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NASA - Langley

DEPLOYMENT TECHNIQUES OF A PARAWING USED AS A RECOVERY DEVICE FOR MANNED REENTRY VEHICLES AND LARGE BOOSTERS

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One of the problems associated with recovery of manned reentry vehicles and large boosters is deployment of the recovery device, and studies of this problem at Langley to date have been primarily on parawings. A slide has been prepared showing the status of parawing-deployment investigations at Langley.

SLIDE NO. 1, PLEASE

The majority of the investigations were made at low subsonic speeds utilizing dynamic models in free flight. For the investigations made to date, the results obtained are primarily in the form of movie film which shows the deployment process. As the chart indicates, most of the deployment tests have been on parawings having rigid leading edge and keel members. I would like to discuss very briefly these tests. The drop tests consisted, in general, of releasing dynamic models at low speeds ($q \approx 5^{\#}/ft^2$) from a hovering helicopter; most of the deployments were successful. Results from rocket launch tests indicated successful deployments could be obtained at Mach numbers between 2.0 and 3.0 and at altitudes ranging up to 180,000 feet. On the landing loads track models were deployed at a dynamic pressure of about $13^{\#}/ft^2$. The wind tunnel tests consisted of deploying the model at a dynamic pressure of $13^{\#}/ft^2$ and also at Mach numbers between 2.5 and 4.5. Currently planned investigations include drop tests of a full scale model of a parawing which will be used in the micrometeoroid experiments. This model will be released at low speeds from a helicopter. Finally, for the wind tunnel tests two aeroelastically scale models are being constructed. Tests will include the determination of the loads during deployment and also its proper deployment sequence. A third parawing configuration is under study which would have curved leading edges or a cylindrical canopy shape so as to obtain larger L/D's. (Slide off)

My talk today will deal with the results of an investigation involving complete deployment of a parawing when stowed as a recovery device on a 1/5-scale model of a manned reentry vehicle and on a 1/12-scale model of a large booster. These models were radio-controlled and released from a helicopter for flight testing at an approximate altitude of 3500 feet. The next slide shows the full-scale characteristics and schematic drawings of the booster-parawing combination and of the manned reentry vehicle-parawing combination.

SLIDE NO. 2, PLEASE

The results of the investigation will be shown in motion pictures and will illustrate some of the problem areas encountered and how a satisfactory deployment technique was developed. However, because some of the details of the deployment technique may be hard to follow in the motion picture film, the sequence for satisfactory deployment is shown on slides. First, a deployment is shown utilizing a folded parawing for compact stowage on the booster, and then a deployment is shown utilizing a telescoped parawing on the reentry vehicle. The next slide shows the satisfactory deployment technique for the booster.

SLIDE NO. 3, PLEASE

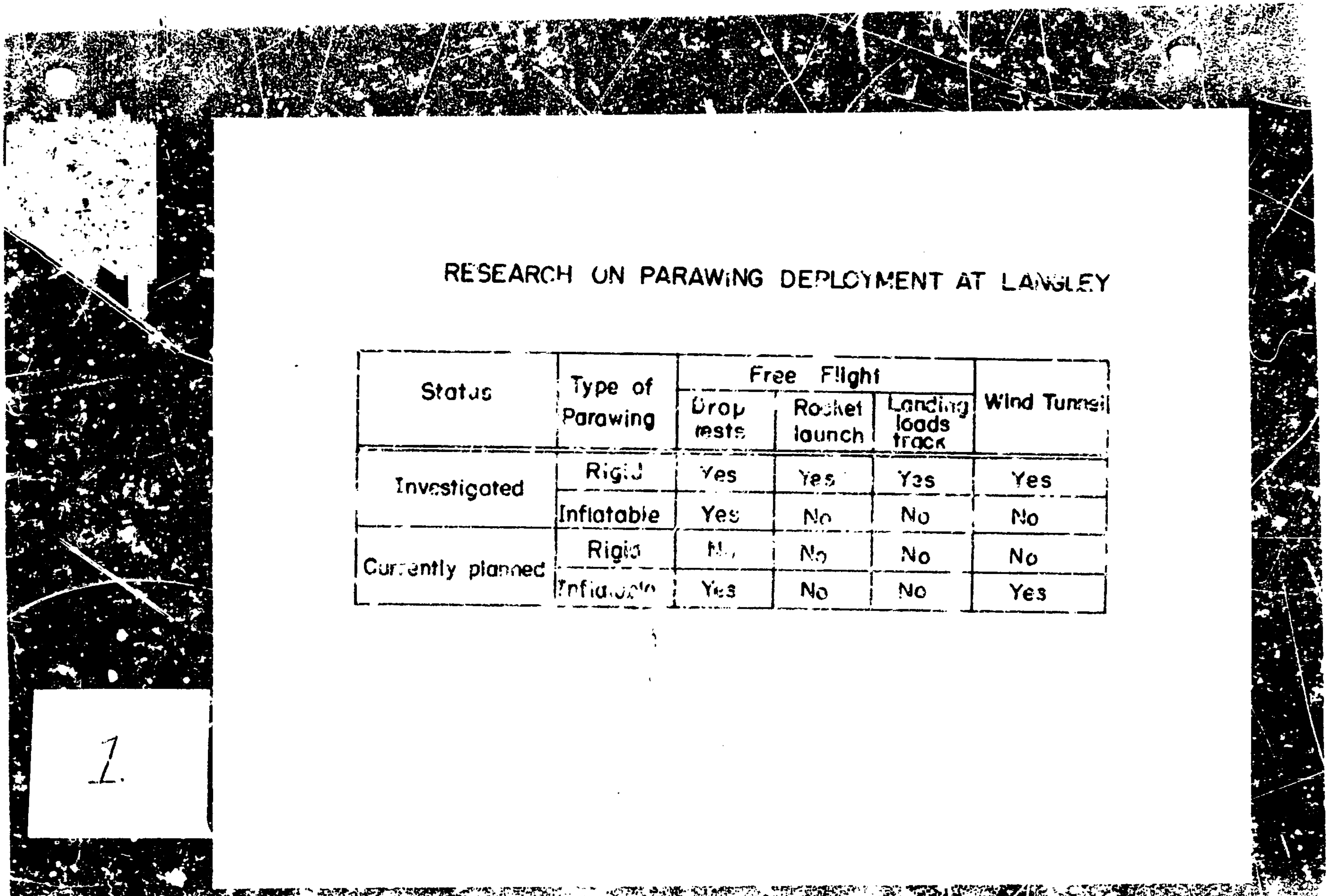
The next slide shows the satisfactory deployment technique for the reentry vehicle.

SLIDE NO. 4, PLEASE

The movie film I am going to show you depicts some of the highlights of the investigation, including, as previously mentioned, some of the problems encountered and the satisfactory technique developed.

MOVIE FILM PLEASE

In conclusion, on the basis of the ensuing motions obtained in this investigation it appears that deployment problems, not considering loads, associated with parawings as a recovery device at low speeds can be satisfactorily solved within the present state of the art.



RESEARCH ON PARAWING DEPLOYMENT AT LANGLEY

Status	Type of Parawing	Free Flight			Wind Tunnel
		Drop tests	Rocket launch	Landing loads track	
Investigated	Rigid	Yes	Yes	Yes	Yes
	Inflatable	Yes	No	No	No
Currently planned	Rigid	No	No	No	No
	Inflatable	Yes	No	No	Yes

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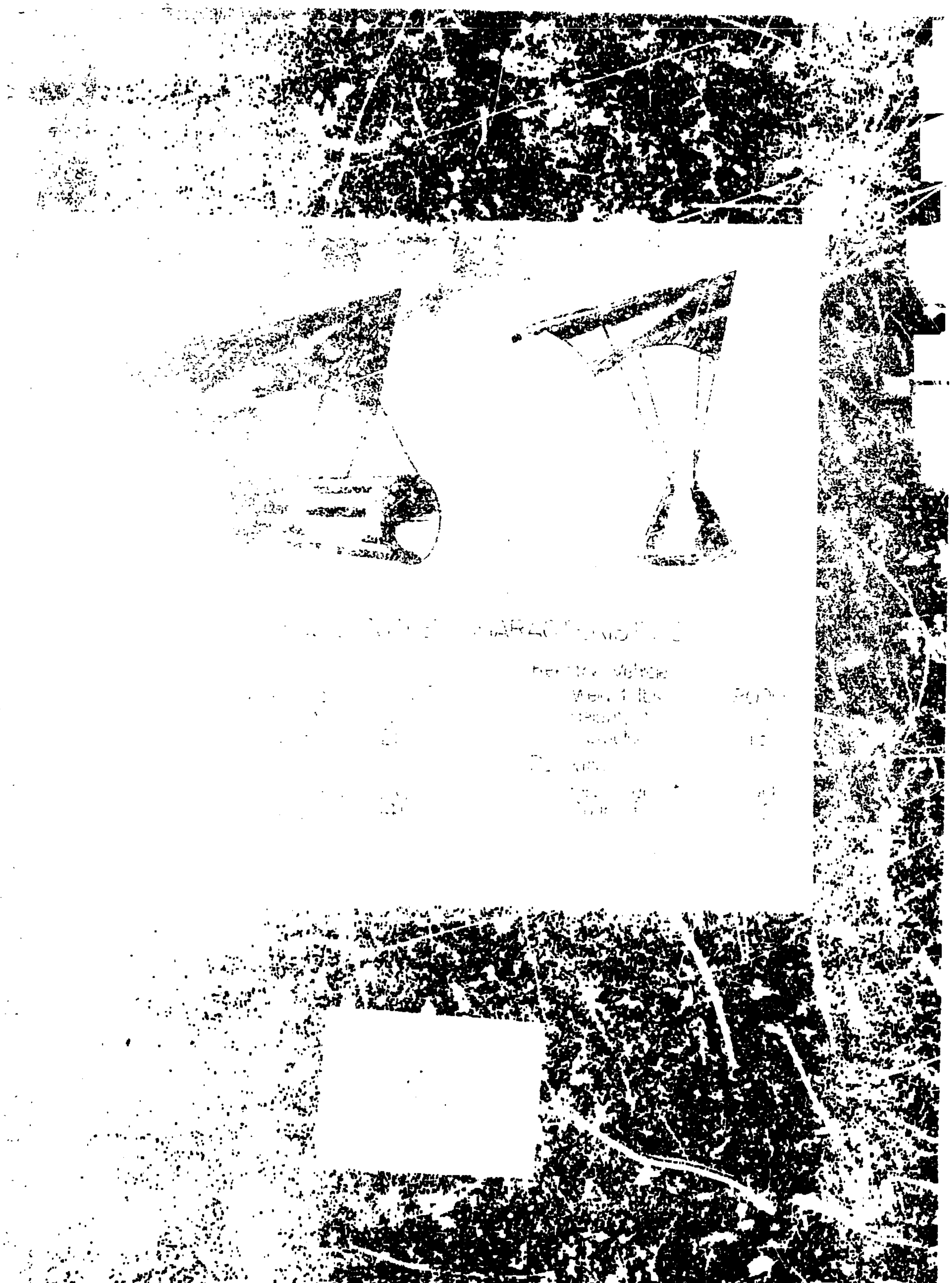
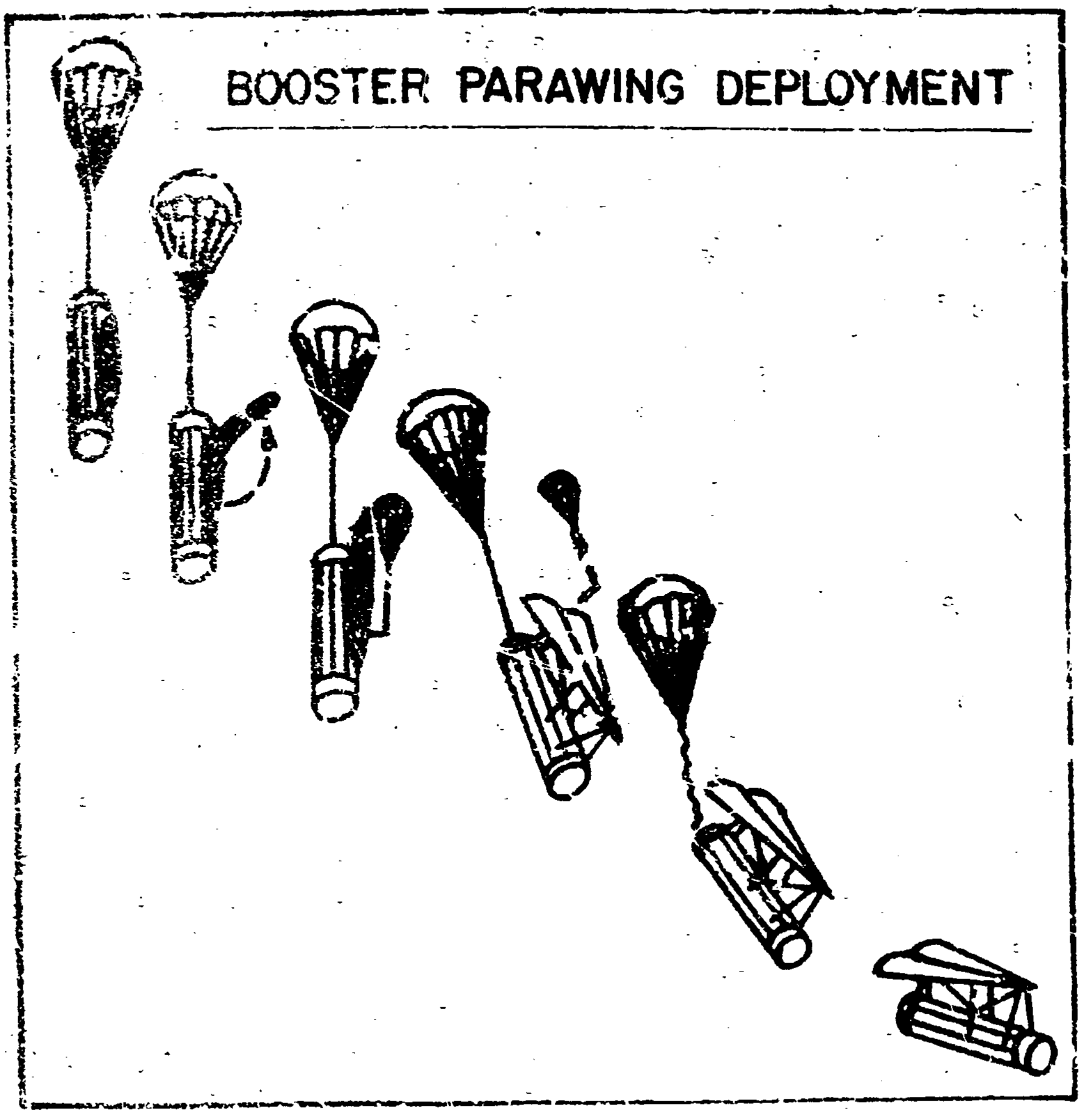

Reentry Vehicle



BOOSTER PARAWING DEPLOYMENT

REENTRY VEHICLE

PARAWING DEPLOYMENT