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Structure Design of Payload Section of KSR-III

Young-Soon Jang*, Yeong-Moo Yi**

Abstract

In this paper, structure design of the payload section of the KSR-III was performed. The payload section of the KSR-III, which corresponds to the second stage, consists of the Scientific Payload Section for the mission of the rocket, the Payload Section (Electronics) for the communication between the rocket and the ground station, and the Payload Section (Attitude Control) for the attitude control of the rocket. In order to accomplish the mission, every payload and component should operate successfully during the mission period and the structure must satisfy the requirements of the payloads.

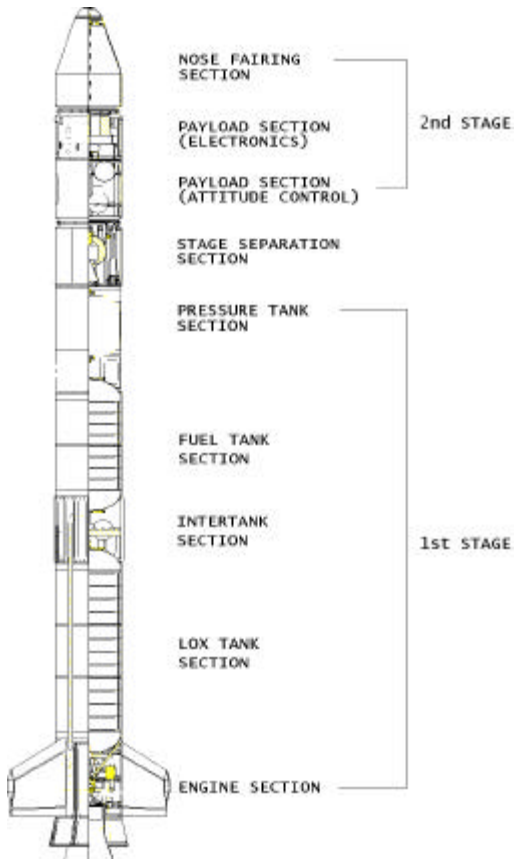
In this research, precise composition of the payload section and payloads arrangement of the KSR-III were performed. And the modification of the structure to meet the requirements were described.

“3 ()”
 KSR-III 2 ,
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 ,
 KSR-III
 , /
 : 3 (KSR-III), (payload section), (structure design)

1.

3 (KSR-III) 1 2 1 2
 * . / ysjang@kari.re.kr . KSR-III
 ** . / ymy@kari.re.kr (Scientific Payload Section),

(Payload)
 Electronics) () (Payload Section,), 2 가
 Attitude Control) () (Payload Section,)



1. Configuration of KSR-III

2nd STAGE KSR-III

2.

2.1

KSR-III

KSR-III 1
2

2

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가
 (Environmental Loads)

2.1.1

[1,2,3]

KSR-III

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(AGP), (IMS),
 (MAG/ AIM, MAG/ SIM), (UVR),
 (LEP)

가

(FOV)
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2.1.2

2.1.1

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5 , 5

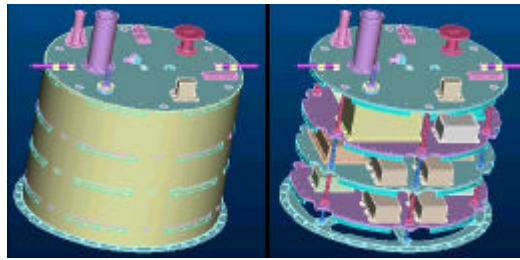
635 mm , 5

953 mm

1. Design requirements of the scientific payload section

Design limit load	Shear	18.31 kN
	Bending	13.30 kN
	Axial	41.94 kN
Temperature	60. C (Duration: 10 min.)	
Natural freq.	100 Hz	
CG offset	1.0 mm	
Payloads (Sensors, Circuit, Power)	AGP	
	IMS	
	MAG	
	LEP	
	UVR	
	Micro_G	
	DAM 1	
DAM 2		

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2. Configuration of the scientific payload section

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1.0 mm

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2. Mass properties of the scientific payload section

	Mass (kg)	CG (mm) (ref. : sta. 2097.7)		
		X	Y	Z
Structure	62.60	-	-	-
Payloads	58.68	-	-	-
Total	121.28	-386.25	1.10	-7.95

2.2

KSR-III

(FTS)

Payloads (Assembly, Sensors, Circuits, Powers)	Electronic payload mount asm
	INS asm
	Antennas (X, S, UHF)
	Ozone sensor asm
	Umbilical connectors (TLM, INS, IGN)

2.2.1.2

가 / 가

2.2.1

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2.2.1.1

[1,2,3]

-38°

X-Band

S-Band

UHF Ranging

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4

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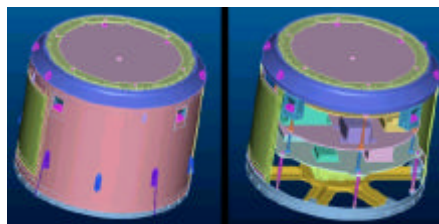
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3. Design requirements of the electronic payload section (skin assembly)

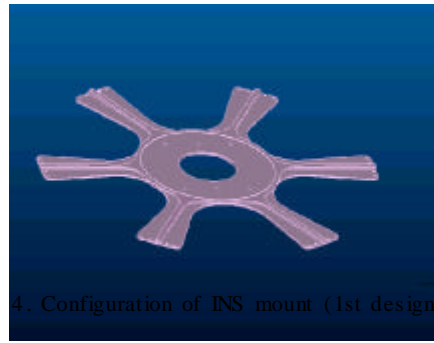
Design limit load	Shear	26.22 kN
	Bending	31.53 kN
	Axial	50.83 kN
Temperature	140, C (Duration: 10 min.)	



3. Configuration of the electronic payload section (skin assembly)

4. Mass properties of the electronic payload section (skin assembly)

	Mass (kg)	CG (mm) (ref. : sta. 2900)		
		X	Y	Z
Structure	42.49	-	-	-
Payloads	17.48	-	-	-
Total	59.97	-274.58	-4.84	7.46



2.2.1.3

(INS)



가 0.03°

가 KSR-III 300 Hz



■ 1 [4]

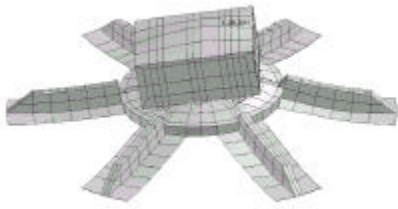
가 28.17 Hz

가

1 1

273.44 Hz

7



7. Deformation shape of the INS assembly (2nd design, 1st mode)

■ 2

[6]

■ 2

[5]

5

5. Natural frequencies of the INS mount with hinge BC (2nd design)

Mode	1	2	3	4
Frequency(Hz)	109.87	177.55	192.37	438.57

6

가 (Impact hammer)

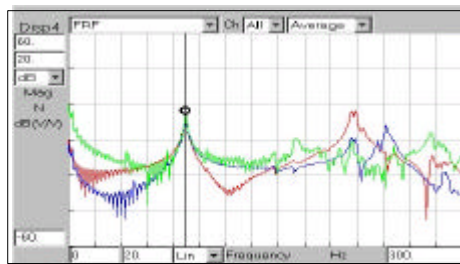
2

1 가

가

2

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8. FRF of the INS mount (2nd design)

8

89.4 Hz

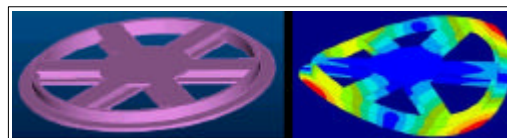
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9. Configuration and deformation shape of the INS mount (3rd design)



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6. Natural frequencies of the INS mount with free BC (3rd design)

Mode	1	2	3	4
Frequency(Hz)	253.10	253.83	404.85	448.85

2.2.2

2.2.2.1

[1,2,3]

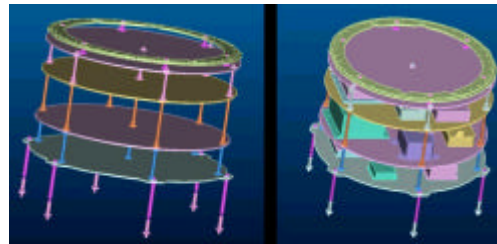
KSR-III

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가 7

7. Design requirements of the electronic payload section (mount assembly)

Design limit load	Inertia force of mount asm + 0.5xLoad of skin asm
Temperature	50. C (Duration: 10 min.)
Natural freq.	100 Hz
CG offset	1.0 mm (with skin asm)
Payloads (Sensors, Circuit, Power)	Transmitter/ Receiver/ TEU
	Battery 1,2,3/ PCU
	EDU Circuit/ Battery
	FTS 1,2 Decoder/ Battery
	Transponder
	DAM 3,4,5
	Shock Circuit
Ozone Sensor Circuit	



10. Configuration of the electronic payload section (mount assembly)

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2.2.2.2

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8. Mass properties of the electronic payload section (mount assembly)

	Mass (kg)	CG (mm) (ref. : sta. 2900)		
		X	Y	Z
Structure	54.43	-	-	-
Payloads	57.30	-	-	-
Total	111.73	-503.21	2.25	-3.34

9 가

9. Mass properties of the electronic payload section

	Mass (kg)	CG (mm) (ref. : sta. 2900)		
		X	Y	Z
Structure	96.32	-	-	-
Payloads	74.79	-	-	-
Total	171.71	-423.35	-0.22	0.43

2.3.

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가 2

2.3.1

[1,2,3]

가 (N2)
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10. Design requirements of the control payload section

Design limit load	Shear	28.42 kN
	Bending	58.97 kN
	Axial	61.39 kN
Temperature	50% C (Duration: 10 min.)	
Natural Freq.	100 Hz	
CG offset	1.0 mm	
Payloads (Assembly, Sensors, Circuits, Powers)	Spin/ 3-Axis thruster	
	Umbilical connector, Safe_arm device	
	High pressure tank/ N2 gas	
	Battery, PCU, DAM 6/ 7	
	Valve, Pipe, Fitting	

2.3.2

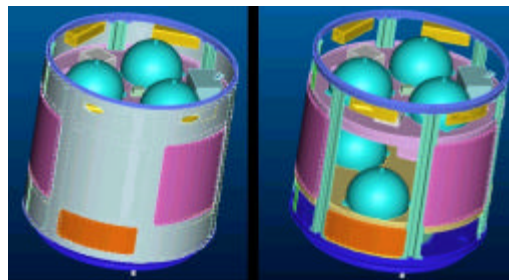
2.3.2.1

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11. Configuration of the control payload section

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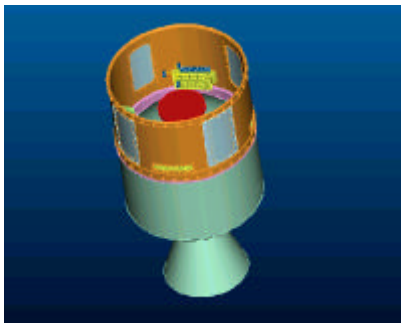
2.3.3 [7]

1 가 2 3 가 4 가 2 가 12 가

10 100Hz

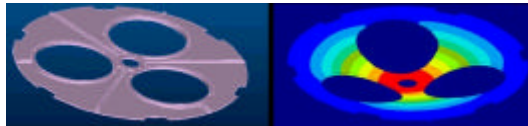
11. Mass properties of the control payload section

	Mass (kg)	CG (mm) (ref. : sta. 3900)		
		X	Y	Z
Total	180.39	-459.52	-13.40	5.62



12. Configuration of the kick motor assembly

1 가 1 가 13 1 1 1 24.92 Hz



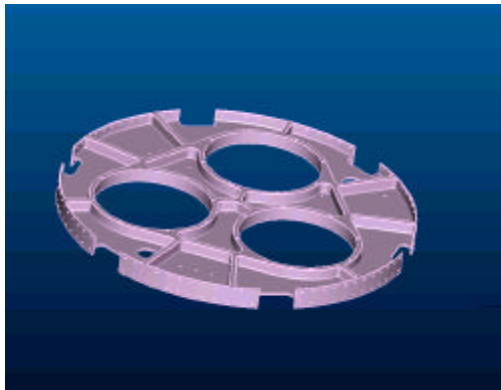
13. Configuration and deformation shape of mount 1 of the control payload section (1st design)

90° 3 4 가 11 14 가

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1
100 Hz
120.10 Hz
가

Ç# 12. Comparisons between 1st and 2nd design of mount of the control payload section

	1st Design	2nd Design
Mount thickness	4 mm	6 mm
Rib thickness/height	8/ 14 mm	20/ 32 mm
Weight	6.753 kg	17.588 kg
Fundamental freq.	24.92 Hz	120.10Hz

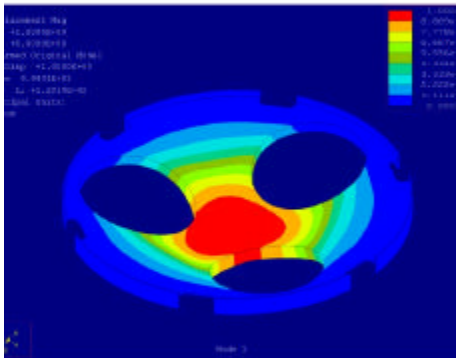


payload section (2nd design)

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KSR-III



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가 20% ,
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 (I) , , 1998.4.
2. , 3
 (II) , , 1999.4.
3. , 3
 (III) , , 2000.4.
4. ,
 , KSR-III , KARI-
 DN- -00-42, 2000.7.
5. , (II),
 KSR-III , KARI-TN-
 -01-51, 2001.8.
6. ,
 (II), KSR-III , KARI-
 DN- -01-36, 2001.8.
7. ,
 , KSR-III , KARI-
 DN- -00-52, 2000.10.