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LONG-TERM COMPATIBILITY TEST OF RDX WITH HNS

Patricia A. Foster

DEVELOPMENT DIVISION

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MASTER

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ABSTRACT

A long-term compatibility study of cyclotrimethylenetrinitramine (RDX) Type B Class B and Type B Class G with hexanitrostilbene II (HNS) has been partially completed. The test configuration for this study was an RDX pellet sandwiched between two HNS pellets. Sandwiches were then placed into containers having a helium atmosphere and thermally aged at 60 and 100 C. The study at 100 C has been completed.

DISCUSSION

RDX Type B Class B which is recrystallized from acetone was the main concern of this compatibility study conducted at temperatures of 60 and 100 C. RDX Type B Class G (recrystallized from cyclohexanone) was included to determine if differences in compatibility of materials recrystallized from different solvents could be detected. Both the RDX and HNS used in this study were supplied by Sandia Laboratories. The test configuration, containers and starting material have been previously discussed(1).

The schedule for the removal of the containers from the aging ovens is given in Table I. The study at 60 C has been only partially completed. The composition of the evolved gas atmosphere for the containers which have been removed from the 60 C ovens is given in Table II. All containers that were placed in the 100 C oven have been removed, and their atmosphere analysis is given in Table III.

From the 100 C aging data it was concluded that RDX Type B Class G in both the control and coupon configurations decomposes faster than the Type B Class B because:

1. Control samples of RDX Type B Class G evolved more NO, N₂O and CO₂ than RDX Type B Class B (see Table III).
2. Coupon samples (RDX sandwiched between HNS pellets) evolved more NO, N₂O and CO₂ with RDX Type B Class G than with RDX Type B Class B (see Table III).
3. Chemical reactivity test data show that after aging RDX Type B Class G evolved more NO, N₂O and CO₂ than RDX Type B Class B (see Table IV).
4. RDX Type B Class G both alone and with HNS exhibited a darker color after aging than RDX Type B Class B (see Figs. 1 and 2).

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(1) Foster, P. A., *Long-Term Compatibility of RDX with HNS*, July - Sept. 1974, P.O. 58-6301.

Neither the RDX Type B Class G nor the Type B Class B aged for 1 year at 60 C exhibited any visual difference from the starting material. However, when aged at 100 C for 1 year RDX Type B Class G turned much darker than the Class B material. Fig. 3 shows sandwiches using both RDX classes after being aged for 1 year at 100 C. The side of the HNS pellets next to the RDX Class G turned much darker than the same assembly containing the RDX Class B.

Differential thermal analysis of RDX Class B and Class G both before and after aging disclosed no differences in the thermal decomposition of the two materials. Thin layer chromatography evaluation of the HNS after aging for 6 months and 1 year with the RDX Type B Class G indicated no significant change. Henkin tests are being scheduled.

COMMENTS AND CONCLUSIONS

HNS appears to be more compatible with RDX Type B Class B than RDX Type B Class G. Compatibility problems at 100 C such as increased amounts of evolved gas and darker coloration after aging are associated with the RDX Class G both alone and with HNS. The RDX Class G properties responsible for this behavior are not known. However, it is evident that the RDX Class G is decomposing at a faster rate than the Class B. Decomposition rates will be determined after the 60 C study has been completed.

Table I. RDX Class B or G Pellet Sandwiched Between Two HNS Pellets

Container No.	Temperature (C)	Date Removed From Oven	Approximate Date to Be Removed From Oven	Approximate Time in Oven (months)
RDX Lot 4RCG 110, Type B, Class G				
107	100	05/18/1974		1
82	100	07/23/1974		3
91	100	09/26/1974		6
87	100	04/21/1975		12
111	60	07/25/1974		3
113	60	09/27/1974		6
105	60	04/27/1975		12
106	60		10/20/1975	18
110	60		04/20/1976	24
108	Ambient		04/20/1976	24
RDX Lot 72 C, Type B, Class B				
109	100	05/21/1974		1
41	100	07/24/1974		3
7	100	09/26/1974		6
88	100	04/21/1975		12
101	60	07/25/1974		3
103	60	09/27/1974		6
44	60	04/22/1975		12
48	60		10/20/1975	18
17	60		04/20/1976	24
14	Ambient		04/20/1976	24
HNS and RDX Controls				
46 ^a	100	04/21/1975		12
102 ^b	100	04/21/1975		12
47 ^c	100	04/21/1975		12

^aContainer 46 contains 1 HNS pellet only.

^bContainer 102 contains 1 RDX Lot 72 C, Type B, Class B pellet only.

^cContainer 47 contains 1 RDX Lot 4RCG 110, Class G pellet only.

Table II. Gas Analysis of Samples Removed from 60 C Oven
(Numbers are in Volume Percent)

<u>Container No.</u>	<u>Approximate Time in Oven (months)</u>	<u>N₂</u>	<u>H₂</u>	<u>CO</u>	<u>NO</u>	<u>CO₂</u>	<u>N₂O</u>	<u>Ar</u>	<u>Acetone</u>	<u>He</u>	<u>O₂</u>
HNS/RDX Class G/HNS											
111	3	1.50	-	-	-	0.11	-	-	-	98.18	0.11
113	6	0.89	-	-	-	0.13	-	0.03	-	98.95	-
105	12	0.57	-	-	-	0.07	0.42	-	-	98.83	0.11
HNS/RDX Class B/HNS											
101	3	0.08	-	-	-	0.06	-	-	0.02	99.84	-
103	6	0.07	0.10	-	-	0.06	-	-	-	99.77	-
44	12	0.47	-	-	-	0.07	-	-	0.04	99.42	-

Table III. Gas Analysis of Samples Removed from 100 C Oven

(Numbers are in Volume Percent)

Container No.	Approximate Time in Oven (months)	N ₂	H ₂	CO	NO	CO ₂	N ₂ O	Ar	Acetone	He	O ₂	CH ₄
HNS/RDX Class G/HNS												
107	1	0.66	-	-	0.33	-	1.55	0.06	-	97.40	-	-
82	3	0.47	0.05	-	0.73	0.59	2.64	0.04	-	95.48	-	-
91	6	1.73	-	0.12	1.35	2.03	4.20	-	-	90.57	-	-
87	12	6.90	0.15	-	3.77	10.60	19.01	-	0.04	59.22	0.12	0.19
HNS/RDX Class B/HNS												
109	1	0.73	-	-	-	0.16	0.14	0.05	0.12	98.80	-	-
41	3	0.18	0.07	-	0.23	0.65	-	0.02	0.08	98.77	-	-
7	6	0.38	-	-	-	-	2.25	0.08	0.07	97.22	-	-
88	12	5.82	0.21	-	0.77	1.39	-	0.09	0.08	91.49	0.15	-
102*	12	4.94	0.18	-	1.86	7.49	19.44	-	0.09	65.83	0.17	-
47**	12	17.21	0.05	-	-	24.74	43.61	-	-	14.02	0.21	0.16
46***	12	77.44	-	-	-	0.10	-	0.94	-	-	21.52	-

*Only contains 1 RDX Class B pellet.

**Only contains 1 RDX Class G pellet.

***Only contains 1 HNS pellet - Container leaked.

Table IV. Chemical Reactivity Test Data of RDX Type B Class B and RDX Type B Class G Before and After Aging

(Gas Volumes are in ml at STP)

Material	Time in Oven (months)	Temperature of Oven (C)	N ₂	CO	NO	CO ₂	N ₂ O	Total
RDX Class G	Before Aging		0.012	T	-	0.004	0.018	0.034
	Before Aging		0.003	-	0.001	0.003	0.019	0.026
	1	100	0.008	0.001	0.002	0.005	0.018	0.034
	1	100	0.029	0.001	-	0.006	0.015	0.051
	3	100	0.007	0.001	0.002	0.004	0.014	0.028
	3	100	0.021	0.001	-	0.004	0.014	0.040
	6	100	0.017	0.001	-	0.007	0.019	0.044
	6	100	0.015	0.001	-	0.007	0.018	0.041
	12	100	0.035	0.003	0.017	0.034	0.060	0.149
	12	100	0.034	0.002	0.016	0.033	0.060	0.145
	3	60	0.007	T	-	0.004	0.018	0.029
	3	60	0.003	T	0.001	0.003	0.018	0.025
	6	60	0.014	T	-	0.002	0.018	0.034
	6	60	0.036	T	-	0.003	0.014	0.053
RDX Class B	Before Aging		0.032	T	-	0.005	0.005	0.042
	Before Aging		0.027	T	-	0.005	0.005	0.037
	1	100	0.028	-	-	0.001	0.005	0.034
	1	100	0.003	-	T	0.002	0.005	0.010
	3	100	0.013	T	-	0.003	0.006	0.022
	3	100	0.056	T	-	0.003	0.006	0.065
	6	100	0.011	T	0.004	0.004	0.007	0.026
	6	100	0.005	T	0.005	0.004	0.007	0.021
	12	100	0.008	-	0.001	0.003	0.009	0.021
	12	100	0.006	T	0.002	0.004	0.010	0.022
	3	60	0.016	T	-	0.004	0.007	0.027
	3	60	0.010	T	-	0.003	0.006	0.019
	6	60	0.015	T	0.001	0.004	0.003	0.023
	6	60	0.022	0.001	0.004	0.007	0.004	0.036

T = Trace or < 0.01 µl

A

B

C

D

E

F

- A. RDX Lot 4RCG 110, Type B, Class G
- B. HNS E-B, MFB-504412
- C. RDX Lot 72C, Type B, Class B
- D. RDX, Class G Control Pellet
- E. RDX, Class B Control Pellet
- F. HNS Control Pellet, Container No. 46

Fig. 1. RDX and HNS Before and After Separate Aging at 100 C for 1 Year

HNS Control (Aged alone for 1 year at 100 C)

1 Month

3 Months

6 Months

1 Year

HNS Aged with RDX Class B

1 Month

3 Months

6 Months

1 Year

HNS Aged with RDX Class G

Fig. 2. HNS After Aging at 100 C

HNS

RDX Type B
Class B

HNS

HNS

RDX Type B
Class G

HNS

Fig. 3. HNS/RDX/HNS Sandwiches After Aging for 1 Year at 100 C