10.1 (Reserved)

10.2 (Reserved)

10.3 (Reserved)

10.4 (Reserved)

10.5 (Reserved)

10.6 ORBITER/CARGO BAY PARTICULATES AND GASES ENVIRONMENT

10.6.1 Purge Gas in the Cargo Bay

10.6.1.1 Ground Operations With Closed Cargo Bay

Conditioned gas (air or GN_2) which has been HEPA filtered, Class 5000, and containing 15 PPM or less hydrocarbons based on methane equivalent, shall be used to purge the cargo bay as specified in Tables 6.2.1.1-1. The cargo shall have been installed, the cargo bay doors closed, and the Shuttle Vehicle fully mated before purge is started.

10.6.1.2 Lift-off Through Orbit Insertion

The cargo bay gas shall be the residue remaining from the Orbiter ground purge conducted prior to lift-off. The nominal cargo bay pressure during ascent shall be within the curves shown in Figure 10.6.1.2-1. The maximum cargo bay ascent pressure decay rate (i.e., dP/dt) is shown in Figure 10.6.1.2-2 with a maximum value of 0.76 psi/second. Table 10.6.1.2-1 presents values for the data plotted in Figures 10.6.1.2-1 and 10.6.1.2-2.

10.6.1.3 Entry and Descent

Atmospheric air filtered through 35-micron glass-bead-rating filters shall be used to repressurize the cargo bay. Figure 10.6.1.3-1, the Orbiter Cargo Bay internal pressure history, is to be used by payloads for design and venting analysis. Orbiter Cargo Bay vent door opening shall occur at altitudes between 70,000 ft (21,336 m) and 94,000 ft (28,651 m). The repressurization rate (i.e., dP/dt) of the Cargo Bay shall not exceed 0.3 psi/sec during descent. Figure 10.6.1.3-1 (Sheet 2 of 2) presents values for the data plotted in Figure 10.6.1.3-1 (Sheet 1 of 2).

10.6.2 Contamination

10.6.2.1 Accessibility for Cleaning

Interior surfaces of the Cargo Bay and exterior surfaces of the Cargo shall be designed to provide accessibility for cleaning purposes.

10.6.2.1.1 Cargo Bay and Cargo Element Cleaning Condition

Internal Cargo Bay surfaces and external Cargo element surfaces shall be maintained to a visibly clean level, as defined in NSTS Specification SN-C-0005, both prior to and following, Cargo element installation in the Cargo Bay.

10.6.2.2 Cargo Effluents

The formation or transfer, within the cargo bay, of any cargo effluents which can result in payload cross-contamination or jeopardize the performance of Orbiter systems (i.e., radiators, windows, optics, etc.) shall be precluded.

The Cargo shall provide cleanable exterior surfaces. All nonmetallic materials exposed to the cargo bay shall be selected for low outgassing characteristics. Material selection criteria of 1 percent, or less, total mass loss and 0.1 percent, or less, volatile condensible material (VCM) as defined in NASA/JSC Specification SP-R-0022, or its equivalent, shall be used.

10.6.2.3 Gases and Liquids Vented Overboard
Fluids vented overboard shall limit contamination of the cargo, cargo bay, Orbiter windows, optical surfaces, and/or Orbiter thermal protection system surfaces to a level which does not jeopardize mission objectives. Dump design shall be time-selectable in order to program occurrences to be compatible with other flight operations. No payload shall dump or vent any fluids into the Cargo Bay during ascent or descent (including aborts). On-orbit dumps of non-hazardous fluids shall be performed only with the Cargo Bay doors open. Venting or dumping, as used in this paragraph, shall not include the release of non-hazardous gases in internal unpressurized volumes at atmospheric pressure at liftoff which are continuously vented during ascent and continuously repressurized during entry. All other payload venting requirements shall be agreed to in the Payload Integration Plan (PIP).

10.6.2.4 Cargo Bay Liner
The Orbiter shall provide a cargo bay liner, as required, to isolate cargo element surfaces which are sensitive to particulate contamination effects from the Orbiter lower mid-fuselage. The liner shall prevent the transfer of particulates greater than 35 microns GBR (nominal max. particle size 87 microns in length) from the lower mid-fuselage to the cargo bay. All cargo bay surfaces, including the cargo bay liner, shall be cleaned to a visibly clean level as defined in NSTS specification SN-C-0005.

10.6.2.5 Orbiter Sources of Contamination
Number column density and return flux predictions for outgassing, flash evaporator, leakage, and RCS effluents for various lines-of-sight and altitudes are shown in Table 10.6.2.5-1.

10.6.3 (Reserved)

10.6.4 Cargo Bay Venting Velocity and Pressure Environments for Payloads
The Orbiter cargo bay is vented through vent openings on both the port and starboard sides of the vehicle during ascent and entry in order to equalize the internal/external pressure environment. The airflow during this venting process can have an adverse effect upon payloads or payload components. In addition, excessive blockage of the vents by a payload can result in damage to the Orbiter. Therefore, the payload is required to make an assessment of the effects of this induced environment upon their payload and/or its components.

For assessment purposes, the payload shall be assumed to be located directly in front of a vent. Should this assessment indicate a hazardous condition or an adverse effect upon the payload or the orbiter (due to excessive blockage), the payload shall notify the SSP.

Approximate vent locations are shown in Figure 3.3.4.4-1.

10.6.4.1 Vent Flow Environment/Analysis Methodology
During inflow venting, a jet of air flows into the payload bay through the down stream portion (in the Xo direction) of the vent filter as described in

Figure 10.6.4.1-1. The inflow through the upstream portion of the filter is low compared with the flow within the jet. Within the core of the jet, the inflow velocity remains constant. Beyond the core, the centerline velocity gradually decays with increasing distance from the vent filter. However, the total force acting upon any payload component located within the jet impingement region remains constant for all distances from the filter, so long as the component continues to capture the entire jet.

Depending upon its size and location in the payload bay, a payload can be exposed to both an inflow condition at one vent and an outflow condition from another vent at the same time.

During outflow venting, flow-velocity is essentially uniform across the entire area of the vent filter. In addition, the velocity and pressure of the vent flow is affected by the size of the payload component.

For purposes of payload size definition, large components are those that do not meet the definition of a small component. Small payload components are defined as follows:

$$A \leq 0.24\ (Y + 14)^2$$

where A = area of the payload component projected onto the filter, in.^{2}

Y = distance from the filter to the closest point on the payload, in.

10.6.4.1.1 Ascent Vent Flow Environment

Maximum inflow velocity and dynamic pressure during ascent are as shown in Figure 10.6.4.1.1-1. Maximum outflow velocity and dynamic pressure are shown in Figure 10.6.4.1.1-2 for small payload components and in Figure 10.6.4.1.1-3 for larger payload components.

10.6.4.1.2 Entry Vent Flow Environment

Maximum inflow velocity and dynamic pressure during entry are shown in Figure 10.6.4.1.2-1. Maximum outflow velocity and dynamic pressure are shown in Figure 10.6.4.1.2-2 for small payload components and in Figure 10.6.4.1.2-3 for larger payload components.

TABLE 10.6.1.2-1 ASCENT CARGO BAY PRESSURE AND DECAY RATE

TIME	MAXIMUM CARGO BAY PRESSURE	MINIMUM CARGO BAY PRESSURE	MAXIMUM RATE OF DEPRESSURIZATION
10	14.45	14.20	0.155
20	13.20	12.50	0.255
30	11.25	10.00	0.360
35	10.05	8.90	0.510
38	9.40	8.20	0.735
39	9.15	7.60	0.760
40	8.95	7.20	0.760
41	8.70	6.80	0.760
45	7.75	5.70	0.640
48	7.20	5.10	0.570
49	7.05	4.90	0.575
50	6.90	4.70	0.550
51	6.60	4.50	0.520
52	6.10	4.30	0.455
55	5.35	3.65	0.355
60	4.30	2.70	0.273
65	3.50	2.00	0.255
70	2.70	1.40	0.195
80	1.30	0.60	0.150
90	0.60	0.20	0.115
100	0.25	0.10	0.075

NOTE:

(1) PRESSURE IN PSIA

(2) RATE OF DEPRESSURIZATION IN PSI/SECOND

(3) TIME IN SECONDS FROM LIFT-OFF

TABLE 10.6.2.5-1 PREDICTED NUMBER COLUMN DENSITY AND RETURN FLUX CONTRIBUTIONS FROM SHUTTLE ORBITER SOURCES OF CONTAMINATION

Source	Parameter	Number Column Density (Molecules/cm^2)	Return Flux (RF) (Molecules/cm^2/sec) 300 Km	400 Km	700 Km
Outgassing	LOS 1	2.1×10^{10}	5.2×10^{10}	1.1×10^{10}	2.5×10^{8}
	3	3.1×10^{10}	2.9×10^{10}	6.2×10^{9}	1.4×10^{8}
	7	2.7×10^{10}	2.5×10^{10}	5.3×10^{9}	1.2×10^{8}
FES	LOS 1	6.7×10^{13}	3.0×10^{12}	6.3×10^{11}	1.4×10^{10}
	7	3.3×10^{14}	1.6×10^{12}	3.4×10^{11}	7.9×10^{9}
VRCS AFT -Z Right Side	LOS 1	2.8×10^{14}	1.4×10^{13}	2.9×10^{12}	6.6×10^{10}
	7	6.8×10^{14}	3.4×10^{12}	7.2×10^{11}	1.7×10^{10}
VRCS AFT +Y	LOS 1	1.6×10^{14}	8.1×10^{12}	1.7×10^{12}	4.0×10^{10}
	7	8.7×10^{14}	3.7×10^{12}	7.9×10^{11}	1.8×10^{10}
PRCS AFT -Z	LOS 1	8.9×10^{15}	5.4×10^{13}	1.1×10^{13}	2.6×10^{11}
	7	3.6×10^{16}	5.4×10^{12}	1.1×10^{12}	2.6×10^{10}
PRCS AFT +Y	LOS 1	8.6×10^{15}	6.0×10^{13}	1.3×10^{13}	3.0×10^{11}
	7	2.9×10^{16}	5.4×10^{12}	1.1×10^{12}	2.6×10^{10}

NOTES:

(1) Ambient velocity direction: -Z, Field of view: 10°, medium density atmosphere.

(2) Maximum temperature, after 100 hours.

(3) LOS 1, zero degree line-of-sight (in the +Zo direction) originating at Xo = 1107, Yo = 0, Zo = 507.
LOS 3, 60° off of +Z towards + Xo (backward) originating at Xo = 1107, Yo = 0, Zo = 507.
LOS 7, 60° off of +Z towards +Yo (right) originating at Xo = 1107, Yo = 0, Zo = 507.

(4) Elevon is in nominal position, maximum flow.

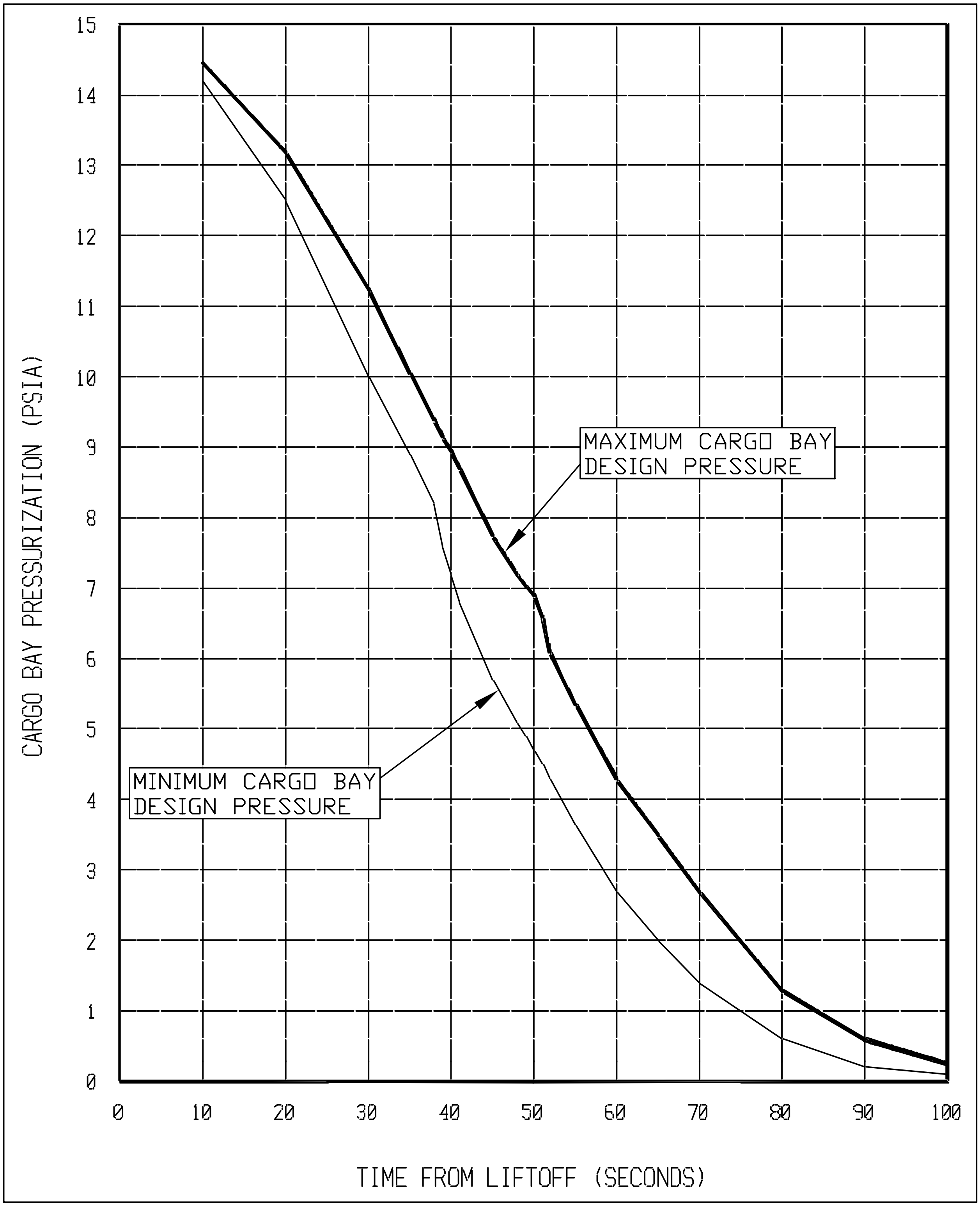


FIGURE 10.6.1.2-1 ORBITER CARGO ELEMENT INTERNAL PRESSURE HISTORY DURING ASCENT

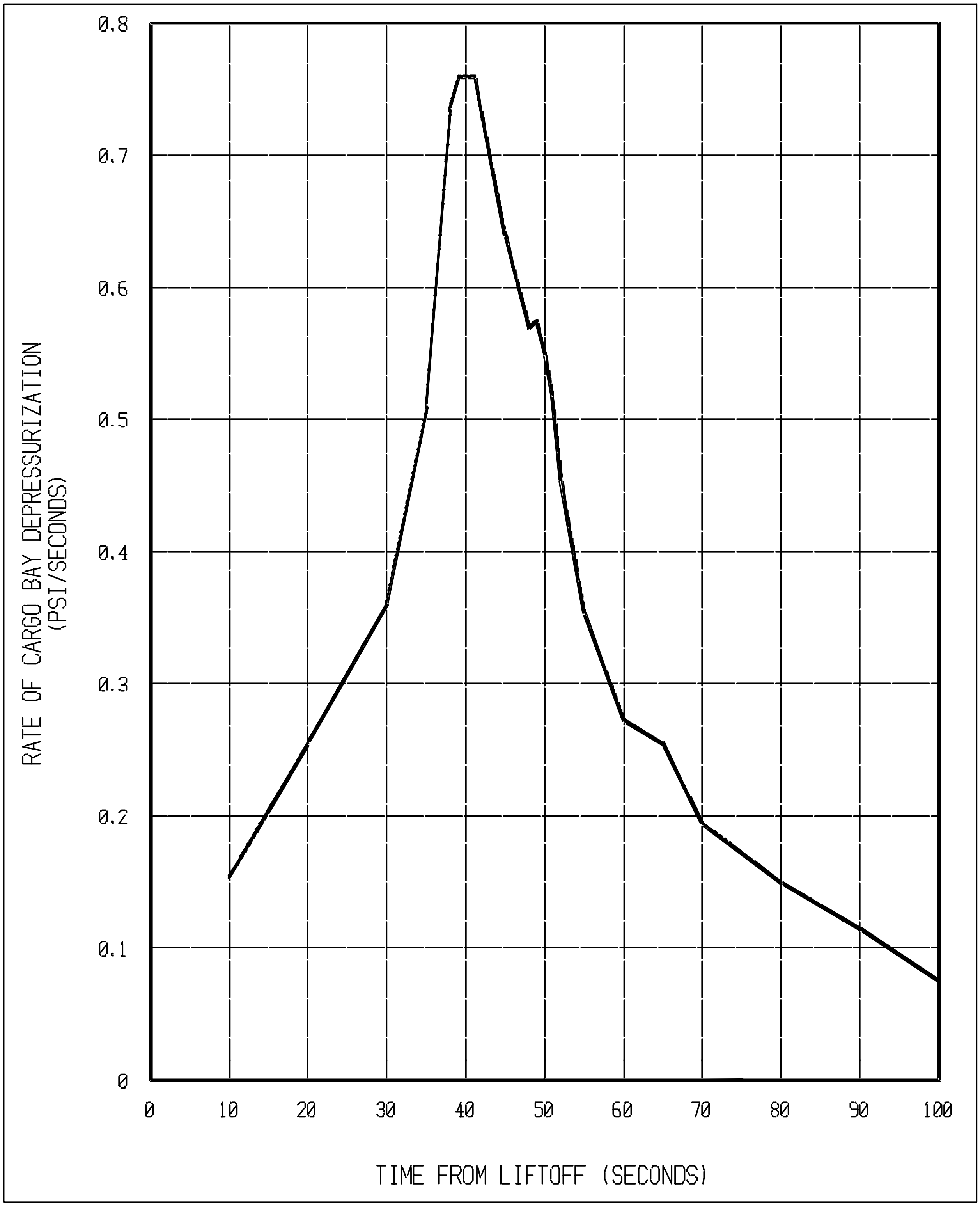


FIGURE 10.6.1.2-2 MAXIMUM CARGO BAY PRESSURE DECAY RATE DURING ASCENT

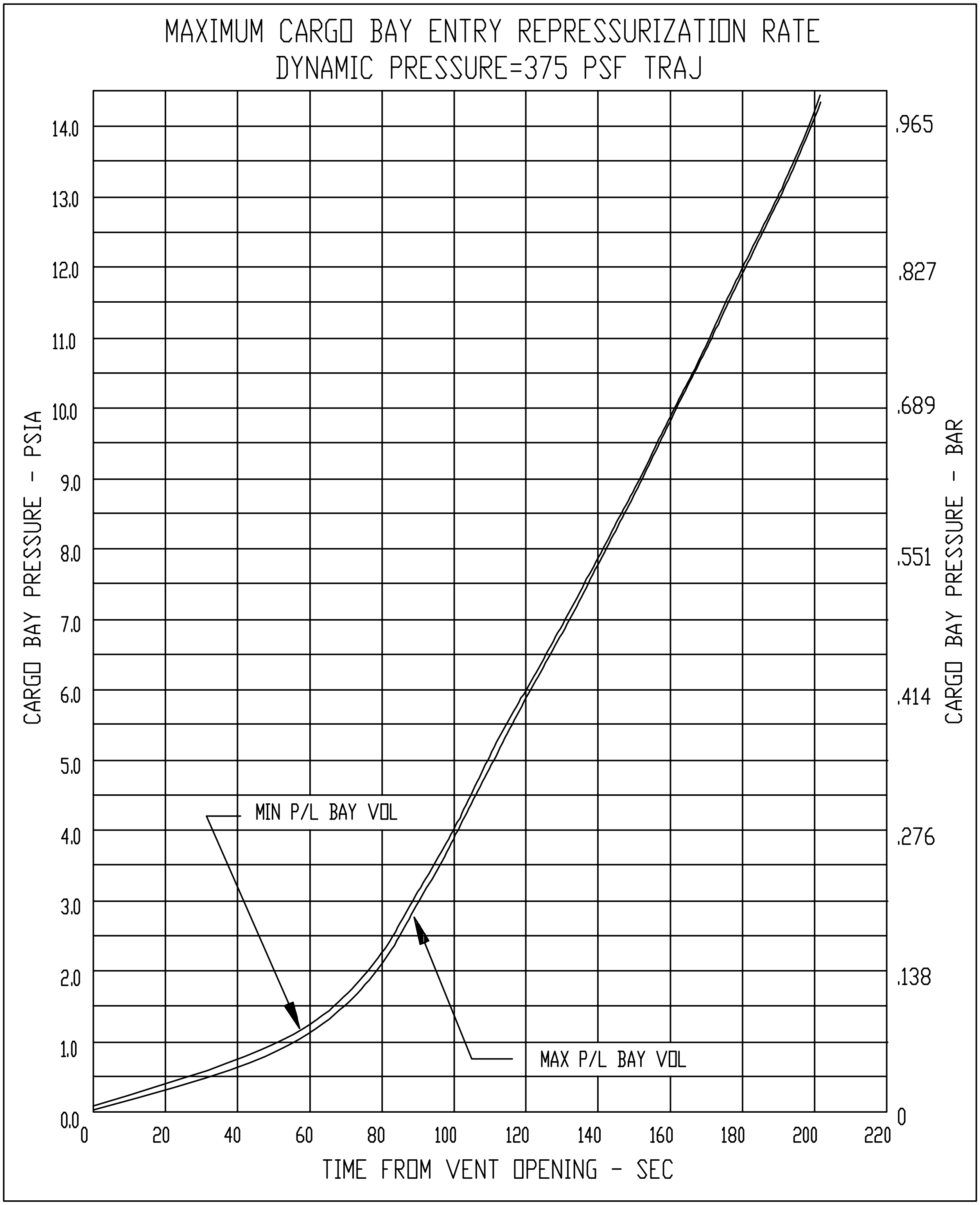


FIGURE 10.6.1.3-1 ENTRY PHASE CARGO BAY INTERNAL PRESSURE HISTORY, TO BE USED FOR PAYLOAD DESIGN
(SHEET 1 OF 2)

Time From Vent Opening (Sec)	Cargo Bay Pressure (psia) Max. P/L Bay Volume	Cargo Bay Pressure (psia) Min. P/L Bay Volume
0.45	0.11	0.17
5.57	0.13	0.21
10.70	0.20	0.31
15.82	0.27	0.41
20.95	0.35	0.49
26.07	0.44	0.57
31.20	0.52	0.64
36.32	0.61	0.71
41.45	0.69	0.79
46.57	0.79	0.89
51.70	0.90	1.01
56.82	1.03	1.14
61.95	1.19	1.31
67.07	1.41	1.54
72.20	1.66	1.80
77.32	1.94	2.09
82.45	2.29	2.44
87.57	2.74	2.92
92.70	3.23	3.39
97.82	3.66	3.79
102.95	4.18	4.32
108.07	4.69	4.82
113.20	5.19	5.36
118.32	5.71	5.84
123.45	6.16	6.26
128.57	6.64	6.73
133.70	7.12	7.21
138.82	7.61	7.70
143.95	8.11	8.19
149.07	8.62	8.70
154.20	9.13	9.21
159.32	9.66	9.73
164.45	10.18	10.25
169.57	10.69	10.76
174.70	11.23	11.31
179.82	11.78	11.86
184.95	12.31	12.38
190.07	12.82	12.89
195.20	13.37	13.44
200.32	14.00	14.08

FIGURE 10.6.1.3-1 ENTRY PHASE CARGO BAY INTERNAL PRESSURE HISTORY, TO BE USED FOR PAYLOAD DESIGN
(SHEET 2 OF 2)

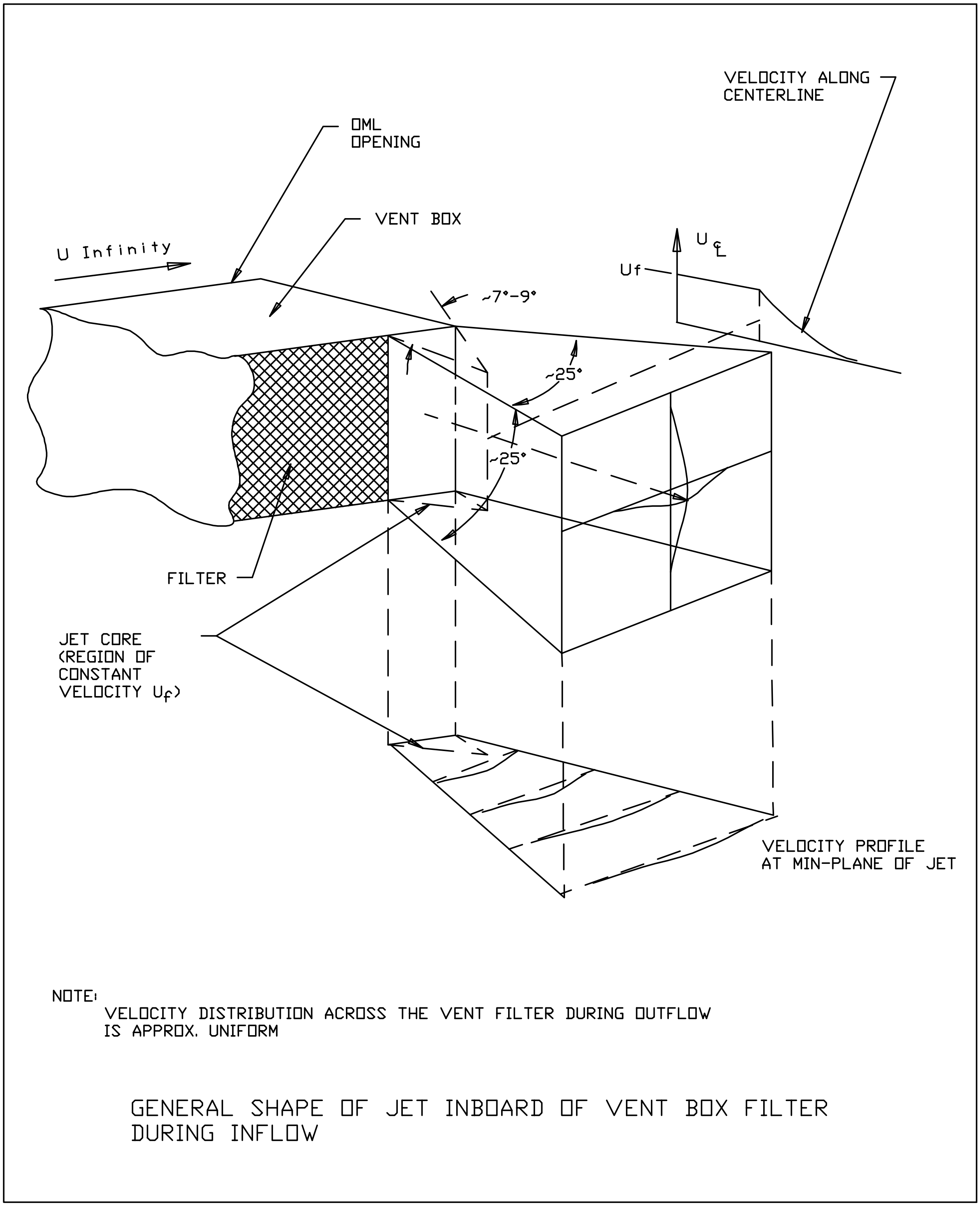


FIGURE 10.6.4.1-1 VENT FLOW CHARACTERISTICS

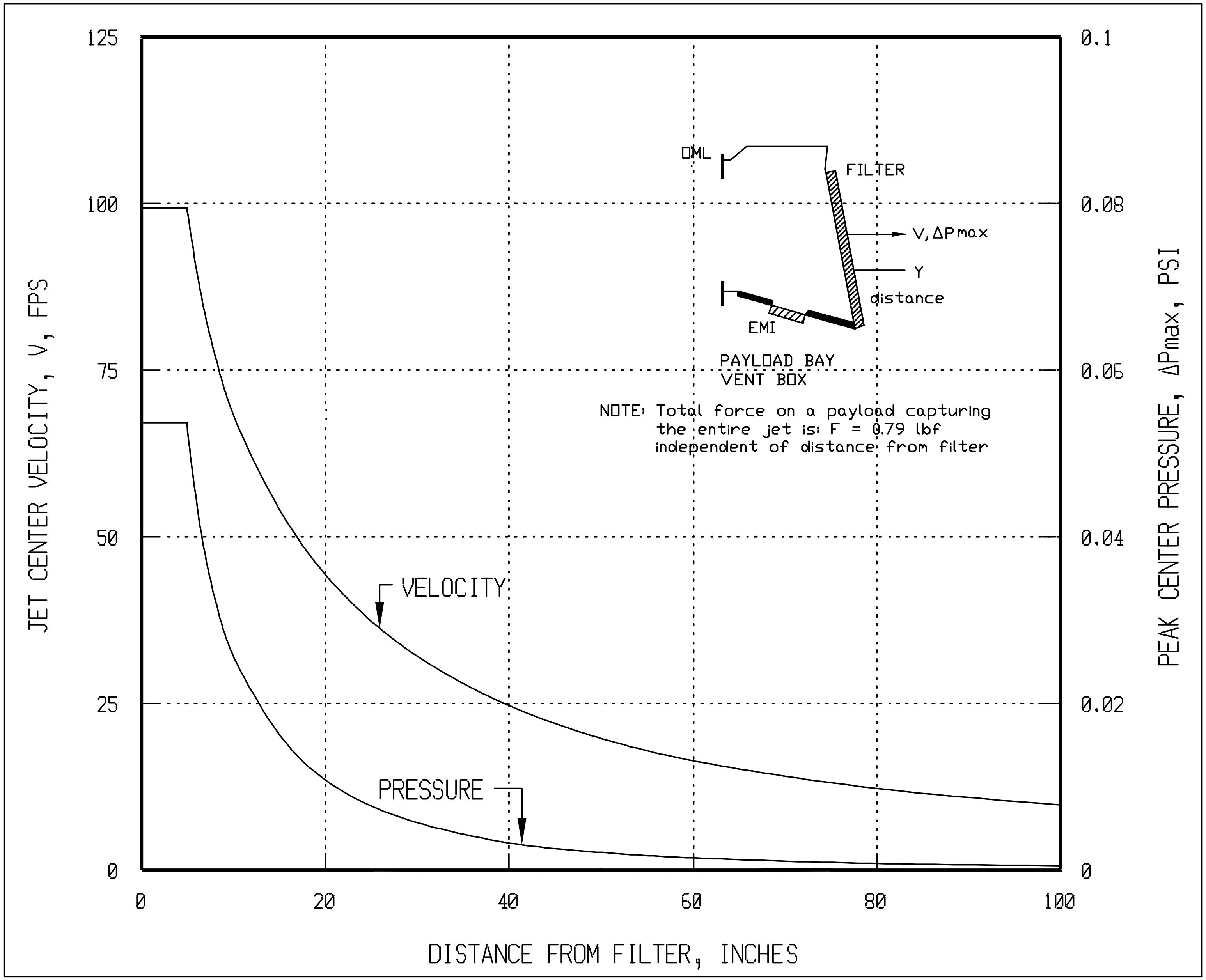


FIGURE 10.6.4.1.1-1 MAXIMUM VENT INFLOW CHARACTERISTICS DURING ASCENT

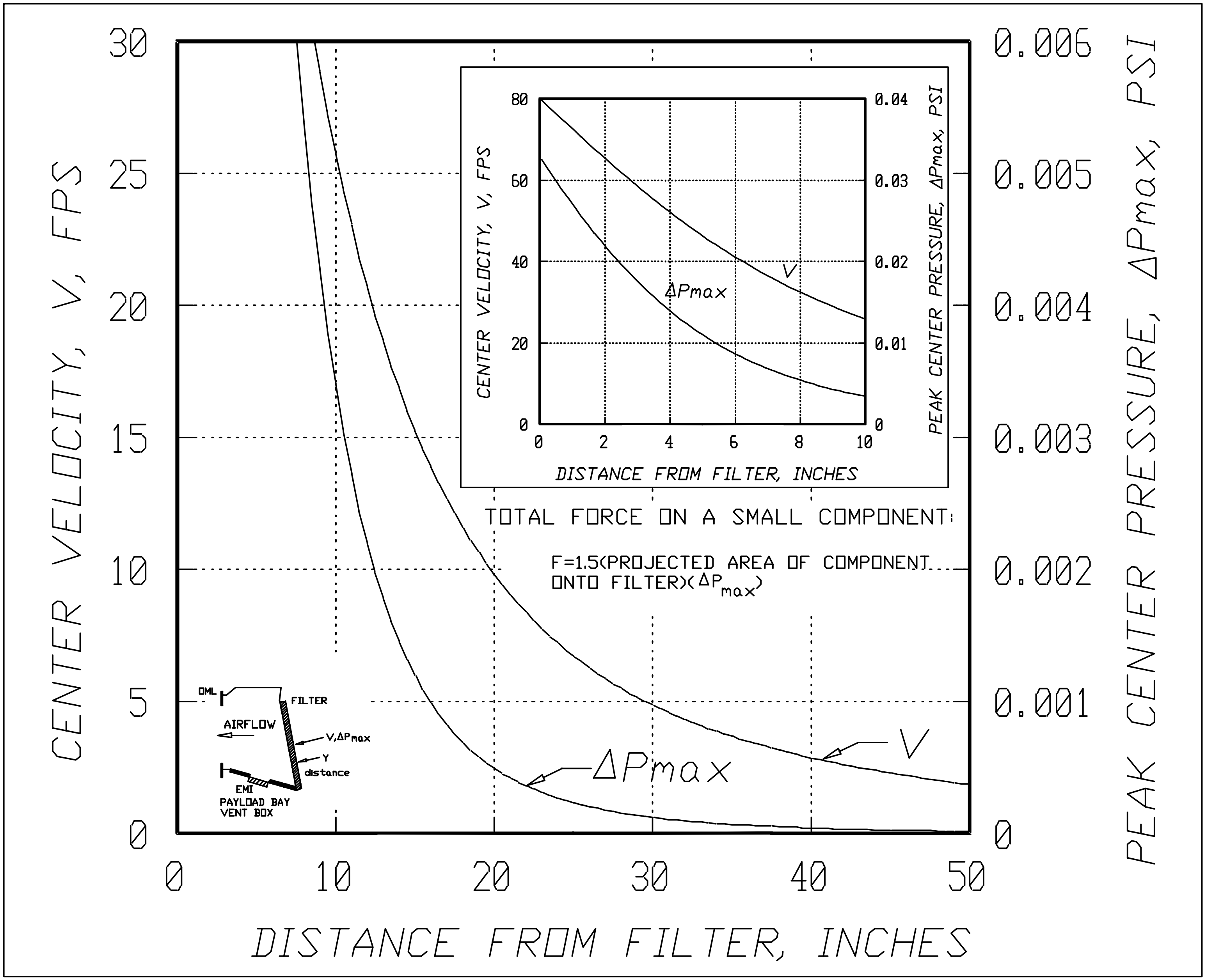


FIGURE 10.6.4.1.1-2 MAXIMUM VENT OUTFLOW CHARACTERISTICS DURING ASCENT FOR SMALL PAYLOAD COMPONENTS

FIGURE 10.6.4.1.1-3 MAXIMUM VENT OUTFLOW CHARACTERISTICS DURING ASCENT FOR LARGE PAYLOAD COMPONENTS

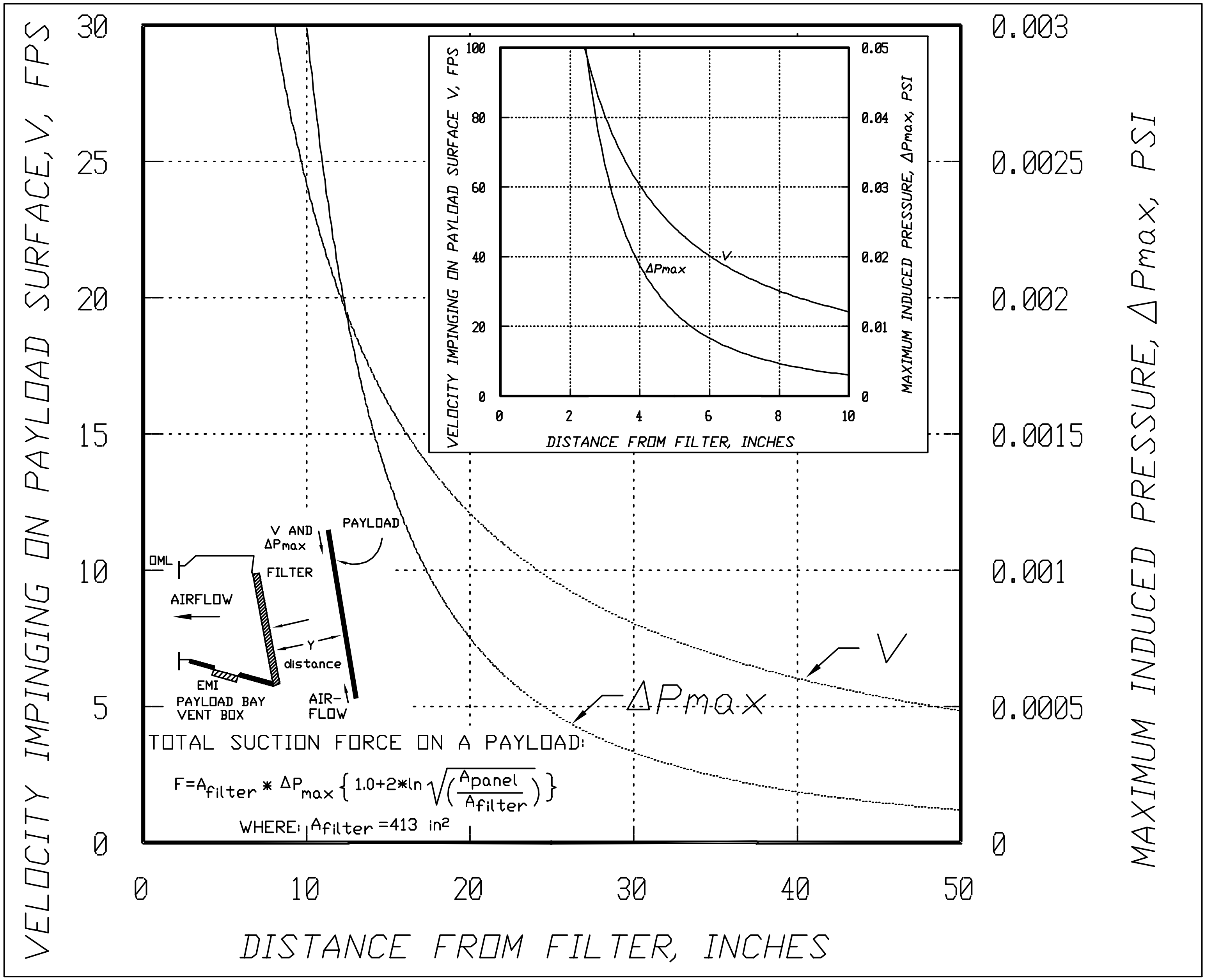


FIGURE 10.6.4.1.2-1 MAXIMUM VENT INFLOW CHARACTERISTICS DURING ENTRY

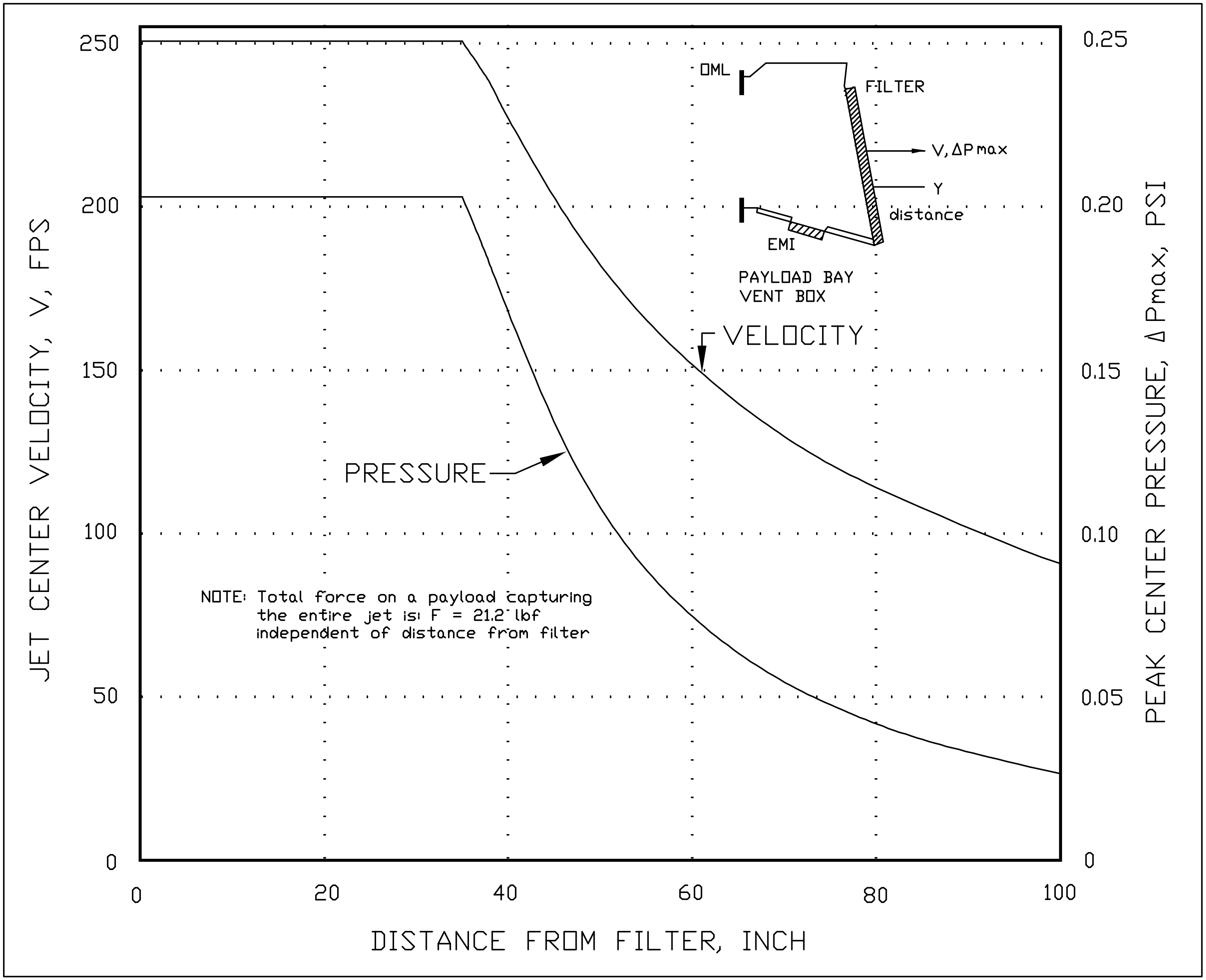


FIGURE 10.6.4.1.2-2 MAXIMUM VENT OUTFLOW CHARACTERISTICS DURING ENTRY FOR SMALL PAYLOAD COMPONENTS

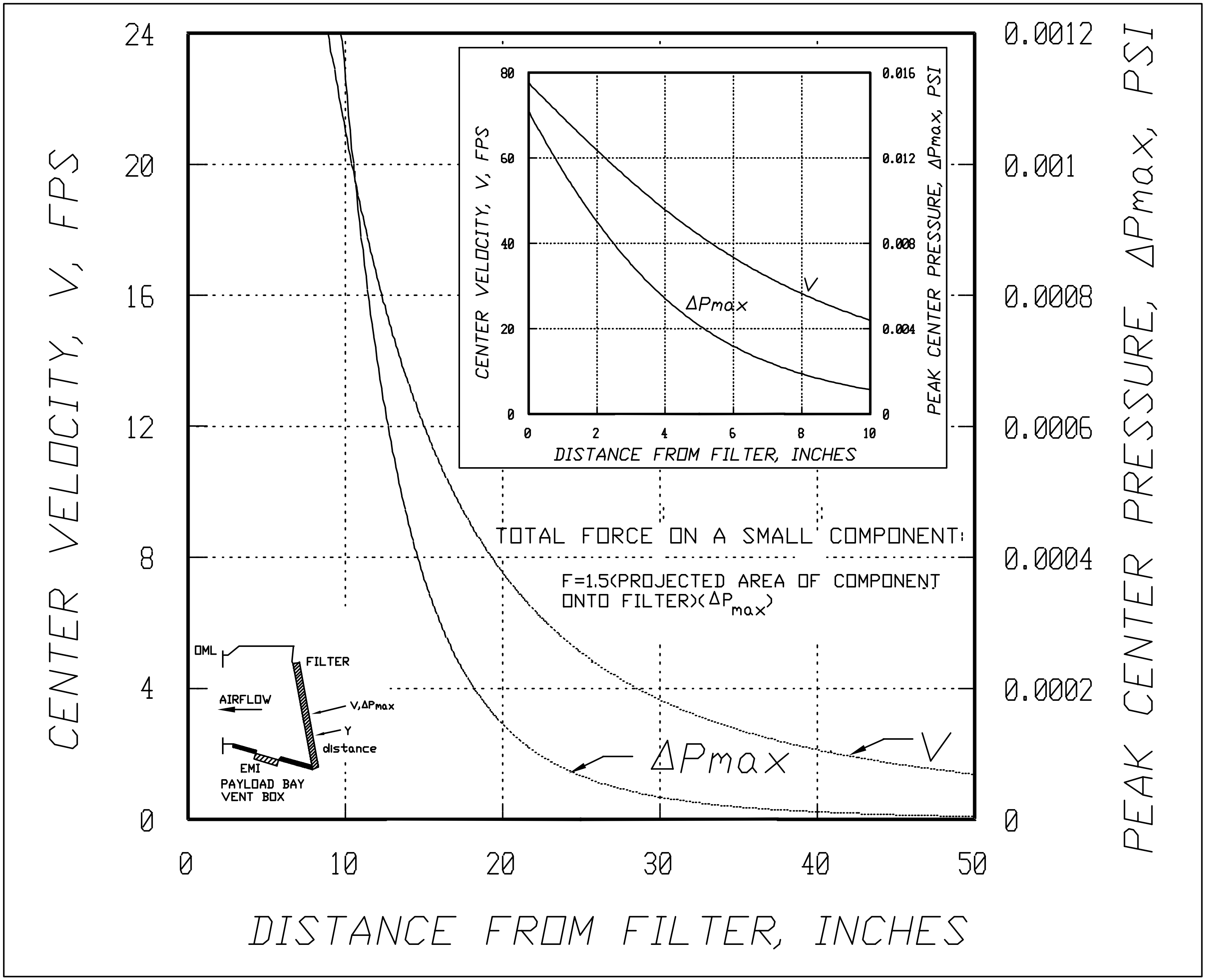
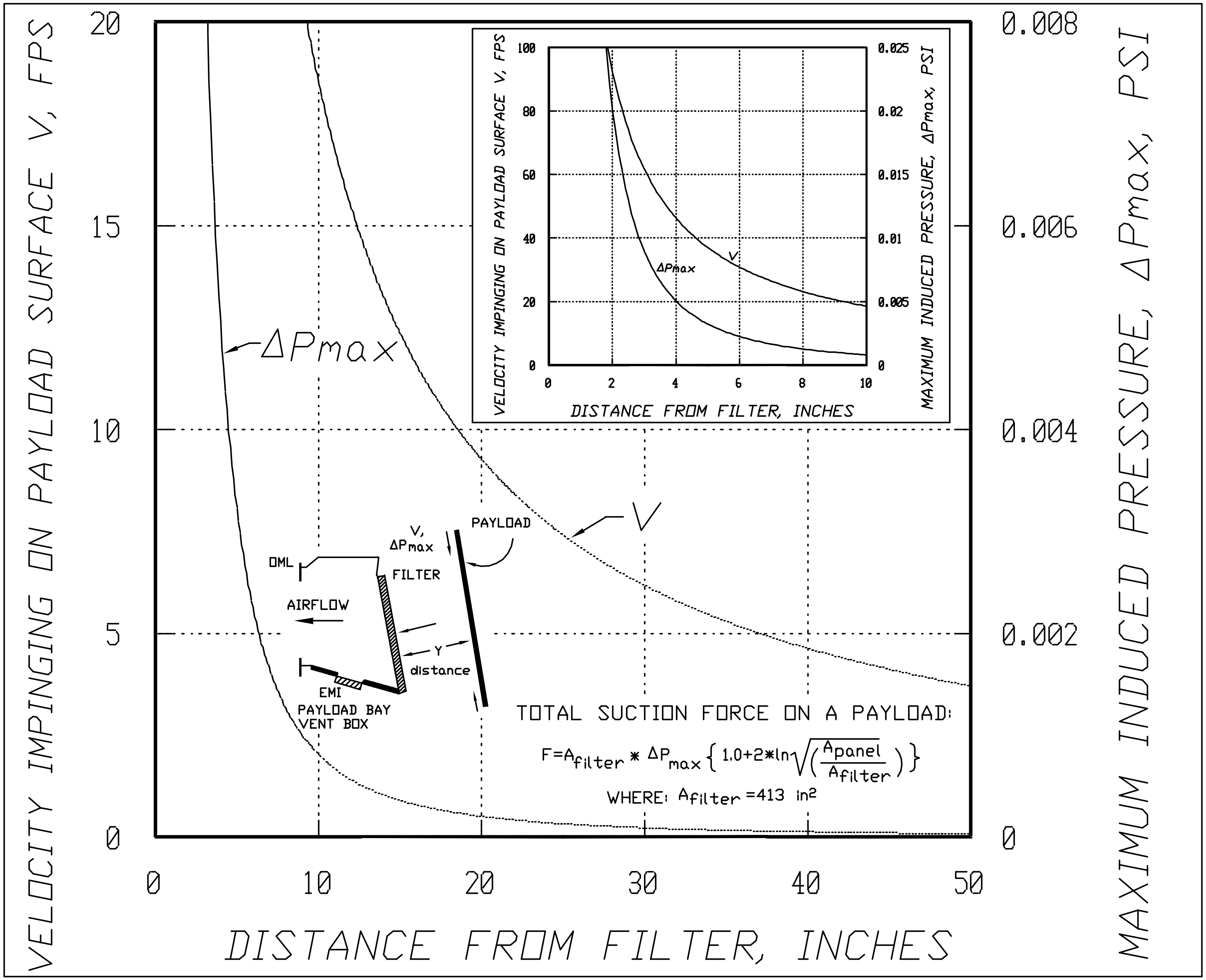


FIGURE 10.6.4.1.2-3 MAXIMUM VENT OUTFLOW CHARACTERISTICS DURING ENTRY FOR LARGE PAYLOAD COMPONENTS



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