

## ASCENT AND ORBIT INSERTION

Miss Seq. No.	STS- No.	Orb. OV-	Notes	Shuttle Lift-off Weight, lb	Max Q, psf, at M=	Calculated Wind Load Data, L-3.5 Hour Winds		SRB Sep Met, sec/ Vel,fps/ Alt, ft	MECO Met, sec/ Vel,fps/ Alt, ft	ET Sep Met, sec/ Vel,fps/ Alt, ft	OMS-1 Burn			OMS-2 Burn		
						Top Load Indicator Code/Description/ Location	Load (a) Value, Percent				Tig Met, h:m:s	Burn Duration, sec.	Apogee/ Perigee Alt.,nmi	Tig Met, h:m:s	Burn Duration, sec.	Apogee/ Perigee Alt.,nmi
1	1	102		4,457,111	617 1.06	PBD WEB Payload Bay Door Shear Hinge Fitting Web	80.7	131.7	514	532.1	00 : 10 : 34.0	87		00 : 44 : 02.0	75	
2	2	102		4,470,308	640 1.09	FWD FFOIN Foward External Tank Attach Fitting Load	90	130	513.8	537.2	00 : 10 : 33.9	77.6		00 : 41 : 41.7	71	
3	3	102		4,468,755	651 1.04	OMSL-6 Left OMS Pod Frame  X = 232.7	91.8	127.9	513.4	531.5	00 : 10 : 34.4	86		00 : 40 : 50.4	88	
4	4	102		4,481,935	721 1.74	ET 4-11 Midpoint Lefthand Vertical Strut (P4)	97.4	130  156024	512.7 25677	530.4 354800	00 : 10 : 32.6	88	130 34	00 : 37 : 40.6	105	130 130
5	5	102		4,487,268	738 1.7	VT-6-R Vertical Tail Root Rib	96.6	129.08  155206	510.68 25672 361206	528.77 366193	00 : 10 : 30.8	137.8	160.2 51.8	00 : 44 : 40.8	116.8	160 160
6	6	99		4,487,255	688 1.47	WINGRA17 Right Wing Spar Web  X = 1249, Y = 130	104.6	129.42  151453	499.4 25672 361122	517.55 366139	00 : 10 : 19.6	135.3	154.2 50.6	00 : 43 : 37.6	117	154.6 154
7	7	99		4,482,241	701 1.56	WINGRA17 Right Wing Spar Web  X = 1249, Y =130	90.8	126.2 4319 149357	500.1 25595 361420	518.2 25668 366506	00 : 10 : 20.2	139.5	160.2 51.9	00 : 44 : 30.2	117.5	160.4 160.2

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						Top Load Indicator Code/Description/ Location	Load (a) Value, Percent				Tig Met, h:m:s	Burn Duration, sec.	Apogee/ Perigee Alt.,nmi	Tig Met, h:m:s	Burn Duration, sec.	Apogee/ Perigee Alt.,nmi
8	8	99		4,492,074	701 1.53	WINGRA17 Right Wing Spar Web  X = 1249, Y = 130	106.9	124.34 4235 152110	521.62 25593 360803	539.66 25669 365878	00 : 10 : 41.7	138.1	160 51.5	00 : 44 : 51.7	115.6	160.5 160.2
9	9	102		4,503,361	676 1.52	WINGLA22 Left Wing Spar Web  X = 1191, Y =130	93.7	126.24 4289 161689	509.18 25647 372249	527.32 25723 378580	00 : 10 : 29.3	63.8	135 44.6	00 : 40 : 37.3	101.5	134.9 134.4
10	41B	99		4,498,443	676 1.55	WLE8R Left Wing Leading Edge	94.8	127.92 4330 152605	521.42 25589 361029	539.57 25667 366061	00 : 10 : 41.6	150.2	165.1 51.1	00 : 45 : 24.6	125	165 165
11	41C	99	b	4,508,234	635 1.03	WINGLA17 Left Wing Spar Web	94.8	125.57 4137 169426	510.76 25942 360986	528.9 26013 37011	: :			00 : 42 : 54.0	95.2	251.6 115.4
12	41D	103		4,517,534	611 1.26	F2L Left Wing Carry-through Structure X = 1365, Y = 82	96.1	124.5 3990 162535	515.19 25595 360945	533 25666 365877	00 : 10 : 36.9	153.5	160.8 50.9	00 : 44 : 52.2	126.2	160.8 160.8
13	41G	99		4,493,317	716 1.42	OMS PT6R Left OMS Pod Point 6	85	124.12 4157 157374	530.34 25644 372883	548.41 25719 378859	00 : 10 : 50.4	134.5	190.5 53.4	00 : 46 : 30.4	143.3	191.7 190.4
14	51A	103		4,519,901	651 1.1	WINGRA20 Right Wing Spar Web  X = 1365, Y = 240	91.1	125.72 4095 156242	513.16 25593 361491	531.29 25669 366591	00 : 10 : 33.3	151	160.2 51.7	00 : 44 : 43.0	114.8	160.1 150.4

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						Top Load Indicator Code/Description/ Location	Load (a) Value, Percent				Tig Met, h:m:s	Burn Duration, sec.	Apogee/ Perigee Alt.,nmi	Tig Met, h:m:s	Burn Duration, sec.	Apogee/ Perigee Alt.,nmi	
15	51C	103	c								:	:					185 185
16	51D	103	b	4,505,245	666 1.25	WINGLA20 Left Wing Spar Web  X = 1365, Y = 240	98.3	126.84 4077 153102	531.96 25938 360594	550 26014 369603	:	:			00 : 43 : 15.0	142.6	248.6 160.4
17	51B	99		4,512,009	700 1.31	WINGLA15 Left Wing Spar Web  X = 1307, Y = 136	87.2	125.88 4195 156700	514.96 25647 372561	533.05 25723 378806	00 : 10 : 35.0	133.4	190.6 53.6	00 : 46 : 15.0	145.2	190.6 190.4	
18	51G	103	b	4,516,613	648 1.24	WINGLA20 Left Wing Spar Web  X = 1365, Y = 240	88.7	124.68 3973 164000	515.77 25842 360915	533.93 25914 368228	:	:			00 : 40 : 29.0	177.6	192.1 190.5
19	51F	99	d	4,515,554	762 1.63	ROWINDOW Right Overhead Window	91.3	125.24 4284 157308	581.24 25690 372077	599.29 25756 381932	00 : 11 : 41.0	106.4	142.6 2.96	00 : 33 : 00	119.4	142.9 108.7	
20	51I	103	b	4,512,130	735 1.61	WINGLA8 Left Wing Spar Web  X = 1365, Y = 334	101.5	121 4235 154479	507.59 25839 361481	525.77 25912 368863	:	:			00 : 40 : 28.0	183.2	190.3 189.7
21	51J	104	c								:	:					

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						Top Load Indicator Code/Description/ Location	Load (a) Value, Percent				Tig Met, h:m:s	Burn Duration, sec.	Apogee/Perigee Alt.,nmi	Tig Met, h:m:s	Burn Duration, sec.	Apogee/Perigee Alt.,nmi
22	61A	99		4,508,496	665 1.25	LWINGMX Left Wing Root Bending Moment	85.7	125.08 4190 162256	514.96 25646 372707	533.05 25721 379121	00 : 10 : 35.0	121.2	178 52.4	00 : 44 : 40.0	131.6	177.7 175.8
23	61B	104	b	4,514,530	723 1.16	LWINGMX Left Wing Root Bending Moment	89.1	123.56 4274 146782	511.29 25643 360661	529.45 25915 367881	: :			00 : 40 : 25.0	180.4	191.2 190.6
24	61C	102		4,509,360	696 1.13	WINGLA14 Left Wing Upper Spar Cap X = 1307, Y = 131	92.1	127.23 4442 152555	501.64 25594 360985	519.77 25670 36643	00 : 10 : 22.0	164.2	175.1 53.9	00 : 46 : 06.0	134.6	176.5 175.1
25	51L	99	e	4,526,583	720 1.35	ET 3-42 External Tank Barrel Panel THETA = 43 °, X = 1859	83.2				: :			: :		
26	26	103	b,f	4,523,334	707 1.16	WLE-14R WLE-14L	102	124.8 4127 151816	513.43 25871 360878	530.5 25869 367122	: :			00 : 39 : 56.0	141.6	178 162
27	27	104	c	4,509,447		L-2, WRA 18 Upper Spar Cap Mid Right X = 1307					: :			: :		244 239
28	29	103	b	4,524,484	710 1.44	L-2 AFT OMS Frame inner cap X = 1360	98	124.5 4200 154800	510.8 25827 361300	528 25868 367500	: :			00 : 39 : 58.0	141.6	166.6 162.5

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						Top Load Indicator Code/Description/ Location	Load (a) Value, Percent				Tig Met, h:m:s	Burn Duration, sec.	Apogee/ Perigee Alt.,nmi	Tig Met, h:m:s	Burn Duration, sec.	Apogee/ Perigee Alt.,nmi
29	30	104		4,527,349	676 1.07	L-2 WING LA18 Upper Spar Cap Mid Left X = 1307	97	125.26 4190 155000	509.37 25664 360962	526.67 25677 365579	: 10 : 29.0	141.8	160.5 50.7	00 : 44 : 27.0	125.6	166.3 160
30	28	102	c	4,512,795	679 1.12	LP-2.0 AFT OMS F OMS Frame Inner Cap X=1360	93.2				: :			: :		166 160
31	34	104	b	4,524,262	687.9 1.63	LP-2.0 Aft OMS F OMS Frame Inner Cap X=1360	89.8	124.98 5277.04 156990	511.88 25780.63 365780	530.08 25868.83 371779	: :			00 : 39 : 55.0	140.6	168.46 161.35
32	33	103	c	4,531,977	729.3 1.5	LP-2.0 AFT OMS F OMS Frame Inner Cap X=1360	96.1				: :			: :		302 126
33	32	102	b	4,520,125	641.1 1.05	L-2.0 AFT OMS F OMS Frame Inner Cap X=1360	91.3	125 5281.42 157254	511 25750.66 361119	530 25911.68 368882	: :			00 : 40 : 25.6	139.5	178 173
34	36	104	c	4,508,125	743.9 1.49	L-2.0 AFT OMS F OMS Frame Inner Cap X=1360	94				: :			: :		132 115
35	31	103	b	4,511,496	656.3 1.08	L-2.0 Aft OMS F OMS Frame Inner Cap X=1360	92.7	125 5324.21 155453	510 26016.36 360068	528 26134.83 372084	: :			00 : 42 : 35.9	304.4	333 327

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						Top Load Indicator Code/Description/ Location	Load (a) Value, Percent				Tig Met, h:m:s	Burn Duration, sec.	Apogee/ Perigee Alt.,nmi	Tig Met, h:m:s	Burn Duration, sec.	Apogee/ Perigee Alt.,nmi
36	41	103	b	4,526,408	665 1.1	L-2.0 AFT OMS F OMS Inner Frame Cap	88	126.16 4113 156553	510.39 25868.2	528.37	: : : : : :			00 : 39 : 53.4	143.6	160.2 159.4
37	38	104	c	4,533,057							: : : : : :			: : : : : :		142 115
38	35	102	b	4,521,590	696 0	L-2.0 WING LA 20 Left Wing Spar Shear X = 1362, y = 235	92	125.68 4200 152000	511.6	529.67	: : : : : :			00 : 40 : 24.7	179.2	190.2 187.7
39	37	104	b	4,519,695	681 1.57	L-2.0 Wing LA20	85	125.28 5294.5 156097	512.71 25912 361246	530.16 26000.7 369797	: : : : : :			00 : 41 : 43.1	234.7	247 239
40	39	103	b	4,512,885	706.6 1.65	L-2.0 Aft OMS	99	124.76 5035.9 152683	514.51 25720.4 361306	531.4 25793.3 367696	: : : : : :			00 : 36 : 07.5	129	140 138
41	40	102	b	4,520,674	688.9 1.12	L-2.0 Wing LA21	88	124.74 5275.1 153002	509.8 25803.2 361444	527.86 25869 366809	: : : : : :			00 : 42 : 17.6	124.1	157 146
42	43	104	b	4,522,967	775 1.62	L-2.0 Throttle low yaw positive WLE-P7	91	125.6 4265.2 149261	507.8 25796 360846	526.04 25689 366906	: : : : : :			00 : 39 : 51.0	142.7	174 161

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43	48	103	b	4,503,383	767.4 0	L-2.0 DOLILU Wing L-A21	96	125.04 4148.9 155365	516.12 26002 372308	534.52 26074 382935	: :			00 : 43 : 40.0	266.2	313 302
44	44	104	b	4,520,772	730 1.45	L-2.0 Nominal Aft OMS F	90	126.56 4229.3 152899	509.7 25826 360535	528.07 25924 367944	: :			00 : 40 : 48.0	183.8	197 194
45	42	103	b	4,506,634	685 1.39	L-2.0 Nominal  WLE P7	87	127.84 4252.7 155716	510.1 24938 373301	528.6 24994 382889	: :			00 : 36 : 08.1	159.2	163 161
46	45	104	b	4,496,505	670 1.4	L-2.0 Yaw neg Aft OMS F	91	128 4221.5 155044	510.4 24845 372180	528.6 24994 382889	: :			00 : 36 : 20.0	145.6	162 159
47	49	105	b	4,520,042	675 1.55	L-2.0 DOLILU  Wing L-A21	83	127.2 4215.8 156553	509.4 24350.6 360713	527.6 24446 368365	: :			00 : 39 : 57.8	124.3	182 148
48	50	102	b	4,519,688	659.8	L-2.0 NOMINAL  WING L-A14	96	126.24 4215.7 157456	507.2 25794 360806	526.5 25868 366831	: :			00 : 39 : 50.7	141.3	160 160
49	46	104	b	4,516,704	730	L-2.0 DOLILU  WING L-A14	94	125.12 4232.6 152815	509.4 25907 350589	527.7 25978 369300	: :			00 : 41 : 23.4	222.4	230 228

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50	47	105	b	4,504,773	682.4	L-2.0 NOMINAL RO WINDOW	96	124 4121.8 157413	513.6 25746 372695	532 25822 381731	: : : : : :			00 : 39 : 50.7	158.7	160 160
51	52	102	b	4,515,323	706.4	L-2.0 DOLILU TANK LT 1-14	101	123.12 4107.9 149168	512.08 25795 360888	530.4 25866 367142	: : : : : :			00 : 39 : 55.5	137.4	163 160
52	53	103	b	4,507,048	699.81 1.3	L-2.0 DOLILU WING A16L	102	126.32 4216.2 153648	513.36 25805 371923	531.57 25875.5 383692	: : : : : :			00 : 36 : 53.8	204	200.9 200.7
53	54	105	b	4,522,968	697.44 1.55	L-2.0 DOLILU PLBT BOX	96	125.68 4212.1 152106.7	509.92 25797 360792	528.29 25868.9 366833	: : : : : :			00 : 38 : 53.4	143.8	164.1 160.3
54	56	103	b	4,501,523	707 1.5	L-2.0 NOMINAL PLBT BOX	94	125.84 4178.9 151247.7	514.3 25749 372390	532.7 25820.1 381364	: : : : : :			00 : 37 : 18.2	148.8	160.7 158.9
55	55	102	b	4,518,260	703.43 1.55	L-2.0 DOLILU PLBT BOX	95	125.52 4171.9 154325.6	510.28 25758 360743	528.62 25866.6 367076	: : : : : :			00 : 39 : 54.9	140.2	162.9 157.2
56	57	105	b	4,516,626	780.57 1.65	L-2.0 NOMINAL PLBT BOX	96	124.72 4224.29 146296	512.16 25914.6 361543	531.41 26019.6 370822	: : : : : :			00 : 42 : 12.4	198.6	252.2 210.5

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57	51	103	b	4,522,949	709.21 1.5	L-2.0 DOLILU  PLBT BOX	92	124.72 4202.9 154673	509.52 25797 360970	528.78 25866.5 367409	: :			00 : 39 : 53.8	145.2	160.4 160
58	58	102	b	4,516,930	693.36 1.35	L-2.0 NOMINAL  PLBT BOX	96	123.6 4073.82 152511.2	515.56 24584.18 367699.1	534.43 24659.49 373247.4	: :			00 : 41 : 54.9	124.88	155.2 152
59	61	105	b	4,510,263	695 1.5	L-2.0 DOLILU  PLBT BOX	97	126.48 4229.32 154032	511.36 26041.1 361401	530.56 26107.6 372736	: :			00 : 43 : 30.2	201.4	308.4 214.9
60	60	103	b	4,508,310	706.05 1.44	L-2.0 DOLILU  PLBT BOX	98	125.04 4216.1 154650	512.04 25839.2 372670	531.26 25911.6 380432	: :			00 : 42 : 16.3	163.5	191.4 189.6
61	62	102	b	4,519,392	674.99 1.1	L-2.0 DOLILU  PLBT BOX	96	126.32 4227 155483	510.72 25806.5 367277	529.74 25882.4 372880	: :			00 : 42 : 20.0	132.2	163 160
62	59	105	b	4,510,997	678.09 1.45	L-2.0 DOLILU LEFT OVHD WINDOW	86	124.08 4196.4 150886	513.08 25698.4 372933	532.4 25774.6 379629	: :			00 : 35 : 10.3	100.2	121.3 120.5
63	65	102	b	4,521,154	710.5 1.55	L-2.0 NOMINAL LO WINDOW	92	123.44 4138.1 150801	510.6 25798.7 361251.7	529.9 25872.3 367744	: :			00 : 39 : 55.2	141.3	162.9 160.3

a = STS-1 thru STS-4 based on a systems dispersion of 99 percent, all other flights based on a systems dispersion of 90 percent.

b = OMS-1 Not Performed - Direct Insertion

c = Data not available - Department of Defense Mission

d = Abort to orbit

e = Vehicle lost at approximately 73 seconds

f = Comparison of launch-day wind load conditions with an existing stress analysis that has comparable wind loads showed positive margins of safety for the winds, and as a result, the launch countdown was resumed

g = Data not available at time of publication.

Source: JSC/VF Orbiter Mass Properties Summary, STS-1 and subsequent missions. Rockwell International, Postflight Summary, STS-1 and subsequent missions.

## ASCENT AND ORBIT INSERTION

Miss Seq. No.	STS- No.	Orb. OV-	Notes	Shuttle Lift-off Weight, lb	Max Q, psf, at M=	Calculated Wind Load Data, L-3.5 Hour Winds		SRB Sep Met, sec/ Vel,fps/ Alt, ft	MECO Met, sec/ Vel,fps/ Alt, ft	ET Sep Met, sec/ Vel,fps/ Alt, ft	OMS-1 Burn			OMS-2 Burn		
						Top Load Indicator Code/Description/ Location	Load (a) Value, Percent				Tig Met, h:m:s	Burn Duration, sec.	Apogee/ Perigee Alt.,nmi	Tig Met, h:m:s	Burn Duration, sec.	Apogee/ Perigee Alt.,nmi
64	64	103	b	4,502,604	687.23 1.61	L-2.0 NOMINAL LO WINDOW	87	122.48 4155.8 148952	514.6 25723.2 373194	533.84 25798.8 381528	: : : : : :			00 : 36 : 04.8	125.4	140.8 139.9
65	68	105	b	4,510,709	679.91 1.67	L-2.0 NOMINAL LO WINDOW	87	123.6 4158 151793	513.72 25695.4 372898.4	532.72 25771.2 379587	: : : : : :			00 : 35 : 09.0	99	119.7 119.4
66	66	104	b	4,508,175	726.64 1.41	L-2.0 NOMINAL WING LA8	89	124.72 4196.5 149107	513.88 25748.6 372849	533.12 25822.1 383039	: : : : : :			00 : 36 : 13.1	160	165.1 164
67	63	103	b	4,510,822	663.97 1.04	L-2.0 NOMINAL LO WINDOW	86	124.88 4241.8 155357	511.1 25809.6 368745	530.1 25884 377632	: : : : : :			00 : 42 : 10.0	155.7	183.9 168.8
68	67	105	b	4,519,438	676.3 1.1	L-2.0 DOLILU  ET 3-73	102	125.04 4263.6 152923	507 25841.2 360925	526.27 25908.9 368592	: : : : : :			00 : 40 : 21.5	177.6	190.4 187.3
69	71	104	b	4,511,856	716.21 1.734	L-2.0 DOLILU  FTO-8	91	123.52 4280 150973	510.56 25871.3 371041	529.62 24868 377285	: : : : : :			00 : 42 : 57.7	47.1	160 84
70	70	103	b	4,519,889	686.32 1.128	L-3.0 DOLILU II  FTO-8	89	122.72 4157.4 152664	510.6 25871.2 367444	529.82 24432 36714	: : : : : :			00 : 38 : 49.4	143.2	160.6 160.3

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f = Comparison of launch-day wind load conditions with an existing stress analysis that has comparable wind loads showed positive margins of safety for the winds, and as a result, the launch countdown was resumed

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Source: JSC/VF Orbiter Mass Properties Summary, STS-1 and subsequent missions. Rockwell International, Postflight Summary, STS-1 and subsequent missions.

## ASCENT AND ORBIT INSERTION

Miss Seq. No.	STS- No.	Orb. OV-	Notes	Shuttle Lift-off Weight, lb	Max Q, psf, at M=	Calculated Wind Load Data, L-3.5 Hour Winds		SRB Sep Met, sec/ Vel,fps/ Alt, ft	MECO Met, sec/ Vel,fps/ Alt, ft	ET Sep Met, sec/ Vel,fps/ Alt, ft	OMS-1 Burn			OMS-2 Burn		
						Top Load Indicator Code/Description/ Location	Load (a) Value, Percent				Tig Met, h:m:s	Burn Duration, sec.	Apogee/ Perigee Alt.,nmi	Tig Met, h:m:s	Burn Duration, sec.	Apogee/ Perigee Alt.,nmi
71	69	105	b	4,518,478	714.59 1.14	L-2.0 DOLILU II FTO-8	90	122.4 4205.6 151749	510.15 25937.6 360853	529.3 24464 368783	: : : :			00 : 41 : 44.4	187.1	200.8 199.2
72	73	102	b	4,521,440	713.41 1.127	L-4.5 DOLILU II RO WINDOW	93	123.52 4216.6 153975	509.36 26858.3 367753	528.58 24638 373585	: : : :			: 41 : 28.7	118.4	150.5 146.6
73	74	104	b	4,511,500	711.32 1.138	L-2 DOLILU II RO WINDOW	87	122.88 4205.1 151230	512.64 25871.5 371138	532.82 24930 377862	: : : :			: 41 : 51.9	131.1	162.5 162.3
74	72	105	b	4,512,954	712.63 1.114	L-2.0 DOLILU II FTO-8	92	124.32 4216.5 156819	506.68 26018.4 361546	529.62 24868 377285	: : : :			: 43 : 30.0	71.6	248.9 95.2
75	75	102	b	4,527,738	701.75 1.571	L-2:15 DOLILU II FT08	94	126.24 4244.7 155143	508.01 25871.1 360865	527.3 24511 367741	: : : :			: 39 : 52.4	144.2	161 159.3
76	76	102	b	4,510,934	682.27 1.116	L-2:15 DOLILU II RO WINDOW	87	125.76 4248 153959	512.58 25870.6 371183	531.82 24922 377247	: : : :			: 42 : 21.9	47.4	159.4 85.3
77	77	105	b	4,517,872	685.37 1.057	L-2:15 DOLILU II RO WINDOW	89	124.16 4236.4 154408	507.74 25859.2 367683	526.98 24605 373450	: : : :			: 41 : 47.1	126.1	153.2 152.8

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c = Data not available - Department of Defense Mission

d = Abort to orbit

e = Vehicle lost at approximately 73 seconds

f = Comparison of launch-day wind load conditions with an existing stress analysis that has comparable wind loads showed positive margins of safety for the winds, and as a result, the launch countdown was resumed

g = Data not available at time of publication.

Source: JSC/VF Orbiter Mass Properties Summary, STS-1 and subsequent missions. Rockwell International, Postflight Summary, STS-1 and subsequent missions.

## ASCENT AND ORBIT INSERTION

Miss Seq. No.	STS- No.	Orb. OV-	Notes	Shuttle Lift-off Weight, lb	Max Q, psf, at M=	Calculated Wind Load Data, L-3.5 Hour Winds		SRB Sep Met, sec/ Vel,fps/ Alt, ft	MECO Met, sec/ Vel,fps/ Alt, ft	ET Sep Met, sec/ Vel,fps/ Alt, ft	OMS-1 Burn			OMS-2 Burn		
						Top Load Indicator Code/Description/ Location	Load (a) Value, Percent				Tig Met, h:m:s	Burn Duration, sec.	Apogee/ Perigee Alt.,nmi	Tig Met, h:m:s	Burn Duration, sec.	Apogee/ Perigee Alt.,nmi
78	78	102	b	4,516,637	698.36 1.313	L-2:15 DOLILU II  RO WINDOW	93	123.68 4226.8 155249	509.3 25858.6 367709	528.5 24653 373616	: : : :	: : : :	: : : :	41 : 28.6 117.5	153.6 146.7	
79	79	104	b	4,511,714	707.84 1.49	g DOLILU II  g	0	121.92 4177.5 152913	514.03 25869 371116	533.36 25866 377680	: : : :	: : : :	: : : :	42 : 53.3 47.4	159 85.4	
80	80	102	b	4,522,305	699.78 1.55	g DOLILU II  g	0	124.74 4213 154621	510.34 25914 363670	535.3 25907 370959	: : : :	: : : :	: : : :	40 : 24.4 182	190.4 187.9	
81	81	104	b	4,511,710	687.33 1.55	g DOLILU II  g	0	125.12 4222 153816	512.64 24841 371416	531.92 25877 377525	: : : :	: : : :	: : : :	43 : 00.1 47.3	160.1 85.2	
82	82	103	b	4,513,793	670.73 1.23	g DOLILU II  LWING	83	123.68 4214.3 155372	509.35 26122 361323	528.7 26116 372748	: : : :	: : : :	: : : :	44 : 33.6 172	313 186.3	
83	83	102	b	4,521,943	695.85 1.26	g DOLILU II  g	0	123.04 4178 151302	510.41 25871 360974	530.02 25867 367486	: : : :	: : : :	: : : :	00 : 39 : 54.7 142.8	310 186.3	
84	84	104	b	4,511,290	681.95 1.25	g DOLILU II  g	0	123.84 4233.6 152341	512.88 25868 371149	532.22 25866 377380	: : : :	: : : :	: : : :	00 : 44 : 04.1 47.3	160.9 85.6	

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d = Abort to orbit

e = Vehicle lost at approximately 73 seconds

f = Comparison of launch-day wind load conditions with an existing stress analysis that has comparable wind loads showed positive margins of safety for the winds, and as a result, the launch countdown was resumed

g = Data not available at time of publication.

Source: JSC/VF Orbiter Mass Properties Summary, STS-1 and subsequent missions. Rockwell International, Postflight Summary, STS-1 and subsequent missions.

## ASCENT AND ORBIT INSERTION

Miss Seq. No.	STS- No.	Orb. OV-	Notes	Shuttle Lift-off Weight, lb	Max Q, psf, at M=	Calculated Wind Load Data, L-3.5 Hour Winds		SRB Sep Met, sec/ Vel,fps/ Alt, ft	MECO Met, sec/ Vel,fps/ Alt, ft	ET Sep Met, sec/ Vel,fps/ Alt, ft	OMS-1 Burn			OMS-2 Burn		
						Top Load Indicator Code/Description/ Location	Load (a) Value, Percent				Tig Met, h:m:s	Burn Duration, sec.	Apogee/ Perigee Alt.,nmi	Tig Met, h:m:s	Burn Duration, sec.	Apogee/ Perigee Alt.,nmi
85	94	102	b	4,519,811	0 0	g DOLILU II g	0	123.56 4195.1 154302	528.73 25873 360975	527.94 25867 371149	: :			00 : 39 : 53.0	142.7	163.4 159.5
86	85	103	b	4,511,117	0 0	g g g	0	123.87 4225 156447	512.12 25825 372578	531.38 26820 372586	: :			00 : 37 : 04.0	160	160.7 159.6
87	86	104	b	4,513,814	0 0	g DOLILU II g	0	123.06 4231 153405	510.86 24843 371693	530.06 25869 377982	: :			00 : 41 : 51.0	108	161.2 138.9
88	87	102	b	4,521,645	0 0	g DOLILU II g	0	124.22 4220 151750	510.02 24428 361503	529.22 25864 366604	: :			00 : 41 : 08.0	128	154.5 150.8
89	89	105	b	4,512,426	0 0	L-6:15 DOLILU II g	76	123.28 4231.8 155386	509.04 25791 371741	528.38 25873 378254	: :			00 : 41 : 48.4	136	163.4 102.5
90	90	102	b	4,523,791	0 0	g DOLILU II g	0	125.42 4234 153988	508.42 24588 368146	527.62 25855 373938	: :			00 : 41 : 27.0	112	153.8 137.7
91	91	103	b	4,514,378	0 0	g DOLILU II g	0	123.1 4238 154520	510.1 25928 343878	529.3 25924 347352	: :			00 : 44 : 10.8	104.8	177.2 129.3

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## ASCENT AND ORBIT INSERTION

Miss Seq. No.	STS- No.	Orb. OV-	Notes	Shuttle Lift-off Weight, lb	Max Q, psf, at M=	Calculated Wind Load Data, L-3.5 Hour Winds		SRB Sep Met, sec/ Vel,fps/ Alt, ft	MECO Met, sec/ Vel,fps/ Alt, ft	ET Sep Met, sec/ Vel,fps/ Alt, ft	OMS-1 Burn			OMS-2 Burn		
						Top Load Indicator Code/Description/ Location	Load (a) Value, Percent				Tig Met, h:m:s	Burn Duration, sec.	Apogee/ Perigee Alt.,nmi	Tig Met, h:m:s	Burn Duration, sec.	Apogee/ Perigee Alt.,nmi
92	95	103	b	4,521,292	0	g	0	122.6	501.24	520.46	: :			00 : 41 : 57.0	305.4	295.4
					0	g		4402	25100.5	26093						303.2
						g		153662	361056	373176						
93	88	105	b	4,519,508	0	g	0	123.88	502.12	521.31	: :			00 : 43 : 41.0	66.8	175
					0	g		4376	25929.8	25927						87.2
						g		154436	341405	367414						

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Source: JSC/VF Orbiter Mass Properties Summary, STS-1 and subsequent missions. Rockwell International, Postflight Summary, STS-1 and subsequent missions.

## ORBITER MASS PROPERTIES

Miss. Seq. No.	STS- No.	Orb. OV-	Notes	Lift-off Weight, lb			Pre-Deorbit burn Weight, lb			Entry Interface Weight, lb			Mach 3 Weight, lb			Landing Weight, lb			Ferry Weight, lb		
				CG X	Y	Z	CG X	Y	Z	CG X	Y	Z	CG X	Y	Z	CG X	Y	Z	CG X	Y	Z
1	1	102		219,440.7			202,769.9			196,868.7			195,942.7			195,472.7			197,023.0		
				1125.2	0.2	379.7	1108.4	0.1	376.1	1099	0.2	373.1	1096.7	0.2	372.4	1098.1	0.2	369.6	1120.7	0.3	371
2	2	102		230,938.9			215,530.2			206,842.5			204,355.5			204,262.5			206,455.0		
				1120.6	0.1	379.8	1106.1	0.3	377.1	1100.5	0.2	373.8	1096.6	0.2	372.3	1098.1	0.2	369.7	1116	0.1	372.7
3	3	102		235,556.1			214,949.6			208,790.2			207,349.2			207,072.9			211,200.0		
				1119.2	-0.5	379.4	1106.3	-0.5	376.1	1097.9	-0.5	373.3	1095.4	-0.5	372.4	1096.9	-0.5	369.8	1117.8	-0.4	373.5
4	4	102		241,772.0			218,163.6			211,184.0			209,140.5			208,946.8			214,526.0		
				1122.2	-0.3	381.8	1106.6	-0.5	377.7	1096.2	-0.5	374.5	1092.9	-0.5	373.3	1094.4	-0.5	370.7	1114.5	-0.4	375
5	5	102		247,112.9			209,890.1			203,775.9			202,642.7			202,480.3			205,727.0		
				1116.3	1.1	379.7	1105	1	374.5	1096.6	1	371.6	1094.8	1	371	1096.3	1	368.3	1118.4	1	371.9
6	6	099		256,928.1			197,427.8			191,384.2			190,627.2			190,330.2			191,966.0		
				1127.8	0.5	382.9	1111.2	0.3	374.6	1101.2	0.3	371.5	1099.7	0.4	370.9	1101.2	0.4	368	1131.4	0.4	371.9
7	7	099		249,362.7			211,737.0			204,983.4			204,340.4			204,043.4			204,576.0		
				1123.6	-0.2	381.2	1102	-0.6	376.5	1091.3	-0.6	373.3	1089.8	-0.6	372.8	1091.2	-0.6	370.1	1119.6	-0.6	373.6
8	8	099		242,912.3			212,911.0			205,243.4			204,141.4			203,945.4			205,874.0		
				1124.5	0.2	382	1098.2	-0.1	376.7	1092.5	-0.1	373.8	1090.4	-0.1	373	1091.9	-0.1	370.4	1119.4	-0.2	374.3
9	9	102		247,807.3			227,648.0			221,143.4			220,288.4			220,027.4			219,910.0		
				1109.7	-0.1	379	1097	0	376.6	1087.3	-0.1	373.7	1085.8	-0.1	373.2	1087.1	-0.1	370.7	1113.4	0	374.1
10	10	099	a	250,482.7			209,746.1			202,966.5			201,528.5			201,238.5					
				1124.5	0.2	381.5	1101.4	1.2	375.8	1090.7	1.3	372.6	1087.9	1.3	371.6	1089.3	1.3	368.8			
11	41C	099					208,206.4			198,072.8			197,169.8			196,975.8			198,830.0		
				1113.4	0.2	383.4	1117.4	-0.1	376.5	1101.8	-0.1	371.6	1100	-0.1	371	1101.6	-0.1	368.2	1130.9	-0.1	372.4
12	41D	103		263,477.4			211,075.1			203,382.5			202,316.5			201,674.5			202,366.0		
				1118	0	382.8	1100	-0.1	376.6	1093.4	-0.2	373.5	1090.7	-0.1	372.6	1091.7	-0.2	369.6	1121.8	-0.2	373.8

- a = KSC landing
- b = NA/DOD = Not Available/Department of Defense Mission
- c = Vehicle destroyed at approximately 73 seconds
- d = Computations not available

Source: JSC/VF Orbiter Mass Properties Summary,  
STS-1 and subsequent mission.

## ORBITER MASS PROPERTIES

Miss. Seq. No.	STS- No.	Orb. OV-	Notes	Lift-off Weight, lb			Pre-Deorbit burn Weight, lb			Entry Interface Weight, lb			Mach 3 Weight, lb			Landing Weight, lb			Ferry Weight, lb		
				CG X	Y	Z	CG X	Y	Z	CG X	Y	Z	CG X	Y	Z	CG X	Y	Z	CG X	Y	Z
13	41G	099	a	242,790.8			209,799.7			203,651.1			202,829.1			202,266.1					
				1119	-0.1	381.7	1093.5	-0.2	374.6	1085.4	-0.2	371.9	1083.7	-0.2	371.3	1084.8	-0.1	368.4			
14	51A	103	a	263,324.6			215,715.3			209,163.7			207,982.7			207,505.7					
				1120.9	-0.1	382.6	1090.2	-0.2	375.2	1083.4	-0.2	372.5	1081.4	-0.2	371.8	1082.6	-0.1	369.1			
15	51C	103	a,b																		
16	51D	103	a	250,891.6			209,102.8			199,742.2			198,167.2			198,014.2					
				1126.5	-0.1	381.7	1110.6	-0.2	377	1095.8	-0.1	372.5	1092.7	-0.1	371.3	1094.3	-0.1	368.6			
17	51B	099		247,291.3			226,859.0			214,787.4			213,795.4			213,499.4			213,363.0		
				1114.2	-0.2	381.4	1096.7	-0.3	378	1085.7	-0.3	373.4	1084.1	-0.3	372.8	1085.4	-0.3	370.3	1114.8	-0.2	373.8
18	51G	103		256,421.9			213,105.0			205,624.4			204,321.4			204,169.4			204,387.0		
				1109.6	0.2	379.6	1091.5	-0.2	375.2	1084.3	0	372.2	1082.1	0	371.4	1083.7	0	368.8	1114.2	0	372.9
19	51F	099		252,628.9			225,398.0			218,227.4			216,894.4			216,735.4			217,564.7		
				1111.6	-0.4	381.8	1091.1	-0.5	376.3	1082.3	-0.6	373.4	1079.8	-0.6	372.5	1081.3	-0.6	370	1109.5	-0.5	373.9
20	51I	103		262,309.7			207,794.8			197,824.4			196,856.4			196,674.4			197,259.3		
				1121.3	0.5	382.5	1110	0.2	376.7	1094.4	0.2	371.9	1092.4	0.3	371.3	1094.2	0.3	368.5	1124.9	0.3	372.7
21	51J	104	b																191,623.0		
22	61A	099		243,762.5			223,317.8			215,255.4			214,325.4			214,171.4			214,138.3		
				1109	-0.1	380.4	1091.8	-0.4	377.1	1085.5	-0.4	374.2	1083.8	-0.4	373.6	1085.2	-0.4	371.1	1116.4	-0.3	374.5
23	61B	104		261,610.1			213,335.8			206,187.4			205,880.4			205,732.4			205,682.3		
				1110.3	0	379.3	1096.9	-0.1	375.3	1085.8	-0.2	372	1084.4	-0.1	371.5	1085.9	-0.1	368.9	1118	-0.1	373.2
24	61C	102		256,003.0			221,485.8			211,194.4			210,325.4			210,161.4			210,430.0		
				1110.3	0.4	380.3	1096.1	0.4	375.7	1085.2	0.4	371.4	1083.6	0.4	370.9	1085.1	0.4	368.3	1114.9	0.5	373.2

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STS-1 and subsequent mission.

## ORBITER MASS PROPERTIES

Miss. Seq. No.	STS- No.	Orb. OV-	Notes	Lift-off Weight, lb			Pre-Deorbit burn Weight, lb			Entry Interface Weight, lb			Mach 3 Weight, lb			Landing Weight, lb			Ferry Weight, lb		
				CG X	Y	Z	CG X	Y	Z	CG X	Y	Z	CG X	Y	Z	CG X	Y	Z	CG X	Y	Z
25	51L	099	c	268,829.6																	
				1119.1	-0.2	384															
26	26	103		254,606.5			202,676.3			194,985.3			194,347.3			194,184.3			193,936.0		
				1118.4	0.3	380.6	1104.7	0.1	374.6	1097.9	0.2	371.4	1096.6	0.2	371	1098.3	0.2	368.2	1131.8	-0.1	372
27	27	104	b				200,752.5			192,095.3			191,105.3			190,956.3			191,337.7		
							1107.9	-0.9	374.6	1095.2	-0.9	370.3	1093.4	-0.9	369.7	1095.1	-0.9	366.8	1127.1	-0.9	370.8
28	29	103		256,357.6			202,517.6			195,531.6			194,939.6			194,789.6			194,710.0		
				1116.4	0.6	380.8	1104.1	0.5	374.6	1095.1	0.5	371.4	1093.7	0.5	370.9	1095.3	0.5	368.1	1128.6	0.3	372
29	30	104		261,118.9			201,074.6			193,349.6			192,557.6			192,459.6			193,031.0		
				1123.4	0.5	382.6	1106.8	0.4	374.5	1098.7	0.4	371.1	1097.3	0.4	370.6	1099.1	0.4	367.8	1130.7	0.2	371.7
30	28	102	b				207,482.2			201,294.2			200,331.2			200,214.2			200,509.7		
							1096.7	-0.1	373.1	1089.7	-0.1	370.4	1087.8	-0.1	369.7	1089.4	-0.1	367	1120.5	-0.2	370.8
31	34	104		257,569.2			204,439.2			196,784.2			196,112.2			195,954.2			195,804.0		
				1114.2	0.4	380.8	1101.8	0.2	375	1094.5	0.3	371.7	1093.1	0.2	371.2	1094.7	0.3	368.5	1128.2	0.1	372.3
32	33	103	b				203,006.2			195,185.2			194,463.2			194,282.2			195,242.7		
							1106.2	0	375.1	1094.1	0.1	371.1	1093.2	0.1	370.8	1094.8	0.1	368	1124.7	0.1	371.8
33	32	102		255,994.0			241,970.2			229,892.2			228,523.2			228,335.2			227,868.7		
				1131.3	-0.9	381.4	1096.3	-0.9	378.6	1080.8	-0.9	373.8	1078.2	-0.9	372.9	1079.6	-0.9	370.5	1108.8	-0.8	373.8
34	36	104	b				193,208.2			188,059.2			187,316.2			187,200.2			187,944.7		
							1105.2	0.1	373.1	1096.2	0.2	370.4	1094.7	0.2	369.8	1096.4	0.2	366.9	1128.9	0.1	370.8
35	31	103		249,109.2			202,753.2			190,566.2			189,309.2			189,118.2			189,691.7		
				1114.8	-0.5	384.2	1107.2	-1	376.4	1090	-1	370.5	1087.9	-1	369.7	1089.7	-1	366.6	1125.1	-1	370.3
36	41	103		259,593.9			204,007.2			197,986.2			196,982.2			196,869.2			197,369.7		
				1115.2	-0.1	381.4	1100.4	-0.5	374.7	1090.4	-0.5	371.8	1089.4	-0.4	371.2	1091.2	-0.4	368.3	1124.4	-0.5	372

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## ORBITER MASS PROPERTIES

Miss. Seq. No.	STS- No.	Orb. OV-	Notes	Lift-off Weight, lb			Pre-Deorbit burn Weight, lb			Entry Interface Weight, lb			Mach 3 Weight, lb			Landing Weight, lb			Ferry Weight, lb		
				CG X	Y	Z	CG X	Y	Z	CG X	Y	Z	CG X	Y	Z	CG X	Y	Z	CG X	Y	Z
37	38	104	a				196,781.2			191,862.2			191,409.2			191,091.2					
							1106.3	0.2	372.8	1098.1	0.2	370.3	1096.2	0.2	369.9	1098.6	0.2	366.7			
38	35	102		256,385.6			236,566.2			226,613.2			225,531.2			225,329.2			223,330.7		
				1106.4	-0.5	378.1	1092.5	-0.5	375.4	1080.8	-0.5	371.4	1079.1	-0.5	370.8	1080.5	-0.4	368.4	1114.7	-0.3	371.6
39	37	104		255,824.0			201,055.2			191,569.2			190,266.2			190,098.2			190,023.7		
				1116.5	-0.3	381.7	1103	-0.6	375.4	1089.6	-0.6	370.9	1087.4	-0.6	370	1089.2	-0.6	367	1124.2	-0.6	370.6
40	39	103	a	247,373.4			218,919.2			212,806.2			211,673.2			211,512.2					
				1111.1	0	382.5	1091	-0.4	376.8	1082.2	-0.3	374.1	1080.3	-0.4	373.5	1082	-0.4	370.8			
41	40	102		251,970.3			235,196.2			227,709.2			226,737.2			226,535.2			225,326.7		
				1100.2	-0.1	376.4	1089.5	-0.2	374.9	1081.1	-0.2	371.9	1079.6	-0.2	371.4	1080.9	-0.2	369	1112.9	-0.1	372.2
42	43	104	a	259,374.7			203,898.2			197,472.2			196,353.2			196,088.5					
				1113.9	-0.2	380.4	1099.5	-0.3	374.2	1088.8	-0.3	371	1087.4	-0.3	370.3	1089.7	-0.3	367.3			
43	48	103		240,062.6			204,685.2			193,665.2			192,925.2			192,780.2			193,583.7		
				1125.5	-0.9	381.9	1113.1	-0.9	375.9	1097.4	-1	370.6	1096	-1	370	1097.8	-0.9	367	1130.2	-0.9	371.3
44	44	104		259,904.0			204,165.2			196,229.2			195,047.2			194,818.2			194,087.1		
				1116.2	0	381	1102.6	-0.2	374.4	1092.4	-0.2	370.7	1090.8	-0.2	370	1092.5	-0.2	367	1128.6	-0.1	371.1
45	42	103		243,494.1			227,227.2			219,459.2			218,159.2			218,089.2			216,224.7		
				1104.8	-0.1	378.3	1091.4	-0.3	376.6	1082.3	-0.3	373.4	1080.6	-0.3	372.8	1082.2	-0.3	370.1	1115.6	-0.2	373.1
46	45	104	a	233,652.0			215,275.2			206,495.2			205,672.3			205,588.2					
				1113.1	-0.3	377.6	1100.3	-0.5	375.2	1086.3	-0.5	371	1085.4	-0.4	370.5	1087.2	-0.4	367.7			
47	49	105		256,392.3			209,002.2			202,094.2			201,400.2			201,235.2			199,831.2		
				1119.5	-0.3	383.9	1096.7	-0.6	375	1085.8	-0.7	371.7	1084.4	-0.6	371.2	1086.2	-0.6	368.3	1122.7	-0.5	371.9
48	50	102	a	257,338.6			236,634.2			227,587.2			225,865.2			225,615.2					
				1106	-0.5	378.8	1089.7	-0.6	375.9	1079.8	-0.7	372.4	1107.7	-0.7	371.6	1079.1	-0.7	369			

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STS-1 and subsequent mission.

## ORBITER MASS PROPERTIES

Miss. Seq. No.	STS- No.	Orb. OV-	Notes	Lift-off Weight, lb			Pre-Deorbit burn Weight, lb			Entry Interface Weight, lb			Mach 3 Weight, lb			Landing Weight, lb			Ferry Weight, lb		
				CG X	Y	Z	CG X	Y	Z	CG X	Y	Z	CG X	Y	Z	CG X	Y	Z	CG X	Y	Z
49	46	104	a	256,026.3			216,581.2			210,995.2			209,851.2								
				1113.8	-0.3	382.4	1087.1	-0.5	374.8	1080.2	-0.5	372.4	1078.2	-0.5	371.7	1079.6	-0.5	368.9			
50	47	105	a	244,645.2			228,709.2			221,374.2			220,325.2			220,195.2					
				1103.9	-0.4	379.1	1091.1	-0.5	377.5	1085.4	-0.5	374.9	1083.7	-0.5	374.3	1085.3	-0.5	371.7			
51	52	102	a	250,399.4			223,297.2			217,359.2						215,979.2					
				1109.5	-0.3	377.5	1090.3	-0.4	373.5	1084.5	-0.4	371.1	1082.6	-0.4	370.4	1084.3	-0.3	367.7			
52	53	103		243,944.4			201,376.2			194,826.2			194,028.2			193,851.2			193,848.3		
				1112.3	0.1	380.7	1100.2	0	373.9	1090.4	0.1	370.5	1089.5	0	370.2	1091.3	0.1	367.1	1125.3	0.2	370.8
53	54	105	a	259,764.2			205,293.6			198,296.6			197,481.2			197,353.2					
				1115.7	0.3	381.2	1101.4	0.2	375	1093.5	0.2	371.9	1091.6	0.2	371.3	1093.4	0.2	368.4			
54	56	103	a	237,213.0			217,922.2			209,229.2			208,052.2			207,946.2					
				1109.5	-0.3	379.3	1098.3	-0.5	376.9	1086.3	-0.5	373.4	1084.6	-0.4	372.5	1086.3	-0.4	369.7			
55	55	105		255,441.8			236,094.2			228,546.6			227,484.2			227,209.2			226,360.2		
				1101.6	-0.6	377.5	1089	-0.6	375.4	1080.1	-0.6	372.4	1078.4	-0.6	371.9	1079.7	-0.6	369.2	1111.8	-0.5	372.3
56	57	105	a,d	252,710.1						226,573.5			225,019.5			224,906.5					
				1112.6	-0.1	382.9				1083	-0.2	375.2	1080.9	-0.2	374.6	1082.5	-0.2	372			
57	51	103	a,d	261,486.6						208,048.5			207,042.5			206,931.5					
				1116.5	-0.6	381.5				1086.6	-0.8	373.5	1084.7	-0.7	373.1	1086.5	-0.7	370.3			
58	58	102	d	256,097.0						230,447.7			229,480.7			229,368.7			229,953.7		
				1103.4	-0.4	378				1080	-0.5	373	1078.8	-0.5	372.7	1080.4	-0.5	370.2	1107.9	-0.6	373.7
59	61	105	a,d	250,279.1						213,640.5			212,946.5			212,835.5					
				1113.5	-0.1	381.6				1080.2	0	372.2	1078.8	0.1	371.9	1080.5	0.07	369.2			
60	60	103	a,d	245,767.5						217,583.5			216,662.5			216,594.5					
				1104.8	-0.7	380.2				1081.2	-0.9	374.1	1079.6	-0.9	373.7	1081.3	-0.9	371.1			

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## ORBITER MASS PROPERTIES

Miss. Seq. No.	STS- No.	Orb. OV-	Notes	Lift-off Weight, lb			Pre-Deorbit burn Weight, lb			Entry Interface Weight, lb			Mach 3 Weight, lb			Landing Weight, lb			Ferry Weight, lb		
				CG X	Y	Z	CG X	Y	Z	CG X	Y	Z	CG X	Y	Z	CG X	Y	Z	CG X	Y	Z
61	62	102	a,d	256,584.1						229,091.2			228,360.2			228,250.2					
				1107.4	-0.6	379.2				1084	-0.7	373.5	1182.6	-0.6	373.2	1084.1	-0.6	370.6			
62	59	105	d	246,851.0						222,698.0			221,931.0			221,865.0			222,734.0		
				1095.8	-0.5	378.7				1090.9	-0.4	374.7	1079.6	-0.4	374.5	1081.2	-0.4	371.9	1109.1	-0.6	375.5
63	65	102	a	258,585.0			237,613.0			230,624.0			229,410.0			229,307.0					
				1104.2	-0.2	378.8	1087.4	-0.6	375.6	1080.7	-0.6	373	1079	-0.6	373	1080.1	-0.6	370			
64	64	103		240,884.0			221,336.0			213,510.0			212,565.0			212,141.0			212,251.0		
				1105.5	-0.5	379.5	1090.1	-0.7	376.8	1083.7	-0.8	373.5	1082	-0.8	373.1	1083.9	-0.7	370.4	1117.1	-0.5	373.8
65	68	105		247,136.0			228,874.0			222,752.0			221,460.0			221,571.0			221,390.0		
				1099.1	-0.5	378.5	1087.8	-0.4	376.8	1080.1	-0.4	374.3	1078.1	-0.4	373.7	1080.3	-0.4	371.4	1112.2	-0.4	374.6
66	66	104		243,089.0			221,520.0			212,378.0			211,434.0			211,327.0			210,966.0		
				1113	-0.1	379.5	1096.8	-0.1	375.9	1085.9	-0.1	371.9	1084.3	-0.1	371.6	1086	-0.1	368.9	1120.1	0	372.4
67	63	103	a	247,555.0			224,130.0			213,717.0			212,772.0			212,646.0					
				1111.1	-0.2	382.2	1095.7	-0.5	378.4	1081.4	-0.6	373.9	1079.7	-0.5	373.5	1079.3	-0.5	373.6			
68	67	105		256,293.0			231,034.0			218,563.0			217,568.0			217,481.0			216,663.0		
				1118	0	381.5	1101.4	0	377.5	1084.1	0	372	1082.5	0	371.6	1083.1	0	371.9	1117.9	0	372.9
69	71	104	a	248,856.8			227,051.7			217,202.0			215,036.6			214,879.4					
				1110.1	-0.3	380.4	1094.1	-0.2	377.1	1081.9	-0.2	372.4	1080.1	0	372.1	1081	-0.2	369.4			
70	70	103	a	258,798.0			205,687.5			197,482.7			196,725.9			196,574.8					
				1120.2	0.1	380.8	1106.6	0.1	375.1	1099	0.1	371.5	1097.6	-0.1	371.2	1099.4	0.1	368.2			
71	69	105	a	256,644.9			229,422.3			220,383.0			219,494.4			219,377.0					
				1112.6	0.2	383.3	1092.9	0.4	378.4	1082.2	0.05	374.7	1080.5	0.4	374.3	1081.3	0.4	371.6			
72	73	102	a	257,017.5			239,035.7			231,578.0			230,621.7			230,469.3					
				1101.3	-0.6	377.2	1089.3	-0.5	375.8	1081.9	-0.5	372.9	1080.5	-0.5	372.6	1082	-0.5	370			

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## ORBITER MASS PROPERTIES

Miss. Seq. No.	STS- No.	Orb. OV-	Notes	Lift-off Weight, lb			Pre-Deorbit burn Weight, lb			Entry Interface Weight, lb			Mach 3 Weight, lb			Landing Weight, lb			Ferry Weight, lb		
				CG X	Y	Z	CG X	Y	Z	CG X	Y	Z	CG X	Y	Z	CG X	Y	Z	CG X	Y	Z
73	74	104	a	274,560.2			215,856.9			204,058.7			203,101.9			202,950.9					
				1113	0.1	381.7	1113.4	0.7	370.4	1080.8	0.2	371.5	1078.8	0.2	371	1080.5	0.2	368.2			
74	72	105	a	247,320.5			226,239.4			218,151.1			217,394.2			217,243.4					
				1117.6	-0.1	381.7	1090.5	0	376.2	1081.9	0	372.9	1080.6	0	372.6	1082.2	0.1	369.9			
75	75	102	a	261,250.1			240,782.4			229,357.8			228,601.1			228,449.9					
				1106	-0.4	379.9	1092.6	-0.3	377.5	1079.7	-0.3	373	1078.4	-0.3	372.7	1079.9	-0.3	370.2			
76	76	104		246,337.3			220,475.9			211,094.8			210,143.0			209,993.4			210,600.3		
				1109.7	-0.2	379.7	1095.8	0	375.8	1083.4	0	371.6	1081.7	0	371.2	1083.3	0	368.4	1113.5	-0.1	372.4
77	77	105	a	254,890.5			233,219.3			222,936.2			221,979.5			221,828.4					
				1106.4	-0.1	380.4	1094.6	-0.1	377.6	1081.8	-0.1	373.4	1080.3	-0.1	373	1081.8	-0.1	370.4			
78	78	102	a	256,144.6			238,077.2			229,652.9			228,696.3			228,545.4					
				1102.7	-0.4	377.2	1088.9	-0.2	375.6	1081.9	-0.2	372.5	1080.5	-0.2	372.1	1082	-0.2	369.5			
79	79	104	a	249,327.5			225,654.4			216,359.8			215,177.8			215,026.5					
				1109.2	0	379.8	1094.2	0.1	376	1081.2	0.1	371.9	1079.4	0.1	371.4	1081	0.2	368.7			
80	80	102	a	260,935.2			238,607.0			228,516.3			227,534.4			227,383.2					
				1106.5	-0.3	381	1091.2	-0.4	377.7	1080.2	-0.4	373.8	1078.4	-0.4	373.4	1079.9	-0.4	370.9			
81	81	104	a	249,935.7			225,432.8			216,042.8			214,861.6			214,710.6					
				1110.7	0	379.6	1079.1	0.2	376.1	1082.7	0.3	371.8	1080.8	0.3	371.3	1082.5	0.3	368.6			
82	82	103	a	251,238.1			221,530.0			214,393.2			213,636.6			213,485.7					
				1112.8	-0.1	381.2	1087.2	0.1	374.6	1079.2	0.1	371.6	1077.9	0.1	371.3	1079.5	0.1	368.5			
83	83	102	a,d	259,143.6			240,257.2			231,584.3			230,507.6			230,276.3					
				1102.1	-0.3	378.2	1088.5	-0.2	376.8	1081.7	-0.2	373.7	1079.9	-0.2	373.3	1081.3	-0.2	370.5			
84	84	104	a	249,462.2			224,584.2			214,653.8			213,697.9			213,547.2					
				1109.1	0.1	379.7	1094.6	0.3	375.9	1080	0.3	371.4	1078.4	0.3	371	1080	0.4	368.3			

- a = KSC landing
- b = NA/DOD = Not Available/Department of Defense Mission
- c = Vehicle destroyed at approximately 73 seconds
- d = Computations not available

Source: JSC/VF Orbiter Mass Properties Summary,  
STS-1 and subsequent mission.

## ORBITER MASS PROPERTIES

Miss. Seq. No.	STS- No.	Orb. OV-	Notes	Lift-off Weight, lb			Pre-Deorbit burn Weight, lb			Entry Interface Weight, lb			Mach 3 Weight, lb			Landing Weight, lb			Ferry Weight, lb		
				CG X	Y	Z	CG X	Y	Z	CG X	Y	Z	CG X	Y	Z	CG X	Y	Z	CG X	Y	Z
85	94	102	a	260,248.6			240,407.8			231,591.0			230,514.5			230,283.5					
				1102.1	-0.2	378.1	1088.6	-0.2	376.3	1080.2	-0.3	373	1079.6	-0.3	372.6	1080	-0.2	370.1			
86	85	103	a	249,695.6			228,129.5			220,185.2			219,228.6			219,077.0					
				1102.7	0	379.5	1088.5	0.1	376.8	1079.9	0.1	373.6	1078.4	0.1	373.2	1079.9	0.1	370.6			
87	86	104	a	252,035.4			225,501.0			215,616.7			214,660.0			214,509.0					
				1109.8	0.3	379.8	1094.5	0.3	376.1	1080.6	0.3	371.3	1079	0.3	371.3	1080.6	0.3	368.5			
88	87	102	a	260,799.0			241,095.5			231,017.1			230,260.7			230,110.0					
				1104	-0.2	379	1090.6	-0.1	376.9	1079.8	-0.1	373	10786	0.1	372.7	1080.1	0	370.1			
89	89	105	a	252,316.0			226,971.4			217,909.0			216,953.0			216,802.0					
				1108.1	0.1	380	1093.5	0.2	376.1	1081.3	0.2	372.2	1079.8	0.2	371.8	1081.4	0.2	369.1			
90	90	102	a	262,357.0			239,492.6			232,451.9			231,493.0			231,342.5					
				1103.7	-0.5	377.9	1086.3	-0.5	374.8	1080.1	-0.5	372.2	1078.7	-0.5	371.8	1080.2	-0.5	369.3			
91	91	103	a	259,653.0			236,965.9			227,125.0			226,168.8			226,017.0					
				1107.4	-0.2	380.5	1094.2	-0.2	377.6	1081.7	-0.2	373.5	1080.1	-0.2	373.1	1081.6	-0.2	370.6			

a = KSC landing

b = NA/DOD = Not Available/Department of Defense Mission

c = Vehicle destroyed at approximately 73 seconds

d = Computations not available

Source: JSC/VF Orbiter Mass Properties Summary,  
STS-1 and subsequent mission.

## ENTRY AERODYNAMICS

Miss Seq. No.	STS- No.	Orb. OV-	Notes	Entry Interface			Cross Range, nmi.	Max. Load Factor, g	Max. Dyn. Press., psf	First Roll Rev. Vel., fps	Term. Area Energy Mgmt				Approach and Landing			
				Velocity, fps	Flt. Pth. Angle, deg	Range, nmi.					I/F Range, nmi.	Load Factor, g	Max. Dyn. Press., psf	I/F Alt ft.	Glide Slope, deg	Velocity, Keas		
																Max.	Over thld	At MGTD
1	1	102		25,731.	-1.19	4372	228	1.6	217	18,310.	58.9	1.7	286	10,000	20	315	250	183
2	2	102		25,726.	-1.17	4474	63	1.61	215	20,297.	59.7	1.93	280	5,000	19	276	206	197
3	3	102		25,659.	-1.13	4136	276	1.62	220	17,784.	59.1	1.54	295	10,000	19	302	232	220
4	4	102		25,797.	-1.28	3817	581	1.77	241	11,461.	59.4	1.46	278	10,000	19	295	215	204
5	5	102		25,758.	-1.24	4036	580	1.59	219	11,397.	59.8	1.59	280	10,000	19	298	216	198
6	6	99		25,755.	-1.24	4045	378	1.53	207	15,808.	59.9	1.41	257	10,000	19	293	213	190
7	7	99		25,771.	-1.25	4040	738	1.59	220	7,143.	59.6	1.65	305	9,834	19	295	232	202
8	8	99		25,649.	-1.12	4037	519	1.54	223	12,900.	58.9	1.56	281	5,000	19	309	226	195
9	9	102		25,696.	-1.18	4349	69	1.6	232	21,581.	59.9	1.52	280	10,000	17	295	203	185
10	41B	99		25,752.	-1.2	4137	524	1.57	220	12,957.	59.4	1.59	289	10,000	19	292	218	196
11	41C	99		25,998.	-1.52	4089	381	1.54	216	16,208.	59.4	1.43	293	10,000	19	313	234	213
12	41D	103		25,776.	-1.26	4112	474	1.54	206	14,072.	60	1.42	265	10,000	19	299	227	200
13	41G	99		25,684.	-1.12	4308	614	1.54	241	11,927.	60.2	1.4	285	10,000	19	296	216	208
14	51A	103		25,869.	-1.35	4141	486	1.56	225	14,063.	60.5	1.46	285	10,000	19	299	217	186
15	51C	103		25,855.	-1.32	4144	380	1.54	211.8	16,118.	60.1	1.5	281	10,000	19	293	223	185
16	51D	103		25,955.	-1.45	4064	518	1.59	211.1	13,573.	60.9	1.4	294	10,000	19	301	215	200
17	51B	99		25,857.	-1.26	4264	274	1.57	241.6	18,500.	59.1	1.5	282	10,000	19	300	219	204
18	51G	103		25,850.	-1.34	4050	694	1.58	217.7	8,680.	59.3	1.6	218	5,000	19	301	0	198
19	51F	99		25,813.	-1.19	4221	603	1.58	235.6	11,537.	59.7	1.54	290	10,000	19	306	244	199
20	51I	103		25,829.	-1.31	4004	692	1.58	215.3	8,626.	59.7	1.56	274	10,000	19	307	204	191
21	51J	104	a															
22	61A	99		25,830.	-1.19	4345	69	1.55	241	22,257.	59.8	1.3	319	10,000	19	303	231	203
23	61B	104		25,882.	-1.35	4106	533	1.54	232	13,172.	59.1	1.4	286	10,000	19	293	224	189
24	61C	102		25,815.	-1.31	4154	661	1.56	224	9,480.	59.2	1.42	292	10,000	19	311	233	217
25	51L	99	a											0				
26	26	103		25,790.	-1.25	4117	383	1.56	203	15,774.	60	1.3	288	10,000	19	297	219	187
27	27	104		25,121.	-1.5	4220	520	1.61	206	14,564.6	60.2	1.4	294	10,000	19	297	211	194
28	29	103		25,787.	-1.23	4163	384	1.54	207	15,852.	60.1	1.6	287	10,000	19	307	218	205
29	30	104		25,788.	-1.22	4155	350	1.56	207	16,452.	60.08	1.5	287	9,957	19	295	206	196
30	28	102		25,803.	-1.11	4332	186	1.54	213	19,494.	58.8	1.6	295	10,000	19	299	224	155
31	34	104		25,784.	-1.19	4156	496	1.54	219	13,653.	60.1	1.7	286	10,000	19	305	220	195
32	33	103		25,998.	-1.48	4068	226	1.52	215	16,988.	60.2	1.5	301	10,000	19	300	211	199
33	32	102		25,823.	-1.25	4317	372	1.62	253	16,293.	58.8	1.7	295	10,000	17	300	230	207
34	36	104		25,713.	-1.18	4338	255	1.57	204	18,520.	59.5	1.9	325	5,000	19	298	218	199
35	31	103		26,120.	-1.61	4121	420	1.6	205	15,905.	60.2	1.54	279	10,000	19	299	194	177
36	41	103		25,762.	-1.2	4147	492	0	212.7	13,639.	60	1.67	291	9,777	19	306	224	192
37	38	104		25,729.	-1.16	4146	3	1.57	207	20,816.	60.3	1.42	273	9,819	19	301	218	199

a - Data not Available - DOD Mission  
b - Report containing data not as yet published

Source: JSC/DM5 Flight Design and Dynamics Division  
Descent Post-flight summarie

## ENTRY AERODYNAMICS

Miss Seq. No.	STS- No.	Orb. OV-	Notes	Entry Interface			Cross Range, nmi.	Max. Load Factor, g	Max. Dyn. Press., psf	First Roll Rev. Vel., fps	Term. Area Energy Mgmt				Approach and Landing			
				Velocity, fps	Flt. Pth. Angle, deg	Range, nmi.					I/F Range, nmi.	Load Factor, g	Max. Dyn. Press., psf	I/F Alt ft.	Glide Slope, deg	Velocity, Keas		
																Max.	Over thld	At MGTD
38	35	102		25,858.	-1.32	4266	426	1.58	245.8	15,406.	59.15	1.59	279	8,052	17	300	217	201
39	37	104		24,612.	-1.4	4175	375	1.57	205	16,455.	59	1.66	276	5,048	19	288	161	168
40	39	103		25,765.	-1.06	4502	616	1.57	246.5	11,543.	60.2	1.5	295	9,862	19	302	222.1	218
41	40	102		25,772.	-1.23	4339	211	1.56	245.4	18,904.	58.9	1.7	298	10,014	17	311	218.6	203
42	43	104		25,794.	-1.16	4312	180	1.57	294	19,141.	60.3	1.4	223	10,000	19	295	221	197
43	48	103		26,077.	-1.58	4194	690	1.56	286	11,167.	59.9	1.5	217.5	10,000	19	297	219	203
44	44	104		25,868.	-1.28	4195	379	1.6	285	16,190.	60.5	1.74	222.5	9,833	19	295	222	189
45	42	103		25,785.	-1.12	4358	536	1.61	232	14,053.	59.6	1.4	308	10,000	19	310	229	196
46	45	104		25,785.	-1.13	4231	679	1.56	241.23	10,840.6	60.4	1.82	328	7,451	19	309	212	192
47	49	105		25,841.	-1.28	4162	410.8	1.56	215	15,850.	59.2	1.57	293	9,931	19	299	217	194
48	50	102		25,786.	-1.18	4347	389	1.51	248.4	15,984.3	59.7	1.51	313	9,885	17	311	229	203
49	46	104		25,698.	-0.99	4397	499	1.57	225	13,624.	59.7	1.45	299	9,869	19	303	216	195
50	47	105		25,803.	-1.11	4341	669	1.57	240.1	11,228.4	60.6	1.39	307	9,917	17	305	233	202
51	52	102		25,666.	-0.94	4454	223	1.58	247	18,350.	60.1	1.51	297	9,820	19	302	224	211
52	53	103		25,813.	-1.28	4237	791	1.56	210	7,202.	60	1.96	287	9,431	19	301	226	212
53	54	105		25,780.	-1.2	4213	320	1.56	211	17,043.	60.5	1.8	295	9,873	19	302	232	212
54	56	103		25,797.	-1.23	4375	6	1.63	227	21,354.	60.1	1.69	291	9,844	19	304	219	206
55	55	102		25,779.	-1.16	4299	640	1.56	260	10,463.	58.8	1.5	309	9,848	17	319	238	217
56	57	105		25,988.	-1.43	4210	587	1.58	252	12,389.	58.9	1.38	320	9,907	17	313	233	207
57	51	103		25,794.	-1.22	4250	89	1.56	221	20,253.	59.9	1.43	281	9,840	19	302	222	194
58	58	102		25,755.	-1.21	4378	144	1.58	250	19,625.	59.2	1.51	323	9,888	18	315	237	198
59	61	105		26,096.	-1.56	4220	3	1.54	231	21,281.	60.8	1.68	312	9,787	20	312	236	201
60	60	103		25,858.	-1.35	4349	376	1.57	230	16,900.	59.9	1.72	308	9,866	20	315	235	205
61	62	102		25,708.	-1.13	4391	116	1.59	250	19,802.	59.5	1.49	309	9,964	18	306	236	207
62	59	105		25,660.	-1.02	4468	721	1.57	252	9,331.	59.2	1.62	318	9,937	18	315	231	215
63	65	102		25,720.	-1.1	4381	180	1.59	265	19,114.	59	1.45	315	9,966	18	305	233	199
64	64	103		25,727.	-0.98	4433	110	1.54	228	20,344.	59.7	1.77	305	9,892	20	311	229	198
65	68	105		25,658.	-1.02	4479.5	746	1.57	258	8,686.	58.4	1.75	314	9,841	18	305	234	193
66	66	104		25,798.	-1.09	4387	310	1.58	251	17,796.	59.7	1.5	309	9,914	20	314	232	193
67	63	103		25,903.	-1.36	4329	469	1.56	243	15,176.	59.7	1.81	316	9,897	20	319	229	212
68	67	105		25,852.	-1.26	4216	628	1.56	242	10,780.	59.9	1.5	309	9,843	20	317	227	209
69	71	104		25,913.	-1.19	4320	645	1.6	245	11,299.	60	1.5	308	9,972	-20	311	221	201
70	70	103		25,789.	-1.14	4265	430	1.56	202	15,057.	60.1	1.35	297	9,805	-20	310	225	198
71	69	105		25,839.	-1.23	4332	202	1.59	255	18,979.	59.6	1.55	309	9,839	-18	309	233	201
72	73	102		25,744.	-1.1	4519	231	1.58	250	18,580.	59.6	1.56	319	9,939	-18	313	246	214
73	74	104		25,840.	-1.29	4346	612	1.58	237	12,026.	59.4	1.45	313	9,802	-20	321	233	196
74	72	105		25,799.	-1.17	4340	220	1.56	239	18,619.	60.2	1.7	309	9,891	-20	306	231	193

a - Data not Available - DOD Mission  
b - Report containing data not as yet published

Source: JSC/DM5 Flight Design and Dynamics Division  
Descent Post-flight summarie

## ENTRY AERODYNAMICS

Miss Seq. No.	STS- No.	Orb. OV-	Notes	Entry Interface			Cross Range, nmi.	Max. Load Factor, g	Max. Dyn. Press., psf	First Roll Rev. Vel., fps	Term. Area Energy Mgmt				Approach and Landing			
				Velocity, fps	Flt. Pth. Angle, deg	Range, nmi.					I/F Range, nmi.	Load Factor, g	Max. Dyn. Press., psf	I/F Alt ft.	Glide Slope, deg	Velocity, Keas		
																Max.	Over thld	At MGTD
75	75	102		25,816.	-1.21	4375	234	1.58	256	18,518.	59.5	1.47	301	9,885	-18	321	243	211
76	76	104		25,898.	-1.4	4243	763	1.59	245	8,918.	59.3	1.57	303	9,908	-20	313	223	198
77	77	105		25,763.	-1.16	4378	314	1.6	240	17,534.	60.5	1.55	304	9,776	-18	309	234	216
78	78	102		25,749.	-1.11	4466	91	1.59	251	20,165.	59.9	1.48	308	9,920	-18	309	233	208
79	79	104		25,872.	-1.34	4276	777	1.56	251	8,360.	59.4	1.7	315	9,882	-20	309	232	217
80	80	102		25,877.	-1.29	4346	72	1.54	258	21,647.	60.2	1.66	316	9,932	-18	307	243	203
81	81	104		25,891.	-1.33	4428	34	1.57	245	21,700.	60.2	1.44	301	9,824	-20	307	236	195
82	82	103		26,120.	-1.57	4238	484	1.59	235	14,908.	60.4	1.46	313	9,791	-20	311	224	191
83	83	102		25,791.	-1.17	4402	56	1.55	280	21,390.	59.1	1.58	314	9,897	-18	319	238	197
84	84	104		25,906.	-1.31	4397	31	1.57	244	21,620.	60.5	1.48	305	9,886	-20	306	232	208
85	94	102		25,792.	-1.17	4396	82	1.56	249	20,441.	59.8	1.54	305	9,826	-18	306	236	202
86	85	103		25,755.	-0.98	4492	346	1.59	238	17,272.	60.2	1.42	298	9,829	-18	304	224	192
87	86	104		25,898.	-1.18	4380	376	1.56	258	16,778.	60	1.54	304	9,922	-20	309	228	194
88	87	102		25,670.	-1.11	4424	66	1.55	254	21,497.	60.4	1.57	304	9,820	-18	313	231	196
89	89	105		25,900.	-1.17	4341	600	1.56	257	11,999.	60.6	1.34	312	9,884	-20	308	231	198
90	90	102		25,758.	-1.15	4422	246	1.56	251	18,456.	60.7	1.54	316	9,828	-18	308	234	218
91	91	103		25,889.	-1.15	4418	317	1.56	238	17,719.	60.4	1.45	311	9,797	-18	308	225	207
92	95	103		26,063.	-1.52	4290	174	1.58	245	19,699.	60.4	1.67	312	9,852	-18	314	241	196
93	88	105		25,889.	-1.2	4343	153	1.57	224	19,934.	61.8	1.41	302	9,787	-21.5	312	234	197

a - Data not Available - DOD Mission  
b - Report containing data not as yet published

Source: JSC/DM5 Flight Design and Dynamics Division  
Descent Post-flight summarie

## LANDING DECELERATION

Miss Seq. No.	STS- No.	Orb. OV-	Notes	Velocities and Rates					Distance from Threshold, ft <sup>a</sup>				Total Rollout, ft	Rollout time, sec	Runway Data
				MGTD kgs b	Sink rates, ft/sec	NGTD, kgs a	Pitch rate, deg/sec	Brake init., kgs b	MGTD	NGTD	Brake init.	Stop			
1	1	102		190.3	0.8	152.9	4.8	104.7	6,053	9,152	12,025	15,046	8,993.00	60	Edwards 23 Lakebed
2	2	102		185.9	1.0	135	4.4	109.5	780	4,429	5,780	8,491	7,711.00	53	Edwards 23 Lakebed
3	3	102		232.5	5.7	177.4	7.2	149	1,092	6,261	8,159	14,824	13,732.00	83	White Sands 17 Lakebed
4	4	102		195.7	2.0	161.2	3.2	133.2	948	4,988	7,839	10,826	9,878.00	73	Edwards 22 Concrete
5	5	102		201	1.0	175.9	4	167	1,637	4,675	5,286	11,190	9,553.00	63	Edwards 22 Concrete
6	6	099		180	2.0	147	3.4	136	2,026	4,970	5,072	9,270	7,244.00	49	Edwards 22 Concrete
7	7	099		200	2.5	154.4	4.4	124.5	2,726	6,843	7,040	13,176	10,450.00	75	Edwards 15 Lakebed
8	8	099		196	1.6	174.6	3.7	154.3	2,793	5,515	7,403	12,164	9,371.00	50	Edwards 22 Concrete
9	9	102		204	2.5	144.6	8.5	126	1,649	5,897	6,749	10,105	8,456.00	53	Edwards 17L Lakebed
10	41B	099		198.2	<2.0	159.5	2.4	135.9	1,930	5,789	7,448	12,737	10,807.00	67	KSC 15 Concrete
11	41C	099		220	2.0	138	4	110	1,912	7,167	8,538	10,628	8,716.00	49	Edwards 17L Lakebed
12	41D	103		216.3	<2.0	166	4.8	106.5	2,510	6,713	10,018	12,785	10,275.00	60	Edwards 17L Lakebed
13	41G	099	c	209.4	1.8c	161	2.6	113	962	5,505	8,986	11,527	10,565.00	54	KSC 33 Concrete
14	51A	103	c	193.7	2.0c	157.8	4	141.6	2,724	6,380	7,550	12,178	9,454.00	58	KSC 15 Concrete
15	51C	103	c	179.1	0.7c	142.7	3.4	116.7	2,753	5,752	7,677	10,105	7,352.00	50	KSC 15 Concrete
16	51D	103	c	209	2.8c	180	5.1	156	1,639	4,303	6,667	11,937	10,298.00	63	KSC 33 Concrete
17	51B	099		206.5	<1.0	153	6.1	106	1,576	5,528	7,589	9,893	8,317.00	59	Edwards 17L Lakebed
18	51G	103		202.3	5.0	159.6	6.9	154.2	1,117	4,990	5,248	8,550	7,433.00	42	Edwards 23 Lakebed
19	51F	099		204.3	4.0	171.8	6.1	126.2	3,713	6,412	9,059	12,282	8,569.00	55	Edwards 23 Lakebed
20	51I	103		175	<2.0	142	4.8	114	2,101	4,384	5,571	8,201	6,100.00	47	Edwards 23 Lakebed
21	51J	104		187	3.0	154.8	4.8	117.2	2,476	4,873	7,421	10,532	8,056.00	65	Edwards 23 Lakebed
22	61A	099		209.9	1.0	173.8	6.7	110.9	1,829	4,767	7,923	10,133	8,304.00	45	Edwards 17L Lakebed
23	61B	104		201.3	1.0	165.7	3.1	126.4	2,386	5,909	9,321	13,145	10,759.00	78	Edwards 22 Concrete
24	61C	102		217	2.0	162.9	2.7	138.4	1,530	6,300	7,831	10,197	10,202.00	59	Edwards 22 Concrete
25	51L	099	d												
26	26	103		195	1.0	154	4	134	2,569	5,671	6,750	10,020	7,451.00	46	Edwards 17L Lakebed
27	27	104		204	1.0	168	3.8	134	1,469	4,423	5,908	8,592	7,123.00	43	Edwards 17L Lakebed
28	29	103		204	2.9	163	1.7	130	1,195	5,027	7,550	10,534	9,339.00	52.7	Edwards 22 Concrete
29	30	104		204	2.4	164	2	138	1,314	5,088	6,028	11,609	10,295.00	64.3	Edwards 22 Concrete
30	28	102		158	1.0	128	7.6	82	5,311	7,393	9,776	11,326	6,015.00	46.5	Edwards 17L Lakebed
31	34	104		204.7	1.0	157.9	3.4	77.6	1,871	5,355	10,063	11,548	9,677.00	60.4	Edwards 23L Lakebed
32	33	103		191.6	3.0	159.4	2.9	148	740	3,982	4,856	8,504	7,764.00	46.1	Edwards 04 Concrete
33	32	102		209.3	1.0	161.5	2.2	141.3	2,399	6,606	8,096	12,495	10,096.00	62.2	Edwards 22 Concrete
34	36	104		187.8	1.0	143.2	3.8	97	1,622	4,862	6,405	9,522	7,900.00	52.9	Edwards 23L Lakebed

a. Based on runway measurements except for brake initiation (onboard service)

b. kgs = knots, ground speed

c. Sink rate based on LaRC analysis of KSC spin-up measurement

d. Data not available

Source: JSC/ES6, Mechanical Design and Analysis Branch  
In-house Mission Reports

## LANDING DECELERATION

Miss Seq. No.	STS- No.	Orb. OV-	Notes	Velocities and Rates					Distance from Threshold, ft <sup>a</sup>				Total Rollout, ft	Rollout time, sec	Runway Data
				MGTD kgs b	Sink rates, ft/sec	NGTD, kgs a	Pitch rate, deg/sec	Brake init., kgs b	MGTD	NGTD	Brake init.	Stop			
35	31	103		180.1	3.0	144.4	2.9	118.6	1,176	4,560	6,718	10,065	8,889.00	60.7	Edwards 22 Concrete
36	41	103		194.6	1.0	155.5	2.3	135.7	2,295	6,359	7,713	10,827	8,532.00	49.2	Edwards 22 Concrete
37	38	104		196.5	1.0	162.9	2.6	130.5	1,414	4,600	6,966	10,417	9,003.00	56.3	KSC 33 Concrete
38	35	102		207.9	1.0	169.5	3.4	134.5	1,535	5,559	8,465	12,101	10,566.00	57.7	Edwards 22 Concrete
39	37	104		156.6	2.3	131.8	7.3	93.6	623	1,200	3,197	5,741	6,364.00	53.9	Edwards 33 Lakebed
40	39	103		210.4	2.0	159.8	2.5	136.5	168	4,700	6,316	9,403	9,235.00	55.5	KSC 15 Concrete
41	40	102		199.8	2.0	153.3	3.5	135.2	1,485	5,914	7,323	10,923	9,438.00	54.6	Edwards 22 Concrete
42	43	104		203.4	2.0	166.6	2.4	132.5	1,986	5,517	8,243	11,876	9,890.00	58.9	KSC 15 Concrete
43	48	103		215.7	1.0	172	2.5	145.4	1,235	4,882	6,851	10,619	9,384.00	49.6	Edwards 22 Concrete
44	44	104		183.4	1.0	150	4.5	15.2	2,607	5,077	13,570	13,798	11,191.00	106.6	Edwards 05R Lakebed
45	42	103		199.5	2.0	169	3.7	134.8	2,835	5,901	8,769	12,676	9,841.00	58.3	Edwards 22 Concrete
46	45	104		187.7	1.0	162.6	3.6	135.3	1,765	4,393	6,721	10,992	9,227.00	59.6	KSC 33 Concrete
47	49	105		211	1.0	175.1	3	96.3	2,156	5,770	9,923	11,646	9,490.00	57.7	Edwards 22 Concrete
48	50	102		209.4	2.0	151.2	4.4	112.9	2,321	7,832	10,573	12,995	10,674.00	58.6	KSC 33 Concrete
49	46	104		203.8	2.0	156	3.7	132.2	1,865	6,521	8,510	12,725	10,860.00	65.6	KSC 33 Concrete
50	47	105		210.6	1.0	137	1.9	115.6	2,458	7,651	8,591	11,025	8,567.00	50.9	KSC 33 Concrete
51	52	102		219.6	1.0	151.4	3	101.1	1,080	6,949	9,321	11,788	10,708.00	63.1	KSC 33 Concrete
52	53	103		208.8	3.0	144.9	1.9	106.2	1,108	6,329	7,927	11,273	10,165.00	72.8	Edwards 22 Concrete
53	54	105		205	2.0	150.2	2.7	106.8	1,536	6,249	8,233	10,260	8,724.00	49.2	KSC 33 Concrete
54	56	103		196.1	3.0	143.8	2.9	128	1,075	5,587	6,295	10,605	9,530.00	63.1	KSC 33 Concrete
55	55	102		210.3	3.5	149	3.9	85	1,819	7,283	10,030	11,944	10,125.00	60.9	Edwards 22 Concrete
56	57	105		203	1.5	135	2.9	99.7	2,297	7,498	9,371	12,251	9,954.00	65.3	KSC 33 Concrete
57	51	103		198.4	1.5	144.1	3.3	113.4	2,099	6,539	7,977	10,370	8,271.00	50.1	KSC 15 Concrete
58	58	102		204.9	2.0	167.6	3.2	137.2	3,380	6,948	8,772	13,020	9,640.00	60.9	Edwards 22 Concrete
59	61	105		192.1	1.5	148.7	3	118	2,903	6,635	8,029	10,825	7,922.00	53.4	KSC 33 Concrete
60	60	103		191.9	2.0	118.2	3.52	97.5	2,463	7,455	8,295	10,234	7,771.00	49.8	KSC 15 Concrete
61	62	102		210.5	3.0	148.2	3.2	122.4	3,004	8,746	10,044	13,155	10,151.00	54.5	KSC 33 Concrete
62	59	105		228.3	3.5	171.4	3.8	117.9	1,664	7,067	9,819	12,355	10,691.00	53.7	EAFB 22 Concrete
63	65	102		206.9	3.0	138.7	-4.9	114.6	2,996	8,313	9,655	13,207	10,211.00	68.4	KSC 33 Concrete
64	64	103		207.8	1.0	163.4	-5.8	133.3	3,386	7,192	7,595	13,042	9,656.00	61.5	EAFB 4 Concrete
65	68	105		196.8	1.0	137.9	-4.4	81.8	3,522	7,299	9,888	12,107	8,495.00	61.8	EAFB 22 Concrete
66	66	104		195.8	1.0	150.6	-3.8	108.5	3,224	6,390	8,376	10,866	7,642.00	51.5	EAFB 22 Concrete
67	63	103		205.9	3.0	149.2	-4.2	57.1	1,349	5,437	10,617	12,351	11,002.00	80.4	KSC 15 Concrete
68	67	105		201	2.5	151.5	-5.4	141.6	17	6,240	6,936	11,634	11,617.30	60.9	EAFB 22 Concrete

a. Based on runway measurements except for brake initiation (onboard service)

b. kgs = knots, ground speed

c. Sink rate based on LaRC analysis of KSC spin-up measurement

d. Data not available

Source: JSC/ES6, Mechanical Design and Analysis Branch  
In-house Mission Reports

## LANDING DECELERATION

Miss Seq. No.	STS- No.	Orb. OV-	Notes	Velocities and Rates					Distance from Threshold, ft <sup>a</sup>				Total Rollout, ft	Rollout time, sec	Runway Data
				MGTD kgs b	Sink rates, ft/sec	NGTD, kgs a	Pitch rate, deg/sec	Brake init., kgs b	MGTD	NGTD	Brake init.	Stop			
69	71	104		206.2	2.0	166	-5.2	143.9	2,243	5,474	5,471	10,607	8,364.00	53.8	KSC 15 Concrete
70	70	103		198.7	1.6	163.4	-5.2	89.4	2,601	5,478	9,051	11,066	8,465.00	58.4	KSC 33 Concrete
71	69	105		218.1	4.4	167.1	-5.6	118	1,912	6,325	8,710	12,142	10,230.00	59.9	KSC 33 Concrete
72	73	102		213.3	2.0	157.1	-4.9	125.3	2,500	7,098	8,541	11,617	9,117.00	55.6	KSC 33 Concrete
73	74	104		195.8	2.2	156.6	-5.8	71.5	2,471	5,567	9,732	11,162	8,691.00	57.8	KSC 33 Concrete
74	72	105		191	1.4	145.5	-5.8	86.3	3,386	6,574	10,049	12,115	8,729.00	65.3	KSC 15 Concrete
75	75	102		189.3	0.4	130.4	-4.4	99.5	2,175	6,451	7,739	10,635	8,460.00	64.3	KSC 33 Concrete
76	76	104		204.1	4.2	154.1	-4.2	116	2,185	5,747	7,579	10,645	8,460.00	55	Edwards 22 Concrete
77	77	105		215.1	3.0	150.5	-4.1	107.4	1,688	6,612	8,688	10,978	9,290.00	52.3	KSC 33 Concrete
78	78	102		214	1.3	158	-4.5	124.3	2,304	6,537	8,145	11,639	9,335.00	57.1	KSC 33 Concrete

- a. Based on runway measurements except for brake initiation (onboard service)
- b. kgs = knots, ground speed
- c. Sink rate based on LaRC analysis of KSC spin-up measuremer
- d. Data not available

Source: JSC/ES6, Mechanical Design and Analysis Branch  
In-house Mission Reports

## LANDING AND FERRY

Miss Seq. No.	STS- No.	Orb. OV-	Notes	Planned/ Actual Landing Site	Landing Time, G.m.t		Runway Data		Winds	Ferry Flight Data				Remarks
					Main Gear	Nose Gear			True Dir Deg./Speed(a.)	Prep. Time d:h:m	Actual Departure Date/Time	Actual Landing Date/Time	Stops	
					Wheels Stop	No	Type	Alt,ft			Over Night	Fuel		
1	1	102		EAFB /	104 : 18 : 20 : 57.0 104 : 18 : 21 : 07.0 104 : 18 : 21 : 57.0	23	Dry lake bed	000 / 00 (Calm)	12 : 22 : 55	04 / 27 / 81 10 : 16 pdt / / :	04 / 28 / 81 11 : 00 edt / / :	1	0	
2	2	102		EAFB /	318 : 21 : 23 : 11.0 318 : 21 : 23 : 27.0 318 : 21 : 24 : 04.0	23	Dry lake bed	220 / 08	10 : 01 : 05	11 / 24 / 81 14 : 28 pst / / :	11 / 25 / 81 13 : 19 est / / :	1	0	
3	3	102		EAFB / WSSH,NM	089 : 16 : 04 : 46.0 089 : 16 : 05 : 00.0 089 : 16 : 06 : 09.0	17	Gyp- sum lake bed	220 / 13	06 : 21 : 55	04 / 06 / 82 07 : 00 ms / / :	04 / 06 / 82 16 : 00 est / / :	0	1	Wet EAFB lakebed resulted in landing at WSSH, NM.
4	4	102		EAFB /	185 : 16 : 09 : 31.0 185 : 16 : 09 : 54.0 185 : 16 : 10 : 44.0	22	Con- crete	240 / 12	09 : 22 : 36	07 / 14 / 82 07 : 46 pdt / / :	07 / 15 / 82 10 : 30 edt / / :	1	0	
5	5	102		EAFB /	320 : 14 : 33 : 26.0 320 : 14 : 33 : 34.0 320 : 14 : 34 : 29.0	22	Con- crete	012 / 02	05 : 00 : 57	11 / 21 / 82 07 : 30 pst / / :	11 / 22 / 82 12 : 16 est / / :	1	0	
6	6	099		EAFB /	099 : 18 : 53 : 42.0 099 : 18 : 53 : 53.0 099 : 18 : 54 : 31.0	22	Con- crete	210 / 18	04 : 19 : 06	04 / 14 / 83 06 : 00 pst / / :	04 / 16 / 83 12 : 45 est / / :	2	0	
7	7	099		KSC / EAFB	175 : 13 : 56 : 59.0 175 : 13 : 57 : 19.0 175 : 13 : 58 : 14.0	15	Dry lake bed	190 / 07	04 : 03 : 33	06 / 28 / 83 10 : 30 pdt / / :	06 / 29 / 83 10 : 20 edt / / :	1	0	Poor visibility at KSC resulted in landing at EAFB.
8	8	099		EAFB /	248 : 07 : 40 : 43.0 248 : 07 : 40 : 50.0 248 : 07 : 41 : 33.0	22	Con- crete	210 / 06	04 : 05 : 41	09 / 09 / 83 06 : 22 pdt / / :	09 / 09 / 83 19 : 00 edt / / :	0	1	First night landing.
9	9	102		EAFB /	342 : 23 : 47 : 24.0 342 : 23 : 47 : 38.0 342 : 23 : 48 : 17.0	17L	Dry lake bed	010 / 03	05 : 17 : 08	12 / 14 / 83 08 : 55 pst / / :	12 / 15 / 83 14 : 53 est / / :	1	2	

a  
ρ = peak

Source: JSC/ZS8, NOAA Spaceflight Meteorology Group, and  
JSC/ES6, Mechanical Design and Analysis Branch  
In-house Mission Reports  
JSC/CC2, Aircraft Systems Quality Assurance Branch, Report

## LANDING AND FERRY

Miss Seq. No.	STS- No.	Orb. OV-	Notes	Planned/ Actual Landing Site	Landing Time, G.m.t		Runway Data		Winds	Ferry Flight Data				Remarks
					Main Gear	Nose Gear			True Dir Deg./Speed(a.)	Prep. Time d:h:m	Actual Departure Date/Time	Actual Landing Date/Time	Stops	
					Wheels Stop		No	Type					Alt,ft	
10	41B	099		KSC /	042 : 12 : 15 : 55.0 042 : 12 : 16 : 06.0 042 : 12 : 17 : 02.0	15	Concrete	010 / 03	: : : / / :	/ / : / / :	/ / : / / :			Wind caused change from RW 33 to 15. Landed at KSC. No ferry required.
11	41C	099		KSC / EAFB	104 : 13 : 38 : 07.0 104 : 13 : 38 : 22.0 104 : 13 : 38 : 56.0	17L	Dry lake bed	000 / 00 (Calm)	04 : 00 : 09	04 / 17 / 84 05 : 47 pst / / :	04 / 18 / 84 10 : 08 est / / :	1	0	Storms at KSC resulted in landing at EAFB.
12	41D	103		EAFB /	249 : 13 : 37 : 54.0 249 : 13 : 38 : 08.0 249 : 13 : 38 : 54.0	17L	Dry lake bed	220 / 04	03 : 23 : 57	09 / 09 / 84 06 : 35 pdt / / :	09 / 10 / 84 11 : 45 edt / / :	0	1	Stopped O/N at Altus AFB, OK for refueling and to wait for weather to clear at KSC.
13	41G	099		KSC /	287 : 16 : 26 : 38.0 287 : 16 : 26 : 47.0 287 : 16 : 27 : 32.0	33	Concrete	320 / 08	: : : / / :	/ / : / / :	/ / : / / :			Landed at KSC. No ferry required.
14	51A	103		KSC /	321 : 11 : 59 : 56.0 321 : 12 : 00 : 09.0 321 : 12 : 00 : 54.0	15	Concrete	330 / 05	: : : / / :	/ / : / / :	/ / : / / :			Landed at KSC. No ferry required.
15	51C	103		KSC /	027 : 21 : 23 : 23.0 027 : 21 : 23 : 35.0 027 : 21 : 24 : 13.0	15	Concrete	160 / 08	: : : / / :	/ / : / / :	/ / : / / :			Landed at KSC. No ferry required.
16	51D	103		KSC /	109 : 13 : 54 : 28.0 109 : 13 : 54 : 36.0 109 : 13 : 55 : 31.0	33	Concrete	090 / 09	: : : / / :	/ / : / / :	/ / : / / :			Landed at KSC. No ferry required.
17	51B	099		EAFB /	126 : 16 : 11 : 04.0 126 : 16 : 11 : 16.0 126 : 16 : 12 : 03.0	17L	Dry lake bed	210 / 05	04 : 03 : 09	05 / 10 / 85 12 : 20 pdt / / :	05 / 11 / 85 11 : 05 edt / / :	1	0	Stopped at Kelly AFB, TX.
18	51G	103		EAFB /	175 : 13 : 11 : 52.0 175 : 13 : 12 : 05.0 175 : 13 : 12 : 34.0	23	Dry lake bed	160 / 11	03 : 23 : 58	06 / 28 / 85 06 : 10 pdt / / :	06 / 28 / 85 16 : 52 edt / / :	0	1	Fuel stop at Bergstrom AFB, TX.

a  
p = peak

Source: JSC/ZS8, NOAA Spaceflight Meteorology Group, and  
JSC/ES6, Mechanical Design and Analysis Branch  
In-house Mission Reports  
JSC/CC2, Aircraft Systems Quality Assurance Branch, Report

## LANDING AND FERRY

Miss Seq. No.	STS- No.	Orb. OV-	Notes	Planned/ Actual Landing Site	Landing Time, G.m.t		Runway Data		Winds	Ferry Flight Data				Remarks
					Main Gear	Nose Gear			True Dir Deg./Speed(a.)	Prep. Time d:h:m	Actual Departure Date/Time	Actual Landing Date/Time	Stops	
					Wheels Stop		Alt,ft				Over Night	Fuel		
19	51F	099		EAFB /	218 : 19 : 45 : 26.0 218 : 19 : 45 : 33.0 218 : 19 : 46 : 21.0	23	Dry lake bed	220 / 10	03 : 18 : 05	08 / 10 / 85 02 : 51 pdt / / :	08 / 11 / 85 12 : 40 edt / / :	1	2	Fuel stops at Davis-Monthan AFB, AZ, and Eglin AFB, FL, overnight stop at Kelly AFB, TX.
20	51I	103		EAFB /	246 : 13 : 15 : 43.0 246 : 13 : 15 : 51.0 246 : 13 : 16 : 30.0	23	Dry lake bed	240 / 18	04 : 00 : 14	09 / 07 / 85 06 : 30 pdt / / :	09 / 08 / 85 11 : 30 edt / / :	1	0	Overnight stop at Kelly AFB, TX.
21	51J	104		EAFB /	280 : 17 : 00 : 08.0 280 : 17 : 00 : 15.0 280 : 17 : 01 : 13.0	23	Dry lake bed	270 / 12	03 : 20 : 55	10 / 11 / 85 06 : 55 pdt / / :	10 / 11 / 85 18 : 10 edt / / :	0	1	Fuel stop at Kelly AFB, TX.
22	61A	099		EAFB /	310 : 17 : 44 : 53.0 310 : 17 : 45 : 01.0 310 : 17 : 45 : 38.0	17L	Dry lake bed	170 / 01	03 : 21 : 05	11 / 10 / 85 06 : 50 pst / / :	11 / 11 / 85 13 : 35 est / / :	1	2	Fuel stops at Davis-Monthan AFB, AZ, and Eglin AFB, FL. Overnight stop at Kelly AFB, TX
23	61B	104		EAFB /	337 : 21 : 33 : 49.0 337 : 21 : 34 : 00.0 337 : 21 : 35 : 07.0	22	Concrete	010 / 05	03 : 16 : 56	12 / 07 / 85 06 : 30 pst / / :	12 / 07 / 85 17 : 15 est / / :	0	1	Fuel stop at Kelly AFB, TX.
24	61C	102		KSC EAFB /	018 : 13 : 58 : 51.0 018 : 13 : 59 : 07.0 018 : 13 : 59 : 50.0	22	Concrete	260 / 01	04 : 01 : 06	01 / 22 / 86 07 : 05 pst / / :	01 / 23 / 86 14 : 20 est / / :	1	2	Fuel stop at Davis-Monthan AFB, AZ, and Eglin AFB, FL. Overnight stop at Kelly AFB, TX.
25	51L	099		/	: : : : : : : : :			/	: :	/ / : / / :	/ / : / / :			Vehicle destroyed at 73 seconds.
26	26	103		EAFB /	277 : 16 : 37 : 11.0 277 : 16 : 37 : 17.0 277 : 16 : 37 : 56.0	17L	Dry lake-bed	010 / 02	04 : 22 : 06	10 / 08 / 88 07 : 43 pdt / / :	10 / 08 / 88 19 : 03 edt / / :	0	1	Fuel stop at Kelly AFB, TX.
27	27	104		EAFB /	341 : 23 : 36 : 11.0 341 : 23 : 36 : 17.0 341 : 23 : 36 : 52.0	17L	Dry lake-bed	110 / 02	04 : 23 : 48	12 / 11 / 88 15 : 24 pst / / :	12 / 13 / 88 18 : 37 est / / :	2	0	Fuel stop at Davis-Monthan AFB, AZ, and Kelly AFB, TX.

a  
p = peak

Source: JSC/ZS8, NOAA Spaceflight Meteorology Group, and  
JSC/ES6, Mechanical Design and Analysis Branch  
In-house Mission Reports  
JSC/CC2, Aircraft Systems Quality Assurance Branch, Report

## LANDING AND FERRY

Miss Seq. No.	STS- No.	Orb. OV-	Notes	Planned/ Actual Landing Site	Landing Time, G.m.t		Runway Data		Winds	Ferry Flight Data					Remarks
					Main Gear	Nose Gear	No	Type	True Dir Deg./Speed(a.) Alt,ft	Prep. Time d:h:m	Actual Departure Date/Time	Actual Landing Date/Time	Stops		
													Wheels Stop	Over Night	
28	29	103		EAFB /	077 : 14 : 35 : 50.0 077 : 14 : 36 : 00.0 077 : 14 : 36 : 40.0	22	Con-crete	220 / 06	05 : 04 : 24	03 / 23 / 89 11 : 00 pst / / :	03 / 24 / 89 12 : 05 est / / :	1	1	Fuel stop at Kelly AFB, TX.	
29	30	104		EAFB /	128 : 19 : 43 : 26.0 128 : 19 : 43 : 37.0 128 : 19 : 44 : 30.0	22	Con-crete	280 / 08P16 Crosswind DTO 8	05 : 02 : 57	05 / 13 / 89 15 : 40 pdt / / :	05 / 15 / 89 20 : 09 edt / / :	2	3	Biggs AAF, TX, for overnight. DFW Dallas, TX Fuel. Robbins AFB, GA - Fuel.	
30	28	102		EAFB /	225 : 13 : 37 : 08.0 225 : 13 : 37 : 13.0 225 : 13 : 37 : 52.0	17L	Dry lake bed	160 / 06	07 : 00 : 00	08 / 20 / 89 06 : 37 pdt / / :	08 / 21 / 89 12 : 45 edt / / :	1	1	Fuel stop at Kelly AFB, TX. Overnight at Robbins AFB, GA.	
31	34	104		EAFB /	296 : 16 : 33 : 01.0 296 : 16 : 33 : 10.0 296 : 16 : 34 : 00.0	23L	Dry lake bed	170 / 04	04 : 21 : 32	10 / 28 / 89 07 : 05 pst / / :	10 / 29 / 89 17 : 05 est / / :	1	1	Biggs AAF, TX, for overnight; Columbus AFB, MS., for fuel.	
32	33	103		EAFB /	332 : 00 : 30 : 18.0 332 : 00 : 30 : 26.0 332 : 00 : 31 : 02.0	04	Con-crete	070 / 08P19	05 : 14 : 07	12 / 03 / 89 06 : 37 pst / / :	12 / 04 / 89 10 : 20 est / / :	1	1	Fuel stop at Kelly AFB, TX. Overnight at Eglin AFB, FL.	
33	32	102		EAFB /	020 : 09 : 35 : 36.0 020 : 09 : 35 : 50.0 020 : 09 : 36 : 38.0	22	Con-crete	300 / 04P05	05 : 05 : 54	01 / 25 / 90 07 : 30 pst / / :	01 / 26 / 90 15 : 29 est / / :	1	2	Fuel stop at Davis Monthan AFB, AZ. Overnight and fuel stops at Kelly AFB TX., and Eglin AFB	
34	36	104		EAFB /	063 : 18 : 08 : 44.0 063 : 18 : 08 : 54.0 063 : 18 : 09 : 37.0	23L	Dry lake-bed	260 / 16P18	06 : 22 : 44	03 / 11 / 90 08 : 53 pst / / :	03 / 13 / 90 12 : 50 est / / :	2	1	Overnight (2) Biggs AAF, TX, and fuel stop at Columbus AFB, MS. Weather delay.	
35	31	103		EAFB /	119 : 13 : 49 : 57.0 119 : 13 : 50 : 09.0 119 : 13 : 50 : 58.0	22	Con-crete	180 / 07P10	06 : 00 : 54	05 / 05 / 90 07 : 44 pdt / / :	05 / 07 / 90 11 : 22 edt / / :	2	2	Sheppard AFB, TX, and Robbins AFB, GA - Overnight and fuel.	
36	41	103		EAFB /	283 : 13 : 57 : 19.0 283 : 13 : 57 : 31.0 283 : 13 : 58 : 08.0	22	Con-crete	279 / 03	04 : 23 : 48	10 / 15 / 90 06 : 45 pdt / / :	10 / 16 / 90 15 : 59 edt / / :	1	2	Fuel - Sheppard AFB, TX; RON at Eglin AFB, FL.	

a  
p = peak

Source: JSC/ZS8, NOAA Spaceflight Meteorology Group, and  
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JSC/CC2, Aircraft Systems Quality Assurance Branch, Report

## LANDING AND FERRY

Miss Seq. No.	STS- No.	Orb. OV-	Notes	Planned/ Actual Landing Site	Landing Time, G.m.t		Runway Data		Winds	Ferry Flight Data				Remarks
					Main Gear	Nose Gear			True Dir Deg./Speed(a.) Alt,ft	Prep. Time d:h:m	Actual Departure Date/Time	Actual Landing Date/Time	Stops	
					Wheels Stop		No	Type					Over Night	
37	38	104		EAFB / KSC	324 : 21 : 42 : 46.0 324 : 21 : 42 : 52.0 324 : 21 : 43 : 38.0	33	Concrete	020 / 05P07	: :	/ / : / / :	/ / : / / :			Weather concerns at EAFB resulted in landing at KSC. No ferry required.
38	35	102		EAFB /	345 : 05 : 54 : 09.0 345 : 05 : 54 : 20.0 345 : 05 : 55 : 06.0	22	Concrete	014 / 01P02	07 : 09 : 06	12 / 18 / 90 07 : 00 pst	12 / 20 / 90 13 : 01 est	2	3	Refuel at Biggs AAF, TX and Kelly AFB, TX. RON Kelly AFB. Refuel and RON at
39	37	104		EAFB /	101 : 13 : 55 : 29.0 101 : 13 : 55 : 35.0 101 : 13 : 56 : 24.0	33	Dry lake bed	008 / 17P21	05 : 03 : 15	04 / 16 / 91 10 : 10 pdt	04 / 18 / 91 09 : 36 edt	2	2	RON at Columbus AFB, MS., and RON at MacDill AFB, FL.
40	39	103		EAFB / KSC	126 : 18 : 55 : 37.0 126 : 18 : 55 : 49.0 126 : 18 : 56 : 31.0	15	Concrete	155 / 12P16	: :	/ / : / / :	/ / : / / :			Landed at KSC. No ferry required.
41	40	102		EAFB /	165 : 15 : 39 : 11.0 165 : 15 : 39 : 25.0 165 : 15 : 40 : 05.0	22	Concrete	227 / 12P17	05 : 00 : 20	06 / 19 / 91 08 : 59 pdt	06 / 21 / 91 08 : 28 edt	2	2	RON at Biggs AAF, TX, and at Columbus AFB, MS.
42	43	104		KSC /	223 : 12 : 23 : 25.0 223 : 12 : 23 : 36.0 223 : 12 : 24 : 23.0	15	Concrete	240 / 07	: :	/ / : / / :	/ / : / / :			Landed at KSC. No ferry required.
43	48	103		KSC / EAFB	261 : 07 : 38 : 42.0 261 : 07 : 38 : 53.0 261 : 07 : 39 : 31.0	22	Concrete	200 / 08	06 : 08 : 59	09 / 24 / 91 09 : 38 pdt	09 / 26 / 91 12 : 15 edt	2	3	Fuel stop at Biggs AAF, TX; RON at Tinker AFB, OK; RON at Columbus AFB, MS
44	44	104		KSC / EAFB	335 : 22 : 34 : 44.0 335 : 22 : 34 : 50.0 335 : 22 : 36 : 28.0	05R	Dry lake bed	074 / 13P15	05 : 17 : 25	12 / 07 / 91 07 : 40 pst	12 / 08 / 91 12 : 27 est	1	1	RON at Sheppard AFB, TX.
45	42	103		EAFB /	030 : 16 : 07 : 17.0 030 : 16 : 07 : 27.0 030 : 16 : 08 : 15.0	22	Concrete	300 / 02	15 : 00 : 03	02 / 14 / 92 08 : 10 pst	02 / 16 / 92 12 : 50 est	2	1	RON at Biggs AAF, TX. RON at Kelly AFB, TX.

a  
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## LANDING AND FERRY

Miss Seq. No.	STS- No.	Orb. OV-	Notes	Planned/ Actual Landing Site	Landing Time, G.m.t		Runway Data		Winds True Dir Deg./Speed(a.) Alt,ft	Ferry Flight Data				Remarks	
					Main Gear	Nose Gear				Prep. Time d:h:m	Actual Departure Date/Time	Actual Landing Date/Time	Stops		
					Wheels Stop		No	Type	Over Night				Fuel		
46	45	104		KSC /	093 : 11 : 23 : 08.0	08.0	33	Concrete	290 / 08P12	: :	/ /	/ /			Landed at KSC. No ferry required.
					093 : 11 : 23 : 13.0						:	:			
					093 : 11 : 24 : 04.0						/ /	/ /			
47	49	105		EAFB /	137 : 20 : 57 : 38.0	38.0	22	Concrete	232 / 02P06	10 : 15 : 57	05 / 27 / 92	05 / 30 / 92	2	2	RON at Biggs AAF, TX. RON at Kelly AFB, TX.
					137 : 20 : 57 : 48.0						05 : 55 pdt	10 : 00 edt			
					137 : 20 : 58 : 36.0						/ /	/ /			
48	50	102		EAFB / KSC	191 : 11 : 42 : 27.0	27.0	33	Concrete	258 / 05P08	: :	/ /	/ /			Landed at KSC. No ferry required.
					191 : 11 : 42 : 44.0						:	:			
					191 : 11 : 43 : 25.0						/ /	/ /			
49	46	104		KSC /	221 : 13 : 11 : 51.0	51.0	33	Concrete	330 / 01	: :	/ /	/ /			Landed at KSC. No ferry required.
					221 : 13 : 12 : 05.0						:	:			
					221 : 13 : 12 : 55.0						/ /	/ /			
50	47	105		KSC /	264 : 12 : 53 : 23.0	23.0	33	Concrete	270 / 02P04	: :	/ /	/ /			Landed at KSC. No ferry required.
					264 : 12 : 53 : 39.0						:	:			
					264 : 12 : 54 : 13.0						/ /	/ /			
51	52	102		KSC /	306 : 14 : 05 : 52.0	52.0	33	Concrete	080 / 06P09	: :	/ /	/ /			Landed at KSC. No ferry required.
					306 : 14 : 06 : 10.0						:	:			
					306 : 14 : 06 : 55.0						/ /	/ /			
52	53	103		KSC / EAFB	344 : 20 : 43 : 46.6	46.6	22	Concrete	274 / 14P19	06 : 01 : 11	12 / 15 / 92	12 / 18 / 92	3	1	RON (3) at Kelly AFB, TX.
					344 : 20 : 44 : 03.6						13 : 55 pst	14 : 45 est			
					344 : 20 : 44 : 59.4						/ /	/ /			
											:	:			
53	54	105		KSC /	019 : 13 : 37 : 46.8	46.8	33	Concrete	360 / 04P06	: :	/ /	/ /			Landed at KSC. No ferry required.
					019 : 13 : 38 : 02.4						:	:			
					019 : 13 : 38 : 36.0						/ /	/ /			
											:	:			
54	56	103		KSC /	107 : 11 : 37 : 23.0	23.0	33	Concrete	320 / 06P08	: :	/ /	/ /			Landed at KSC. No ferry required.
					107 : 11 : 37 : 34.0						:	:			
					107 : 11 : 38 : 21.7						/ /	/ /			
											:	:			

a  
p = peak

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JSC/CC2, Aircraft Systems Quality Assurance Branch, Report

## LANDING AND FERRY

Miss Seq. No.	STS- No.	Orb. OV-	Notes	Planned/ Actual Landing Site	Landing Time, G.m.t		Runway Data		Winds	Ferry Flight Data					Remarks
					Main Gear	Nose Gear			True Dir Deg./Speed(a.)	Prep. Time d:h:m	Actual Departure Date/Time	Actual Landing Date/Time	Stops		
					Wheels Stop		Alt,ft	Over Night					Fuel		
55	55	102		KSC / EAFB	126 : 14 : 29 : 59.1 126 : 14 : 30 : 17.0 126 : 14 : 31 : 00.0	22	Concrete	220 / 14P19	05 : 04 : 26	05 / 11 / 93 11 : 56 pst / / :	05 / 14 / 93 14 : 30 edt / / :	3	1	RON at Biggs AAF, TX. RON (2) at Kelly AFB, TX	
56	57	105		KSC /	182 : 12 : 52 : 15.7 182 : 12 : 52 : 33.4 182 : 12 : 53 : 21.0	33	Concrete	320 / 07P10	: :	/ / : / / :	/ / : / / :			Landed at KSC. No ferry required.	
57	51	103		KSC /	265 : 07 : 56 : 06.3 265 : 07 : 56 : 21.3 265 : 07 : 56 : 56.4	15	Concrete	000 / 00 calm	: :	/ / : / / :	/ / : / / :			Landed at KSC. No ferry required.	
58	58	102		EAFB /	305 : 15 : 05 : 42.1 305 : 15 : 05 : 53.1 305 : 15 : 06 : 43.0	22	Concrete	029 / 02P03	05 : 22 : 59	11 / 7 / 93 06 : 05 pdt / / :	11 / 08 / 93 10 : 00 est / / :	1	2	RON at Columbus AFB Ms.	
59	61	105		KSC /	347 : 05 : 25 : 32.6 347 : 05 : 25 : 45.2 347 : 05 : 26 : 26.0	33	Concrete	330 / 05P08	: :	/ / : / / :	/ / : / / :			Landed at KSC. No ferry required.	
60	60	103		KSC /	042 : 19 : 19 : 22.2 042 : 19 : 19 : 41.1 042 : 19 : 20 : 13.0	15	Concrete	150 / 08P18	: :	/ / : / / :	/ / : / / :			Landed at KSC. No ferry required.	
61	62	102		KSC /	077 : 13 : 09 : 40.5 077 : 13 : 09 : 59.6 077 : 13 : 10 : 35.0	33	Concrete	190 / 05P08	: :	/ / : / / :	/ / : / / :			Landed at KSC. No ferry required.	
62	59	105		KSC / EAFB	110 : 16 : 54 : 29.3 110 : 16 : 54 : 45.2 110 : 16 : 55 : 23.0	22	Concrete	354 / 00P02	08 : 23 : 05	04 / 29 / 94 09 : 00 pdt / / :	05 / 02 / 94 09 : 00 edt / / :	3	1	RON at Biggs AAF, Tx. RON (2) at Little Rock Air Force Base, Ark.	
63	65	102		KSC /	204 : 10 : 37 : 59.6 204 : 10 : 38 : 17.3 204 : 10 : 39 : 08.0	33	Concrete	150 / 3P4	: :	/ / : / / :	/ / : / / :			Landed at KSC. No ferry required.	

a  
p = peak

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## LANDING AND FERRY

Miss Seq. No.	STS- No.	Orb. OV-	Notes	Planned/ Actual Landing Site	Landing Time, G.m.t		Runway Data		Winds	Ferry Flight Data				Remarks	
					Main Gear	Nose Gear	No	Type	True Dir Deg./Speed(a.) Alt,ft	Prep. Time d:h:m	Actual Departure Date/Time	Actual Landing Date/Time	Stops		
													Over Night		Fuel
64	64	103		KSC / EAFB	263 : 21 : 12 : 51.54 263 : 21 : 13 : 03.3 263 : 21 : 13 : 53.0	4	Concrete	40 / 10P13	05 : 20 : 53	09 / 26 / 94 11 : 05 pdt / / :	09 / 27 / 94 10 : 30 edt / / :	1	0	RON at Kelly AFB, TX	
65	68	105		KSC / EAFB	284 : 17 : 02 : 08.022 284 : 17 : 02 : 21.1 284 : 17 : 03 : 09.8	22	Concrete	200 / 8P10	08 : 00 : 53	10 / 19 / 94 10 : 55 pdt / / :	10 / 20 / 94 16 : 05 edt / / :	1	2	RON at Dyess AFB, TX.	
66	66	104		KSC / EAFB	318 : 15 : 33 : 45.222 318 : 15 : 33 : 55.7 318 : 15 : 34 : 36.7	22	Concrete	360 / 4P4	06 : 21 : 52	11 / 21 / 94 06 : 25 pst / / :	11 / 22 / 94 09 : 25 est / / :	1	1	RON at Eglin AFB, FL.	
67	63	103		KSC /	042 : 11 : 50 : 19.215 042 : 11 : 50 : 32.8 042 : 11 : 51 : 39.6	15	Concrete	170 / 5P7	: :	/ / : / / :	/ / : / / :			Landed at KSC. No ferry required.	
68	67	105		KSC / EAFB	077 : 21 : 46 : 59.122 077 : 21 : 47 : 14.2 077 : 21 : 48 : 00.0	22	Concrete	231 / 15P22	07 : 19 : 12	03 / 26 / 95 10 : 00 pst / / :	03 / 27 / 95 16 : 50 est / / :	1	1	RON at Dyess AFB, TX.	
69	71	104		KSC /	188 : 14 : 54 : 34.115 188 : 14 : 54 : 44.1 188 : 14 : 55 : 27.9	15	Concrete	30 / 7P11	: :	/ / : / / :	/ / : / / :			No ferry required.	
70	70	103		KSC /	203 : 12 : 01 : 59.633 203 : 12 : 02 : 08.6 203 : 12 : 02 : 58.0	33	Concrete	200 / 5P5	: :	/ / : / / :	/ / : / / :			No ferry required	
71	69	105		KSC /	261 : 11 : 37 : 54.933 261 : 11 : 38 : 08.2 261 : 11 : 38 : 54.8	33	Concrete	220 / 5P5	: :	/ / : / / :	/ / : / / :			No ferry required	
72	73	102		KSC /	309 : 11 : 45 : 21.033 309 : 11 : 45 : 35.3 309 : 11 : 46 : 16.7	33	Concrete	34 / 5P7	: :	/ / : / / :	/ / : / / :			No ferry required	

a  
p = peak

Source: JSC/ZS8, NOAA Spaceflight Meteorology Group, and  
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## LANDING AND FERRY

Miss Seq. No.	STS- No.	Orb. OV-	Notes	Planned/ Actual Landing Site	Landing Time, G.m.t		Runway Data		Winds	Ferry Flight Data					Remarks
					Main Gear	Nose Gear			True Dir Deg./Speed(a.)	Prep. Time d:h:m	Actual Departure Date/Time	Actual Landing Date/Time	Stops		
							Wheels Stop	No					Type	Alt,ft	
73	74	104		KSC /	324 : 17 : 01 : 27.0 324 : 17 : 01 : 37.0 324 : 17 : 02 : 24.7	33	Concrete	10 / 7P10	: :	/ / : / / :	/ / : / / :			No ferry required	
74	72	105		KSC /	020 : 07 : 41 : 40.4 020 : 07 : 41 : 50.7 020 : 07 : 42 : 45.6	15	Concrete	315 / 6P8	: :	/ / : / / :	/ / : / / :			No ferry required	
75	75	102		KSC /	069 : 13 : 58 : 20.4 069 : 13 : 58 : 35.6 069 : 13 : 59 : 24.7	33	Concrete	326 / 13P20	: :	/ / : / / :	/ / : / / :			No ferry required	
76	76	104		KSC / EAFB	091 : 13 : 28 : 56.6 091 : 13 : 29 : 07.7 091 : 13 : 29 : 51.6	22	Concrete	142 / 1P4	05 : 04 : 24	04 / 06 / 96 12 : 53 pst 4 / 11 / 96 9 : 00 pst	04 / 06 / 96 01 : 10 pst 4 / 12 / 96 2 : 05 est	1	2	*Abort  RON at Dyess AFB, TX	
77	77	105		KSC /	150 : 11 : 09 : 19.0 150 : 11 : 09 : 34.3 150 : 11 : 10 : 11.2	33	Concrete	260 / 8P11	: :	/ / : / / :	/ / : / / :			No ferry required	
78	78	102		KSC /	189 : 12 : 36 : 34.1 189 : 12 : 36 : 47.1 189 : 12 : 37 : 31.3	33	Concrete	180 / 3P5	: :	/ / : / / :	/ / : / / :			No ferry required	
79	79	104		KSC /	270 : 12 : 13 : 13.0 270 : 12 : 13 : 29.0 270 : 12 : 14 : 34.0	15	Concrete	120 / 4P9	: :	/ / : / / :	/ / : / / :			No ferry required	
80	80	102		KSC /	342 : 11 : 49 : 06.0 342 : 11 : 49 : 16.7 342 : 11 : 50 : 13.0	33	Concrete	200 / 6P9	: :	/ / : / / :	/ / : / / :			No ferry required	
81	81	104		KSC /	022 : 14 : 22 : 46.0 022 : 14 : 22 : 56.0 022 : 14 : 23 : 51.0	33	Concrete	140 / 4P7	: :	/ / : / / :	/ / : / / :			No ferry required	

a  
p = peak

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## LANDING AND FERRY

Miss Seq. No.	STS- No.	Orb. OV-	Notes	Planned/ Actual Landing Site	Landing Time, G.m.t		Runway Data		Winds True Dir Deg./Speed(a.) Alt,ft	Ferry Flight Data				Remarks
					Main Gear	Nose Gear				Prep. Time d:h:m	Actual Departure Date/Time	Actual Landing Date/Time	Stops	
					Wheels Stop	No	Type	Over Night	Fuel					
82	82	103		KSC /	052 : 08 : 32 : 24.0 052 : 08 : 32 : 35.0 052 : 08 : 33 : 16.0	15	Concrete	140 / 7P15	: : : / / :	/ / : / / :	/ / : / / :			No ferry required
83	83	102		KSC /	098 : 18 : 33 : 11.0 098 : 18 : 33 : 23.0 098 : 18 : 34 : 11.0	33	Concrete	20 / 9P18	: : : / / :	/ / : / / :	/ / : / / :			No ferry required
84	84	104		KSC /	144 : 13 : 27 : 43.5 144 : 13 : 27 : 51.5 144 : 13 : 28 : 35.6	33	Concrete	111 / 9P13	: : : / / :	/ / : / / :	/ / : / / :			No ferry required
85	94	102		KSC /	198 : 10 : 46 : 33.3 198 : 10 : 46 : 44.3 198 : 10 : 47 : 28.8	33	Concrete	150 / 1P1	: : : / / :	/ / : / / :	/ / : / / :			No ferry required
86	85	103		KSC /	231 : 11 : 07 : 58.2 231 : 11 : 08 : 08.4 231 : 11 : 09 : 06.9	33	Concrete	200 / 6P9	: : : / / :	/ / : / / :	/ / : / / :			No ferry required
87	86	104		KSC /	279 : 21 : 55 : 08.7 279 : 21 : 55 : 18.7 279 : 21 : 56 : 30.8	15	Concrete	075 / 9P14	: : : / / :	/ / : / / :	/ / : / / :			No ferry required
88	87	102		KSC /	339 : 12 : 20 : 05.0 339 : 12 : 20 : 15.0 339 : 12 : 21 : 02.0	33	Concrete	078 / 6P12	: : : / / :	/ / : / / :	/ / : / / :			No ferry required
89	89	105		KSC /	031 : 22 : 35 : 10.0 031 : 22 : 35 : 21.0 031 : 22 : 36 : 21.0	15	Concrete	020 / 5P11	: : : / / :	/ / : / / :	/ / : / / :			No ferry required
90	90	102		KSC /	123 : 16 : 08 : 59.0 123 : 16 : 09 : 13.0 123 : 16 : 09 : 57.0	33	Concrete	230 / 4P11	: : : / / :	/ / : / / :	/ / : / / :			No ferry required

a  
p = peak

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## LANDING AND FERRY

Miss Seq. No.	STS- No.	Orb. OV-	Notes	Planned/ Actual Landing Site	Landing Time, G.m.t		Runway Data		Winds	Ferry Flight Data					Remarks
					Main Gear	Nose Gear	No	Type	True Dir Deg./Speed(a.) Alt,ft	Prep. Time d:h:m	Actual Departure Date/Time	Actual Landing Date/Time	Stops		
													Wheels Stop	Over Night	
91	91	103		KSC /	163 : 18 : 00 : 24.0 163 : 18 : 00 : 28.0 163 : 18 : 01 : 28.0	15	Concrete	040 / 7P11	: :	/ / : / / :	/ / : / / :			No ferry required	
92	95	103		KSC /	311 : 17 : 03 : 31.0 311 : 17 : 03 : 46.0 311 : 17 : 04 : 30.0	33	Concrete	060 / 9P14	: :	/ / : / / :	/ / : / / :			No ferry required	
93	88	105		KSC /	350 : 03 : 53 : 33.0 350 : 03 : 53 : 38.0 350 : 03 : 54 : 16.0	15	Concrete	310 / 5P9	: :	/ / : / / :	/ / : / / :			No ferry required	

a  
p = peak

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