

Contents

1	Basic Principles of Static And Dynamic Air Movement	1
1.1	Atmospheric pressure	1
1.2	Static pressure	3
1.3	Velocity pressure	5
1.4	Total pressure	7
1.5	Air flow through different sections	8
1.6	Aerodynamic paradox	12
1.7	Airfoils	14
2	Fan Terminology And Definitions	17
2.1	Standard air	17
2.2	Water gauge	17
2.3	Air volume	18
2.4	Fan total pressure	18
2.5	Fan static pressure	19
2.6	Fan velocity pressure	19
2.7	Air horse power (AHP)	20
2.8	Brake horse power (BHP)	20
2.9	Static efficiency (SE)	20
2.10	Mechanical efficiency (ME)	20
2.11	Application range	20
2.12	Blocked tight static pressure	20
2.13	Free delivery (WOCFM)	20
2.14	Wide open brake horsepower (WOBHP)	21
2.15	Tip speed	21
2.16	Stall	21
3	Fans And Blowers-Types And Construction	23
3.1	Types of fans	23
3.2	Centrifugal fans	27
3.3	Axial flow fans	29
3.4	Mixed flow fans (Axial-centrifugal fans)	34
3.5	Roof ventilators	35
3.6	Air curtains	37
3.7	Air screens	38
3.8	Air knife	39
3.9	Difference between fans and blowers	40
3.10	Types of blowers	41

3.11	Centrifugal blowers	41
3.12	Vortex regenerative blowers	44
3.13	Positive displacement blowers	46
3.14	Cross-flow blowers	47
3.15	Submerged blowers	49
4	Fan Laws	51
4.1	Units of measurements	51
4.2	Fan laws-descriptions (fixed system)	52
4.3	Effect of speed change	56
4.4	Effect of fan wheel diameter change (constant volume)	57
4.5	Effect of fan wheel diameter change (constant speed)	58
4.6	Effect of density change (constant volume)	59
4.7	Effect of density change (constant static pressure)	60
4.8	Effect of density change (constant mass flow)	61
4.9	Inlet pressure correction	62
5	Centrifugal Fans	65
5.1	Air flow pattern in centrifugal fans	66
5.2	Blade construction-centrifugal fans	68
5.3	Operating principle of centrifugal fans	74
5.4	Volume control in centrifugal fans	74
5.5	Centrifugal fan's drive mechanism	78
5.6	Multi-fan arrangement	79
5.7	Centrifugal fans in series	80
5.8	Centrifugal fans in parallel	80
5.9	Selection of centrifugal fans	84
5.10	Specific speed and specific diameter	84
6	Axial Flow Fans	87
6.1	Air flow pattern in axial flow fans	88
6.2	Blade angle or twist, and velocity distribution	91
6.3	Effect of tip clearance in axial flow fans	92
6.4	Multistage axial flow fans	93
6.5	Effect of outlet diffuser and outlet tail piece	95
6.6	Selection of axial flow fans	95
6.7	Description of mixed flow fans (axial-centrifugal)	97
6.8	Performance of mixed flow fans	99
6.9	Axial fans in series and parallel operation	100

7	Systems Resistance	105
7.1	Air flow principles	105
7.2	Airflow through various systems	107
7.3	Air systems and systems resistance	108
7.4	Pressure losses through various systems	110
7.5	Comparison of system curves and changing speed curves	112
7.6	Flow coefficient and pressure coefficient	117
7.7	Volume regulation	119
7.8	Fan filter media, housings, filter boxes	125
7.9	Fan filters-operating principles	126
7.10	Fan pack units / air-tight housings	128
8	Performance Testing Of Fans	131
8.1	About AMCA	131
8.2	AMCA testing standards	132
8.3	AMCA test code	135
8.4	Application guides	135
8.5	Certified ratings programme	136
8.6	Educational texts	137
8.7	AMCA laboratory testing facilities	138
8.8	Type of tests	139
8.9	Fans –air performance tests	141
8.10	Air flow and pressure measurement	143
8.11	Traversing duct-average air velocity and volume	144
8.12	Dampers – performance testing	146
8.13	Air flow measuring stations	149
8.14	Inlet and outlet accessories for test setups	150
8.15	Instruments used in test methods	153
8.16	System effect or fan installation effect	156
9	Fan Drives	163
9.1	Prime movers	163
9.2	Type of electrical motors	168
9.3	Drive arrangements for centrifugal fans	168
9.4	Fan rotation and discharge locations –CF	170
9.5	Drive arrangements for axial flow fans	171
9.6	Fan rotation and discharge locations –AF	173
9.7	Spark resistance construction	173

10	Fans-Maintenance And Trouble-Shooting	175
10.1	Fans maintenance	175
10.2	Trouble-shooting – General	178
10.3	Trouble-shooting guidelines	178
10.4	Excessive vibration and noise	180
10.5	Premature failures	183
10.6	Low capacity or pressure	184
10.7	Overloaded driver or overheated motor	186
10.8	Overheated bearings	188
10.9	Field related trouble-shooting	189
10.10	Safety precautions and protective devices	189
10.11	Lubrication of fan bearings	190
11	Annexure 1-Objective Type Questions	193
12	Annexure 2-Practical Exercises	197