TOPCON DL101 DIGITAL LEVELING OBSERVATIONS PROCEDURES

When running a level line according to National Geodetic Survey procedures and FGCS specifications, some functions built into the digital level software are not used. For one thing elevations are not usually carried and field checks are dealt with in terms of section closures (comparison of forward and backward differences of elevations (d.e.). To make the leveling data compatible with the requirements for the NGS bluebook format, information not generated by the level instrument has to be recorded (input) with the data. Information like observer initials, survey point serial numbers, instrument and rod serial numbers, and temperatures need to be entered. The info fields of the on-board software can be used for this purpose. Unfortunately, the Topcon digital levels are not as flexible in this respect as some of the others available. The following procedures indicate when and where to enter this extra info along with other items such as setting the ground height to zero each time a section is started and recording observations.

	Operating Procedure	Operation	Display
1.	Press the enter key at the menu leveling prompt.		Menu Leveling
2.	Press the [Ent] key. The previously used Job number with be displayed as the default.	[Ent]	Menu ↕ Start L
3.	Enter the job number (8 alphanumeric characters) a letter followed by the date, A030402 and press [Ent]	Job No. Input [Ent]	Job No.? **A030402**
4.	Use the [↑] or [↓] key to scroll through the 3 different methods of Line Leveling. Press [Ent] when the **Level 3 BF** method is displayed. Since all new leveling must be double run (forward and back), it is not necessary to use the BFFB method. When line ties are made, the section is run in one direction and compared with the published d.e. so BF can still be used.	Scroll Mode List ↕ ↕ [Ent]	Level L1 ↕ B1F1F2B2 Level L2 ↕ B1B2F1F2 **Level L3** ↕ **BF**
5.	Enter the benchmark Survey Point Serial Number (SPSN) SPSNs are project dependent and four digits 0000-9999. Input is limited to 8 alphanumeric characters for this field.	[Ent]	BM No? **1000**
6.	Enter the BM starting elevation (ground height) at the GH? prompt. **Always enter 0.0 for the starting elevation**.	Ground Hgt. Input [Ent]	GH? **0.0**
7.	Enter the following at the “Info1 ?” prompt: Observer’s Code “1-99", Instrument type “101", Instrument Serial Number “HX0378" all as one character string. Example: “01101HX0378". Bluebook information. Press the [Esc] then the [Ent] key to store. **Note: If [Ent] is pressed with no entry, Info1 will be skipped. Be careful NOT to do this.**	[Esc] [Ent]	Info1 ? **01101HX0378**
8.	Enter the following at the “Info2 ?” prompt: Rod #1 Serial Number “A16107" precede serial number with the letter A, Rod #2 Serial Number “B16109" precede serial number with the letter B, Rod on the mark “R1" or “R2". Example: “A16107B16109R1" **Note: If [Ent] is pressed with no entry, Info2 and Info3 will be skipped. Be careful NOT to do this.**	[Esc] [Ent]	Info2 ? **A16107B16109R1**

9.	Enter the following at the “Info3 ?” prompt: Collimation Error in arc seconds “-2.1" (if collimation error is negative enter the negative sign), Temperature units “C” for Celsius “F” for Fahrenheit, Starting Temperature to tenths of a degree “16.3". Example: “-2.1C16.3"	[Esc] [Ent]	Info3 ? **-2.1C16.3**
10.	After completing step 9, the display will show the prompt for the first backsight reading and is ready to collect the measurements for the first setup. Note: the point number will be the SPSN for the first setup.		Back Pn 1000
11.	**Backsight** - Collimate (point and focus) to the staff (rod) on the backsight point. Press the measure key [Meas} to start measuring. With the Set Measure set to N-times and 3, the level will take 3 measurements (rod readings) as depicted in the display column: Rod 1, Rod 2, Rod 3 and then stop and display the Rod average which is then stored. With Set Item set to extended the following info can be recalled to the display using the Up/Dn arrows. Average Backsight rod reading Average Backsight Distance Number of rod readings and standard deviation. It is important here to monitor the standard deviation and assure that it is 0.10 or less to meet FGCS specifications. **If it is greater than 0.10, the backsight must be re-measured until it is 0.10 or less**. Backsight - Foresight distance (d). Since Foresight has not been read the backsight-foresight is 8.7-0 which is 8.7. Backsight + Foresight distance (Σ) is 8.7+ 0 which is 8.7. A change in the values will be more evident after the foresight is read. Instrument Height - Ground height + rod back reading	Collimate Bk [Meas] (Average) ↕ ↕ ↕ ↕ ↕	Back Pn 1000 Meas Mn >>>>>>> RodBk 1 2.80130 RodBk 2 2.80128 RodBk 3 2.80129 Rod Bk 2.80129 Rod Bk 2.80129 Dist Bk 8.692m n 3 σ 0.00mm d 8.7 Σ 8.7m Inst HT 2.80129

12.	**Gradient Temperatures** - If gradient temperatures are being recorded, the only way to store them with the data is between the backsight and foresight readings using <u>Modify Point Number</u> function.		Fore Pn 1
	At the Fore Pn prompt, press the [Esc] key. The point number will shift left. Pressing [Esc] again will delete the numbers from right to left and a new number can be entered. However, instead of pressing [Esc] again, press the [Ent] key. This will bring up an Info1? prompt. Key in the upper and lower gradient temperatures without the decimal point. Example: Upper 16.5, Lower 16.8 enter as 165168 and press the [Ent] key. The program returns to the foresight prompt.	[Esc] [Ent] [Ent]	Fore Pn 1 Info1 ? 165168 Fore Pn 1

13.	**Foresight** - Collimate (point and focus) to the staff (rod) on the foresight point. Note: The foresight point number is now 1 instead of the SPSN number.	Collimate Bk	Fore Pn 1
	Press the measure key [Meas} to start measuring. With the Set Measure set to N-times and 3, the level will take 3 measurements (rod readings) as depicted in the display column: Rod 1, Rod 2, Rod 3 and then stop and display the Rod average which is then stored.	[Meas]	Meas Mn >>>>>>> RodFr 1 2.80130 RodFr 2 2.80128 RodFr 3 2.80129 Rod Fr 2.80129
		(Average)	
	With Set Item set to Extended the following info can be recalled to the display using the Up/Dn arrows.	↕	
	Average Backsight rod reading	↕	Rod Fr 2.80129
	Average Backsight Distance	↕	Dist Fr 8.692m
	Number of rod readings and standard deviation. It is important here to monitor the standard deviation and assure that it is 0.10 or less to meet FGCS specifications. **If it is greater than 0.10, the backsight must be re-measured until it is 0.10 or less.**	↕	n 3 σ 0.0 mm
	Backsight - Foresight distance (d). Now that Foresight has been read the backsight-foresight is 8.7-8.7 = 0.0. Setup was balanced. Backsight + Foresight distance (Σ) is 8.7+ 8.7 which is 17.4. Linear distance leveled, so far.	↕	d 0.0 Σ 17.4m
	Difference in elevation from the backsight to the foresight.	↕	HD if Fr 0.17432→
	Ground elevation. Note: right arrow next to number means more digits to the right. Press the right arrow to scroll numbers. A left arrow appears if there are numbers or - sign to the left.	↕	GH Fr 0.17432→
	Foresight point number	↕	PointNo 1
	Returns to next backsight reading.		Back Pn 1
14.	Continue leveling repeating steps 10-13.		

15.	**Recall and record end of line/section info onto Backup Sheet** - After reading the last foresight on the ending BM and at the prompt for the next backsight, use the Up/Dn arrows to recall the ending data and record onto backup sheet. Total Setups - Pn number ..... = 10 Total Distance - Σ 1025.4m ..... = 1.03 km Accumulated Imbalance - d 3.2 ..... = 3.2 m Elevation Difference - GH Fr -2.174323 m = -2.174323 Also, record on the backup sheet: Ending SPSN ..... = 1001 BM designation = C 251 Bm stamping from actual BM mark..... = C 251 1991 Ending Time ..... = 09:45 Rod on the mark (1 or 2)..... = 1 Ending Temperature = ... = 17.5 Wind/Sun Code (see below) ..... = 02		Back Pn 10 Rod Fr 2.80129 Dist Fr 8.692m n 3 σ 0.0 mm d 3.2 Σ 1025.4m HDif Fr 0.17432→ GH Fr -2.17432→

16.	**End of Line Leveling (End on Benchmark) -** After reading the last foresight on the ending BM and at the prompt for the next backsight, press the [Menu] key.	[Menu]	Back Pn 1
	Use the Up/Dn arrow keys to scroll to the Menu End Mode item in the menu list and then press the [Ent] key.	↕	Menu End Mode
	Use the Up/Dn arrow keys to scroll to the End of BM item.	↕	End of CP
	At the End of BM prompt, press the [Ent] key.	[Ent]	End of BM
	Enter the ending benchmark Survey Point Serial Number (SPSN). Use the [Esc] key to edit displayed SPSN and then press the [Ent] key to store.	[Esc] [Ent]	BM No? 1001
	At the Info 1? prompt, enter the the ending temperature without decimal point, the ending rod on the mark code, the 2 digit code for the Sun and Wind and press the [Esc] then [Ent] key to store. Example: 167R102 <u>Sun/Wind Codes</u> **Wind Code** - (**0**) 0-6 mph (**1**) 6-15 mph (**2**) >15 mph **Sun Code** - (**0**) 25% Sun (**1**) 25-75% Sun (**2**) >75% Sun	[Esc] [Ent]	Info 1 ? 167R102
	At the Info 2? prompt, press the [Ent] key to skip.	[Ent]	Info 2 ?
	Recall ending information and check against info recorded on backup sheet. There are 3 items. Δh BM - difference of elevation between BM s ΣD BM - Accumulated linear distance between BM s GH BM - difference of elevation between BM s. This is the same as the Δh BM since we started with a 0.0 ground height at the start of the section. This will be the same as the GH Fr at the last setup before executing the End of Line Leveling item above. The Display should now return to the Main Menu Mode. At this point a new section can be started. The Job number and SPSN will be defaulted.		Δh BM -2.17432→ ΣD BM 1025.4m GH BM -2.17432→ Menu ↕ Start L
	End of Day or Observer/Equipment Change - When the leveling is completed for the day or if observer or equipment is changed, start with a new Job Number. If the ending job was A032602, enter B032602 or C032602. This will place a marker in the data file which will help manage the data in post-processing.		Job No.? **B030402**