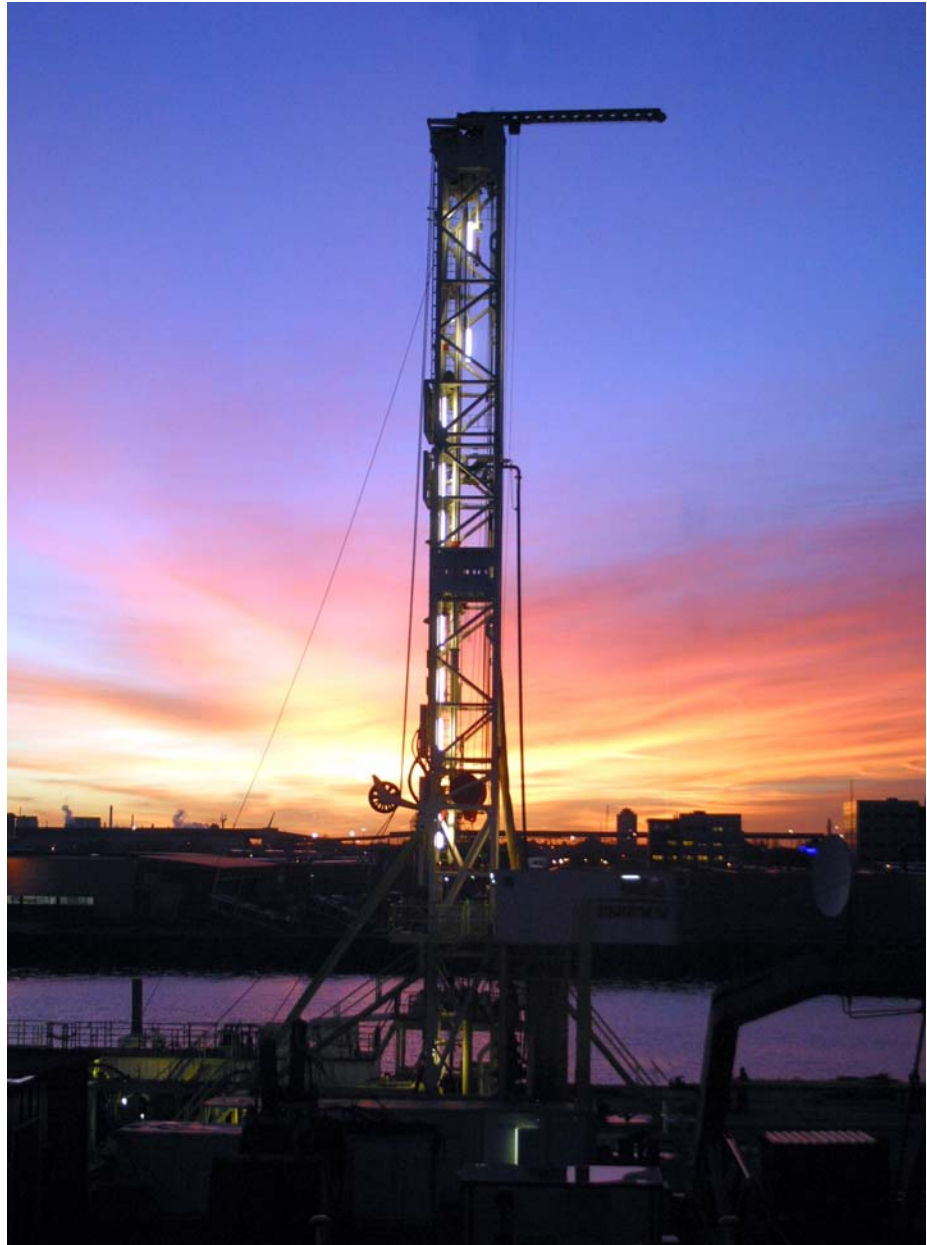


# Huisman

Worldwide Lifting, Drilling and Subsea Solutions



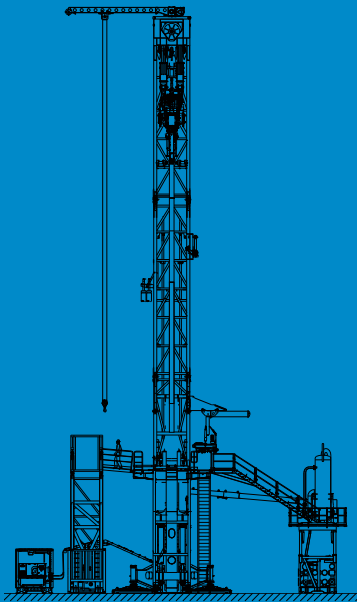
LOC 400  
Drilling Rig

# LOC 400

## Drilling Rig

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## 1 DESCRIPTION

### 1.1 Introduction

The oil and gas exploration and production industry is being challenged to exploit smaller pockets of recoverable reserves at more remote locations. At the same time, operators are required to meet safety targets and environmental regulations in a cost constrained and competitive environment.

The LOC 250, an innovative new rig concept, was introduced to the market in 2005. The LOC 250 – Land and Offshore Containerized 250t drilling rig - was designed to take advantage of emerging Casing While Drilling technology in order to reduce the costs as well as the environmental impact of drilling a well. The demand for faster operation, more flexibility, and deeper wells triggered the development of the LOC 250's successor: the LOC 400.

The LOC 400 is Huisman's drilling solution designed to meet today's challenges.

#### *Main advantages of the LOC 400*

- Total solution for Casing While Drilling AND Conventional drilling
- Containerized design
- Automation
- Integrated Design
- System is proven in a working environment
- Other benefits include:
  - 6 mt service crane with man riding basket → *Safety*
  - Power unit designed to work with gen-sets or local grid → *Efficiency*
  - Offline BOP testing → *Efficiency*

LOC 400 on site in Werkendam, NL



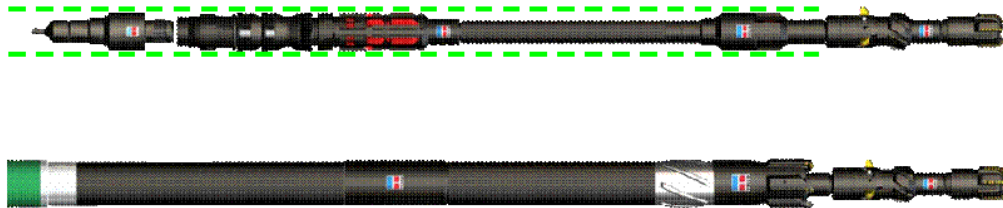
## 1.2 Casing While Drilling

Casing While Drilling (CWD) technology enables the drilling of wells using standard oilfield casing in stead of drill pipe. This enables an operator to simultaneously drill and case a well. Drill bits and other tools can be lowered on a wire line inside the casing to the bottom of the hole where they can be latched onto the last joint of casing while mud circulation continues. Retrieval of drill bits and tools occurs in the same way. The use of modern CWD drillable bits and drill through technology is also possible.

The CWD process eliminates tripping and its associated risks. A top drive system is used to rotate the casing, which remains in the hole at all times. The casing remains on bottom, at all times and is eventually cemented in place once the casing depth is reached.

Using CWD can often eliminate a casing string from the well design. It has been proven that drilling efficiency can be improved by 20 to 50%.

*Casing Drilling Down Hole Tools – External and Internal Views*



*CWD Drillable bit*



### *Casing While Drilling Advantages:*

- Less tripping:
  - Reduced flat time
  - Reduced risks of kicks and blow-outs
    - *Efficiency*
    - *Safer working conditions*
- Casing is always on bottom
  - Reduced risks of kicks and blow-outs
  - Improved well bore stability
    - *Safer working conditions*
- Easier to drill through difficult and unstable formations
- Improved mud circulation leading to a reduction in the required pump power:
  - Lower noise,
  - Lower fuel consumption,
  - Less mud consumption.
    - *Efficiency*
    - *Reduced environmental impact*

### 1.3 Containerized Design

Two of the most important features of the LOC 400 are its compact size and the possibility to break down the entire rig into 18 modules (26 including loose items.) Within 30 hours including limited transportation time, a crew can demobilize the entire rig and rebuild it at another location.

As the standard ISO containers can be transported quickly and economically by any container ship, train, or truck, the LOC 400 can be used to drill wells anywhere in the world. Transportation costs between worldwide locations are no longer an issue.



Its modular design enables the LOC 400 to be used in various ways: on land, on skid beams, and offshore on platforms, jack-ups and barges. Offshore, the LOC 400 can be fitted compactly onto x-y beams enabling two dimensional movement of the rig over the platform's array of wells. Due to the modular design, only the essential drilling elements of the rig need to be set up on the skidding system, limiting the weight on the platform.

#### *Containerized Design Advantages:*

- Standard ISO container design
  - 19 x 40' containers and 7 x 20' containers
  - Easy, cheap, and quick worldwide transportation
  - No special road permits
  - *Efficiency*
- Modular design allows for a flexible footprint
  - Minimal foot print
  - Containers can be stacked
  - *Efficiency, Reduced environmental impact*



## 1.4 Automated Drilling

### Pipe Handling

The LOC 400 is equipped with an automatic pipe handler enabling highly efficient and safe handling of both casing and drill pipe. The pipe handler picks up the tubulars from the horizontal pipe rack and places them vertically directly over the well centre where the top drive takes over.

The top drive or the optional power tongs are used to spin in the tubulars and to torque-up the connections. Automated power slips are integrated into the rotary table.

The LOC 400 is capable of tripping 35 joints an hour (based on the speed of the pipe handler) which equates to almost 1600 ft/hr of range 3 drill pipe. The entire drilling process is controlled from the driller's cabin, making personnel on the drill floor unnecessary. As casing handling is identical to drill pipe handling, the same team can carry out both tasks.



### Autodriller

The autodriller is used to keep a constant Weight on Bit (WOB) or a constant Standpipe Pressure. The measurement of the hook load is not done at the dead end as on conventional rigs, but in the connection pins of the lower block, eliminating friction and hysteresis in the measured load signal. The control of the drawworks is extremely accurate with exact speed control – even down to zero speed – without using mechanical brakes. This results in an improved drilling performance.

#### *Advantages of Automation:*

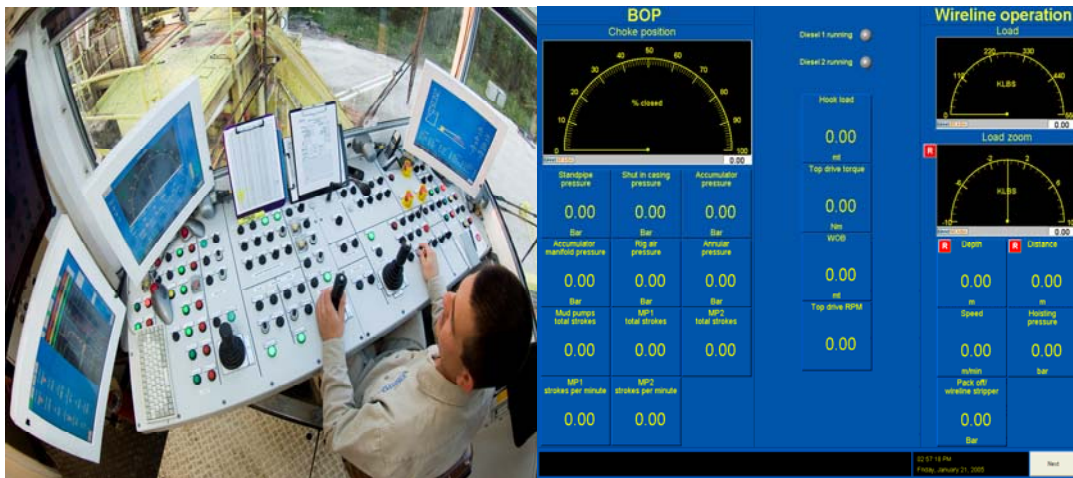
- Automated pipe handling and automated power tongs:
  - Remove people from drill floor
  - Automated handling of tubulars up to 13 3/8"
  - Power tongs can automatically find joints
    - ➔ Efficiency
    - ➔ Safety
  
- Autodriller
  - Can keep constant Weight on Bit or constant Standpipe Pressure
  - Load measurement on block, not at dead end
  - Improved drilling performance
  - Optimized bit performance and life
    - ➔ Efficiency

### 1.5 Integrated Design

Most conventional rigs are combinations of components and systems that are developed and maintained by different suppliers. The LOC 400, however, is a fully integrated drilling rig that is offered as one complete package. All components, including the drawworks, top drive, mud pumps, power unit, mud treatment system, pipe handling, and BOP, are tested prior to delivery to ensure trouble free operations. All systems are combined into a fully integrated control and monitoring system. This means full control of all equipment from a single control desk made by one single supplier.

A complete Geolograph is also included.

The monitoring system is prepared for satellite/linked remote diagnosis, which enables Huisman engineers to help solve customer's specific needs.



#### Advantages:

- Complete control system from single supplier
- Equipment outfitted with local backup controls
- Remote access and troubleshooting
- Huisman Geolograph included
- All systems are fully tested and commissioned prior to delivery



### 1.6 Offline BOP testing

To reduce non-productive time, BOP's can be pressure tested offline on a dedicated test stump that also serves as a mouse hole. The control hoses do not have to be disconnected after testing to move the BOP onto the wellhead. The BOP container is used to transfer the BOP from the test stump onto the well head.

### 1.7 Emergency Backup Systems

Even the most reliable systems can encounter interruptions. Thus all vital systems on the rig have a back-up. The drawworks and top drive can be controlled manually from a separate diesel driven hydraulic power unit. This can prevent stuck pipe and can save the well should power be interrupted while drilling.

The mud pumps can also be operated manually. This means that even if the PLC system or network is down, the mud pumps can be operated.

### 1.8 Energy Efficient

The LOC 400 has a significantly lower adverse impact on the environment compared with traditional rigs. Drilling a well with the LOC 400 using CWD requires lower pump pressures and flow rates. Two 800hp mud pumps are usually sufficient for most drilling applications. This, along with the reduction in time required for drilling a well, results in significantly lower fuel consumption.

The foot print of the LOC, at 1200m<sup>2</sup>, is much smaller than the footprint required by a traditional rig of the same capabilities.

### 1.9 Service Crane

A service crane capable of lifting 6 mt (6.6 sht) is mounted on the crown. Any operations or maintenance requiring work above the drill floor can be done using the crane and a man riding basket. The crane can also be used to help lift heavy items to the drill floor and for lifting heavy tubulars.





## 2 SPECIFICATIONS

### 2.1 General

The modular rig is rated for 20,000 [ft].

The rig consists of 26 ISO containers loads – 19 x 40' and 7 x 20' containers.

Main power consumers are electrically AC driven. Auxiliary functions are AC and hydraulically driven.

#### General

##### Substructure

Height drill floor above ground level	8.0 [m]	26 [ft]
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##### Mast

Static rated load (API 4F)	360 [mt]	400 [sht]
Clear height, drill floor to bottom water table	27.8 [m]	90 [ft]
Total height from ground level	38.1 [m]	125 [ft]
8 Stands BHA setback, max. weight of 1 stand	5500 [kg]	12000 [lbs]

### 2.2 Hoisting

#### Hoisting

##### Service crane

Maximum capacity, at max. 6 [m] radius	6000 [kg]	13200 [lbs]
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##### Drawworks with Autodriller

Block speed at full load, 12 falls	11 [m/min]	36 [ft/min]
Block speed at red. Load, 12 falls	44 [m/min]	144 [ft/min]
Block speed at full load, 8 falls	16 [m/min]	54 [ft/min]
Block speed at red. load, 8 falls	66 [m/min]	216 [ft/min]

##### Travelling block

6 sheave assembly. Split blocks with room for wire line passage in the centre line.

Thread saver cylinders incorporated.

Block capacity (under top drive), 12 falls	317 [mt]	350 [sht]
Block capacity (under top drive), 8 falls	227 [mt]	250 [sht]

### 2.3 Rotating Equipment

#### Rotating Equipment

##### Top drive

Integrated swivel. Extend – Retract function for working over well and mouse hole

Link-tilt function for P/U tubulars. Single joint elevators mechanically locked with load

Max. capacity (excl. dyn factor)	317 [mt]	350 [sht]
Max. torque (Make up)	61100 [Nm]	45000 [ft*lbs]
Max. speed	220 [rpm]	

External/internal casing drive assemblies and drill pipe drive assembly available

##### Rotary Table

Power slips inside the rotary table, a standard API master bushing can be inserted

Hang of capacity	317 [mt]	350 [sht]
Table opening (slips removed)	953 [mm]	37.5 [inch]
Power slips maximum size	508 [mm]	18 5/8 [inch]

## 2.4 Pipe Handling

### Pipe Handling

#### Automatic pipe handler - 1 button for complete cycle

Max. weight of tubular	3.0 [mt]	3.3 [sht]
Max. length of tubular	14.3 [m]	47 [ft]
Cycle time (1 complete cycle)	~100 sec	

#### Pipe rack

Automatic indexing arm incorporated	
Capacity of 7" casing joints (2 racks)	60 [-]

## 2.5 Mud System

### Mud System – Active system

Huisman design

Mud tank capacity (approx.)

Mud treatment container	41.3 [m <sup>3</sup> ]	255 [Bbls]
Active mud container	54 [m <sup>3</sup> ]	340 [Bbls]
Mud mix container	41.3 [m <sup>3</sup> ]	255 [Bbls]
Trip tank	3.5 [m <sup>3</sup> ]	22 [Bbls]
<b>TOTAL CAPACITY</b>	<b>140 [m<sup>3</sup>]</b>	<b>872 [Bbls]</b>

All tanks (except sand trap) are fitted with electric driven agitators

All tanks (except sand trap) are fitted with level transducers

1 Centrifugal degasser

2 Electric driven shakers, MI-SWACO or client specific (additional shakers are optional)

3 centrifugal pumps mud transfer, mud mixing, or charging mud pumps

#### Mud Pumps

Standard delivery:	3x
Model: Triplex HHF-800, AC driven	Independent drive gearbox, lube pump, wash pump
Rated power	600 [kW] 800 [HP]
Maximum strokes per minute	160 [spm]
Strokes	228.6 [mm] 9 [inch]
Liner sizes	101.6 – 158.75 [mm] 4 – 6 ¾ [inch]
Maximum output pressure (4" liner)	345 [bar] 5000 [psi]

#### Output with nominal speed and maximum pressure (1 mud pump)

Number of strokes (approx.)	120 [spm]						
Liner size	4	5	5.5	6	6.5	6.75	[inch]
Maximum pressure	345	220	180	152	129	121	[Bar]
	5000	3190	2610	2204	1878	1750	[Psi]
Flow	666	1041	1261	1503	1760	1900	[l/min]
	176	275	333	397	465	502	[Gpm]

#### Output with maximum speed and reduced pressure (1 mud pump)

Number of strokes (approx.)	150 [spm]						
Liner size	4	5	5.5	6	6.5	6.75	[inch]
Maximum pressure	276	176	144	122	103	97	[Bar]
	4000	2550	2087	1768	1493	1400	[Psi]
Flow	832	1300	1576	1875	2200	2374	[l/min]
	220	344	417	496	582	627	[Gpm]

2.6 Well Control

**Well Control**

Blow Out Preventer

BOP can be controlled from the drillers cabin, tool pushers office, or from the BOP control unit  
8 station BOP control unit included, remote controlled

Bore size			13 5/8	[inch]
Pressure (single and double rams)	690	[bar]	10000	[psi]
Pressure (annular)	345	[bar]	5000	[psi]

2.7 Power

**Rig Power Consumption**

Electric power system

Main consumers (mud pumps, draw works, top drive): electrical inverter controlled  
Centrifugal pumps, shakers, agitators, BOP control unit, etc.: electrical

Required power, standard delivery	2000	[kW]	3737	[HP]
Power source	480	[V]	60	[Hz]

**Hydraulic power system**

Auxiliary consumers (Rotary table, small cylinders etc.) hydraulic

Required electric power for HPU	220	[kW]	300	[HP]
Volume tank hydraulic oil	2000	[l]	527	[USG]

2.8 Optional Items

**Backup and Rig Up system**

1 backup mover: Hatz, Type: 4L41C	40	[kW]	54	[HP]
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**Casing while Drilling Package**

**Casing Drive Assemblies**

Tubular sizes (casing)	4 1/2	[inch]	18 5/8	[inch]
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**Wire line hoist winch**

Capacity at surface	Approx.	15.3	[mt]	16.8	[sht]
Hoisting speed at reduced load <= 6 [mt]		70	[m/min]	230	[ft/min]
Max. depth below surface	Approx.	6000	[m]	20000	[ft]

**Wireline BOP**

Bore size	22	[mm]		
Pressure	345	[bar]	5k	[psi]

**Generators, 2 or 3,**

Total rated electrical power (PRIME)	3000	[kW]	4000	[HP]
Power output	480	[V]	60	[Hz]

**Power tong, Rogers Oil Tools**

Minimum pipe size	108	[mm]	4 1/4	[inch]
Maximum pipe size	184	[mm]	7 1/4	[inch]
Maximum torque	88000	[Nm]	65000	[ft*lbs]
Vertical stroke	800	[mm]	31.5	[inch]

**Reserve mud tanks**

Mud tank capacity (approx.)				
Reserve mud container	42	[m3]	264	[Bbls]

For more information or options, contact Huisman.



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