UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF INDUSTRIAL TECHNOLOGY

FINAL EXAMINATION
JANUARY 2016 SEMESTER

COURSE CODE	:	JFB 30503
COURSE TITLE	:	STATIC EQUIPMENTS
PROGRAMME LEVEL	:	BACHELOR
DATE	:	24 MAY 2016
TIME	:	9.00 AM – 12.00 PM
DURATION	:	3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consists of ONE (1) section.
4. This question paper consists of FIVE (5) questions.
5. Answer FOUR (4) questions only.
6. Please write your answers on the answer booklet provided.
7. Table and formula are enclosed as reference.
8. Please answer all questions in English only.

THERE ARE 5 PAGES OF QUESTIONS EXCLUDING THIS PAGE.

Total: 100Marks

INSTRUCTION: Answer FOUR (4) Question Only

Please use the answer booklet provided.

Question 1

(a) Pneumatic systems are power systems using compressed air as a working medium for the power transmission. Their principle of operation is similar to that of the hydraulic power systems. Both application are design by using valve system. An air compressor converts the mechanical energy of the prime mover into, mainly, pressure energy of the compressed air

i. Describe **TWO (2)** advantage **TWO (2)** disadvantage of pneumatic and hydraulic system.

(4 marks)

ii. In pneumatic system, where is the part for static equipment. Explain with a basic block diagram of the system.

(4 marks)

(b) One of the static equipment element is a valve. As an engineer you are required to design valve system in pneumatic based on algorithm below;

A+ B+ C+ D+ D-
A- B- C-

i. Base on the requirement, design the system by using pneumatic system.

(10 marks)

ii. Based on question (b)(i), explain the system by using displacement step diagram.

(7 marks)

Question 2

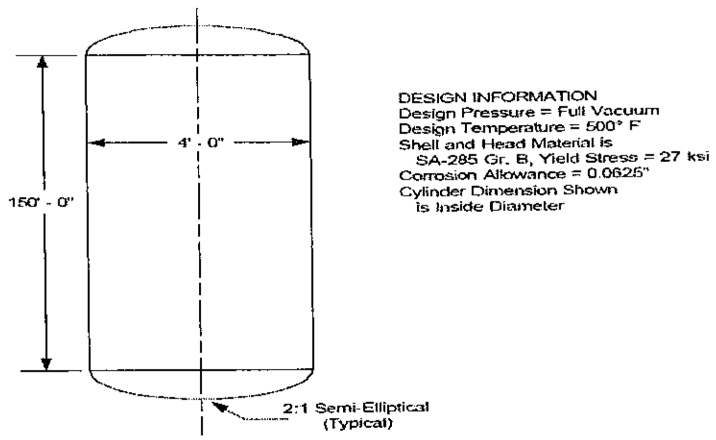


Figure 1: Cylindrical Tower

A tall cylindrical tower is being supplied. The geometry and design conditions are specified in Figure 1. The vendor has proposed that the wall thickness of this tower be 7/16 in., and no stiffener rings have been specified. Is the 7/16 in. thickness acceptable for external pressure? If it is not acceptable, what minimum thickness is required? Round your answer upward to the nearest 1/16 in.

(a) Calculate the below item:

i. unstiffened design length, L

(2 marks)

ii. outside diameter Do

(2 marks)

iii. ratios L/Do

(2 marks)

iv. corrosion allowance

(2 marks)

v. ratio Do/t

(2 marks)

(b) Referring to Appendix section, find the Factor A and maximum allowable external pressure for the value of t, psi.

Note: If L/Do >50, use L/Do = 50. For L/Do < 0.05, use L/Do = 0.05.

(8 marks)

(c) If the proposed shell thickness is not sufficient which is Pa < 15 psi, evaluate a new size of thickness for Pressure Vessel by proving in proper calculation and referring to references in Appendix section.

(7 marks)

Question 3

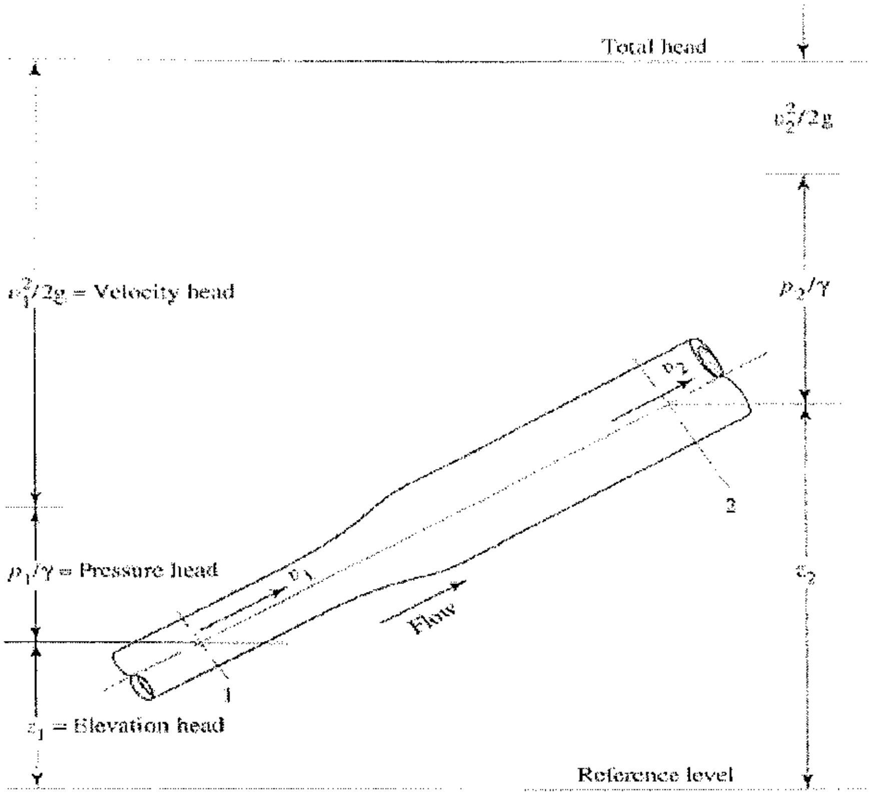


Figure 2: Pipeline

Figure 2 shows a part of piping system for oil industry. Diameter D1 = 25mm, liquid temperature = 10C, y = 9.81kN/m. Input pressure in the pipeline is 345kPa and the velocity of the liquid is 3m/s.

(a) Explain the function of pipe in oil and gas industry.

(3 marks)

(b) Find velocity of the output (V2)

(5 marks)

(c) Calculate the pressure flow in the output (p2)

(10 marks)

(d) If the size of pipe change to 50mm (D1) and diameter output is 100mm(D2), input flow velocity is 8m/s,y = 9.81kN/m, and the input pressure is 978kg/m, evaluate mass flow rate in the pipeline.

(7 marks)

Question 4

(a) Explain the function of single effect of evaporator.

(8 marks)

(b) Calculate the amount of water would be required in a jet condenser to condense the vapors from an evaporator evaporating $5000kgh^{-1}$ of water under a pressure of 15cm of mercury. The condensing water is available at 18°C and the highest allowable temperature for water discharged from the condenser is 35°C. (Condensing temperature of water under pressure 20kpa - 60° and the total corresponding latent heat of vaporization is $2358kJg^{-1}$

(10 marks)

(c) Evaluate the exchange area would be required for a surface condenser working under the same conditions as the jet condenser in question 4A. Assuming a U value of $2270Jm^{-2}s^{-1}\,^0C^{-1}$, and disregarding any sub-cooling of the liquid.

(7 marks)

Question 5

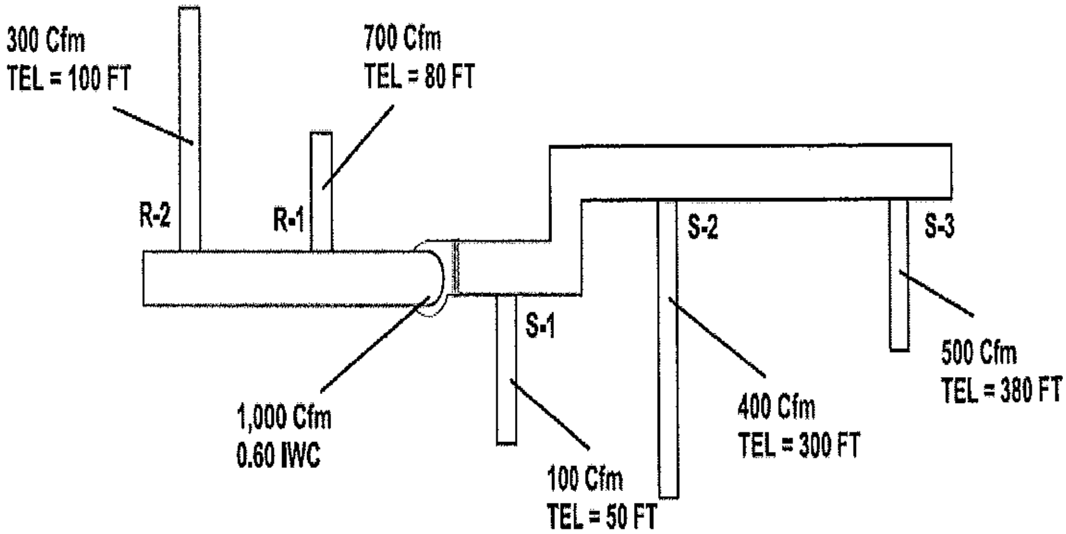


Figure 3: Ducting System

Figure 3 shows a diagram of ducting system which are design to apply in building. Internal resistance for the heater is 0.08IWC and the blower use in this system is 1000cfm and 0.60IWC.

(a) Explain the function of ducting system in HVAC system.

(8 marks)

(b) Estimate the size of trunk section with a consideration of air velocity for noise control with maximum at supply side.

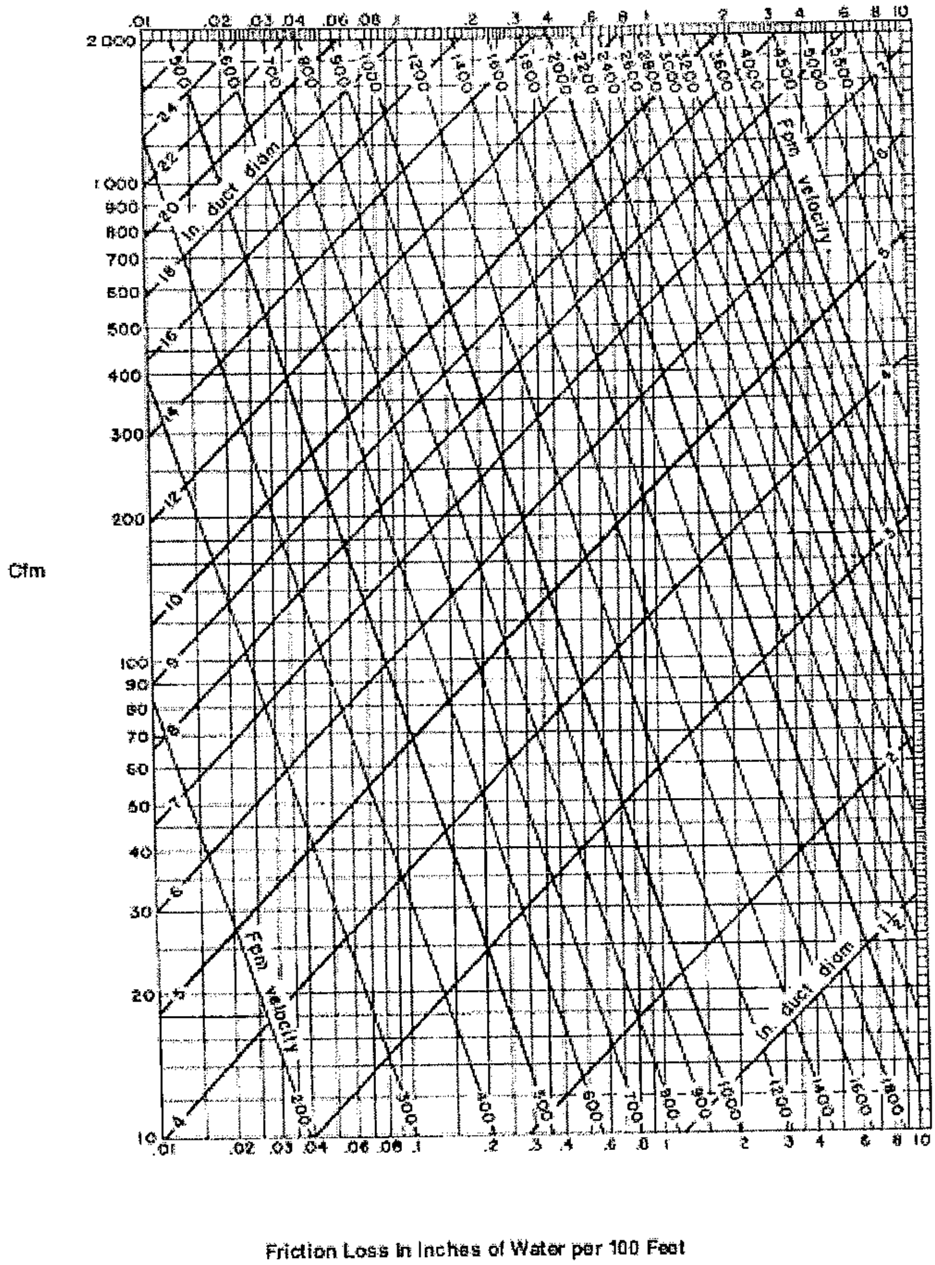
(10 marks)

(c) Estimate the size of run out section with consideration for air velocity for noise control with maximum at return side.

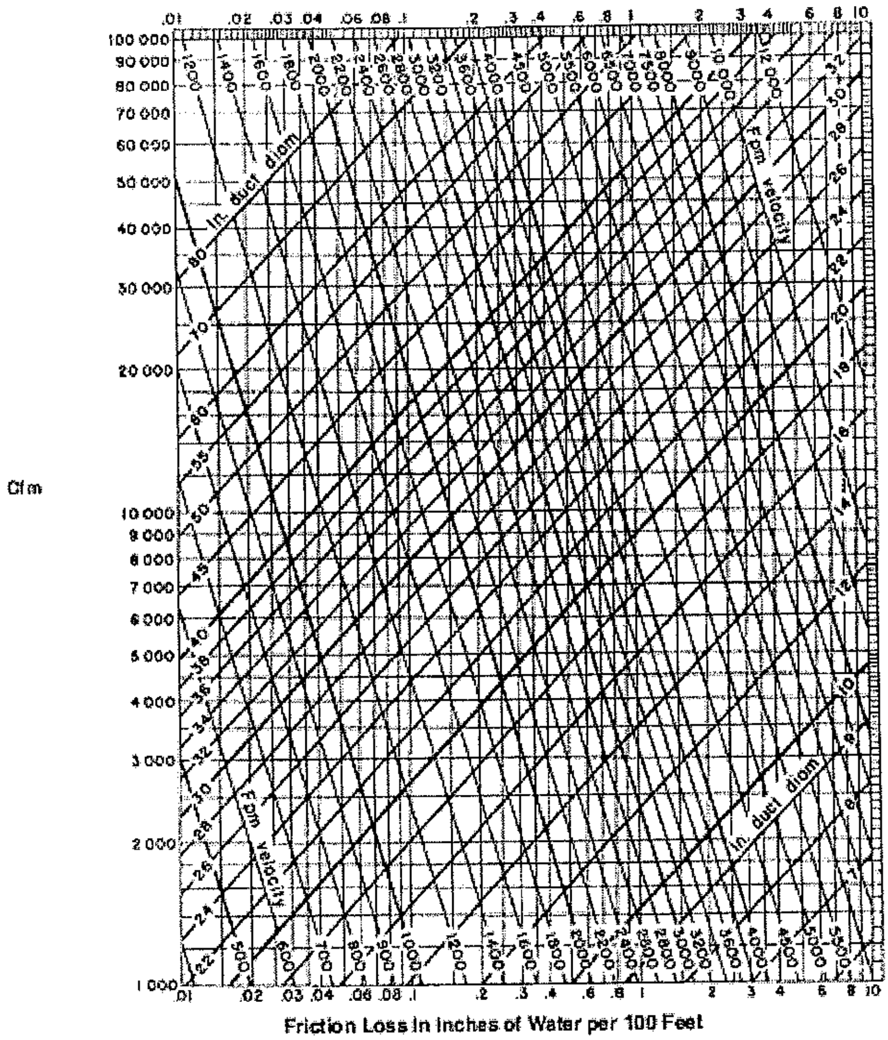
(7 marks)

END OF QUESTION

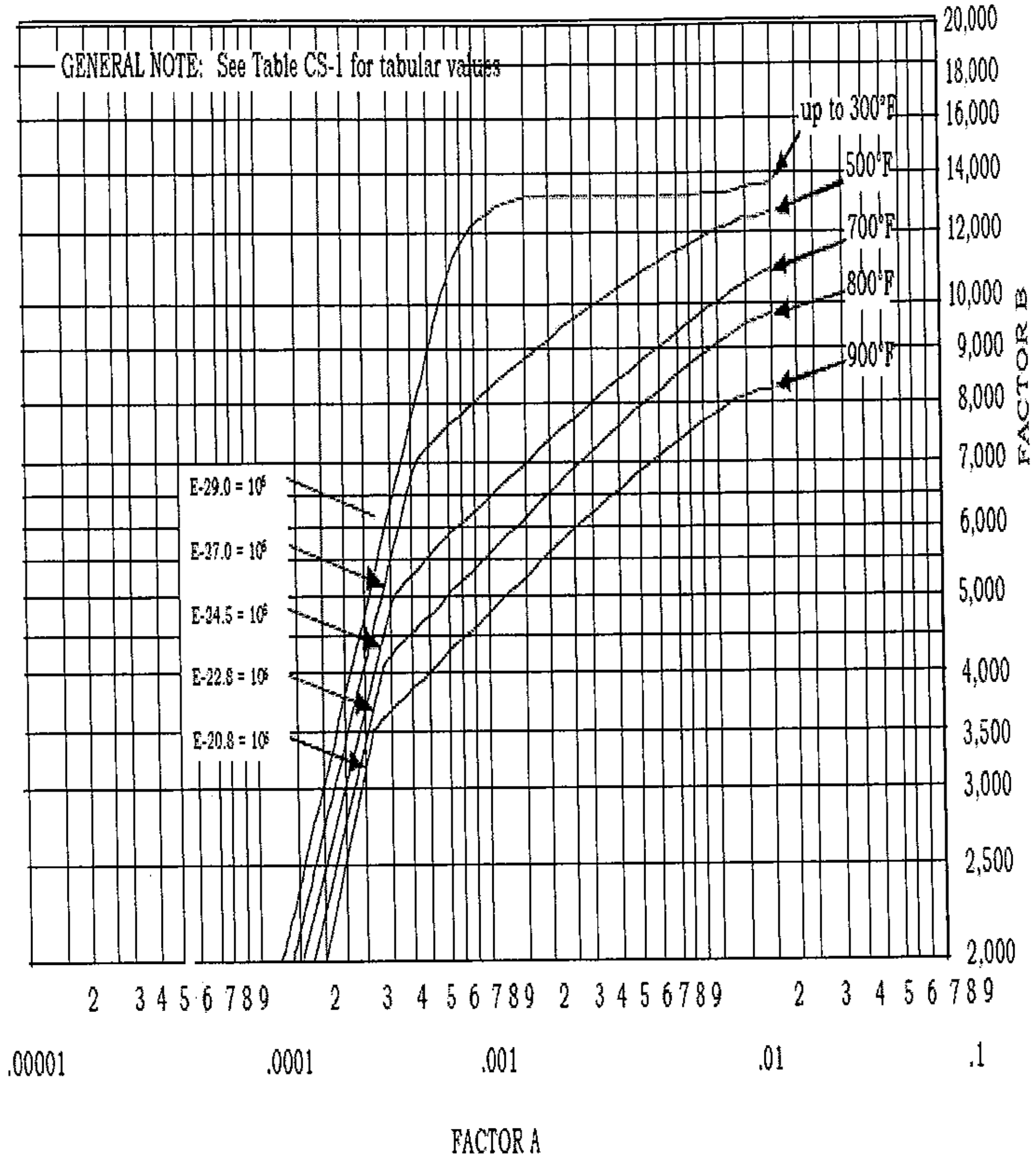
Appendix 1: Round Galvanized Metal Duct 10 Cfm to 2,000 Cfm



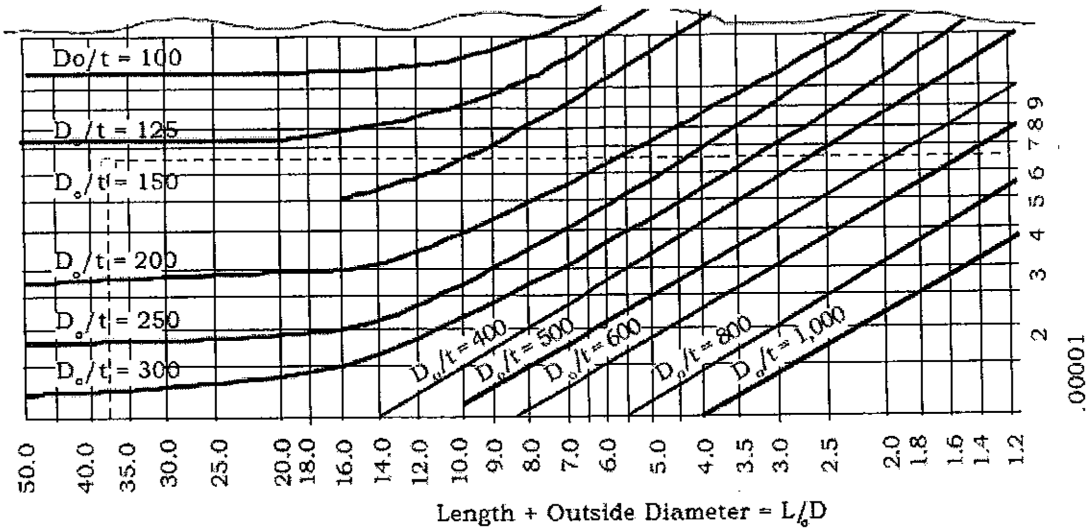
Appendix 2: Round Galvanized Metal Duct 1,000 Cfm to 100,000 Cfm



Appendix 3: Factor A



Appendix 4: Factor A



Factor A

Appendix 5: Formula

Part	Thickness, t_p, in.	Pressure, P, psi	Stress, S, psi
Cylindrical shell	$\frac{Pr}{SE_1 - 0.6P}$	$\frac{SE_1 t}{r + 0.6t}$	$\frac{P(r + 0.6t)}{tE_1}$
Spherical shell	$\frac{Pr}{2SE_1 - 0.2P}$	$\frac{2SEt}{r + 0.2t}$	$\frac{P(r + 0.2t)}{2tE}$
2:1 Semi -Elliptical head	$\frac{PD}{2SE - 0.2P}$	$\frac{2SEt}{D + 0.2t}$	$\frac{P(D + 0.2t)}{2tE}$
Torispherical head with 6% knuckle	$\frac{0.885PL}{SE - 0.1P}$	$\frac{SEt}{0.885L + 0.1t}$	$\frac{P(0.885L + 0.1t)}{tE}$
Conical Section (α = 30°)	$\frac{PD}{2\cos\alpha(SE - 0.6P)}$	$\frac{2SEt\cos\alpha}{D + 1.2t\cos\alpha}$	$\frac{P(D + 1.2t\cos\alpha)}{2tE\cos\alpha}$

Summary of ASME Code Equations

Appendix 6: Air Velocity for Noise Control

Air Velocity for Noise Control Subject to Notes 1, 2 and 8								
Component	Supply Side (Fpm)				Return-Side (Fpm)			
	Conservative		Maximum		Conservative		Maximum	
	Rigid	Flex	Rigid	Flex	Rigid	Flex	Rigid	Flex
Trunk Ducts	700	700	900	900	600	600	700	700
Branch Ducts	600	700	900	900	500	600	700	700
Supply Outlet Face Velocity	Size for Throw		700 Note 7		—		—	
Return Grille Face Velocity	—		—		—		500	
Filter Grille Face Velocity	—		—		—		300	

1) The design friction rate is affected if air velocity exceeds 900 Fpm (fitting equivalent lengths are for 900 Fpm or less).

2) System resistance considerations supercede velocity considerations (minimum acceptable airway size shall be based on the local Cfm value and the design friction rate). Airway size shall be increased if the local air velocity exceeds the maximum limit.

3) This table applies to metal duct with transverse seams and metal fittings (duct runs and fittings not lined or wrapped with insulating material).

4) This table applies to flexible wire helix duct with duct board junction box fittings.

5) Maximum velocities may be exceeded when construction has less surface irregularities (no transverse seams or less irregularity at transverse seams, and very efficient fittings); and has a sound absorbing attribute (duct board or duct liner).

6) Authoritative guidance concerning velocity limits for aerodynamically efficient and/or sound absorbing designs is not available at this time.

7) The velocity limit for a supply outlet may be ignored if the noise criteria (NC) value for a grille, register or diffuser is 30 or less over the range of Cfm values that will flow through the device (or combination of devices, if a damper is involved), during any mode of system operation.

8) Air velocity limits are superceded by measured noise criteria (NC) values for low rise dwellings (Notes 1 and 2 still apply).

- NC values measured by sound meter in middle of the room when normal human ear perceives maximum HVAC system noise.
- Measured NC equals or exceeds 30 with comfort system off; measured NC shall not increase by more than 3 with comfort system on.
- Measured NC less than 30 with comfort system off; measured NC shall not exceed 33 with comfort system on.

Appendix 7

Joint Type	Acceptable Joint Categories	Degree of Radiographic Examination		
		Full	Spot	None
1	A, B, C, D	1.00	0.85	0.70
2	A, B, C, D (See ASME Code for limitations)	0.90	0.80	0.65
3	A, B, C	NA	NA	0.60
4	A, B, C (See ASME Code for limitations)	NA	NA	0.55
5	B, C (See ASME Code for limitations)	NA	NA	0.50
6	A, B, (See ASME Code for limitations)	NA	NA	0.45

Appendix 8

ALLOWABLE STRESS IN TENSION FOR CARBON AND LOW ALLOY STEEL
Max Allowable Stress, ksi (Multiply by 1,000 to Obtain psi)
for Metal Temperature, °F, Not Exceeding

650	700	750	800	850	900	950	1000	1050	1100	1150	1200	Spec No.
								Carbon Steel Plates and Sheets				
13.8	13.3	12.1	10.2	8.4	6.5	4.5	2.5	–	–	–	–	SA-515
15.0	14.4	13.0	10.8	8.7	6.5	4.5	2.5	–	–	–	–	SA-515
16.3	15.5	13.9	11.4	9.0	6.5	4.5	2.5	–	–	–	–	SA-515
17.5	16.6	14.8	12.0	9.3	6.5	4.5	2.5	–	–	–	–	SA-515
13.8	13.3	12.1	10.2	8.4	6.5	4.5	2.5	–	–	–	–	SA-516
15.0	14.4	13.0	10.8	8.7	6.5	4.5	2.5	–	–	–	–	SA-516
16.3	15.5	13.9	11.4	9.0	6.5	4.5	2.5	–	–	–	–	SA-516
17.5	16.6	14.8	12.0	9.3	6.5	4.5	2.5	–	–	–	–	SA-516
								Plate-Low Alloy Steels (Cont'd)				
13.8	13.8	13.8	13.8	13.8	13.3	9.2	5.9	–	–	–	–	SA-387
17.5	17.5	17.5	17.5	17.5	16.9	9.2	5.9	–	–	–	–	SA-387
13.8	13.8	13.8	13.8	13.4	12.9	11.3	7.2	4.5	2.8	1.8	1.1	SA-387
16.3	16.3	16.3	16.3	15.8	15.2	11.3	7.2	4.5	2.8	1.8	1.1	SA-387
15.0	15.0	15.0	15.0	14.6	13.7	9.3	6.3	4.2	2.8	1.9	1.2	SA-387
18.8	18.8	18.8	18.8	18.3	13.7	9.3	6.3	4.2	2.8	1.9	1.2	SA-387
15.0	15.0	15.0	15.0	14.4	13.6	10.8	8.0	5.7	3.8	2.4	1.4	SA-387
17.7	17.2	17.2	16.9	16.4	15.8	11.4	7.8	5.1	3.2	2.0	1.2	SA-387

Appendix 9

ALLOWABLE STRESS IN TENSION FOR CARBON AND LOW-ALLOY STEEL

Spec No.	Grade	Nominal Composition	P-No.	Group No.	Min. Yield (ksi)	Min. Tensile (ksi)
Carbon Steel Plates and Sheets						
SA-515	55	C-Si	1	1	30	55
	60	C-Si	1	1	32	60
	65	C-Si	1	1	35	65
	70	C-Si	1	2	38	70
SA-516	55	C-Si	1	1	30	55
	60	C-Mn-Si	1	1	32	60
	65	C-Mn-Si	1	1	35	65
	70	C-Mn-Si	1	2	38	70
Plate - Low Alloy Steels						
SA-387	2 Cl.1	½ Cr-½ Mo	3	1	33	55
	2 Cl.2	½ Cr-½ Mo	3	2	45	70
	12 Cl.1	1Cr-½ Mo	4	1	33	55
	12 Cl.2	1Cr-½ Mo	4	1	40	65
	11 Cl.1	1 ¼ Cr-½Mo-Si	4	1	35	60
	11 Cl.2	1 ¼ Cr-½Mo-Si	4	1	45	75
	22 Cl.1	2 ¼ Cr-1Mo	5	1	30	60
	22 Cl.2	2 ¼ Cr-1Mo	5	1	45	75