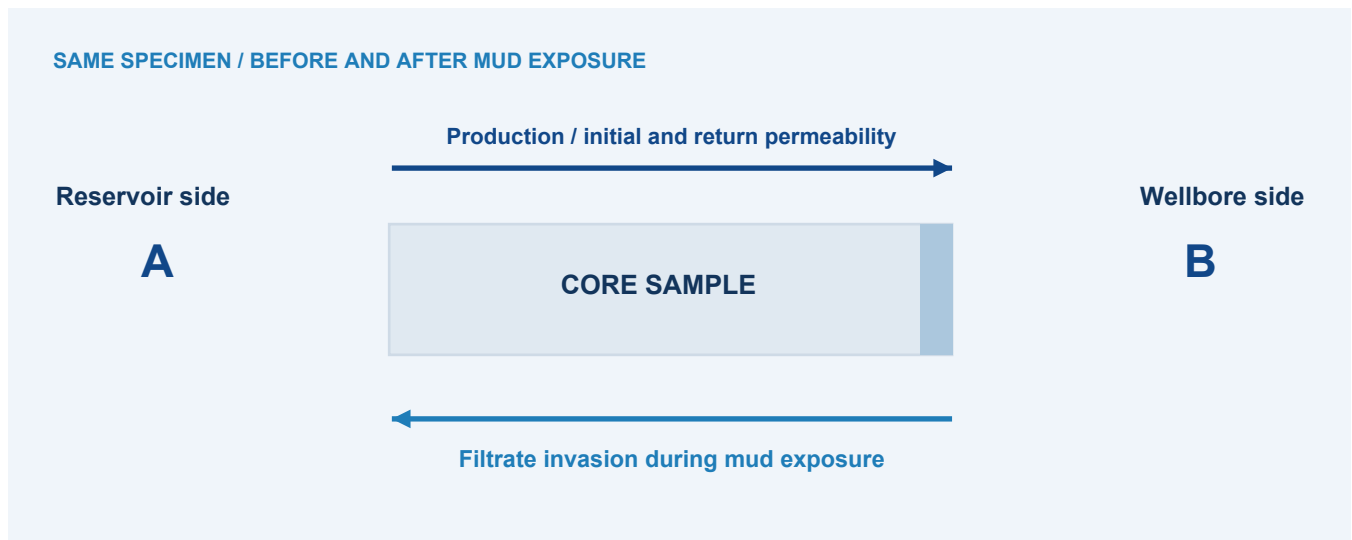


FORMATION DAMAGE / DYNAMIC FILTRATION

NEWRPTA-10k

Return Permeability Test Apparatus

Evaluate permeability retention after dynamic drilling-fluid exposure under controlled pressure and temperature.



REFERENCE OPERATING ENVELOPE

6,000

psi

Mud and pore pressure

7,500

psi

Confining pressure

350

°F / 177 °C

Maximum temperature

The system supports laboratory screening of drilling and completion fluids, additives and lost-circulation materials against reservoir rock. A single specimen is used for initial permeability, mud exposure and return-flow measurements.

The 10k model designation does not define the working pressure of every circuit. The mud, pore and confining limits above govern the reference configuration.

Test sequence and flow direction

The specimen remains in the holder throughout the test. Face A is the reservoir-side far face; face B is the slotted wellbore-side face. Both permeability measurements use production flow from A to B. Filtrate invasion during mud exposure proceeds from B towards A.

- 01

Establish initial permeability, K_i

Saturate the prepared specimen with the selected reference liquid. Establish test temperature, pore pressure and confining pressure, then inject the reference liquid at the planned rate. Determine K_i from a stable differential-pressure interval and document the stability criterion.
- 02

Apply dynamic mud exposure

Stop reference-liquid injection through the core. Circulate mud through the slot across face B at the selected rate. Mud-side pressure exceeds outlet pore pressure, driving filtrate into the core while a filter cake can form at the exposed face. Record the exposure conditions and receiver mass against time. A static period may follow with circulation stopped.
- 03

Measure return permeability, K_r

Stop circulation, isolate the mud loop and restore reference-liquid flow from A to B. Use the same comparison conditions as for K_i . Record the recovery transient and determine K_r from a stated stable interval. Document any change to the exposed face or filter cake before this measurement.

Functional routing

Stage	Core flow	Mud circuit
Initial / return permeability	A to B, production direction	Isolated from the permeability path
Dynamic filtration	B to A; filtrate from face A to collection	Circulation across face B; mud returns to reservoir
Saturation / selected injection	Direction selected by manifold	Set to the relevant test mode

A comparable before-and-after measurement

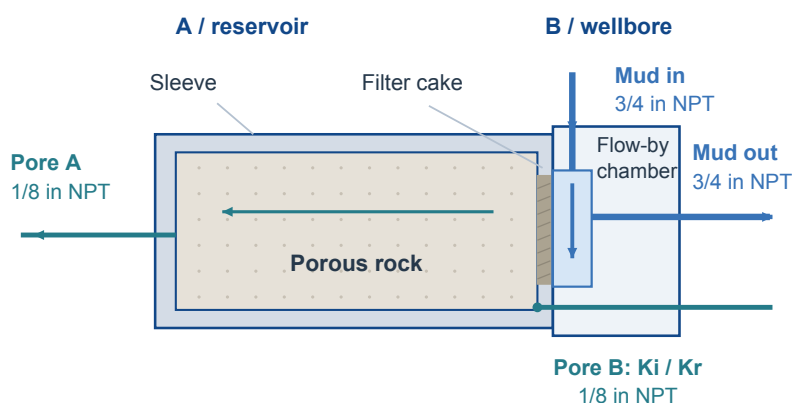
Use the same reference liquid, temperature, flow rate, pore pressure, net confining stress and direction for K_i and K_r . Report the laboratory protocol with the permeability ratio.

02 / SPECIMEN ASSEMBLY

Core-face geometry and preparation

The wellbore-side head provides a mud flow-by path across face B and a separate pore-fluid connection for permeability measurement. A project-selected face spacer opens the flow path over the exposed core face.

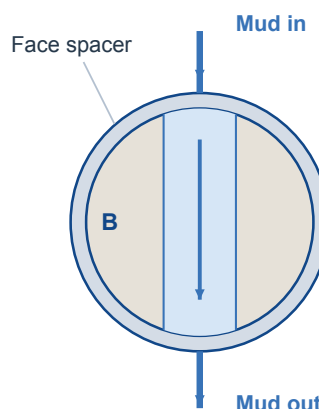
A LONGITUDINAL SECTION



Core: Ø1.0 or Ø1.5 in; length up to 6 in.

Filtration: B → A. Production (K_i , K_r): A → B.

B VIEW OF THE B FACE



Flow-by slot

0.25 in deep × 1.125 in wide

Mud sweeps across the face.

Functional schematic / not to scale.

Internal port routing and face-spacer geometry are illustrative; no fabrication detail is implied.

Functional illustration, not to scale. Internal channel routing and spacer geometry are defined in the project core-holder drawing.

Slot flow and pressure

The reference slot is 0.25 in deep by 1.125 in wide, with 3/4 in NPT mud ports and 1/8 in NPT liquid ports. Circulation rate and nominal face velocity describe the imposed flow. A shear-rate estimate additionally requires a defined channel geometry and fluid rheology; filter-cake growth can change the local passage.

Preparation and measurement boundary

Prepare parallel core ends, measure length and diameter, and record the saturation procedure. Check the pressure-sensing baseline and follow the supplied procedure for equalisation, flow reversal and cleaning. Identify the pressure-tap locations used for K_i and K_r ; report whether the measured pressure drop includes end-piece or filter-cake resistance.

Separate paths and sensor protection

Bulk mud circulation and pore-fluid measurement use separate connections. Protection of sensing lines and pressure regulators follows the selected manifold and isolation arrangement; this separation is not a guarantee that no fines can be transported through the specimen.

03 / CONTROLLED AND MEASURED VARIABLES

System architecture and control

The forced-air bath contains CH-1, the three piston-separated test-fluid vessels, the mud reservoir and hot tubing. Pumps, pressure-control equipment, the balance and electronics remain outside the bath. The piston vessels separate the clean hydraulic drive from the test liquid.

Function	Set or selected	Measured / recorded
Permeability flow	Reference-liquid vessel, flow rate and direction	Pump rate, cumulative delivered volume and core differential pressure
Mud exposure	Circulation rate, mud pressure and exposure duration	Pressure, temperature and filtrate receiver mass; circulation channel per project
Pore / outlet pressure	Flow-line back-pressure regulation	System-pressure channels
Confinement	Pressure with margin relative to the higher internal pressure	Confining-pressure feedback; sensor allocation per project
Temperature	Bath / fluid-line set-points	Temperature channels; two reference controllers

Acquisition, control and operator actions

The supplied Windows PC and acquisition/control package record pressures, differential pressure, temperatures, transfer-pump rate and cumulative volume, confining pressure and balance mass. Derived results are K_i , K_r , return permeability and filtrate volume against time. Spreadsheet export and retention of the raw record support later review.

The pump and temperature controllers maintain their selected set-points. Vessel selection, direction changes and mud-loop isolation follow the supplied operating procedure. Project control documentation identifies the set-points and valves controlled through the PC, together with any supported automatic sequence.

Pressure management and protection

Maintain the selected confining margin relative to the higher of pore and mud pressures during pressure changes. The protection package includes pressure relief devices, emergency stop and independent bath over-temperature protection. Alarm-to-pump actions and valve interlocks are defined in the project control documentation.

04 / HOW THE RESULTS ARE OBTAINED

Calculations and interpretation

4.1 Permeability from liquid flow

For steady, laminar, single-phase liquid flow, Darcy’s law relates flow rate to the pressure drop assigned to the specimen:

$$K = \mu Q L / (A \Delta P)$$

Term	Definition	SI unit
K	Permeability	m²
μ	Dynamic viscosity at test conditions	Pa·s
Q	Volumetric flow rate through the specimen	m³/s
L / A	Specimen length / cross-sectional area	m / m²
ΔP	Pressure drop over the stated measurement boundary	Pa

Use consistent units; 1 mD = 9.869233 × 10⁻¹⁶ m². State any treatment of line and end losses. If the measured pressure drop includes filter-cake or end-piece resistance, identify that boundary when reporting the apparent permeability.

4.2 Return permeability

Return permeability (%) = 100 × K_r / K_i. The ratio expresses permeability retention under the stated test protocol. Interpret it with the pressure history, comparison conditions and treatment of the exposed face; it does not directly predict field productivity.

4.3 Filtrate volume from mass

V(t) = [m(t) - m₀] / ρ. Use density at receiver conditions and consistent mass/volume units. For changing density, convert individual mass increments with the appropriate density. Identify the collection stage and account for line displacement or receiver changes that affect the trace.

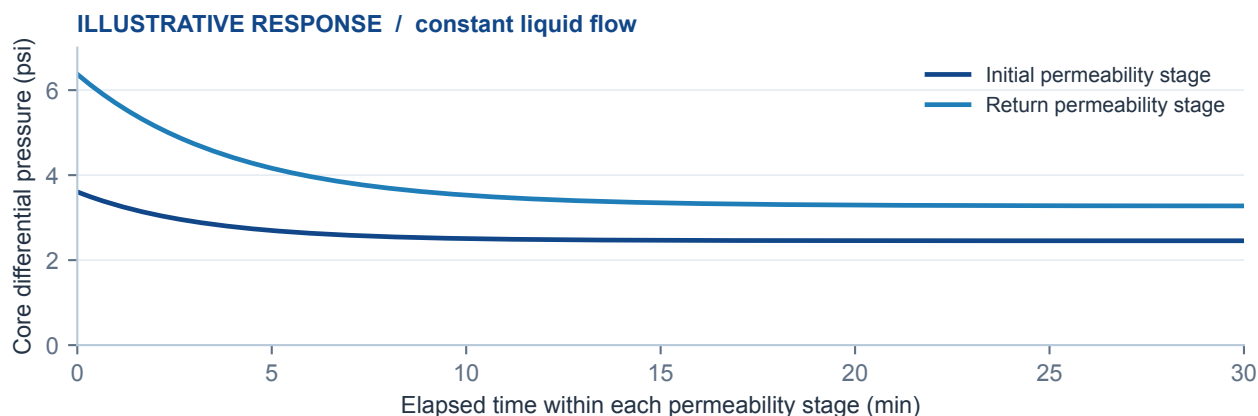
Reporting practice

Record specimen ID, dimensions, reference-liquid identity and viscosity, saturation procedure, temperature, pressures, flow rates, net-stress definition, exposure conditions, directions and stage times. State the stable intervals used for K_i and K_r. These are reporting recommendations; the approved software specification defines the delivered report format.

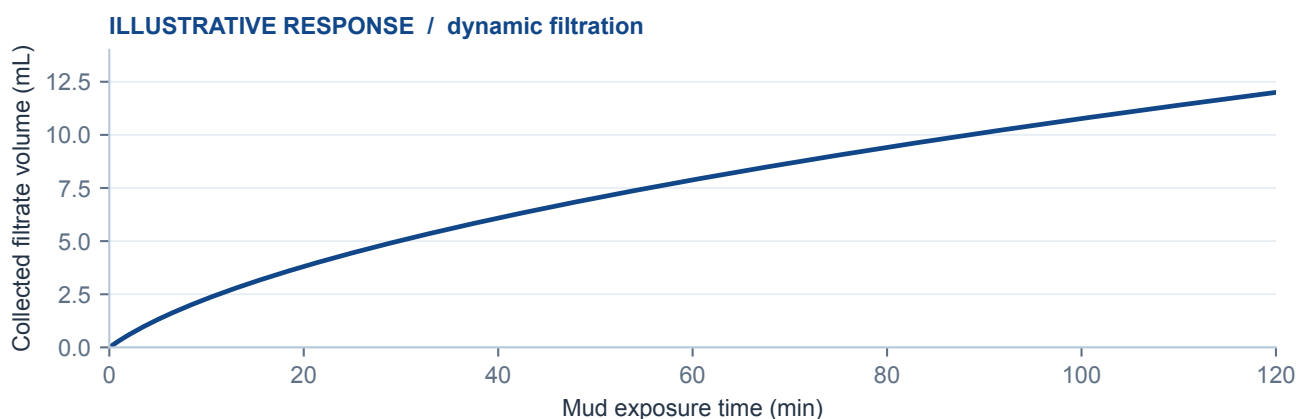
05 / ILLUSTRATIVE REPORT

Reading a test result

The plots below use synthetic data to explain the result. They are not measured performance, an acceptance test or a screenshot of the delivered software.



At fixed liquid viscosity, flow rate and specimen geometry, a higher stable pressure drop corresponds to lower permeability.



The filtration trace shows cumulative receiver volume during the exposure stage. Evaluate it together with time, overbalance, mud flow and temperature.

Example interpretation

$K_i = 100$ mD; $K_r = 75$ mD; return permeability = 75%. These selected values illustrate a 25% reduction under the stated comparison conditions. They do not establish a performance target or an expected result for a particular rock or fluid.

For the pressure-drop example: reference-liquid viscosity 1.0 mPa·s, flow 1.0 mL/min, specimen diameter 25.4 mm and length 50.8 mm. The stable pressure drops are approximately 2.46 psi before exposure and 3.27 psi after exposure. The filtrate curve is a separate illustrative trace.

06 / REFERENCE CONFIGURATION

Technical characteristics

The values below describe the 6,000 psi / 350 °F reference configuration. Component ratings are not interchangeable with the allowable working pressure of the assembled system.

6.1 Operating envelope

Parameter	Value
Confining pressure	Up to 7,500 psi working. A 10,000 psi-rated confining module is specified separately in the proposed equipment package.
Mud and pore pressure	Up to 6,000 psi.
Back pressure	Regulated at the effluent outlet, operator set-point, up to pore pressure.
Overbalance	Set by mud-loop pressure and effluent back pressure, controlled independently of each other.
Temperature	Ambient to 350 °F (177 °C), forced-air bath, digital control.
Temperature measurement	0 to 350 °F.
Temperature control	Two controllers: core holder and fluid lines.

6.2 Core holder and samples

Parameter	Value
Core holder type	Hassler type with slotted wellbore-side end plug for dynamic filtration.
Sample diameter	1.0 in and 1.5 in (25.4 / 38.1 mm), sleeve and end-plug set for each.
Sample length	Up to 6 in (152 mm); shorter samples with spacers.
Mud flow slot	0.25 in deep by 1.125 in wide.
Mud flow ports	3/4 in NPT.
Liquid flow ports	1/8 in NPT.
Sleeve	FKM, rated for 350 °F.
Wetted materials	316 stainless steel.

06 / TECHNICAL CHARACTERISTICS

Fluid handling and measurement

6.3 Fluid handling

Parameter	Value
Test-fluid vessels	Three, 1,000 cc each, 6,000 psi, 316 stainless steel, piston separated, installed in the bath.
Mud reservoir	1,000 cc, 6,000 psi, 350 °F, 316 stainless steel, in the bath.
Mud circulation rate	Project-dependent; set from the required face velocity and the mud's density and solids.
Transfer pump	Drives clean hydraulic fluid to the piston-separated vessels. Pump type, pressure and flow range are selected as one project configuration; see the alternatives below.
Confining pump	Syringe pump with constant-pressure control. Proposed module rating: 10,000 psi; reference confining working pressure: 7,500 psi.
Back-pressure regulators	Two on the flow lines, one on the mud loop.

Transfer-pump alternatives. The quoted HPLC configuration provides up to 10 mL/min at 6,000 psi; an alternative head provides up to 25 mL/min at 2,500 psi. A separately proposed 10,000 psi dual-cylinder pump supports constant-rate or constant-pressure operation. Its flow range must be confirmed for the selected model. These specifications describe different pump configurations.

6.4 Measurement

Parameter	Value
System pressure	Two transducers, 0 to 7,500 psi, $\pm 0.05\%$ of full scale. Locations and gauge/absolute reference follow the project sensor schedule.
Differential pressure	Three transducers: 0-25, 0-100 and 0-500 psid, $\pm 0.2\%$ of full scale. Range selection and protection are defined in the project manifold.
Filtrate and effluent	Electronic balance, 0 to 2,100 g, 0.001 g resolution, with sealed receiver.
Flow rate and volume	From the transfer pump; cumulative volume per stage.
Computed results	K_i , K_r , $100 \times K_r/K_i$, filtrate volume $V(t)$.

The mud pump is selected for the required rate, fluid rheology and solids. It overcomes circulation-loop resistance, while its pressure boundary and wetted parts must withstand the full loop pressure and temperature.

Utilities and project engineering

7.1 Construction and utilities

Parameter	Value
Layout	Floor-standing frame with the air bath, core holder mount and recirculation pump mount; PC and balance on a bench beside it.
Power supply	220 to 240 VAC, 60 Hz, 3-phase in the reference configuration; single-phase or 380 V 3-phase supply on request.
Instrument air	Clean, dry air where required by the selected pumps or actuators. The proposed pneumatic package uses 85 to 115 psi; final demand is project-specific.
Nitrogen	Regulated supply where required for back-pressure domes or the selected vessel arrangement. Pressure and consumption are stated in the project datasheet.
Footprint and weight	Stated in the project datasheet together with lifting and unpacking instructions.
Radiation source	None. No ionising radiation source is used.

7.2 Inputs for equipment selection

The selected duty defines the mud circulation pump, transfer pump, face spacer, measurement ranges and laboratory interfaces. Provide the following inputs with the test programme:

Fluid and solids	Mud type, rheology, maximum density, solids concentration and largest bridging-particle size.
Flow and pressure	Circulation rate or nominal face velocity; filtration overbalance, pore pressure, temperature and exposure duration.
Rock and reference fluid	Core size and permeability range; reference-liquid viscosity and planned initial / return flow rates.
Laboratory interfaces	Site power, available air or gases, floor space and commissioning requirements.

Configuration and acceptance

The approved project documents fix the equipment list, operating limits, sensor ranges, control functions, interfaces and acceptance criteria before manufacture.

08 / HARDWARE AND DOCUMENTATION

Scope of supply and service

Reference scope of supply. The approved project documents define the final included hardware and deliverables.

Item	Notes
Forced-air bath, 350 °F, on the instrument frame	digital controller, over-temperature trip
Dynamic-filtration core holder	sleeves, end plugs and spacers for 1.0 in and 1.5 in
Piston-separated fluid vessels, 1,000 cc, 6,000 psi	three
Mud circulation module	reservoir, circulation pump, loop back-pressure regulator, flush line
Transfer pump and confining pump	with controllers
Direction manifold, valves, tubing, relief devices	316 stainless steel
Back-pressure regulators, balance and receiver	set
Pressure, differential-pressure and temperature transducers	with calibration certificates
PC with acquisition and control software, monitor, cables	set
Operating and maintenance manual, spare parts list	printed and electronic
Tool kit	for maintenance and minor repairs

Installation, commissioning and training

The instrument requires a level floor. Installation and commissioning are carried out on site by a manufacturer's engineer. A test run on a customer sample is recorded in a commissioning report. Operator and maintenance training is delivered on site, with a training certificate and attendance record. A preventive-maintenance schedule and a spare parts and consumables list are handed over with the instrument.

This document defines the product family. Guaranteed performance, included hardware, exclusions, interfaces and acceptance criteria are stated only in the project-specific technical proposal and approved datasheet.

Coretest Inc.

info@coretest.com | +1 (918) 240-1806

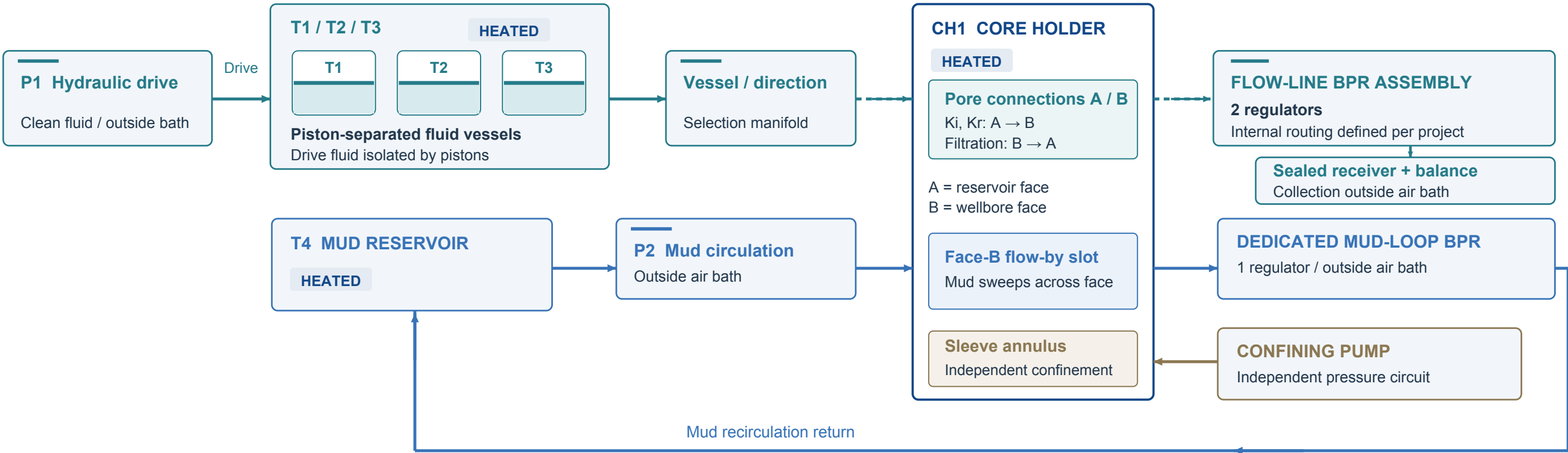
[Product page and source specification](#)

Functional circuit map

The three circuits meet at the core holder through separate connections. The diagram groups the stated equipment without prescribing valve topology or exact sensor locations; these are defined in the approved project P&ID.

NEWRPTA-10k | FUNCTIONAL CIRCUIT MAP

Functional groups are shown. Operating sequences select the actual fluid routes.



WORKING REFERENCE Mud / pore: 6,000 psi | Confinement: 7,500 psi | Heated components: 177 °C (350 °F)

MEASUREMENT INVENTORY

2 system-pressure transducers

0-7,500 psi
±0.05% FS

Channel counts are shown without assigning unconfirmed measurement points.

3 differential-pressure spans

25 / 100 / 500 psid; core ΔP
±0.2% FS

2 temperature controllers

Heated test environment
Controller / sensor routing per project

Electronic balance

Capacity: 0-2,100 g
Resolution: 0.001 g

Functional connections only. The selection manifold determines inlet / outlet routing; arrows do not define a valve sequence.

Not a fabrication drawing or P&ID. The project P&ID defines valve topology and sensor locations. Equipment positions are schematic.

Functional overview. The reference pressure boundary is 6,000 psi for the mud and pore circuits, 7,500 psi for confinement, and 350 °F (177 °C) for the heated assembly.