

# CHAPTER 7

## TECHNICAL DATA ABOUT THE TESTS

CHARACTERISTIC	GX-5	GX-6	GX-7	GX-8	GX-9
DATE	4/10/75	25/10/75	29/11/75	20/12/75	20/12/75
PROPELLANT	60 - 40	60 - 40	60 - 40	60 - 40	60 - 40
- grain type	cigarette	tub. $\phi$ 27	tub. $\phi$ 27	tub. $\phi$ 27	tub. $\phi$ 27
- length cm	15	28	33	15,2	25
- density g/cm <sup>3</sup>	1,6	1,71	1,66	1,63	1,61
- weight g	1237	2195	2515	1135	1845
NOZZLE	81/26/89	81/27/89	81/27/89	81/27/89	81/27/89
ROCKET WEIGHT					
- empty g	-	5260	5330	5305	5235
- full g	-	7455	7845	6440	7080
FREE VOLUME cm <sup>3</sup>	-	-	-	-	-
FREE PORT AREA cm <sup>2</sup>	51,5	5,73	5,73	5,73	5,73
INITIAL BURNING AREA cm <sup>2</sup>	51,5	-	-	-	-
COATING					
- type	poly.	poly.	poly.	poly.	poly.
- weight g	-	-	-	-	-
- density g/cm <sup>3</sup>	-	-	-	-	-
- thickness mm	-	-	-	-	-
DIAPHRAGM					
- type	cone	cone	cone	cone	cone
- thickness mm	-	-	-	-	-
IGNITION PROP.					
- type	KNO <sub>3</sub> /SUG.	KNO <sub>3</sub> /SUG.	KNO <sub>3</sub> /SUG.	KNO <sub>3</sub> /SUG.	KNO <sub>3</sub> /SUG.
- weight g	-	-	-	-	-
- ratio weight to free vol.	-	-	-	-	-
TOTAL IMPULSE N	-	-	2756	-	-
SPECIFIC IMPULSE s	-	-	112	-	-
% FOULING	-	4,1	1,19	1	1,24

NOTE: for the calculation of the specific impulse, the fouling was not taken into account.

CHARACTERISTIC	GX-10	GX-11	GX-12	GX-13	GX-14
DATE	24/1/76	24/1/76	27/3/76	27/3/76	19/4/76
PROPELLANT	60 - 40	60 - 40	60 - 40	60 - 40	60 - 40
- grain type	tub. $\phi$ 27	tub. $\phi$ 27	cigaret.	cigaret.	cigaret.
- length cm	19,1	33	8,95	9,4	18.5
- density g/cm <sup>3</sup>	1,51	1,51	1,72	1,84	1,63
- weight g	1285	2210	775	870	1515
NOZZLE	81/20/89	81/27/89	81/10/33	81/7/33	81/7/33
ROCKET WEIGHT					
- empty g	5310	5330	5225	5270	5310
- full g	6595	7540	6000	7125	6825
FREE VOLUME cm <sup>3</sup>	-	-	-	-	-
FREE PORT AREA cm <sup>2</sup>	5,73	5,73	51,5	51,5	51,5
INITIAL BURNING AREA cm <sup>2</sup>	162,1	280	51,5	51,5	51,5
COATING					
- type	poly.	poly.	poly.	poly.	poly.
- weight g	-	-	-	-	-
- density g/cm <sup>3</sup>	-	-	-	-	-
- thickness mm	-	-	-	-	-
IGNITION PROP.					
- type	KNO <sub>3</sub> /SUG.	KNO <sub>3</sub> /SUG.	KNO <sub>3</sub> /SUG.	KNO <sub>3</sub> /SUG.	KNO <sub>3</sub> /SUG.
- weight g	-	-	-	-	-
- ratio weight to free vol.	-	-	-	-	-
TOTAL IMPULSE N	1405,8	-	737,5	1004,5	-
<u>SPECIFIC IMPULSE s</u>	<u>111,6</u>	-	<u>97</u>	<u>117,7</u>	-
% FOULING	-	-	14,2	-	-

CHARACTERISTIC	GX-24	GX-25	GX-26	GX-27	CANDY 1
DATE	7/8/76	4/9/76	16/10/76	24/10/76	7/11/76
PROPELLANT	60 - 40	60 - 40	60 - 40	60 - 40	60 - 40
- grain type	tub. $\phi$ 27	crucifix	crucifix	tub. $\phi$ 27	crucifix
- length cm	19	28	27,5	30	30
- density g/cm <sup>3</sup>	-	1,775	1,36	1,51	1,61
- weight g	1260	1675	1400	1900	1692
NOZZLE	81/20/89	81/20/33	81/20/89	81/20/89	80/20/70
ROCKET WEIGHT					
- empty g	5310	-	-	-	5015
- full g	6570	-	-	-	-
FREE VOLUME cm <sup>3</sup>	-	-	-	-	-
FREE PORT AREA cm <sup>2</sup>	5,73	10,45	10,45	5,73	10,45
INITIAL BURNING AREA cm <sup>2</sup>	- 14,1	553,9	583,1	215,5	636,2
COATING					
- type	SUG.-SALT	SUG.SALT	SUG.-SALT	SUG.-SALT	SUG.-SALT
- weight g	-	-	-	-	-
- density g/cm <sup>3</sup>	-	-	-	-	-
- thickness mm	-	-	-	-	-
DIAPHRAGM	Zn-S 2/1	Zn-S 2/1	Zn-S 2/1	Zn-S 2/1	Zn-S 2/1
- type	plug	plug	plug	plug	disc
- thickness mm	-	-	-	-	10
IGNITION PROP.	Zn-S 2/1	Zn-S 2/1	Zn-S 2/1	Zn-S 2/1	Zn-S 2/1
- type	powder	powder	powder	powder	powder
- weight g	50	50	50	50	50
- ratio weight to free vol.	-	0,08	0,07	0,11	0,09
TOTAL IMPULSE N	-	1314,5	1314,5	1658,9	1824,7
<u>SPECIFIC IMPULSE. s</u>	-	<u>80</u>	<u>96</u>	<u>89</u>	<u>110</u>
% FOULING	-	-	-	-	-

CHARACTERISTIC	CANDY 2	GX-28	CANDY 3	GX-44	GX-60
DATE	27/11/76	27/11/76	27/3/77	4/6/77	-
PROPELLANT	60 - 40	60 - 40	60 - 40	60 - 40	60 - 40
- grain type	crucifix	tub. $\phi$ 27	crucifix	crucifix	tub. $\phi$ 22,5
- length cm	35,2	28	35,3	32	35
- density g/cm <sup>3</sup>	1,59	1,59	1,76	1,73	1,89
- weight g	2095	1765	2145	2000	2390
NOZZLE	80/20/70	81/20/89	80/20/70	81/20/89	80/ 20/33
ROCKET WEIGHT					
- empty g	3530	4620	5015	-	3495
- full g	-	-	-	-	-
FREE VOLUME cm <sup>3</sup>	500	555	454,5	384,6	139,5
FREE PORT AREA cm <sup>2</sup>	10,45	5,73	10,45	10,45	3,98
INITIAL BURNING AREA cm <sup>2</sup>	746,2	278,3	748,3	678,4	289
COATING					
- type	SUG.-SALT	SUG.-SALT	SUG.-SALT	SUG.-SALT	SUG.-SALT
- weight g	-	-	-	-	580
- density g/cm <sup>3</sup>	-	-	-	-	-
- thickness mm	-	-	-	-	4,2
DIAPHRAGM	Zn-S 2/1	Zn-S 2/1	Zn-S 2/1	Zn-S 2/1	Zn-S 2/1
- type	disc	disc	disc	disc	disc
- thickness mm	10	10	10	10	10
IGNITION PROP.	Zn-S 2/1	Zn-S 2/1	Zn-S 2/1	Zn-S 2/1	Zn-S 2/1
- type	powder	powder	powder	powder	powder
- weight g	50	50	50	50	60
- ratio weight to free vol.	0,10	0,09	0,11	0,13	0,43
TOTAL IMPULSE N	2155	1960	2528	1940,5	-
<u>SPECIFIC IMPULSE s</u>	<u>104,9</u>	<u>113,</u>	<u>120</u>	<u>99</u>	-
% FOULING	-	-	-	7,5	-

CHARACTERISTICS	CANDY 4	NEBEL 1	NEBEL 2	NEBEL 3	NEBEL 4
DATE	-	13/5/78	27/5/78	17/6/78	17/6/78
PROPELLANT	60 - 40	60 - 40	60 - 40	60 - 40	60 - 40
- grain type	cone	tub. $\phi$ 46,2	tub. $\phi$ 48	tub. $\phi$ 40	tub. $\phi$ 50
- length cm	-	34,5	34,4	31	34
- density g/cm <sup>3</sup>	-	1,77	1,75	1,73	1,6
- weight g	2465	2240	2085	2350	1830
NOZZLE	80/20/-	87/20/64	87/20/64	87/20/64	87/20/64
ROCKET WEIGHT					
- empty g	3150	3405	3706	3780	3760
- full g	-	-	-	-	-
FREE VOLUME cm <sup>3</sup>	-	600	600	428,6	667
FREE PORT AREA cm <sup>2</sup>	19,6	16,76	18,02	12,25	19,63
INITIAL BURNING AREA cm <sup>2</sup>	-	573,8	557,9	437,5	558,6
COATING					
- type	SUG.-SALT	SUGAR	SUGAR	SUGAR	SUGAR
- weight	210	295	344	375	-
- density g/cm <sup>3</sup>	-	1,43	1,34	-	-
- thickness mm	-	2,3	2,8	-	2,3
DIAPHRAGM	Zn-S 2/1	WOOD	WOOD	WOOD	WOOD
- type	disc	disc	disc	disc	disc
- thickness mm	10	4	4	4	4
IGNITION PROP.	Zn-S 2/1	Zn-S 2/1	Zn-S 2/1	Zn-S 2/1	Zn-S 2/1
- type	powder	powder	powder	powder	powder
- weight g	-	60	60	60	60
- ratio weight to free vol.	-	0,10	0,10	0,14	0,09
TOTAL IMPULSE N	-	-	2244,5	2743,6	2375,8
SPECIFIC IMPULSE s	-	-	<u>109,7</u>	<u>121,3</u>	<u>134,9</u>
% FOULING	-	4	-	-	-

CHARACTERISTICS	GX-62	NEBEL 5	NEBEL 6	NEBEL 7	NEBEL 8
DATE	17/6/78	16/7/78	29/7/78	29/7/78	15/8/78
PROPELLANT	65 - 35	60-1-39	60 - 40	60 - 40	60 - 40
- grain type	tub.Ø35	tub.Ø41,2	crucifix	crucifix	crucifix
- lenght cm	36,8	34,3	32,4	30,8	30
- density g/cm <sup>3</sup>	1,59	-	1,67	1,70	1,76
- weight g	1970	2180	2325	2200	2210
NOZZLE	81/27/-	62/20,5/64	62/20/64	62/20/64	62/20,5/64
ROCKET WEIGHT					
- empty g	3840	4730	4700	4720	4715
- full g	-	-	-	-	-
FREE VOLUME cm <sup>3</sup>	353	545	429	462	556
FREE PORT AREA cm <sup>2</sup>	9,62	13,33	10,45	10,45	10,45
INITIAL BURNING AREA cm <sup>2</sup>	464	482	729	694	678
COATING					
- type	SUGAR	SUGAR	SUGAR	SUGAR	SUGAR
- weight g	345	450	365	340	305
- density g/cm <sup>3</sup>	-	-	1,48	1,42	1,23
- thickness mm	-	-	2,3	2,6	2,7
DIAPHRAGM	none	WOOD	WOOD	WOOD	WOOD
- type	-	disc	disc	disc	disc
- thickness mm	-	4	4	4	4
IGNITION PROP.	Zn-S 2/1	Zn-S 2/1	Zn-S 2/1	Zn-S 2/1	Zn-S 2/1
- type	powder	powder	powder	powder	powder
- weight g	60	60	60	60	100
- ratio weight to free vol.	0,17	0,11	0,14	0,13	0,18
TOTAL IMPULSE N	-	2238,6	2793	-	-
SPECIFIC IMPULSE s	-	104,7	122,5	-	-
% FOULING	-	5,5	-	-	0,9

CHARACTERISTIC	NEBEL 9	NEBEL 10	NEBEL 11	NEBEL 12	NEBEL 13
DATE	19/8/78	-	24/9/78	-	-
PROPELLANT	60 - 40	60 - 40	60-1-39	60 - 40	60 - 40
- grain type	crucifix	cruxifix	tub. $\phi$ 42	tub. $\phi$ 26	tub. $\phi$ 32
- lenght cm	32	32,7	34,5	34,5	-
- density g/cm <sup>3</sup>	1,72	1,54	1,79	1,57	1,57
- weight g	2350	2150	2485	2570	2430
NOZZLE	62/20/64	62/20/64	62/20/64	62/20/64	62/20/64
ROCKET WEIGHT					
- empty g	3425	3535	3430	3430	3430
- full g	-	-	-	-	-
FREE VOLUME cm <sup>3</sup>	476	385	471	-	283
FREE PORT AREA cm <sup>2</sup>	10,45	10,45	13,85	5,31	8
INITIAL BURNING AREA cm <sup>2</sup>	719	735	456	280	346
COATING					
- type	SUGAR	SUGAR	SUG.-SALT	SUGAR	SUGAR
- weight g	300	250	315	350	280
- density g/cm <sup>3</sup>	1,39	1,40	1,71	1,4	1,17
- thickness mm	2,35	2,0	2,0	2,6	2,5
DIAPHRAGM	WOOD	WOOD	none	none	none
- type	disc	disc	-	-	-
- thickness mm	4	4	-	-	-
IGNITION PROP.	Zn-S 2/1	Zn-S 2/1	Zn-S 2/1	Zn-S 2/1	Zn-S 2/1
- type	powder	powder	powder	powder	powder
- weight g	100	100	66	100 ?	170
- ratio weight to free vol.	0,21	0,26	0,14	0,33-0,55	0,60
TOTAL IMPULSE N	2882	-	-	-	-
SPECIFIC IMPULSE s	125	-	-	-	-
% FOULING	-	-	-	-	-