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Study of Micrometeroid Orbital Debris

by

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INTRODUCTION

The measurement of high velocity impact dynamics in ground based ballistic gun facilities provides a useful and inexpensive methodology for simulating space meteroid impact phenomena. Major thrusts are underway to measure the effects of impact damage at ballistic velocities on space related structural shells, in order to better understand the long term safety characteristics of materials in space, as well as to evaluate the materials currently available for platforms such as the Space Station.

The results of the high impact damages can be measured in a number of different ways in order to evaluate the effects of high velocity impact on structures. The hyperbolic velocity of micrometeroids occur in the velocity range 15 - 20 km/sec, randomly distributed in all directions. On the other hand, space debris occupy circular orbits in the range 7 - 10 km/sec. Relative velocities of these particles with a space platform would then be in the range 8 - 20 km/sec for meteroids and 3 - 12 km/sec for space debris.

Damage assessment studies have shown that impacts above the ballistic limit provide a number of measurable parameters, such as impact flash, penetration depth, spall/fracturing and shear cone. Impacts below the ballistic limit provide information from buckling, mushrooming of the impactor, and embedding. Resulting differences in the target also occur depending upon differences in geometry of the projectile, and relative values of hardness and density between the projectile and the target. Experimental data obtained during the impact experiments are already recorded and consist of kinetic energy data and flash x-ray images. These items are already deposited with other appropriate information stored at MSFC. The mechanical parameters obtained after the impact experiments are the major goal of this report.

Projectile velocities of 3 to 7 km/sec are achievable in the light gas gun at MSFC for particle diameters in the range between 3 to 8 mm. The types of damage observed with a variety of space station bumper and shield materials includes the following:

- Craters A divot located on the front panel causing a dimple on the back side.
- Dimples An outward indentation in the panel on the backside.
- Detached spall Material missing from the backside of the panel.
- Attached spall Material deposited on the backside of the panel.
- Fine spray Small craters that do not create dimples.
- Petals Material that is bent toward the projectile exit.
- Damage diameter The area affected by the projectile.
- Number of holes Total number of pnetrtion holes.
- Deformation A measurement of the deflection of the plate after impact.
- Wagon wheel A fine spray that appears to look like a starburst.

RESULTS - see attached sheets

Alum	Aluminum Projectile				ľ		Ī		
Shot	2nd Projectile	Description	Material	Thickness	Pen.	Hole Diameter	Petal	Petal Length of Crack Petals	Damage Description
1316	0.187" Al-1100	Bumper							
	0 deg target angle	Wall							
		Witness	2024 AI	0.020"	ů				3 craters/dimples, deepest crater 0.03"
1320	0.187" AI-1100	Bumper			Yes	0.336"			
	0 deg target angle	Witness			No				8 lg. craters, several sm. craters, dam area1.75"x2.4", dimples
1321		Shield	6061-T6 Al	0.040"	Yes	0.406" & 0.096"			
	0 deg target angle	Bumper	Matrix	0.063"					Missing
		Wall	2219-T87 AI	0.125"	Yes	0.332"			8 lg. craters/dimples,fine spray, dam area 5.75x7,detached spall
		Witness	2024 AI	0.020"	Yes	Pin Hole	ę	0.19",0.125",0.04"	6 craters, 4 dimples
1324	0.25" Al-1100	Bumper	Matrix #PER-2908		Yes	0.69"			
	0 deg target angle	Wall	2219-T87 AI	0.125"	No				Fine spray, many craters/dimples, lg crater16" dia x .089 deep
1326	0.187" Al-1100	Bumper	Matrix #PER-2486		Yes	0.458"			Fine spray, no dimples
		Wall	2219-T87 AI	0.125"	No				Approx. 14 craters/dimples, dam area 6.5x6.0,fine spray
1327	0.25" AI-1100	Bumper	Matrix #PR-1730		Yes	0.432"			
	0 deg target angle	Wall	2219-T87 AI	0.125"	°Ž				Approx. 20 craters/dimples, dam area 7.25x7.,2 detached spalls
1328	0.187" AI-1100	Bumper	Matrix #D1813		Yes	0.54" x 0.64"			Material peeled back around hole
	45 deg target angle	Wall	2219-T87 AI	0.125"	٥N				Fine spray,lg. crater .17"x.22"x.06" deep, damage area 6"x7.5"
1329		Bumper	Matrix #D1813		Yes	0.55" x 0.57"			Material peeled back around hole, craters, no dimples
	45 deg target angle	Wall	2219-T87 AI	0.125"	Yes	0.125"			Several craters/dimples, largest .185x.074 deep, dam area 7x7.5
		Witness #1	2024 AI	0.020"	°Ż				2 craters, largest 0.07"x0.13"x0.02" deep
1331	0.187" AI-1100	Bumper	Matrix #PER-2505		Yes	0.418" x 0.513"			1 detached spall on backside
	45 deg target angle	Wall	2219-T87 Al	0.125"	°Z				Many craters/dimples, largest .25x.13 deep, dam area 7.5 dia
1332		Bumper	6061-T6 Al	0.080"	Yes	0.388"			
	0 deg target angle	Wall	2219-T87 AI	0.125"			- 1		
		Witness #1	2024 AI	0.020"	Yes		ŝ	0.118",0.107"0.122"	6 craters, 1 hole with 3 petals
1336	0.187" Al-1100	Witness #1	2024 AI	0.020"	°N				Approx. 8 craters with dimples, Damage area: 0.75" x 1.25"
	0 deg target angle								
1338		Shield #1	6061-T6 Al	0.080"	Yes	0.55" Dia.			
	0 deg. target angle	Wall	2219-T87 AI	0.125"	Yes	0.06" Dia.			Many craters, wagon wheel, dam area 10.5" dia, detached spalls
		Witness	2024 AI	0.020"	٥N				Numerous craters, Dam. Area 1.75" x 2.0"
1339	0.250" AI-1100	Wall	2219-T87 AI	0.125"	Yes	Max 1.4" x 1.6"			Numerous holes, wagon wheel, detached spalls
1340	0.250" AI-1100	Shield #1	6061-T6 AI	0.040"	Yes	0.45" x 0.42"			
	0 deg. target angle	Wall	2219-T87 Al	0.125"	Yes	Max:0.17x0.08"			5 measurable holes 0.08,0.09,.16x0.06,.06", detached spalts
1341	0.250" AI-1100	Shield #1	6061-T6 AI	0.080"	Yes	0.59" dia.			
	0 deg. target angle	Wall	2219-T87 AI	0.125"	Yes	Max:0.14x0.16"			3 holes, 5 detached spalls, wagon wheel, dam area 12" x10.5"
1342	0.250" AI-1100	Shield #1	6061-T6 A1	0.040"	Yes	0.52" x 0.46"			
	0 deg. target angle	Wall	2219-T87 AI	0.125"	No				3 detached spalls, 6 dimples, dam area 9.5" x 11", fine spray
		Witness	2024 AI	0.020"	٥'n				~ 8 craters, small crack, damage area 1.5" x 2.0"
1343	0.250" AI-1100	Shield #1	6061-T6 AI	0.040"	Yes	0.44" dia.			
	Ľ	Wall	2219-T87 AI	0.125"	Yes	Max:1.18 x 0.84"			11 holes, detached spalls, dam area 10"x12"
		Witness #1	2024 AI	0.020"	Yes		7	1.23,1.09,0.97,0.44,1.19,1.32,0.8"	0°#
		Witness #2	2024 AI	0.020"	Yes		3	0.58", 0.65", 0.22"	3 holes
1345	0.250" AI-1100	Wall	2219-T87 AI	0.125"	Yes	2.28"x1.09"			Detached spalls, wagon wheel, 9 dimples, dam area 8.5 x 8.0"
1346	0.250" AI-1100	Shield #1	6061-T6 Al	0.050"	Yes	0.50" dia.			2nd hole .22x0.17", 3rd hole has 4 petals, pin holes, fine spray

Page 1

0.250° Al-1100 Wall 2219-T87 Al 0.250° Al-1100 Shield #1 6061-T6 Al 0.250° Al-1100 Shield #1 5061-T6 Al 0.250° Al-1100 Shield #1 2024 Al 0.250° Al-1100 Shield #1 5061-T6 Al 0.250° Al-1100 Shield #1 6061-T6 Al 0.375° Al-1100 Shield #1 2024 Al 0.375° Al-1100 Shield #1 2024 Al 0.375° Al-1100 Shield #1 2024 Al 0.375° Al-1100	Material Thickness	Pen.	Hole Diameter Peti	Petal Length of Crack Petals	Damage Description
0.250° Al-1100 Shield #1 6061-76 Al 0 deg. target angle Wall 2219-T87 Al Witness #1 2024 Al 2024 Al 0 deg. target angle Witness #2 2024 Al 0 deg. target angle Shield #1 6061-76 Al 0 deg. target angle Stuffing MLI 0 deg. target angle Stuffing MLI 20375" Al-1100 Shield #1 6061-76 Al Wall 2219-T87 Al MLI 0 375" Al-1100 Shield #1 6061-76 Al 0.375" Al-1100 Shield #1 6061-76 Al 0 deg. target angle Sutffing 2219-787 Al 0 375" Al-1100 Shield #1 6061-76 Al 0 deg. target angle Sutffing 2219-787 Al 0 deg. target angle Shield #1 2014 Al 0 deg. target angle Shield #1 2019-787 Al 0 deg. targe		Yes	0.76" dia.		1 crater w/ dimple, fine spray
0 deg. target angle Wall 2219-T87 AI Nitness #1 2024 AI 2024 AI 0 deg. target angle Stuffing MI.J.I 0 deg. target angle Stuffing 2219-T87 AI 0 375" AI-1100 Shield #1 6061-T6 AI 0 deg. target angle Stuffing 2219-T87 AI 0 375" AI-1100 Shield #1 6061-T6 AI 0 deg. target angle Stuffing 2219-T87 AI 0 deg. target angle Stuffing 2219-T87 AI 0 deg. target angle Shield #1 2004 AI	┢	Yes	0.51" dia.		
Witness #1 2024 AI 0.250" AI-1100 Shield #1 6061.T6 AI 0.250" AI-1100 Shield #1 6061.T6 AI 0.375" AI-1100 Shield #1 2219-T87 AI 0.375" AI-1100 Shield #1 2054 AI 0.375" AI-1100 Shield #1 2061.T6 AI 0.375" AI-1100 Shield #1 2061.T6 AI 0 deg. target angle Shield #1 2024 AI 0.375" AI-1100 Shield #1 </th <th></th> <td>Yes</td> <td>3</td> <td>0.80",0.77",0.47"</td> <td>Numerous small holes, lg. detached spall 1.8x1.63", fine spray</td>		Yes	3	0.80",0.77",0.47"	Numerous small holes, lg. detached spall 1.8x1.63", fine spray
Witness #2 2024 Al 0.250" Al-1100 Shield #1 6061.76 Al 0.deg. target angle Stuffing MLJ 0.deg. target angle Stuffing MLJ 0.375" Al-1100 Shield #1 6061.76 Al 0.375" Al-1100 Shield #1 2219-787 Al 0.375" Al-1100 Shield #1 2024 Al 0.375" Al-1100 Shield #1 2024 Al 0.375" Al-1100 Shield #1		Yes C	Overall 1.93x1.15		Small crack to the left of holes
0.250° Al-1100 Shield #1 6061-76 Al 0 deg target angle Stuffing MLJ 0 deg target angle Sthield #1 6061-76 Al 0.375° Al-1100 Shield #1 6061-76 Al 0.375° Al-1100 Shield #1 6061-76 Al Null Stuffing MLI 0.375° Al-1100 Shield #1 6061-76 Al 0 deg target angle Stuffing MLI 0.375° Al-1100 Shield #1 6061-76 Al 0 deg target angle Stuffing MLJ 0 deg target angle Stuffing MLI 0 deg target angle Stuffing MLJ 0 deg target angle Stuffing MLI 0 deg target angle Stuffing MLI 0 deg target angle Stuffing 2219-T87 Al 0 deg target angle Stuffing 2024 Al 0 375° Al-1100 Stuffing		No			13 large craters
0 deg. target angle Stuffing ML1 0.375" A1-1100 Shield #1 6061-T6 A1 0.375" A1-1100 Shield #2 6061-T6 A1 0.375" A1-1100 Shield #1 2219-T87 A1 0.375" A1-1100 Shield #1 2024 A1 0.375" A1-1100 Shield #1 2024 A1 0.375" A1-1100		Yes	0.50" dia		
Wall 2219-T87 AI 0.375" AI-1100 Shield #1 6061-T6 AI Shield #1 6061-T6 AI 5 0.375" AI-1100 Shield #1 6061-T6 AI 1 0.375" AI-1100 Shield #1 6061-T6 AI 1 0.375" AI-1100 Shield #1 2219-T87 AI 1 0.375" AI-1100 Shield #1 2024 AI 2024 AI 2024 AI 0.375" AI-1100 Shield #1 2024 AI 2024 AI 2024 AI 2037 1 0 deg. target angle Shield #1 0.375" AI-1100 Shield #1 2024 AI 2024 AI<		Yes	See photo		
0.375" Al-1100 Shield #1 6061-T6 Al Stuffing MLI 3 Stuffing MLI 3 Stuffing MLI 3 Stuffing MLI 3 Stuffing MLI 5061-T6 Al Mall 2219-T87 Al 5061-T6 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 2219-T87 Al 0.375" Al-1100 Suffing MLI 0.375" Al-1100 Shield #1 2024 Al 0.375" Al-1100 Shield #1 2024 Al 0.375" Al-1100 Shield #1 2024 Al 0.375" Al-1100			Max:.32"x0.22"		
Shield #2 6061-T6 AI Sutfing MLI Sutfing MLI Sutfing MLI 0.375" AI-1100 Shield #1 6061-T6 AI 0.375" AI-1100 Shield #1 2219-T87 AI 0.250" AI-1100 Shield #1 2024 AI 0.375" AI-1100 Shield #1 2024 AI </th <th></th> <th>Yes</th> <th>0.59" dia.</th> <th></th> <th></th>		Yes	0.59" dia.		
Stuffing MLI Wall 2319-T87 Al Wall 219-T87 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 </th <th></th> <th>Yes</th> <th>3.4" x 4.6"</th> <th></th> <th>Damage area radiates the whole pattern, wagon wheel</th>		Yes	3.4" x 4.6"		Damage area radiates the whole pattern, wagon wheel
Wall 2219-T87 AI 0.375" AI-1100 Shield #1 6061-T6 AI 0.46e. target angle Stuffing 2219-T87 AI 0.375" AI-1100 Shield #1 6061-T6 AI 0.375" AI-1100 Shield #1 2219-T87 AI 0.375" AI-1100 Shield #1 6061-T6 AI 0.375" AI-1100 Shield #1 2024 AI 0.375" AI-1100 Shield #1 6061-T6 AI 0.375" AI-1100 Shield #1 6061-T6 AI 0.375" AI-11000 Shield #1			See photo		
0.375" Al-1100 Shield #1 6061-T6 Al 0 deg. target angle Stuffing 2219-T87 Al 0 deg. target angle Stuffing 2219-T87 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0 deg. target angle Stuffing 2219-T87 Al 0 deg. target angle Stuffing 2219-T87 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Stuffing MLI 0.250" Al-1100 Stuffing MLI 0.375" Al-1100 Stuffing MLI 0 deg. target angle Shield #1 6061-T6 Al 0 deg. target angle Shield #1 6061-T6 Al 0 deg. target angle Shield #1 2024 Al 0 deg. target angle Witness #1 2024 Al 0 deg. target angle Shield #1 6061-T6 Al 0 deg. target angle Shield #1 6061-T6 Al 0 deg. target angle Shield #1 6061-T6 Al 0 deg. target angle Shield #1 2024 Al	┢	No			No perforation, damage area ~5"
0 deg. target angle Stuffing 219-T87 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.250" Al-1100 Stuffing MLI 0.250" Al-1100 Stuffing MLI 0.375" Al-1100 Stuffing MLI 0.375" Al-1100 Stuffing MLI 0.375" Al-1100 Stuffing MLI 0 deg. target angle Shield #1 6061-T6 Al 0.375" Al-1100 Stuffing MLI 0 deg. target angle Shield #1 6061-T6 Al 0 deg. target angle Shield #1 6061-T6 Al 0 deg. target angle Shield #1 2024 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shie	╞	Yes	0.64" & 0.37"		
Wall 2219-T87 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.462. target angle Stuffing 2219-T87 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.250" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #	2 layers	Yes			
0.375" Al-1100 Shield #1 6061-T6 Al 0 deg. target angle Stuffing 2219-T87 Al 0 deg. target angle Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.0375" Al-1100 Stuffing ML1 0.375" Al-1100 Stuffing ML1 0 deg. target angle Shield #1 6061-T6 Al 0.375" Al-1100 Stuffing #1 6061-T6 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0 deg. target angle Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0 deg. target angle Shield #1 6061-T6 Al 0 deg. target angle	╞─	Yes (Cracks/Pin holes		2 cracks 6.875" & 1.03", damage area ~ 6.875" x 3.5"
0 deg. target angle Stuffing 2219-T87 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.250" Al-1100 Stuffing MLI 0.250" Al-1100 Stuffing MLI 0.250" Al-1100 Stuffing MLI 0.375" Al-1100 Stufiness #1 2024 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 2024 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0 deg. target angle Shield #1 6061-T6 Al 0 deg. target angle Shield #1 2024 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0 deg. target angle Shield #1		Yes	0.64"		Secondary hole 0.38"
Walt 2219-T87 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Stuffing 601-T6 Al 0.250" Al-1100 Stuffing 601-T6 Al 0.250" Al-1100 Stuffing 601-T6 Al 0.250" Al-1100 Stuffing MLI 0.462 target angle Shield #1 6061-T6 Al Wall 2219-T87 Al 2024 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 2024 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-11000 Shield #1 6061-T6 A	2 layers		See photo		
0.375" Al-1100 Shield #1 6061-T6 Al Wall Wall 2219-T87 Al 0.250" Al-1100 Stuffing MLI 0.250" Al-1100 Stuffing MLI 0.250" Al-1100 Stuffing MLI 0.375" Al-1100 Stuffing MLI 0.375" Al-1100 Stuffing MLI 0.375" Al-1100 Stuffing MLI 0.375" Al-1100 Stufield #1 6061-T6 Al Witness #1 2024 Al MLI 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 2024 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 2024 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 2024 Al <t< th=""><th>-</th><th>No</th><th></th><th></th><th>Plate deflected ~ 0.60" damage area 4" dia</th></t<>	-	No			Plate deflected ~ 0.60" damage area 4" dia
Wall 2219-T87 Al 0.250" Al-1100 Stuffing MLI 0.250" Al-1100 Stuffing MLI 0.250" Al-1100 Stuffing MLI 0.375" Al-1100 Stutess #1 2024 Al Witness #1 2024 Al 2024 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 2024 Al 0.375" Al		Yes	0.64" dia.		
0.250" Al-1100 Stuffing MLI 0 deg. target angle Shield #1 6061-T6 Al Wall 2219-T87 Al 0.375" Al-1100 Stuffing MLI 0.375" Al-1100 Stuffing MLI 0.375" Al-1100 Stuffing MLI 0.375" Al-1100 Stuffing MLI 0.375" Al-1100 Stuffing 6061-T6 Al Wall 2219-T87 Al 2024 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 2219-T87 Al 0 deg. target angle Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 2024 Al 0 deg. target angle Shield #1 2024 Al 0 deg. target angle Shield #1 2024 Al		No			~ 0.5" deflection of plate, damage area 5.5" x 5.0"
0 deg. target angle Shield #1 6061-T6 Al Wall 2219-T87 Al Witness #1 2024 Al 0.375" Al-1100 Stuffing MLJ 0.375" Al-1100 Stuffing MLJ 0.375" Al-1100 Stuffing MLJ 0.375" Al-1100 Stuffing 6061-T6 Al Wall 2219-T87 Al 2024 Al Witness #1 2024 Al 2024 Al Witness #2 2024 Al 2024 Al 0.375" Al-1100 Shield #l 6061-T6 Al 0.375" Al-1100 Shield #l 2024 Al 0 deg. target angle <		Yes	See photo		
Wall 2219-T87 Al Witness #1 2024 Al 0.375" Al-1100 Stuffing MLI 0.462 target angle Shield #1 6061-T6 Al 0.462 target angle Shield #1 6061-T6 Al 0.462 target angle Shield #1 6061-T6 Al Witness #1 2219-T87 Al 2219 0.462 target angle Shield #1 6061-T6 Al Witness #2 2024 Al 2024 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 2024 Al 0.375" Al-1100 Shield #1 2024 Al 0.375" Al-1100 Shield #1 2024 Al 0.375" Al-1100 Shield #2 2024 Al 0.375" Al-1100 Shield #1 2024 Al 0.375" Al-1100 Shield #2 2024 Al		Yes	0.52" dia.		
Witness #1 2024 AI 0.375" AI-1100 Stuffing MLI 0.469. target angle Shield #1 6061-T6 AI 0.375" AI-1100 Shield #1 6061-T6 AI Wall 2219-T87 AI 2024 AI Witness #1 2024 AI 2024 AI Witness #2 2024 AI 2024 AI Witness #3 2024 AI 2024 AI 0.375" AI-1100 Shield #1 6061-T6 AI 0.375" AI-1100 Shield #1 2024 AI		Yes	0.14x0.15"		2nd hole .17x.07, 3rd .12x.05, 4th .07" d,dam area 8.5x7.875"
0.375" Al-1100 Stuffing MLl 0 deg. target angle Shield #1 6061-T6 Al Wall 2219-T87 Al Witness #1 2024 Al Witness #1 2024 Al Witness #1 2024 Al Witness #1 2024 Al Witness #2 2024 Al Witness #2 2024 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 2024 Al 0.375" Al-1100 Shield #2 Lanxide Comp. 0 deg. target angle Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 2024 Al 0.375" Al-1100 Shield #1		No			9 craters with dimples, dam area 2.875" x 2.0"
0 deg. target angle Shield #i 6061-T6 Al Wall 2219-T87 Al Witness #1 2024 Al Witness #2 2024 Al Witness #2 2024 Al 0.375" Al-1100 Shield #i 6061-T6 Al 0.375" Al-1100 Shield #i 6061-T6 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0 deg. target angle Shield #2 Lanxide Comp. 0.375" Al-1100 Shield #2 Lanxide Comp. 0.375" Al-1100 Shield #2 Lanxide Comp. 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 2024 Al 0.375" Al-1100 Shield #1 2014 Al 0.375" Al-1100 Shield #1 2014 Al 0.375" Al-1100 Shield #2 Lanxide Comp. 0 deg. target angle Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 2014 Al 0 deg. target angle			See photo		
Wall 2219-T87 AI Witness #1 2024 AI Witness #2 2024 AI Witness #2 2024 AI Witness #2 2024 AI 0.375" AI-1100 Shield #1 6061-T6 AI 0.375" AI-1100 Shield #1 2024 AI 0.375" AI-1100 Shield #1 6061-T6 AI 0.375" AI-1100 Shield #1 6061-T6 AI 0.375" AI-1100 Shield #1 2024 AI 0.375" AI-1100 Shield #1 2024 AI 0.375" AI-1100 Shield #2 2024 AI 0.375" AI-1100 Shield #1 6061-T6 AI		Yes	.070" dia.		
Witness #1 2024 Al Witness #2 2024 Al Witness #3 2024 Al Witness #3 2024 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #2 Lanxide Comp. 0.375" Al-1100 Shield #1 2219-T87 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 2024 Al 0.375" Al-1100 Shield #1 2019-T87 Al 0 deg. target angle Shield #1 2024 Al 0 deg. target angle Shield #1 2014 Al 0 deg. target angle Shield #2 Lanxide Comp. 0 deg. target angle Shield #2 Lanxide Comp.		Yes	3.0" x 2.2"		Wagon wheel, detached material on rear, dam area 8.5" x 11"
Witness #2 2024 AI 0.375" AI-1100 Witness #3 2024 AI 0.375" AI-1100 Shield #1 6061-T6 AI 0.375" AI-1100 Shield #1 6061-T6 AI 0.375" AI-1100 Shield #1 6061-T6 AI 0.375" AI-1100 Shield #2 Lanxide Comp. 0.375" AI-1100 Shield #2 Lanxide Comp. 0 deg. target angle Shield #2 Lanxide Comp. 0.375" AI-1100 Shield #1 6061-T6 AI 0.375" AI-1100 Shield #1 6061-T6 AI 0.375" AI-1100 Shield #1 6061-T6 AI 0.375" AI-1100 Shield #1 2024 AI 0.375" AI-1100 Shield #1 2024 AI 0 deg. target angle Shield #1 2024 AI 0 deg. target angle Shield #1 2024 AI 0 deg. target angle Shield #2 Lanxide Comp. 0 deg. target angle Shield #2 Lanxide Comp.		Yes	6		Damage area 4.375" x 4.75"
Witness #3 2024 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.deg.target angle Honeycomb 6061-T6 Al 0.deg.target angle Honeycomb 6061-T6 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #2 Lanxide Comp. Witness #1 2219-T87 Al 0.375" Al-1100 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #2 Lanxide Comp. Witness #1 2024 Al 2024 Al 0 deg.target angle Witness #2 2024 Al 0 deg.target angle Shield #2 Lanxide Comp. 0 deg.target angle Shield #2 Lanxide Comp.		Yes	6		Damage area 4.25" x 3.75"
0.375" Al-1100 Shield #1 6061-T6 Al 0 deg. target angle Honeycomb 6061-T6 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #2 Lanxide Comp. 0 deg. target angle Shield #2 Lanxide Comp. 0 deg. target angle Shield #1 5024 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #2 Lanxide Comp. 0 deg. target angle Shield #2 Lanxide Comp. 0 deg. target angle Shield #1 6061-T6 Al 0 deg. target angle Shield #2 Lanxide Comp. 0 deg. target angle Shield #1 6061-T6 Al		Yes	1		Damage area 2.75" x 3.00"
0 deg. target angle Honeycomb 6061-T6 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #2 Lanxide Comp. 0 deg. target angle Shield #1 2219-T87 Al 0 vall 2219-T87 Al 2024 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0.375" Al-1100 Shield #2 Lanxide Comp. 0 deg. target angle Shield #2 1 0 deg. target angle Shield #2 2024 Al 0 deg. target angle Shield #1 6061-T6 Al 0 deg. target angle Shield #2 Lanxide Comp.		Yes	0.64"		2nd hole 0.44 x 0.36", 3rd 0.22" x 0.17"
0.375" Al-1100 Shield #1 6061-T6 Al 0 deg. target angle Shield #2 Lanxide Comp. Wall 2219-T87 Al 201 0.375" Al-1100 Shield #1 2024 Al 201 0.375" Al-1100 Shield #1 6061-T6 Al 2024 Al 0.375" Al-1100 Shield #2 Lanxide Comp. 2024 Al 0 deg. target angle Shield #2 12024 Al 2024 Al Wall 2219-T87 Al 2024 Al 2024 Al 0 deg. target angle Shield #1 6061-T6 Al 2024 Al 0.375" Al-1100 Shield #1 6061-T6 Al 2024 Al 0 deg. target angle Shield #1 6061-T6 Al 2024 Al		Yes	See photo		
0 deg. target angle Shield #2 Lanxide Comp. Wall 2219-T87 AI 2219-T87 AI 0.375" Al-1100 Shield #1 6061-T6 AI 2024 AI 0.375" Al-1100 Shield #1 6061-T6 AI 2024 AI 0.375" Al-1100 Shield #1 6061-T6 AI 2024 AI 0 deg. target angle Shield #2 Lanxide Comp. 2024 AI Wall 2219-T87 AI 2024 AI 2024 AI Witness #1 2024 AI 20375" AI-1100 Shield #1 6061-T6 AI 0.375" AI-1100 Shield #1 6061-T6 AI 2024 AI		Yes	0.64" dia.		
Wall 2219-T87 AI Witness #1 2219-T87 AI 0.375" AI-1100 Shield #1 6061-T6 AI 0.475" AI-1100 Shield #2 Lanxide Comp. 0 deg. target angle Shield #2 Lanxide Comp. Witness #1 2024 AI 2024 AI 0 deg. target angle Shield #2 Lanxide Comp. Wall 2219-T87 AI 2024 AI 0 deg. target angle Shield #1 6061-T6 AI 0 deg. target angle Shield #1 6061-T6 AI 0 deg. target angle Shield #2 Lanxide Comp.	-	Yes	2.06 x 1.95"		Wagon wheel
Witness #1 2024 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0 deg.target angle Shield #2 Lanxide Comp. 0 deg.target angle Wall 2219-T87 Al Nall 2219-T87 Al Nall 0 deg.target angle Wall 2219-T87 Al 0 deg.target angle Nitness #1 2024 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0 deg.target angle Shield #2 Lanxide Comp.		Ycs	••	3 4.3" ,3.92" ,2.17"	Damage area 5.25 x 6.5"
0.375" AI-1100 Shield #1 6061-T6 AI 0 dcg. target angle Shield #2 Lanxide Comp. Wall 2219-T87 AI 2010 Witness #1 2024 AI 2024 AI Witness #2 2024 AI 20375" AI-1100 Witness #2 2024 AI 20375" AI-1100 O deg. target angle Shield #1 6061-T6 AI Shield #3 Lanxide Comp.	-	٥			~ 6 craters w/ dimples, damage area 4.5" x 2.25"
0 deg. target angle Shield #2 Lanxide Comp. Wall 2219-T87 Al Witness #1 2024 Al Witness #2 2024 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0 deg. target angle Shield #2 Lanxide Comp. Shield #3 Lanxide Comp.	-	Yes	0.64" dia.		Secondary hole 0.39" x 0.34"
Wall 2219-T87 Al Witness #1 2024 Al Witness #2 2024 Al Witness #2 2024 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0 deg.target angle Shield #2 Lanxide Comp. Shield #3 Lanxide Comp.		Yes	2.34" x 2.40"		Wagon wheel
Witness #12024 AlWitness #22024 Al0.375" Al-1100Shield #16061-T6 Al0 deg. target angleShield #2Lanxide Comp.Shield #3Lanxide Comp.		Ycs	Ŷ		Damage area 4.75" x 5.0"
Witness #2 2024 Al 0.375" Al-1100 Shield #1 6061-T6 Al 0 deg. target angle Shield #2 Lanxide Comp. Shield #3 Lanxide Comp.		Yes	4	1.66,1.96,1.02,1.52,1.50"	Damage area 4.5"
0.375" Al-1100 Shield #1 6061-T6 Al 0 deg. target angle Shield #2 Lanxide Comp. Shield #3 Lanxide Comp.		Yes	1.65" x 0.56" 5	S	Elongated hole, damage area 2.0" x 2.0"
Shield #2 Lanxide Comp. Shield #3 Lanxide Comp.		Yes	0.63" dia.		
Shield #3 Lanxide Comp.		Yes	1.64" dia.		Material deposited on front and rear of panel
		Yes	~2.0" dia. 7	7 2.63,2.43, 62,1.24,1.85,2.14,2.1 Plate broke in 3 pcs.	Plate broke in 3 pcs.
Wall 2219-T87 AI 0.125"		No			Plate deflected ~ 0.57", damage area 4.0" dia., fine spray

Page 2

1368 0.375" Al-1100 1380 0.375" Al-1100 1381 0.375" Al-1100 1383 0.375" Al-1100 1383 0.375" Al-1100 1385 0.25" Al-1100 1385 0.375" Al-1100 1385 0.375" Al-1100 1385 0.25" Al-1100 1386 0.46g target angle 1385 0.25" Al-1100 1386 0.25" Al-1100 1386 0.25" Al-1100 1386 0.25" Al-1100 1403 0.375" Al-1100 1404 0.375" Al-1100 1405 0.46g target angle 1406 0.375" Al-1100 1407 0.375" Al-1100 1408 0.375" Al-1100 1409 0.375" Al-1100 1406 0.375" Al-1100 1406 0.375" Al-1100 1406 0.375" Al-1100 1406	100Shield #1angleShield #2Shield #1Wall100Shield #1Shield #1Shield #2angleShield #1100Shield #1angleShield #1angleShield #1angleShield #1100Shield #1angleShield #1angleShield #1angleShield #1angleShield #1100Shield #1angleWall100Shield #1angleWall100Shield #1angleWall100Shield #1angleWall	╉┿╀┼┼┼┼┼┼┼┼┼┼┼┼┼		0.063" 0.031" 0.031" 0.032" 0.050" 0.032" 0.032" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050"	Yes Yes No No Yes Yes Yes	0.63" dia. 1.80" dia. 5.5" x 4.0" 0.46" Dia.	3 0.96,1.21,1.85" 4 0.37, 0.44, 2.5, 1.48"	Damage area 4" dia.
			anxide Comp. anxide Comp. 2219-T87 AI 2219-T87 AI 6061-T6 AI 6061-T6 AI 6061-T6 AI 2219-T87 AI 2219-T87 AI	┝╁┼┼┼┼┽┽┽╂╋╪┽┼┼┼	Yes Yes No Yes Yes			Damage area 4" dia.
<u> </u>			anxide Comp. 2219-T87 Al 2219-T87 Al 6061-T6 Al 6061-T6 Al MLL Blanket 2219-T87 Al 6061-T6 Al 2219-T87 Al	0.031" 0.125" 0.050" 0.032" 0.032" 0.032" 0.125" 0.125" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050"	Yes No Yes Yes			
			2219-T87 A1 2219-T87 A1 6061-T6 A1 6061-T6 A1 MLL Blanket 2219-T87 A1 2219-T87 A1 2219-T87 A1	0.125" 0.050" 0.032" 0.032" 0.032" 0.032" 0.030" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050"	No Yes Yes	0.46" Dia.		
			6061-T6 Al 6061-T6 Al 6061-T6 Al MLI Blanket 2219-T87 Al 6061-T6 Al	0.050" 0.032" 0.032" 0.032" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.187"	Yes Yes	0.46" Dia.		Plate deflected ~ 0.60", damage area 5.0" dia.
			6061-T6 Al 6061-T6 Al 6061-T6 Al MLI Blanket 2219-T87 Al 6061-T6 Al	0.032" 0.032" 0.125" 0.125" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.125" 0.187"	Yes			Numerous holes, 3 large holes, 0.46"d, 0.19x0.49", 0.29x0.26"
			6061-T6 Al 6061-T6 Al 6061-T6 Al MLI Blanket 2219-T87 Al 6061-T6 Al	0.032" 0.125" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.125" 0.187"	Yes	-		Numerous small holes, fine spray
			6061-T6 Al 6061-T6 Al 6061-T6 Al MLI Blanket 2219-T87 Al 6061-T6 Al	0.125" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.050" 0.135" 0.187"	;	-	6 .72,1.24,1.33,1.5,1.74,1.66	
			6061-T6 AI 6061-T6 AI 6061-T6 AI MLI Blanket 2219-T87 AI 2219-T87 AI	0.125" 0.050" 0.032" 0.125" 0.125" 0.050" 0.050" 0.050" 0.137" 0.187"	Yes	See photo		
			6061-T6 A1 6061-T6 A1 6061-T6 A1 MLI Blanket 2219-T87 A1 2219-T87 A1	0.050" 0.032" 0.125" 0.050" 0.050" 0.050" 0.125" 0.187"	Yes	.36x.19,.15x0.17		10 craters with dimples, fine spray
			6061-T6 A1 6061-T6 A1 6061-T6 A1 MLI Blanket 2219-T87 A1 6061-T6 A1 2219-T87 A1	0.032" 0.125" 0.050" 0.050" 20 layer 0.125" 0.040" 0.187"	Yes	0.47" x 0.42"		
			6061-T6 A1 6061-T6 A1 6061-T6 A1 MLI Blanket 2219-T87 A1 6061-T6 A1 2219-T87 A1	0.125" 0.050" 0.050" 20 layer 0.125" 0.040" 0.187"	Yes	_	7 2.19,1.75,2.06,1.95,1.52,1.97,2.02	2.02
┝╍┽╌┥╴┥╴┥╴┥╴┥╴┥╴┥╴┥╴┥╴┥╴┥╴┥╴┥			6061-T6 A1 6061-T6 A1 MLL Blanket 2219-T87 A1 6061-T6 A1 2219-T87 A1	0.050" 0.050" 20 layer 0.125" 0.040" 0.187"	Yes	Max. 0.61x0.44		Numerous craters, large detached spall
			6061-T6 Al MLI Blanket 2219-T87 Al 6061-T6 Al 2219-T87 Al	0.050" 20 layer 0.125" 0.040" 0.187"	Yes.	Largest 0.52" dia		3 holes, largest hole measured
			MLI Blanket 2219-T87 AI 6061-T6 AI 2219-T87 AI	20 layer 0.125" 0.040" 0.187"	Yes	Largest 0.84" dia		Wagon wheel, largest hole measured
			2219-T87 AI 6061-T6 AI 2219-T87 AI	0.125" 0.040" 0.187"	Yes	See photo		
			6061-T6 Al 2219-T87 Al	0.040" 0.187"	Yes	0.25",0.2", 0.14"		3 holes, 9 craters with dimples, fine spray
┝╍╪╍╡╌╡╌╡╴╡╴╡╴╡╴┥╴┥╸┥╸┥╸┥╸┥╸┥			2219-T87 AI	0.187"	Yes	0.47" x 0.44"		
					No No			~ 6 craters w/ dimples, wagon wheel, dam area 10"x11.5"
			6061-T6 AI	0.040"	Yes	0.47" x 0.41"		
			2219-T87 Al	0.187"	Yes	Largest .67x.24"		4 holes, detached spalls, many craters, 6 craters w/ dimples
	100 Shield #1		6061-T6 AI	0.063"	_	-		Secondary holes 0.28 x 0.21", 0.17 x 0.2", & 0.11" dia
	angle Shield #2		6061-T6 AI	0.063"			7 .8,.5,1.07,.68,.68,.47,.42	Damage area 3.25" x 2.75"
╏╶┨╶╏╶┨╶╏╶┨╶┨╶┨╶┨╶┨╶┨	Shield #2		6061-T6 AI	0.063"	Yes	1.27" x 1.31"		~25 craters w/ dimp., fine spray, dam area 5" x 5.5"
<mark>╴┊┈┨┈┊╴┦╺╃╺╋╸┥╸┥╸┥</mark>	Wall		2219-T87 AI	0.125"	Yes	Pin Hole		2 cracks .32 and 0.11" long, dimp, fine spray dam area 2.75x3
╞╌┨╌┦╴┦╌┩╶┥╴┩┈┦╴┦╴┦	100 Shield #1		6061-T6 AI	0.063"	Yes	0.57" dia.		Secondary holes 0.19" x 0.15", 0.13" x 0.11", 0.21" x 0.14"
┝╍┽╶╡╾╡╺╡╸╡╸╡╴╡	angle Shield #2		6061-T6 Al	0.032"	Yes	1.60" x 1.38"		Numerous craters w/ dimp., wagon wheel, dam area 4.25x6.75"
	Shield #2		6061-T6 Al	0.032"	Yes	3.53" x 3.42"		Damage area 4.75" x 4.25"
┝┥┥┥┥┥	Wall		2219-T87 AI	0.125"	Yes	0.62" x 0.48"		4 petals, petal lengths 1.34,0.73,1.19,1.0, dam area 3.5" dia
			6061-T6 Al	0.063"	Yes	0.63" dia		
┝╍┫╌╢┫╸┫	angle Shield #2		6061-T6 AI	0.063"	Yes	3.20" x 3.0"		Numerous holes, craters, dimples, and det. spalls, wagon wheel
			2219-T87 Al	0.125"	٥N			Fine spray, plate deflection ~0.20", damage area ~9.5" dia.
	100 Shield #1		6061-T6 AI	0.050"	Yes	0.60" dia.		Secondary hole 0.18" dia.
	angle Shield #2		6061-T6 Al	0.050"	Yes	3.20" x 3.42"		Numerous holes, craters, dimples, and detached spalls, ~3 petal
			2219-T87 AI	0.125"	ů			Fine spray, plate deflection ~0.37", damage area 9.5 x 10"
			6061-T6 Al	0.050"	4	0.63" x 0.84"		
45 deg target angle	angle Shield #2		6061-T6 A1	0.050"	Yes	Largest 1.2 x 0.8"		Numerous holes, craters, dimples, and detached spalls
			2219-T87 AI	0.125"	Yes	0.14" x 0.28"		2 holes .13 x .11", ~25 dimples, fine spray, dam area 9 x 12"
1408 0.375" AI-1100	100 Shield #1		6061-T6 Al	0.063"	Yes	0.67" x 0.95"		
4	1		6061-T6 Al	0.063"	Yes	0.79" x 1.25"		Holes, craters, and dimples throughout panel, detached spall
	Wall		2219-T87 AI	0.125"	Yes	0.15" dia.		~ 25 dimples, fine spray
1410 0.375" AI-1100	100 Shield #1		6061-T6 AI	0.080"	Yes	1.0" dia.	-	Edge of hole bent ~0.21" inward (toward projectile entrance)
0 deg target angle	angle Shield #2	#2	6061-T6 AI	0.050"	Yes	1.22" x 1.12"		Edge of hole bent ~0.23" outward (away from proj. entrance)
			2024 AI	0.020"	Yes	1.85" x 1.60"		Plate has curled petals around the hole, 16 petals
	Wall		2219-T87 AI	0.125"	Yes	2.43"x 1.95"		5 cracks on rear, fine spray, dam. area 8.75" x 9.5"
	Witness #1	ss #1	2024 AI	0.020"	Yes	2.33" x 1.75"		Damage area 4.25" x 4.50"

T									
Shot	2nd Projectile	Description	Material	Thickness	Pen.	Hole Diameter	Petal	Petal Length of Crack Petals	Damage Description
		Witness #2	2024 AI	0.020"	Yes	1.98" x 1.02"			Damage area 3.0" x 2.5"
		Witness #3	2024 AI	0.020"	Yes	1.85" x 0.78"			Damage area 1.75" x 1.0"
1411	0.375" AI-1100	Shield #1	6061-T6 AI	0.050"	Yes	0.89" dia.			Edge of hole bent outward ~ 0.11"
	0 deg target angle	Shield #2	6061-T6 Al	0.063"	Yes	0.95 & .18 x .14"			Edge of holes bent outward ~ 0.15"
ſ		Wall	2219-T87 AI	0.125"	Yes	Max 3.11" x 2.5"			- 30 dimples, fine spray
T		Witness #1	2024 AI	0.020"	Yes		7	1.6,1.18,1.38,1.18,.76,1.14,0.75"	
Ī		Witness #2	2024 AI	0.020"	Yes		5		Damage area 5.0" dia.
Γ		Witness #3	2024 AI	0.020"	Yes		5		Damage area 4.5" x 3.75"
1412	0.187" Al-1100	Shield #1	6061-T6 Al	0.032"	Yes	0.38" x 0.33"			
	0 deg. target angle	Shield #2	6061-T6 Al	0.032"	Yes		4	0.92",1.19",1.47",1.0"	Many small holes, slight wagon wheel, dam area 8.75 x 8.5"
		Wall	6061-T6 AI	0.063"	٥N				Dim. on rear, fine spray, slight defl. of plate, dam area 4.5" dia
1413	0.375" AI-1100	Shield #1	6061-T6 Al	0.050"	Yes	Largest 1.01x1.18			Other holes .52x.45", 0.43x0.34", small petals formed on rear
	45 deg target angle	Shield #2	6061-T6 AI	0.063"	Yes	Largest 1.59x1.76			Other holes .39x.5", .41x.3", lrg hole has 7 petals, craters/ dim.
		Wall	2219-T87 AI	0.125"	Yes	Largest .93x.51"			8 holes total, craters w/ dim., fine spray, dam area 9.25x8.5"
1414	0.375" AI-1100	Shield #1	6061-T6 Al	0.080"	Yes	0.75" x 0.96"			
	45 deg target angle	Shield #2	6061-T6 Al	0.032"	Yes	Largest 1.04x.83"			Numerous holes radiate outward, dam area 12" x 9.5"
		Shield #3	6061-T6 Al	0.063"	Yes		8	1.79,1.67,.72,.45,.78,.94,1.18,.3	1.79,1.67,.72,.45,.78,.94,1.18,.3{Fine spray, damage area 7.0" x 9.25"
		Wall	6061-T6 Al	0.063"	No	0.07" x 0.03"			Plate deflected ~0.25", dam area 4"x4.5", crack on rear 0.165"
1415	0.187" AI-1100	Shield #1	6061-T6 Al	0.032"	Yes	Largest .33x.43"			Other holes 0.24x0.18", 0.17x0.12", 0.13x0.08"
	45 deg target angle	Shield #2	6061-T6 Al	0.032"	Ycs	Largest .36x.33"			Numerous holes, craters & dimples,fine spray, dam area 9.5x9"
		Wall	6061-T6 AI	0.063"	Yes	Largest .14x.25"			Numerous holes,~30 dimples, fine spray, dam. area 6.5x9.0"
1419	0.375" AI-1100	Shield #1	6061-T6 AI	0.063"	Yes	0.97" × 0.68"			Second hole 0.51" x 0.33"
	45 deg target angle	Shield #2	6061-T6 AI	0.050"	Yes	0.89" x 0.40"			Holes, craters & dimples radiating throughout plate, det spalls
		Wall	6061-T6 Al	0.125"	Yes	0.15" x 0.17"			~ 30 craters with dimples, fine spray
1420	0.375" AI-1100	Shield #1	6061-T6 Al	0:080"	Yes	0.71,0.16",0.11"	0		
Γ	0 deg target angle	Shield #2	6061-T6 AI	0.032"	Yes		8	1.23,0.16,0.87,0.40,0.57 0.86,1.04,1.59	4,1.59
		Shield #3	6061-T6 Al	0.063"	Yes		7	1.65,1.54,2.16,2.23,2.5,2.41,2.46	
		Wall	6061-T6 Al	0.063"	²		0		Plate bent away from projectile impact, dam area 4.5"x5.68"
1425	0.375" AI-1100	Shield #1	6061-T6 AI	0.080"	Yes	0.77" × 0.71"	0		Smaller hole meas. 2, 17, 12, 16, 07", craters, detached spall
	0 deg. target angle	Shield #2	6061-T6 AI	0.032"	Yes		8	0.9,0.89,0.43,0.68,0.56,0.62,0.52,0.88	,0.88
		Stuffing	Kevlar/ MLI	10 layers	Yes	See photo			
		Wall	2219-T87 Al	0.125"	No				Slight deflection of plate, fine spray, dam. area 4.6 x 4.25"
1426	0.375" Al-1100	Shield #2	6061-T6 Al	0.063"	Yes	0.76" x 1.1"			Numerous holes, craters and detached spalls
	45 deg target angle	Wall	2219-T86 AI	0.125"	Yes				2 small pin holes, numerous craters
1427	0.375" Al-1100	Shield #1	6061-T6 AI	0.050"	Yes	0.89" x 0.69"			10 small holes, numerous craters
Γ	45 deg target angle	Shield #2	6061-T6 AI	0.063"	Yes		8	0.74, 27, 39, 45, 24, 25, 16, 48, 53	3
		Wall	2219-T86 AI	0.125"	Yes	0.07 x 0.08"			Several craters, dam area 5.18" dia.
1429	0.375" AI-1100	Shield #1	6061-T6 Al	0.080"	Yes	0.75" x 0.95"			Small hole 0.02" dia.
	45 deg target angle	Stuffing	Kevlar	6 layers	Yes		6	1.08,1.25,1.37,1.27,1.76,1.67	
		Shield #2	6061-T6 Al	0.063"					
		Wall	6061-T6 AI	0.063"	No				~ 16 craters w/ dimples, slight defl. of plate, dam area 3.5 x3.8"
1430	0.375" Al-1100	Shield #1		0.080"	Yes	0.74" x 0.91"			Fine spray
Γ	45 deg. target angle	Stuffing	Kevlar	8 layers	Yes		7	3.18,3.94,3.75,3.72,2.77,5.11,5.16	9
		Shield #2		0.032"	Yes	See photo			
		Wall	6061-T6 Al	0.080"	Yes	0.05"			Numerous craters w/ dimples, fine spray, dam area 4" x 5.45"

Shot	2nd Projectile	Description	Material	Thickness	Pen.	Hole Diameter	Petal	Petal Length of Crack Petals	Damage Description
1431	0.375" AI-1100	Shield #1	6061-T6 Al	0.080"	Yes	0.74" x 0.92"			Fine spray on front and rear of panel
	45 deg. target angle	Shield #2	6061-T6 Al	0.032"	Yes		10	66, 58, 4, 61, 64, 57, 74, 48, 27, 42	.42
		Stuffing	Kevlar/MLI	10 layers		See photo			
		Wall	2219-T86 AI	0.125"	No				8 craters w/ dimples, fine spray, dam area 3.55x5.07"
1432	0.375" AI-1100	Shield #1	6061-T6	0.032"	Yes				4 largest holes 0.52",0.34x0.29", 0.33x0.26", 0.14"
	0 deg. target angle								
1433	0.375" Al-1100	Shield #1	6061-T6	0.050"	Yes	Largest 0.89 x 0.63			Smaller holes 0.51x0.38", 0.17'x0.11", numerous craters/spalls
	45 deg. target angle	Shield #2	6061-T6	0.032"	Yes		7	1.12,.57,.47,.43,.5,.54,.85	
		Stuffing	Kevlar	8 layers	Yes	See photo			
		Shield #3	6061-T6	0.032"	Yes		8	3.54,2.89,2.66,2.44,3.57,3.72,2.24,3.42	24,3.42
		Wali	6061-T6	0.080"	No				12 craters w/ dimples, ~ 0.19" defl., dam area 3.75 x 4.5"
1436	0.187" AI-1100	Shield #1	6061-T6	0.012"	Yes	0.33x0.32,0.28x0.23"			
	0 deg. target angle	Shield #2	6061-T6	0.040"	Yes	0.85" x 1.05"	2	0.17,0.52,0.14	Fine spray, 2 holes, 2nd hole 0.05" dia.
		Wall	6061-T6	0.040"	Yes		5	0.59,0.52,0.41,0.38,0.37	Det. spall, many craters with dimples, fine spray, 3 pin holes
1437	0.187" AI-1100	Shield #1	6061-T6	0.012"	Yes	0.32" x 0.25"			Numerous pin holes
	0 deg. target angle	Stuffing	MLI Blanket		Yes	See photo			
		Shield #2	6061-T6	0.040"	Yes		9	0.57,0.94,1.18,1.22,0.5,0.4	
		Wall	6061-T6	0.040"	Yes	Largest .12x.09"			Numerous small holes and craters
1438	0.187" AI-1100	Shield #1	6061-T6	0.012"	Yes	Largest .325 x .27"			
	0 deg. target angle	Stuffing	MLI Blanket		Yes	See photo			
		Shield #2	6061-T6	0.040"	Yes		7	1.46,0.36,1.23,1,.85,0.71	
		Wall	6061-T6	0.040"					Missing
1439	0.187" Al-1100	Shield #1	6061-T6	0.012"	Yes	0.35" x 0.31"			Numerous pin holes
		Stuffing	MLI Blanket		Yes	See photo			
		Shield #2	6061-T6	0.040"	Yes		8	.90,.73,.23,.75,.75,.78,.9,.99	
		Wall	6061-T6	0.040"	Yes	0.125" dia.			3 meas holes .125",.1 x .06", .063x.074", pin holes, fine spray
1442	0.187" AI-1100	Shield #1		0.012"	Yes	0.31" x 0.22"			Several pin holes around projectile entrance
1443	0.187" AI-1100	Shield #1		0.012"	Yes	0.31" dia.			Small hole below and to the right 0.04", numerous pin holes
1444	0.187" Al-1100	Shield #1	6061-T6 Al	0.012	Yes	0.295" dia.			Shield severely bent, shield cracked on bottom right side
1446	0.187" Al-1100	Shield #1	6061-T6 AI	0.012"	Yes	0.270" dia.			Shield severely bent, numerous pin holes
1450	0.5" Al-1100	Shield #1	6061-T6 Al	0.050"	Yes	0.720" dia.			Detached spall
	0 deg target angle	Shield #2	6061-T6 AI	0.050"	Yes	4.43" max dia.			Wagon wheel, many craters, & dimples
		Wall	2219-T87 AI	0.125"	Yes	0.811" x 0.708"	4	4.34",5.19",4.29",3.25"	Numerous craters
1451	0.5" Al-1100	Shield #1	6061-T6 AI	0.050"	Yes	1.163" x 0.794"	0		Elliptical hole
	45 deg target angle	Al Mesh			Yes	See photo	0		
		Nextel 62		6 layers	Yes	See photo	0		
		Kevlar 710		6 layers	Yes	See photo	0		
		MLI Blanket			Yes	See photo	0		
		Wall	2219-T87 AI	0.125"	Yes	0.661"	3	2.80",1.93",2.16"	Numerous craters, no dimples
1452	0.5" Al-1100	Shield #1	6061 T6 Al	0.063"	Yes	1.168" x 1.040"	0		Several debris holes and craters
	45 deg target angle	Al Mesh			Yes	See photo	0		
		Nextel 62		6 layers	Yes	See photo	0		
		Kevlar 710		6 layers	Yes	See photo	0		

Shot	2nd Proiectile	Description	Material	Thickness	Pen.	Hole Diameter	Petal	Petal Length of Crack Petals	Damage Description
2		MLI Blanket		6 layers	Yes	See photo	0		
		Wall	2219-T87 AI	0.125"	Yes	0.25"	3	0.81",2.12",1.41"	Elliptical damage area 6.042"x4.670"
1453	0.5" AI-1100	Shield	6061 T6 AI	0.063"	Yes	1.114" x 0.825"	0		Debris holes, 2 attached spalls, 4 dimples
	45 deg target angle	Al Mesh				See photo	0		
		Nextel 62		6 layers		See photo	0		
		Kevlar 710		6 layers		See photo	0		
ſ		MLI Blanket		6 layers		See photo	0		
		Wall	2219-T87 AI	.061.0	٥N		0		6 lg. craters, ~ deflection of wall 0.821"
1454	0.5" Al-1100	Shield #1	6061 T6 Al	0.063"	Yes	1.101" x 0.835"	0		Debris holes and craters, 2 detached spalls
	45 deg target angle	Al Mesh				See photo	0		
T))	Nextel 62		6 layers		See photo	0		
		Kevlar 710		6 layers		See photo	0		
		MLI Blanket		6 layers		See photo	0		
		Wall	2219-T87 AI	0.190"	No		0		4 lg. craters, many pits, dam. area 6.1 "x4.64", wall defl. ~.362"
1455	0.5" AI-1100	Shield #1	6061 T6 A1	0.063"	Yes	0.773" max. dia.	0		1 debris hole
	0 deg target angle	B2+ Stuffing			Yes	See photo	0		
		MLI			Yes	See photo	0		
Γ		Wall	2219-T87 AI	0.190"	Yes	0.880"	Ś	3.43,1.53,3.15, 2.05,0.73	Damage area 7.176"
		Witness #1			Yes	3.214"	0		Maximum length from edge to edge
		Witness #2			Yes	3.407"	0		Maximum length from edge to edge
		Witness #3			Yes	3.318"	0		Maximum length from edge to edge
1456	0.5" Al-1100	Shield #1	6061 T6 AI	0.063"	Yes	1.143"x 0.840"	0		Plated bent toward projectile
	45 deg target angle	Kevlar		26 layers	Yes	See photo	0		
		MLI			Yes	See photo	0		
		Wall	2219-T87 AI	0.190"	Yes	0.727"x 0.365"	0		Many pits, no dimples
1457	Bad Shot						0		
1458	0.5" Al-1100	Shield #1	6061 T6 Al	0.063"	Yes	1.126"x 0.836"	0		
	45 deg target angle	AF26 Nextel		3 layers	Yes	See photo	0		
		Kevlar 120		11 layers	Yes	See photo	0		
		MLI			Yes	See photo	0		
		Wall	2219-T87 AI	0.190"	Yes	0.035"	0		Fine spray, damage area 5.684"x 3.343
1459	Bad Shot						0		
1466	0.313" AI-1100	Shield #1	6061 T6 Al	0.032"	Yes	0.750"x 0.522"	0		Fine spray
	45 deg target angle	Nextel		3 layers	Yes	See photo	0		
		Kevlar		3 layers	Yes	See photo	0		
		MLI		10 layers	Yes	See photo	0		
		Wail	2219-T87 AI	0.100"	Yes	0.836"x 0.264"	4	1.71",1.74",1.96",1.34"	Length of petal crack
		Witness #1			٥N		٥		Numerous large craters
		Witness #2			Ŷ		0		No apparent damage

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1467	0.375" Al-1100	Shield #1		0.040	Yes	0.809 X U.395	-		Shield Dent outward
	45 deg target angle	Al Mesh			Yes	See photo	0		
		Nextel		2 layers	Yes	See photo	0		
		Kevlar		7 layers	Yes	See photo	0		
		MLI		15 layers	Yes	See photo	0		
		Wall		0.125"	Yes	0.552"x 0.294"	4	1.82",1.92",1.59",2.08"	Length of petal crack
		Witness #1			No		0		Lg. plate defl., 1 detached spall, craters
1468	Bad Shot						0		
1469	0.5" Al-1100	Shield #1	2024 AI	0.025"	Yes		0		
	75 deg target angle	Nextel		2 layers	Yes	See photo	0		
		Kevlar		l layers	Yes	See photo	0		
		MLI		11 layers	Yes	See photo	0		
		Wall	6061-T6	0.063"	Yes	1.716"	5	2.07,1.55,0.91,1.52,2.17	Length of petal crack
		Witness #1			Yes		0		Damage area 3.05" dia.
		Witness #2			Yes	.188,.16,.52x.26	0		3 holes & 3 craters
1470	0.5" Al-1100	Shield #1	6061-T6 AI	0.063"	Yes	0.81" x 1.10"			
	45 deg target angle	Stuffing			Yes	See photo			
		Wall	2219-T87 AI	0.190"	°Ż				2 dimples on rear, 10 craters w/o dimp., dam area 4.25 x 4.5"
1476	0.313" AI-1100	Shield #1	6061-T6 Al	0.040"	Yes	0.54 x 0.79"			
	45 deg target angle	Nextel		2 layers	Yes	See photo			
		Kevlar		7 layers	Yes	See photo			
		MLI		15 layers	Yes	See photo			
		Wall	2219-T87 Al	0.125"	٥N				Crack 0.07" long, fine spray, 2 dimples, dam area 2.0 x 2.75"
		Witness #1	2024 AI	0.020"	No				Attached spall, damage area 0.23" x 0.18"
1477	0.375" AI-1100	Shield #1	6061-T6 Al	0.040"	Yes	0.59" x 0.82"			
	45 deg target angle	Nextel		4 layers	Yes	See photo			
		Kevlar		4 layers	Yes	See photo			
		MLI		15 layers	Yes	See photo			
		Wall	2219-T87 AI	0.125"	Yes	0.84" x 0.85"	4	1.03,1.57,0.65,1.84"	Damage area 2.875" x 4.0"
		Witness #1	2024 AI	0.020"	Yes				5 pin holes, damage area 2.5" x 3.0"
		Witness #2	2024 AI	0.020"	٥N				5 craters w/ dimples
1478	0.375" Al-1100	Shield #1	6061-T6 Al	0.040"	Yes	0.80" x 0.58"			9 secondary, plate bent toward proj entrance, dimp on front
	45 deg target angle	Shield #2	6061-T6 Al	0.080"	Yes	2.20" x 1.14"			Numerous craters w/ dimples, dam area 4.5 x 4.375"
		Wall	2219-T87 AI	0.125"	Yes	1.23" x 1.19"			2 smaller holes 0.17 x 0.14" & 0.14" d. dam area 2.88 x 3.38"
		Witness #1	2024 AI	0.020"	Yes	4.45" x 3.16"			8 petals
		Witness #2	2024 AI	0.020"	Yes	3.72" x 2.27"			8 petals
1481	0.313" AI-1100	Shield #1	6061-T6 AI	0.063"	Yes	0.68" x 0.97"			6 secondary holes
	45 deg target angle	Shield #2	6061-T6 AI	0.032"	Yes	2.94" x 3.52"	∞	1.18, 1.25, 0.28, 1.1, 1.19, 0.58, 0.47, 0.62	0.47, 0.62
		MLI		12 layers	Yes	See photo			

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Shot	2nd Projectile	Description	Material	Thickness	Pen.	Hole Diameter	Petal	Length of Crack Petals	Damage Description
		Wall	2219-T87 Al	0.100"	Yes	2.66" long			Dimples, craters, fine spray, dam area 3.0" x 4.75"
		Witness #1	2024 AI	0.020"	Yes	Pin hole			Attached spalls, damage area 1.875" x 2.375"
1482	0.313" AI-1100	Shield #1	6061-T6 Al	0.063"	Yes	0.67" x 0.84"			2 small secondary holes, fine spray
	45 deg target angle	Nextel		l layer	Yes	See photo			
		Kevlar		3 layers	Yes	See photo			
		MLI		12 layers	Yes	See photo			
		Wall	2219-T87 Al	0.100"	Yes	Max. 0.6 x 0.48"	5	1.21,1.19,1.63,1.18,1.77"	Damage area 4.0" x 6.0"
		Witness #1	2024 AI	0.020"	No				4 dimples on rear, damage area 3.375" x 4.5"
1483	0.375" AI-1100	Shield #1	6061-T6 Al	0.080"	i				
	45 deg target angle	Shield #2	6061-T6 AI	0.040"	Yes	2.64" x 2.75"			Slight petal effect, petals have holes, craters, & dimples
		Blanket	ITIM	15 layers	Yes	See photo			
		Wall	2219-T87 Al	0.125"	Yes	0.98" x 1.59"			1 petal, crack lengths 1.25 & 1.72, fine spray, dam area 5 x 7"
		Witness #1	2024 AI	0.020"	Yes	0.80" x 0.59"			~8 craters w/ dimples dam. area 2.0" x 1.75"
		Witness #2	2024 AI	0.020"	Yes	2.65" x 3.83"			Damage area 4.25" x 5.75"
		Witness #3	2024 AI	0.020"	Yes	Pin holes			9 pin holes , attached spalls, dam area 3.5" x 4.0"
1484	0.375" Al-1100	Shield #1	6061-T6 Al	0.080"	Yes	0.76" x 1.0"			
	45 deg target angle	Nextel		2 layer	Yes	See photo			
		Kevlar		2 layers	Yes	See photo			
		MLI		15 layers	Yes	See photo			
		Wall	2219-T87 AI	0.125"	Yes	0.94" x 1.40"			3 petals, crack length 0.49, .73, .58,1.8", dam area 4.25 x 4.75
		Witness #1	2024 AI	0.020"	Yes	Crack 1.51" long			Crack 1.51 x 0.27", 5 pin holes, dam area 4.0" x 4.5"
		Witness #2	2024 AI	0.020"	No				Dent in plate 0.50" long
1485	0.250" AI-1100	Shield #1	6061-T6 Al	0.050"	ż				
	0 deg target angle	Wall	2219-T87 AI	0.125"	ċ				
		Witness #1	2024 AI	0.020"	ů				Attached spalls, ~11 dimples, dam area 1.875" x 1.375"
1489	0.250" AI-1100	Shield #1	6061-T6 Al	0.0075"	ć				
	0 deg target angle	Wall	2219-T87 AI	0.125"	۰.		Τ		
		Witness #1	2024 AI	0.020"	Yes	0.29" x 0.26"			Numerous craters w/ dimples, damage area 3.25" x 2.875"
		Witness #2	2024 AI	0.020"	οŊ				Small dent 0.25" long, attached spall, dam area 0.38" x 0.50"
1491	0.250" AI-1100	Blanket	Kevlar	l ply	Yes	See photo			
	0 deg target angle	Blanket	B₄C		Yes	See photo			
		Blanket	AL	0.20"	Yes	See photo			
		Blanket	Kevlar	5 layers	Yes	See photo			
		Wall	2219-T87 AI	0.125"	i				
1493	0.250" Al-1100	Shield #1	2024 AI	0.025"	Yes	0.37" x 0.56"			0.08" x 0.11" secondary holes, and 2 pin holes
	45 deg target angle	Blanket	Mesh		Yes	See photo			
		Blanket	Nextel	2 layers	Yes	See photo			
		Blanket	Kevlar	4 layers	Yes	See photo			
		Blanket	MILI	9 layers	Yes	See photo			

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Shot	2nd Projectile	Descrintion	Material	Thickness	Pen.	Hole Diameter P	Petal	Petal Length of Crack Petals	Damage Description
		Wall	6061-T6	0.080"	Yes		s	7"	Damage area (max dim) 2.25" x 2.25"
		Witness #1	2024 AI	0.020"	Yes	2 pin holes			Damage area 3.25" diameter
1494	0.375" AI-1100	Shield #1	6061-T6 AL	0.040"	Yes	0.60" x 0.88"			
	45 deg target angle	Blanket	Mesh		Yes	See photo			
		Blanket	Nextel	4 layers	Yes	See photo			
		Blanket	Kevlar	4 layers	Yes	See photo			
		Blanket	ITM	15 layers	Yes	See photo			
		Wall	2219-T87 AI	0.125"	Yes	Max. 0.7" x 0.4"	4 (0.88", 0.31", 0.96", 0.75"	Damage area 3.625" x 4.5"
		Witness #1	2024 AI	0.020"	Yes	Lrg 0.32" x .29"			3 holes, damage area 3.75 x 4.0"
		Witness #2	2024 AI	0.020"	No				2 craters w/ dimples, damage area 0.41" x 0.14"
1495	0.375" AI-1100	Shield #1	2024 AI	0.040"	Yes	0.53" x 0.76"			9 secondary holes
	45 deg target angle	Blanket	Mesh		Yes	See photo			
		Blanket	Nextel	2 layers	Yes	See photo			
		Blanket	Kevlar	4 layers	Yes	See photo			
		Blanket	MLJ	9 layers	Yes	See photo			
		Wall	6061-T6 Al	0.080"	Yes	Max 1.58 x 1.41"	s	0.38,0.47,0.2,0.42,0.15	2 small holes, craters dimples, fine spray,dam area 5.75 x 8.5"
		Witness #1	2024 AI	0.020"	Yes	Max. 2.71 x 2.3"			Attached spall around hole, damage area 3.375" x 3.5"
1496	0.313" AI-1100	Shield #1	2024 AI	0.040"	Yes	0.46" x 0.51"			
	25 deg target angle	Blanket	Al Mesh		ć				
		Blanket	Nextel	2 layers	ć		1		
		Blanket	Kevlar	4 layers	i				
		Blanket	MLI	9 layers	i	-			
		Wall	6061-T6 Al	0.080"	Yes	Max 3.25 x 3.48"	~	2,1.72,1.33,1.7,1.83,1.94,1.59,1.84	84
		Witness #1	2024 AI	0.020"	Yes	Max 4.44 x 4.6"	8		Damage area 4.75 x 5.75"
		Witness #2	2024 AI	0.020"	Yes	Max 2.5" x 0.52"			Attached spalls, damage area 4.75 x 5.5"
1498	0.250" AI-1100	Shield #1	6061-T6 Al	0.050"	Yes	0.58" x 0.60"			
1502	0.5" Al-1100	Shield #1	6061-T6 A1	0.063"	Yes	1.150"x 0.837"	0		Severely bent outward ,craters ,detached spall
	45 deg target angle	MLI		20 layers	Yes	See photo	0		
		Nextel		3 layers	Yes	See photo	0		
		Keviar		6 layers	Yes	See photo	0		
		Graphite Ep.		Sheet	Yes	See photo	0		
		Wall	2219-T87 AI	0.188"	Yes	0.137"	4	0.59",0.52",0.88",0.34"	Fine spray, dam. area 4.69" x 6.0"
1503	0.5" Al-1100	Shield #1	6061 T6 AI	0.063"	Yes	1.118" x 0.822"	0		
	45 deg target angle	MLI			Yes	See photo	0		
		AF-62 Nextel		5 layers	Yes	See photo	0		
		Graphite Ep.		Sheet	Yes	See photo	0		
		Wall	2219-T87 Al	0.188"	Yes	0.362" x 0.223"	0		Fine spray
		Witness #1			Yes 0.	0.61"x.46" & 0.39" x 0.19"	-19		Damage area 1.43"x 1.67"

2nd Projectile	Description	Material	Thickness	Pen.	Hole Diameter	Hole Diameter Petal Length of Crack Petals	Damage Description
304 Stainless Steel Projectile	tile						
2nd Projectile	Description	Material	Thickness	Pen.	Hole Diameter	Petal Length of Crack Petals	Damage Description
0.25" 304 S.S.	Shield #1			Yes	0.327"	0	
	Wall #1	-		Yes	0.40"	0	Minor detached spalls
	Wall #2			Yes	0.42"	0	Fine spray
	Wall #3			Yes	0.45"x 0.35"	0	Damage area 1.1" x 1.3"
0.25" 304 S.S.	Shield #1			Yes	0.351"	0	
	Wall #1			Yes	0.413" x 0.387"	0	Fine spray
	Wall #2			Yes	0.470" x 0.575"	0	Fine spray
	Wall #3			Yes	0.400" x 0.489"	0	Fine spray

Aluminum Projectile

Shot	2nd Projectile	Description	Material	Thickness	Pen.	Hole Diameter	Petal	Petal Length of Crack Petals	Damage Description
1507	0.25" AI-1100	Shield #1	2219 T87 AI	0.125"	Yes	0.685"	0		
		Shield #2	6061-T6 Al	0.032"	Yes		8	Max=1.62", Min=1.23	Numerous small holes, fine spray
		Shield #3	2024 AI	0.020"	Yes		7	Max=2.2", Min=1.68"	
		Shield #4	2024 AI	0.020"	Yes		5	2.96",2.25",1.7",2.28",3"	
		Wall	6061-T6 AI	0.080"	٥N		0		Slight indentation at impact
1509	0.313" AI-1100	Shield #1	6061-T6 Al	0.040"	Yes	0.722" x 0.527"	0		Fine spray
	45 deg target angle	MLI					0		
		Nextel		2 layers			0		
		Kevlar		2 layers			0		
		Wall	2219 T87 AI	0.125"	No		0		Craters, damage area 5.17" x 3.15"
1524	0.25" Al-1100	Shield #1	2219 T87 AI	0.125"	Yes	0.69"	0		
		Shield #2	6061-T6 AI	0.032"	Yes		10	Max.=2.13",Min=1.5"	Numerous small holes
		Shield #3	6061-T6 AI	0.012"	Yes		10	Max=1.88",Min=0.743"	Numerous craters, small holes
		Shield #4	6061-T6 AI	0.012"	Yes		7	Max=2.43",Min=1.67"	
		Wall	6061-T6 AI	0.080"	No		0		Slight indent, fine spray, dam area 2.19" dia
1528	0.313" AI-1100	Shield #1	6061-T6 AI	0.040"	Yes	0.72" x 0.52"	0		
	45 deg target angle	MLI		15 layers	Yes	See photo	0		
		Nextel		2 layers	Yes	See photo	0		
		Kevlar		2 layers	Yes	See photo	0		
		Wall	2219 T87 AI	0.125"	Yes	0.53"	1	0.38", 0.47"	Damage area 2.5"
		Witness #1			Yes	0.03"	0		21 craters
1529	0.187" AI-110	Shield #1	2219 T87 AI	0.125"	Yes	.579"	0		
	0 deg target angle	Shield #2	6061-T6 AI	0.032"	Yes		9	.92",1.13",1.17",1.18", 82",1.13"	
		MLI		25 layers			0		
		Shield #3	6061-T6 Al	0.012"	Yes	Max .16,Min .02	0		8 holes total, damage area 2.25" dia.

MI <th>Shot</th> <th>2nd Projectile</th> <th>Description</th> <th>Material</th> <th>Thickness</th> <th>Pen.</th> <th>Hole Diameter</th> <th>Petal</th> <th>Petal Length of Crack Petals</th> <th>Damage Description</th>	Shot	2nd Projectile	Description	Material	Thickness	Pen.	Hole Diameter	Petal	Petal Length of Crack Petals	Damage Description
model field #4 6061.T6 AI 0012* No 0 0 Wall 6061.T6 AI 0.080° Yes 0.01° 0 0 0.313* AI-1100 Shield #1 6061.T6 AI 0.080° Yes 0.01° Yes 0.01° 0.04 fact 2.291 YB7 AI 0.125° Yes 0.01° Yes 2.75°×1.0° N 0.04 fact 0.020° Yes 2.75°×1.0° N N N Netness #1 2.204 AI 0.020° Yes 2.75°×1.0° N N 0.375* AI-1100 Shield #1 6061.T6 AI 0.020° Yes 2.75°×1.0° N N 0.375* AI-1100 Shield #1 6061.T6 AI 0.020° Yes See photo N N 1535* AI-1100 Shield #1 6061.T6 AI 0.020° Yes See photo N N 0.375* AI-1100 Shield #1 6061.T6 AI 0.020° Yes See photo N N 0.375* AI-1100 </th <th></th> <th></th> <th>MLI</th> <th></th> <th>15 layers</th> <th></th> <th></th> <th>0</th> <th></th> <th></th>			MLI		15 layers			0		
Wall 666i-T6 AI 0.080° No 0 0 0.313° AI-1100 Shield #1 666i-T6 AI 0.050° Yes 0.61" Dia 0 0.04° Mainess #1 2203 AI 0.020° Yes 2.75"x 1.0" 3 2.25", 18" & 34.38.35" Witness #2 2024 AI 0.020° Yes 2.75"x 1.0" 3 2.25", 18" & 34.38.35" Witness #2 2024 AI 0.020° Yes 2.75"x 1.0" 3 2.25", 18" & 34.38.35" Witness #2 2024 AI 0.020° Yes 2.75"x 1.0" 3 2.25", 18" & 34.38.35" Witness #1 6061-T6 AI 0.020° Yes 2.75"x 1.0" 3 2.25", 18" & 34.38.35" 45 deg target angle MI 0.020° Yes See photo 1 1 0.355" AI-1100 Shield #1 0.020° Yes See photo 1 1 Veviat Veviat Yes See photo 1 1 1 1 0.355" AI-1100 Shield #1 0.020"			Shield #4	6061-T6 Al	0.012"	No		0		2 craters
0.313* Al-1100 Shield #1 6061-T6 Al 0.030' Yes 0.61" Dia 1 0 deg target angle Wali 2219 T87 Al 0.125' Yes Witness #1 2203 Al 0.020' Yes 2.75'x 1.0' 3 2.25'', 18''& 34, 38, 35'' Witness #1 2024 Al 0.020' Yes 2.75'x 1.0' 3 2.25'', 18''& 34, 38, 35'' Witness #3 2024 Al 0.020' Yes 0.65'' x0.91'' A 2.25'', 18''& 34, 38, 35'' Witness #3 2024 Al 0.020'' Yes 5.6 photo A 2.25'', 18''& 34, 38, 35'' 45 dg target angle M.L 0.020'' Yes 5.6 photo A 2.25'', 18''& 34, 38, 35'' 14 bayet Yes Yes See photo A			Wall	6061-T6 Al	0.080"	No		0		No visible damage
0 deg target angle Walt 2219 T87 AI 0.125° Yes 2.75° X 1.0° A 1 witness #1 2024 Ai 0.020° Yes 2.75° X 1.0° 3 2.25°18° & 3.4.3835° 1 witness #2 2024 Ai 0.020° Yes 2.75° X 1.0° 3 2.25°18° & 3.4.3835° 1 witness #2 2024 Ai 0.020° Yes 0.65° X 0.91° > 2.25°18° & 3.4.3835° 0.375° Al-1100 Shield #1 6061-T6 Ai 0.020° Yes 0.65° X 0.91° > 1 A betel 15 layers Yes See photo > 0.75° X 1.0° > 2.75° 18° & 3.4.3835° 1 Witness #1 0.020° Yes See photo > 2.75° 18° & 3.4.3835° 1 Witness #1 2024 Ai 0.125° Yes See photo > 2.75° 18° & 3.5.4.33835° 1 0.375° Al-1100 Shield #1 6001° Yes See photo	1531	0.313" Al-1100	Shield #1	6061-T6 AI	0.050"	Yes	0.61" Dia			Numerous small holes
witness #1 2024 Ai 0.020" Yes $2.75"x 1.0"$ 3 $2.25".18"$ $x3.35"$ witness #2 2024 Ai 0.020" Yes $3.255".18"$ $x3.35"$ witness #3 2024 Ai 0.020" Yes $3.255".18"$ $x3.35"$ witness #3 2024 Ai 0.020" Yes $0.65"x 0.91"$ 3 $2.25".18"$ $x3.35.3"$ u375" Ai-1100 Shield #1 6061-T6 Ai $0.020"$ Yes $8.6e$ photo 3 $2.25".18"$ $x3.35.3"$ witness #1 2.014 $0.020"$ Yes $8.6e$ photo 3 $2.75".16"$ $x1.35.35"$ witness #1 2.014 Ai $0.020"$ Yes $8.6e$ photo 3 $2.25".18"$ $x3.35.3"$ $0.375" Ai-1100$ Shield #1 $6061-T6$ Ai $0.020"$ Yes $5.6e$ photo 3 $4.83m^2$ $8.80m^2$ $8.8m^2$ $8.8m^2$ $8.8m^2$ $8.8m^2$ $8.8m^2$ $8.8m^2$ <th></th> <th>0 deg target angle</th> <th>Wall</th> <th>2219 T87 AI</th> <th>0.125"</th> <th>Yes</th> <th></th> <th></th> <th></th> <th></th>		0 deg target angle	Wall	2219 T87 AI	0.125"	Yes				
witness #22024 AI0.020°Yes32.25"18" &.343835"Witness #32024 AI0.020°No \sim 32.25"18" &.343835"Witness #32024 AI0.020°No \sim \sim \sim \sim 0.375" AI-1100Shield #16061-T6 AI0.020°Yes \sim \sim \sim 45 deg target angleMLI $<$ $<$ $15 layersYesSee photo\sim\simNextelNextel<<13 layersYesSee photo\sim<\simWitness #12219 T87 AI0.125^\circYesSee photo\sim<<<Witness #12219 T87 AI0.125^\circYesSee photo\sim<<<0.375" AI-1100Shield #16061-T6 AI0.020^\circNo<<<<0.375" AI-1100Shield #16061-T6 AI0.020^\circYesSee photo<<<0.375" AI-1100Shield #16061-T6 AI0.020^\circYesSee photo<<<0.375" AI-1100Shield #16061-T6 AI0.020^\circYesSee photo<<<0.375" AI-1100Shield #12024 AI0.020^\circYes<<<<0.037" AI-1100Shield #12024 AI0.020^\circYes<<<<0.037" AI-1100Shield #10.020$			Witness #1	2024 AI	0.020"	Yes	2.75"x 1.0"			
witness #32024 Al0.020'NoNo $0.375'$ Al-1100Shield #1 $6061.T6$ Al $0.050''$ Yes $0.65'' x 0.91''$ A 45 deg target angleML1 15 layersYes $See photoANextelNextel15 layersYesSee photoANextelNextel2219 T87 Al0.020''YesSee photoANextel2219 T87 Al0.125''YesSee photoAANextel2219 T87 Al0.125''Yes0.50'' x 0.06''AAWitness #12024 Al0.020''NoAAA0.375' Al-1100Shield #16061-T6 Al0.022''Yes560'' x 0.06'''A0.375'' Al-1100Shield #16061-T6 Al0.020''Yes560'' x 0.06'''A0.375'' Al-1100Shield #16061-T6 Al0.020''Yes560'' x 0.89'''A0.375'' Al-1100Shield #12024 Al0.020''Yes560'' x 0.89'''A0.375'' Al-1100Shield #22219 T87 Al0.020''''' YesYes560'' x 0.89''''''''''''''''''''''''''''''''''''$			Witness #2	2024 AI	0.020"	Yes		3	2, 25", 18"&. 34, 38, 35"	3 holes, 2 w/ 3 petals & 1 w/ debris in hole, 3rd small
0.375° Al-1100 Shield #i 6061 -T6 Al 0.050° Yes 0.65° 0.66° 0.66° 0.66° 0.66° 0.66° 0.66° 0.66° 0.66° 0.66° 0.026° N_{0} 0.50° 0.066° 0.66° $0.6^$			Witness #3	2024 AI	0.020"	No				1 large crater 0.22" x 0.15"
45 deg target angle ML1 15 layers Yes See photo I Nextel Nextel 1 layers Yes See photo I Kevlar Kevlar 2219 T87 Al 0.125" Yes See photo I Wall 2219 T87 Al 0.125" Yes See photo I I Wall 2219 T87 Al 0.125" Yes 0.50"x 0.066" I I Wall 2024 Al 0.020" No 50"x 0.066" I I Witness #1 2024 Al 0.032" Yes 61x1.05.28x.41" I I 0.375" Al-1100 Shield #1 6061-T6 Al 0.032" Yes See photo I Nextel 2219 T87 Al 0.032" Yes See photo I I Wall 2219 T87 Al 0.020" Yes See photo I I 0.375" Al-1100 Shield #1 6061-T6 Al 0.020" Yes See photo I 0.375" Al-1100	1545	0.375" AI-1100	Shield #1	6061-T6 Al	0.050"	Yes	0.65"x 0.91"			Plate bulged toward proj, several small holes & craters
Nextel Mextel Mextel Mextel Hayers Yes See photo Nethod Kevlar Kevlar 219 T87 AI 0.125" Yes See photo Nethod Wall 2219 T87 AI 0.125" Yes 0.50"x 0.066" Nethod Nethod Witness #I 22024 AI 0.020" No Nethod Nethod Nethod 0.375" AI-1100 Shield #I 6061-T6 AI 0.032" Yes 0.50"x 0.066" Nethod 0.375" AI-1100 Shield #I 6061-T6 AI 0.020" Yes 5611.05.28x 41" Nethod 60 deg target angle MLI 0.020" Yes 56e photo Nethod Nethod Nextel 2219 T87 AI 0.032" Yes See photo Nethod Nethod Wall 2219 T87 AI 0.020" Yes See photo Nethod Nethod Wall 2219 T87 AI 0.020" Yes See photo Nethod Nethod Wall 2219 T87 AI 0.0		45 deg target angle	MLI		15 layers	Yes	See photo			
(kevlar<			Nextel		4 layers	Yes	See photo			
walt $2219 T87 AI$ 0.125° Yes $0.50^{\circ} x 0.066^{\circ}$ >>Winess #1 $2024 AI$ 0.020° No \sim >> $0.375^{\circ} AI 100$ Shield #1 $6061 \cdot T6 AI$ 0.020° Yes $61 x 1.05.28x.41^{\circ}$ > $60 deg target angleMLJ\sim0.032^{\circ}Yes5ee photo>>60 deg target angleMLJ\sim3 layersYesSee photo>>NextelNextel3 layersYesSee photo>>>Nextel2219 T87 AI0.033^{\circ}YesSee photo>>>Nextel2219 T87 AI0.093^{\circ}YesSee photo>>>Nalt2219 T87 AI0.020^{\circ}NoNo>>>>0.375^{\circ} AI-1100Shield #16061 \cdot T6 AI0.020^{\circ}Yes0.65^{\circ} x 0.89^{\circ}>>0.375^{\circ} AI-1100Shield #16061 \cdot T6 AI0.020^{\circ}Yes0.65^{\circ} x 0.89^{\circ}>>0.375^{\circ} AI-1100Shield #16061 \cdot T6 AI0.020^{\circ}Yes0.65^{\circ} x 0.89^{\circ}>>>0.375^{\circ} AI-1100Shield #22219 \cdot T87 AI0.025^{\circ}Yes0.65^{\circ} x 0.89^{\circ}>>0.375^{\circ} AI-1100Shield #22219 \cdot T87 AI0.025^{\circ}Yes0.65^{\circ} x 0.89^{\circ}>>0.375^{\circ} AI-10.025^{\circ}Yes0.65^{\circ} x $			Kevlar		4 layers	Yes	See photo			
Witness #1 2024 Al 0.020° No $<$ $<$ 0.375° Al-1100Shield #1 6061 -T6 Al 0.032° Yes $61x1.05.28x.41^{\circ}$ $<$ 0.375° Al-1100Shield #1 6061 -T6 Al 0.032° Yes $56e$ photo $<$ 60 deg target angleML1 $<$ 0.032° Yes See photo $<$ 60 deg target angleML1 2219 T87 Al 10 layersYes See photo $<$ $Kevlar2219 T87 Al0.093^{\circ}YesSee photo<<Wall2219 T87 Al0.093^{\circ}YesSee photo<<Wall2219 T87 Al0.093^{\circ}YesSee photo<<0.375^{\circ} Al-1100Shield #16061-T6 Al0.020^{\circ}Yes0.65^{\circ}x 0.89^{\circ}<0.375^{\circ} Al-1100Shield #16061-T6 Al0.020^{\circ}Yes0.65^{\circ}x 0.89^{\circ}<0.375^{\circ} Al-1100Shield #22219 T87 Al0.020^{\circ}Yes0.65^{\circ}x 0.68^{\circ}<0.375^{\circ} Al-1100Shield #22219 T87 Al0.125^{\circ}Yes0.65^{\circ}x 0.63^{\circ}x 0.64^{\circ}<0.375^{\circ} Al-1100Shield #22219 T87 Al0.020^{\circ}Yes0.6^{\circ}x 0.63^{\circ}x 0.64^{\circ}<0.375^{\circ} Al-10.020^{\circ}Yes0.6^{\circ}x 0.63^{\circ}x 0.64^{\circ}<<0.375^{\circ} Al0.020^{\circ}Yes0.6^{\circ}x 0.63^{\circ}x 0.64^{\circ}<<$			Wall	2219 T87 AI	0.125"	Yes	0.50"x 0.066"			1 large horizontal crack 2.9", several large craters
0.375" Al-1100 Shield #1 6061-T6 Al 0.032" Yes 61x1.05.28x.41" A 60 deg target angle ML1 2001 Pes See photo P 60 deg target angle ML1 10 layers Yes See photo P 70 bestel Nextel 3 layers Yes See photo P 70 bestel 219 T87 Al 0.093" Yes See photo P 70 bestel 2219 T87 Al 0.093" Yes See photo P 70 bestel 2219 T87 Al 0.030" Yes See photo P P 70 bestel 2024 Al 0.030" Yes 0.65"x 0.89" P P 70 bestel 2014 M1 0.050" Yes 0.65"x 0.89" P P 70 bestel 2014 M1 0.050" Yes 0.65"x 0.89" P P 70 bestel 2015 T31 0.050" Yes 0.65"x 0.89" P P 70 bestel 2011 M1 0.050"			Witness #1	2024 AI	0.020"	Νo				Damage area 1.22"x 0.64", 3 dimples on rear
$60 \deg target angle MLI 10 layers Yes See photo 10 Kevelar Nextel 3 layers Yes See photo 10 Kevelar Nextel 3 layers Yes See photo 10 Kevelar 2219 T87 Al 0.093^{\circ} Yes See photo 10 Walt 2219 T87 Al 0.093^{\circ} Yes See photo 10 Walt 2219 T87 Al 0.020^{\circ} No 10 10 Walt 2024 Al 0.050^{\circ} Yes 0.65^{\circ} x 0.89^{\circ} 10 0.375^{\circ} Al-1100 Shield #1 6061 \cdot T6 Al 0.050^{\circ} Yes 0.65^{\circ} x 0.89^{\circ} 0.375^{\circ} Al-1100 Shield #2 2219 T87 Al 0.056^{\circ} X 0.89^{\circ} 4 2.13^{\circ} 1.72^{\circ} 1.67^{\circ} 1.73^{\circ} 0.375^{\circ} Al-1100 Shield #2 2024 Al 0.125^{\circ} Yes 4 2.13^{\circ} 1.72^{\circ} 1.67^{\circ} 1.73^{\circ} 0.375^{\circ} Al-10 0.020^{\circ} Yes Yes 0.66^{\circ} X 0.63^{\circ} X 0.64^{\circ} 4 <$	1546	0.375" Al-1100	Shield #1	6061-T6 Al	0.032"	Yes	.61x1.05,.28x.41			Shield severely bulged toward the projectile entrance
Mextel Mextel 3 layers Yes See photo A Kevlar 3 layers Yes See photo A Wall 2219 T87 AI 0.093" Yes A A Witness #1 2024 AI 0.093" Yes A A 0.375" AI-1100 Shield #1 6061-T6 AI 0.020" Yes A A 0.375" AI-1100 Shield #2 2024 AI 0.050" Yes A A 0.375" AI-1100 Shield #2 2021 T87 AI 0.050" Yes A A 0.375" AI-1100 Shield #2 2219 T87 AI 0.050" Yes A A Wall 2219 T87 AI 0.050" Yes Max. 2.54x1.47" A A Wall 2014 MI 0.020" Yes A		60 deg target angle	MLI		10 layers	Yes	See photo			
Kevlar $3 layers$ YesSee photo $>$ Wall $2219 T87 Al$ $0.093"$ Yes $>$ $>$ Witness #1 $2219 T87 Al$ $0.093"$ Yes $>$ $>$ $0.375" Al-1100$ Shield #1 $6061 T6 Al$ $0.020"$ Yes $0.65"x 0.89"$ $>$ $0.375" Al-1100$ Shield #1 $6061 T6 Al$ $0.050"$ Yes $0.65"x 0.89"$ $>$ $0.375" Al-1100$ Shield #2 $2219 T87 Al$ $0.050"$ Yes $Max . 2.54x l.47"$ $>$ $60 deg target angleShield #22219 T87 Al0.125"YesMax . 2.54x l.47">Wall2219 T87 Al0.125"YesMax . 2.54x l.47">>Witness #12024 Al0.020"Yes0.6"x 0.63"x 0.64">Witness #22024 Al0.020"Yes>>>Witness #22024 Al0.020"Yes>>>$			Nextel		3 layers	Yes	See photo			
Walt 2219 T87 AI 0.093" Yes Witness #1 2024 AI 0.030" No 0.375" AI-1100 Shield #1 6061-T6 AI 0.020" No 60 deg target angle Shield #2 2219 T87 AI 0.096" Yes 0.65"x 0.89" Walt 2219 T87 AI 0.096" Yes Max 2.54x1.47" 4 2.13",1.72",1.67",1.73" Walt 2219 T87 AI 0.125" Yes Max 2.54x1.47" 4 2.13",1.72",1.67",1.73" Witness #1 2024 AI 0.020" Yes 0.6"x0.63"x0.64" 4 2.13",1.72",1.67",1.73" Witness #2 2024 AI 0.020" Yes 0.6"x0.63"x0.64" 3 0.16",0.38",0.55"			Kevlar		3 layers	Yes	See photo			
Witness #1 2024 AI 0.020" No No 0.375" AI-1100 Shield #1 6061-T6 AI 0.050" Yes 0.65"x 0.89" 60 deg target angle Shield #2 2219 T87 AI 0.056" Yes 0.65"x 0.89" 60 deg target angle Shield #2 2219 T87 AI 0.096" Yes Max. 2.54x1.47" Walt 2219 T87 AI 0.125" Yes Max. 2.54x1.47" 4 2.13",1.72",1.67",1.73" Witness #1 2024 AI 0.020" Yes 0.6"x0.63"x0.64" 4 2.13",0.75",0.55" Witness #2 2024 AI 0.020" Yes 0.6"x0.63"x0.64" 3 0.16",0.38",0.55"			Wall	2219 T87 AI	0.093"	Yes				Vert. crack 1.4", wall bulged toward proj,many craters, no hole
0.375" Al-1100 Shield #1 6061-T6 Al 0.050" Yes 0.65"x 0.89" 60 deg target angle Shield #2 2219 T87 Al 0.096" Yes Max. 2.54x1.47" Nalt 2219 T87 Al 0.125" Yes Max. 2.54x1.47" Walt 2219 T87 Al 0.125" Yes Max. 2.54x1.47" Witness #1 2024 Al 0.125" Yes 0.6"x0.63"x0.64"			Witness #1	2024 AI	0.020"	No				No apparent damage
Shield #2 2219 T87 Al 0.096" Yes Max. 2.54x1.47" A Walt 2219 T87 Al 0.125" Yes 4 2.13",1.72",1.67",1.73" Walt 2024 Al 0.020" Yes 0.6"x0.63"x0.64" 4 2.13",0.72",0.57" Witness #1 2024 Al 0.020" Yes 0.6"x0.63"x0.64" 3 0.16",0.38",0.55"	1548	0.375" AI-1100	Shield #1	6061-T6 Al	0.050"	Yes	0.65"x 0.89"			Shield bulged toward proj. entrance
Walt 2219 T87 AI 0.125" Yes 4 2.13",1.72",1.67",1.73" Witness #1 2024 AI 0.020" Yes 0.6"x0.63"x0.64" 4 2.13",0.72",0.67" Witness #2 2024 AI 0.020" Yes 0.6"x0.63"x0.64" 3 0.16",0.38",0.55"		60 deg target angle	Shield #2	2219 T87 AI	0.096	Yes	Max. 2.54x1.47"			Large hole w/ fingers, craters, 3 cracks .37, 18, 29, small hole
2024 AI 0.020" Yes 0.6"x0.63"x0.64" 3 0.16",0.38",0.55" 2024 AI 0.020" Yes 3 0.16",0.38",0.55"			Wall	2219 T87 AI	0.125"	Yes			2.13",1.72",1.67",1.73"	2 holes, small hole 0.16" to left of Ig hole
2024 AI 0.020" Yes 3 0.16",0.38",0.55"			Witness #1	2024 AI	0.020	Yes	0.6"x0.63"x0.64"			Numerous small holes, largest hole triangular shaped
			Witness #2	2024 AI	0.020"	Yes			0.16",0.38",0.55"	4 holes, 1 crack joins 2 holes

CONCLUSIONS

A number of physical parameters from high velocity impacts on space station walls and bumpers were measured and recorded. The amount of impact damage observed includes a large range of combinations. • . ,