America's Municipal Water Operator

Pipeline

www.AMWOP.com



EGLE D

License

Wastewater Exam Prep

Mission Statement

America’s Municipal Water Operator Pipeline™

To secure the future of water and wastewater infrastructure by building the strongest workforce pipeline in the nation — recruiting purpose-driven talent, equipping them through elite, industry-aligned training, and connecting municipalities with professionals prepared to protect public health, uphold regulatory excellence, and lead the next generation of essential operations.

We exist to strengthen communities, elevate the standards of the profession, and ensure that every utility — regardless of size — has access to skilled people, proven leadership, and a sustainable path forward.

MICHIGAN CLASS D WASTEWATER OPERATOR — STUDY EDITION
Prepared by: America’s Municipal Water Operator Pipeline™ (AMWOP)
Location: Michigan, United States
Date: 2026 Study Edition

COPYRIGHT PAGE

© 2026 America’s Municipal Water Operator Pipeline™ (AMWOP). All rights reserved.

No part of this publication may be reproduced, distributed, transmitted, or stored in any form or by any means — including electronic, mechanical, photocopying, recording, or otherwise — without prior written permission from the publisher, except for brief educational quotations.

This Study Edition is an independent educational resource and is not affiliated with, sponsored by, or endorsed by the Michigan Department of Environment, Great Lakes, and Energy (EGLE), the State of Michigan, or any regulatory agency. All material is provided strictly for training, education, and exam-preparation purposes.

ACKNOWLEDGEMENTS

Special recognition is given to the wastewater operators, mentors, trainers, municipal leaders, and industry professionals whose commitment to public health and environmental protection continues to inspire the next generation of operators. Their field experience, professionalism, and dedication helped shape the structure and philosophy of this Study Edition.

AMWOP also acknowledges the many Class D operators across Michigan who perform essential daily work protecting communities, waterways, and infrastructure.

DISCLAIMER

Every effort has been made to ensure that the information contained in this Study Edition reflects current wastewater operational practices and Level D exam concepts. However, regulatory requirements, EGLE guidance, and examination standards may change over time.

Users should always verify critical regulatory information through official sources, including:

- Michigan EGLE guidance documents
- 40 CFR regulations and applicable federal rules
- Facility-specific Standard Operating Procedures (SOPs)

This publication is intended to supplement — not replace — hands-on operational training, employer-provided instruction, or official state-issued study materials. Safe operation, regulatory compliance, and professional judgment must always take priority.

INTRODUCTION

The Michigan Class D Wastewater Operator — Study Edition was developed to provide a clear, structured, and modern approach to preparing for entry-level wastewater certification. Many traditional resources can feel outdated, overly technical, or disconnected from real plant operations. This edition bridges the gap between classroom learning and practical field knowledge.

The goal of this Study Edition is to help operators:

- Understand core treatment concepts at the Class D level
- Build strong safety and compliance habits
- Develop confidence before advancing to higher license levels
- Study efficiently using a consistent, repeatable process

Content has been organized to reflect how operators actually learn best — through repetition, clear explanations, and practical exam-focused structure.

This book is designed to support a structured study routine. Most operators preparing for the Michigan Class D exam benefit from a steady daily study plan over several months. Each chapter builds on previous material so operators can progress from fundamental concepts to complete process understanding.

The structure of this Study Edition was intentionally built to simulate real exam progression — concept learning, applied practice, review, and reinforcement.

AMWOP STUDY EDITION STANDARD

Exam-Ready • Safety-Focused • Professionally Accountable
Building Michigan’s Next Generation of Certified Wastewater Operators.

AMERICA'S MUNICIPAL WATER OPERATOR PIPELINE™ (AMWOP)

LEVEL 1 STUDY EDITION — PUBLISHER INDEX (AUTO-NUMBER READY)

CHAPTER 1 — ROLE OF THE WASTEWATER OPERATOR

1.1 Mission of the Operator ..... Pg 9

1.2 Responsibility & Accountability ..... Pg 9

1.3 Legal Authority & Regulatory Compliance ..... Pg 10

1.4 Chain of Command ..... Pg 10

1.5 Safety & PPE ..... Pg 11

1.6 Standard Operating Procedures (SOPs) ..... Pg 11

1.7 Monitoring & Data Integrity ..... Pg 12

1.8 Equipment Awareness ..... Pg 12

1.9 Emergency Response ..... Pg 13

1.10 Professional Conduct & Ethics ..... Pg 13

1.11 Documentation & Recordkeeping ..... Pg 14

1.12 Certification & Continuing Education ..... Pg 15

Practice Exam — Chapter 1 ..... Pg 17

Answer Key — Chapter 1 ..... Pg 21

Math .....Pg 22

CHAPTER 2 — CHARACTERISTICS OF WASTEWATER

2.1 Definition & Sources ..... Pg 23

2.2 Physical Characteristics ..... Pg 24

2.3 Solids Classifications (TS, TSS, TDS) ..... Pg 24

2.4 Chemical Characteristics ..... Pg 25

2.5 Oxygen Demand (BOD & COD) ..... Pg 25

2.6 Biological Characteristics ..... Pg 25

2.7 Pathogens & Indicator Organisms ..... Pg 26

2.8 Nutrients (Nitrogen & Phosphorus) ..... Pg 27

2.9 pH & Temperature ..... Pg 27

2.10 Environmental Impacts ..... Pg 29

Practice Exam — Chapter 2 ..... Pg 31

Answer Key — Chapter 2 ..... Pg 35

Math .....Pg 36

CHAPTER 3 — PRELIMINARY & PRIMARY TREATMENT

3.1 Treatment Process Overview ..... Pg 38

3.2 Screening Systems ..... Pg 39

3.3 Grinders & Comminutors ..... Pg 40

3.4 Grit Removal Systems ..... Pg 40

3.5 Primary Clarifiers ..... Pg 41

3.6 Sludge vs Scum ..... Pg 42

3.7 Removal Efficiencies ..... Pg 42

3.8 Hydraulic Considerations ..... Pg 42

3.9 FOG Control ..... Pg 43

Practice Exam — Chapter 3 ..... Pg 45

Answer Key — Chapter 3 ..... Pg 50

Math .....Pg 51- 61

CHAPTER 4 — SECONDARY (BIOLOGICAL) TREATMENT

4.1 Biological Treatment Principles ..... Pg 62

4.2 Role of Microorganisms ..... Pg 63

4.3 Activated Sludge Process ..... Pg 64

4.4 Aeration Systems ..... Pg 64

4.5 Mixed Liquor & MLSS ..... Pg 64

4.6 Secondary Clarifiers ..... Pg 65

4.7 Return Activated Sludge (RAS) ..... Pg 65

4.8 Waste Activated Sludge (WAS) ..... Pg 66

4.9 Food-to-Microorganism Ratio (F/M) ..... Pg 66

4.10 Sludge Age ..... Pg 66

4.11 Trickling Filters ..... Pg 67

Practice Exam — Chapter 4 ..... Pg 70

Answer Key — Chapter 4 ..... Pg 75

Math .....Pg 76 - 82

CHAPTER 5 — DISINFECTION & EFFLUENT QUALITY

5.1 Purpose of Disinfection ..... Pg 83

5.2 Indicator Organisms ..... Pg 84

5.3 Chlorination Principles ..... Pg 84

5.4 CT Concept ..... Pg 85

5.5 Contact Chambers ..... Pg 85

5.6 Dechlorination ..... Pg 86

5.7 UV Disinfection ..... Pg 86

5.8 Effluent Quality & Permit Limits ..... Pg 87

5.9 Operator Responsibilities ..... Pg 88

Practice Exam — Chapter 5 ..... Pg 90

Answer Key — Chapter 5 ..... Pg 95

Math .....Pg 96 - 100

CHAPTER 6 — SOLIDS HANDLING & SLUDGE PROCESSING

6.1 Sludge Definitions ..... Pg 101

6.2 Primary vs Secondary Sludge ..... Pg 102

6.3 Sludge Thickening ..... Pg 102

6.4 Stabilization & Digestion ..... Pg 103

6.5 Anaerobic Digestion ..... Pg 103

6.6 Aerobic Digestion ..... Pg 104

6.7 Dewatering Methods ..... Pg 104

6.8 Biosolids Management ..... Pg 105

6.9 Percent Solids Concepts ..... Pg 105

6.10 Safety Hazards ..... Pg 105

Practice Exam — Chapter 6 ..... Pg 109

Answer Key — Chapter 6 ..... Pg 114

Math .....Pg 115 - 122

CHAPTER 7 — COLLECTION SYSTEMS & LIFT STATION OPERATIONS

7.1 What Is a Collection System? ..... Pg 123

7.2 Gravity Sewer Systems ..... Pg 124

7.3 Manholes ..... Pg 124

7.4 Lift Stations & Pump Stations ..... Pg 125

7.5 Force Mains ..... Pg 125

7.6 Infiltration & Inflow (I/I) ..... Pg 126

7.7 Sanitary Sewer Overflows (SSOs) ..... Pg 127

7.8 Odors, Septic Conditions & Corrosion ..... Pg 127

7.9 Collection System Maintenance ..... Pg 128

7.10 Safety in Collection Systems ..... Pg 128

7.11 Level 1 Operator Responsibilities ..... Pg 129

7.12 How Collection Systems Affect the Treatment Plant ..... Pg 129

7.13 Why Collection Systems Matter ..... Pg 129

Practice Exam — Chapter 7 ..... Pg 131

Answer Key — Chapter 7 ..... Pg 136

Math .....Pg 137 - 140

CHAPTER 8 — LABORATORY TESTING, SAMPLING & DATA INTEGRITY

8.1 Why Laboratory Testing Matters ..... Pg 141

8.2 Types of Wastewater Samples ..... Pg 142

8.3 Proper Sample Collection ..... Pg 142

8.4 Field Testing ..... Pg 143

8.5 Common Laboratory Tests ..... Pg 144

8.6 Quality Assurance / Quality Control (QA/QC) ..... Pg 144

8.7 Data Integrity & Documentation ..... Pg 145

8.8 Chain of Custody ..... Pg 145

8.9 Laboratory Safety ..... Pg 146

8.10 Level 1 Operator Responsibilities ..... Pg 146

8.11 Common Exam Traps ..... Pg 147

8.12 How Lab Data Drives Operations ..... Pg 147

Practice Exam — Chapter 8 ..... Pg 148

Answer Key — Chapter 8 ..... Pg 154

Math .....Pg 155 - 175

True/False Review..... Pg 176

Complete Answer Key - Module 1..... Pg 179

Practice Certification Exam..... Pg 185

Multiple-Choice Exam - Classes D..... Pg 193

Formula Reference Sheet..... Pg 205

Parts I D..... Pg 210 - 220

AMWOP Study Edition

Chapter 7 — Collection Systems & Lift Station Operations

America's Municipal Water Operator Pipeline™ (AMWOP)
Building Exam-Ready Operators Nationwide

AMWOP Chapter Purpose Statement

This chapter explains how wastewater is conveyed from homes and businesses to the treatment plant, the components of collection systems, common failures, and the operator's role in protecting public health and preventing overflows. Collection systems are heavily tested on Level 1 exams because failures upstream directly cause plant upsets, permit violations, and public health emergencies.

AMWOP Core Principle:

Most treatment problems start in the collection system.

---

1. What Is a Collection System? (Universal Exam Concept)

A **collection system** is the network of pipes, structures, and pumping facilities that transports wastewater from its source to the treatment plant.

Collection systems include:

- Gravity sewers
- Force mains
- Manholes
- Lift stations / pump stations
- Service laterals

The collection system is considered part of wastewater treatment because:

- Untreated wastewater poses an immediate public health risk
- Failures can cause sanitary sewer overflows (SSOs)
- Collection problems directly impact plant hydraulics and biology

AMWOP Exam Rule:
Collection systems protect public health before wastewater ever reaches the plant.

2. Gravity Sewer Systems

How Gravity Sewers Work

Gravity sewers rely on **slope and velocity** to move wastewater without pressure.

Key concepts:

- Wastewater flows downhill
- Adequate slope prevents solids from settling
- Low velocity causes blockages and odors

Common Gravity Sewer Problems

- Low slope or sagging pipes
- Grease buildup
- Root intrusion
- Debris accumulation

AMWOP Exam Insight:
Low velocity = solids deposition.

---

3. Manholes

Purpose of Manholes

Manholes provide:

- Access for inspection and maintenance
- Changes in direction, slope, or pipe size
- Venting of sewer gases

Manhole Components

- Frame and cover
- Barrel
- Invert
- Benching

Manholes as Inflow Sources

Manholes are a major source of **inflow** due to:

- Pick holes
- Damaged covers
- Poor seals

Safety Hazards

- Confined space
- Hydrogen sulfide (H_2S)
- Oxygen deficiency

AMWOP Safety Rule:
Never enter a manhole without confined space authorization.

---

4. Lift Stations & Pump Stations (Top Exam Area)

Why Lift Stations Are Needed

Lift stations are used when wastewater cannot flow by gravity alone.

They:

- Lift wastewater to a higher elevation
- Prevent basement backups
- Prevent SSOs

Basic Lift Station Components

- Wet well
- Pumps (submersible or dry-pit)
- Controls and level sensors
- Alarms and power supply

Wet Well vs. Dry Well

- **Wet well:** Contains wastewater
- **Dry well:** Contains pumps and controls

AMWOP Exam Rule:
Lift stations prevent backups — not overflows.

---

5. Force Mains

What Is a Force Main?

A **force main** is a pressurized pipe that carries wastewater from a lift station.

Key characteristics:

- Flow under pressure
- No gravity slope required
- Prone to anaerobic conditions

Common Force Main Issues

- Septic wastewater
- Odors (H_2S)
- Air binding
- Corrosion

AMWOP Exam Insight:
Force mains often deliver septic wastewater to the plant.

---

6. Infiltration & Inflow (I/I) — Heavily Tested

Infiltration

- Groundwater entering the system
- Through cracked pipes, joints, manholes
- Occurs slowly and continuously

Inflow

- Surface water entering directly
- Through roof drains, yard drains, manhole covers
- Occurs rapidly during rain events

Effects of I/I

- Hydraulic overload
- Reduced treatment efficiency
- Increased SSOs
- Higher operating costs

AMWOP Exam Rule:
I/I causes high flow — not high BOD.

7. Sanitary Sewer Overflows (SSOs)

What Is an SSO?

An SSO is any discharge of untreated wastewater from the collection system.

Common Causes

- Blockages
- Pump failures
- Power outages
- Excessive I/I

Public Health Impact

- Exposure to pathogens
- Surface water contamination
- Property damage

Operator Responsibilities

- Protect public health
- Stop the overflow if possible
- Notify supervision immediately
- Document and report per regulations

AMWOP Exam Rule:
Public health protection comes first — reporting is mandatory.

---

8. Odors, Septic Conditions & Corrosion

Why Odors Occur

Odors form when wastewater becomes **anaerobic**.

Key gas:

- Hydrogen sulfide (H_2S)
    - Rotten egg odor
    - Toxic and corrosive

Corrosion

- H_2S converts to sulfuric acid
- Destroys concrete pipes and structures

AMWOP Exam Insight:
Odors indicate oxygen depletion.

---

9. Collection System Maintenance

Routine maintenance includes:

- Sewer cleaning
- Root control
- Grease (FOG) management
- Manhole inspections
- Lift station inspections

Preventive maintenance:

- Reduces SSOs
- Extends system life
- Lowers emergency response costs

AMWOP Operator Rule:
Preventive maintenance is cheaper than emergency response.

---

10. Safety in Collection Systems

Major Hazards

- Confined spaces
- H_2S and methane
- Traffic hazards
- Slips, trips, and falls
- Electrical equipment

Critical Safety Rules

- Never enter confined spaces without permit
- Use gas detection

- Wear required PPE
- Follow lockout/tagout

AMWOP Safety Principle:
No collection task is worth a life.

---

11. Level 1 Operator Responsibilities

Level 1 operators may be responsible for:

- Visual inspections
- Responding to alarms
- Reporting blockages or SSOs
- Assisting with maintenance
- Accurate documentation

Operators must:

- Stay within certification scope
- Follow SOPs
- Report abnormal conditions immediately

---

12. How Collection Systems Affect the Treatment Plant

Collection problems can cause:

- Hydraulic surges
- Septic influent
- Increased grit
- Biological upsets
- Disinfection failures

Key Concept:
Many “plant problems” start upstream.

---

13. Why Collection Systems Matter

Effective collection systems:

- Protect public health
- Prevent environmental damage
- Support stable plant operation
- Reduce regulatory risk

AMWOP Operator Mindset:

You can't run a good plant with a failing collection system.

AMWOP EXAM FOCUS SUMMARY

Top Collection System Concepts Tested Nationwide

- Gravity vs. force mains
- Manhole purpose and hazards
- Lift station function
- Wet well vs. dry well
- Infiltration vs. inflow
- SSOs and reporting
- Odors and H_2S
- Collection system safety
- Impact on plant operations

AMWOP Study Edition Standard

This chapter ensures operators understand how wastewater reaches the plant, how collection failures affect treatment, and why collection systems are a frontline public health responsibility. Mastery of this material is essential for Level 1 exam success and competent municipal operation.

AMWOP – Chapter 7 Exam

Collection Systems & Lift Station Operations

Level 1 Practice Exam

Instructions:
Select the **best** answer for each question.

---

1. The primary purpose of a wastewater collection system is to:

A. Treat wastewater
B. Store wastewater
C. Convey wastewater to the treatment plant
D. Disinfect wastewater

---

2. Collection systems are considered part of wastewater treatment because they:

A. Improve effluent quality
B. Protect public health before treatment
C. Remove pathogens
D. Reduce BOD

---

3. Gravity sewers rely primarily on:

A. Pumps
B. Pressure
C. Slope and velocity
D. Chemicals

---

4. Low velocity in gravity sewers can result in:

A. Improved flow
B. Solids deposition and blockages
C. Better odor control
D. Increased treatment efficiency

5. Which structure provides access for inspection and maintenance of sewers?

A. Lift station
B. Clarifier
C. Manhole
D. Force main

---

6. A major safety hazard associated with manholes is:

A. High temperature
B. Confined space conditions
C. UV exposure
D. Noise

---

7. Hydrogen sulfide (H_2S) is dangerous because it is:

A. Odorless and harmless
B. Only corrosive
C. Toxic and corrosive
D. Only explosive

---

8. Lift stations are required when wastewater:

A. Must be disinfected
B. Cannot flow by gravity alone
C. Has high BOD
D. Is treated biologically

---

9. The primary function of a lift station is to:

A. Treat wastewater
B. Store wastewater
C. Lift wastewater to a higher elevation
D. Remove solids

---

10. The portion of a lift station that contains wastewater is the:

A. Dry well
B. Control panel
C. Wet well
D. Force main

11. Which type of pipe carries wastewater under pressure?

A. Gravity sewer
B. Force main
C. Lateral
D. Manhole barrel

---

12. Force mains are prone to which condition?

A. High dissolved oxygen
B. Aerobic treatment
C. Septic wastewater and odors
D. Improved clarity

---

13. Infiltration is best described as:

A. Surface water entering rapidly
B. Groundwater entering through defects
C. Wastewater backing up into homes
D. Treated effluent discharge

---

14. Inflow is best described as:

A. Slow groundwater seepage
B. Wastewater leaving the system
C. Surface water entering during storms
D. Treated sludge return

---

15. Infiltration and inflow (I/I) primarily cause:

A. Higher BOD
B. Hydraulic overload
C. Increased pathogen levels
D. Improved treatment

---

16. A sanitary sewer overflow (SSO) is defined as:

A. Treated effluent discharge
B. Stormwater runoff
C. Any discharge of untreated wastewater from the collection system
D. Sludge disposal

---

17. The FIRST priority during an SSO is to:

A. Complete paperwork
B. Protect public health
C. Repair equipment
D. Notify regulators

---

18. Odors in collection systems usually indicate:

A. Aerobic conditions
B. High chlorine residual
C. Anaerobic conditions
D. Proper operation

---

19. Hydrogen sulfide contributes to corrosion by forming:

A. Nitric acid
B. Sulfuric acid
C. Carbonic acid
D. Hydrochloric acid

---

20. Which activity helps prevent collection system failures?

A. Emergency response only
B. Preventive maintenance
C. Ignoring minor blockages
D. Increasing flow

---

21. Fats, oils, and grease (FOG) primarily cause:

A. Improved velocity
B. Reduced odors
C. Blockages
D. Lower maintenance costs

---

22. Which hazard is common during collection system work?

A. Radiation
B. Confined spaces and traffic
C. High-altitude exposure
D. Extreme cold

---

23. Level 1 operators may be responsible for:

A. Designing sewer systems
B. Writing permits
C. Responding to alarms and reporting issues
D. Approving capital projects

---

24. Collection system failures can cause which plant problem?

A. Reduced influent flow
B. Septic influent and biological upsets
C. Improved effluent quality
D. Lower operating costs

---

25. Which statement best summarizes the operator's role in collection systems?

A. Collection systems are separate from treatment
B. Collection systems only matter during storms
C. Collection systems protect public health and plant stability
D. Collection systems require no documentation

✅ AMWOP – Chapter 7 Answer Key

Question	Correct Answer
1	**C**
2	**B**
3	**C**
4	**B**
5	**C**
6	**B**
7	**C**
8	**B**
9	**C**
10	**C**
11	**B**
12	**C**
13	**B**
14	**C**
15	**B**
16	**C**
17	**B**
18	**C**
19	**B**
20	**B**
21	**C**
22	**B**
23	**C**
24	**B**
25	**C**

PROBLEM 7.1 Flow Through Pipe

Pipe diameter = 10 inches, velocity = 3 ft/sec. Find gpm.

Given Information	Value or Detail
Pipe diameter	10 in
Velocity	3 ft/sec
Conversion	448.8 gpm per cfs
Required result	Flow in gpm

Step by Step Solution

STEP 1	Convert the diameter to feet 10 in ÷ 12 in/ft = 0.833 ft
STEP 2	Write the area formula using diameter in feet Area = $0.785 \times D^2$
STEP 3	Insert the diameter Area = $0.785 \times 0.833^2 = 0.545$ ft²
STEP 4	Calculate flow in cfs Flow = 0.545 ft² × 3 ft/sec = 1.635 cfs
STEP 5	Convert cfs to gpm 1.635 × 448.8 = 734 gpm

Final Answer **Flow = 734 gpm.**

PROBLEM 7.2

Pumping Rate

A pump fills 18,000 gallons in 45 minutes. Find gpm.

Given Information	Value or Detail
Volume pumped	18,000 gal
Time	45 minutes
Required result	Pumping rate in gpm

Step by Step Solution

STEP 1	Write the pumping rate formula gpm = Gallons ÷ Minutes
STEP 2	Insert the values gpm = 18,000 ÷ 45
STEP 3	Divide gpm = 400 gpm

Final Answer

Pumping rate = 400 gpm.

PROBLEM 7.3

Speed of the Second Pulley

Given Information	Value or Detail
Driver diameter D_1	6 in
Driver speed RPM_1	600 RPM
Driven diameter D_2	18 in
Assumption	No belt slip
Required result RPM_2	Second pulley speed

Step by Step Solution

STEP 1	Write the pulley relationship $D_1 \times RPM_1 = D_2 \times RPM_2$
STEP 2	Solve for the second pulley speed $RPM_2 = (D_1 \times RPM_1) \div D_2$
STEP 3	Insert the known values $RPM_2 = (6 \text{ in} \times 600 \text{ RPM}) \div 18 \text{ in}$
STEP 4	Multiply the numerator $RPM_2 = 3{,}600 \div 18 \text{ RPM}$

STEP 5	Divide to find the speed RPM_2 = 200 RPM

Final Answer

Second pulley speed = 200 RPM.

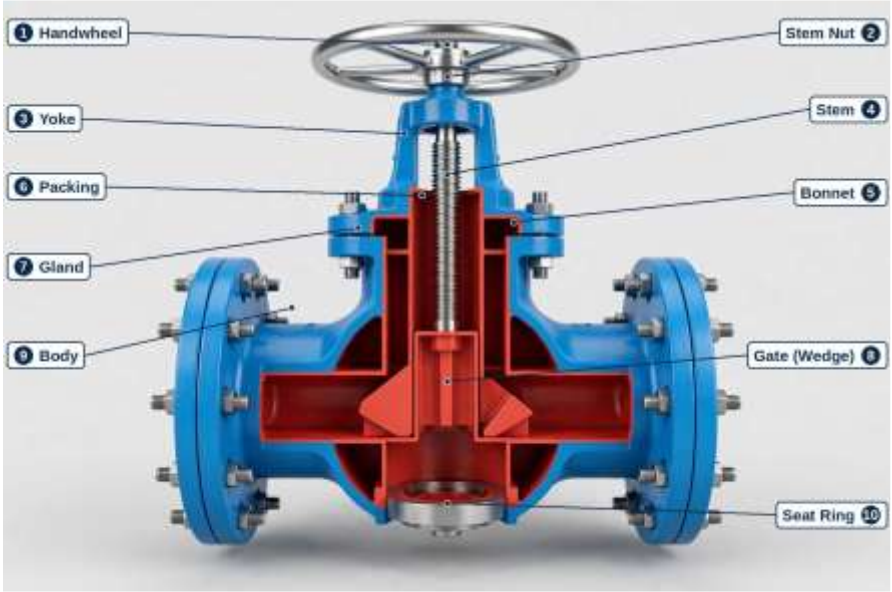
Check: a pulley three times larger turns at one third of the driver speed.

AMWOP™
VISUAL ATLAS

GATE VALVE

Rising Stem • Flanged • Bolted Bonnet

EQUIPMENT TYPE
VALVE



AMWOP™
VISUAL ATLAS

PLUG VALVE

Lubricated Plug • Pressure Balanced

EQUIPMENT TYPE
VALVE

