

LIST OF FIGURE

Sr. Number	Title	Page No.
Figure 1.1	Parts of Internal combustion engine	2
Figure 1.2	Position of different type of piston rings on piston	4
Figure 1.3	Most Common shape, b- barrel-shaped face profile, c- tapered face profile	8
Figure 1.4	Bevelled ring edge configuration (ISO 6621-1)	8
Figure 1.5	Half keystone ring (ISO 6621-1)	9
Figure 1.6	Compression & Oil Control Rings	9
Figure 1.7	Coating deposition technologies	13
Figure 1.8	Coating Porosity Calculations	19
Figure 1.9	Abrasive wear of thermal spray coating	28
Figure 1.10	Fretting wear of thermal spray coating	31
Figure 1.11	Erosion wear of thermal spray coating	32
Figure 2.1	Slurry abrasions wear of thermal spray coating	38
Figure 2.2	Pin on disc wear test of thermal spray coating	40

Figure 3.1	Induction Arc Furnace Used for the Melting of Charge	51
Figure 3.2	Powder as charged (A) Mn Slab (B) Cu Powder (C) Si Powder (D) Cr Powder	52
Figure 3.3	Plasma Arc spraying machine with the sample mounted on it for the purpose of coating	56
Figure 3.4	Schematic of Plasma arc spraying	56
Figure 3.5	Schematic diagram of Plasma Arc coating	57
Figure 3.6	(A) Plasma Spray Coating machine unit (B) Arc during the operation of coating (C) Coating Powder container	58
Figure 3.7	Common nitriding cycle	66
Figure 3.8	Wear and friction monitor machine for pin on disc test	69
Figure 3.9	Hard Chrome coating before wear test	69
Figure 3.10	Hard Chrome coating during wear test	70
Figure 3.11	Hard Chrome coating after wear test	70
Figure 3.12	Scanning electron microscope at DTU, Delhi	72
Figure 3.13	X-Ray diffractometer in DTU, Delhi	75
Figure 3.14	Vickers micro hardness indentations	76
Figure 3.15	Optical microscope	77
Figure 4.1	(A) Top View of Thermal Sprayed Coating (B) Cross-sectional View of Plasma Spray Coating	79-80
Figure 4.2	Top View of Hard Chrome plating	80
Figure 4.3	(A) shows the variation of the wear rate of the plasma spray coating at different loads with different counter	81

	bodies.	
	(B) Shows the variation of the wear rate of the different counter bodies at different loads with plasma sprayed plate.	82
Figure 4.4	(A) shows the variation of the wear rate of the chrome plating at different loads with different counter bodies.	85
	(B) Shows the variation of the wear rate of the different counter bodies at different loads with chrome plating.	85
Figure 4.5	(A) shows the variation of the wear rate of the gas nitride plate at different loads with different counter bodies.	88
	(B) Shows the variation of the wear rate of the different counter bodies at different loads with gas nitride plate.	89
Figure 4.6	(A) Variation of coefficient of friction of plasma spray coated plate with En-31 pin at various loading condition with time.	91
	(B) Variation of coefficient of friction of plasma spray coated plate with tungsten carbide pin at various loading condition with time	92
Figure 4.7	(A) Variation of coefficient of friction of chrome plated plate with En-31 pin at various loading and sliding conditions.	94
	(B) Variation of coefficient of friction of chrome plated plate with tungsten carbide pin at various loading and	95

	sliding conditions	
	(C) Variation of coefficient of friction of chrome plated plate with En-31 pin , tungsten carbide and nickel pin at similar loading and sliding conditions	95
	(D) Variation of coefficient of friction of chrome plated plate with En-31 pin , tungsten carbide and nickel pin at similar loading and sliding conditions	96
Figure 4.8	(A, B,& C) Variation of coefficient of friction of gas nitrided plate with En-31,Nickel and tungsten carbide pin pin at various loading and sliding conditions.(D, E & F) CoF of gas nitrided plate with different counter bodies at 40,50 & 60 N load	98-101
Figure 4.9	(A) Worn surface of plasma spray coating with EN-31 pin at 50N load	103
	(B) Worn surface of plasma spray coating with EN-31 at 60N laod	103
	(C) Worn Surface of Plasma Spray Coating with WC at 30N Load	104
	(D) Worn Surface of Gas nitriding with Nickel Pin at 50 N Load	104
	(E) Worn surface of Hard Chrome Plated disc with HCS at 50 N load	104
	(F) Worn Surface of gas nitriding disc with EN-31 at 40N	104

	load	
	(G) Worn Surface of gas nitriding disc with En-31 at 50N	105
	load	
Figure 4.10	Worn surface of plasma spray coating with tungsten carbide pin, at (A) 100 X (B) 500 X (C) 1k X	107
Figure 4.11	Worn surfaces chrome plating with En-31 at 500 rpm speed and (A) 100 X (B) 500 X (C) 1000 X	109
Figure 4.12	Worn surfaces chrome plating with tungsten carbide pin at 500 rpm speed and (A) 25 X (B) 500 X (C) 1000 X	110
Figure 4.13	Worn surfaces of gas nitriding with En-31 at 500 rpm speed and (A) 100 X (B) 100 X (C) 500 X	112
Figure 4.14	Worn surfaces of gas nitriding with nickel at 500 rpm speed and (A) 100 X (B) 1000 X (C) 500 X	113
Figure 4.15	Worn surfaces of gas nitriding with tungsten carbide at 500 rpm speed and (A) 1000 X (B) 500 X (C) 1000 X	114

