

Page	Location	Correction (changes in <b>bold</b> )
1	2 <sup>nd</sup> para., last sent.	Preparation of this book by the <b>Center for Chemical Process Safety (CCPS)</b> was in response to this need.
6	2 <sup>nd</sup> para., 1 <sup>st</sup> sent.	...variety of pressure relief devices, such as... {omit components}
7	1 <sup>st</sup> para., 2 <sup>nd</sup> sent.	...in general in CCPS (1989c and 1992). {omit and in API Standard 750}
13	3 <sup>rd</sup> para., 3 <sup>rd</sup> line	...important is proper testing, maintenance, <b>and</b> effective management of change.
15-129	Chapter 2 odd numbered page headings	RELIEF DESIGN CRITERIA <b>AND</b> STRATEGY {move <b>and</b> }
17	Penultimate para.	In summary, engineering judgment...
31	Table 2.3-2, 'Both fire exposure and other overpressurization scenarios' row, 'Staged or Additional Devices' column	105
32	4 <sup>th</sup> bullet, last line	...such as SuperChems™ for DIERS {omit Lite}
32	2 <sup>nd</sup> para., last line	...by documented industrial experience ( <b>Fauske, 1984a</b> ).
34	Last para., 1 <sup>st</sup> sent.	<b>Compensation</b> for the effect...
41	§2.4.2.2 2 <sup>nd</sup> para., last line	...increase in the <b>disc contact area</b> . {omit relief area}
43	2 <sup>nd</sup> sent.	<b>Variations in the forces acting on the disc may result in oscillations or instability of the disc. There are other factors that can contribute to oscillations or instability of the disc, resulting from the dynamic response of the damped spring-mass disc system.</b> {replace second sentence}
43	2 <sup>nd</sup> para., 1 <sup>st</sup> sent.	Excessive friction losses in the piping from the vessel to the valve (inlet loss) <b>may</b> cause chatter. {omit are a}
49	2 <sup>nd</sup> para., 1 <sup>st</sup> sent.	...high set pressures ( <b>Van Boskirk, 1982</b> ).
51	Table 2.4-1, 5 <sup>th</sup> column heading	{omit *}
51	Table 2.4-1, 7 <sup>th</sup> column heading	Consolidated <b>Outlet Area to Nozzle Area</b> Ratio {omit *}
80	§2.5.3 7 <sup>th</sup> para., Penultimate sentence	...minimal piping, restrictions do apply.
103	Item 3c	Plugging <b>or</b> fouling
103	Item 3	Blocked <b>or</b> closed outlet(s)
145	§3.2.3.5, 3 <sup>rd</sup> para.	...represents the net <b>volumetric discharge rate</b> through the emergency vent,...
157	§3.2.7.2, 1 <sup>st</sup> para., 5 <sup>th</sup> line	Equations (3.2-1) and (3.2-17), the <b>constant volume criteria</b> Equation (3.2-23)...

Page	Location	Correction (changes in bold)
166	C <sub>0</sub>	C <sub>0</sub> = <b>Best fit</b> correlating parameter given by <b>Churn-Turbulent Bubbly Homogeneous</b> 1.5                      1.2                      1.01
168	§3.2.9.4 penultimate paragraph	$X_m(A_v G - j'_{g\infty} \rho_g A_x)$ <b>is the weight rate of vapor entering the vent due to the net upward flow of aerated liquid which is in addition to the vapor flow relative to the liquid necessary to swell the liquid to the top of the vessel.</b>
168	§3.2.9.4 last paragraph	$A_v G - j'_{g\infty} \rho_g A_x$ <b>is the weight rate of swelled liquid or aerated, two-phase vapor-liquid mixture entering the vent in addition to the vapor which must pass up through the liquid to just swell the liquid to the top of the vessel.</b>
269	Last sentence in the penultimate para.	...actual relief system devices, can be found in the <b>literature.</b>
286	Eqn. 4.2-2	$G_0 = \rho_n \left( -2 \int_{P_1}^{P_2} \frac{dP}{\rho} \right)^{1/2}$
286	2 <sup>nd</sup> para., 4 <sup>th</sup> line	... $g_c$ ( <b>32.17</b> (lb <sub>m</sub> ft) / lb <sub>f</sub> sec <sup>2</sup> ),...
290	2 <sup>nd</sup> para., 3 <sup>rd</sup> line	...set pressure (based on the rated capacity at <b>3 psi or 10% overpressure</b> ); <b>commonly called the API 3% Rule.</b>
292	Eqn. 4.2-17	$G_c = \sqrt{k P_0 \rho_0 \left( \frac{2}{k+1} \right)^{\frac{k+1}{k-1}}}$ {entire equation under radical}
295	3 <sup>rd</sup> para.	<b>Balanced Bellows Valves:</b> {omit Relief valve sizing:}
298	§4.2.2, 1 <sup>st</sup> para., 2 <sup>nd</sup> line	...homogeneous flow, meaning that...
298	§4.2.2, 2 <sup>nd</sup> para., 6 <sup>th</sup> line	...holdup, or mass fraction of liquid, within...
299	3 <sup>rd</sup> para.	(Homogeneous – Non-Equilibrium Model – HNE) {omit Q}
303	Eqn. 4.2-41 Definitions	$v_{f_0}$ = stagnation liquid specific volume
303	Eqn. 4.2-41 Definitions	$v_{f_{g_0}}$ = stagnation specific volume difference = $v_{g_0} - v_{f_0}$
309	Below Eqn. 4.2-53	...choked flow Gas/vapor mass flux: {omit equation}
310	§4.2.3 6 <sup>th</sup> line	...flow regime, independent of...
312	Eqn. 4.2-17	$G_c = \sqrt{k P_0 \rho_0 \left( \frac{2}{k+1} \right)^{\frac{k+1}{k-1}}}$ {entire equation under radical}
312	1 <sup>st</sup> para., last line	...friction loss, which is <b>not accounted for in the isentropic model).</b>
312	§4.2.3.3, 3 <sup>rd</sup> para., 2 <sup>nd</sup> sent.	...values can <b>be as high as 0.975</b> for a...
315	2 <sup>nd</sup> para., 3 <sup>rd</sup> sent.	... $P_e = P_e^* > P_b$ , <b>where <math>P_b</math></b> is the...
315	§4.2.4.1, 1 <sup>st</sup> para., 2 <sup>nd</sup> sent.	...discharge pipe to 10 percent <b>of the set pressure</b> (10% Rule)...
315	§4.2.4.1, 1 <sup>st</sup> para., 3 <sup>rd</sup> sent.	...backpressure of 12-13 percent <b>of the set pressure.</b>
316	$k$ definition	$k$ = <b>ideal gas</b> $C_p/C_v$ ratio

Page	Location	Correction (changes in bold)
316	1 <sup>st</sup> para.	If $(P_e - P_{atm}) > 0.1 P_{set}$ ...
319	1 <sup>st</sup> para., 3 <sup>rd</sup> sent.	...gas flow ( <b>k = 1.4</b> ).
321	1 <sup>st</sup> para., 4 <sup>th</sup> line	...in a vessel at stagnation... {omit or vessel}
321	2 <sup>nd</sup> para., 1 <sup>st</sup> sent.	...from a process or storage vessel through the inlet... {omit or vessel}
326	3 <sup>rd</sup> para., 1 <sup>st</sup> sent.	The loss coefficient for a <b>square entrance</b> to a pipe...
326	5 <sup>th</sup> para., last sent.	...as a function of Reynolds numbers...
327	Table 4.4-2 all N subscripts	$N_{ReI}$
329	Para. Below Eqn. 4.4-12	...pipeline and <b>KE</b> (kinetic energy <b>correction factor</b> ) = 1...
330	Line after Eqn. 4.4-17	...is needed to evaluate $\rho_1$ and the average...
331	3 <sup>rd</sup> para., 1 <sup>st</sup> line	The effect of <b>the change in</b> kinetic energy...
331	4 <sup>th</sup> para. Heading	<b>Adiabatic Compressible Choked Flow:</b> {omit Flow}
332	4 <sup>th</sup> para. Heading	<b>Adiabatic Compressible Flow from Container or Vessel Through Pipe:</b>
336	4 <sup>th</sup> para.	As well as $\Delta v$ , the <b>increase in</b> specific volume...
339	2 <sup>nd</sup> line after Eqn. 4.4-34	...is <b>calculated</b> using...
348	§4.4.9, 2 <sup>nd</sup> para.	$H + \frac{u^2}{2} + gz = const.$
349	Eqn. 4.4-73	$T_n = T_0 \eta_n^{\frac{k-1}{k}} + \frac{\sum K_f}{c_v} \int u du = T_0 \eta_n^{\frac{k-1}{k}} + \frac{1}{2} \frac{\sum K_f G^2}{c_v} (v_n^2 - v_0^2)$
356	1 <sup>st</sup> para.	{omit last sentence}
369	Table 5.6-1 six instances	Best estimate of $K_R$
387	1 <sup>st</sup> para.	...class 150 flanges...class 300 flanges... {omit lb}
453	2 <sup>nd</sup> para., 2 <sup>nd</sup> line	...equal to 0.27 ft/s (0.0823 m/s)... {omit a zero following decimal}
454	Eqn. 7.4.2-2	$u_e = K_g \left[ \left( 32.174(2.2046E - 3)\sigma(\rho_f - \rho_g) \right) / (\rho_g^2) \right]^{1/4}$
454	Below Eqn. 7.4.2-2	$u_e = ft/sec$
454	2 <sup>nd</sup> line	$g$ = the <b>acceleration due to</b> gravity; 9.8 m/s <sup>2</sup> {omit constant}
454	Dimensionless viscosity number equation	$N_\mu = \frac{\mu_f}{\left( \rho_f \sigma \sqrt{\frac{\sigma}{g(\rho_f - \rho_g)}} \right)^{1/2}}$
556	Table B.3-1	Insert table shown below
664	Figure D.5.3-1	Reverse direction of Force arrowheads
666	Figure D.5.3-2	Reverse direction of Force arrowheads
667	Figure D.5.4-1	Reverse direction of Force arrowheads
669	Figure D.5.4-3, Row 5, ES	0.0018 (See Figure Below)
669	Figure D.5.4-4, Row 5, ES	0.0018 (See Figure Below)

Page	Location	Correction (changes in bold)
670	Figure D.5.5-1	Reverse direction of Force arrowheads
670	3 <sup>rd</sup> para., last line	Equation (D.5.3-2)
671	2 <sup>nd</sup> eqn., below figure	$\frac{3.447}{1.3} \sqrt{2(1.3 + 1)} = 5.687$
673	Figure D.5.6-1	Reverse direction of Force arrowheads
675	Figure D.5.7-1	Reverse direction of Force arrowheads
675	2 <sup>nd</sup> para.	The relief piping discharge line friction loss in velocity heads is calculated below <b>using the Darcy-Weissbach friction factor of 0.015.</b>
678	Figure D.5.8-1	Reverse direction of Force arrowheads
678	1 <sup>st</sup> para. Insert second sentence	<b>The upstream pressure is 124.7 psia, which exceeds the saturation pressure of 109.0 psia, making the stream slightly subcooled.</b>
678	2 <sup>nd</sup> para.	The relief piping discharge line friction loss in velocity heads is calculated below <b>using the Darcy-Weissbach friction factor of 0.015.</b>
743	Index	Page numbers revised (See Pages Below)

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***** COMPRESSIBLE GAS FLOW IN PIPING *****
1> Choose: (1) U.S. Cust.-F (2) U.S. Cust.-C (3) Metric Units [2]
2> Est.: (1) W (2) P1 (3) D (4) P2 from P0 (5) P2 from P1 [1]
3> D, P0, P3, T0 = 6.065, 124.7, 14.7, 25
4> MW, K, MU, Z = 29, 1.4, 0.018, 1
5> L, KF, ES = 0., 0.5, 0.0018

==== RESULTS ===== PIPE EXIT ===== EXPANDED JET =====
W = 250112.09          P2 = 55.31          D3 = 8.17
                      TZ = -24.69          T3 = -90.5
                      U2 = 1036.08          U3 = 1579.5
                      F2 = 3410.66

===== (1-5) CHANGE DATA LINES 1-5 (R) RERUN (X) EXIT [ ] =====
NOMENCLATURE & UNITS          U.S. Cust.    METRIC
-----
D,ES,L    pipe Diam., roughness, Length    in,in,ft    mm,mm,m
K,MW,Z    Cp/Cv, Mol. Wt., compress.          -           -
P,T       Pressure, Temperature              psia,F/C    kPa,C
MU,W      viscosity, mass flowrate          cp,lb/hr    Pa s,kg/s
F,U       Force, Velocity                   lbf,ft/s    N,m/s
FF,RE,KF,N Fan. f, Rey. no., fitt. loss, total loss    -           -

===== 0:RESERVOIR, 1:INLET, 2:OUTLET, 3:SURROUNDING, S:STAGNATION =====

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FIGURE D.5.4-3. Transient Force from COMFLOW (Correct ES)

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***** COMPRESSIBLE GAS FLOW IN PIPING *****
1> Choose: (1) U.S. Cust.-F (2) U.S. Cust.-C (3) Metric Units [2]
2> Est.: (1) W (2) P1 (3) D (4) P2 from P0 (5) P2 from P1 [1]
3> D, P0, P3, T0 = 6.065, 234.7, 14.7, 25
4> MW, K, MU, Z = 29, 1.4, 0.018, 1
5> L, KF, ES = 0., 0.5, 0.0018

==== RESULTS ===== PIPE EXIT ===== EXPANDED JET =====
W = 470740.24          P2 = 104.11          D3 = 10.47
                      T2 = -24.69          T3 = -104.4
                      U2 = 1036.08        U3 = 1671.6
                      F2 = 6793.89

===== (1-5) CHANGE DATA LINES 1-5 (R) RERUN (X) EXIT [ ] =====
NOMENCLATURE & UNITS          U.S. Cust.    METRIC
-----
D,ES,L      pipe Diam., roughness, Length      in,in,ft     mm,mm,m
K,MW,Z      Cp/Cv, Mol. Wt., compress.                -           -
P,T         Pressure, Temperature                psia,F/C     kPa,C
MU,W        viscosity, mass flowrate            cp,lb/hr     Pa s,kg/s
F,U         Force, Velocity                    lbf,ft/s     N,m/s
FF,RE,KF,N  Fan. f, Rey. no., fitt. loss, total loss -           -

===== 0:RESERVOIR, 1:INLET, 2:OUTLET, 3:SURROUNDING, S:STAGNATION =====

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FIGURE D.5.4-4. Tension Force from COMFLOW (Correct ES)

**TABLE B.3-1.** Input/Output Variables: Nomenclature and Units

Input or Output	Variables		English-1	English-2	Metric-3
I	AN	Nozzle area	in <sup>2</sup>	in <sup>2</sup>	mm <sup>2</sup>
I	CPL	Liquid specific heat	Btu/lb/°F	Btu/lb/°F	J/kg/K
I	D	Diameter	in	in	mm
I	dH	Elevation difference	ft	ft	m
I	ES	Sand roughness	in	in	mm
O	G	Mass velocity	lb/s/ft <sup>2</sup>	lb/hr/in <sup>2</sup>	kg/s/m <sup>2</sup>
I	HFG	Heat of vaporization	Btu/lb	Btu/lb	J/kg
I	K	Nozzle flow coefficient	-	-	-
I	L	Length of pipe	ft	ft	m
I	MF	Laminar loss coefficient	-	-	-
I	KF	Fitting and pipe loss coefficient	-	-	-
I,O	N	Total loss coefficient	-	-	-
I,O	P	Pressure, thrust/area	psia	psia	kPa
I	R	Fluid density	lb/ft <sup>3</sup>	lb/ft <sup>3</sup>	kg/m <sup>3</sup>
I,O	T	Temperature	°F	°F	°C
O	V	Velocity	ft/s	ft/s	m/s
I,O	W	Mass flow rate	lb/s	lb/hr	kg/s
I,O	X	Weight fraction gas	-	-	-
I	Z	Viscosity	cp	cp	Pa·s
<b>SUBSCRIPTS</b>					
	0	RESERVOIR			
	1	ENTRANCE			
	2	EXIT PLANE OF PIPE OR NOZZLE			
	3	SURROUNDING, I.E., DOWNSTREAM OF PIPE OR NOZZLE			
	A-C	PROPERTY DATA SET			
	G	GAS			
	L	LIQUID			
<b>FILE INPUT SWITCHES (OPTIONS)</b>					
	IC	PROBLEM TYPE: 1 = FIND FLOW RATE, 2 = FIND BACK PRESSURE, 3 = ADVANCED USER			
	IPTS	CHOICE OF PROPERTY MODEL			
	IU	CHOICE OF ABOVE UNITS: 1,2 = ENGLISH, 3=SI			
	IV	OPTIONS:			
		1 = SIMPLE NON-VISCOUS INPUT			
		2 = NOZZLE INPUT: AREA, FLOW COEFFICIENT, AND VISCOSITIES			
		-2 = SAME AS IV = 2, BUT NO VISCOSITY ENTRY (1)			
		3 = PIPE INPUT: DIAMETER, LENGTH, FITTING LOSSES, AND VISCOSITIES			
		-3 = SAME AS IV = 3, BUT NO VISCOSITY ENTRY (1)			
(1) When IV = -2 or -3, no viscosity data are entered. HEM defaults to a value of 1 cP (0.001 Pa·s) for the liquid and 0.018 cP (0.000018 Pa·s) for the gas					
OPTIONS 2 AND 3 AVAILABLE WITH DATA FILE INPUT OPTION (BUT NOT WITH OPTION OF KEYBOARD INPUT DURING PROGRAM EXECUTION)					

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