

Contents

List of Figures	ix
List of Tables	xi
List of Symbols	1
Introduction	1
1 Practical configurations of unsteady pressure measurements systems	5
1.1 Flush-mounted pressure transducers	5
1.2 Sub-surface mounted transducers	10
1.3 Pressure transducer connected to a pressure tap	12
1.4 Multiple pressure measurement using scanning valve	14
1.5 Multiple pressure measurement using electronic pressure scanners	17
1.6 Practical tips for pressure transducer connecting	19
2 Theoretical Evaluation Methods	23
2.1 Time Domain Methods	23
2.1.1 Analysis of the pressure response of a line-cavity system	23
2.1.1.1 Fluid behaviour in line	24
2.1.1.2 Fluid behaviour in cavity	25
2.1.1.3 Combined line-cavity system	26
2.1.1.4 System with multiple lines and cavities	28
2.1.2 Simplified linear analysis of unsteady pressure measuring systems . .	32
2.1.2.1 Single line-cavity systems	32

2.1.2.2	Systems with multi-segments line	36
2.2	Frequency Domain Methods	37
2.2.1	Organ Pipe Resonance	37
2.2.2	Cavity Resonance (Helmholtz)	37
2.2.3	Deriving the step response from the frequency response	38
2.2.3.1	Linear Theory for Small Pressure Disturbances	39
2.2.3.2	Application of the theory	40
2.2.3.2.1	The effect of tube length on the frequency response	41
2.2.3.2.2	The effect of tube diameter on the frequency response	42
2.2.3.2.3	The effect of cavity volume on the frequency response	42
2.2.3.2.4	The effect of length and diameter on the frequency response	43
2.2.3.2.5	Verification of the theory with measured data . . .	44
2.2.3.3	System step response	44
2.2.3.3.1	Transforming the frequency response to step response	44
2.2.3.3.2	The effect of tube length on the step response . . .	45
2.2.3.3.3	The effect of tube diameter on the step response . .	46
2.2.3.3.4	The effect of a volume on the step response	47
2.2.3.3.5	Validation of the theory with measured data	48
2.2.3.3.6	Comparison with the line-cavity theory	49
3	Experimental Evaluation Methods	51
3.1	Water hammer pipe	52
3.2	Fast depressurization system	53
3.3	Shock tube	54
3.3.1	Description of Components	54
3.3.2	Description of Shock Tube Phenomena	55
4	Resonance Frequency, Phase Shift and Bandwidth	63
4.1	Generalities	63

4.2	Examples	65
4.2.1	Effect of RTV coating on a piezoresistive sensor chip	65
4.2.2	Effect of protecting screen on fast response sensor	68
4.2.3	Effect of recess length and diameter for sub-surface mounted sensors .	69
	Bibliography	72