
CONTENTS

Preface	ix
Nomenclature	x
1 INTRODUCTION	1
2 ANALYTIC CALCULATION OF FLAT PLATE DRAG AND HEAT TRANSFER	7
2.1 Computational Technique	7
2.2 Drag on the Plate	24
2.3 Heat Transfer of a Plate	31
3 EXPERIMENTAL TECHNIQUE	43
3.1 Experimental Apparatus	44
3.2 Determination of Heat Transfer	49
3.3 Determination of Flow Variables	57
3.4 Determination of Thermal Parameters	62
3.5 Specific Features of the Measurements	67
4 VELOCITY AND TEMPERATURE DISTRIBUTIONS IN THE BOUNDARY LAYER	69
	v

vi CONTENTS

4.1	Velocity Profiles	69
4.2	Temperature Profiles	76
4.3	Distortion of Profiles in the Case of Variable Physical Properties	84
4.4	Velocity and Temperature Profiles in Accelerated Flows	88
4.5	Velocity and Temperature Profiles in Turbulized Flows	92
5	EXPERIMENTAL STUDY OF HEAT TRANSFER FROM A PLATE	99
5.1	Effect of Fluid Properties and Temperature Difference on the Heat Transfer from a Plate	99
5.2	Heat Transfer in the Transition Region	102
5.3	Local Heat Transfer to a Flow of Air	112
5.4	Local Heat Transfer to Flows of Various Fluids	114
5.5	Mean Heat Transfer from a Plate	120
5.6	Heat Transfer to Accelerating Flows	122
5.7	Effect of a Single Turbulence Promotor on Heat Transfer from a Plate	125
6	CERTAIN FEATURES OF THE THERMAL BOUNDARY LAYER	127
6.1	Value of Pr_t in the Boundary Layer	127
6.2	Value of Pr_t in the Wake of a Plate	134
6.3	Intensity of Temperature Fluctuations	138
6.4	Correlation Function Measurements	142
7	ANALYSIS OF RESULTS	151
7.1	Specific Features of a Flow over a Plate	151
7.2	Analysis of Results on Heat Transfer from a Plate	155
7.3	Features of Heat Transfer across the Boundary Layer at $Pr > 1$	161
8	CONCLUSIONS AND RECOMMENDATIONS	171

8.1	General Description of the Boundary Layer	171
8.2	Flow over a Plate	174
8.3	Drag on a Plate	176
8.4	Mean Temperature Profiles	176
8.5	Turbulent Prandtl Number Pr_t	177
8.6	Structural Features of Turbulent Transport	180
8.7	Heat Transfer from a Plate at Different Pr	180
8.8	Concluding Remarks	185
APPENDIX		187
1.	Data from Analytic Calculations	187
2.	Thermophysical Properties of Fluids	192
3.	Experimental Data on the Friction of a Plate in a Flow of Various Fluids	193
4.	Experimental Data on Velocity and Temperature Profiles in the Boundary Layer	194
5.	Experimental Data on Velocity and Temperature Profiles in the Wall Region	209
6.	Experimental Data on Distortion of Velocity and Temperature Profiles in the Boundary Layer in Flows of Various Fluids at High Heat Fluxes	215
7.	Experimental Data on Distortion of Velocity and Temperature Profiles in the Boundary Layer Due to Flow Acceleration	226
8.	Experimental Data on the Distortion of Velocity and Temperature Profiles in the Boundary Layer Due to Placement of a Turbulence Promotor	229
9.	Experimental Data on Local Heat Transfer from a Plate in the Region of Boundary Layer Transition for Various Fluids	232
10.	Experimental Data on Local Heat Transfer from a Plate at Low Heat Fluxes	235
11.	Experimental Data on Local Heat Transfer from a Plate at High Heat Fluxes	241
12.	Experimental Data on the Mean Heat Transfer between a Plate and Various Fluid Flows	245