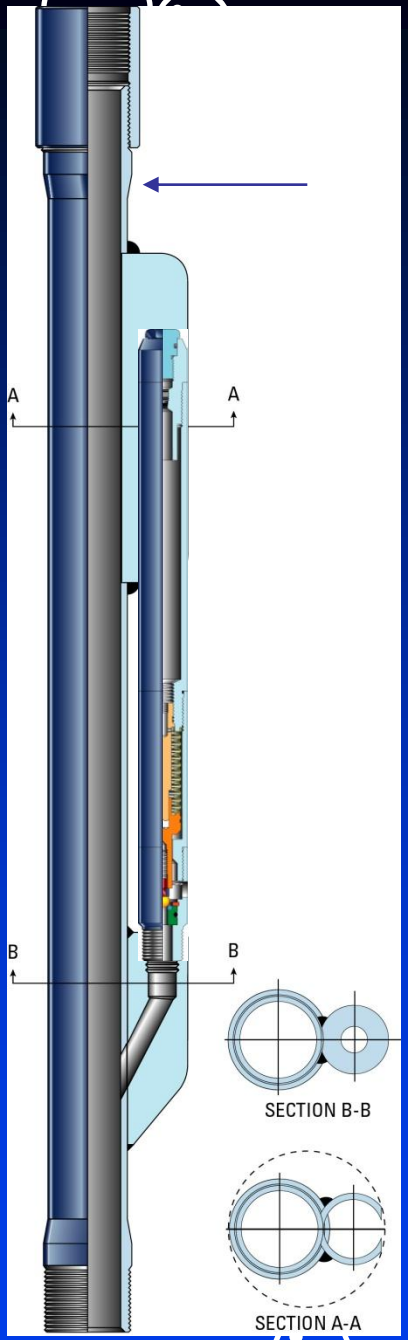
GAS LIFT EQUIPMENT

GAS LIFT EQUIPMENT

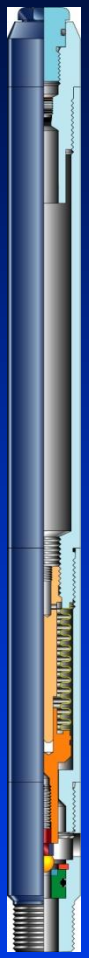
- Gas Lift Mandrels
  - Conventional
  - Retrievable
- Gas Lift Valves
  - Injection Pressure Operated
  - Production Pressure Operated
  - Orifice Valves
  - Latches
- Kickover Tools
- Surface Equipment

GAS LIFT EQUIPMENT

- Gas Lift Mandrels
  - Effectively a hole in the tubing
- Gas Lift Valves
  - Control gas or fluid passage through the mandrel



Conventional Mandrel

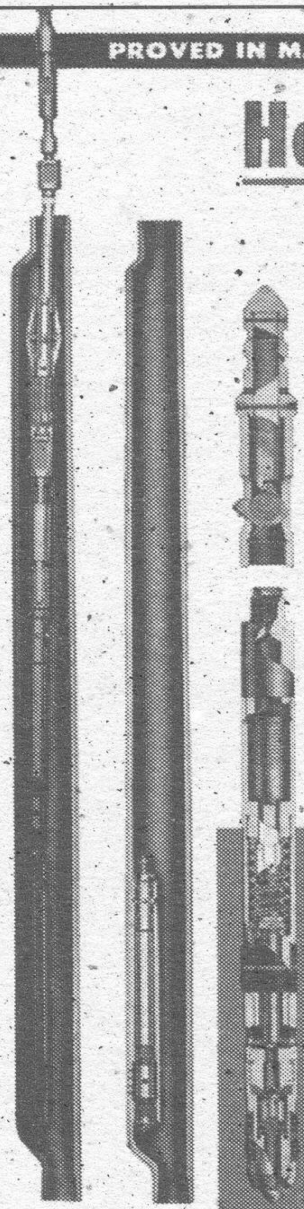


Conventional Gas Lift Valve

Conventional Gas Lift Equipment

PROVED IN MANY WELLS!

How to save the cost of pulling tubing on gas lift wells



With Camco retrievable mandrels installed in your tubing string, any Camco retrievable valve may be placed or removed **in any selected mandrel** . . . at any depth . . . without disturbing any of the other valves in the string and **without pulling a single joint of tubing.** In operation, Camco retrievable equipment functions identically to the respective Camco gas lift valves, and allows a free, unrestricted flow through tubing.

It will pay you now and in the future to get the full story of Camco Retrievable Gas Lift Equipment. Ask your Camco Representative or write for your free copy of the new Camco catalog.

"CAMCO LEADS THE GAS LIFT FIELD,
NOW AND IN THE FUTURE."

CAMCO, INC. - 7315 Canal St.
Houston, Texas

Export Representative:
INTERNATIONAL GAS LIFT, S. A., APARTADO 3249, CARACAS, VENEZUELA

CAMCO

RETRIEVABLE GAS LIFT EQUIPMENT

is the answer!

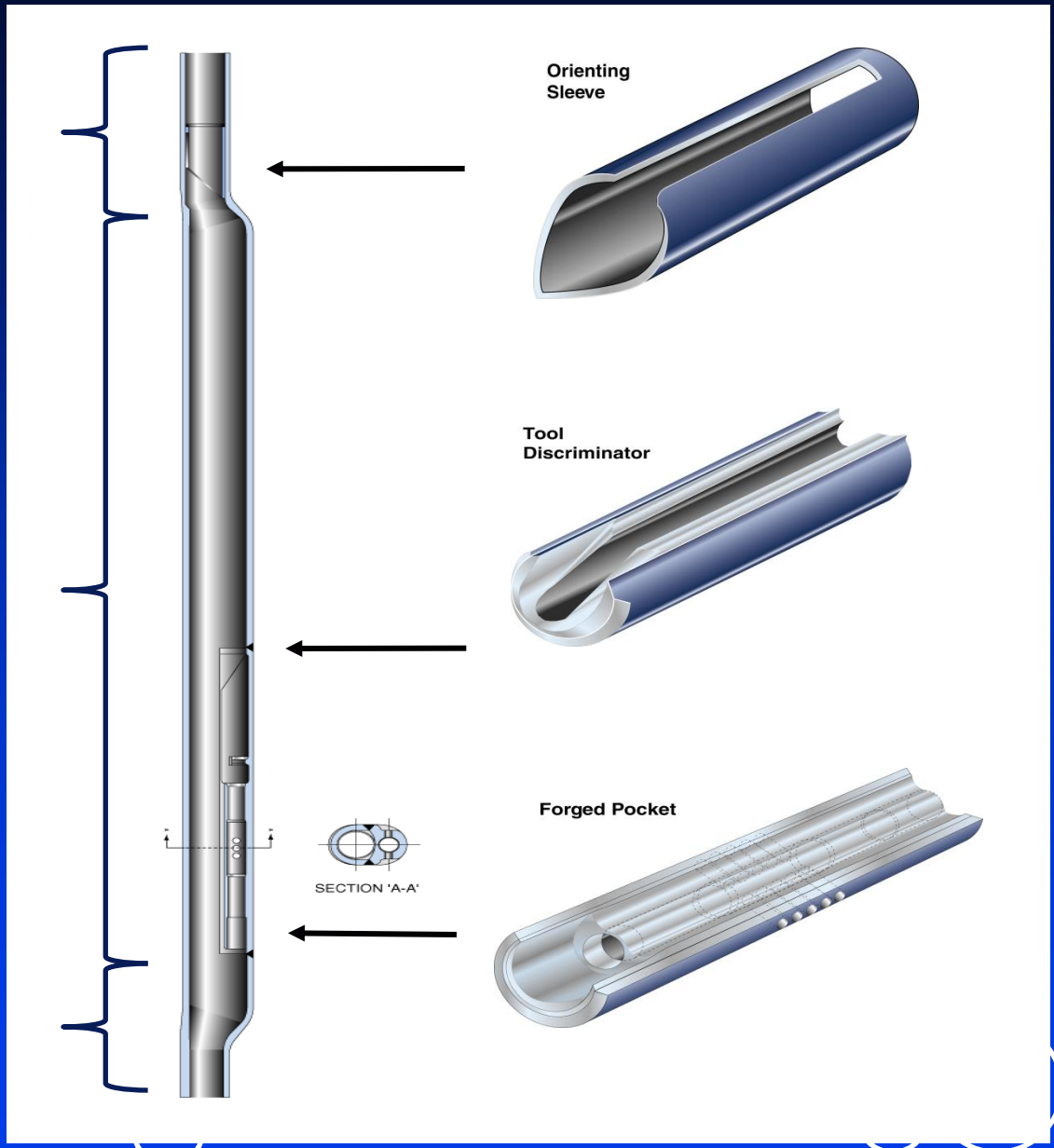
Circa 1951

SIDEPOCKET MANDRELS

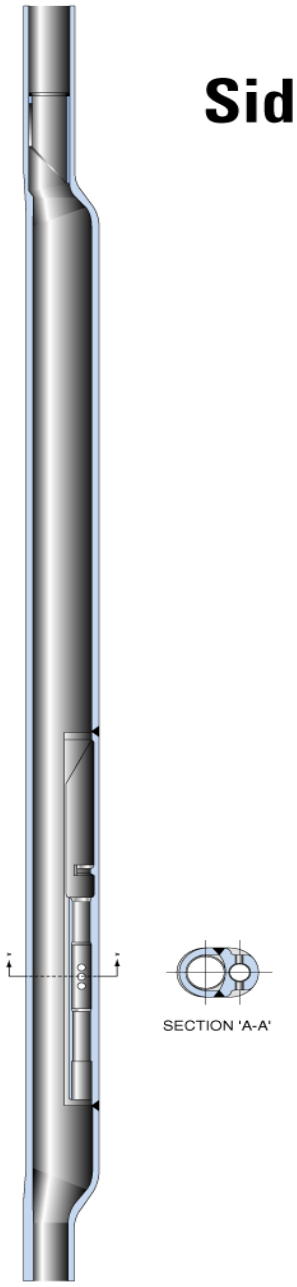
Upper Swage Assembly

Pipe Body

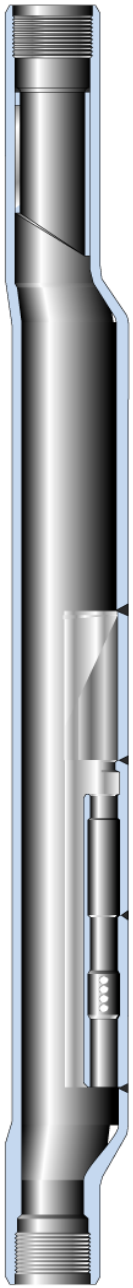
Lower Swage Assembly

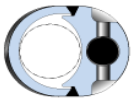


KBMG Series
Side Pocket Mandrels



MMG Series
Side Pocket Mandrels



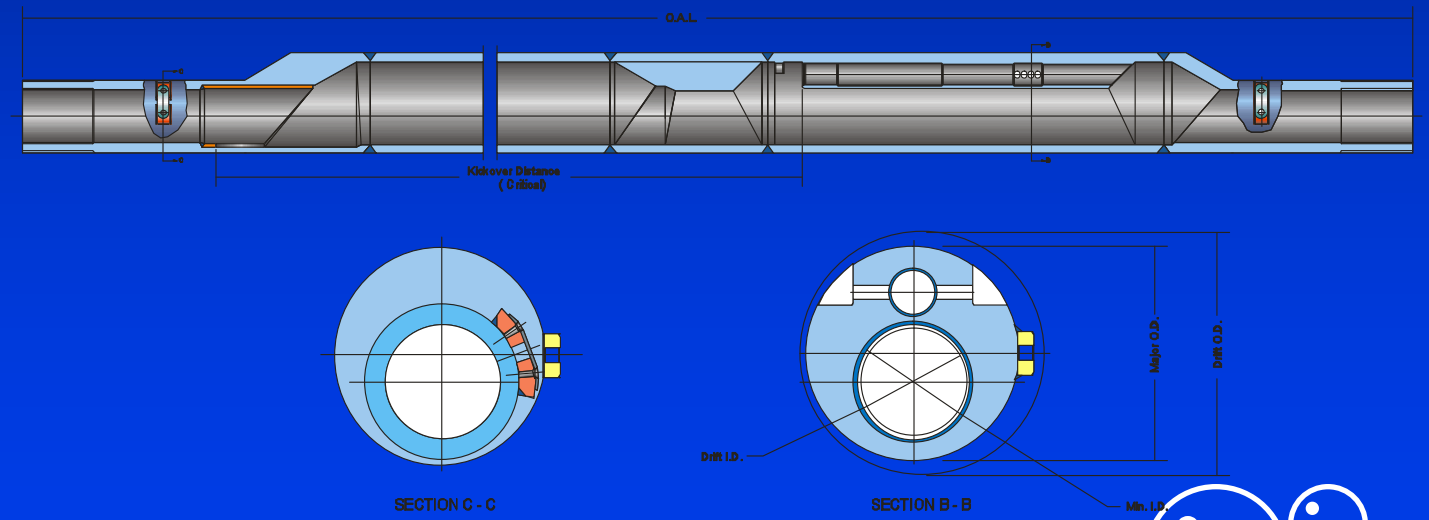


SECTION "A-A"

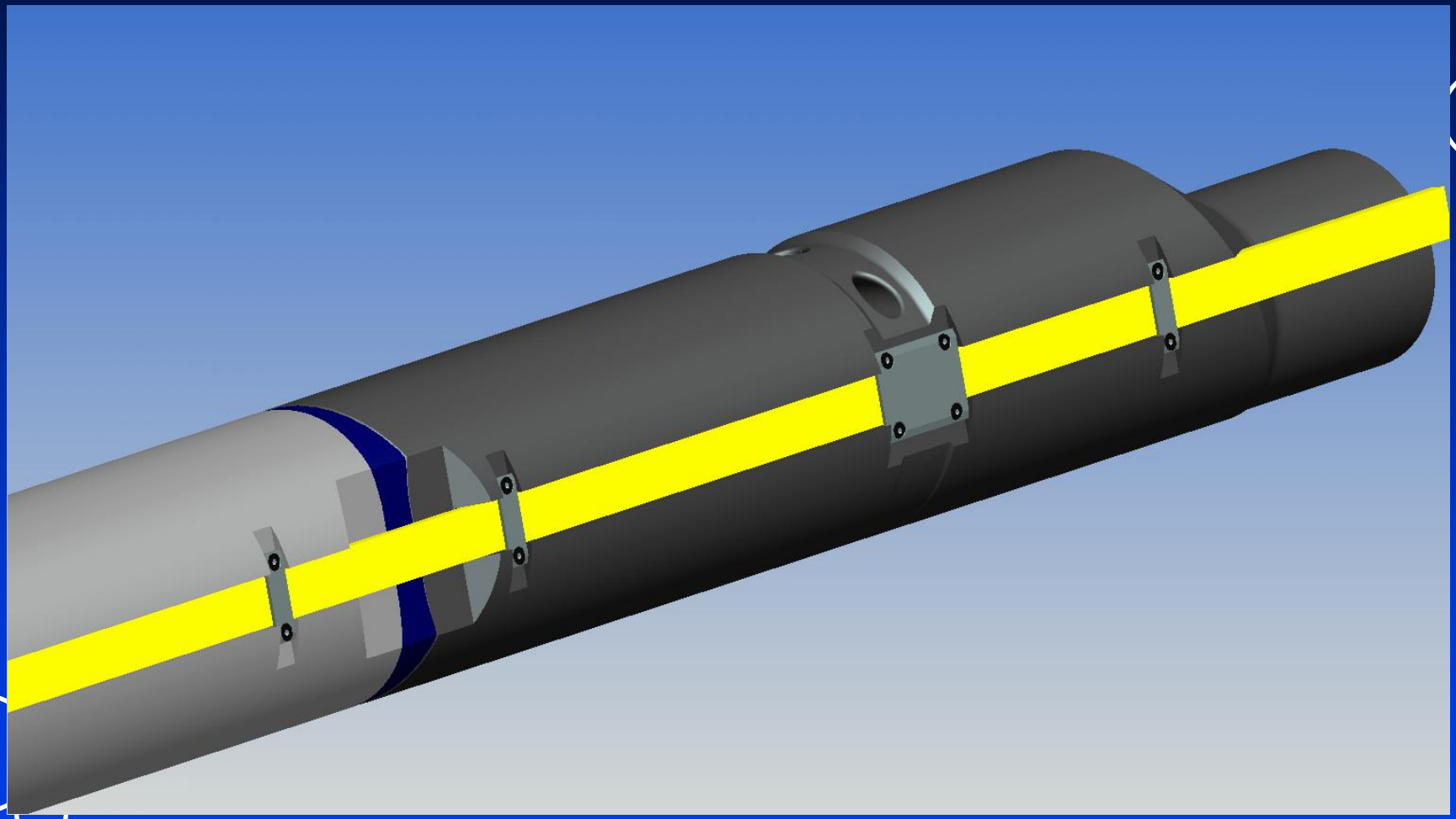
1) Heated to 1200 Deg C but they are brittle	3 hours	Wipes Slate Clean, allows grains to grow –
2) Then need to quench – Oil is the best, but it starts on fire - so a polymer quench is used	60 sec	Freezes Grains to seal hardness, but mandrel is not tough
3) Reheat to 700 Deg C	4 hours	This process allows the grains to fit well and ensures the mandrel is tough
4) Air Quench	30 min	
5) Reheat to 7000 Deg C	4 hours	
6) Air Quench	30 min	

GAS LIFT EQUIPMENT

- Sidepocket Mandrels
  - 1 or 1-1/2” Valve Pockets
  - Compatibility with tubulars (ratings and dimensionally)
  - Material selection (4130, 13Cr, Alloy 450, Inconel 718)



SIDEPOCKET MANDRELS



GAS LIFT VALVES

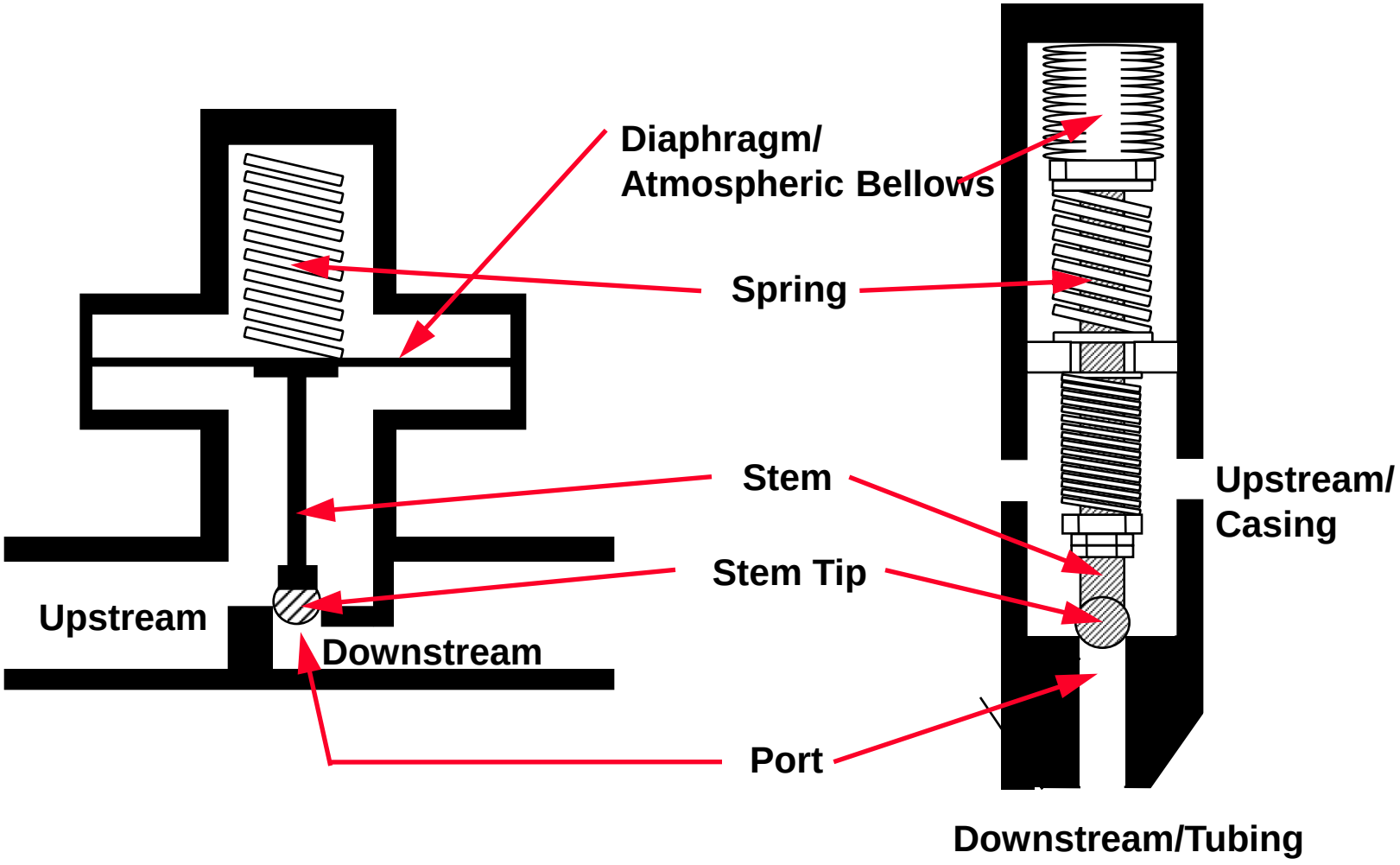
GAS LIFT VALVES

Three basic types of gas lift valve,

Each available in 1” & 1-1/2” sizes:

DUMMY VALVES	ORIFICE VALVES	UNLOADING VALVES
	• SQUARE EDGED • VENTURI (NOVA)	• INJECTION PRESSURE (CASING) OPERATED VALVES • PRODUCTION PRESSURE (FLUID) OPERATED VALVES • THROTTLING/PROPORTIONAL RESPONSE VALVES

UNLOADING VALVES

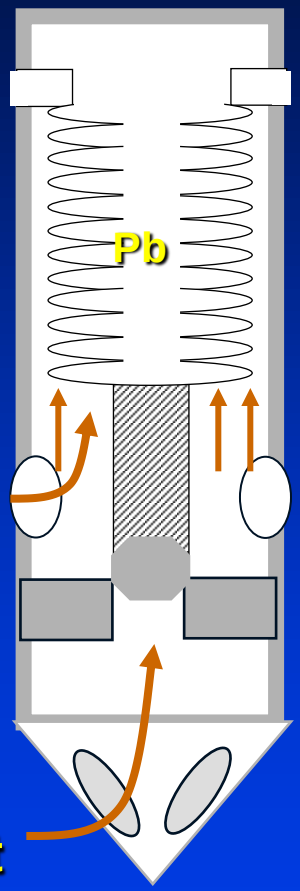


Pressure Regulator

Spring Operated Gas Lift Valve

VALVE OPENING & CLOSING PRESSURES

$F = P \times A$

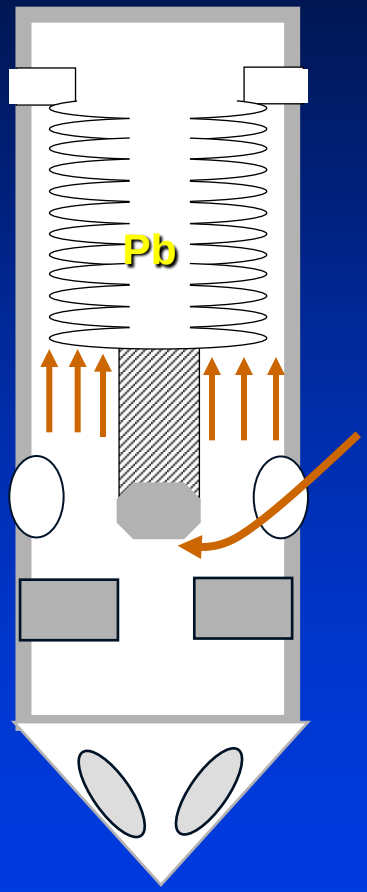


WHEN THE VALVE IS CLOSED TO OPEN IT.....

$Fo = Pc_1 (Ab - Ap) + Pt\ Ap$

WHEN THE VALVE IS OPEN TO CLOSE IT.....

$Fc = Pc_2 (Ab)$



VALVE OPENING & CLOSING PRESSURES

CLOSING FORCE (IPO VALVE) $Fc = PbAb$

OPENING FORCES (IPO VALVE) $Fo_1 = Pc\ (Ab - Ap)$
$Fo_2 = Pt\ Ap$

TOTAL OPENING FORCE $Fo = Pc\ (Ab - Ap) + Pt\ Ap$

JUST BEFORE THE VALVE OPENS THE FORCES ARE EQUAL

$$Pc\ (Ab - Ap) + Pt\ Ap = Pb\ Ab$$

SOLVING FOR Pc

$$Pc = \frac{Pb - Pt\ (Ap/Ab)}{1 - (Ap/Ab)}$$

WHERE:

- Pb = Pressure in bellows
- Pt = Tubing pressure
- Pc = Casing pressure
- Ab = Area of bellows
- Ap = Area of port

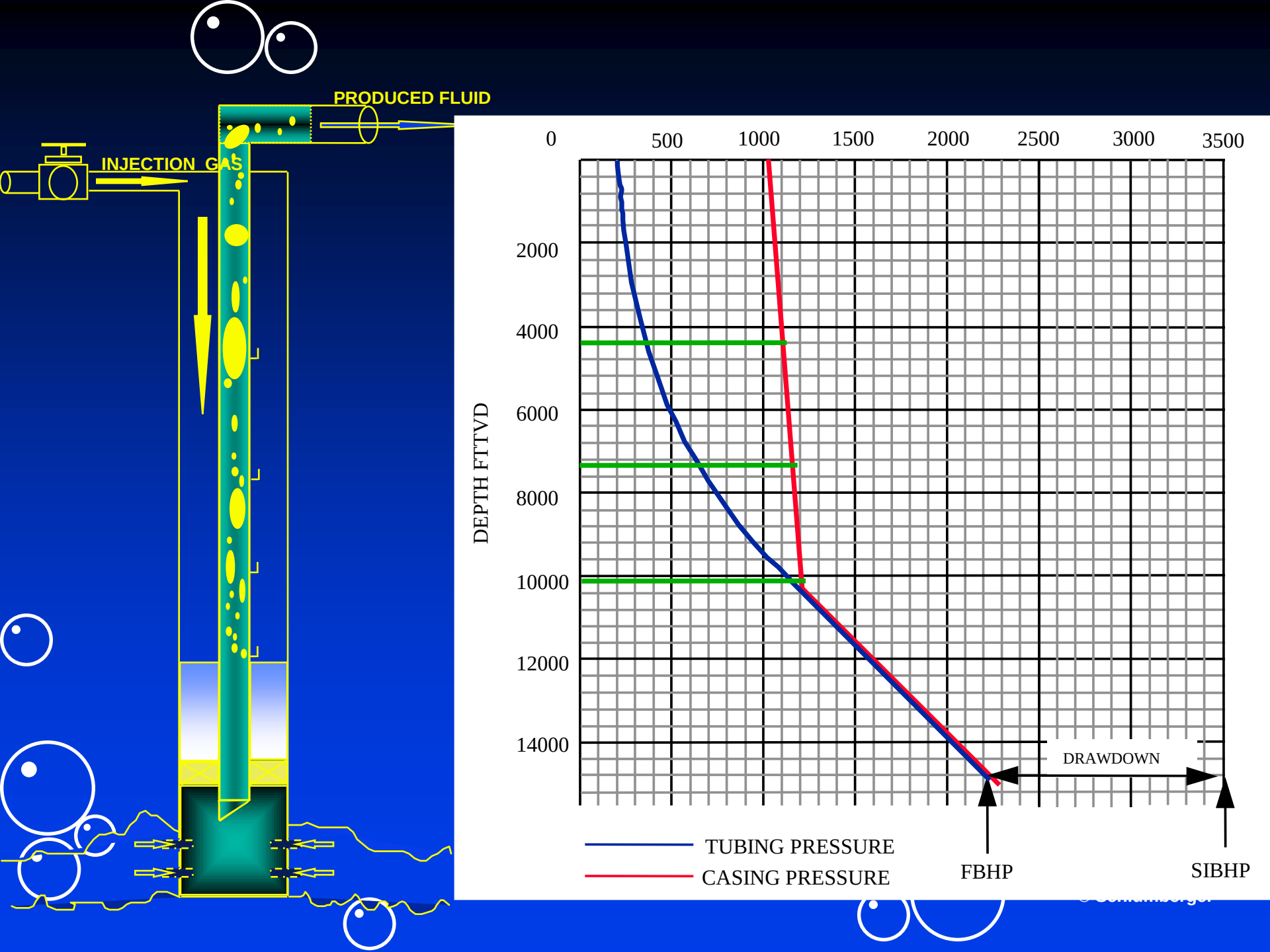
VALVE OPENING & CLOSING PRESSURES

$$Pc = \frac{Pb - Pt\,(Ap/Ab)}{1 - (Ap/Ab)}$$

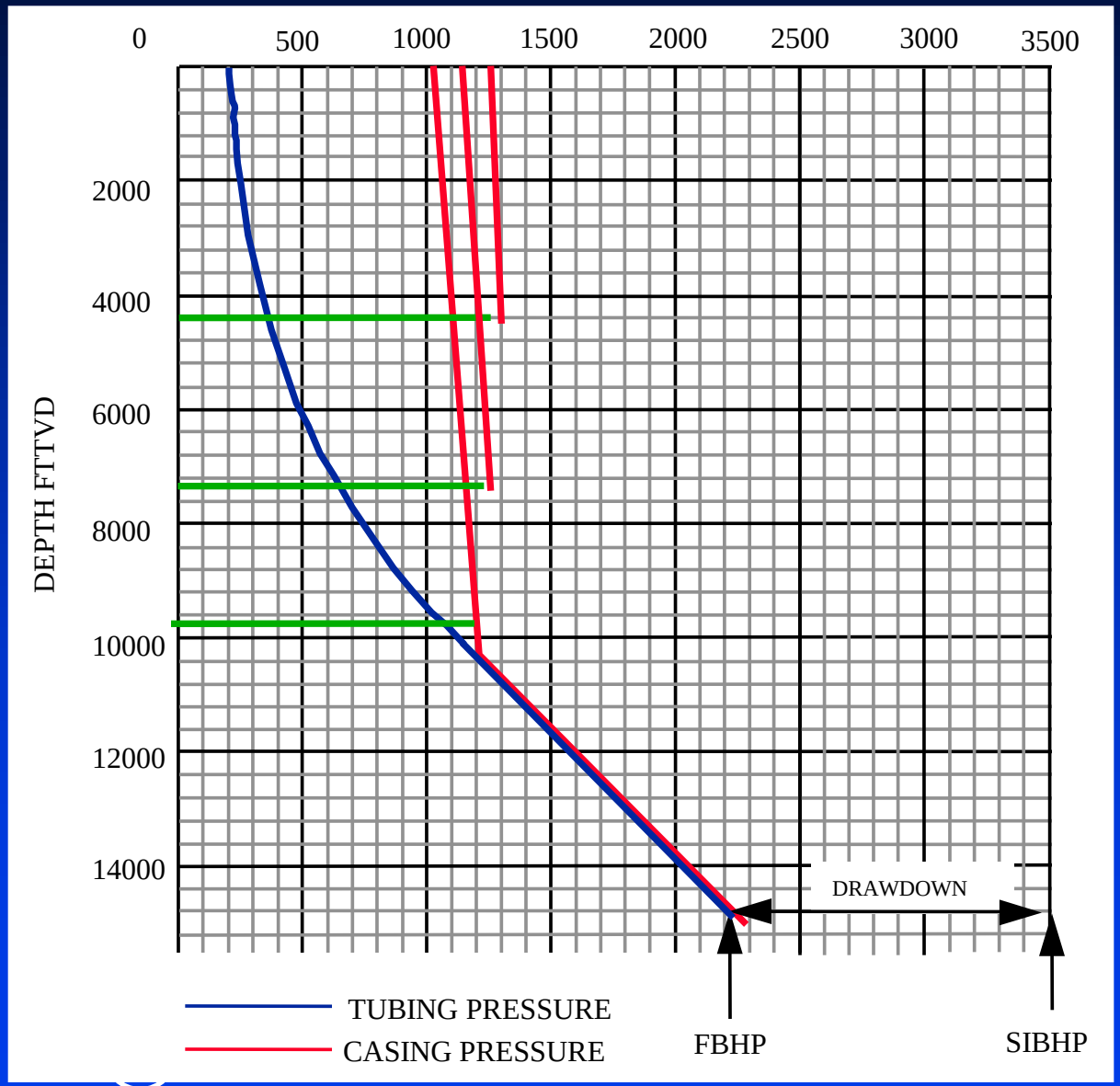
$$Pc = \frac{Pb - Pt\,(R)}{1 - R}$$

$$Pb = Pc\,(1 - R) + Pt\,(R)$$

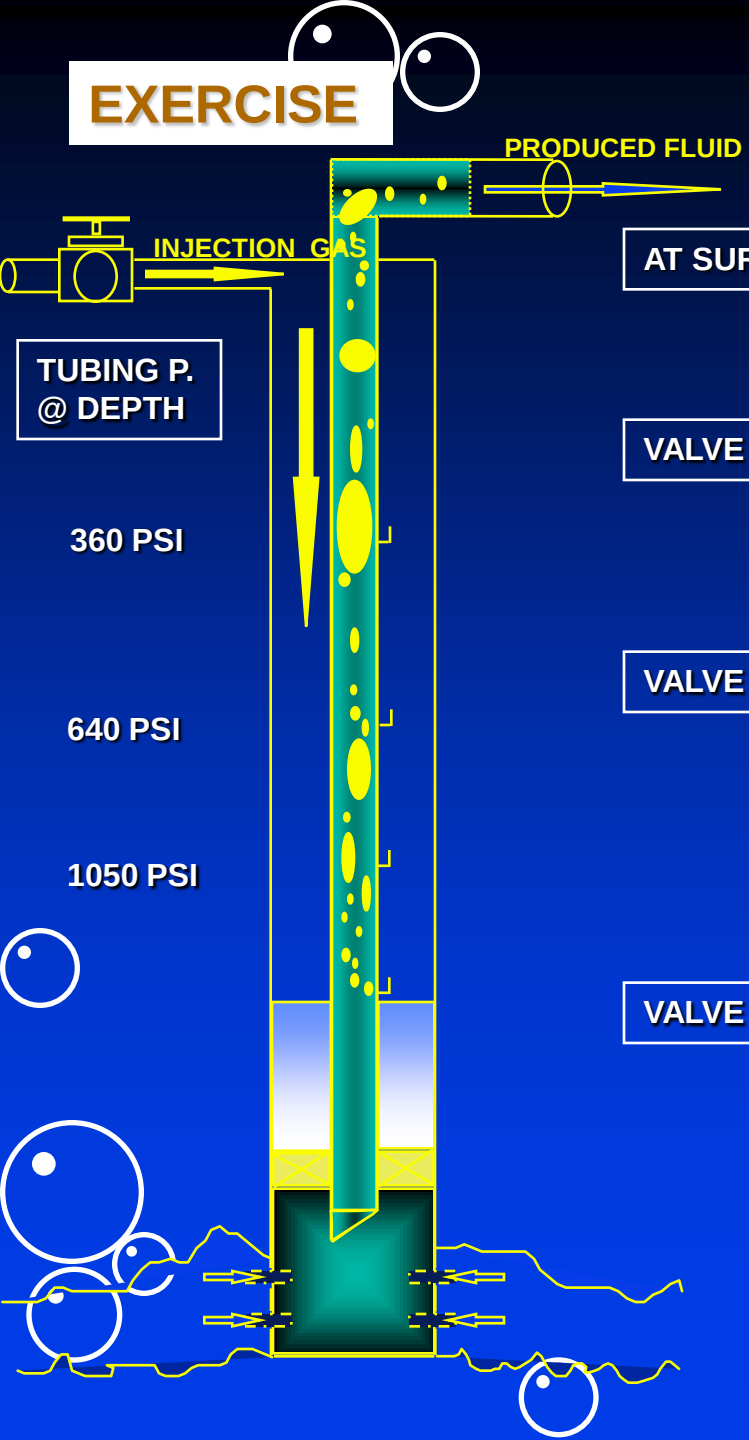
Where R = Ratio Ap/Ab


PRODUCED FLUID
INJECTION GAS
0
500
1000
1500
2000
2500
3000
3500
2000
4000
6000
8000
10000
12000
14000
DEPTH FTTVD
DRAWDOWN
TUBING PRESSURE
CASING PRESSURE
FBHP
SIBHP

GAS LIFT VALVES CLOSE IN SEQUENCE

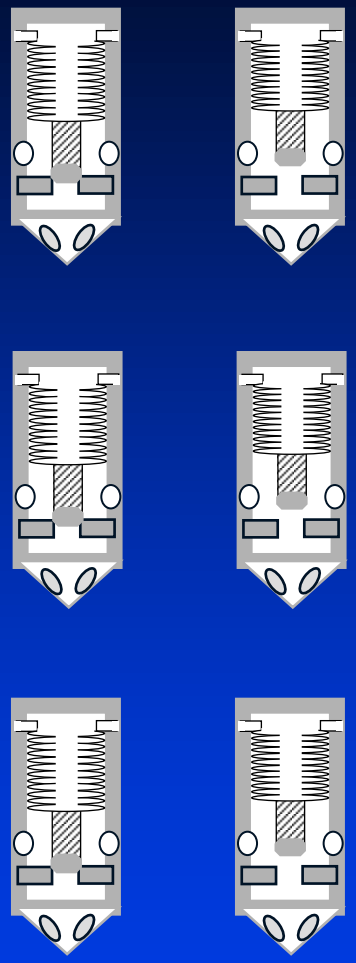


EXERCISE



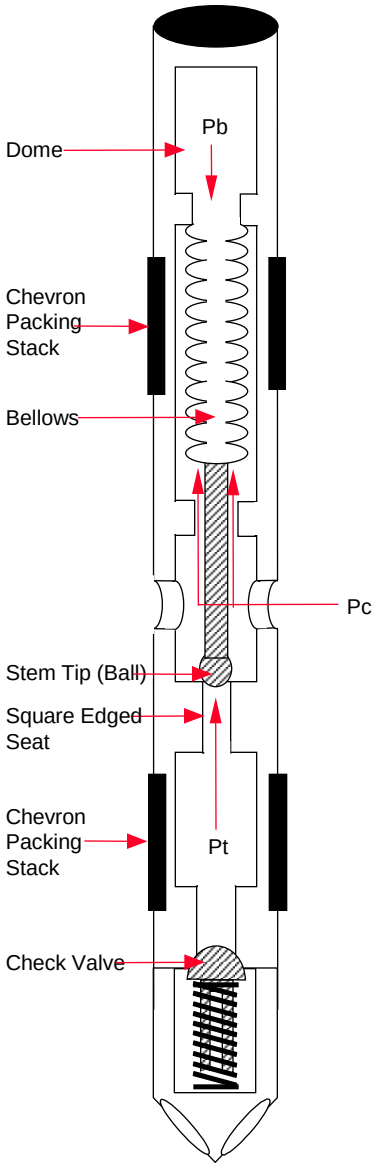
	DESIGN CASING P. TO OPEN	REQUIRED CASING P TO CLOSE
AT SURFACE	1250 PSI	
VALVE # 1	1310 PSI	? PSI
VALVE # 2	1260 PSI	? PSI
VALVE # 3	1200 PSI	? PSI

DOME P.

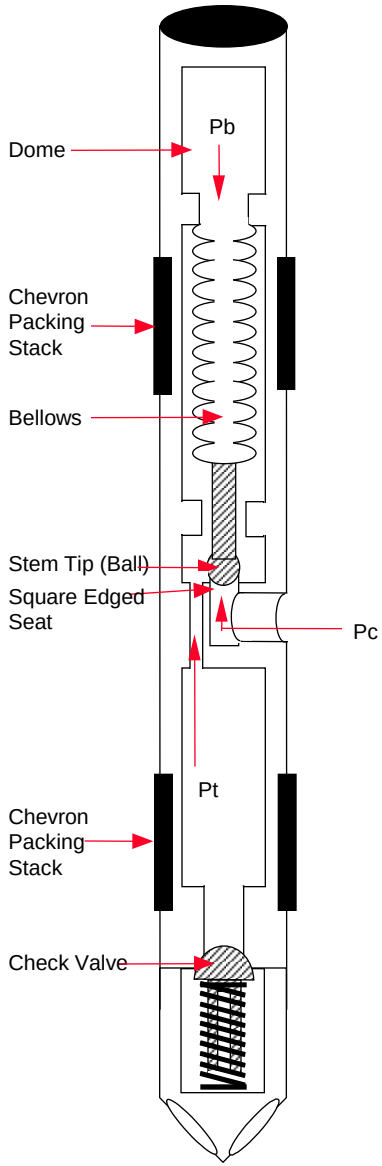


$$Pb = Pc (1-R) + Pt (R)$$

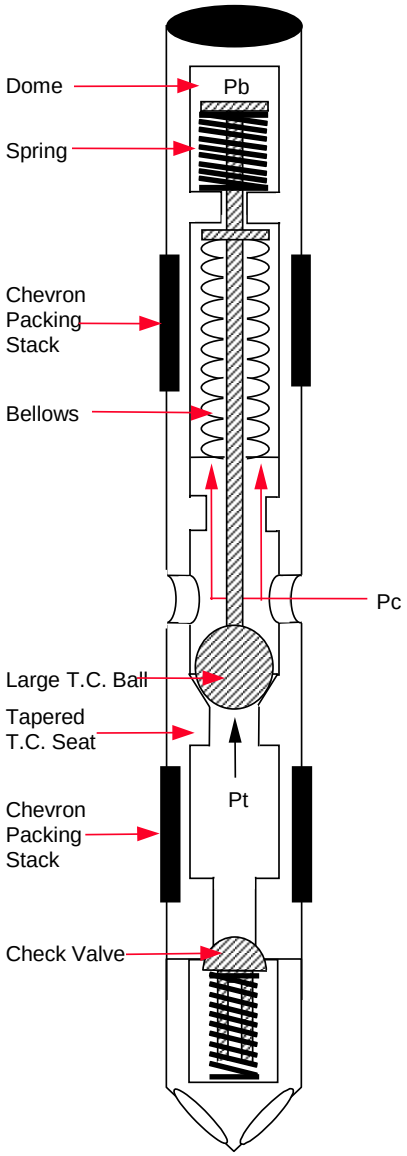
NOTE : ALL VALVES 3/16" R-20
R = 0.038 1-R = 0.962



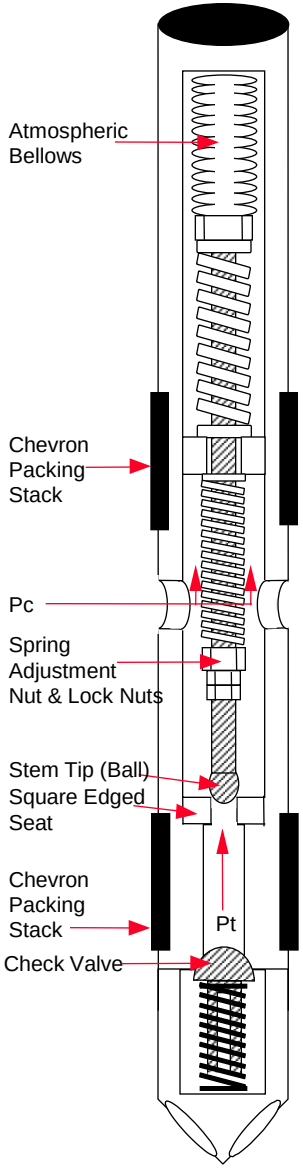
Nitrogen Charged Bellows Type
Injection Pressure (Casing) Operated Gas Lift Valve



Nitrogen Charged Bellows Type
Production Pressure (Fluid) Operated Gas Lift Valve

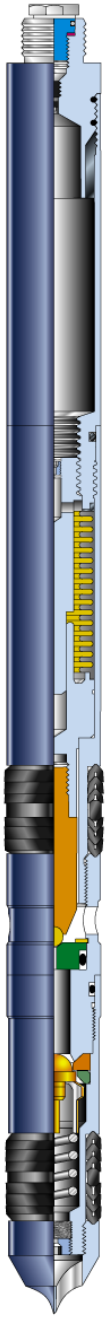


Nitrogen Charged Bellows Type
Proportional Response Gas Lift Valve



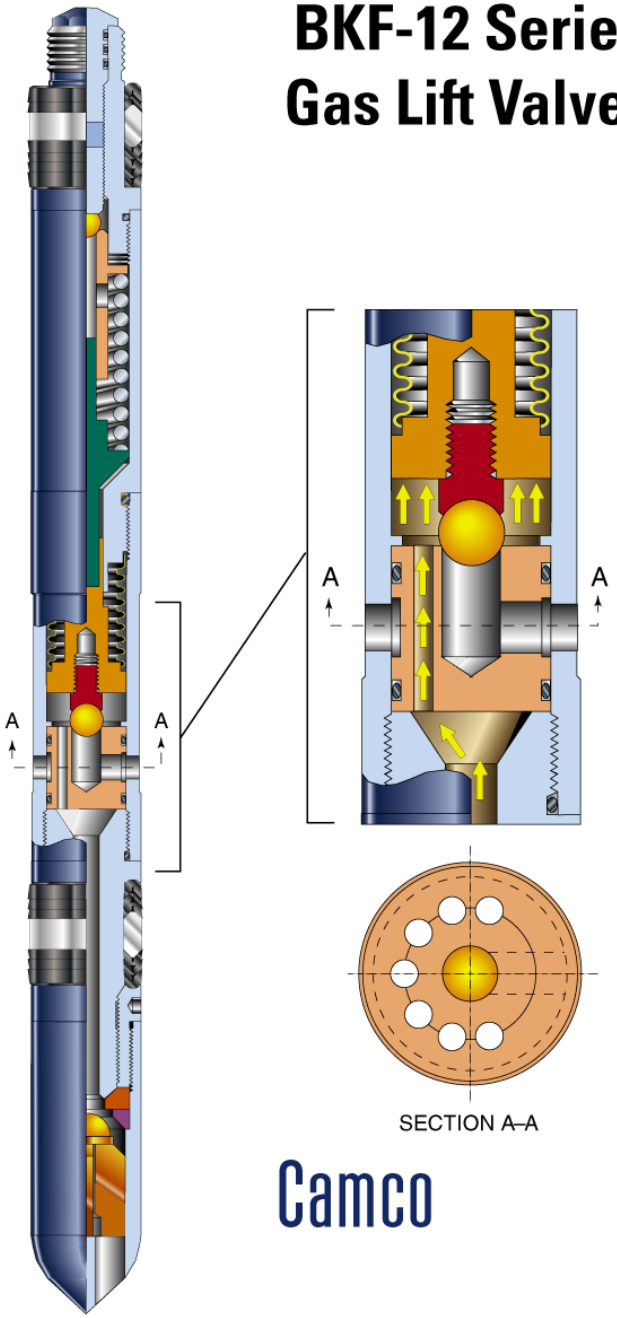
Spring Operated
Injection Pressure (Casing) Operated Gas Lift Valve

R-20 Series
Gas Lift Valves



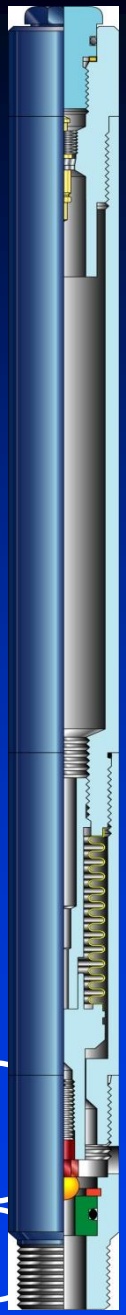
Camco

BKF-12 Series
Gas Lift Valves



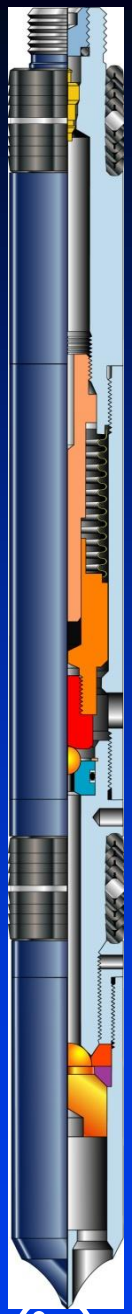
SECTION A–A

Camco



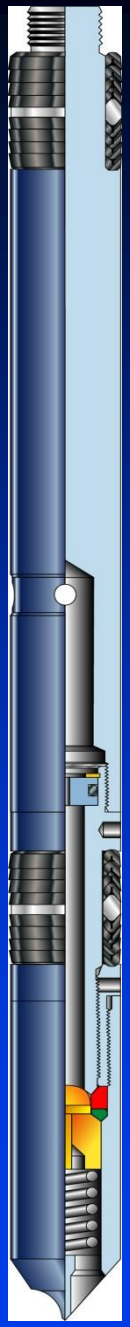
Conventional Tubing Retrievable Gas Lift Valve

IPO

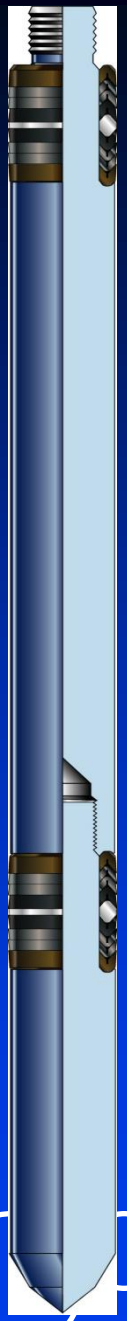


Wireline Retrievable Gas Lift Valve

IPO



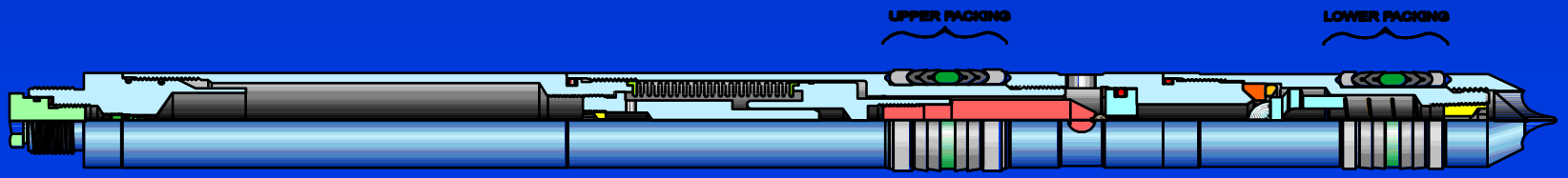
Wireline Retrievable Gas Lift Orifice Valve



Wireline Retrievable Dummy Valve

GAS LIFT VALVE FEATURES

- Bellows protection
- Max dome charge
- Check valve
- Stem travel
- Metallurgy
- Elastomers
- Max fluid rate



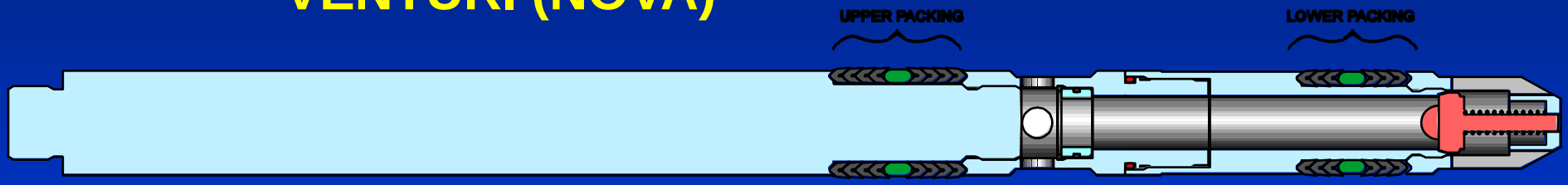
UNLOADING GAS LIFT VALVE

- Normally required during unloading phase only
- Open only when annulus and tubing pressures are high enough to overcome valve set pressure
- Valve closes after transfer to next station
- May be spring or nitrogen charged

ORIFICE VALVES

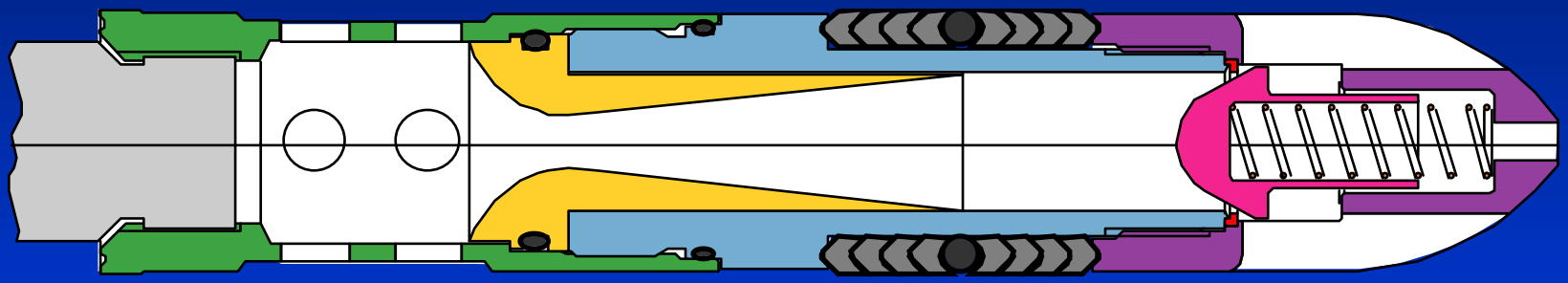
THERE ARE 2 TYPES OF ORIFICE VALVE:

- **SQUARED EDGED ORIFICE**
- **VENTURI (NOVA)**



- **Valve designed for accurate gas passage prediction.**
- **One-way check valve for tubing integrity.**

NOVA VALVE

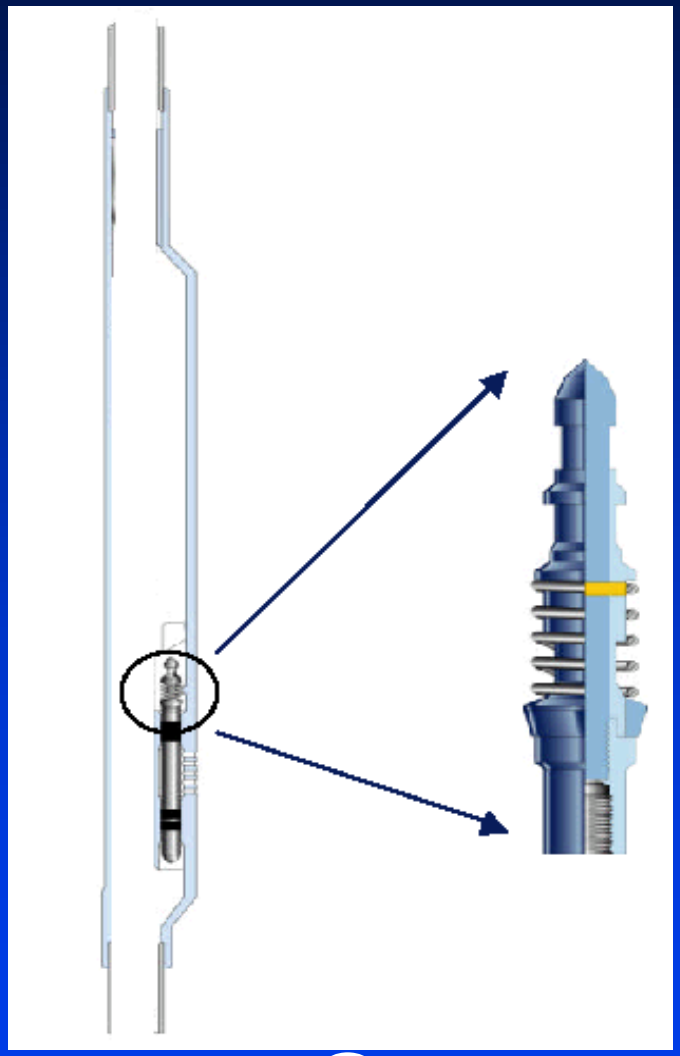


OPERATING GAS LIFT VALVE

- Typically an ‘orifice’ type Gas lift valve
- Always open - allows gas flow whenever correct differential exists
- Gas injection controlled by size and differential across replaceable choke
- Back-check prevents reverse flow of well fluids from the production conduit

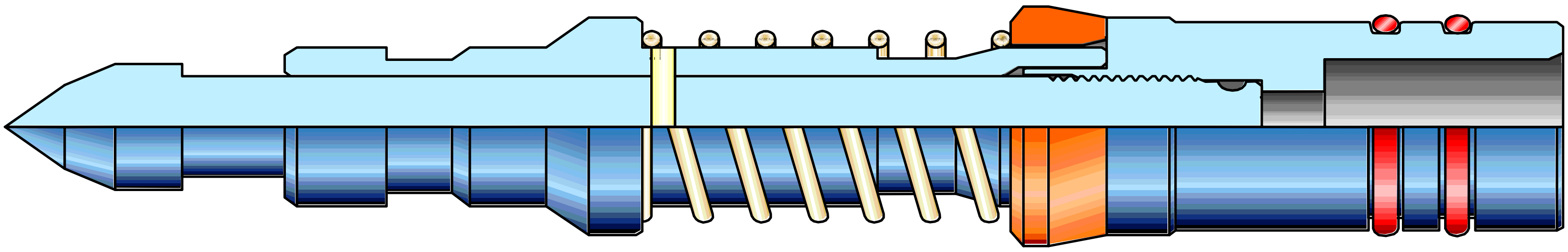
GAS LIFT LATCHES & KICKOVER TOOLS

GAS LIFT LATCH



Common Latch Types

- 1-1/2” RK
- 1-1/2” RA
- 1-1/2” RM
- 1-1/2” RT-2
- 1” BK



CAMCO Inc.

DESCRIPTION

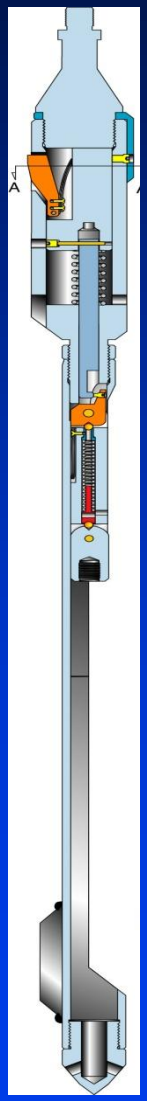
RK LATCH

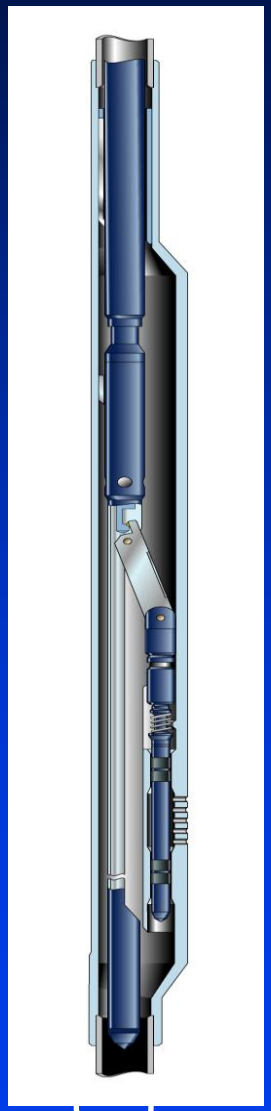
NOT DRAWN TO SCALE

N.B. FOR ILLUSTRATION PURPOSES ONLY

REV. 0 | FILED: K:\tech\gaslift\a4draw\rk_latch.cdr

KICKOVER TOOL

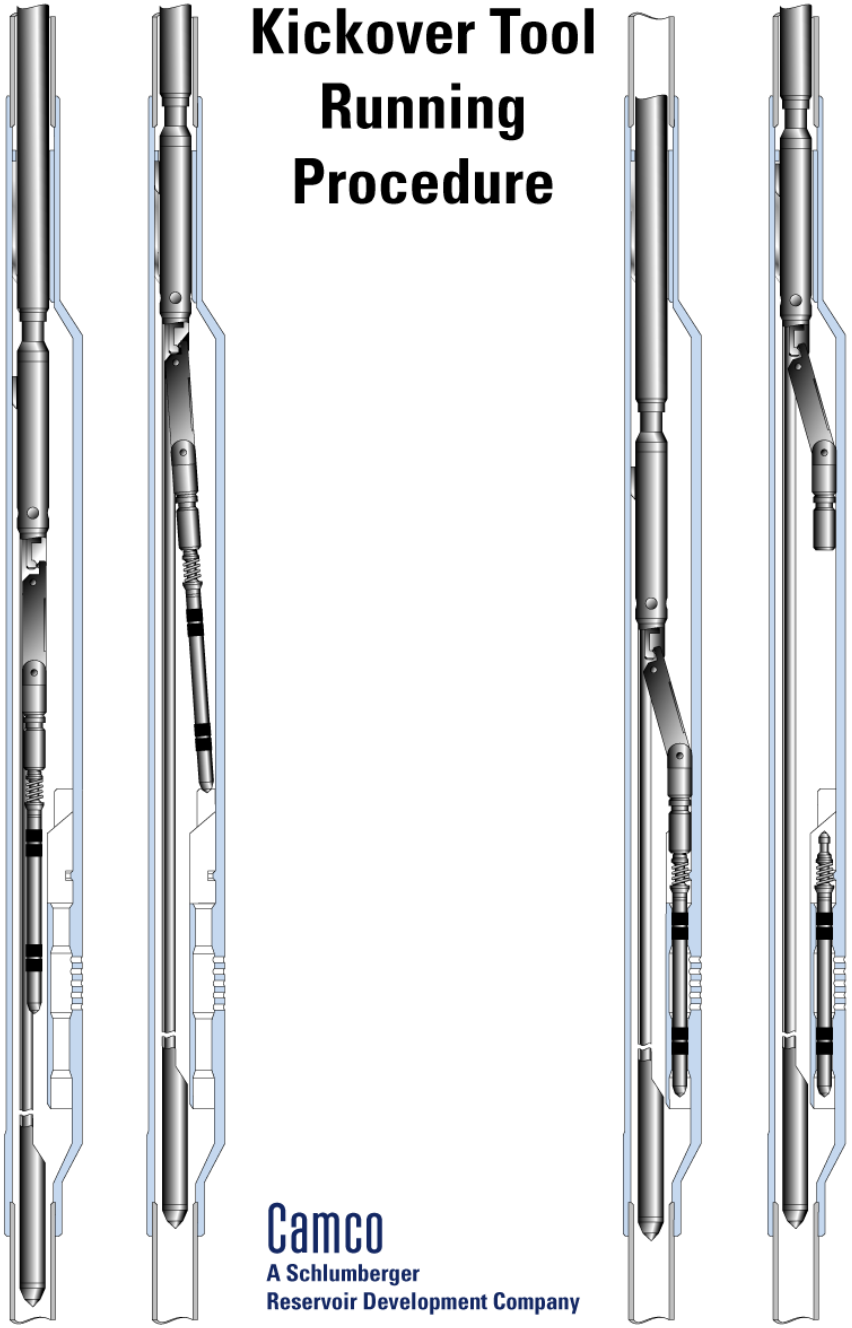




The Camco OK and OM Series Kickover Tools are slickline service tools used to install and retrieve side pocket, subsurface control devices in Camco series side pocket mandrels.

The ability to slickline change out gas lift valves gives great flexibility in the gas lift design.

Kickover Tool Running Procedure



Camco

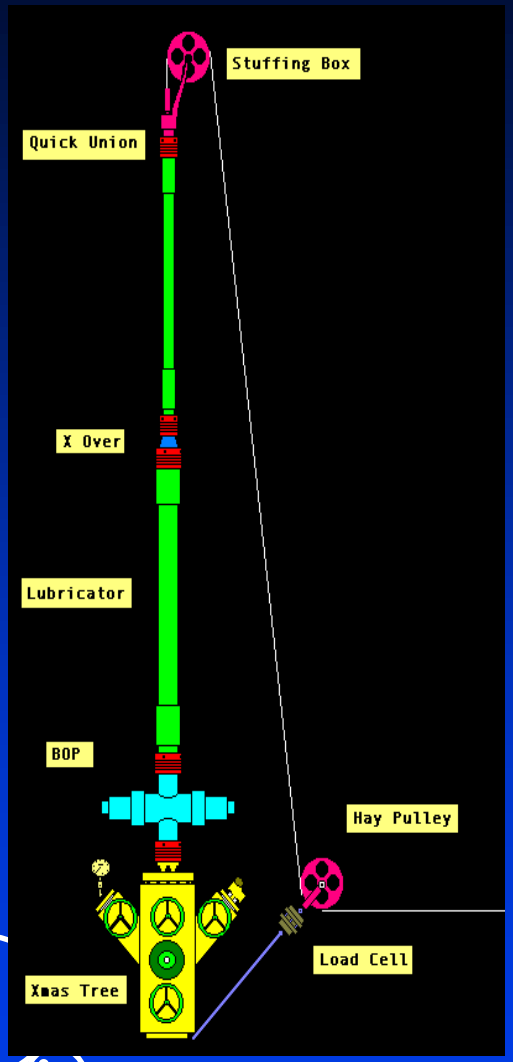
A Schlumberger
Reservoir Development Company

Kickover Tool Pulling Procedure

Camco
A Schlumberger
Reservoir Development Company

Slickline Operations

Slickline Operations



Downhole intervention

Running Procedure

Gas lift valve and latch, pinned to the running tool.

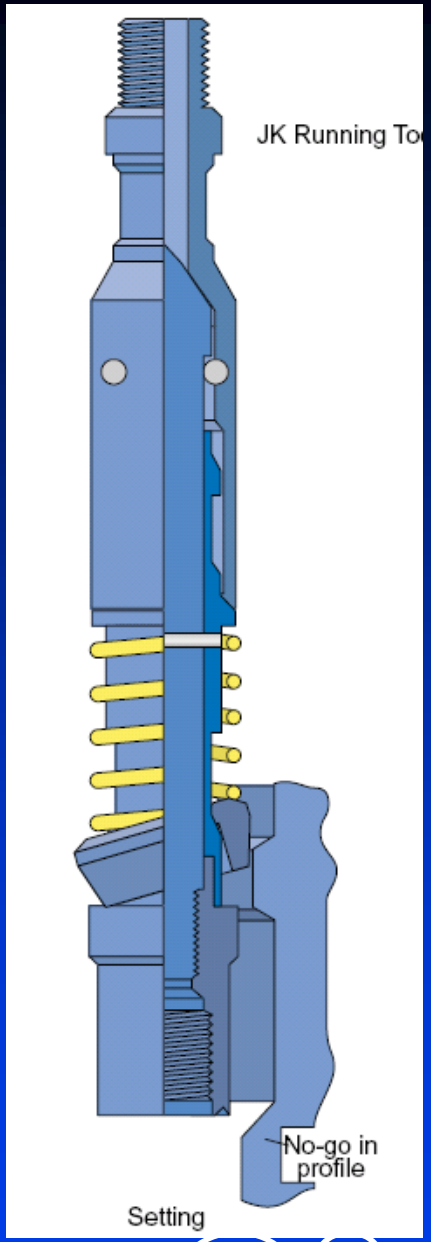
Diagram shows lock ring being deflected upwards and inwards whilst assembly is jarred down into pocket.

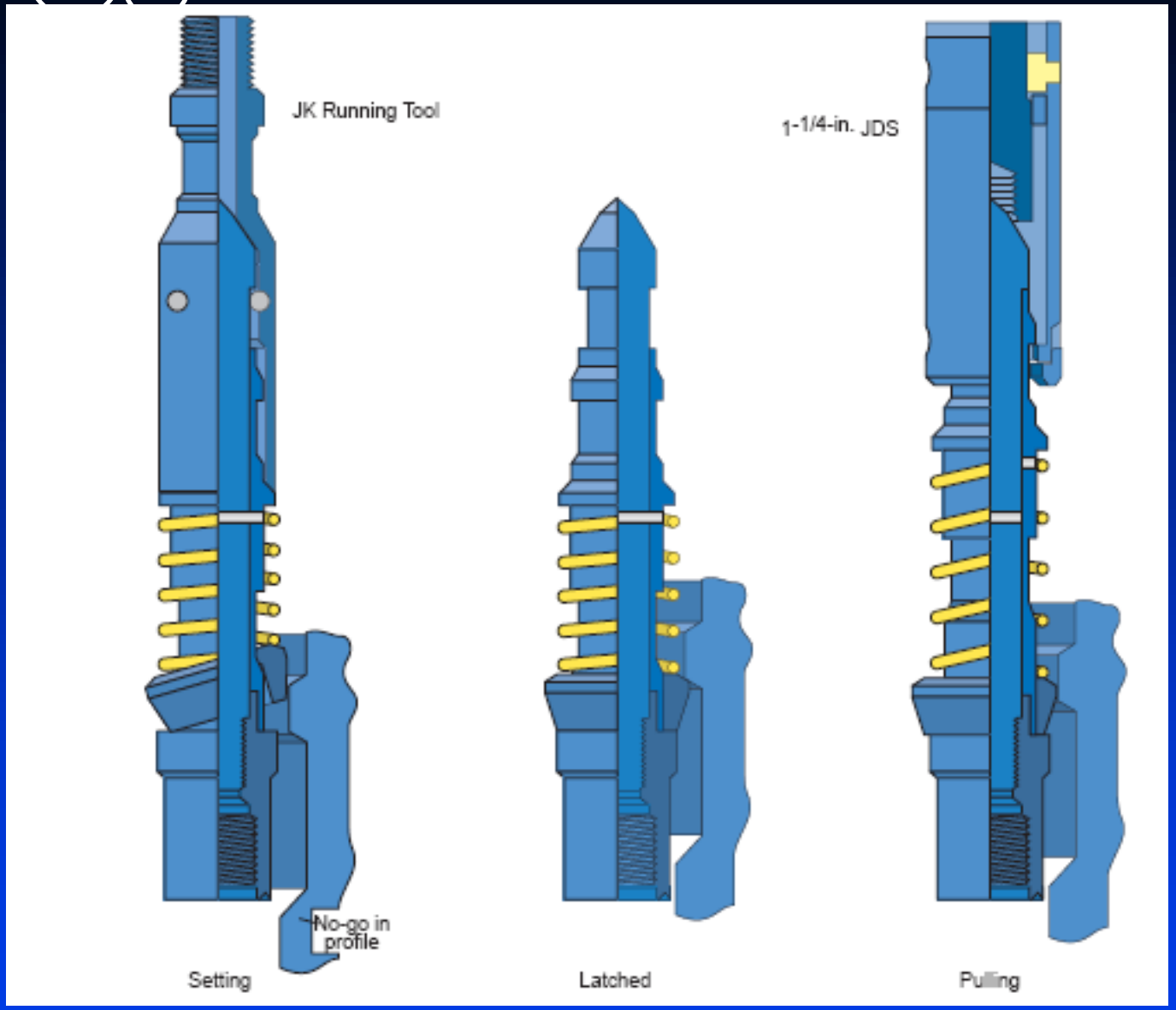
This allows lock ring to pass the mandrel lug.

Once past, spring returns lock ring to resting position.

Latch then locked in place. No-go down (latch base to pocket no-go profile shown) and no-go up (lock ring to underside of mandrel lug).

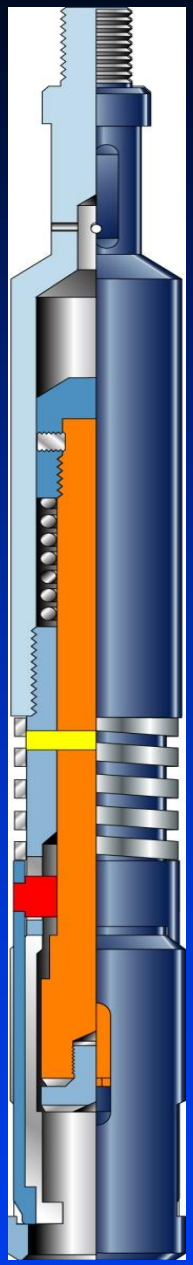
Upwards jarring shears the tangential pins to release the running tool.



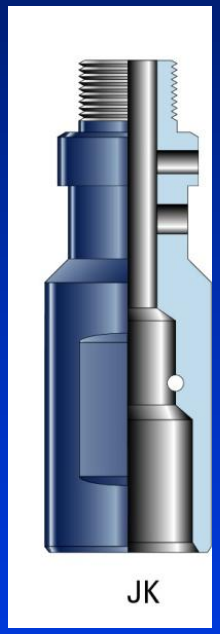


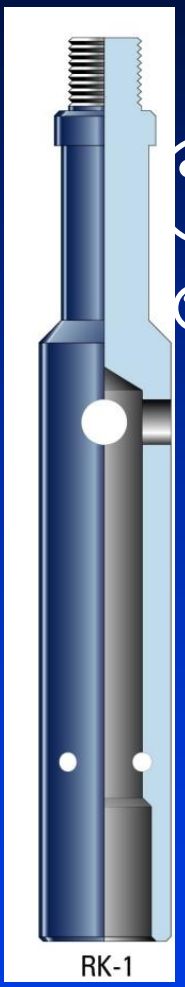
JD Series Pulling Tools

- Specially hardened material for durability
- Rugged, field proven design
- Includes jar down emergency release
- Industry standard top connection and fishing neck
- Available in premium alloys



JK & RK-1 Running Tools

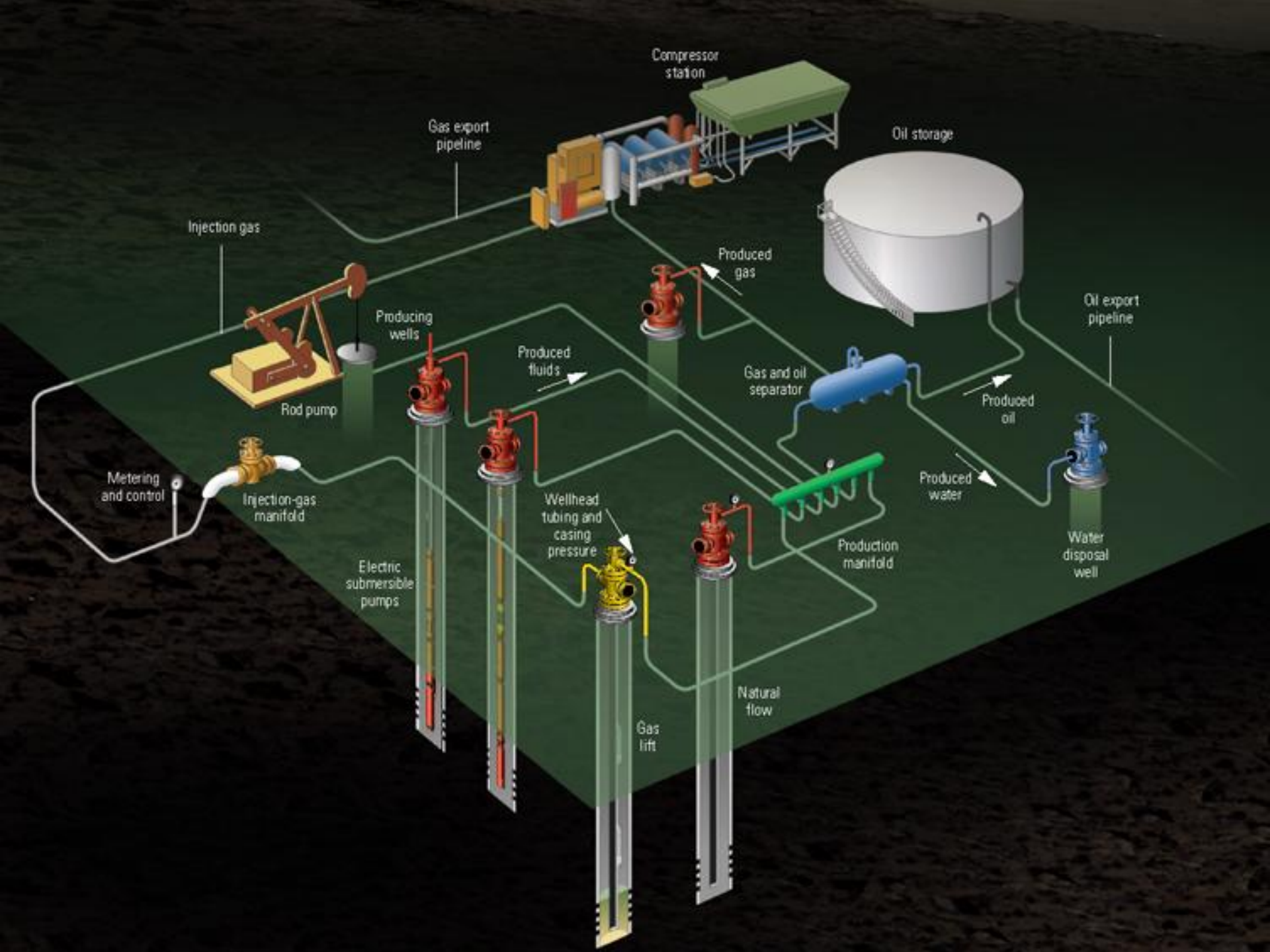




GAS LIFT VALVE CHANGEOUTS!

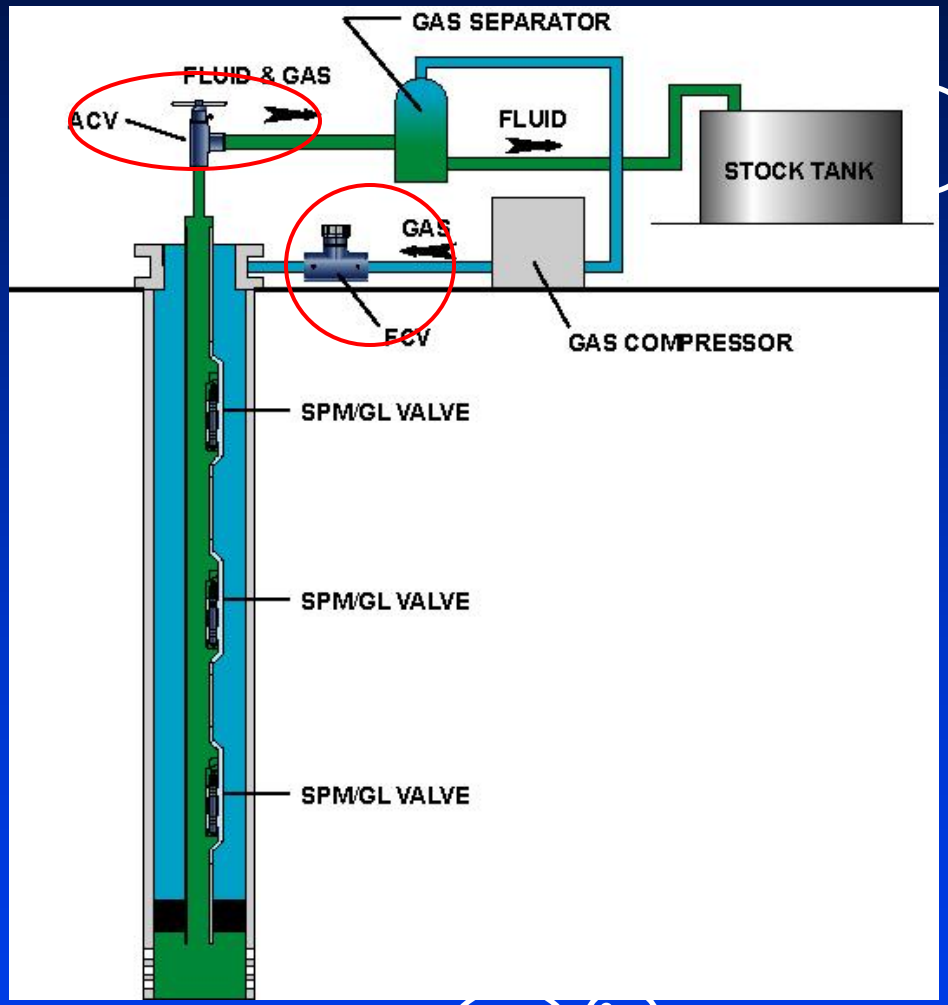
- Methodical
- Equalise pressure
- Valve catcher
- Latches
- Running / pulling tools
- Pressure tests
- Experience
- Risk

SURFACE EQUIPMENT

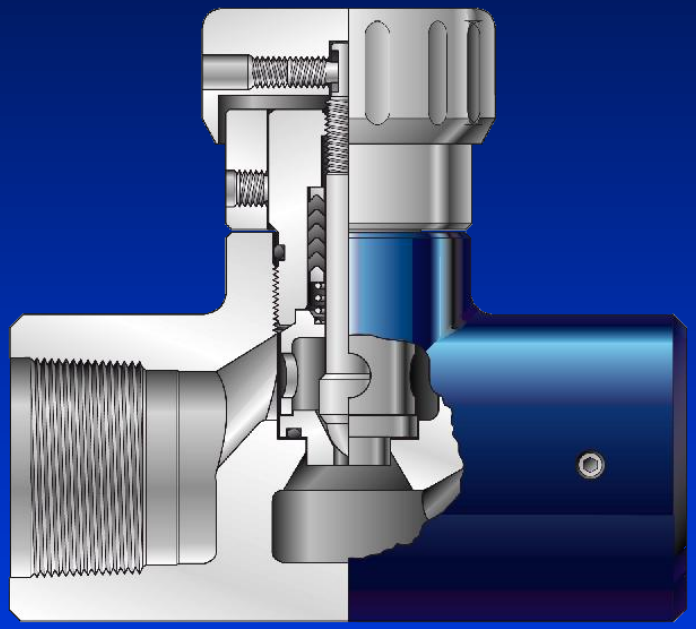

Compressor station
Gas export pipeline
Oil storage
Injection gas
Produced gas
Oil export pipeline
Producing wells
Produced fluids
Gas and oil separator
Produced oil
Rod pump
Metering and control
Injection-gas manifold
Produced water
Wellhead tubing and casing pressure
Production manifold
Water disposal well
Electric submersible pumps
Natural flow
Gas lift

SURFACE EQUIPMENT

- Primary Purpose
  - Control and measure flow from a producing oil and gas well, water or gas injection well and injected gas in a gas lift field operation
- Secondary Purpose
  - Real time flow control measurement which allows precise valve positioning from a remote RTC by use of an electronic actuator



SURFACE EQUIPMENT, MANUAL

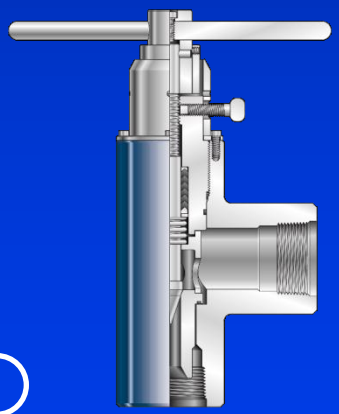


- Packing and trim changed without removing body from line
- Easy-to-read indicator ring in 1/64 in. scale
- Variety of trim sizes, materials and connections

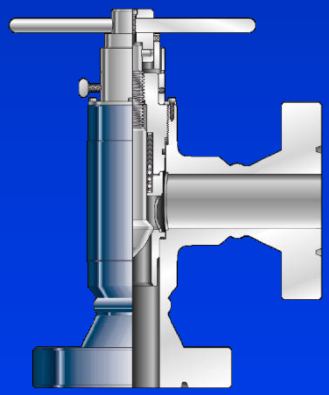
Camco/Merla FCV flow control valve

SURFACE EQUIPMENT, PRODUCTION

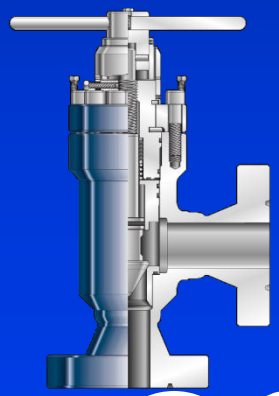
- Three body sizes for accurate match to flow rate
  - ACV-5, ACV-8 and ACV-12
- Common Features
  - Available with API or ANSI flanges, socket weld, butt weld or threaded connections
  - Variety of trim and body materials to match application
  - No stem leaks with spring-loaded, bubble-tight sealing system



ACV-5



ACV-8



ACV-12

SURFACE EQUIPMENT, REMOTE

FCV with electric actuator

- Actuators for electric control and automation systems
  - Available for FCV and ACV series valves
  - 120 Vac or 24 Vdc with low current draw for remote applications
  - High modulation rate for precise positioning
  - 4-20 ma or Digital Hart communication control
  - Corrosion resistance housing