pnnPlus

Well Logging Equipment

PULSE NEUTRON NEUTRON TOOL 1400.0000

Max Temperature:	175°C (350 °F)
Max Pressure:	103 MPa (15,000 psi)
Tool Length:	5.110 mm (201,18")
Tool OD:	43 mm (1-11/16”)
Max Temperature:	350F 175°C
Min Hole Diameter:	47.6 mm (1-7/8")
Tool Weight:	31,57 kg (69,60 lb)
Logging Speed:	3,5 m/min (11,5 ft/min)
Recommended Borehole Fluid:	Any
Tool Voltage:	160VDC
Tool Current:	35 mA (generator off) 110 mA (generator on)

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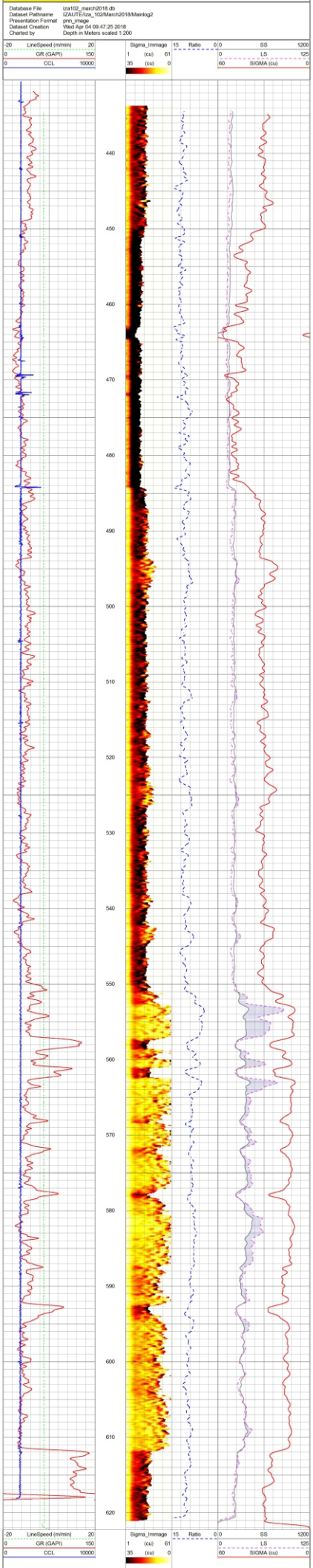
AUSTRIA TECHNOLOGY WIZARDS



PULSE NEUTRON NEUTRON TOOL 1400.0000 measures Sigma, the ability of material to capture thermal Neutrons, in capture units (c.u.).

PNN counts directly the thermal neutrons reaching the detectors after their interaction with the surrounding formation; then, the usual inference by common Thermal decay tools that count Gamma Rays where High-counts means high-Sigma-Values changes by the PNN tool into High-counts means Low-Sigma-Values, and it has the significance of obtaining statistical uncertainties reduction for low Sigma values. This sole measuring approach allows better differentiation in environments of low Sigma values, which is the case when fresh water, oil and/or gas are present in the pore spaces, overcoming by this way, the low salinity formation water problem which appears as a limitation factor of standard Thermal Decay Time tools; additionally, Neutron readings are less affected by Neutron activation, hence, logging of Time-driven Stop-Checks in area of interest helps reduce the statistical uncertainties of readings at any desired depth spot. All of this makes pnnPlus tool, in conjunction with our PNN processing and analysis, a competitive behind-casing formation evaluation tool for high to moderate water salinity formations and the ultimate thermal decay tool for evaluation of lower salinity and lower porosity formations.

Application

Water saturation behind casing, porosity, remaining Hydrocarbon reserves estimation, Oil-water, gas-water and gas-oil contacts location, etc

Operation

The formation is bombarded with pulses of high-energy neutrons (14 MeV) generated by the tool. Neutrons interact
with the surrounding atoms and, during the lapse of time between high-energy neutron pulses, the thermal neutron
population that reaches the Neutron detectors is sampled by two detectors with 60 time channels each; Per Channel
Neutrons counted are used to compute the rate of decay, it is equivalent to measuring the rate at which thermal neutrons
are absorbed into the formation, the greater fluids and minerals capture thermal neutrons, the higher the value of Sigma.

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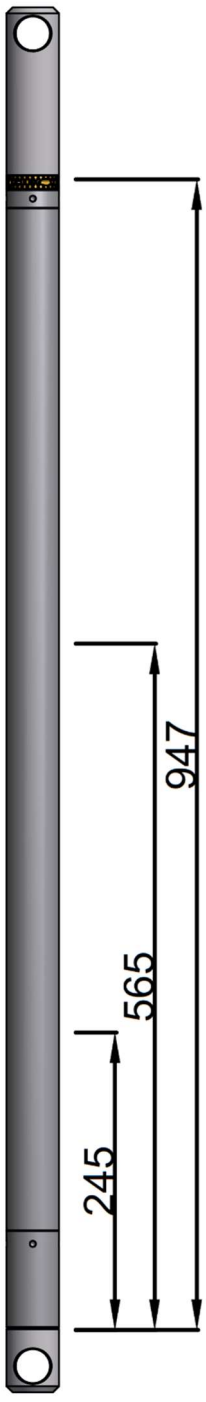
1 Specification

ABBREVIATION:	PNN-COMM
TOOL LENGTH:	2067.0 mm (81.4”)
MEASURING POINTS:	
GAMMA RAY	1.69 m (65.75”)
TEMP	0.652 m (25.7”)
CCL	0.377m (14.8”)
TOOL DIAMETER:	43mm (1-11/16”)
TOOL WEIGHT:	14kg (31lbs)
PRESSURE RATING:	103MPa (15 000psi)
TEMPERATURE RATING:	175°C (350°F)
POWER:	$150V_{DC}$/15mA single conductor cable head GO type
OUTPUT SIGNAL:	digital signal compatible to surface panel P/N 3038.1000 & Warrior
SENSORS:	• CCL • Gamma Ray • borehole temperature • electronics temperature inside flask
APPLICATION:	• communication between the surface panel and the PNNPlus sections above the Communication Section • GR correlation, temperatures and CCL measurement

1 Specification

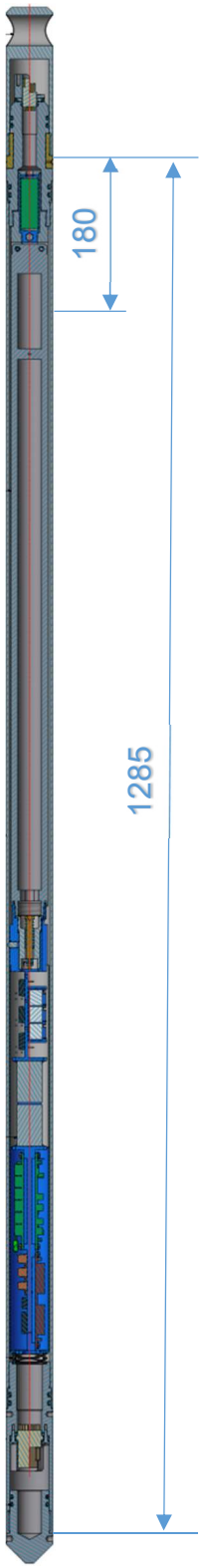
ABBREVIATION:	PNN-DN
TOOL LENGTH:	947 mm (37.3”)
MEASURING POINTS:	
SSN:	31mm (1.2”)
LSN:	191 mm (7.5”)
SIGMA:	31mm (1.2”)
RATIO:	110 mm (4.35”)
TOOL DIAMETER:	43mm (1-11/16”)
TOOL WEIGHT:	5kg (11lbs)
PRESSURE RATING:	103MPa (15 000psi)
TEMPERATURE RATING:	175°C (350°F)
POWER:	150V_{DC}/30mA
OUTPUT SIGNAL:	compatible to surface communication section P/N 1346.1000 P/N 1195.0000
DETECTOR TYPE:	He3 proportional thermal neutron detector
APPLICATION:	• behind casing fluid contact determination • behind casing porosity determination • behind casing saturation determination



1. Specification

PNN GENERATOR SECTION
P/N 1355.1000

ABBREVIATION:	PNN-GEN
TOOL LENGTH:	1285 mm (50.59”)
NETRON SOURCE:	180mm (7.1”) From the top
TOOL DIAMETER:	43mm (1-11/16”)
TOOL WEIGHT:	6.55kg (14.3lbs)
PRESSURE RATING:	103MPa (15 000psi)
TEMPERATURE RATING:	175°C (350°F)
POWER:	$150V_{DC}$/10mA, neutron generator not active $150V_{DC}$/150mA, neutron generator active
OUTPUT NEUTRON FLUX:	2×10^8 n/s
OUTPUT NEUTRON ENERGY:	14.1 MeV
NETRON PULSE DURATION:	1 to 3µs, 75ms between two pulses



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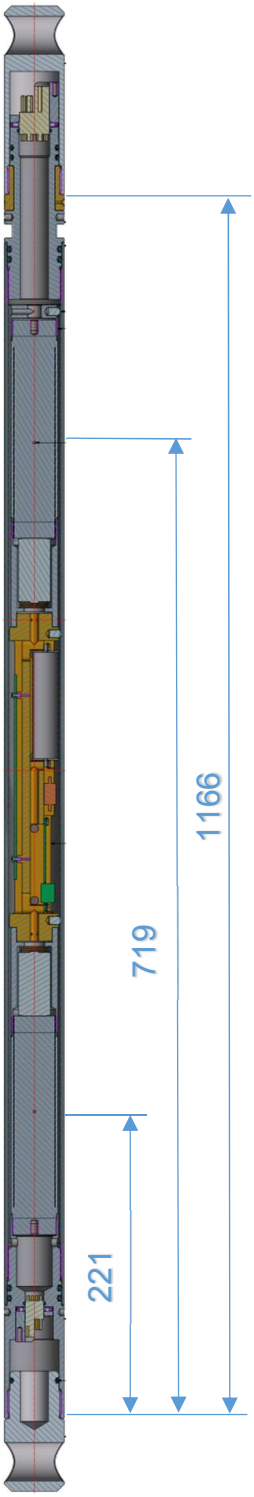
ISO 9001
Certificate No.: AJA 03/6995

1. Specification

PNN DUAL GAMMA RAY SECTION
P/N 1356.0000

ABBREVIATION:	PNN-DUAL-GR
TOOL LENGTH:	1166 mm (45,90”)
MEASURING POINT:	
GR1:	221mm (8.70”)
GR2:	719mm (28.30”)
TOOL DIAMETER:	43mm (1-11/16”)
TOOL WEIGHT:	6.55kg (14.3lbs)
PRESSURE RATING:	103MPa (15 000psi)
TEMPERATURE RATING:	175°C (350°F)
POWER:	150V_{DC}/15mA
OUTPUT SIGNAL:	compatible to surface communication section P/N 1195.0000
DETECTOR TYPE:	NaI crystal (Ø30mm X 150mm long)
APPLICATION:	Activated Gamma Ray Detection



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