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HEAVY OIL OPERATING

SYSTEM – HOOS

LIFTING EFFICIENCY

WELL SELECTION CRITERIA

1.



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2. Executive Summary

2.1. About this document

HOOS is the ultimate development of artificial oil lifting technology using information technology injection and oleophilic continuous belt to produce a whole new domain, that is, vertical transportation.

HOOS is an acronym of Heavy Oil Operating System, combining artificial oil lifting and the Operating System by integrating last generation computer science: digital oil field and smart metering. Starting with heavy oil applications, HOOS continuously invested in R&D and broadly expanded the applicability area to less than heavy oil, high production depths as well as increased productivity.

The purpose of this document is to provide general well selection criteria that fit HOOS Technology requirement.

Please note that all parameters work in conjunction and however extreme a parameter value might be, the other parameters count too in taking the final decision regarding the applicability of the technology in that specific well.

2.2. Summary of important parameters

There is a broad range of applicable wells, especially wells that are not economically efficient due to significant gravity/density/API, presence of sand, water, wax. Although HOOS technology is developing at a fast pace, it is not applicable anywhere and everywhere. Below is a summary of present limitations of the technology:

Limitations	Applicability
Casing/tubing size	Casing or tubing diameter should be no less than 122mm. For smaller diameters, technical team should qualify the well.
Casing integrity	Inner casing within the well should be intact, with no claws where the production belt could hook on it.



Verticality	Well should not be deviated more than 5 degrees.
Acidity	If previous chemical stimulation with acid substances, production belt might be consumed by the acids inside.
Location	Well should be located onshore

3.

Crude oil well selection criteria

3.1. Depth

HOOS technology is designed to work at different depth levels, from surface to the dynamic level or to the perforations level. The following table summarizes the applicability of HOOS to different down hole unit depths:

Depth	Applicability
Lower than 500m	Perfectly applicable, maximum productivity, maximum energy efficiency.
Depth between 500-1500	Perfectly applicable, good productivity, electrical motors higher than 7.5KW might be needed.
More than 1500m depth	Applicable for low water cut wells, high energy consumption.

1.1. Casing integrity

Due to its specific non-iron, flexible subsurface components, HOOS technology is rather sensible to the casing integrity within the well. The following table summarizes the applicability of HOOS to deviated wells:

Deviation	Applicability
No hooks inside	Perfectly applicable
Small irregularities	Applicable
Hooks inside	Not applicable

1.2. Vertical deviation

Due to its specific non-iron, flexible subsurface components, HOOS technology is rather sensible to the verticality of well casing. The following table summarizes the applicability of HOOS to deviated wells:

Deviation	Applicability
No deviation	Perfectly applicable



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Less than 5 degrees	Applicable
Higher than 5 degrees	Please contact HOOS to analyze applicability
Horizontal wells	Possible only in the vertical section of the well

1.3. Temperatures

1.3.1. Bottom hole temperature

HOOS technology is limited by high bottom hole temperature. The oil absorbent belt is made of Dyneema, polyethylene or polyacrilic yarn types which has a melting type around 160 degrees Celsius or Zetex yarns which has a melting point above 700 degrees Celsius. The following table summarizes the applicability of HOOS to different bottom hole temperatures:

Temperature	Applicability
Cold wells	Perfectly applicable
Less than 100 degrees Celsius	Applicable
Between 100 and 540 degrees Celsius	Under development with a special belt based on Zetex yarns
Between 540 and 700 degrees Celsius	Under development with a special belt based on Zetex yarns. Works on limited period of time
Higher than 700 degrees Celsius	Not applicable



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1.3.2. Surface temperature

The surface temperature is a rather less important point for the operation of HOOS technology, however limits need to be taken into consideration. The following table summarizes the applicability of HOOS to external temperature:

Temperature	Applicability
Less than -60 Celsius	Applicable only with additional heating devices to keep the industrial electronics working
Between -60 and 80 Celsius	Applicable
Higher than 80 Celsius	Applicable only with additional heating devices to keep the industrial electronics working

1.4. H2S content

HOOS technology is designed to totally isolate the well gas and liquids from the surface air components. However, while fine-tuning the belt depth, there might appear the need to break the isolation level, having the risk of spreading H2S in the near atmosphere. The following table summarizes the applicability of HOOS to H2S wells:

H2S Content	Applicability
No H2S	Perfectly applicable
Less than 5%	Applicable
Higher than 5%	Please contact HOOS for applicability analysis



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1.5. Chemical treatment

HOOS technology is designed to produce oil in harsh underground environment, by using a vertical transportation production belt. Traditional technologies use various types of chemicals injected in the production layer in order to increase production. Old stimulation techniques used acid chemicals for stimulation which have now the potential to damage the belt sewing and structure. The following table summarizes the applicability of HOOS to wells with chemical treatment:

Acid Content	Applicability
No chemical treatment	Perfectly applicable
Chemical stimulation with no acid or very low acid content	Applicable
High acid content	Not applicable

1.6. Sand content

HOOS technology is designed to be insensitive to sand content in the oil. The following table summarizes the applicability of HOOS to wells with sand content:

Sand/solids content	Applicability
Less than 1%	Perfectly applicable. No maintenance necessary
Between 1% and 30%	Perfectly applicable. Maintenance of the metering unit (measurement unit) might be needed to remove accumulated sand
Higher than 30%	Not tested to date.



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1.7. GOR ration

HOOS technology is insensitive to GOR. There is no cavity to be affected.

1.8. Pressures

1.8.1. Bottom hole pressure

HOOS technology is insensitive to bottom hole pressure.

1.8.2. Flowline pressure

HOOS technology is insensitive to flowline pressure. The production is either delivered to a local tank or to a gathering park trough the flowline. The lifted liquids are forward pushed by a horizontal PCP, after metering point. The horizontal PCP is designed according to the flowline pressures it needs to meet.

1.8.3. Wellhead pressure

HOOS technology is isolated up to 150 bars pressure at the well head and tested up to 50 bars. For optimal fine tuning process, we would recommend selecting a test well with lower than 5 bars pressure at the well head.

1.9. Production rates

HOOS technology is designed to production rates up to 500 barrels of liquid per day. The following table summarizes the applicability of HOOS to production rates:

Production rates	Applicability
Less than 100 bbl/day, no water cut	Perfectly applicable
Less than 50 bbl/day, water cut less than 30%	Perfectly applicable
Between 100 and 200 bbl/day, less	Applicable



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than 50% water cut	
Higher than 200 bbl, water cut higher than 20%	Applicable
Higher than 500 bbl/day	Not applicable. Research under development.

1.10. Paraphine or asphaltine

HOOS technology is insensitive to paraphine or asphaltine content. For high content, special heating device is provided.

1.11. Viscosity

HOOS technology works best with high viscosity oil types, however it can handle liquids with viscosity as low as water viscosity. The following table summarizes the applicability of different viscosity liquid types with HOOS unit:

Viscosity	Applicability
Less than 1 CP	Not applicable unless water
Between 1 and 9 CP	Applicable with belt designed for that special type of liquid
Between 10 and 100 CP	Applicable.
Between 100 and 1 000 CP	Perfectly applicable.
Between 1 000 CP and 10 000 CP	Perfectly applicable.
Higher than 10 000 CP	Applicable as long as it flows.



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1.12. Gravity

HOOS technology is not affected by the oil gravity but by its specific viscosity as specified previously. However, since gravity and viscosity are often correlated, we provide the following table to summarize the applicability of different oil density types with HOOS unit:

Density	Applicability
Light oil (higher than 32 API)	Applicable in less than 50 bbl/day wells
Medium oil (between 32 and 22 API)	Applicable in less than 150 bbl/day wells
Heavy oil (between 22 and 10 API)	Perfectly applicable.
Extra heavy oil (between 10 and 4 API)	Perfectly applicable.

1.13. Water cut

HOOS technology is designed to reduce water cut. The following table summarizes the applicability of different water cut levels with HOOS unit:

Water cut	Applicability
No water cut	Perfectly applicable.
Less than 30%	Perfectly applicable. Test cases shown a reduction of the water cut from 30% to 0% in 3 months period of time.
Between 30% and 70%	Perfectly applicable. Test cases shown a reduction of the water cut from 70% to 10% in 3 months period of time.



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Higher than 70%	If water is to be lifted also, then it is applicable. If water is not to be lifted, then applicable with pre-test: 20% of the wells might be flooded.
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1.14. Power supply

HOOS technology is designed to work in harsh conditions and adapt to different power supply. The following table summarizes the applicability of different power supply options with HOOS unit:

Power supply	Applicability
Alternative or continuous power source	Alternative preferred, continuous is still applicable with power converter.
Wired power supply, stable quality	Perfectly applicable.
Wired power supply, unstable quality	Applicable with local battery (UPS) or power line stabilizer.
Local diesel generator	Perfectly applicable. Power needed is less than 7.5 KW in standard applications.
Local green power generator (solar, wind, others)	Applicable with local battery (UPS) and power line stabilizer.
No power supply	Not applicable.



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1.15. Collection of production

HOOS technology is not affected by the method used for collection of production. The following table summarizes the applicability of different methods used for collection of production with HOOS unit:

Collection of production	Applicability
Local tank	Applicable
Gathering park / pipeline	Perfectly applicable, local pump used to push the production through the pipeline

1.16. Data transfer

HOOS technology is affected by the availability of data transfer technology. The following table summarizes the applicability of different data transfer technologies with HOOS unit:

Data transfer	Applicability
Full GSM coverage	Perfectly applicable
Low GSM coverage	Applicable, minor loss of functionality or delays in data availability might be recorded
WiFi available	Perfectly applicable
Wired data transfer	Perfectly applicable
Satellite	Applicable, minor loss of functionality or delays in data availability might be recorded
No data transfer available	Applicable, remote control functionality and delays in data availability



1.17. Well head connection

HOOS technology is not affected by well head connection flange. HOOS unit is delivered with special connection flange fitting your well head connection flange.

1.18. Casing

1.18.1. Diameter

HOOS technology is not affected by the casing diameter as long as production is allowed to be directly within the casing. Otherwise, the minimum tested diameter is 122 mm. Smaller diameters are possible if pre-approved by HOOS engineering team.

1.18.2. Integrity

HOOS technology is not affected by the casing integrity, as long as it does not inflict a deviation higher than 5 degrees or there are no hooks inside the casing that might hook up the downhole belt.

1.19. Location

HOOS technology is only designed for onshore applications.