

Contents

| | Page |
|-----------------------------------------------------------------------------------------------------------|------|
| Foreword | vii |
| 7 Controlled-volume metering pumps | 1 |
| 7.0 General description of controlled-volume metering pumps | 1 |
| 7.1 Types and nomenclature | 1 |
| 7.1.1 Construction characteristics of controlled-volume metering pumps | 1 |
| 7.1.2 Description of liquid ends | 2 |
| 7.1.3 Drive and control mechanisms | 5 |
| 7.1.4 Nomenclature | 8 |
| 7.2 Definitions | 11 |
| 7.2.1 Accuracy and performance | 11 |
| 7.2.2 Accuracy, steady state | 11 |
| 7.2.3 Capacity, rate of flow | 11 |
| 7.2.4 Pump displacement (D) | 11 |
| 7.2.5 Efficiency, mechanical | 12 |
| 7.2.6 Efficiency, volumetric | 12 |
| 7.2.7 Linearity | 12 |
| 7.2.8 Net positive suction head available (NPSHA)/net positive inlet pressure available (NPIPA) | 12 |
| 7.2.9 Head, acceleration/pressure, acceleration | 13 |
| 7.2.10 Power, pump input | 14 |
| 7.2.11 Power, pump output power (hydraulic horsepower) | 14 |
| 7.2.12 Pressure, differential | 14 |
| 7.2.13 Pressure, discharge (p_d) | 15 |
| 7.2.14 Pressure, discharge, rated | 15 |
| 7.2.15 Pressure, friction loss (p_f) | 15 |
| 7.2.16 Pressure, suction (p_s) | 15 |
| 7.2.17 Pressure, suction, maximum allowable ($p_{s\ max}$) | 15 |
| 7.2.18 Pressure, suction, minimum allowable (MASP) | 15 |
| 7.2.19 Pressure, total system discharge | 15 |
| 7.2.20 Repeatability | 15 |
| 7.2.21 Slip (S) | 15 |
| 7.2.22 Stroke length (L_m) | 15 |
| 7.2.23 Stroke speed (n) | 15 |

| | | |
|------------|-----------------------------------------------------------|----|
| 7.2.24 | Stroke speed, maximum allowable | 16 |
| 7.2.25 | Stroke speed, minimum allowable | 16 |
| 7.2.26 | Suction, flooded | 16 |
| 7.2.27 | Suction lift, static | 16 |
| 7.2.28 | Suction lift, total | 16 |
| 7.2.29 | Temperature, maximum rated (t_{max}) | 16 |
| 7.2.30 | Temperature, minimum rated (t_{min}) | 16 |
| 7.2.31 | Turndown ratio | 16 |
| 7.3 | Application of controlled-volume metering pumps | 16 |
| 7.3.1 | Typical uses and industries | 16 |
| 7.3.2 | General principles | 19 |
| 7.3.3 | Sizing and selection | 21 |
| 7.3.4 | System components | 22 |
| 7.4 | Installation, operation, and maintenance | 23 |
| 7.4.1 | Safety | 23 |
| 7.4.2 | Storage | 24 |
| 7.4.3 | Location of pump | 24 |
| 7.4.4 | Foundation | 24 |
| 7.4.5 | Installation | 24 |
| 7.4.6 | Inspection | 26 |
| Appendix A | Index | 28 |

Figures

| | |
|-----------------------------------------------------------------------------|---|
| Figure 7.1 — Basic elements of a controlled-volume metering pump | 1 |
| Figure 7.1.2.1 — Plunger pump | 2 |
| Figure 7.1.2.2 — Piston pump | 3 |
| Figure 7.1.2.3 — Mechanically coupled disc diaphragm | 3 |
| Figure 7.1.2.4a — Hydraulic disc with contour plates | 4 |
| Figure 7.1.2.4b — Hydraulic disc with diaphragm positioning valve | 4 |
| Figure 7.1.2.5 — Hydraulic tubular diaphragm | 5 |
| Figure 7.1.2.6 — Hydraulic conical diaphragm | 5 |
| Figure 7.1.3.1 — Electromagnetic drive | 6 |
| Figure 7.1.3.2 — Reciprocating air drive | 7 |
| Figure 7.1.3.3 — Fixed stroke-length drive | 7 |
| Figure 7.1.3.4 — Mechanical lost-motion drive | 8 |
| Figure 7.1.3.5 — Hydraulic lost-motion drive | 9 |

| | |
|-----------------------------------------------------------------------------------------------|----|
| Figure 7.1.3.6 — Variable stroke-length drive (non-lost-motion) | 9 |
| Figure 7.3.1a — Rate of flow versus pressure. | 19 |
| Figure 7.3.1b — Flow profile for reciprocating pump | 20 |
| Figure 7.3.1c — Actual flow curve, rate of flow versus stroke length. | 20 |
| Figure 7.3.1d — Theoretical and actual flow curve, rate of flow versus stroke length. | 20 |

Tables

| | |
|---------------------------------------------------------------------------|----|
| Table 7.2a — Symbols. | 17 |
| Table 7.2b — Subscripts | 18 |
| Table 7.4.6 — Locating trouble: controlled-volume metering pumps. | 26 |