

Abstract

Instructions are given for running the Tasmania Department of Mines SIE single conductor well logger.

INTRODUCTION

The Tasmania Department of Mines SIE well logging system has a motor winch with approximately 600 m of single conductor cable. Two channel chart recording is standard, with digital recording on cassette tape an option. The basic logging suite is natural gamma plus single point SP/resistivity, and the three slots for interchangeable modules are filled by the T3 Control module on the far left hand, the T150 Ratemeter module and T2 Electric module in the other two slots. Do not remove the T3 Control module. The other two modules may be interchanged or replaced by alternate modules. The Ratemeter module will also control the flowmeter and the gamma-gamma density tool. The temperature probe requires its own module (which must not be fitted together with any other module).

This manual is based on both field experience and the SIE manuals provided with the equipment.

OPERATOR CHECK LIST

The operator should check that he/she has the following items, as applicable.

Basic

- T107 WINCH in wooden case with plug-in cablehead and winding handle attached
- Power cable for T107 WINCH
- 12V battery (at least one, motor vehicle type)
- Manual winding handle (usually kept clipped to side of winch)
- Light rope or stout cord to stay tripod and winch
- Four steel stakes for staying tripod and/or winch
- Tripod, complete with pulley and cable wiper
- Rags in sufficient quantity and of sufficient cleanliness to keep equipment clean (including probes and cable)
- Mudpit electrode
- Single Point SP/Resistivity probe complete with end cap
- Gamma ray probe complete with end cap, in carry case
- Gamma ray probe calibrator
- Insulating tape (sufficient to cover cablehead)
- Container Lubriplate grease
- Cable speed indicator unit
- T201 recorder in wooden case complete with chart paper and spare, red and blue pens and spares, T3 control module (do not remove), T2 electric module and T150 Ratemeter module
- Power cable for T201
- Two signal leads terminated each end by 6 pin female connectors
- Dummy tool (if available)
- A copy of this manual

Optional

- T35 digital recorder in wooden case.
 - Cassette tapes
 - 1 Signal lead terminated each end by 6 pin female connectors
 - 1 Signal lead terminated each end by 5 pin female connectors
- Battery charger for overnight battery recharging
- Jumper leads
- Probes not requiring alternate control modules
 - GAMMA GAMMA DENSITY probe complete with cap socket and cap plug in carrying case
 - Two spacers for above, screwed together and complete with one cap socket and one cap plug
 - Density source padlocked in carrying container, complete with cap socket
 - Keys for density source padlock
 - Radiation film badge
 - Radiation monitor (check batteries before leaving)
 - Calibration for gamma-gamma detector
 - Bowspring assembly
 - FLOWMETER complete with end cap, in carrying case
 - Appropriate choke for above
 - Allen key or other appropriate tool for fixing choke
- Probe requiring alternate control modules
 - TEMPERATURE tool, complete with cap sockets, in carrying case
 - T22 Temperature module
 - Dummy module (if available)
 - Module removal tool

FIELD OPERATION

Set up the tripod over the borehole so that the cable will run centrally down the hole and one tripod leg is on the opposite side of the hole from the winch and in line with the borehole-winch direction. Stay the tripod against the pull of the winch. Stay the winch against the pull of the tripod if it is anticipated that this will be necessary (this may be done later after lowering the probe but the tripod must be stayed before logging commences).

It will usually be most convenient to set up the winch and recorders on their wooden carrying boxes. A comfortable winch to tripod working distance is about 3 to 5 metres. Before making any electrical connections ensure that all switches (winch, T201 recorder and modules, digital recorder if in use) are switched off. Connect the bulldog battery clips to the battery and plug the other end of the winch power lead into the power inlet. Similarly for the T201 recorder. Plug one end of a six wire signal lead into the six pin outlet on the side of the winch and plug the other end into one of the six pin connectors on the back panel of the cable speed indicator instrument. Plug a second six wire lead into the other cable speed indicator connector and the other end of this lead into "SIGNAL" on the T201 recorder if not using the digital recorder OR into "WINCH" on the digital recorder. If using the digital recorder connect it to the T210 recorder using both a six wire lead ("SIGNAL" to "SIGNAL") and a five wire lead ("TAPE" to "TAPE").

Turn the winch "SPEED" knob fully anti-clockwise (zero speed) and turn the DOWN/OFF/UP switch to "OFF". The ON/OFF switch (which should have been "OFF" when the power cable was connected) may now be switched to "ON". This switch is also an over-current circuit breaker, replacing the fuse of

the earlier model motorised winch. Turn the DOWN/OFF/UP switch to "DOWN" to feed out cable and "UP" to reel in cable. The rate at which cable is reeled in or out is controlled by the "SPEED" knob.

Ensure that the NUCLEAR/ELECTRIC switch on the side of the winch is in the appropriate position. Reel out sufficient cable to feed the cablehead through the tripod pulley. If in doubt about the condition of the hole, lower the cablehead (with greased end plug in place) down the hole before lowering any probes (or, preferably, lower the dummy tool if this is available). To attach a tool to the cable, remove the end plug from the cablehead and the end cap from the tool. Smear a small amount of "Lubriplate" grease on the threads and "O" rings. Screw the tool onto the cablehead. It may be necessary to pause for a minute or two once or twice (to allow the trapped air to escape) while doing this step. Lower the tool down the hole to the zero position. Set the depth counter to zero (and also the depth counter on the digital recorder if this is in use).

Fit the pen (or pens, as required) and chart paper in the T201 recorder. The red pen slides into the holder with the red pointer and the blue pen into the holder with the blue pointer. If the chart paper needs to be changed, the Chart Cassette is removed by depressing the latch at the bottom right of the recorder. Place your hand under the cassette and swing forward ninety degrees and pull towards you to remove cassette. The cassette is removed very easily using the correct technique. If unsuccessful do not use force - the chart recorder is not particularly robust. Place cassette on bench (or flat surface) with flat plate down and sprocket roller towards you; pull top feed roller towards you against springs and lift out of cassette; insert feed roller into new chart roll with long sprocket holes nearest flange of feed roller; insert feed roller with chart into cassette with flange in left side ensuring both ends of feed roller click into slots and are held firm by springs; pull out end of chart roll; tip cassette away from you on bench; pull approximately 40 cm of chart towards you over sprocket roller; lift out chart finger plates; align chart squarely on sprocket roller with sprockets showing through sprocket holes of chart; push back finger plate to hold chart in position. Tip cassette away from you once more; pass end of chart over plate and bar; insert chart into slotted take-up roller. (If desired take-up roller may be clipped out for threading). With chart end in slot and centralised, roll up surplus chart by rotating knurled flange wheel on take-up roller.

The Chart Cassette is refitted into recorder chassis following the reverse procedure to that already described for chart removal. On refitting the cassette into the slots you will notice that there are two identical cylindrical projections on each side of the cassette. Fit the projections nearest the chart finger plates into the slots. Make sure the catch clicks up into position, retaining cassette.

Switch on the power to the T201 recorder (if the digital recorder is in use see the relevant section for appropriate action at this stage). The switch on the bottom right hand corner of the chart cassette holder may be used for manual chart advance at the rate determined by the "CHART SPEED" switch. The chart will advance when this switch is operated, regardless of the position of the "CHART DIRECTION" switch. The "CHART SPEED" switch has an OFF position and 100, 200, 500 positions which provide depth to chart scale ratios of 1:100, 1:200, 1:500 respectively. The "CHART DIRECTION" switch is a two position switch which controls the direction of chart drive so that the chart may be advanced regardless of whether cable is being reeled out or in. (It is possible to drive the chart backwards but this is not recommended as the paper tends to jam).

REVERSE position is for travel down the borehole. Normal position is for travel up the borehole. On the T3 CONTROL module are three controls. The "CH 1 ZERO" and "CH 2 ZERO" knobs are the potentiometer type zero controls allowing pen positioning on the chart paper at the desired reference zero for the red pen and the blue pen respectively, regardless of the position of the "CH. MODE" switch. The "CH. MODE" switch provides facility for switching the output signals from the Log Modules. The signal is switched from Input 1 of Pen Amplifier to Input 2 of Pen Amplifier and vice versa.

NOTE: It is advisable to occasionally approximately check the cable speed by means of a watch and the winch mechanical depth counter (the cable speed indicator instrument has been known to read incorrectly when battery voltage is low). Also ensure that the cable speed indicator instrument is on the correct range (0-10 or 0-50 m/min).

Single Point SP/Resistivity

Set up equipment in logging position at the hole as previously described, including connection of the (electric) logging tool to the cablehead. Ascertain the estimated condition and approximate total depth of the hole from the driller or other informed person(s) before commencing logging. Verify hole depth and condition with cablehead only or (preferably) dummy tool before winding tool down hole.

- Set the NUCLEAR/ELECTRIC switch to ELECTRIC
- Tape the metal parts of the cablehead so that the brass contact is the only part exposed, if this has not already been done. The tape may be left on after logging.
- Locate the electric logging tool in the hole at zero depth and set the depth counter to zero.
- Locate the mudpit electrode in the mud pit. Connect cable from mudpit electrode to ground electrode connector on winch unit.

At many boreholese a mudpit will not exist. In such cases a mudpit should be dug with a mudpit electrode installed (not the one provided but some suitable item less valuable) at least 24 hours before logging commences. The mudpit should be kept wet from digging to the end of logging.

- Prepare both pens so that ink flows smoothly onto the chart paper as the paper drive mechanism is advanced. This may usually be achieved by driving the chart slowly forward while moving the pens gently backwards and forwards with the zero controls.
- Make sure the T150 module (if fitted) is off at all times. Turn the T2 Electric Log module function switch from OFF to LINE.
- Adjust the ZERO controls on the control module and the SP and Resistivity range switches on the T2 module to get both pens into the operating range of the chart.
- Lower the Electric Logging Tool down the hole, watching carefully for a very definite shift in the base line of the pens. This is the water or mud level indication.

As SP and resistivity are only measured in a fluid-filled hole, stop the tool after the water or mud has been contacted.

- Turn the electric log module function switch to ZERO.
- Using the control module zero controls, zero the SP pen and the Single Point Resistivity pen on the left side of the chart (with the "CH. MODE" switch at N the SP pen is Channel 1 [red pen] and

the Resistivity pen is Channel 2 [blue pen]. If the "CH. MODE" switch is on R the SP pen is Channel 2 and the Resistivity pen is Channel 1).

- Turn the electric log module function switch to check SP and Resistivity pen deflection using SP 25 and 250 mV and resistivity 25 and 250 ohm switch positions as necessary.
- Turn Electric Log Module function switch to LINE.
- Turn the SP zero control on the control module to approximately set the SP in the centre of the chart strip. This should be close to the shale base line.
- Lower the tool, carefully observing the pens movements on the chart. Adjust the range switches and SP zero control to make the best use of chart width without having peaks going off scale. It is advisable to consider adjusting the Resistivity zero for the same reasons.
- When the bottom of the hole is reached set the brake if advisable but do not forget to release it before attempting to raise the tool or you will overload the motor and (hopefully) trip the circuit breaker.
- Recheck the calibration as outlined above.
- Turn the "CHART SPEED" switch to the desired scale.
- Turn the "CHART DIRECTION" switch to the NORMAL position (it should have been at REVERSE if you were running the chart on the way down the hole).
- Mark depth measurement, identifying information and scales on the chart.
- Release the brake.
- Wind the cable up at a rate of 15-25 metres per minute. This is not critical in most instances.
- Continue to wind to the top of the hole. Mark zero depth and any other pertinent information on the chart. Do not worry if pens go off scale when tool leaves mud or water. NOTE: the cable has a maximum stretch of 100 mm per 100 metres.
- Turn "CHART SPEED" switch to OFF.
- Turn Electric Log Module function switch to OFF.
- Turn Recording unit power switch to OFF.
- Remove the Electric Logging Tool from the hole.
- Remove the Electric Logging Tool from the cablehead. Wipe the threads and "O" rings to remove dirt and water. Replace protective caps.
- Remove the mud electrode from the mudpit.

Gamma Ray

Set up equipment in logging position at the hole as previously described, including connection of the (gamma ray) logging tool to the cablehead. Ascertain the estimated condition and approximate total depth of the hole from the driller or other informed person(s) before commencing logging. Verify hole depth and condition with cablehead only or (preferably) dummy tool before winding tool down hole.

- Set the NUCLEAR/ELECTRIC switch to NUCLEAR.
- Prepare the gamma pen (either may be used) so that ink flows smoothly onto the chart paper as the paper drive mechanism is advanced.
- Turn the recording unit power switch to ON. The LED should illuminate giving indication of adequate battery power (for the recorder, but not necessarily for the motor).
- Turn the T150 Ratemeter module "T.C." switch to the desired

- position. This would normally be set on 2 for gamma logging but this may be altered if required.
- Turn the Ratemeter module "CPS" switch to the desired range.
- With the Ratemeter module function switch in ZERO position adjust the control module zero control to zero the gamma pen on the left side of the chart.
- Turn Ratemeter module function switch to LINE.
- Using the test calibrator (labelled 16K) check gamma tool calibration. The calibrator should give the same count per second reading each time providing that it is located in exactly the same position and providing the background count has not changed. The background count is that obtained above ground without the calibrator.
- Locate the gamma tool in the hole at zero depth. The zero depth point is approximately 140 mm from the bottom of the tool. The exact point will be where the calibrator induces maximum counts. Measure from the exact centre of the calibrator to the end of the bullnose.
- Set the depth counter to zero.
- Lower the tool, carefully observing the pen movements on the chart. Adjust the range switch to make the best use of chart width without having peaks going off scale.
- When the bottom of the hole is reached set the brake if advisable but do not forget to release it before attempting to raise the tool or you will overload the motor and (hopefully) trip the circuit breaker.
- Turn the "CHART SPEED" switch to the desired scale.
- Turn the "CHART DIRECTION" switch to the NORMAL position (it should have been at REVERSE if you were running the chart on the way down the hole).
- Mark depth measurement, identifying information and scales on the chart.
- Release the brake.
- Wind the cable up at a rate of 6 metres per minute. This speed is critical and must be controlled carefully in order to get a consistent and accurate log.
- Continue to wind to the top of the hole. Mark zero depth and any other pertinent information on the chart.

NOTE: The cable has a maximum stretch of 100 mm per 100 metres.

- Turn the recording unit "CHART SPEED" switch to OFF.
- Turn Ratemeter function switch to OFF.
- Turn recording unit power switch to OFF.
- Remove the gamma tool from the hole.
- Remove the gamma tool from the cablehead. Wipe the threads and "O" rings to remove dirt and water. Replace protective caps.

Gamma-Gamma density

Set up logger and tripod in operating positions as previously described. Make certain all interconnecting cables are in place. Ascertain the estimated condition and approximate total depth of the hole from the driller or other informed person(s) before commencing logging. Verify hole depth and condition with cablehead only or (preferably) dummy tool before winding tool down hole.

- Set the NUCLEAR/ELECTRIC switch to NUCLEAR.

It must be ascertained prior to density logging that the risk of losing the gamma source downhole is acceptably low. Consult with the

driller or others familiar with the hole, inspect the condition of the hole visually. Consider the type of strata penetrated and the time elapsed since drilling ceased. Lower the natural gamma tool down the hole as a further check (it being a relatively long probe) after checking with the cablehead (or preferably the dummy tool if available). Beware of bends in the hole which may snag the long gamma-gamma density probe.

- Prepare the cablehead. Smear a small amount of "Lubriplate" grease on the threads and "O" rings. Connect the gamma-gamma density logging tool to the cablehead (again, pausing once or twice to allow the air to escape).
- Prepare the gamma-gamma density pen (either channel) so that the ink flows smoothly onto the chart paper as the chart drive mechanism is advanced.
- Turn the recording unit power switch to ON. The LED should illuminate giving indication of adequate battery power (for the recorder).
- Turn Ratemeter module "T.C." switch to desired position. This would normally be set on 2 for density logging.
- Turn the ratemeter module "CPS" switch to desired range.
- With the Ratemeter module function switch in ZERO position adjust the control module zero control to zero the density pen on the left side of the chart.
- Turn the Ratemeter module function switch to LINE.
- Using the test calibrator (labelled 16K) check the density tool calibration. The calibrator should give the same count per second reading each time providing it is located in exactly the same position and providing the background count has not changed.
- Remove the protective plug from the bottom of the tool.
- Screw in the spacers as required (see unpublished report 1984/65 for calibration curves with different spacers).
 No spacer gives 200 mm spacing
 SHORT spacer gives 300 mm spacing
 LONG spacer gives 350 mm spacing
 BOTH spacers give 450 mm spacing
- Unlock source storage container
- Remove protective cap from source.
- Screw density tool onto source holder until tight. The cable will suffer twisting during this operation. It may be untwisted with minimum radiation exposure by pulling the source just far enough out of the container so that it may rotate freely. Otherwise, attach spacers to source and tool to spacers before attaching tool to cablehead; then pull source out just far enough for it to rotate and attach tool to cablehead.
- Slip the bowspring assembly over the density tool and slide it down so the sleeves are over the tool case.
- Align it so that the source window will be against the wall of the borehole. This is indicated by the mark engraved on the side of the tool (the source in fact appears to emit strongly in a radial disc pattern with the disc axis being aligned with the tool). Tighten the two screws on the top sleeve. Leave the bottom sleeve free to float to facilitate change in hole size.
 NOTE: A problem has been experienced with the bowspring when the total weight of the downhole assemblage is not sufficient to overcome the frictional resistance of the bowspring in a relatively narrow hole and the tool will not descend. This may be overcome by taping the bowspring near its middle so that the tool will descend but the source is nevertheless pressed

against the side of the hole. This is quite difficult to achieve in practice, and the success of the operation should be checked by repeating at least part of the logging run to see if the same results are obtained. There is no way to allow for hole widening to such an extent that the minimum taping required for descent is too much to allow correct reading in a widened section. Therefore it is advisable with a taped bowspring (or in any case if widening is suspected to be widespread or excessive) to repeat the whole run in order to obtain a reasonable estimate of reliability of the results.

- Remove safety lock from source storage container if not already removed.
 - Taking adequate precautionary measures (i.e. stand and move so as to receive as little radiation as possible - film badge must be worn) quickly remove tool from source storage container and set it into the hole. DO NOT STAND IN FRONT OF THE WINDOW. That is, do not stand in the radiation disc.
 - Locate the density tool in the hole at zero depth. Note the mark on the side of the tool approximately 140 mm from the bottom. This is the zero point.
 - Set the depth counter to zero.
 - Lower the tool, carefully observing the pen movements on the chart. Adjust the range switch to make best use of the chart width without having peaks going off scale.
 - When the bottom of the hole is reached set the brake if advisable but do not forget to release it before raising tool or you will overload the motor and (hopefully) trip the circuit breaker.
 - Turn the "CHART SPEED" switch to the desired scale.
 - Turn the "CHART DIRECTION" switch to NORMAL.
 - Mark depth measurement, identifying information and settings on the chart.
 - Release the brake if set.
 - Wind the cable up at a rate of 6 metres per minute. This speed is critical and must be controlled carefully in order to get a consistent and accurate log.
 - Continue to wind to the top of the hole.
 - Mark zero depth (and any other pertinent information) on the chart.
- NOTE: The cable has a stretch of 100 mm per 100 metres.
- Turn "CHART SPEED" switch OFF.
 - Turn Ratemeter function switch to OFF.
 - Turn recording unit power switch to OFF.
 - Remove the density tool from the hole, clean it but do not touch the source area and quickly insert it into the source storage container.
 - Remove the bowspring assembly.
 - Insert the safety pin into the source storage container.
 - Unscrew the tool from the source holder. Clean the ends and replace the protective caps.
 - Lock the source storage container.
 - Remove the tool from the cablehead. Wipe the threads and "O" rings to remove dirt and water. Replace protective caps.

Flowmeter

Flowmeter surveys are used to measure fluid flows in either cased or uncased boreholes. The flowmeter may be run into or out of the hole at a constant rate for a continuous measurement of the flow versus depth or it may be stopped at various levels within the hole to measure total flow.

The flowmeter tool is 43 mm in diameter to enable it to be used in a minimum hole diameter of 50 mm. For larger hole sizes the tool can be fitted with various rubber fluid guides to help confine the flow to the area near the impeller blades. Currently (February 1985) only one fluid guide (90 mm diameter) is available but others could be constructed if required.

- Set up logger and tripod as previously described.
- Ascertain the estimated condition and approximate total depth of the hole from the driller or other informed person(s) before commencing logging. Verify hole depth and condition with cablehead only or (preferably) dummy tool before winding tool down hole.
- Switch NUCLEAR/ELECTRIC switch to NUCLEAR.
- Smear a small amount of "Lubriplate" grease on the threads and "O" rings and connect the flowmeter to the cablehead.
- Prepare the chosen pen so that ink flows smoothly onto the chart paper as the paper drive mechanism is advanced.
- Switch on the T201 recorder.
- Turn the Ratemeter "T.C." switch to 1. This can be decreased to 0.5 if a faster pen response is desired.
- Turn the ratemeter "CPS" switch to the desired scale.
- Set the Ratemeter function switch to ZERO and adjust the control module zero control to zero the flowmeter pen on the left side of the chart.
- Turn the Ratemeter function switch to LINE.
- Locate the flowmeter tool in the hole at zero depth. The zero point is at the impeller blades. Set the winch depth counter to zero.
- Set the "CHART SPEED" switch to the desired scale. Set the "CHART DIRECTION" switch to REVERSE. Mark zero depth identifying information and scales on the chart.
- Lower the tool at a constant rate. The tool speed varies the flowmeter response directly and must be kept constant to observe the effect of the fluid flow.
- Mark the variations in fluid flow for later stationary tests.
- Continue to wind until the bottom of the hole is reached. Mark total depth and any other pertinent information on the chart.
- Wind the tool to the top of the hole, stopping at any marked variations in fluid flow to perform stationary tests.
- Turn the "CHART SPEED", Ratemeter function and power switches to OFF.
- Remove the flowmeter tool from the cablehead.
- Wipe the threads and "O" rings and replace all protective caps.

Before storage, clean the flowmeter tool as follows: Remove the two grub screws on the 43 mm cage. Unscrew the cage. Unscrew the impeller body sub. Loosen grub screw in magnet body from spindle shaft. Slide the spindle shaft through impeller shaft being careful not to lose the bearings. Wash the bearings with diesel or very light oil. Replace spindle shaft through impeller body sub. Pour diesel or light oil into the aperture around the spindle shaft. Replace the bearing. Screw on the magnet body allowing approximately 0.01 mm end play (if done up too tight the bearing will not turn freely). Tighten the grub screw on the magnet body. Screw on the impeller body sub. Screw on the 43 mm cage. Replace the two grub screws on the 43 mm cage.

Temperature Tool

Set up the logger and tripod as previously described. DO NOT TURN ON THE T201 RECORDER POWER YET.

Ascertain the estimated condition and approximate total depth of the hole from the driller or other informed person(s) before commencing logging. Do not verify hole depth and condition with cablehead or dummy tool before winding tool down hole because such action will disturb the borehole fluid and render the temperature readings unreliable. If this action is deemed necessary, return after a suitable number of days have elapsed and the borehole is again thermally stable.

- Smear a small amount of silicone grease on the threads and "O" rings and connect the temperature tool to the cablehead.
- Place the T22 Temperature module in the T201 Recorder central module slot (directly above the "CHART SPEED" switch).

MAKE CERTAIN THAT ALL OTHER LOG MODULES ARE REMOVED (THAT IS, THE RIGHT HAND MODULE SLOT IS EMPTY OR, PREFERABLY, OCCUPIED BY THE DUMMY MODULE IF AVAILABLE). IF POWER IS APPLIED WHEN ANY OTHER MODULE IS CONNECTED DAMAGE WILL OCCUR TO THE CIRCUITS.

- Switch NUCLEAR/ELECTRIC switch on side of winch to NUCLEAR.
- Turn T201 Recorder power on.
- Locate the Temperature Logging Tool in the hole at zero depth.
- Set the depth counter to zero.
- Prepare Temperature and Δ Temperature pens so that ink flows smoothly onto the chart paper as the paper drive mechanism is advanced.
- Make certain the "TEMPERATURE" switch is set to OFF. Adjust the temperature pen to zero on the left hand side of the chart paper using the zero control on the control module.
- Turn the temperature function switch to the required scale 10, 20, 50, 100 degrees C.
- If the temperature exceeds the range at any time or if you wish to have a more expanded scale than the range permits turn the calibrated offset control to bring the pen back within the span of the paper. Note the offset control graduations and mark them on the chart (1 turn = 10 degrees C).
- Adjust the Δ Temperature pen to zero at a suitable point near the centre of the chart paper using the zero control located on the control module.
- Increase the Δ Temperature sensitivity (clockwise) for maximum acceptable noise and to maintain the pen on the chart paper. It may be necessary to adjust this during the log.

NOTE: The Temperature / Δ Temperature should be logged going down the hole to minimize effects of disturbing fluid in the borehole which could significantly affect the temperature.

- Turn the "CHART SPEED" switch to desired scale.
- Turn the "CHART DIRECTION" switch to REVERSE.
- Mark depth measurement, identifying information and scales on the chart.
- Release the brake if set.
- Lower the temperature tool to the bottom of the hole. The speed is not critical but should be consistent and should not exceed 6 metres per minute. When the bottom of the hole is reached set the brake if advisable but do not forget to release it before attempting to raise the tool or you will overload the motor and (hopefully) trip the circuit breaker.
- Turn the "CHART SPEED" switch OFF, "TEMPERATURE" switch OFF, T201 Recorder switch OFF.

- Wind up the cable after releasing the brake if engaged.
- Remove the temperature logging tool from the hole.
- Remove the temperature logging tool from the cablehead. Wipe the threads and "O" rings to remove dirt and water. Replace protective caps.

T35 Digital Cassette Recorder

Connect the signal, tape, winch and power cables as previously described. After turning the power on to the T201 Recorder, insert a tape into the cassette recorder and turn its power switch to ON. The tape should rewind and the display should be filled with "8"s. All internal registers are cleared to zero.

There are ten registers numbered 0 to 9.

- Register 0 contains the current depth of the probe in metres.
- Registers 1 and 2 contain the digital values corresponding to the positions of the chart recorder pens. Full scale deflection on the charts corresponds to a register value of 100.0.

Register 3's first two digits should be left at 00 for playback to chart. The second two digits contain the file number of the current file during the record cycle and that of the record to be played back during the playback cycle. At the end of any log recording the T35 automatically increments this two digit record number in preparation for the next log. During playback the system will search for a record of this file number before replaying data in any mode.

Registers 4 to 9 may be used to store user numbers and have no effect on system operation.

The T35 indicates both operator and internal errors and failures by entering an error code into the display and turning on the arrow at the left side of the display. These codes include:

- 1 = attempted write to protected file
- 2 = tape not ready
- 3 = file not found during playback search
- 4 = depth not found during playback search
- 5 = end of tape detected
- 6 = tape data transfer error

If any of the first five errors occur during normal operation correct the cause of the error and restart the normal control function. Error six usually occurs only after serious failures in the tape data transfer function. If this happens replace the tape and turn the T35 POWER switch to the OFF position and then back on to reset the control program.

To display the contents of any of the ten internal registers type RCL function key followed by the number of the required register. The T35 immediately fetches the register contents from memory and puts it into the LCD display.

To change the contents of the currently displayed register type the new number in followed by the STO key.

Actual data recording is a totally automatic process that, after initialisation, requires no operator intervention. Depth, digitiser values

12/12

and error codes are provided as a check of system status. To make a log recording:

1. Initialise the record number and depth registers if necessary. If system power has been interrupted both will be reset to zero. Reset the depth register to zero when the tool is at zero depth.
2. If desired, enter the contents of the user registers 4 through 9 to be recorded in the header block.
3. Make sure the tape transport contains either a blank or properly recorded tape. Records following a faulty area of tape and records without proper file marks cannot be replayed. In order to protect previously recorded data, the T35 is set to only write on clean tape. Old tapes cannot be overwritten and the field recorder cannot erase tapes.
4. Press the REC key after all registers have been set to their initial values. The system first searches for blank tape and then writes the header block. When this cycle is complete the T35 is in the automatic record mode and input data is scanned and stored on tape after each 50 mm of cable motion in either direction. The operator can continuously monitor either the depth count in Register 0 or the digitiser values in Registers 1 or 2.
5. At the end of the log interval stop the winch and press the HLT key. The T35 fills the remainder of the current data block with zeros and writes it to tape followed by the end of file mark. This mark must be written to the tape for proper operation of the playback logic.

To playback to the T201 chart recorder:

- Enter the desired record number in register 3.
- Enter the depth at which playback is to begin in register 0. To playback the entire record enter a 0. Playback begins at the block of data on tape containing that depth reading.
- Make sure that the chart recorder is ready to receive data. The T201 "CHART DIRECTION" switch should be in the NORMAL position and the chart depth scale should be set to the ratio required. Logs can be played back at any depth ratio regardless of that of the original logging run.
- Press the PBK key. The control processor rewinds the tape to BOT and searches at high speed for the requested record number. Playback begins at the depth indicated and continues until the end of the record or until the HLT key is pressed.

The REWIND key

The RWD key rewinds the tape to the clear leader area at the beginning of tape. Always rewind tapes prior to removing them from the unit in order to protect the oxide coating in the active area.

[14 March 1985]