HALLIBURTON LOGGING SERVICES, INC.

FINAL PRINT

SPECTRAL DENSITY DUAL SPACED NEUTRON LOG

5" = 100'

COMPANY ______________
WELL ________________
FIELD ________________
COUNTY __________ ST __

COMPANY ARCO OIL AND GAS COMPANY

WELL C.E.R. 41-16-64

FIELD MIST

COUNTY COLUMBIA

STATE OR

API NO.
LOCATION :
217.27 FEET SOUTH AND
796.34 FEET WEST FROM THE
NORTHEAST CORNER OF:
SEC. 16 TWP 6N RGE 4W

OTHER SERVICES

DIG/AVL

PERMANENT DATUM G.L. ELEV. 1616.5
LOG MEASURED FROM K.B. 11.5FT.ABOVE PERM.DATUM
DRILLING MEASURED FROM KELLY BUSHING

ELEV.:K.B. 1628.0
D.F. ------
G.L. 1616.5

DATE	09/10/89			
RUN NO.	ONE			
DEPTH-DRILLER	2107			
DEPTH- LOGGER	2104			
BTM. LOG INTER.	2090			
TOP LOG INTER.	870			
CASING-DRILLER	7 IN.@1104	@	@	@
CASING- LOGGER	1104			
BIT SIZE	6 1/4			
TYPE FLUID IN HOLE	E-Z POLYMER			
DENS. : VISC	9.5 :43	:	:	:
PH : FLUID LOSS	10.0 :6.2	:	:	:
SOURCE OF SAMPLE	CIRCULATED			
RM @ MEAS. TEMP.	5.0 @72.	@	@	@
RMF @ MEAS. TEMP.	4.8 @78.	@	@	@
RMC @ MEAS. TEMP.	3.1 @78.	@	@	@
SOURCE RMF : RMC	MEAS.:MEAS.	:	:	:
RM @ BHT	3.59 @103.	@	@	@
TIME SINCE CIRC.	7.0 HOURS			
TIME ON BOTTOM	10:30 PM			
MAX. REC. TEMP.	103. @BHT	@	@	@
EQUIP. : LOCATION	2890 :WDLND	:	:	:
RECORDED BY	D.MCDANIEL			
WITNESSED BY	R.SPAETH	J.EASTES		

Fold Here

Service Ticket No.: 12268 API Serial No.: PGM Version: 1.31 PC

Change in Mud Type or Additional Samples

Date/Sample No.	09/10/89:ONE	/ / :
Depth-Driller		
Type Fluid in Hole		
Dens. : Visc.	:	:
pH. : Fluid Loss	:	:
Source of Sample		
Rm @ Meas.Temp.	@	@
Rmf @ Meas.Temp.	@	@
Rmc @ Meas.Temp.	@	@
Source: Rmf:Rmc	:	:
Rm @ BHT	3.59 @103.	@
Rmf @ BHT	3.71 @103.	@
Rmc @ BHT	2.39 @103.	@

RESISTIVITY SCALE CHANGES

Type Log	Depth	Scale Up Hole	Scale Down Hole

RESISTIVITY EQUIPMENT DATA

Run No	Tool Type & No	Pad Type	Tool Pos.	Other
N/A	DUAL #W109432	N/A	1.5"S.O.	M412
N/A	SGRD #W108932	N/A	1.5"S.O.	M416

EQUIPMENT DATA

GAMMA		ACOUSTIC		DENSITY		NEUTRON	
Run No.	ONE	Run No.	N/A	Run No.	ONE	Run No.	ONE
Serial No.	W108594	Serial No.	W112458	Serial No.	W109742	Serial No.	W108750
Model No.	432	Model No.	305	Model No.	465	Model No.	434
Diameter	3 5/8	No.of Cent.	FOUR	Diameter	4 1/2	Diameter	3 5/8
Detector Model No.	N/A	Spacing	1 FOOT	Log Type	GAMMA	Log Type	NEUTRON
Type	SCINT.			Source Type	CS137	Source Type	AM241BE
Length	4 IN.	LSA	Y	Serial No.	118	Serial No.	66
Distance To Source	N/A	FWDA	N	Strength	1.5 CU.	Strength	19.5 CU

LOGGING DATA

GENERAL				GAMMA		ACOUSTIC			DENSITY			NEUTRON		
Run	Depth		Speed	Scale		Scale			Scale			Scale		
No.	From	To	Ft/Min	L	R	L	R	Matrix	L	R	Matrix	L	R	Matrix
ONE	2090	870	30.	0.	150.				1.65	2.65	2.65	60.	0.	SAND
					GAPI						G/CC		P.U.	

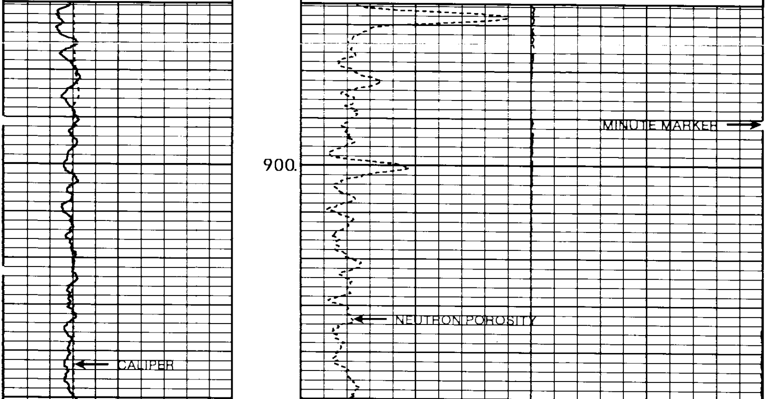
Remarks: NO DECENTRALIZER RUN ON DSN DUE TO SMALL HOLE SIZE.
DENSITY TOOL FAILURE AT 1300 FEET. CONTINUED LOGGING WITH DSN ONLY.

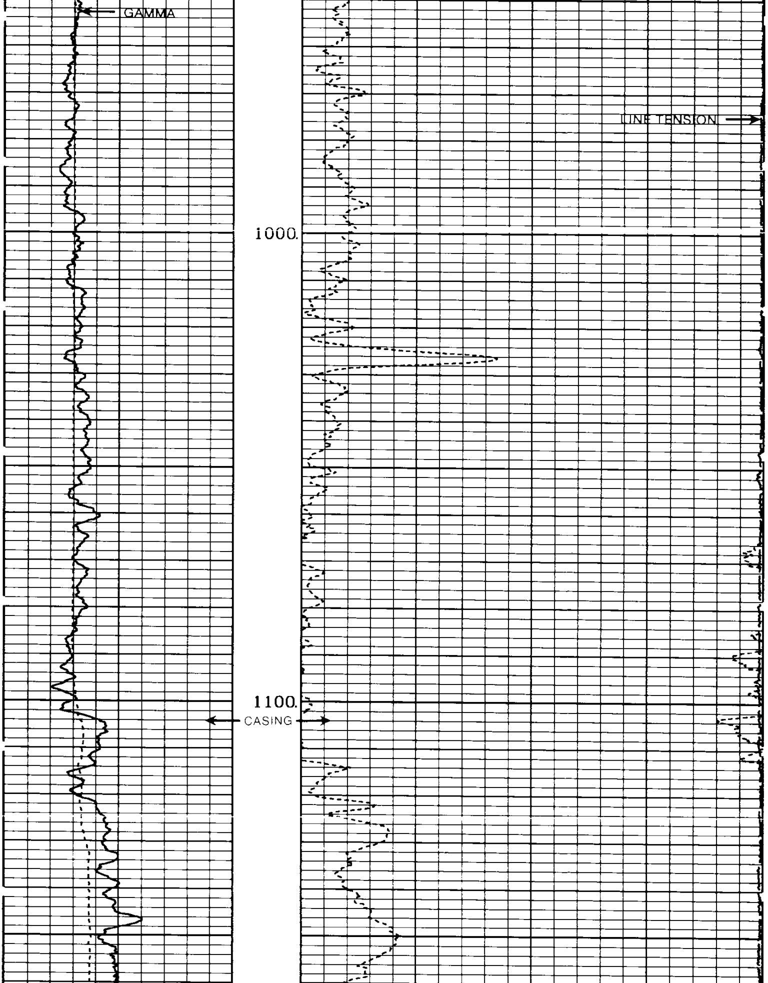
THANK YOU FOR USING HALLIBURTON LOGGING SERVICES!!

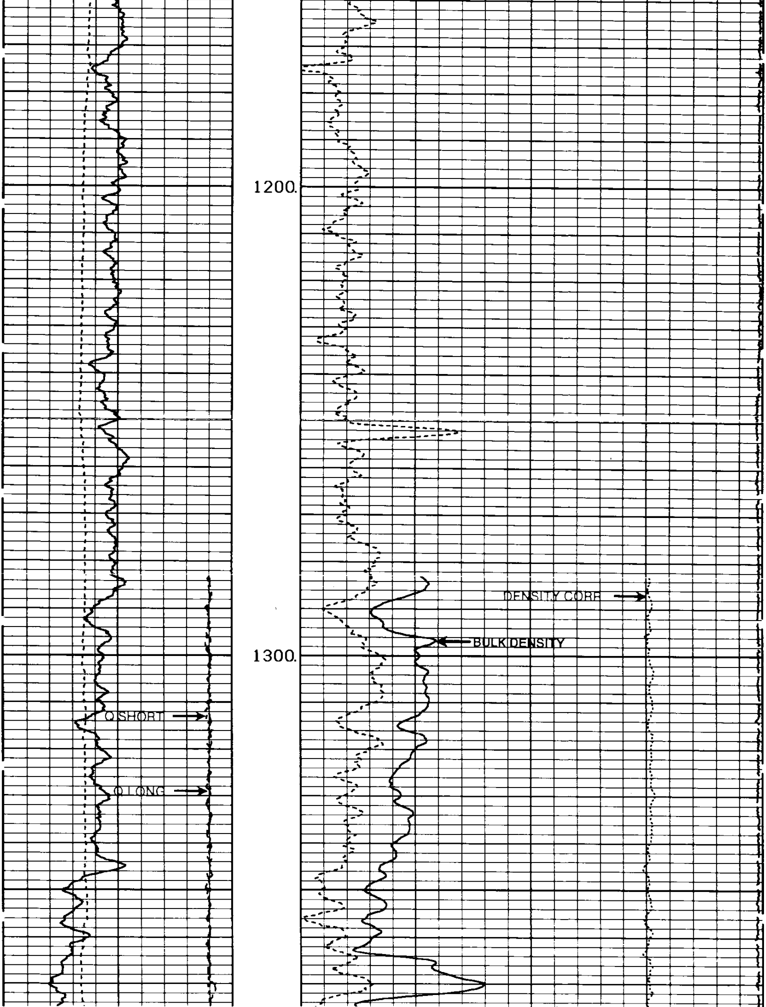
Halliburton Logging Services, Inc. does not guarantee the accuracy of any interpretation of log data, conversion of log data to physical rock parameters or recommendations which may be given by HLS personnel or which may appear on the log or in any other form. Any user of such data, interpretations, conversions or recommendations agrees that HLS is not responsible except where due to gross negligence or wilful misconduct, for any loss, damages, or expenses resulting from the use thereof.

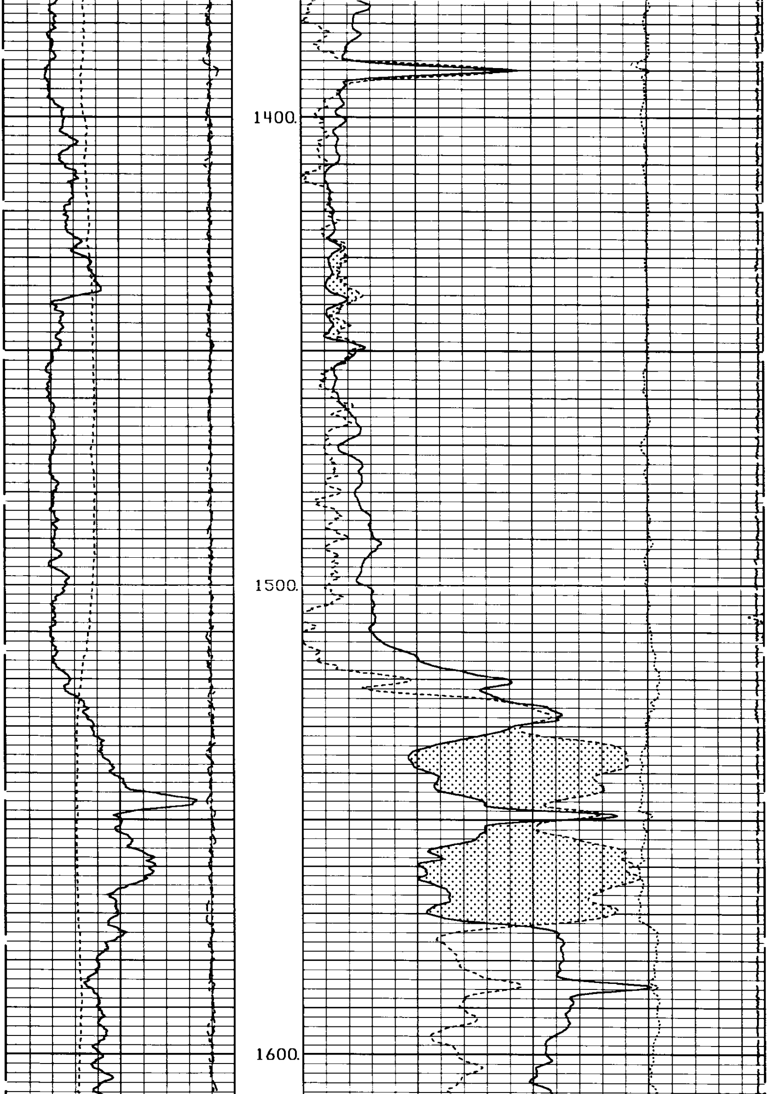
	Q SHORT	
-4.5		.5
	Q LONG	
4.5		-.5
	GAMMA	
0	API	150
	CALIPER	
4	INCHES	14

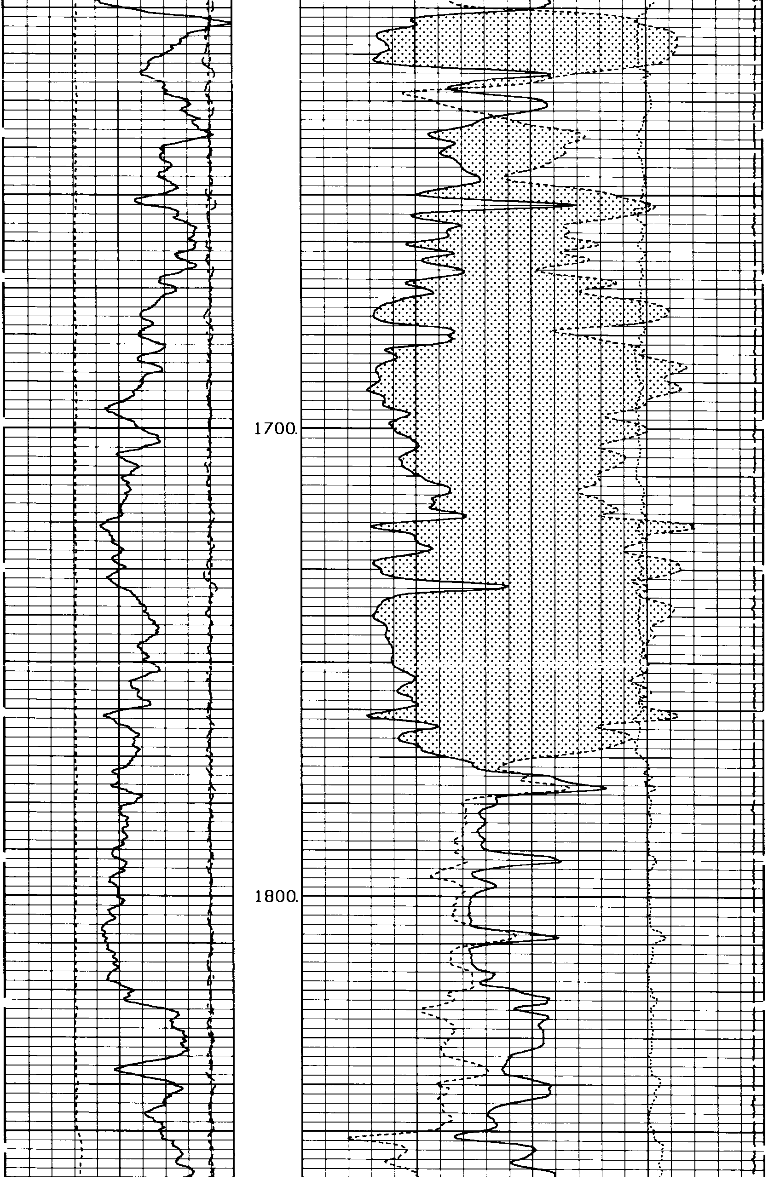
	TENSION	
6000	POUNDS	1000
	DEN CORR	
-.25	GM/CC	.25
	DENSITY	
1.65	GM/CC	2.65
	NEU POROS	
60	SS PU	0

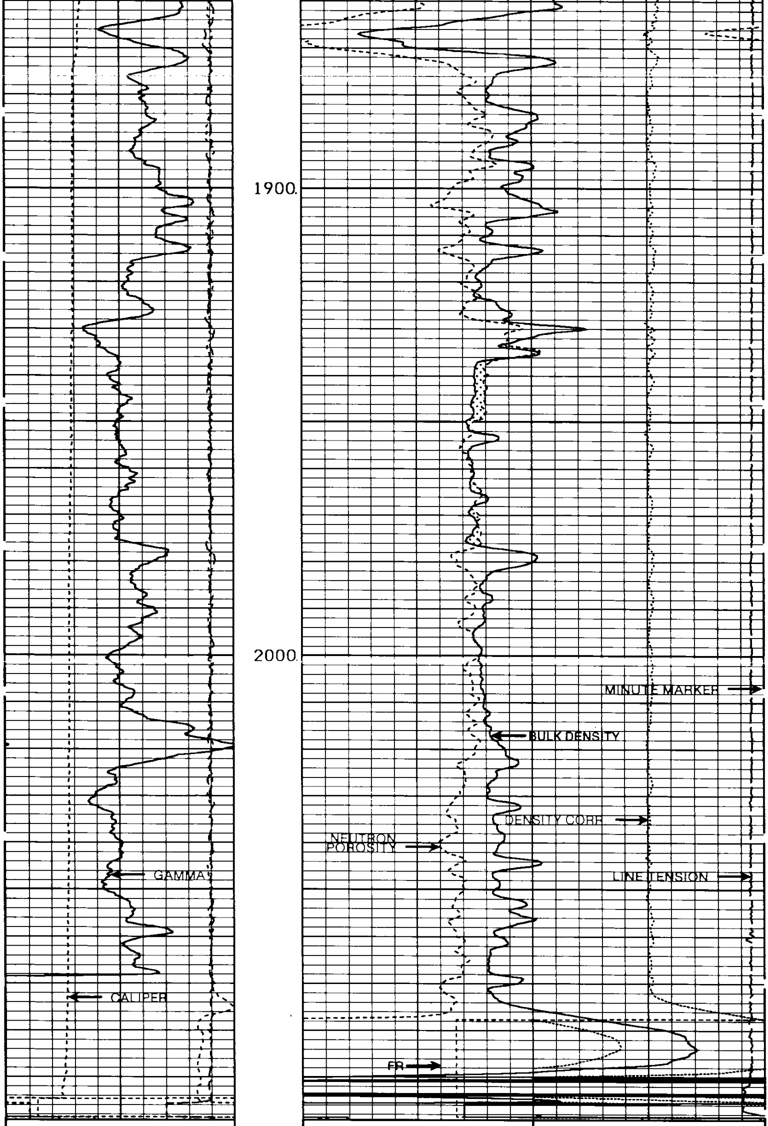


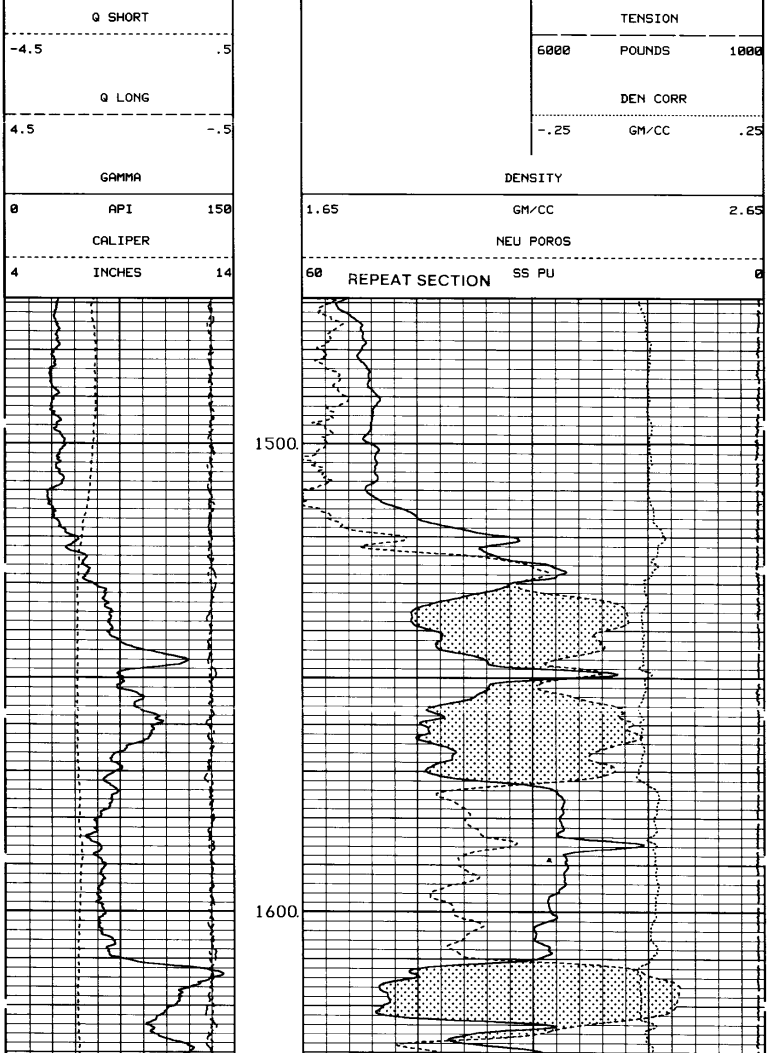


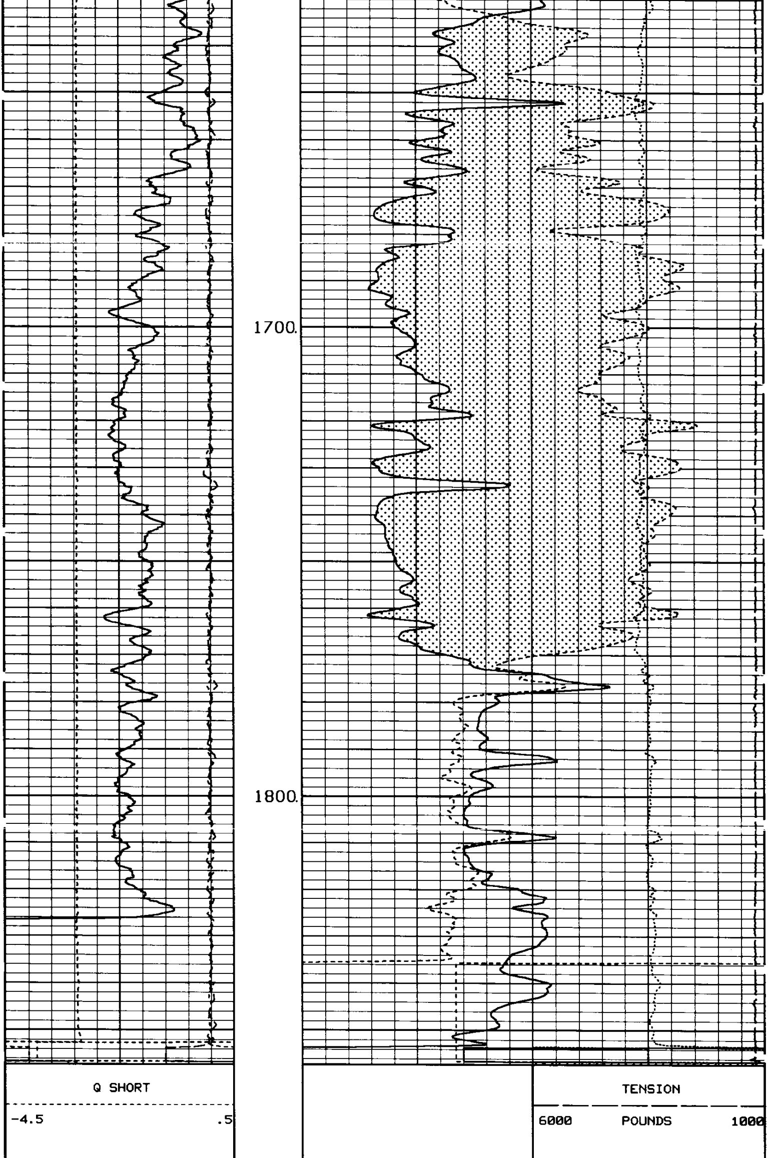












```
          Q LONG                                                     DEN CORR
 ----------------------------                              -------------------------------
 4.5                      -.5                             -.25        GM/CC            .25

          GAMMA                                          DENSITY

 0         API            150        1.65                 GM/CC                        2.65

         CALIPER                                         NEU POROS
 ----------------------------        ---------------------------------------------------
 4        INCHES           14        60                   SS PU                           0
```

```
********************************************************************************

                    GAMMA   SHOP CALIBRATION SUMMARY
PERFORMED:  10:05:26  09/01/89    LAST SHOP CALIBRATION:   14:24:17  08/08/89
SERIAL NUMBER: 108594             PROGRAM VERSION: 1.31 PC
MODEL: #432          FIELD CALIBRATOR: #2141
PERFORMED BY: MCDANIEL

                        MEASURED        CALIBRATED          UNITS
                        --------        ----------          -----
BACKGROUND                 13               13             API-CPS
BACKGROUND+CALIBRATOR     269              271             API-CPS
CALIBRATOR                256              258             API-CPS

                    GAMMA  BEFORE SURVEY FIELD CHECK SUMMARY
PERFORMED:  20:25:14  09/10/89    LAST SHOP CALIBRATION:   10:05:26  09/01/89
FIELD CALIBRATOR: #2141

                          SHOP             FIELD            UNITS
                        --------        ----------          -----
BACKGROUND                 13               22             API-CPS
BACKGROUND+CALIBRATOR     271              286             API-CPS
CALIBRATOR                258              265             API-CPS

                    GAMMA  AFTER SURVEY FIELD CHECK SUMMARY
PERFORMED:  00:19:52  09/11/89    LAST SHOP CALIBRATION:   10:05:26  09/01/89

                         BEFORE            AFTER            UNITS
                        --------        ----------          -----
BACKGROUND                 22               21             API-CPS
BACKGROUND+CALIBRATOR     286              293             API-CPS
CALIBRATOR                265              272             API-CPS

********************************************************************************

               DUAL SPACE NEUTRON  SHOP CALIBRATION SUMMARY
PERFORMED:  10:33:14  09/01/89    LAST SHOP CALIBRATION:   14:42:54  08/08/89
SERIAL NUMBER: 108750             PROGRAM VERSION: 1.31 PC
MODEL: #434         FIELD CALIBRATOR: #4916         SOURCE: #66
PERFORMED BY: MCDANIEL

                                 PRIMARY CALIBRATOR

                        MEASURED        CALIBRATED          UNITS
                        --------        ----------          -----
RATIO                     6.500            6.371
POROSITY                 24.563           23.962              %
```

```
                                    FIELD CHECK BLOCK

                          MEASURED         DEFINED          UNITS
                          --------        ----------        -----
CHECK RATIO                  7.132           6.990
CHECK POROSITY              27.512          26.847             %

               DUAL SPACE NEUTRON BEFORE SURVEY FIELD CHECK SUMMARY
PERFORMED:  20:34:29  09/10/89    LAST SHOP CALIBRATION:   10:33:14  09/01/89
FIELD CALIBRATOR: #4916         SOURCE: #66

                            SHOP            FIELD           UNITS
                          --------        ---------        ------
CHECK RATIO                  6.990           6.994
CHECK POROSITY              26.847          26.863             %


               DUAL SPACE NEUTRON AFTER SURVEY FIELD CHECK SUMMARY
PERFORMED:  00:27:13  09/11/89    LAST SHOP CALIBRATION:   10:33:14  09/01/89

                           BEFORE           AFTER           UNITS
                          --------        ---------         -----
CHECK RATIO                  6.994           6.946
CHECK POROSITY              26.863          26.639             %


*****************************************************************************

                  SDL CALIPER   SHOP CALIBRATION SUMMARY
PERFORMED:  11:29:27  09/01/89    LAST SHOP CALIBRATION:   15:32:40  08/08/89
SERIAL NUMBER: 64                 PROGRAM VERSION: 1.31 PC
MODEL: #465
PERFORMED BY: JOHNSON

                          MEASURED        CALIBRATED          UNITS
                          --------        ----------          -----
VALUE 1                      7.782           8.000            INCHES
VALUE 2                     15.985          16.000            INCHES

                  SDL CALIPER  BEFORE SURVEY FIELD CHECK SUMMARY
PERFORMED:  20:28:05  09/10/89    LAST SHOP CALIBRATION:   11:29:27  09/01/89

                            SHOP            FIELD             UNITS
                          --------        ---------           -----
VALUE 1                      8.000           8.158            INCHES

                  SDL CALIPER  AFTER SURVEY FIELD CHECK SUMMARY
PERFORMED:  00:21:47  09/11/89    LAST SHOP CALIBRATION:   11:29:27  09/01/89

                           BEFORE           AFTER             UNITS
                          --------        ---------           -----
VALUE 1                      8.158           8.031            INCHES


*****************************************************************************

                SPECTRAL DENSITY  SHOP CALIBRATION SUMMARY
PERFORMED:  11:22:36  09/01/89    LAST SHOP CALIBRATION:   15:24:00  08/08/89
SERIAL NUMBER: 109742             PROGRAM VERSION: 1.31 PC
MODEL: #465       FIELD CALIBRATOR: #AL          SOURCE: #118
PERFORMED BY: MCDANIEL



                                      PRIMARY CALIBRATOR
                          MEASURED        CALIBRATED          UNITS
                          --------        ----------          -----
ALUMINUM BLOCK
--------------
ALUMINUM DENSITY             2.593           2.595            gm/cc
ALUMINUM CORRECTION           .037            .039            gm/cc
ALUMINUM Pe SHORT            3.217           3.209
AUMMINUM Pe LONG             3.203           3.179
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ALUMINUM BLOCK W/SLEEVE
-----------------------
ALUMINUM DENSITY            2.586             2.588            gm/cc
ALUMINUM CORRECTION         -.060             -.059            gm/cc
ALUMINUM Pe SHORT           5.995             6.000
AUMMINUM Pe LONG            6.202             6.169

MAGNESIUM BLOCK
---------------
MAGNESIUM DENSITY           1.673             1.672            gm/cc
MAGNESIUM CORRECTION         .010              .010            gm/cc
MAGNESIUM Pe SHORT          3.195             3.188
MAGNESIUM Pe LONG           2.849             2.827


                                     FIELD CHECK BLOCK
                         MEASURED        DEFINED               UNITS
                         --------       ----------             -----
ALUMINUM SLIDE
--------------
ALUMINUM DENSITY            1.665             1.664            gm/cc
ALUMINUM CORRECTION         -.041             -.042            gm/cc
ALUMINUM Pe SHORT           4.470             4.468
ALUMINUM Pe LONG            4.191             4.165

ALUMINUM SLIDE IN
-----------------
ALUMINUM DENSITY            2.174             2.177            gm/cc
ALUMINUM CORRECTION          .015              .017            gm/cc
ALUMINUM Pe SHORT           4.719             4.718
ALUMINUM Pe LONG            3.878             3.853

BRASS SLIDE
-----------
BRASS DENSITY               2.368             2.370            gm/cc
BRASS CORRECTION            -.366             -.367            gm/cc
BRASS Pe SHORT              5.964             5.969
BRASS Pe LONG               3.654             3.629


                   SPECTRAL DENSITY BEFORE SURVEY FIELD CHECK SUMMARY
PERFORMED:  20:38:31  09/10/89    LAST SHOP CALIBRATION:   11:22:36  09/01/89
FIELD CALIBRATOR: #AL             SOURCE: #118


ALUMINUM SLIDE IN          SHOP              FIELD             UNITS
-----------------        --------          ---------           -----
ALUMINUM DENSITY            2.177             2.178            gm/cc
ALUMINUM CORRECTION          .017              .016            gm/cc
ALUMINUM PE SHORT           4.718             4.692
ALUMINUM PE LONG            3.853             4.073

                   SPECTRAL DENSITY AFTER SURVEY FIELD CHECK SUMMARY
PERFORMED:  00:30:53  09/11/89    LAST SHOP CALIBRATION:   11:22:36  09/01/89


ALUMINUM SLIDE IN          BEFORE            AFTER             UNITS
-----------------        --------          -------             -----
ALUMINUM DENSITY            2.178             2.178            gm/cc
ALUMINUM CORRECTION          .016              .016            gm/cc
ALUMINUM PE SHORT           4.692             4.759
ALUMINUM PE LONG            4.073             4.138


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                          TENSION   SHOP CALIBRATION SUMMARY
PERFORMED:  17:08:21  09/10/89    LAST SHOP CALIBRATION:   23:16:08  09/06/89
SERIAL NUMBER: TOP                PROGRAM VERSION: 1.31 PC
```

HLS CALIBRATION SUMMARY TABLE

SERVICE or SIGNAL	SHOP	BEFORE	AFTER	CHANGE	TOLERANCE
GAMMA	258	265	272	-7	+/- 9.0
DSN POROSITY	26.847	26.863	26.639	.224	+/-.90
CALIPER VALUE 1	8.000	8.158	8.031	.127	+/- 0.50
BULK DENSITY	2.177	2.178	2.178	-.000	+/-.015
DENSITY CORRECTION	.017	.016	.016	.000	+/-.015
DENSITY PE SHORT	4.718	4.692	4.759	-.066	+/-.30
DENSITY PE LONG	3.853	4.073	4.138	-.065	+/-.30

EVENTS

```
 1 21:16: 9 00000 >DATE OF LOG: MMDD              910
 2 21:18:59 01000 >PLS SOFTWARE REVISION         1.31
 3 21:18:59 01000 >CURRENT REVISION UPDATE NUMBER PC
 4 21:24:28 01059 >IS THIS A CASED HOLE? (Y/N)   N
 5 21:24:28 01060 >CASING SIZE O.D. (INCHES)      5.500+0
 6 21:24:28 01061 >CASING WEIGHT? (POUNDS/FT)     1.700+1
 7 21:24:29 01064 >CASING SIZE O.D. (INCHES)      5.500+0
 8 21:24:31 01065 >BIT SIZE? (INCHES)             7.875+0
 9 21:24:32 01068 >MATRIX DENSITY? (1.5<RHOM<4.5) 2.710+0
10 21:24:32 01069 >FLUID DENSITY (.10<RHOF<1.2)   1.000+0
11 21:24:32 01070 >MUD DENSITY (#/GAL)            9.500+0
12 21:24:33 01071 >ANY BARITE IN THE MUD? (Y/N)  Y
13 21:24:33 01072 >UN-FILTERED PE DATA? (Y/N)    N
14 21:24:34 01075 >DSN BAD HOLE CORRECTION? (Y/N) Y
15 21:24:34 01075 >DSN STANDOFF? (INCHES)         0.000+0
16 21:24:34 01076 >LITHOLOGY:L=1,S=2,D=3,LS=4,LD=5     1
17 21:24:35 01078 >FOR "F": DSN=1, DEN=2, CROSS=3     2
18 21:24:35 01079 >FOR "F" USE: (.5<A<2.5)        1.000+0
19 21:24:36 01080 >FOR "F" USE: (1.2<M<2.5)       2.000+0
20 21:24:57 01142 >BIT SIZE? (INCHES)             6.250+0
21 21:25: 8 01176 >MATRIX DENSITY? (1.5<RHOM<4.5) 2.650+0
22 21:25:39 01267 >LITHOLOGY:L=1,S=2,D=3,LS=4,LD=5     2
23 21:25:48 01293 >FOR "F" USE: (.5<A<2.5)        8.100-1
24 21:26: 4 01341 >>LOG PARAMETERS UPDATED HERE
25 21:33:15 02521 > SDL OPEN MANDREL.
26 21:40:39 01789 >LOGGING SECTION NO.                 2
27 21:43:25 01706 >"HALTING" END OF SECTION
28 21:43:25 01706 >"HALTING" END OF SECTION
29 21:44: 2 01687 > SDL CLOSE MANDREL.
30 21:46:16 01648 > SDL OPEN MANDREL.
31 21:47:51 01846 >LOGGING SECTION NO.                 3
32 21:56: 8 01594 >"HALTING" END OF SECTION
33 21:56:49 01573 > SDL CLOSE MANDREL.
34 21:59:58 01530 > SDL OPEN MANDREL.
35 22: 1:29 01865 >LOGGING SECTION NO.                 4
36 22:14: 5 01476 >"HALTING" END OF SECTION
37 22:14:42 01457 > SDL CLOSE MANDREL.
38 22:19:57 01416 > SDL OPEN MANDREL.
39 22:21:12 02107 >LOGGING SECTION NO.                 5
40 22:49:55 01217 >"HALTING" END OF SECTION
41 22:49:57 01217 >"HALTING" END OF SECTION
42 22:50:37 01195 > SDL CLOSE MANDREL.
43 22:54:40 01146 > SDL OPEN MANDREL.
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44 22:56:22 01496 >LOGGING SECTION NO.                 6
45 22:59:15 01408 >"HALTING" END OF SECTION
46 22:59:15 01408 >"HALTING" END OF SECTION
47 22:59:54 01388 > SDL CLOSE MANDREL.
48 23: 8: 5 01193 > SDL OPEN MANDREL.
49 23: 9:39 01480 >LOGGING SECTION NO.                 7
50 23:32: 9 00782 >"HALTING" END OF SECTION
51 23:32:24 00774 > SDL CLOSE MANDREL.
52 23:48:50 01480 >SELECTED CURVE: " RHOB   "          7
53 23:48:57 01480 >TRIGGER CURVE OFF (Y/N) ?      Y
54 23:49: 5 01480 >SELECTED CURVE: " DRHO   "          8
55 23:49: 8 01480 >TRIGGER CURVE OFF (Y/N) ?      Y
56 23:49:30 01480 >SELECTED CURVE: " QL     "         14
57 23:49:32 01480 >TRIGGER CURVE OFF (Y/N) ?      Y
58 23:49:36 01480 >SELECTED CURVE: " QS     "         15
59 23:49:44 01480 >TRIGGER CURVE OFF (Y/N) ?      Y
60 23:50:26 01480 >ENTER DEPTH TO TURN CURVES OFF      0
61  0: 0: 3 00008 >DATE OF LOG: MMDD               911
```