STORABLE SPACE TUG SYSTEMS STUDY

DATA DUMP

VOLUME 4, MISSION ACCOMPLISHMENT

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GRUMMAN

VOLUME 4
MISSION ACCOMPLISHMENT

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4.1 INTRODUCTION

4.1.1 Background

This volume contains the Grumman traffic capture assessment conducted during the Space Tug System Study phase culminating with this Data Dump. The results of the capture analysis constitute a vital element in the flow leading to establishing program definition and cost. The relationships of this effort to other elements in the flow, and of this volume to other volumes comprising the data dump, are defined in Figure 4.1-1.

A total of six storable tug concepts, applied to four different program options as shown in Figure 4.1-2, were evaluated during this study phase. The purpose of the capture analysis was to establish the effectiveness of each of the concepts, characterized in Figure 4.1-3, in accomplishing the mission model assigned to its program option. In addition, it provided definition of the number, type, and distribution of flights required by each concept to provide a significant input to establishing required Tug fleet size, auxiliary flight elements, operations support, and other elements leading to total program defintion.

The material in this volume is organized to provide both summary results and detailed accountability of the derivation of these results. All parameters used in the conduct of the analyses are provided and identified to allow easy access to the specifics of the capture assessment.

Section 4.2 provides a top level summary of the capture results, permitting a quick comparison of the mission models used for each program option, as well as the relative efficiencies of each concept.

Section 4.3 contains detailed summary charts and the details of the assessment itself for each option and concept. In addition to mission-by-mission definition of Tug flight distributions, it provides all performance characteristics used in the analyses, incremental summaries for each generic mission classification (i.e. geosynchronous, non-geosynchronous earth-orbital, and planetary), and inputs to the Programmatic/Costing effort.

4.1.2 Groundrules, Guidelines, and Assumptions

The capture analyses were conducted within the framework of guidelines and assumptions consistent for all concepts and options, with limited exceptions for unique circumstances. The exceptions to the general groundrules cited below are listed at the beginning of the specific section to which they apply.

a. The primary goal of the traffic assessment is to minimize the number of Tug/Shuttle flights required to capture the mission model.

b. For this analysis, a mission is defined as the transportation of a specified payload to or from orbit. A flight consists of one or more missions.

c. A clear Orbiter P/L bay volume of 60'L by 15'D is assumed to be available for P/L and Tug plus auxiliary flight elements (i.e. kick stages, retrieval delay modules, etc.). Clearances for rotation are recognized but have not been considered in this analysis.

d. Sortie missions must remain attached to the Tug at all times from lift-off through landing. The use of kick stages, retrieval delay modules, and expendable mode Tugs are excluded from consideration.

e. A maximum of three (3) payloads may be deployed on a single Tug flight.

f. Only one (1) payload may be retrieved on a single Tug flight.

g. Mixing of NASA and DOD payloads is not allowed.

h. NASA missions 1-8 may be mixed on a single Tug flight in any mode.

i. NASA missions 12-16 may be mixed on a single Tug flight in any mode.

j. NASA planetary payloads (missions 17-24) and payload 9 must be single deployment flights.

k. DOD payloads may not be mixed on a single Tug flight in any mode.

l. DOD flight modes (i.e. multi-deployments, round trips) must be consistent with Table A-4 of the "Space Tug Systems Study Annex A - DOD Mission Descriptions", dated 15 February 1973.

m. Multiple deployments of NASA missions 12-16 require no Tug phasing for payload positioning within an orbit.

n. Payload weights and dimensions quoted in the NASA and DOD mission models are assumed to include allowances for adapters between the Tug and payload, and between multiple payloads.

o. DOD mission 32 (3A) may be deployed either singly or in a package of two. No orbit positioning is required by Tug.

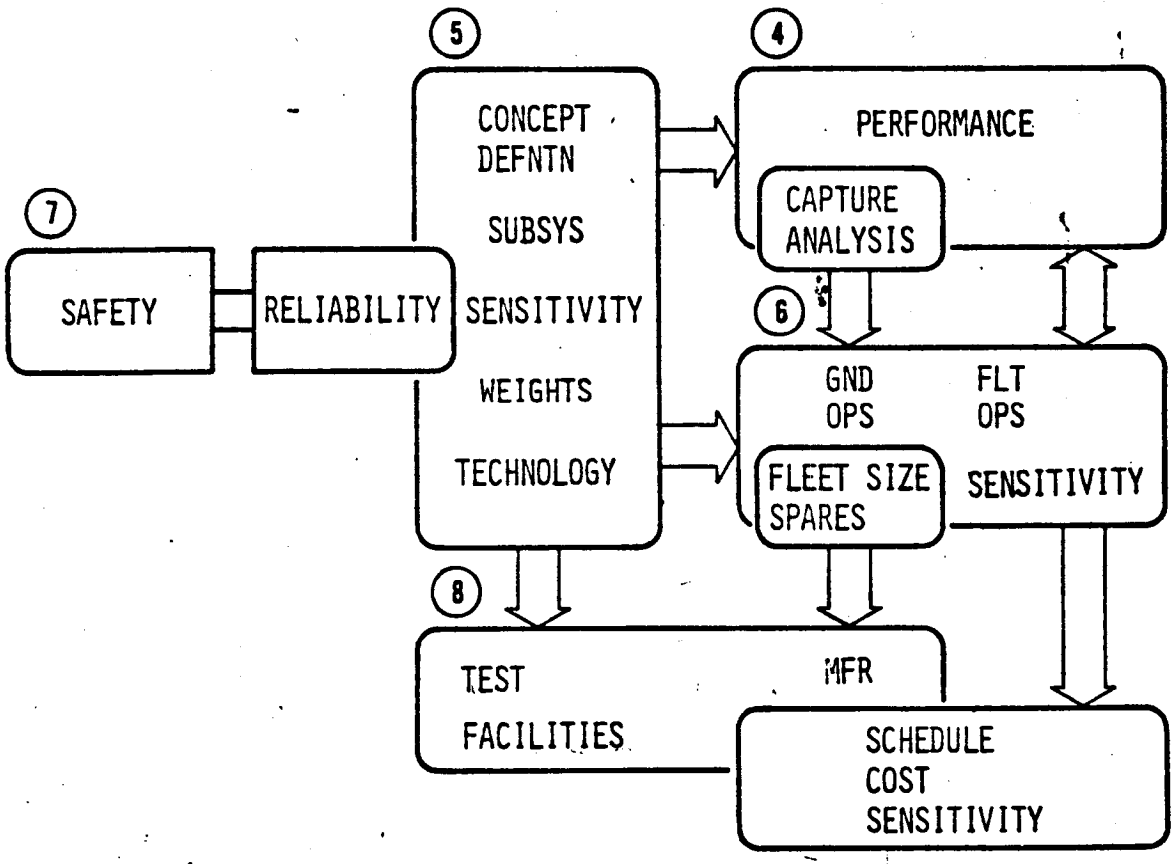
p. DOD missions 36-38 (11a-11c) may be multiply deployed as a unit. No orbit positioning is required by Tug.

q. DOD mission 29 (12b) is assumed to have a fixed weight of 2400 lbs.

r. Expendable Tug flight modes will be considered only for planetary missions.

s. A maximum of two NASA payload 16's of Low Cost Design may be carried on a single Tug flight to comply with Shuttle abort constraints.

DATA DUMP VOLUME GENERATION



VOLUME	EDITOR
4 MISSION ACCOMP	B. SIDOR LR5-1491
5 SYSTEMS	C. J. GOODWIN LR5-2453 M. H. DANDRIDGE LR5-1494
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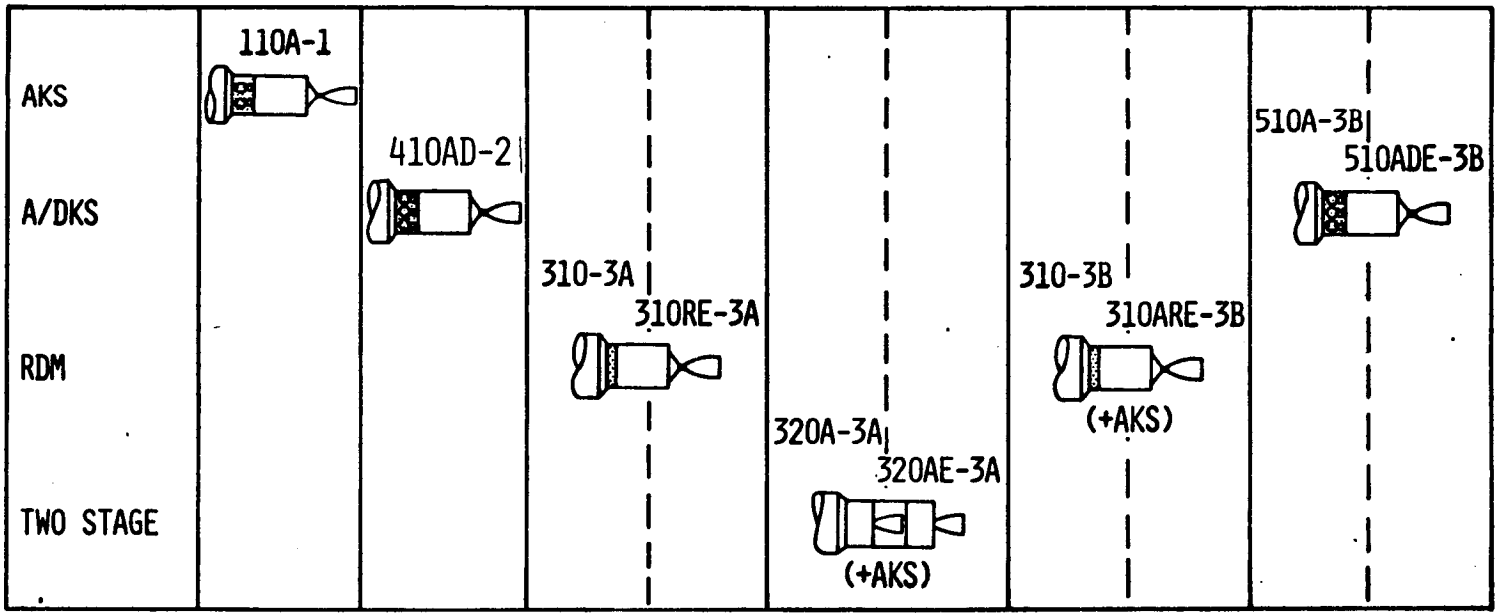
8 PROGRAMMATICS	R. McCAFFREY LR5-1487

DATA DUMP MATRIX

OPTION	1	2	3A				3B			
IOC	DEC '79	DEC '83	DEC '79	DEC '83	DEC '79	DEC '83	DEC '79	DEC '83	DEC '79	DEC '83
GEOSYNCH DEPLOY, LB	3500									
GEOSYNCH RETRV, LB	0	3500	0	2200	0	2200	0	3500	0	3500
COST EMPHASIS	MIN DDT&E	LOW DDT&E - LOW TOTAL COST								

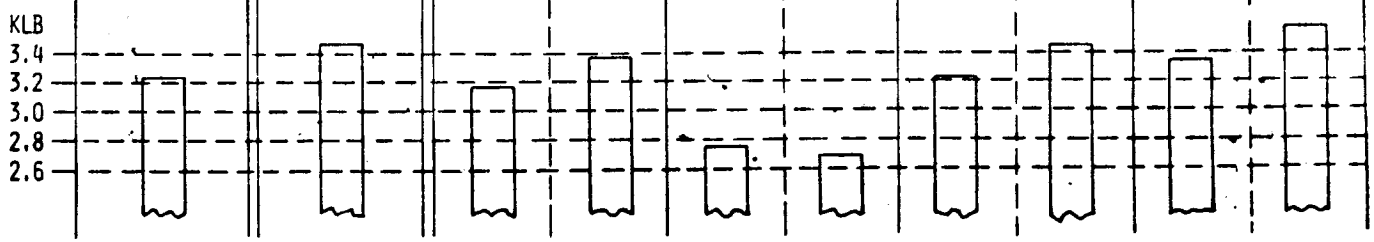


SENSITIVITY STUDIES	o DELAY IOC 2 YR	o ADV IOC 2 YR o DKS VS RDM o SERVICE MISS.	o DELAY IOC 2 YR

SUMMARY OF TUG CHARACTERISTICS

OPTION	1	2	3A				3B			
GEOSYNCH RETRIEVE CAP (LB)	—	3500	—	2200	—	2200	—	3500	—	3500
TUG DESIGNATION	110A-1	410AD-2	310-3A	310RE-3A	320A-3A	32CAE-3A	310-3B	310ARE-3B	510A-3B	510ADE-3B
TUG LENGTH, FT	27.92	24.75	24.75		17.06 EACH		24.75		25.0	
BODY DIA, FT	9.92	10.0	10.0		8.16		10.0		10.0	
MAIN PROP. CAPACITY, KLB	56.9	59.5	59.5		32 EACH		59.5		59.5	
MAIN ENGINE										
- OME F=7.5K ISP=	327.2	—	—		—		—		327.2	
- CL. 1 F=12K ISP=	—	338	338		—		338		—	
- CL. 1 (RET.NOZ.) F=12K ISP=	—	—	—		338		—		—	
SUBSYS TECH										
- LOW COST	▭	—	—		—		—		▭	
- HIGH PERF.	—	▭	▭		▭		▭		—	
AUTONOMY LEVEL	IIIA	IIB	IIIA	IIB	IIIA		IIIA	IIB	IIIA	IIB

FIXED WT
NASA MISSIONS SHOWN,
ADD SECURE COMM
FOR DOD MISSIONS



4.2 SUMMARY DATA

While the variations in mission models and performance requirements for each option make comparisons of Tug concepts extremely complex, it is inevitable that such comparisons will be made. In order to place any such comparison in proper perspective, certain fundamental considerations must be kept in mind.

The mission models for the four program options were each dervied from a Total Program Space Tug Study Traffic Model, Table 4.2-1, but none of the models duplicate it in its entirety. Option 1 does not consider payload retrieval at all while Option 2 excludes all Tug flights prior to 1984. Using the Total Program model and the groundrules established for each option, the mission opportunities afforded by total program traffic have been compared to the option mission models in Table 4.2-2. (For this comparison, as well as for the capture analyses themselves, sortie missions have been tracked separately because of their unique requirements. Since a sortie mission has been treated as a deploy plus retrieve in the directed mission models, simply adding the number of sortie missions to both the deploy and retrieve cited in the Grumman analyses will yield the directed mission distributions). The comparison of mission models shows a significant variation in total opportunities, but a fairly consistent capture of those opportunities by the individual option models. It is interesting to note that the increase in required retrieval capability between Options 3A and 3B (2200 and 3500 pounds respectively) increases capture by only one percent, a total of nine missions.

Similarly, the individual Tug concepts yield a wide range of performance capabilities under the influence of the specified option requirements. Table 4.2-3 summarizes the geosynchronous performance capabilities for the primary flight modes of each Tug concept, providing some visibility into their relative abilities.

Table 4.2-4 summarizes, for each Tug concept, the number of Tug flights in each basic flight mode (i.e. deploy, retrieve, round trip, and sortie) required to capture the mission model for its option. Using the

mission model comparison (Table 4.2-2) as a point of reference, it is possible to compare the concepts on the basis of efficiency from a traffic capture standpoint. While such a comparison is admittedly rudimentary, not considering operational complexity, development risk, or overall program cost, it does reflect one aspect of desirability - that of maximum load factor (payloads or missions/flight). From this viewpoint, Table 4.2-4 shows that Concept 310A/320AE-3A, a two stage design, is more effective than any of the other concepts, with Concept 410AD-2 a close second. The influencing factors in this conclusion are the number of round-trip flights employed and the relatively low number of dedicated deployment flights. Since each of the more effective concepts perform comparable numbers of round trip flights, the basic discriminator becomes the deployment flights, where Concept 320A/320AE enjoys the advantage of considerably more multiple payload flights.

SPACE TUG STUDY TRAFFIC MODEL — OPTION: TOTAL TRAFFIC

MISSION ID	CURRENT DESIGN			LOW COST DESIGN			CALENDAR YEAR											TOTAL
	WT	L	D	WT	L	D	80	81	82	83	84	85	86	87	88	89	90	
1	500	6	5	900	10	6	2 /	2 / 1	2 / 2	1 / 2	2 / 2	1 / 1	1 / 2	1 / 1	2 / 1	1 / 1	2 / 2	17 / 15
2	800	8	5	1700	8	8	1 /	2 /	/	1 /	/ 3	1 / 1	/ 2	1 /	/ 1	1 /	/ 1	7 / 8
3	1100	10	6	2100	12	8	3 /	7 /	3 /	3 / 1	1 / 3	5 / 7	5 / 3	6 / 3	7 / 1	2 / 5	3 / 5	45 / 28
4	1500	22	9	1800	10	14	1 /	1 /	/	2 /	1 / 2	1 / 1	/ 1	2 /	1 / 2	/ 1	/ 1	9 / 8
5	1800	17	10	2800	12	14	/	/ 1	/	3 /	/	/ 3	/	/	/	3 /	/	6 / 4
6	2600	12	8	5000	11	14	1 /	/	1 / 1	/	/ 1	1 /	/	1 / 1	/	/ 1	2 /	6 / 4
7	3000	20	10	5500	16	14	1 /	1 / 1	2 / 1	2 / 1	1 / 2	2 / 2	/ 1	2 / 2	1 /	1 / 2	/ 1	13 / 13
8	3500	25	14	4000	25	14	2 /	1 /	1 /	2 /	2 /	2 /	2 / 1	2 / 2	2 / 1	2 / 1	2 / 2	20 / 7
SUB-TOTAL							11 / 0	14 / 3	9 / 4	14 / 4	7 / 13	13 / 15	8 / 10	15 / 9	13 / 6	10 / 11	9 / 12	123 / 87
9	750	7	5	1400	9	6	1 /	/	1 /	/	1 /	/	2 /	/	1 /	/	2 /	8 / 0
10	6000	12	8	9500	18	14	/	1 /	/	/ 1	1 /	/	/ 1	1 /	/	/ 1	1 /	4 / 3
11	800	8	5	1700	8	8	1 /	1 /	/	1 /	/	1 / 1	/ 1	1 /	/ 1	1 /	/ 1	6 / 4
12	1200	8	4	2000	8	6	/	/	/	1 /	/ 1	1 /	/ 1	1 /	/ 1	1 /	/ 1	4 / 4
13	650	8	5	1000	7	7	/	/	/	1 /	/ 1	1 /	/ 1	1 /	/ 1	1 /	/ 1	4 / 4
14	400	7	3	800	10	5	/	/	/	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	8 / 8
15	1000	6	5	2000	8	11	/	/	/	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	8 / 8
16	2600	12	6	4500	11	13	/	/	/	4 / 4	/	4 / 4	/	/ 4	/	6 /	/	14 / 12
SUB-TOTAL							2 / 0	2 / 0	1 / 0	9 / 7	4 / 4	9 / 7	4 / 6	6 / 6	3 / 5	11 / 3	5 / 5	56 / 43
17	1000	12	10	2000	12	14	1 /	/	/	/	/	/	/	/	/	2 /	/	3 / 0
18	2000	12	10	3300	10	14	/	/	/	/	2 /	/	/	/	/	/	/	2 / 0
19	5500	20	12	7900	20	14	/	/	/	/	/	/	1 /	2 /	/	/	/	3 / 0
20	900	17	10	1500	14	14	/	/	2 /	/	2 /	/	/	/	/	/	/	4 / 0
21	1600	15	10	2500	15	14	/	/	/	/	/	/	/	/	/	/	/	0 / 0
22	2500	16	12	4000	18	14	/	/	/	/	/	/	1 /	1 /	/	1 /	1 /	4 / 0
23	5000	17	12	6600	16	14	/	/	/	/	/	/	2 /	/	/	/	/	2 / 0
24	3300	17	12	4400	15	14	/	/	/	/	2 /	/	/	/	/	2 /	/	4 / 0
SUB-TOTAL							1 / 0	0 / 0	2 / 0	0 / 0	6 / 0	0 / 0	4 / 0	3 / 0	0 / 0	5 / 0	1 / 0	22 / 0
TOTAL	NASA						14 / 0	16 / 3	12 / 4	23 / 11	17 / 17	22 / 22	16 / 16	24 / 15	16 / 11	26 / 14	15 / 17	201 / 130
25 (2)				690	12	5	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	22 / 22
26 (3b)				1570	15	5	1 /	/	1 /	1 / 1	1 / 1	/	1 / 1	1 / 1	1 / 1	/	1 / 1	8 / 6
27 (15)				1970	16	10	1 /	/	1 /	1 /	1 / 1	1 / 1	/	1 / 1	1 / 1	1 / 1	1 / 1	9 / 6
28 (17)				2200	12	10	/	/	/	2 /	2 /	/	1 /	/	1 /	1 / 2	1 / 2	8 / 4
29 (12b)	SORTIE			2400	20	10	/	/	1 / 1	/	1 / 1	/	1 / 1	/	1 / 1	/	1 / 1	5 / 5
30 (6)				3480	20	9	/	/	/	/	/	2 /	/	1 /	/	1 /	/	4 / 0
31 (4a)				3480	25	15	/	2 /	/	/	2 / 2	/	/	2 / 2	/	/	2 / 2	8 / 6
SUB-TOTAL							4 / 2	4 / 2	5 / 3	6 / 3	9 / 7	5 / 3	5 / 4	7 / 6	6 / 5	5 / 5	8 / 9	64 / 49
32 (3a)				1570	15	5	4 /	/	4 /	4 / 4	4 / 4	/	4 / 4	4 / 4	4 / 4	/	4 / 4	32 / 24
33 (4b)				3480	25	15	1 /	/	2 / 2	1 / 1	/	2 / 2	1 / 1	/	2 / 2	1 / 1	/	10 / 9
34 (10)				2745	20	9	/	1 /	/	1 /	/ 1	/	/ 1	/	/ 1	/	/	2 / 3
35 (8)				2430	25	12.7	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	22 / 22
36 (11a)				850	9	6	3 /	/	/	3 /	/	/	/	/	3 /	/	/	9 / 0
37 (11b)				850	9	6	3 /	/	/	/	3 /	/	/	/	/	3 /	/	9 / 0
38 (11c)				850	9	6	3 /	/	/	/	/	3 /	/	/	/	/	3 /	9 / 0
39 (5)				735	3	5	/	/	/	3 /	3 /	/	3 /	3 /	/	3 /	3 /	18 / 0
40 (16)				2610	14.5	6.7	/	/	/	4 /	/	2 /	2 / 4	/	2 / 2	2 / 2	/	12 / 8
41 (12a)				6000	20	10	/	/	/	1 / 1	/	1 / 1	/	1 / 1	/	1 / 1	/	4 / 4
SUB-TOTAL							16 / 2	3 / 2	8 / 4	19 / 8	12 / 7	10 / 5	12 / 12	10 / 7	13 / 11	12 / 6	12 / 6	127 / 70
TOTAL	DOD						20 / 4	7 / 4	13 / 7	35 / 17	[illegible] / 14	15 / 8	17 / 16	17 / 13	19 / 16	17 / 11	20 / 15	191 / 119
COMBINED TOTAL							34 / 4	23 / 7	25 / 11	48 / 22	38 / 31	37 / 30	33 / 32	41 / 28	35 / 27	43 / 25	35 / 32	392 / 249

TABLE 4.2-1

MISSION MODE		OPTION 1	2	3A	3B
OPPORTUNITIES	DEPLOY	383	255	383	383
	RETRIEVE	0	198	198	198
	SORTIE	9	7	9	9
	(TOTAL)	(392)	(460)	(590)	(590)
MISSION MODEL	DEPLOY	356	255	383	383
	RETRIEVE	0	176	167	176
	SORTIE	4	3	4	4
	(TOTAL)	(360)	(434)	(554)	(563)
PERCENT CAPTURE		92	94	94	95

MISSION MODEL COMPARISON

TABLE 4.2-2

OPTION #	PERFORMANCE REQUIREMENT DEPLOY	PERFORMANCE REQUIREMENT RETRIEVE	CONCEPT	DEPLOY PLAIN SINGLE P/L	DEPLOY PLAIN DOUBLE P/L	DEPLOY WITH AKS SINGLE P/L	DEPLOY WITH AKS DOUBLE P/L	RETRIEVE PLAIN	RETRIEVE WITH DKS	ROUND TRIP PLAIN	ROUND TRIP WITH A/DKS	RETRIEVAL DELAY MISSION 1 DEPLOY	RETRIEVAL DELAY MISSION 2 DEPLOY W/AKS	RETRIEVAL DELAY MISSION 2 RETRIEVE
1	3500	N/A	110A-1	4014	2007	8207	4103	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2	3500	3500	410AD-2	4914	2170	6021	3500	1574	3920	1080	2640	N/A	N/A	N/A
3A	3500	N/A	310-3A	5418	2530	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		2200	310RE-3A	5026	2250	N/A	N/A	1618	N/A	1096	N/A	3021	N/A	3021
	3500	N/A	320A-3A	5094 *	2375 *	N/A	4708 **	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		3500	320AE-3A	5920 $	2770 $	N/A	4728 **	3800 $	N/A	2340 $	N/A	N/A	N/A	N/A
3B	3500	N/A	310-3B	5212	2350	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		3500	310ARE-3B	4841	2160	3500	3515	1543	N/A	1054	N/A	2400	3500	2400
												2760	N/A	2760
	3500	N/A	510A-3B	3410	1440	6090	3815	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		3500	510ADE-3B	3035	1250	6546	3815	805	3825	528	2385	N/A	N/A	N/A

* 2 STAGES OPERATING IN SLINGSHOT MODE
** LOWER STAGE
$ 2 STAGES OPERATING IN REVERSE SLINGSHOT MODE

GEOSYNCHRONOUS PERFORMANCE SUMMARY
(Payload - lbs)

TABLE 4.2-3

FLIGHT MODE	1	2	3A		3B	
	110A-1	410AD-2	310/310 RE	320A/320AE	310/310ARE	510A/510ADE
DEPLOY	226	83	214 (1)	154	197 (2)	181
RETRIEVE	0	42	105	25	103	32
ROUND TRIP	0	134	67	142	90 (3)	144
SORTIE	4	3	4	4	4	4
(TOTAL TUG FLIGHTS)	(230)	(262)	(390)	(325)	(394)	(361)
TOTAL MISSIONS	360	434	554	554	563	563
MISSIONS / FLIGHT	1.56	1.66	1.42	1.70	1.43	1.56

NOTES: (1) INCLUDES 54 DEPLOY + RTRVL DELAY FLTS
(2) INCLUDES 49 DEPLOY + RTRVL DELAY FLTS
(3) INCLUDES 25 DEPLOY + DELAYED RTRV FLTS

CONCEPT TRAFFIC COMPARISON

TABLE 4.2-4

4.3 Mission Accomplishment Analysis

This section contains the detailed results of the traffic capture analyses conducted on each of the six Tug concepts included in the four study options. The material is organized to present each option, and each concept within that option, sequentially beginning with Option 1. Since the type of data presented is identical for all concepts, the following description of the analysis approach applies to all subsections. Considerations unique to a specific option or concept are noted on the applicable subsection cover page.

4.3.X.1 Mission Model

For convenience, the mission model used in the capture analysis for each option has been included. Subtotals for each generic mission grouping (i.e., geosynchronous, non-synchronous earth-orbital, and planetary) have been provided in addition to NASA, DOD, and combined totals to permit direct comparison of mission and flight distributions at finer levels of detail. Each Tug concept must capture every mission in the model.

4.3.X.Y Concept abc

4.3.X.Y.1 Performance

As a point of reference for the ensuing capture analysis, the performance characteristics of the particular Tug concept are presented first. Any special considerations applicable to the derivation of performance characteristics are listed on the cover page.

The performance data for each concept follows the same order of presentation, as follows:

- Flight Modes

  For clarity, pictorial representations of each of the flight modes considered in the capture analysis have been provided. Additional details are contained in Volume 6.

- Geosynchronous Performance

  The Tug concept characteristics required for calculation of performance capabilities have been extracted from Volumes 5 and 6, and the applicable geometry constraints and performance characteristics tabulated. Each parameter used in the capture analysis has been "boxed in" for ease of identification and parametric data has been referenced where appropriate. For the evolutionary concepts (Options 3A and 3B), the initial Tug version is presented first.

  Where required, parametric presentations of the geosynchronous performance data follow the tabulations. Each of these presentations is appropriately labeled as to Tug version and parameters considered.

- Geosynchronous Performance Sensitivities

  The performance sensitivities for the core vehicle only are tabulated for each concept.

- General Performance Characteristics

  Generalized performance plots (ΔV vs P/L vs i) are included for each flight mode. Each plot identifies the reference geosynchronous performance capability as a "dot" on the i = 28.5° capability curve. The consistent order of presentation is basic Tug first, followed by core + kick stage. As with the tabular data, the initial Tug data is presented first for evolved Tug concepts.

  In order to meet the schedule of preparation for the Data Dump, the capture analyses for the first three Tug concepts were completed prior to final refinement of vehicle weights. The refined weights for 110A-1, 410AD-2, and 310/310RE-3A showed increases in Tug/Orbiter adapter weight and Tug fixed weight which, in turn, affect the performance capabilities of the Tugs. Table 4.3-1 summarizes the weight and performance differences. In all cases, the performance capabilities differ by only a small amount. Examination of the completed capture analysis indicated that the corrected performance figure would have little effect on the results. The most profound effect would be noted in the mixed missions where a re-arrangement of the combined payloads would neutralize the impact.

4.3.X.Y.2 Flight Summary

This represents the first of the three successive subsections of the capture analysis which constitute the Mission Accomplishment input to the Programmetics/Costing effort reported on in Volume 8. The Flight Summaries are presented, in order, for NASA, DOD, and combined NASA/DOD traffic. The entries for each concept are intended to emphasize the principle characteristics of the subject concept. These summaries are augmented by more detailed summaries with finer resolution contained in the Detailed Traffic Assessment Data (paragraph 4.3.X.Y.6) following the generic mission groupings.

Information relative to expendable mode and WTR operations may be obtained from the Flight Element Requirements (paragraph 4.3.X.Y.3) and/or the Detailed Traffic Assessment Data.

4.3.X.Y.3 Flight Element Requirements

These summaries are the second input to Programmatics/Costing. The charts identify the number of Tugs and auxiliary flight elements flown each year for each of the categories listed. For those Tug concepts employing kick stages, recovery of the kick stages is determined from the Flight Summary and/or Detailed Traffic Assessment Data. In addition, summary descriptions of the kick stages used are included where applicable. As with the Flight Summaries, the order of presentation is NASA, DOD and Combined NASA/DOD traffic.

4.3.X.Y.4 Initial Flight Schedule - Programmatics/Cost

This constitutes the last input to the Programmatics/Costing effort. In the capture analyses, it was assumed that, at Tug IOC, enough Tugs of full capability were available to accommodate the entire traffic profile. The Programmatics/Costing and Operations efforts, however, were subject to hardware delivery schedules, turnaround capabilities, etc. which dictated that they assume a graduated build-up in the number of Tug flights flown in the early years of a program as explained in Volume 8. These build-up rates will affect the degree of mission capture as well as the deploy/retrieve combination opportunities in later years. Using the definition of numbers are type of Tug flights to be flown during the build-up period, a representative list of the flights to be flown was compiled from the traffic distributions defined by the capture analysis. These lists cover only the years when the build up rate results in less than complete satisfaction of the capture analysis requirements. It must be emphasized that the costed Flight Build-up charts are only representative since different flights and different combinations of mixed payloads could be selected to satisfy the build-up constraints. Since the effect of the build up rates on total capture is so dependent upon the specific payloads flown, and that selection is dependent on payload priorities not available for this study, the effects have not been included in the traffic distributions contained in this volume.

4.3.X.Y.5 Additional Payload Capture Potential

This material is presented in accordance with the direction supplied by NASA. Where required, clarifying notes are included on the cover page.

4.3.X.Y.6 Detailed Traffic Assessment Data

This paragraph contains the detailed analysis from which the summary charts in the preceding paragraphs were extracted. The material is organized in the following order:

- NASA traffic assessment data
- NASA geosynchronous mixed missions
- NASA non-geosynchronous mixed missions
- DOD traffic assessment data

Each mission (payload) is addressed individually identifying the specific flight mode and number of Tug flights required per year. For the NASA traffic, mixed payload flights are identified first. The specific make-up of these mixed payload flights are identified in the appropriate mixed mission sheets which also indicate the combined weight and volume utilized by the payloads. Where the combined payloads could be arranged in alternate ways, the

combined dimensions of these alternates are also included. In addition to the mixed payload flight distributions, the Traffic Assessment sheets list each payload that is flown independent of other payloads. At the conclusion of both the NASA and DOD traffic Assessment sheets, the flight distributions for each generic mission grouping are summarized with a finer delineation of flight modes than was possible on the Flight Summaries and Flight Element Requirements. A detailed total summary is also provided.

The assessment was conducted within the confines of the groundrules, guidelines, and assumptions cited in paragraph 4.1.2. Generally, the approach was to compare the weight and ΔV required for each payload, or combination of payloads if allowed, with the available P/L length and performance capabilities defined for the concept. An overlying goal was to minimize the number of Tug/Shuttle flights required to effect mission model capture. As each flight was defined, it was entered in the appropriate location on the assessment sheets.

PARAMETER		110A-1		410AD-2		310 / 310RE-3A	
		CAPTURE ANALYSIS	CURRENT	CAPTURE ANALYSIS	CURRENT	CAPTURE ANALYSIS	CURRENT
$W_{INITIAL}$ (lbs)		63721	63490	63721	63490	63777	63490
W_{FIXED} (lbs)		3191	3205	3413	3411	3173 (310) 3396 (310RE)	3190 (310) 3394 (310RE)
PAYLOAD (lbs)	DEPLOY	4014	3901	4914	4862	5417 (310) 5026 (310RE)	5277 4921
	RETRIEVE	N/A	N/A	1574	1552	1618	1573
	ROUND TRIP	N/A	N/A	1080	1063	1096	1077

EFFECT OF REVISED CONCEPT WTS

TABLE 4.3-1

4.3.1 OPTION 1

Deploy: 3500 lbs. starting Dec. 1979

Retrieve: 0 lbs.

Para	Subject	Page
4.3.1.1	Mission Model	4-19
4.3.1.2	Concept 110A-1	4-21
4.3.1.2.1	Performance	4-21
*4.3.1.2.2	Flight Summary	4-29
*4.3.1.2.3	Flight Element Requirements	4-33
*4.3.1.2.4	Initial Flight Schedule	4-38
4.3.1.2.5	Add'l. P/L Capture Potential	4-40
4.3.1.2.6	Detailed Traffic Assessment Data	4-42

*Inputs to Programmatics/Costing - Volume 8

4.3.1.1 Mission Model

Table 4.3.1-1 Space Tug Study Traffic Model

(Option 1)

SPACE TUG STUDY TRAFFIC MODEL — OPTION: 1

MISSION ID	CURRENT DESIGN			LOW COST DESIGN			CALENDAR YEAR											TOTAL
	WT	L	D	WT	L	D	80	81	82	83	84	85	86	87	88	89	90	
1	500	6	5				2	2	2	1	2	1	1	1	2	1	2	17 0
2	800	8	5				1	2		1		1		1		1		7 0
3	1100	10	6				3	7	3	3	1	5	5	6	7	2	3	45 0
4	1500	22	9				1	1		2	1	1		2	1			9 0
5	1800	17	10							3						3		6 0
6	2600	12	8				1		1			1		1			2	6 0
7	3000	20	10				1	1	2	2	1	2		2	1	1		13 0
8	3500	25	14				2	1	1	2	2	2	2	2	2	2	2	20 0
SUB-TOTAL							11 0	14 0	9 0	14 0	7 0	13 0	8 0	15 0	13 0	10 0	9 0	123 0
9	750	7	5				1		1		1		2		1		2	8 0
10	6000	12	8					1			1			1			1	4 0
11	800	8	5				1	1		1		1		1		1		6 0
12	1200	8	4							1		1		1		1		4 0
13	650	8	5							1		1		1		1		4 0
14	400	7	3							1	1	1	1	1	1	1	1	8 0
15	1000	6	5							1	1	1	1	1	1	1	1	8 0
16	2600	12	6							4		4				6		14 0
SUB-TOTAL							2 0	2 0	1 0	9 0	4 0	9 0	4 0	6 0	3 0	11 0	5 0	56 0
17	1000	12	10				1									2		3 0
18	2000	12	10								2							2 0
19	5500	20	12										1	2				3 0
20	900	17	10						2		2							4 0
21	1600	15	10															0 0
22	2500	16	12										1	1		1	1	4 0
23	5000	17	12										2					2 0
24	3300	17	12								2					2		4 0
SUB-TOTAL							1 0	0 0	2 0	0 0	6 0	0 0	4 0	3 0	0 0	5 0	1 0	22 0
TOTAL	NASA						14 0	16 0	12 0	23 0	17 0	22 0	16 0	24 0	16 0	26 0	15 0	201 0
25 (2)				690	12	5	2	2	2	2	2	2	2	2	2	2	2	22 0
26 (3b)				1570	15	5	1		1	1	1		1	1	1		1	8 0
27 (15)				1970	16	10	1		1	1	1	1		1	1	1	1	9 0
28 (17)				2200	12	10				2	2		1		1	1	1	8 0
29 (12b)	SORTIE			2400	20	10												0 0
30 (6)				3480	20	9						2		1		1		4 0
31 (4a)				3480	25	15		2			2			2			2	8 0
SUB-TOTAL							4 0	4 0	4 0	6 0	8 0	5 0	4 0	7 0	5 0	5 0	7 0	59 0
32 (3a)				1570	15	5	4		4	4	4		4	4	4		4	32 0
33 (4b)				3480	25	15	1		2	1		2	1		2	1		10 0
34 (10)				2745	20	9		1		1								2 0
35 (8)				2430	25	12.7	2	2	2	2	2	2	2	2	2	2	2	22 0
36 (11a)				850	9	6												0 0
37 (11b)				850	9	6												0 0
38 (11c)				850	9	6												0 0
39 (5)				735	3	5				3	3		3	3		3	3	18 0
40 (16)				2610	14.5	6.7				4		2	2		2	2		12 0
41 (12a)	SORTIE			6000	20	10				1 1		1 1		1 1		1 1		4 4
SUB-TOTAL							7 0	3 0	8 0	16 1	9 0	7 1	12 0	10 1	10 0	9 1	9 0	100 4
TOTAL							11 0	7 0	12	22 1	17 0	12 1	16 0	17 1	15	14 1	16 0	159 4
COMBINED TOTAL							25 0	23 0	24 0	45 1	34 0	34 1	32 0	41 1	31 0	40 1	31 0	360 4

TABLE 4.3.1-1

4.3.1.2 Concept 110A-1

4.3.1.2.1 Performance

	Page
o Flight Modes (Figure 4.3.1.2-1)	4-22
o Geosynchronous Performance	4-23
o Geosynchronous Performance Sensitivities (Table 4.3.1.2-1)	4-25
o General Performance (Figures 4.3.1.2-2 thru -4)	4-26

Comments:

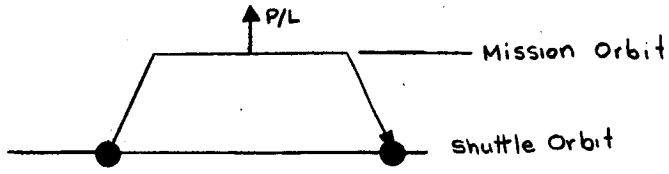
a. The Tug provides no capability for longitudinal positioning of payloads after attaining orbit. The payload (or payloads) is assumed to have on-board capability for any additional maneuvers required for final positioning.

b. No retrieval capability is required.

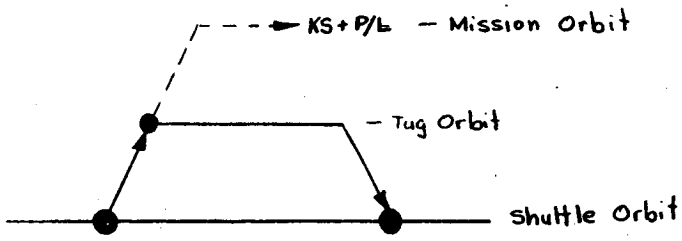
CONCEPT 110A-1

FLIGHT MODES

1. CORE ALONE DEPLOY



2. CORE + AKS DEPLOY



3. CORE EXPENDED DEPLOY - PLANETARY ONLY

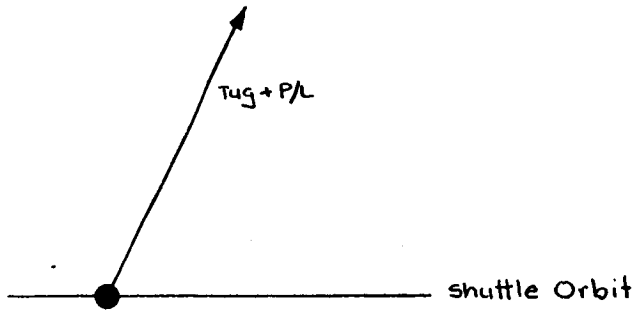


FIGURE 4.3.1.2-1

CONCEPT 110A-1

GEOSYNCH DEPLOY PERFORMANCE

$W_i = W_{PLO} - W_{ADAPT}$

$= 65000 - 1279$

$W_i = \underline{63721}$ lbs

$I_{SP} = 327.2$ sec

$I_{SP_{EFF}} = (.983)\, I_{SP} = \underline{321.6376}$ sec

$W_{FIXED} = \underline{3191}$ lbs

$W_{BO} = W_{FIXED} + 0.17$ Consumables

$= 3191 + 0.17\,C$

Tug Length $= L_T = 335$ in

AKS Length $= L_K = 66$ in

Available P/L Length $= 720 - 335 = 385$ in $= 32.08$ ft $\approx$ **32 ft** w/o KS

$= 720 - 335 - 66 = 319$ in $= 26.58$ ft $\approx$ **26 ft** with KS

NASA MISSIONS

WITHOUT KICK STAGES

$W_{BO} = 3191 + 0.17(329) = 3247$ lbs

$W_{P/L} = f(321.6\text{ sec}, 3247\text{ lbs}) =$ **4014 lbs** (Ref Fig. 4.3.1.2-2)

WITH KICK STAGES

Planetary Missions

KS 101 $W_{P/L} =$ **f(P/L WT, ΔV)** (Ref Fig 4.3.1.2-3)

GEOSYNCH MISSIONS

KS 102 $W_{P/L} =$ **8207 lbs** (Ref Fig 4.3.1.2-4)

CONCEPT 110A-1 (cont)

DOD MISSIONS

WITHOUT KICK STAGES

$$W_{BO} = W_{BO(NASA)} + \Delta W_{COMM}$$

$$= 3247 + 13$$

$$= \underline{3260} \text{ lbs}$$

$$W_{P/L} = f(321.6 \text{ sec}, w_f = 3260 \text{ lbs}) = \boxed{3964 \text{ lbs}}$$ (Ref Fig 4.3.1.2-2)

WITH KICK STAGES

USE NASA Kick Stage Performance

FLIGHT MODE	SENSITIVITY					
	$\frac{\partial P/L}{\partial W_{FIXED}}$ P/L TO FIXED WT (lbs/lbs)	$\frac{\partial P/L}{\partial W_o}$ P/L TO INITIAL WT (lbs/lb)	$\frac{\partial P/L}{\partial I_{sp}}$ P/L TO SPEC. IMPLS (lb/sec)	$\frac{\partial P/L}{\partial \Delta V_{OUT}}$ P/L TO OUTBOUND ΔV (lbs/fps)	$\frac{\partial P/L}{\partial \Delta V_{IN}}$ P/L TO INBOUND ΔV (lbs/fps)	$\frac{\partial P/L}{\partial \Delta V_{AKS}}$ P/L TO AKS ΔV (lbs/fps)
DEPLOY CORE ALONE	-3.83	0.258	117.0	-1.59	-1.21	—
DEPLOY CORE + AKS	-2.32	0.248	90.2	-1.59	-0.70	-0.9

CONCEPT 110A-1

PAYLOAD SENSITIVITIES

TABLE 4.3.1.2-1

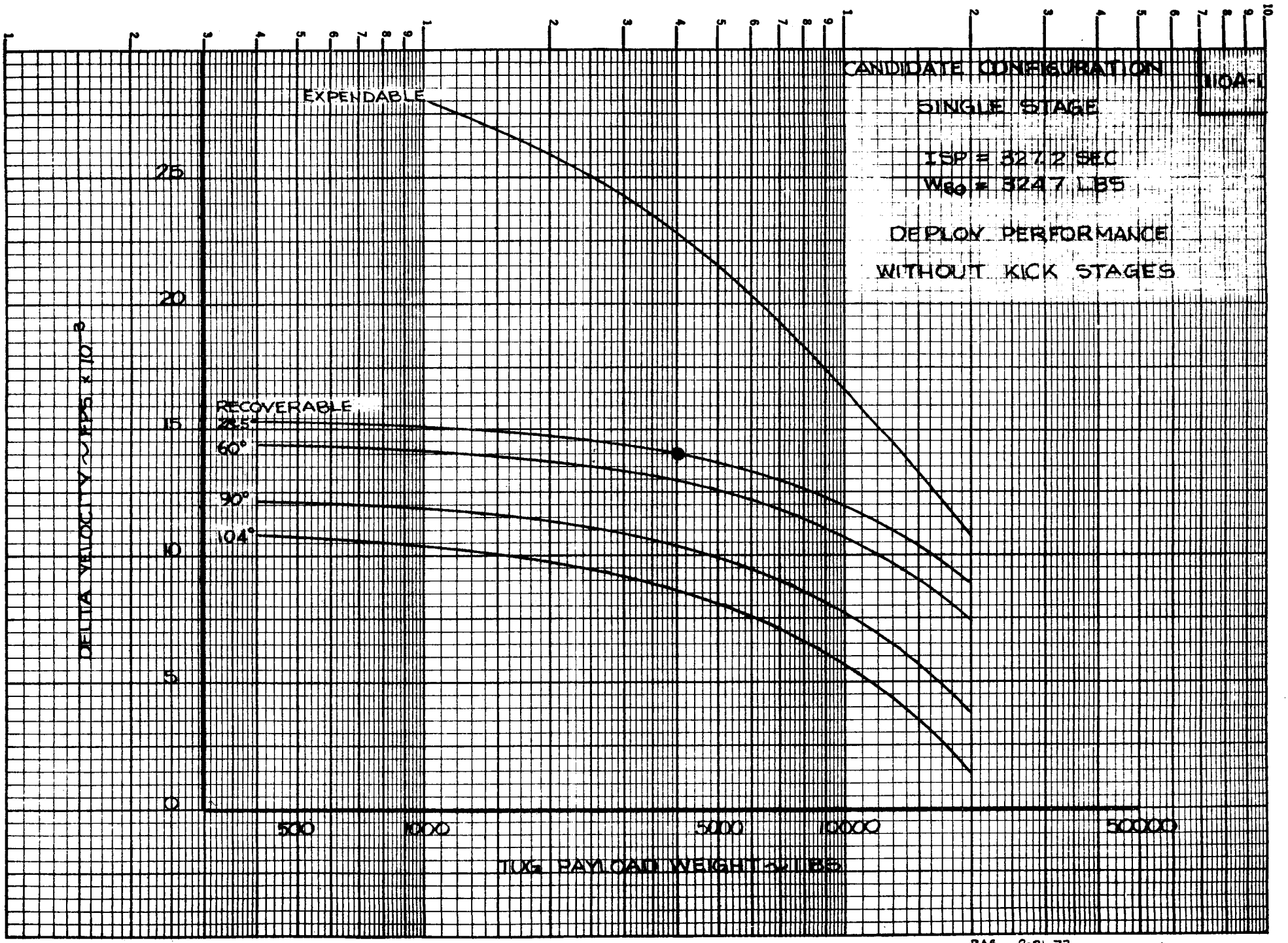


Figure 4.3.1.2-2

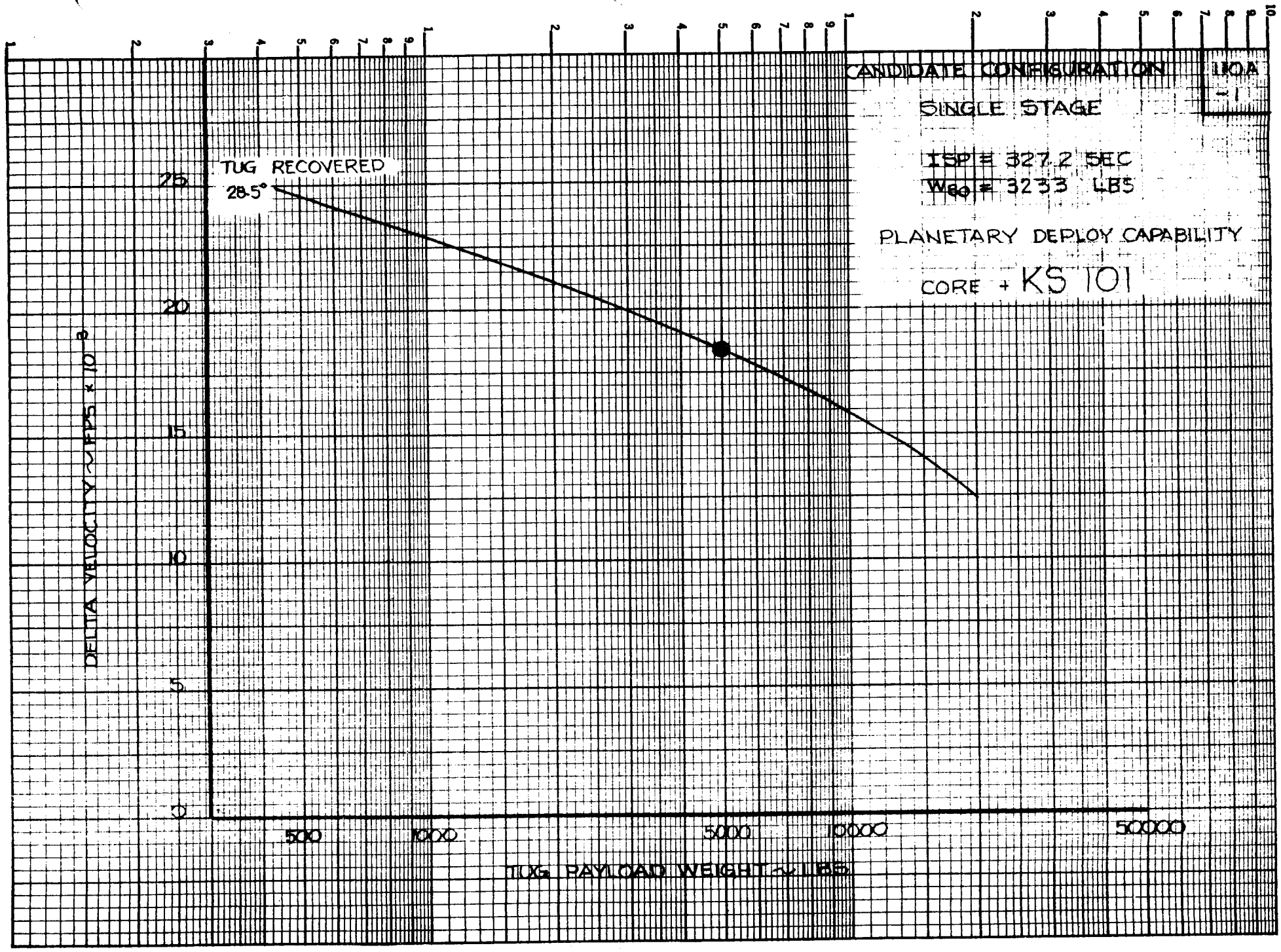


Figure 4.3.1.2-3

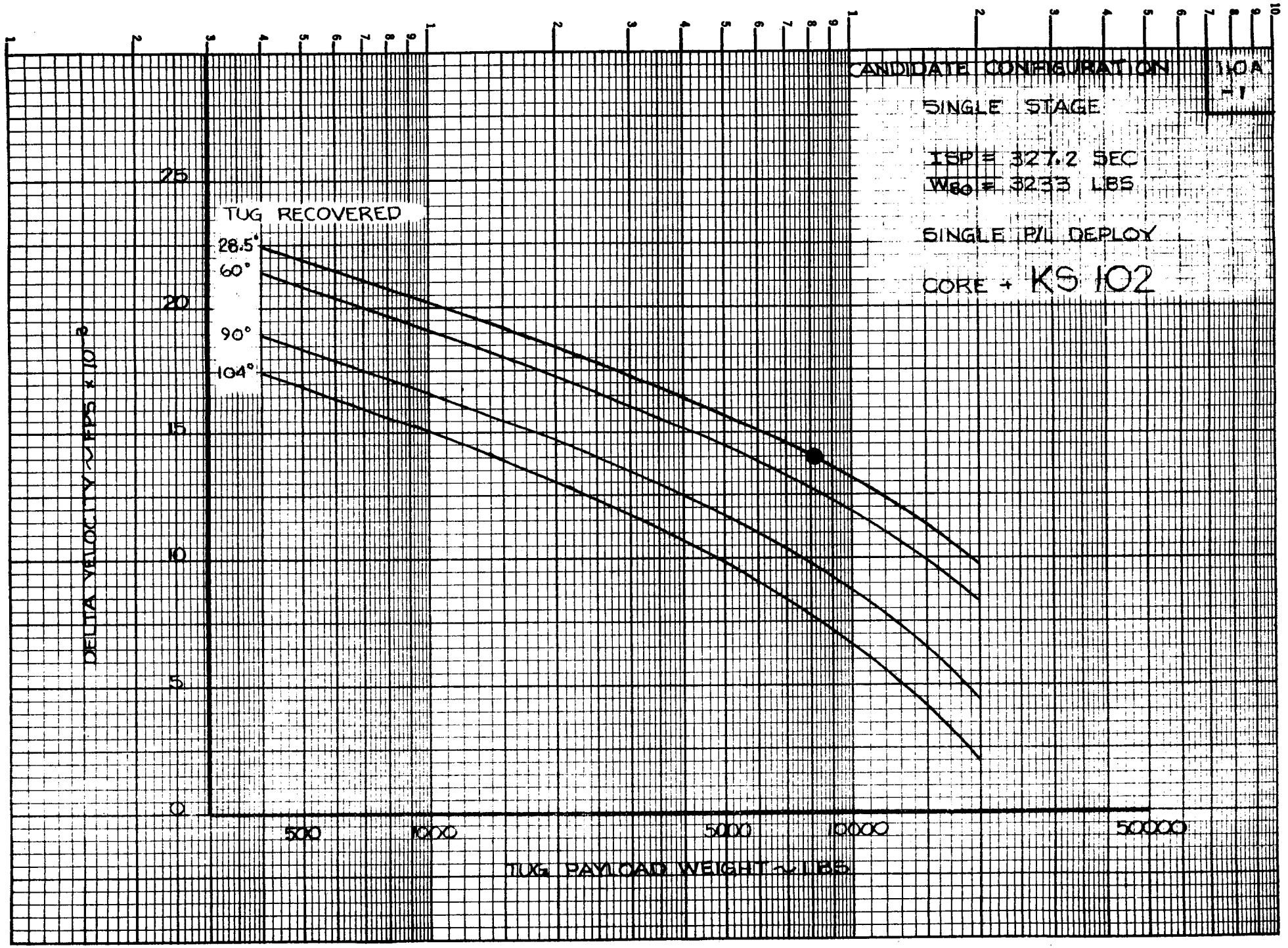


Figure 4.3.1.2-4

4.3.1.2.2 Flight Summary

Table 4.3.1.2-2 NASA Traffic

Table 4.3.1.2-3 DOD Traffic

Table 4.3.1.2-4 Combined NASA/DOD Traffic

Comments:

a. From a Tug viewpoint, all deployments are single payloads, regardless of the number of payloads actually carried. A more detailed breakdown has been provided to satisfy other efforts, such as Programmatics/Costing and Operations.

FLIGHT SUMMARY

OPTION: 1 110A-1

FLIGHT MODE		CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
TOTAL FLIGHTS	SHUTTLE	8	7	8	13	13	11	11	14	8	16	9	118
	TUG												SAME
TUG FLIGHT DISTRIBUTION	DEPLOY	(8)	(7)	(8)	(13)	(13)	(11)	(11)	(14)	(8)	(16)	(9)	(118)
	SINGLE - CORE ALONE	3	2	3	5	7	3	4	6	2	9	4	48
	- CORE + AKS			2		2		3	2				9
	DOUBLE - CORE ALONE	4	1	2	6	4	5	3	2	4	4	3	38
	- CORE + AKS											1	1
	TRIPLE - CORE ALONE	1	3	1	2		3	1	3	2	3	1	20
	- CORE + AKS		1						1				2
MISSION MODEL	(TOTAL)	(14)	(16)	(12)	(23)	(17)	(22)	(16)	(24)	(16)	(26)	(15)	(201)
	DEPLOY	14	16	12	23	17	22	16	24	16	26	15	201
	RETRIEVE												0
	SORTIE												0

TABLE 4.3.1.2-2
NASA TRAFFIC

GRUMMAN

FLIGHT SUMMARY

OPTION: 1 110A-1

FLIGHT MODE		CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
TOTAL FLIGHTS	SHUTTLE	8	6	9	14	11	10	10	12	11	10	11	112
	TUG												SAME
TUG FLIGHT DISTRIBUTION	DEPLOY	(8)	(6)	(9)	(13)	(11)	(9)	(10)	(11)	(11)	(9)	(11)	(108)
	SINGLE - CORE ALONE	5	5	6	6	6	7	5	7	7	6	7	67
	DOUBLE - CORE ALONE	3	1	3	5	3	2	4	3	4	2	3	33
	- CORE + AKS				1	1							2
	TRIPLE - CORE ALONE				1	1		1	1		1	1	6
	SORTIE				(1)		(1)		(1)		(1)		(4)
MISSION MODEL	(TOTAL)	(11)	(7)	(12)	(22)	(17)	(12)	(16)	(17)	(15)	(14)	(16)	(159)
	DEPLOY	11	7	12	21	17	11	16	16	15	13	16	155
	RETRIEVE												0
	SORTIE				1		1		1		1		4

TABLE 4.3.1.2-3

DOD TRAFFIC

GRUMMAN

FLIGHT SUMMARY

OPTION: 1 110A-1

FLIGHT MODE		CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
TOTAL FLIGHTS	SHUTTLE	16	13	17	27	24	21	21	26	19	26	20	230
	TUG												SAME
TUG FLIGHT DISTRIBUTION	DEPLOY	(16)	(13)	(17)	(26)	(24)	(20)	(21)	(25)	(19)	(25)	(20)	(226)
	SINGLE P/L - CORE ALONE	8	7	9	11	13	10	9	13	9	15	11	115
	- CORE + AKS			2		2		3	2				9
	DOUBLE P/L - CORE ALONE	7	2	5	11	7	7	7	5	8	6	6	71
	- CORE + AKS				1	1						1	3
	TRIPLE P/L - CORE ALONE	1	3	1	3	1	3	2	4	2	4	2	26
	- CORE + AKS		1						1				2
	SORTIE				(1)		(1)		(1)		(1)		(4)
MISSION MODEL	(TOTAL)	(25)	(23)	(24)	(45)	(34)	(34)	(32)	(41)	(31)	(40)	(31)	(360)
	DEPLOY	25	23	24	44	34	33	32	40	31	39	31	356
	RETRIEVE												0
	SORTIE				1		1		1		1		4

TABLE 4.3.1.2-4
COMBINED NASA/DOD TRAFFIC

GRUMMAN

FLIGHT ELEMENT REQUIREMENTS OPTION: 1 110A-1

ITEM			CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
SHUTTLE FLIGHTS		TOTAL	8	7	8	13	13	11	11	14	8	16	9	118
BASIC TUG FLIGHTS	ETR	RECOVERED	8	7	8	10	10	8	9	11	7	9	7	94
		EXPENDED					2		1	1		3	1	8
	WTR	RECOVERED				3	1	3	1	2	1	4	1	16
	(TOTAL)		(8)	(7)	(8)	(13)	(13)	(11)	(11)	(14)	(8)	(16)	(9)	(118)
KICK STAGES	KS 101				2		2		3	2				9
	KS 102			1	2					1			1	3
	(TOTAL)			(1)	(4)		(2)		(3)	(3)			(1)	(12)

TABLE 4.3.1.2 -5

NASA TRAFFIC

GRUMMAN

FLIGHT ELEMENT REQUIREMENTS OPTION: 1 110A-1

ITEM			CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
SHUTTLE FLIGHTS		TOTAL	8	6	9	14	11	10	10	12	11	10	11	112
BASIC TUG FLIGHTS	ETR	RECOVERED	8	6	9	10	10	8	8	10	10	7	10	96
		EXPENDED												0
	WTR	RECOVERED				4	1	2	2	2	1	3	1	16
	(TOTAL)		(8)	(6)	(9)	(14)	(11)	(10)	(10)	(12)	(11)	(10)	(11)	(112)
KICK STAGES	KS 101													
	KS 102					1	1							2
	(TOTAL)					(1)	(1)							(2)

TABLE 4.3.1.2-6

DOD TRAFFIC

GRUMMAN

FLIGHT ELEMENT REQUIREMENTS OPTION: 1 110A-1

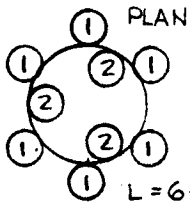
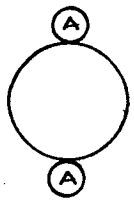
ITEM			CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
SHUTTLE FLIGHTS		TOTAL	16	13	17	27	24	21	21	26	19	26	20	230
BASIC TUG FLIGHTS	ETR	RECOVERED	16	13	17	20	20	16	17	21	17	16	17	190
		EXPENDED					2		1	1		3	1	8
	WTR	RECOVERED				7	2	5	3	4	2	7	2	32
	(TOTAL)		(16)	(13)	(17)	(27)	(24)	(21)	(21)	(26)	(19)	(26)	(20)	(230)
KICK STAGES	KS 101				2		2		3	2				9
	KS 102			1		1	1			1			1	5
	(TOTAL)			(1)	(2)	(1)	(3)		(3)	(3)			(1)	(14)
									RELIABILITY =					+2 FLTS

TABLE 4.3.1.2-7
COMBINED NASA/DOD TRAFFIC

GRUMMAN

CONCEPT 110A-1

KICK STAGE DEFINITION

KICK STAGE DESIGNATION	GEOMETRY (all stages >10 ft diam. & are 5.5 ft long unless otherwise noted)		PERFORMANCE (geosynch) Payload (lbs)	SRM CHARACTERISTICS INDIVIDUAL WEIGHT (lbs)	NUMBER	TOTAL SRM WEIGHT (lbs)	STAGE INERT WEIGHT (lbs)	TOTAL STAGE WEIGHT (lbs)
KS 101	 PLANETARY L = 6 ft 8 in	STAGE 1	5000 lbs TO ΔV = 18,400 fps	1667	6	10002	–	10002
		STAGE 2		1667	3	5001	545	5546
		(TOTAL)						(15548)
KS 102	 DEPLOY AKS		8207	1667	2	3334	529	(3863)

BAC 9-6-73

TABLE 4.3.1.2-8

4.3.1.2.4 Initial Flight Schedule - Programmatics/Cost

Table 4.3.1.2-9 Costed Flight Build-Up

Comments:

a. The capture analysis traffic distribution identifies P/L #8 as a mixed-P/L flight of D1 + D8 in 1981. To accommodate flight test requirements, it would be flown as a single P/L flight using an AKS although the core vehicle has adequate deploy performance capability.

FLIGHT	PAYLOAD ID OF PAYLOADS FLOWN		
	1980	1981	1982
1	9	8*	ALL
2	17	10	
3	26	11	
4		1 + 8	
5		1 + 3 + 4	
6		3 + 3 + 3	
7		25 + 25	
8		31	
9		31	
10		34	
11		35	
12		35	
TOTAL P/L'S FLOWN	3	18	24

TOTAL P/L'S SCHEDULED	25	23	24
TOTAL FLTS SCHEDULED	16	13	17

* Flown with AKS for test purposes only. AKS not req'd for mission.

CONCEPT 110A-1

COSTED FLIGHT BUILDUP

TABLE 4.3.1.2-9

4.3.1.2.5 Additional Payload Capture Potential

Table 4.3.1.2-10 Additional Payload Capture Potential

Comments:

None

OPTION 1

ADDITIONAL PAYLOAD CAPTURE POTENTIAL

MISSIONS EXCLUDED FROM OPTION MISSION MODEL					CONCEPT 110A-1		
DESIGNATION		DEPLOY	RETRIEVE	SORTIE	TUG MODE		
ID NO.	WEIGHT				DEPLOY	RETRIEVE	SORTIE
N 9	1400	8	-	-	8 (KS 102)		
N 17	2000	3	-	-	3 (CORE)		
N 18	3300	2	-	-	2 (CORE)		
N 19	7900	3	-	-	3 (KS 101)		
N 20	1500	4	-	-	4 (EXPEND)		
N 22	4000	4	-	-	0		
N 23	6600	2	-	-	2 (EXPEND)		
N 24	4400	4	-	-	4 (EXPEND)		
D29 (12b)	2400	-	-	5	-		0
D36 (11a)	850	9	-	-	9 (KS 102)		
D37 (11b)	850	9	-	-	9 (KS 102)		
D38 (11c)	850	9	-	-	9 (KS 102)		
TOTALS	DEPLOY	57			53		
	RETRIEVE		N/A			N/A	
	SORTIE			5			0
	(TOTAL)	62			53		

N = NASA
D = DOD

TABLE 4.3.1.2-10

4.3.1.2.6 Detailed Traffic Assessment Data

Table 4.3.1.2-11 NASA Traffic Assessment

Table 4.3.1.2-12 NASA Geosynch Mixed Missions

Table 4.3.1.2-13 NASA Non Geosynch Mixed Missions

Table 4.3.1.2-14 DOD Traffic Assessment

Comments:

a. All missions are core only unless otherwise noted.

TRAFFIC ASSESSMENT: NASA GEOSYNCH

OPTION: 1 (110A-1)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
MIXED PAYLOADS - GEO - See Pages 4-6	CORE														
	DOUBLE DEPLOY			4	1	2	5	3	4	1	2	3	2	2	29
	TRIPLE DEPLOY			1	1						2		1		5
	CORE + KS	KS 102													
	DOUBLE DEPLOY														
	TRIPLE DEPLOY				1						1				2
	(TOTAL)			(5)	(3)	(2)	(5)	(3)	(4)	(1)	(5)	(3)	(3)	(2)	(36)
3	SINGLE DEPLOY	CORE ALONE													
	DOUBLE DEPLOY	"								1					1
	TRIPLE DEPLOY	"			2	1			1	1		2		1	8
	(TOTAL)				(2)	(1)			(1)	(2)		(2)		(1)	(9)
4	SINGLE DEPLOY	CORE ALONE					2								2
	(TOTAL)						(2)								(2)
5	SINGLE DEPLOY												2		2
	(TOTAL)												(2)		(2)
6	SINGLE DEPLOY					1									1
	DOUBLE DEPLOY	Ⓐ KS 102												1 Ⓐ	1 Ⓐ
	(TOTALS)					(1)								(1)	(2)
7	SINGLE DEPLOY					1	1	1	1		1	1			6
	(TOTAL)					(1)	(1)	(1)	(1)		(1)	(1)			(6)
8	SINGLE DEPLOY						1		1	1	1		1		5
	(TOTAL)						(1)		(1)	(1)	(1)		(1)		(5)
	[SUB-TOTAL]			[5]	[5]	[5]	[9]	[4]	[7]	[4]	[7]	[6]	[6]	[4]	[62]

TABLE 4.3.1.2-11

TRAFFIC ASSESSMENT

OPTION: 1 (110A-1)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
MIXED P/L'S NON-GEO (See Page 7)	Double Deploy	CORE ALONE					1	1	1	1		1	2	1	8
	TRIPLE DEPLOY						1		1		1				3
	(TOTAL)						(2)	(1)	(2)	(1)	(1)	(1)	(2)	(1)	(11)
9	SINGLE DEPLOY			1		1		1		2		1		2	8
	(TOTAL)			(1)		(1)		(1)		(2)		(1)		(2)	(8)
10	SINGLE DEPLOY				1			1			1			1	4
	(TOTAL)				(1)			(1)			(1)			(1)	(4)
11	SINGLE DEPLOY			1	1		1		1		1		1		6
	(TOTAL)			(1)	(1)		(1)		(1)		(1)		(1)		(6)
16	TRIPLE DEPLOY						1		1				2		4
	(TOTAL)						(1)		(1)				(2)		(4)
17	SINGLE DEPLOY			1									2		3
	(TOTAL)			(1)									(2)		(3)
18	SINGLE DEPLOY							2							2
	(TOTAL)							(2)							(2)
19	SINGLE DEPLOY	KS 102								1	2				3
	(TOTAL)									(1)	(2)				(3)
20	SINGLE DEPLOY	KS 102				2		2							4
	(TOTAL)	KS = 14.5K				(2)		(2)							(4)
22	SINGLE DEPLOY	EXPEND TUG								1	1		1	1	4
	(TOTAL)									(1)	(1)		(1)	(1)	(4)
15	SINGLE DEPLOY										1				1
	(TOTAL)										(1)				(1)

TABLE 4.3.1.2-11 (cont)

TRAFFIC ASSESSMENT

OPTION: 1 (110A-1)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
23	SINGLE DEPLOY	KS 102								2					2
	(TOTAL)									(2)					(2)
24	SINGLE DEPLOY	EXPEND TUG						2					2		4
	(TOTAL)							(2)					(2)		(4)
NASA GEO-SYNCH TRAFFIC SUMMARY	SINGLE DEPLOY	CORE ALONE				2	4	1	2	1	2	1	3		16
	DOUBLE DEPLOY	CORE ALONE		4	1	2	5	3	4	2	2	3	2	2	30
	TRIPLE DEPLOY	CORE ALONE		1	3	1			1	1	2	2	1	1	13
	(SUB-TOTAL)			(5)	(4)	(5)	(9)	(4)	(7)	(4)	(6)	(6)	(6)	(3)	(59)
	DOUBLE DEPLOY	CORE + AKS												1	1
	TRIPLE DEPLOY	CORE + AKS			1						1				2
	(SUB-TOTAL)				(1)						(1)			(1)	(3)
	(TOTAL)			(5)	(5)	(5)	(9)	(4)	(7)	(4)	(7)	(6)	(6)	(4)	(62)
NASA NON-GEO E.O. TRAFFIC SUMMARY	SINGLE DEPLOY	CORE ALONE		2	2	1	1	2	1	2	3	1	1	3	19
	DOUBLE DEPLOY	CORE ALONE					1	1	1	1		1	2	1	8
	TRIPLE DEPLOY	CORE ALONE					2		2		1		2		7
	(TOTAL)			(2)	(2)	(1)	(4)	(3)	(4)	(3)	(4)	(2)	(5)	(4)	(34)
PLANETARY	RECOVERABLE	CORE ALONE		1				2					2		5
		CORE + KS 102				2		2		3	2				9
	EXPENDED							2		1	1		3	1	8
	(TOTAL)			(1)		(2)		(6)		(4)	(3)		(5)	(1)	(22)
TOTAL TRAFFIC DIST				8	7	8	13	13	11	11	14	8	16	9	118

TABLE 4.3.1.2-11 (cont)

MIXED MISSIONS - GEOSYNCH OPTION: 1 (110A-1)

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
80		②	①	③	①	-	①	①	②	-	-	-
	1	1							1		4000	31 x 14
	2	1							1		"	"
	3		1					1			3800	28 x 10 20 x 15
	4			1			1				3700	22 x 8 12 x 14
	5			2	1						3700	32 x 12 22 x 15
81		②	②	⑦	①	-	-	①	①	-	-	-
	1	1							1		4000	31 x 14
	2		2					1		KS 102	4600	20 x 15
	3	1		1	1						3100	32 x 11 32 x 14 22 x 15
	④			3							3300	30 x 6 20 x 12 10 x 13
	⑤			3							"	"
82	-	②	-	③	-	-	①	②	①	-	-	-
	1	1							1		4000	31 x 14
	2	1						1			3500	26 x 10 20 x 15
	③							1			3000	20 x 10
	④						1				2600	12 x 8
	⑤			3							3300	30 x 6 20 x 12 10 x 13
83	-	①	①	③	②	③	-	②	②	-	-	-
	1	1							1		4000	31 x 14
	②								1		3500	25 x 14
	3		1					1			3800	28 x 10 20 x 15
	④							1			3000	20 x 10
	5			1		1					2900	27 x 10
	6			1		1					"	"
	7			1		1					"	"
	⑧				1						1500	22 x 9
	⑨				1						"	"
84	-	②	-	①	①	-	-	①	②	-	-	-
	1	1							1		4000	31 x 14
	2	1							1		"	"
	③							1			3000	10 x 6
	4			1	1						2600	32 x 9 22 x 15

TABLE 4.3.1.2-12

MIXED MISSIONS - GEOSYNCH OPTION: 1 (110A-1)

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
85	-	①	①	⑤	①	-	①	②	②	-	-	-
	1	1							1		4000	31 x 14
	②								1		3500	25 x 14
	3		1					1			3800	{28 x 10, 20 x 15}
	④							1			3000	20 x 10
	5			1			1				3700	{22 x 8, 12 x 14}
	6			1	1						2600	{32 x 9, 22 x 15}
	⑦			3							3300	{30 x 6, 20 x 12, 10 x 13}
86	-	①		⑤	-	-	-	-	②	-	-	-
	1	1							1		4000	31 x 14
	②								1		3500	25 x 14
	③			3							3300	{30 x 6, 30 x 12, 30 x 13}
	④			2							2200	{80 x 6, 10 x 12}
87	-	①	①	⑥	②	-	①	②	②	-	-	-
	1	1							1		4000	31 x 14
	②								1		3500	25 x 14
	3		1					1			3800	{28 x 10, 20 x 15}
	④							1			3000	20 x 10
	5			2			1			KS 102	4800	22 x 14
	6			2	1						3700	{32 x 12, 22 x 15}
	7			2	1						"	"
88	-	②	-	⑦	①	-	-	①	②	-	-	-
	1	1							1		4000	31 x 14
	2	1							1		"	"
	③							1			3000	20 x 10
	4			1	1						2600	{32 x 9, 22 x 15}
	⑤			3							3300	{30 x 6, 20 x 12, 10 x 13}
	⑥			3							"	"
89	-	①	①	②	-	③	-	①	②	-	-	-
	1	1							1		4000	31 x 14
	②								1		3500	25 x 14
	3		1					1			3800	{28 x 10, 20 x 15}
	4			2		1					4000	27 x 12
	⑤					1					1800	17 x 10
	⑥					1					"	"

TABLE 4.3.1.2-12 (cont)

MIXED MISSIONS - GEOSYNCH OPTION: 1 (110A-11)

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
90	—	②	-	③	-	-	②	-	②	—	—	—
	1	1							1		4000	31 x 14
	2	1							1		"	"
	③						2			KS 102	5200	24 x 8
	④			3							3300	30 x 6 20 x 12 10 x 13

TABLE 4.3.1.2-12 (cont)

MISSIONS NON-GEOSYNCH OPTION: I C110A-11

	FLT NO	PAYLOAD #	12	13	14	15	16	#	#	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
80	-	NOT APPLICABLE										
81	-	NOT APPLICABLE										
82	-	NOT APPLICABLE										
83	-		1	1	1	1	4			-	-	-
	1						3			100°	7800	24x12, 12x13
	2					1	1			100°	3600	18x6, 12x11
	3		1	1	1					90°	2250	23x5, 15x9, 8x9
84	-				1	1				-	-	-
	1				1	1				90°/100°	1400	13x5, 7x8
85	-		1	1	1	1	4			-	-	-
	1						3			100°	7800	24x12, 12x13
	2					1	1			100°	3600	18x6, 12x11
	3		1	1	1					90°	2250	23x5, 15x9, 8x9
86	-				1	1				-	-	-
	1				1	1				90°/100°	1400	13x5, 7x8
87	-		1	1	1	1				-	-	-
	1					1				100°	3600	18x6, 12x11
	2		1	1	1					90°	2250	23x5, 15x9, 8x9
88	-				1	1				-	-	-
	1				1	1				90°/100°	1400	13x5, 7x8
89	-		1	1	1	1	6			-	-	
	1						3			100°	7800	24x12, 12x13
	2						3			"	"	
	3		1			1				90/100	2200	14x5, 8x9
	4			1	1					90	1050	15x5, 8x8
90	-				1	1				-	-	-
	1				1	1				90°/100°	1400	13x5, 7x8

TABLE 4.3.1.2-13

TRAFFIC ASSESSMENT

OPTION: 1 (110A-1)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
25	DOUBLE DEPLOY			1	1	1	1	1	1	1	1	1	1	1	11
26	SINGLE DEPLOY			1		1	1	1		1	1	1		1	8
27	SINGLE DEPLOY			1		1	1	1	1		1	1	1	1	9
28	SINGLE DEPLOY									1		1	1	1	4
	DOUBLE DEPLOY	KS 102					1	1							2
	(TOTAL)						(1)	(1)		(1)		(1)	(1)	(1)	(6)
30	SINGLE DEPLOY								2		1		1		4
31	SINGLE DEPLOY				2			2			2			2	8
32	DOUBLE DEPLOY			2		2	2	2		2	2	2		2	16
33	SINGLE DEPLOY			1		2	1		2	1		2	1		10
34	SINGLE DEPLOY				1		1								2
35	SINGLE DEPLOY			2	2	2	2	2	2	2	2	2	2	2	22
39	TRIPLE DEPLOY						1	1		1	1		1	1	6
40	DOUBLE DEPLOY						2		1	1		1	1		6

TABLE 4.3.1.2-14

TRAFFIC ASSESSMENT

OPTION: 1 (110A-1)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION												
			CALENDAR YEAR												TOTAL
			79	80	81	82	83	84	85	86	87	88	89	90	
41	SORTIE						1		1		1		1		4
DOD TRAFFIC SUMMARY	SINGLE DEPLOY	CORE ALONE		5	5	6	6	6	7	5	7	7	6	7	67
	DOUBLE DEPLOY	CORE ALONE		3	1	3	5	3	2	4	3	4	2	3	33
	DOUBLE DEPLOY	CORE + K.S.					1	1							2
	TRIPLE DEPLOY	CORE ALONE					1	1		1	1		1	1	6
	SORTIE	CORE ALONE					1		1		1		1		4
	(TOTAL)			(8)	(6)	(9)	(14)	(11)	(10)	(10)	(12)	(11)	(10)	(11)	(112)

TABLE 4.3.1.2-14 (cont)

4.3.2 OPTION 2

Deploy:	3500 lbs.	starting Dec. 1983
Retrieves:	3500 lbs.	

Para.	Subject	Page
4.3.2.1	Mission Model	4-52
4.3.2.2	Concept 410AD-2	4-55
4.3.2.2.1	410AD Performance	4-55
*4.3.2.2.2	410AD Flight Summary	4-72
*4.3.2.2.3	410AD Flight Element Requirements	4-76
*4.3.2.2.4	410AD Initial Flight Schedule	4-81
4.3.2.2.5	410AD Add'l P/L Capture Potential	4-83
4.3.2.2.6	410AD Detailed Traffic Assessment Data	4-85

*Inputs to Programmatics/Costing - Volume 8

4.3.2.1 Option 2 Mission Model

Table 4.3.2-1 Space Tug Study Traffic Model
(Option 2)

SPACE TUG STUDY TRAFFIC MODEL — OPTION: 2

MISSION ID	CURRENT DESIGN			LOW COST DESIGN			CALENDAR YEAR											TOTAL
	WT	L	D	WT	L	D	80	81	82	83	84	85	86	87	88	89	90	
1				900	10	6					2/2	1/1	1/2	1/1	2/1	1/1	2/2	10/10
2				1700	8	8					/3	1/1	/2	1/	/1	1/	/1	3/8
3				2100	12	8					1/3	5/7	5/3	6/3	7/1	2/5	3/5	29/27
4				1800	10	14					1/2	1/1	/1	2/	1/2	/1	/1	5/8
5				2800	12	14						/3				3/		3/3
6	2600	12	8									1/		1/			2/	4/0
7	3000	20	10								1/	2/		2/	1/	1/		7/0
8	3500	25	14								2/	2/	2/	2/	2/	2/	2/	14/0
SUB-TOTAL											7/10	13/13	8/8	15/4	13/5	10/7	9/9	75/56
9				1400	9	6					1/		2/		1/		2/	6/0
10	6000	12	8								1/			1/			1/	3/0
11				1700	8	8						1/1	/1	1/	/1	1/	/1	3/4
12				2000	8	6					/1	1/	/1	1/	/1	1/	/1	3/4
13				1000	7	7					/1	1/	/1	1/	/1	1/	/1	3/4
14				800	10	5					1/1	1/1	1/1	1/1	1/1	1/1	1/1	7/7
15				2000	8	11					1/1	1/1	1/1	1/1	1/1	1/1	1/1	7/7
16				4500	11	13						4/4		/4		6/		10/8
SUB-TOTAL											4/4	9/7	4/5	6/6	3/5	11/2	5/5	42/34
17	1000	12	10													2/		2/0
18	2000	12	10								2/							2/0
19	5500	20	12										1/	2/				3/0
20	900	17	10								2/							2/0
21	1600	15	10															0/0
22	2200	16	12										1/	1/		1/	1/	4/0
23	5000	17	12										2/					2/0
24	3300	17	12								2/					2/		4/0
SUB-TOTAL											6/		4/	3/		5/	1/	19/0
TOTAL	NASA										17/14	22/20	16/13	24/10	16/10	26/9	15/14	136/90
25 (2)				690	12	5					2/2	2/2	2/2	2/2	2/2	2/2	2/2	14/14
26 (3b)				1570	15	5					1/1		1/1	1/1	1/1		1/1	5/5
27 (15)				1970	16	10					1/1	1/1		1/1	1/1	1/1	1/1	6/6
28 (17)				2200	12	10					2/		1/		1/	1/2	1/2	6/4
29 (12b)	SORTIE			2400	20	10												0/0
30 (6)				3480	20	9						2/		1/		1/		4/0
31 (4a)				3480	25	15					2/2			2/2			2/2	6/6
SUB-TOTAL											8/6	5/3	4/3	7/6	5/4	5/5	7/8	41/35
32 (3a)				1570	15	5					4/4		4/4	4/4	4/4		4/4	20/20
33 (4b)				3480	25	15						2/2	1/1		2/2	1/1		6/6
34 (10)				2745	20	9					/1		/1		/1			0/3
35 (8)				2430	25	12.7					2/2	2/2	2/2	2/2	2/2	2/2	2/2	14/14
36 (11a)				850	9	6									3/			3/0
37 (11b)				850	9	6					3/					3/		6/0
38 (11c)				850	9	6						3/					3/	6/0
39 (5)				735	3	5					3/		3/	3/		3/	3/	15/0
40 (16)				2610	14.5	6.7						2/	2/4		2/2	2/2		8/8
41 (12a)	SORTIE			6000	20	10						1/1		1/1		1/1		3/3
SUB-TOTAL											12/7	10/5	12/12	10/7	13/11	12/6	12/6	81/54
TOTAL	DOD										20/13	15/8	16/15	17/13	18/15	17/11	19/14	122/89
COMBINED TOTAL											37/27	37/28	32/28	41/23	34/25	43/20	34/28	258/179

TABLE 4.3.2-1

4.3.2.2 Concept 410AD-2

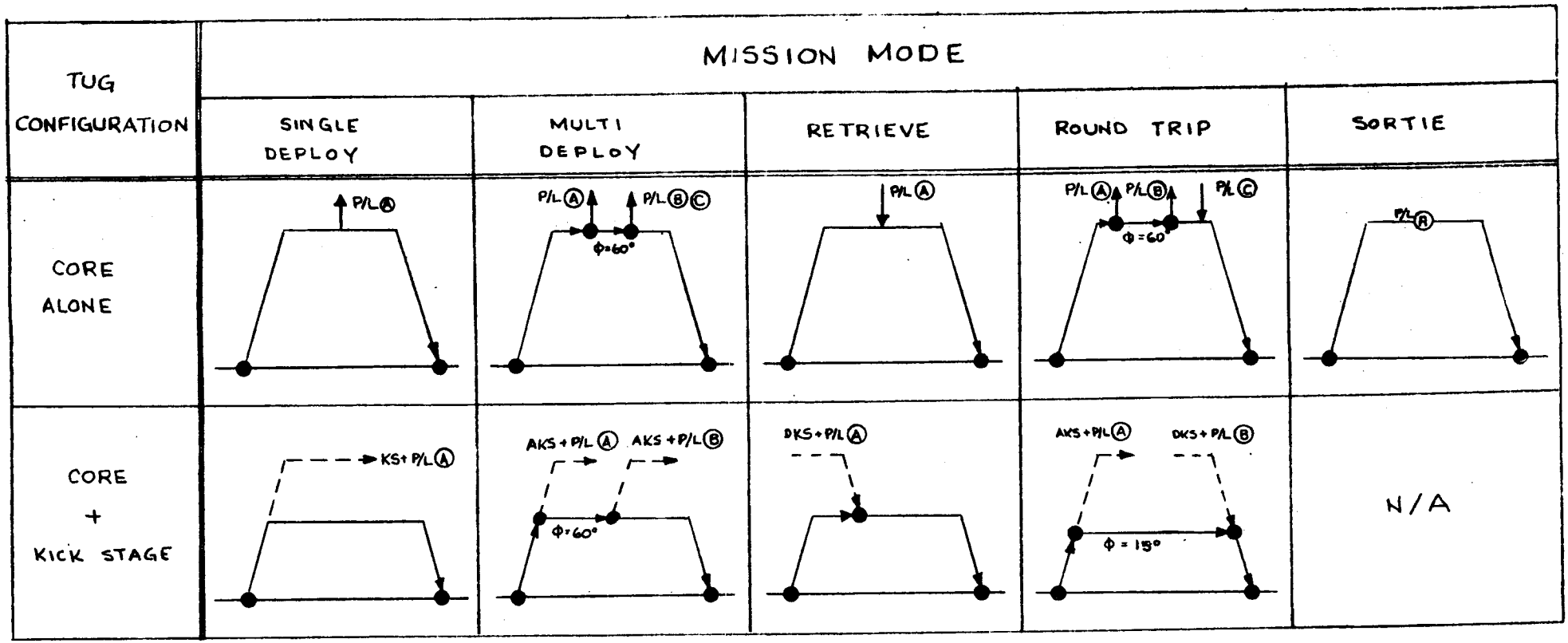
4.3.2.2.1 410AD Performance

	Page
o Flight Modes	
- Figure 4.3.2.2-1	4-56
o Geosynchronous Performance	4-57
- Figures 4.3.2.2-2,-3	
o Geosynchronous Performance Sensitivity	4-63
- Table 4.3.2.2-1	
o General Performance	4-64
- Figures 4.3.2.2-4 thru -11	

Comments:

a. For multi deploy flights, the Tug provides a one-time 60° longitude shift capability after attaining mission orbit for payload positioning.

b. For triple deploy flights, one P/L is deployed upon insertion into mission orbit. The remaining two P/L's are deployed following a 60° phasing by the Tug.



CONCEPT 410AD-2

FLIGHT MODES

FIGURE 4.3.2.2-1

CONCEPT 410AD-2

GEOSYNCH PERFORMANCE

REFERENCES:

a. 410AD-1 Concept Definition, Issue 1, dated 16 August 1973

b. B81M047-73054, "Tug Requirements, Revision 2," dated 15 Aug 1973

GENERAL INFORMATION

W_{FIXED} = 3413 lbs

$W_i = P/L_o - W_{ADAPT}$

$= 65000 - 1279$

W_i = 63721 lbs

$W_{BOI} = W_{FIXED} + f(cons)$

ISP = 338 sec

$ISP_{EFF} = .983\ ISP$ = 332.254 sec

Tug Length = L_T = 297 in

Kick Stage Length = L_K = 66 in

Orbiter P/L Bay Length = L_o = 720 in

Available P/L Bay Length = $L_P = L_o - (L_T + x L_K)$

$L_{P(w/o\ K.S.)}$ = 720 - 297	= 423 in	= 35.25 ft	≈	35 ft
$L_{P(with\ 1\ K.S.)}$ = 720 - (297 + 66)	= 357 in	= 29.75 ft	≈	29 ft
$L_{P(with\ 2\ K.S.)}$ = 720 - (297 + 132)	= 291 in	= 24.25 ft	≈	24 ft

NOTE: Kick Stage Diameter = 10-12 ft

NASA MISSIONS

WITHOUT KICK STAGES

Single Payload

$W_{BO(Deploy)} = W_{BOI} - W_{RTRV} = 3413 + 0.17(350) - 107$ = 3365.5 lbs

$W_{BO(Retrieve)} = W_{BOI} = 3413 + 0.28(491)$ = 3550 lbs

$W_{BO(Round\ Trip)} = W_{BOI} = 3413 + 0.27(602)$ = 3576 lbs

CONCEPT 410AD-2 (cont)

Single Payload (cont)

$W_{P/L\,(Deploy)} = f(W_i = 63721, W_{BO} = 3365.5, ISPE = 332.254) = \boxed{4914 \text{ lbs}}$ (Ref Fig 4.3.2.2-4)

$W_{P/L\,(Retrieve)} = f(63721, 3550, 332.254) = \boxed{1574 \text{ lbs}}$ (Ref Fig 4.3.2.2-5)

$W_{P/L\,(Round\ Trip)} = f(63721, 3576, 332.254) = \boxed{1080 \text{ lbs}}$ (Ref Fig 4.3.2.2-6)

Multi-Payloads

$W_{P/L\,(Deploy)} = f(\text{Figure } 4.3.2.2-2)$

$W_{P/L\,(Round\ Trip)} = f(\text{Figure } 4.3.2.2-3)$

WITH KICK STAGES

KS 401 Planetary Deploy

$\omega_{BO} = \omega_{BOI} - \omega_{RTRV} = 3413 + 0.17(265) - 107 = \underline{3351}$ lbs

$\omega_{P/L\,(Planetary)} = f(P/L\,wt, \Delta V) = \boxed{5000 \text{ lbs TO } \Delta V = 18{,}400 \text{ fps}}$ See Fig 4.3.2.2-7

KS 403 Single P/L Deploy - Retrieval on Later Flight

$\omega_{BO} = \omega_{BOI} = 3413 + 0.17(265) - 107 = \underline{3351}$ lbs (Deploy Flight)

$\omega_{BO} = \omega_{BOI} = 3413 + 0.28(660) = \underline{3598}$ lbs (Retrieve Flight)

$\omega_{P/L} = f(\omega_i, \omega_{BO}, ISPE, \Delta V) = \boxed{3920 \text{ lbs}}$ See Fig 4.3.2.2-8

KS 404 Double P/L Deploy - Individual Retrieval on Later Flights

$\omega_{BO} = \omega_{BOI} - \omega_{RTRV} = 3413 + 0.17(335) - 107 = \underline{3363}$ lbs (Deploy Flight)

$\omega_{BO} = \omega_{BOI} = 3413 + 0.28(660) = \underline{3598}$ lbs (Retrieval Flight)

$\omega_{P/L} = f(\omega_i, \omega_{BO}, ISPE, \Delta V) = \boxed{2770 \text{ lbs/PL}}$ See Fig 4.3.2.2-9

CONCEPT 410AU-2 (cont)

KS 405 Single P/L Round Trip

$\omega_{BO} = \omega_{BOI} = 3413 + 0.27(522) = \underline{3554}$ lbs

$\omega_{P/L} = f(\omega_i, \omega_{BO}, ISPE, \Delta V) =$ **2640 lbs** See Fig 4.3.2.2-10

KS 405A Deploy Heavy, Non-Recoverable P/L On Round-Trip Flight

$\omega_{BO} = \omega_{BOI} = 3413 + 0.27(522) = \underline{3554}$ lbs

$\omega_{P/L} = f(\omega_i, \omega_{BO}, ISP, \Delta V) =$ **6620 lbs** See Fig 4.3.2.2-11

CONCEPT 410AD-2 (cont)

DOD MISSIONS

WITHOUT KICK STAGES

Single Payload

$W_{BO} = W_{BO(NASA)} + \Delta W_{comm} = W_{BO(NASA)} + 33$

$W_{BO(DEPLOY)} = 3365 + 33 = \underline{3398}$ lbs

$W_{BO(RETRIEVE)} = 3550 + 33 = \underline{3583}$ lbs

$W_{BO(ROUND\ TRIP)} = 3576 + 33 = \underline{3609}$ lbs

			See
$W_{P/L(Deploy)}$	=	4798 lbs	Fig 4.3.2.2-4
$W_{P/L(Retrieve)}$	=	1525 lbs	Fig 4.3.2.2-5
$W_{P/L(Round\ Trip)}$	=	1044 lbs	Fig 4.3.2.2-6

Multi-Payloads

$W_{P/L(Deploy)} = f$ (Figure 4.3.2.2-2)

$W_{P/L(Retrieve)} = f$ (Figure 4.3.2.2-3)

WITH KICK STAGES

Use NASA Kick Stage Performance

See Figures 4.3.2.2-8 through -11

K+E 10 X 10 TO ½ INCH 46 1327
7 X 10 IN. • ALBANENE® MADE IN U.S.A.
KEUFFEL & ESSER CO.

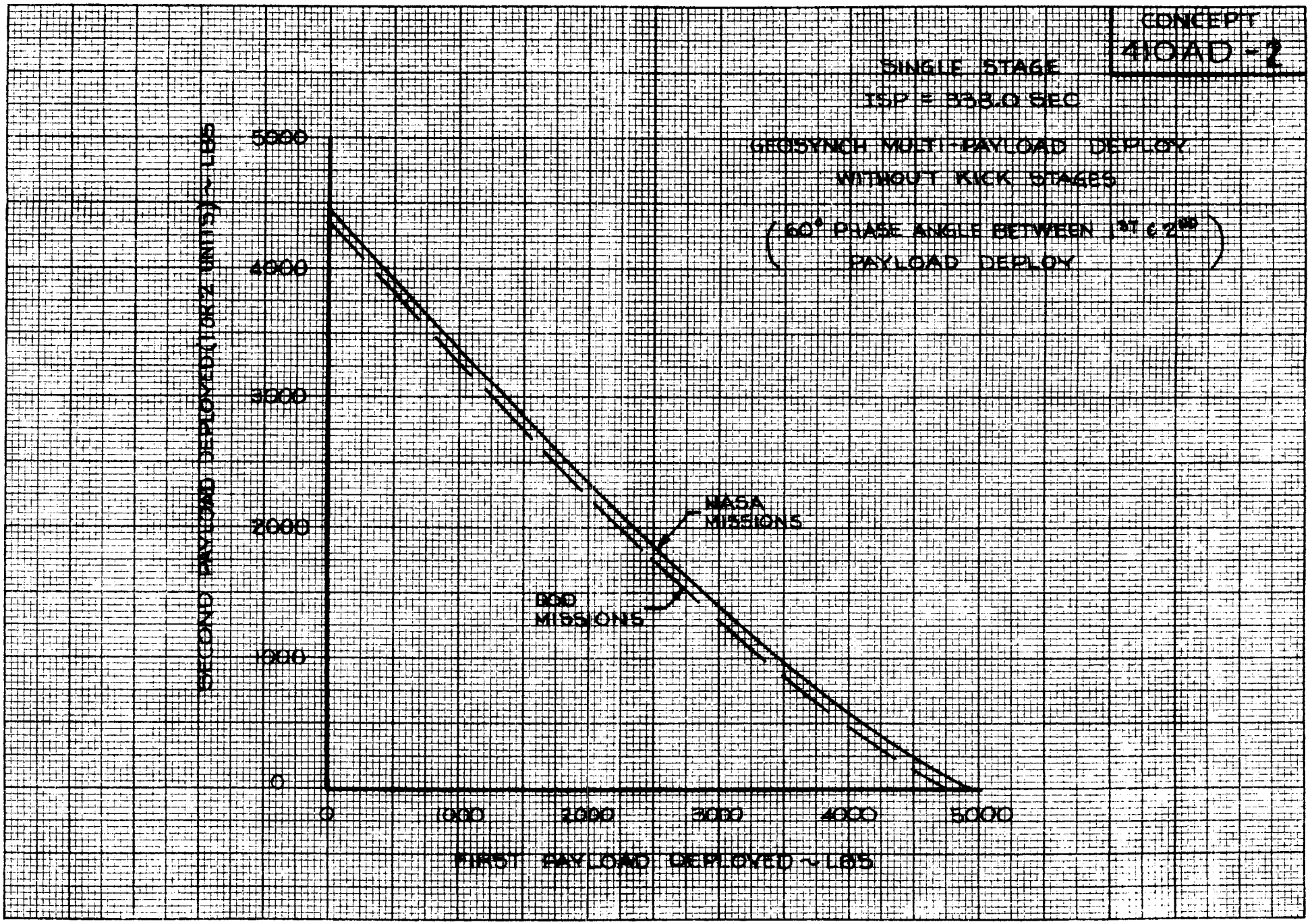


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FIGURE 4.3.2.2-2

K+E 10 X 10 TO ½ INCH 46 1327
7 X 10 IN • ALBANENE®
KEUFFEL & ESSER CO. MADE IN U.S.A.

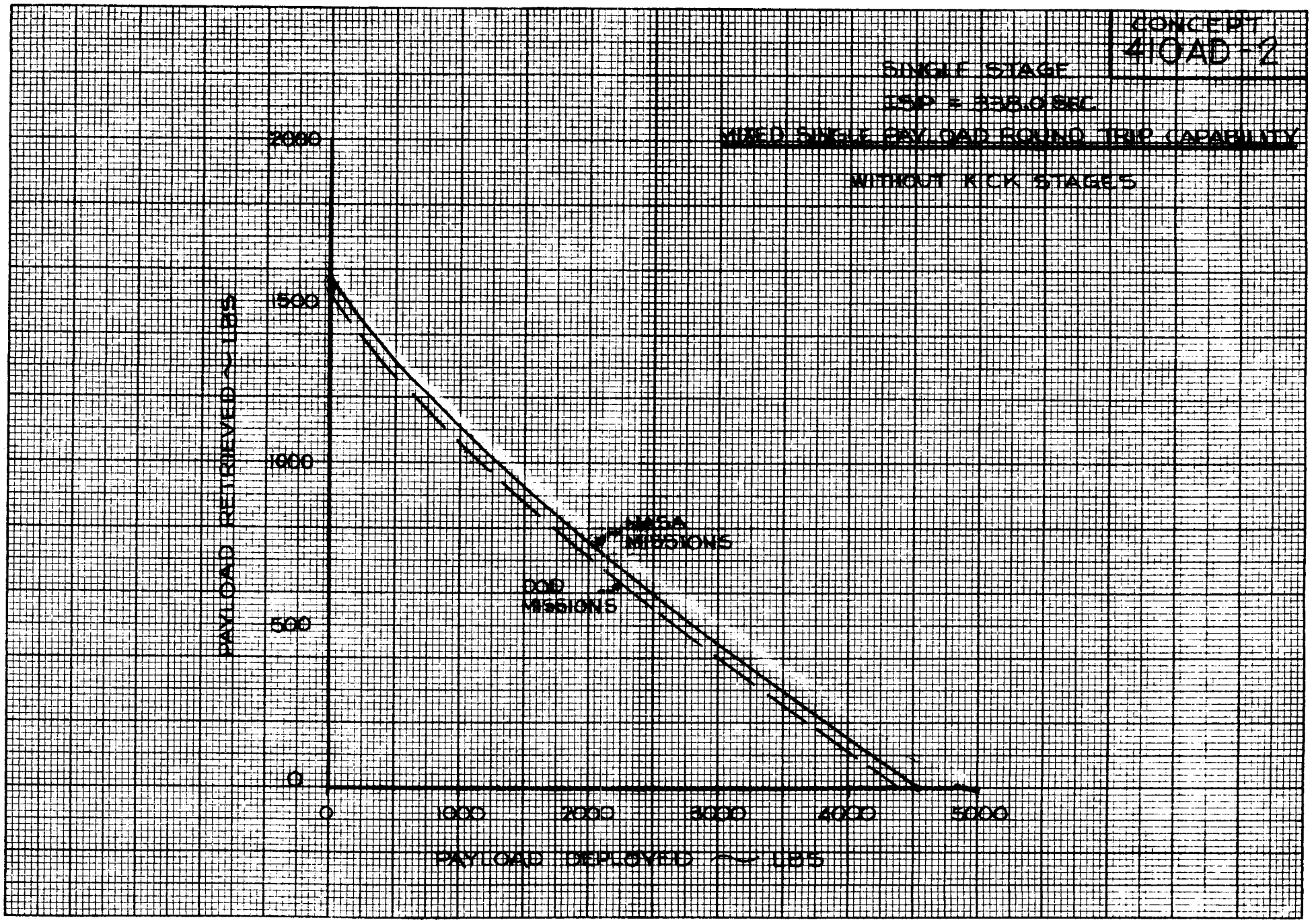

FIGURE 4.3.2.2-3

BAS 8-24-73

FLIGHT MODE	SENSITIVITY					
	$\partial PL/\partial W_{FIXED}$ P/L TO FIXED WEIGHT (lbs/lb)	$\partial PL/\partial W_o$ P/L TO INITIAL WEIGHT (lbs/lb)	$\partial PL/\partial I_{SP}$ P/L TO SPECIFIC IMPULSE (lbs/sec)	$\partial PL/\partial \Delta V_{OUT}$ P/L TO OUTBOUND ΔV (lbs/fps)	$\partial PL/\partial \Delta V_{IN}$ P/L TO INBOUND ΔV (lbs/fps)	$\partial PL/\partial \Delta V_{AKS}$ P/L TO AKS ΔV (lbs/fps)
DEPLOY CORE ALONE	-3.66	0.27	97.0	-1.6	-1.2	-
DEPLOY CORE + AKS	-2.66	0.26	93.0	-1.6	-0.8	-0.7
RETRIEVE CORE ALONE	-1.37	0.10	55.0	-0.6	-0.7	-
ROUND TRIP CORE ALONE	-1.00	0.07	37.0	-0.4	-0.4	-

CONCEPT 410AD-2

PAYLOAD SENSITIVITIES

TABLE 4.3.2.2-1

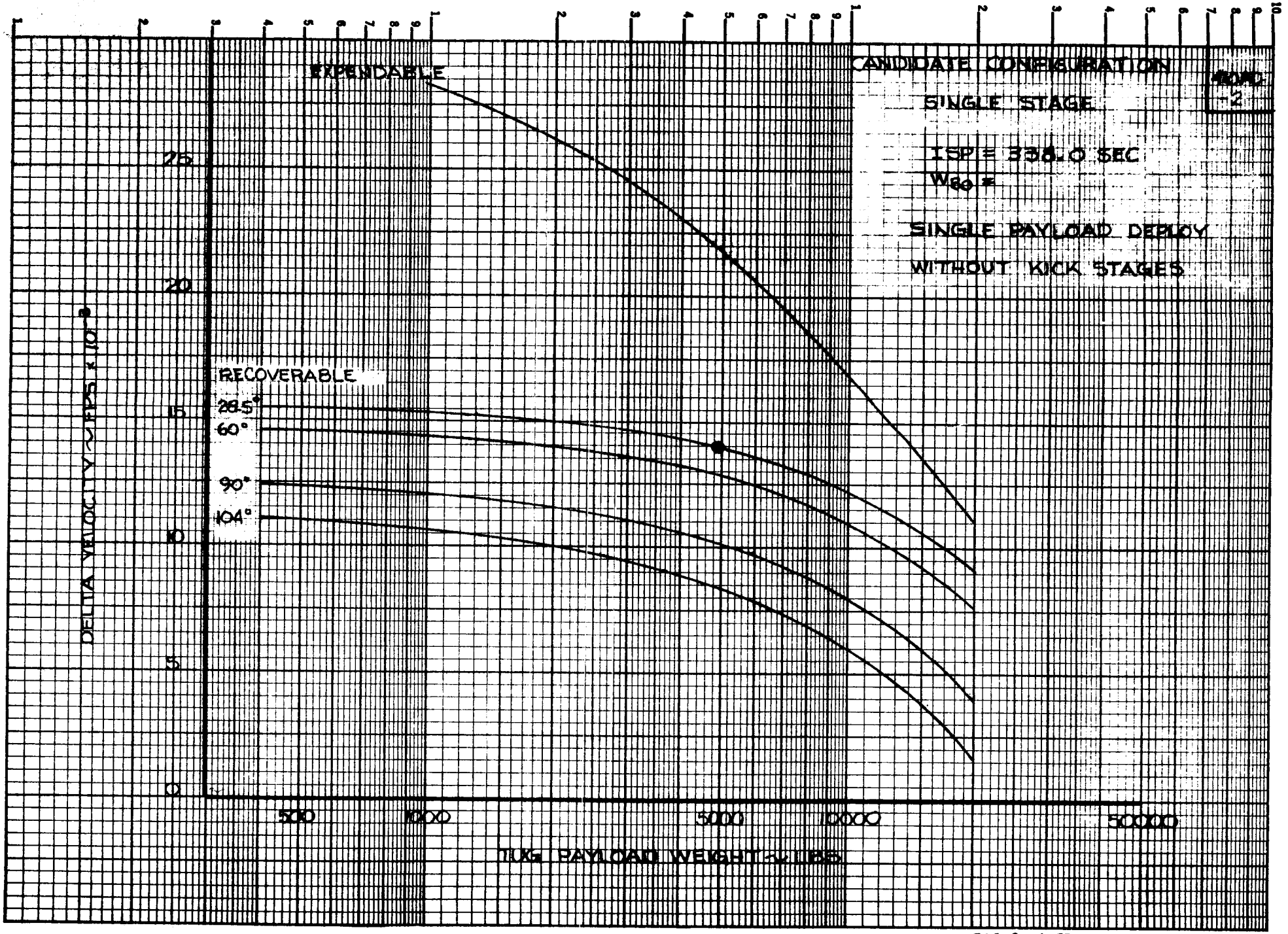

FIGURE 4.3.2.2-4

K+E SEMI-LOGARITHMIC 46 5492
3 CYCLES X 70 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.

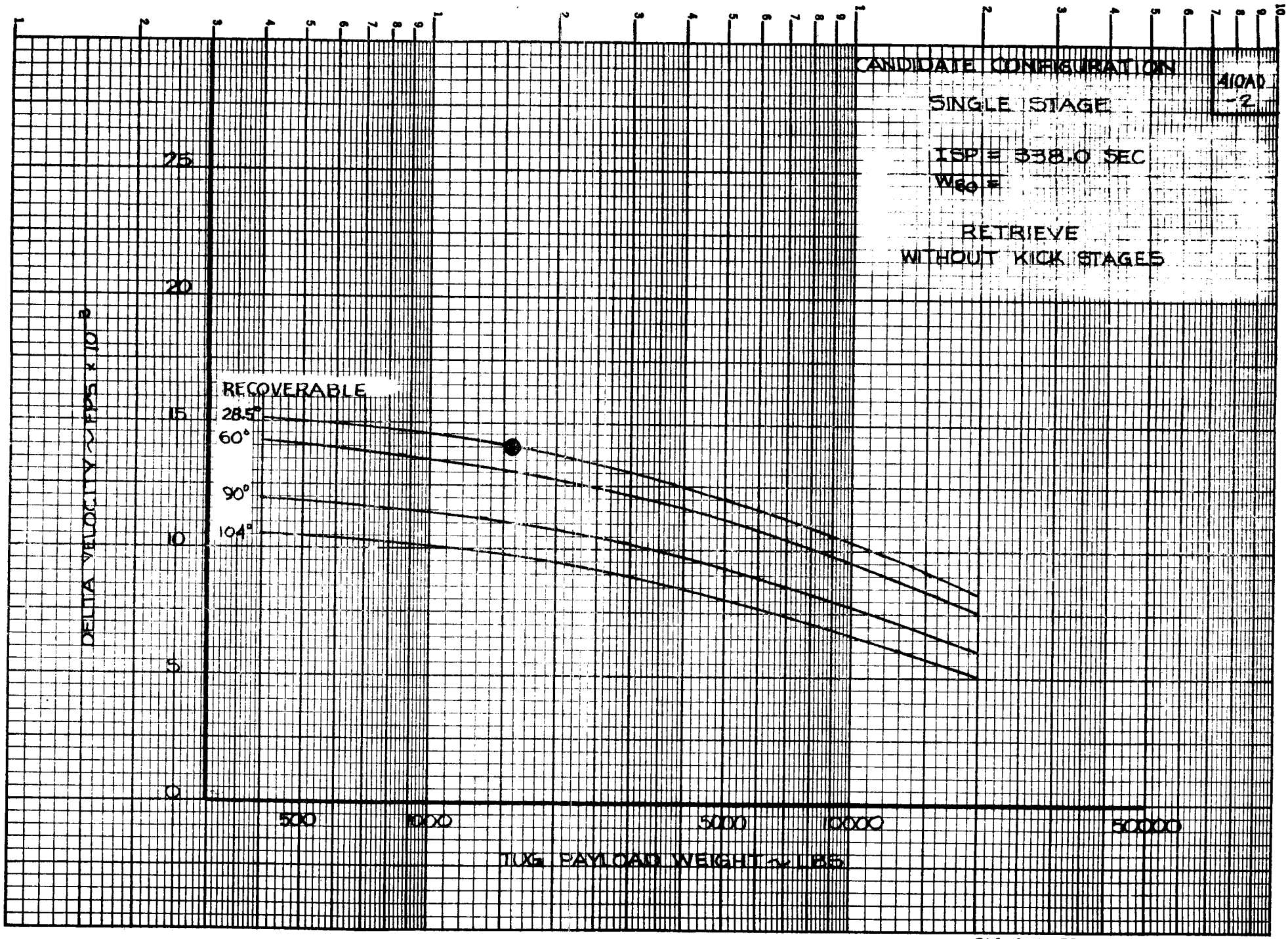

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FIGURE 4.3.2.2-5

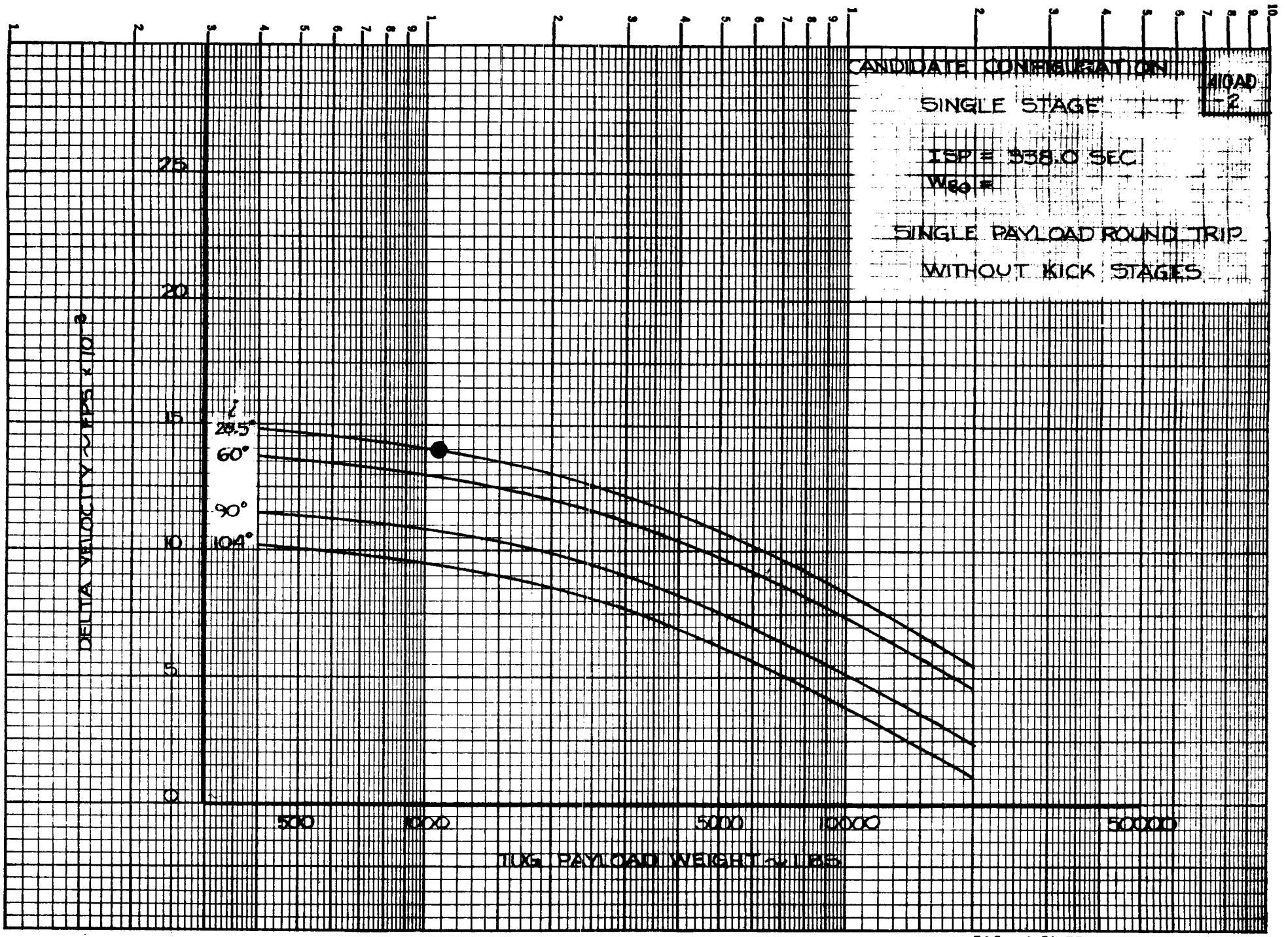

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FIGURE 4.3.2.2-6

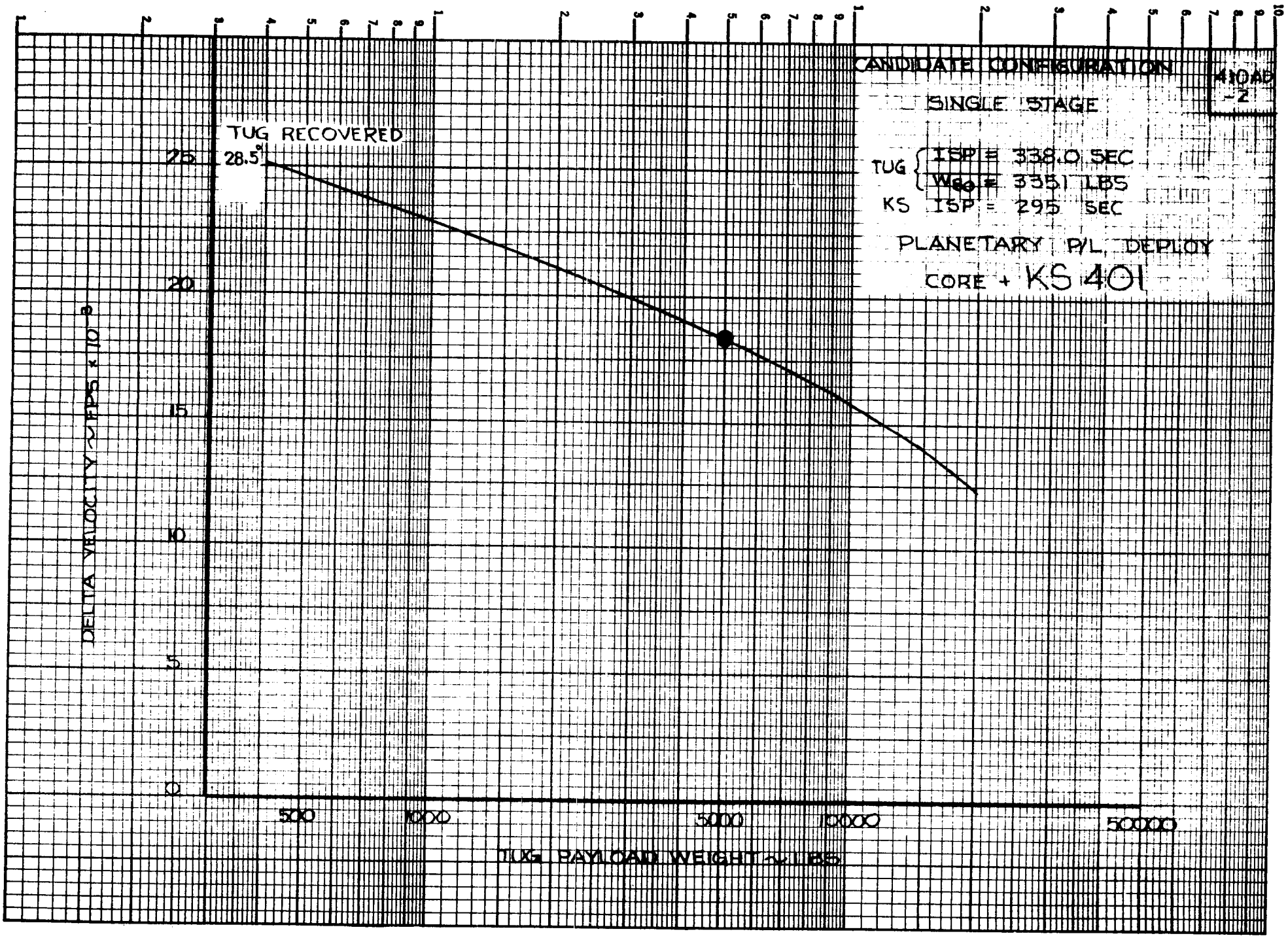

FIGURE 4.3.2.2-7

K+E SEMI-LOGARITHMIC 46 5492
3 CYCLES X 70 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.

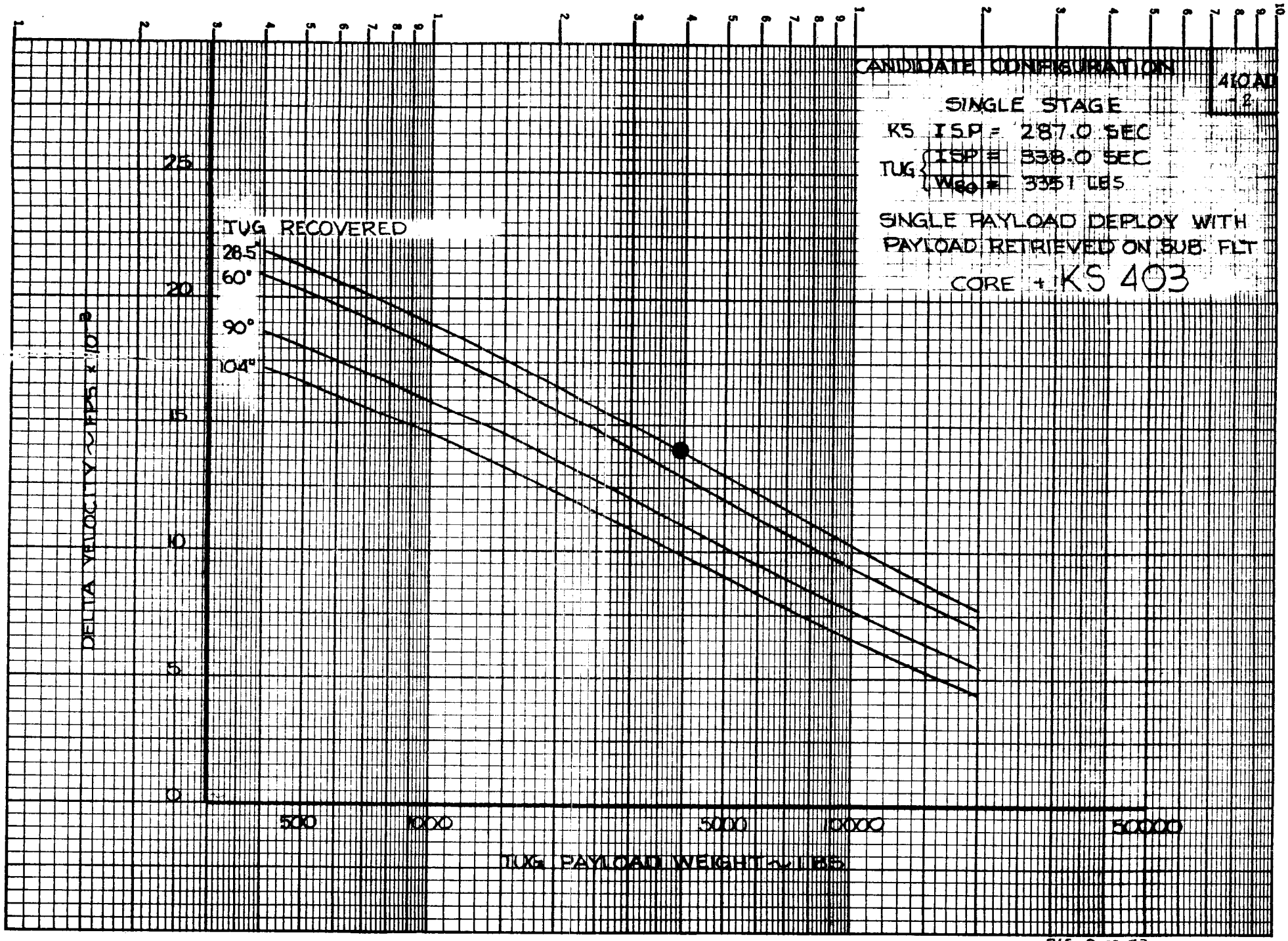

FIGURE 4.3.2.2-8

K+E SEMI-LOGARITHMIC 46 5492
3 CYCLES X 70 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.

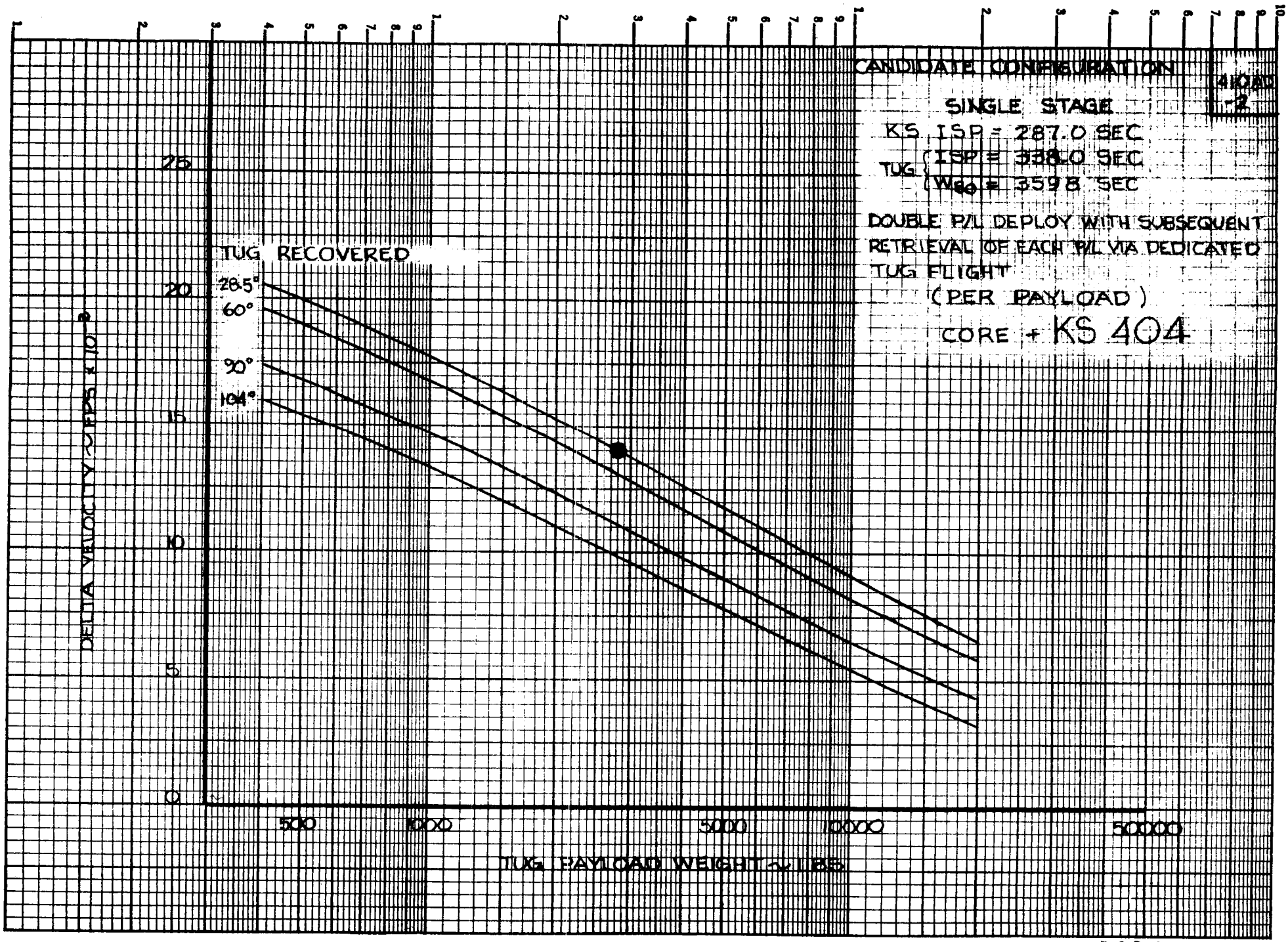

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FIGURE 4.3.2.2-9

K+E SEMI-LOGARITHMIC 46 5492
3 CYCLES X 70 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.

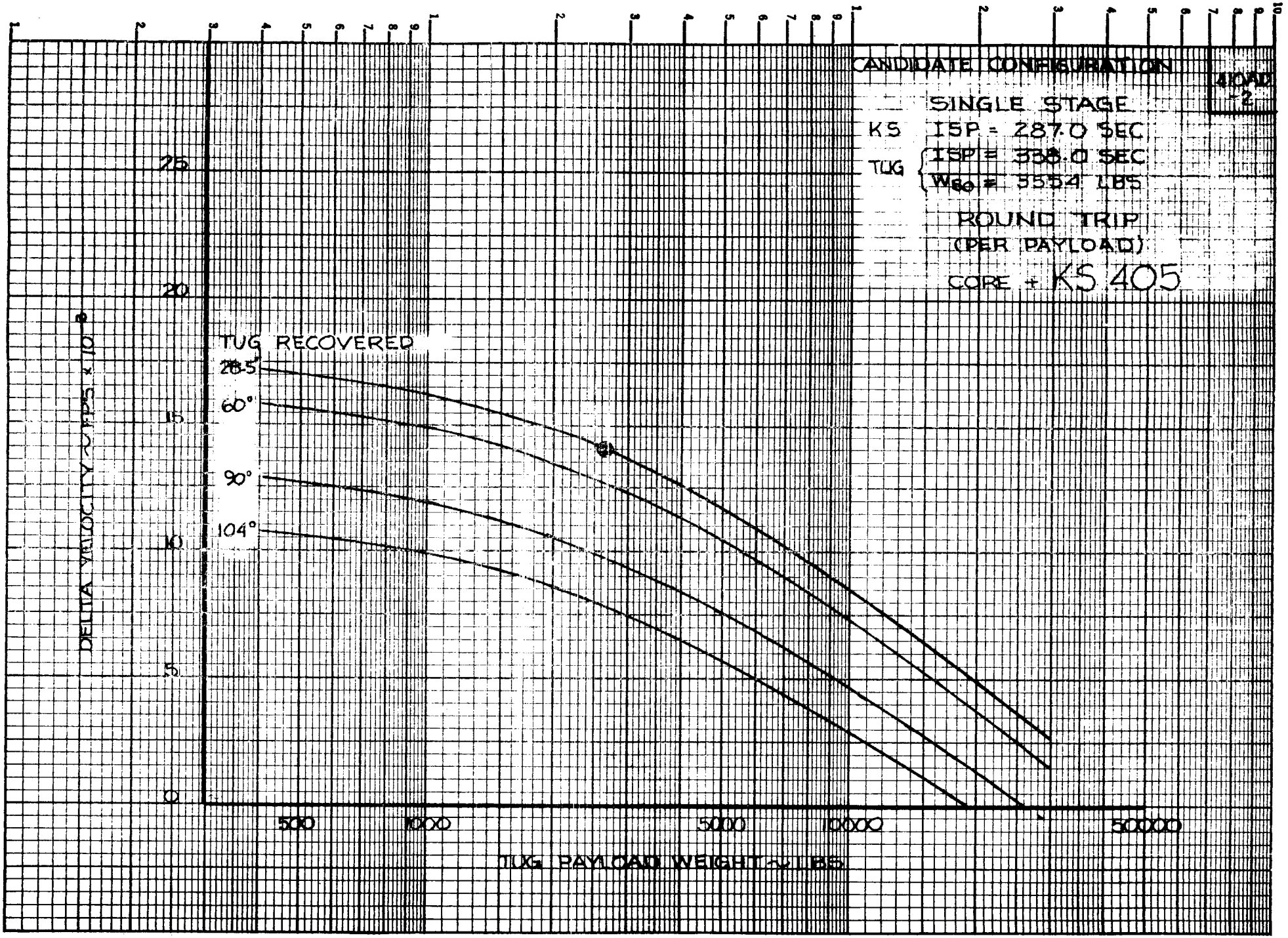

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FIGURE 4.3.2.2-10

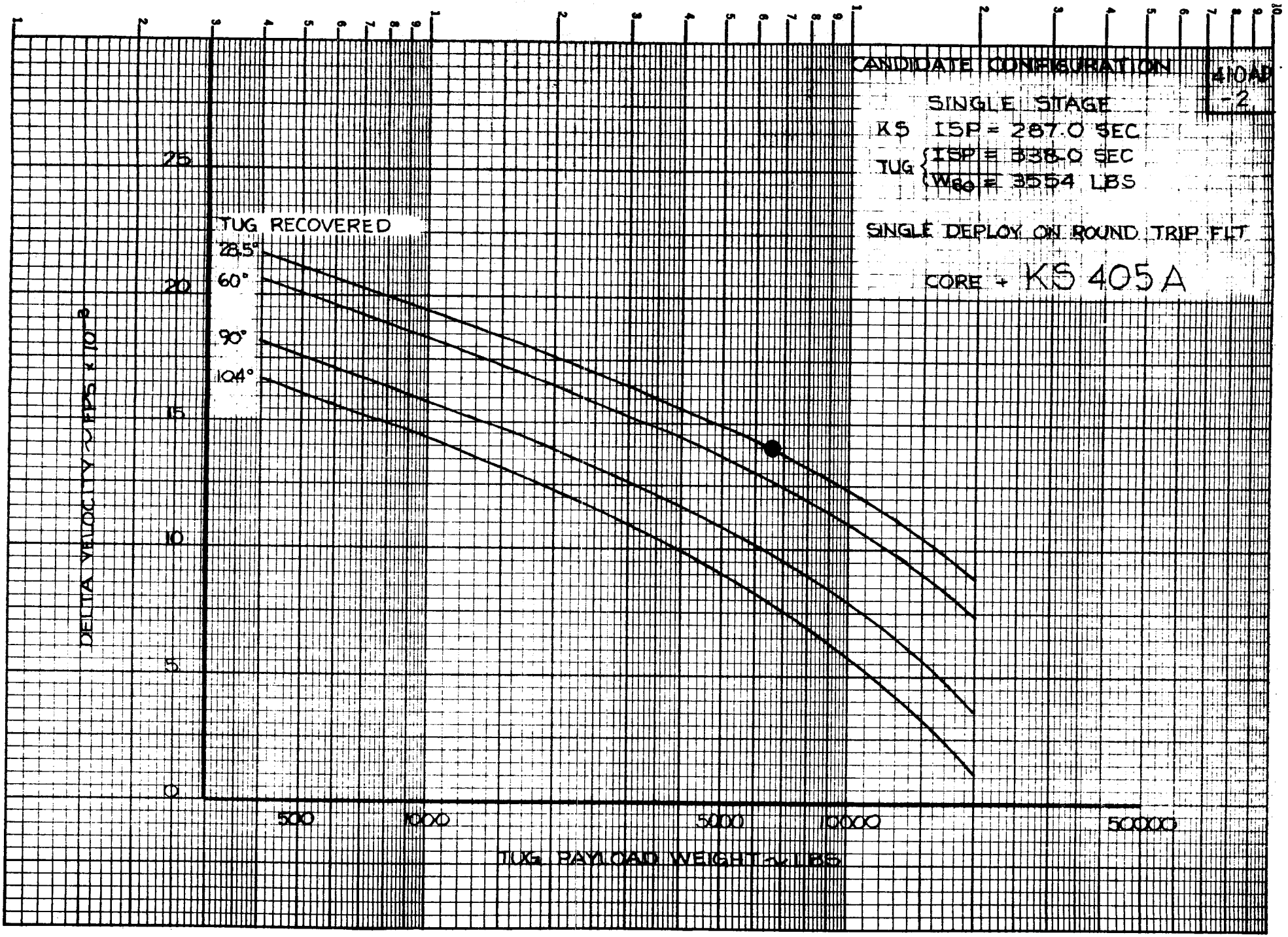

FIGURE 4.3.2.2-11

4.3.2.2.2 <u>41OAD Flight Summary</u>

Table 4.3.2.2-2 NASA Traffic

Table 4.3.2.2-3 DOD Traffic

Table 4.3.2.2-4 NASA/DOD Traffic

<u>Comments</u>:

None

FLIGHT SUMMARY

OPTION: 2 (410 AD-2)

FLIGHT MODE		CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
TOTALS	SHUTTLE					24	23	21	21	16	23	20	148
	TUG												SAME
TUG FLIGHT DISTRIBUTION	DEPLOY					(10)	(3)	(8)	(11)	(6)	(14)	(6)	(58)
	SINGLE P/L - CORE					6	3	5	3	3	5	5	30
	- CORE + KS					2		2	2		3		9
	- EXPEND TUG					2		1	1		3	1	8
	MULTI P/L - CORE								1	1	3		5
	- CORE + KS								4	2			6
	RETRIEVE					(7)	(3)	(5)	(4)	(3)	(2)	(5)	(29)
	CORE ONLY					2		4	4	3		3	16
	CORE + KS					5	3	1			2	2	13
	ROUND TRIP					(7)	(17)	(8)	(6)	(7)	(7)	(9)	(61)
	CORE ONLY					4	7	3	2	3	3	4	26
	CORE + KS					3	10	5	4	4	4	5	35
MISSION MODEL	TOTAL					(31)	(42)	(29)	(34)	(26)	(35)	(29)	(226)
	DEPLOY					17	22	16	24	16	26	15	136
	RETRIEVE					14	20	13	10	10	9	14	90

NASA TRAFFIC

TABLE 4.3.2.2-2

FLIGHT SUMMARY

OPTION: 2 (410AD-2)

FLIGHT MODE		CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
TOTAL FLIGHTS	SHUTTLE					19	12	17	17	17	14	18	114
	TUG												SAME
TUG FLIGHT DISTRIBUTION	DEPLOY					(6)	(4)	(2)	(4)	(2)	(3)	(4)	(25)
	SINGLE P/L - CORE						2		1		1		4
	- CORE + KS					4		1	2	1		2	10
	MULTI P/L - CORE					2	2	1	1	1	2	2	11
	- CORE + KS												0
	RETRIEVE					(3)		(3)	(2)	(1)	(1)	(3)	(13)
	CORE ONLY					1		3		1			5
	CORE (+ KS)					2			2		1	3	8
	ROUND TRIP					(10)	(7)	(12)	(10)	(14)	(9)	(11)	(73)
	CORE ONLY					4	6	7	4	8	7	4	40
	CORE + KS					6	1	5	6	6	2	7	33
	SORTIE						(1)		(1)		(1)		(3)
MISSION MODEL	(TOTAL)					(33)	(22)	(31)	(29)	(33)	(27)	(33)	(208)
	DEPLOY					20	14	16	16	18	16	19	119
	RETRIEVE					13	7	15	12	15	10	14	86
	SORTIE						1		1		1		3

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DOD TRAFFIC

TABLE 4.3.2.2-3

FLIGHT SUMMARY

OPTION: 2 (410AD-2)

FLIGHT MODE		CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
TOTAL FLIGHTS	SHUTTLE					43	35	38	38	33	37	38	262
	TUG												SAME
TUG FLIGHT DISTRIBUTION	DEPLOY					(16)	(7)	(10)	(15)	(8)	(17)	(10)	(83)
	SINGLE P/L - CORE					6	5	5	4	3	6	5	34
	- CORE + KS					6		3	4	1	3	2	19
	- EXPEND TUG					2		1	1		3	1	8
	MULTI-P/L - CORE					2	2	1	2	2	5	2	16
	CORE+KS								4	2			6
	RETRIEVE					(10)	(3)	(8)	(6)	(4)	(3)	(8)	(42)
	CORE ONLY					3		7	4	4		3	21
	CORE + KS					7	3	1	2		3	5	21
	ROUND TRIP					(17)	(24)	(20)	(16)	(21)	(16)	(20)	(134)
	CORE ONLY					8	13	10	6	11	10	8	66
	CORE+KS					9	11	10	10	10	6	12	68
	SORTIE						(1)		(1)		(1)		(3)
MISSION MODEL	(TOTAL)					(64)	(64)	(60)	(63)	(59)	(62)	(62)	(434)
	DEPLOY					37	36	32	40	34	42	34	255
	RETRIEVE					27	27	28	22	25	19	28	176
	SORTIE						1		1		1		3

COMBINED NASA/DOD TRAFFIC

TABLE 4.3.2.2-4

4.3.2.2.3 410AD Flight Element Requirements

Table 4.3.2.2-5 NASA Traffic

Table 4.3.2.2-6 DOD Traffic

Table 4.3.2.2-7 Combined NASA/DOD Traffic

Table 4.3.2.2-8 Concept 410AD-2 Kick Stage Definition

Comments:

a. Deorbit kick stages are accounted for in the year they are launched, not in the year they are retrieved.

b. Deorbit kick stages launched prior to 1984 to support Tug P/L retrievals are charged to the Tug program.

c. Deorbit kick stages required to support Tug P/L retrievals and launched in 1979 are accounted for in 1980.

d. No Deorbit kick stages can be launched prior to 1980.

FLIGHT ELEMENT REQUIREMENTS OPTION: 2 (410AD-1)

ITEM			CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
SHUTTLE FLIGHTS		TOTAL					24	23	21	21	16	23	20	148
BASIC TUG FLIGHTS	ETR	RECOVERED					18	17	16	14	12	15	15	107
		EXPENDED					2		1	1		3	1	8
	WTR	RECOVERED					4	6	4	6	4	5	4	33
	(TOTAL)						(24)	(23)	(21)	(21)	(16)	(23)	(20)	(148)
KICK STAGES	KS 401						2		2	2				6
	KS 403		5	1		3						3		12
	KS 404									8	4			12
	KS405		5	9	3	7	2	8	5	1	4	3	3	50
	KS405A						1	2		3		1	2	9
	(TOTAL)		(10)	(10)	(3)	(10)	(5)	(10)	(7)	(14)	(8)	(7)	(5)	(89)

NASA TRAFFIC

TABLE 4.3.2.2-5

FLIGHT ELEMENT REQUIREMENTS OPTION: 2 (410AD-1)

ITEM			CALENDAR YEAR											TOTAL
			80	81	82	83	84	85	86	87	88	89	90	
SHUTTLE FLIGHTS		TOTAL					19	12	17	17	17	14	18	114
BASIC TUG FLIGHTS	ETR	RECOVERED					18	10	12	15	15	10	17	97
		EXPENDED												0
	WTR	RECOVERED					1	2	5	2	2	4	1	17
	(TOTAL)						(19)	(12)	(17)	(17)	(17)	(14)	(18)	(114)
KICK STAGES	KS 403			2		1	3		1	2	1		2	12
	KS 405		7		6	7	7	1	5	6	6	2	7	54
	(TOTAL)		(7)	(2)	(6)	(8)	(10)	(1)	(6)	(8)	(7)	(2)	(9)	(66)

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DOD TRAFFIC

TABLE 4.3.2.2-6

FLIGHT ELEMENT REQUIREMENTS OPTION: 2 (410 AD-1)

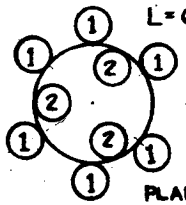
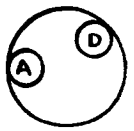
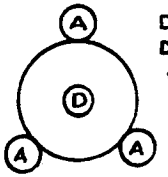
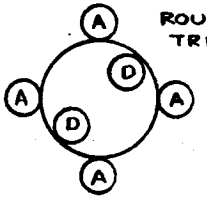
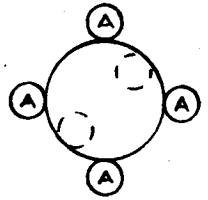
ITEM			CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
SHUTTLE FLIGHTS		TOTAL					43	35	38	38	33	37	38	262
BASIC TUG FLIGHTS	ETR	RECOVERED					36	27	28	29	27	25	32	204
		EXPENDED					2		1	1		3	1	8
	WTR	RECOVERED					5	8	9	8	6	9	5	50
	(TOTAL)						(43)	(35)	(38)	(38)	(33)	(37)	(38)	(262)
KICK STAGES	KS 401						2		2	2				6
	KS 403		5	3		4	3		1	2	1	3	2	24
	KS 404									8	4			12
	KS 405		12	9	9	14	9	9	10	7	10	5	10	104
	KS 405A						1	2		3		1	2	9
	(TOTAL)		(17)	(12)	(9)	(18)	(15)	(11)	(13)	(22)	(15)	(9)	(14)	(155)

COMBINED NASA/DOD TRAFFIC

TABLE 4.3.2.2-7

410AD-2

KICK STAGE DEFINITION**

KICK STAGE DESIGNATION	GEOMETRY (all stages >10 ft diam. & are SEM large unless otherwise noted)		PERFORMANCE (Geosynch Payload) (lbs)	SRM CHARACTERISTICS INDIVIDUAL WEIGHT (lbs)	NUMBER	TOTAL SRM WEIGHT (lbs)	STAGE INERT WEIGHT (lbs)	TOTAL STAGE WEIGHT (lbs)
KS 401	 L=6'8" PLANETARY	STAGE 1	5000 lbs TO ΔV=18400 fps	1880	6	11280	-	11280
		STAGE 2		1880	3	5640	545	6185
		(TOTAL)						(17465)
KS403	 DEPLOY — RTRV	AKS	3920	1880	1	1880	-	1880
		DKS	3920	1880	1	1880	804*	2684
		(TOTAL)						(4564)
KS404	 DOUBLE DEPLOY RTRV	AKS	2770	1880	3	5640	-	5640
		DKS	2770	1300	1	1300	818*	2118
		(TOTAL)						(7758)
KS405	 ROUND TRIP	AKS	2640	1880	4	7520	-	7520
		DKS	2640	1880	2	3760	864*	4624
		(TOTAL)						(12144)
KS405A		AKS Delete 2 DKS from KS 405	6620	1880	4	7520	643*	8163

* ADD 12 lb FOR DOD MISSIONS

** Based on Kick Stage Characteristics, Issue 2, dated 8-29-73

BAS 8-30-73

TABLE 4.3.2.2-8

4.3.2.2.4 <u>41OAD Initial Flight Schedule</u>

Table 4.3.2.2-9 Costed Flight Build-UP

<u>Comments</u>:

None

FLIGHT	PAYLOADS FLOWN		
	1984	1985	1986
1	D-8	D-7	ALL
2	D-8	D-8	
3	D-9	D-8	
4	D-10	R-5 (KS)	
5	D-18	R-5 (KS)	
6	D-18	R-5 (KS)	
7	D-20 (KS)	D1 + R3 (KS)	
8	D-20 (KS)	D2 + R2 (KS)	
9	R-12	D3 + R3 (KS)	
10	R-13	D3 + R3 (KS)	
11	D1 + R1	D3 + R3 (KS)	
12	D1 + R1	D3 + R3 (KS)	
13	D14 + R14	D4 + R4 (KS)	
14	D15 + R15	D6 + R3 (KS)	
15	D-28 (KS)	D7 + R1 (KS)	
16	D-28 (KS)	D11 + R11	
17	D-31 (KS)	D16 + R16	
18	D-31 (KS)	D16 + R16	
19	D37 + D37 + D37	D16 + R16	
20	D39 + D39 + D39	D12 + D14 + R14	
21	R-34	D13 + D15 + R15	
22	D25 + R25	D-30	
23	D25 + R25	D-30	
24	D35 + R35	D40 + D40	
25	D35 + R35	D38 + D38 + D38	
26		D25 + R25	
27		D25 + R25	
28		D27 + R27 (KS)	
29		D33 + R33	
30		D33 + R33	
31		D35 + R35	
32		D35 + R35	
33		SORTIE 41	
34			
FLTS: FLOWN / SCHED	25 / 43	33 / 35	38 / 38
P/L DEPLOY: FLOWN / SCHED	26 / 37	34 / 36	32 / 32
P/L RTRV: FLOWN / SCHED	11 / 27	25 / 27	28 / 28
SORTIES: FLOWN / SCHED	0 / 0	1 / 1	0 / 0

TABLE 4.3.2.2-9 CONCEPT 410AD-2 COSTED FLIGHT BUILDUP

4.3.2.2.5 410AD Additional Payload Capture Potential

Table 4.3.2.2-10 Additional P/L Capture Potential

Comments:

a. Time did not permit the examination of additional Tug flight modes, such as on-orbit assembly for two stage operation or modified kick stage applications. Rough estimates indicate that if KS 405 were used as a single P/L deploy with subsequent retrieval by a dedicated Tug flight instead of round-trip, it would have adequate performance to deploy and retrieve 5500 pounds at geosynchronous conditions. Since this estimate cannot be substantiated at this time, however, additional capture potential for missions N-6 thru N-8 has not been claimed.

OPTION 2

ADDITIONAL PAYLOAD CAPTURE POTENTIAL

MISSIONS EXCLUDED FROM OPTION MISSION MODEL					CONCEPT 410AD-2		
DESIGNATION		DEPLOY	RETRIEVE	SORTIE	TUG MODE		
ID NO.	WEIGHT				DEPLOY	RETRIEVE	SORTIE
N6	5000	-	3	-	-	0	-
N7	5500	-	10	-	-	0	-
N8	4000	-	7	-	-	0	-
N 10	9500	-	2	-	-	0	-
N 17	2000	2	-	-	2 (CORE)	-	-
N 18	3300	2	-	-	2 (CORE)	-	-
N 19	7900	3	-	-	3 (KS 401)	-	-
N 20	1500	2	-	-	2 (EXPEND)	-	-
N 22	4000	4	-	-	0	-	-
N 23	6600	2	-	-	2 (EXPEND)	-	-
N 24	4400	4	-	-	4 (EXPEND)	-	-
D 12b	2400	-	-	4	-	-	0
TOTALS	DEPLOY	19			15		
	RETRIEVE		22			0	
	SORTIE			4			0
	(TOTAL)	45			15		

N = NASA
D = DOD

TABLE 4.3.2.2-10

4.3.2.2.6 410AD Detailed Traffic Assessment Data

Table 4.3.2.2-11 NASA Traffic Assessment

Table 4.3.2.2-12 NASA Geosynch Mixed Missions

Table 4.3.2.2-13 NASA Non-Geosynch Mixed Missions

Table 4.3.2.2-14 DOD Traffic Assessment

Comments:

a. Kick Stage Designations enclosed by parentheses ( ) indicate retrieved Kick Stages

b. All missions are accomplished by the basic Tug core unless otherwise indicated.

TRAFFIC ASSESSMENT

OPTION: (410 AD-2)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
MIXED P/L'S GEO (see pgs 6-9)	ROUND TRIP+KS	KS 405							1	2	1	2	1		7
	"	KS 405A						1	2		3		1	2	9
	DOUBLE DEPLOY										1	1			2
	TOTAL							(1)	(3)	(2)	(5)	(3)	(2)	(2)	(18)
1	ROUND TRIP							2		1		1	1	2	7
	RETRIEVE									1					1
	(TOTAL)							(2)		(2)		(1)	(1)	(2)	(8)
2	ROUND TRIP+KS	KS 405							1						1
	RETRIEVE + KS	KS 403						3							3
	"	KS 405												1	1
	(TOTAL)							(3)	(1)					(1)	(5)
3	ROUND TRIP+KS	KS 405						1	5	3		1	2	3	15
	RETRIEVE+KS	KS403						2							2
	"	KS405											2		2
	DOUBLE DEPLOY+KS	2x (KS404)									3	2			5
	(TOTAL)							(3)	(5)	(3)	(3)	(3)	(4)	(3)	(24)
4	ROUND TRIP+KS	KS 405						1	1			1			3
	RETRIEVE+KS	KS 403								1					1
	"	KS405												1	1
	DOUBLE DEPLOY+KS	2x (KS 404)									1				1
	(TOTAL)							(1)	(1)	(1)	(1)	(1)		(1)	(6)
5.	DEPLOY + KS	KS 403											3		3
	RETRIEVE + KS	"							3						3
	(TOTAL)								(3)				(3)		(6)

TABLE 4.3.2.2-11

TRAFFIC ASSESSMENT

OPTION: 410AD-2

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
7	DEPLOY								1			1			2
8	DEPLOY							2	2	2	1	1	2	2	12
NASA GEOSYNCH TRAFFIC SUMMARY MISSIONS (1-8)	DEPLOY							2	3	2	1	2	2	2	14
	" +KS	KS 403											3		3
	DOUBLE DEPLOY										1	1			2
	" +KS	2x KS 404									4	2			6
	ROUND TRIP							2		1		1	1	2	7
	"	KS 405A						1	2		3		1	2	9
	"	KS405					6 x KS	2	8	5	1	4	3	3	26
	RETRIEVE									1					1
	" +KS	(KS 403)		5xKS	1 x KS		3 x KS	5	3	1					9
	" "	(KS 405)		5xKS.	9 x KS	3 x KS	1 x KS						2	2	4
	(TOTAL)			(10 x KS)	(10 x KS)	(3 x KS)	(10 x KS)	(12)	(16)	(10)	(10)	(10)	(12)	(11)	(81)

ENTRIES PRIOR TO 1984 ARE KS's LAUNCHED TO SUPPORT P/L RETRIEVAL BY TUG

TABLE 4.3.2.2-11 (cont)

TRAFFIC ASSESSMENT: NASA NON-GEOSYNCH, EARTH ORBIT — OPTION: 2 (410AD-2)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION — CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
9	SINGLE DEPLOY							1		2		1		2	6
	(TOTAL)							(1)		(2)		(1)		(2)	(6)
10	SINGLE DEPLOY							1			1			1	3
	(TOTAL)							(1)			(1)			(1)	(3)
11	SINGLE DEPLOY										1		1		2
	RETRIEVE									1		1		1	3
	ROUND TRIP								1						1
	(TOTAL)								(1)	(1)	(1)	(1)	(1)	(1)	(6)
MIXED PAYLOADS NON-GEO	DOUBLE DEPLOY ROUND TRIP	(See pages 10-11)							2		2		2		6
	(TOTAL)	WTR LAUNCH							(2)		(2)		(2)		(6)
12	RETRIEVE	WTR LAUNCH						1		1		1		1	4
13	RETRIEVE	WTR LAUNCH						1		1		1		1	4
14	ROUND TRIP	WTR LAUNCH						1		1		1		1	4
15	ROUND TRIP	WTR LAUNCH						1		1		1		1	4
16	DOUBLE DEPLOY	WTR LAUNCH											3		3
	ROUND TRIP	WTR LAUNCH							4						4
	RETRIEVE	WTR LAUNCH									4				4
	(TOTAL)								(4)		(4)		(3)		(11)

TABLE 4.3.2.2-11 (cont)

TRAFFIC ASSESSMENT

OPTION: (410AD-2)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
NASA NON-GEO E.O. TRAFFIC SUMMARY MISSIONS (9-16)	DEPLOY							2		2	2	1	1	3	11
	DOUBLE DEPLOY												3		3
	DOUBLE DEPLOY ROUND TRIP								2		2		2		6
	ROUND TRIP							2	5	2		2		2	13
	RETRIEVE							2		3	4	3		3	15
	(TOTAL)							(6)	(7)	(7)	(8)	(6)	(6)	(8)	(48)

TABLE 4.3.2.2-11 (cont)

TRAFFIC ASSESSMENT: NASA PLANETARY — OPTION: 2 (410AD-1)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION — CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
17	SINGLE DEPLOY												2		2
	(TOTAL)												(2)		(2)
18	SINGLE DEPLOY							2							2
	(TOTAL)							(2)							(2)
19	SINGLE DEPLOY	KS 401								1	2				3
	(TOTAL)									(1)	(2)				(3)
20	SINGLE DEPLOY	KS 401						2							2
	(TOTAL)							(2)							(2)
22	SINGLE DEPLOY	EXPEND TUG								1	1		1	1	4
	(TOTAL)									(1)	(1)		(1)	(1)	(4)
23	SINGLE DEPLOY	KS 401								2					2
	(TOTAL)									(2)					(2)
24	SINGLE DEPLOY	EXPEND TUG						2					2		4
	(TOTAL)							(2)					(2)		(4)
NASA PLANETARY TRAFFIC SUMMARY	SINGLE DEPLOY							2		1			2		5
	"	KS 401						2		2	2				6
	"	EXPEND TUG						2		1	1		3	1	8
	(TOTAL)							(6)		(4)	(3)		(5)	(1)	(19)

TABLE 4.3.2.2-11 (cont)

MIXED MISSIONS: NASA GEOSYNCH OPTION: (410 AD-2)

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
84	◇	②		①	①			①	②			
	◇	②	③	③	②							
	①	D R								—	900 "	10×6 "
	②	D R								—	" "	" "
	3				R			D		KS 405A (KS 405)	3000 1800	20×10 10×14
	④				D R					KS 405 (KS 405)	" "	" "
	⑤			D R						KS 405 (KS 405)	2100 "	12×8 "
	⑥			R						(KS 403)	"	"
	⑦			R						"	"	"
	⑧		R							"	1700	8×8
	⑨		R							"	"	"
	⑩		R							"	"	"
	⑪								D	—	3500	25×14
	⑫								D	—	"	"
85	◇	①	①	⑤	①		①	②	②			
	◇	①	①	⑦	①	③						
	1	D		R						KS 405 (KS 405)	900 2100	10×6 12×8
	②		D R							KS405 (KS405)	1700 "	8×8 "
	③				D R					KS 405 (KS405)	1800 "	10×14 "
	④			D R						KS 405 (KS 405)	2100 "	12×8 "
	⑤			D R						KS 405 (KS405)	" "	" "
	⑥			D R						KS405 (KS405)	" "	" "
	⑦			D R						KS405 (KS405)	" "	" "

TABLE 4.3.2.2-12

MIXED MISSIONS: NASA GEOSYNCH (cont) OPTION: (410 AD-2)

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
85	8			D						KS405	2100	12x8
				R						(KS405)	"	"
	9						D			KS405A	2600	"
				R						(KS405)	2100	"
	10							D		KS405A	3000	20x10
		R								(KS405)	900	10x6
	11					R				(KS403)	2800	12x14
	12					R				"	"	"
	13					R				"	"	"
	14							D		—	3000	20x10
	15								D	—	3500	25x14
	16								D	—	"	"
86	D	1		5					2			
	R	2	2	3	1							
	1								D	—	3500	25x14
	2								D	—	"	"
	3			D						KS405	2100	12x8
			R							(KS405)	1700	8x8
	4			D						KS405	2100	12x8
			R							(KS405)	1700	8x8
	5			D						KS405	2100	12x8
				R						(KS405)	"	"
	6			D						KS405	"	"
				R						(KS405)	"	"
	7			D						KS405	"	"
				R						(KS405)	"	"
	8	D								—	900	10x6
		R									"	"
	9	R								—	"	"
	10				R					(KS403)	1800	10x14
87	D	1	1	6	2		1	2	2			
	R	1		3								
	1	D							D		4400	35x14
	2								D		3500	25x14
	3							D		KS405A	3000	20x10
				R						(KS405)	2100	12x8

TABLE 4.3.2.2-12 (cont)

MIXED MISSIONS: NASA GEOSYNCH (cont) OPTION: (410 AD-1)

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
87	4							D		KS405A	3000	20x10
				R						(KS405)		
	5						D			KS405A	2600	12x8
				R						(KS405)		
	6				2D					2x KS404	1800 / 1800	20x14
	7			2D						"	2100 / 2100	24x8
	8			2D						"	"	"
	9			2D						"	"	"
	10		D							KS405	1700	8x8
		R								(KS405)	900	10x6
88	D	2		7	1			1	2			
	R	1	1	1	2							
	1	D								—	900	10x6
		R									"	"
	2			D						KS405	2100	12x8
				R						(KS405)	"	"
	3			2D						2xKS404	2100 / 2100	24x8
	4			2D						"	"	"
	5			D						KS 405	2100	12x8
			R							(KS 405)	1700	8x8
	6	D							D	—	4400	35x14
	7			D						KS 405	2100	12x8
					R					(KS 405)	1800	10x14
	8				D					KS 405	"	"
					R					(KS 405)	"	"
	9								D	—	3500	25x14
	10							D		—	3000	20x10
89	D	1	1	2		3		1	2			
	R	1		5	1							
	1								D	—	3500	25x14
	2								D	—	"	"
	3							D		KS405A	3000	20x10
				R						(KS 405)	2100	12x8
	4					D				KS403	2800	12x14
	5					D				"	"	"
	6					D				"	"	"

TABLE 4.3.2.2-12 (cont)

MIXED MISSIONS: NASA GEOSYNCH (cont) OPTION: (410AD-2)

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
89	7	D R									900 "	10x6 "
	8		D		R					KS405 (KS405)	1700 1800	8x8 10x14
	9			D R						KS405 (KS405)	2100 "	12x8 "
	10			D R						KS405 (KS405)	" "	" "
	11			R						"	"	"
	12			R						"	"	"
90	D	2		3			2		2			
	R	2	1	5	1							
	1								D		3500	25x14
	2								D		"	"
	3			R			D			KS405A (KS405)	2600 2100	12x8 "
	4			R			D			KS405A (KS405)	2600 2100	" "
	5			D R						KS405 (KS405)	" "	" "
	6			D R						KS405 (KS405)	" "	" "
	7			D R						KS405 (KS405)	" "	" "
	8				R					"	1800	10x14
	9		R							"	1700	8x8
	10	D R								—	900 "	10x6 "
	11	D R								—	" "	" "

TABLE 4.3.2.2-12 (cont)

MIXED MISSIONS: NASA NON-GEOSYNCH OPTION: 2 (410AD-L)

YEAR	FLT NO	PAYLOAD								AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
			12	13	14	15	16					
84	D		–	–	1	1	–	–	–			
	R		1	1	1	1	–					
	1					D/R				–	2000	8 × 11
	2				D/R					–	800	10 × 5
	3			R						–	1000	7 × 7
	4		R							–	2000	8 × 6
85	D		1	1	1	1	4					
	R		–	–	1	1	4					
	1						D/R			–	4500	11 × 13
	2						D/R			–		
	3						D/R			–		
	4						D/R			–		
	5			D		D R				–	3000 2000	15 × 11 8 × 11
	6		D		D R					–	2800 800	{18 × 6 10 × 11 10 × 5
86	D				1	1						
	R		1	1	1	1						
	1					D/R				–	2000	8 × 11
	2				D/R					–	800	10 × 5
	3			R						–	1000	7 × 7
	4		R							–	2000	8 × 6
87	D		1	1	1	1	–					
	R		–	–	1	1	4					
	1						R			–	4500	11 × 13
	2						R			–		
	3						R			–		
	4						R			–		
	5			D		D R					3000 2000	15 × 11 8 × 11
	6		D		D R						2800 800	{18 × 6 10 × 11 10 × 5

TABLE 4.3.2.2-13

MIXED MISSIONS: NASA NON-GEOSYNCH (cont.) OPTION: 2 (4LOAD-1)

YEAR	FLT NO	PAYLOAD								AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
			12	13	14	15	16					
88	D		–	–	1	1	–					
	R		1	1	1	1	–					
	1					D/R				–	2000	8×11
	2				D/R					–	800	10×15
	3			R						–	1000	7×7
	4		R							–	2000	8×6
89	D		1	1	1	1	6					
	R		–	–	1	1	–					
	1						2D			–	9000	22 × 13
	2						2D			–		
	3						2D			–		
	4			D		D				–	3000	15 × 11
						R				–	2000	8 × 11
	5		D		D					–	2800	{18×6 10×11
					R					–	800	10×5
90	D		–	–	1	1	–					
	R		1	1	1	1	–					
	1					D/R				–	2000	8×11
	2				D/R					–	800	10×15
	3			R						–	1000	7×7
	4		R							–	2000	8×6

TABLE 4.3.2.2-13 (cont)

TRAFFIC ASSESSMENT: DOD GEOSYNCH — OPTION: 2 (410AD-2)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION — CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
25	ROUND TRIP	CORE ALONE						2	2	2	2	2	2	2	14
	(TOTAL)							(2)	(2)	(2)	(2)	(2)	(2)	(2)	(14)
26	ROUND TRIP	KS 405		KS		KS	KS	1		1	1	1		1	5
	(TOTAL)							(1)		(1)	(1)	(1)		(1)	(5)
27	ROUND TRIP	KS 405		2 × KS		KS	KS	1	1		1	1	1	1	6
	(TOTAL)							(1)	(1)		(1)	(1)	(1)	(1)	(6)
28	SINGLE DEPLOY	KS 403					KS	1		1		1			3
	SINGLE DEPLOY	KS 405					KS	1							1
	RETRIEVE	(KS 403)											1	1	2
	ROUND TRIP	KS 405											1	1	2
	(TOTAL)							(2)		(1)		(1)	(2)	(2)	(8)
30	SINGLE DEPLOY	CORE ALONE							2		1		1		4
	(TOTAL)								(2)		(1)		(1)		(4)
31	SINGLE DEPLOY	KS 403			2 × KS			2			2			2	6
	RETRIEVE	(KS 403)						2			2			2	6
	(TOTAL)							(4)			(4)			(4)	(12)
DOD GEO TRAFFIC SUMMARY	SINGLE DEPLOY	CORE ALONE							2		1		1		4
		CORE + KS 403			2 × KS		1 × KS	3		1	2	1		2	9
		CORE + KS 405					1 × KS	1							1
	RETRIEVE	(KS 403)						2			2		1	3	8
	ROUND TRIP	CORE ALONE						2	2	2	2	2	2	2	14
		CORE + KS 405		3 × KS		2 × KS	2 × KS	2	1	1	2	2	2	3	13
	(TOTAL)			3 × KS	2 × KS	2 × KS	4 × KS	(10)	(5)	(4)	(9)	(5)	(6)	(10)	(49)

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TABLE 4.3.2.2-14

TRAFFIC ASSESSMENT: DOD NON-GEOSYNCH OPTION: 2 (410 AD-2)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
32	ROUND TRIP	KS 405		4 × KS		4 × KS	4 × KS	4		4	4	4		4	20
	(TOTAL)							(4)		(4)	(4)	(4)		(4)	(20)
33	ROUND TRIP								2	1		2	1		6
	(TOTAL)								(2)	(1)		(2)	(1)		(6)
34	RETRIEVE							1		1		1			3
	(TOTAL)							(1)		(1)		(1)			(3)
35	ROUND TRIP							2	2	2	2	2	2	2	14
	(TOTAL)							(2)	(2)	(2)	(2)	(2)	(2)	(2)	(14)
36	TRIPLE DEPLOY											1			1
	(TOTAL)											(1)			(1)
37	TRIPLE DEPLOY							1					1		2
	(TOTAL)							(1)					(1)		(2)
38	TRIPLE DEPLOY								1					1	2
	(TOTAL)								(1)					(1)	(2)
39	TRIPLE DEPLOY	WTR LAUNCH						1		1	1		1	1	5
	(TOTAL)							(1)		(1)	(1)		(1)	(1)	(5)
40	DOUBLE DEPLOY	WTR LAUNCH							1						1
	RETRIEVE									2					2
	ROUND TRIP									2		2	2		6
	(TOTAL)								(1)	(4)		(2)	(2)		(9)
41	SORTIE	WTR LAUNCH							1		1		1		3
	(TOTAL)								(1)		(1)		(1)		(3)

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TABLE 4.3.2.2-14 (cont)

TRAFFIC ASSESSMENT: DOD NON-GEOSYNCH (cont) OPTION: 2 (410 AD-2)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
DOD NON GEO TRAFFIC SUMMARY (Missions 32-41)	DOUBLE DEPLOY								1						1
	TRIPLE DEPLOY							2	1	1	1	1	2	2	10
	RETRIEVE							1		3		1			5
	ROUND TRIP	CORE ALONE						2	4	5	2	6	5	2	26
		CORE + KS 405		4 x KS		4 x KS	4 x KS	4		4	4	4		4	20
	SORTIE								1		1		1		3
	(TOTAL)			(4 x KS)		(4 x KS)	(4 x KS)	(9)	(7)	(13)	(8)	(12)	(8)	(8)	(65)
TOTAL DOD TRAFFIC SUMMARY (Missions 25-41)	Single Deploy	CORE ALONE							2		1		1		4
		CORE + KS 403			2 x KS		1 x KS	3		1	2	1		2	9
		CORE + KS 405					1 x KS	1							1
	DOUBLE DEPLOY	CORE ALONE							1						1
	TRIPLE DEPLOY	CORE ALONE						2	1	1	1	1	2	2	10
	RETRIEVE	CORE ALONE						1		3		1			5
		(KS 403)						2			2		1	3	8
	ROUND TRIP	CORE ALONE						4	6	7	4	8	7	4	40
		CORE + KS 405		7 x KS		6 x KS	6 x KS	6	1	5	6	6	2	7	33
	SORTIE	CORE ALONE							1		1		1		3
	(TOTAL)			(7 x KS)	(2 x KS)	(6 x KS)	(8 x KS)	(19)	(12)	(17)	(17)	(17)	(14)	(18)	(114)

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TABLE 4.3.2.2-14 (cont)

4.3.3 OPTION 3A

Deploy:	3500 lbs	Starting Dec. 1979
Retrieve:	2200 lbs	Starting Dec. 1983

Paragraph	Subject	Page
4.3.3.1	Mission Model	4-101
4.3.3.2	Concept 310/310RE-3A	4-103
4.3.3.2.1	210/310RE Performance	4-103
*4.3.3.2.2	310/310RE Flight Summary	4-119
*4.3.3.2.3	310/310RE Flight Element Requirements	4-123
*4.3.3.2.4	310/310RE Initial Flight Schedule	4-127
4.3.3.2.5	310/310RE Add'l P/L Capture Potential	4-129
4.3.3.2.6	310/310RE Detailed Traffic Assessment Data	4-131
4.3.3.3	Concept 320A/320AE-3A	4-148
4.3.3.3.1	320A/320AE Performance	4-148
*4.3.3.3.2	320A/320AE Flight Summary	4-170
*4.3.3.3.3	320A/320AE Flight Element Requirements	4-174
*4.3.3.3.4	320A/320AE Initial Flight Schedule	4-178
4.3.3.3.5	320A/320AE Add'l P/L Capture Potential	4-180
4.3.3.3.6	320A/320AE Detailed Traffic Assessment Data	4-182

*Inputs to Programmatics/Costing - Volume 8

4.3.3.1 Option 3A Mission Model

Table 4.3.3-1 Space Tug Study Traffic Model (Option 3A)

COMMENTS

None

SPACE TUG STUDY TRAFFIC MODEL — OPTION: 3A

MISSION ID	CURRENT DESIGN			LOW COST DESIGN			CALENDAR YEAR											TOTAL
	WT	L	D	WT	L	D	80	81	82	83	84	85	86	87	88	89	90	
1				900	10	6	2 /	2 /	2 /	1 /	2 / 2	1 / 1	1 / 2	1 / 1	2 / 1	1 / 1	2 / 2	17 / 10
2				1700	8	8	1 /	2 /	/	1 /	/ 3	1 / 1	/ 2	1 /	/ 1	1 /	/ 1	7 / 8
3				2100	12	8	3 /	7 /	3 /	3 /	1 / 3	5 / 7	5 / 3	6 / 3	7 / 1	2 / 5	3 / 5	45 / 27
4				1800	10	14	1 /	1 /	/	2 /	1 / 2	1 / 1	/ 1	2 /	1 / 2	/ 1	/ 1	9 / 8
5	1800	17	10				/	/	/	3 /	/	/	/	/	/	3 /	/	6 / 0
6	2600	12	8				1 /	/	1 /	/	/	1 /	/	1 /	/	/	2 /	6 / 0
7	3000	20	10				1 /	1 /	2 /	2 /	1 /	2 /	/	2 /	1 /	1 /	/	13 / 0
8	3500	25	14				2 /	1 /	1 /	2 /	2 /	2 /	2 /	2 /	2 /	2 /	2 /	20 / 0
SUB-TOTAL							11 / 0	14 / 0	9 / 0	14 / 0	7 / 10	13 / 10	8 / 8	15 / 4	13 / 5	10 / 7	9 / 9	123 / 53
9				1400	9	6	1 /	/	1 /	/	1 /	/	2 /	/	1 /	/	2 /	8 / 0
10	6000	12	8				/	1 /	/	/	1 /	/	/	1 /	/	/	1 /	4 / 0
11				1700	8	8	1 /	1 /	/	1 /	/	1 / 1	/ 1	1 /	/ 1	1 /	/ 1	6 / 4
12				2000	8	6	/	/	/	1 /	/ 1	1 /	/ 1	1 /	/ 1	1 /	/ 1	4 / 4
13				1000	7	7	/	/	/	1 /	/ 1	1 /	/ 1	1 /	/ 1	1 /	/ 1	4 / 4
14				800	10	5	/	/	/	1 /	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	8 / 7
15				2000	8	11	/	/	/	1 /	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	8 / 7
16				4500	11	13	/	/	/	4 /	/	4 / 4	/	/ 4	/	6 /	/	14 / 8
SUB-TOTAL							2 / 0	2 / 0	1 / 0	9 / 0	4 / 4	9 / 7	4 / 5	6 / 6	3 / 5	11 / 2	5 / 5	56 / 34
17	1000	12	10				1 /	/	/	/	/	/	/	/	/	2 /	/	3 / 0
18	2000	12	10				/	/	/	/	2 /	/	/	/	/	/	/	2 / 0
19	5500	20	12				/	/	/	/	/	/	1 /	2 /	/	/	/	3 / 0
20	900	17	10				/	/	2 /	/	2 /	/	/	/	/	/	/	4 / 0
21	1600	15	10				/	/	/	/	/	/	/	/	/	/	/	0 / 0
22	2500	16	12				/	/	/	/	/	/	1 /	1 /	/	1 /	1 /	4 / 0
23	5000	17	12				/	/	/	/	/	/	2 /	/	/	/	/	2 / 0
24	3300	17	12				/	/	/	/	2 /	/	/	/	/	2 /	/	4 / 0
SUB-TOTAL							1 / 0	0 / 0	2 / 0	0 / 0	6 / 0	0 / 0	4 / 0	3 / 0	0 / 0	5 / 0	1 / 0	22 / 0
TOTAL	NASA						14 / 0	16 / 0	12 / 0	23 / 0	17 / 14	22 / 17	16 / 13	24 / 10	16 / 10	26 / 9	15 / 14	201 / 87
25 (2)				690	12	5	2 /	2 /	2 /	2 /	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	22 / 14
26 (3b)				1570	15	5	1 /	/	1 /	1 /	1 / 1	/	1 / 1	1 / 1	1 / 1	/	1 / 1	8 / 5
27 (15)				1970	16	10	1 /	/	1 /	1 /	1 / 1	1 / 1	/	1 / 1	1 / 1	1 / 1	1 / 1	9 / 6
28 (17)				2200	12	10	/	/	/	2 /	2 /	/	1 /	/	1 /	1 / 2	1 / 2	8 / 4
29 (12b)	SORTIE			2400	20	10	/	/	/	/	/	/	/	/	/	/	/	0 / 0
30 (6)				3480	20	9	/	/	/	/	/	2 /	/	1 /	/	1 /	/	4 / 0
31 (4a)				3480	25	15	/	2 /	/	/	2 /	/	/	2 /	/	/	2 /	8 / 0
SUB-TOTAL							4 / 0	4 / 0	4 / 0	6 / 0	8 / 4	5 / 3	4 / 3	7 / 4	5 / 4	5 / 5	7 / 6	59 / 29
32 (3a)				1570	15	5	4 /	/	4 /	4 /	4 / 4	/	4 / 4	4 / 4	4 / 4	/	4 / 4	32 / 20
33 (4b)				3480	25	15	1 /	/	2 /	1 /	/	2 / 2	1 / 1	/	2 / 2	1 / 1	/	10 / 6
34 (10)				2745	20	9	/	1 /	/	1 /	/ 1	/	/ 1	/	/ 1	/	/	2 / 3
35 (8)				2430	25	12.7	2 /	2 /	2 /	2 /	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	22 / 14
36 (11a)				850	9	6	3 /	/	/	3 /	/	/	/	/	3 /	/	/	9 / 0
37 (11b)				850	9	6	3 /	/	/	/	3 /	/	/	/	/	3 /	/	9 / 0
38 (11c)				850	9	6	3 /	/	/	/	/	3 /	/	/	/	/	3 /	9 / 0
39 (5)				735	3	5	/	/	/	3 /	3 /	/	3 /	3 /	/	3 /	3 /	18 / 0
40 (16)				2610	14.5	6.7	/	/	/	4 /	/	2 /	2 / 4	/	2 / 2	2 / 2	/	12 / 8
41 (12a)	SORTIE			6000	20	10	/	/	/	1 / 1	/	1 / 1	/	1 / 1	/	1 / 1	/	4 / 4
SUB-TOTAL							16 / 0	3 / 0	8 / 0	19 / 1	12 / 7	10 / 5	12 / 12	10 / 7	13 / 11	12 / 6	12 / 6	127 / 55
TOTAL	DOD						20 / 0	7 / 0	12 / 0	25 / 1	20 / 11	15 / 8	16 / 15	17 / 11	18 / 15	17 / 11	19 / 12	186 / 84
COMBINED TOTAL							34 / 0	23 / 0	24 / 0	48 / 1	37 / 25	37 / 25	32 / 28	41 / 21	34 / 25	43 / 20	34 / 26	387 / 171

TABLE 4.3.3-1

4.3.3.2 Concept 310/310RE-3A

4.3.3.2.1 320A/320AE Performance

- o Flight Modes — Page 4-104
  - Figure 4.3.3.2-1
- o Geosynchronous Performance — 4-105
  - 310 — 4-105
  - 310RE — 4-107
  - Figures 4.3.3.2-2 thru -5 — 4-110
- o Geosyncrhonous Performance Sensitivity — 4-114
  - Table 4.3.3.2-1
- o General Performance — 4-115
  - Figures 4.3.3.2-6 thru -9

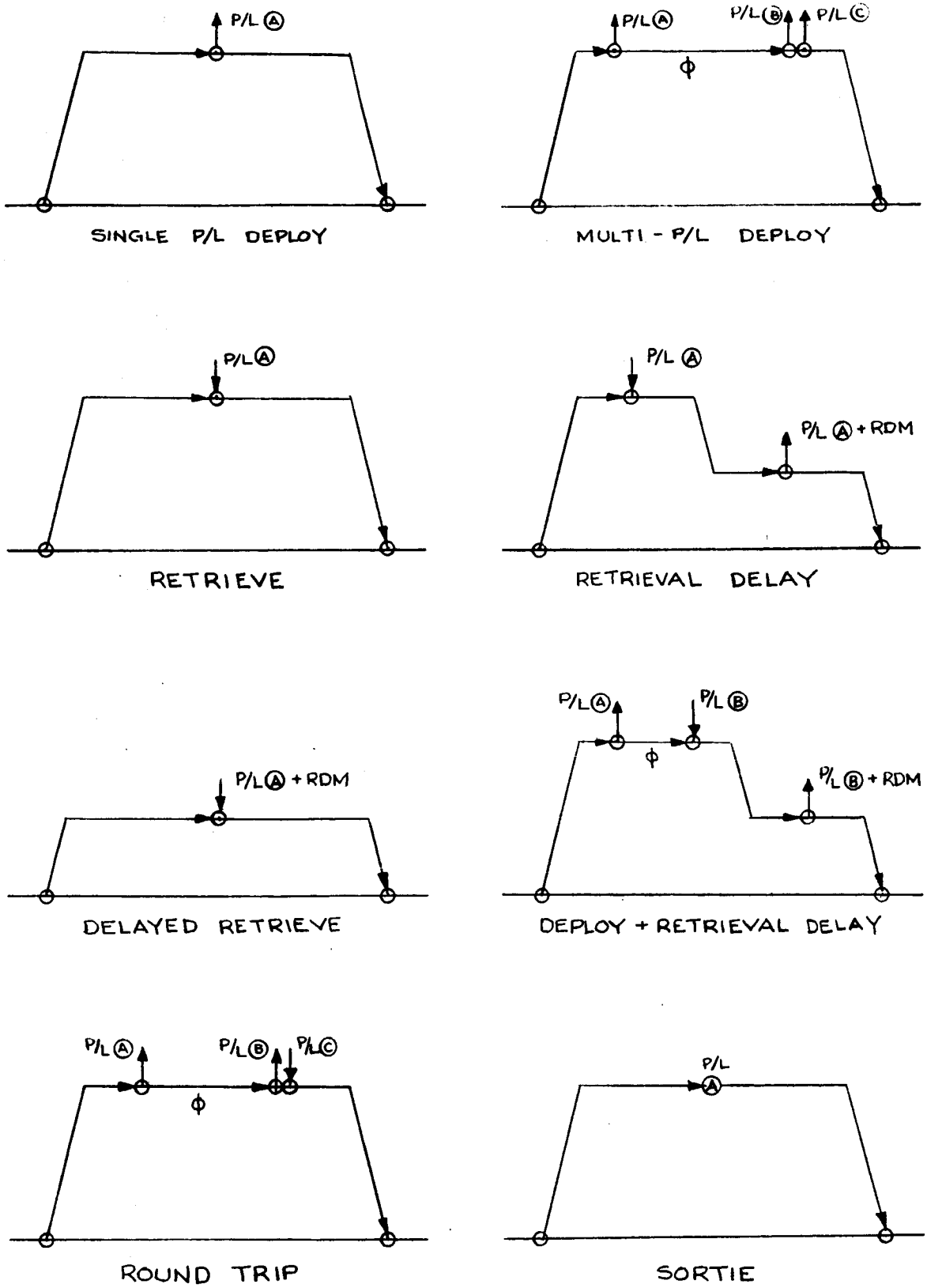
COMMENTS:

a. For multi deploy flights, the Tug provides a one-time 60° longitude shift capability after attaining mission orbit for P/L positioning.

b. For triple deploy flights, one P/L is deployed upon insertion into mission orbit. The remaining two P/L's are deployed following a 60° phasing by the Tug.

c. For double deploy/retrieve round-trip flights, one P/L is deployed upon insertion into mission orbit. The remaining P/L is deployed following a 60° phasing by the Tug. The retrieved P/L is assumed to be coincident with the second deployment.

d. The 310RE Retrieval Delay performance (Figure 4.3.3.2-5) is corrected for the weight (544 lbs) of the Retrieval Delay Module.



CONCEPT 310/310 RE-3A

FLIGHT MODES

FIGURE 4.3.3.2-1

CONCEPT 310-3A

GEOSYNCH DEPLOY PERFORMANCE

REFERENCES:

a. 3A10-1 Concept Definition, Issue 1, dated 16 Aug 1973

b. B81M047-73054," Tug Requirements, Revision 2," dated 15 Aug 1973

GENERAL INFORMATION

W_{FIXED} = 3173 lbs

$W_{ADAPTER}$ = 1223 lbs

$W_i = P/L_o - W_{ADAPT} = 65000 - 1223$

W_i = 63777 lbs

ISP = 338.0 sec

ISPE = 0.983 ISP = 332.25 sec

ΔV_U = 13967 fps

ΔV_D = 13885 fps

$W_{BOI} = W_{FIXED} + \chi(\text{Consumables})$ $\chi = 0.17$ (deploy)

$= 3173 + 0.17C$

Tug Length = L_T = 297 in

Orbiter P/L Bay Length = L_o

Available P/L Length = $L_o - L_T = L_P$

$L_P = 720 - 297 = 423$ in = **32.25 ft**

NASA MISSIONS

SINGLE P/L DEPLOY

$W_{BO(Deploy)} = W_{BOI} = 3173 + 0.17(354) =$ 3233.18 lbs

$W_{P/L\,(Deploy)} = f(63777 \text{ lbs}, 3233 \text{ lbs}, 332.25 \text{ sec}, \Delta V) =$ **5417 lbs** See Fig 4.3.3.2-6

MULTI - P/L DEPLOY

$$W_{BO(Multi-P/L)} = W_{BOI} = 3173 + 0.17(534) = \underline{3263.78} \text{ lbs}$$

$$W_{P/L(Multi-P/L)} = f(W_i, W_{BO}, ISPE, \Delta V_u, \Delta V_\phi, \Delta V_b) =$$

$$\Delta V_\phi = f(\phi = 60°) = 292 \text{ fps}$$

See Fig 4.3.3.2-2

DOD MISSIONS

$$W_{BO} = W_{BO(NASA)} + \Delta W_{COMM}$$

$$= W_{BO(NASA)} + 13.2$$

SINGLE P/L DEPLOY

$$W_{BO(Deploy)} = 3233.18 + 13.2 = \underline{3246.38} \text{ lbs}$$

$$W_{P/L(Deploy)} = f(W_i, W_{BO}, ISPE, \Delta V_u, \Delta V_b) = \boxed{5369 \text{ lbs}}$$

See Fig 4.3.3.2-6

MULTI - P/L DEPLOY

$$W_{BO(Multi-P/L)} = 3263.78 + 13.2 = \underline{3276.98} \text{ lbs}$$

$$W_{P/L(Multi-P/L)} = f(W_i, W_{BO}, ISPE, \Delta V_u, \Delta V_\phi, \Delta V_b) =$$

$$\Delta V_\phi = f(\phi = 60°) = 292 \text{ fps}$$

See Fig 4.3.3.2-2

CONCEPT 3IORE-3A

GEOSYNCH PERFORMANCE

REFERENCES:

a. 3AIORE-1 Concept Definition, Issue 1, dated 16 Aug 1973

b. B 81 M047-73054, "Tug Requirements, Revision 2," dated 15 Aug 1973

GENERAL INFORMATION

W_{FIXED} = 3396 lbs

W_{ADAPT} = 1223 lbs

W_{RTRV} = 107 lbs

$W_i = P/L_o - W_{ADAPT} = 65000 - 1223$

W_i = 63777 lbs

$W_{BOI} = W_{FIXED} + x$ (Consumables)

$W_{BOI} = 3396 + xC$

x = 0.17 (Deploy) ; 0.28 (Retrieve) ; 0.27 (Round Trip)

ISP = 338.0 sec

ISPE = 0.983 ISP = 332.25 sec

ΔV_U = 13967 fps

ΔV_D = 13885 fps

ΔV_{∞} = 30 fps (Retrieve)

ΔV_{oo} = 130 fps (Round Trip)

$\Delta V_{\phi} = f(\phi = 60°)$ = 292 fps (Multi-Deploy)

Tug Length = L_T = 297 in

Retrieval Delay Module Length = L_R = 36 in ; RDM diameter = 10 ft

Orbiter P/L Bay Length = L_o = 720 in

Available P/L Length = $L_P = L_o - (L_T + L_R)$

L_P = 720 - (297) = 423 in = 35.25 ft W/O RDM

= 720 - (297+36) = 387 in = 32.25 ft WITH RDM

NASA MISSIONS

WITHOUT RETRIEVAL DELAY MODE

Single P/L

$\omega_{BO(Deploy)} = \omega_{BOI} - \omega_{RTRV} = 3396 + 0.17(354) - 107 = \underline{3349.18}$ lbs

$\omega_{BO(Retrieve)} = \omega_{BOI} = 3396 + 0.28(496) = \underline{3534.88}$ lbs

$\omega_{BO(Round\ Trip)} = \omega_{BOI} = 3396 + 0.27(616) = \underline{3562.32}$ lbs

			See
$\omega_{P/L(Deploy)} = f(\omega_i, \omega_{BO}, ISPE, \Delta V_U, \Delta V_D)$	=	5026 lbs	Fig. 4.3.3.2-7
$\omega_{P/L(Retrieve)} = f(\omega_i, \omega_{BO}, ISPE, \Delta V_U, \Delta V_\infty, \Delta V_D)$	=	1618 lbs	Fig. 4.3.3.2-8
$\omega_{P/L(Round\ Trip)} = f($ " $)$	=	1096 lbs	Fig. 4.3.3.2-9

Multi-P/L's

$\omega_{BO(Deploy)} = \omega_{BOI} - \omega_{RTRV} = 3396 + 0.17(534) - 107 = \underline{3379.78}$ lbs

$\omega_{BO(\text{Multi-Deploy Round Trip})} = \omega_{BOI} = 3396 + 0.27(616) = \underline{3562.32}$ lbs

$\omega_{P/L(Multi\ Deploy)} = f(\omega_i, \omega_{BO}, ISPE, \Delta V_U, \Delta V_D, \Delta V_\phi)$	=	Fig 4.3.3.2-3
$\omega_{P/L(\text{Multi-Deploy Round-Trip})} = f($ " $)$	=	Fig 4.3.3.2-4

WITH RETRIEVAL DELAY MODE

$\omega_{BO(RD)} = \omega_{BOI} = 3396 + 0.27(619) = \underline{3563.13}$ lbs

$\omega_{P/L} = f(P/L_{DEPLOYED}, P/L_{DEORBITED})$ = Fig 4.3.3.2-5

DOD MISSIONS

$\omega_{BO} = \omega_{BO(NASA)} + \Delta\omega_{comm}$

$= \omega_{BO(NASA)} + 33$

WITHOUT RETRIEVAL DELAY MODE

Single P/L

$\omega_{BO(Deploy)} = 3349.18 + 33 = \underline{3382.18}$ lbs

$\omega_{BO(Retrieve)} = 3534.88 + 33 = \underline{3567.88}$ lbs

$\omega_{BO(Round\ Trip)} = 3562.32 + 33 = \underline{3595.32}$ lbs

		See
$\omega_{P/L(Deploy)} = f(\omega_i, \omega_{BO}, ISPE, \Delta V_U, \Delta V_D) =$	4905 lbs	Fig 4.3.3.2-7
$\omega_{P/L(Retrieve)} = f(\omega_i, \omega_{BO}, ISPE, \Delta V_U, \Delta V_\infty, \Delta V_D) =$	1554 lbs	Fig 4.3.3.2-8
$\omega_{P/L(Round\ Trip)} = f($ " $) =$	1062 lbs	Fig 4.3.3.2-9

Multi-P/L Deploy

$\omega_{BO} = 3379.78 + 33 = \underline{3412.78}$ lbs

$\omega_{P/L} = f(\omega_i, \omega_{BO}, ISPE, \Delta V_U, \Delta V_D, \Delta V_\Phi) =$ Fig 4.3.3.2-3

WITH RETRIEVAL DELAY MODE

Use NASA performance

$\omega_{P/L} =$ Fig 4.3.3.2-5

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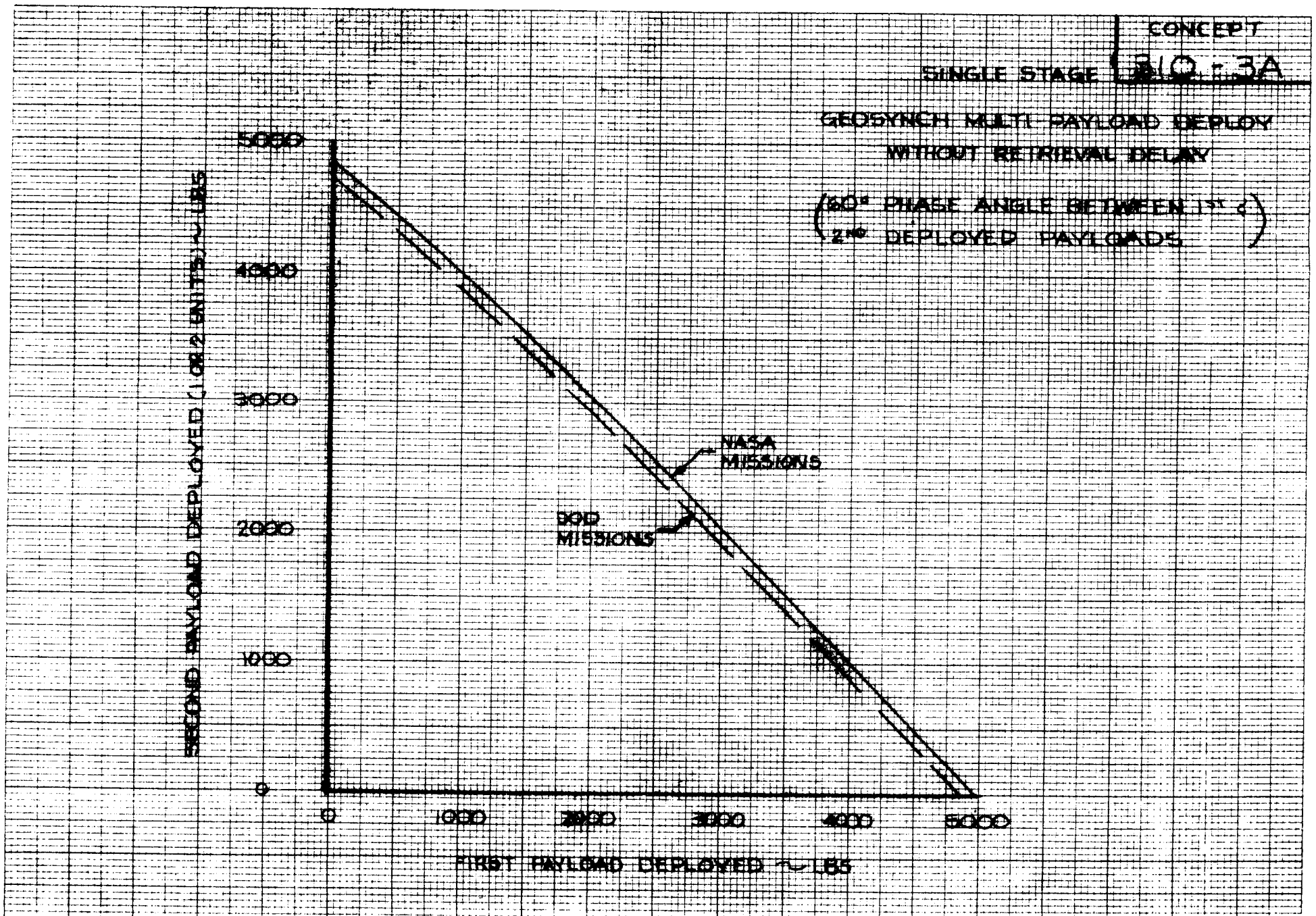
EUGENE DIETZGEN CO.
MADE IN U. S. A.

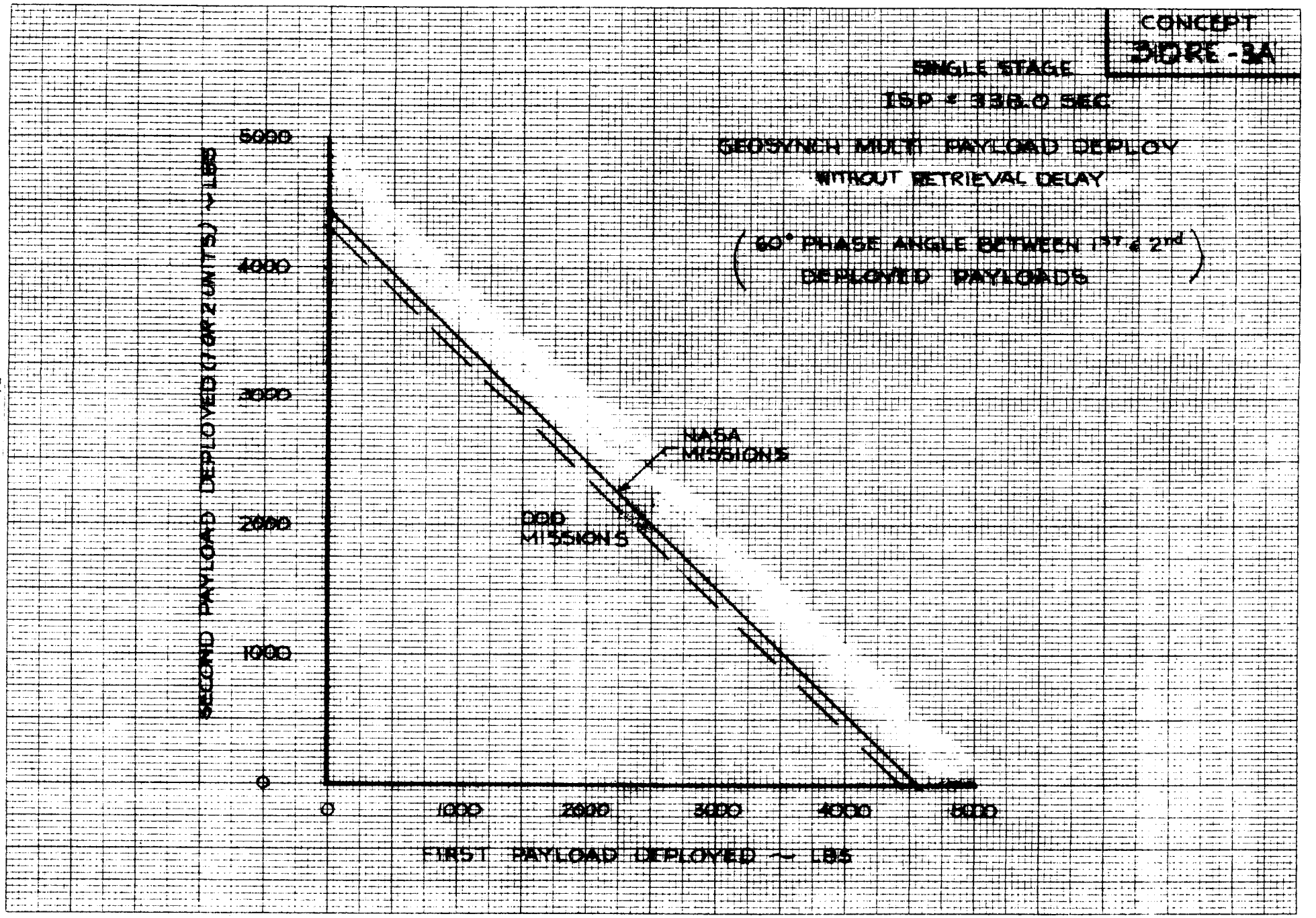


BAS 8-27-73

FIGURE 4.3.3.2-2

NO. 340A-10½ DIETZGEN GRAPH PAPER
10 X 10 PER HALF INCH

EUGENE DIETZGEN CO.
MADE IN U. S. A.

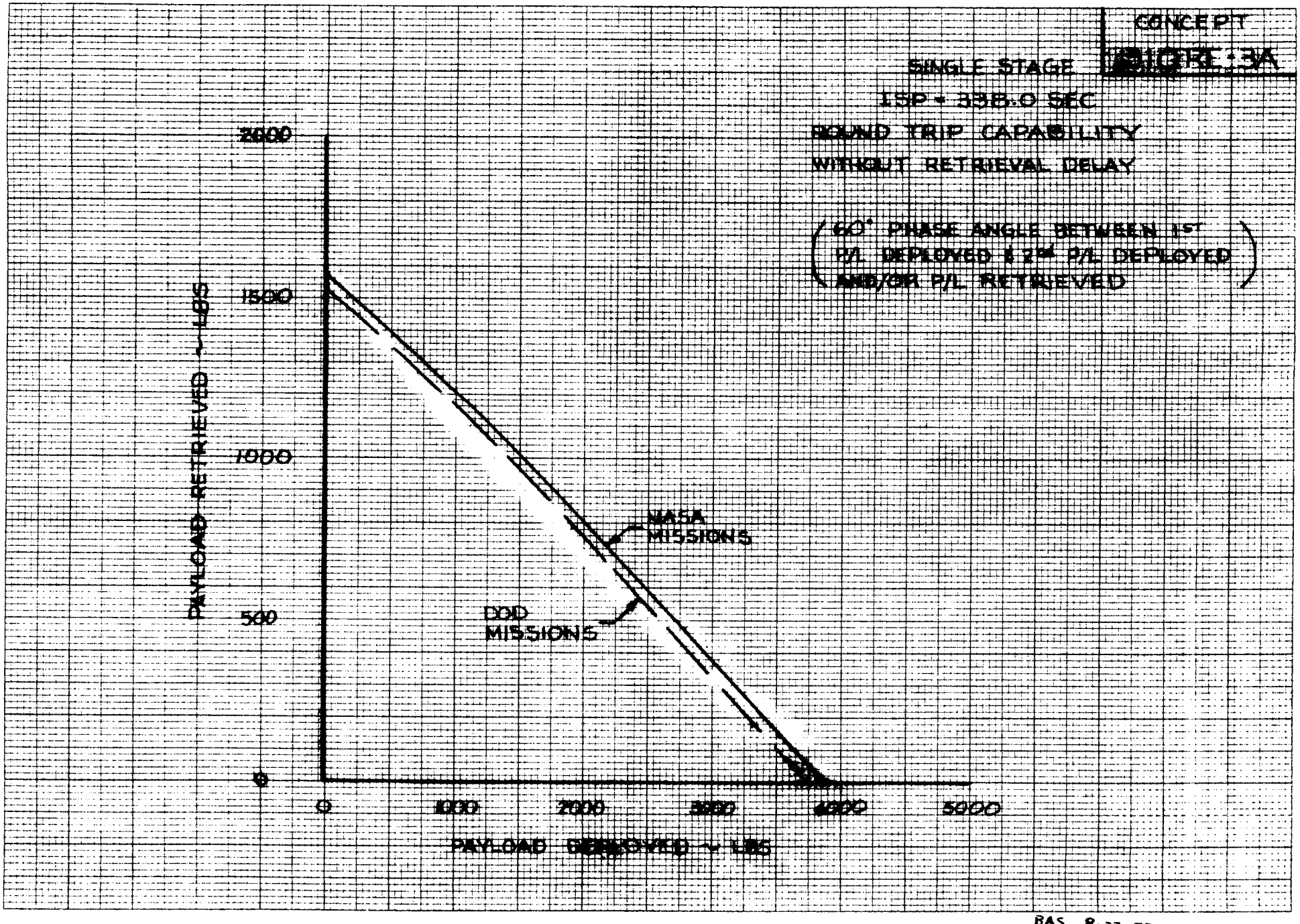


BAS 8-27-73

FIGURE 4.3.3.2-3

NO. 340A-10½ DIETZGEN GRAPH PAPER
10 X 10 PER HALF INCH

EUGENE DIETZGEN CO.
MADE IN U. S. A.



BAS 8-27-73

FIGURE 4.3.3.2-4

K+E 10 X 10 TO THE INCH 46 0703
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

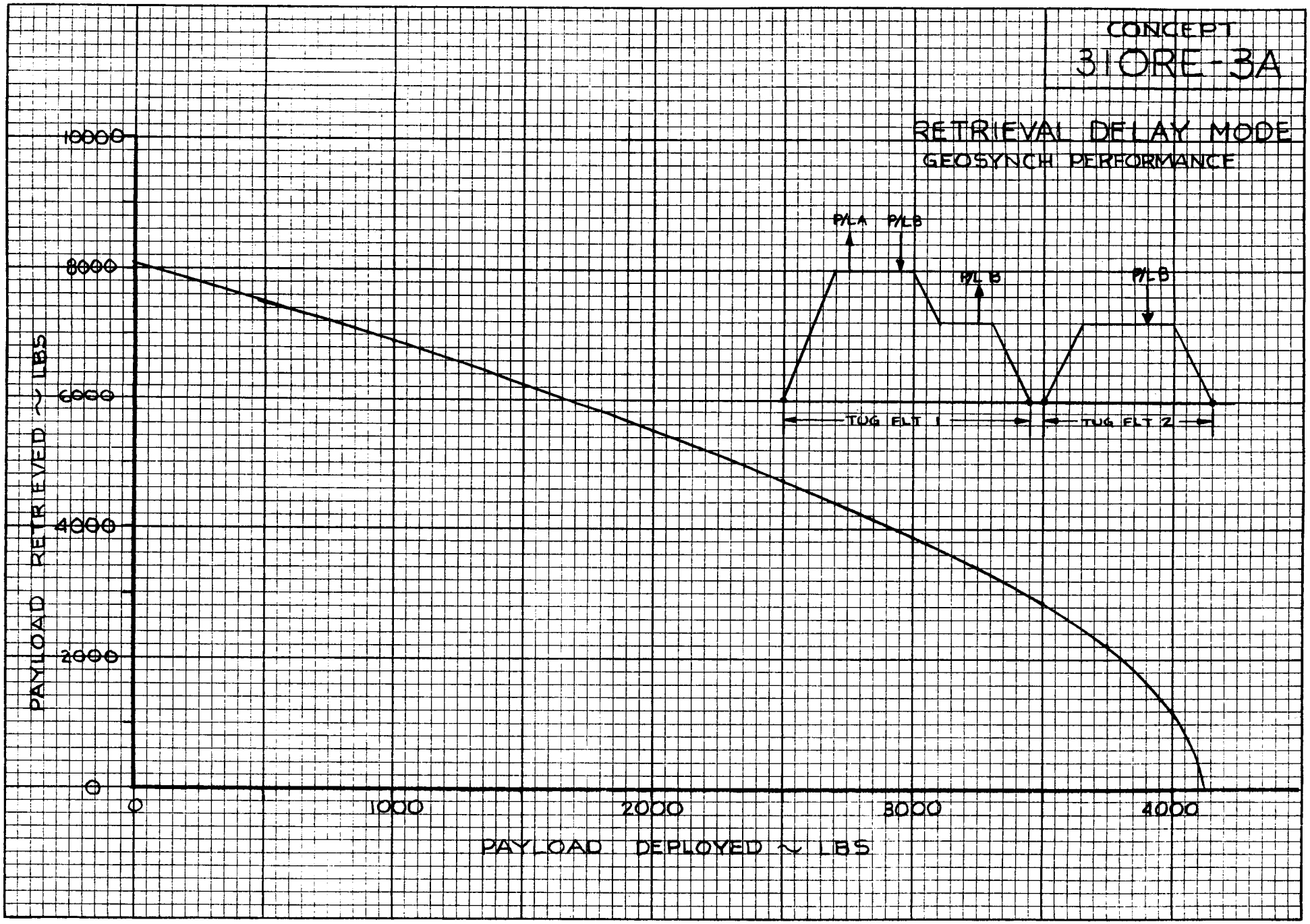


FIGURE 4.3.3.2-5

FLIGHT MODE	SENSITIVITY					
	$\partial PL/\partial W_{FIXED}$ P/L TO FIXED WEIGHT (lbs/lb)	$\partial PL/\partial W_o$ P/L TO INITIAL WEIGHT (lbs/lb)	$\partial PL/\partial I_{SP}$ P/L TO SPECIFIC IMPULSE (lbs/sec)	$\partial PL/\partial \Delta V_{OUT}$ P/L TO OUTBOUND ΔV (lbs/fps)	$\partial PL/\partial \Delta V_{IN}$ P/L TO INBOUND ΔV (lbs/fps)	
DEPLOY	-3.66	0.27	96	-1.60	-1.20	
RETRIEVE	-1.37	0.10	56	-0.61	-0.70	
ROUND TRIP	-1.00	0.07	37	-0.44	-0.44	

CONCEPT 310/310RE-3A

PAYLOAD SENSITIVITIES

TABLE 4.3.3.2-1

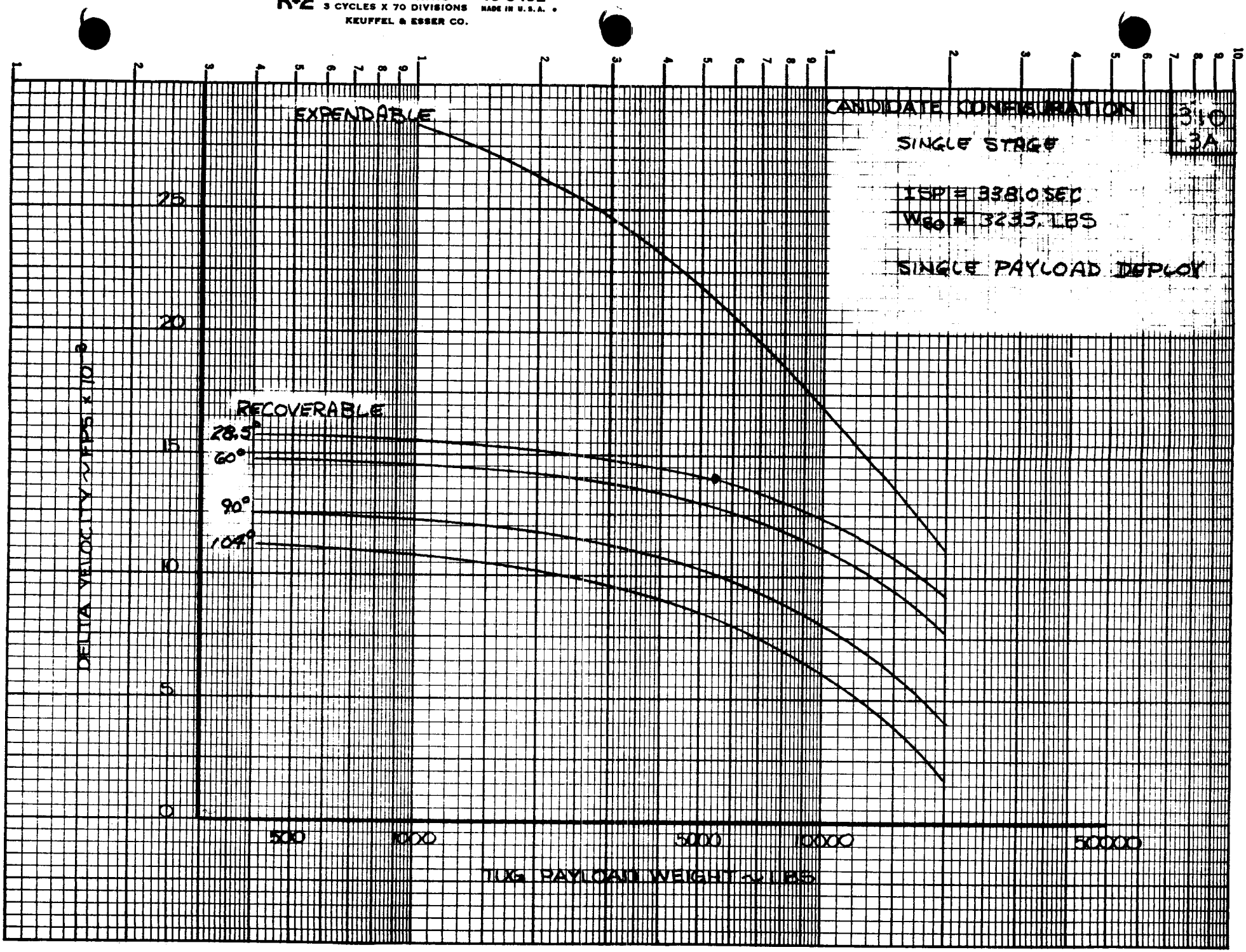


FIGURE 4.3.3.2-6

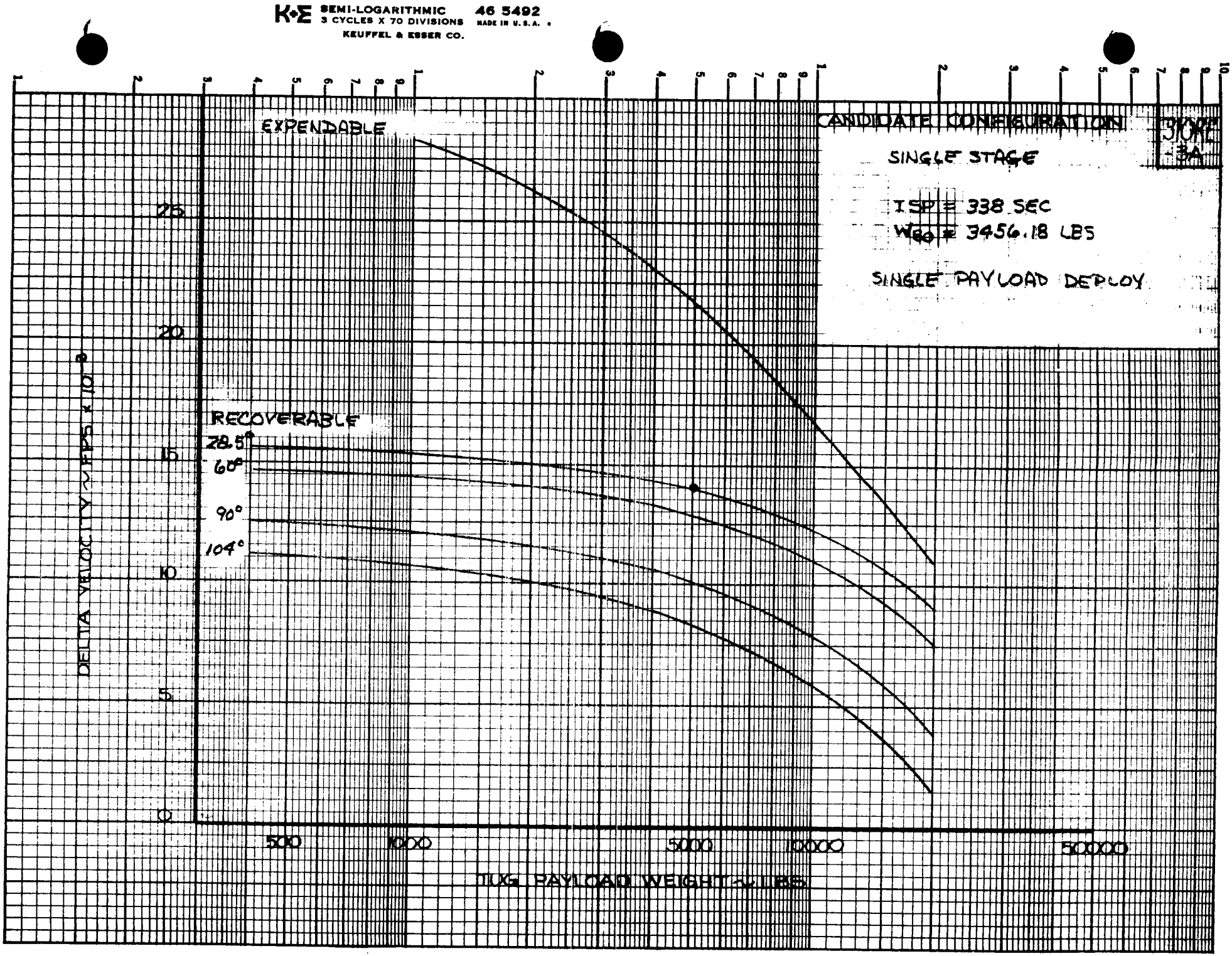


FIGURE 4.3.3.2-7

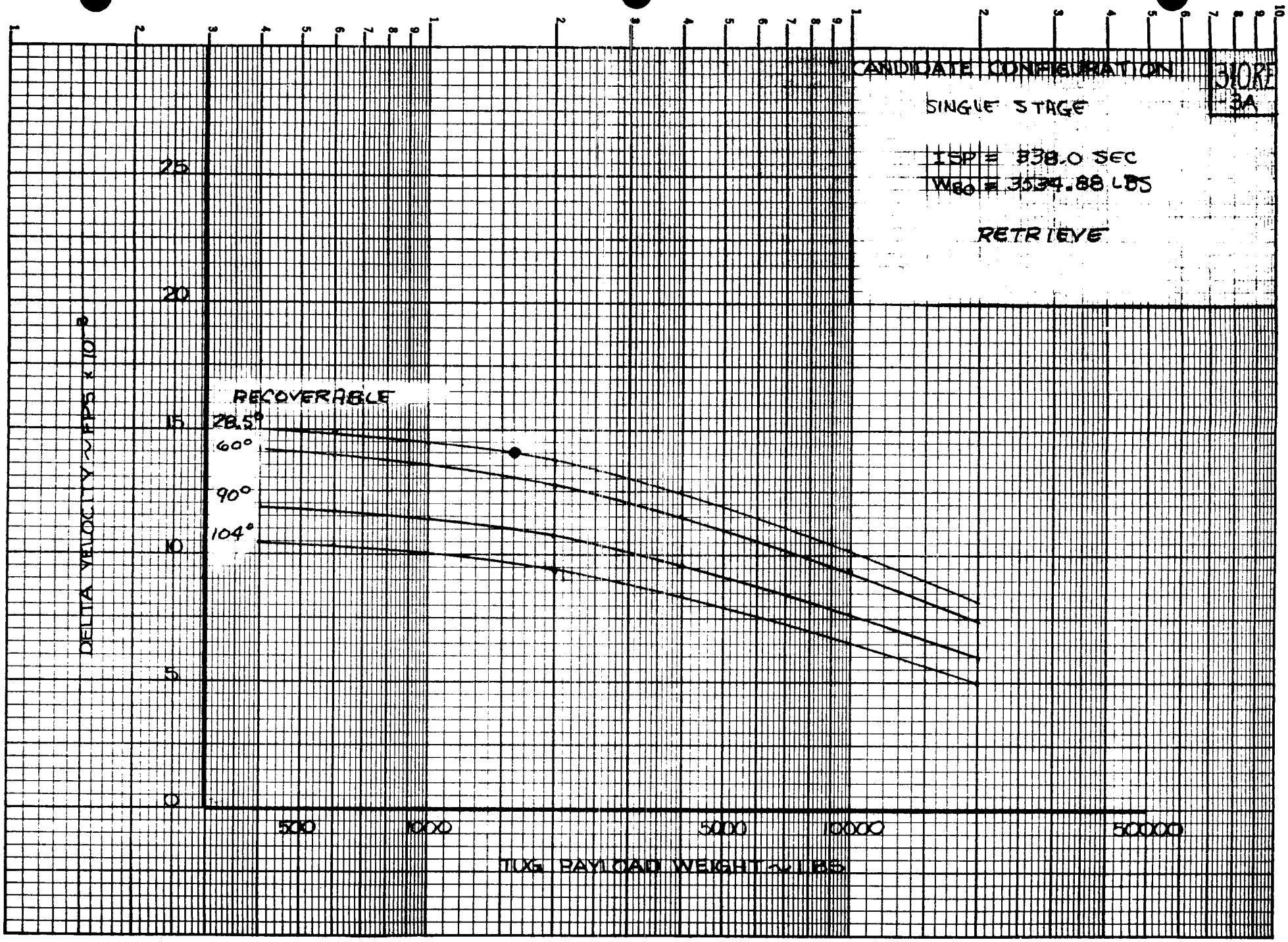


FIGURE 4.3.3.2-8

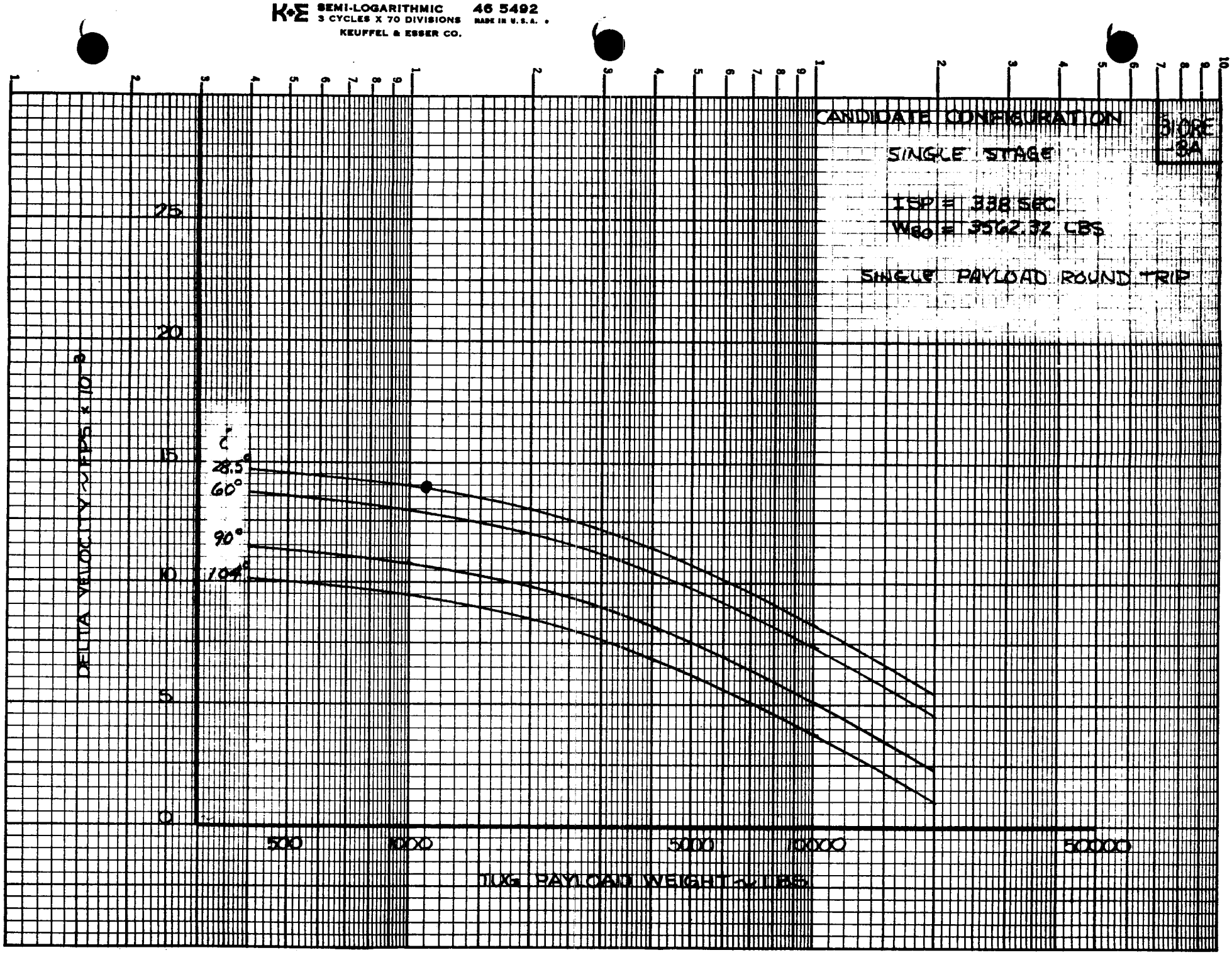


FIGURE 4.3.3.2-9

4.3.3.2.2 310/310RE Flight Summary

Table 4.3.3.2-2 NASA Traffic
-3 DOD Traffic
-4 Combined NASA/DOD Traffic

COMMENTS:

None

FLIGHT SUMMARY

OPTION: 3A (3A10-1/3A10RE-1)

FLIGHT MODE		CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
TOTALS	SHUTTLE	9	9	8	12	30	29	26	24	19	25	25	(216)
	TUG												SAME
TUG FLIGHT DISTRIBUTION	DEPLOY	(9)	(9)	(8)	(12)	(8)	(3)	(6)	(11)	(5)	(10)	(4)	(85)
	SINGLE DEPLOY	4	2	2	3	4	2	2	3	1	4	3	30
	DOUBLE "	5	7	4	7		1		5	4	1		34
	TRIPLE "				2						2		4
	SINGLE " + EXPEND TUG			2		4		4	3		3	1	17
	RETRIEVAL DELAY MODE					(8)	(9)	(7)	(3)	(4)	(6)	(7)	(44)
	RETRIEVAL DELAY					3							3
	SINGLE DEPLOY + RETRIEVAL DELAY					5	9	7	3	4	6	5	39
	DOUBLE " + " "											2	2
	RETRIEVE					(10)	(10)	(10)	(5)	(7)	(6)	(12)	(60)
	ROUND TRIP					(4)	(7)	(3)	(5)	(3)	(3)	(2)	(27)
	ROUND TRIP					4	5	3	5	3	1	2	23
	DOUBLE DEPLOY ROUND TRIP						2				2		4
MISSION MODEL	TOTAL	(14)	(16)	(12)	(23)	(31)	(39)	(29)	(34)	(26)	(35)	(29)	(288)
	DEPLOY	14	16	12	23	17	22	16	24	16	26	15	201
	RETRIEVE					14	17	13	10	10	9	14	87

NASA TRAFFIC

TABLE 4.3.3.2-2

FLIGHT SUMMARY

OPTION: 3A (3A10-1/3A10RE-1)

FLIGHT MODE		CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
TOTALS	SHUTTLE	11	6	9	15	21	13	20	19	21	17	22	174
	TUG												SAME
TUG FLIGHT DISTRIBUTION	DEPLOY	(11)	(6)	(9)	(14)	(8)	(4)	(4)	(6)	(4)	(3)	(6)	(75)
	1 P/L	5	5	6	6	4	2	1	3	1	1	2	36
	2 P/L	3	1	3	6	2	1	2	2	2	0	2	24
	3 P/L	3	0	0	2	2	1	1	1	1	2	2	15
	RETRIEVAL DELAY MODE					(2)	(1)	(1)	(2)	(2)	(3)	(4)	(15)
	RETRIEVAL DELAY										1	1	2
	1 P/L DEPLOY + RETRV DELAY					2	1	1	2	2	2	3	13
	RETRIEVE					(7)	(1)	(8)	(6)	(7)	(3)	(8)	(40)
	RETRIEVE					7	1	8	6	7	3	8	40
	ROUND TRIP				(1)	(4)	(7)	(7)	(5)	(8)	(8)	(4)	(44)
	ROUND TRIP					4	6	7	4	8	7	4	40
	SORTIE				1		1		1		1		4
MISSION MODEL	(TOTAL)	(20)	(7)	(12)	(25)	(31)	(22)	(31)	(27)	(33)	(27)	(31)	(266)
	DEPLOY	20	7	12	24	20	14	16	16	18	16	19	182
	RETRIEVE					11	7	15	10	15	10	12	80
	SORTIE				1		1		1		1		4

DOD TRAFFIC

TABLE 4.3.3.2-3

FLIGHT SUMMARY

OPTION: 3A (3A10-1/3A10RE-1)

FLIGHT MODE		CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
TOTAL FLIGHTS	SHUTTLE	20	15	17	27	51	42	46	43	40	42	47	390
	TUG												SAME
TUG FLIGHT DISTRIBUTION	DEPLOY	(20)	(15)	(17)	(26)	(16)	(7)	(10)	(17)	(9)	(13)	(10)	(160)
	1 P/L	9	7	8	9	8	4	3	6	2	5	5	66
	2 P/L	8	8	7	13	2	2	2	7	6	1	2	58
	3 P/L	3			4	2	1	1	1	1	4	2	19
	1 P/L EXPEND TUG			2		4		4	3		3	1	17
	RETRIEVAL DELAY MODE					(10)	(10)	(8)	(5)	(6)	(9)	(11)	(59)
	RETRIEVAL DELAY					3					1	1	5
	1 P/L DEPLOY + RETRV DELAY					7	10	8	5	6	8	8	52
	2 P/L DEPLOY + RETRV DELAY											2	2
	RETRIEVE					(17)	(11)	(18)	(11)	(14)	(9)	(20)	(100)
	ROUND TRIP				(1)	(8)	(14)	(10)	(10)	(11)	(11)	(6)	(71)
	1 P/L ROUND TRIP					8	11	10	9	11	8	6	63
	2 P/L DEPLOY ROUND TRIP						2				2		4
	SORTIE				1		1		1		1		4
MISSION MODEL	(TOTAL)	(34)	(23)	(24)	(48)	(62)	(61)	(60)	(61)	(59)	(62)	(60)	(554)
	DEPLOY	34	23	24	47	37	36	32	40	34	42	34	383
	RETRIEVE					25	24	28	20	25	19	26	167
	SORTIE				1		1		1		1		4

RELIABILITY = + 4 FLTS

COMBINED NASA/DOD TRAFFIC

TABLE 4.3.3.2-4

4.3.3.2.3 310/310RE Flight Element Requirements

Table 4.3.3.2-5 NASA Traffic
-6 DOD Traffic
-7 NASA/DOD Traffic

COMMENTS:

a. Retrieval Delay Modules are launched and retrieved in same year.

FLIGHT ELEMENT REQUIREMENTS OPTION: 3A 310/310RE-3A

ITEM			CALENDAR YEAR											TOTAL
			80	81	82	83	84	85	86	87	88	89	90	
SHUTTLE FLIGHTS		TOTAL	9	9	8	12	30	29	26	24	19	25	25	216
BASIC TUG FLIGHTS	ETR	RECOVERED	9	9	6	9	22	23	18	15	15	18	20	164
		EXPENDED			2		4		4	3		3	1	17
	WTR	RECOVERED				3	4	6	4	6	4	4	4	35
	(TOTAL)		(9)	(9)	(8)	(12)	(30)	(29)	(26)	(24)	(19)	(25)	(25)	(216)
RETRIEVAL DELAY MODULES							8	9	7	3	4	6	7	44

NASA TRAFFIC

FIGURE 4.3.3.2-5

GRUMMAN

FLIGHT ELEMENT REQUIREMENTS

OPTION: 3A 310/310RE-3A

ITEM			CALENDAR YEAR											TOTAL
			80	81	82	83	84	85	86	87	88	89	90	
SHUTTLE FLIGHTS		TOTAL	11	6	9	15	21	13	20	19	21	17	22	174
BASIC TUG FLIGHTS	ETR	RECOVERED	11	6	9	11	20	11	15	17	19	13	21	153
		EXPENDED												0
	WTR	RECOVERED				4	1	2	5	2	2	4	1	21
	(TOTAL)		(11)	(6)	(9)	(15)	(21)	(13)	(20)	(19)	(21)	(17)	(22)	(174)
RETRIEVAL DELAY MODULES							2	1	1	2	2	3	4	15

DOD TRAFFIC

FIGURE 4.3.3.2-6

GRUMMAN

FLIGHT ELEMENT REQUIREMENTS

OPTION: 3A 310/310RE-3A

ITEM			CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
SHUTTLE FLIGHTS		TOTAL	20	15	17	27	51	42	46	43	40	42	47	390
BASIC TUG FLIGHTS	ETR	RECOVERED	20	15	15	20	42	34	33	32	34	31	41	317
		EXPENDED			2		4		4	3		3	1	17
	WTR	RECOVERED				7	5	8	9	8	6	8	5	56
	(TOTAL)		(20)	(15)	(17)	(27)	(51)	(42)	(46)	(43)	(40)	(42)	(47)	(390)
RETRIEVAL DELAY MODULES							10	10	8	5	6	9	11	59
									RELIABILITY				=	+4 FLTS

COMBINED NASA/DOD TRAFFIC

FIGURE 4.3.3.2-7

GRUMMAN

4.3.3.2.4 310/310RE Initial Flight Schedule

Table 4.3.3.2-8 Costed Flight Build-Up

COMMENTS:

a. Abbreviations used in Table

D = Deploy
R = Retrieve
EXP = Expended Tug
DR = Delayed Retrieve
RD = Retrieval Delay

FLIGHT	PAYLOAD FLOWN					
	1980	1981	1982	1983	1984	1985
1	D-9	D-9	ALL	ALL	D-9	ALL
2	D-17	D-11			D-10	
3	D-35	D1 + D8			D-18	
4		D2 + D3			D-20 (EXP)	
5		D3 + D3			D-20 (EXP)	
6		D4 + D7			D-24 (EXP)	
7		D-31			D-24 (EXP)	
8		D-31			R-1	
9		D-34			R-1	
10		D-35			R-2 (DR)	
11		D-35			R-2 (DR)	
12		D25 + D25			R-3 (DR)	
13					R-3 (DR)	
14					RD-2	
15					RD-2	
16					D8 + RD3	
17					D8 + RD3	
18					D14 + R14	
19					D-28	
20					D-28	
21					D-31	
22					D-31	
23					R-26 (DR)	
24					R-27 (DR)	
25					D32 + D32	
26					D32 + D32	
27					D25 + R25	
28					D26 + RD26	
29					D27 + RD27	
30					D37 + D37 + D37	
31					D39 + D39 + D39	
32					D-18	
FLTS FLOWN / SCHED	3/20	12/15	17/17	27/27	32/51	42/42
P/L'S DEPLOYED FLOWN / SCHED	3/34	17/23	24/24	47/47	28/37	36/36
P/L'S RETRIEVED FLOWN / SCHED	0/0	0/0	0/0	0/0	10/25	24/24
SORTIES FLOWN / SCHED	0/0	0/0	0/0	1/1	0/0	1/1

CONCEPT 310/310RE-3A

COSTED FLIGHT BUILD-UP

TABLE 4.3.3.2-8

4.3.3.2.5 310/310RE Additional Payload Capture Potential

Table 4.3.3.2-9 Additional Payload Capture Potential

COMMENTS:

a. The Retrieval Delay Mode provides the capability of retrieving up to 8000 pounds from geosynchronous orbit, far in excess of the quoted deploy capability for this concept. The complement of the Retrieval Delay Mode, however, a Deploy Delay Mode which was not required to satisfy the requirements of the option, offers the capability of deploying payloads far in excess of the basic approach and would permit deployment of missions N7.

b. Within the groundrules established for conduct of the sortie mission, this concept cannot capture mission D29. It is possible, however, to explore applications of the Retrieval Delay Mode which offer the potential of performing a variation of the sortie, namely de-orbiting but not retrieving the sortie payload on the same flight.

OPTION 3A

ADDITIONAL PAYLOAD CAPTURE POTENTIAL

MISSIONS EXCLUDED FROM OPTION MISSION MODEL					CONCEPT 310/310RE-3A		
DESIGNATION		DEPLOY	RETRIEVE	SORTIE	TUG MODE		
ID NO.	WEIGHT				DEPLOY	RETRIEVE	SORTIE
N 5	2800	-	3	-	-	3 (RD)	-
N 6	5000	-	3	-	-	3 (RD)	-
N 7	5500	-	10	-	-	10 (RD)	-
N 8	4000	-	7	-	-	7 (RD)	-
N 10	9500	-	2	-	-	2 (RD)	-
N 17	2000	3	-	-	3 (CORE)	-	-
N 18	3300	2	-	-	2 (CORE)	-	-
N 19	7900	3	-	-	.3 (EXPEND)	-	-
N 20	1500	4	-	-	4 (EXPEND)	-	-
N 22	4000	4	-	-	0	-	-
N 23	6600	2	-	-	2 (EXPEND)	-	-
N 24	4400	4	-	-	4 (EXPEND)	-	-
D 29 (12b)	2400			5	-	-	0
TOTALS	DEPLOY	22			18		
	RETRIEVE		25			25	
	SORTIE			5			0
	(TOTAL)	52			43		

N = NASA
D = DOD

RD = RETRIEVAL DELAY

FIGURE 4.3.3.2-9

4.3.3.2.6 310/310RE Detailed Traffic Assessment Data

Table 4.3.3.2-10	NASA Traffic Assessment
-11	NASA Geosynch Mixed Missions
-12	NASA Non-Geosynch Mixed Missions
-13	DOD Traffic Assessment

COMMENTS:

a. All missions are accomplished without Retrieval Delay unless otherwise indicated.

TRAFFIC ASSESSMENT: NASA

OPTION: 3A (3A10-1/3A10RE-1)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
MIXED PAYLOADS -GEO- (see Pages 5-10)	DOUBLE DEPLOY	CORE ALONE		4	5	3	4		1		3	1			21
	ROUND TRIP								1		1		1		3
	DEPLOY + RD	RDM						3	7	5	3	4	6	5	33
	DOUBLE DEPLOY + RD	RDM												2	2
	(TOTAL)			(4)	(5)	(3)	(4)	(3)	(9)	(5)	(7)	(5)	(7)	(7)	(59)
1	SINGLE DEPLOY												1		1
	RETRIEVE									1				2	3
	ROUND TRIP							2		1		1			4
	(TOTAL)							(2)		(2)		(1)	(1)	(2)	(8)
2	SINGLE DEPLOY						1								1
	RETRIEVE							3	1	2		1		1	8
	DEPLOY + RD	RDM													
	RETRY DELAY	RDM						3							3
	(TOTAL)						(1)	(6)	(1)	(2)		(1)		(1)	(12)
3	SINGLE DEPLOY								1		1				2
	DOUBLE DEPLOY			1	2	1	1				2	3	1		11
	RETRIEVE							3	7	3	3	1	5	5	27
	DEPLOY + RETRY DELAY	RDM						1	2	2					5
	(TOTAL)			(1)	(2)	(1)	(1)	(3)	(10)	(5)	(6)	(4)	(6)	(5)	(45)
4	SINGLE DEPLOY			1											1
	RETRIEVE							2	1	1		2	1	1	8
	DEPLOY + RD	RDM						1							1
	(TOTAL)			(1)				(3)	(1)	(1)		(2)	(1)	(1)	(10)
5	DOUBLE DEPLOY						1								1
	(TOTAL)						(1)								(1)

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TABLE 4.3.3.2-10

TRAFFIC ASSESSMENT

OPTION 3A (3A10-1/3A10RE-1)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
7	SINGLE DEPLOY					1									1
	(TOTAL)					(1)									(1)
8	SINGLE DEPLOY						1								1
	(TOTAL)						(1)								(1)
NASA GEOSYNCH TRAFFIC SUMMARY (Missions 1-8)	SINGLE DEPLOY			1		1	2		1		1		1		7
	DOUBLE DEPLOY			5	7	4	6		1		5	4	1		33
	RETRIEVE							8	9	7	3	4	6	9	46
	ROUND TRIP							2	1	1	1	1	1		7
	DEPLOY + RD	RDM						5	9	7	3	4	6	5	39
	DOUBLE DEPLOY + RD	RDM												2	2
	RETRV DELAY	RDM						3							3
	(TOTAL)			(6)	(7)	(5)	(8)	(18)	(21)	(15)	(13)	(13)	(15)	(16)	(137)
9	SINGLE DEPLOY			1		1		1		2		1		2	8
	(TOTAL)			(1)		(1)		(1)		(2)		(1)		(2)	(8)
10	SINGLE DEPLOY				1			1			1			1	4
	(TOTAL)				(1)			(1)			(1)			(1)	(4)
11	SINGLE DEPLOY			1	1		1		1		1		1		6
	RETRIEVE								1	1		1		1	4
	(TOTAL)			(1)	(1)		(1)		(2)	(1)	(1)	(1)	(1)	(1)	(10)
MIXED PAYLOADS NON-GEO (See pages 11-12)	TRIPLE DEPLOY	WTR LAUNCH					2						2		4
	ROUND TRIP	WTR LAUNCH									2				2
	DOUBLE DEPLOY ROUND TRIP	WTR LAUNCH							2				2		4
	(TOTAL)						(2)		(2)		(2)		(4)		(10)

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TABLE 4.3.3.2-10 (cont)

TRAFFIC ASSESSMENT

OPTION: 3A (3A10-1/3A10RE-1)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
12	RETRIEVE	WTR LAUNCH						1		1		1		1	4
	(TOTAL)							(1)		(1)		(1)		(1)	(4)
13	RETRIEVE	WTR LAUNCH						1		1		1		1	4
	(TOTAL)							(1)		(1)		(1)		(1)	(4)
14	ROUND TRIP	WTR LAUNCH						1		1	1	1		1	5
	(TOTAL)							(1)		(1)	(1)	(1)		(1)	(5)
15	ROUND TRIP	WTR LAUNCH						1		1	1	1		1	5
	(TOTAL)							(1)		(1)	(1)	(1)		(1)	(5)
16	DOUBLE DEPLOY	WTR LAUNCH					1								1
	RETRIEVE	WTR LAUNCH									2				2
	ROUND TRIP	WTR LAUNCH							4						4
	(TOTAL)						(1)		(4)		(2)				(7)
NASA NON-GEO E.O TRAFFIC SUMMARY (MISSIONS 9-16)	SINGLE DEPLOY			2	2	1	1	2	1	2	2	1	1	3	18
	DOUBLE DEPLOY						1								1
	TRIPLE DEPLOY						2						2		4
	RETRIEVE							2	1	3	2	3		3	14
	ROUND TRIP							2	4	2	4	2		2	16
	DOUBLE DEPLOY ROUND TRIP								2				2		4
	(TOTAL)			(2)	(2)	(1)	(4)	(6)	(8)	(7)	(8)	(6)	(5)	(8)	(57)

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TABLE 4.3.3.2-10 (cont)

TRAFFIC ASSESSMENT - NASA PLANETARY

OPTION: 3A (3A10-1/3A10RE-1)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
17	SINGLE DEPLOY			1									2		3
	(TOTAL)			(1)									(2)		(3)
18	SINGLE DEPLOY							2							2
	(TOTAL)							(2)							(2)
19	SINGLE DEPLOY	EXPEND TUG								1	2				3
	(TOTAL)									(1)	(2)				(3)
20	SINGLE DEPLOY	EXPEND TUG				2		2							4
	(TOTAL)					(2)		(2)							(4)
22	SINGLE DEPLOY	EXPEND TUG								1	1		1	1	4
	(TOTAL)									(1)	(1)		(1)	(1)	(4)
23	SINGLE DEPLOY	EXPEND TUG								2					2
	(TOTAL)									(2)					(2)
24	SINGLE DEPLOY	EXPEND TUG						2					2		4
	(TOTAL)							(2)					(2)		(4)
NASA PLANETARY TRAFFIC SUMMARY (MISSIONS 17-24)	SINGLE DEPLOY	RECOVER TUG		1				2					2		5
	SINGLE DEPLOY	EXPEND TUG				2		4		4	3		3	1	17
	(TOTAL)			(1)		(2)		(6)		(4)	(3)		(5)	(1)	(22)

TABLE 4.3.3.2-10 (cont)

MIXED MISSIONS: NASA GEOSYNCH OPTION: 3A (3A10-1/3A10RE-1)

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
80	D	2	1	3	1	-	1	1	2	-	-	-
	R	-	-	-	-	-	-	-	-	-	-	-
	1	1							1	-	4300	35 × 14
	2	1							1	-	"	"
	3		1					1		-	5100	32 × 10
	4			1			1			-	4700	24 × 8
	5				1					-	1800	10 × 14
	6			2						-	4200	24 × 8
81	D	3	2	7	1	-	-	1	1	-	-	-
	R	-	-	-	-	-	-	-	-	-	-	-
	1	1							1	-	4300	35 × 14
	2				1			1		-	4800	30 × 14
	3	1		1						-	3000	22 × 8 / 12 × 14
	4		1	1						-	3800	20 × 8
	5		1	1						-	"	"
	6			2						-	4200	24 × 8
	7			2						-	"	"
82	D	2	-	5	-	-	1	2	1	-	-	-
	R	-	-	-	-	-	-	-	-	-	-	-
	1	1							1	-	4300	35 × 14
	2	1						1		-	3900	30 × 10
	3							1		-	3000	20 × 10
	4			1			1			-	4700	24 × 8
	5			2							4200	24 × 8
83	D	1	1	5	2	3	-	2	2	-	-	-
	R	-	-	-	-	-	-	-	-	-	-	-
	1	1							1	-	4300	35 × 14
	2								1	-	3500	25 × 14
	3		1		1			1		-	4800	30 × 14
	4				1			1		-	"	"
	5					2					3600	34 × 10
	6			1		1					3900	29 × 10
	7			2							4200	24 × 8
	8		1								1700	8 × 8

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TABLE 4.3.2.2-11

MIXED MISSIONS: NASA GEOSYNCH (cont) OPTION: 3A10-RE

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
85	7			RD				D		RDM	3000	20x10
	8			R							2100	12x8
	9			RD			D			RDM	2600	12x8
	10			R							2100	12x8
	11			RD	D					RDM	1800	10x14
	12			R							2100	12x8
	13			D RD						RDM	2100	12x8
	14			R							2100	12x8
	15			D RD						RDM	2100	12x8
	16			R							2100	12x8
	17		RD	D						RDM	2100	12x8
	18		R								1700	8x8
	19	R	D								1700 900	8x8 10x6
	20	D		D							3000	12x14 22x8
	21			D							2100	12x8
86		1 2	2	5 3	1				2			
	1				RD				D		3500	25x14
	2				R						1800	10x14
	3			RD					D	RDM	3500	25x14
	4			R							2100	12x8
	5			D RD						RDM	2100	12x8
	6			R							2100	12x8
	7			D RD						RDM	2100	12x8
	8			R							2100	12x8

TABLE 4.3.3.2-11 (cont)

MIXED MISSIONS: NASA GEOSYNCH (cont) OPTION: 3A10-RE

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
86	9		RD	D						RDM	2100	12x8
	10		R								1700	8x8
	11		RD	D						RDM	2100	12x8
	12		R								1700	8x8
	13	RD		D						RDM	2100	12x8
	14	R									900	10x6
	15	D R									" "	" "
87		1 1	1	6 3	2		1	2	2			
	1			RD					D	RDM	3500	25x14
	2			R							2100	12x8
	3			RD					D	RDM	3500	25x14
	4			R							2100	12x8
	5	R	D								1700 900	8x8 10x6
	6	D						D			3900	30x10
	7			RD				D		RDM	3000	20x10
	8			R							2100	12x8
	9				D		D				4400	22x14
	10			D	D						3900	22x14
	11			2D							4200	24x8
	12			2D							4200	24x8
	13			D							2100	12x8
88		2 1	1	7 1	1 2			1	2			
	1				RD				D	RDM	3500	25x14
	2				R						1800	10x14

TABLE 4.3.3.2-11 (cont)

MIXED MISSIONS: NASA GEOSYNCH (Cont) OPTION: SMIU RL

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
88	3								D		3500	25x14
					RD					RDM		
	4				R						1800	10x14
	5							D			3000	20x10
				RD						RDM		
	6			R							2100	12x8
	7			D	D						3900	22x14
	8			2D							4200	24x8
	9			2D							"	"
	10			2D							"	"
	11	D									900	10x6
			RD							RDM		
	12		R								1700	8x8
	13	D									900	10x6
		R									"	"
89		1	1	2		3		1	2			
		1		5	1							
	1								D		3500	25x14
					RD					RDM		
	2				R						1800	10x14
	3								D		3500	25x14
				RD						RDM		
	4			R							2100	12x8
	5							D			3000	20x10
				RD						RDM		
	6			R							2100	12x8
	7					D					1800	17x10
				RD						RDM		
	8			R							2100	12x8
	9					D					1800	17x10
				RD						RDM		
	10			R							2100	12x8
	11					D					1800	17x10
				RD						RDM		
	12			R							2100	12x8
	13			2D							4200	24x8

TABLE 4.3.2.2-11 (cont)

MIXED MISSIONS: NASA GEOSYNCH (cont) OPTION: 3A10-RE

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
89	14		D								1700	8x8
		R									900	10x6
	15	D									900	10x6
90		2		3			2		2			
		2	1	5	1							
	1								D		3500	25x14
					RD					RDM		
	2				R						1800	10x14
	3								D		3500	25x14
				RD						RDM		
	4			R							2100	12x8
	5						D				2600	12x8
				RD						RDM		
	6			R							2100	12x8
	7						D				2600	12x8
				RD						RDM		
	8			R							2100	12x8
	9	D		D							3000	18x14 22x8
				RD						RDM		
	10			R							2100	12x8
	11	D		D							3000	12x14 22x8
				RD						RDM		
	12			R							2100	12x8
	13			D							2100	12x8
			RD							RDM		
	14		R								1700	8x8
	15	R									900	10x6
	16	R									900	10x6

TABLE 4.3.3.2-11 (cont)

MIXED MISSIONS - NASA NON-GEOSYNCH OPTION: 3A (3A10-1 / 3A10RE-1)

YEAR	FLT NO	PAYLOAD ~~11~~	12	13	14	15	16	~~17~~	~~18~~	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
83		D R	1 –	1 –	1 –	1 –	4 –					
	1					D	2D				11000	30 × 13
	2						2D				9000	22 × 13
	3		D	D	D							
84		D R	– 1	– 1	1 1	1 1	– –					
	1					D R					2000	8 × 11
	2				D R						800	10 × 15
	3			R							1000	7 × 7
	4		R								2000	8 × 6
85		D R	1 –	1 –	1 1	1 1	4 4					
	1						D R				4500	11 × 13
	2						D R					
	3						D R					
	4						D R					
	5			D		D R					3000 2000	15 × 11 8 × 11
	6		D		D R						2800 800	{18 × 6 {10 × 11 10 × 5
86		D R	 1	 1	1 1	1 1	– –					
	1					D R					2000	8 × 11
	2				D R						800	10 × 5
	3			R							1000	7 × 7
	4		R								2000	8 × 6

TABLE 4.3.3.2-12 (cont)

MIXED MISSIONS - NASA NON-GEOSYNCH OPTION: 3A (3A1D-1/3A1ORE-1)

YEAR	FLT NO	PAYLOAD								AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
		11	12	13	14	15	16	17	18			
87		D	1	1	1	1	-					
		R	-	-	1	1	4					
	1			D							1000	7×7
							R				4500	11×13
	2		D								2000	8×6
							R				4500	11×13
	3						R				4500	11×13
	4						R					
	5					D					2000	8×11
						R						
	6				D						800	10×5
					R							
88		D	-	-	1	1	-					
		R	1	1	1	1	-					
	1					D					2000	8×11
						R						
	2				D						800	10×5
					R							
	3			R							1000	7×7
	4		R								2000	8×6
89		D	1	1	1	1	6					
		R	-	-	1	1	-					
	1					D	D				6500	19×13
						R					2000	8×11
	2				D		D				5300	21×13
					R						800	10×5
	3			D			2D				10000	29×13
	4		D				2D				11000	30×13
90		D	-	-	1	1	-					
		R	1	1	1	1	-					
	1					D					2000	8×11
						R						
	2				D						800	10×15
					R							
	3			R							1000	7×7
	4		R								2000	8×6

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TABLE 4.3.3.2-12 (cont)

TRAFFIC ASSESSMENT – DOD GEOSYNCH

OPTION 3A(3A10-1/3A10RE-1)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
25	DOUBLE DEPLOY			1	1	1	1								4
	ROUND TRIP							2	2	2	2	2	2	2	14
	(TOTAL)			(1)	(1)	(1)	(1)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(18)
26	SINGLE DEPLOY			1		1	1								3
	DEPLOY + RD	RDM						1		1	1	1		1	5
	RETRIEVE							1		1	1	1		1	5
	(TOTAL)			(1)		(1)	(1)	(2)		(2)	(2)	(2)		(2)	(13)
27	SINGLE DEPLOY			1		1	1								3
	DEPLOY + RD	RDM						1	1		1	1	1	1	6
	RETRIEVE							1	1		1	1	1	1	6
	(TOTAL)			(1)		(1)	(1)	(2)	(2)		(2)	(2)	(2)	(2)	(15)
28	SINGLE DEPLOY							2		1		1			4
	DEPLOY + RD	RDM											1	1	2
	DOUBLE DEPLOY						1								1
	RETRV DELAY	RDM											1	1	2
	RETRIEVE												2	2	4
	(TOTAL)						(1)	(2)		(1)		(1)	(4)	(4)	(13)
30	SINGLE DEPLOY								2		1		1		4
	(TOTAL)								(2)		(1)		(1)		(4)
31	SINGLE DEPLOY				2			2			2			2	8
	(TOTAL)				(2)			(2)			(2)			(2)	(8)

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TABLE 4.3.3.2-13

TRAFFIC ASSESSMENT – DOD GEOSYNCH

OPTION: 3A (3A10-1/3A10RE-1)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION												
			CALENDAR YEAR												TOTAL
			79	80	81	82	83	84	85	86	87	88	89	90	
DOD GEO TRAFFIC SUMMARY (Missions 25-31)	SINGLE DEPLOY			2	2	2	2	4	2	1	3	1	1	2	22
	DEPLOY + RD	RDM						2	1	1	2	2	2	3	13
	DOUBLE DEPLOY			1	1	1	2								5
	RETRV DELAY	RDM											1	1	2
	RETRIEVE							2	1	1	2	2	3	4	15
	ROUND TRIP							2	2	2	2	2	2	2	14
	(TOTAL)			(3)	(3)	(3)	(4)	(10)	(6)	(5)	(9)	(7)	(9)	(12)	(71)

TABLE 4.3.3.2-13 (cont)

TRAFFIC ASSESSMENT: DOD NON-GEOSYNCH

OPTION: 3A (3A10-1/3A10RE-1)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
32	DOUBLE DEPLOY			2		2	2	2		2	2	2		2	16
	RETRIEVE							4		4	4	4		4	20
	(TOTAL)			(2)		(2)	(2)	(6)		(6)	(6)	(6)		(6)	(36)
33	SINGLE DEPLOY			1		2	1								4
	ROUND TRIP								2	1		2	1		6
	(TOTAL)			(1)		(2)	(1)		(2)	(1)		(2)	(1)		(10)
34	SINGLE DEPLOY				1		1								2
	RETRIEVE							1		1		1			3
	(TOTAL)				(1)		(1)	(1)		(1)		(1)			(5)
35	SINGLE DEPLOY			2	2	2	2								8
	ROUND TRIP							2	2	2	2	2	2	2	14
	(TOTAL)			(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(22)
36	TRIPLE DEPLOY			1			1					1			3
	(TOTAL)			(1)			(1)					(1)			(3)
37	TRIPLE DEPLOY			1				1					1		3
	(TOTAL)			(1)				(1)					(1)		(3)
38	TRIPLE DEPLOY			1					1					1	3
	(TOTAL)			(1)					(1)					(1)	(3)
39	TRIPLE DEPLOY	WTR LAUNCH					1	1		1	1		1	1	6
	(TOTAL)						(1)	(1)		(1)	(1)		(1)	(1)	(6)
40	DOUBLE DEPLOY	WTR LAUNCH					2		1						3
	RETRIEVE									2					2
	ROUND TRIP									2		2	2		6
	(TOTAL)						(2)		(1)	(4)		(2)	(2)		(11)

TABLE 4.3.3.2-13 (cont)

TRAFFIC ASSESSMENT: DOD NON-GEOSYNCH (Cont) OPTION: 3A (3A10-1 / 3A10RE-1)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
41	SORTIE	WTR LAUNCH					1		1		1		1		4
	(TOTAL)						(1)		(1)		(1)		(1)		(4)
DOD NON-GEO TRAFFIC SUMMARY (Missions 32-41)	SINGLE DEPLOY			3	3	4	4								14
	DOUBLE DEPLOY			2		2	4	2	1	2	2	2		2	19
	TRIPLE DEPLOY			3			2	2	1	1	1	1	2	2	15
	RETRIEVE							5		7	4	5		4	25
	ROUND TRIP							2	4	5	2	6	5	2	26
	SORTIE						1		1		1		1		4
	(TOTAL)			(8)	(3)	(6)	(11)	(11)	(7)	(15)	(10)	(14)	(8)	(10)	(103)
TOTAL DOD TRAFFIC SUMMARY (Missions 25-41)	DEPLOY														
	• SINGLE DEPLOY			5	5	6	6	4	2	1	3	1	1	2	36
	• DEPLOY + RD	RDM						2	1	1	2	2	2	3	13
	• DOUBLE DEPLOY			3	1	3	6	2	1	2	2	2		2	24
	• TRIPLE DEPLOY			3			2	2	1	1	1	1	2	2	15
	RETRIEVE														
	• RTRV DELAY	RDM											1	1	2
	• RETRIEVE							7	1	8	6	7	3	8	40
	ROUND TRIP							4	6	7	4	8	7	4	40
	SORTIE						1		1		1		1		4
	(TOTAL)			(11)	(6)	(9)	(15)	(21)	(13)	(20)	(19)	(21)	(17)	(22)	(174)

TABLE 4.3.3.2-13 (cont)

4.3.3.3 Concept 320A/320AE-3A

4.3.3.3.1 320A/320AE Performance

- o Flight Modes — Page 4-149
  - Figure 4.3.3.3-1
- o Geosynchronous Performance — 4-150
  - 320A — 4-150
  - 320AE — 4-153
  - Figures 4.3.3.3-2 thru -4 — 4-158
- o Geosynchronous Performance Sensitivity (Not Available)
- o General Performance — 4-161
  - Figures 4.3.3.3-5 thru -12

COMMENTS:

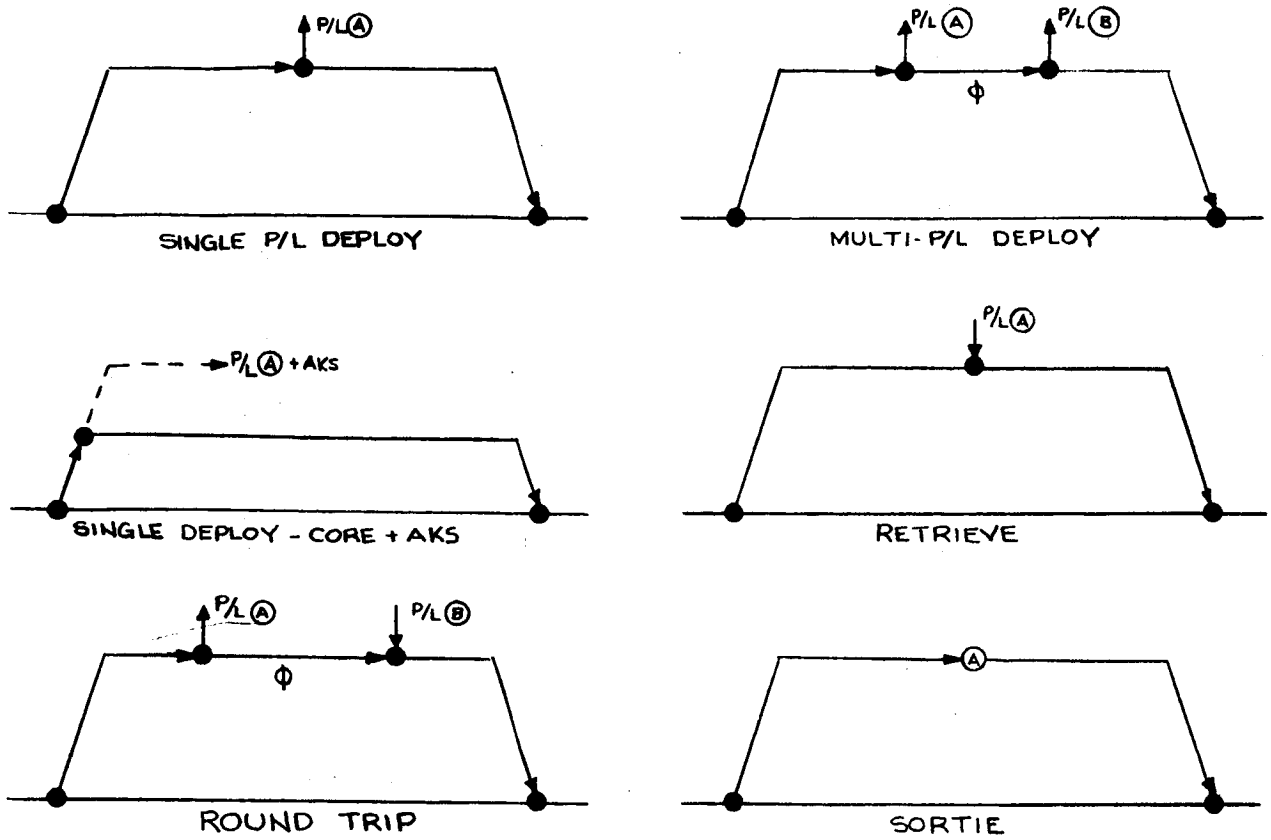
a. Performance is quoted for both one and two stage flight modes.

b. Two Stage Slingshot performance was calculated for 320A. Because Reverse Slingshot is primary high performance flight mode for 320AE and excess capability associated with 320A Slingshot, the 320A value was considered representative of 320AE Slingshot performance.

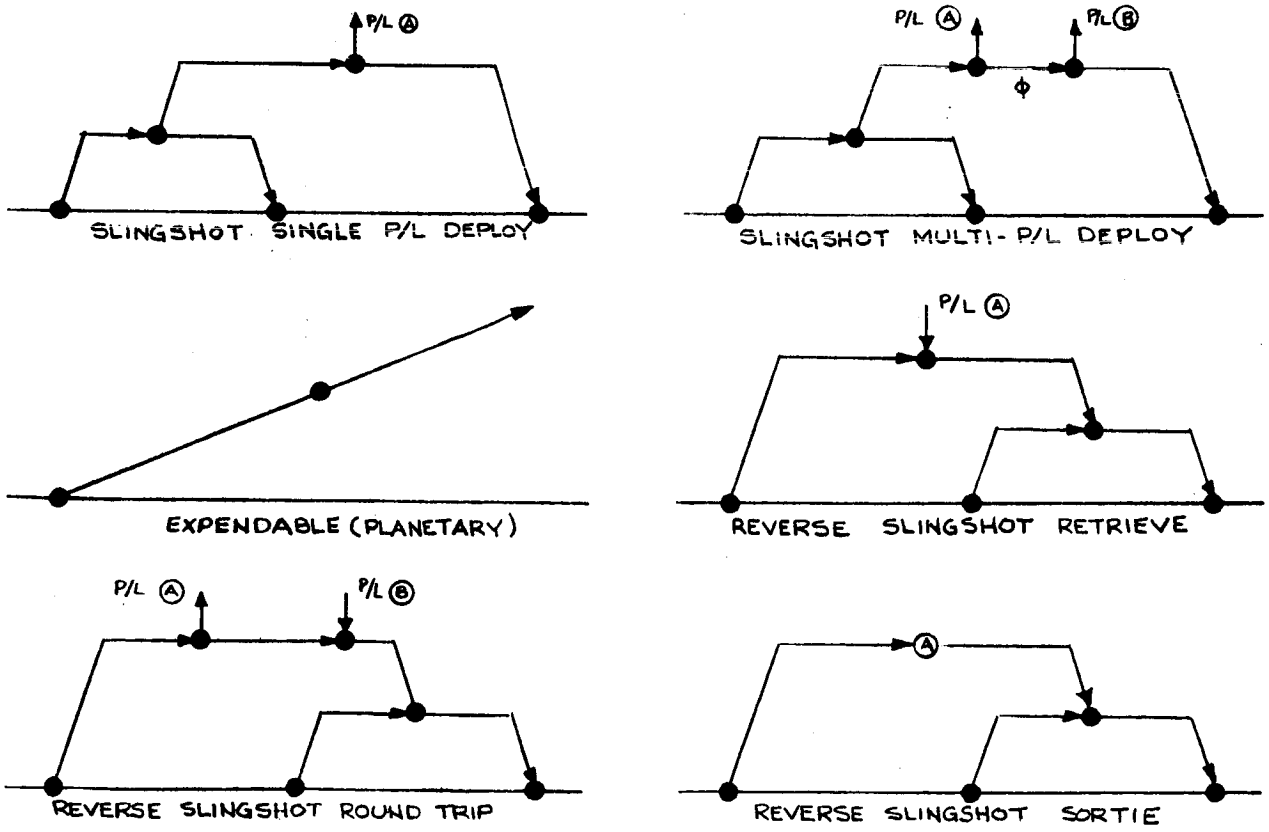
c. One stage deploy performance for 320AE equal to or greater than that of 320A. Accordingly, 320A performance curves (Figure 4.3.3.3-5) were used for both Tug versions.

d. The Tug provides a single 60° phasing between first and second deployments for multi-deployment flights. No additional phasing is provided for a third deployment or a subsequent retrieval.

ONE STAGE



TWO STAGE



CONCEPT 320A/320AE-3A

FLIGHT MODES

FIGURE 4.3.3.3 - 1

CONCEPT 320A-3A

GEOSYNCH PERFORMANCE

REFERENCES:

a. 320A-1 Concept Definition, Issue 2, dated 28-29 Aug 1973

GENERAL INFORMATION

W_{FIXED} = 2695 lbs

W_{ADAPT} = 1611 lbs (one stage)

= 1924 lbs (two stage)

I_{SP} = 338.0 Sec

I_{SP} = 0.983 ISP = 332.25 sec

$W_i = P/L_o - W_{ADAPT}$

W_i = 65000 - 1611 = 63389 lbs

W_i = 65000 - 1924 = 63076 lbs

$W_{BOI} = W_{FIXED} + \chi$ (consumables) $\chi = 0.17$ (Deploy)

= 2695 + 0.17C

Tug Length = L_T = 204.76 in/stg

Tug Interstage Adapter Length = L_A = 3.0 in (Two Stg Flts Only)

Tug Forward Mounting = L_F = 112 in (One Stg Flts Only)

Kick Stage Length = L_K = 100 in (KS 321) NOTE: Used with one stage only

Orbiter P/L Bay Length = L_o = 720 in

Available P/L Length = $L_p = L_o - (2L_T + L_A)$ (Two Stg Flts)

$= L_o - (L_T + L_F + L_K)$ (One Stg Flts)

L_p = 720 - [2(204.76) + 3.0] =	307.48 in	=	25.62 ft	Two Stg
= 720 - (204.76 + 112) =	403.24 in	=	33.60 ft	One Stg w/o KS
= 720 - (204.76 + 112 + 100) =	303.24 in	=	25.27 ft	One Stg with KS

NASA MISSIONS

ONE STAGE

Without Kick Stages

$\omega_{BO(Deploy)} = \omega_{BOI} = 2695 + 0.17(354) = \underline{2755}$ lbs

$\omega_{P/L(Deploy)} = f(\omega_i, \omega_{BO}, ISPE, \Delta V_U, \Delta V_D) =$ Fig 4.3.3.3-5

With Kick Stage KS 321 (Planetary Only)

$\omega_{BO(Deploy)} = \omega_{BOI} = 2695 + 0.17(265) = \underline{2740}$ lbs

$\omega_{P/L} = f(\omega_i, \omega_{BO}, ISPE, \Delta V_U, \Delta V_D, KS) =$ Fig 4.3.3.3-6

TWO STAGE

Slingshot Mode

Single P/L Deploy

$\omega_{BO(Deploy)} = \omega_{BOI} = 2695 + 0.17(102) = \underline{2712}$ lbs (1ST STG)

$= 2695 + 0.17(281) = \underline{2744}$ lbs (2ND STG)

$\omega_{P/L(Deploy)} = f(\omega_i, \omega_{BO}, ISPE, \Delta V) =$ 5094 lbs See Fig 4.3.3.3-7

Multi P/L Deploy

$\omega_{BO(Deploy)} = \omega_{BOI} = 2695 + 0.17(102) = \underline{2712}$ lbs (1ST STG)

$= 2695 + 0.17(281) = \underline{2744}$ lbs (2ND STG)

$\omega_{P/L(Deploy)} = f(\omega_i, \omega_{BO}, ISPE, \Delta V_U, \Delta V_D, \Delta V_\phi) =$ Fig 4.3.3.3-2

$\Delta V_\phi = f(\phi = 60°) = 292$ fps

DOD MISSIONS

$\omega_{BO} = \omega_{BO(NASA)} + \Delta W_{COMM}$

$= \omega_{BO(NASA)} + 13.2$

ONE STAGE

$\omega_{BO} = 2755 + 13.2 = \underline{2768}$ lbs

$\omega_{P/L}$ = (Use NASA Performance) = Fig 4.3.3.3-5

TWO STAGE

$\omega_{BO} = 2712 + 13.2 = \underline{2725}$ lbs (1st Stg)

$= 2744 + 13.2 = \underline{2757}$ lbs (2nd Stg)

Slingshot Mode

Single P/L Deploy

$\omega_{P/L(Deploy)} = f(\omega_i, \omega_{BO}, ISPE, \Delta V) =$ 5045 lbs see Fig 4.3.3.3-7

Multi-P/L Deploy

$\omega_{P/L(Deploy)} = f(\omega_i, \omega_{BO}, ISPE, \Delta V_\theta) =$ Fig 4.3.3.3-2

CONCEPT 320AE-3A

GEOSYNCH PERFORMANCE

REFERENCES

a. 320AE-1 Concept Definition, Issue 2, dated 29 Aug 1973

GENERAL INFORMATION

W_{FIXED} = 2768 lbs

W_{ADAPT} = 1611 lbs (One Stg Opns)

= 1924 lbs (Two Stg Opns)

W_{RTAV} = 107 lbs

ISP = 338.0 sec

ISPE = 0.983 ISP = 332.25 sec

$W_i = P/L_o - W_{ADAPT}$

W_i = 63389 lbs (one stg opns)

W_i = 63076 lbs (two Stg opns)

$W_{BOI} = W_{FIX} + \chi$ (Consumables) χ = 0.17 (Deploy); 0.28 (Retrieve); 0.27 (Round Trip)

Consumables (Two Stg. Opns) = 102 lbs (1st Stg); 281 lbs (2nd Stg)

Tug Length = L_T = 204.76 in/stg

Tug Interstage Adapter = L_I = 3.0 in (Two Stg Ops only)

Tug Fwd Mounting = L_F = 112 in (One Stg Ops Only)

KS 321 Length = L_K = 100 in (Used only with One Stg Ops)

Orbiter P/L Bay Length = L_o = 720 in

Available P/L Bay Length = $L_p = L_o - (\chi L_T + L_A + L_K)$

L_p =	25.62 ft	Two Stg
	33.60 ft	One Stg
	25.27 ft	One Stg + Kick Stg

NASA MISSIONS

ONE STAGE (Single P/L Only)

Without Kick Stage

$W_{BO(Deploy)} = W_{BOI} - W_{RTRV} = 2768 + 0.17(354) - 107 = \underline{2738}$ lbs

$W_{BO(RTrv)} = W_{BOI} = 2768 + 0.28(496) = \underline{2907}$ lbs

$W_{BO(RT)} = W_{BOI} = 2768 + 0.27(616) = \underline{2934}$ lbs

$W_{P/L(Deploy)} =$ (Use 320A-3A Perf) =	Fig 4.3.3.3 - 5
$W_{P/L(RTrv)} = f(W_i, W_{Bo}, Isp_E, \Delta V_B, \Delta V_{oo}) =$	Fig 4.3.3.3 - 8
$W_{P/L(RT)} = f($ " $) =$	Fig 4.3.3.3 - 9

With Kick Stage KS 321 (Planetary Only)

$W_{BO} = W_{BOI} - W_{RTRV} = 2768 + 0.17(265) - 107 = \underline{2706}$ lbs

$W_{P/L}$ = (Use 320A-3A Perf) = **Fig 4.3.3.3-6**

TWO STAGE

Slingshot Mode (Deploy Only)

Single P/L

$W_{BO(Deploy)} = 2768 + 0.17(102) - 107 = \underline{2785}$ lbs

$= 2768 + 0.17(281) - 107 = \underline{2816}$ lbs

$W_{P/L(Deploy)}$ = (Use 320A-3A Perf) = **5094 lbs** See Fig 4.3.3.3-7

Multi-P/L

$W_{BO(Deploy)} = 2768 + 0.17(102) - 107 = \underline{2785}$ lbs

$= 2768 + 0.17(281) - 107 = \underline{2816}$ lbs

$W_{P/L(Deploy)} = f(W, \Delta V_{U,D}, \Delta V_\phi, ISPE) =$ **Fig 4.3.3.3-3**

$\Delta V_\phi = 292$ fps

Reverse Slingshot Mode

Single P/L

$W_{BO(Deploy)} = W_{BOI} - W_{RTEV} = 2768 + 0.17(101) - 107 = \underline{2785}$ lbs (1st Stg)

$= 2768 + 0.17(281) - 107 = \underline{2816}$ lbs (2nd Stg)

$W_{BO(Rtrv)} = W_{BOI} = 2768 + 0.28(101) = \underline{2796}$ lbs (1st Stg)

$= 2768 + 0.28(281) = \underline{2847}$ lbs (2nd Stg)

$W_{BO(RT)} = W_{BOI} = 2768 + 0.27(101) = \underline{2795}$ lbs (1st Stg)

$= 2768 + 0.27(281) = \underline{2844}$ lbs (2nd Stg)

			See
$W_{P/L(Deploy)} = f(W, I_{SP}, \Delta V) =$	5920 lbs		Fig 4.3.3.3-10
$W_{P/L(Rtrv)} = f(\quad " \quad) =$	3800 lbs		Fig 4.3.3.3-11
$W_{P/L(Round\ Trip)} = f(\quad " \quad) =$	2430 lbs		Fig 4.3.3.3-12

Multi-P/L

$W_{BO(Deploy)} = \underline{2785}$ lbs (1st Stg)

$= \underline{2816}$ lbs (2nd Stg)

$W_{BO(Dbl\ Deploy\ Round\ Trip)} = \underline{2795}$ lbs (1st Stg)

$= \underline{2844}$ lbs (2nd Stg)

$\Delta V = f(\phi = 60°) = 292$ fps

$W_{P/L(Deploy)} = f(W, I_{SPE}, \Delta V_{UD}) =$	Fig 4.3.3.3-3
$W_{P/L(Dbl\ Deploy\ R.T.)} = f(W, I_{SPE}, \Delta V_{UD}, \Delta V_{\phi}) =$	Fig 4.3.3.3-4

DOD MISSIONS

$\omega_{BO} = \omega_{BO(NASA)} + \Delta\omega_{COMM}$

$= \omega_{BO(NASA)} + 33$

ONE STAGE

$\omega_{BO(Deploy)} = 2738 + 33 = \underline{2771}$ lbs

$\omega_{BO(Rtrv)} = 2907 + 33 = \underline{2940}$ lbs

$\omega_{BO(Rnd\ Trip)} = 2934 + 33 = \underline{2967}$ lbs

$\omega_{P/L(Deploy)}$	=	Fig 4.3.3.3-5
$\omega_{P/L(Rtrv)}$	=	Fig 4.3.3.3-8
$\omega_{P/L(Rnd\ Trip)}$	=	Fig 4.3.3.3-9

TWO STAGE

Slingshot Mode (Deploy Only)

Single P/L

$\omega_{BO} = 2785 + 33 = \underline{2818\ lbs}$ (1st Stg)

$= 2816 + 33 = \underline{2849\ lbs}$ (2nd Stg)

$\omega_{P/L(Deploy)} =$ **4972 lbs** See Fig 4.3.3.3-7

Multi P/L

$\omega_{BO} = \underline{2818}$ lbs (1st Stg)

$= \underline{2849}$ lbs (2nd Stg)

$\omega_{P/L} =$ Fig 4.3.3.3-3

Reverse Slingshot Mode

Single P/L

$W_{BO\,(Deploy)} = 2785 + 33 = \underline{2818}$ lbs (1ST stg)

$= 2816 + 33 = \underline{2849}$ lbs (2ND stg)

$W_{BO\,(Retrieve)} = 2796 + 33 = \underline{2829}$ lbs (1ST stg)

$2847 + 33 = \underline{2880}$ lbs (2ND stg)

$W_{BO\,(Round\ Trip)} = 2795 + 33 = \underline{2828}$ lbs (1ST Stg)

$2844 + 33 = \underline{2877}$ lbs (2ND Stg)

			See
$W_{P/L}$ (Deploy)	=	5798 lbs	Fig 4.3.3.3-10
$W_{P/L}$ (Retrieve)	=	3701 lbs	Fig 4.3.3.3-11
$W_{P/L}$ (Round Trip)	=	2400 lbs	Fig 4.3.3.3-12

Multi-P/L

$W_{BO\,(Deploy)} = 2785 + 33 = \underline{2818}$ lbs (1ST Stg)

$= 2816 + 33 = \underline{2849}$ lbs (2ND Stg)

$W_{P/L\,(Deploy)} =$ Fig 4.3.3.3-3

K+E 10 X 10 TO ½ INCH 46 1327
7 X 10 IN • ALBANENE® MADE IN U.S.A.
KEUFFEL & ESSER CO.

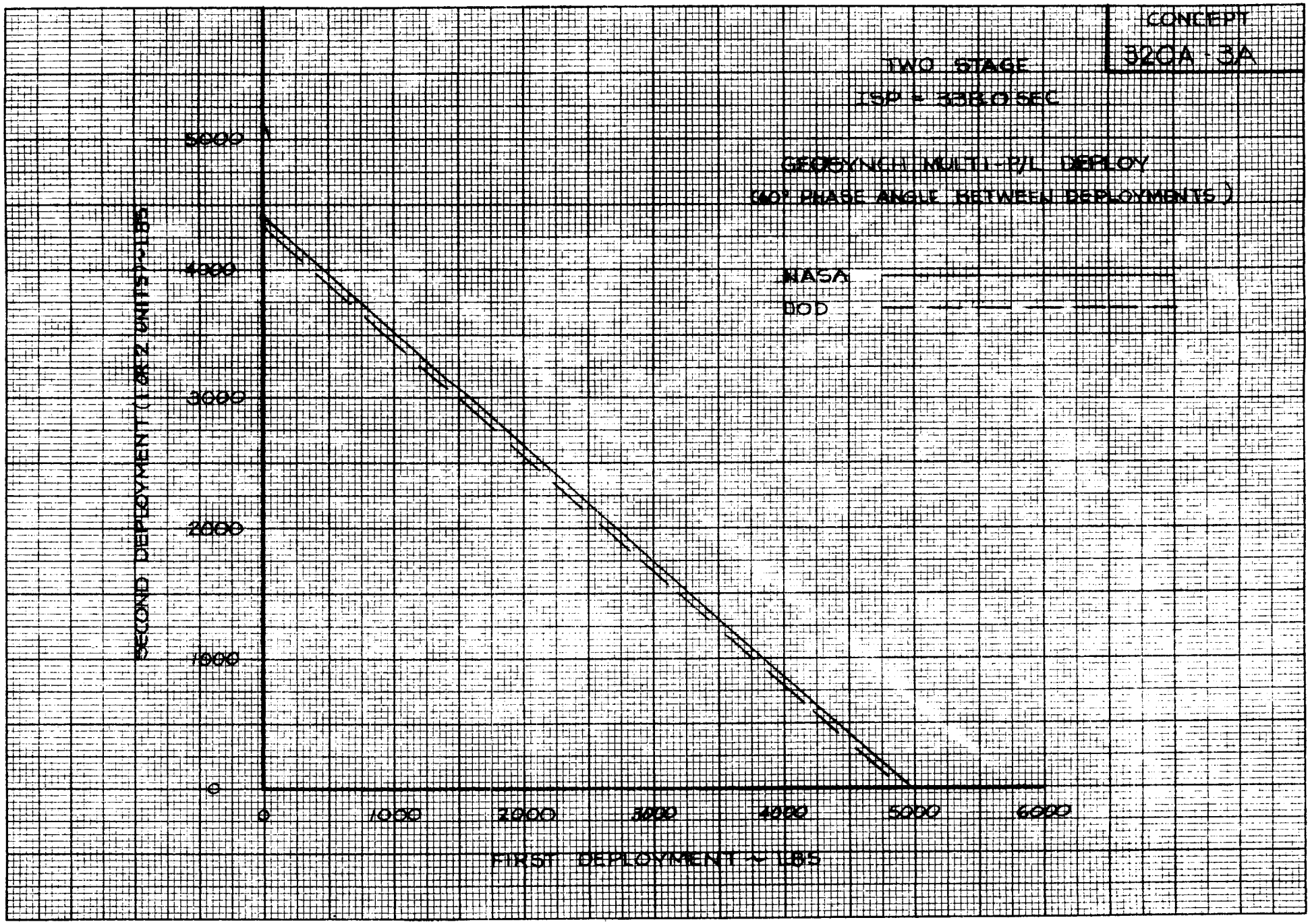


FIGURE 4.3.3.3-2

NO 340A-10 DIETZGEN GRAPH PAPER
10 X 10 PER HALF INCH
EUGENE DIETZGEN CO.
MADE IN U. S. A.

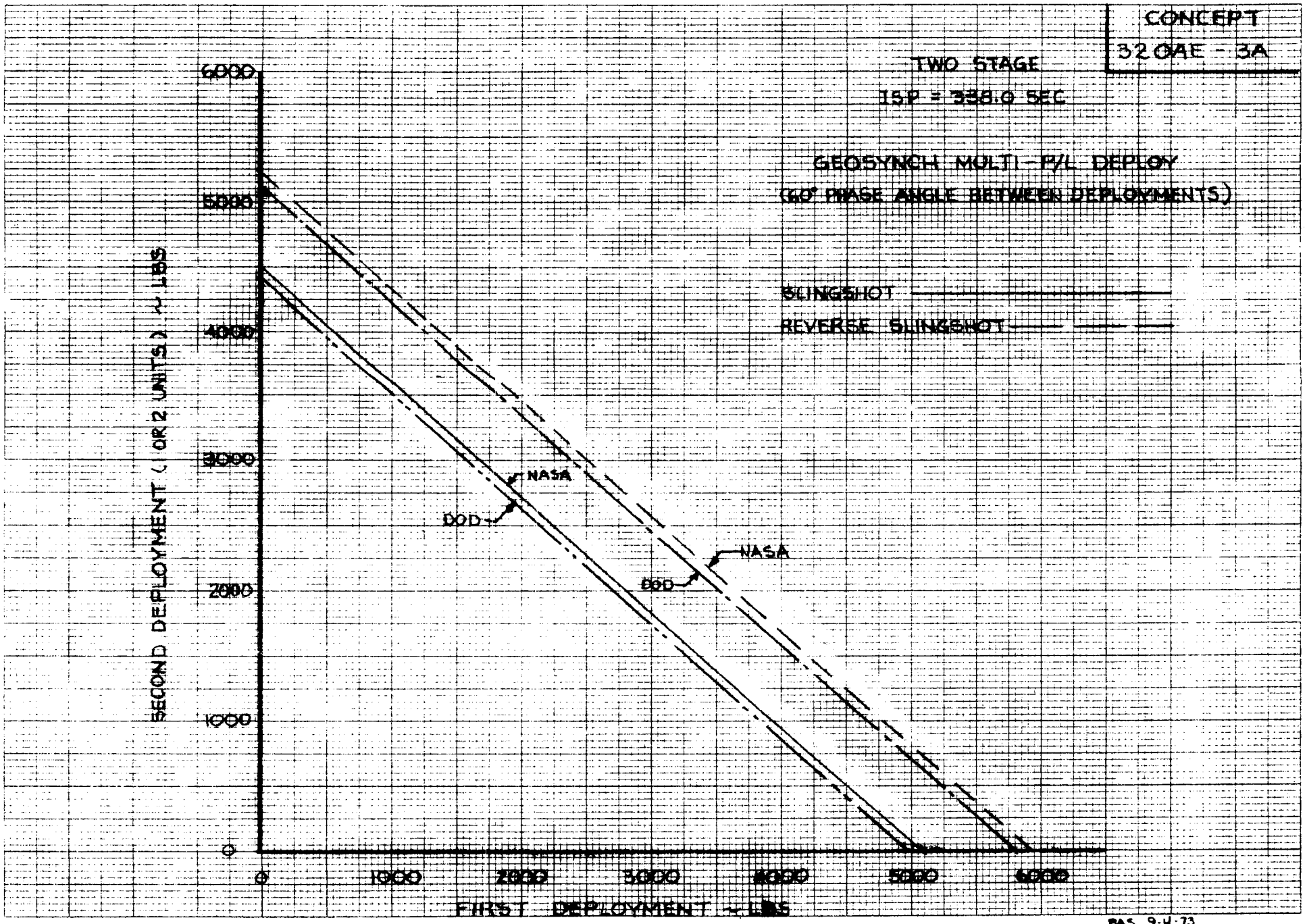


FIGURE 4.3.3.3-3

NO. 340A-10½ DIETZGEN GRAPH PAPER
10 X 10 PER HALF INCH

EUGENE DIETZGEN CO.
MADE IN U. S. A.

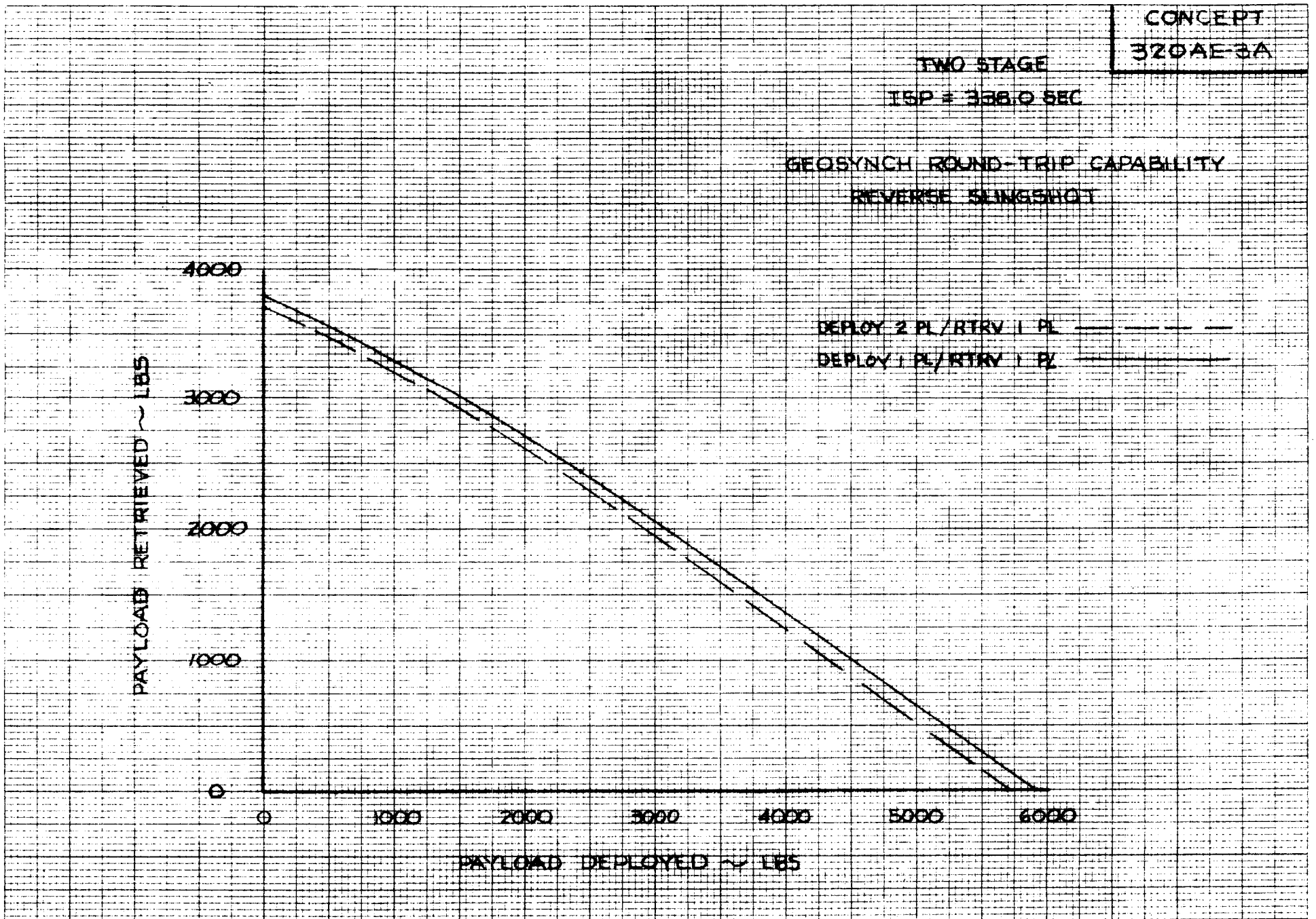


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FIGURE 4.3.3.3-4

K+E SEMI-LOGARITHMIC 46 5492
3 CYCLES X 70 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.

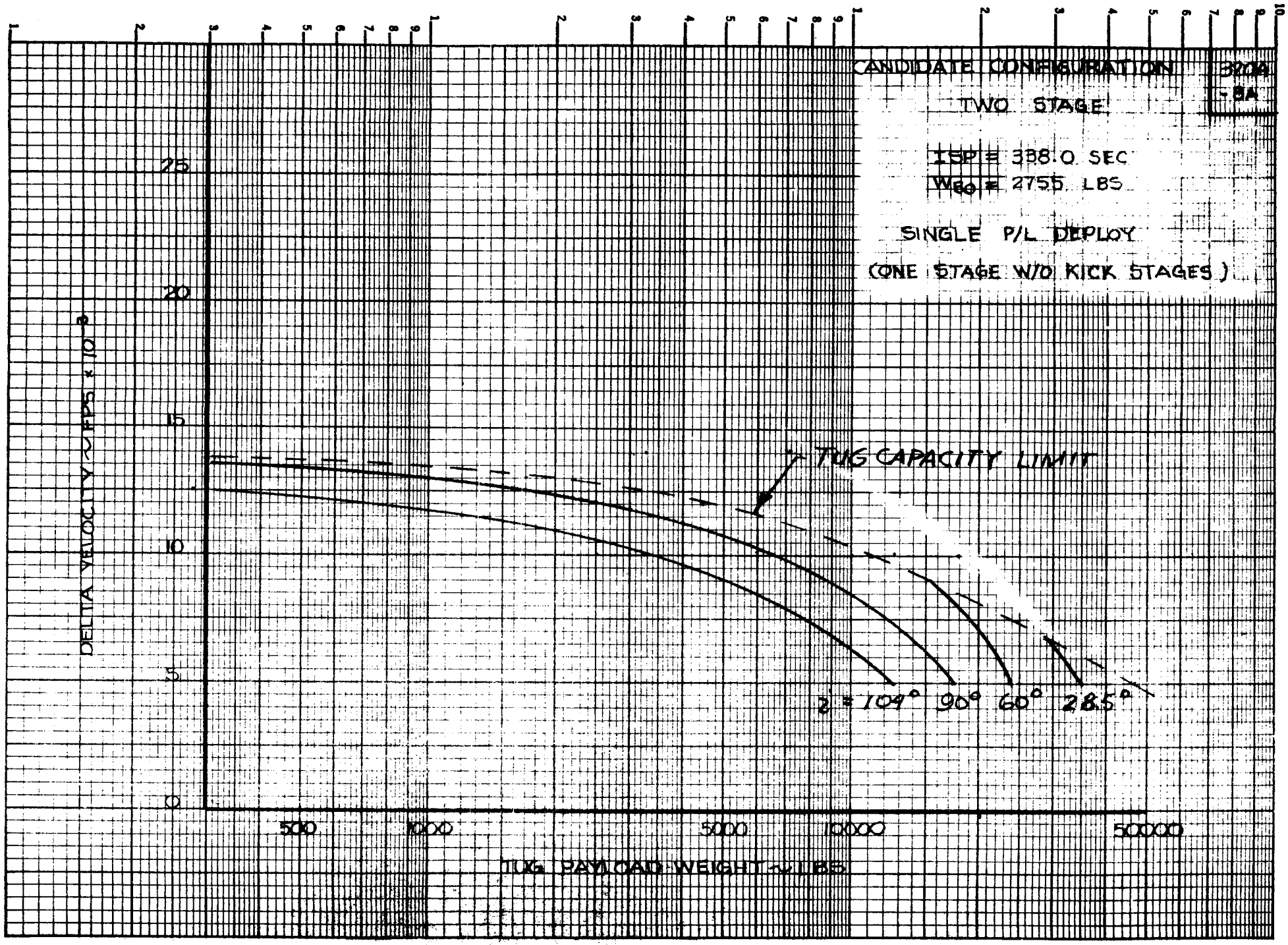

FIGURE 4.3.3.3-5

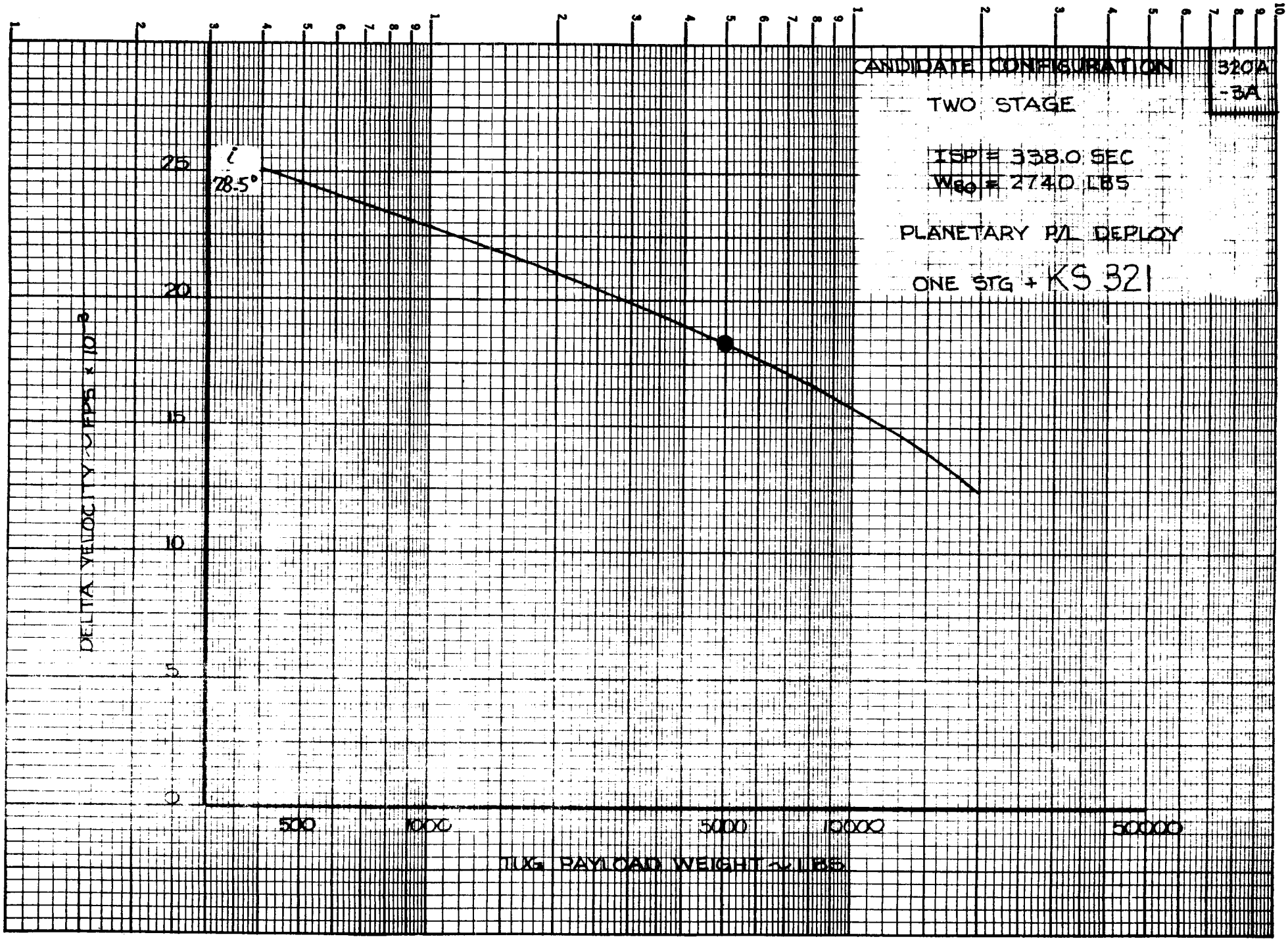

FIGURE 4.3.3.3-6

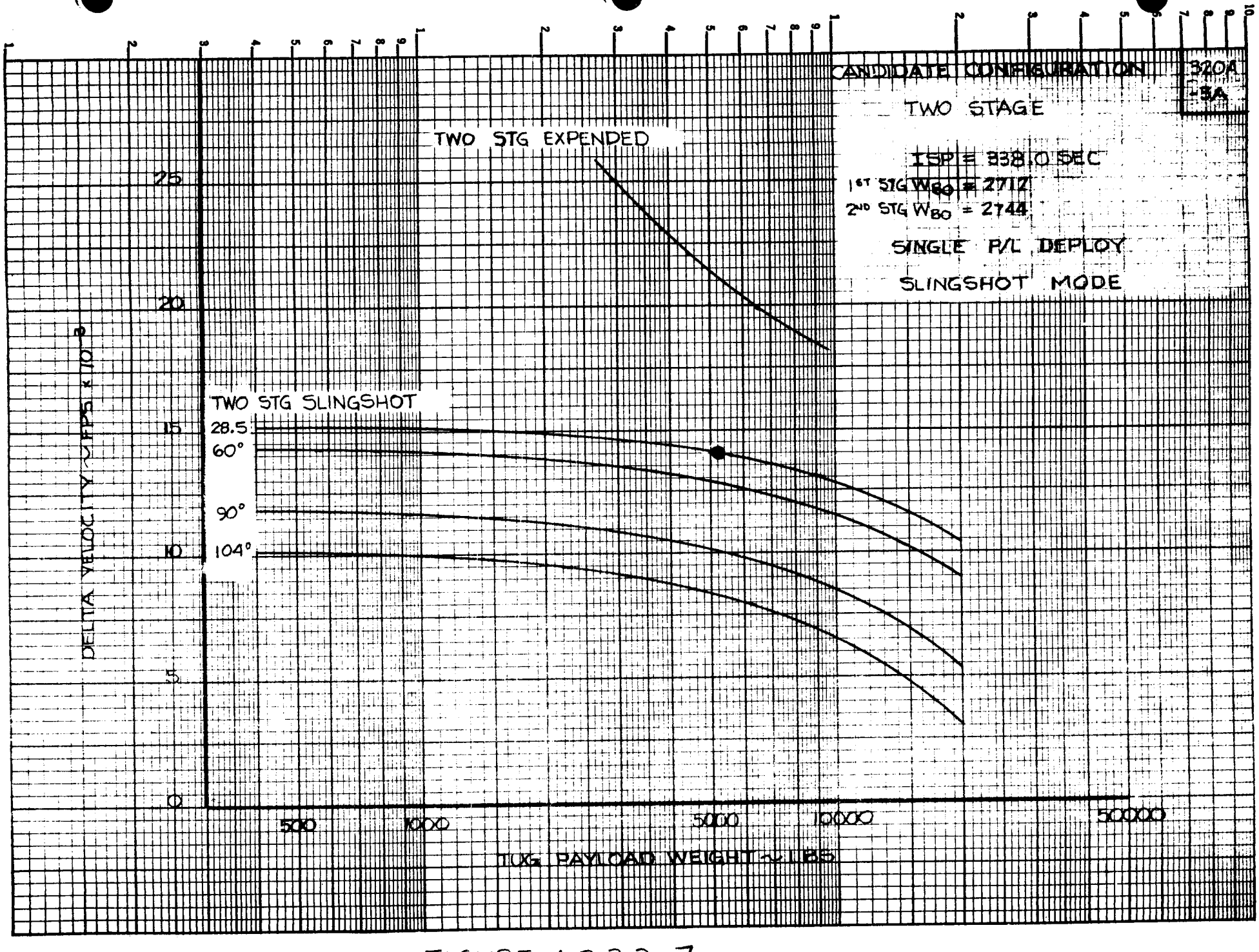

FIGURE 4.3.3.3-7

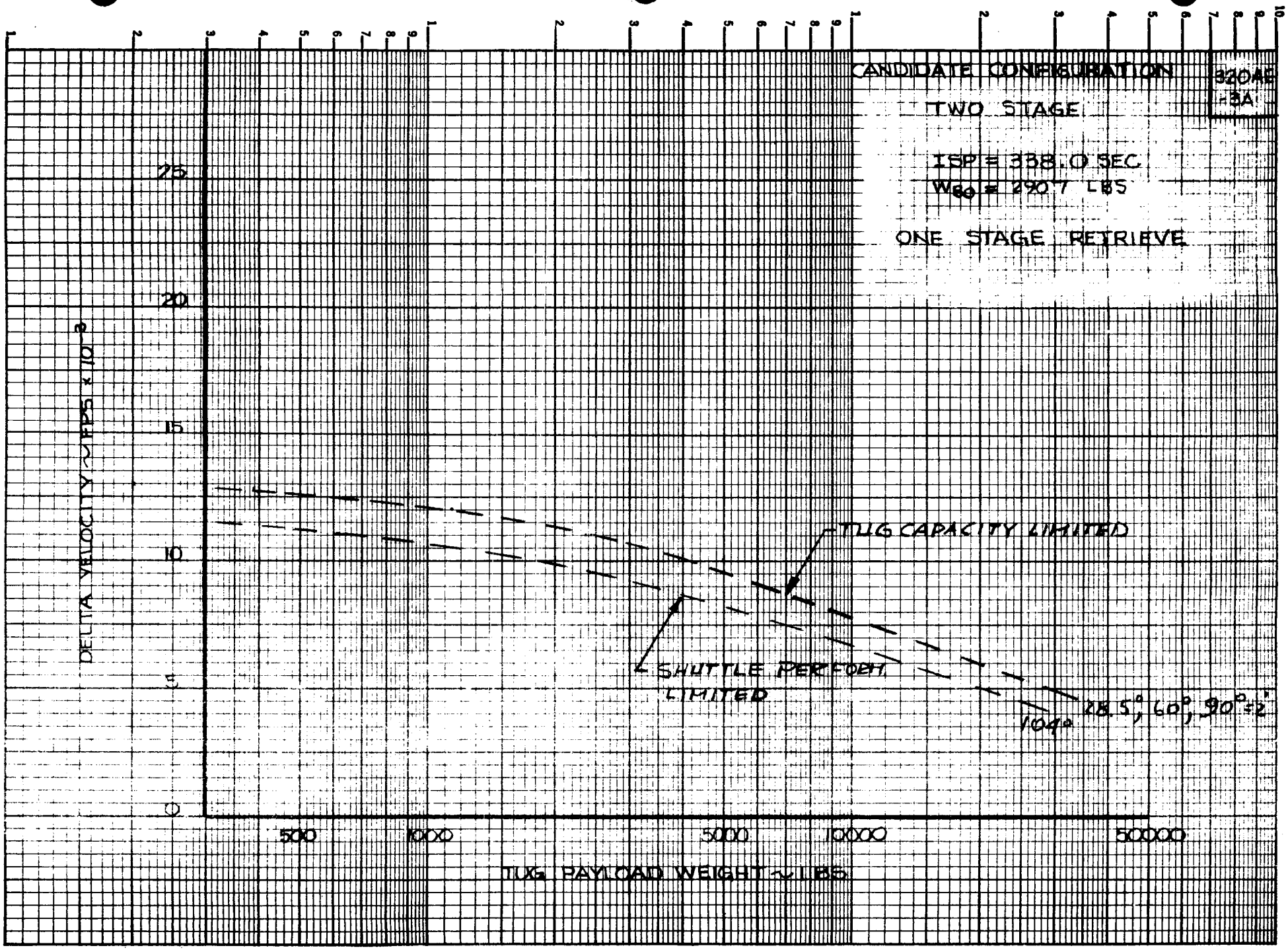

FIGURE 4.3.3.3-8

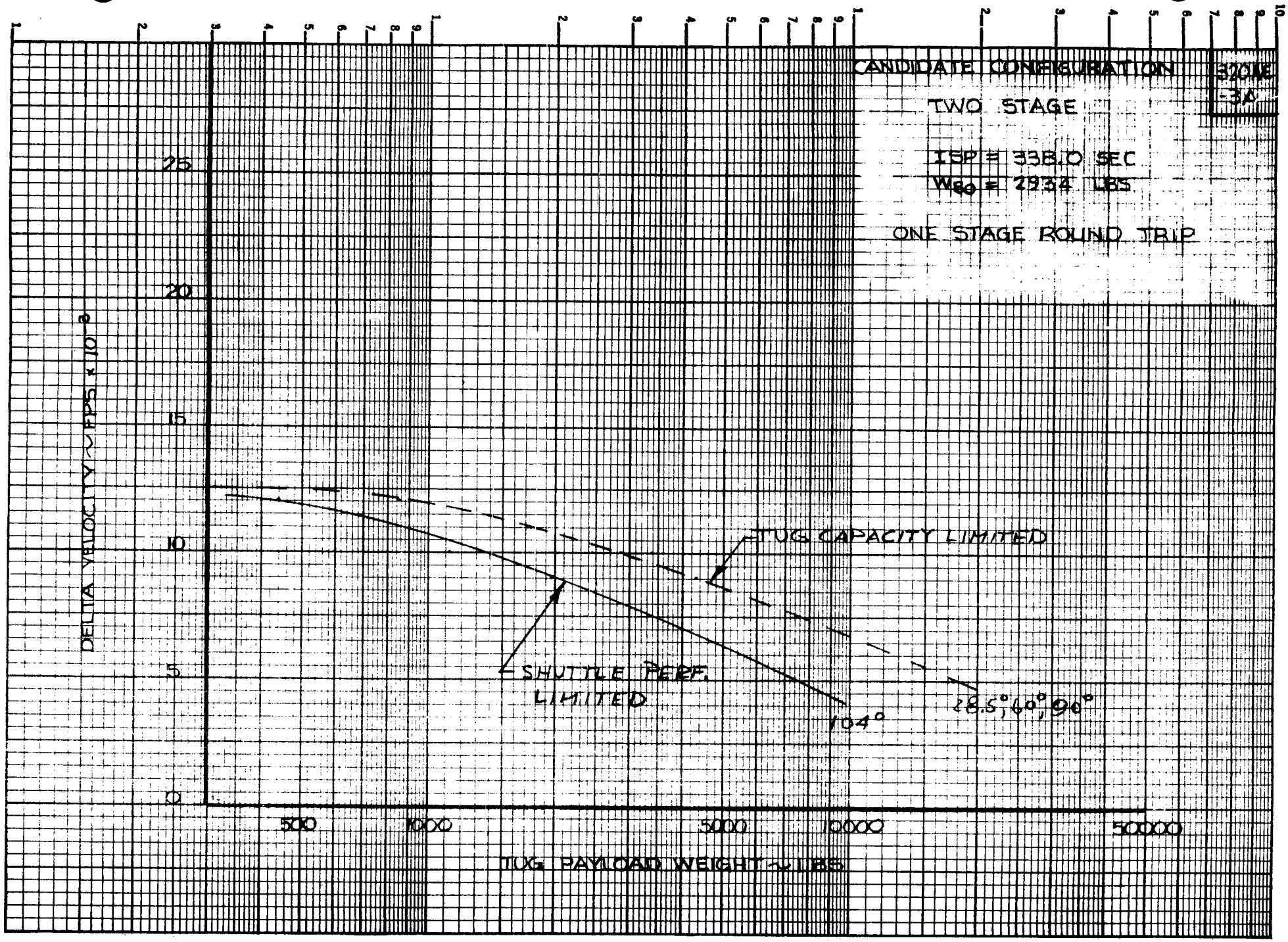

FIGURE 4.3.3.3-9

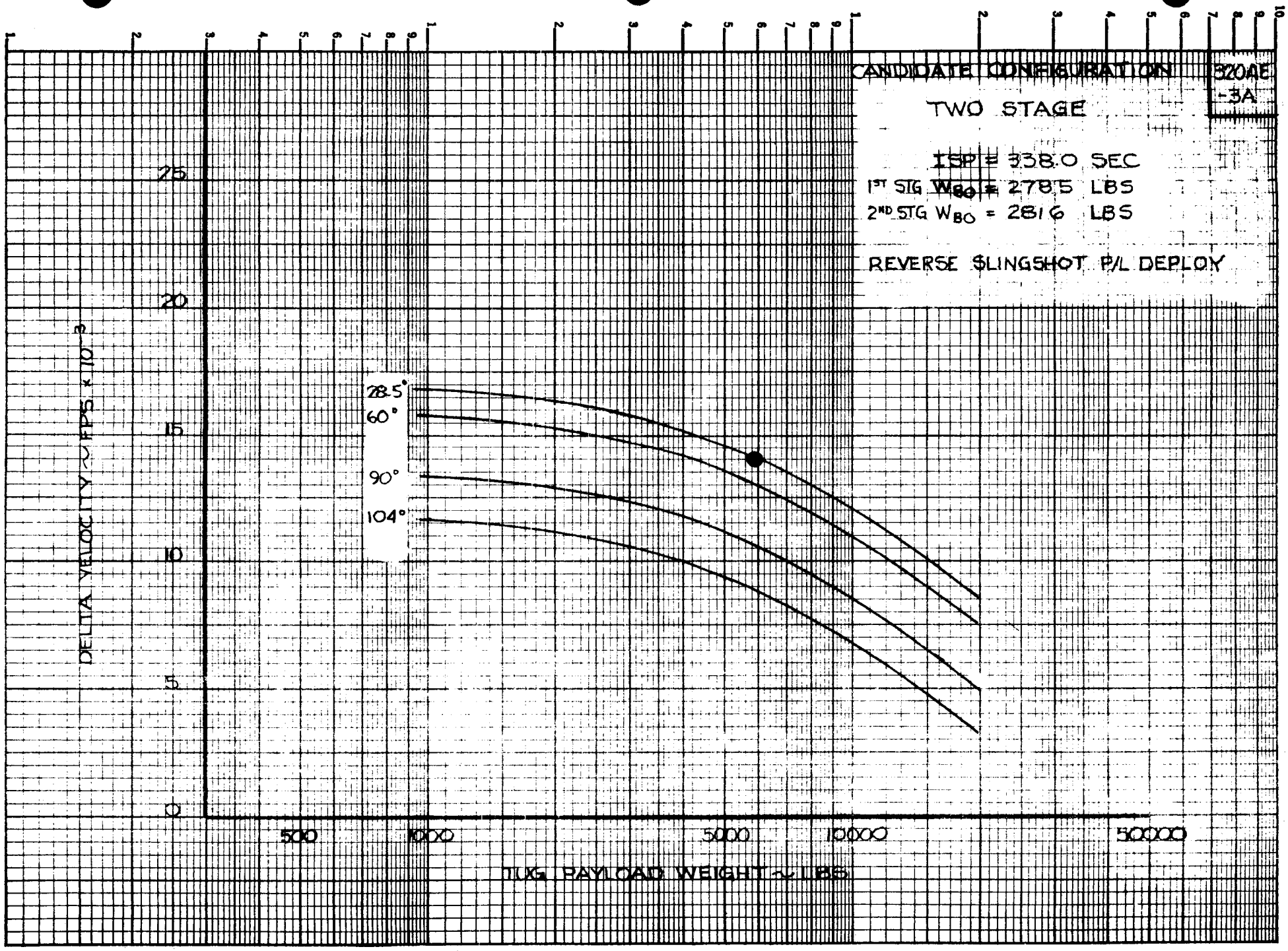

FIGURE 4.3.3.3-10

K+E SEMI-LOGARITHMIC 46 5492
3 CYCLES X 70 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.

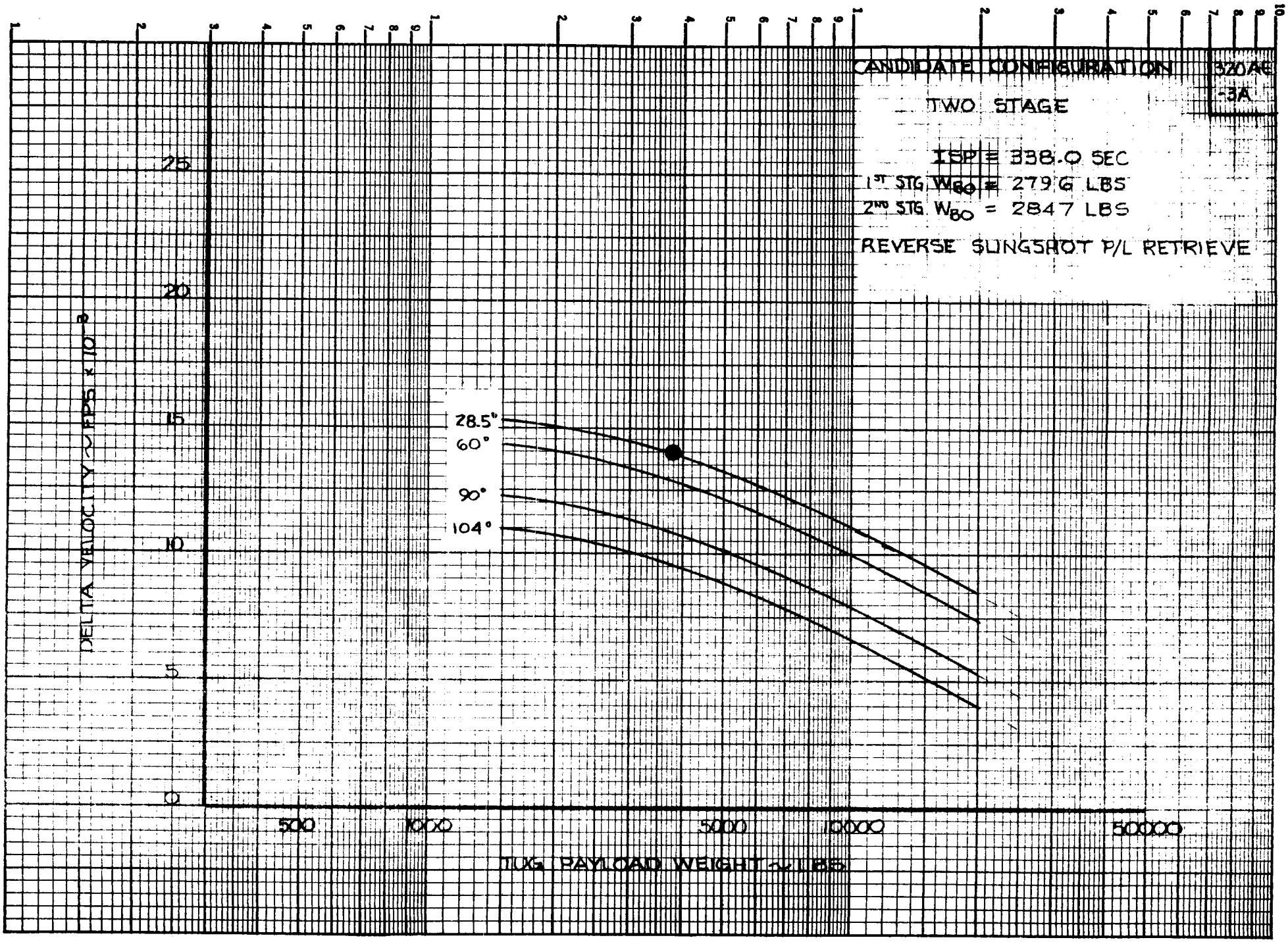

FIGURE 4.3.3.3-11

K+E SEMI-LOGARITHMIC 46 5492
3 CYCLES X 70 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.

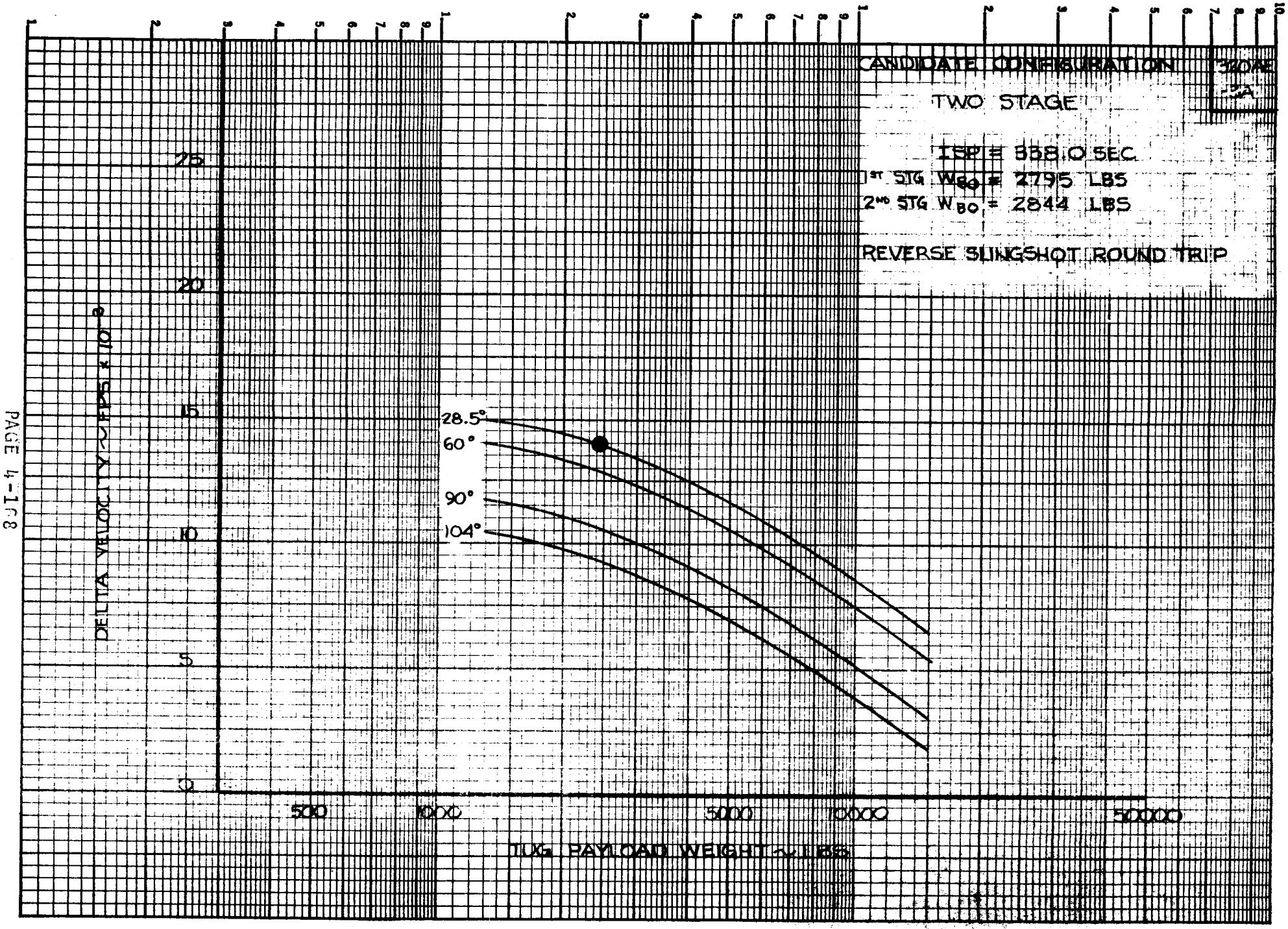

FIGURE 4.3.3.3-12

4.3.3.3.2 320A/320AE Flight Summary

Table 4.3.3.3-1 NASA Traffic
-2 DOD Traffic
-3 Combined NASA/DOD Traffic

COMMENTS:

a. In the Two-Stage configuration, the Slingshot flight mode was used for all deployments, both single and multiple, throughout the program. Use of the Reverse Slingshot mode with even greater capability is an optional choice for the 320AE version.

FLIGHT SUMMARY

OPTION: 3A 320A/320AE-3A

FLIGHT MODE		CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
TOTAL FLIGHTS	SHUTTLE	10	10	9	14	22	19	19	22	15	19	18	177
	TUG STAGES	18	18	16	24	35	32	31	34	26	31	31	296
TUG FLIGHT DISTRIBUTION	ONE STAGE	(2)	(2)	(2)	(4)	(9)	(6)	(7)	(10)	(4)	(7)	(5)	(58)
	DEPLOY	(2)	(2)	(2)	(4)	(5)		(3)	(4)		(5)	(1)	(28)
	- SINGLE P/L	2	2	2	1	5		3	4		3	1	23
	- MULTI P/L				3						2		5
	RETRIEVE					(2)		(2)	(4)	(2)		(2)	(12)
	ROUND TRIP					(2)	(6)	(2)	(2)	(2)	(2)	(2)	(18)
	TWO STAGE	(8)	(8)	(7)	(10)	(13)	(13)	(12)	(12)	(11)	(12)	(13)	(119)
	DEPLOY (Slingshot)	(8)	(8)	(7)	(10)	(3)	(2)	(3)	(8)	(5)	(5)	(3)	(62)
	- SINGLE P/L	4	2	5	6	3	1	3	5	1	4	3	37
	- MULTI P/L	4	6	2	4		1		3	4	1		25
	RETRIEVE (Rvrs Sling)					(3)		(1)		(1)		(1)	(6)
	ROUND TRIP (Rvrs Sling)					(7)	(11)	(8)	(4)	(5)	(7)	(9)	(51)
MISSION MODEL	(TOTAL)	(14)	(16)	(12)	(23)	(31)	(39)	(29)	(34)	(26)	(35)	(29)	(288)
	DEPLOY	14	16	12	23	17	22	16	24	16	26	15	201
	RETRIEVE					14	17	13	10	10	9	14	87
	SORTIE												

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NASA TRAFFIC

TABLE 4.3.3.3-1

GRUMMAN

FLIGHT SUMMARY

OPTION: (3A) 320A/320AE - 3A

FLIGHT MODE		CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
TOTAL FLIGHTS	SHUTTLE	11	6	9	15	16	12	17	15	17	14	16	148
	TUG STAGES	17	9	12	20	28	20	26	26	29	22	29	238
TUG FLIGHT DISTRIBUTION	ONE STAGE	(5)	(3)	(6)	(10)	(4)	(4)	(8)	(4)	(5)	(6)	(3)	(58)
	DEPLOY	(5)	(3)	(6)	(9)	(1)	(1)	(1)	(1)		(1)	(1)	(29)
	- SINGLE P/L	3	3	4	4								14
	- MULTI P/L	2		2	5	1	1	1	1		1	1	15
	RETRIEVE					(1)		(3)		(1)			(5)
	ROUND TRIP					(2)	(2)	(4)	(2)	(4)	(4)	(2)	(20)
	SORTIE				(1)		(1)		(1)		(1)		(4)
	TWO STAGE	(6)	(3)	(3)	(5)	(12)	(8)	(9)	(11)	(12)	(8)	(13)	(90)
	DEPLOY (Slingshot)	(6)	(3)	(3)	(5)	(4)	(3)	(1)	(3)	(2)	(2)	(3)	(35)
	- SINGLE P/L	2	2	2	2	2	2	1	3	1	1	2	20
	- MULTI P/L	4	1	1	3	2	1			1	1	1	15
	RETRIEVE (Rvrs Sling)										(1)	(1)	(2)
	ROUND TRIP (Rvrs Sling)					(8)	(5)	(8)	(8)	(10)	(5)	(9)	(53)
MISSION MODEL	(TOTAL)	(20)	(7)	(12)	(25)	(31)	(22)	(31)	(27)	(33)	(27)	(31)	(266)
	DEPLOY	20	7	12	24	20	14	16	16	18	16	19	182
	RETRIEVE					11	7	15	10	15	10	12	80
	SORTIE				1		1		1		1		4

DOD TRAFFIC

TABLE 4.3.3.3-2

(2)

GRUMMAN

FLIGHT SUMMARY

OPTION: 3A 320A/320AE-3A

FLIGHT MODE		CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
TOTAL FLIGHTS	SHUTTLE	21	16	18	29	38	31	36	37	32	33	34	325
	TUG STAGES	35	27	28	44	63	52	57	60	55	53	60	534
TUG FLIGHT DISTRIBUTION	ONE STAGE	(7)	(5)	(8)	(14)	(13)	(10)	(15)	(14)	(9)	(13)	(8)	(116)
	DEPLOY	(7)	(5)	(8)	(13)	(6)	(1)	(4)	(5)		(6)	(2)	(57)
	-SINGLE P/L	5	5	6	5	5		3	4		3	1	37
	-MULTI P/L	2		2	8	1	1	1	1		3	1	20
	RETRIEVE					(3)		(5)	(4)	(3)		(2)	(17)
	ROUND TRIP					(4)	(8)	(6)	(4)	(6)	(6)	(4)	(38)
	SORTIE				(1)		(1)		(1)		(1)		(4)
	TWO STAGE	(14)	(11)	(10)	(15)	(25)	(21)	(21)	(23)	(23)	(20)	(26)	(209)
	DEPLOY (Slingshot)	(14)	(11)	(10)	(15)	(7)	(5)	(4)	(11)	(7)	(7)	(6)	(97)
	-SINGLE P/L	6	4	7	8	5	3	4	8	2	5	5	57
	-MULTI P/L	8	7	3	7	2	2		3	5	2	1	40
	RETRIEVE (Rvrs Sling)					(3)		(1)		(1)	(1)	(2)	(8)
	ROUND TRIP (Rvrs Sling)					(15)	(16)	(16)	(12)	(15)	(12)	(18)	(104)
MISSION MODEL	(TOTAL)	(34)	(23)	(24)	(48)	(62)	(61)	(60)	(61)	(59)	(62)	(60)	(554)
	DEPLOY	34	23	24	47	37	36	32	40	34	42	34	383
	RETRIEVE					25	24	28	20	25	19	26	167
	SORTIE				1		1		1		1		4

COMBINED NASA/DOD TRAFFIC

TABLE 4.3.3.3-3

GRUMMAN

4.3.3.3.3 320A/320AE Flight Element Requirements

Tables 4.3.3.3-4 NASA Traffic
-5 DOD Traffic
-6 Combined NASA/DOD Traffic
-7 320A/320AE Kick Stage Definition

COMMENTS:

None

FLIGHT ELEMENT REQUIREMENTS

OPTION: 3A 320A/320AE-3A

ITEM			CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
SHUTTLE FLIGHTS		TOTAL	10	10	9	14	22	19	19	22	15	19	18	177
BASIC TUG FLIGHTS (ONE STAGE)	ETR	RECOVERED	2	2	2	1	5		3	4		3	1	23
		EXPENDED												0
	WTR	RECOVERED				3	4	6	4	6	4	4	4	35
	(TOTAL)		(2)	(2)	(2)	(4)	(9)	(6)	(7)	(10)	(4)	(7)	(5)	(58)
BASIC TUG FLIGHTS (TWO STAGE)	ETR	RECOVERED	8	8	7	10	11	13	11	11	11	9	12	111
		EXPENDED					2		1	1		3	1	8
	WTR	RECOVERED												0
	(TOTAL)		(8)	(8)	(7)	(10)	(13)	(13)	(12)	(12)	(11)	(12)	(13)	(119)
TOTAL TUG STAGES FLOWN			18	18	16	24	35	32	31	34	26	31	31	296
KICK STAGES (USED ONLY WITH RECOVERABLE ONE STAGE FLIGHTS FROM ETR)	KS 321				2		2		3	2				9
	(TOTAL)				(2)		(2)		(3)	(2)				(9)

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NASA TRAFFIC

TABLE 4.3.3.3-4

GRUMMAN

FLIGHT ELEMENT REQUIREMENTS

OPTION: 3A 320A/320AE-3A

ITEM			CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
SHUTTLE FLIGHTS		TOTAL	11	6	9	15	16	12	17	15	17	14	16	148
BASIC TUG FLIGHTS (ONE STAGE)	ETR	RECOVERED	5	3	6	6	3	2	3	2	3	2	2	37
		EXPENDED												0
	WTR	RECOVERED				4	1	2	5	2	2	4	1	21
	(TOTAL)		(5)	(3)	(6)	(10)	(4)	(4)	(8)	(4)	(5)	(6)	(3)	(58)
BASIC TUG FLIGHTS (TWO STAGE)	ETR	RECOVERED	6	3	3	5	12	8	9	11	12	8	13	90
		EXPENDED												0
	WTR	RECOVERED												0
	(TOTAL)		(6)	(3)	(3)	(5)	(12)	(8)	(9)	(11)	(12)	(8)	(13)	(90)
TOTAL TUG STAGES FLOWN			17	9	12	20	28	20	26	26	29	22	29	238
KICK STAGES	KS 321													0
	(TOTAL)													0

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DOD TRAFFIC

TABLE 4.3.3.3-5

GRUMMAN

FLIGHT ELEMENT REQUIREMENTS

OPTION: 3A 320A/320AE-3A

ITEM			CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
SHUTTLE FLIGHTS		TOTAL	21	16	18	29	38	31	36	37	32	33	34	325
BASIC TUG FLIGHTS (ONE STAGE)	ETR	RECOVERED	7	5	8	7	8	2	6	6	3	5	3	60
		EXPENDED												0
	WTR	RECOVERED				7	5	8	9	8	6	8	5	56
	(TOTAL)		(7)	(5)	(8)	(14)	(13)	(10)	(15)	(14)	(9)	(13)	(8)	(116)
BASIC TUG FLIGHTS (TWO STAGE)	ETR	RECOVERED	14	11	10	15	23	21	20	22	23	17	25	201
		EXPENDED					2		1	1		3	1	8
	WTR	RECOVERED												0
	(TOTAL)		(14)	(11)	(10)	(15)	(25)	(21)	(21)	(23)	(23)	(20)	(26)	(209)
TOTAL TUG STAGES FLOWN			35	27	28	44	63	52	57	60	55	53	60	534
KICK STAGES (USED ONLY WITH RECOVERABLE ONE STAGE FLIGHTS FROM ETR)	KS 321				2		2		3	2				9
	(TOTAL)				(2)		(2)		(3)	(2)				(9)
									RELIABILITY				=	+3 FLTS

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COMBINED NASA/DOD TRAFFIC

TABLE 4.3.3.3-6

GRUMMAN

CONCEPT 320A/320AE-3A

KICK STAGE DEFINITION

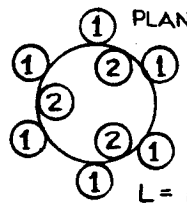
KICK STAGE DESIGNATION	GEOMETRY (all stages >10 ft diam. & are 5.5 ft long unless otherwise noted)		PERFORMANCE (Geosynch Payload) (lbs)	SRM CHARACTERISTICS INDIVIDUAL WEIGHT (lbs)	NUMBER	TOTAL SRM WEIGHT (lbs)	STAGE INERT WEIGHT (lbs)	TOTAL STAGE WEIGHT (lbs)
KS 321		STAGE 1	5000 lbs TO ΔV = 18400 fps	1900	6	11400	-	11400
		STAGE 2		1900	3	5700	545	6245
		(TOTAL)						17645

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TABLE 4.3.3.3-7

4.3.3.3.4 320A/320AE Initial Flight Schedule

Table 4.3.3.3-8 Costed Flight Build-Up

COMMENTS:

a. Abbreviations used in the Table

D = Deploy
R = Retrieve
EXP = Expended Tug
KS = Kick Stage
1S = One stage

b. All missions are accomplished via two-stage flight modes unless otherwise indicated.

FLIGHT	PAYLOAD FLOWN					
	1980	1981	1982	1983	1984	1985
1	D-11 (IS)	D-7	ALL	ALL	D-9	ALL
2	D-17 (IS)	D-8			D-10 (IS)	
3	D-35 (IS)	D-10 (IS)			D-18 (IS)	
4		D-11 (IS)			D-18 (IS)	
5		D1 + D1			D-20 (IS+KS)	
6		D2 + D2			D-20 (IS+KS)	
7		D3 + D3			D-24 (EXP)	
8		D3 + D3			D-24 (EXP)	
9		D3 + D4			R-2	
10		D-31			R-3	
11		D-31			R-3	
12		D-34 (IS)			D1 + R1	
13		D-35 (IS)			D7 + R4	
14		D-35 (IS)			D8 + R2	
15		D25 + D25			D14 + R14 (IS)	
16					D15 + R15 (IS)	
17					R-12 (IS)	
18					R-13 (IS)	
19					D-31	
20					D-31	
21					R-34	
22					D28 + D28	
23					D37 + D37 + D37	
24					D25 + R25	
25					D25 + R25	
26					D26 + R26	
27					D32 + R32	
28					D35 + R35 (IS)	
29					D35 + D35	
30					D39 + D39 + D39	
FLTS FLOWN / SCHED	3/21	15/16	18/18	29/29	30/38	31/31
DEPLOY P/L FLOWN / SCHED	3/34	21/23	24/24	47/47	29/37	36/36
DEPLOY D/L FLOWN / SCHED	0/0	0/0	0/0	0/0	17/25	24/24
SORTIES FLOWN / SCHED	0/0	0/0	0/0	1/1	0/0	1/1

CONCEPT 320A/320AE-3A

COSTED FLIGHT BUILD-UP

TABLE 4.3.3.3-8

4.3.3.3.5 320A/320AE Additional Payload Capture Potential

Table 4.3.3.3-9 Additional Payload Capture Potential

COMMENTS:

None

OPTION 3A

ADDITIONAL PAYLOAD CAPTURE POTENTIAL

MISSIONS EXCLUDED FROM OPTION MISSION MODEL					CONCEPT 320A/320AE-3A		
DESIGNATION		DEPLOY	RETRIEVE	SORTIE	TUG MODE		
ID NO.	WEIGHT				DEPLOY	RETRIEVE	SORTIE
N 5	2800	-	3	-	-	3 (2S)	-
N 6	5000	-	3	-	-	0	-
N 7	5500	-	10	-	-	0	-
N 8	4000	-	7	-	-	0	-
N 10	9500	-	2	-	-	2 (2S)	-
N 17	2000	3	-	-	3 (1S)	-	-
N 18	3300	2	-	-	2	-	-
N 19	7900	3	-	-	3 (KS 321)	-	-
N 20	1500	4	-	-	4 (2S EXPEND)	-	-
N 22	4000	4	-	-	0	-	-
N 23	6600	2	-	-	2 (2S EXPEND)	-	-
N 24	4400	4	-	-	4 (2S EXPEND)	-	-
D 29 (12b)	2400	-	-	5	-	-	4 (2S)
TOTALS	DEPLOY	22			18		
	RETRIEVE		25			5	
	SORTIE			5			4
	(TOTAL)	52			27		

N = NASA
D = DOD

1S = ONE STG
2S = TWO STG

TABLE 4.3.3.3-9

4.3.3.3.6 320A/320AE Detailed Traffic Assessment Data

Table 4.3.3.3-10 NASA Traffic Assessment
-11 NASA Geosynch Mixed Missions
-12 NASA Non-Geosynch Mixed Missions
-13 DOD Traffic Assessment

COMMENTS:

a. For 1984 and subsequent, the two-stage Reverse Slingshort mode may be substituted for the Slingshot mode without affecting traffic distributions.

TRAFFIC ASSESSMENT: NASA GEOSYNCH

OPTION: 3A 320A/320AE - 3A

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION												
			CALENDAR YEAR												TOTAL
			79	80	81	82	83	84	85	86	87	88	89	90	
MIXED P/L'S - GEOSYNCH - (See Pages 7-11)	DOUBLE DEPLOY	Slingshot		2	1		2		1		1		1		8
	TRIPLE DEPLOY	S				1									1
	ROUND TRIP	Reverse Slingshot						3	5	4	1	3	5	5	26
	DOUBLE DEPLOY ROUND TRIP	RS									1				1
	(TOTAL)			(2)	(1)	(1)	(2)	(3)	(6)	(4)	(3)	(3)	(6)	(5)	(36)
1	DOUBLE DEPLOY	S		1	1							1			3
	ROUND TRIP	RS						2		1				1	4
	(TOTAL)			(1)	(1)			(2)		(1)		(1)		(1)	(7)
2	DOUBLE DEPLOY	S			1										1
	RETRIEVE	RS						1							1
	(TOTAL)				(1)			(1)							(2)
3	SINGLE DEPLOY	S				1					1				2
	DOUBLE DEPLOY	S		1	3	1	1				1	3			10
	RETRIEVE	RS						2							2
	ROUND TRIP	RS						1	5	3	2	1	2	3	17
	(TOTAL)			(1)	(3)	(2)	(1)	(3)	(5)	(3)	(4)	(4)	(2)	(3)	(31)
4	DOUBLE DEPLOY	S					1				1				2
	ROUND TRIP	RS						1				1			2
	(TOTAL)						(1)	(1)			(1)	(1)			(4)
5	SINGLE DEPLOY	S					2								2
	(TOTAL)						(2)								(2)
7	SINGLE DEPLOY	S		1	1	2	2		1		2				9
	(TOTAL)			(1)	(1)	(2)	(2)		(1)		(2)				(9)
8	SINGLE DEPLOY	S		2	1	1	2				1		1		8
	(TOTAL)			(2)	(1)	(1)	(2)				(1)		(1)		(8)

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TABLE 4.3.3.3-10

GRUMMAN

TRAFFIC ASSESSMENT: NASA GEOSYNCH (cont)

OPTION: 3A 320A/320AE-3A

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
NASA GEOSYNCH TRAFFIC SUMMARY (Missions 1 - 8)	TWO STG														
	SINGLE DEPLOY	Slingshot		3	2	4	6		1		4		1		21
	DOUBLE DEPLOY	Slingshot		4	6	1	4		1		3	4	1		24
	TRIPLE DEPLOY	Slingshot				1									1
	RETRIEVE	Reverse Slingshot						3							3
	ROUND TRIP	Reverse Slingshot						7	10	8	3	5	7	9	49
	DOUBLE DEPLOY ROUND TRIP	Reverse Slingshot									1				1
	(TOTAL)			(7)	(8)	(6)	(10)	(10)	(12)	(8)	(11)	(9)	(9)	(9)	(99)

TABLE 4.3.3.3-10 (cont)

GRUMMAN

TRAFFIC ASSESSMENT: NASA NON-GEOSYNCH

OPTION: (3A) 320A/320AE-3A

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
MIXED P/L'S NON-GEO (See Pages 12-13)	TRIPLE DEPLOY	(A) ONE STG					2						2		4
	DOUBLE DEPLOY ROUND TRIP	(B) WTR LAUNCH							2		2		2		6
	(TOTAL)						(2)		(2)		(2)		(4)		(10)
9	SINGLE DEPLOY	TWO STG SLINGSHOT		1		1		1		2		1		2	8
	(TOTAL)			(1)		(1)		(1)		(2)		(1)		(2)	(8)
10	SINGLE DEPLOY	ONE STG			1			1			1			1	4
	(TOTAL)				(1)			(1)			(1)			(1)	(4)
11	SINGLE DEPLOY	ONE STG		1	1		1				1		1		5
	RETRIEVE	TWO STG RVRS SLINGSHOT								1		1		1	3
	ROUND TRIP	TWO STG RVRS SLINGSHOT							1						1
	(TOTAL)			(1)	(1)		(1)		(1)	(1)	(1)	(1)	(1)	(1)	(9)
12	RETRIEVE	(A) ONE STG						1		1		1		1	4
	(TOTAL)	(B) WTR LAUNCH						(1)		(1)		(1)		(1)	(4)
13	RETRIEVE	(A) ONE STG						1		1		1		1	4
	(TOTAL)	(B) WTR LAUNCH						(1)		(1)		(1)		(1)	(4)
14	ROUND TRIP	(A) ONE STG						1		1		1		1	4
	(TOTAL)	(B) WTR LAUNCH						(1)		(1)		(1)		(1)	(4)
15	ROUND TRIP	(A) ONE STG						1		1		1		1	4
	(TOTAL)	(B) WTR LAUNCH						(1)		(1)		(1)		(1)	(4)
16	DOUBLE DEPLOY	(A) ONE STG					1								1
	RETRIEVE	(B) WTR LAUNCH									4				4
	ROUND TRIP								4						4
	(TOTAL)						(1)		(4)		(4)				(9)

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TABLE 4.3.3.3-10 (cont)

GRUMMAN

TRAFFIC ASSESSMENT: NASA NON-GEOSYNCH (cont)

OPTION: 3A 320A/320AE-3A

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
NASA NON-GEO TRAFFIC SUMMARY (Missions 9 - 16)	ONE STG			(1)	(2)		(4)	(5)	(6)	(4)	(8)	(4)	(5)	(5)	(44)
	SINGLE DEPLOY			1	2		1	1			2		1	1	9
	DOUBLE DEPLOY						1								1
	TRIPLE DEPLOY						2						2		4
	RETRIEVE							2		2	4	2		2	12
	ROUND TRIP							2	4	2		2		2	12
	DOUBLE DEPLOY ROUND TRIP								2		2		2		6
	TWO STG			(1)		(1)		(1)	(1)	(3)		(2)		(3)	(12)
	SINGLE DEPLOY	Slingshot		1		1		1		2		1		2	8
	RETRIEVE	Reverse Slingshot								1		1		1	3
	ROUND TRIP	Reverse Slingshot							1						1
	(TOTAL)			(2)	(2)	(1)	(4)	(6)	(7)	(7)	(8)	(6)	(5)	(8)	(56)

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TABLE 4.3.3.3-10 (cont)

GRUMMAN

TRAFFIC ASSESSMENT: NASA PLANETARY

OPTION: 3A 320A/320AE-3A

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
17	SINGLE DEPLOY	ONE STG		1									2		3
	(TOTAL)			(1)									(2)		(3)
18	SINGLE DEPLOY	ONE STG						2							2
	(TOTAL)							(2)							(2)
19	SINGLE DEPLOY	ONE STG + KS 321								1	2				3
	(TOTAL)									(1)	(2)				(3)
20	SINGLE DEPLOY	ONE STG + KS 321				2		2							4
	(TOTAL)					(2)		(2)							(4)
22	SINGLE DEPLOY	TWO STG EXPENDED								1	1		1	1	4
	(TOTAL)									(1)	(1)		(1)	(1)	(4)
23	SINGLE DEPLOY	ONE STG + KS 321								2					2
	(TOTAL)									(2)					(2)
24	SINGLE DEPLOY	TWO STG EXPENDED						2					2		4
	(TOTAL)							(2)					(2)		(4)
NASA PLANETARY TRAFFIC SUMMARY (Missions 17 - 24)	SINGLE DEPLOY														
	ONE STG			1				2					2		5
	ONE STG	+ KS 321				2		2		3	2				9
	TWO STG	EXPENDED						2		1	1		3	1	8
	(TOTAL)			(1)		(2)		(6)		(4)	(3)		(5)	(1)	(22)

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TABLE 4.3.3.3-10 (cont)

TRAFFIC ASSESSMENT: NASA DETAILED TRAFFIC SUMMARY — OPTION: 3A 320A/320AE-3A

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION — CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
NASA TOTAL TRAFFIC SUMMARY (Missions 1 - 24)	ONE STG			(2)	(2)	(2)	(4)	(9)	(6)	(7)	(10)	(4)	(7)	(5)	(58)
	SINGLE DEPLOY			2	2		1	3			2		3	1	14
	SINGLE DEPLOY + KICK STG	KS 321				2		2		3	2				9
	DOUBLE DEPLOY						1								1
	TRIPLE DEPLOY						2						2		4
	RETRIEVE							2		2	4	2		2	12
	ROUND TRIP							2	4	2		2		2	12
	DOUBLE DEPLOY ROUND TRIP								2		2		2		6
	TWO STG			(8)	(8)	(7)	(10)	(13)	(13)	(12)	(12)	(11)	(12)	(13)	(119)
	SINGLE DEPLOY	Slingshot		4	2	5	6	1	1	2	4	1	1	2	29
	SINGLE DEPLOY - EXPENDED	EXPEND TUG						2		1	1		3	1	8
	DOUBLE DEPLOY	Slingshot		4	6	1	4		1		3	4	1		24
	TRIPLE DEPLOY	Slingshot				1									1
	RETRIEVE	Reverse Slingshot						3		1		1		1	6
	ROUND TRIP	Reverse Slingshot						7	11	8	3	5	7	9	50
	DOUBLE DEPLOY ROUND TRIP	Reverse Slingshot									1				1
	(TOTAL)			(10)	(10)	(9)	(14)	(22)	(19)	(19)	(22)	(15)	(19)	(18)	(177)

TABLE 4.3.3.3-10 (cont)

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GRUMMAN

MIXED MISSIONS: NASA GEOSYNCH OPTION: (3A) 320A/320AE - 3A

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
80	◇	②✓	①✓	③✓	①✓	-	①✓	①✓	②✓			
	①								D	Stingshot	3500	25 × 14
	②								D	S		
	③							D		S	3000	20 × 10
	4			D			D			S	4700	24 × 8
	5		D		D					S	3500	18 × 14
	⑥			2D						S	4200	24 × 8
	⑦	2D								S	1800	{20 × 6, 10 × 12}
81	◇	②✓	②✓	①✓	①✓	--	-	①✓	①✓			
	①								D	S	3500	25 × 14
	②							D		S	3000	20 × 10
	3			D	D					S	3900	22 × 14
	④			2D						S	4200	24 × 8
	⑤			2D						S		
	⑥			2D						S		
	⑦		2D							S	3400	16 × 8
	⑧	2D								S	1800	{20 × 6, 10 × 12}
82	◇	②✓	-	③✓	-	-	①✓	②✓	①✓			
	①								D	S	3500	25 × 14
	②							D		S	3000	20 × 10
	③							D		S		
	4	2D					D			S	4400	24 × 12
	⑤			2D						S	4200	24 × 8
	⑥			D						S	2100	12 × 8
83	◇	①✓	①✓	③✓	②✓	③✓	-	②✓	②✓			
	①								D	S	3500	25 × 14
	②								D	S		
	③							D		S	3000	20 × 10
	④							D		S		
	5		D			D				S	3500	25 × 10
	⑥					D				S	1800	17 × 10
	⑦					D				S		
	⑧				2D					S	3600	20 × 14
	⑨			2D						S	4200	24 × 8
	10	D		D						S	3000	{22 × 8, 12 × 14}

TABLE 4.3.3.3-11

GRUMMAN

MIXED MISSIONS: NASA GEOSYNCH (cont) OPTION: (3A) 320A/320AE-3A

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
84	◇D	②✓	-	①✓	①✓	-	-	①✓	②✓			
	◇R	②✓	③✓	③✓	②✓	-	-	-	-			
	1		R						D	Reverse Sling	3500 1700	25 × 14 8 × 8
	2		R						D	RS	"	"
	3				R			D		RS	3000 1800	20 × 10 10 × 14
	④				D/R					RS	1800	10 × 14
	⑤			D/R						RS	2100	12 × 8
	⑥			R						RS		
	⑦			R						RS		
	⑧		R							RS	1700	8 × 8
	⑨	D/R								RS	900	10 × 6
	⑩	D/R								RS		
85	◇D	①	①	⑤✓	①✓	-	①✓	②✓	②✓			
	◇R	①✓	①✓	⑦✓	①✓	-	-	-	-			
	1		R						D	RS	3500 1700	25 × 14 8 × 8
	2	R							D	RS	3500 900	25 × 14 10 × 6
	3				R			D		RS	3000 1800	20 × 10 10 × 14
	④							D		S	3000	20×10
	5			R			D			RS	2600 2100	12 × 8 12 × 8
	6			R	D					RS	1800 2100	10 × 14 12 × 8
	⑦			D/R						RS	2100	12 × 8
	⑧			D/R						RS		
	⑨			D/R						RS		
	⑩			D/R						RS		
	⑪			D/R						RS		
	12	D	D							S	2600	18 × 8 10 × 14

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TABLE 4.3.3.3-11 (cont)

GRUMMAN

MIXED MISSIONS: NASA GEOSYNCH (cont) OPTION: 3A 320A/320AE - 3A

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
86	D	1✓	-	5✓	-	-	-	-	2✓			
	R	2✓	2✓	3✓	1✓	-	-	-				
	1								D	RS	3500	25 × 14
			R								1700	8 × 8
	2								D	RS	"	"
			R									
	3			D						RS	2100	12 × 8
					R						1800	10 × 14
	4			D						RS	2100	12 × 8
		R									900	10 × 6
	5			D/R						RS	2100	12 × 8
	6			D/R						RS		
	7			D/R						RS		
	8	D/R								RS	900	10 × 6
87	D	1✓	1✓	6✓	2✓	-	1✓	2✓	2✓			
	R	1✓	-	3✓	-	-	-	-	-			
	1								D	RS	3500	25 × 14
		R									900	10 × 6
	2								D	S	3500	25 × 14
	3							D		S	3000	20 × 10
	4							D		S		
	5	D	D							RS	2600	{18 × 8, 10 × 14}
				R							2100	12 × 8
	6			D			D			S	4700	24 × 8
	7			D/R						RS	2100	12 × 8
	8			D/R						RS		
	9			D						S		
	10			2D						S	4200	24 × 8
	11				2D					S	3600	20 × 14
88	D	2✓		7✓	1✓	-	-	1✓	2✓			
	R	1✓	1✓	1✓	2✓	-	-	-	-			
	1								D	RS	3500	25 × 14
			R								1700	8 × 8
	2								D	RS	3500	25 × 14
		R									900	10 × 6
	3				D/R					RS	1800	10 × 14

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TABLE 4.3.3.3-11 (cont)

GRUMMAN

MIXED MISSIONS: NASA GEOSYNCH (cont) OPTION: (3A) 320A/320AE - 3A

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
88 (cont)	4				R			D		RS	3000 1800	20 x 10 10 x 14
	⑤			D/R						RS	2100	12 x 8
	⑥			2D						S	4200	24 x 8
	⑦			2D						S		
	⑧			2D						S		
	⑨	2D								S	1800	{20 x 6 10 x 12
89	◇D	①✓	①✓	②✓	–	③✓	–	①✓	②✓			
	◇R	①✓	–	⑤✓	①✓	–	–	–	–			
	1	R							D	RS	3500 900	25 x 14 10 x 6
	②								D	S	3500	25 x 14
	3				R			D		RS	3000 1800	20 x 10 10 x 14
	4			R		D				RS	1800 2100	17 x 10 12 x 8
	5			R		D				RS	"	"
	6			R		D				RS	"	"
	⑦			D/R						RS	2100	12 x 8
	⑧			D/R						RS		
	9	D	D							S	2600	{18 x 8 10 x 14
90	◇D	②✓	–	③✓	–	–	②✓	–	②✓			
	◇R	②✓	①✓	⑤✓	①✓	–	–	–	–			
	1		R						D	RS	3500 1700	25 x 14 8 x 8
	2	R							D	RS	3500 900	25 x 14 10 x 6
	3			R			D			RS	2600 2100	12 x 8 12 x 8
	4			R			D			RS	"	"
	⑤			D/R						RS	2100	12 x 8
	⑥			D/R						RS		
	⑦			D/R						RS		

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GRUMMAN

TABLE 4.3.3.3-11 (cont)

MIXED MISSIONS: NASA GEOSYNCH (cont) OPTION: (3A) 320A/320AE - 3A

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
90 (cont)	8	D								RS	900	10 × 6
					R						1800	10 × 14
	(9)	D/R								R/S	900	10 × 6

TABLE 4.3.3.3-11 (cont)

GRUMMAN

MIXED MISSIONS: NASA NON-GEOSYNCH OPTION: (3A) 320A/320AE-3A

YEAR	FLT NO	PAYLOAD								AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
			12	13	14	15	16					
83	◇D		①✓	①✓	①✓	①✓	④✓					
	1					D	2D			ONE STG	11000	30 x 13
	②						2D			ONE STG	9000	22 x 13
	3		D	D	D					ONE STG	4700	{25x7 / 15x14
84	◇D		–	–	①✓	①✓	–					
	◇R		①✓	①✓	①✓	①✓	–					
	①					D/R				ONE STG	2000	8 x 11
	②				D/R					ONE STG	800	10 x 5
	③			R						ONE STG	1000	7 x 7
	④		R							ONE STG	2000	8 x 6
85	◇D		①✓	①✓	①✓	①✓	④✓					
	◇R		–	–	①✓	①✓	④✓					
	①						D/R			ONE STG	4500	11 x 13
	②						D/R			ONE STG		
	③						D/R			ONE STG		
	④						D/R			ONE STG		
	5			D		D				ONE STG	3000	15 x 11
						R					2000	8 x 11
	6		D		D					ONE STG	2800	{18 x 6 / 10 x 11
					R						800	10 x 5
86	◇D		–	–	①✓	①✓	–					
	◇R		①✓	①✓	①✓	①✓	–					
	①					D/R				ONE STG	2000	8 x 11
	②				D/R					ONE STG	800	10 x 5
	③			R						ONE STG	1000	7 x 7
	④		R							ONE STG	2000	8 x 6
87	◇D		①✓	①✓	①✓	①✓	–					
	◇R		–	–	①✓	①✓	④✓					
	①						R			ONE STG	4500	11 x 13
	②						R			ONE STG		
	③						R			ONE STG		
	④						R			ONE STG		
	5			D		D				ONE STG	3000	15 x 11
						R					2000	8 x 11
	6		D		D					ONE STG	2800	{18 x 16 / 10 x 11
					R						800	10 x 5

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TABLE 4.3.3.3-12

GRUMMAN

MIXED MISSIONS: NASA NON-GEOSYNCH (cont) OPTION: 3A 320A/320AE-3A

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	REMARKS	TOTAL P/L WT	TOTAL P/L VOL
88	D		-	-	1✓	1✓	-					
	R		1✓	1✓	1✓	1✓	-					
	1					D/R				ONE STG	2000	8×11
	2				D/R					ONE STG	800	10×5
	3			R						ONE STG	1000	7×7
	4		R							ONE STG	2000	8×6
89	D		1✓	1✓	1✓	1✓	6✓					
	R		-	-	1✓	1✓	-					
	1					D R	D			ONE STG	6500 2000	19 × 13 8 × 11
	2				D R		D			ONE STG	5300 800	21 × 13 10 × 5
	3			D			2D			ONE STG	10000	29 × 13
	4		D				2D			ONE STG	11000	30 × 13
90	D		-	-	1✓	1✓	-					
	R		1✓	1✓	1✓	1✓	-					
	1					D/R				ONE STG	2000	8 × 11
	2				D/R					ONE STG	800	10 × 5
	3			R						ONE STG	1000	7 × 7
	4		R							ONE STG	2000	8×6

TABLE 4.3.3.3-12 (cont)

GRUMMAN

TRAFFIC ASSESSMENT: DOD GEOSYNCH

OPTION: 3A 320A/320AE - 3A

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
25	DOUBLE DEPLOY	Slingshot		1	1	1	1								4
	ROUND TRIP	Reverse Slingshot						2	2	2	2	2	2	2	14
	(TOTAL)			(1)	(1)	(1)	(1)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(18)
26	SINGLE DEPLOY	S		1		1	1								3
	ROUND TRIP	RS						1		1	1	1		1	5
	(TOTAL)			(1)		(1)	(1)	(1)		(1)	(1)	(1)		(1)	(8)
27	SINGLE DEPLOY			1		1	1								3
	ROUND TRIP							1	1		1	1	1	1	6
	(TOTAL)			(1)		(1)	(1)	(1)	(1)		(1)	(1)	(1)	(1)	(9)
28	SINGLE DEPLOY	S								1		1			2
	DOUBLE DEPLOY	S					1	1							2
	RETRIEVE	RS											1	1	2
	ROUND TRIP	RS											1	1	2
	(TOTAL)						(1)	(1)		(1)		(1)	(2)	(2)	(8)
30	SINGLE DEPLOY	S							2		1		1		4
	(TOTAL)								(2)		(1)		(1)		(4)
31	SINGLE DEPLOY	S			2			2			2			2	8
	(TOTAL)				(2)			(2)			(2)			(2)	(8)
DOD GEOSYNCH TRAFFIC SUMMARY (Missions 25 - 31)	TWO STG														
	SINGLE DEPLOY	SLINGSHOT		2	2	2	2	2	2	1	3	1	1	2	20
	DOUBLE DEPLOY	SLINGSHOT		1	1	1	2	1							6
	RETRIEVE	REVERSE SLINGSHOT											1	1	2
	ROUND TRIP	REVERSE SLINGSHOT						4	3	3	4	4	4	5	27
	(TOTAL)			(3)	(3)	(3)	(4)	(7)	(5)	(4)	(7)	(5)	(6)	(8)	(55)

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TABLE 4.3.3.3-13

GRUMMAN

TRAFFIC ASSESSMENT: DOD NON-GEOSYNCH

OPTION: (3A) 320A/320AE-3A

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
32	DOUBLE DEPLOY	ONE STG		2		2	2								6
	ROUND TRIP	TWO STG RVRS SLINGSHOT						4		4	4	4		4	20
	(TOTAL)			(2)		(2)	(2)	(4)		(4)	(4)	(4)		(4)	(26)
33	SINGLE DEPLOY	ONE STG		1		2	1								4
	ROUND TRIP	TWO STG RVRS SLINGSHOT							2	1		2	1		6
	(TOTAL)			(1)		(2)	(1)		(2)	(1)		(2)	(1)		(10)
34	SINGLE DEPLOY	ONE STG			1		1								2
	RETRIEVE	ONE STG						1		1		1			3
	(TOTAL)				(1)		(1)	(1)		(1)		(1)			(5)
35	SINGLE DEPLOY	ONE STG		2	2	2	2								8
	ROUND TRIP	ONE STG						2	2	2	2	2	2	2	14
	(TOTAL)			(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(22)
36	TRIPLE DEPLOY	TWO STG SLINGSHOT		1			1					1			3
	(TOTAL)			(1)			(1)					(1)			(3)
37	TRIPLE DEPLOY	TWO STG SLINGSHOT		1				1					1		3
	(TOTAL)			(1)				(1)					(1)		(3)
38	TRIPLE DEPLOY	TWO STG SLINGSHOT		1					1					1	3
	(TOTAL)			(1)					(1)					(1)	(3)
39	TRIPLE DEPLOY	(A) ONE STG					1	1		1	1		1	1	6
	(TOTAL)	WTR LAUNCH					(1)	(1)		(1)	(1)		(1)	(1)	(6)
40	DOUBLE DEPLOY	(A) ONE STG					2		1						3
	RETRIEVE	(B) WTR LAUNCH								2					2
	ROUND TRIP									2		2	2		6
	(TOTAL)						(2)		(1)	(4)		(2)	(2)		(11)

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TABLE 4.3.3.3-13 (cont)

GRUMMAN

TRAFFIC ASSESSMENT: DOD NON-GEOSYNCH (cont)

OPTION: (3A) 320A/320AE-3A

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
41	SORTIE	(A) ONE STG					1		1		1		1		4
	(TOTAL)	(B) WTR LAUNCH					(1)		(1)		(1)		(1)		(4)
DOD NON-GEO TRAFFIC SUMMARY (Missions 32 - 41)	ONE STG			(5)	(3)	(6)	(10)	(4)	(4)	(8)	(4)	(5)	(6)	(3)	(58)
	SINGLE DEPLOY			3	3	4	4								14
	DOUBLE DEPLOY			2		2	4		1						9
	TRIPLE DEPLOY						1	1		1	1		1	1	6
	RETRIEVE							1		3		1			5
	ROUND TRIP							2	2	4	2	4	4	2	20
	SORTIE						1		1		1		1		4
	TWO STG			(3)	(0)	(0)	(1)	(5)	(3)	(5)	(4)	(7)	(2)	(5)	(35)
	TRIPLE DEPLOY	Slingshot		3			1	1	1			1	1	1	9
	ROUND TRIP	Reverse Slingshot						4	2	5	4	6	1	4	26
	(TOTAL)			(8)	(3)	(6)	(11)	(9)	(7)	(13)	(8)	(12)	(8)	(8)	(93)

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TABLE 4.3.3.3-13 (cont)

GRUMMAN

TRAFFIC ASSESSMENT: DOD DETAILED TRAFFIC SUMMARY — OPTION: 3A 320A/320AE-3A

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION — CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
DOD TOTAL TRAFFIC SUMMARY (Missions 25-41)	ONE STG			(5)	(3)	(6)	(10)	(4)	(4)	(8)	(4)	(5)	(6)	(3)	(53)
	SINGLE DEPLOY			3	3	4	4								14
	DOUBLE DEPLOY			2		2	4		1						9
	TRIPLE DEPLOY						1	1		1	1		1	1	6
	RETRIEVE							1		3		1			5
	ROUND TRIP							2	2	4	2	4	4	2	20
	SORTIE						1		1		1		1		4
	TWO STG			(6)	(3)	(3)	(5)	(12)	(8)	(9)	(11)	(12)	(8)	(13)	(90)
	SINGLE DEPLOY	SLINGSHOT		2	2	2	2	2	2	1	3	1	1	2	20
	DOUBLE DEPLOY	SLINGSHOT		1	1	1	2	1							6
	TRIPLE DEPLOY	SLINGSHOT		3			1	1	1			1	1	1	9
	RETRIEVE	REVERSE SLINGSHOT											1	1	2
	ROUND TRIP	REVERSE SLINGSHOT						8	5	8	8	10	5	9	53
	(TOTAL)			(11)	(6)	(9)	(15)	(16)	(12)	(17)	(15)	(17)	(14)	(16)	(148)

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TABLE 4.3.3.3-13 (Cont.)

GRUMMAN

4.3.4 OPTION 3B

Deploy:	3500 lbs	Starting Dec. 1979
Retrieve:	3500 lbs	Starting Dec. 1983

Paragraph	Subject	Page
4.3.4.1	Mission Model	4-201
4.3.4.2	Concept 310/310ARE-3A	4-203
4.3.4.2.1	310/310ARE Performance	4-203
*4.3.4.2.2	310/310ARE Flight Summary	4-222
*4.3.4.2.3	310/310ARE Flight Element Requirements	4-226
*4.3.4.2.4	310/310ARE Initial Flight Schedule	4-231
4.3.4.2.5	310/310ARE Add'l Payload Capture Potential	4-233
4.3.4.2.6	310/310ARE Detailed Traffic Assessment Data	4-235
4.3.4.3	Concept 510A/510ADE-3A	4-255
4.3.4.3.1	510A/510ADE Performance	4-255
*4.3.4.3.2	510A/510ADE Flight Summary	4-280
*4.3.4.3.3	510A/510ADE Flight Element Requirements	4-284
*4.3.4.3.4	510A/510ADE Initial Flight Schedule	4-290
4.3.4.3.5	510A/510ADE Add'l Payload Capture Potential	4-292
4.3.4.3.6	510A/510ADE Detailed Traffic Assessment Data	4-294

*Inputs to Programmatics/Costing - Volume 8

4.3.4.1 Option 3B Mission Model

Table 4.3.4-1 Space Tug Study Mission Model (Option 3B)

SPACE TUG STUDY TRAFFIC MODEL — OPTION: 3B

MISSION ID	CURRENT DESIGN			LOW COST DESIGN			CALENDAR YEAR											TOTAL
	WT	L	D	WT	L	D	80	81	82	83	84	85	86	87	88	89	90	
1				900	10	6	2	2	2	1	2 / 2	1 / 1	1 / 2	1 / 1	2 / 1	1 / 1	2 / 2	17 / 10
2				1700	8	8	1	2		1	/ 3	1 / 1	/ 2	1	/ 1	1	/ 1	7 / 8
3				2100	12	8	3	7	3	3	1 / 3	5 / 7	5 / 3	6 / 3	7 / 1	2 / 5	3 / 5	45 / 27
4				1800	10	14	1	1		2	1 / 2	1 / 1	/ 1	2	1 / 2	/ 1	/ 1	9 / 8
5				2800	12	14				3		/ 3				3		6 / 3
6	2600	12	8				1		1			1		1			2	6 / 0
7	3000	20	10				1	1	2	2	1	2		2	1	1		13 / 0
8	3500	25	14				2	1	1	2	2	2	2	2	2	2	2	20 / 0
SUB-TOTAL							11 / 0	14 / 0	9 / 0	14 / 0	7 / 10	13 / 13	8 / 8	15 / 4	13 / 5	10 / 7	9 / 9	123 / 56
9				1400	9	6	1		1		1		3		1		2	8 / 0
10	6000	12	8					1			1			1			1	4 / 0
11				1700	8	8	1	1		1		1 / 1	/ 1	1	/ 1	1	/ 1	6 / 4
12				2000	8	6				1	/ 1	1	/ 1	1	/ 1	1	/ 1	4 / 4
13				1000	7	7				1	/ 1	1	/ 1	1	/ 1	1	/ 1	4 / 4
14				800	10	5				1	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	8 / 7
15				2000	8	11				1	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	8 / 7
16				4500	11	13				4		4 / 4		/ 4		6		14 / 8
SUB-TOTAL							2 / 0	2 / 0	1 / 0	9 / 0	4 / 4	9 / 7	4 / 5	6 / 6	3 / 5	11 / 2	5 / 5	56 / 34
17	1000	12	10				1									2		3 / 0
18	2000	12	10								2							2 / 0
19	5500	20	12										1	2				3 / 0
20	900	17	10						2		2							4 / 0
21	1600	15	10															0 / 0
22	2500	16	12										1	1		1	1	4 / 0
23	5000	17	12										2					2 / 0
24	3300	17	12								2					2		4 / 0
SUB-TOTAL							1 / 0	0 / 0	2 / 0	0 / 0	6 / 0	0 / 0	4 / 0	3 / 0	0 / 0	5 / 0	1 / 0	22 / 0
TOTAL	NASA						14 / 0	16 / 0	12 / 0	23 / 0	17 / 14	22 / 20	16 / 13	24 / 10	16 / 10	26 / 9	15 / 14	201 / 90
25 (2)				690	12	5	2	2	2	2	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	22 / 14
26 (3b)				1570	15	5	1		1	1	1 / 1		1 / 1	1 / 1	1 / 1		1 / 1	8 / 5
27 (15)				1970	16	10	1		1	1	1 / 1	1 / 1		1 / 1	1 / 1	1 / 1	1 / 1	9 / 6
28 (17)				2200	12	10				2	2		1		1	1 / 2	1 / 2	8 / 4
29 (12b)	SORTIE			2400	20	10												0 / 0
30 (6)				3480	20	9						2		1		1		4 / 0
31 (4a)				3480	25	15		2			2 / 2			2 / 2			2 / 2	8 / 6
SUB-TOTAL							4 / 0	4 / 0	4 / 0	6 / 0	8 / 6	5 / 3	4 / 3	7 / 6	5 / 4	5 / 5	7 / 8	59 / 35
32 (3a)				1570	15	5	4		4	4	4 / 4		4 / 4	4 / 4	4 / 4		4 / 4	32 / 20
33 (4b)				3480	25	15	1		2	1		2 / 2	1 / 1		2 / 2	1 / 1		10 / 6
34 (10)				2745	20	9		1		1	/ 1		/ 1		/ 1			2 / 3
35 (8)				2430	25	12.7	2	2	2	2	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	2 / 2	22 / 14
36 (11a)				850	9	6	3			3					3			9 / 0
37 (11b)				850	9	6	3				3					3		9 / 0
38 (11c)				850	9	6	3					3					3	9 / 0
39 (5)				735	3	5				3	3		3	3		3	3	18 / 0
40 (16)				2610	14.5	6.7				4		2	2 / 4		2 / 2	2 / 2		12 / 8
41 (12a)	SORTIE			6000	20	10				1 / 1		1 / 1		1 / 1		1 / 1		4 / 4
SUB-TOTAL							16 / 0	3 / 0	8 / 0	19 / 1	12 / 7	10 / 5	12 / 12	10 / 7	13 / 11	12 / 6	12 / 6	127 / 55
TOTAL	DOD						20 / 0	7 / 0	12 / 0	25 / 1	20 / 13	15 / 8	16 / 15	17 / 13	18 / 15	17 / 11	19 / 14	186 / 90
COMBINED TOTAL							34 / 0	23 / 0	24 / 0	48 / 1	37 / 27	37 / 28	32 / 28	41 / 23	34 / 25	43 / 20	34 / 28	387 / 180

TABLE 4.3.4-1

4.3.4.2 Concept 310/310ARE-3B

4.3.4.2.1 310/310ARE Performance

- o Flight Modes — Page 4-204
  - Figure 4.3.4.2-1
- o Geosynchronous Performance — 4-205
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  - 310ARE — 4-207
  - Figures 4.3.4.2-2 thru -5
- o Geosynchronous Performance Sensitivity — 4-215
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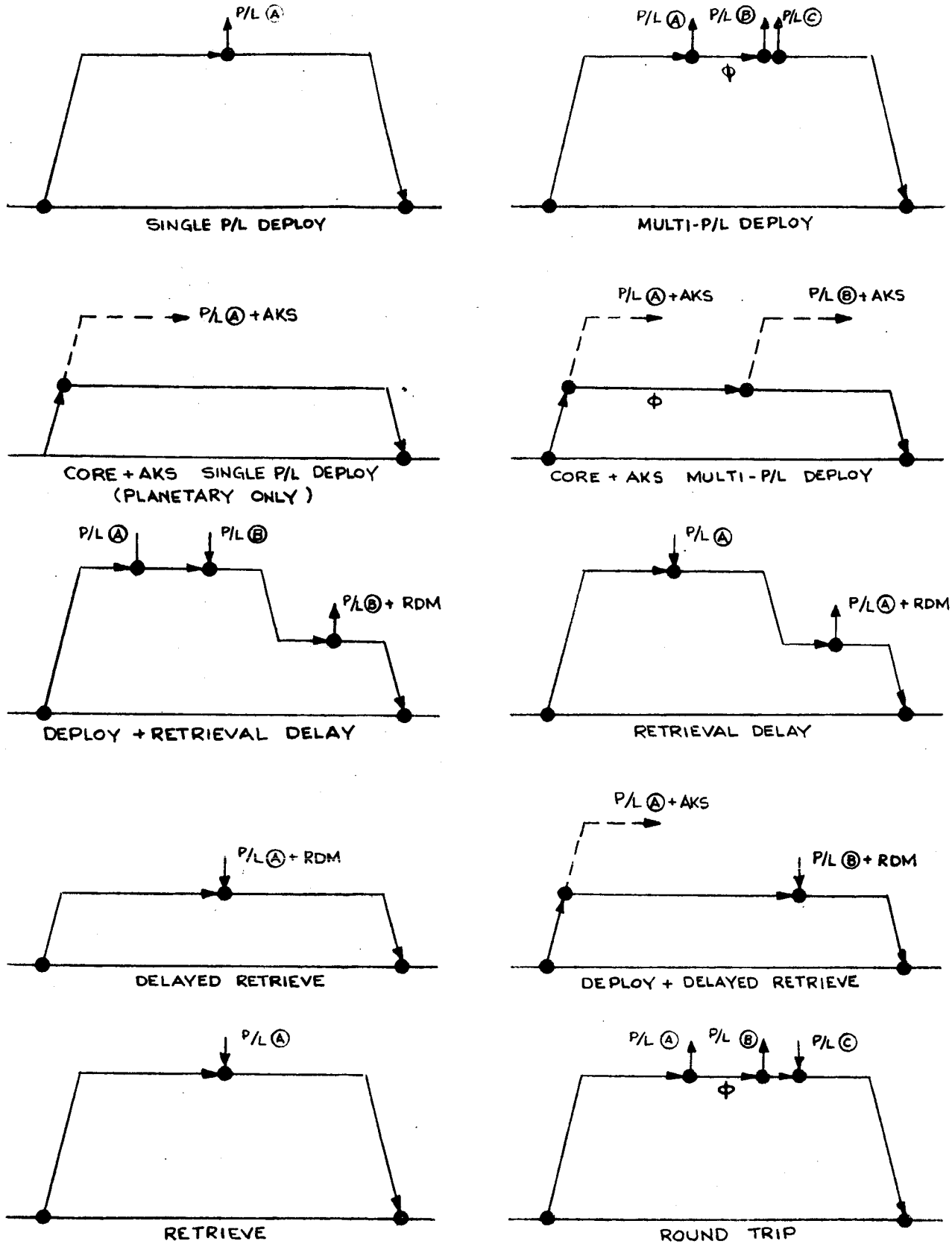
- o General Performance — 4-216
  - Figures 4.3.4.2-6 thru -11

COMMENTS:

a. For multi-deployment flights, the Tug provides 60° phasing between the first and second deployments. No additional phasing is provided for a third deployment or a subsequent retrieval.

b. The Retrieval Delay Performance (Figure 4.3.4.2-5) considers the effects of Retrieval Delay Module Weight (544 lbs).



+ EXPENDED TUG; + SORTIE

CONCEPT 310/310ARE-3B

FLIGHT MODES

FIGURE 4.3.4.2-1

CONCEPT 310-3B

GEOSYNCH PERFORMANCE

REFERENCES:

a. 3B10-1 Concept Definition, Issue 2, dated 29 Aug 1973

b. B81M047-73054, "Tug Requirements, Revision 2," dated 15 Aug 1973

GENERAL INFORMATION

W_{FIXED} = 3212 lbs

W_{ADAPT} = 1510 lbs

I_{SP} = 338.0 sec

I_{SPE} = 0.983 (338) = 332.25 sec

$W_i = P/L_o - W_{ADAPT}$

$= 65000 - 1510$

W_i = 63490 lbs

ΔV_U = 13967 fps

ΔV_D = 13885 fps

$W_{BOI} = W_{FIXED} + x(\text{Consumables})$

$= 3212 + xC$

$x_{DEPLOY} = 0.17$

Tug Length = L_T = 297 in

Orbiter P/L Bay Length = L_o = 720 in

Available P/L Length = $L_P = L_o - L_T$

$L_P = 720 - 297 = 423 \text{ in} =$ **35.25 ft**

NASA MISSIONS

Single Payload

$W_{BO(DEPLOY)} = W_{BOI} = 3212 + 0.17(329) = 3267.93$ lbs

$W_{P/L(DEPLOY)} = f(W_i, W_{BO}, ISPE, \Delta V_U, \Delta V_D) =$ **5212 lbs** See Fig 4.3.4.2-6

CONCEPT 310-3B (cont)

Multi-Payloads

$W_{BO}(n\ P/L's) = W_{BOI} = 3212 + 0.17(534) = \underline{3302.78}$ lbs

$W_{P/L} = f(W_i, W_{BO}, ISPE, \Delta V_U, \Delta V_\phi, \Delta V_D) =$ $\boxed{\text{Fig 4.3.4.2-2}}$ Multi-P/L's

$\Delta V_\phi = f(\phi = 60°) = 292$ fps

DOD MISSIONS

$W_{BO} = W_{BO(NASA)} + \Delta W_{comm}$

Single Payload

$W_{BO} = 3267.93 + 13.2 = \underline{3281.13}$ lbs

$W_{P/L(Deploy)} = f(W_i, W_{BO}, ISPE, \Delta V_U, \Delta V_D) =$ $\boxed{5164 \text{ lbs}}$ see Fig 4.3.4.2-6

Multi-Payloads

$W_{BO} = 3302.78 + 13.2 = 3315.98$ lbs

$W_{P/L} = f(W_i, W_{BO}, ISPE, \Delta V_U, \Delta V_\phi, \Delta V_D) =$ $\boxed{\text{Fig 4.3.4.2-2}}$ Multi-P/L Deploy

CONCEPT 310ARE-3B

GEOSYNCH PERFORMANCE

REFERENCES:

a. 3B10ARE-1 Concept Definition, Issue 2, dated 29 Aug 1973

b. B81M047-73054, "Tug Requirements, Revision 2," dated 15 Aug 1973

GENERAL INFORMATION

$W_{FIXED} = 3416$ lbs

$W_{ADAPT} = 1510$ lbs

$W_{RTEV} = 107$ lbs

$I_{SP} = 338.0$ sec

$I_{SPE} = 0.983(338.0) = \underline{332.25}$ sec

$\Delta V_U = 13967$ fps

$\Delta V_\infty = 30$ fps (Retrieve)

$= 130$ fps (Round Trip)

$\Delta V_D = 13885$ fps

$W_i = P/L_o - W_{ADAPT} = 65000 - 1510$

$W_i = \underline{63490}$ lbs

$W_{BO} = W_{FIXED} + \kappa(\text{Consumables})$

$= 3416 + \kappa C$

$\kappa = 0.17$ Deploy

$= 0.28$ Retrieve

$= 0.27$ Round Trip

Tug Length $= L_T = 297$ in

Retrieval Delay Module Length $= L_{RDM} = 36$ in ; diam $= 10$ ft

Kick Stage Length $= L_K = 66$ in (KS 302, 303) } diam ≈ 10-12 ft.

$= 80$ in (KS 301)

Orbiter P/L Bay Length $= L_o = 720$ in

Available P/L Length $= L_o - (L_T + nL_K)$ or $= L_o - (L_T + L_{RDM})$

$L_{P(w/o\ KS\ or\ RDM)} = 720 - 297 = 423 =$	35.25 ft
$L_{P(with\ RDM)} = 720 - (297 + 36) = 387 =$	32.25 ft
$L_{P(with\ KS\ 301)} = 720 - (297 + 80) = 343 =$	28.58 ft
$L_{P(with\ 1KS)} = 720 - (297 + 66) = 357 =$	29.75 ft
$L_{P(with\ 2KS)} = 720 - (297 + 132) = 291 =$	24.25 ft

CONCEPT 310ARE-3B (cont)

NASA MISSIONS

WITHOUT RETRIEVAL DELAY MODE

Without Kick Stages

Single Payload

$W_{BO(Deploy)} = W_{BOI} - W_{RTRV} = 3416 + 0.17(354) - 107 = \underline{3369.18}$ lbs

$W_{BO(Retrieve)} = W_{BOI} = 3416 + 0.28(496) = \underline{3554.88}$ lbs

$W_{BO(Round\ Trip)} = W_{BOI} = 3416 + 0.27(616) = \underline{3582.32}$ lbs

			See
$W_{P/L(Deploy)} = f(W_i, W_{BO}, ISPE, \Delta V_U, \Delta V_D)$	=	4841 lbs	Fig 4.3.4.2-7
$W_{P/L(Retrieve)} = f(W_i, W_{BO}, ISPE, \Delta V_U, \Delta V_{\infty}, \Delta V_D)$	=	1543 lbs	Fig 4.3.4.2-8
$W_{P/L(Round\ Trip)} = f(W_i, W_{BO}, ISPE, \Delta V_U, \Delta V_{\infty}, \Delta V_D)$	=	1054 lbs	Fig 4.3.4.2-9

Multi-Payloads

Deploy Only

$W_{BO} = W_{BOI} - W_{RTRV} = 3416 + 0.17(534) - 107 = \underline{3399.78}$ lbs

$W_{P/L(n\ P/L\ Deploy)} = f(W_i, W_{BO}, ISPE, \Delta V_U, \Delta V_\phi, \Delta V) =$ Fig 4.3.4.2-3

$\Delta V_\phi = f(\phi = 60°) = 292$ fps

Double Deploy / Retrieve

$W_{BO} = W_{BOI} = 3416 + 0.27(616) = \underline{3582.32}$ lbs

$W_{P/L} = f(W_i, W_o, ISPE, \Delta V_U, \Delta V_\phi, \Delta V_D) =$ Fig 4.3.4.2-4

With Kick Stages

$W_{BO(PLANETARY)} = W_{BOI} - W_{RTRV} = 3416 + 0.17(269) - 107 = \underline{3354.73}$ lbs

$W_{BO(Double\ Deploy)} = W_{BOI} - W_{RTRV} = 3416 + 0.17(342) - 107 = \underline{3367.14}$ lbs

CONCEPT 310ARE-3B (cont)

With Kick Stages (cont)

$W_{P/L}$ (PLANETARY) =	5000 lb to $\Delta V = 18400$ fps	KS 301 (See fig 4.3.4.2-10)
$W_{P/L}$ (Double Deploy) =	3515 lbs each	KS 302 (See fig 4.3.4.2-11)

WITH RETRIEVAL DELAY MODE

With and Without Kick Stage KS 303

$$W_{BO} = W_{BOI} = 3416 + 0.27(619) = \underline{3583} \text{ lbs}$$

$W_{P/L}$ = Fig. 4.3.4.2-5

DOD MISSIONS

$$W_{BO} = W_{BO(NASA)} + \Delta W_{COMM} = W_{BO(NASA)} + 33$$

WITHOUT RETRIEVAL DELAY MODE

Without Kick Stages

Single Payload

$$W_{BO(Deploy)} = 3369.18 + 33 = \underline{3402.18} \text{ lbs}$$

$$W_{BO(Retrieve)} = 3554.88 + 33 = \underline{3587.88} \text{ lbs}$$

$$W_{BO(Round\ Trip)} = 3582.32 + 33 = \underline{3615.32} \text{ lbs}$$

			See
$W_{P/L(Deploy)} = f(W, ISP, \Delta V)$	=	4720 lbs	Fig. 4.3.4.2-7
$W_{P/L(Retrieve)} = f($ " $)$	=	1444 lbs	Fig 4.3.4.2-8
$W_{P/L(Round\ Trip)} = f($ " $)$	=	1021 lbs	Fig 4.3.4.2-9

CONCEPT 310ARE-3B (cont)

Multi-Payloads

Deploy Only

$W_{BO} = 3399.78 + 33 = \underline{3432.78}$ lbs

$W_{P/L(n\ P/L\ Deploy)} = f(w, Isp, \Delta V) =$ Fig. 4.3.4.2-3

Double Deploy/Retrieve

$W_{BO} = 3582.32 + 33 = \underline{3615.32}$ lbs

$W_{P/L} = f(w, Isp, \Delta V) =$ Fig. 4.3.4.2-4

With AKS

$W_{BO} = 3367.14 + 33 = \underline{3400.14}$ lbs

$W_{P/L(Double\ Deploy)} =$ use NASA KS 302 Perf (2 @ 3515 lbs) (see fig 4.3.4.2-11)

WITH RETRIEVAL DELAY MODE

With and Without Kick Stages

$W_{P/L} =$ Fig. 4.3.4.2-5

NO. 340A-10½ DIETZGEN GRAPH PAPER
10 X 10 PER HALF INCH
EUGENE DIETZGEN CO.
MADE IN U. S. A.

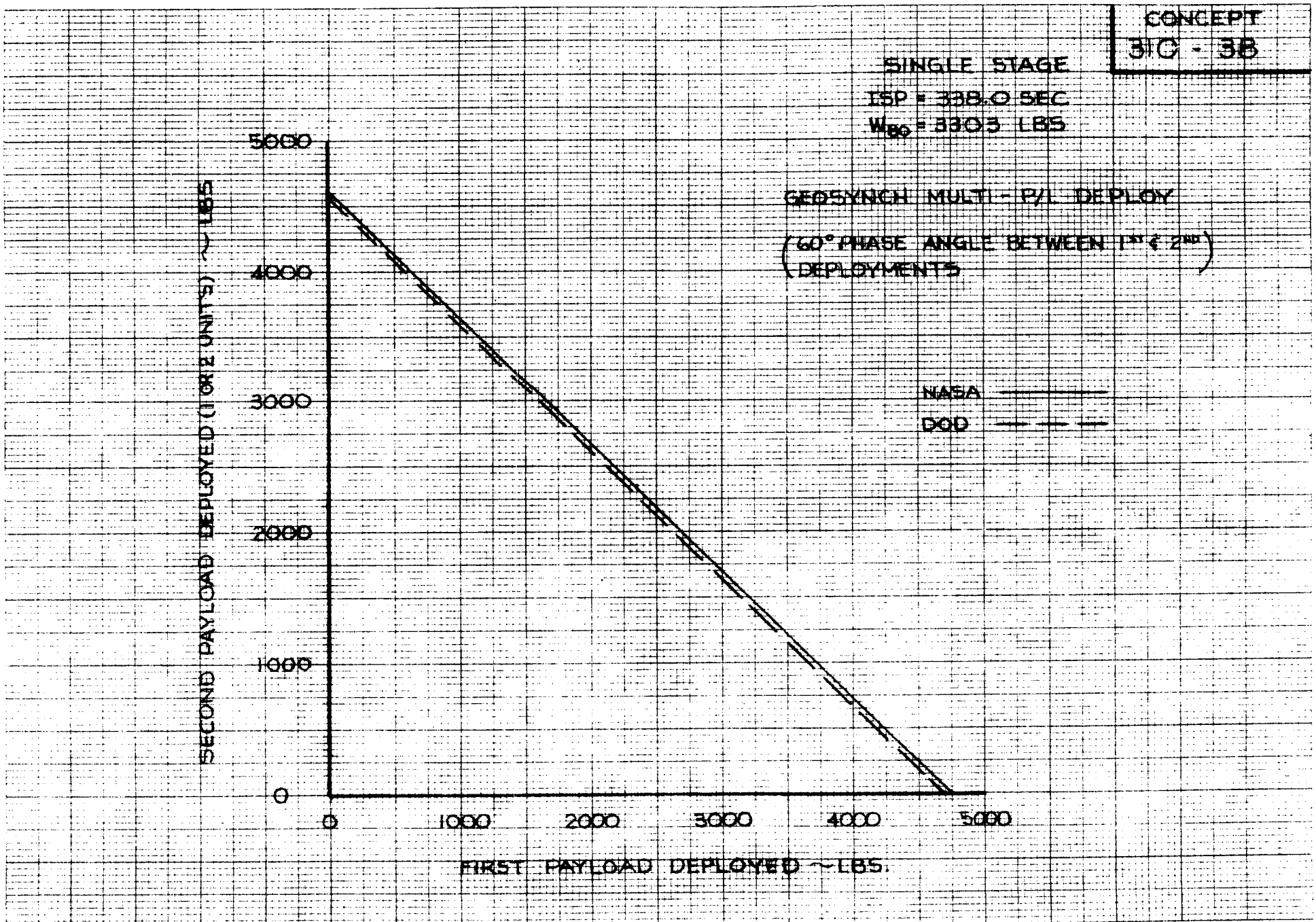


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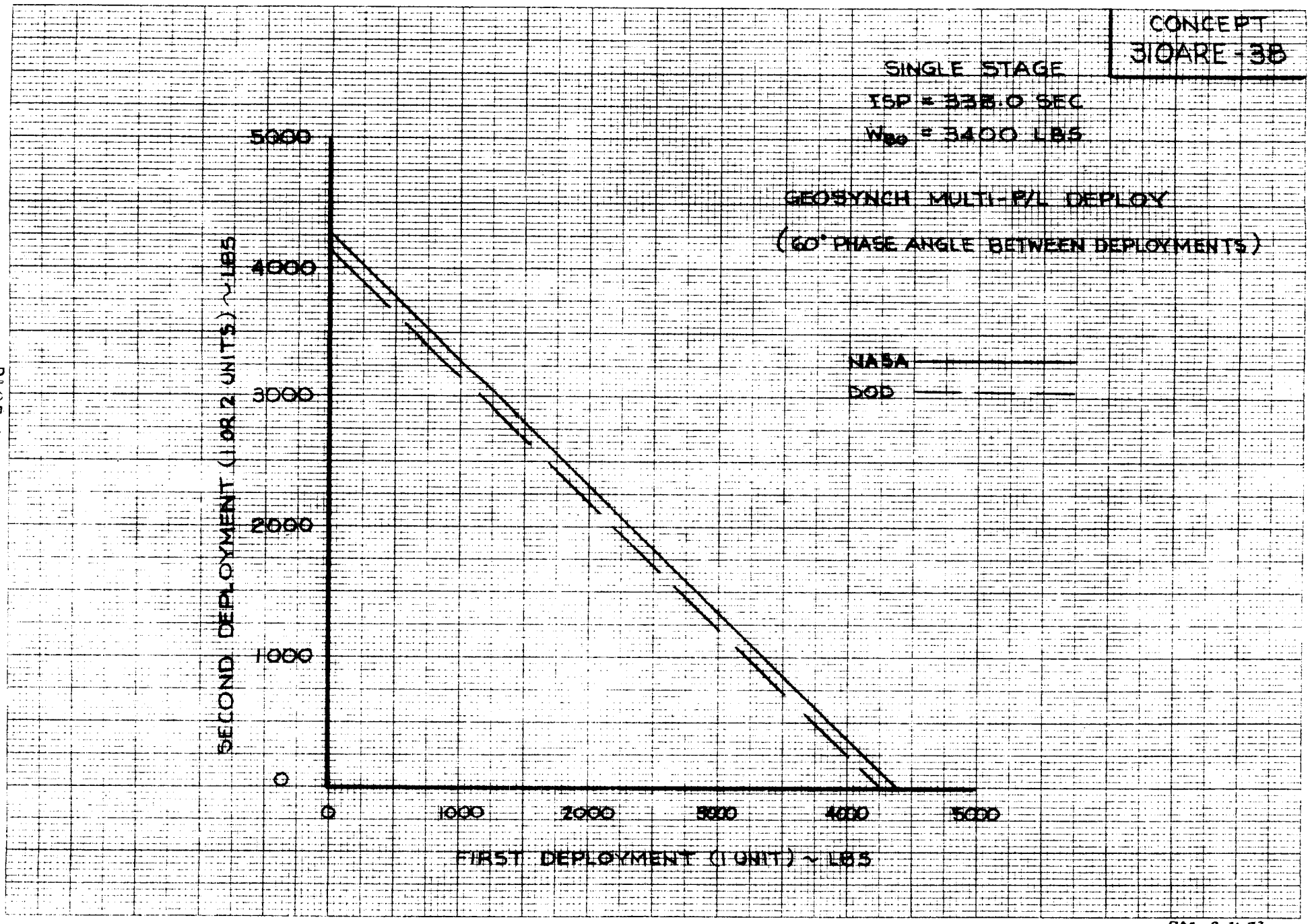
FIGURE 4.3.4.2-2

NO. 340A-10½ DIETZGEN GRAPH PAPER
10 X 10 PER HALF INCH
EUGENE DIETZGEN CO.
MADE IN U. S. A.



BAS 8-31-73

FIGURE 4.3.4.2-3

NO. 340A-10 DIETZGEN GRAPH PAPER
10 X 10 PER HALF INCH
EUGENE DIETZGEN CO.
MADE IN U. S. A.

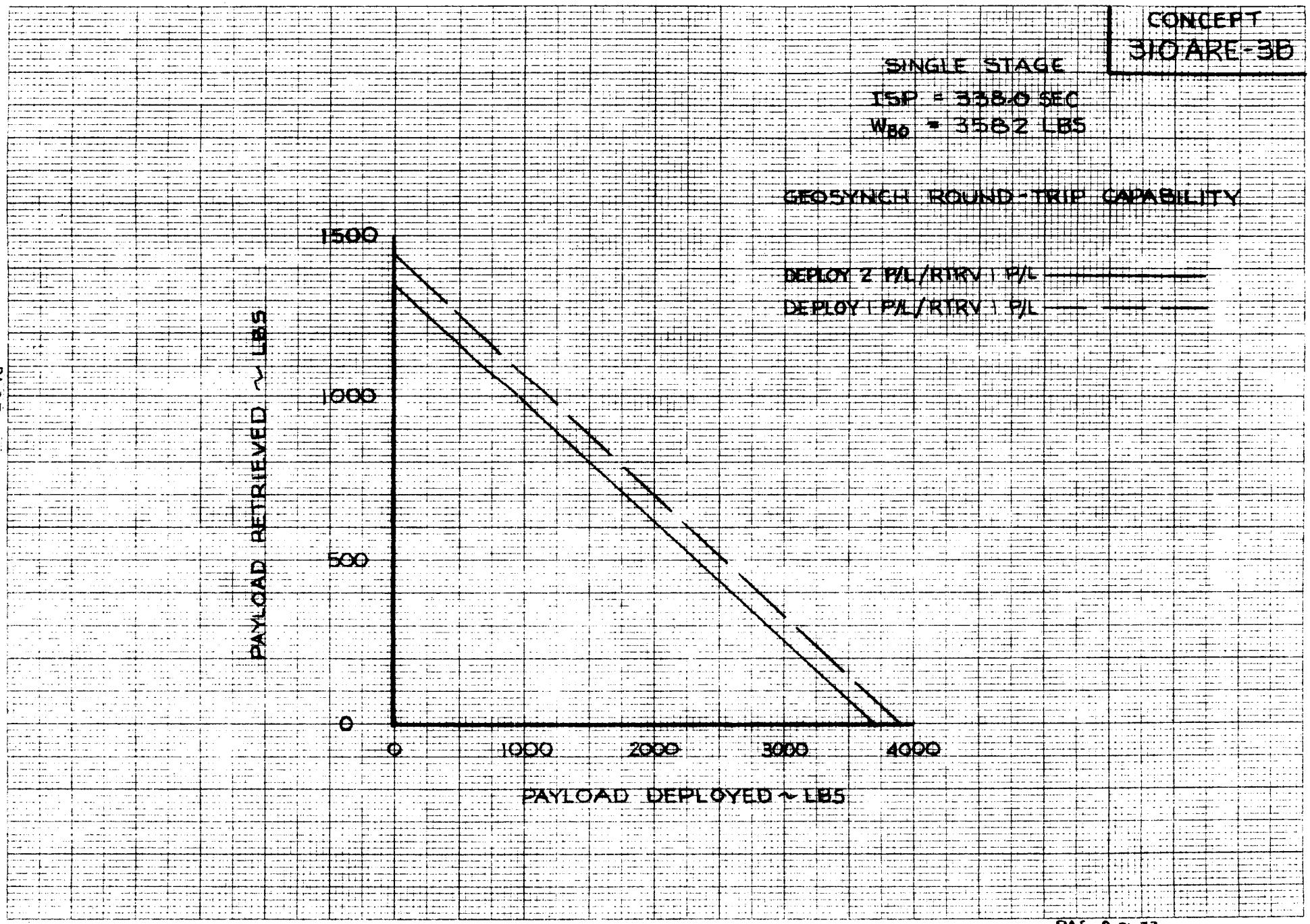


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FIGURE 3.4.3.2-4

NO. 340A-10½ DIETZGEN GRAPH PAPER
10 X 10 PER HALF INCH

EUGENE DIETZGEN CO.
MADE IN U. S. A.

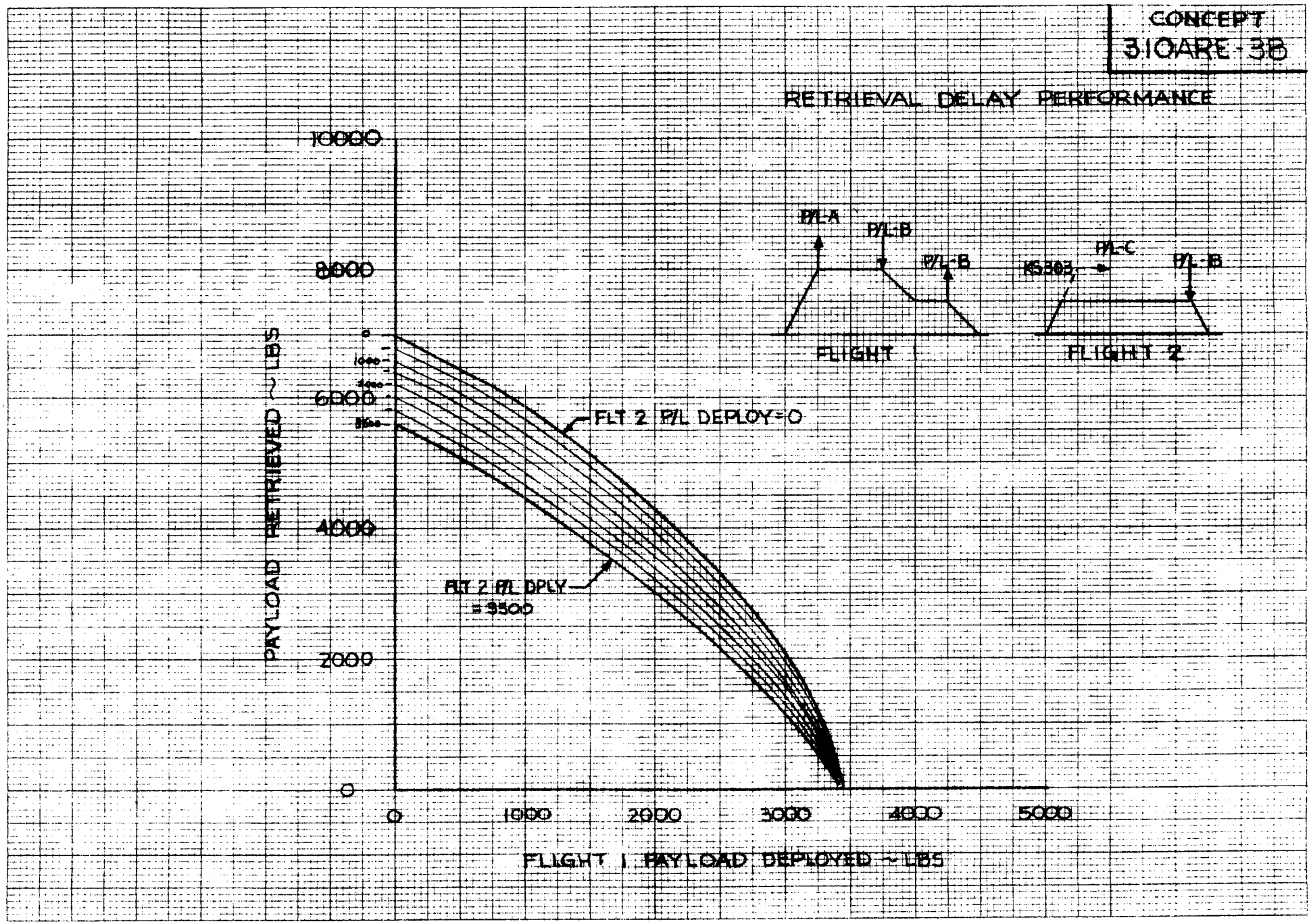

FIGURE 4.3.4.2.-5

FLIGHT MODE	SENSITIVITY					
	$\partial PL/\partial W_{FIXED}$ P/L TO FIXED WEIGHT (lbs/lb)	$\partial PL/\partial W_o$ P/L TO INITIAL WEIGHT (lbs/lb)	$\partial PL/\partial I_{SP}$ P/L TO SPECIFIC IMPULSE (lbs/sec)	$\partial PL/\partial \Delta V_{OUT}$ P/L TO OUTBOUND ΔV (lbs/fps)	$\partial PL/\partial \Delta V_{IN}$ P/L TO INBOUND ΔV (lbs/fps)	
DEPLOY	- 3.66	0.27	97	-1.60	-1.20	
RETRIEVE	- 1.37	0.10	55	-0.60	-0.70	
ROUND TRIP	- 1.00	0.07	37	-0.44	-0.44	

CONCEPT 310/310ARE-3B

PERFORMANCE SENSITIVITIES

TABLE 4.3.4.2-1

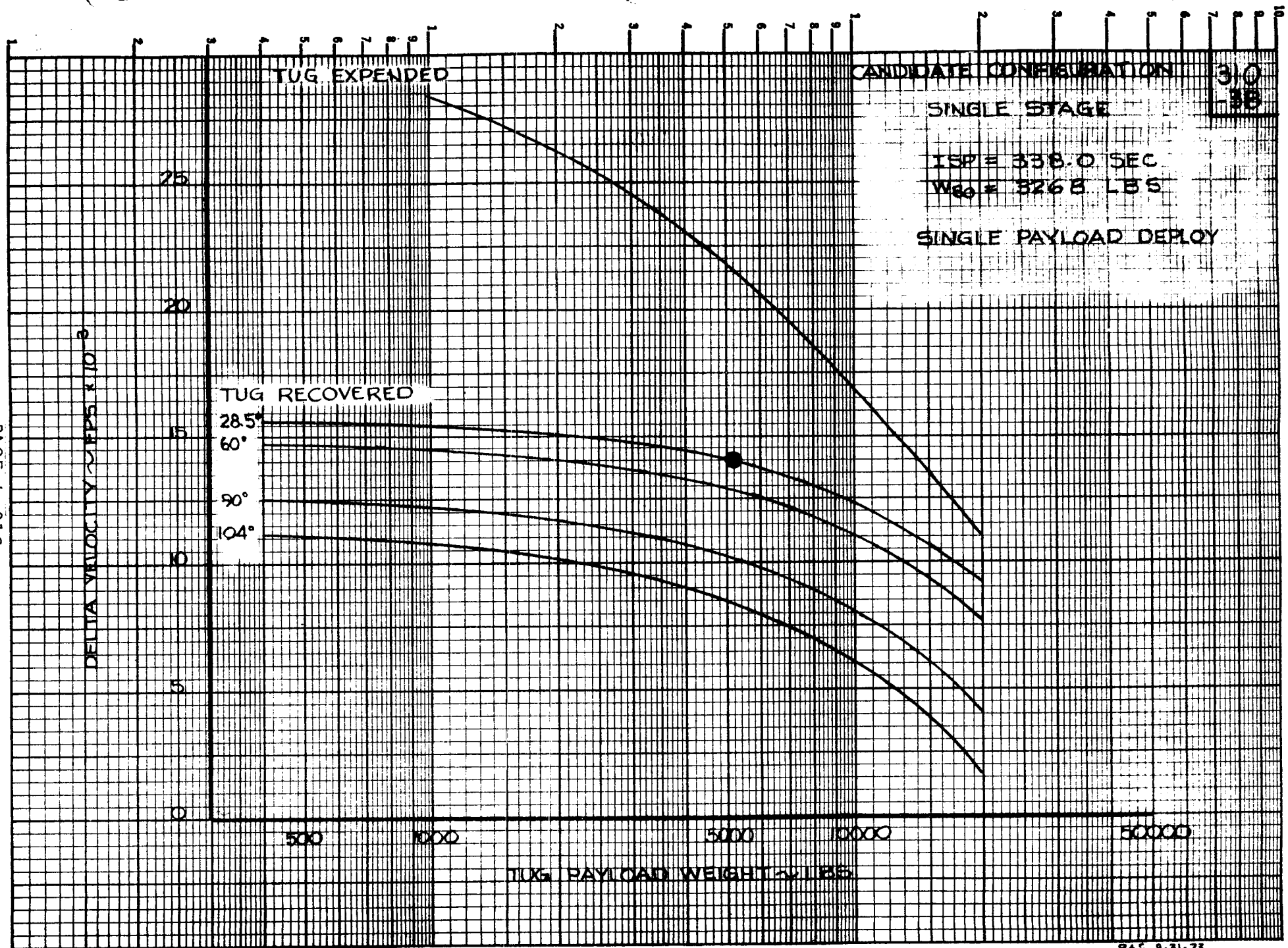

FIGURE 4.3.4.2-6

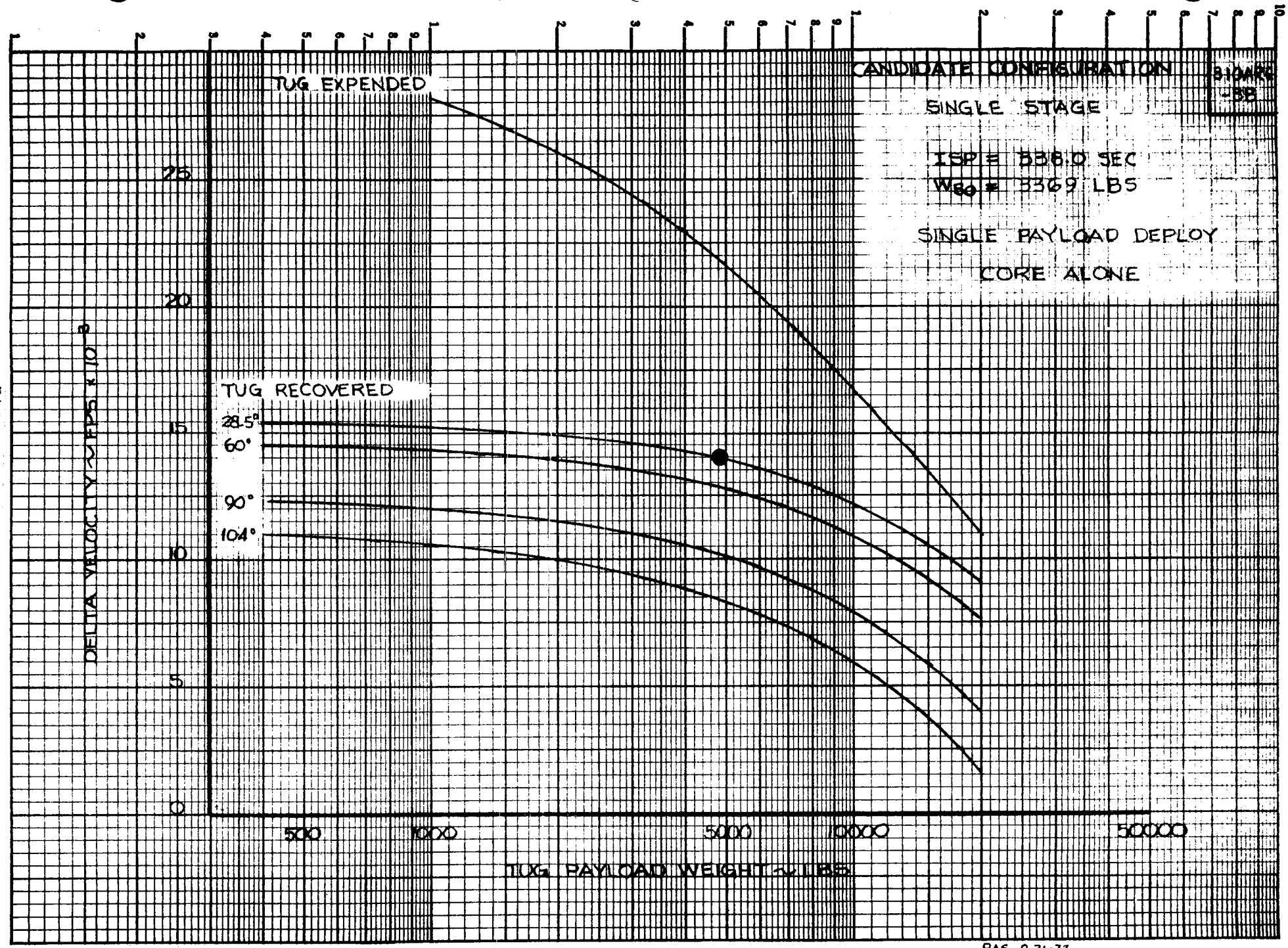

FIGURE 4.3.4.2-7

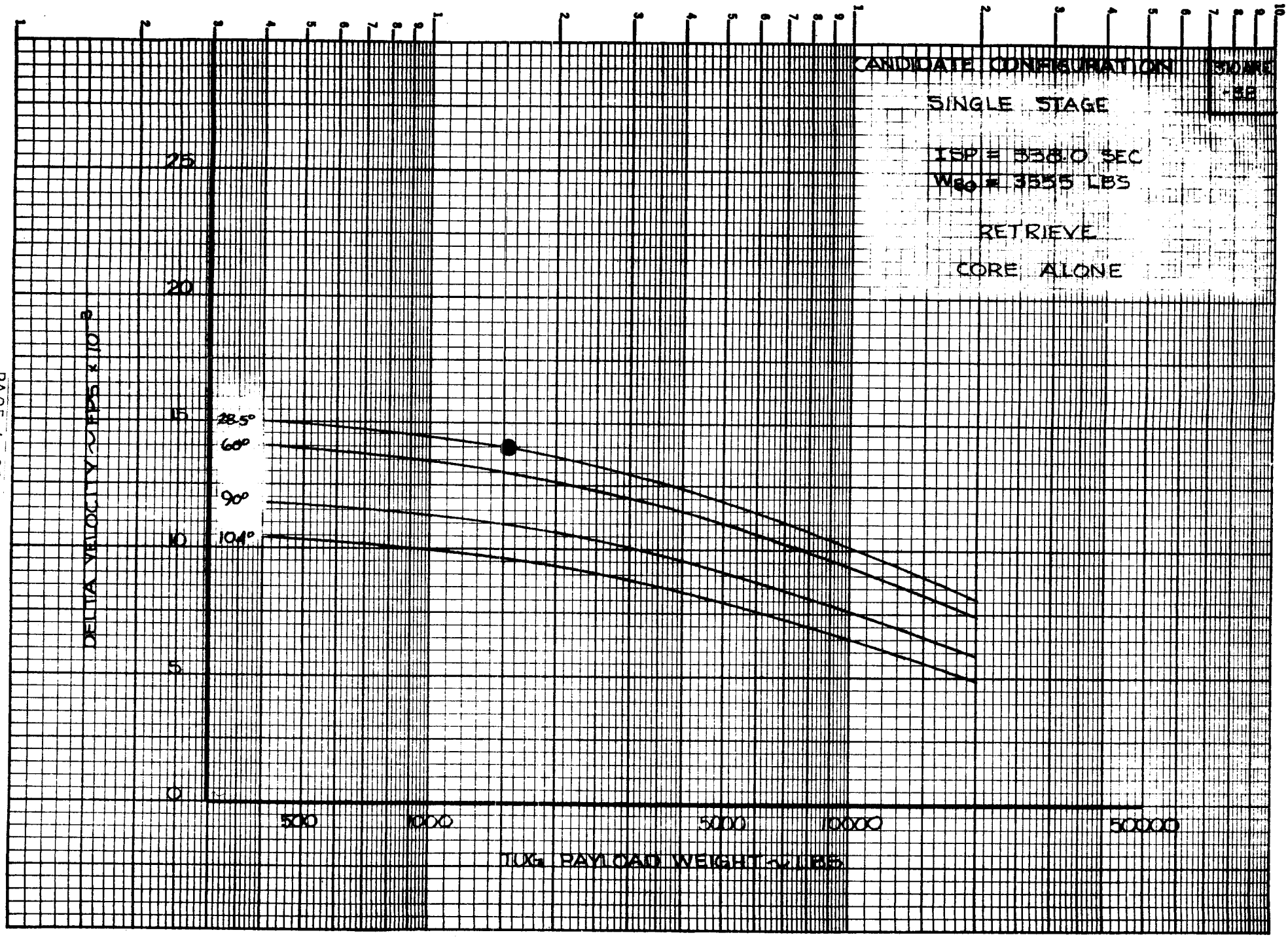

FIGURE 4.3.4.2-8

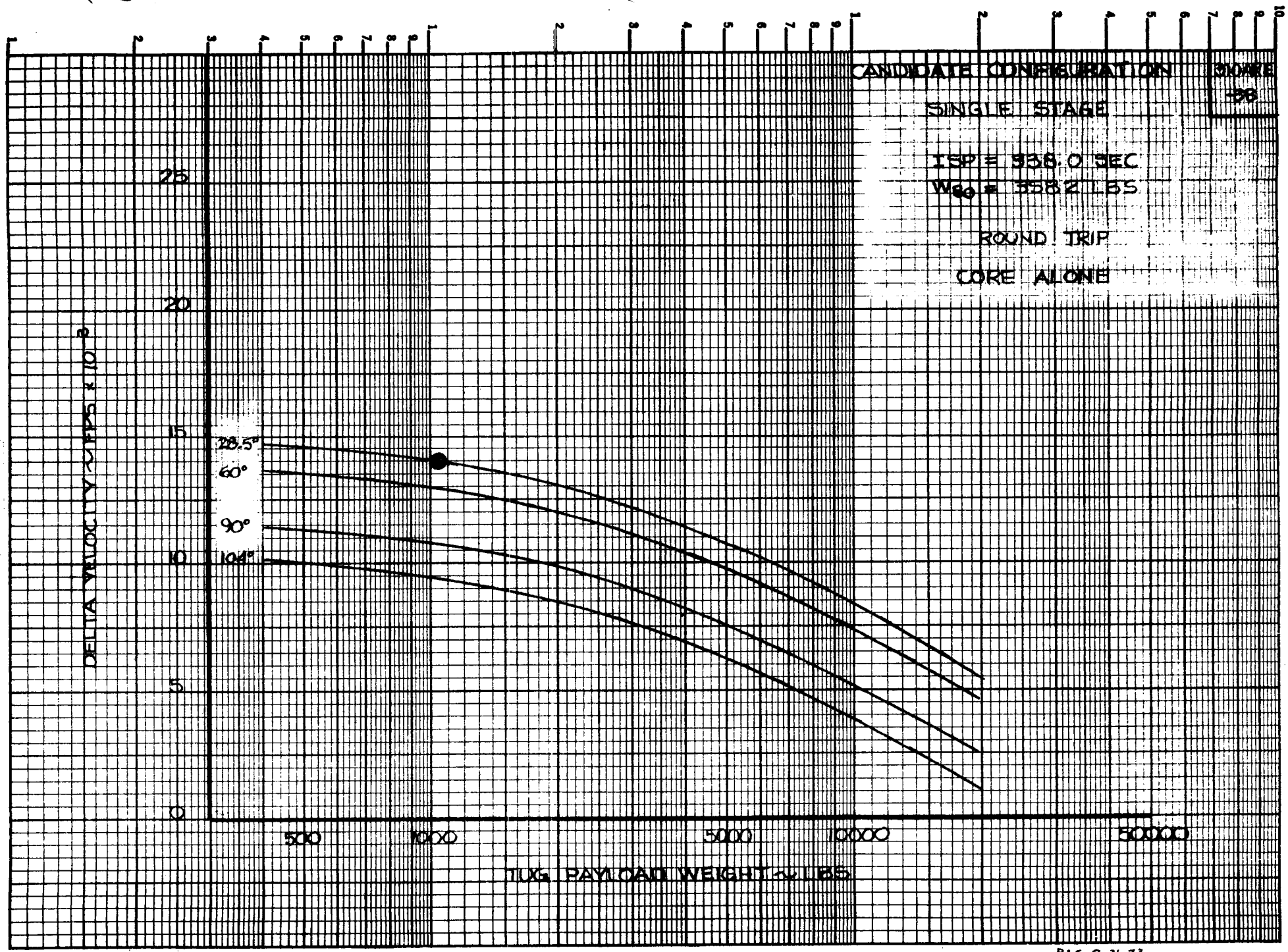

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FIGURE 4.3.4.2-9

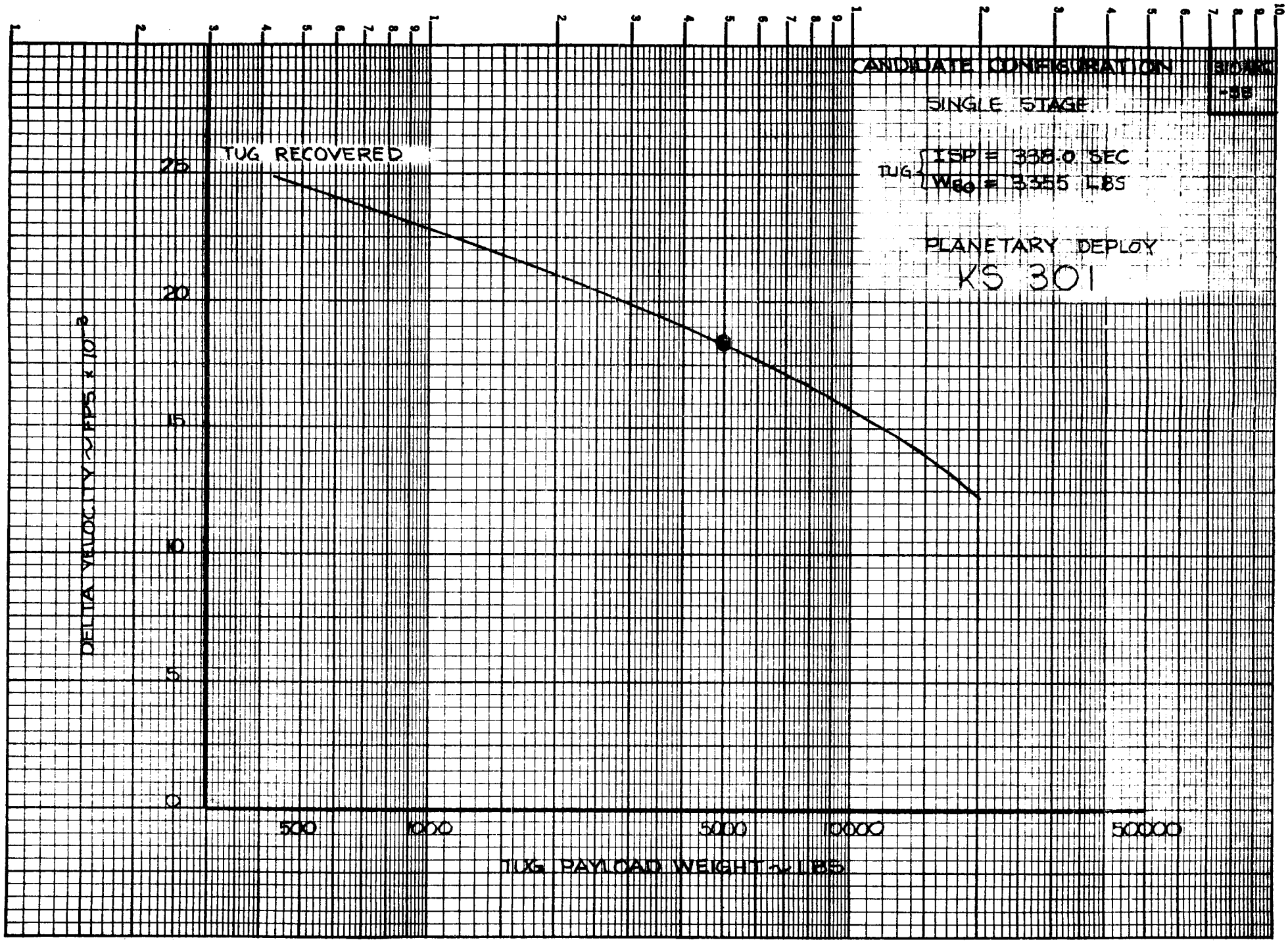

FIGURE 4.3.4.2-10

K+E SEMI-LOGARITHMIC 46 5492
3 CYCLES X 70 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.

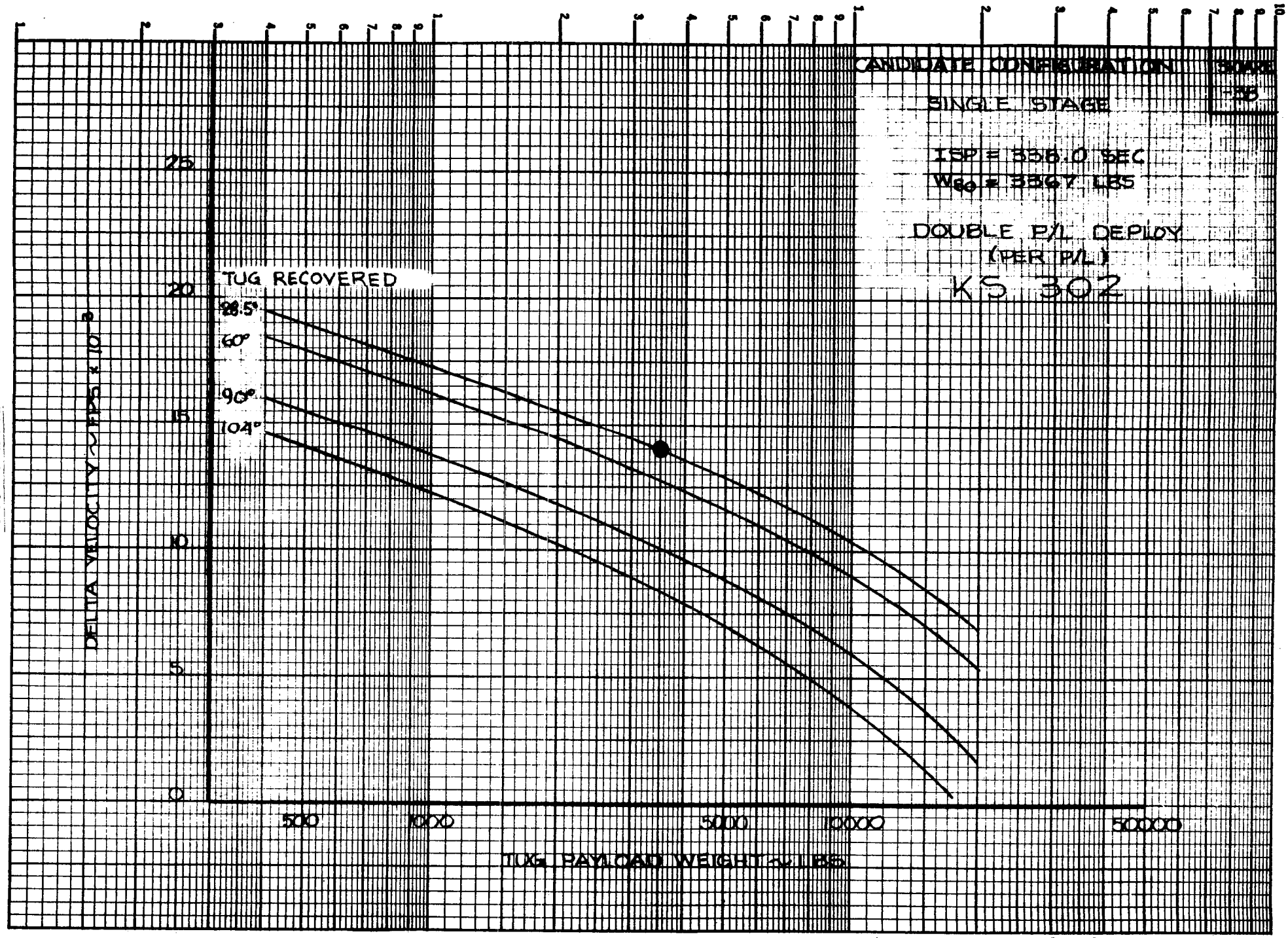

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FIGURE 4.3.4.2-11

4.3.4.2.2 310/310ARE Flight Summary

Table 4.3.4.2-2 NASA Traffic
-3 DOD Traffic
-4 Combined NASA/DOD Traffic

COMMENTS:

a. Core + KS round-trip flights are actually synonomous with mission 2 of the Retrieval Delay Mode and entail a kick stage deployment of a single P/L plus a delayed retrieval of a second P/L.

FLIGHT SUMMARY

OPTION: (310/310 ARE - 3B)

FLIGHT MODE		CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
TOTAL FLIGHTS	SHUTTLE	9	9	8	13	30	32	25	23	17	24	25	215
	TUG												(SAME
TUG FLIGHT DISTRIBUTION	DEPLOY	(9)	(9)	(8)	(13)	(12)	(7)	(10)	(13)	(7)	(13)	(9)	(110)
	SINGLE P/L + CORE	4	2	4	5	6		3	5	1	6	4	40
	+ CORE + RD					4	7	4	3	4	4	4	30
	+ CORE + KS					2		3	2				7
	MULTI P/L - CORE	5	7	4	8				3	2	2	1	32
	- CORE + KS										1		1
	RETRIEVE					(13)	(12)	(9)	(4)	(3)	(5)	(9)	(55)
	CORE RETRIEVE					4		4	4	3	1	3	19
	RETRIEVAL DELAY					4	5	2			2	2	15
	DELAYED RETRIEVE					5	7	3			2	4	21
	ROUND TRIP					(5)	(13)	(6)	(6)	(7)	(6)	(7)	(50)
	CORE ONLY					2	8	3	3	3	2	4	25
	CORE + KS					3	5	3	3	4	4	3	25
MISSION MODEL	(TOTAL)	(14)	(16)	(12)	(23)	(31)	(42)	(29)	(34)	(26)	(35)	(29)	(291)
	DEPLOY	14	16	12	23	17	22	16	24	16	26	15	201
	RETRIEVE					14	20	13	10	10	9	14	90
	SORTIE												0

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NASA TRAFFIC

TABLE 4.3.4.2-2

FLIGHT SUMMARY

OPTION: (310 / 310 ARE - 3B)

FLIGHT MODE		CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
TOTAL FLIGHTS	SHUTTLE	11	6	9	15	22	13	20	21	21	17	24	179
	TUG												SAME
TUG FLIGHT DISTRIBUTION	DEPLOY	(11)	(6)	(9)	(14)	(9)	(5)	(5)	(8)	(6)	(5)	(9)	(87)
	SINGLE P/L - CORE	5	5	6	6		2	1	1	1	1		28
	- CORE + RD					4	1	1	4	2	2	5	19
	MULTI-P/L - CORE	6	1	3	8	4	2	3	3	3	2	4	39
	- CORE + KS					1							1
	RETRIEVE					(9)	(1)	(8)	(8)	(7)	(4)	(11)	(48)
	RETRIEVAL DELAY										1	1	2
	PURE RETRIEVE					5		7	4	5		4	25
	DELAYED RETRIEVAL					4	1	1	4	2	3	6	21
	ROUND TRIP					(4)	(6)	(7)	(4)	(8)	(7)	(4)	(40)
	SORTIE				(1)		(1)		(1)		(1)		(4)
MISSION MODEL	(TOTAL)	(20)	(7)	(12)	(25)	(33)	(22)	(31)	(29)	(33)	(27)	(33)	(272)
	DEPLOY	20	7	12	24	20	14	16	16	18	16	19	182
	RETRIEVE					13	7	15	12	15	10	14	86
	SORTIE				1		1		1		1		4

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DOD TRAFFIC

TABLE 4.3.4.2-3

FLIGHT SUMMARY

OPTION: (310/310ARE - 3B)

FLIGHT MODE		CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
TOTAL FLIGHTS	SHUTTLE	20	15	17	28	52	45	45	44	38	41	49	394
	TUG												SAME
TUG FLIGHT DISTRIBUTION	DEPLOY	(20)	(15)	(17)	(27)	(21)	(12)	(15)	(21)	(13)	(18)	(18)	(197)
	SINGLE P/L - CORE	9	7	10	11	6	2	4	6	2	7	4	68
	- CORE + RD					8	8	5	7	6	6	9	49
	- CORE + KS					2		3	2				7
	MULTI P/L - CORE	11	8	7	16	4	2	3	6	5	4	5	71
	- CORE + KS					1					1		2
	RETRIEVE					(22)	(13)	(17)	(12)	(10)	(9)	(26)	(103)
	RETRIEVAL DELAY					4	5	2			3	3	17
	PURE RETRIEVE					9		11	8	8	1	7	44
	DELAYED RETRIEVE					9	8	4	4	2	5	10	42
	ROUND TRIP					(9)	(19)	(13)	(10)	(15)	(13)	(11)	(90)
	CORE ONLY					6	14	10	7	11	9	8	65
	CORE + KS					3	5	3	3	4	4	3	25
	SORTIE				(1)		(1)		(1)		(1)		(4)
MISSION MODEL	(TOTAL)	(34)	(23)	(24)	(48)	(64)	(64)	(60)	(63)	(59)	(62)	(62)	(563)
	DEPLOY	34	23	24	47	37	36	32	40	34	42	34	383
	RETRIEVE					27	27	28	22	25	19	28	176
	SORTIE				1		1		1		1		4

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COMBINED NASA/DOD TRAFFIC

TABLE 4.3.4.2-4

4.3.4.2.3 310/310ARE Flight Element Requirements

Tables 4.3.4.2-5 NASA Traffic
-6 DOD Traffic
-7 Combined NASA/DOD Traffic

COMMENTS:

None

FLIGHT ELEMENT REQUIREMENTS OPTION: (310/310 ARE - 3B)

ITEM			CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
SHUTTLE FLIGHTS		TOTAL	9	9	8	13	30	32	25	23	17	24	25	215
BASIC TUG FLIGHTS	ETR	RECOVERED	9	9	6	10	24	26	20	16	13	17	20	170
		EXPENDED			2		2		1	1		3	1	10
	WTF	RECOVERED				3	4	6	4	6	4	4	4	35
	(TOTAL)		(9)	(9)	(8)	(13)	(30)	(32)	(25)	(23)	(17)	(24)	(25)	(215)
RETRIEVAL DELAY MODULES (ALL AT ETR)							8	12	6	3	4	6	6	45
KICK STAGES	KS 301						2		3	2				7
	KS 302											2		2
	KS 303						3	5	3	3	4	4	3	25
	(TOTAL)						(5)	(5)	(6)	(5)	(4)	(6)	(3)	(34)

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NASA TRAFFIC

TABLE 4.3.4.2-5

FLIGHT ELEMENT REQUIREMENTS OPTION: (310/310ARE-3B)

ITEM			CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
SHUTTLE FLIGHTS		TOTAL	11	6	9	15	22	13	20	21	21	17	24	179
BASIC TUG FLIGHTS	ETR	RECOVERED	11	6	9	11	21	11	15	19	19	13	23	158
		EXTENDED												0
	WTR	RECOVERED				4	1	2	5	2	2	4	1	21
	(TOTAL)		(11)	(6)	(9)	(15)	(22)	(13)	(20)	(21)	(21)	(17)	(24)	(179)
RETRIEVAL DELAY MODULES (ALL AT ETR)							4	1	1	4	2	3	6	21
KICK STAGES	KS 301													
	KS 302						2							2
	KS 303													
	(TOTAL)						(2)							(2)

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DOD TRAFFIC

TABLE 4.3.4.2-6

FLIGHT ELEMENT REQUIREMENTS OPTION: (310 / 310ARE - 3B)

ITEM			CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
SHUTTLE FLIGHTS		TOTAL	20	15	17	28	52	45	45	44	38	41	49	394
BASIC TUG FLIGHTS	ETR	RECOVERED	20	15	15	21	45	37	35	35	32	30	43	328
		EXPENDED			2		2		1	1		3	1	10
	WTR	RECOVERED				7	5	8	9	8	6	8	5	56
	(TOTAL)		(20)	(15)	(17)	(28)	(52)	(45)	(45)	(44)	(38)	(41)	(49)	(394)
RETRIEVAL DELAY MODULES (ALL AT ETR)							12	13	7	7	6	9	12	66
KICK STAGES	KS 301						2		3	2				7
	KS 302						2					2		4
	KS 303						3	5	3	3	4	4	3	25
	(TOTAL)						(7)	(5)	(6)	(5)	(4)	(6)	(3)	(36)

RELIABILITY = + 4 FLTS

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COMBINED NASA / DOD TRAFFIC

TABLE 4.3.4.2-7

CONCEPT 310ARE-3B

KICK STAGE DEFINITION

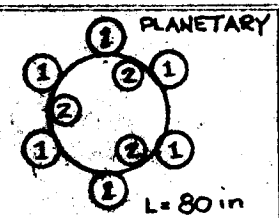
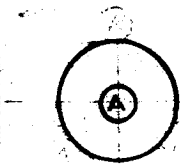
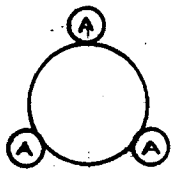
KICK STAGE DESIGNATION	GEOMETRY (all stages >10 ft diam. & are 5.5 ft long unless otherwise noted)		PERFORMANCE (Geosynch Payload) (lbs)	SRM CHARACTERISTICS INDIVIDUAL WEIGHT (lbs)	NUMBER	TOTAL SRM WEIGHT (lbs)	STAGE INERT WEIGHT (lbs)	TOTAL STAGE WEIGHT (lbs)
KS 301		STAGE 1	5000 lbs TO ΔV=18400 fps	1880	6	11280	-	11280
		STAGE 2		1880	3	5640	494	6134
		(TOTAL)						17,414
KS 302		DOUBLE DEPLOY AKS	3515 (each P/L)	1880	1	1880	516	2396
KS 303		DELAYED RETRIEVE SINGLE DEPLOY AKS	P/L = f(RTRV'D P/L)	1483	3	4449	523	4972

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TABLE 4.3.4.2-8

4.3.4.2.4 310/310ARE Initial Flight Schedule

Table 4.3.4.2-9 Costed Traffic Build-Up

COMMENTS:

a. Abbreviations used in the accompanying table

D = Deploy
R = Retrieve
RD = Retrieval Delay
KS = Kick Stage
EXP = Expendable

FLIGHT	PAYLOAD FLOWN					
	1980	1981	1982	1983	1984	1985
1	D-3	D-10	ALL	ALL	D-9	ALL
2	D-11	D-11			D-10	
3	D-35	D1 + D3			D-18	
4		D1 + D8			D-18	
5		D2 + D7			D-20 (KS)	
6		D3 + D3			D-20 (KS)	
7		D-31			D-24 (EXP)	
8		D-31			D-24 (EXP)	
9		D-34			R-1	
10		D-35			R-1	
11		D-35			R-12	
12		D25 + D25			R-13	
13					RD-2	
14					RD-2	
15					RD-2	
16					R-2	
17					R-2	
18					R-2	
19					RD-4	
20					R-4	
21					D1 + RD3	
22					D8 + DR3	
23					D14 + R14	
24					D15 + R15	
25					D28 + D28 (KS)	
26					D32 + D32	
27					D32 + D32	
28					D37 + D37 + D37	
29					D39 + D39 + D39	
30					R-32	
31					R-32	
32					R-32	
33					R-32	
34					R-34	
35					D27 + RD27	
36					DR-27	
37					D25 + R25	
38					D25 + R25	
39					D35 + R35	
FLIGHTS FLOWN/SCHED	3/20	12/15	17/17	28/28	39/52	45/45
DEPLOY P/L'S FLOWN/SCHED	3/34	17/23	24/24	47/47	28/37	36/36
RTRV P/L'S FLOWN/SCHED	0/0	0/0	0/0	0/0	18/27	27/27
SORTIES FLOWN/SCHED	0/0	0/0	0/0	1/1	0/0	1/1

CONCEPT 310/310ARE-3B

COSTED TRAFFIC BUILD-UP

TABLE 4.3.4.2 - 9

4.3.4.2.5 310/310ARE Additional Payload Capture Potential

Table 4.3.4.2-10 Additional Payload Capture Potential

COMMENTS:

a. The Retrieval Delay Mode enables retrieval of very large payloads, up to $\approx$ 7000 pounds, but maximum deployment capability for the flight modes considered is somewhat less than 5000 pounds. The complement of Retrieval Delay, Deployment Delay, which was not considered for this concept since the basic flight modes more than satisfied performance requirements, has an inherent capability of deploying significantly more than 5000 pounds which would enable deployment of missions N6 and N7.

b. Although not considered for this analysis because of the groundrules assumed for sortie missions, variations of the Retrieval Delay Mode offer the potential of capturing mission D29 if the groundrules can be relaxed to allow brief separations of the sortie module from the Tug.

OPTION 3B

ADDITIONAL PAYLOAD CAPTURE POTENTIAL

MISSIONS EXCLUDED FROM OPTION MISSION MODEL					CONCEPT 310/310ARE-3B		
DESIGNATION		DEPLOY	RETRIEVE	SORTIE	TUG MODE		
ID NO.	WEIGHT				DEPLOY	RETRIEVE	SORTIE
N 6	5000	-	3	-	-	3 (RD)	-
N 7	5500	-	10	-	-	10 (RD)	-
N 8	4000	-	7	-	-	7 (RD)	-
N 10	9500	-	2	-	-	2 (RD)	-
N 17	2000	3	-	-	3 (CORE)	-	-
N 18	3300	2	-	-	2 (CORE)	-	-
N 19	7900	3	-	-	3 (KS 301)	-	-
N 20	1500	4	-	-	4 (EXPEND)	-	-
N 22	4000	4	-	-	0	-	-
N 23	6600	2	-	-	2 (EXPEND)	-	-
N 24	4400	4	-	-	4 (EXPEND)	-	-
D 29 (12b)	2400	-	-	5	-	-	0
TOTALS	DEPLOY	22			18		
	RETRIEVE		22			22	
	SORTIE			5			0
	(TOTAL)	49			40		

N = NASA
D = DOD

RD = RETRIEVAL DELAY MODE

TABLE 4.3.4.2-10

4.3.4.2.6 310/310ARE Detailed Traffic Assessment Data

Table 4.3.4.2-11 NASA Traffic Assessment
-12 NASA Geosynch Mixed Missions
-13 NASA Non-Geosynch Mixed Missions
-14 DOD Traffic Assessment

COMMENTS:

None

TRAFFIC ASSESSMENT: NASA GEOSYNCH — OPTION: (310/310ARE-3B)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION — CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
MIXED P/L'S - GEO - (See Pages 7-13)	SINGLE DEPLOY + RD	RDM						2		1		2	2	1	8
	DOUBLE DEPLOY			4	4	3	4				1	1			17
	DEPLOY + DELAYED RTRV	KS303 (RDM)						3	5	2	3	4	4	3	24
	(TOTAL)			(4)	(4)	(3)	(4)	(5)	(5)	(3)	(4)	(7)	(6)	(4)	(49)
1	RETRIEVE							2		1			1		4
	ROUND TRIP								1	1	1	1		2	6
	(TOTAL)							(2)	(1)	(2)	(1)	(1)	(1)	(2)	(10)
2	SINGLE DEPLOY														
	DEPLOY + RD	RDM							1						1
	RETRV DELAY	RDM						3		2				1	6
	DELAYED RTRV	(RDM)						3	1	2				1	7
	(TOTAL)							(6)	(2)	(4)				(2)	(14)
3	SINGLE DEPLOY			1			1				1				3
	DEPLOY + RD	RDM						1	5	3	3	1	2	3	18
	DOUBLE DEPLOY			1	3	1	1				1	1		1	9
	RETRV DELAY	RDM							2				2		4
	DELAYED RTRV	(RDM)							2				2	2	6
	DEPLOY + DELAYED RTRV	KS303 (RDM)								1					1
	(TOTAL)			(2)	(3)	(1)	(2)	(1)	(9)	(4)	(5)	(2)	(6)	(6)	(41)
4	DEPLOY + RD	RDM						1	1			1			3
	DOUBLE DEPLOY										1				1
	RETRV DELAY	RDM						1						1	2
	DELAYED RTRV	(RDM)						2	1	1				1	5
	(TOTAL)							(4)	(2)	(1)	(1)	(1)		(2)	(11)

(RDM) = returned RDM's

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TABLE 4.3.4.2-11

TRAFFIC ASSESSMENT: NASA GEOSYNCH (cont) OPTION: (310/310 ARE - 3B)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
5	SINGLE DEPLOY						1								1
	DOUBLE DEPLOY	2 × KS 302											1		1
	RETRV DELAY	RDM							3						3
	DELAYED RTRV	(RDM)							3						3
	(TOTAL)						(1)		(6)				(1)		(8)
7	SINGLE DEPLOY					1	1				1				3
	(TOTAL)					(1)	(1)				(1)				(3)
8	SINGLE DEPLOY						1								1
	(TOTAL)						(1)								(1)
NASA GEOSYNCH TRAFFIC SUMMARY (Missions 1 - 8)	SINGLE DEPLOY			1		1	4				2				8
	DEPLOY + RD	RDM						4	7	4	3	4	4	4	30
	DOUBLE DEPLOY			5	7	4	5				3	2		1	27
	DOUBLE DEPLOY + KS	2 × KS 302											1		1
	RTRVL DELAY	RDM						4	5	2			2	2	15
	RETRIEVE							2		1			1		4
	DELAYED RTRV	(RDM)						5	7	3			2	4	21
	ROUND TRIP								1	1	1	1		2	6
	DEPLOY + DELAYED RTRV	Ⓐ KS 303 Ⓑ (RDM)						3	5	3	3	4	4	3	25
	(TOTAL)			(6)	(7)	(5)	(9)	(18)	(25)	(14)	(12)	(11)	(14)	(16)	(137)

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TABLE 4.3.4.2-11 (cont)

TRAFFIC ASSESSMENT: NASA NON-GEOSYNCH — OPTION: (310/310ARE-3B)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION — CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
MIXED P/L'S NON-GEO (see pages 14-15)	TRIPLE DEPLOY	WTR LAUNCH					2						2		4
	DOUBLE DEPLOY ROUND TRIP	WTR LAUNCH							2		2		2		6
	(TOTAL)						(2)		(2)		(2)		(4)		(10)
9	SINGLE DEPLOY			1		1		1		2		1		2	8
	(TOTAL)			(1)		(1)		(1)		(2)		(1)		(2)	(8)
10	SINGLE DEPLOY				1			1			1			1	4
	(TOTAL)				(1)			(1)			(1)			(1)	(4)
11	SINGLE DEPLOY			1	1		1				1		1		5
	RETRIEVE									1		1		1	3
	ROUND TRIP								1						1
	(TOTAL)			(1)	(1)		(1)		(1)	(1)	(1)	(1)	(1)	(1)	(9)
12	RETRIEVE	WTR LAUNCH						1		1		1		1	4
	(TOTAL)							(1)		(1)		(1)		(1)	(4)
13	RETRIEVE	WTR LAUNCH						1		1		1		1	4
	(TOTAL)							(1)		(1)		(1)		(1)	(4)
14	ROUND TRIP	WTR LAUNCH						1		1		1		1	4
	(TOTAL)							(1)		(1)		(1)		(1)	(4)
15	ROUND TRIP	WTR LAUNCH						1		1		1		1	4
	(TOTAL)							(1)		(1)		(1)		(1)	(4)
16	DOUBLE DEPLOY	WTR LAUNCH					1								1
	RETRIEVE	WTR LAUNCH									4				4
	ROUND TRIP	WTR LAUNCH							4						4
	(TOTAL)						(1)		(4)		(4)				(9)

TABLE 4.3.4.2-11 (cont)

TRAFFIC ASSESSMENT: NASA NON-GEOSYNCH (cont) OPTION: (310/310ARE-3B)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
NASA NON-GEO TRAFFIC SUMMARY (Missions 9-16)	SINGLE DEPLOY			2	2	1	1	2		2	2	1	1	3	17
	DOUBLE DEPLOY						1								1
	TRIPLE DEPLOY						2						2		4
	RETRIEVE							2		3	4	3	-	3	15
	ROUND TRIP							2	5	2		2		2	13
	DOUBLE DEPLOY ROUND TRIP								2		2		2		6
	(TOTAL)			(2)	(2)	(1)	(4)	(6)	(7)	(7)	(8)	(6)	(5)	(8)	(56)

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TABLE 4.3.4.2-11 (cont)

TRAFFIC ASSESSMENT: NASA PLANETARY

OPTION: (310/310ARE - 3B)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
17	SINGLE DEPLOY			1									2		3
	(TOTAL)			(1)									(2)		(3)
18	SINGLE DEPLOY							2							2
	(TOTAL)							(2)							(2)
19	SINGLE DEPLOY	KS 301								1	2				3
	(TOTAL)									(1)	(2)				(3)
20	SINGLE DEPLOY	Ⓐ EXPEND TUG				2 Ⓐ		2 Ⓑ							4
	(TOTAL)	Ⓑ KS 301				(2)		(2)							(4)
22	SINGLE DEPLOY	EXPEND TUG								1	1		1	1	4
	(TOTAL)									(1)	(1)		(1)	(1)	(4)
23	SINGLE DEPLOY	KS 301								2					2
	(TOTAL)									(2)					(2)
24	SINGLE DEPLOY	EXPEND TUG						2					2		4
	(TOTAL)							(2)					(2)		(4)
NASA PLANETARY TRAFFIC SUMMARY (Missions 17 - 24)	SINGLE DEPLOY	CORE ALONE		1				2					2		5
		+ KS 301						2		3	2				7
		EXPEND TUG				2		2		1	1		3	1	10
	(TOTAL)			(1)		(2)		(6)		(4)	(3)		(5)	(1)	(22)

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TABLE 4.3.4.2-11 (cont)

TRAFFIC ASSESSMENT: DETAILED NASA TRAFFIC SUMMARY OPTION: (310/310AR 3B)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
	SINGLE DEPLOY	CORE ALONE		4	2	2	5	4		2	4	1	3	3	30
	DEPLOY + RD	RDM						4	7	4	3	4	4	4	30
	DEPLOY + KS	KS 301						2		3	2				7
	SINGLE DEPLOY	EXPEND TUG				2		2		1	1		3	1	10
	DOUBLE DEPLOY	CORE ALONE		5	7	4	6				3	2		1	28
		2 × KS 302											1		1
	TRIPLE DEPLOY	CORE ALONE					2						2		4
	RTRVL DELAY	RDM						4	5	2			2	2	15
	RETRIEVE							4		4	4	3	1	3	19
	DELAYED RTRV	(RDM)						5	7	3			2	4	21
	ROUND TRIP							2	6	3	1	3		4	19
	DEPLOY + DELAYED RTRV	KS 303 (RDM)						3	5	3	3	4	4	3	25
	DOUBLE DEPLOY ROUND TRIP								2		2		2		6
	(TOTAL)			(9)	(9)	(8)	(13)	(30)	(32)	(25)	(23)	(17)	(24)	(25)	(215)

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TABLE 4.3.4.2-11 (cont)

MIXED MISSIONS: NASA GEOSYNCH OPTION: 3B (310 /310ARE-3B)

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
80	◇	②′	①	③	①′	-	①′	①′	②′			
	1	D							D	-	4400	35 × 14
	2	D							D	-		
	3		D					D		-	4700	28 × 10
	4				D		D			-	4400	22 × 14
	⑤			2D						-	4200	24 × 8
	⑥			D						-	2100	12 × 8
81	◇	②	②′	⑦	①′	-	-	①′	①′			
	1	D							D	-	4400	35 × 14
	2		D					D		-	4700	28 × 10
	3		D		D					-	3500	18 × 14
	④			2D						-	4200	24 × 8
	⑤			2D						-		
	⑥			2D						-		
	7	D		D						-	3000	22 × 8 10 × 14
82	◇	②′	-	③′	-	-	①′	②′	①′			
	1	D							D	-	4400	35 × 14
	2	D						D		-	3900	30 × 10
	③							D		-	3000	20 × 10
	4			D			D			-	4700	24 × 8
	⑤			2D						-	4200	24 × 8
83	◇	①′	①′	③	②′	③′	-	②′	②′			
	1	D							D	-	4400	35 × 14
	②								D	-	3500	25 × 14
	3		D					D		-	4700	28 × 10
	④							D		-	3000	20 × 10
	5				D	D				-	4600	22 × 14
	6				D	D				-		
	⑦					D				-	2800	12 × 14
	⑧			2D						-	4200	24 × 8
	⑨			D						-	2100	12 × 8

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TABLE 4.3.4.2-12

MIXED MISSIONS: NASA GEOSYNCH (cont) OPTION: (310/310ARE-3B)

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
84	◇D	②✓	–	①✓	①✓	–	–	①✓	②✓			
	◇R	②	③✓	③✓	②✓	–	–	–	–			
	①			D RD						– RDM	2100	12 x 8
	2			R					D	KS 303 (RDM)	3500 2100	25 x 14 12 x 8
	3	D		RD						– RDM	900	10 x 6
	4			R					D	KS 303 (RDM)	3500 2100	25 x 14 12 x 8
	5	D		RD						– RDM	900	10 x 6
	6			R				D		KS 303 (RDM)	3000 2100	20 x 10 12 x 8
	⑦				D RD					– RDM	1800	10 x 14
	⑧				R					(RDM)		
	⑨				RD					RDM		
	⑩				R					(RDM)		
	⑪		RD							RDM	1700	8 x 8
	⑫		R							(RDM)		
	⑬		RD							RDM		
	⑭		R							(RDM)		
	⑮		RD							RDM		
	⑯		R							(RDM)		
	⑰	R								–	900	10 x 6
	⑱	R								–		
85	◇D	①✓	①✓	⑤✓	①✓	–	①✓	②✓	②✓			
	◇R	①✓	①✓	⑦✓	①✓	③✓	–	–	–			
	①			D RD						– RDM	2100	12 x 8
	2			R					D	KS 303 (RDM)	3500 2100	25 x 14 12 x 8
	③			D RD						– RDM	2100	12 x 8

(RDM) = Recovered RDM

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TABLE 4.3.4.2-12 (cont)

MIXED MISSIONS: NASA GEOSYNCH (cont) OPTION: (310 / 310ARE-3B)

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
85 (cont)	4			R					D	KS 303 (RDM)	3500 2100	35 x 14 12 x 8
	5			D RD						RDM	2100	12 x 8
	6			R				D		KS 303 (RDM)	3000 2100	20 x 10 12 x 8
	7			D RD						– RDM	2100	12 x 8
	8			R				D		KS 303 (RDM)	3000 2100	20 x 10 12 x 8
	9			D RD						– RDM	2100	12 x 8
	10			R			D			KS 303 (RDM)	2600 2100	12 x 8 12 x 8
	11			RD						RDM	2100	12 x 8
	12			R						(RDM)		
	13			RD						RDM		
	14			R						(RDM)		
	15				D RD					– RDM	1800	10 x 14
	16				R					(RDM)		
	17		D RD							– RDM	1700	8 x 8
	18		R							(RDM)		
	19					RD				RDM	2800	12 x 14
	20					R				(RDM)		
	21					RD				RDM		
	22					R				(RDM)		
	23					RD				RDM		
	24					R				(RDM)		
	25	D/R								–	900	10 x 6

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TABLE 4.3.4.2-12 (cont)

MIXED MISSIONS: NASA GEOSYNCH (cont) OPTION: (310/310ARE-3B)

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
86	◇	①✓	–	⑤✓	–	–	–	–	②✓			
	◇R	②✓	②✓	③✓	①✓	–	–	–	–			
	①			D RD						– RDM	2100	12 × 8
	2			R					D	KS 303 (RDM)	3500 2100	25 × 14 12 × 8
	③			D RD						– RDM	2100	12 × 8
	4			R					D	KS 303 (RDM)	3500 2100	15 × 14 12 × 8
	⑤			D RD						– RDM	2100	12 × 8
	⑥			D R						KS 303 (RDM)		
	7			D	RD					– RDM	2100	12 × 8
	⑧				R					(RDM)	1800	10 × 14
	⑨		RD							RDM	1700	8 × 8
	⑩		R							(RDM)		
	⑪		RD							RDM		
	⑫		R							(RDM)		
	⑬	D/R								–	900	10 × 6
	⑭	R										
87	◇	①✓	①✓	⑥✓	②✓	–	①✓	②✓	②✓			
	◇R	①✓	–	③✓	–	–	–	–	–			
	①			D RD						– RDM	2100	12 × 8
	2			R					D	KS303 (RDM)	3500 2100	25 × 14 12 × 8
	③			D RD						– RDM	2100	12 × 8
	4			R					D	KS 303 (RDM	3500 2100	25 × 14 12 × 8
	⑤			D RD						– RDM	2100	12 × 8

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TABLE 4.3.4.2-12 (cont)

MIXED MISSIONS: NASA GEOSYNCH (cont) OPTION: (310/310ARE-3B)

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
87 (cont)	6			R				D		KS 303 (RDM)	3000 2100	20×10 12×8
	7							D		–	3000	20×10
	8		D				D			–	4300	20×8
	9				2D					–	3600	20×14
	10			2D						–	4200	24×8
	11			D						–	2100	12×8
	12	D/R								–	900	10×6
88	D	2	–	7✓	1✓	–	–	1✓	2✓			
	R	1	1✓	1✓	2✓	–	–	–	–			
	1			D RD						– RDM	2100	12×8
	2			R					D	KS 303 (RDM)	3500 2100	25×14 12×8
	3				D RD					– RDM	1800	10×14
	4				R				D	KS 303 (RDM)	3500 1800	25×14 10×14
	5			D	RD					– RDM	2100	12×8
	6				R			D		KS 303 (RDM)	3000 1800	20×10 10×14
	7		RD	D						– RDM	2100	12×8
	8		R	D						KS 303 (RDM)	2100 1700	12×8 8×8
	9	D		D						–	3000	{22×8 12×14}
	10			2D						–	4200	24×8
	11	D/R								–	900	10×6
89	D	1✓	1✓	2✓	–	3✓	–	1✓	2✓			
	R	1	–	5✓	1✓	–	–	–	–			
	1			D RD						– RDM	2100	12×8
	2			R					D	KS 303 (RDM)	3500 2100	25×14 12×8

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TABLE 4.3.4.2-12 (cont)

MIXED MISSIONS: NASA GEOSYNCH (cont) OPTION: (310/310 ARE-3B)

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
89 (cont)	③			D RD						– RDM	2100	12×8
	4			R					D	KS 303 (RDM)	3500 2100	25×14 12×8
	5		D	RD						– RDM	1700	8×8
	6			R				D		KS 303 (RDM)	3000 2100	20×10 12×8
	7	D			RD					– RDM	900	10×6
	8				R	D				KS 303 (RDM)	2800 1800	12×14 10×14
	⑨					2D				2×KS 302	2@2800	24×14
	⑩			RD						RDM		
	⑪			R						(RDM)	2100	12×8
	⑫			RD						RDM		
	⑬			R						(RDM)	2100	12×8
	⑭	R								–	900	10×6
90	◇	②	–	③'''	–	–	②''	–	②''			
	◇	②	①'	⑤'''	①'	–	–	–	–			
	①			D RD						– RDM	2100	12×8
	2			R					D	KS 303 (RDM)	3500 2100	25×14 12×8
	③			D RD						– RDM	2100	12×8
	4			R					D	KS 303 (RDM)	3500 2100	25×14 12×8
	⑤			D RD						– RDM	2100	12×8
	6			R			D			KS 303 (RDM)	2600 2100	12×8 12×8
	7			RD			D			– RDM	2600	12×8
	⑧			R						(RDM)	2100	12×8
	⑨			RD						RDM		

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TABLE 4.3.4.2-12 (cont)

MIXED MISSIONS: NASA GEOSYNCH (cont) OPTION: (310/310ARE-3B)

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
90 (cont)	10			R						(RDM)	2100	12×8
	11				RD					RDM		
	12				R					(RDM)	1800	10×14
	13		RD							RDM		
	14		R							(RDM)	1700	8×8
	15	D/R								—	900	10×6
	16	D/R								—		

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TABLE 4.3.4.2-12 (cont)

MIXED MISSIONS: NASA NON-GEOSYNCH OPTION: (310/310ARE - 3B)

YEAR	FLT NO	PAYLOAD								AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
		~~11~~	12	13	14	15	16	~~17~~	~~18~~			
83	◇D		①	①	①	①	④					
	1					D	2D			–	11000	30 × 13
	②						2D			–	9000	22 × 13
	3		D	D	D					–	3800	23 × 8 16 × 15 15 × 13
84	◇D		–	–	①	①	–					
	◇R		①	①	①	①	–					
	①					D/R				–	2000	8 × 11
	②				D/R					–	800	10 × 5
	③			R						–	1000	7 × 7
	④		R							–	2000	8 × 6
85	◇D		①	①	①	①	④					
	◇R		–	–	①	①	④					
	①						D/R			–	4500	11 × 13
	②						D/R			–		
	③						D/R			–		
	④						D/R			–		
	5			D		D				–	3000	15 × 11
						R					2000	8 × 11
	6		D		D					–	2800	18 × 16 10 × 11
					R						800	10 × 5
86	◇D		–	–	①	①	–					
	◇R		①	①	①	①	–					
	①					D/R				–	2000	8 × 11
	②				D/R					–	800	10 × 5
	③			R						–	1000	7 × 7
	④		R							–	2000	8 × 6
87	◇D		①	①	①	①	–					
	◇R		–	–	①	①	④					
	①						R			–	4500	11 × 13
	②						R			–		
	③						R			–		
	④						R			–		
	5			D		D				–	3000	15 × 11
						R					2000	8 × 11
	6		D		D						2800	18 × 16 10 × 11
					R						800	10 × 5

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TABLE 4.3.4.2-13

MIXED MISSIONS: NASA NON-GEOSYNCH (cont) OPTION: (310/310ARE-3B)

YEAR	FLT NO	PAYLOAD								AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
		~~11~~	12	13	14	15	16	~~17~~	~~18~~			
88	D		–	–	1	1	–					
	R		1	1	1	1	–					
	1					D/R				–	2000	8×11
	2				D/R					–	800	10×5
	3			R						–	1000	7×7
	4		R							–	2000	8×6
89	D		1	1	1	1	6					
	R		–	–	1	1	–					
	1					D R	D			–	6500 2000	19×13 8×11
	2				D R		D			–	5300 800	21×13 10×5
	3			D			2D			–	10000	29×13
	4		D				2D			–	11000	30×13
90	D		–	–	1	1	–					
	R		1	1	1	1	–					
	1					D/R				–	2000	8×11
	2				D/R					–	800	10×5
	3			R						–	1000	7×7
	4		R							–	2000	8×6

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TABLE 4.3.4.2-13 (cont)

TRAFFIC ASSESSMENT: DOD GEOSYNCH — OPTION: (310/310ARE-3B)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION — CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
25	DOUBLE DEPLOY			1	1	1	1								4
	ROUND TRIP							2	2	2	2	2	2	2	14
	(TOTAL)			(1)	(1)	(1)	(1)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(18)
26	SINGLE DEPLOY			1		1	1								3
	DEPLOY + RD	RDM						1		1	1	1		1	5
	DELAYED RTRV	(RDM)						1		1	1	1		1	5
	(TOTAL)			(1)		(1)	(1)	(2)		(2)	(2)	(2)		(2)	(13)
27	SINGLE DEPLOY			1		1	1								3
	DEPLOY + RD	RDM						1	1		1	1	1	1	6
	DELAYED RTRV	(RDM)						1	1		1	1	1	1	6
	(TOTAL)			(1)		(1)	(1)	(2)	(2)		(2)	(2)	(2)	(2)	(15)
28	SINGLE DEPLOY									1		1			2
	DEPLOY + RD	RDM											1	1	2
	DOUBLE DEPLOY	CORE ONLY					1								1
		CORE + 2×KS302						1							1
	RETRV DELAY	RDM											1	1	2
	DELAYED RTRV	(RDM)											2	2	4
	(TOTAL)						(1)	(1)		(1)		(1)	(4)	(4)	(12)
30	SINGLE DEPLOY								2		1		1		4
	(TOTAL)								(2)		(1)		(1)		(4)
31	SINGLE DEPLOY				2										2
	DEPLOY + RD	RDM						2			2			2	6
	DELAYED RTRV	(RDM)						2			2			2	6
	(TOTAL)				(2)			(4)			(4)			(4)	(14)

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TABLE 4.3.4.2-14

TRAFFIC ASSESSMENT: DOD GEOSYNCH (cont) OPTION: (310 / 310ARE - 3B)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
DOD GEO TRAFFIC SUMMARY (MISSIONS 25 - 31)	SINGLE DEPLOY			2	2	2	2		2	1	1	1	1		14
	DEPLOY + RD	RDM						4	1	1	4	2	2	5	19
	DOUBLE DEPLOY	CORE ALONE		1	1	1	2								5
		CORE + 2× KS 302						1							1
	RETRV DELAY	RDM											1	1	2
	DELAYED RTRV	(RDM)						4	1	1	4	2	3	6	21
	ROUND TRIP							2	2	2	2	2	2	2	14
	(TOTAL)			(3)	(3)	(3)	(4)	(11)	(6)	(5)	(11)	(7)	(9)	(14)	(76)

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TABLE 4.3.4.2-14 (cont)

TRAFFIC ASSESSMENT: DOD NON-GEOSYNCH — OPTION: (310/310 ARE - 3B)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION — CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
32	DOUBLE DEPLOY			2		2	2	2		2	2	2		2	16
	RETRIEVE							4		4	4	4		4	20
	(TOTAL)			(2)		(2)	(2)	(6)		(6)	(6)	(6)		(6)	(36)
33	SINGLE DEPLOY			1		2	1								4
	ROUND TRIP								2	1		2	1		6
	(TOTAL)			(1)		(2)	(1)		(2)	(1)		(2)	(1)		(10)
34	SINGLE DEPLOY				1		1								2
	RETRIEVE							1		1		1			3
	(TOTAL)				(1)		(1)	(1)		(1)		(1)			(5)
35	SINGLE DEPLOY			1	2	2	2								8
	ROUND TRIP							2	2	2	2	2	2	2	14
	(TOTAL)			(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(22)
36	TRIPLE DEPLOY			1			1					1			3
	(TOTAL)			(1)			(1)					(1)			(3)
37	TRIPLE DEPLOY			1				1					1		3
	(TOTAL)			(1)				(1)					(1)		(3)
38	TRIPLE DEPLOY			1					1					1	3
	(TOTAL)			(1)					(1)					(1)	(3)
39	TRIPLE DEPLOY	WTR LAUNCH					1	1		1	1		1	1	6
	(TOTAL)						(1)	(1)		(1)	(1)		(1)	(1)	(6)
40	DOUBLE DEPLOY	WTR LAUNCH					2		1						3
	RETRIEVE									2					2
	ROUND TRIP									2		2	2		6
	(TOTAL)						(2)		(1)	(4)		(2)	(2)		(11)

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TABLE 4.3.4.2-14 (cont)

TRAFFIC ASSESSMENT: DOD NON-GEOSYNCH (cont) DIVISION: (310/310ARE-3B)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
41	SORTIE	WTR LAUNCH		1			1		1		1		1		4
	(TOTAL)						(1)		(1)		(1)		(1)		(4)
DOD NON-GEO TRAFFIC SUMMARY (Missions 32-41)	SINGLE DEPLOY			3	3	4	4								14
	DOUBLE DEPLOY			2		2	4	2	1	2	2	2		2	19
	TRIPLE DEPLOY			3			2	2	1	1	1	1	2	2	15
	RETRIEVE							5		7	4	5		4	25
	ROUND TRIP							2	4	5	2	6	5	2	26
	SORTIE						1		1		1		1		4
	(TOTAL)			(8)	(3)	(6)	(11)	(11)	(7)	(15)	(10)	(14)	(8)	(10)	(103)
DOD TOTAL TRAFFIC SUMMARY (Missions 25-41)	SINGLE DEPLOY			5	5	6	6		2	1	1	1	1		28
	DEPLOY + RD	RDM						4	1	1	4	2	2	5	19
	DOUBLE DEPLOY			3	1	3	6	2	1	2	2	2		2	24
	DOUBLE DEPLOY + KS	2 × KS 302						1							1
	TRIPLE DEPLOY			3			2	2	1	1	1	1	2	2	15
	RTRV DELAY	RDM											1	1	2
	RETRIEVE							5		7	4	5		4	25
	DELAYED RTRV	(RDM)						4	1	1	4	2	3	6	21
	ROUND TRIP							4	6	7	4	8	7	4	40
	SORTIE						1		1		1		1		4
	(TOTAL)			(11)	(6)	(9)	(15)	(22)	(13)	(20)	(21)	(21)	(17)	(24)	(179)

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TABLE 4.3.4.2-14 (cont)

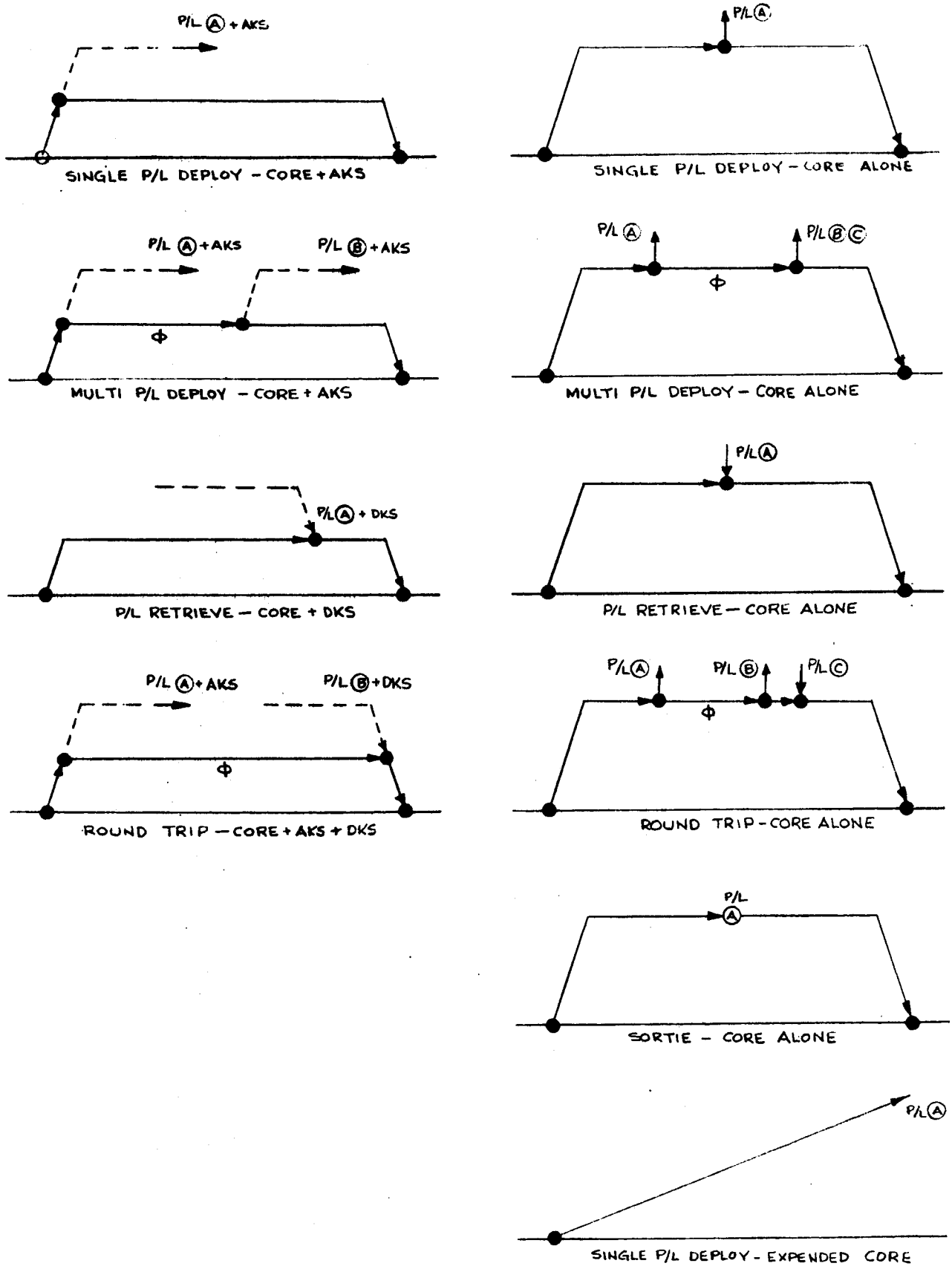
4.3.4.3 Concept 510A/510ADE-3B

4.3.4.3.1 510A/510ADE Performance

- o Flight Modes
  - Figure 4.3.4.3-1
- o Geosynchronous Performance
  - 510A
  - 510ADE
  - Figures 4.3.4.3-2 thru -4
- o Geosynchronous Performance Sensitivities
  - Table 4.3.4.3-1
- o General Performance
  - Figures 4.3.4.3-5 thru -14

Comments:

a. For multi-deploy flights, the Tug will provide a 60° phasing between the first and second deployments. No additional phasing will be provided for a third deployment or a subsequent retrieval.



CONCEPT 510A/510ADE-3B

FLIGHT MODES

FIGURE 4.3.4.4-1

CONCEPT 510A-3B

GEOSYNCH PERFORMANCE

REFERENCES:

a. 510A-1 Concept Definition, Issue 2, dated 29 Aug 1973

b. B81M047-73054, "Tug Requirements, Revision 2," dated 15 Aug 1973

GENERAL INFORMATION:

W_{FIXED} = 3329 lbs

W_{ADAPT} = 1510 lbs

$\omega_i = P/L_o - W_{ADAPT} = 65000 - 1510$

ω_i = 63490 lbs

$\omega_{BOI} = W_{FIXED} + \chi(\text{Consumables})$

$= 3329 + \chi C$

ISP = 327.2 sec

ISPE = 0.983 ISP = 321.638

Δv = 14018 fps

ΔV_D = 13891 fps

$\chi_{Deploy} = 0.17$

$\chi_{Retrieve} = 0.28$

$\chi_{Round\ Trip} = 0.27$

Tug Length = L_T = 300 in

Kick Stage Length = L_K = 66 in (for KS 501, L_K = 80 in)

Orbiter P/L Bay Length = L_o = 720 in

Available P/L Length = $L_P = L_o - (L_T + n L_K)$

$L_{P(w/o\ K.S.)}$	= 720 - 300 = 420 in	=	35.0 ft
$L_{P(with\ KS\ 501)}$	= 720 - (300 + 80) = 340 in	=	28.3 ft
$L_{P(with\ 1\ K.S.)}$	= 720 - (300 + 66) = 354 in	=	29.5 ft
$L_{P(with\ 2\ K.S.)}$	= 720 - (300 + 132) = 288 in	=	24.0 ft

CONCEPT 510A-3B (cont)

NASA MISSIONS:

WITHOUT KICK STAGES

Single Payload

$\omega_{BO\,(Deploy)} = \omega_{BOI} = 3329 + 0.17(354) = \underline{3389.18}$ lbs

$\omega_{P/L} = f(\omega_i, \omega_{BO}, ISPE, \Delta V_U, \Delta V_D) =$ **3410 lbs** See Fig 4.3.4.3-5

Multi Payloads

$\omega_{BO\,(n\,P/L)} = \omega_{BOI} = 3329 + 0.17(534) = \underline{3419.78}$ lbs

$\omega_{P/L\,(n\,P/L)} = f(\omega_i, \omega_{BO}, ISPE, \Delta V_U, \Delta V_\phi, \Delta V_D) =$ **Fig 4.3.4.3-2** Multi P/L's

$\Delta V_\phi = f(\phi = 60°) = 292$ fps

WITH KICK STAGES

KS 501 Planetary P/L Deploy

$\omega_{BO} = \omega_{BOI} = 3329 + 0.17(269) = \underline{3375}$ lbs

$\omega_{P/L\,(Planetary)} =$ **Fig 4.3.4.3-9**

KS 502 Double P/L Deploy - No Retrieval Later

$\omega_{BO} = \omega_{BOI} = 3329 + 0.17(342) = \underline{3387}$ lbs

$\omega_{P/L\,(2\,P/L\,Deploy)} =$ **3815 lbs/PL** See Fig 4.3.4.3-10

CONCEPT 510A-3B (cont)

KS 503 Single P/L Deploy - Later Retrieval

$\omega_{BO} = \omega_{BOI} = 3329 + 0.17(269) = \underline{3375}$ lbs

$\omega_{P/L} =$ **3825 lbs** See Fig 4.3.4.3-11

KS 504 Double P/L Deploy - Later Retrieval

$\omega_{BO} = \omega_{BOI} = 3329 + 0.17(342) = \underline{3387}$ lbs

$\omega_{P/L} =$ **2400 lbs/PL** See Fig 4.3.4.3-12

KS 505 Single P/L Round Trip

$\omega_{BO} = \omega_{BOI} = 3329 + 0.17(269) = \underline{3375}$ lbs

$\omega_{P/L} =$ **2385 lbs each way** See Fig 4.3.4.3-13

KS 505A Single P/L Deploy on Round Trip Mission

$\omega_{BO} = \omega_{BOI} = 3329 + 0.17(269) = \underline{3375}$ lbs

$\omega_{P/L} =$ **6090 lbs** See Fig 4.3.4.3-14

CONCEPT 510A-3B (cont)

DOD MISSIONS

WITHOUT KICK STAGES

Single Payload

$$W_{BO(Deploy)} = W_{BO(NASA)} + \Delta W_{COMM}$$

$$= 3329.18 + 13.2$$

$$W_{BO(Deploy)} = \underline{3402.38} \text{ lbs}$$

$$W_{P/L} = f(W_i, W_{BO}, I_{SPE}, \Delta V_U, \Delta V_D) = \boxed{3359 \text{ lbs}}$$ See Fig. 4.3.4.3-5

Multi Payloads

$$W_{BO(n\ P/L)} = W_{BO(n\ P/L)(NASA)} + \Delta W_{COMM}$$

$$= 3419.78 + 13.2$$

$$W_{BO(n\ P/L)} = \underline{3432.98} \text{ lbs}$$

$$W_{P/L} = f(W_i, W_{BO}, I_{SPE}, \Delta V_U, \Delta V_\phi, \Delta V_D) = \boxed{\text{Fig. 4.3.4.3-2}}$$

WITH KICK STAGES

Use NASA K.S. Performance

See Fig's 4.3.4.3-10 thru -14

CONCEPT 510ADE-3B

GEOSYNCH PERFORMANCE

REFERENCES:

a. 510ADE-1 Concept Definition, Issue 2, dated 29 Aug 1973

b. 510ADE-1 Kick Stage Characteristics, Issue 2, dated 29 Aug 1973

c. B81M047-73054, "Tug Requirements, Revision 2," dated 15 Aug 1973

GENERAL INFORMATION:

W_{FIXED} = 3534 lbs

W_{ADAPT} = 1510 lbs

W_{RTRV} = 107 lbs

ISP = 327.2 sec

$ISPE = 0.983\ ISP$ =

ΔV_U = 14018 fps (core only)

$\Delta V_{DO(RTRV)}$ = 30 fps (core only)

$\Delta V_{DO(RT)}$ = 130 fps (core only)

ΔV_D = 13891 fps (core only)

$W_i = P/L_o - W_{ADAPT} = 65000 - 1510 = 63490$ lbs

$W_{BOI} = W_{FIXED} + \chi(\text{Consumables})$

$= 3534 + \chi C$

$\chi_{Deploy} = 0.17$

$\chi_{Retrv} = 0.28$

$\chi_{Round\ Trip} = 0.27$

Tug Length = L_T = 300 in

Kick Stage Length = L_K = 66 in (only KS 501 L_K = 80 in)

Orbiter P/L Bay Length = L_o = 720 in

Available P/L Length = $L_P = L_o - (L_T + nL_K)$

$L_{P\ (w/o\ KS)}$	= 720 − 300	= 420 in	=	35 ft
$L_{P\ (with\ KS\ 501)}$	= 720 − (300 + 80)	= 340 in	=	28.3 ft
$L_{P\ (with\ 1\ KS)}$	= 720 − (300 + 66)	= 354 in	=	29.5 ft
$L_{P\ (with\ 2\ KS)}$	= 720 − (300 + 132)	= 288 in	=	24.0 ft

KS Diameter ≈ 10-12 ft

CONCEPT 510ADE-3B (cont)

NASA MISSIONS

WITHOUT KICK STAGES

Single Payload

$\omega_{BO(Deploy)} = \omega_{BOI} - \omega_{RTRV} = 3534 + 0.17(354) - 107 = \underline{3487.18}$ lbs

$\omega_{BO(Retrieve)} = \omega_{BOI} = 3534 + 0.28\,(496) = \underline{3672.88}$ lbs

$\omega_{BO\ (Round\ Trip)} = \omega_{BOI} = 3534 + 0.27\,(616) = \underline{3700.32}$ lbs

			See
$\omega_{P/L\ (Deploy)} = f(\omega_i, \omega_{BO}, ISPE, \Delta V_U, \Delta V_D)$	=	3035 lbs	Fig 4.3.4.3-6
$\omega_{P/L\ (Retrieve)} = f(\omega_i, \omega_{BO}, ISPE, \Delta V_U, \Delta V_{OO}, \Delta V_D)$	=	805 lbs	Fig 4.3.4.3-7
$\omega_{P/L\ (Round\ Trip)} = f\ (\quad " \quad)$	=	528 lbs	Fig 4.3.4.3-8

Multi Payloads

Deploy

$\omega_{BO(n\ P/L\ Deploy)} = \omega_{BOI} - \omega_{RTRV} = 3534 + 0.17(534) - 107 = \underline{3517.78}$ lbs

$\omega_{P/L(n\ P/L\ Deploy)} = f(\omega_i, \omega_{BO}, ISPE, \Delta V_U, \Delta V_\phi, \Delta V_D) =$ Fig. 4.3.4.3-3 Multi-P/L Deploy

$\Delta V_\phi = f(\phi = 60°) = 292$ fps

Round Trip (Multi-P/L Deploy)

$\omega_{BO} = 3534 + 0.27\,(616) = \underline{3700.32}$ lbs

$\omega_{P/L(2\ P/L\ Depl,\ 1\ P/L\ RT)} = f(\omega_i, \omega_{BO}, ISPE, \Delta V_U, \Delta V_\phi, \Delta V_D) =$ Fig 4.3.4.3-4 Multi-P/L Deploy + Single P/L Retrieve

WITH KICK STAGES

KS 501 Planetary P/L Deploy

$\omega_{BO} = \omega_{BOI} - \omega_{RTRV} = 3534 + 0.17(269) - 107 = \underline{3473}$ lbs

$\omega_{P/L} =$ Fig 3.4.3.4-9

CONCEPT 510ADE-3B (cont)

KS 502 Double P/L Deploy - No Retrieval

$w_{BO} = w_{BOI} - w_{RTRV} = 3534 + 0.17(342) - 107 = \underline{3485}$ lbs

$w_{P/L} =$ **3815 lbs/PL** See Fig 4.3.4.3-10

KS 503 Single P/L Deploy - Later Retrieval

$w_{BO} = w_{BOI} - w_{RTRV} = 3534 + 0.17(269) - 107 = \underline{3473}$ lbs (Deploy)

$w_{BO} = w_{BOI} = 3534 + 0.28(660) = \underline{3719}$ lbs (Retrieve)

$w_{P/L} =$ **3825 lbs** See Fig 4.3.4.3-11

KS 504 Double P/L Deploy - Later Individual Retrieval

$w_{BO} = w_{BOI} - w_{RTRV} = 3534 + 0.17(342) - 107 = \underline{3485}$ lbs (Deploy)

$w_{BO} = w_{BOI} = 3534 + 0.28(660) = \underline{3719}$ lbs (Retrieve)

$w_{P/L} =$ **2400 lbs/PL** See Fig 4.3.4.3-12

KS 505 Single P/L Round Trip

$w_{BO} = w_{BOI} = 3534 + 0.27(529) = \underline{3684}$ lbs

$w_{P/L} =$ **2385 lbs** See Fig 4.3.4.3-13

CONCEPT 510ADE-3B (cont)

KS 505A Single P/L Deploy (No Later Retrieval) on Round Trip Mission

$$\omega_{BO} = \omega_{BOI} = 3534 + 0.27(529) = \underline{3684} \text{ lbs}$$

$$\omega_{P/L} = \boxed{6090 \text{ lbs}}$$ See Fig 4.3.4.3-14

CONCEPT 510ADE-3B (cont)

DOD MISSIONS

$W_{BO} = W_{BO(NASA)} + \Delta W_{comm} = W_{BO(NASA)} + 33$ lbs

WITHOUT KICK STAGES

Single Payload

$W_{BO\,(Deploy)} = 3487.18 + 33 = \underline{3520.18}$ lbs

$W_{BO\,(Retrieve)} = 3672.88 + 33 = \underline{3705.88}$ lbs

$W_{BO\,(Round\ Trip)} = 3700.32 + 33 = \underline{3733.32}$ lbs

		See
$W_{P/L\,(Deploy)} = f(W, ISPE, \Delta V) =$	2908 lbs	Fig 4.3.4.3-6
$W_{P/L\,(Retrieve)} = f(W, ISPE, \Delta V) =$	698 lbs	Fig 4.3.4.3-7
$W_{P/L\,(Round\ Trip)} = f(W, ISPE, \Delta V) =$	495 lbs	Fig 4.3.4.3-8

Multi-Payloads

Deploy

$W_{BO} = 3517.78 + 33 = \underline{3550.78}$ lbs

$W_{P/L} = f(W, ISPE, \Delta V) =$ Fig 4.3.4.3-3 (Multi-P/L Deploy)

$\Delta V\ \Phi = f(\Phi = 60°) = 292$ fps

Round Trip with Multi-P/L Deploy

$W_{BO} = 3700.32 + 33 = \underline{3733.32}$ lbs

$W_{P/L} = f(W, ISPE, \Delta V) =$ Fig 4.3.4.3-4 (Multi-P/L Deploy + Single P/L Retrieve)

$\Delta V_{\Phi} = f(\Phi = 60°) = 292$ fps

WITH KICK STAGES

Use NASA K.S. Performance

See Fig's 4.3.4.3-10 thru -14

510 A
MULTI DEPLOY

CONCEPT
510A - 5B

SINGLE STAGE
TSP = 327.2 SEC
GEOSYNCH MULTI-P/L DEPLOY
WITHOUT KICK STAGES

(60° PHASE ANGLE BETWEEN 1ST & 2ND DEPLOYMENTS)

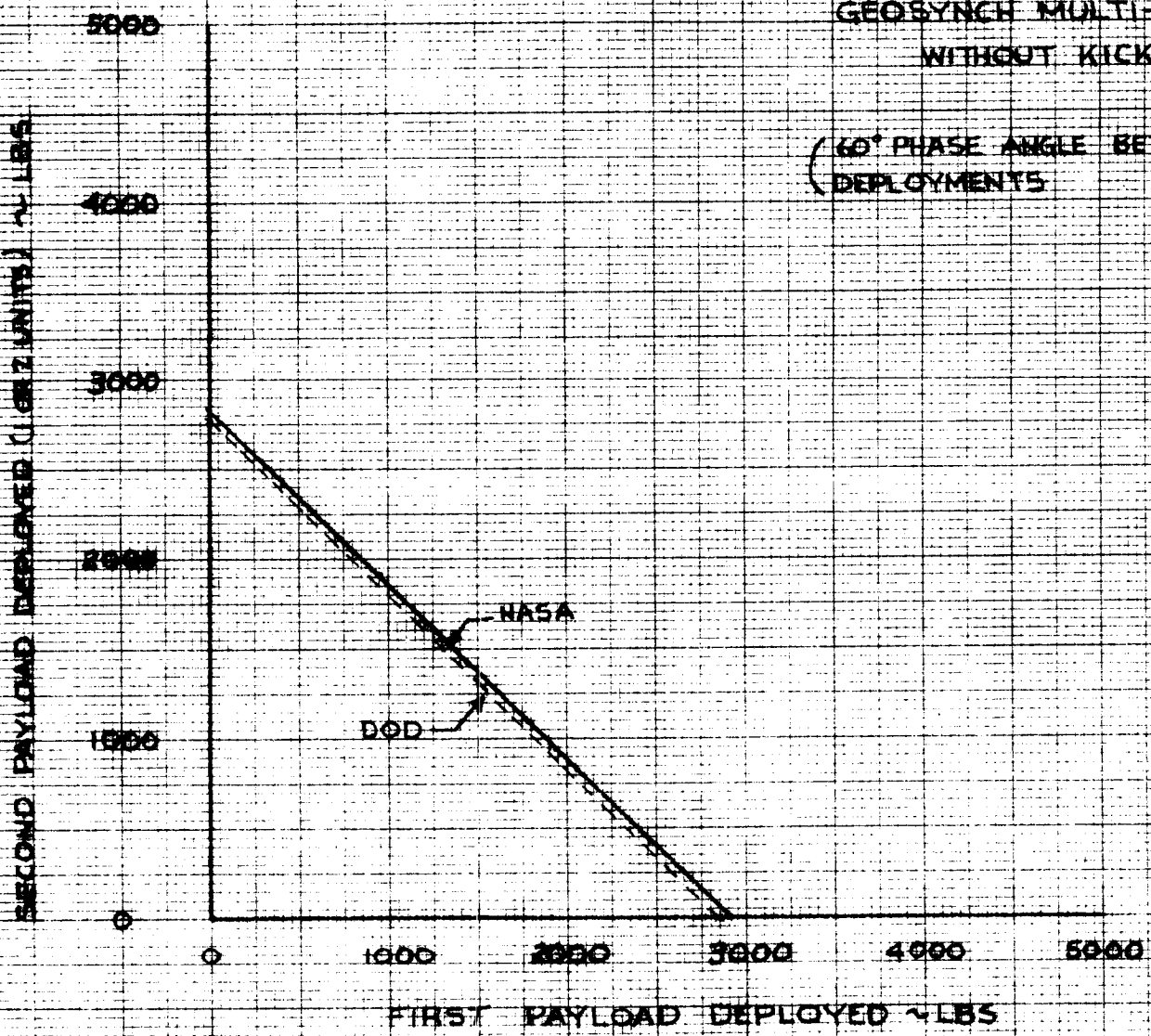


FIGURE 4.3.4.3-2

510ADE
MULTI DEPLOY

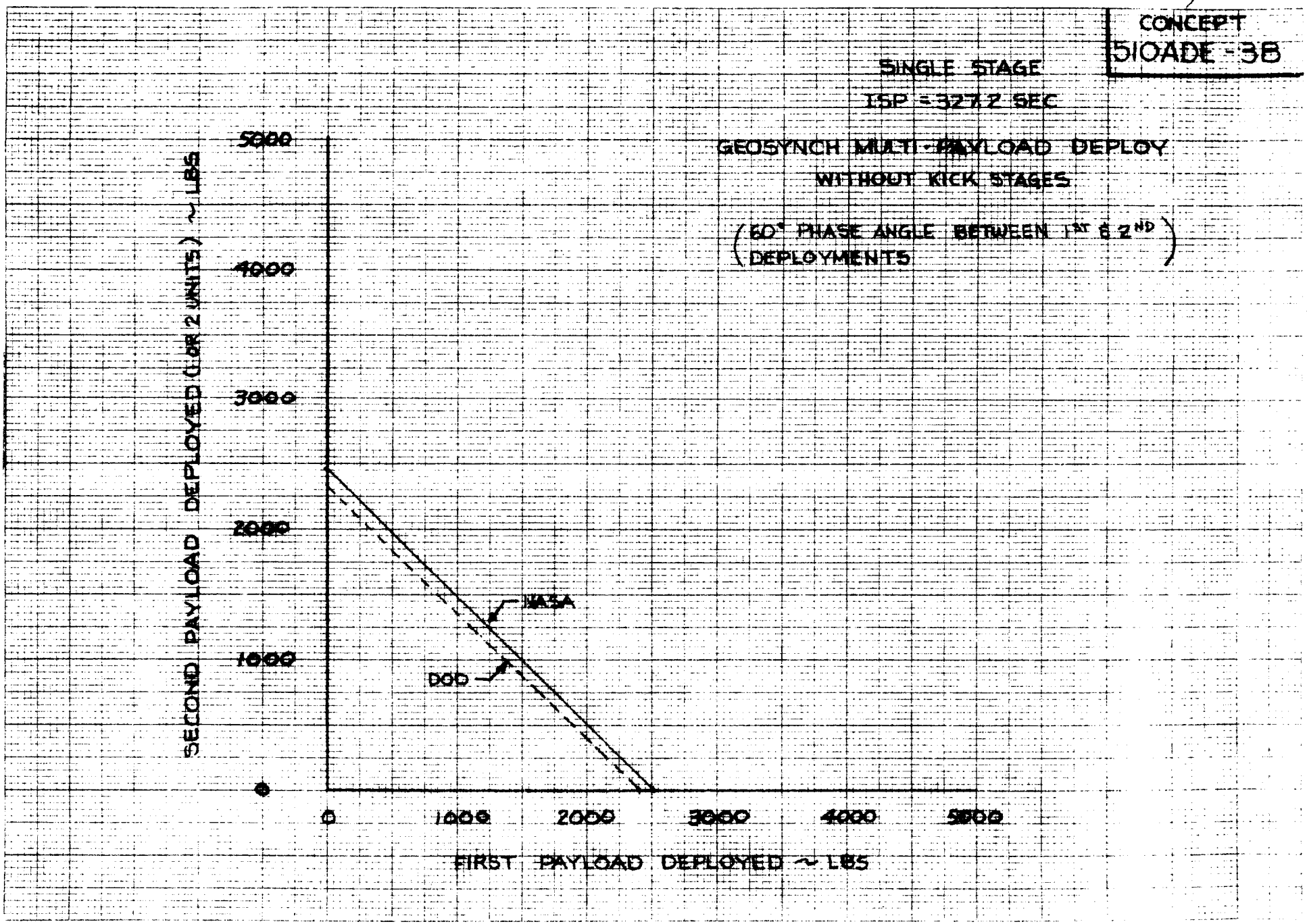


FIGURE 4.3.4.3-3

K+E 10 X 10 TO ½ INCH 46 1327
7 X 10 IN. • ALBANENE® MADE IN U.S.A.
KEUFFEL & ESSER CO.

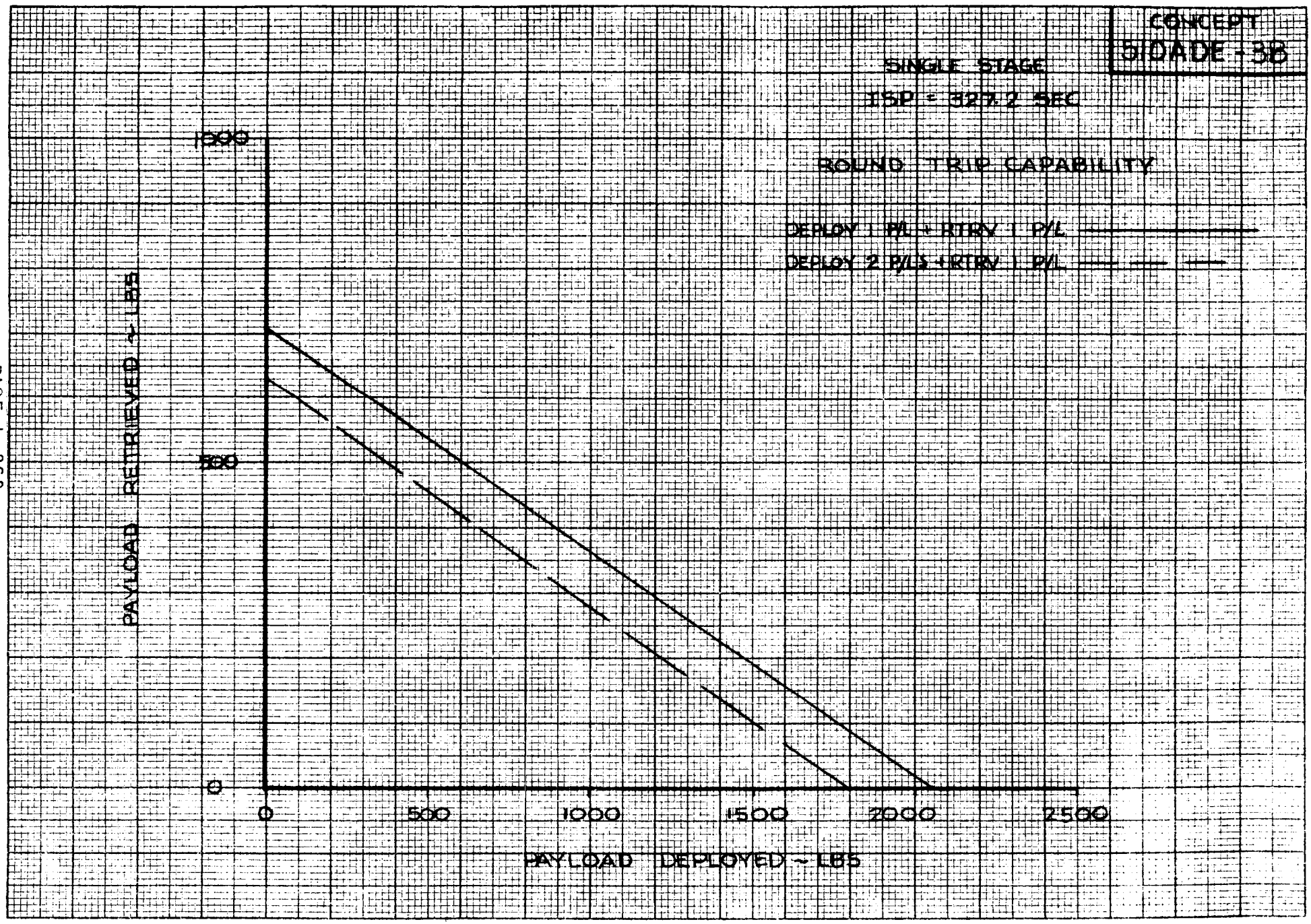


FIGURE 4.3.4.3-4

FLIGHT MODE	SENSITIVITY					
	$\partial PL/\partial W_{FIXED}$ P/L TO FIXED WEIGHT (lbs/lb)	$\partial PL/\partial W_o$ P/L TO INITIAL WEIGHT (lbs/lb)	$\partial PL/\partial I_{SP}$ P/L TO SPECIFIC IMPULSE (lbs/sec)	$\partial PL/\partial \Delta V_{OUT}$ P/L TO OUTBOUND ΔV (lbs/fps)	$\partial PL/\partial \Delta V_{IN}$ P/L TO INBOUND ΔV (lbs/fps)	$\partial PL/\partial \Delta V_{AKS}$ P/L TO AKS ΔV (lbs/fps)
DEPLOY CORE ALONE	-3.82	0.26	112	-1.6	-1.3	-
DEPLOY CORE + AKS	-2.44	0.25	92	-1.5	-0.8	-0.7
RETRIEVE	-1.35	0.09	51	-0.6	-0.6	-
ROUND TRIP	-1.00	0.067	36	-0.3	-0.4	-

CONCEPT 510A/510ADE-3B

PAYLOAD SENSITIVITIES

TABLE 4.3.4.3-1

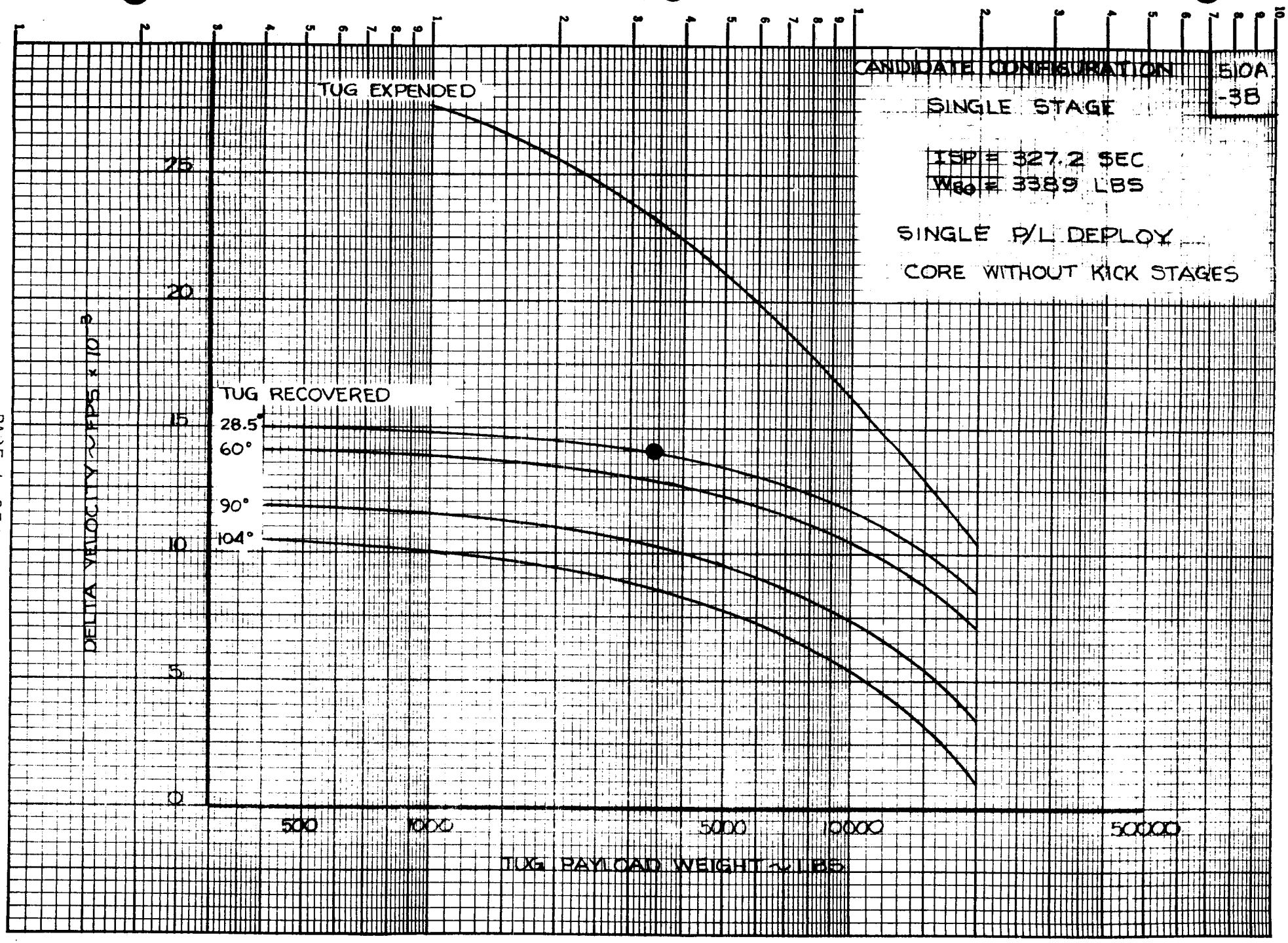


FIGURE 4.3.4.3-5

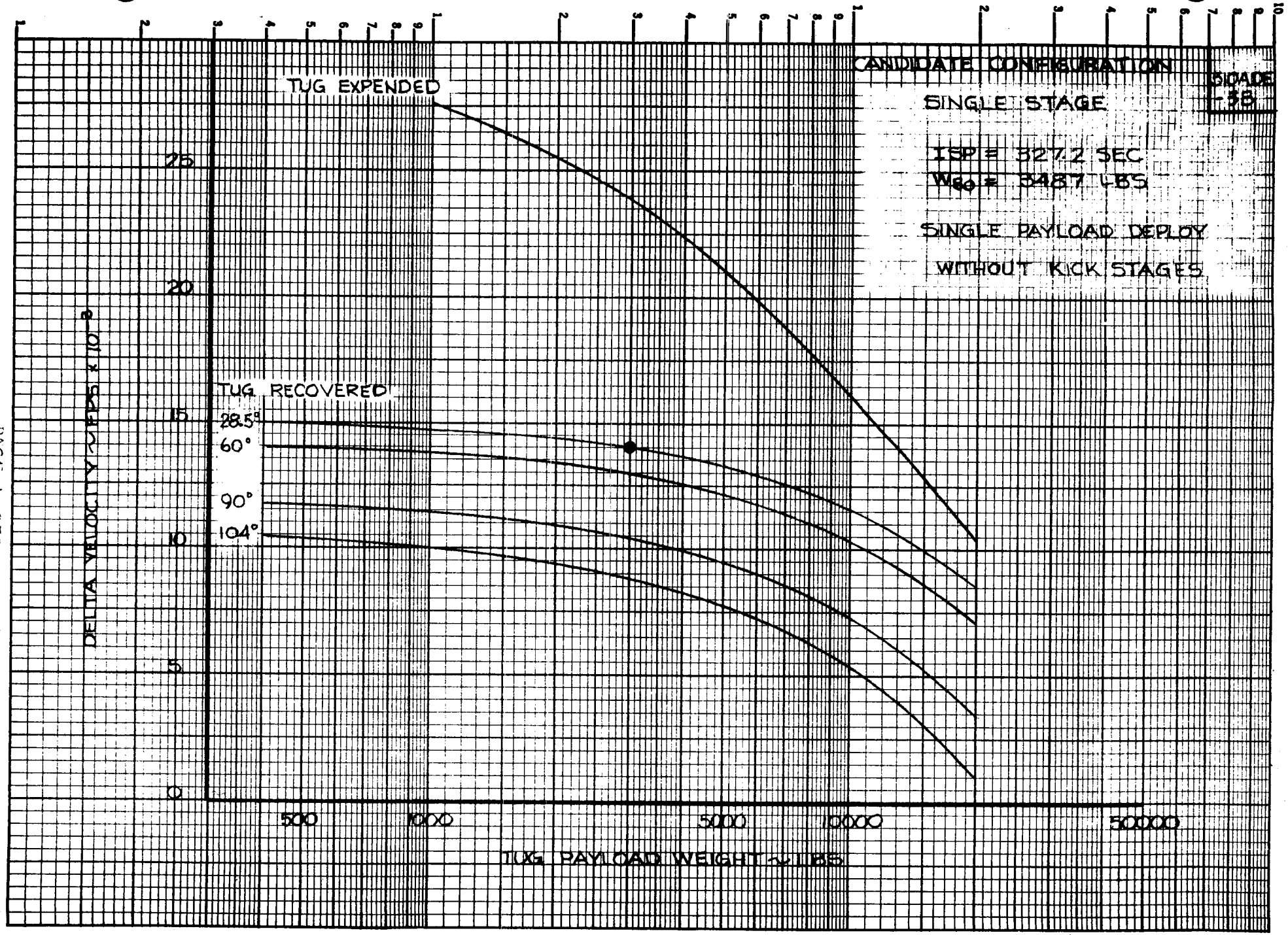


FIGURE 4.3.4.3-6

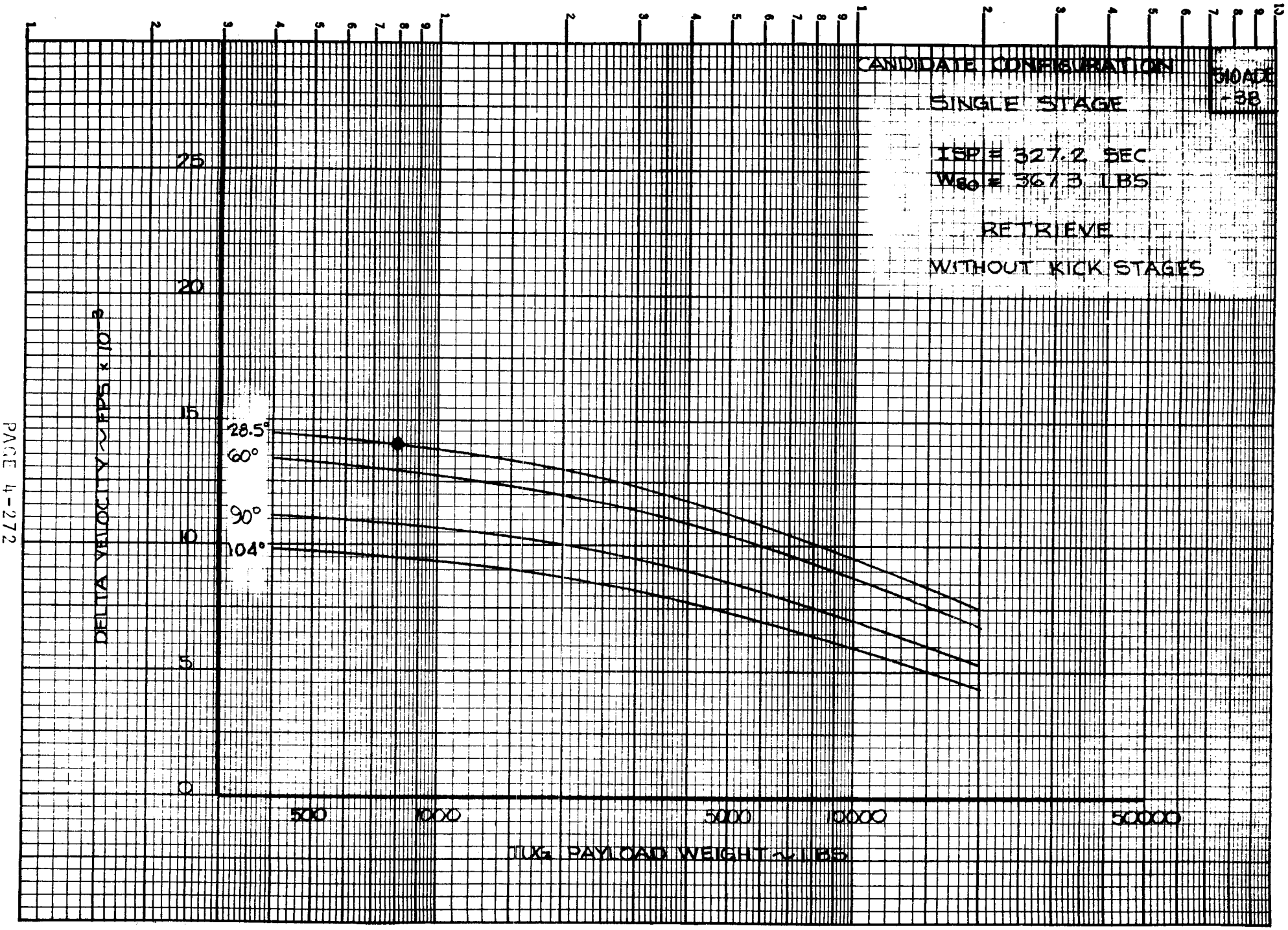


FIGURE 4.3.4.3-7

K+E SEMI-LOGARITHMIC 46 5492
3 CYCLES X 70 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.

510ADE
RT

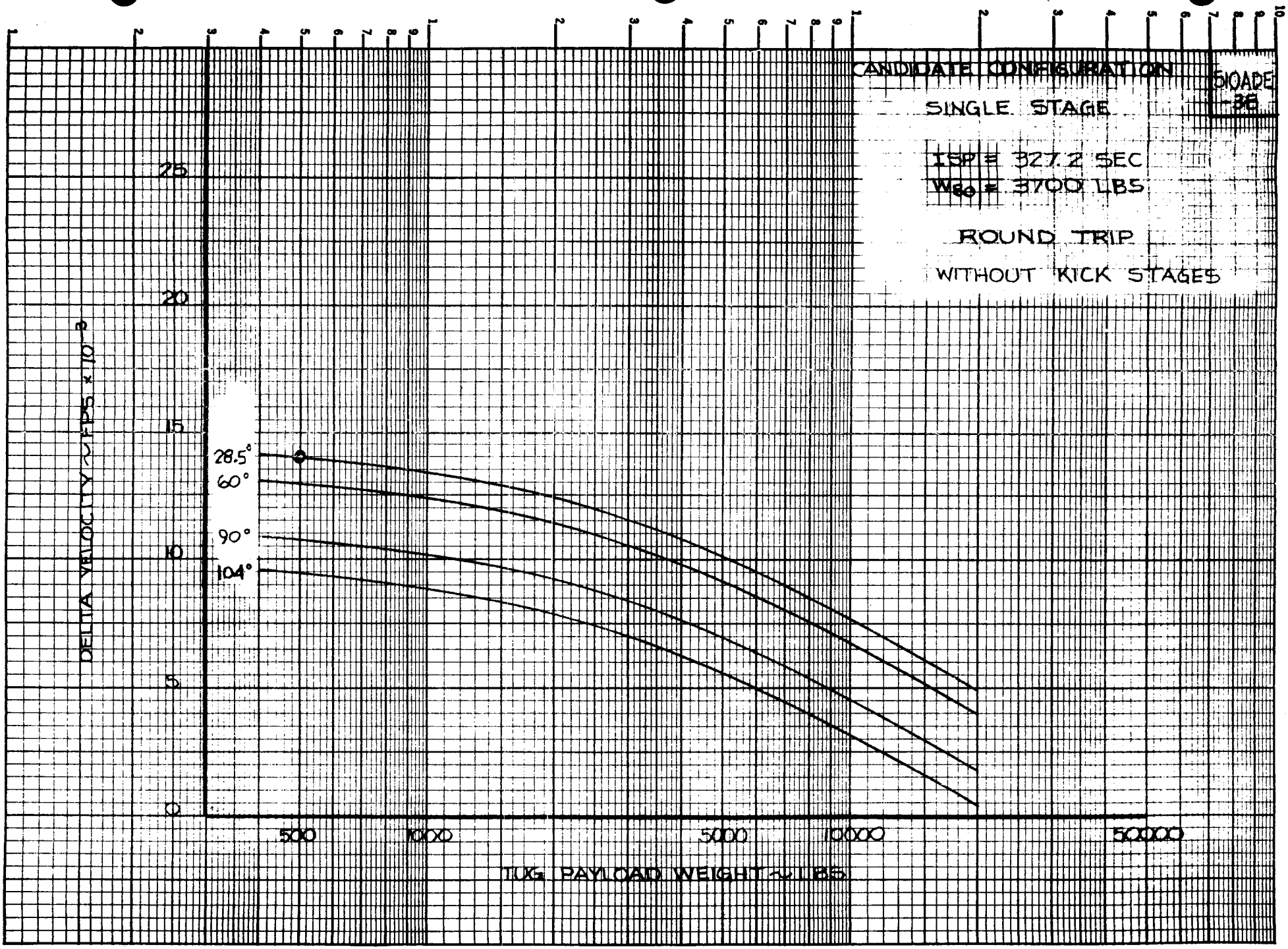


FIGURE 4.3.4.3-8

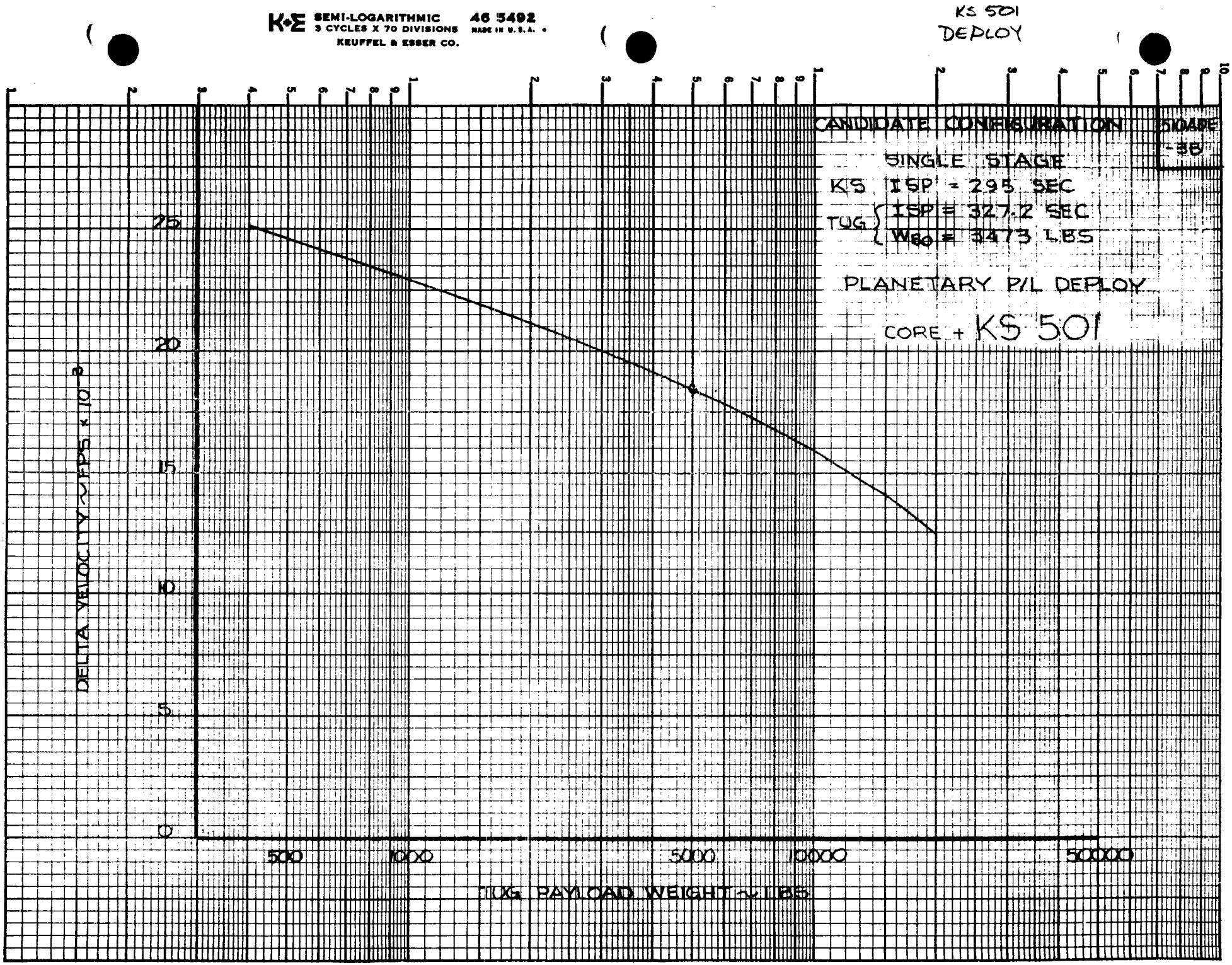


FIGURE 4.3.4.3-9

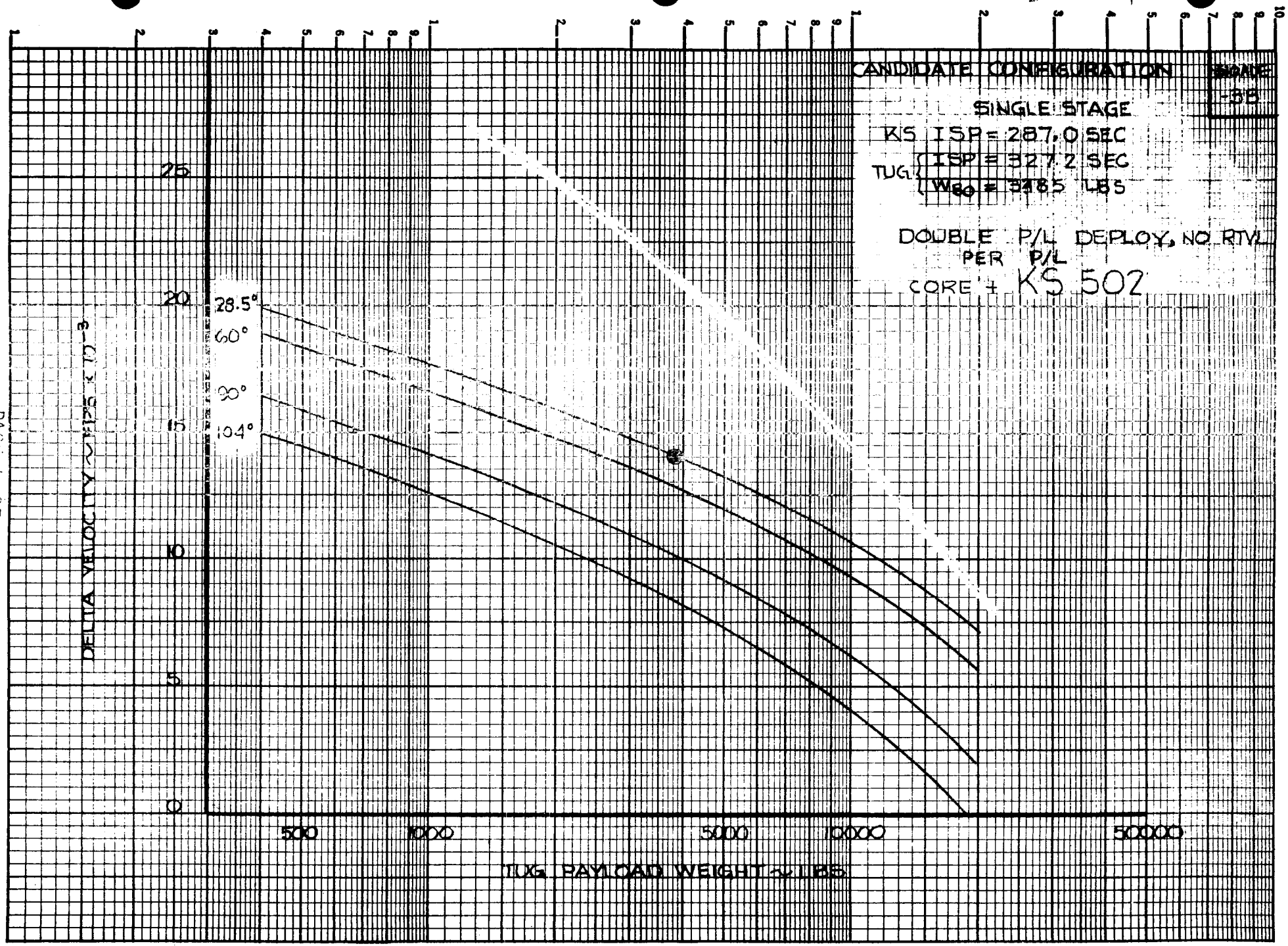


FIGURE 4.3.4.3-10

K+E SEMI-LOGARITHMIC 46 5492
3 CYCLES X 70 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.

KS 503
RETRIM

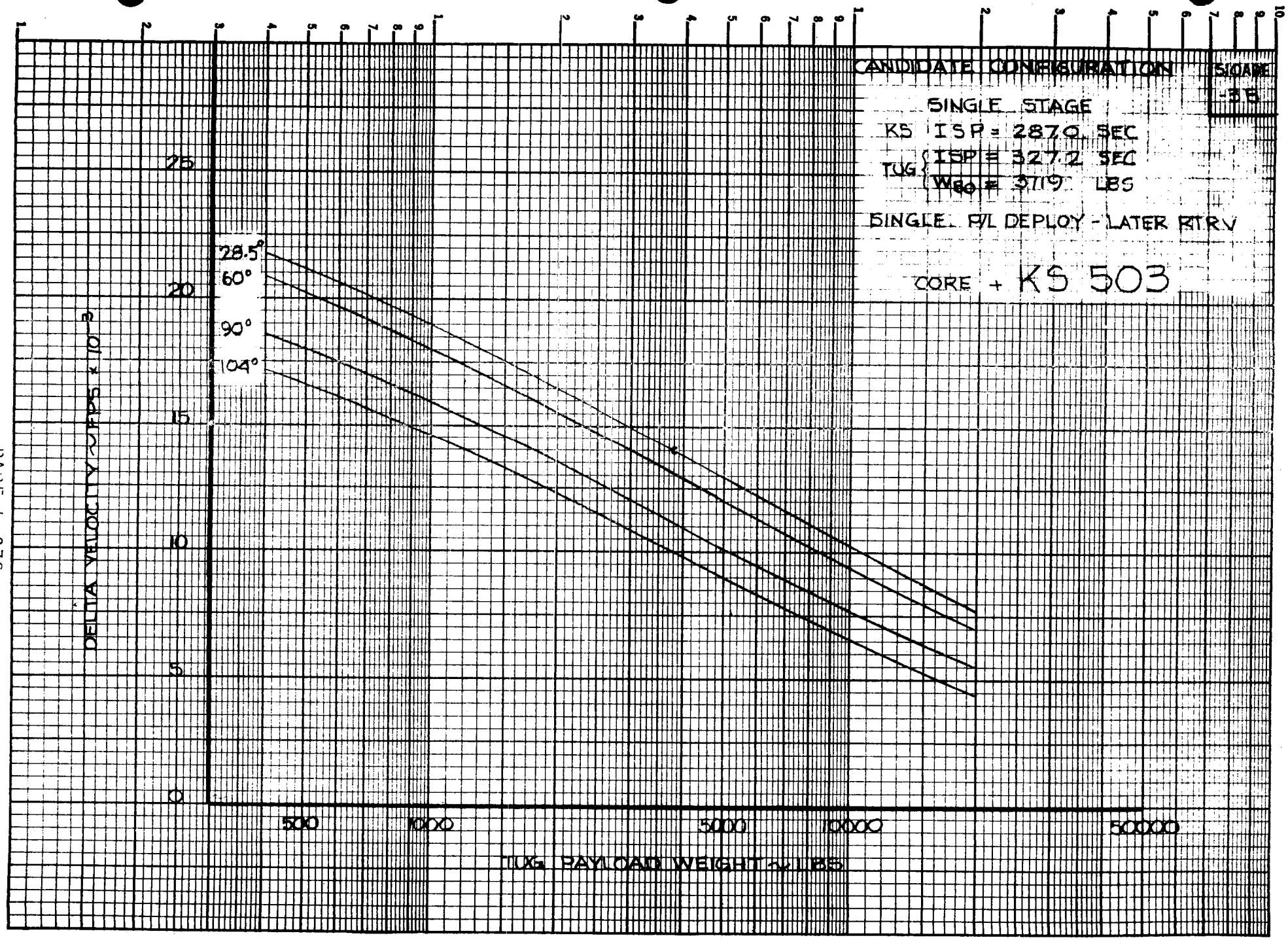


FIGURE 4.3.4.3.-11

K+E SEMI-LOGARITHMIC 46 5492
3 CYCLES X 70 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.

KS 504 RETRIEVE

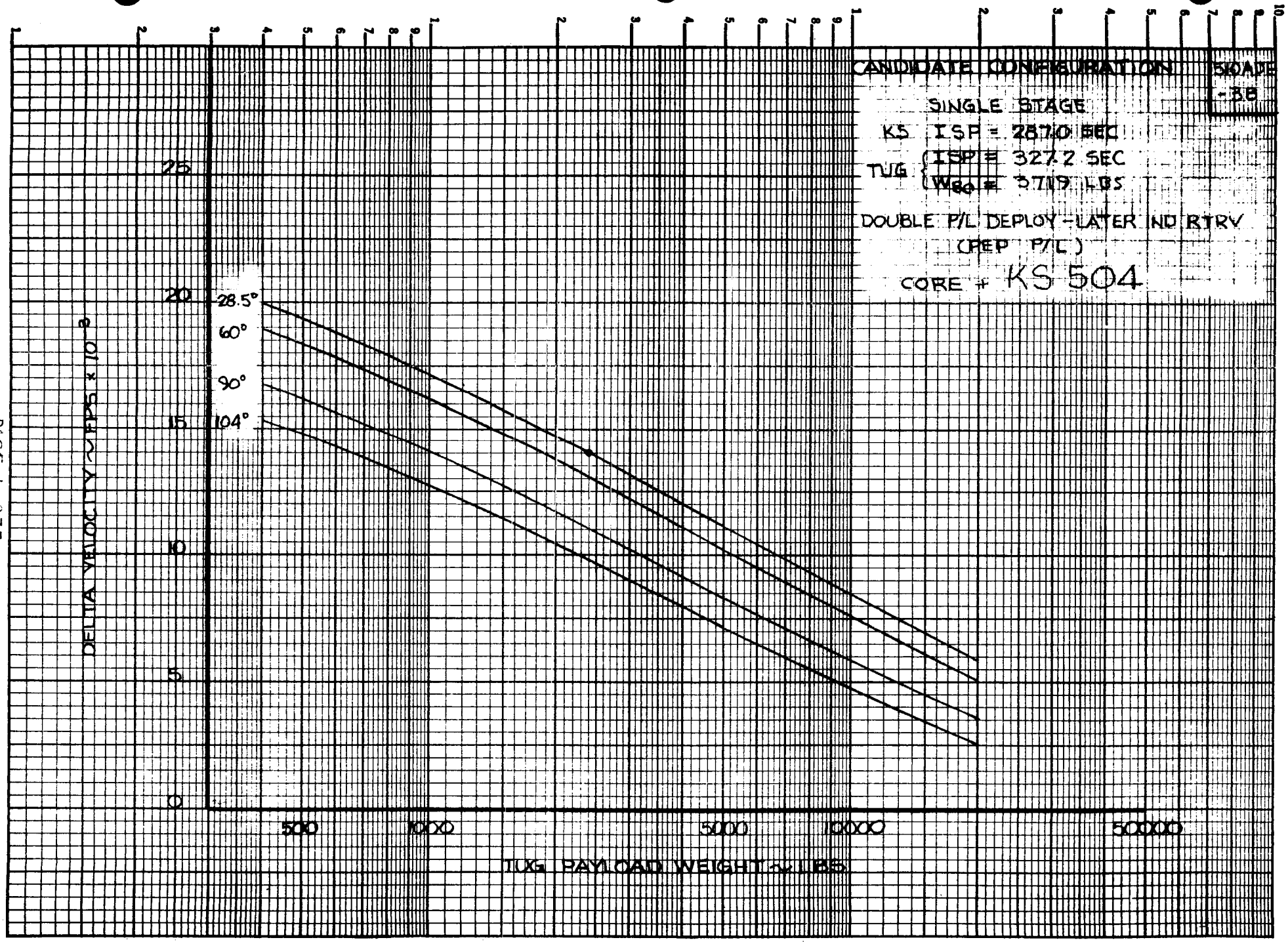


FIGURE 4.3.4.3-12

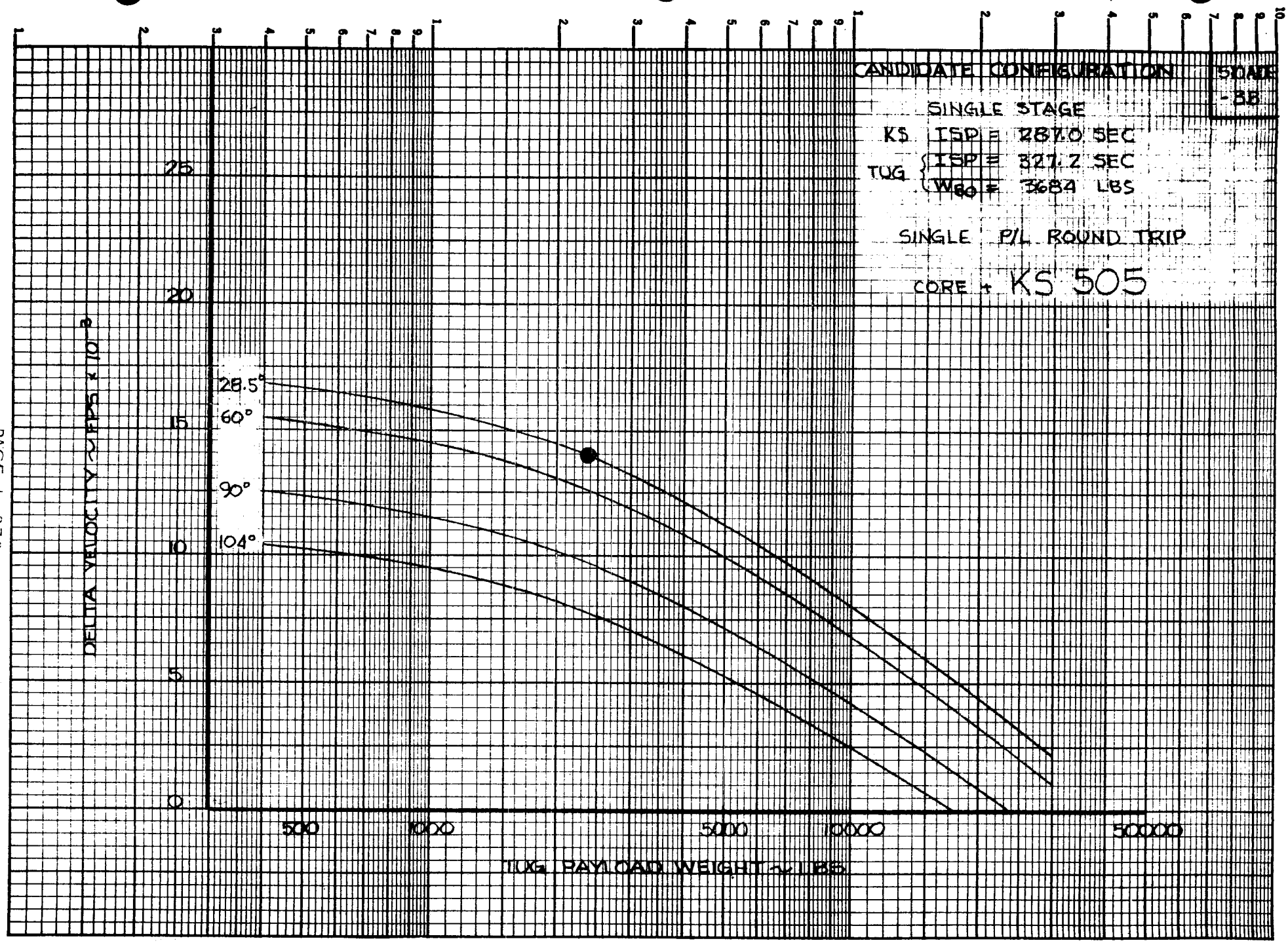


FIGURE 4.3.4.3-13

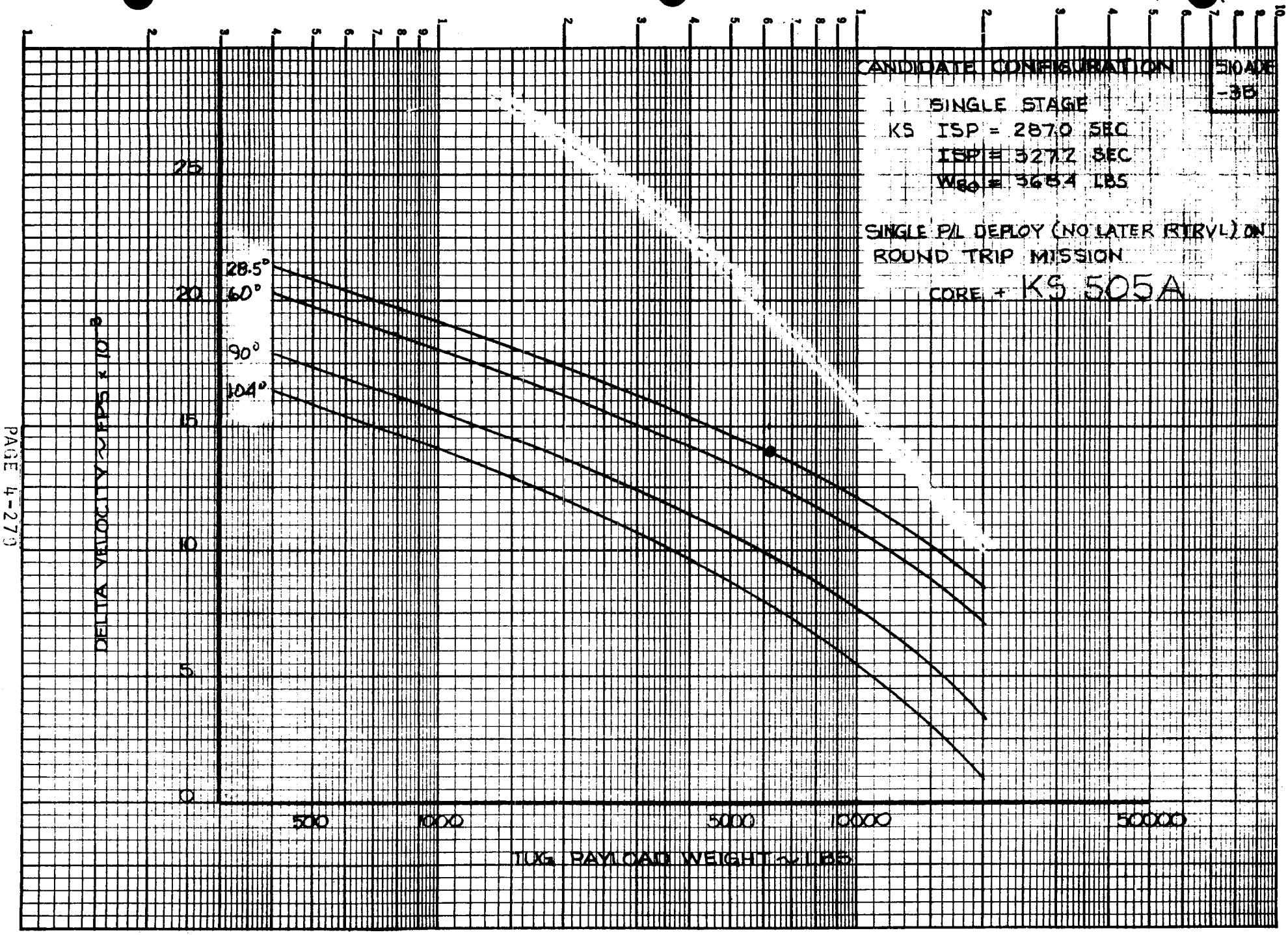


FIGURE 4.3.4.3-14

4.3.4.3.2 <u>510A/510ADE Flight Summary</u>

Table 4.3.4.3-2 NASA Traffic

-3 DOD Traffic

-4 Combined NASA/DOD Traffic

Comments:

None

FLIGHT SUMMARY

OPTION: (510/510ADE-3B)

FLIGHT MODE		CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
TOTAL FLIGHTS	SHUTTLE	13	15	12	18	22	24	19	22	16	19	18	198
	TUG												SAME
TUG FLIGHT DISTRIBUTION	DEPLOY	(13)	(15)	(12)	(18)	(8)	(4)	(6)	(12)	(6)	(10)	(4)	(108)
	SINGLE P/L - CORE	4	3	4	3	4	3	2	5	2	4	3	37
	- CORE + KS	8	11	8	12	2		3	2	1			47
	CORE + - EXPEND TUG					2		1	1		3	1	8
	MULTI P/L - CORE	1	1		3		1				2		8
	- CORE + KS								4	3	1		8
	RETRIEVE					(5)	(3)	(3)	(2)	(3)		(3)	(19)
	CORE ONLY					2		3	2	3		2	12
	CORE + KS					3	3					1	7
	ROUND TRIP					(9)	(17)	(10)	(8)	(7)	(9)	(11)	(71)
	CORE ONLY					2	6	2	4	2	2	2	20
	CORE + KS					7	11	8	4	5	7	9	51
MISSION MODEL	(TOTAL)	(14)	(16)	(12)	(23)	(31)	(42)	(29)	(34)	(26)	(35)	(26)	(288)
	DEPLOY	14	16	12	23	17	22	16	24	16	26	15	201
	RETRIEVE					14	20	13	10	10	9	11	87
	SORTIE												

NASA TRAFFIC

TABLE 4.3.4.3-2

FLIGHT SUMMARY

OPTION: 6510

FLIGHT MODE		CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
TOTAL FLIGHTS	SHUTTLE	13	6	11	19	19	12	17	17	17	14	18	163
	TUG												SAME
TUG FLIGHT DISTRIBUTION	DEPLOY	(13)	(6)	(11)	(18)	(6)	(4)	(2)	(4)	(2)	(3)	(4)	(73)
	SINGLE P/L-CORE	3	3	4	4								14
	CORE + KS	6	2	6	10	4	2	1	3	1	1	2	38
	MULTI P/L-CORE	4	1	1	4	2	2	1	1	1	2	2	21
	RETRIEVE					(3)		(3)	(2)	(1)	(1)	(3)	(13)
	CORE ONLY					1		3		1			5
	CORE + KS					2			2		1	3	8
	ROUND TRIP					(10)	(7)	(12)	(10)	(14)	(9)	(11)	(73)
	CORE ONLY					2	4	5	2	6	5	2	26
	CORE + KS					8	3	7	8	8	4	9	47
	SORTIE				(1)		(1)		(1)		(1)		(4)
MISSION MODEL	(TOTAL)	(20)	(7)	(12)	(25)	(33)	(22)	(31)	(29)	(33)	(27)	(33)	272
	DEPLOY	20	7	12	24	20	14	16	16	18	16	19	182
	RETRIEVE					13	7	15	12	15	10	14	86
	SORTIE				1		1		1		1		4

DOD TRAFFIC

TABLE 4.3.4.3-3

FLIGHT SUMMARY — OPTION: (510/510ADE-3B)

FLIGHT MODE		CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
TOTAL FLIGHTS	SHUTTLE	26	21	23	37	41	36	36	39	33	33	36	361
	TUG												SAME
TUG FLIGHT DISTRIBUTION	DEPLOY	(26)	(21)	(23)	(36)	(14)	(8)	(8)	(16)	(8)	(13)	(8)	(181)
	SINGLE P/L - CORE	7	6	8	7	4	3	2	5	2	4	3	51
	- CORE + KS	14	13	14	22	6	2	4	5	2	1	2	85
	- CORE + EXPEND TUG					2		1	1		3	1	8
	MULTI P/L - CORE	5	2	1	7	2	3	1	1	1	4	2	29
	- CORE+KS								4	3	1		8
	RETRIEVE					(8)	(3)	(6)	(4)	(4)	(1)	(6)	(32)
	CORE ONLY					3		6	2	4		2	17
	CORE+KS					5	3		2		1	4	15
	ROUND TRIP					(19)	(24)	(22)	(18)	(21)	(18)	(22)	(144)
	CORE ONLY					4	10	7	6	8	7	4	46
	CORE+KS					15	14	15	12	13	11	18	98
	SORTIE				(1)		(1)		(1)		(1)		(4)
MISSION MODEL	(TOTAL)	(34)	(23)	(24)	(48)	(64)	(64)	(60)	(63)	(59)	(62)	(59)	(560)
	DEPLOY	34	23	24	47	37	36	32	40	34	42	34	383
	RETRIEVE					27	27	28	22	25	19	25	173
	SORTIE				1		1		1		1		4

COMBINED NASA & DOD TRAFFIC

TABLE 4.3.4.3-4

4.3.4.3.3 <u>510A/510ADE Flight Element Requirements</u>

Table 4.3.4.3-5 NASA Traffic

-6 DOD Traffic

-7 Combined NASA/DOD Traffic

-8 Kick Stage Definition

<u>Comments:</u>

a. Deorbit Kick Stage (DKS) required for Tug payload retrieval launched in 1979 are charged to the Tug program and are accounted for in 1980.

b. DKS's are accounted for in the year they are launched, not retrieved.

FLIGHT ELEMENT REQUIREMENTS OPTION: 3B (510A/510ADE - 3B)

ITEM			CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
SHUTTLE FLIGHTS		TOTAL	13	15	12	18	22	24	19	22	16	19	18	198
BASIC TUG FLIGHTS	ETR	RECOVERED	13	15	12	15	16	17	14	15	12	12	13	154
		EXPENDED					2		1	1		3	1	8
	WTR	RECOVERED				3	4	7	4	6	4	4	4	36
	(TOTAL)		(13)	(15)	(12)	(18)	(22)	(24)	(19)	(22)	(16)	(19)	(18)	(198)
KICK STAGES	KS 501				2		2		3	2				9
	KS 502													0
	KS 503		3*			3	3	3						12
	KS 504									8	6	2		16
	KS 505		8**	10	5	7	4	9	6	2	4	2	6	63
	KS 505A		2	1	1	2	3	2	2	2	2	5	4	26
	(TOTAL)		(13)***	(11)	(8)	(12)	(12)	(14)	(11)	(14)	(12)	(9)	(10)	(126)***

* LAUNCHED IN 1979 FOR SUBSEQUENT RETRIEVALS

** INCLUDES 2 KS LAUNCHED IN 1979 FOR SUBSEQUENT RETRIEVALS

*** INCLUDES 5 KS LAUNCHED IN 1979 FOR SUBSEQUENT RETRIEVALS

BAS 9-4-73

NASA TRAFFIC

TABLE 4.3.4.3-5

FLIGHT ELEMENT REQUIREMENTS

OPTION: 3B (510A/510ADE-3B)

ITEM			CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
SHUTTLE FLIGHTS		TOTAL	13	6	11	19	19	12	17	17	17	14	18	163
BASIC TUG FLIGHTS	ETR	RECOVERED	13	6	11	15	18	10	12	15	15	10	17	142
		EXPENDED												0
	WTR	RECOVERED				4	1	2	5	2	2	4	1	21
	(TOTAL)		(13)	(6)	(11)	(19)	(19)	(12)	(17)	(17)	(17)	(14)	(18)	(163)
KICK STAGES	KS 501													0
	KS 502													0
	KS 503			2		1	5		1	4	1	1	5	20
	KS 504													0
	KS 505		7*		6	9	9	3	7	8	8	4	9	70
	KS 505A													0
	(TOTAL)		(7)	(2)	(6)	(10)	(14)	(3)	(8)	(12)	(9)	(5)	(14)	(90)

*INCLUDES 1 KS LAUNCHED IN 1979 FOR SUBSEQUENT RETRIEVAL

BAS 9-4-73

DOD TRAFFIC

TABLE 4.3.4.3-6

FLIGHT ELEMENT REQUIREMENTS — OPTION: 3B (510A/510ADE - 3B)

ITEM			CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
SHUTTLE FLIGHTS		TOTAL	26	21	23	37	41	36	36	39	33	33	36	361
BASIC TUG FLIGHTS	ETR	RECOVERED	26	21	23	30	34	27	26	30	27	22	30	296
		EXPENDED					2		1	1		3	1	8
	WTR	RECOVERED				7	5	9	9	8	6	8	5	57
	(TOTAL)		(26)	(21)	(23)	(37)	(41)	(36)	(36)	(39)	(33)	(33)	(36)	(361)
KICK STAGES	KS 501				2		2		3	2				9
	KS 502													0
	KS 503		3*	2		4	8	3	1	4	1	1	5	32
	KS 504									8	6	2		16
	KS 505		15*	10	11	16	13	12	13	10	12	6	15	133
	KS 505A		2	1	1	2	3	2	2	2	2	5	4	26
	(TOTAL)		(20)**	(13)	(14)	(22)	(26)	(17)	(19)	(26)	(21)	(14)	(24)	(216)**

KS'S LAUNCHED IN 1979 FOR SUBSEQUENT RETRIEVALS
* 3
** 6

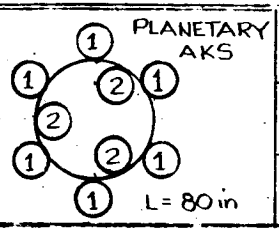
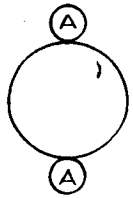
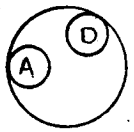
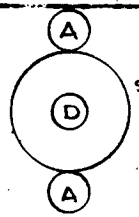
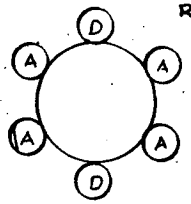
RELIABILITY = + 4 FLTS

BAS 9-4-23

COMBINED NASA/DOD TRAFFIC
TABLE 4.3.4.3-7

CONCEPT 510A/510ADE-3B

KICK STAGE DEFINITION

KICK STAGE DESIGNATION	GEOMETRY (all stages >10 ft diam. & are 5.5 ft long unless otherwise noted)		PERFORMANCE (geosynch Payload) (lbs)	SRM CHARACTERISTICS: INDIVIDUAL WEIGHT (lbs)	NUMBER	TOTAL SRM WEIGHT (lbs)	STAGE INERT WEIGHT (lbs)	TOTAL STAGE WEIGHT (lbs)
KS 501		STAGE 1	5000 lbs TO ΔV = 18,400 fps	1742	6	10452	–	10 452
		STAGE 2		1742	3	5226	545	5771
		(TOTAL)						(16223)
KS 502		DOUBLE DEPLOY AKS	3815 (each P/L)	1742	2	3484	516	(4000)
KS 503		AKS	3825	2500	1	2500	–	2500
		DKS		2500	1	2500	804	3304
		(TOTAL)						(5804)
KS 504		AKS	2400 (each P/L)	2500	2	5000	–	5000
		DKS		1400	1	1400	818	2218
		(TOTAL)						(7218)
KS 505		AKS	2385 (each way)	1742	4	6968	–	6968
		DKS		1742	2	3484	864	4348
		(TOTAL)						(11316)

BAS 9-4-23

TABLE 4.3.4.3-8

CONCEPT 510/510ADE-3B

KICK STAGE DEFINITION (cont)

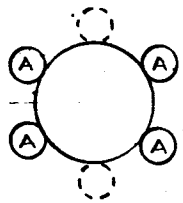
KICK STAGE DESIGNATION	GEOMETRY (all stages >10 ft diam. & are 5.5H long unless otherwise noted)	PERFORMANCE (geosynch Payload) (lbs)	SRM CHARACTERISTICS			STAGE INERT WEIGHT (lbs)	TOTAL STAGE WEIGHT (lbs)
			INDIVIDUAL WEIGHT (lbs)	NUMBER	TOTAL SRM WEIGHT (lbs)		
KS 505A	 AKS Delete 2 DKS from KS 505	6090	1742	4	6968	643	7611

TABLE 4.3.4.3-8 (cont)

4.3.4.3.4 <u>510A/510ADE Initial Flight Schedule</u>

Table 4.3.4.3-9 Costed Flight Build Up

<u>Comments:</u>

a. Abbreviations used in the accompanying table

D = Deploy

R = Retrieve

KS = Kick Stage

EXP = Expended Tug

FLIGHT	PAYLOAD FLOWN					
	1980	1981	1982	1983	1984	1985
1	D-6	D-2 (KS)	ALL	ALL	D-9	ALL
2	D-17	D-2 (KS)			D-10	
3	D-35	D-3 (KS)			D-18	
4		D-3 (KS)			D-18	
5		D-3 (KS)			D-20 (KS)	
6		D-3 (KS)			D-20 (KS)	
7		D-4 (KS)			D-24 (EXP)	
8		D-7			D-24 (EXP)	
9		D-8 (KS)			R-2 (KS)	
10		D-10			R-2 (KS)	
11		D-11			R-2 (KS)	
12		D1 + D1			R-12	
13		D31 (KS)			R-13	
14		D-31 (KS)			D1 + R1 (KS)	
15		D-34			D3 + R3 (KS)	
16		D-35			D4 + R4 (KS)	
17		D-35			D7 + R4 (KS)	
18		D25 + D25			D8 + R3 (KS)	
19					D8 + R3 (KS)	
20					D14 + R14	
21					D15 + R15	
22					D-28 (KS)	
23					D-28 (KS)	
24					D-31 (KS)	
25					D-31 (KS)	
26					R-31 (KS)	
27					R-31 (KS)	
28					R-34 (KS)	
29					D25 + R25 (KS)	
30					D25 + R25 (KS)	
31					D26 + R26 (KS)	
32					D27 + R27 (KS)	
33					D32 + R32 (KS)	
34					D32 + R32 (KS)	
35					D35 + R35	
36					D35 + R35	
37					D37 + D37 + D37	
38					D39 + D39 + D39	
FLIGHTS FLOWN/SCHED	3/26	18/21	23/23	37/37	38/41	36/36
DEPLOY P/L'S FLOWN/SCHED	3/34	20/23	24/24	47/47	34/37	36/36
RTRV P/L'S FLOWN/SCHED	0/0	0/0	0/0	0/0	24/27	27/27
SORTIES FLOWN/SCHED	0/0	0/0	0/0	1/1	0/0	1/1

CONCEPT 510/510ADE-3B

COSTED FLIGHT BUILD-UP

TABLE 4.3.4.3-9

4.3.4.3.5 <u>510A/510ADE Additional Payload Capture Potential</u>

Table 4.3.4.3-10 Additional Payload Capture Potential

<u>Comments:</u>

a. The basic Tug and Kick Stages sized and applied to meet the requirements of this option do not capture the additional retrieval missions quoted. However, it appears probable that utilization of the round-trip kick stage, KS405, as a single deploy with later retrieve will significantly enhance performance capability. Since this has not yet been substantiated, the additional capture of the retrieval mission has not been claimed.

OPTION 3B

ADDITIONAL PAYLOAD CAPTURE POTENTIAL

MISSIONS EXCLUDED FROM OPTION MISSION MODEL					CONCEPT 510A/510ADE-3B		
DESIGNATION		DEPLOY	RETRIEVE	SORTIE	TUG MODE		
ID NO.	WEIGHT				DEPLOY	RETRIEVE	SORTIE
N 6	5000	-	3	-	-	0	-
N 7	5500	-	10	-	-	0	-
N 8	4000	-	7	-	-	0	-
N 10	9500	-	2	-	-	0	-
N 17	2000	3	-	-	3 (CORE)	-	-
N 18	3300	2	-	-	2 (CORE)	-	-
N 19	7900	3	-	-	3 (KS 501)	-	-
N 20	1500	4	-	-	4 (EXPEND)	-	-
N 22	4000	4	-	-	0	-	-
N 23	6600	2	-	-	2 (EXPEND)	-	-
N 24	4400	4	-	-	4 (EXPEND)	-	-
D 29 (12b)	2400	-	-	5	-	-	0
TOTALS	DEPLOY	22			18		
	RETRIEVE		22			0	
	SORTIE			5			0
	(TOTAL)	49			18		

N = NASA
D = DOD

TABLE 4.3.4.3-10

4.3.4.3.6 <u>510A/510ADE Detailed Traffic Assessment Data</u>

Table 4.3.4.3-11 NASA Traffic Assessment

-12 NASA Geosynch Mixed Missions

-13 NASA Non-Geosynch Mixed Missions

-14 DOD Traffic Assessment

<u>Comments:</u>

a. Where Deorbit Kick Stages (DKS's) must be launched in 1979 to support Tug P/L retrievals, they are accounted for separately as shown on the accompanying data sheets. They are charged to the Tug program in 1980.

b. DKS's are accounted for in the year they are launched, not retrieved. Retrieval dates may be determined by applying the specified Mean Mission Duration (MMD) to the launch date.

c. The first page of Table 4.3.4.3-12 is devoted to defining the Kick Stage launches required in 1979 to support Tug P/L retrievals. The flight number column contains identification of the mixed mission flights and year for which the Kick Stages are required.

TRAFFIC ASSESSMENT: NASA GEOSYNCH — OPTION: (510/510ADE-3B)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION — CALENDAR YEAR 80*	80	81	82	83	84	85	86	87	88	89	90	TOTAL
MIXED PAYLOADS GEOSYNCH (see pages 6-17)	ROUND TRIP	KS 505								2	1	1			4
	ROUND TRIP	KS 505A						3	2	2	2	1	5	4	19
	DOUBLE DEPLOY	2xKS 404											1		1
	(TOTAL)							(3)	(2)	(4)	(3)	(2)	(6)	(4)	(24)
1	SINGLE DEPLOY	KS 505				2	1								3
	DOUBLE DEPLOY			1	1										2
	ROUND TRIP	KS 505						2	1	1	1	1		2	8
	(TOTAL)			(1)	(1)	(2)	(1)	(2)	(1)	(1)	(1)	(1)		(2)	(13)
2	SINGLE DEPLOY	KS 503	3												—
	SINGLE DEPLOY	KS 505		1	2		1								4
	RETRIEVE	KS 503						3							3
	ROUND TRIP	KS 505							1						1
	(TOTAL)		—	(1)	(2)		(1)	(3)	(1)						(8)
3	SINGLE DEPLOY	KS 505		3	7	3	3								16
	DOUBLE DEPLOY	2xKS 504									3	3			6
	ROUND TRIP	KS 505						1	5	3		1	2	3	15
	(TOTAL)			(3)	(7)	(3)	(3)	(1)	(5)	(3)	(3)	(4)	(2)	(3)	(37)
4	SINGLE DEPLOY	KS 505	2												—
	SINGLE DEPLOY	KS 505		1	1		2								4
	DOUBLE DEPLOY	2XKS 504									1				1
	ROUND TRIP	KS 505						1	1			1			3
	(TOTAL)		—	(1)	(1)		(2)	(1)	(1)		(1)	(1)			(8)
5	SINGLE DEPLOY	KS 503					3								3
	RETRIEVE	KS 503							3						3
	(TOTAL)						(3)		(3)						(6)

* Kick Stages Launched prior to 1980 to Support Tug P/L Retrievals

TABLE 4.3.4.3-11

TRAFFIC ASSESSMENT: NASA GEOSYNCH (cont) OPTIONS (510A/510ADE-38)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 80*	80	81	82	83	84	85	86	87	88	89	90	TOTAL
6	SINGLE DEPLOY			1		1			1		1				4
7	SINGLE DEPLOY			1	1	2	2		2		2	1	1		12
8	SINGLE DEPLOY	KS 505A		2	1	1	2					1			7
NASA GEOSYNCH TRAFFIC SUMMARY MISSIONS (1-8)	SINGLE DEPLOY			2	1	3	2		3		3	1	1		16
	"	KS 503					3								3
	"	KS 505		5	10	5	7								27
	"	KS 505A		2	1	1	2					1			7
	DOUBLE DEPLOY			1	1										2
	"	2x KS 504									4	3	1		8
	RETRIEVE	KS 503						3	3						6
	ROUND TRIP	KS 505						4	8	6	2	4	2	5	31
	"	KS 505A						3	2	2	2	1	5	4	19
	(TOTAL)			(10)	(13)	(9)	(14)	(10)	(16)	(8)	(11)	(10)	(9)	(9)	(119)
	DEPLOY	KS 503	3												—
	"	KS 505	2												—
		(TOTAL)	5												(—)

* Kick Stages launched Prior To 1980 To Support Tug P/L Retrievals

TABLE 4.3.4.3-11 (cont)

TRAFFIC ASSESSMENT: NASA NON-GEOSYNCH E.O. OPTIONS (510A/510ADE-38)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
9	SINGLE DEPLOY			1		1		1		2		1		2	8
10	SINGLE DEPLOY				1			1			1			1	4
11	SINGLE DEPLOY				1		1				1		1		4
	"	KS 505		1											1
	RETRIEVE									1		1			2
	"	KS 505												1	1
	ROUND TRIP	KS 505							1						1
	(TOTAL)			(1)	(1)		(1)		(1)	(1)	(1)	(1)	(1)	(1)	(9)
MIXED PAYLOADS NON-GEO (see Pages 18-19)	DOUBLE DEPLOY	WTR LAUNCH					1		1						2
	TRIPLE DEPLOY	WTR LAUNCH					2						2		4
	ROUND TRIP	WTR LAUNCH									2				2
	DOUBLE DEPLOY ROUNDTRIP	WTR LAUNCH											2		2
	(TOTAL)						(3)		(1)		(2)		(4)		(10)
12	RETRIEVE	WTR LAUNCH						1		1		1		1	4
								(1)		(1)		(1)		(1)	(4)
13	RETRIEVE	WTR LAUNCH						1		1		1		1	4
								(1)		(1)		(1)		(1)	(4)
14	ROUNDTRIP	WTR LAUNCH						1	1	1	1	1		1	6
								(1)	(1)	(1)	(1)	(1)		(1)	(6)
15	ROUND TRIP	WTR LAUNCH						1	1	1	1	1		1	6
								(1)	(1)	(1)	(1)	(1)		(1)	(6)
16	RETRIEVE	WTR LAUNCH									2				2
	ROUNDTRIP	WTR LAUNCH							4						4
	(TOTAL)								(4)		(2)				(6)

TABLE 4.3.4.3-11 (cont)

TRAFFIC ASSESSMENT: NASA NON-GEOSYNCH E.O. (cont) / PLANETARY OPTION: (510A/510ADE-3B)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION												TOTAL
			CALENDAR YEAR												
			79	80	81	82	83	84	85	86	87	88	89	90	
NASA NON-GEO TRAFFIC SUMMARY	SINGLE DEPLOY			1	2	1	1	2		2	2	1	1	3	16
	"	KS 505		1											1
	DOUBLE DEPLOY						1		1						2
	TRIPLE DEPLOY						2						2		4
	RETRIEVE							2		3	2	3		2	12
	"	KS 505												1	1
	ROUND TRIP							2	6	2	4	2		2	18
	"	KS 505							1						1
	DOUBLE DEPLOY ROUND TRIP												2		2
	(TOTAL)			(2)	(2)	(1)	(4)	(6)	(8)	(7)	(8)	(6)	(5)	(8)	(57)
17	SINGLE DEPLOY			1									2		3
18	SINGLE DEPLOY							2							2
19	SINGLE DEPLOY	KS 501								1	2				3
20	SINGLE DEPLOY	KS 501				2		2							4
22	SINGLE DEPLOY	EXPEND TUG								1	1		1	1	4
23	SINGLE DEPLOY	KS 501								2					2
24	SINGLE DEPLOY	EXPEND TUG						2					2		4

TABLE 4.3.4.3-11 (cont)

TRAFFIC ASSESSMENT: NASA PLANETARY / SUMMARY — OPTION: (510A/510ADE-3B)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION — CALENDAR YEAR 80*	80	81	82	83	84	85	86	87	88	89	90	TOTAL
NASA PLANETARY MISSIONS TRAFFIC SUMMARY	SINGLE DEPLOY			1				2					2		5
	"	KS 501				2		2		3	2				9
	"	EXPEND TUG						2		1	1		3	1	8
	(TOTAL)			(1)		(2)		(6)		(4)	(3)		(5)	(1)	(22)
NASA TRAFFIC SUMMARY	SINGLE DEPLOY			4	3	4	3	4	3	2	5	2	4	3	37
	"	KS 501				2		2		3	2				9
	"	KS 503	③				3								3
	"	KS 505	②	6	10	5	7								28
	"	KS 505A		2	1	1	2					1			7
	"	EXPEND TUG						2		1	1		3	1	8
	DOUBLE DEPLOY			1	1		1		1						4
	"	2XKS 504									4	3	1		8
	TRIPLE DEPLOY						2						2		4
	RETRIEVE							2		3	2	3		2	12
	"	KS 503						3	3						6
	"	KS 505												1	1
	ROUND TRIP							2	6	2	4	2		2	18
	"	KS 505						4	9	6	2	4	2	5	32
	"	KS 505A						3	2	2	2	1	5	4	19
	DOUBLE DEPLOY ROUND TRIP												2		2
	(TOTAL)		—	(13)	(15)	(12)	(18)	(22)	(24)	(19)	(22)	(16)	(19)	(18)	(198)

* Kick Stages Launched Prior to 1980 To Support Tug P/L Retrievals

TABLE 4.3.4.3-11 (cont)

MIXED MISSIONS: NASA GEOSYNCH OPTION: KICK STAGES

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
79			3		2							
	84-8		D							KS 503		
	-9		D							"		
	-10		D							"		
	84-4				D					KS 505		
	-7				D					"		

TABLE 4.3.4.3-12

MIXED MISSION : NASA GEOSYNCH (cont) VEHICLE : (510A/510ADE-3B)

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL PAYL WT	TOTAL PAYL VOL
80		2	1	3	1		1	1	2			
	①		D							KS 505	1700	8x8
	②			D						"	2100	12x8
	③			D						"	"	"
	④			D						"	"	"
	⑤				D					"	1800	10x14
	⑥	2D								—	"	20x6 10x12
	⑦						D			—	2600	12x8
	⑧							D		—	3000	20x10
	⑨								D	KS 505A	3500	25x14
	⑩								D	KS 505A	"	"

TABLE 4.3.4.3-12 (cont)

MIXED MISSION: NASA GEOSYNCH (cont) OPTION: (510A/510ADE-3B)

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
81		2	2	7	1			1	1			
	1		D							KS 505	1700	8×8
	2		D							"	"	"
	3			D						"	2100	12×8
	4			D						"	"	"
	5			D						"	"	"
	6			D						"	"	"
	7			D						"	"	"
	8			D						"	"	"
	9			D						"	"	"
	10				D					"	"	"
	11								D	KS 505A	3500	25×14
	12							D		—	3000	20×10
	13	2D								—	1800	20×6 10×12

TABLE 4.3.4.3-12 (cont)

MIXED MISSIONS: NASA GEOSYNCH (cont) OPTION: (510A/510ADE-3B)

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
82		2		3			1	2	1			
	1	D								KS505	900	10x6
	2	D								"	"	"
	3			D						"	2100	12x8
	4			D						"	"	"
	5			D						"	"	"
	6						D			—	2600	"
	7							D		—	3000	20x10
	8							D		—	"	"
	9								D	KS505A	3500	25x14

TABLE 4.3.4.3-12 (cont)

MIXED MISSION : NASA GEOSYNCH (cont) OPTION: (510A / 510ADE -0B)

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
83		1	1	3	2	3		2	2			
	1	D								KS505	900	10x6
	2		D							"	1700	8x8
	3			D						"	2100	12x8
	4			D						"	"	"
	5			D						"	"	"
	6				D					"	1800	10x14
	7				D					"	"	"
	8					D				KS503	2800	12x14
	9					D				"	"	"
	10					D				"	"	"
	11							D		—	3000	20x10
	12							D		—	"	"
	13								D	KS505A	3500	25x14
	14								D	"	"	"

TABLE 4.3.4.3-12 (cont)

MIXED MISSION : NASA GEOSYNCH (cont) OPTION: (510A/510ADE-38)

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
84		2		1	1			1	2	7		
		2	3	3	2					10		
	1	D								KS 505	900	10x6
		R								(KS 505)	"	"
	2	D								KS505	"	"
		R								(KS 505)	"	"
	3			D						KS 505	2100	12x8
				R						(KS 505)	"	"
	4				D					KS 505	1800	10x14
					R					(KS 505)	"	"
	5								D	KS 505A	3500	25x14
				R						(KS 505)	2100	12x8
	6								D	KS505A	3500	25x14
				R						(KS505)	2100	12x8
	7							D		KS505A	3000	20x10
					R					(KS505)	1800	10x14
	8		R							(KS 503)	1700	8x8
	9		R							"	"	"
	10		R							"	"	"

TABLE 4.3.4.3-12 (cont)

MIXED MISSIONS: NASA GEOSYNCH (cont) OPTION: (510A/510ADE-3B)

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
85		1	1	5	1		1	2	2	13		
		1	1	7	1	3				13		
	1	D								KS505	900	10x6
		R								(KS505)	"	"
	2		D							KS505	1700	8x8
			R							(KS505)	"	"
	3			D						KS505	2100	12x8
				R						(KS505)	"	"
	4			D						KS505	"	"
				R						(KS505)	"	"
	5			D						KS505	"	"
				R						(KS505)	"	"
	6			D						KS505	"	"
				R						(KS505)	"	"
	7			D						KS505	"	"
				R						(KS505)	"	"
	8				D					KS505	1800	10x14
					R					(KS505)	"	"
	9								D	KS505A	3500	25x14
				R						KS(505)	2100	12x8
	10								D	KS505A	3500	25x14
				R						KS(505)	2100	12x8
	11					R				(KS 503)	2800	12x14
	12					R				"	"	"
	13					R				"	"	"
	14						D			—	2600	12x8
	15							D		—	3000	20x10
	16							D		—	"	"

TABLE 4.3.4.3-12 (cont)

MIXED MISSIONS: NASA GEOSYNCH (cont) OPTION: (510A/510ADE-3B)

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
86		1		5					Z	8		
		2	2	3	1					8		
	①	D								KS 505	900	10×6
		R								(KS 505)	"	"
	②			D						KS 505	2100	12×8
				R						(KS 505)	"	"
	③			D						KS 505	"	"
				R						(KS 505)	"	"
	④			D						KS 505	"	"
				R						(KS 505)	"	"
	5			D						KS 505	"	"
					R					(KS 505)	1800	10×14
	6			D						KS 505	2100	12×8
			R							(KS 505)	1700	8×8
	7								D	KS 505A	3500	25×14
			R							(KS 505)	1700	8×8
	8								D	KS 505A	3500	25×14
		R								(KS 505)	900	10×6

TABLE 4.3.4.3-12 (cont)

MIXED MISSIONS: NASA GEOSYNCH (cont) OPTION: (510A/510ADE-3B)

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
87		1	1	6	2		1	2	2	15		
		1		3						4		
	1								D	KS505A	3500	25x14
				R						(KS505)	2100	12x8
	2								D	KS505A	3500	25x14
				R						(KS505)	2100	12x8
	3		D							KS505	1700	8x8
				R						(KS505)	2100	12x8
	4			2D						2x KS504	{2100 2100	24x8
	5			2D						"	"	"
	6			2D						"	"	"
	7				2D					"	{1800 1800	20x14
	8	D								KS505	900	10x6
		R								(KS505)	"	"
	9							D		—	3000	20x10
	10							D		—	"	"
	11						D			—	2600	12x8

TABLE 4.3.4.3-12 (cont)

MIXED MISSIONS: NASA GEOSYNCH (cont) OPTION: (510A/510ADE-3B)

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
88		2		7	1			1	2	13		
		1	1	1	2					5		
	1								D	KS 505A	3500	25 x 14
					R					(KS 505)	1800	10 x 14
	2	D								KS 505	900	10 x 6
			R							(KS 505)	1700	8 x 8
	3				D					KS 505	1800	10 x 14
					R					(KS 505)	"	"
	4			D						KS 505	2100	12 x 8
				R						(KS 505)	"	"
	5			2D						2x KS 504	2100 / 2100	24 x 8
	6			2D						"	"	"
	7			2D						"	"	"
	8	D								KS 505	900	10 x 6
		R								(KS 505)	"	"
	9								D	KS 503	3500	25 x 14
	10							D		—	3000	20 x 10

TABLE 4.3.4.3-12 (cont)

MIXED MISSIONS: NASA GEOSYNCH (cont) OPTION: (510A/510ADE-3B)

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
89		1	1	2		3		1	2	10		
		1		5	1					7		
	1								D	KS505A	3500	25x14
					R					(KS 505)	1800	10x14
	2								D	KS505A	3500	25x14
				R						(KS505)	2100	12x8
	3			D						KS505	"	"
				R						(KS505)	"	"
	4			D						KS 505	"	"
				R						(KS 505)	"	"
	5					D				KS505A	2800	12x14
				R						(KS505)	2100	12x8
	6					D				KS 505A	2800	12x14
				R						(KS505)	2100	12x8
	7					D				KS 505A	2800	12x14
		R								(KS 505)	900	10x6
	8							D		—	3000	20x10
	9	D	D							2x KS504	2600	18x8 10x14

TABLE 4.3.4.3-12 (cont)

MIXED MISSIONS: NASA GEOSYNCH (cont) OPTION: (510A/510ADE-38)

YEAR	FLT NO	PAYLOAD 1	2	3	4	5	6	7	8	AUX. ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
90		2		3			2		2	9		
		2	1	5	1					9		
	1								D	KS505A	3500	25x14
					R					(KS505)	1800	10x14
	2								D	KS505A	3500	25x14
			R							(KS505)	1800	10x14
	3						D			KS505A	2600	12x8
				R						(KS505)	2100	"
	4						D			KS505A	2600	"
				R						(KS505)	2100	"
	5			D						KS505	"	"
				R						(KS505)	"	"
	6			D						KS505	"	"
				R						(KS505)	"	"
	7			D						KS505	"	"
				R						(KS505)	"	"
	8	D								KS505	900	10x6
		R								(KS505)	"	"
	9	D								KS505	"	"
		R								(KS505	"	"

TABLE 4.3.4.3-12 (cont)

MIXED MISSION : NASA NON-GEOSYNCH OPTION: (510A/510ADE-3B)

YEAR	FLT NO	PAYLOAD 12	13	14	15	16	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
83		1	1	1	1	4			
	1	D				2D		11000	30x13
	2		D			2D		10000	29x13
	3			D	D			2800	18x16
84				1	1				
		1	1	1	1				
	①				D			2000	8x11
					R			"	"
	②			D				800	10x5
				R				"	"
	③		R					1000	7x7
	④	R						2000	8x6
85		1	1	1	1	4			
				1	1	4			
	①					D		4500	11x13
						R		"	"
	②					D		"	"
						R		"	"
	③					D		"	"
						R		"	"
	④					D		"	"
						R		"	"
	⑤				D			2000	8x11
					R			"	"
	⑥			D				800	10x5
				R				"	"
	7	D	D					3000	8x13 15x7
86				1	1				
		1	1	1	1				

SAME AS '84 MISSION SPREAD

TABLE 4.3.4.3-13

MIXED MISSION : NASA NON-GEOSYNCH (cont) OPTION : (510A/510ADE-38)

YEAR	FLT NO	PAYLOAD 12	13	14	15	16	AUX ELEMENT	TOTAL P/L WT	TOTAL P/L VOL
87		1	1	1	1				
				1	1	4			
	①				D			2000	8x11
					R			"	"
	②			D				800	10x5
				R				"	"
	③					R		4500	11x13
	④					R		"	"
	5		D					2000	8x6
						R		4500	11x13
	6			D				1000	7x7
						R		4500	11x13
88				1	1				
			1	1	1				
SAME AS '84 MISSION SPREAD									
89			1	1	1	6			
					1	1			
	1				D	D		6500	19x13
					R			2000	8x11
	2			D		D		5300	21x13
				R				800	10x5
	3			D		2D		10000	29x13
	4		D			2D		11000	30x13
90				1	1				
			1	1	1	1			
SAME AS '84 MISSION SPREAD									

TABLE 4.3.4.3-13 (cont)

TRAFFIC ASSESSMENT: DOD GEOSYNCH — OPTION: (510A/510ADE-38)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION — CALENDAR YEAR 80*	80	81	82	83	84	85	86	87	88	89	90	TOTAL
25	SINGLE DEPLOY	KS 505					2								2
	DOUBLE DEPLOY			1	1	1									3
	ROUND TRIP	KS 505						2	2	2	2	2	2	2	14
	(TOTAL)			(1)	(1)	(1)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(19)
26	SINGLE DEPLOY	KS 505		1		1	1								3
	ROUND TRIP	KS 505						1		1	1	1		1	5
	(TOTAL)			(1)		(1)	(1)	(1)		(1)	(1)	(1)		(1)	(8)
27	SINGLE DEPLOY	KS 505	1	1		1	1								3
	ROUND TRIP	KS 505						1	1		1	1	1	1	6
	(TOTAL)		–	(1)		(1)	(1)	(1)	(1)		(1)	(1)	(1)	(1)	(9)
28	SINGLE DEPLOY	KS 503					1	1		1		1			4
	"	KS 505					1	1							2
	RETRIEVE	KS 503											1	1	2
	ROUND TRIP	KS 505											1	1	2
	(TOTAL)						(2)	(2)		(1)		(1)	(2)	(2)	(10)
30	SINGLE DEPLOY	KS 505A							2		1		1		4
31	SINGLE DEPLOY	KS 503			2			2			2			2	8
	RETRIEVE	KS 503						2			2			2	6
					(2)			(4)			(4)			(4)	(14)

* Kick Stages Launched Prior To 1980 To Support Tug P/L Retrievals

TABLE 4.3.4.3-14

TRAFFIC ASSESSMENT: DOD GEOSYNCH (cont) OPTION: (510A/510ADE-3B)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 80*	80	81	82	83	84	85	86	87	88	89	90	TOTAL
DOD GEOSYNCH TRAFFIC SUMMARY MISSIONS (25-31)	SINGLE DEPLOY	KS 503			2		1	3		1	2	1		2	12
	"	KS 505		2		2	5	1							10
	"	KS 505A							2		1		1		4
	DOUBLE DEPLOY			1	1	1									3
	RETRIEVE	KS 503						2			2		1	3	8
	ROUND TRIP	KS 505						4	3	3	4	4	4	5	27
	(TOTAL)			(3)	(3)	(3)	(6)	(10)	(5)	(4)	(9)	(5)	(6)	(10)	(64)
	DEPLOY	KS 505	①												—
	(TOTAL)		①												—

* Kick Stages Launched Prior To 1980 To Support Tug P/L Retrievals

TABLE 4.3.4.3-14 (cont)

TRAFFIC ASSESSMENT: DOD NON-GEOSYNCH — OPTION: (510A/510ADE-38)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION — CALENDAR YEAR 80	81	82	83	84	85	86	87	88	89	90	TOTAL
32	SINGLE DEPLOY	KS 505	4		4	4								12
	ROUND TRIP	KS 505					4		4	4	4		4	20
	(TOTAL)		(4)		(4)	(4)	(4)		(4)	(4)	(4)		(4)	32
33	SINGLE DEPLOY		1		2	1								4
	ROUNDTRIP							2	1		2	1		6
	(TOTAL)		(1)		(2)	(1)		(2)	(1)		(2)	(1)		(10)
34	SINGLE DEPLOY			1		1								2
	RETRIEVE						1		1		1			3
	(TOTAL)			(1)		(1)	(1)		(1)		(1)			(5)
35	SINGLE DEPLOY		2	2	2	2								8
	ROUND TRIP						2	2	2	2	2	2	2	14
	(TOTAL)		(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	22
36	TRIPLE DEPLOY		1			1					1			3
37	TRIPLE DEPLOY		1				1					1		3
38	TRIPLE DEPLOY		1					1					1	3
39	TRIPLE DEPLOY	WTR LAUNCH				1	1		1	1		1	1	6
40	DOUBLE DEPLOY	WTR LAUNCH				2		1						3
	ROUND TRIP	WTR LAUNCH							2		2	2		6
	RETRIEVE	WTR LAUNCH							2					2
	(TOTAL)					(2)		(1)	(4)		(2)	(2)		(11)

TABLE 4.3.4.3-14 (cont)

TRAFFIC ASSESSMENT: DOD NON-GEOSYNCH (cont) OPTION: (51DA/510ADE-38)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION CALENDAR YEAR 79	80	81	82	83	84	85	86	87	88	89	90	TOTAL
41	SORTIE	WTR LAUNCH					1		1		1		1		4
DOD NON-GEO TRAFFIC SUMMARY MISSIONS (32-41)	SINGLE DEPLOY			3	3	4	4								14
	"	KS 505		4		4	4								12
	DOUBLE DEPLOY						2		1						3
	TRIPLE DEPLOY			3			2	2	1	1	1	1	2	2	15
	RETRIEVE							1		3		1			5
	ROUND TRIP							2	4	5	2	6	5	2	26
	"	KS 505						4		4	4	4		4	20
	SORTIE						1		1		1		1		4
	(TOTAL)			(10)	(3)	(8)	(13)	(9)	(7)	(13)	(8)	(12)	(8)	(8)	(99)

TABLE 4.3.4.3-14 (cont)

TRAFFIC ASSESSMENT: DOD SUMMARY — OPTION: (510A/510ADE-38)

MISSION DESIGNATION	FLIGHT MODE	REMARKS	FLIGHT DISTRIBUTION — CALENDAR YEAR 80*	80	81	82	83	84	85	86	87	88	89	90	TOTAL
DOD TRAFFIC SUMMARY	SINGLE DEPLOY			3	3	4	4								14
	"	KS 503			2		1	3		1	2	1		2	12
	"	KS 505	①	6		6	9	1							22
	"	KS 505A							2		1		1		4
	DOUBLE DEPLOY			1	1	1	2		1						6
	TRIPLE DEPLOY			3			2	2	1	1	1	1	2	2	15
	RETRIEVE							1		3		1			5
	"	KS 503						2			2		1	3	8
	ROUND TRIP							2	4	5	2	6	5	2	26
	"	KS 505						8	3	7	8	8	4	9	47
	SORTIE						1		1		1		1		4
	(TOTAL)		—	(13)	(6)	(11)	(19)	(19)	(12)	(17)	(17)	(17)	(14)	(18)	(163)

1. Kick Stages Launched Prior To 1980 To Support Tug P/L Retrievals

TABLE 4.3.4.3-14 (cont)