



**BAUERBERG KLEIN**  
TRAINING & CONSULTING





Module 9  
PRESSURE CONDITIONS DURING  
PERFORATING

# CONTENT

- *Fundamentals of pressure conditions during perforating*
- *Perforating overbalance*
- *Static underbalance*
- *Principles of dynamic underbalance*
- *Extreme overbalance conditions*

## FUNDAMENTALS OF PRESSURE CONDITIONS

Different well and reservoir conditions require different pressure conditions during perforating, two (2) very important issues are addressed through pressure:

### 1. Well control

The need for well control is critical and is a safety priority therefore, in reservoirs that are over pressurized an strict control is required during deployment, activation and actual firing of the gun

### 2. Productivity impairment

Reservoir pressures and/or firing of the gun creates pressures that push debris, fluids, solids into the tunnel causing damage.

Additionally the creation of the tunnel generates mechanical damage that will also contribute to production impairment.

# FUNDAMENTALS OF PRESSURE CONDITIONS DURING PERFORATING

Three (3) main pressure conditions are considered

1. Balance, where the wellbore pressure is equal to reservoir pressure

$$P_{\text{res}} = P_{\text{wellbore}}$$

2. Overbalance, where wellbore pressure is much higher than reservoir pressure

$$P_{\text{res}} \gg P_{\text{wellbore}}$$

3. Underbalanced, where wellbore pressure is lower than reservoir pressure

$$P_{\text{res}} \ll P_{\text{wellbore}}$$

Two types of underbalanced conditions are recognised: Static & Dynamic

## PERFORATING OVERBALANCE

Overbalance pressure conditions are applied through the density of the perforating fluid, the magnitude of the overbalance will depend on reservoir pressure, fluid (oil/gas) and equipment pressure ratings, additionally overbalance can:

- Typical values vary between  $100 \text{ psi} < \Delta P_{OB} < 1000 \text{ psi}$ .
- Induce invasion of fluids and solids into the perforated tunnel and near wellbore
- Such a fluids can cause pore blocking and/or fluid-rock interaction that will result in formation damage at the near wellbore
- Might require an additional source of pressure different from fluid's density (Surface pressure)
- Fracture pressure is considered the limit of overbalance

## PERFORATING UNDERBALANCE

### Static underbalance

Static underbalance is based on reducing the hydrostatic pressure at reservoir level by varying the density of the perforating fluids. Downhole this can:

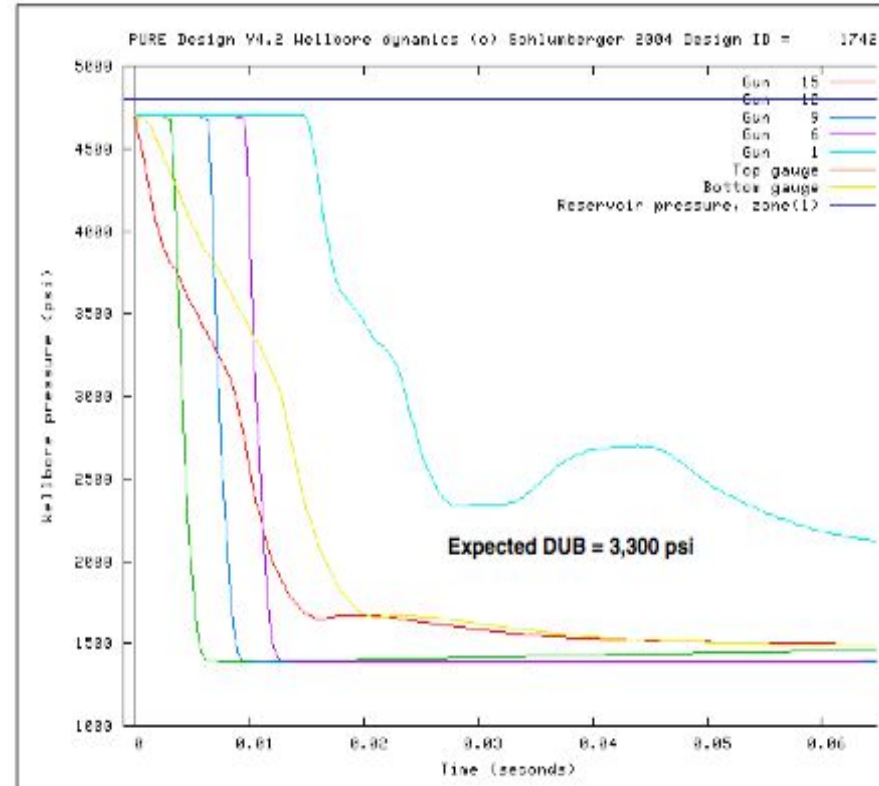
- Create a pressure lower than reservoir pressure at the interval to be perforated
- A combination of fluid/gas can be used to reduce the hydrostatic column pressure

The fact is that until the moment when the gun is activated that underbalance is present but it is overcome by the overpressure generated by the detonation of the charge

## PERFORATING UNDERBALANCE (Continued)

### Dynamic underbalance

- Focalized UB is generated by configuring the gun and generating negative pressures
- Technologies differ for each supplier as to the location within the gun to generate the UB pressure
- Along (SLB), in place of some charges or at the top/bottom(HES) of the gun
- Perforation's collapse pressures can be used as a limit for the maximum level of underbalance





## PERFORATING USING EXTREME OVERBALANCE

The concept is based on applying pressures that are above the formation fracture pressure to induce the initiation of a fracture as the gun is activated

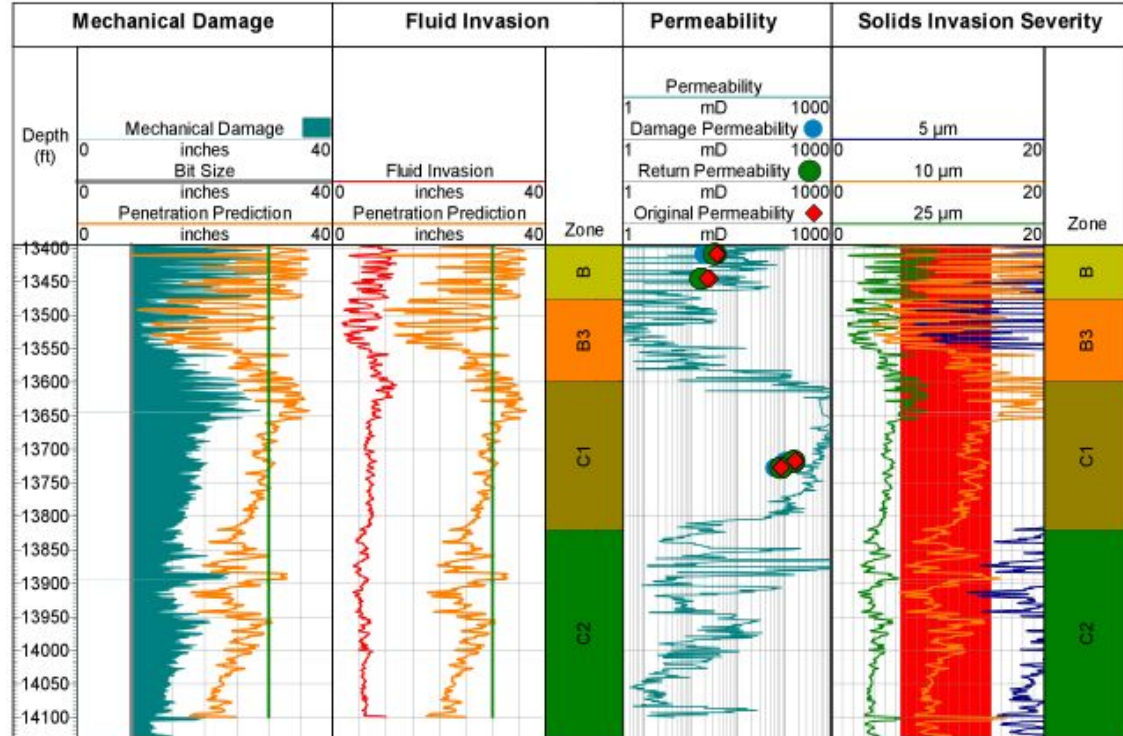
- The excessive pressures might compromise formation's isolation and well integrity
- Pressuring the whole casing is avoided by trying to apply the overbalance only to the interval to be perforated
- The high pressure differentials induce the invasion of fluid, debris and solids into the created fracture and tunnel

# PRODUCTIVITY IMPAIRMENT

Type of damage includes:

- Mechanical damage from drilling & completions
- Filtrate invasion
- Solid's invasion

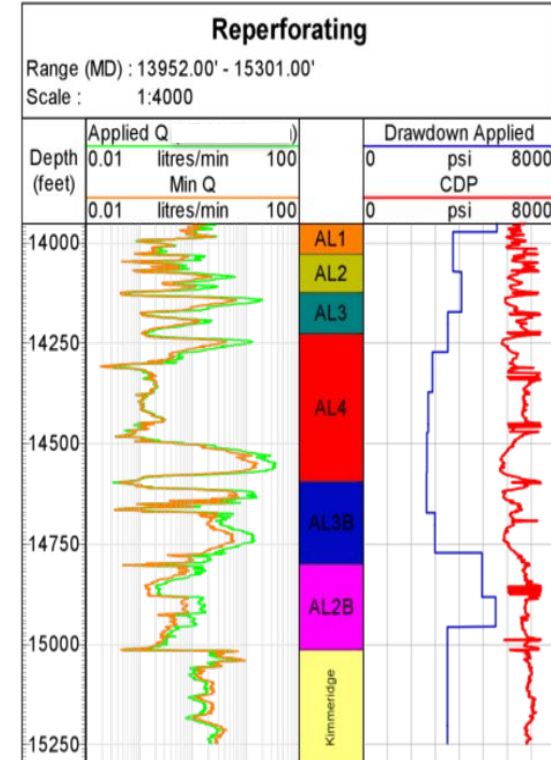
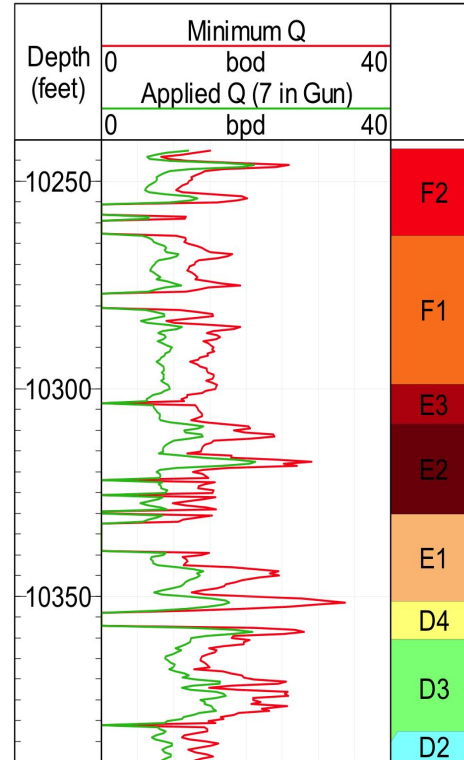
Resulting in permeability impairment hence reduced inflow



## PRODUCTIVITY IMPAIRMENT (Continued)

Impaired perforation tunnels need cleaning to restore productivity. A natural way to clean the tunnels is with inflow:

- Inflow can be generated by either underbalance or drawdown
- UB will create inflow during perforating
- Drawdown will generate inflow during well start up & production
- For UB and drawdown the limit is the critical drawdown pressure
- Other methods of cleaning the tunnels include chemical treatments



## SUMMARY

The selection of the pressure conditions during perforating is critical to short and long term productivity from the reservoir.

- Three (3) main scenarios exists; balance, overbalance and underbalance pressure
- Conditions such as well pressure, near wellbore impairment, equipment availability will dictate the more suitable scenario, method and guns to use
- Two (2) types of underbalance pressure conditions are available; a static and a dynamic pressure. The latter being very favourable where high formation damage is present
- The use of underbalance pressure conditions induce inflow of fluids into the wellbore enhancing the cleaning effect of the tunnels
- Well control control and productivity impairment continue to be the priority in the selection of the downhole pressure conditions



**BAUERBERG KLEIN**  
TRAINING & CONSULTING

