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-THÈME/TITLE-

Case Study Of DST Operation In Hassi Messaoud Field Of MDZ-802 Well

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Dedication

I dedicate this dissertation to a number of people without whom this thesis might not have been written and to whom I am greatly indebted.

*A special feeling of gratitude to my loving parents, my inspiration and wonderful mother *Rezeg Farida* the example in every step i take in my life, my right hand after God, i just want to tell you that I can't imagine the world without you dear Mom . The tender, amazing Father *Rezeg Khadraoui* which is a real school to me, a pure and kind soul, a real men that prepared me for every single thing that i might face in this life. Both of you father and mother are words of encouragement and push for tenacity ring in my ears. My sister *Radia* and my brother *Abdou* who have never left my side, having you is having a stars in my sky. May God protect you all and guide you to the right path.*

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Abstract

The current work is dedicated to determining the petro physical parameters of the Mdz-802 well, the potential of the reservoir, the nature of the reservoir fluid.

A DST test provides a method of temporarily completing a well to determine the production characteristics of a specific area. As originally designed, a DST test mainly provides an indication of the content of the training. Analysis of build-up data in a properly planned and executed DST using software can provide good data for Assist in assessing production problems in some wells, estimating reservoir parameters, area productivity, well completion, skin's degree of damage, and possibly the need for stimulation.

Key words : Drill Stem Test, production, build up, well completion, skin's degree, stimulation.

Résumé

Le présent travail est consacré à la détermination de les paramètres pétrophysiques du puits Mdz-802, le potentiel du réservoir, la nature du fluide du réservoir.

Un test DST est une méthode permettant de compléter temporairement un puits afin de déterminer les caractéristiques de production d'une zone spécifique. Tel qu'il a été conçu à l'origine, un test DST fournit principalement une indication sur le contenu de la formation. L'analyse des données d'accumulation dans un DST correctement planifié et exécuté à l'aide d'un logiciel peut fournir de bonnes données pour aider à évaluer les problèmes de production dans certains puits, à estimer les paramètres du réservoir, la productivité de la zone, l'achèvement du puits, le degré d'endommagement de Skin et, éventuellement, la nécessité d'une stimulation.

Mot clés : Test de tige de forage, production, construction, complétion de puits, degré de peau, stimulation.

ملخص

يكرس العمل الحالي لتحديد البارامترات البتروفيزيائية وإمكانات المكمن وطبيعة السائل المكمني للبئر.

يوفر اختبار جذع الحفر طريقة لاستكمال البئر بشكل مؤقت لتحديد خصائص الإنتاج في منطقة معينة. كما تم تصميمه في الأصل، يوفر اختبار جذع الحفر بشكل أساسي مؤشراً لمحتوى التدريب. يمكن أن يوفر تحليل بيانات التراكم في اختبار جذع الحفرالمخطط والمنفذ بشكل صحيح باستخدام البرمجيات بيانات جيدة للمساعدة في تقييم مشاكل الإنتاج في بعض الآبار، وتقدير بارامترات المكمن، وإنتاجية المنطقة، وإكمال البئر، ودرجة تلف الجلد، وربما الحاجة إلى التحفيز.

.الكلمات المفتاحية: اختبار جذع الحفر، والإنتاج، والبناء، وإكمال البئر، ودرجة الجلد، والتحفيز

Summary :

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Chapter I : General information about Hassi Messaoud field

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List of Abbreviations:

DST: Drill Stem Test.

BSW: Basic sediment and water.

ESD: Emergency Shut Down System

FP : Flow Period.

MD: measured depth.

IRIS: Intelligent Remote Implementation System.

IRDV: Intelligent Remote Implementation System Dual Valve.

SHRV: Single-Shot Hydrostatic Overpressure Reverse Valve.

PCT: Pressure Control Test.

WP: Working pressure.

WHP: Well head pressure

WHSIP: Wellhead Shut In Pressure.

TV: Tester Valve.

CV: Circulating Valve.

DGA: Downhole Gauge Adapter.

RT: Rotary Table.

POOH : Pull out of the hole.

STV : Select tester valve.

BHA : Bottom hole assembly.

STT : Surface test tree.

RIH : Run into hole.

SWT : surface well testing.

General introduction

General introduction :

The D.S.T. is a method for determining the productivity of the layers crossed by a borehole and for taking fluid samples during the drilling of a well consisting of a temporary completion. The temporary completion represented by a test involves isolating the layer to be studied from those that are not by using a packer, and reducing the hydrostatic pressure at the level of the layer, by placing the portion of the well isolated by the packer in communication with the drill pipes used for lowering the equipment, with the interior of the pipes at atmospheric pressure or at a pressure significantly lower than the pressure of the layers to be tested, using a system of valves.

Drill stem tests (DST) is the only operations that can provide highly accurate information about the potential flow rate and pressures of the layers crossed. They are also one of the safest methods of determining the nature of the fluids contained.

They are the perfect complement to electrical logging and mechanical coring. In other words, they allow us to recover data relating to the formation (reservoir pressure and temperature), it can used to determine the parameters of the deposit (permeability, skin, etc.).

There are open-hole and cased-hole tests. Each type of test has its advantages and disadvantages and there is different test trains. They are different in terms of construction technology and operating principles. But, they all have the same objective of having openings (flow) and closures (build up).

This dissertation is organized as follows :
The first chapter presents General information about Hassi Messaoud field.
The second chapter talks about Definitions and general information about well testing.
The third chapter describes the drill stem test and the procedure for all the operations that need to be carried out during this kind of test.
The last chapter talks about the DST operation of MDz-802 well.

The objective of this study is to establish a technical case study of DST operation of well MDz-802 which was carried out on 2-Apr-2024 within the ENF-47 rig on Hassi Messaoud field with a theoretical and general study on the well tests.

The Hassi Messaoud field

I.1 Introduction :

Hassi Messaoud field is one of the most complex fields in the world. During geological history, this field underwent on the one hand, an intense tectonic evolution characterized by compressive and distinctive phases. On the other hand, by the diagenetic transformation in the reservoir during its burial during geological time, until the deposit has taken shape as represented by the current configuration.

I.2. Location of the Hassi Messaoud field :

I.2.1. Geographical location :

The Hassi Messaoud field is located in the north-east of the Algerian desert, 850 km south-east of Algiers and 350 km from the Algerian-Tunisian border, on the edge of the Great Eastern Erg. The field covers an area of 2,500 km² and is bordered to the north by Touggourt, to the south by Gassi-Touil and to the west by Ouargla. [1]

Its location in geographical coordinates is as follows:

- To the north at latitude 32°15.
- To the south at latitude 31°30.
- To the west at longitude 5°40.
- To the east at longitude 6°35.

Lambert coordinates :

- X= 790.000 to 840.000 Est.
- Y= 110,000 to 150,000 North.

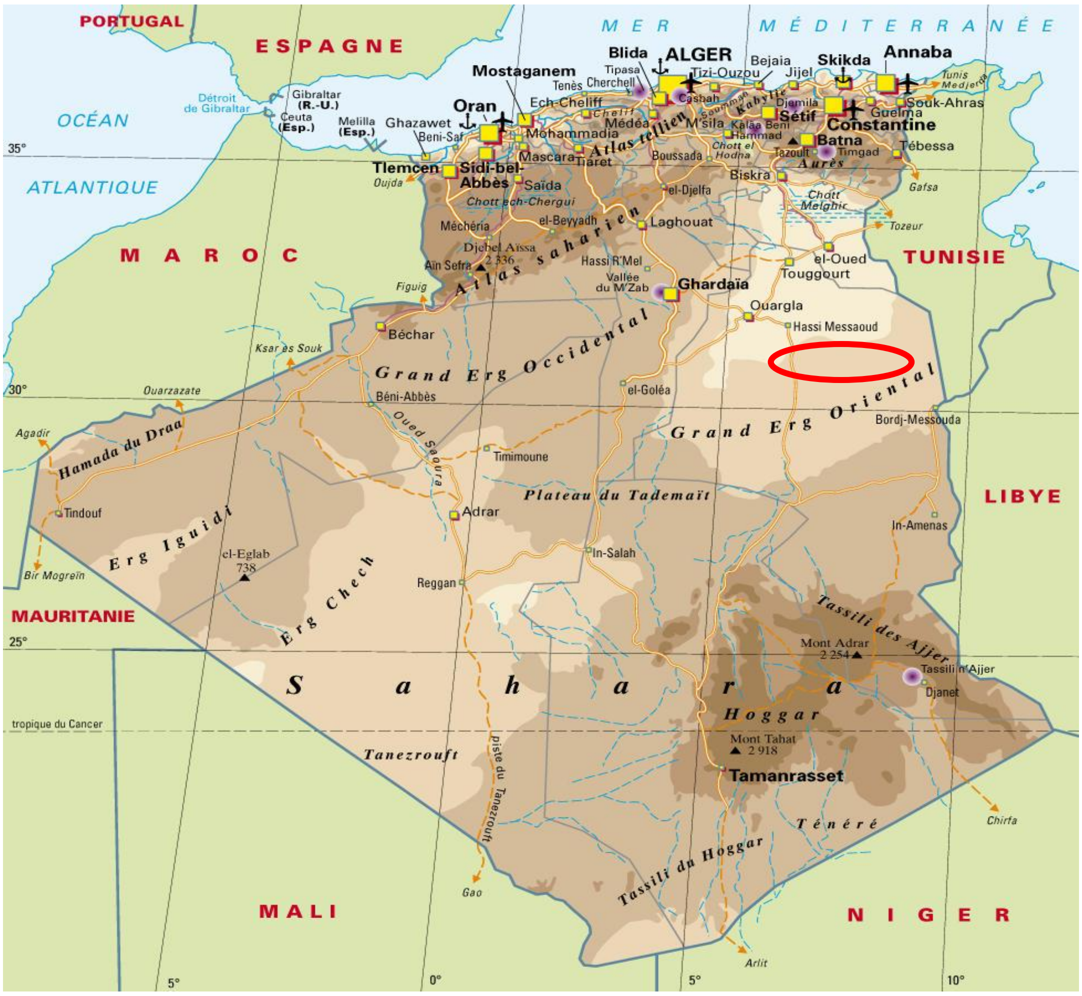


Fig I.1 Geographical location of the Hassi-Messaoud field [2]

I.2.2 Geological setting :

Hassi Messaoud field is located in the central part of the Triassic area. In terms of surface area and reserves, it is the largest oil field in Algeria Compared with other fields, the Hassi Messaoud field is limited:

- To the north-west, the Ouargla fields (Guellela, Ben Kahla and Haoud Berkaoui).
- to the south-west by the El Gassi, Zotti and El Agreb oil fields.
- to the south-east by the Rhourde El Baguel and Mesdar fields.

The Hassi Messaoud dome is the result of a rather complicated palaeotectonic history. It is the extension of the Amguid El Biod ridge, which is over 800 km long. The structure is part of a group of structures forming the North Eastern Triassic province. [1]

Geologically, it is limited:

- To the west by the Oued Mya depression.

- To the south, the Amguid El Biod breakwater.
- To the north by the Djamaa-Touggourt structure.
- To the east by the Dahar shoals, Rhoude El Baguel and the Berkine depression.

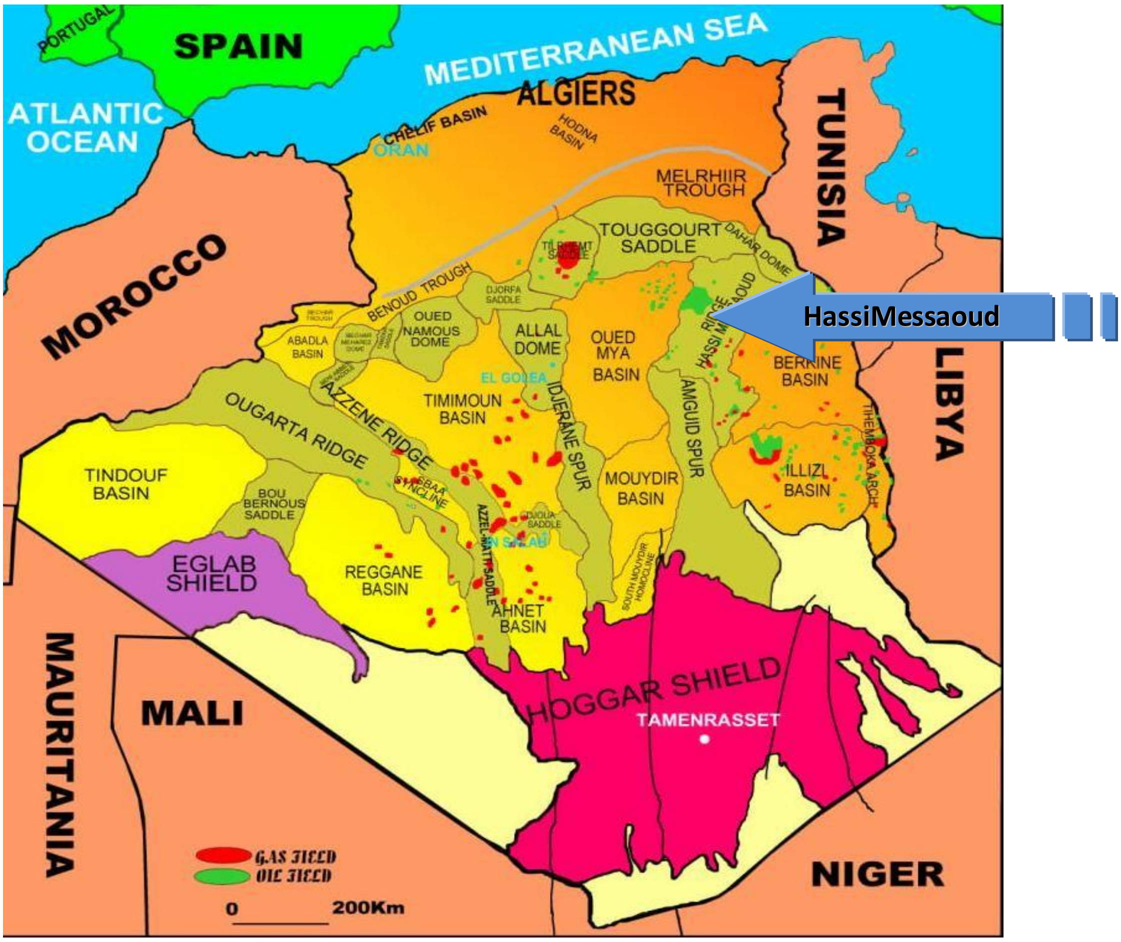


Figure.I.2. Geological setting of the Hassi-Messaoud field [2]

I.3. Zoning and numbering of wells:

The Hassi Messaoud field is divided into numbered zones. This division is deduced naturally from the features of the production and the geology. The evolution of well pressures, as a function of production, has enabled the field to be subdivided into 25 production zones. A production zone is defined as a group of wells that communicate with each other but with little or no communication with the surrounding zones.

It should be noted that the current subdivision is not satisfactory, as the same zone can be subdivided into sub-zones. [1]

The Hassi Messaoud field is divided from east to west into two different parts:

The South field and the North field, each with its own numbering system. [1]

- North field: This is a geographical numbering system supplemented by a chronological numbering system, for example: OMO38, ONM14.

O: Capital letter, Ouargla. m: surface area of the oil zone: 1600 km2.

o: Tiny, oil area 100 km2, 3: Abscissa and 8: Ordinate.

- The south field: The zones are numbered chronologically. Ex: MD33, MD254, MDZ703.

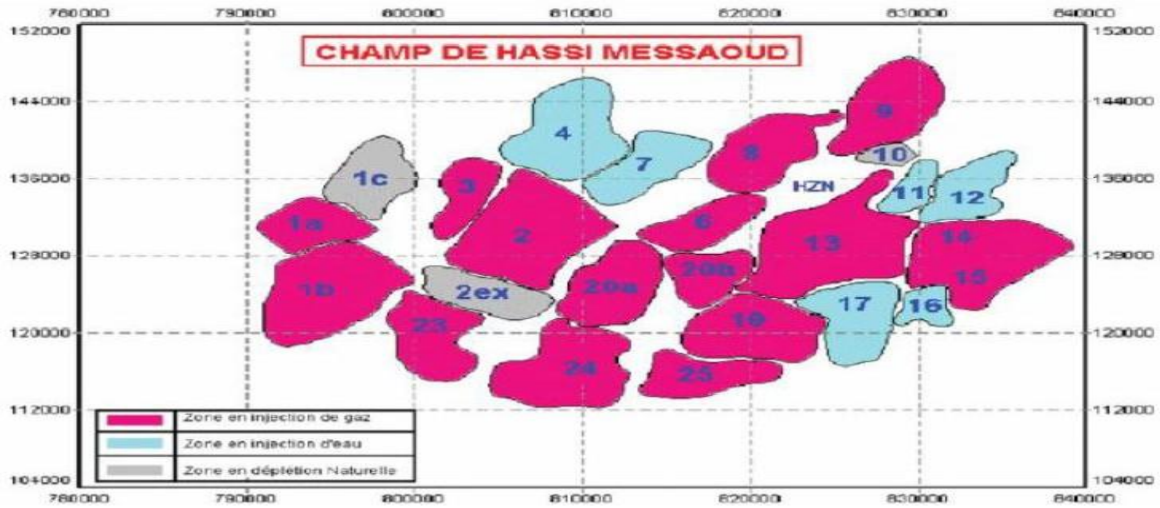


Fig I.3 Zoning of the Hassi-Messaoud field [2]

I.4. Petro physical properties of the reservoir:

Tab. I.1. Average petro physical properties of the reservoir

Réservoir	K min md	K moy md	K max md	Φ min	Φ	Φ	Swi	Vsh moy	Hu/Ht (fraction)
Ri	0.3	1	2	6	7	17	15	15	0.5-0.9
Ra	2	15	100	6	8	10	7	7	0.8-1
R2		2.5	7	-	10	17	20	20	0.65-0.8
R3		1			11	17	30	30	0.65

I.5. Fluid composition :

The properties of the oil are different depending on the region. In the East, the bubble point can reach 200 kg /cm2 for a gas dissolving ratio Rs equal to 240 stm3 /m3, in the South, the bubble point can reach 200 kg /cm2 for a gas dissolving ratio Rs equal to 240 stm3 /m3.

l'Ouest il peut descendre jusqu'un140 kg / cm2, pour un rapport de dissolution de gaz égal à 160 stm3 / m3. [1]

The average fluid characteristics at Hassi Messaoud are shown below:

I.5.1 Oil characteristics :

- The oil is light with a specific gravity of 0.8 (API = 45.4).
- The reservoir pressure ranges from 400 to 120 kg/cm2.
- The temperature is around 118°c.
- The GOR is 219 m3/m3 except for the wells in breakthrough where the GOR can reach 800 m3/m3 and more (case of Oml 63 and Oml 633).
- Average porosity is low: 5 to 10%.
- Permeability is fairly low.
- Viscosity is 0.2 cp.
- The volume factor is 1.7.

I.5.2. The gas characteristics associated with :

A bubble point of 160 kg/cm2.
Gas viscosity is 0.02 cp.
Compressibility is 0.8 bar-1.

I.6. Description of the reservoir :

The Hassi Messaoud deposit is between 3,100 and 3,380 meters deep. It is up to 200 m thick and comprises three Cambrian-age sandstone reservoirs resting directly on the granitic bedrock. It is represented by a sandstone series, part of which is affected by Paleozoic post erosion in the centre of the field. It is subdivided from top to bottom into: [1]

- Ri: Isometric zone 45m thick, essentially fine-grained quartzite and tigillite. It corresponds to the D5 drain.
- Ra: Anisometric zone with an average thickness of around 120m, composed of sandstone with medium to coarse grained silico-clay cement. It is subdivided into drainages respectively from bottom to top: D1, ID, D2, D3, D4. [1]
- R2: Clay-cement sandstone series, with an average thickness of 80 m.
- R3: Approximately 300 m high, this is a very coarse to micro-conglometric, very clayey sandstone series resting on the granitic bedrock encountered at a depth of less than 4,000 m. It is a pink porphyroid granite. [1]

I.7. Specific information related to (MDZ-802) Well :

This are a specific information's about the well that we did our study about

Tab.I.2. Coordinates of the well

Location		**HZS/24**
Type of well	**Designation**	Developpement
	Type of design	Producer
	Type of fluide	Oil
Drilling rig		**ENF47**
Geographical coordinates(UTM)		**X : 780704.03**
		Y : 3491997.06
Mud density (OBM)		1.35
Elevation (Zs)		141.89m
Table of rotation : (Zt)		151 m
Shoe 7" (MD)	MD (m)	3418 m
	TVD (m)	3398m
CAMBRIEN (TVD)	MD (m)	3395 m
	TVD (m)	3418m
Final well depth (TD)	MD (m)	3918m
	TVD (m)	3438m
Well profile		Horizontal
Top Liner 7" (CS)		2604 m

I.8. Conclusion :

The Hassi-Messaoud oil field (sandstone reservoir) is heterogeneous, causing its physical properties to fluctuate greatly, resulting in fluctuations in production From one area to another and from one well to another. The expansion of the field means differences in the production of its different parts. The cumulative production history to date clearly prove this.

Definitions and general information about well testing

II.1. General information about the deposit :

There is still a widespread belief among the general public, who are unfamiliar with the oil industry, that hydrocarbons are stored underground in vast natural cavities. This is why we commonly speak of ‘gas pockets’ and imagine ‘oil slicks’ in the same way as the underground lakes or seas described by Jules Verne in ‘Journey to the Centre of the Earth’.

The reality is quite different, and a ‘reservoir’ impregnated with hydrocarbons looks more like a huge sugar loaf soaked in coffee, for example, and trapped underground.

A deposit consists of one or more reservoir rocks containing hydrocarbons in a single-phase or two-phase (oil and gas) state and water, which may be in communication with a water-bearing formation that may be very widespread, topped by a watertight cap rock that acts as a trap. [11]

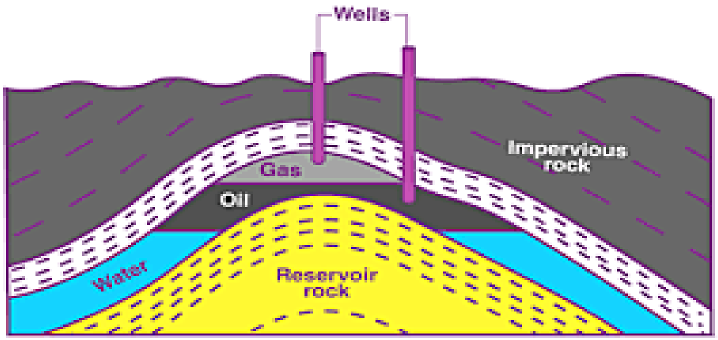


Figure.II.1. Vertical cross-section of a deposit[11]

II.2. Study of reservoir rocks and their content :

When drilling a well, it is very important to know the characteristics of the layers crossed that are likely to be productive. This is usually done using mechanical coring to extract rock samples, which are then analyzed in the laboratory. The aim of these measurements is to determine the porosity, permeability and fluid saturation of the rock, as well as the limits of the zones of interest. The other fundamental tool is delayed logging, which provides continuous information.

The reservoir rocks are mainly sandstone and carbonates (limestone and dolomite).

II.2.2. Permeability :

the ability of a rock to allow a fluid to flow through its pores. It is expressed by Darcy's law.

the capacity of a medium to allow a fluid to pass through it under the effect of a pressure gradient. The movement of fluid along a rock depends not only on the permeability of the rock, but also on the nature of the fluid and the pressure gradient applied.

For a liquid in steady state, if the flow is straight, the law is :

$$\mathbf{K = Q\,(dI/dP)\,/\,(\mu/S)}$$

The unit of measurement for permeability (K) is the Darcy. [11]

With :

k = permeability

Q = flow rate

S = cross-sectional area of rock sample

dP = pressure drop due to the passage of the fluid

μ = viscosity

dI = length of sample

dP = pressure drop due to fluid flow

$$\mathbf{k = Q\,\mu\,B\,\ln(R/a)\,/\,2\,\pi\,h\,(P_G - P_F)}$$

h = productive height of the rock.

PG = reservoir pressure.

PF = bottom pressure.

B = oil volume factor.

ln = log neperian.

R = drainage radius.

a = well radius.

II.2.3.Darcy's Law :

Darcy's law assumes that the reaction between the fluid and the rock is zero and that there is only one fluid flowing (absolute K).

The permeability of a rock is its capacity to allow the flow of fluids contained in its pore space, which does not allow the movement of fluids unless its pores are interconnected. darcy is the permeability of a body assimilated to a continuous and isotropic medium through which a homogeneous fluid with viscosity equal to that of water at 20°C.[11]

$$Q = \frac{K.DP.A}{\mu.L}$$

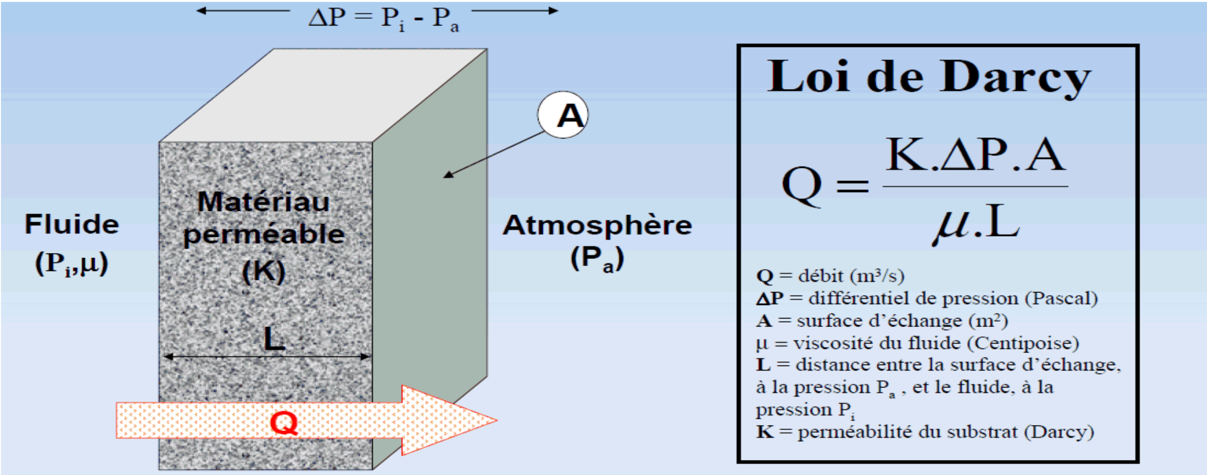


Figure.II.2. Darcy's Law [11]

II.2.4. Porosity :

A reservoir rock is made up of solid particles cemented together. The gaps formed between these particles are called pores, in which the fluid accumulates. Porosity is the ratio between the volume of these voids (VP) and the total volume (VT) of the rock. [11]

Φ= porosity (%)

$$V_P = V_T - V_S$$

VP = pore volume

$$\Phi = V_P / V_T$$

VT = total volume

The porosity of only those pores that communicate with each other and with the outside world is called useful porosity.

A rock with a porosity of less than 3% is considered to be compact, and it has a very good porosity if it is more than 20%.

II.1.5. Saturation:

Fluid saturation (Sf) is the ratio between the volume of fluid contained in the pores (Vf) and the volume of the pores (VP). It is considered irreducible if it is too low, resulting in zero permeability to the fluid. [11]

$$Sw\ (water) = \frac{Vw}{Vp} \qquad Sg\ (gas) = \frac{Vg}{Vp} \qquad Sw\ (oil) = \frac{Vo}{Vp}$$

II.2.6. The Skin:

It is a reservoir damage (permeability) factor, considered as a pressure loss in the immediate vicinity of the well. [11]

A high Skin level means:

- A decrease in production rate.
- A drop in background pressure due to an alteration in the layer-hole bond.

Positive: Damage to the reservoir.

Negative: Flow improvement (by stimulation, Fracturing or acidizing).

Nil: No change in reservoir permeability (Darcy's law).

Darcy's law provides for an expected formation pressure (Pe) and an expected flow rate (De), but in practice the measured pressure (Pm) and the measured flow rate (Dm) may be lower or higher than the expected formation pressure and flow rate.

The decrease or increase in pressure is caused by the SKIN, which can be positive or negative. [3]

Pp = Pressure loss caused by the Skin.

Pp = Pe – Pm

Positive Pp: damage to permeability

Pp negative: improved permeability

Pp = 0 : No Skin (Skin = 0)

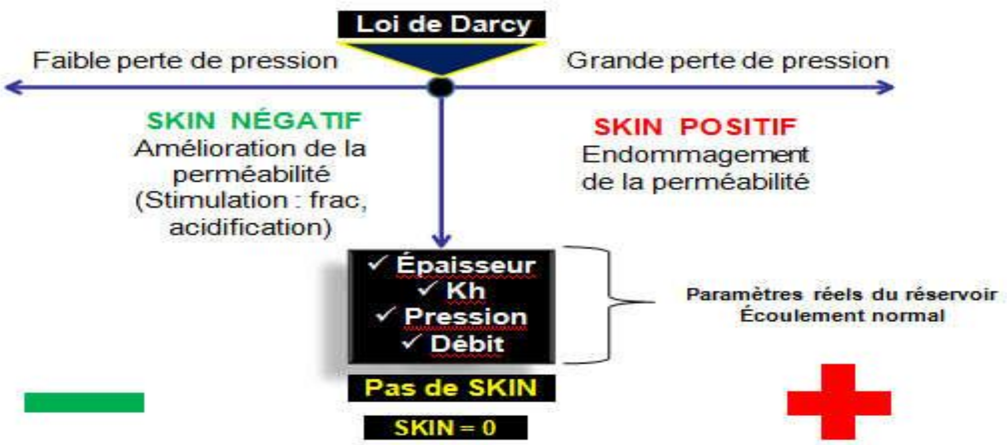


Fig.II.3. Impact of the skin on reservoir permeability [11]

Origins of Skin: The main causes

- **Clogging:**

The permeability around the hole may be different from the natural permeability of the reservoir. In particular, it may be :

Inferior as a result of clogging initiated by filtration of the drilling, completion or work over fluid under the action of excess pressure (which exists during these phases) between the well pressure and the reservoir pressure; this will generate pressure losses that are higher than those where the permeability around the borehole remains unchanged from the initial permeability of the reservoir. [11]

Assuming that the layer to be produced has been perforated over its entire height, and that the perforations are ideal (no restriction of permeability due to clogging, a crushed zone, etc.), the pressure losses when a layer is produced through perforations will be Compared to those that would be produced if we produced directly through the drilled hole (completion type "open hole") higher, equal or lower according to :

- Perforation "geometry" (penetration of perforations into the formation, number of perforations per foot, number of shooting directions, diameter of perforations, etc.).

- Reservoir isotropy (ratio of vertical permeability to horizontal permeability, with vertical permeability often much lower than horizontal permeability).

The effect of all these disturbances is characterised by the global skin:

$$\Delta P = \frac{Q\,B\,\mu}{2\,\pi\,h\,k}\,\mathrm{Ln}\,\frac{R}{r_W}$$

q = Q B = oil flow rate under reservoir conditions

h = height of the layer.

k = reservoir permeability.

μ = fluid viscosity (at reservoir conditions)

Ln = natural logarithm

R = well drainage radius

rw = well radius

S = skin effect

II.2.7. FVF, GOR, WOR and BSW:

To recover 1 cubic metre of oil from storage, a greater volume of hydrocarbons has to be extracted from the reservoir, known as the formation volume factor (FVF):

$$\text{FVF (formation volume factor)} = \frac{\text{volume of oil at deposit conditions}}{\text{volume of oil at storage conditions}}$$

At the same time as this cubic metre of oil was stored, a certain volume of gas was either recovered or burnt. This volume, measured under standard conditions (15°C, 76 cm of mercury), it is called the solubility of the gas in the oil, the GOR (Gas-Oil Ratio) of dissolving.

In practical terms, FVFs are written Bo for oil (and Bg for gas). Bo and RS vary greatly according to the type of oil: light, medium and heavy. [11]

In general: $1.05 < Bo < 2$ $\quad 10 < RS < 200\ m^3/m^3$

The values for light oils are often higher than these figures.

WOR : (Water Oil Ratio) :

Volume of water associated with the production of a unit volume of storage oil.

BSW (Basic Sediment and Water) :

The proportion of water and sediment in the ‘liquid’ phase (oil + water + sediment).

How to reduce Skin?

- Forage in UBD (Underbalanced): avoiding invasion.
- Hydraulic fracturing.
- Acidification.
- TCP (Tubing Conveyed Perforation) test in UBD.

II.2.8. The productivity index:

The productivity index (PI) represents the evolution of the inflow, which is the migration of fluids from the reservoir to the well. The PI is the liquid flow rate (Qliq) divided by the difference between the static reservoir pressure. [11]

$$PI_{(m^3/j/psi)} = \frac{Q_{liq\,(m^3/j)}}{(P_{res} - P_{fd})_{(psi)}}$$

(Pres) the bottom flow pressure. (Pfd) (opposite the perforations).(Pres - Pfd): represents the drawdown.

This formula is used when the tank pressure (Pres) is greater than the bubble pressure (meaning when the flow is monophasic within the reservoir) [11]

II.3. The Well Tests:

II.3.1.Definition of well tests:

Wells tests are special tests carried out on oil or gas wells to obtain very useful information and estimate the production parameters of these wells so that they can be operated in good conditions. There are several types of test. [4]

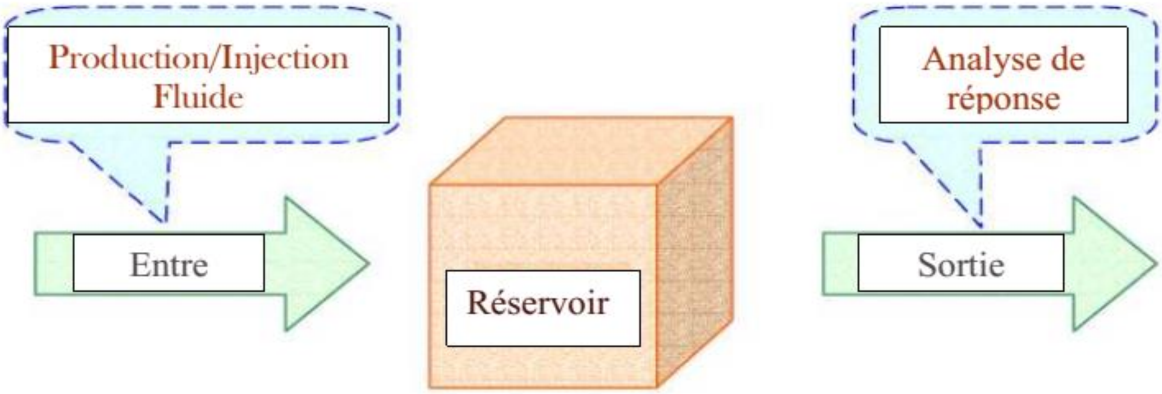
II.3.2. Objectives of well testing :

Generally speaking, the aim of a well test is to obtain information about a well and a reservoir, including:

- Reservoir permeability.
- Degree of damage to the well (Skin effect).
- Reservoir pressure Pr.
- The geometric limits of the reservoir.
- The type of reservoir.
- Characterization of reservoir fracturing.
- Evaluating communications between wells.

II.3.3. Well test principle :

The concept behind a well test is to change the flow rate in the well in order to disturb the existing pressures in the reservoir. Measuring the change in pressure as a function of time and interpreting it provides information about the reservoir and the well. [4]



FigureII.4. Well test principle[4]

II.3.4. Different types of test:

II.3.4.1. DST (drill stem test):

Bringing a well on production immediately after it has been drilled by provisionally completing it using a test string, in order to determine the parameters of the productive layer and decide on the type of final completion to be lowered into the well. [4]

II.3.4.2. Gauging test:

Gauging is a very important well surface operation, used to determine the production parameters of a well under operating conditions (head pressure, line pressure, liquid flow rate, gas flow rate). This allows us to know the optimum exploitation parameters of this well and to monitor it regularly in order to make it as profitable as possible and in good conditions. [4]

Before you start gauging a gas well, you need to :

- Installation of test surface equipment.
- Hydraulic test of the installation at a pressure greater than 1.5 to the operating pressure. Opening the well on the separator. Counting for a certain time.
- Closing the well.

> **Note:**

In the case of a gas well, the setting pressure of the bottom safety valve must be known. The equipment used for this test is as follows:

- Separator.
- Separator connection installation.
- Oil or capacitors metering and storage tanks.
- The pumps.

II.3.4.3. The Build up test:

Pressure buildup is the most widely used test in the petroleum industry, requiring wells to be shut-in, the increase in down hole pressure in front of the formation to be measured as a function of time, shut-in in addition to assumptions made about the solution of the diffusivity equation, a basic theory used to analyze shut-in test data, assumes that the well produces at a constant rate for a certain time before shut-in. [4]

The objectives of this test are to evaluate and analyze:

- Effective permeability of the reservoir.
- Formation damage rate.
- Average reservoir pressure.
- The limits of the reservoir (faults).
- Issues of interpretation (the capacity effect).

- **The advantages of Build up testing:**

This test is recommended over other tests for the following reasons:

- Le contrôle de débit (puits fermé Q = 0).
- La durée de l'effet de capacité peut être réduite ou éliminée en introduisant une vanne de fermeture au fond.
- The test can be used in certain wells that operate by artificial means (pumping).

- **The disadvantages of Build up:**

- Loss of production during the test.
- Redistribution of fluids in the well during the test makes data analysis difficult when the down hole shut-off valve does not exist.
- Requires a constant flow rate in the run-up to shutdown.
- The Buildup test is a two-rate test, so overlay methods should be used to analyze the data.

The Buildup test is a two-flow test, which means that the pressure variations measured during shut-in are not only influenced by the shut-in, but also by the flow period prior to shut-in. Two cases can be considered, depending on the radius of investigation reached during the period of flow before closure (steady state or pseudo-steady state) [4]

II.3.4.4. The interference test:

This is a test carried out between several wells to study the communication between the producing layers of the wells. The principle is to record the pressure disturbance caused by the opening of a well in the surrounding wells. [4]

To provide the following interference test:

- Shaft closure.
- Descent using wire-line equipment and pressure recorders.
- Installation of a test facility in one of the shafts and testing of the equipment at a pressure equal to 1.5 times the operating pressure.
- Opening well on test separator.
- Recording of the continuous pressure in the other wells of the disturbance caused by the opening and closing sequences of the Well.
- Reassembling the recorders.
- Interpretation of recordings.

Interference test equipment even gauge test equipment with:

- Down hole pressure recorders.
- Wire-line equipment for lowering the recorders.

II.3.4.5. Test Draw Down :

Drawdown well tests with recording at the bottom, followed by a build-up of pressure; these tests are used to assess the reservoir. [4]

The results of the analysis give us :

- the average permeability.
- Drainage radius.
- distance to impermeable barrier.
- skin (damage)

The drawdown test sequence is as follows:

- Closing the well.
- Descent using wire-line equipment and down hole recorder.
- Surface installation and equipment test at a pressure equal to 1.5 operating pressure.
- Well opening on test separator.
- Down hole pressure recorded.
- Well closure to increase pressure.

- Raise the recorder.
- Recording interpretation.

As the interference test uses Gauging test equipment with the following equipment:

- wire-line equipment lowering tool + airlock.
- Bottom pressure recorder.

II.3.Conclusion :

This chapter talks about all the characteristics of the reservoir rock and their content and how can we demonstrate it with their formulas and talks about the well testing and the different types of this and their procedure.

Drill stem test details and procedure

III.1. DST (Drill stem test):

III.2. History of DST :

Brothers Edgar and Mordica Johnston carried out the first commercial DST (Drill Stem Test) operation in 1926, resulting in two test certificates for a dozen formations being issued.
Before the Johnston brothers had introduced their innovative methods, exploration wells were tested by lowering a hollow tube on a cable to capture a sample of formation fluid after a casing had been fixed and cemented over the zone of interest. The brothers' success led to the creation of the company (The Johnston Formation Testing Company), which Schlumberger acquired in 1956. [7]

Today, the most common tests while drilling (DST) are completions of temporary wells through which operators produce formation fluids while the drilling unit is on site.

During DST, formation fluids are generally produced through drill pipes or tubing. This is followed by a separator or other temporary surface treatment facility, where the fluids are measured, sampled and analyzed.

DST involves the acquisition of different types of data. A descriptive test involves acquiring fluid samples from the bottom reservoir and closed well pressures; a productivity test involves identifying maximum flow rates or reservoir data. In exploration wells, the objectives of the primary well test are well capability, skin, fluid sample, reservoir characteristics, etc. In development wells, the objectives are generally related to measurements of average reservoir pressure, skin, and reservoir characteristics.

Well test operations include closed flow cycles and bottom hole pressure (BHPS) monitoring. Reservoir engineers apply this data to make initial predictions about reservoir potential through a process known as transitional pressure analysis, in which the rate of change of pressure as a function of time during the shut-in and application of a cycle is plotted on a logarithmic scale.

The results presented reveal the response of the reservoir, which can be associated with specific mathematical models using generalized type graphs; these can be used to determine the characteristics of the reservoir: skin, permeability and half the length of induced fractures. length of the fractures induced.

The shut-in mechanism must be as close as possible to the point where the formation fluids enter the well in order to eliminate the influence on the pores. The pores refer to the volume of fluid that can be compressed or expanded, or to a moving liquid/gas interface as a result of a variation in production rate. [7]

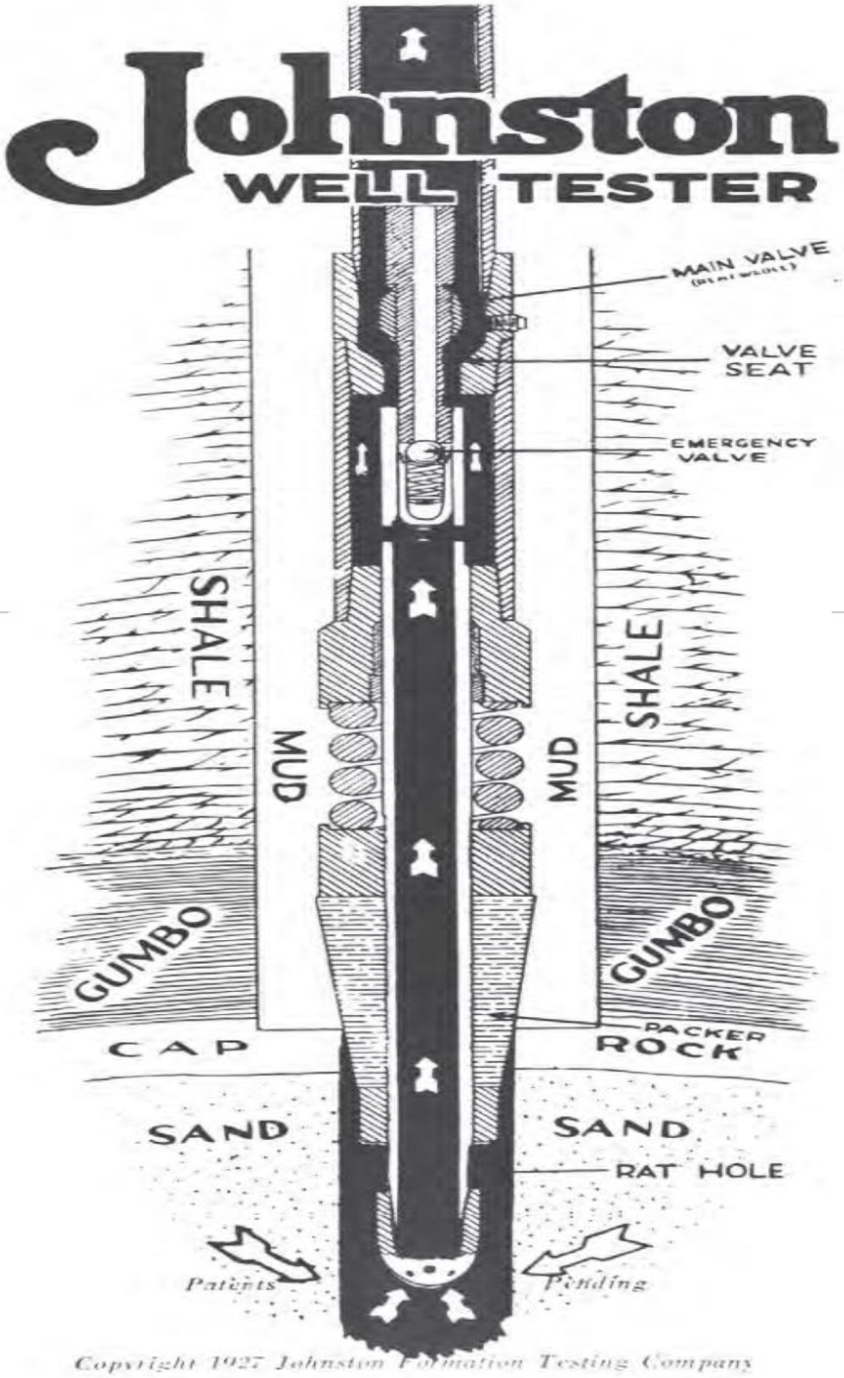


Figure.III.1. Johnston well tester [7]

An essential part of the analysis is to determine the effect of pressure on storage capacity and the response of the reservoir that can be read in the early stages of the test.

During the test, technicians can capture representative samples of the forming fluids through a series of tests. The samples are sent to a lab for PVT analysis in a process that can take several months.

Much more accurate, effective and powerful, the main components of today's DST assemblies are similar to those deployed by the Johnston Formation Testing Company in the 1930s.

These components are mainly based on four types of device:

- A packer to provide isolation.
- Bottom valves to control fluid flow.
- Pressure recorders to assist analysis.
- Devices to capture fluid samples

The modifications made to the test systems over time have been confined mainly to the addition of auxiliary components such as: circulation valves, jars, safety seals and other devices aimed at reducing the time needed to retrieve well data after a series of tests or to provide the information to kill a well.

In recent years, service companies have done much to reduce the uncertainty and costs associated with testing, while increasing safety and efficiency. An important step in this progression includes the Quartet down hole tank testing system.

Down hole tank testing system. The Quartet test tool allows operators to perform the four essential functions of a DST assembly: isolation, control, measurement and sampling in a single operation. [7]

III.3. Definition of DST:

It is the process of bringing a well into production immediately after it has been drilled by means of a provisional completion which allows the fluids contained in the reservoir rocks to be transferred to the surface, with the aim of determining the parameters of the producing layer and deciding on the final type of completion to be lowered into the well. [5]

The main objectives of the DST are :

- Identify the presence of hydrocarbons in the reservoir.
- Determination of production capacity.
- Determination of reservoir pressure.
- Take samples for PVT study.
- Determine the petro physical parameters of the reservoir (k, Skin).
- Determination of reservoir model, if required.

III.4. DST principles:

The principle of a DST is the installation of a temporary completion string in order to bring the reservoir into production, and therefore to reduce the hydrostatic pressure of the mud at the reservoir in order to discharge it**.**

A rubber seal called a packer is attached to the top of the tank to support the column of mud. The pressure inside the test train is very low compared with that in the reservoir, and is equal to the hydrostatic pressure of the tampon liquid, which allows the fluid to flow out as soon as the bottom valve is opened and up through the inside of the test train until it reaches the surface. There, it passes through a system of valves called the production head and a small nozzle manifold before leaving for the separation and storage or disposal facility. [5]

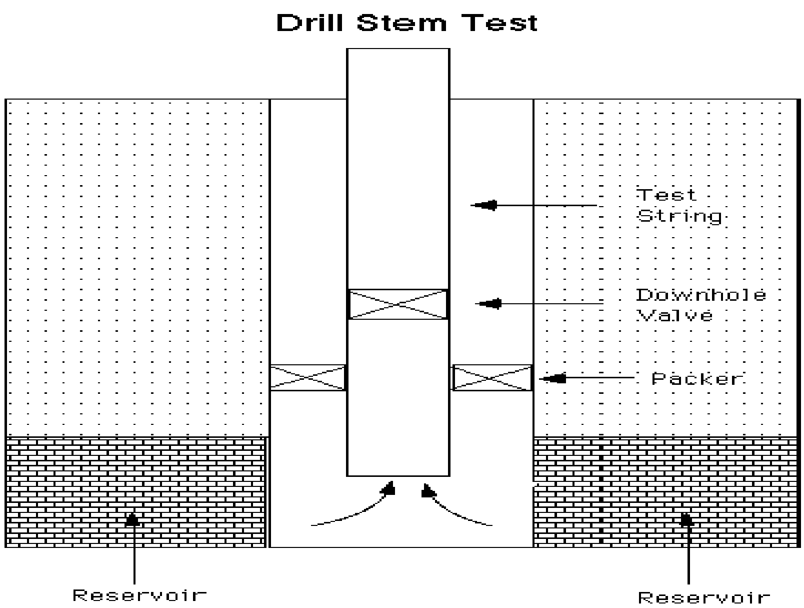


Figure.III.2. DST key Components [4]

The 4 basic equipment for a DST consist of a string (tubing or drill pipe), a packer a tester and a circulating valve.

III.5. Different types of DST:

A classification can be made according to the way in which the area to be tested is isolated from the rest of the well.

This determines the general type of test pack required and, in conjunction with the test objectives, influences the selection of individual tools and the final design of the test jar.

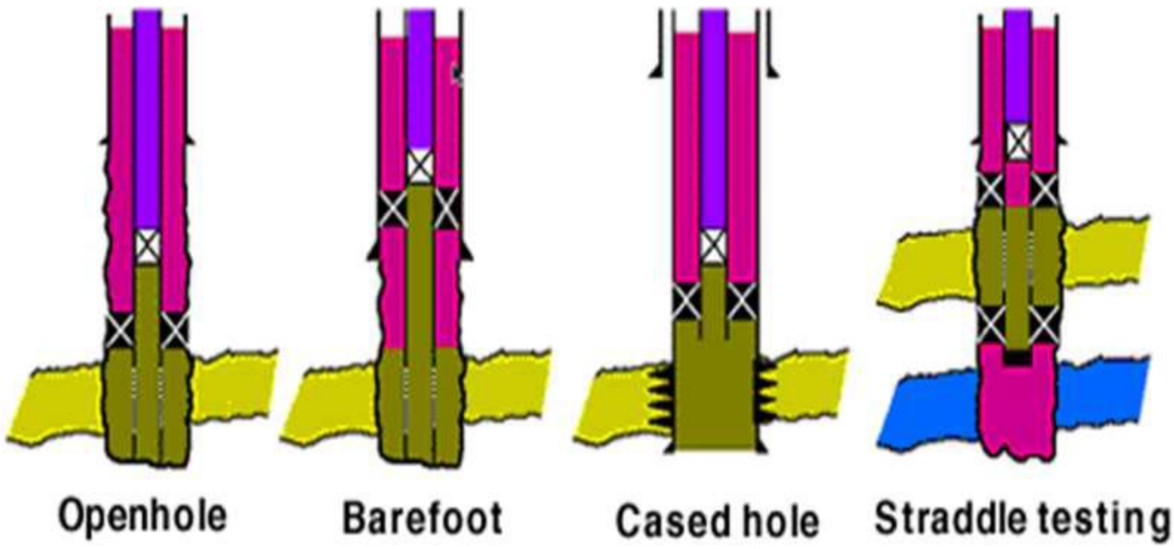


Figure.III.3. Different types of DST [5]

III.5.1. Open hole test:

Open-hole DST is a short-term production test on an uncased geological interval thought to contain hydrocarbons. This interval is isolated by a packer attached immediately above it (standard test), or by two packers attached on either side (straddle test), the second packer being used to isolate this zone from another lower down. In both cases, the packers are fixed in the open ground. [5]

The risks involved: getting stuck, frequent leaks from the packer, this type of DST can only be short-term. It is used in exploration wells with a normal gradient. It enables rapid geological investigation (fluid recognition):

- while drilling: tests by descending in 9 to 30m using a packer.
- Or when the bore hole has reached its final depth, in which case, if there are several geological intervals to be tested, the use of two packers is necessary, except for the lowest zone to be tested, which does not have to be isolated.

III.5.1.1.Advantages:

- Simplicity of testing, surface equipment can be reduced to a minimum.
- Quick to install and reduced operational time.
- Avoids problems of poor cementing behind the casing, so very precise identification of the effluent contained in the level tested.
- Does not disturb the progress of the drilling program.
- Can avoid unjustified down hole casing at the end of the hole (dry well).

III.5.1.2. Disadvantages:

- There is always a significant risk of getting stuck, and the instrumentation is more delicate than in a cased hole.
- Type of test not suitable for non-reinforced reservoirs.
- The sealing of the packer can be an issue if the hole is not properly measured.
- Information obtained during this type of test is very limited (this is because of the low flow rates required during this type of DST).

III.5.2. Cased hole test :

A cased-hole DST is a short-term production operation in a geological interval, after a casing has been lowered into the interval. The casing is perforated at the zone to be tested and a packer is attached above it to ensure annular isolation during testing operations. However, in some situations, the zone to be tested is not cased but the packer is attached to the technical casing above. [5]

The bottom valve (tester) can be either mechanically controlled, as for open hole testing, or controlled by annular pressure.

The field of application of DST in a cased hole covers practically all possible cases:

- Fixed or floating drilling rigs.
- Straight or deviated wells.
- Area to be tested with normal or abnormal pressure gradient.
- Shallow or deep wells.

DST in a cased hole generally achieves all the objectives of exploration and delineation well testing.

The only restriction that can be envisaged relates to safety:

- Gas wells at high pressure or with a high percentage of corrosive gas.
- Test program requiring a long operating time.

In both these cases, lowering a temporary completion may be better or necessary.

III.5.3. Straddle test :

If the zone to be tested is far from the bottom of the well or above another reservoir level, the lower part of the well can be isolated from the zone to be tested by an additional packer. [5] This is usually done using a test string:

- with two inflatable packers, in an open hole.
- with a retrievable packer and a bridge plug, in a cupped hole.

III.5.4. Barefoot test :

In this case, the area under test is an open hole, but the test packer is attached to the casing section above the open hole. [5]

III.6. Equipment used in a DST:

III.6.1. Down-hole equipment:

III.6.1.1Basic functions to be performed:

To execute a test, particularly an open-hole test, you need to be able to :

- Release the pressure exerted by the column of mud on the area to be tested and reduce the pressure in front of this area to a value lower than that of the fluids contained in the layer.
- Canalize these fluids to the surface without the risk of any pollution of the mud or a blowout.
- Maintain the drilling pressure exerted by the mud column on untested formations to prevent them from collapsing or fluids from entering without using the hydrostatic pressure of the mud.
- Record the temperature and pressure at the bottom of the well, and how they change during the test.

At the end of the test, remove the test string after switching the entire well back on to the control fluid. [6]

III.6.1.2. Basic components:

The basic elements of a test string, making it possible in particular to perform the functions described in the previous paragraph, are as follows:

III.6.1.3. The tubular:

Made of drill pipes or tubing, as the case may be.

This tubular is used :

- for the effluent that will be produced.
- To support the other elements.

Drill stems are most commonly used for short duration DST (Drill Stem Test) in a low or medium pressure zone. In other cases, and especially if there is a risk of the presence of sulphuric acid (H2S), we prefer to use tubing with better sealing at the joints. [6]

III.6.1.4. Sleep joints :

They allow short vertical movements of the test lining, generated by variations in temperature and pressure during the different flow and closing phases. Their number depends on the depth, the bottom temperature and the planned flow rate of the well. [6]

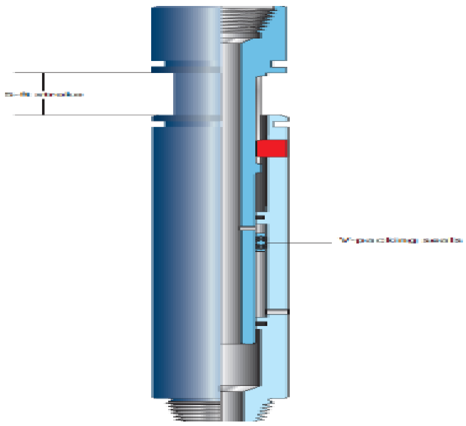


Figure.III.4. Sleep joints [6]

III.6.1.5. Packer:

A rubber sleeve located above the zone to be tested is pressed against the walls of the hole, making a leak-proof seal and separating the well into two zones with no communication between them.

- **The packer for open hole :**

It consists of a long rubber string attached to a mandrel which slides into the body.

The test string simply rests on the bottom of the well via the stand (or on the walls of the well via the lateral anchoring device if the bottom is far away), and then weight is placed on the packer to compress the rubber lining, which flows into the well and conforms to the shape of the walls, creating a leak proof seal between the bottom and top sections. [6]

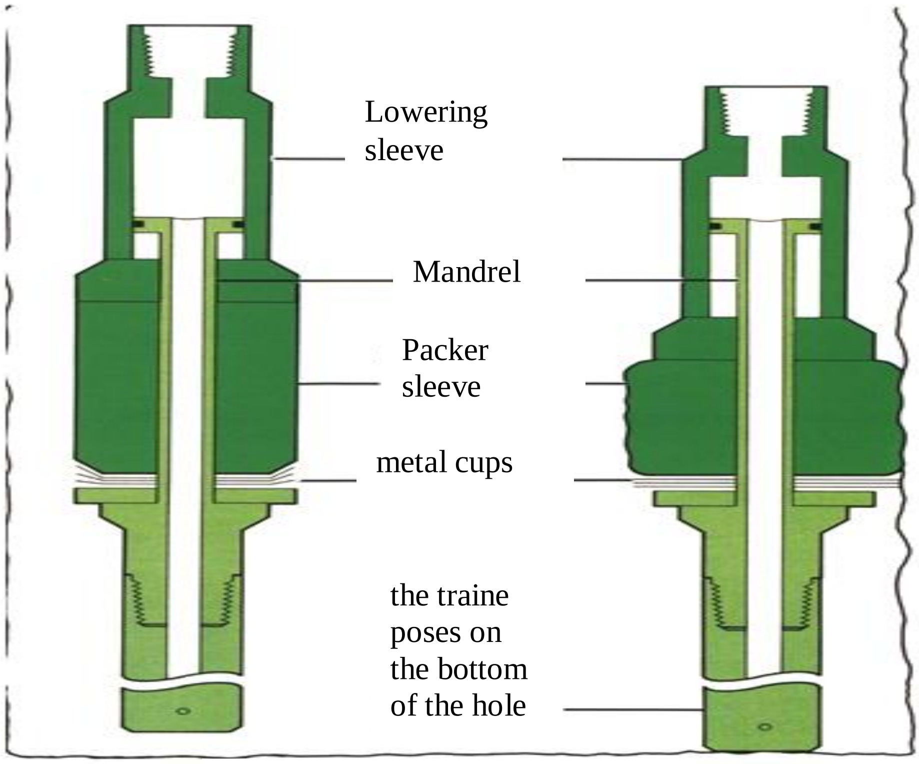


Figure.III.5. Open hole packer [6]

The packer anchoring rib must be strong and well calibrated to avoid leaks at this point. The weight required to attach the packer is of the order of one tone per inch of packer diameter.

Sometimes, if the diameter of the hole is large, two packers are used, screwed one on top of the other to increase the chances of providing a perfect leak proof seal.

While the packer is being lowered into the open water, make sure that the weight of the packer does not exceed 10 tones, otherwise there is a risk of the packer becoming attached and, if time is lost (2 to 3 minutes), the tester valve may open (in the case of MFE) in its turn. For this reason, if the packer is installed during the descent, it must be removed immediately.

If the packer is not properly attached and does not provide a leak proof seal, once the tester valve opens, the mud will pass behind the packer, enter through the borehole tubes and rise up into the drill string, reducing the hydrostatic column in the annulus and possibly causing a leak. If a leak is detected, the tester must be closed immediately and the well filled. To do this, both pumps must be ready to fill as soon as the leak is detected.

- **Packer for cased hole**

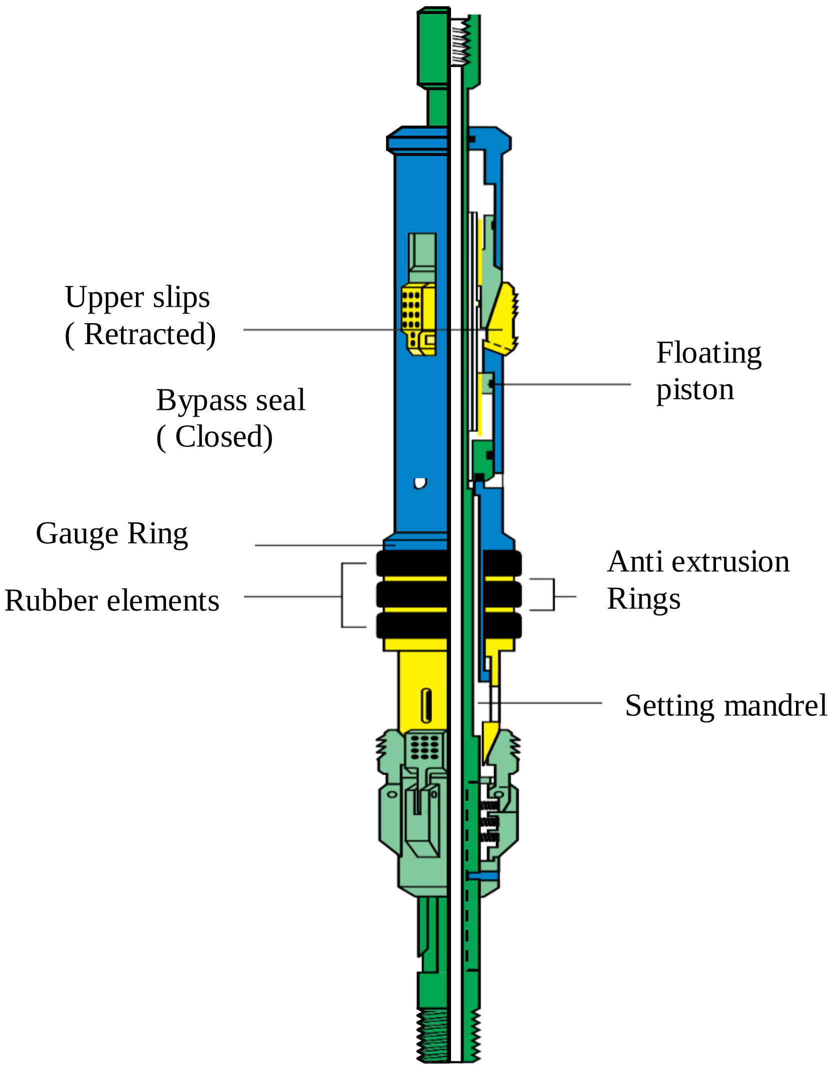


Figure.III.6. Packer for cased hole [6]

In the cased hole test, the bottom is generally very far away, which makes it impossible to use a stand. A lateral anchoring device integrated into the packer is used as a support point.

All you have to do is release the edges and press them against the walls of the hole by rotating the test string. The weight is then applied to attach the packer (around 1 tone per inch of packer diameter).

The cased hole packer has three short string seals. If acid or other fluids are injected underneath the packer, there is a risk that it will be released. [6]

To avoid this, we use a packer that attaches upwards and downwards. The upward-anchoring corners are operated by internal pressure-operated pistons.

III.6.1.6. Tester:

Basically, it's a valve (or several valves) that can be opened or closed at any time.

When closed, it is covered inside the pipes by a cushion of liquid of suitable density and height (a tampon of water or diesel fuel, for example) so that the corresponding hydrostatic pressure is lower than the pressure of the fluids present in the area to be tested.

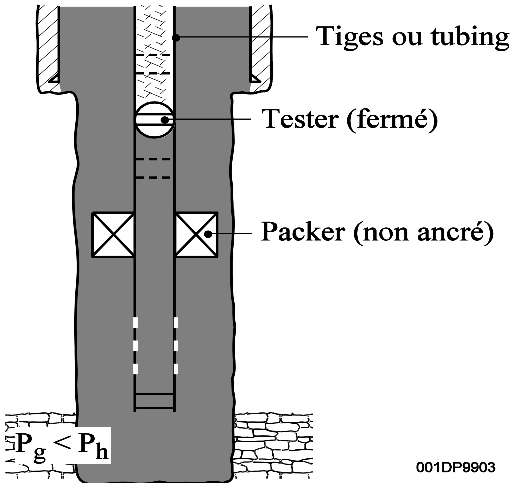


Figure.III.7. A tester (closed)

Opening the tester: after the packer has been attached, the fluids under the packer and in the area under test are decompressed by the pressure created by the tampon fluid above the tester. This decompression allows the fluids to flow.

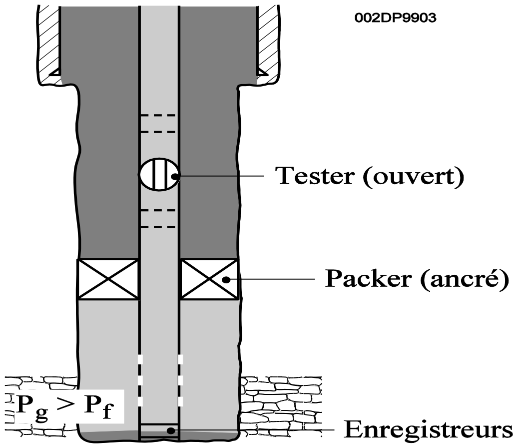


Figure.III.8. A tester (Opened)

Closing the tester: with the packer still attached, it is possible to stop the flow (without using the hydrostatic pressure of the mud) and cause the pressure to increase. Its position close to the bottom of the well minimizes the disturbance caused by the recompression of the volume in the well (capacity effect) when the pressure increases. [6]

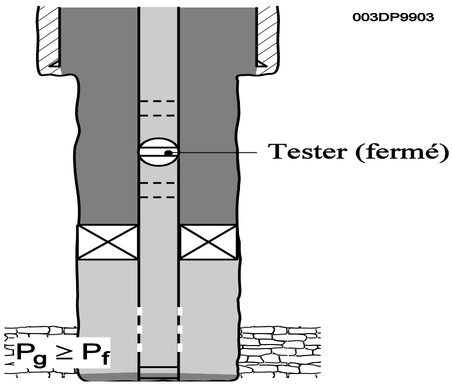


Figure.III.9. A tester (Reclosed)

These operations of opening and closing the tester, with the packer attached, can be repeated as many times as necessary.

III.6.1.7. The recorder holder sleeve :

a sleeve containing a Bourdon tube to measure pressure and a gauge to measure temperature. It is placed in front of the tank to measure and record on a special paper the variations in pressure from the start of the descent of the test train until it rises again.

Depending on their position and arrangement in the string, the pressure recorders can record either the pressure inside the string or the pressure outside the string, and therefore in particular the change in bottom pressure during the draw-down phase and the build-up phase.

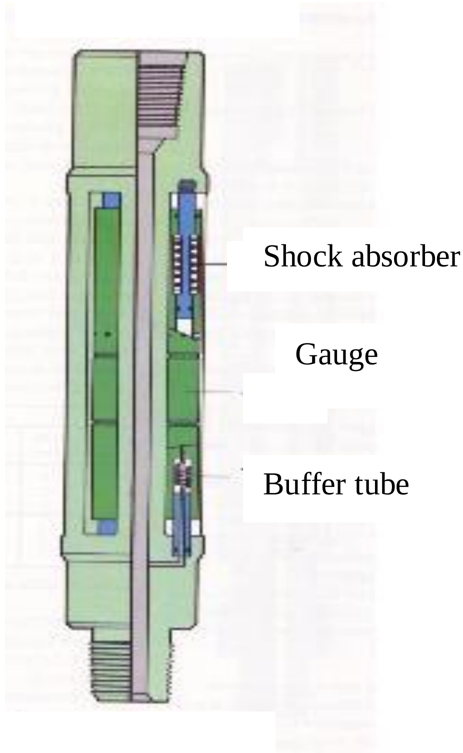


Figure.III.10.Recorder holders (RCAR)

A second recorder door is located above the safety joint. It is mainly used to recover data in the case of the packer being stuck and the part under the safety joint being abandoned.
The recorder can be an electronic type with built-in memory. [6]

III.6.1.8. The equalizing valve :

When the test is executed, the pressure under the packer is different from the hydrostatic pressure of the mud above the packer.
In order to be able to decompress and release the packer at the end of the test, it is necessary to equalize the pressures on both sides of the packer.
This is achieved using an equalizing valve located between the packer and the tester. At the end of the test, it opens communication between the annulus and the inside of the test packer (the part below the tester) and therefore :

- To equalize the pressures on either side of the packer.

- Provided there is enough injectivity, push the effluent produced (located in the packer below this point) back into the formation under test by pumping drilling mud into the head of the annular space, with the annular jaws of the BOPs closed.

When the test train is lowered, this valve is in the open position and acts as a bypass for the fluid to pass from below to above the packer as the string is lowered. It will be closed before the initial opening of the tester. [6]

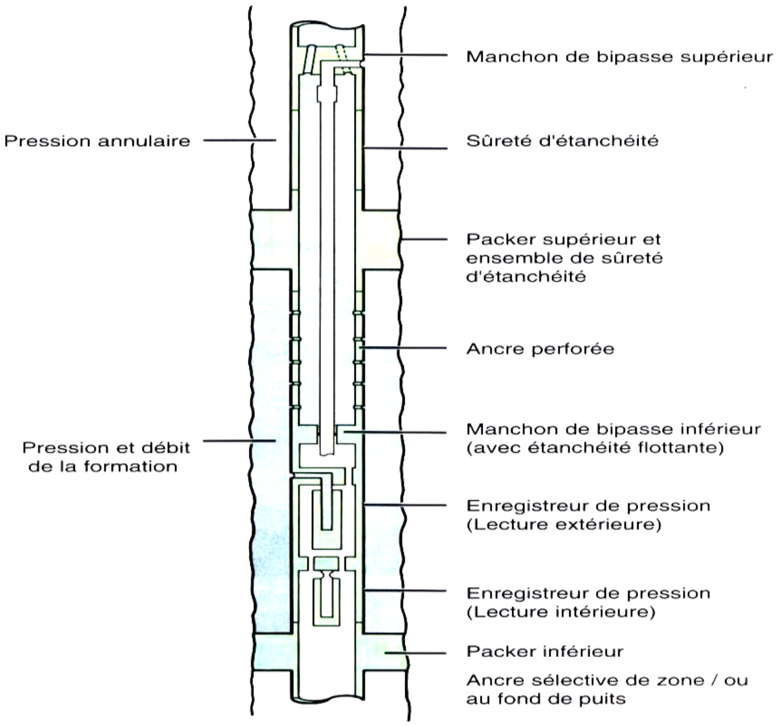


Figure.III.11. By-pass system [6]

III.6.1.9. Reverse circulation valve :

At the end of the test, if the well has been productive, the test string is partially or completely filled with effluent. It is then dangerous to carry out the ascent operation with this flammable fluid inside the test string.

The reverse circulation valve is placed above the tester and is opened at the end of the test to allow the mud to pass from the annulus to the inside of the drill string to replace the effluent before reassembling the test string, During reverse flow, it is important to make sure that the pressure in the annulus does not exceed the maximum permissible pressure. A test train must contain two valves of different types. [6]

A test train must include two valves of different types, so that if the first doesn't work, the second can be used. In general, the first valve to be used is the percussion valve and the second is the bursting plate valve.

There are several types:

- **The percussion valve:**

a connector with holes communicating with the annular space and plugged by hollow plugs. To open it, a bar is thrown from the production head, which breaks the plugs, opening the holes that allow the mud to flow inwards from the annular space. The bar continues its downward movement until it rests on a lower receptacle. [6]

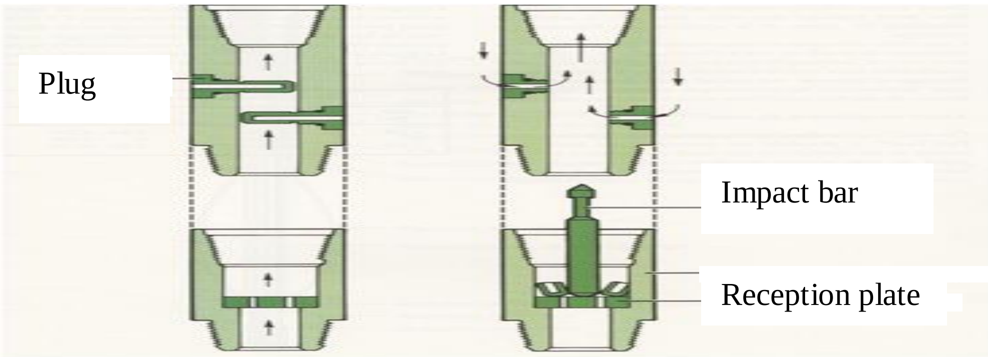


Figure.III.12. The percussion valve [6]

- **Burst plate valve:**

a connector with holes communicating with the annular space and plugged by plates set at a differential pressure of around 1500 psi, which burst when pumped from the inside.

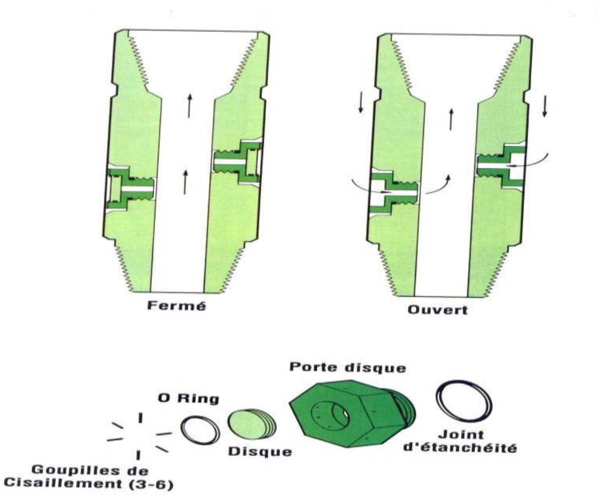


Figure.III.13. Burst plate valve [6]

- **Internal pressure valve:**

A connector with holes communicating with the annular space and plugged by a liner held in place by pins set at a certain pressure (generally 1500 to 2000 psi). When pumping from the inside, the pressure enters through ports and pushes the liner until the pins are sheared; the liner releases and moves upwards, freeing the flow ports. [6]

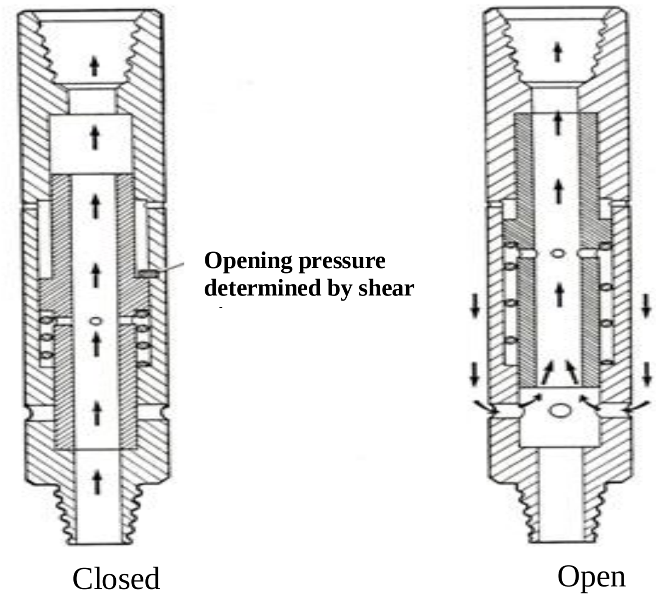


Figure.III.14. Ineternal pressure valve [6]

- **Valve opening by rotation:**

The liner that closes the holes through which the mud passes is screwed into another liner attached to a mandrel that rotates in relation to the valve body. All you have to do to open the valve is to turn it about ten turns to the right. [6]

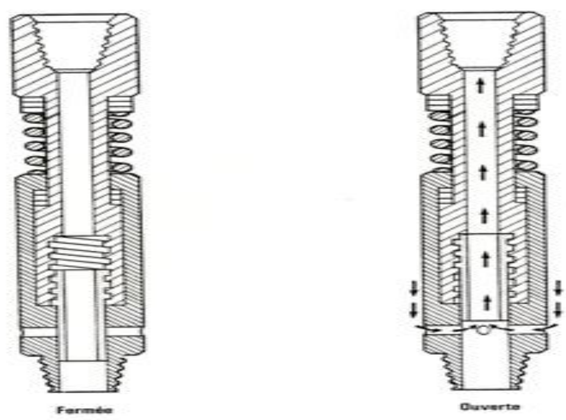


Figure.III.15. Valve opening by rotate [6]

There are other models, and we'll look at them quickly below:

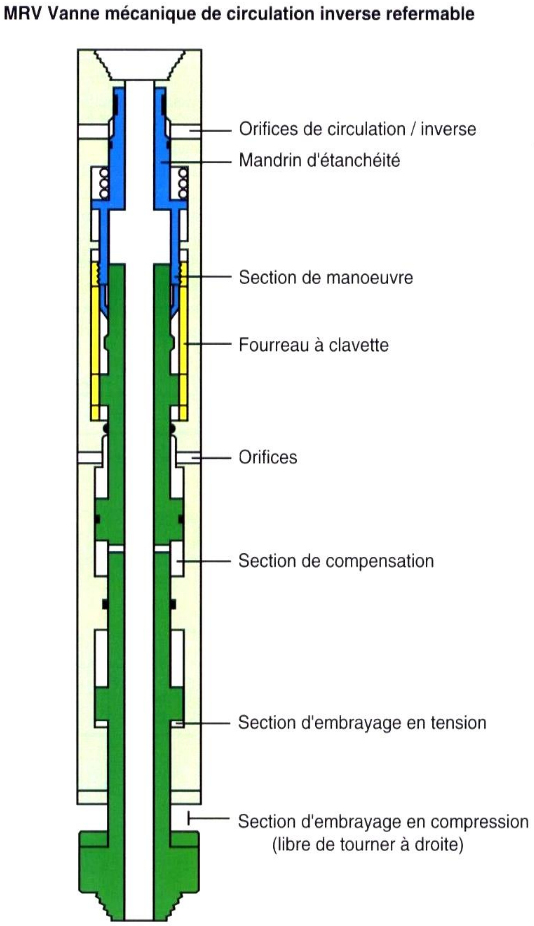


Figure.III.16. mechanical reclosable reverse circulation Valve [6]

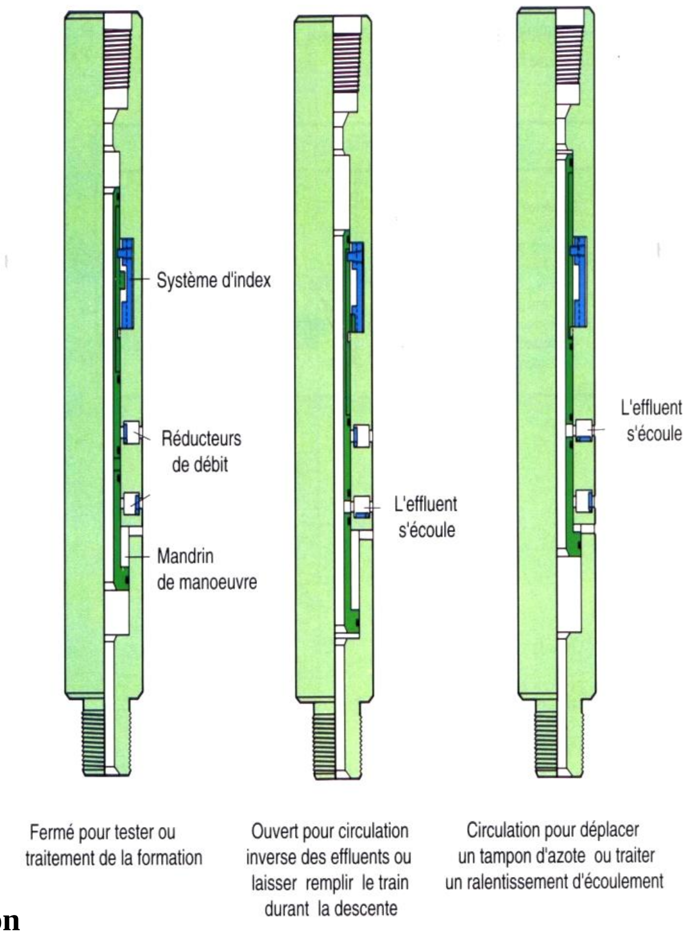


Figure.III.17. multi-cycle circulation [6]

III.6.2.Other components :

Depending on whether the test is performed in an open hole or in a cased hole, many other elements can also be integrated into a test train, specifically :

III.6.2.1. The Crutch:

To attach the packer, the end of the test train must rest on the bottom. To do this, we connect weight rods from the recorder holder sleeves to the bottom. These weights - rods represent the crutch that enables the packer to be anchored and the tester to be opened. [6]

III.6.2.2. The lateral anchoring device :

If the bottom is very far from the recorder sleeves, a device is used which has corners that attach to the walls of the well (open well) thus supporting the test string and anchoring the packer. It is screwed to the end of the test string and is attached by rotation. Friction springs prevent rotation of the liner to allow the corners to extend and grip the well walls. [6]

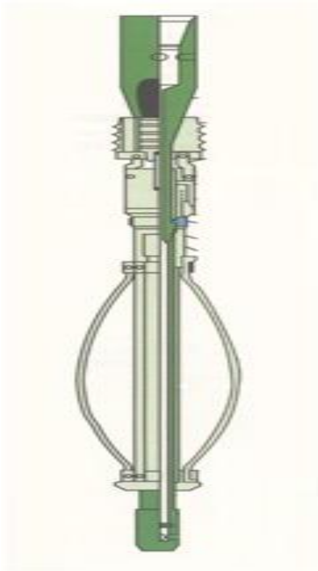


Figure.III.18. Lateral anchoring device [6]

III.6.2.3. The shoe:

This element is located at the very bottom of the test packer. In the case of an open-hole test, it is a flat-bottomed fitting that rests on the bottom of the well and therefore compresses the packer. [6]

III.6.2.4. The strainers:

Perforated tubes allow the effluent from the area under test to enter the test string and act as a filter for any dirt produced. [6]

III.6.2.5. Hydraulic locking of the packer:

It keeps the packer attached even when the weight of the string is taken on to operate the tools on top of the packer, and in particular to test it. This locking tool is activated by over pressure between the hydrostatic pressure due to the mud in the annulus and the pressure that exists in the test train (under the tester) during the actual test.

It is deactivated when the equalizing valve between the packer and the tester is opened at the end of the test. [6]

III.6.2.6. safety joint :

Especially when testing in an open hole, there is a high risk of the packer becoming trapped. In this case, unscrewing the safety joint allows the free part of the string to be recovered. [6]

III.6.2.7. The hydraulic slide:

Before unscrewing the safety joint in the case of sticking, an attempt is made to release the packer by applying traction forces to the packer using the hydraulic slide placed above the safety joint. [6]

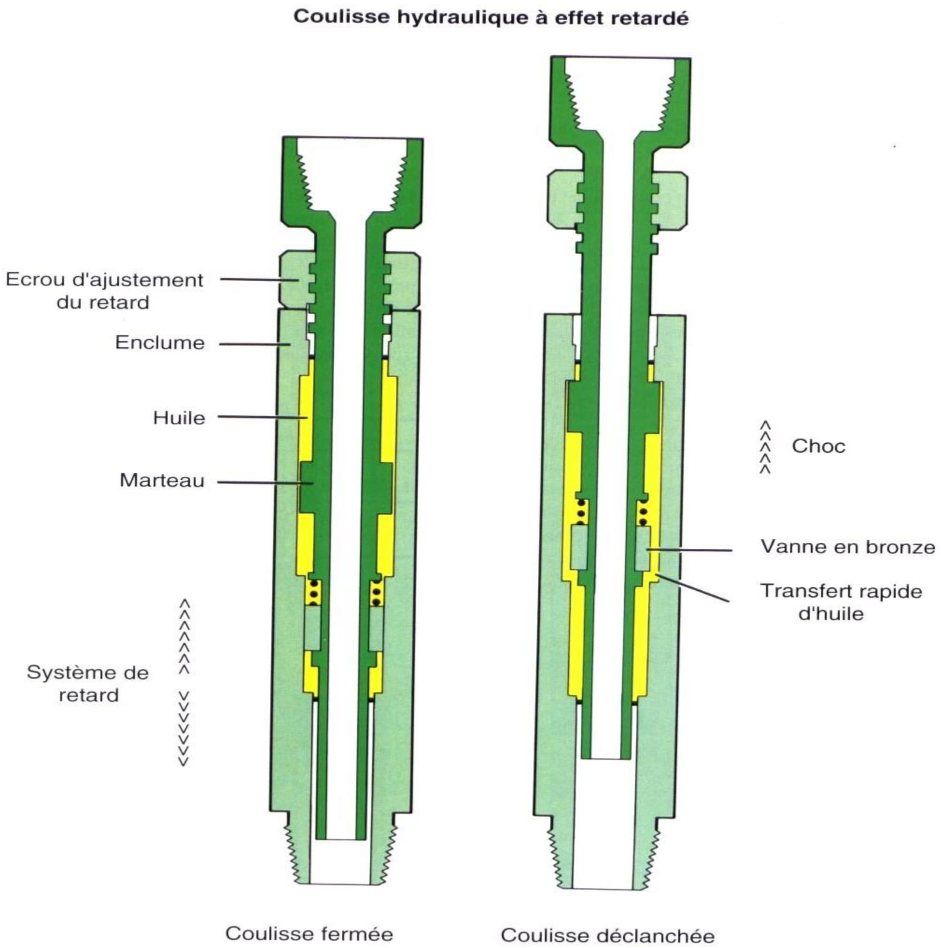


Figure.III.19. The hydraulic slide [6]

III.6.2.8. The drill collars:

Placed above the reverse circulation device, they provide enough weight for :

- compressing the packer seals.
- In the case of a mechanical test, open the test valve.

III.6.2.9. The bottom safety valve:

It is used to close the string test at the bottom of the well in case the tester valve fails.

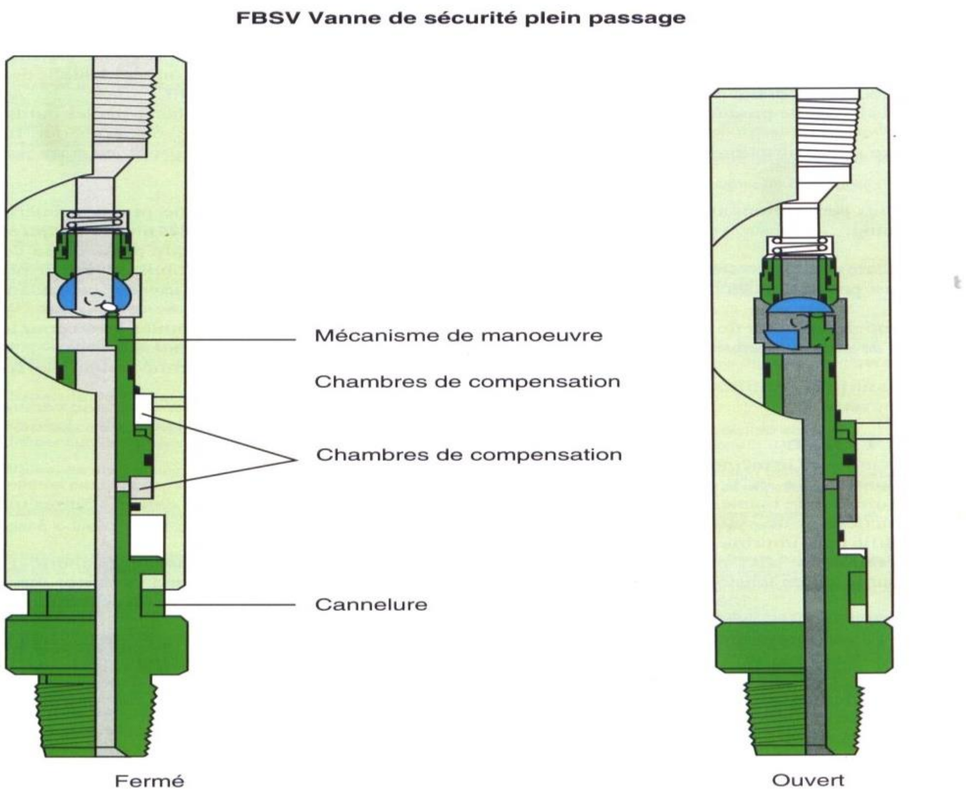


Figure.III.20. The bottom safety valve [6]

III.6.2.10. the bottom sampler :

Integrated into the string, it traps the effluent present at this level. It is activated at the end of the last flow phase.

III.7. The installation arrangement of the previous elements :

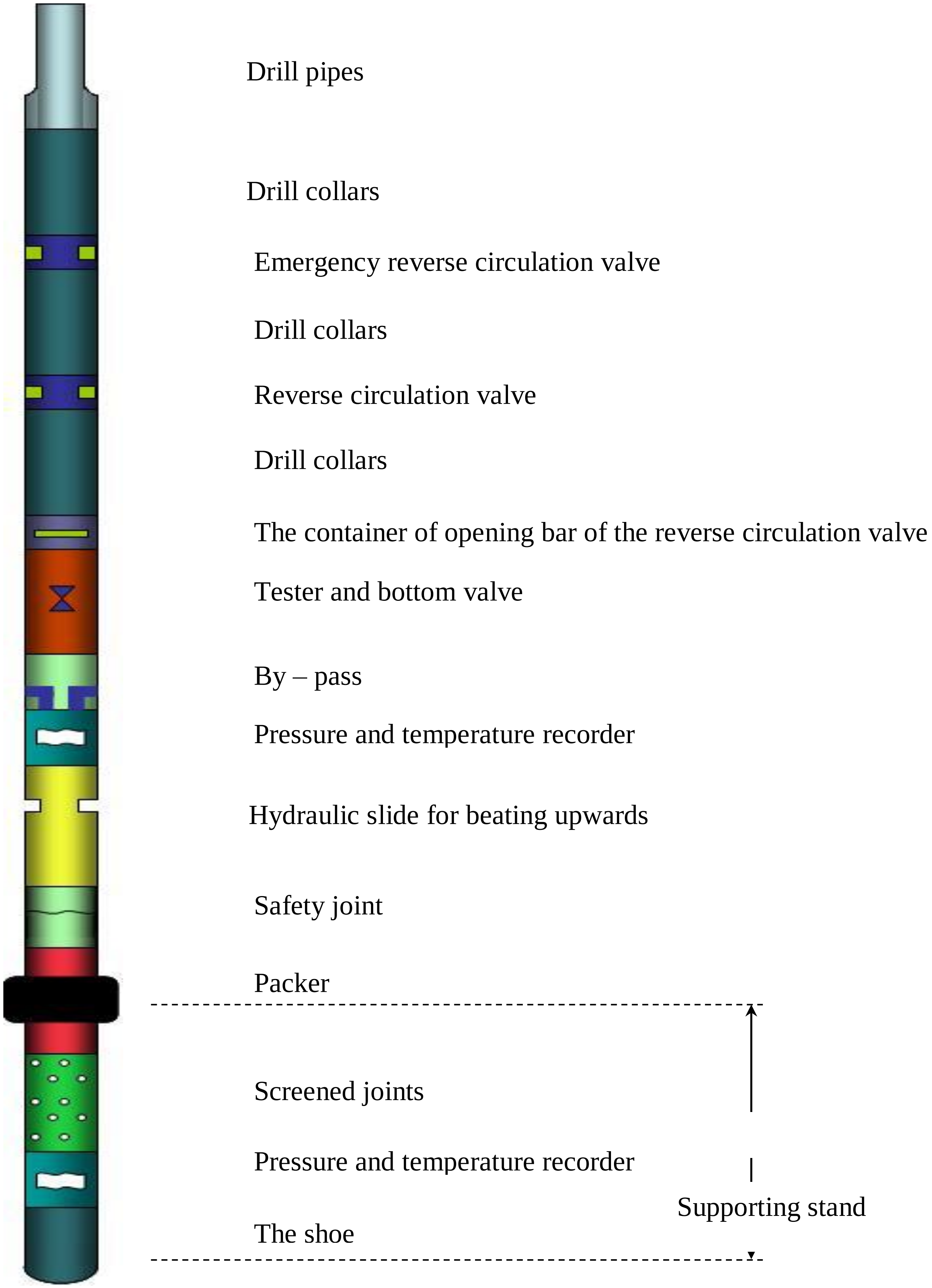


Figure.III.21.The test train installation order [6]

III.8. The MFE tester and its accessories (open hole) :

III.8.1. String description :

The testers are bottom valves that are opened and closed a number of times to drain the reservoir or pressurize it. In the open hole, these valves are operated mechanically, either by translation or rotation. Valves operated by annular pressure are not used in the open hole, because the pressure can affect the stability of the hole walls and cause the packer to get stuck.

Johnston's Multi Flow Evaluator (MFE) features a mandrel that controls effluent flow by translation. It allows an unlimited number of closures and openings.

A sample (with a capacity of 2500 cubic cm for a 5"inch MFE) is trapped in a chamber as soon as the tool is closed.

The MFE opens for pre-flow a few moments after the packer is anchored (2 to 3 minutes). A hydraulic delay system prevents the MFE from opening before the packer is anchored. The opening can be seen on the surface by a drop in the string of 3 centimeters, or by the blast coming out of the pipe connected to the nozzle manifold (if the flow is strong), or even on the weight indicator by the vibration of the needle.

By pulling upwards, the MFE closes immediately before the bypass opens. But if the tension is maintained so that the MFE remains closed, there is a risk of opening the by-pass valve and even sliding the packer against the walls of the hole. [6]

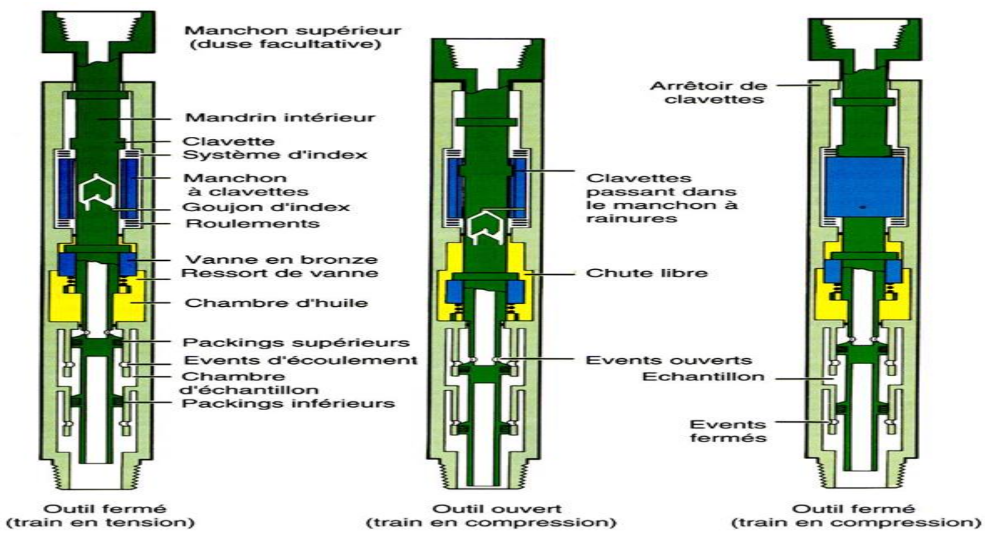


Figure.III.22. The MFE tester [6]

To avoid all this, the mandrel is attached to a grooving system that keeps the MFE closed in an intermediate position that puts it in compression (position 4). In this system, the grooved sleeve is attached to the mandrel and the pin is attached to the body, Due to its design, the MFE does not allow full internal passage for cable work. [6]

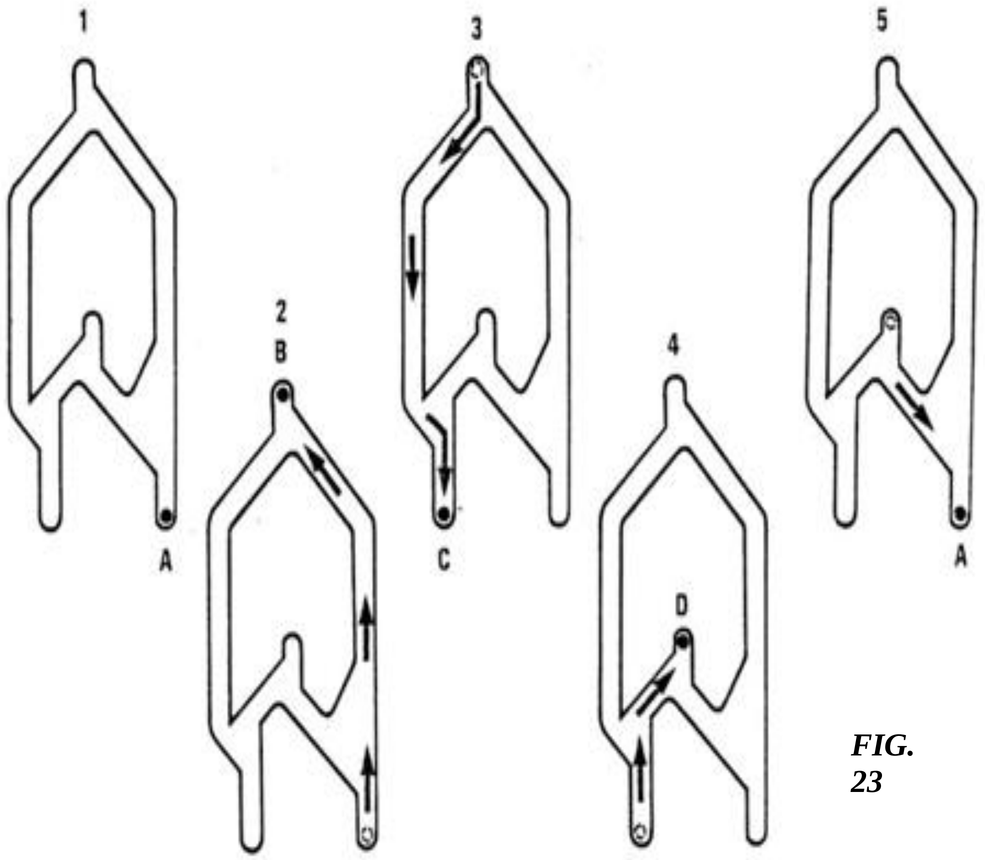


FIG. 23

	Mouvement	J.pin	Vanne
1	**Lowering test train**	**A**	**Closed**
2	**Delayed downward slide**	**B**	**Opened**
3	**Free running upwards**	**C**	**Closed**
4	**Delayed downward slide**	**D**	**Closed**
5	**Free running upwards**	**A**	**Closed**

Table.III.1.The valve states with the different positions of j.pin.

III.8.2.The MFE by-pass :

This is a valve located below the tester and operated by translation to allow the mud to pass between the annular space below the closed MFE and the inside of the test train to exit under the packer via the screened tubes.

It is open during the descent and raising of the test train to avoid pistoning due to the restricted passage between the packer and the walls of the hole, It can also be used to equalize pressure to unlock and release the packer. [6]

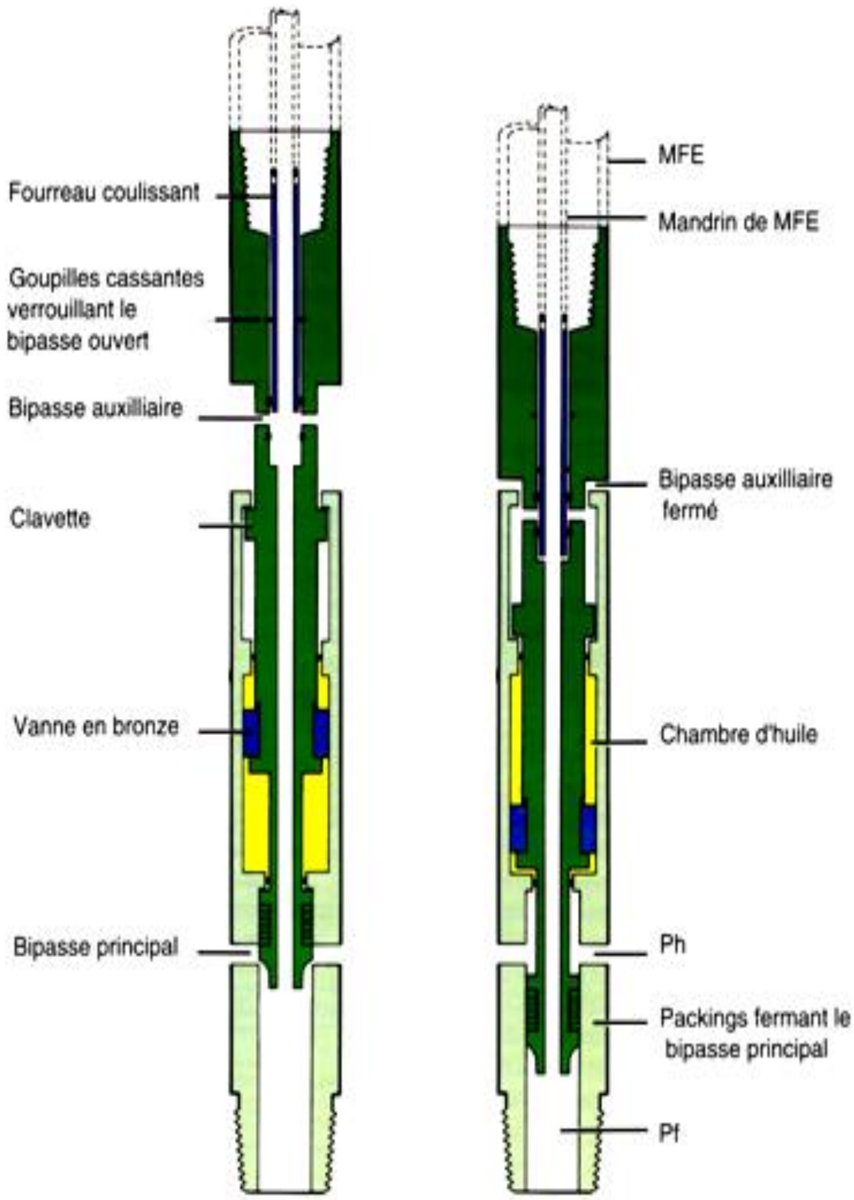


Figure.III.23. The MFE by-pass [6]

closes immediately when weight is applied to attach the packer and opens after the MFE is closed and before the packer is released.

III.8.3. The MFE safety seal :

The safety seal is placed immediately at the top of the packer to lock it in place and prevent it from coming loose when the test train is turned on.

a hydraulic system comprising a mandrel attached to the packer mandrel, which moves upwards when the weight is placed on the packer to attach it. As it moves upwards, it pushes the oil up from the lower chamber to the upper chamber through a non-return valve. When the bypass closes and the bottom valve opens, the pressure difference between the inside and outside of the test train is high, which pushes a cylinder valve inwards to block the passage of oil between the two chambers. This means that if the test train is energized, the oil cannot pass from the upper chamber to the lower one, being prevented on one side by the non-return valve and on the other by the cylinder valve.

The packer only unlocks when the bypass is opened after the MFE is closed, which equalizes the pressures and the spring pushes the cylinder valve outwards, allowing oil to flow from top to bottom.

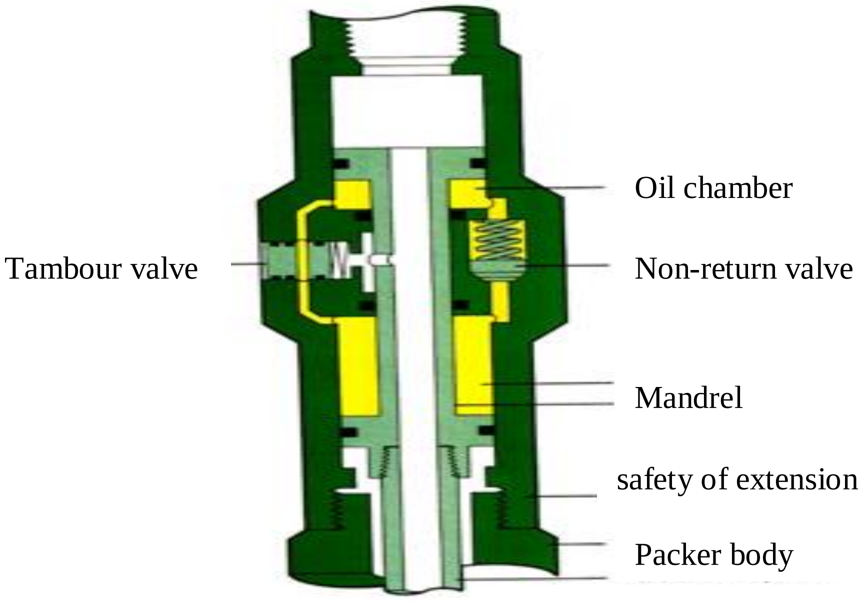


Figure.III.24. The MFE safety seal [6]

III.9. Johnston equipment (Schlumberger) :

III.9.1. The PCT tester (Pressure Controlled Tool) :

This tool comprises a piston floating in the lower part of a nitrogen chamber pre-charged to 2500 psi. A sleeve containing a piston is operated by the pressure in the annular space. This tool is lowered with another tool, called HRT (Hydrostatic Reference Tool), which works in

the same way as the MFE, but which also has a by-pass, which is closed by the MFE liner when it moves downwards after anchoring the packer to open the tester.
Both tools are dropped closed. When the packer is attached, the HRT opens. When pressure is applied to the annulus, the PCT sleeve moves downwards, freeing the passage for the effluent. When the pressure is released, the sleeve returns to its initial position and closes the passage.
It can then be operated an unlimited number of times, but can only be opened when the HRT is open, The PCT also has a locking system that keeps it closed by raising the pressure to around 2,500 psi. [6]

This tool has no sampling chamber and is always lowered with an independent sampler.
The full-flow PCT has a spherical valve and is lowered with a full-flow HRT, which has a non-return valve.

III.9.2. Circulation valve SSARV (Single Shot Annulus Reversing Valve) :

a reverse circulation valve which opens as the pressure rises in the annular space, pushing a sleeve which moves downwards, uncovering the reverse circulation holes.

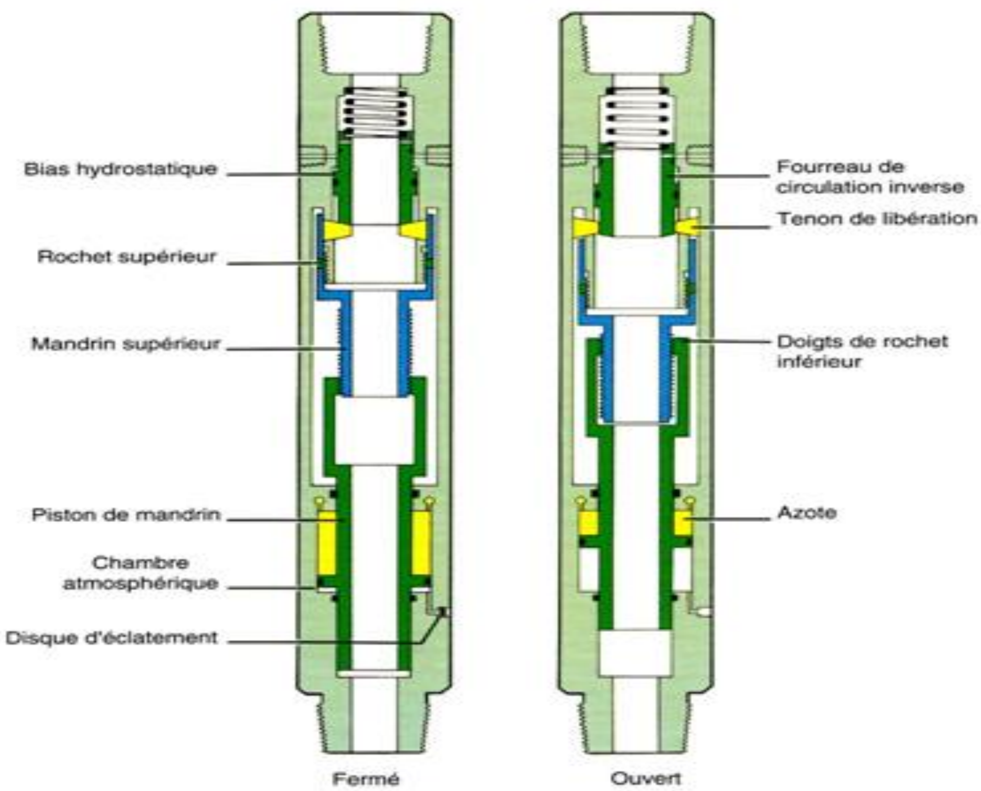


Figure.III.25. SSARV (Single Shot Annulus Reversing Valve) [6]

III.9.3. The Full Bore Pressure Controlled Tester [FB PCT] :

This tool is made up of 2 parts :

- The valve section (ball valve).
- The hydro mechanical operator section.

The PCT is pre-charged with azotes at the surface (depending on the hydrostatic pressure in the well) so as to regulate the pressure to be exerted at the head of the annulus to open it.

The PCT remains open as long as this pressure is maintained at the head of the annulus. To close the PCT, simply release the annular pressure. By re-applying pressure in the annulus, An accessory (Hold open) can be added which allows the string to be lowered and raised with the PCT in the open position even though the annulus is not under pressure. [6]

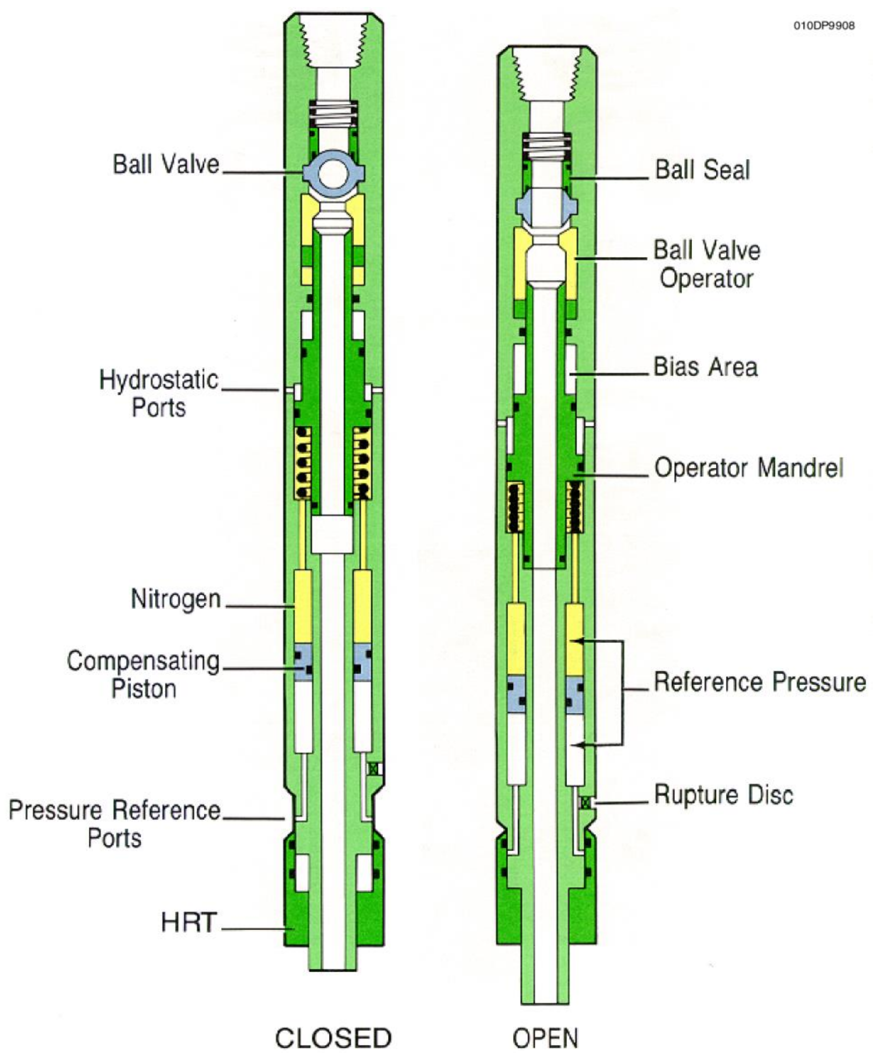


Figure.III.26. The Full Bore Pressure Controlled Tester [FB PCT] [6]

III.9.4. The sampler :

This is a full-flow device which has a sampling chamber trapped between two spherical valves. Installed above the PCT tester, it is lowered with two open valves. They are only closed by annular pressure at the end of the test. [6]

III.10. Surface equipment :

III.10.1. Basic functions to be performed :

In particular, the surface equipment must allow :

- to support the pressures at the head and ensure safety at the surface.
- maintain a flow rate suitable within the capacity of the facilities and the test program.
- recover samples.
- if necessary, measure the flow of air contained in the test string at the start of the test and pushed by the flow of effluent coming from the bottom of the hole.
- separate the effluent if it arrives at the surface to count the oil, gas and water .
- to know the flow, separation, counting and sampling conditions.
- to store or burn the effluent.

III.11. Basic equipment :

The basic surface equipment is the following:

III.11.1. The Flowhead :

When testing a well, surface shut off is usually provided by a flow control head or Flowhead that functions as a temporary Christmas Tree.

The flowhead is located on top of the well and it is the first piece of equipment at the surface that fluids flows through. [8]

- **The Flowhead functions : [8]**
  - It supports the weight of the test string.
  - It allows up and down rotation movement of the test string.
  - It flows out of the well through a flow valve .
  - It allows to pump fluid into the well through a kill valve.
  - It allows tools to be introduced into the well through the swab valve.

The flowhead is used to provide temporary shut off at the surface for the following:

- Pre-completion testing.

- Drill stem testing.
- Post-completion testing.

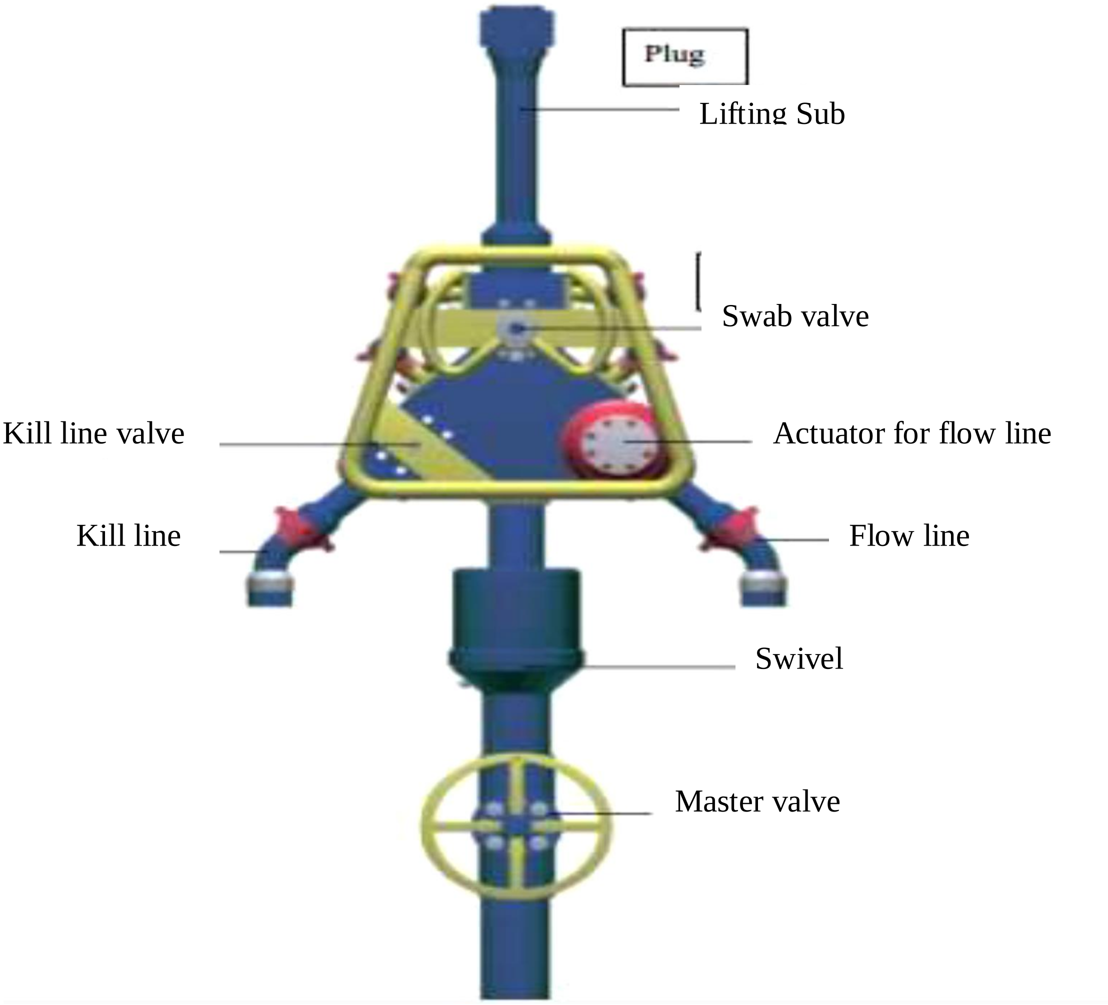


Figure.III.27. The Flowhead [8]

- **The flow head has the following features and benefits : [8]**
  - A master valve that allows isolation of the surface equipment from the downhole test string.
  - A swab valve that permits introduction and retrieval of wireline tools.
  - A flow line valve to allow fluid to flow from the well, This valve is usually operated with a hydraulic actuator, allowing remote and automatic closure.
  - A kill line valve used to pump fluid into the well.
  - An optional swivel allowing the test string suspended from the flowhead to be rotated independently of the main flowhead block.

- An elevator sub used to handle the flowhead with the rig elevators.
- A threaded connection on top of the elevator sub used to attach pressure equipment.

III.11.2. Data/Injection Header :

his element is installed just before the choke manifold and provides :

- Pressure and temperature measurement points.
- Sampling points.
- Chemical injection connections.

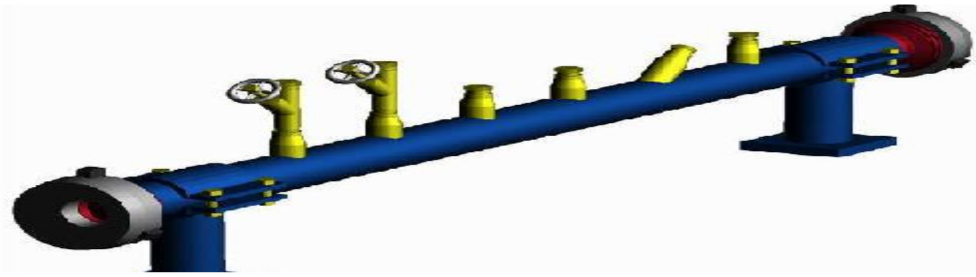


Figure.III.28. Data/Injection Header [8]

III.11.3. Choke manifold :

The choke manifold is used to control the fluid from the well by reducing the flowing pressure and by achieving a constant flow rate before the fluid enters the processing equipment on the surface.

When testing a well the aim is to impose critical flow across the choke, when critical flow is achieved changes pressure and flow rate made downstream from the choke do not affect downhole pressure and flow rate.[8]

Figure.III.29. The choke manifold[8]

The choke manifold consists of :

4 gate valves used to isolate the choke boxes on either side of the choke manifold. [8]

- A fixed choke box to insert calibrated choke beams of different diameters depending on the pressure and flow rate required.
- An adjustable choke to gain quick control of the well and to change fixed choke beams without interrupting the flow.
- Tapping points for measurement of the upstream and downstream pressures.
- A thermometer well inserted in the flow path allowing the fluid temperature to be monitored.

III.11.4. Gas manifold :

It is placed after the DST chock manifold to connect one side with the rig manifold (for the return of mud during reverse circulation) and the other side with the separator. [6]

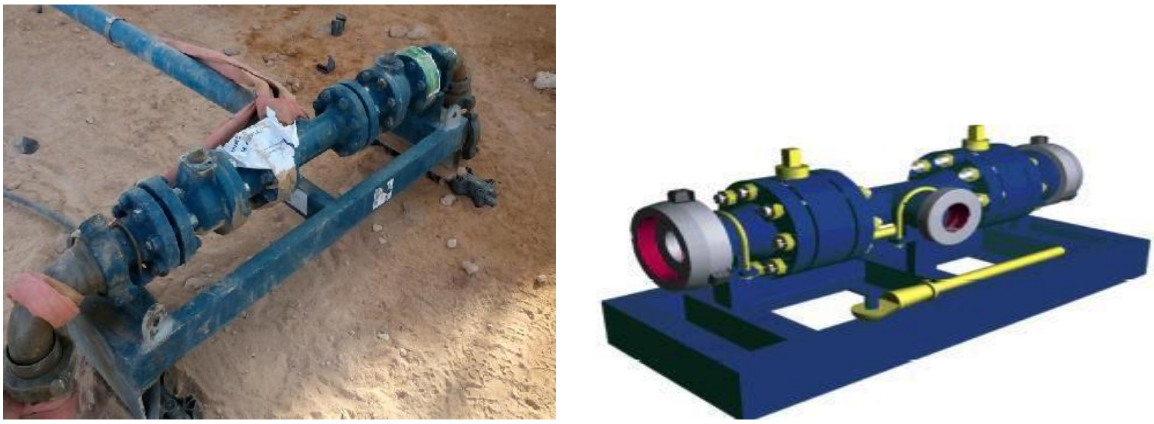


Figure.III.30. The gas manifold

III.11.5. Oil manifold :

This is the main piece of equipment needed to connect the gas manifold, separator, storage tank and torch. [6]

Figure.III.31. Oil manifold

III.11.6. The Coflexip :

Used to connect the flowhead and the chock manifold, it must be installed correctly to avoid damage during vertical movement of the of the test string. [6]

Figure.III.32. Coflexip [6]

III.11.7. Heaters and Steam Exchangers :

Heaters and steam heat exchangers are used to raise the temperature of well effluence to prevent high-grade formation viscosity and break down emulsions for efficient separation of oil and water.

In the case of oil, especially viscous oil, it promotes oil flow and oil-water separation by reducing the viscosity of the oil. In the case of a gas, it heats the gas to prevent the formation of hydrates. [8]

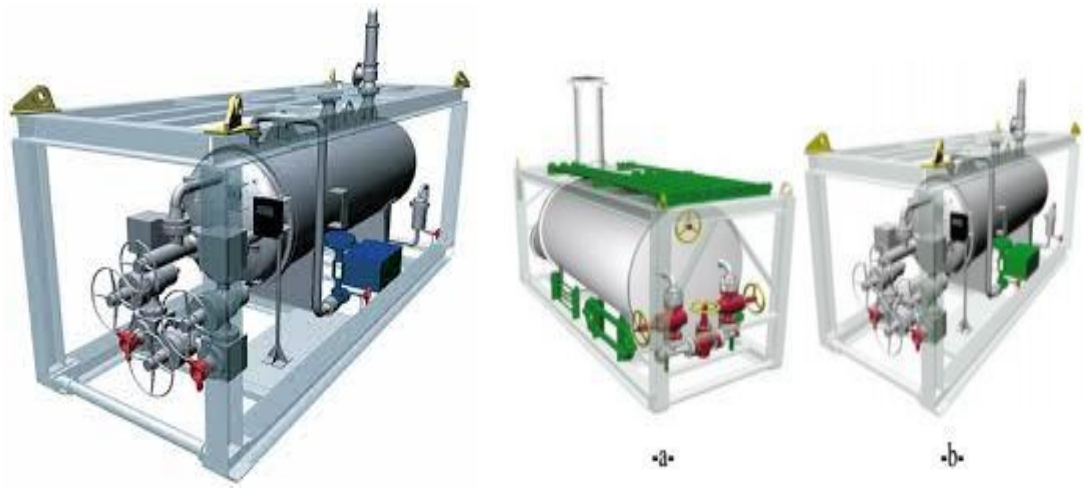


Figure.III.33. Heater and Steam Exchanger [6]

III.11.8. The separator :

The test separator is the principal part of the process system. It manipulates the stream of produced fluid to take advantage of the density differences that exist between gas, oil and water, and that causes these phases to separate.

Because of the relative densities of gas and the liquid their separation is quick usually a few seconds, some liquid may remain for a time in the gas in fine mist, Densities of oil and water however are closer and can take a few minutes to separate. [8]

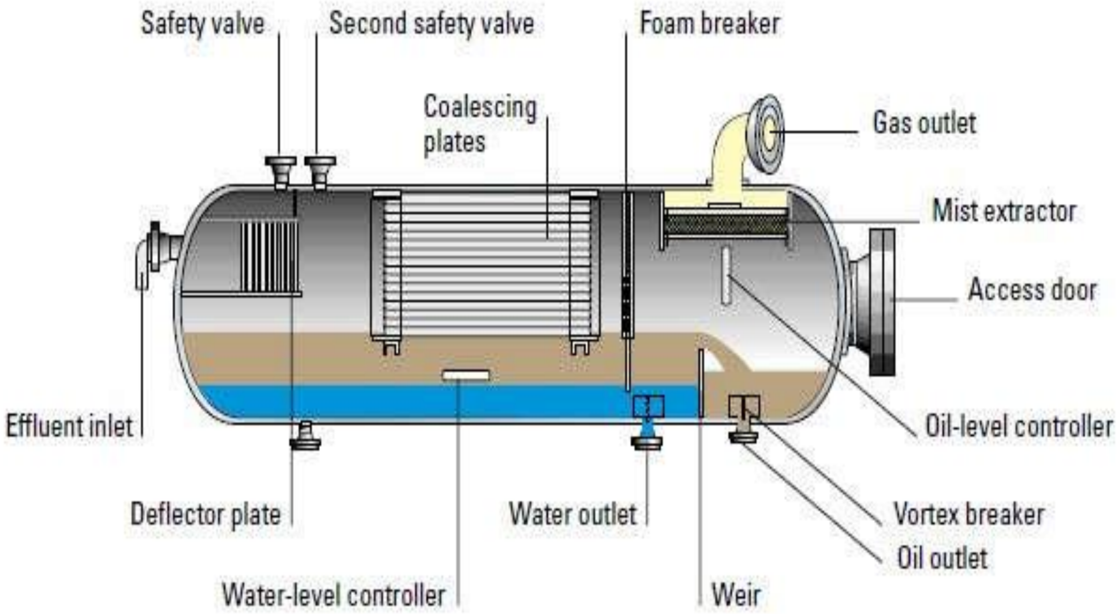


Figure.III.34. The separator [6]

The test separator is mainly composed of [8]:

- **Effluent inlet.**
- **Deflector plate :**

A flow breaker is placed in front of the inlet, the gas flows round the breaker and the liquid falls to the bottom of the vessel.

- **Coalescing plate :**

Dixon or coalescing plate arranged in an inverted v-shape group small droplets of oil into bigger drops which under the action of gravity trickle down into the liquid, gas leaving the coalescing plates may not yet be dry.

- **Foam breaker :**

A wire mesh foam breaker prevents waves of foam passing along the separator and being carried away with the gas.

- **Mist extractor :**

Before leaving the separator the gas will pass through a mist extractor composed of a massive wire mesh, it is designed to stop tiny oil droplets down to 10 microns from leaving the separator out of the gas line.

- **Weir :**

If the level of the water is controlled or were placed in the bottom of the vessel will allow only oil to overflow and spill into the oil compartment.

- **Vortex breaker :**

Oil and water pass through vortex breakers on the outlets to prevent gas flowing out these lines.

- **Oil level controller :**

When the oil changes according to the principle of Archimedes the plunger will be buoyed up by a force equal to the weight of the displaced fluid.

- **Water level controller :**

The controller can be adjusted for throttling action if there is a steady flow of water or for SNAP action if the water is to be drained at one time.

- **Oil water and gas outlet.**
- **Pressure safety valves.**
- **Man hole :** to service the separator during its maintenance.

- **The troches :**

Hydrocarbons that cannot be stored must be burnt to avoid polluting the atmosphere. To do this, two torches are used (one for the oil and the other for the gas) with a diameter of between 2 and 4", at least 100 meters long, with a low to medium operating pressure. At the outlet of the torch, a cavity must be dug and the fire lit before the start of the test.

These torches must be directed in the same direction as the wind, have enough clear ground in front of them and be well anchored to the ground by means of
fixed on cement pads, 8 to 10 meters apart.

- **The burner boom :**

A burner can also be used instead of a torch to reduce the level of pollution.

III.11.9. Gauge Tanks & Surge Tanks :

The non-pressurized gauge tank is used to measure low flow rates or calibrate the separator oil measurement meters. It has two compartments, one of which can be emptied by the transfer pump while the other compartment is being filled.

The pressurized surge tank is used to measure flow rates. It has a single or double compartment (single is more common) with an automatic pressure control valve on the gas outlet to maintain a constant back pressure, if required.

The vertical surge tank replaces the gauge tank where H2S is present in the effluent. [8]

Figure.III.35. Gauge Tank & Surge Tank [8]

III.11.10. Emergency Shut Down system (ESD) :

The emergency shutdown system (ESD) controls the flowline valve actuator and, if necessary, an additional surface safety valve located upstream of the choke manifold.

The Emergency Shut-Down (ESD) system is used when quick closure is required due to an emergency , equipment break or failure, fire start-up or any other emergency situation. The ESD system allows a safety valve to be closed from a remote control station or from the ESD console. [8]

Figure.III.36. Emergency Shutdown console [8]

III.12. Other equipment :

III.12.1. Surface Safety Valve (SSV):

a hydraulic or pneumatic valve, sometimes used before the choke manifold to increase safety, it is recommended for wells with high flow rates and high pressure or where H2S is present.

The SSV is remotely operated by an emergency shutdown device (ESD). [6]

Figure.III.37. Surface Safety Valve (SSV) [6]

III.12.2. Transfer Pump :

Transfer pump is typically used to draw oil from the gauge or surge tank and discharge it at sufficiently high pressure to the burners.

III.12.3. Chemical Injector Pump :

The chemical injector pump is generally used in well testing to inject chemical inhibitor, methanol or glycol, to fight hydrates formation, it is mainly connected to the data header upstream of the choke manifold.

III.13. surface installation diagram:

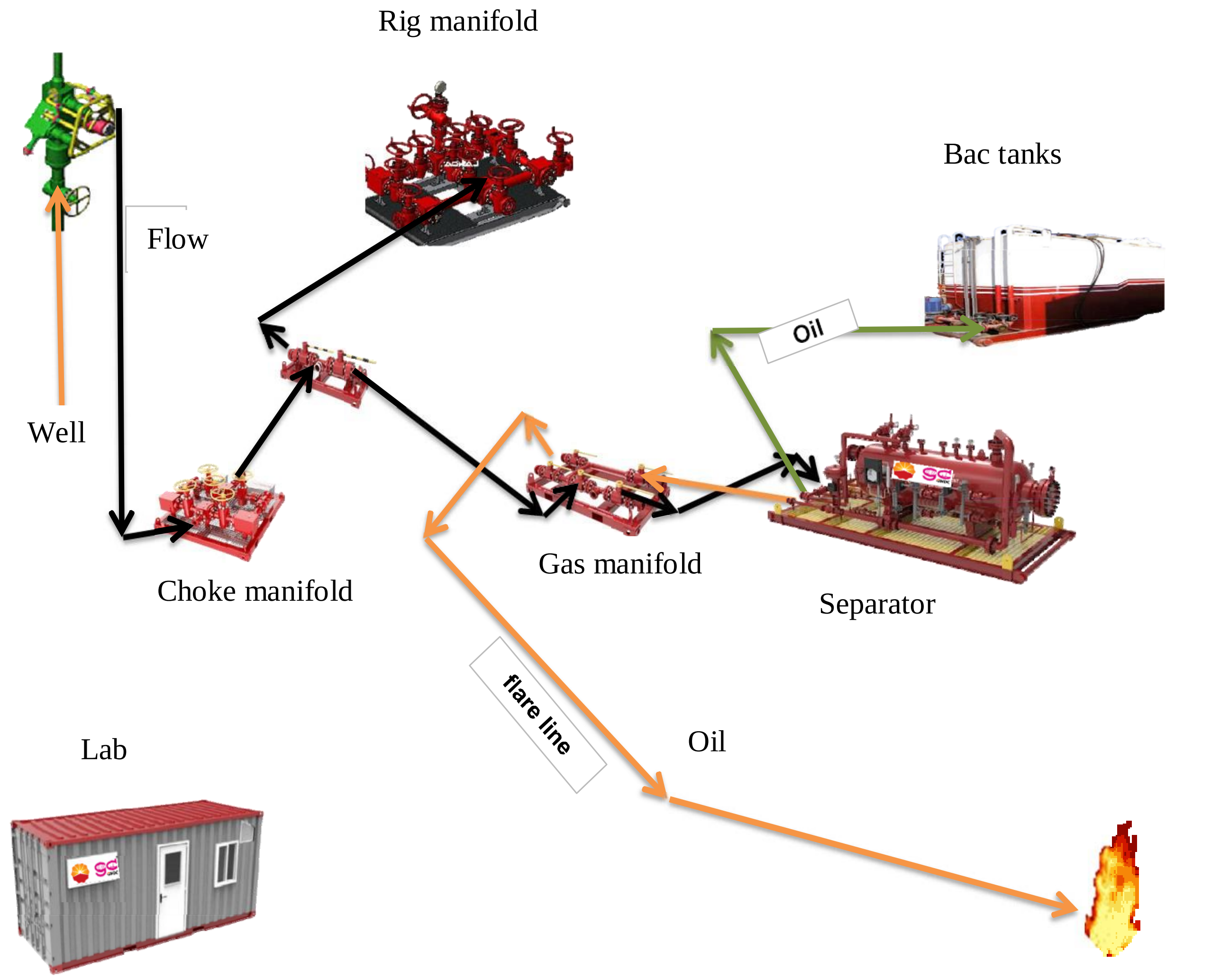


Figure.III.38. surface installation diagram [9]

III.14. Execution program and process of a DST operation :

Executing a test is always a delicate operation. Before deciding to carry out a test, it is important to ensure that the operation can be performed safely and under acceptable technical conditions. [4]

A schedule must be drawn up for all the operations to be performed during the test, which may include the following points:

III.14.1. Well data :

Before starting the test, you need to know a number of information and parameters about the well to be tested: The diagram of the well, the depth reached, the drilling stop stage, the state of completion (open hole, perforated casing or screened liner), Drilling mud.
We must know the formation and the interval to be tested, as well as the nature of the reservoir rock (crumbly or hard or consolidated). [4]

III.14.2 Data from nearby wells :

If there are wells already drilled in the same zone, we can estimate some information (reservoir pressure, nature of the fluids, etc.). [4]

III.14.3. The water buffer :

The use of a buffer of pressurized water or nitrogen in the pipes has become widespread for the following reasons [4]:

- To reduce the differential pressure between the two packer faces.
- To reduce bottom pressure.
- To reduce water shots (which can cause surface damage).
- To prevent packer crushing.

The purpose of the buffer is to :

- Prevent the formation from collapsing during the first opening.
- Prevent the liner from being crushed.
- reduce water hammer, which can be dangerous on the surface.

III.14.4. Choosing the anchoring dimension :

The packer is anchored according to the tester man's instructions. The packers frequently used in DST trains are mechanical packers with rotational anchoring. [4]

The following points should be taken into consideration during the anchoring operation:

- The concrete opposite the anchoring dimension is well cemented.
- Inking should be avoided opposite a connection between two joints (preferably in the middle of a joint).
- To reach the exact anchoring measurement, the depth correction must be made between the electrical measurement and the depth measurement.

III.14.5. Test equipment information :

The equipment is chosen according to reservoir pressure, bottom hole temperature, the nature of the fluid, the presence of H2S and well data.

III.14.6. Operation sequences :

At the end of the design and test program, preparations must be considered to ensure that the operation runs smoothly.

III.14.6.1. Well preparation :

Before starting the operation, it must be checked that :

- Make sure that the area to be anchored has been taped off.
- Make sure the mud circulates well before descending the DST (to homogenize the mud).
- Stacking of the pipes needed to lower the DST train to the required height.
- BOP'S test.

At the end of BOP's test, all the equipment and the test supervisor are on location.

III.14.6.2. Supervising and following up the operation :

a) Lowering the test train and anchoring the packer :

- During descent, we check that the valve is lowered in the closed position, to create a pressure difference suitable for well start-up.

- We assemble and lower the test string slowly, filling the packer with water from the valve up to the slip joint (i.e. all the drills collar + the first length of drill pipe) and pressure testing the BHA.
- Continue lowering the test train at reduced speed to the bottom, not forgetting to calibrate the string.
- Install surface equipment (flow head, coflexip, choke manifold, seperator, gas manifold, oil manifold,...) and test under pressure.
- Anchoring and testing the packer, installing the slickline, lowering and topping the valve in the closed position (the recorded dimension will be used as a reference for the rest of the DST).

b) The surface equipment test :

- flow line (flow control head - choke manifold).
- choke manifold.
- separator inlet.
- Checking metering equipment
- Visual check of nozzles.

c) Safety meeting :

Before the well is opened, a safety meeting should be organised to clarify and define the unclear points and tasks of the operation, as well as the communication method that is most necessary to do a good job. This meeting is for all employees involved in the DST operation.

The safety meeting is prepared in collaboration with the exploration supervisor, the drilling supervisor, the site manager, the test man and the HSE supervisor. [4]

At this meeting, they will discuss the following tasks:

- Description of operations.
- Emergency system: BOP's, remote closure of ESD production valve.
- Description of the bottom valve.
- Identification of the areas of risk and restrictions (access, movement of machinery and workers, etc....).
- Fire risks (check and locate fire extinguishers).
- Pressure risks.
- It is forbidden to use mobile phones inside the security zone.
- General safety precautions (no smoking, welding or handling within the safety area).

III.14.6.3 Well evaluation :

a)Pre-flow (initial flow) :

The goal of this first test is to [4] :

- To decompress the area around the well, as the hydrostatic pressure caused by the drilling mud has tended to over-compress this zone to a value greater than the reservoir pressure.
- Establish good communication between the reservoir and the well.
- This should normally be done during the day.
- This pre-flow period generally lasts a few minutes (5 -15 minutes).

b) Initial closure (virgin pressure) :

The test is reclosed in order to measure the initial pressure (virgin pressure). The closure time is generally 90 minutes in order to recompress the bottom of the well to obtain a pressure as close as possible to the reservoir pressure.

Virgin pressure is a fundamental piece of information in itself: the reservoir studies carried out during the early stages of production are all based on this initial parameter.

The value of the virgin pressure is taken into account when calculating the stocks. [4]

c)Main flow (Discharge) :

The purpose of this period is to clean the well properly, to have clean production with stable well pressure parameters and to be able to measure the effluents produced through the separator. [4]

- **If the well is producing hydrocarbons :**

As soon as the well is clean and producing gas or oil on the surface, take an immediate measurement of the percentage of CO_2, percentage of BSW and percentage of H_2S. If the percentage of H_2S exceeds 10 ppm, shut down the well at surface and immediately inform the company's management.

Pressure must be maintained in the pipes during the build-up to act as a counter-pressure to the opening of the well.

Once the overhead pressure has stabilized, and when the BSW $\leq 1\%$, we pass through the fixed nozzle in order to pass over the separator after stabilization of (Down Stream Pressure) to the effect of counting the flow suitable for each nozzle offered (most often 24/64" and 32/64").[4]

- **If the well is producing salt water :**

We do the reverse circulation.

- **If the well is non-productive :**

A dry well with no bubbling or gas flow. We keep the well open all day long, so we have to confirm openings and closings with the slick line unit.

In the case of a blast with no surface arrival, we measure the pressure gradient.

- **The pressure gradient :**

This involves lowering pressure recorders to measure the pressure gradient of the fluids in the well in order to locate their static levels and possibly their types, which will allow us to estimate the static level of our reservoir fluid.

To create a pressure gradient, we need to go through the following steps:

- Select the pressure recording stages.
- Check the inside of the DST pipes using a Gauge Cutter.
- Slick line train descent with P and T recorders.
- During the ascent we stop at stations (stages) that we have already determined all the way to the surface.
- We have the depths of the sampled stages, so we can calculate ΔP, ΔH and the pressure gradient ($\Delta P/\Delta H$) between each two successive stages, knowing that :
  $\Delta P = P_i - P_{i-1}$ $\Delta H = H_i - H_{i-1}$ And we have: grad p = ($\Delta P/\Delta H$).
- We can also calculate the average density in the interval ΔH by the equation
  $d_{fluid} = \Delta P/(\Delta H.g.\varrho_{water})$ and according to this density we can eventually determine the type of fluid present in this interval, and therefore we can estimate the static level of our reservoir fluid in the hydrostatic column. [4]

d) Close for Build up:

This phase is very important for gathering data about the reservoir and the well. From the interpretation of the pressure build-up, we try to determine :

- P*: reservoir pressure (this reservoir pressure is generally taken from the pressure rise).
- S = skin effect or reservoir damage effect.
- K: Reservoir permeability.

In order to stabilize the rise in pressure, enough time is needed. The longer the shut-in period, the more the farthest limits of the reservoir will be observed. [4]

e)Reverse circulation (Well neutralization) :

Reverse circulation allows the well to be brought under control of the hydrostatic pressure of the mud. It consists of expelling the hydrocarbons trapped in the test string via the reverse circulation valves or through the packer bypass. [4]

f) Removing the packer and reinstalling the test string :

To remove the packer, first open the pressure equalization device and take on the weight of the test string, The test string is raised only after the effluent in the test string above it has been circulated as far as possible.

The test string can only be reinstalled after :

- pumped the effluent under the test back into the formation via the annulus and the pressure equalization valve, which open.
- opened the reverse circulation valve and circulated the effluent located in the test pack above the tester as best as possible; this should normally be done during the day. [4]

III.15. Conclusion :

The drill stem test is a very complicated operation that consists of a surface equipment and down hole equipment and the procedure of this operation must be under safety conditions and surveillance.

DST Case study of MDz-802 well

IV.1. Introduction :

Drilling in the HMD region started in 1956 with a first well (MD1) drilled on 16/01/1956, so we are talking about development drilling. In this chapter we will study the DST operation carried out by GWDC (great wall drilling company) in the MDz-802 well. [9]

IV.2 DST objectives for MDz-802 well :

The MDz-802 well is a development well.

The objective of this DST is :

I.V.2.1 Direct objectives:

- Identify the presence of oil or gas in the reservoir.
- Determine the production capacity.
- Determine reservoir pressure.
- Take representative samples for PVT study.
- Determine the petro physical parameters of the reservoir (k, Skin).
- Determine reservoir model, if required.

I.V.2.2. Indirect objectives :

It is necessary to choose the type of connection between the reservoir and the well to enable the effluent to reach the surface in an effective and completely safe way. [9]

There are two main types of this connection:

- Completion in open hole.
- Completion in cased hole.

In this way, DST results can be used to choose the mode of this connection and optimize well production operations.

IV.3. Well informations :

IV.3.1. Geographic location :

X	: 780847.986M
Y	: 3491315.017M
Z(sol)	: 14186m
Z(table)	: 9.14m

IV.3.2. information about the well :

Well type	: Horizontal
Fluid type	: Oil

Completion type : Temporary

Casing Diameter : 7”

Minimum Restriction : Casing ID 6.184”

Deviation degree : 20

Tubing Size : 5" 1/2 ,3" ½

Drilling Coast : 3918.04m

Reservoir : HMD ouargla

IV.3.3. Mud properties :

Type of Mud : OBM

Mud density : 1.35

Water buffer : 1600m

Viscosity : 47

IV.3.4. operational information :

Depth reference : Rotation table

Logger measurement point : 3250.985m

Packer coast : 3262m

Low packer : 11.57m

High packer : 26.97m

IV.4. Equipment used during the DST :

IV.4.1.Test string :

The train used was of the type that operates by annular pressure (POTV). The number of cycles of the STV is linked to the type of test and the productivity of the reservoir to be tested. A cycle is an opening and closing or a pressurized and purged return to zero, The test operation was performed by the GWDC services company using RIH Halliburton DST Tools

IV.4.2. Down hole equipment :

Type of recorder-holder : CGM5 metrlog.

Packer type : 7"Champ packer.

Type of bottom valve : 5"Select Tester Valve.

Type of circulation valve : 5" RD Circulating Valve.

IV.4.3. Surface equipment :

Pressure measurement : Bourdon tube pressure gauge.

Temperature measurement : Thermometer.

Type of Coflexip : 3" 1/16, 15 k psi WP.

Type of choke Manifold : Wom 3" 1/16, 15k psi WP.

Wellhead type : Wom 3" 1/16, 10k psi WP.

Separator type : Three-phase (triphasique) 1440 psi

Diverter type : 1440 psi

Storage tank type : 50 m3

Wellhead connection type : 5 ½" FH.

Return tank connection type : 3" 602.

Gas torch connection type : 4 ½" New Vam * 3" 602.

IV.5. The composition of the test train :

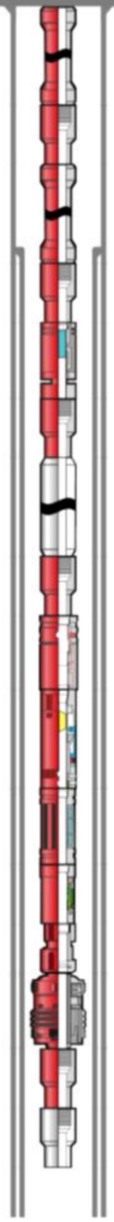
HALLIBURTON

PREPARED BY Mohammed.B / Nassim ARFA | VERSION Final | DATE OF RECORD 4/3/2024

DST-1

START DATE	04/02/2024	START TIME	16 : 00 : 00		
CLIENT	SH DP	COMPANY REP	Mr. Mehdi DJABOURABI	LOCATION	HMD
RIG NAME	ENF 47	WELL NAME	MDz 802	WELL NUMBER	MDz 802
AREA / COUNTRY	Algeria	FIELD / LEASE	Hassi Messaoud	FIELD NAME	HMD
RIG TYPE	Land	ZERO POINT REFERENCE	Drill floor	FLUID DENSITY	1.35 SG
SURFACE TEMPERATURE	22.0 °C	DOWNHOLE TEMPERATURE	106.0 °C	CASING LIMIT	3500 psi

LARGEST OD 5.750 in | SMALLEST ID 2.062 in | TOTAL STRING WEIGHT*170556 kg



DESCRIPTION	SUPPLIER	TRACKING #	WEIGHT kg	Connection TOP	Connection BOTTOM	Dimensions OD in	Dimensions ID in	Dimensions LENGTH m	TOP DEPTH MD m
Drill Pipe 5-1/2" FH 21.9 #/ft (21 Stands)	ENF 47	ENF 47	43298	5-1/2" FH Box	5-1/2" FH Pin	5.500	4.778	602.780	-2.351
Crossover, 5-1/2"FH BOX 3-1/2" IF Pin	ENF 47	ENF 47	200	5-1/2" FH Box	3-1/2" IF Pin	5.500	2.764	1.120	600.429
Drill Pipe 3-1/2" IF 13.3#/ft (81 stand+ 01 single)	ENF 47	ENF 47	101777	3-1/2" IF Box	3-1/2" IF Pin	3.500	2.764	2333.060	601.549
Crossover, 3-1/2"IF BOX 3-7/8" CAS Pin	Halliburton	HMD 70	34	3-1/2" IF Box	3-7/8" CAS Pin	5.000	2.250	0.495	2934.609
Slip Joint (Round Mandrel) 5 OD-100065393	Halliburton	10820561	279	3-7/8" CAS Box	3-7/8" CAS Pin	5.030	2.310	6.100	2935.104
Crossover, 3-7/8" CAS Box x 3-1/2" IF Pin	Halliburton	HMD 66	34	3-7/8" CAS Box	3-1/2" IF Pin	5.000	2.250	0.510	2941.204
Heavy weight 3-1/2" IF 23.44 #/ft (10 Stands + 02 singles)	ENF 47	ENF 47	23097	3-1/2" IF Box	3-1/2" IF Pin	3.500	2.062	300.420	2941.714
Crossover, 3-1/2" IF Box x 3-7/8" CAS Pin	Halliburton	HMD 07	34	3-1/2" IF Box	3-7/8" CAS Pin	5.000	2.250	0.490	3242.134
RD Circulating Valve 5 OD, -100066685 RD 9.5 Kpsi burst range Min: 2931 psi -Max: 3498 psi	Halliburton	10145300	150	3-7/8" CAS Box	3-7/8" CAS Pin	5.030	2.280	1.091	3242.624
Select Tester Valve 5 OD-100065657	Halliburton	11307123	510	3-7/8" CAS Box	3-7/8" CAS Pin	5.030	2.250	7.270	3243.715
Gauge Carrier, DYNASTRING 5 , 102 SLOT, 4 +x 1.25 Gauges -101679560	Halliburton	2592127	243	3-7/8" CAS Box	3-7/8" CAS Pin	5.030	2.280	6.330	3250.985
Jar- Big John 5 OD, 3.875 CAS -100066630	Halliburton	11185796	109	3-7/8" CAS Box	3-7/8" CAS Pin	5.030	2.300	1.840	3257.315
RTTS Safety Joint 7 IN 3 7/8 CAS BOX X PIN 2.28 ID-100066934	Halliburton	11430175	100	3-7/8" CAS Box	3-7/8" CAS Pin	5.000	2.280	1.115	3259.155
Depth Ref: 3262.00 m, Distance to Top of the Tool: 1.73 m, CHAMP V Packer 7 IN 29-35 PPF 15K 3-7/8 CAS-101380053	Halliburton	10832463	240	3-7/8" CAS Box	3-7/8" CAS Pin	5.750	2.250	3.220	3260.270
Sub 3-7/8" CAS Box x 3-1/2" IF Pin	Halliburton	HMD 68	34	3-7/8" CAS Box	3-1/2" IF Pin	5.000	2.250	0.510	3263.490
Drill Pipe 3-1/2"IF 13.3 #/ft (01 single)	ENF 47	ENF 47	417	3-1/2" IF Box	3-1/2" IF Pin	3.500	2.764	9.570	3264.000
									3273.570

Figure. IV.1. Test string [9]

IV.6. The role of each element :

All the elements of the test string are well detailed in the previous chapter, so we'll explain them quickly and clearly below:

- **Crossover :**

It is used to reduce and homogenize diameters and different types of thread.

- **Drill pipe :**

provides the necessary length for the DST train to reach the target elevation, and supplies the flow to the surface.

- **Slip joint :**

Its job is to absorb the stretching of the rods during the operation. The number of times it is present in the composition of the string depends on the depth and bottom temperature. In the case of our gasket they used (01) slip joint. [9]

It is 6.1m long.

During anchoring, the weight of the rods is free and suspended from the rotation table (thanks to the length of this element).

- **Drill collar :**

It is used to create the weight on the packer and separate the circulation valve and the test valve.

- **(RD) Circulating Valve :**

The (RD) acts as both a safety valve and a circulation valve, functioning as a safety valve when the annular pressure reaches a predetermined value.

At this pressure, the valve will isolate the work string below the RD and establish communication between the annular space and the column above.

This tool is converted to a circulation valve when the ball valve is removed. [9]

- **POTV (select tester valve) :**

  This tool works by applying pressure to the annulus. It is opened and closed by a bail valve. Each rise in pressure in the annulus (approximately 1300 psi) causes it to open and each zero pressure in the annulus causes it to close, except for the last HOOP cycle (remains open). [9]

So it has two parts:

- A mechanical part, which controls the number of cycles as well as opening and closing.
- One part is presented by a nitrogen chamber, a piston balancer, which balances the tool to the chosen dimension.

- **Internal Gauge Carrier :**

Sheath for the two recorders measuring pressure and temperature

- **Hydraulic Jar :**

provides upward shocks to free the column in the case of trapping.

- **RTTS Safety joint :**

Its role is to release the test seal in the event of it getting stuck.

- **The packer :**

The packer used is the casing packer; all casing packers are fitted with dogs, which enable it to hook onto the inside of the tube to anchor it.

So once the dogs have been attached to the casing, the necessary weight is applied and the string inflate, creating a waterproof seal.

All these packers are attached by a tower on the right, and locking is automatic (de-anchoring). [9]

- **Number of turns :**

On the surface, the casing packers are attached by a quarter turn. This means that at 1000m, 1/4 turn=1turn.

The packer dimension = 3260m → the minimum number of turns was 3 turns. [9]

- **Anchoring weight :**

Weight = (1 tone to 1.5 tones) x casing diameter

In our case: the anchoring was done in case 7". Weight = 1.5 x 7 = 10.5 tones.

- **Choosing a packer :**

A packer is chosen according to :

-The nominal weight and diameter of the casing.

- The operation to be carried out.

IV.7. Surface equipment :

IV.7.1. Flow-head:

acts as a production wellhead and is made up of four components:

Master valve: for total closure of the inside as long as the upper part remains fixed.

Flow line valve: this is a fast-closing hydraulic valve. It secures the flow circuit.

Flow line: flow outlet.

Kill line valve:

this is a manual valve which remains closed throughout the test operation. It is only opened during surface equipment tests and to circulate through the inside of the pipes.

Swab valve: this is a drain valve. It opens to allow a special tool to pass through.

Manipulating the flow-head :

For test equipment :

- Master valve closed.
- Low line open.
- Kill line open.
- Swab valve closed.

For DST operations :

- Master valve open.
- Flow line valve open.
- Kill line valve closed.
- Swab valve closed (except during special operations).

IV.7.2. Emergency Shut Down (ESD):

used to close the well and bring surface equipment to safety if necessary. Sometimes a surface safety valve is used before the choke manifold. to increase safety on site (for rapid shutdown in the case of a leak).

IV.7.3.choke manifold:

this regulates the well flow and lowers the effluent pressure to below the operating pressure of downstream equipment.

IV.7.4. gas manifold:

placed at the outlet of the DST choke manifold, to connect one side to the separator and the other to the rig manifold.

IV.7.5 oil manifold:

this directs the oil leaving the separator either to the storage tank (or the surge tank) or to the settling tank or one of the burning beams.

IV.7.6. Separator:

used to separate the different fluids making up the effluent brought up from the reservoir, in order to measure their flow rates and volumes separately and take samples. It is connected to the oil and gas manifolds.

IV.7.7. Storage tank:

at certain times during the test, the oil leaving the separator is sent to this tank. This enables the oil meter(s) to be calibrated, and certain factors to be taken into account, such as the degassing of the oil downstream of the separator or the additional settling of water that is still dispersed (in emulsion) in the oil at the separator's oil outlet.

IV.8. Operations before DST:

Before the DST operation we performed preparations consisting of :

IV.8.1. End-of-well logging operations :

logging to check the condition of the 7" casing, as the packer must not be attached in a position where there is a tool joint for water tightness reasons.

IV.8.2. Scraping :

For scraping, first of all we have to limit the area where we are going to scrape, which must contain the inking dimension of the packer, this is defined by the DST operator, then we start to lower the BHA of the scraping until we reach the upper dimension of the area to be scraped, then we start scraping by making two passes for each length lowered, once we have reached the lower limit of the area to be scraped we stop scraping. A circulation is then made to clean the hole and condition the mud.

The well is observed to be stable (flow check), so we begin the lift to the surface of the scraping BHA. [9]

Fig.IV.2. Scraper [6]

IV.8.3. Well cleaning and circulation :

With BHA at the bottom, we pump a medium viscosity plug, then another plug with a higher viscosity. Of course, the order of these two plugs is not random, because if we reverse the order, the second plug will have no effect, as the High Viscosity will clean everything, which means that the Low Viscosity plug is a primary cleaning and the High Viscosity plug is a final cleaning.

After sending these two plugs, we continue to circulate with the aim of cleaning the well.

IV.8.4. BOP test :

The BOP test is required before each DST operation, because as we know, DST is a well potential test, so for safety reasons.

BOPs must be tested to avoid any surprises when the well is flowing (risk of an arrival). [9]

The test is performed on the following equipment:

- Test 1: Annular + 3 Master valve choke manifold 300-2000 psi.
- Test 2: Pipe rams + 3 Master valve choke manifold 300-5000 psi.
- Test 3: Pipe rams + Chock line 300-5000 psi.
- Test 4: Pipe rams + 3MV + Kill line 300-5000 psi.

IV.8.5. Water buffer:

part of the string is filled with a calculated volume of generalized water for the following reasons:

- To reduce the differential pressure between the two packer faces.
- To absorb bottom pressure.
- To absorb water hammer (which can cause surface damage).
- To prevent string from being crushed.

The water buffer height used was 1600m, which gave a hydrostatic pressure of :

$$Ph\ (psi) = (De \times H \times 14.5) / 10.2$$

H: height of filled water buffer in meters.

De: density of the water in sg.

Ph: hydrostatic pressure of the filled water in psi.

14.5: to transfer the bar in psi: (1bar = 14.59 psi)

A.N : Ph : 1600 x 14.59/10.2 = 2288.627 psi

IV.9. DST test procedure :

IV.9.1. Safety meeting :

Organize a safety meeting with all personnel involved in test operations. The safety meeting is prepared in collaboration between the DP supervisor, the DF supervisor, the site manager, the HSE engineer and the GWDC tester. [9]

The meeting addressed the following points:

- Description of operations.
- Emergency system: BOP's, remote closure of ESD production valve.
- Description of the bottom valve.
- Identification of the areas of risk and restrictions (access, movement of machinery and workers, etc....).
- Fire risks (check and locate fire extinguishers).
- Pressure risks.
- It is forbidden to use mobile phones inside the security zone.
- General safety precautions (no smoking, welding or handling within the safety area).

IV.9.2. Lowering the test train:

The test string installation operations were carried out by ENF47 rig under the supervision and control of GWDC engineers who gave a copy of the descent instructions to the supervisor and site manager in advance.

Before starting the descent operations, a scraper pass was made in line with the packer anchoring dimension. The diameter of the casing was also checked with a gauge. [9]

- **Instructions for lowering the test train :**

- Assemble the BHA according to the DST test train diagram in the presence of tester man.
- Note the volume in the tanks.
- Use of a trip tank is required.
- Block the rotation table.
- The descent must be slow (3min per length), while calibrating all the fittings (DC+DP).
- Make sure during the descent that the return volume is equal to the external volume (steel volume + internal volume).
- Lower slowly and avoid sudden stops.
- In the case of premature anchoring of the packer, immediately release the string by 2 to 3 m if possible and continue the descent. If the anchoring persists, clear one or two stands and set the safety valve and warn the tester man.
- After descending every 15 stands, observe for 05 minutes.
- If there are any problems, inform the tester man.
- Before arriving at the bottom warn the tester man to set up the surface equipment.

IV.9.3. Reverse circulation :

At the end of the DST test, we proceeded to the reverse circulation through the RD-CV To carry out this operation, Applied pressure in to annulus to sheared DR and Applied 2400 psi into annulus to unlock STV, which allowed us to open the passage to the reverse circulation. [

IV.9.4. Calculating the volume of mud in the well:

Volume of mud = volume of hole - volume of string steel .

a) Calculation of steel volume:

The formula used is:

$$V = \frac{\pi \times (OD^2 - ID^2) \times h}{4}$$

h: the height of the element.

OD: outside diameter.

ID: inside diameter.

- **Volume of steel in drill pipes:**

OD = 3" 1/2 = 0,0889m ; Id = 2.764= 0,0702m ; h = 2333.060 m.

V_{steel} DP = (π x (0.0889^2– 0.0702^2) x 2333.060) / 4 = 5.45 m^3.

- **Volume of steel slip joint :**

D = 5.030 in = 0,1277 m ; d = 2.310" = 0,0586 m ; h = 6.1 m.

$V_{steel\ SJ}$ = 0.0617 m^3.

- **Volume of DC steel:**

D= 3.5 in = 0,0889m ; d=2.062 in=0,0523m; h = 300.420 m.

$V_{STEEL\ DC}$ = 1.22 m^3.

So if we neglect the other elements :

Total steel volume = 6.732 m^3

b) Calculating hole volume :

V_{hole} = C x H

With : Casing 7″: D = 7 = 0.178 m H = 3260.270m C(Capacity) = 19.22 l/m

V_{hole} = 62.66 m^3

- **Mud volume :** V_{mud} = 62.66 – 6.732 = 55.928 m^3

IV.9.5. Removing the packer and reinstalling the test string :

Once the flow-head has been removed, the weight that has been placed on the packer is eliminated. Once the packer has been removed, it is lowered by one length to confirm that it is in the ‘removal’ position.

The well was observed for 10 minutes to stabilize the levels and to ensure that the well was under primary control so that we could begin the safe recovery of the train. [9]

IV.9.6. Instructions for raising the test train :

- Measure volumes in the bins.
- Use of trip tank is required.
- Block the rotation table.
- Prepare for lift (safety valve, gray valve, stem wiper, etc.)
- Ascent must be slow (to avoid pistoning) at a speed of 4 minutes per stand.
- In the event of pulling, warn the test man.
- During the ascent, ensure that the filling volume is equal to the volume of steel
- the volume of steel leaving the shaft.
- Fill every 03 stands.
- After raising every 10 stands, observe for 10 minutes.

IV.10. Timing of operations :

After all the operations before DST the timing of the operation was like this :

2-April-2024 :

14:00 Well test Crew and Equipments left GWDC Base to MDZ-802/ ENF-47.

15:00 Well test Crew and Equipments On location.

15:10 Met Company man and held a safety induction.

15:20 Situation on location pull out of the hole with 7" scrapper.

15:25 Spotted surface well test equipments on well site location.

15:30 Scrapper 7" at Surface.

16:40 Started test BOPs.

19:30 Test BOPs OK.

22:00 Started rigging up SWT equipment.

21:40 Started RIH DST Tools Halliburton,

22:00 RIH Assembly Champ packer.

22:40 RIH Select Tester Valve With RD Circulating Valve.

23:20 Started RIH Heavy weight DP and filling with water.

3-April-2024 :

5:15 Completed RIH Heavy weight DP,

5:25 RIH RM Slip Joint,

5:45 RIH One stand DP 3" 1/2 drifted and filling with water.

6:10 Connected tester cup with DP.

6:40 Started test BHA 6000 psi

6:55 Test ok.

7:00 Continued RIH 3" 1/2 DP and filling with water 45 stands 3”1/2 DP.,

8:00 Continued Rig UP surface Well test equipment's.

12:00 Completed Rig UP surface well test equipment's.

4-April-2024 :

7:00 GWDC crew on location.

7:10 Held safety meeting,

7:20 Situation on location continued RIH 5" 1/2 DP,

10:45 BHA at desired depth.

10:50 Started rigging up flow head and coflexip hoses.

13:15 Finished rigging up flow head and coflexip hoses.

14:00 Connected flare line with separator.

14:05 Held safety meeting for test equipment surface.

14:10 Switched mud to water.

14:15 Closed Swab valve and master valve opened kill valve and flow valve

14:20 Started flushing surface well test lines with water.

14:30 Completed flushing surface well test lines .

14:35 Connected flare line test cap.

14:40 Pressure test flare line @500psi.

14:50 Test ok.

14:55 Closed Separator bypass and inlet separator.

15:00 Pressure test separator bypass and inlet separator @1000psi.

15:10 Test ok. Closed down stream choke manifold valves.

15:15 Pressure test downstream choke manifold valves @3000psi.

15:25 Test ok. Closed Up stream choke manifold valves.

15:30 Pressure test Up stream choke manifold valves @5000psi.

15:45 Test ok.

5-April-2024 :

7:00 GWDC Crew on location.

7:10 Held safety meeting.

8:13 Set packer.

8:15 Closed pipe rams and open chock line and kill line.

8:33 Applied 300 psi in to annulus to test packer.

8:44 Pressure annuls decreased to 240 psi.

9:10 Applied 300 psi in to annulus.

9:20 Pressure annuls decreased to 250 psi.

10:13 Open pipe rams to checked annuls volume.

10:27 Closed hydril and pipe rams.

10:37 Applied 300 psi in to annulus to test packer.

10:47 Pressure annuls decreased to 250 psi.

10:54 bleed off annuls to zero psi.

11:00 Held safety meeting with all rig crew to opened the well.

11:09 Applied 1200psi into annulus to open STV (initial opening).

11:10 Bubbles at surface.

11:25 Bleed off annulus pressure STV closed (initial build up)

12:29 Applied 1100 psi into annulus to open STV (First flow).

12:30 Bubbles at surface.

14:16 Bleed off annulus pressure STV closed,

14:30 Bubbles at surface.

14:40 Bubbles at surface.

14:35 Applied 2400 psi into annulus to LOCK open STV.

12:30 Bubbles at surface.

14:52 Bleed off annulus pressure STV Locked open

15:00 Strong bubbles at surface.

16:00 Strong bubbles at surface.

17:00 Closed upstream and downstream choke manifold valves (First Build up on surface).

17:10 Opened pipe rams and closed choke line and kill line BOB.

6-April-2024 :

7:00 On location.

7:05 Held safety meeting.

7:08 Opened up stream choke manifold valves to 16/64.

7:10 Started rig up NESR CTU Unit equipments.

7:20 Opened Up plug swab valve.

7:40 Well head pressure decreased.

8:00 Water at surface.

8:13 increased Adj MC to 20Adj.

8:20 Water at surface.

9:00 Water at surface.

9:30 increased Adj MC to 24Adj.

9:56 increased Adj MC to 26Adj.

11:00 WHP Pressure increased to300psi.

11:03 decreased Adj chock to 24 Adj.

11:08 Water at surface, and WHP increased.

11:09 Mud at surface.

11:10 Mud at surface.

11:12 increased Adj MC to 26 Adj.

11:15 Mud at surface.

11:17 Mud at surface.

11:24 Rocked the chock.

11:28 Increased Adj chock to 28 Adj.

11:30 Mud at surface.

11:32 WHP Pressure increased.

11:40 Mud at surface.

11:50 WHP Pressure increased.

12:00 Closed upstream chock manifold.

12:02 Ignited flare.

12:05 Open the chock ar 16 Adj to flare line.

12:07 Increased Adj chock to 20 Adj.

12:09 Increased Adj chock to 24 Adj.

12:11 Increased Adj chock to 26 Adj.

12:22 Decreased Adj chock 24 Adj, Oil at surface.

12:30 Started rig down NESR CTU Unit equipments.

12:45 BS&W= 100 % Oil.

13:00 BS&W= 100 % Oil.

13:15 BS&W= 100 % Oil.

13:25 Finished rig down NESR CTU Unit equipments.

13:30 BS&W= 100 % Oil.

13:45 BS&W= 100 % Oil.

14:00 BS&W= 100 % Oil.

14:15 BS&W= 100 % Oil.

14:30 BS&W= 100 % Oil.

14:45 BS&W= 100 % Oil.

15:00 BS&W= 100 % Oil.

15:15 BS&W= 100 % Oil.

15:30 BS&W= 100 % Oil.

16:00 BS&W= 100 % Oil.

16:15 BS&W= 100 % Oil.

16:30 BS&W= 100 % Oil.

16:45 BS&W= 100 % Oil.

17:00 Closed up steam chock manifold and flow valve.

17:15 Open pipe rams and close chock line kill line.

7-April-2024 :

7:00 Crew GWDC at Location ,

7:05 Held safety meeting.

7:10 Open flow valve WHP 2400 psi

7:36 Opened up stream choke manifold valves to 16A /64.

7:46 Increased Adj chock to 20 Adj

7:56 Increased Adj chock to 24 Adj

8:00 BS&W= 100 % Oil.

8:15 BS&W= 100 % Oil.

8:16 Rocked the chock manifold,

8:15 BS&W= 100 % Oil..

8:30 BS&W= 100 % Oil.

8:37 Switched Adj chock to fix 24 F

8:45 BS&W= 100 % Oil.

9:00 BS&W= 100 % Oil.

9:15 BS&W= 100 % Oil.

9:30 BS&W= 100 % Oil.

9:45 BS&W= 100 % Oil.

10:00 BS&W= 100 % Oil.

10:15 BS&W= 100 % Oil.

10:30 BS&W= 100 % Oil.

10:45 Switched to the Separator.

10:45 BS&W= 100 % Oil.

11:00 Installed orifice 1,750 and Barton (0-400 INH2O).

11:05 Separator is set wait for level.

11:15 started counting rates.

15:15 Finished flow rate calculation.

15:03 Applied 2400 psi in to annuls to un lock STV.

15:17 By-pass Test Separator.

15:18 purge off pressure annulus to 0 psi STV Closed.

15:20 Open pipe rams and close chock line kill line.

8-April-2024 :

7:00 GWDC crew on location.
8:00 Build up in progress.

9-April-2024 :

7:00 GWDC crew on location

7:40 Ignited flare.

7:50 Opened up stream chock manifold to purge tubing pressure to 0 psi.

8:40 Completed purge off tubing pressure to 0 psi.

8:45 Opened kill valve and started filling up tubing with mud 1.35 SG.

8:50 Closed up stream chock manifold.

9:38 Completed filling up tubing with mud. V= 13.5 M3.

9:45 Safety meeting with all rig crew and company man to discussed about reverse circulation.

10:05 Applied 2400 psi into annulus to LOCK open STV.

10:10 Applied 250 psi in to tubing to check ball valve STV opened.

10:11 Pressure annulus decreased ball valve opened.

10:15 Opened up stream chock manifold to purge pressure to 0 psi.

10:19 Closed up stream chock manifold.

10:20 purge off pressure annulus to 0 psi STV LOCKED OPEN.

10:35 Applied 2400 psi into annulus to UN LOCK STV.

11:00 Applied pressure in to annulus to sheared DR.

11:10 Rig pumps pumping Max 3400 psi.

11:18 RD sheared and Opened up stream chock manifold 20/64 Adj.

11:20 Diverted flow to poor boy. Reverse Circulating started.

11:30 Increased choke manifold to 28/64" Adj.

11:35 Rocked choke manifold.

11:45 Increased choke manifold to 36/64" Adj.

12:00 Mud at surface.

12:15 Mud at surface.

12:30 Mud at surface.

12:45 Mud at surface.

13:00 Continued Reverse Circulating.

13:15 Mud at surface.

13:30 Mud at surface.

13:45 Mud at surface.

14:00 Mud at surface.

14:15 Mud at surface.

14:30 Mud at surface.

14:45 Mud at surface.

15:00 Mud at surface.

15:15 Mud at surface.

15:30 Mud at surface.

15:35 Stopped Reverse Circulating

15:36 Opened pipe rams

15:37 Closed master valve and opened kill valve.

15:40 Flow check.

15:55 Switched flow from mud to water.

16:00 Started flushing surface equipments.

16:30 Finished flushing surface equipments.

16:32 Switched flow from water to mud.

16:35 Started rigging down STT and coflexip hoses.

17:30 ENF crew Connected flare line to rig manifold.

17:40 Finished rigging down STT and coflexip hoses.

17:50 Un set packer.

18:06 Flow check.

18:21 Started POOH 3" 1/2 DP.

10-April-2024 :

7:30 DST crew at well site location.

9:30 GWDC crew on location

9:40 Held safety meeting.

9:50 Continued rigging down surface test equipments.

10:00 Continuing pool out of the hole DST BHA

11:50 Finished rigging down surface test equipments.

12:30 Slip Joint at rotary table

13:00 Started pulling out of the hole with Heavy weight DP.

14:55 Finished pulling out of the hole with Heavy weight DP.

15:00 STV and RD Circulating Valves at surface.

15:45 Dynastring Gauge Carrier at surface.

16:30 15K 7" Champ Packer assembly at rotary table.

17:30 Retrieve and download memory Gauges.

18:00 Presented data to customer.

11-April-2024 :

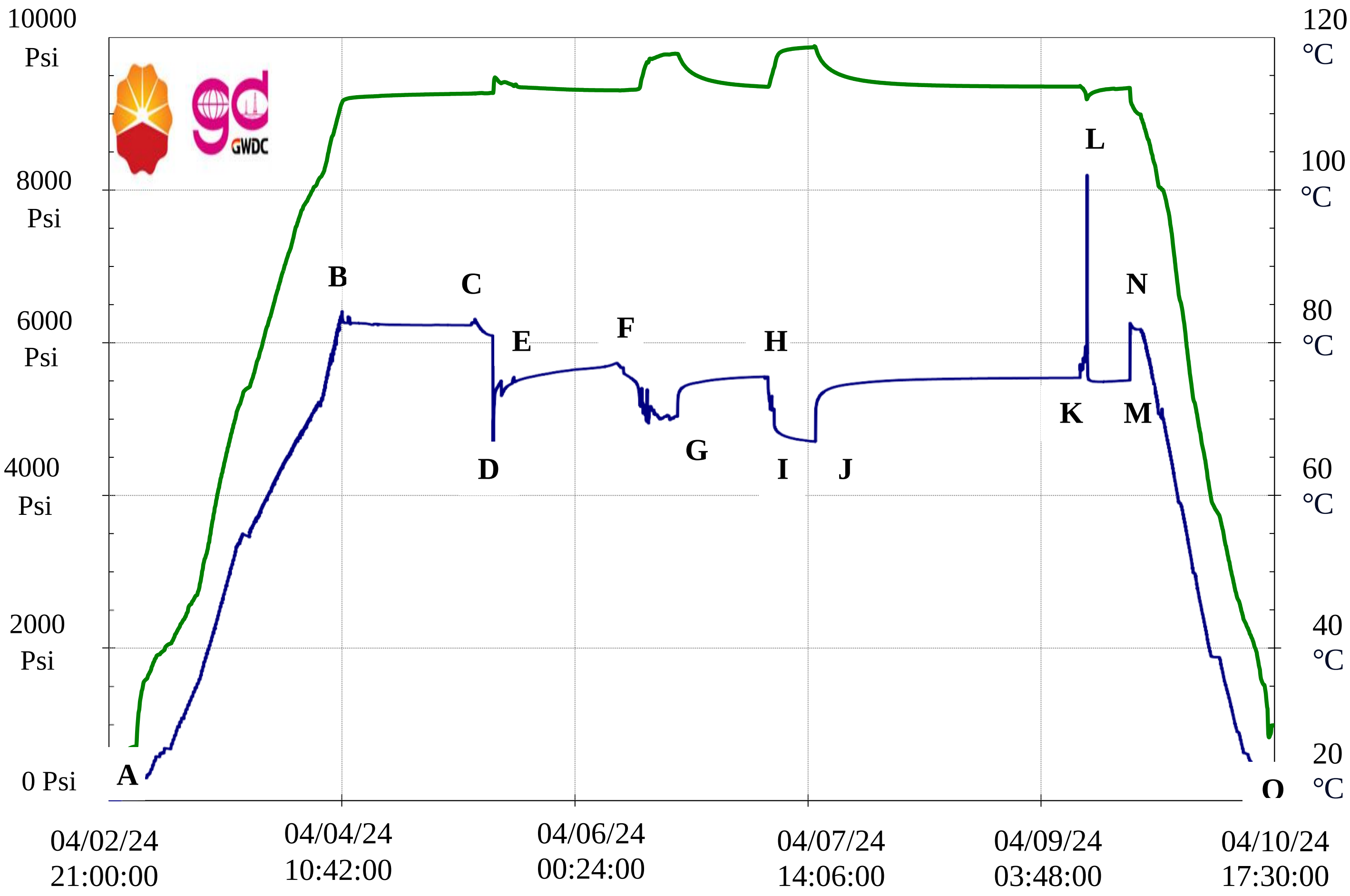
10:00 GWDC crew left location MDz 802, ENF 47.

IV.11. Recorder results :

Once all the equipment had been recovered, the recorders were also recovered, shortly afterwards and using a reader and special software, the recorded data was transmitted to the computer, which gave us the following graph.

The graph is dressed in a way that allows us to identify the different stages of the test.

The most important thing is the pressure curve (blue curve), which gives us more information about the reservoir.



IV.11.1. Splitting the pressure graph :

A-B : descente de train de test.

B-C: several operations have been carried out:

- Started rigging up flow head and coflexip hoses.
- Completed assembly of surface equipment.
- Connected flare line with separator.
- Held safety meeting for test equipment surface.
- Pressure test separator bypass and inlet separator @1000psi.
- Pressure test down stream choke manifold valves @3000psi.

C-D : anchoring and testing the packer.

D : first opening of STV for pre-flow.

D-E : pre-flow time.

E : STV closure for virgin pressure.

E-F : the virgin pressure recording period.

F-G : STV opening for flow.

G-H : Bubbles at surface.

H-I : Intermediate pressure build-up (STV closure).

I-J : Opened Up plug swab valve.

J-K : several operations have been carried out:

- Opened up stream choke manifold valves to 16A /64.
- By-pass Test Separator.
- Bleed off pressure annulus to 0 psi STV Closed.
- final pressure rise.

K-L : Reverse circulation.

M-N : Removing the Packer and observe the static level of the well.

N-O : removed the surface equipment and reassembled the test train.

IV.12. Interpretation results :

After finishing the operation the interpretation results are the main thing that we need for deciding the future of this well and what we need to do in the completion program

Tab.IV.1. Interpretation results

PG @ - 3100m (KG/CM²)	**391**
Pfd @ - 3100 m (kg/cm²)	**331**
Pg @ - 3200m (kg/cm²)	**397.5**
IP (m3/h/ kg/cm²)	**0.196**
KH (m.md)	**173**
Skin	**-1.21**

IV.13. Gauging results :

Tab.IV.2. Gauging results

Date	07/04/2024
Pt (kgcm²)	123.1
Nozzle (∅) (mm)	9.53
Oil flow (m3/h)	11.78
GOR	264

IV.14.Separator Report Data :

Tab.IV.3. Separator Report Data

	TestN.	Well Name/Number MDz-802	Customer Sonatrach DP Departement Techniques Production	Date(day,month,year) 07.04.2024	Field: HMD

Oil Meter Size	Meter Type	Orifie Plate	Gas Meter Run Size	Well head Choke Size	Cust. Rep.	Mr.Salah BEKHOUCHE	GWCR ep.:	Walid. REDJAI
N/A	Tank Metering	1.750"	5.761"	24 /64F 9.53mm				

	Well head Data			Gas Metering					Oil Metering						H2ORate	Gas Oil Ratio
Time hh:mm	Well head Pressure	D/stream Pressure	Well head Temp	Static Pressure	Diff Pressure	Gas Temp	Gas Gravity	Gas Rate	Oil Temp	Tank Readings	Oil Rate	Oil Rate	Oil Specific Gravity	BS&W	Water Rate	G.O.R.
(24 Hr Clock)	(kg/cm²)	(kg/cm²)	(ºC)	(kg/cm²)	(inH2O)	(ºC)	(Air=1)	(sm³/hr)	(ºC)	(cm)	(m³/½hr)	(m³/hr)	(uncorrected)	(%)	(m³/½hr)	(sm³/m³)
11:00	123.1	9.6	60													
11:05	Diverted flow through the separator.															
11:15	Started flow rate calculation.									36.00						
11:45	123.1	9.5	60	9.1	190	41	1.030	3101.46	37	87.50	5.30	10.61			0.00	292.342
12:15	123.1	10.2	60	9.8	195	42	1.030	3212.13	38	155.00	6.95	13.91			0.00	231.005
12:45	123.1	10.2	61	9.8	195	43	1.030	3205.38	39	207.00	5.36	10.71	0,790@39℃		0.00	299.232
13:15	123.1	10.2	61	9.8	205	44	1.030	3198.71	41	267.00	6.18	12.36			0.00	258.795
13:45	123.1	10.2	61	9.8	210	45	1.030	3185.50	41	325.00	5.97	11.95			0.00	266.614
14:15	123.1	10.2	62	9.8	215	46	1.030	3198.71	41	386.00	6.28	12.57			0.00	258.795
14:45	123.1	10.2	62	9.8	210	47	1.030	3185.50	41	446.00	6.18	12.36			0.00	266.614
15:15	123.1	10.2	62	9.8	210	47	1.030	3172.46	41	504.00	5.97	11.95			0.00	265.522
15:15	Bypassed separator.															
Average During Test	123.1	10.1	61.1	9.8	204	44.4	1.0	3182.5	39.9	6.026	12.05				0.00	267.36

IV.15.Conclusion :

The test train consisted basically of a 7" Champ packer, CGM5 metrolog recorder holder, 5" Select tester valve and RD circulation valve. After pressure testing, anchoring of the Packer and a safety meeting, the well was opened at the bottom valve and at surface at the nozzle manifold. A pressure of 1200 psi at the head and oil at the surface were observed during the pre-flow. After the second opening, several adjustable nozzles were on . Over the following two days, the flow was diverted to a test separator for successive counting on adjusted 28/64" and 32/64" choke manifold.

General conclusion

Conclusion and recommandations :

DST is a very important operation, because it can define with a certain degree of precision the characteristics of a reservoir that may contain hydrocarbons, and those of the effluent it contains, in order to optimize its drainage and improve its performance.

The program should clearly define the objectives of the trial and prioritize them so that key information can be collected even if it proves impossible to complete the trial program. complete the test program, all the information relating to the actual conduct of the test must be recorded (in particular, the diagrams must be labeled on site after the operation).

The DST of MDz-802 well is technically successful and the well has given an average flow on the 24/64‘’ and 34/64‘’ nozzles of 9.53m3/h with an average GOR of 264 sm3/m3 BS&W= 100 % Oil and the skin -1.21, oil flow 11.78 (m^3/h)

Therefore we recommend :

- to use hydraulic fracturing or acidizing to improve permeability.
- A large number of people (representatives of different parts of the project owner, personnel from the drilling contractor, personnel from one or more specialist service companies) are involved in a well test. It is therefore important to clearly define the main objectives and each person's task and responsibility.
- Continue the completion program.

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