

Appendix B CORPSCON Technical Documentation and Operating Instructions

B-1. General

a. Background. The National Geodetic Survey has developed three programs called NADCON (North American Datum Conversion), VERTCON (Vertical Conversion), and Geoid96. NADCON provides consistent results when converting to and from the North American Datum of 1983 (NAD 83) and the North American Vertical Datum of 1988 (NAVD 88). NADCON converts coordinates between NAD 83 and the following datums; NAD 27, Old Hawaiian Datum, Puerto Rico Datum, St. George Island (Alaska) Datum, St. Paul Island (Alaska) Datum and St. Lawrence Island (Alaska) Datum. For organizational purposes, the latter six datums are referred to as NAD 27 within the program. VERTCON converts orthometric heights between National Geodetic Vertical Datum of 1929 (NGVD 29) and NAVD 88. Geoid96 calculates the separation between the Geoid and the Geodetic Reference System of 1980 (GRS 80) ellipsoid. NADCON, VERTCON, and Geoid96 work exclusively in geographical coordinates (Latitude/Longitude).

b. CORPSCON. The US Army Topographic Engineering Center (USATEC) created a more comprehensive program called CORPSCON (Corps Convert), which is based on NADCON, VERTCON and Geoid96. In addition to transformations between NAD 83 and NAD 27 geographical coordinates, CORPSCON also converts between State Plane Coordinates Systems (SPCS), Universal Transverse Mercator (UTM) and geographical coordinates; thus eliminating several steps in the total process of converting between SPCS 27, SPCS 83, UTM 27, and UTM 83. Inputs can be in either geographic or SPCS/UTM coordinates (SPCS 27 X and Y or SPCS 83 Northing and Easting). This program can also be used to convert between state plane, geographic, and UTM coordinates on the same datum. CORPSCON will convert orthometric and ellipsoidal heights in Geographic, State Plane and UTM coordinate systems. CORPSCON allows conversions based on US Survey and International Feet. As of 1997, 19 states have specified, by statute, units of measure for grid coordinates as follows:

(1) US Survey Foot - California, Colorado, Connecticut, Idaho, Indiana, Kentucky, Maryland, Massachusetts, Mississippi, New Mexico, New York, North Carolina, Oklahoma, Pennsylvania, Tennessee, Texas, Washington and Wisconsin.

(2) International Survey Foot - Arizona, Michigan, Montana, North Dakota, Oregon, South Carolina and Utah.

c. Horizontal datums. The Federal Geodetic Control Subcommittee (FGCS) has adopted NAD 83 as the official horizontal datum for US surveying and mapping activities performed or financed by the Federal Government (Federal Register / Vol. 54, No. 113, June 14, 1989). The FGCS also stated that NADCON will be the standard conversion method for all mathematical transformations between NAD 83 and NAD 27. CORPSCON includes conversions based on High Accuracy Regional Networks (HARN).

d. Vertical datums. FGCS has affirmed that NAVD 88 shall be the official vertical reference datum for the United States (Federal Register / Vol. 58, No. 120, June 24, 1993).

e. Coverage. The current version performs NAD 27/NAD 83 and NAVD 88/GRS 80 conversions for the continental US (CONUS), including the 200 mile commercial zone, Alaska, Hawaii, Puerto Rico, and the US Virgin Islands. Current (1996) areas of coverage for HARNs are Alabama, Arizona, California, Colorado, Florida, Idaho-Montana, Kentucky, Louisiana, Maine, Maryland-Delaware, Mississippi, Nebraska, New England (Connecticut, Massachusetts, New Hampshire, Vermont),

New Mexico, Oklahoma, Puerto Rico-Virgin Islands, Tennessee, Texas, Virginia, Washington-Oregon, Wisconsin and Wyoming. The current version performs NGVD 29/NAVD 88 conversions for the continental US only.

f. Accuracy. NADCON and VERTCON transformations between datums are based on a model of over 250,000 common stations. Therefore, conversions are approximate and accuracy can vary depending on location and proximity to common stations. The accuracy of the NADCON transformations should be viewed with some caution. At the 67 percent confidence level, this method introduces approximately 0.15 meter uncertainty within the conterminous United States, 0.50 meter uncertainty within Alaska, 0.20 meter uncertainty within Hawaii and 0.05 meter uncertainty within Puerto Rico and the US Virgin Islands. In areas of sparse geodetic data coverage, NADCON may yield less accurate results, but seldom in excess of 1.0 meter. Transformations between NAD 83 and states/regions with High Accuracy Reference Networks (HARNs) introduce approximately 0.05 meter uncertainty. Transformations between old datums (NAD 27, Old Hawaiian, Puerto Rico, etc.) and HARN could combine uncertainties (i.e., NAD 27 to HARN equals $0.15\text{m} + 0.05\text{m} = 0.20\text{m}$). In near offshore regions, results will be less accurate, but seldom in excess of 5.0 meters. Farther offshore NAD 27 undefined. Therefore, the NADCON computed transformations are extrapolations and no accuracy can be stated. The VERTCON 2.0 model was computed on May 5, 1994 using 381,833 datum difference values. A key part of the computation procedure was the development of the predictable, physical components of the differences between the NAVD 88 and NGVD 29 datums. This included models of refraction effects on geodetic leveling, and gravity and elevation influences on the new NAVD 88 datum. Tests of the predictive capability of the physical model show a 2.0 cm RMS agreement at our 381,833 data points. For this reason, the VERTCON 2.0 model can be considered accurate at the 2 cm (one sigma) level. Since 381,833 data values were used to develop the corrections to the physical model, VERTCON 2.0 will display even better overall accuracy than that displayed by the uncorrected physical model. This higher accuracy will be particularly noticeable in the eastern United States.

B-2. Source of Program and Assistance

To obtain copies of the CORPSCON program, contact:

US Army Topographic Engineering Center
ATTN: CEERD-TS-G
7701 Telegraph Road
Alexandria, Virginia 22315-3864
(703) 428-6766
or
<http://www.tec.army.mil>

and follow links to software distribution.

B-3. Hardware and Software Requirements

a. Hardware. A 80486 (or higher) PC with and 20 MB of hard disk space is required. CORPSCON is compatible with most PC monitors, although color monitors (EGA and VGA) provide the most favorable and easily discernible menu display. If a printer is to be used, it must be interfaced through the parallel port (LPT1 or LPT2) in order to be recognized by the program.

b. Software. CORPSCON runs under MS-Windows 3.1, MS-Windows 95 or MS-Windows NT. The CONFIG.SYS file must have FILES set to 25.

B-4. Installation Procedures

a. Diskette installation. To install the CORPSCON program from diskette, perform the following steps:

(1) Insert Distribution Disk #1 in the a: drive of the computer.

(2) For Windows 95, select Run from the Start menu. For Windows 3.1, go to the Program Manager group box and select File and then Run. A Run window should appear.

(3) Enter 'a:setup' in the Command Line item of the Run window. This should activate the CORPSCON installation window.

(4) Follow the directions on screen to install the program.

b. CD installation. To install the CORPSCON program from CD, perform the following steps:

(1) Insert the CD in the computer.

(2) For Windows 95, select Run from the Start menu. For Windows 3.1, go to the Program Manager group box and select File and then Run. A Run window should appear.

(3) Enter 'd:\corpcon\setup' in the Command Line item of the Run window. This should activate the CORPSCON installation window. If the CD-ROM is on a drive other than the >d:= drive, replace the >d:= with the appropriate drive letter.

(4) Follow the directions on screen to install the program.

B-5. Program and Data Files

a. Program Files. Upon installation, the following files should be located in the destination directory (c:\CORPSCON if the default installation was used):

corpswin.exe	corpswin.cfg	utms.hlp
geoareas.lst	corpswin.wri	geoid96.txt
vertcon.txt	conus.las	conus.los
hawaii.las	hawaii.los	prvi.las
prvi.los	vertcone.94	vertconc.94
vertconw.94	geoid96ne.geo	geoid96nc.geo
geoid96nw.geo	geoid96se.geo	geoid96sc.geo
geoid96sw.geo	haw96.geo	prvi96.geo
alhpgn.las	alhpgn.los	azhpgn.las
azhpgn.los	cahpgn.las	cahpgn.los
cohpgn.las	cohpgn.los	emhpgn.las
emhpgn.los	ethpgn.las	ethpgn.los
flhpgn.las	flhpgn.los	kyhpgn.las
kyhpgn.los	lahpgn.las	lahpgn.los
mehpgn.las	mehpgn.los	mdhpgn.las
mdhpgn.los	mshpgn.las	mshpgn.los
nehpgn.las	nehpgn.los	nmhpgn.las
nmhpgn.los	okhpgn.las	okhpgn.los

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pvhpgn.las	pvhpgn.los	tnhpgn.las
tnhpgn.los	vahpgn.las	vahpgn.los
wihpgn.las	wihpgn.los	wmhp gn.las
wmhp gn.los	wohpgn.las	wohpgn.los

If the Alaska Data Files were installed, the following files should be copied to the destination directory (c:\CORPSCON if the default installation was used):

alaska.las	alaska.los	stlrc.las
stlrc.los	stgeorge.las	stgeorge.los
stpaul.las	stpaul.los	geo96an.geo
geo96as.geo		

b. LAS/.LOS, .94, and .GEO Files. Files with .las and .los extensions are NADCON data files. These files are used for NAD 27/NAD 83/HPGN conversions. Files with .94 extensions are VERTCON data files. These files are used for NGVD 29/NAVD 88 conversions. File with .geo extensions are Geoid96 files. These files are used for GRS 80/NAVD 88 conversions.

c. CORPSCON.CFG File. When CORPSCON is run, the CORPSCON.cfg file will be updated. This file will hold all of the configuration information for the most recent conversion. Information maintained includes input and output datums, zones, units, and output file names.

d. CORPSCON.INI File. The CORPSCON.ini file will be created in the Windows directory by the installation program. The CORPSCON.ini file contains several variables required for program execution. Each variable holds a directory name as specified below.

programfiles - directory for all program files (corpswin.exe & utms.hlp)

nadconfiles - directory for all NADCON (.las & .los) files

vertconfiles - directory for all VERTCON (.94) files

geoid9396files - directory for all Geoid96 (.geo) files

tempfiles - directory where temporary files are created

configfiles - directory where the configuration file (corpswin.cfg) is stored

The CORPSCON.ini file also contains descriptions and base filenames of HARN areas. This file may be modified to include new or updated HARN files. The format of entries in this file is:

description = basefilename

For example, the files used to cover Maryland and Delaware are mdhpgn.las and mdhpgn.los. The corresponding entry in the CORPSCON.ini file would be:

Maryland - Delaware = mdhpgn

The .las and .los file extensions should NOT be included in the filename. The CORPSCON.ini file may be modified by hand using any text editor, or entries may be added by using the Utilities/Add New HPGN File option.

e. Geoareas.lst file. The *geoareas.lst* file contains a list of all Geoid96 data files. This file must be present or CORPSCON will default to using Geoid93 data files.

B-6. Operating Instructions

a. General. Execute the CORPSCON program through the Start Menu for Windows 95 or through the CORPSCON icon for Windows 3.1. This should open the CORPSCON Main Window. The CORPSCON Window consists of four items: the Main Menu Bar, the Input Format information box, the Output Format information box, and the Send Data information box. All user interaction is performed through the use of the main menu bar. The information boxes are included for reference purposes only. The basic procedure for performing a conversion is:

- (1) Specify input data information using the Input Data Format menu item.
- (2) Specify output data information using the Output Data Format menu item.
- (3) Specify the devices/files to which the data should be sent using the Send Data menu item.
- (4) Perform the conversion using the Convert menu item.

The main menu bar consists of six menu items: Convert, Input Format, Output Format, Send Data, Utilities, and Help.

b. Convert. The convert menu item has three sub-items:

- Single Point (Manual Input)
- CORPSCON Batch File
- User Defined Input File

(1) Convert/Single Point. The single point sub-item is used to convert a single data point. When this item is selected, a window will appear prompting the user to input relevant information. For grid coordinate conversions, the user must enter the Northing and Easting or X and Y values. For geographic conversions, the user will need to enter the latitude and longitude. If vertical conversions are being performed, the user must also enter an elevation value. An optional point name may be entered. The user should enter in the appropriate information and press the OK button to perform the conversion. If data is to be sent to an output and/or printer file, other windows will appear which will allow the specification of the names of these output files. If data is to be sent to an Output Window, the results of the conversion will appear in a separate window.

(2) Convert/CORPSCON Batch File. The CORPSCON Batch File sub-item is used to convert files, which are in the standard CORPSCON Batch File Format. Files in this format may be created by using the Utilities/Build New CORPSCON Batch File menu item. The details of this file format are included below. When this sub-item is selected, a window will appear prompting the user to select the name of the input CORPSCON Batch File. The user should select an input filename and press the OK button to perform the conversion. If data is to be sent to an output and/or printer file, other windows will appear which will allow the specification of the names of these output files. If data is to be sent to an Output Window, the results of the conversion will appear in a separate window.

(3) CORPSCON Batch File Format. A CORPSCON Batch File is an ASCII text file containing three or four comma-delimited fields. For geographic coordinates the fields are:

Point Name
Latitude
Longitude
Elevation (optional)

Latitude and longitude values may be in decimal degrees, degrees-decimal minutes, or degrees-minutes-decimal seconds. Longitude values have a positive west sign convention. Degree, minute, and second values must be separated by a space within the latitude or longitude field. The point name is not required, but a ',' must appear before the latitude value in order to be accepted as a valid line. The fourth field is required only if vertical conversions are to be performed. For grid coordinates, the fields are:

Point Name
Easting or X value
Northing or Y value
Elevation (optional)

Again, the fourth field is required only if vertical conversions are to be performed. Lines beginning with a ';', ' ' or '# ' characters in CORPSCON Batch Files are interpreted as comment lines. No conversion of data will be performed for comment lines.

c. Convert/User defined input file. The User Defined Input File sub-item is used to convert files in a format which is specified by the user. These files may contain up to six fields and may be comma or space delimited. When this option is selected, a window will appear prompting the user to specify the format of the input file. At a minimum, the type of data each field will contain and the delimiter of fields (comma or space) in the data file must be specified. If the input file contains geographic coordinates, the format of these coordinates must also be specified. Geographic coordinates may be in decimal degrees, degrees-decimal minutes or degrees-minutes-decimal seconds. The user should specify the format of the input file and press the OK button to continue. The User Defined File window and examples of its use are included below. After specification of the input file format, a window will appear which will allow entry the input data file name. The user should enter the name and press the OK button to continue. If data is to be sent to an output file, another User Defined File window will appear which allows specification of the format of the output file. The output file may have a different format than that of the input file. The user should specify the format of the output file and press the OK button to continue. After specification of the output file format, a window will appear which will allow entry of the output data file name. The user should enter the name and press the OK button to perform the conversion. If data is to be sent to a printer file, another window will appear which will allow specification of the name of the printer file. If data is to be sent to an Output Window, the results of the conversion will appear in a separate window.

(1) User Defined File Dialog Box. The User Defined File dialog box consists of two blocks of information: the field specifications and other file information. The six fields that a user defined file may have are:

Point Name,
Northing/Y/Latitude,
Easting/X/Longitude,
Elevation,
Carry Field 1,
Carry Field 2.

The Carry Fields act as place-holders of extra information which may be included in the file but is not necessary for the conversion. These carry fields can be included in an output file. The field delimiter of the file must also be specified by selecting commas or spaces in the Delimiter drop-down box. If the input file contains geographic coordinate information, the coordinate format must also be specified in the Degree Format drop down box. Valid formats are decimal degrees, degrees-decimal minutes or degrees-minutes-decimal seconds. Geographic coordinates that are in degrees-decimal minutes or degrees-minutes-decimal seconds must have a space between the degree-minute and minute-second values in the input file. If the user-defined file is to be an output file, header information may be included in the output. Header information will contain data on the output datums, data/time, and company/project names. These lines will have a ';' as their leading character which indicates a comment.

d. Input/Output Format Menu Items. Input/Output Format menu items allow the user to select Geographic, UTM, or State Plane coordinates on NAD 27, NAD 83, or HPGN.

(1) Geographic Coordinates. Geographic coordinates are selected, a window will appear which allows the user to specify the vertical datum (NGVD 29, NAVD 88 or GRS 80) and units.

(2) UTM Coordinates. UTM coordinates are selected a window will appear which prompts the user to input the UTM zone, horizontal units, vertical datum (if any) and vertical units.

(3) SPCS Coordinates. State Plane coordinates are selected, a window will appear which prompts the user to input the State Plane zone, horizontal units, vertical datum (if any) and vertical units.

(4) HPGN Coordinates. HPGN conversion is selected a second dialog box will appear prompting the user to selected the desired area for the HPGN conversion.

A check will appear next to the currently selected format.

e. Send Data. The send data menu items allow the user to specify where the output data should be sent. Data may be sent to an Output Window, Output File, Printer File or to the Printer. Data may be sent to more than one device or file. A check will appear next to the sub-item that is to receive output data.

f. Utilities. The Utilities menu item has the following sub-items:

- Build CORPSCON Batch File
- Append Existing CORPSCON Batch File
- View NADCON/VERTCON/Geoid96 File Status
- Degree Conversion and Preferences.

(1) Build CORPSCON Batch File. This sub-item allows the user to create input files in the CORPSCON Batch File Format. The user may build geographic or grid files which may or may not contain elevation values.

(2) Append Existing Batch File. This sub-item allows the user to add points to an existing CORPSCON Batch File.

(3) View NADCON/VERTCON/Geoid93/96 File Status. CORPSCON requires that several data files be located and opened successfully in order to perform NAD 27/NAD 83 and NGVD 29/NAVD 88/GRS 80 conversions. This sub-item allows the user to determine which data files have been opened successfully.

(4) Degree Conversion. This tool allows the user to input a degree value in decimal degrees, degrees-decimal minutes, or degrees-minutes-decimal seconds. The value is then displayed in an output window in decimal degrees, degrees-decimal minutes, and degrees-minutes-decimal seconds.

(5) Add New HPGN File. This tool allows the user to add new or updated HPGN files to the program. The user should enter the area description and the base filename. The base filename should NOT include .las or .los extensions.

(6) Preferences. The Preferences dialog box allows specification of a Company and Project name. It also allows specification of the NADCON, VERTCON, and Geoid96 files directories. Grid coordinate entry and display may also be set here. A Northing-Easting or X-Y display may be selected.

g. Help. The Help menu item has the following sub-items:

(1) UTM Zones. This sub-item will display information about UTM zones. A diagram displaying approximate UTM zones for the continental US is included.

(2) About. The About sub-item will display information about the program including version number.

B-7. Error Messages

a. General. CORPSCON is designed to prompt the user for most cases in which a system or runtime error occurs. These errors are as follows:

(1) No Math Co-Processor. A Math co-processor (hardware item) must be installed in the computer to run the program.

(2) No Input File. A file with the name specified was not found; enter the correct file name or create the file before running CORPSCON. Check to be certain that the file and program CORPSCON are in same directory and sub-directory.

(3) Printer Error. The program is unable to send the output to the printer. Check the following:

printer connection
printer turned on
printer interfaced through the parallel port
paper in printer
printer in "on-line" or "ready-to-print" status