

# Artificial Lift Training: How Gas Lift Works – Lesson Design Document

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## Lesson Overview

This lesson, M2L3 - How Gas Lift Works, is one of four lessons in the Artificial Lift Concepts module. The other lessons in the module include:

- M2L1 - How Rod Pump Works
- M2L2 - How Electric Submersible Pump (ESP) Works
- M2L4 - How Plunger Lift Works

Conceptual knowledge describes knowledge of categories, principles, theories, and structures that are applied to all lifts in a class, i.e., “the general idea.” Concept modules will ensure technicians can apply (use) facts they acquired in previous module(s) and lessons.

Learners will acquire practical knowledge and learn rules and relationships. Verification may include verbs such as “Describe how”, “Relate cause to effect”, “Describe impact”, “Interpret”, or “Explain purpose.”

Concept modules will have a higher cognitive load than fact modules and may require basic analytical skills.

This lesson ensures technicians develop a factual and conceptual understanding of gas lift, its components, operation, and optimization strategies. The lesson integrates high-fidelity visuals, 3D animated models, interactive exercises, and voice-over narration to enhance learning.

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## Lesson Objectives / Verification Outcomes

After completing this lesson, How Gas Lift Works, technicians will be able to:

## Introduction to Gas Lift

1. Identify specific applications of gas lift in artificial lift operations, providing examples of when it is the preferred method.
2. Explain the principles and characteristics of gas lift, including the role of injected gas in creating a pressure differential between the wellhead and reservoir, with a focus on optimizing production efficiency.
3. Differentiate between continuous and intermittent gas lift, explaining the operational differences and identifying conditions where each type is most effective based on well and reservoir characteristics.
4. Describe and compare the two primary methods of gas lift valve operation— injection-pressure-operated (IPO) and production-pressure-operated (PPO) valves—detailing their functionality, advantages, and best-use scenarios.

## Gas Lift System Operations and Components

1. Describe the operation of gas lift, explaining the step-by-step process of how injected gas reduces hydrostatic pressure, allowing liquids to move from the production zone to the wellhead.
2. Analyze the effects of pressure on gas lift performance, detailing how variations in reservoir pressure, injection pressure, and tubing pressure impact production efficiency.
3. Identify and compare typical gas lift flow patterns, describing the characteristics of continuous and intermittent gas flow and their influence on well performance.
4. Explain the process of gas well unloading, outlining the sequence of unloading valves opening, pressure changes, and the transition to stable gas lift operation.
5. Identify and describe the components of a gas lift well, explaining the function of each part—including mandrels, gas lift valves, tubing, and injection lines—in maintaining efficient lift operations.

## Abnormal Operating Conditions

1. Identify and explain common abnormal gas lift operating conditions, such as gas lock, unstable flow, and heading, describing their causes and potential production impacts.
2. Describe the effects of hydrates and improper gas injection rates on gas lift performance, explaining how these issues develop and outlining strategies for prevention and mitigation.
3. Analyze the factors influencing pressure drop in a gas lift system, including friction, fluid properties, well depth, and gas injection rates, and explain how these factors impact overall system efficiency.

## Prerequisites

No prerequisites are required for this module. However, if bundled on WebCAT, all Artificial Lift Concept lessons should be taken in sequence.

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## Primary Target Audience

Technicians and personnel responsible for operating, maintaining, and troubleshooting gas lift systems at our facilities, in alignment with the Artificial Lift Competency Framework.

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## Lesson Duration

30 minutes

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## Instructional Approach

This lesson includes:

- 3D augmented model(s) of gas lift components.
  - Interactive features engaging learners every 2-3 slides.
  - Instructional design elements such as:
    - Learner interaction
    - XOM 360, ZYNQ 360, Veerum images
    - 2D and 3D animations/models
    - Video snippets
    - Voice-over narration
    - Hover-over vocabulary definitions
    - Glossary
    - Transcript
    - Navigation instructions for progressing through screens
    - Limited knowledge checks after each section
    - Verification questions aligned with the PAV Competency Framework
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## Delivery Methods

- Delivered via WebCAT
  - Packaged as a stand-alone eLearning module for remote sites
  - Packaged for instructor-led classroom training (ILT)
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## Topical Outline

### Lesson 1: Introduction to Gas Lift

Duration: 5 minutes

Topics Covered:

- Welcome to Gas Lift Operations Training: How Gas Lift Works
- Where this lesson fits in the Artificial Lift curriculum
- Purpose of the lesson: Importance of gas lift in hydrocarbons
- Basic function of gas lift: How gas injection helps production

Questions Addressed:

- What is gas lift?
- What are the advantages of gas lift over other lift methods?
- What is the difference between continuous and intermittent gas lift?

Learning Objectives:

- Define gas lift and its role in artificial lift methods.
- Explain the basic physics behind gas lift.
- Differentiate continuous vs. intermittent gas lift.

Visuals & Media:

- Animation: Gas lift system in action
  - Video snippet: Gas lift application in the field
  - Knowledge Check: Identify correct gas lift applications
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### Lesson 2: Gas Lift System Components

Duration: 8 minutes

Topics Covered:

- Gas Lift System Overview
- Surface & Subsurface Components
- Types of Gas Lift Valves
- Gas Injection Control & Optimization

Questions Addressed:

- What are the key components of a gas lift system?
- How do gas lift valves function?
- What factors influence gas lift efficiency?

Learning Objectives:

- Identify surface components: compressor, gas injection line, wellhead.
- Identify subsurface components: mandrels, gas lift valves, production tubing.
- Compare injection pressure-operated (IPO) vs. production pressure-operated (PPO) valves.
- Explain how well conditions affect valve performance.

Visuals & Media:

- Labeled diagram of gas lift system
- Interactive diagram: Hover over components for descriptions
- 3D model of gas lift valves & mandrels
- Knowledge Check: Match gas lift components to functions

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### Lesson 3: Gas Lift Operations & Optimization

Duration: 12 minutes

Topics Covered:

- How Gas Lift Works: Injection pressure, fluid movement
- Optimizing Gas Lift Performance
- Abnormal Operating Conditions & Troubleshooting
- Gas Lift Surveillance & Maintenance

Questions Addressed:

- How does gas injection impact production?

- What are the best practices for gas lift optimization?
- What are common problems and failures in gas lift systems?

#### Learning Objectives:

- Describe the gas lift operating cycle.
- Explain the relationship between injection pressure, well depth, and production rate.
- Identify signs of gas lift inefficiency.
- List corrective actions for gas lock, unstable flow, and valve failure.
- Understand surveillance techniques to monitor gas lift efficiency.

#### Visuals & Media:

- Animation: Gas lift cycle from injection to production
  - Simulation: Adjusting gas injection rates in a virtual well
  - Audio cues: Recognizing gas lock sounds in operation
  - Interactive scenario: Diagnosing gas lift failure based on wellhead readings
  - Knowledge Check: Identify best optimization strategy for given well conditions
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### Lesson 4: Summary & Conclusion

Duration: 2 minutes

- Key takeaways: Gas lift benefits, operations, and optimization
  - Encouragement to review glossary and additional resources
  - Introduction to verification
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### Lesson 5: Verification

Duration: 6 minutes

Assessment Type: Multiple-choice, image-based matching, drag-and-drop activities

- Question 1: Identify the correct sequence in a gas lift cycle. (*Drag & Drop*)
  - Question 2: Match gas lift components to their functions.
  - Question 3: Select the best response for gas lock prevention.
  - Question 4: Identify correct gas lift optimization steps for a given scenario.
  - Question 5: Troubleshooting question: What abnormal operating condition is occurring?
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## Glossary

- Artificial Lift: A method to enhance production when reservoir pressure is insufficient.
  - Gas Lift: Injection of gas to lighten the hydrostatic pressure and assist fluid movement.
  - Gas Lift Valves: Subsurface valves regulating gas injection.
  - Continuous Flow Gas Lift: Constant gas injection to maintain production.
  - Intermittent Gas Lift: Periodic gas injection to lift slugs of fluid.
  - Gas Lock: Excessive gas causing a pump to lose efficiency.
  - Unloading Valves: Valves used to gradually move gas injection deeper.
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## Sources

- UARL-005-EN-GBL – Artificial Lift Basics
- UARL-010-EN-01-LG-GBL – Gas Lift System Theory & Operations
- Prod. Engineering Artificial Lift 2024
- Gas Lift Design Guide

## Lesson Duration

1. Lesson 1: Introduction to Gas Lift – 5 minutes
2. Lesson 2: Gas Lift System Components – 8 minutes
3. Lesson 3: Gas Lift Operations & Optimization – 12 minutes
4. Lesson 4: Summary & Conclusion – 2 minutes
5. Lesson 5: Verification – 6 minutes

Total Time: The estimated module duration is 33 minutes.