

Dec. 6, 1957.

Mr. M.A. Pesando.

W. Kuzyk.

ARROW 4 MISSION PROFILE GOR 339.

The Toss Bomb mission profile presented herein falls short of GOR 339 in the following ways:

1. The basic structure is designed to 720 KTS EAS, i.e. M 1.09 at S.L., and any attempt to increase the S.L. capability to a higher Mach Number would involve vast changes, e.g. increasing EAS to 990 KTS, or to M 1.5 at S.L.

This involves,

- (a) Increasing the wing torsional stiffness by a factor of 1.9.
 - (b) Increasing that portion of the structure stressed for differential pressures by about 1.9.
 - (c) The fin stiffness would have to be increased by a factor of 1.5.
 - (d) The Rudder Hinge Moment would be approximately doubled.
2. Further the Arrow 4B presently carries 50,895 lb. of fuel, and this amount would not provide for say 200 n.m. supersonic dash.

The Arrow 4B is capable of the toss bomb mission profile shown in fig. 3 attached.

WK.

W. Kuzyk,
Sr. Project Research Engineer.

WK/js

Arrow 4B Mission #8

AUW = 103,015 lb.

Fuel = 50,895 lb.

<u>Operation</u>	<u>Time</u> <u>Minutes</u>	<u>Distance</u> <u>Nautical Miles</u>	<u>Fuel</u> <u>Pounds</u>	<u>Remarks</u>
Take-off	.6	-	950	
Climb to 37,000'	4.2	42	3000	
Cruise 37-39,000'	38	336	8450	
Descend to S.L.	2.5	22	500	
Toss Bomb	39	400	19,500	
Climb to 45,000'	4.2	42	3000	
Cruise 45-47,000'	40.6	358	6280	
Land	4	-	1000	
Reserve			8215	16.2%

WK/js
Dec. 9/57

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Take-off	.6	-	950		-
Climb to 37,000'	4.2	42	3000		-
Cruise 37-39,000'	38	336	8450		.92
Descend to S.L.	2.5	22	500		-
Toss Bomb	39	400	19,500		.92
Climb to 45,000'	4.2	42	3000		-
Cruise 45-47,000'	40.6	358	6280		.92
Land	4	-	1000		-
Reserve			8215	16.2%	

For Arrow 4A

9%

WK/js
Dec. 9/57

ARROW 4B - MISSION PROFILE #8

T.O. WT = 103,015 lbs

TOTAL FUEL 59835 lbs

*LIMITING MN BASED ON 720 KTS EAS

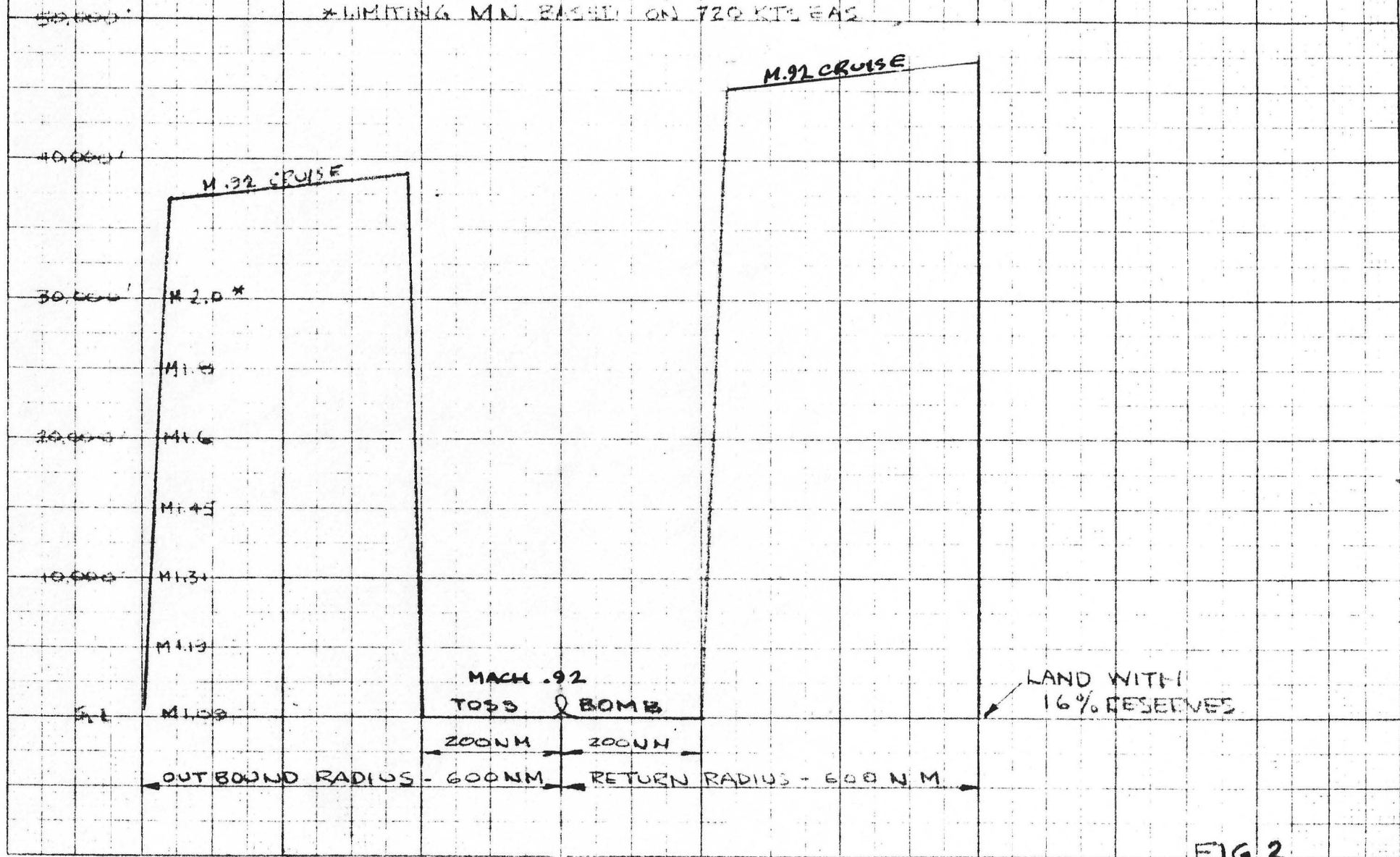


FIG 2

Descent
PEL/7/1
AR



INTER-DEPARTMENTAL MEMORANDUM

DATE Dec. 6, 1957.
TO Mr. M.A. Pesando.
FROM W. Kuzyk.
SUBJECT ARROW 4 MISSION PROFILE GOR 339.

The Toss Bomb mission profile presented herein falls short of GOR 339 in the following ways:

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- (a) Increasing the wing torsional stiffness by a factor of 1.9.
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 - (d) The Rudder Hinge Moment would be approximately doubled.

2. Further the Arrow 4B presently carries 50,895 lb. of fuel, and this amount would not provide for say 200 n.m. supersonic dash.

The Arrow 4B is capable of the toss bomb mission profile shown in fig. 3 attached.

W. Kuzyk,
Sr. Project Research Engineer.

WK/js

Dec. 11, 1957.

Mr. J.C. Floyd.

M.A. Pesando.

ARROW 4 MISSION PROFILE GOR 339

We have carried out a brief investigation on the Arrow 4 with regard to meeting the requirements of GOR 339. The Arrow 4 does meet the mission profile in principle, but being a high altitude aeroplane, it falls down on the high Mach requirements at sea level. The subsonic mission profile is given on the table below and on the attached graph. If the low level dash is performed at the aircraft limiting Mach, that is $M = 1.09$ instead of $M = .92$ as shown in the attached graph, the range is reduced from 200 n.m. to 100 n.m. with the same fuel reserve (i.e. 16%). If the reserves are entirely depleted this dash range at $M = 1.09$ would be of the order of 140 - 150 n.m.

If it should be desired to increase the EAS to 990 knots ($M = 1.5$ at sea level) the following major changes would be involved:

- (a) Increased wing torsional stiffness by a factor of 1.9.
- (b) Increase in that portion of the structure stressed for differential pressures by about 1.9.
- (c) The fin stiffness would have to be increased by a factor of 1.5.
- (d) The Rudder Hinge Moment would be approximately doubled.

Arrow 4B Mission #8

AUW = 103,015 lb.

Fuel = 50,895 lb.

<u>Operation</u>	<u>Time</u> <u>Minutes</u>	<u>Distance</u> <u>Nautical Miles</u>	<u>Fuel</u> <u>Pounds</u>	<u>Mach No.</u>	<u>Remarks</u>
Take-off	.6	-	950	-	
Climb to 37,000'	4.2	42	3000	-	
Cruise 37-39,000'	38	336	8450	.92	
Descend to S.L.	2.5	22	500	-	
Toss Bomb	39	400	19,500	.92	
Climb to 45,000'	4.2	42	3000	-	
Cruise 45-47,000'	40.6	358	6280	.92	
Land	4	-	1000	-	
Reserve			8215		16.2%
" (for Arrow 4A)					9%

ARROW 5 PROPOSAL FOR GOR 339

1. Weight Breakdown

ARROW 2	Operational Weight Empty	44,200
Modifications:	Outer wing stiffened	+ 500
	Wheel well	+ 200
	Elevator and control box	+ 100
	Pods (for 19,942 fuel)	+2,420
	Pylons	+ 500
	Armament bay	+ 200
Toss Bomb		4,000
		<hr/>
ARROW 5	Operational Weight Empty	52,120

2. Modifications

Wheel Well	- posted box structure for integral fuel tanks. - skin cover, removal of main u/c hardware. - outer spar added to former u/c pickup.
Elevator	- general stiffening - skin, ribs, hinges (to cater to increase in A.U.W.). Subject to aerodynamic approval.
Pod - Pylon - U/C	- new structure.
AMO Pack	- new structure.
AMO Bay	- formers 292 and 485, pack attachments strengthened side skins stiffened.

ARROW 5 work content.

Location.	New parts.	Drawings.
-----	-----	-----
Outer wing.....	1000.....	500
Wheel well.....	200.....	100
Pod	...2000.....	1000.
Pod attachmt		
Armt bay.....	200.....	100.
Pack.....	1000.....	500.
	----	----
Totals.....	4400.....	2200
	----	----

COPY

3. (a) ARROW 5 - IPOQUOIS 2 @ 4,500 #

Fuel Load	ARROW 2 internal fuel	19,438
	Armament Bay	4,600
	Wheel well integral tanks	3,900
	Fuel pods	19,942
		<hr/>
		47,880 #
Operational weight empty (includes 4,000 # bomb)		52,120 #
		<hr/>
Gross Take Off Weight		100,000 #

(b) ARROW 5 - OLYMPUS @ 4,500 #

Fuel Load	ARROW 2 internal fuel	19,438
	Armament Bay	4,600
	Wheel well integral tanks	3,900
	Fuel pods	14,355
		<hr/>
		42,293 #
Operational weight empty (includes 4,000 # bomb)		52,120 #
		<hr/>
Gross Take Off Weight		94,413 #

(c) ARROW 5 - CONWAY @ 6,000 #

Fuel Load	ARROW 2 internal fuel	19,438
	Armament Bay	4,600
	Wheel well integral tanks	3,900
	Fuel pods	8,942
		<hr/>
		36,880 #
Operational weight empty (includes 4,000 # bomb)		55,120 #
		<hr/>
Gross Take Off Weight		92,000 #

Notes:

1. For low level cruise at M. 92 instead of M. 90 at 3,000', increase fuel consumption by 20%.
2. For high altitude climb, cruise at M. 92 instead of M. 90 at altitude increase fuel consumption by 20%.
3. For low level cruise at 1,500 feet instead of 3,000 feet, increase fuel consumption by 5%.
4. Max fuel load possible for APPOW 5 is as follows:

APPOW 2 internal fuel	19,438
Wheel well integral tanks	4,000
Armament bay	8,000
Pylon-pod tankage	32,000

Recommended max. total 63,438 # of JP4

5. With the proposed main u/c arrangement any reasonable L.C.N. (runway Load Carrying Number) can be catered for.
6. All engines equipped afterburners to provide max thrust at T.O. Jato or equivalent must be used to meet T.O. requirement.

ARROW 5 - IROQUOIS 2

T.O. Wt. = 100,000 #
Fuel = 47,880 #
Iroquois Eng. Wt. = 4,500 #

CONDITION	TIME MINS.	DISTANCE N.M.	FUEL LBS.	A/C WT.
Start Weight	-	-	-	100,000
T.O.	2.7	15	1,422	98,578
Climb (with A/B)	6	70	2,862	95,716
Cruise Out	80	695	14,200	81,516
Descend	2	20	500	81,016
Toss Bomb M .90, 3,000' alt.	41	400	16,100	64,916
Climb	7	65	2,300	62,616
Cruise	82	710	9,196	53,420
Descend	2	25	500	52,920
Land with 5 min. Endurance at S.L.	-	-	800	52,120

ARROW 5 - OLYMPUS B.O.L.7R

T.O. Weight = 94,413 #
Fuel = 42,293 #
Olympus Eng. Wt. = 4,500 #

CONDITION	TIME MINS.	DISTANCE N.M.	FUEL LBS.	A/C WT.
Start Weight	-	-	-	94,413
T.O.	2.7	15	1,218	93,195
Climb (with A/B)	6	65	2,660	90,535
Cruise Out	81	700	12,350	78,185
Descend	2	20	500	77,685
Toss Bomb M.90, 3,000' alt.	41	400	14,000	63,685
Climb	7	60	2,120	61,565
Cruise	83	715	8,145	53,420
Descend	2	25	500	52,920
Land with 5 min. Endurance at S.L.	-	-	800	52,120

ARROW 5 - CONWAY IIR STAGE 3B

T.O. Wt. = 92,000 lb.
Fuel = 36,880
Engine Wt. = 6,000 lb. per engine

CONDITION	ELAPSED TIME (MINS)	DISTANCE N.M.	FUEL LB.	A/C WEIGHT LBS.
Start Wt.	-	-	-	92,000
T.O.	2.7	15	1,014	90,986
Climb (no 4/B)	10.7	97	3,036	87,950
Cruise Out	80	668	10,500	77,450
Descend	2	20	500	76,950
Toss Bomb	41	400	11,620	65,330
Climb	12.1	95	1,612	63,718
Cruise	82.5	680	7,298	56,420
Descend	2	25	500	55,920
Land with 5 Min. Endurance at S.L.	-	-	800	55,120

ARROW & OR. 339

1. ARROW 2 WITH EXTRA 10,000 LB. FUEL (AS PER ARROW 3) GIVES 400 N.M. + 60 MILE S.L. INWARD & OUTWARD RADIUS COMPARED WITH 400 N.M. + 200 MILE S.L. REQUIRED ACCORDING TO EWINGS AND 800 N.M. + 200 MILE S.L. ACCORDING TO O.R. 339.

ARROW 4 HAS CAPABILITY OF THE ORDER OF 600 N.M. + 200 N.M. S.L. AT APPROX. 110,000 LB. GROSS.
2. VERY LIMITED S.L. SUPERSONIC DASH ON ARROW 2 PRESENTLY $M = 1.09$ WHICH IS IMPRACTICAL OPERATIONALLY. SUBSTANTIAL BEEFING UP OF STRUCTURE REQUIRED TO IMPROVE THIS TO $M = 1.50$, PLUS HEAVY DRAIN ON RADIUS.
3. OPERATION OF ARROW A PROBLEM FROM DISPERSED AREA - AT BEST 3000' RUNWAY, GROUND SUPPORT EQUIPMENT PRESENTLY INCOMPATIBLE WITH SUCH CONCEPT: INDEPENDENCE OF RUNWAYS NOT POSSIBLE.
4. CREW VISIBILITY AND COMMUNICATION REQUIRED INDICATES SIDE BY SIDE SEATING.
5. CHARACTERISTICS OF O.R. 1127 TACTICAL NUCLEAR WEAPON NOT KNOWN - HOWEVER 4000 - 6000 LB. BOMB LOAD STOWAGE PLUS ROCKETS INDICATE QUITE A PAYLOAD PROBLEM.
6. SELF-CONTAINED NAVIGATION QUITE A PROBLEM ACCORDING TO STEPHENS & HURLEY IN USAF EXPERIENCE - A MAJOR OBSTACLE TO SUCCESSFUL DEVELOPMENT OF WEAPON SYSTEM.

INDICATIONS ARE THAT ARROW WOULD REQUIRE COMPLETE RE-ENGINEERING TO FULLFILL MISSION. UNLIKELY THIS ACCEPTABLE OF FOREIGN AIRCRAFT BY U.K.

RELAXATION OF REQUIREMENTS (SPECS.) ??

RFM/js
January 1958.

