	94	00
	2.55	11.7	60.5	94	00
	2.60	10.5	62.0	94	00
	2.65	9.3	63.5	94	00
	2.70	8.1	65.0	94	00
	2.75	6.9	66.5	94	00
	2.80	5.7	68.0	94	00
	2.85	4.5	69.5	94	00
	2.90	3.3	71.0	94	00
	2.95	2.1	72.5	94	00
	3.00	0.9	74.0	94	00
	3.05	-0.3	75.5	94	00
	3.10	-1.5	77.0	94	00
	3.15	-2.7	78.5	94	00
	3.20	-3.9	80.0	94	00
	3.25	-5.1	81.5	94	00
	3.30	-6.3	83.0	94	00
	3.35	-7.5	84.5	94	00
	3.40	-8.7	86.0	94	00
	3.45	-9.9	87.5	94	00
	3.50	-11.1	89.0	94	00
	3.55	-12.3	90.5	94	00
	3.60	-13.5	92.0	94	00
	3.65	-14.7	93.5	94	00
	3.70	-15.9	95.0	94	00
	3.75	-17.1	96.5	94	00
	3.80	-18.3	98.0	94	00
	3.85	-19.5	99.5	94	00
	3.90	-20.7	101.0	94	00
	3.95	-21.9	102.5	94	00
	4.00	-23.1	104.0	94	00
	4.05	-24.3	105.5	94	00
	4.10	-25.5	107.0	94	00
	4.15	-26.7	108.5	94	00
	4.20	-27.9	110.0	94	00
	4.25	-29.1	111.5	94	00
	4.30	-30.3	113.0	94	00
	4.35	-31.5	114.5	94	00
	4.40	-32.7	116.0	94	00
	4.45	-33.9	117.5	94	00
	4.50	-35.1	119.0	94	00
	4.55	-36.3	120.5	94	00
	4.60	-37.5	122.0	94	00
	4.65	-38.7	123.5	94	00
	4.70	-39.9	125.0	94	00
	4.75	-41.1	126.5	94	00
	4.80	-42.3	128.0	94	00
	4.85	-43.5	129.5	94	00
	4.90	-44.7	131.0	94	00
	4.95	-45.9	132.5	94	00
	5.00	-47.1	134.0	94	00
	5.05	-48.3	135.5	94	00
	5.10	-49.5	137.0	94	00
	5.15	-50.7	138.5	94	00
	5.20	-51.9	140.0	94	00
	5.25	-53.1	141.5	94	00
	5.30	-54.3	143.0	94	00
	5.35	-55.5	144.5	94	00
	5.40	-56.7	146.0	94	00
	5.45	-57.9	147.5	94	00
	5.50	-59.1	149.0	94	00
	5.55	-60.3	150.5	94	00
	5.60	-61.5	152.0	94	00
	5.65	-62.7	153.5	94	00
	5.70	-63.9	155.0	94	00
	5.75	-65.1	156.5	94	00
	5.80	-66.3	158.0	94	00
	5.85	-67.5	159.5	94	00
	5.90	-68.7	161.0	94	00
	5.95	-69.9	162.5	94	00
	6.00	-71.1	164.0	94	00
	6.05	-72.3	165.5	94	00
	6.10	-73.5	167.0	94	00
	6.15	-74.7	168.5	94	00
	6.20	-75.9	170.0	94	00
	6.25	-77.1	171.5	94	00
	6.30	-78.3	173.0	94	00
	6.35	-79.5	174.5	94	00
	6.40	-80.7	176.0	94	00
	6.45	-81.9	177.5	94	00
	6.50	-83.1	179.0	94	00
	6.55	-84.3	180.5	94	00
	6.60	-85.5	182.0	94	00
	6.65	-86.7	183.5	94	00
	6.70	-87.9	185.0	94	00
	6.75	-89.1	186.5	94	00
	6.80	-90.3	188.0	94	00
	6.85	-91.5	189.5	94	00
	6.90	-92.7	191.0	94	00
	6.95	-93.9	192.5	94	00
	7.00	-95.1	194.0	94	00
	7.05	-96.3	195.5	94	00
	7.10	-97.5	197.0	94	00
	7.15	-98.7	198.5	94	00
	7.20	-99.9	200.0	94	00
	7.25	-101.1	201.5	94	00
	7.30	-102.3	203.0	94	00
	7.35	-103.5	204.5	94	00
	7.40	-104.7	206.0	94	00
	7.45	-105.9	207.5	94	00
	7.50	-107.1	209.0	94	00
	7.55	-108.3	210.5	94	00
	7.60	-109.5	212.0	94	00
	7.65	-110.7	213.5	94	00
	7.70	-111.9	215.0	94	00
	7.75	-113.1	216.5	94	00
	7.80	-114.3	218.0	94	00
	7.85	-115.5	219.5	94	00
	7.90	-116.7	221.0	94	00
	7.95	-117.9	222.5	94	00
	8.00	-119.1	224.0	94	00
	8.05	-120.3	225.5	94	00
	8.10	-121.5	227.0	94	00
	8.15	-122.7	228.5	94	00
	8.20	-123.9	230.0	94	00
	8.25	-125.1	231.5	94	00
	8.30	-126.3	233.0	94	00
	8.35	-127.5	234.5	94	00
	8.40	-128.7	236.0	94	00
	8.45	-129.9	237.5	94	00
	8.50	-131.1	239.0	94	00
	8.55	-132.3	240.5	94	00
	8.60	-133.5	242.0	94	00
	8.65	-134.7	243.5	94	00
	8.70	-135.9	245.0	94	00
	8.75	-137.1	246.5	94	00
	8.80	-138.3	248.0	94	00
	8.85	-139.5	249.5	94	00
	8.90	-140.7	251.0	94	00
	8.95	-141.9	252.5	94	00
	9.00	-143.1	254.0	94	00
	9.05	-144.3	255.5	94	00
	9.10	-145.5	257.0	94	00
	9.15	-146.7	258.5	94	00
	9.20	-147.9	260.0	94	00
	9.25	-149.1	261.5	94	00
	9.30	-150.3	263.0	94	00
	9.35	-151.5	264.5	94	00
	9.40	-152.7	266.0	94	00
	9.45	-153.9	267.5	94	00
	9.50	-155.1	269.0	94	00
	9.55	-156.3	270.5	94	00
	9.60	-157.5	272.0	94	00
	9.65	-158.7	273.5	94	00
	9.70	-159.9	275.0	94	00
	9.75	-161.1	276.5	94	00
	9.80	-162.3	278.0	94	00
	9.85	-163.5	279.5	94	00
	9.90	-164.7	281.0	94	00
	9.95	-165.9	282.5	94	00
	10.00	-167.1	284.0	94	00

GENERAL MOTORS CORPORATION

SENSITIVITY DATA FOR BLEED, INLET RECOVERY, AND EXHAUST DUCT LOSS

POWER
CLIMB
M.C.

CLIMB
M.C.

CLIMB
M.C.

CLIMB
M.C.

MACH

DEL-SW-IML EL-FH
DEL-SWP-PEB DEL-MF-LED-DEC-FH
K
NO



DATE
FILMED
- 8