BOPs

API states the a BOP should be with the minimum of 3 set of ram and 1 Annuller
But many times the BOP has 2 Annulleres and 4 or 5 set off Rams

An API says that once the BOP is closed it should stay closed even if the hydraulic power is off so in order to keep it closed the BOP has a locking device
And off course every vendor have there own locking system.
(it would be to easy is they had the same system)

To test the lock system is pretty easy, when the stack is on surface close the ram, bled of all pressure and do a pressure test of the bop
if it the lock has a malfunction the rams will creep and you will lose pressure.

I will only describe the locks systems here later a how to do on every lock will be made.

Camron has
Wedge lock witch is old school and pretty easy to overhaul
The system is simple, but more hoses and SPMs are need
and the lock are NOT individual so lock, no other Rams can be closed.
And before open a closed BOP Closing pressure has to be applied to Rams, or else the Wedge lock could damage the tail of the rod.
But some systems has a sequins valve installed to prevent this, so more equipment subsea.

ST locks
New version of Camron lock system
No more need of extra hoses and SPMs
Individual locking of rams
complicated to overhaul, many parts
And in the past many problems,
And to lock it Subsea has to push a botten

Shaffer
They have many lock systems one of them is POS lock
No more need of extra hoses and SPMs
Individual locking of rams
Automatic lock
It takes a lot of time to adjust
Since is only close in one place, VB rams can not be used

Shaffer Multi lock
No more need of extra hoses and SPMs
Individual locking of rams
Automatic lock
Many parts and they can cause many problems
Hydrill MPL
No more need of extra hoses and SPMs
Individual locking of rams
Automatic lock
Works with any kind of rams
not so many parts
complicated to overhaul.
Had some problems with the bearings

To that test the bearings, the stack has to be on surface
Open the doors on the stack.
hook up a chart recorder and apply lower closing pressure, and record the pressures
Over time the closing pressure will increase, that indicates that the lock has to be overhauled

Ram Blocks
Variable bore ram blocks
Good things about them
they can close on more then one size of pipe.
They come with a special Ram block and they are not cheap
they have a limited hang of capability
And they are no good for high temp wells

When you install a new VB ram it should be operated at least 7 og 8 times so you are sure it works, and all the left overs from the moulding process out.

Shear rams
can cut pipe, and in some cases casing, but once it do the ram blocks has to be inspected as soon as possible because the ram block might have cracks.
If Casing is cut, and the rams are open, they might not seal any more.

So how does is seal
close to all Bops are Well assist, that means that the well bore pressures helps to close the stack, in order to get this feature, the ram block doesn't seal on the bottom, but on the top side and the front
The top seal and front packer are normal connected to each other with pins to the rubber cant go down the hole.
The rubber is no compressible
Rember close with out pipe in hole

If there is Well bore pressure it is not recomended to try to open the the BOP
Closing ratio is the minimum pressure it takes to close at max well bore pressure. The closing ratio is fixed and is determined by the area of the hydraulic piston, of the BOP

So since we don’t design them, but work on them
So in the manual the closing ratio is state
but just for fun here is a BOP closing ratio on 7,2
so the pressure for a 10K and 15 K stack is

10k = \frac{100000}{7,2} = 1388 psi

15k = \frac{15000}{7,2} = 2083 psi

API rule is regarding the accumulators, is if all rams have been closed and all annual's as well, there should be at least 1388 psi or 2083 psi left in the bank.

But this is the stack is on surface now it is 7000 feet down
10 k stack
Close ratio 7.2
mud weight 10,6 ppg
bop fluid weight 8,3 ppg
c= is a constant 0,052
h=7000 feet

\[ P = \frac{h \cdot (P_{mud} - P_{fluid}) \cdot C}{\text{close, ratio}} \]
\[ P = \frac{7000 \cdot (10.6 - 8.33) \cdot 0.052}{7,2} = 114.7 psi \]
\[ P_{real} = P + P_{close} = 144.7 + 1388 = 1502 psi \]

Remember if the is a Booster cylinder installed it will have a different closing ratio

If the Rams are closed due to a well control situation and the rams has to be open, then the well bore pressure has to low or else the ram blocks will get damaged.
The bop is well bore assist close so the opening force has to overcome the well bore pressures.
so before open went the pressures out via the fail safe valves.
The same goes after a pressure test open the fail safes before open the rams to bleed of the pressures