

Contents

Page

Foreword	vii
3 Rotary pumps	1
3.0 Introduction	1
3.0.1 Purpose	1
3.0.2 Scope	1
3.0.3 Capability chart	1
3.1 Types and nomenclature	6
3.1.1 Sliding vane (rigid)	7
3.1.2 Axial piston pumps	7
3.1.3 Flexible member	8
3.1.4 Lobe	9
3.1.5 Gear	10
3.1.6 Circumferential piston	12
3.1.7 Screw	12
3.2 Definitions	16
3.2.1 Fluids and liquids	17
3.2.2 Pumping chamber	17
3.2.3 Inlet or suction port	17
3.2.4 Outlet or discharge port	17
3.2.5 Body	17
3.2.6 End plate	17
3.2.7 Stator (Liner)	17
3.2.8 Rotor	18
3.2.9 Bearing	18
3.2.10 Timing gear	18
3.2.11 Rotating assembly	18
3.2.12 Relief valve	18
3.2.13 Stuffing box	19
3.2.14 Gland	19
3.2.15 Packing	19
3.2.16 Lantern ring	19
3.2.17 Seal chamber	19
3.2.18 Mechanical seal	19
3.2.19 Radial seal	19
3.2.20 Direction of rotation	19
3.2.21 Jacketed pump	19
3.2.22 Rate of flow (Q)	20

3.2.23	Displacement (D)	20
3.2.24	Speed (n)	20
3.2.25	Pump volumetric efficiency (η_v)	20
3.2.26	Slip (S)	20
3.2.27	Pressure (p)	20
3.2.28	Pump pressures	22
3.2.29	Net positive inlet pressure available ($NPIPA$)	24
3.2.30	Cavitation	24
3.2.31	Net positive inlet pressure required ($NPIPR$)	24
3.2.32	Power (P)	25
3.2.33	Pump input power (P_p)	25
3.2.34	Pump output power (P_w)	25
3.2.35	Pump torque	25
3.2.36	Pump efficiency (η_p)	26
3.2.37	Multiphase	26
3.2.38	Letter (dimensional) designations	26
3.3	Design and application	36
3.3.1	Temperature (t)	37
3.3.2	Liquid identification and properties	37
3.3.3	Fluid type	37
3.3.4	Entrained or dissolved gases in liquids	38
3.3.5	Viscosity	38
3.3.6	Viscous response types	42
3.3.7	Effect of viscosity on pump and system performance	44
3.3.8	Specific gravity (s)	44
3.3.9	Vapor pressure	45
3.3.10	Effect of vapor pressure on pump performance	45
3.3.11	Other fluid properties	45
3.3.12	Drive specifications	45
3.3.13	Efficiency and energy conservation	45
3.3.14	Duty cycle	46
3.3.15	Other user requirements	46
3.3.16	Slurry applications	46
3.3.17	Rotary pump noise and vibration levels	51
3.3.18	Rotary multiphase pumps in oil and gas application	53
3.3.19	Data sheet	54
3.4	Installation, operation, and maintenance	54
3.4.1	Shipment inspection	54
3.4.2	Storage	58
3.4.3	Installation	58

3.4.4	Operation	68
3.4.5	Maintenance	70
3.4.6	Malfunctions: cause and remedy	71
3.5	Reference and source material	74
3.5.1	ASTM	74
3.5.2	Hydraulic Institute	74
3.5.3	3-A Sanitary Standards	75
3.5.4	API	75
3.5.5	Igor J. Karassik, et al	75
3.5.6	Cameron Hydraulic Data	75
Appendix A	Index	76

Figures

3.0.3b	— Rotary pump consolidated range chart (metric units)	4
3.0.3c	— Rotary pump consolidated range chart (US customary units)	5
3.1	— Types of rotary pumps	6
3.1.1	— Sliding vane pump	7
3.1.2	— Axial piston pump	7
3.1.3.1	— Flexible vane pump	8
3.1.3.2	— Flexible tube pump (peristaltic)	9
3.1.4a	— Single-lobe pump	9
3.1.4b	— Three-lobe pump	10
3.1.5.1	— External gear pump	10
3.1.5.2a	— Internal gear pump (with crescent)	11
3.1.5.2b	— Internal gear pump (without crescent)	11
3.1.6	— Circumferential piston pump	12
3.1.7.1	— Single-screw pump (progressing cavity)	12
3.1.7.2.1	— Two-screw pump (timed)	13
3.1.7.2.2a	— Three-screw single end pump (untimed)	14
3.1.7.2.2b	— Three-screw double end pump (untimed)	14
3.2.38a	— Internal gear pump (foot mounting)	27
3.2.38b	— Internal gear pump (flange mounting)	27
3.2.38c	— Internal gear pump (frame mounting)	28
3.2.38d	— Internal gear pump (close coupled)	28
3.2.38e	— External gear pump (flanged ports)	29
3.2.38f	— External gear pump (threaded ports)	29
3.2.38g	— External gear pump on base plate	30
3.2.38h	— Timed screw pump on baseplate	31
3.2.38i	— Untimed screw pump	32
3.2.38j	— Lobe pump	33

3.2.38k — Vane pump	34
3.2.38l — Stuffing box or seal chamber	35
3.3 — Flow vs. Pressure for PD pumps	37
3.3.4a — Effect of entrained gas only on liquid rate of flow of rotary pumps (metric units)	39
3.3.4b — Effect of entrained gas only on liquid rate of flow of rotary pumps (US customary units)	39
3.3.4d — Effect of dissolved gas only in saturated solution on liquid rate of flow of rotary pumps (US customary units)	40
3.3.4c — Effect of dissolved gas only in saturated solution on liquid rate of flow of rotary pumps (metric units)	40
3.3.13 — Specified conditions: constant speed, constant pressure	47
3.3.16.1.4 — Materials hardness	48
3.3.16.1.6 — Typical slurry system conversion curve	49
3.3.16.2 — Differential pressure versus pump input power	49
3.3.19 — Suggested rotary pump application data sheet	55
3.4.3.3 — Typical foundation bolts	60
3.4.3.6 — Leveling and grouting	61
3.4.3.8 — Types of misalignment	62
3.4.3.10 — V-belt sheave and synchronous sprocket alignment	64
3.4.3.11 — Pipe-to-pump alignment	65
Tables	
3.0.3a — Capability table – Metric	2
3.0.3b — Capability table – US customary units	3
3.2a — Symbols and terminology	16
3.2b — Subscripts	17
3.3.5.4.1 — Viscosity of common fluids	41
3.4.6 — Malfunctions: Cause and remedy	71