argon ™

weather data system

REFERENCE MANUAL

October 2006 / Revised January 2014

argon ™

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disclaimer
Argon is provided without warranty except to replace the hardware and original dataset in the event of a hardware failure. Though we take great care to ensure the integrity of the Argon dataset, defects or errors may exist due to its scale, volume, and complexity. Therefore Argon is sold strictly as-is and the customer assumes all risk and liability arising from the use of Argon. We advise that all results be quality-checked, preferably using a staff meteorologist or a Certified Consulting Meteorologist listed by the American Meteorological Society.

documentation
The information contained in this document is subject to change without notice. If you find any problems in the documentation, please report them to us. This document is not warranted to be error-free.

Special note

Argon is an exceptionally large database, measuring about 165 GB in size. A single table contains over half a billion records. *In the original factory configuration, queries may take many minutes to complete (30 minutes is not uncommon for the large version of the surface table on a budget PC).*

When using the external hard drive, we recommend your computer have the new USB3 standard, which was introduced on computers starting in 2009. This will yield transfer rates of up to 75 MB/s instead of the 12 MB/s that is common with USB 2.0. You can tell if you have USB3 in Windows by checking Control Panel > System > Hardware > Universal Serial Bus Controllers and seeing if USB 3.0 appears in the list. If not, you can purchase a USB3 card from online stores like Amazon and Newegg.com for about $20. If you don't have USB3, the drive is fully backward compatible to USB2.

Even though Argon is slow in its factory configuration, what it offers is *power* and *flexibility*. Using the power of MySQL, you can optimize and shape Argon and its data as you see fit.

Please see the Performance section for more information.

Hardware issues?

If you find that this hard drive is not compatible with your system, cannot be mounted, or you require an externally-powered drive, we will be glad to replace it or make the necessary changes. The hard drive format is NTFS, but if necessary we can also convert the drive to a different file system if you don't have the tools to do so.

Contact us for the best address to mail your drive to.

installing Argon™

Argon, developed by Weather Graphics, is a massive weather and climate hyperdatabase; one of the largest in existence. It contains all available North American weather observations and is provided on an external hard drive. Using the power of mySQL, users can run statistical analyses, find extremes, averages, and frequencies, and export queries in METAR and spreadsheet form.

All data has been blended and unified. Each observation contains latitude/longitude pairs with all known identifiers for WMO, ICAO, FAA, or WBAN, regardless of whether the station actually used the identifier in their report. This is designed to save the user from having to consult station history tables.

Users may access, query, and analyze the information in an unlimited number of ways. One popular example is exporting a subset to a comma-delimited file and then import that into a spreadsheet. Developers may create add-on programs to tap the data. There are unlimited ways to exploit the Argon dataset.

Plugging in Argon

Plug in and turn on Argon. Wait for the drive to connect and be visible. In File Explorer you should see the directories argon, mysql, etc. **Make note of the drive letter**. This is your **Argon Drive Letter**. If you don't see the drive, then you either have a USB connection problem, your operating system does not recognize Windows NTFS drives, or there is a hardware failure.

The first thing you should do to check the settings for the drive. This is not necessary but will speed up database queries. First, make sure the recycle bin is turned off for the Argon drive. On your desktop, right-click on Recycle Bin and look for the drive called "ARGON". Select it and make sure "Don't Move Files To The Recycle Bin" is selected. Then OK. Then in your file explorer, right click on the Argon drive, choose Properties, and under the General tab make sure that "Allow files on this drive to have contents indexed" is unchecked. It will ask you to confirm the changes; when you do this choose to apply the changes to "Drive <x>, subfolders, and files".

Now, do you have MySQL? Bring up a MS-DOS prompt (found in Accessories under Command Prompt) and type mysql and hit return. If you get an error that the command is not recognized, you don't have MySQL and will need to install it as described below. If MySQL is installed already, skip down to "Configuring MySQL".

Installing MySQL

Now it's time to install MySQL! In file explorer navigate to your Argon drive and go to mysql-installers and execute either the win32 or winx64 installer, depending on what version of Windows you have. If you're not sure which Windows version you have, right click on your Computer and go to Properties and look there.

Once the installer starts, choose the Typical Setup with the default directories it suggests. Allow it proceed through installation. This will take about 2 minutes.

Then you will enter the MySQL Enterprise setup window. Make sure Choose Configure the MySQL Server Now is checked. Then click OK.

You will then see the MySQL Server Instance Configuration Wizard. This window has a tendency to disappear under other open programs, so make sure it hasn't gone underneath another open window. If you can't find it at all, go to Start > Programs > MySQL > Instance Config.

In this Wizard, choose the following:
- Select Detailed Configuration.
- Click NEXT.
- Select Developer Machine.
- Click NEXT.
- Select Multifunctional Database.
- Click NEXT.
- Click NEXT (don't change tablespace settings).
- Select Decision Support.
- Click NEXT.
- Select Enable TCP/IP Networking. **MAKE SURE** that Add Firewall Exception is selected.
- Leave Enable Strict Mode on.
- NEXT.
- Select Standard Character Set.
- Select Include Bin Directory in Windows PATH.
- NEXT.
- You should see that the install was successful. Click Finish to close the window.

But wait, there's one more step you need to do. This is very important!

Configuring MySQL

If you discovered that MySQL already exists on your computer, STOP before proceeding further, as

the changes here will cause your other databases to stop working. Instead, you'll need to copy the Argon dataset manually to your pre-existing databases directory, preferably with the assistance of an administrator. See "Moving The Database" on the next page.

Otherwise, if you just installed MySQL, here's what to do. On your Start button, navigate to Notepad and right-click it. Chose Run as Administrator. Now go to File > Open and navigate to your C: drive, then to Program Files, then to MySQL, then to MySQL Server 5.1. Next to file name, change the file type to All Files (*.*). In the files list, select **my.ini** . Scroll down in the file to where it says #Path to the database root" and on the next line you will see **datadir=** Within the quotes change this to your Argon Drive Letter, followed by a colon, and a forward slash (usually on your question mark key). For example if your Argon Drive Letter is E, the line should show:

datadir="E:/"

Essentially you are telling MySQL where to find the "ibdata" file that describes Argon.

Once you've finished, save it with File > Save and exit. You can now run Argon!

Operation

Connecting to the database is simple.

1. Open a Command Prompt (MS-DOS) window, located in your Start menu Programs, by right-clicking on it and choosing **Run As Administrator**. You do not need to run queries as an administrator, but without these permissions you will be unable to start and stop the MySQL engine.

2. Make sure MYSQL is running by typing:
    net start mysql

3. Connect to the database. Type the following:
    mysql -u *root* **-p***root*
Replace root/root with the actual username and password if you have already reset them to something else.

4. Connect to Argon. Type the following:
    use argon;   (with the semicolon)
Remember that all MySQL commands must be ended with a semicolon, or nothing will happen when you press "enter".

5. Enter your MySQL queries. See the appendix for a list of example commands. Read the MySQL documentation at http://dev.mysql.com/doc/ or obtain a MySQL tutorial book for further information on how to query the database. **We cannot provide tutorials or support for using MySQL.** Our support is limited to Argon quality control and configuration issues only. **We only provide the data**.

6. When finished with Argon, exit MySQL:
    exit;

7. If finished with MySQL, you can stop the MySQL engine with:
    net stop mysql

8. Quit the Command Prompt with:
    exit

Performance

Argon is an exceptionally large database, measuring about 150 GB in size. A single table contains over half a billion records. *Queries may take many minutes to complete (30 minutes is not uncommon for the largest surface table on a budget PC).* Even though Argon is slow in its factory configuration, it offers unprecedented access to over a billion weather records.

The bottleneck is largely centered around the size of the dataset and the hard drive transfer, since the database needs to search the entire index file. This index file measures 10 GB in size. Therefore, these are some key tips for improving speed0:

- If you are querying the **surface** table, use the **surfaceshort** table instead if you just need basic data. The surfaceshort table is identical to surface but omits detailed cloud data, plain language remarks, and so forth. This allows the data to be served up faster.

- Make sure your computer is fully USB 3.0 compatible. This will be available in many of the machines built after 2008. You can check this in Windows under Control Panel > System > Hardware > Universal Serial Bus and seeing if a USB 3.0 device appears. If not, you can order a USB 3.0 card for about $20 from Internet sources. The drive is fully USB 2.0 compliant, but you will get transfer rates up to 10 times as fast if you use a USB 3.0 connection.

- Do a filecopy of the database to an internal hard drive, preferably an SSD (solid state) hard drive and use it there, taking advantage of the superior transfer and read/write rates.

- Use a computer with fast processor or more RAM.

- Use your MySQL experience to modify or rebuild the database. An experienced user can easily strip the database down to just the rows and columns that are needed and optimize the tables, which will dramatically improve performance.

Please note that we cannot provide any custom MySQL services as part of our free support, since MySQL is exhaustively documented elsewhere and we are meteorologists rather than database specialists. We strictly provide the data and tables as-is. The end user is responsible for the use, implementation, and optimization of the data. Customized support can be provided only by contract.

Weather Graphics is currently in the process of development work to improve the database and optimize it for speed. Once we determine a good method for this, we will notify you with advice on how to proceed, should you wish to use our suggested changes. We are also working on a front-end viewer to allow beginners easy access via a graphical interface.

Cautionary notes

Do not compress the ARGON files, that is, don't compress the directories and files using Windows disk compression. This will significantly increase I/O, slowing performance and possibly causing intermittent freezes. If this has been done already, see "troubleshooting" for tips on how to revert the files to their original state.

Moving the database

MySQL is flexible about moving the data files off your portable drive onto another hard drive. To do this, do a file copy of all the contents of the Argon drive. The /mysql-installers directory is not necessary but all other files are. The files amount to nearly 200 GB and will take minutes, possibly hours to copy. If you receive any errors while copying the files, which might be caused by a bad cable or bad sector, try again or use a copy manager like Super Copier 2 *<supercopier.sfxteam.org>* to guard against errors.

Before doing any copying work, be sure that the MySQL service is stopped, otherwise you may encounter file sharing errors.

Remember that anytime you change the database location, you must go into your MySQL folder and edit the file **my.ini** file using Notepad or Edit and find the line "#Path to the database root". Change the value in quotes after datadir= to:

X:/

where X is the drive letter for your removable Argon drive (run File Explorer to view My Computer if you don't know it). Note that this location corresponds exactly to where Argon's "ibdata" file is found, and you must use a forward slash, not a backslash at the end.

IMPORTANT: After moving Argon, be sure the files named **ib_logfile*** on the Argon drive's top level directory are deleted or they will cause MySQL errors.

Getting ARGON updates

If you have purchased lifetime ARGON updates, these are available to you for as long as we continue to sell and maintain the ARGON product. Updates for ARGON are available on a quarterly basis via electronic download from our website. Please contact us via e-mail for the latest download links and installation instructions, as they are subject to change.

How ARGON was developed

Since 1997 Weather Graphics has been collecting and warehousing tremendous amounts of weather data. Our primary goal has always been to adapt the data for operational use, avoiding complicated or arcane storage formats. We have been interested in creating an observation superdatabase for quite some time, but only in 2005 did off-the-shelf technology allow this. Development work involved the processing of billions of weather records, 3000 lines of source code, and 400 hours of processing time on Pentium 4 and Intel Core computers. Argon will continue to be an evolving, growing product.

Tips for using ARGON

For basic use of Argon, you can start MySQL in an MS-DOS prompt and run queries, and view the resulting text output. Programmers can develop database applications to directly access the data. For more ideas on querying data, use Google to find sites that explain MySQL commands.

Default username and password

This is only for computers we build using Argon. If you are installing MySQL on your own, ignore these settings.

```
Username = root
Password = root
```

Starting ARGON

```
net start mysql;              Start the mysql server process
mysql -u root -padmin;        Connects to the mysql server
use argon;                    Connects to ARGON
```

General MySQL commands

Capitalized words indicate to specify the actual name (i.e. instead of TABLE use surfaceshort).

```
net start mysql                       Start the mysql server process
mysql -u username -ppassword          Connects to the mysql server
show databases;                       Shows the databases that are available
show tables;                          Shows the available tables
show table status like 'TABLE' \G;    Shows the available tables
use DATABASE;                         Uses the selected database (usually will be argon)
select count(*) from TABLE;           Counts rows in a table
describe TABLE;                        Describes the selected table structures
select distinct COLUMN from TABLE;    Shows different values in the chosen column
mysql < myfile.bat > output.txt       Sends output from a batch query to a text file
show processes;                       Shows all processes in MySQL
show status;                          Show status of MySQL itself (detailed)
```

Command examples

Show all observations at DFW International Airport for December 24, 1983:
```
SELECT * FROM surface WHERE (faa='DFW') and (year=1983) and (month=12) and
(day=24);
```

Find the average of all known hourly temperatures in Atlanta for July 1977, ignoring missing temperatures.
```
SELECT AVERAGE(Temperature) FROM surface WHERE (faa='ATL') and (year=1977) and
(month=7) and (Temperature<>-99);
```

Find all instances of 115° or hotter weather in Phoenix, Arizona for 1990.
```
SELECT * FROM surface WHERE (faa='PHX') and (year=1990) and (Temperature>=115);
```

Count the number of hours for which precipitation was reported at Moline, Illinois in 1993.
```
SELECT COUNT(Weather) FROM surface WHERE (faa='MLI') and (year=1993) and
(Weather1>=50) and (Weather1<=99);
```

Helpful links

http://www.pantz.org/database/mysql/mysqlcommands.shtml

Troubleshooting

These are problems we have seen inhouse, with suggestions for how to resolve them. If you encounter other errors, we recommend Googling them to find more information.

NET START MYSQL: Error 1067
When specifying a new default data directory, you must copy the entire contents of the original data directory to the new location so that it has all the necessary tables. This includes the /mysql table. Check your my.ini file to make sure it is pointing to where the files are located.

NET START MYSQL: System error 5 has occurred.
Your MS-DOS window does not have sufficient permission. Right-click on the MS-DOS Prompt icon and choose Run As Administrator, and in that window you can run **net start mysql**. At that point, with mysql started, you can then continue what you were doing in the other window or application.

MYSQL: Error 2003: Can't connect to MySQL server
You need to run NET START MYSQL. If you already did this and still get this error, restart the system.

Invalid MySQL logon
Go back through the install procedure and make sure you have followed the step requiring Windows to add a Firewall Exception. If you are an advanced user, you can add this exception on your own by making sure Windows Firewall has an exception for "MySQL Server" that lets it communicate on port 3306 via TCP.

Computer freezes intermittently while accessing ARGON
This may occur if you compressed the ARGON files using Windows disk compression. Due to the very large size of the ARGON files and the CPU-intensive overhead required for processing compressed data, this may cause overloading of the I/O stream. To solve this, decompress the files to return them to their original state. Some of the larger files (particularly those over 20 GB) may refuse to decompress. To solve this, simply copy the files to a directory whose contents are specifically set to "uncompressed" (in File Explorer > File Properties > Advanced).

table surface

Field	Type	Null	Key	Default	Extra
prikey	bigint(20) unsigned	NO	PRI	0	
year	smallint(5) unsigned	YES		NULL	
month	tinyint(3) unsigned	YES		NULL	
day	tinyint(3) unsigned	YES		NULL	
hour	tinyint(3) unsigned	YES		NULL	
lat	decimal(6,3)	YES		NULL	
lon	decimal(6,3)	YES		NULL	
elevation	smallint(6)	YES		NULL	
icao	char(4)	YES		NULL	
faa	char(3)	YES		NULL	
wmo	mediumint(8) unsigned	YES		NULL	
wban	mediumint(8) unsigned	YES		NULL	
skycover	tinyint(3) unsigned	YES		NULL	
ceiling	smallint(6)	YES		NULL	
cloud1amt	tinyint(4)	YES		NULL	
cloud1typ	char(2)	YES		NULL	
cloud1hgt	smallint(6)	YES		NULL	
cloud2amt	tinyint(4)	YES		NULL	
cloud2typ	char(2)	YES		NULL	
cloud2hgt	smallint(6)	YES		NULL	
cloud3amt	tinyint(4)	YES		NULL	
cloud3typ	char(2)	YES		NULL	
cloud3hgt	smallint(6)	YES		NULL	
cloud4amt	tinyint(4)	YES		NULL	
cloud4typ	char(2)	YES		NULL	
cloud4hgt	smallint(6)	YES		NULL	
cloud5amt	tinyint(4)	YES		NULL	
cloud5typ	char(2)	YES		NULL	
cloud5hgt	smallint(6)	YES		NULL	
cloud6amt	tinyint(4)	YES		NULL	
cloud6typ	char(2)	YES		NULL	
cloud6hgt	smallint(6)	YES		NULL	
visibility	smallint(5) unsigned	YES		NULL	
weather1	tinyint(3) unsigned	YES		NULL	
weather2	tinyint(3) unsigned	YES		NULL	
weather3	tinyint(3) unsigned	YES		NULL	
temperature	tinyint(4)	YES		NULL	
dewpoint	tinyint(4)	YES		NULL	
winddirection	smallint(5) unsigned	YES		NULL	
windspeed	tinyint(3) unsigned	YES		NULL	
windgust	tinyint(3) unsigned	YES		NULL	
alstg	smallint(5) unsigned	YES		NULL	
slp	smallint(5) unsigned	YES		NULL	
source	tinyint(3) unsigned	YES		NULL	
datatype	tinyint(3) unsigned	YES		NULL	
exactyear	smallint(5) unsigned	YES		NULL	
exactmonth	smallint(5) unsigned	YES		NULL	
exactday	smallint(5) unsigned	YES		NULL	
exacthour	smallint(5) unsigned	YES		NULL	
exactminute	smallint(5) unsigned	YES		NULL	
remark	varchar(255)	YES		NULL	

table surfaceshort

Field	Type	Null	Key	Default	Extra
year	smallint(5) unsigned	YES		NULL	
month	tinyint(3) unsigned	YES		NULL	
day	tinyint(3) unsigned	YES		NULL	
hour	tinyint(3) unsigned	YES		NULL	
lat	decimal(6,3)	YES		NULL	
lon	decimal(6,3)	YES		NULL	
elevation	smallint(6)	YES		NULL	
icao	char(4)	YES		NULL	
faa	char(3)	YES		NULL	
wmo	mediumint(8) unsigned	YES		NULL	
wban	mediumint(8) unsigned	YES		NULL	
country	char(2)	YES		NULL	
state	char(2)	YES		NULL	
skycover	tinyint(3) unsigned	YES		NULL	
ceiling	smallint(6)	YES		NULL	
visibility	smallint(5) unsigned	YES		NULL	
weather1	tinyint(3) unsigned	YES		NULL	
temperature	tinyint(4)	YES		NULL	
dewpoint	tinyint(4)	YES		NULL	
winddirection	smallint(5) unsigned	YES		NULL	
windspeed	tinyint(3) unsigned	YES		NULL	
windgust	tinyint(3) unsigned	YES		NULL	
alstg	smallint(5) unsigned	YES		NULL	
slp	smallint(5) unsigned	YES		NULL	
source	tinyint(3) unsigned	YES		NULL	
datatype	tinyint(3) unsigned	YES		NULL	
exacthour	smallint(5) unsigned	YES		NULL	
exactminute	smallint(5) unsigned	YES		NULL	

table upper

```
+------------------+---------------------+------+-----+---------+-------+
| Field            | Type                | Null | Key | Default | Extra |
+------------------+---------------------+------+-----+---------+-------+
| year             | smallint(5) unsigned | NO  | PRI | 0       |       |
| month            | tinyint(3) unsigned  | NO  | PRI | 0       |       |
| day              | tinyint(3) unsigned  | NO  | PRI | 0       |       |
| hour             | tinyint(3) unsigned  | NO  | PRI | 0       |       |
| lat              | decimal(6,3)         | NO  | PRI | 0.000   |       |
| lon              | decimal(6,3)         | NO  | PRI | 0.000   |       |
| level            | smallint(6)          | NO  | PRI | 0       |       |
| elevation        | smallint(6)          | YES |     | NULL    |       |
| icao             | char(4)              | YES |     | NULL    |       |
| faa              | char(3)              | YES |     | NULL    |       |
| wmo              | mediumint(8) unsigned | YES |    | NULL    |       |
| wban             | mediumint(8) unsigned | YES |    | NULL    |       |
| height           | smallint(6)          | YES |     | NULL    |       |
| temperature      | decimal(5,1)         | YES |     | NULL    |       |
| dewpoint         | decimal(5,1)         | YES |     | NULL    |       |
| winddirection    | smallint(6)          | YES |     | NULL    |       |
| windspeed        | smallint(6)          | YES |     | NULL    |       |
| tropopause       | smallint(6)          | YES |     | NULL    |       |
| tropopausequality | tinyint(3) unsigned | YES |     | NULL    |       |
| releasetime      | smallint(6)          | YES |     | NULL    |       |
| source           | tinyint(3) unsigned  | YES |     | NULL    |       |
| sondetype        | tinyint(3) unsigned  | YES |     | NULL    |       |
+------------------+---------------------+------+-----+---------+-------+
```

Surface elements

Provided here is a detailed explanation of each table column type, in order of appearance in the table.

1. Prikey (unsigned bigint)

This is a primary key for the table. It is an integer comprised of the time, absolute latitude, and absolute longitude for the weather observation, so that it is not possible for more than one observation at the same location and time to exist in the table. The format is:

    yymmddhhnnllllooooo

where yy is the year, mm is the month, dd is the day, hh is the hour, nn is the minute, llll is the absolute latitude, and ooooo is the absolute longitude. **Numbers are not zero filled**, so do not use math functions to attempt decoding of this block. Use the other table columns instead for this purpose.

2. Year (unsigned smallint)

The observation year in whole years (4 digits), using the UTC time zone, rounded to the nearest hour. There is no null value. *(smallint unsigned)*

3. Month (unsigned tinyint)

The observation month in whole months (4 digits), using the UTC time zone, rounded to the nearest hour. There is no null value. *(tinyint unsigned)*

4. Day (unsigned tinyint)

The observation day in whole days of the month, using the UTC time zone, rounded to the nearest hour. There is no null value. *(tinyint unsigned)*

5. Hour (unsigned tinyint)

The observation hour in whole hours (4 digits), using the UTC time zone, rounded to the nearest hour. See "Observation Time" below for obtaining the minute value. There is no null value. *(tinyint unsigned)*

6. Lat (decimal(6,3))

The latitude in whole hundreds of degrees. Negative latitudes are in the southern hemisphere. For null values, the field is set to NULL (formerly -9999).

7. Lon (decimal(6,3))

The longitude in whole hundreds of degrees. Negative longitudes are in the western hemisphere (which includes the U.S.). For null values, the field is set to NULL (formerly -9999).

8. Elevation (smallint)

The station's elevation in whole meters above mean sea level. For null values, the field is set to NULL (formerly -9999).

9. Icao (char(4))

The identifier is the station's International Civil Aviation Organization (ICAO) (4-letter) identifier. For conterminous U.S. locations it begins with "K". For dates before 1996, these are estimated by crossreferencing NWS WBAN tables, since ICAO indicators did not exist for many U.S. stations until the 1990s, and in some cases no ICAO exists. For dates 1996 onward they are taken directly from the surface observations. The field is left empty if no value applies.

10. Faa (char(3))

The identifier is the station's Federal Aviation Administration (FAA) (3-letter) identifier. This is not simply an ICAO with a K or P removed; for example in Alaska the ICAO for Anchorage is PAFA, while the FAA is FAI. For dates before 1996, they are taken directly from surface observations. For dates 1996 onward they are estimated by crossreferencing NWS WBAN tables. The field is left empty if no value applies.

11. WMO (mediumint)

This is the 5-digit World Meteorological Organization (WMO) numerical identifier for the station, as specified in WMO Pub 9A. They do not exist for minor observation sites. A valid WMO number is in the range 1 to 99999. The field is zero if no value applies.

12. Wban (mediumint)

Contains the station's National Weather Service WBAN number as a whole integer. Not all stations have a WBAN value. See www.ncdc.noaa.gov/oa/climate/surfaceinventories.html for further information on the use of this field. A valid WBAN number is in the range 1 to 99999. The field is set to 0 if no value applies.

13. Country (char(2))

Included only in the surfaceshort table at this time. Contains the 2-letter country abbreviation in ISO-3166-1 "Alpha-2" format. Commonly used abbreviations are US for United States, CA for Canada, and MX for Mexico.

14. State (char(2))

Included only in the surfaceshort table at this time. For United States and Canada stations, this field contains the 2-letter state or province abbreviation in ISO-3166-2 format. In the United States and Canada, this essentially equals standard postal abbreviations (e.g. NV for Nevada, NY for New York, and MB for Manitoba).

15. Skycover (tinyint)
This code is in oktas, i.e. eighths (0-8), with 9 indicating an obscuration and 255 indicating missing data. There are some issues with certain rows, due to problems with the source agency:
* Dec 14, 1976 - June 28, 1977. Missing data is encoded as 0 (clear).
* June 28, 1977 - June 13, 1978. Garbled data is encoded as 0 (clear).
* Dec 1976 - Dec 1996 (Source 1). Total sky cover is determined from the "most significant" airways cloud cover code. This conversion is as follows: clear 0; thin obscured 9; thin scattered 2; thin broken 5; thin overcast 8; scattered 3; broken 6; overcast 8; obscured 9. Before March 5, 1980, thin layers were ignored when opaque sky cover was present.
For null values, the field is set to NULL (formerly 255).

16. Ceiling (smallint)
The ceiling is given in as a whole integer in hundreds of feet. Possible values are:
    888   no ceiling
    9999   ceiling is unknown
Notes:
* *Dec 14, 1976 - June 28, 1977*. Missing data is encoded as 888 (unlimited) due to a NWS programming error.
* *June 28, 1977 - June 13, 1978*. Garbled data is encoded as 888 (unlimited) due to a NWS programming error.
For null values, the field is set to NULL (formerly 9999).

17. Cloud1amt, Cloud2amt, Cloud3amt, Cloud4amt, Cloud5amt, Cloud6amt (tinyint)
Indicates the coverage of cloud layer X in oktas (eights). A value of 9 indicates that the layer is an obscuration and that the LyrXHgt is a vertical visibility. For null values, the field is set to NULL (formerly -99).

18. Cloud1typ, Cloud2typ, Cloud3typ, Cloud4typ, Cloud5typ, Cloud6typ (char(2))
Contains the reported cloud type, if known, using the two-letter abbreviation for cloud type: SC for strato-

cumulus, CB for cumulonimbus, CI for cirrus, and so forth. In the U.S. cloud type was only reported every 3 hours at certain stations. Cloud types become rare after 1995 due to the automation of weather observations, and are largely blank after 2000.

19. Cloud1hgt, Cloud2hgt, Cloud3hgt, Cloud4hgt, Cloud5hgt, Cloud6hgt (smallint)
Indicates the height of cloud layer X, where X is a value of 1 to 6.
    -888   observed but unknown height (///)
    888   unlimited (or layer is clear)
    NULL   missing data (formerly 9999)
    9999   indicates no layer was observed.

20. Visibility (smallint)
The visibility is encoded as a whole integer in hundreds of miles (e.g. 1¼ miles will be encoded as 125, i.e. 1.25 miles). Missing data sets it to NULL (formerly 9999).

21. Weather1 (unsigned tinyint)
The primary weather type is expressed as a numerical code. If unknown it is set to NULL (formerly 255). Argon uses two code sets to represent weather:
    * **WMO Weather Code** (0-99), also known as "ww" or "Present Weather Code", is a globally standardized code for weather reporting given in WMO Pub. 306 (see Appendix, Table 1). The range of values from 0 to 99 ascends insignificant to significant phenomena, thus it ascends from low to high rank. The sole exception is 19 (tornado) which always has the highest ranking. Rankings are important and will be discussed shortly.
    * **Supplementary Code** (100-199) is an optional code (Appendix, Table 2) used to clarify phenomena that cannot be described adequately with the WMO Weather Code set. Supplementary Code is non-standard. Since Supplementary Codes may or may not be used, database queries for weather phenomena should always be based on WMO Weather Code.
    Notes about ranking: It is common for multiple weather phenomena to occur simultaneously, such as rain, snow, and fog together. Argon orders the phenomena by rank, and places the highest ranked phenomena in Weather 1, with any applicable lower ranks in Weather2 and Weather3. All WMO Symbol ww phenomena carry a higher rank than Supplementary Codes.
Notes:
* *May 16, 1979, 2200 UTC - January 9, 1980, 2200 UTC (Source 1).* Ice crystals (IC) are incorrectly encoded as light snow (SN) due to a NWS programming error.

22. Weather2 (unsigned tinyint)
If two or more weather phenomena are being reported, the one with lesser ranking than Weather1 is reported here. See the documentation on Weather1 for more information.

23. Weather3 (unsigned tinyint)
If three or more weather phenomena are being reported, the one with lesser ranking than Weather1 and Weather 2 are reported here. See the documentation on Weather1 for more information.

24. Temperature (tinyint)
Air temperature at the standard 2-meter AGL observation level is given in whole degrees Fahrenheit. If unknown, it is set to NULL (formerly -99).

25. Dewpoint (tinyint)
Dewpoint at the standard 2-meter AGL level is given in whole degrees Fahrenheit. If unknown, it is set to NULL (formerly -99).

26. WindDirection (smallint)
The wind direction at the standard 10-meter AGL level is given in tens of degrees relative to true north. If there is no wind direction available, or winds are calm, it is set to NULL (formerly 255).

27. WindSpeed (unsigned tinyint)
The wind speed at the standard 10-meter AGL level is given in whole knots. If there is no available value, it is set to NULL (formerly 255).

28. WindGust (unsigned tinyint)
Wind gust at the standard 10-meter AGL level is given in whole knots. If there is no gust, the value is set to NULL (formerly 255 or 0).

29. Alstg (smallint)
Contains the altimeter setting in whole hundreds of inches (i.e. 29.72" is expressed as 2972). If the data is missing it is set to NULL (formerly 0).

30. slp (smallint)
Contains the sea level pressure in whole tens of millibars (i.e. 1005.8 mb is expressed as 10058). If the data is missing it is set to NULL (formerly 0).

31. source (unsigned tinyint)
Indicates the source of the data. Possible values are:
   1   Original manuscript (before 1984)
   2   SRRS
   3   AFOS
   4   NWS DATSAV
   5   NOAA NMC (NCEP)
   6   Foreign keyed
   7   MAPSO
   8   SRRS plus
   9   Unknown
   10 ASOS (A)
   15 WGT via NOAAPORT (F)
   255 Unknown or missing

32. datatype (unsigned tinyint)
Indicates the type of report.
   10 SAO airways routine observation
   11 SAO airways special observation
   12 METAR routine observation
   13 METAR special observation
   14 AUTO observation
   15 AERO observation
   20 SYNOP (land) observation
   21 SYNOP (ship) observation
   22 SYNOP (mobile) observation
   30 BUOY observation
   104 SYNOP-AERO merged
   102 SYNOP-METAR merged
   100 SYNOP-SAO merged
   105 SYNOP-AUTO merged
   106 SAO-AUTO merged
   109 SYNOP-SAO-AUTO merged
   110 SMARS
   254 Bogus
   255 Unknown or missing

33. exactyear (unsigned smallint)
The observation year in whole years (4 digits), using the UTC time zone, rounded to the nearest minute.

34. exactmonth (unsigned tinyint)
The observation month in whole months (4 digits), using the UTC time zone, rounded to the nearest minute.

35. exactday (unsigned tinyint)
The observation day in whole days of the month, using the UTC time zone, rounded to the nearest minute.

36. exacthour (unsigned tinyint)
The observation hour in whole hours (4 digits), using the UTC time zone, rounded to the nearest hour. See "Observation Time" below for obtaining the minute value.

37. exactminute (unsigned tinyint)
The observation hour in whole hours (4 digits), using

the UTC time zone, rounded to the nearest hour. See "Observation Time" below for obtaining the minute value.

38. remark (varchar(255))

Original remarks, as encoded on the observation. These are generally not available until around 1973. Decoding information is too extensive to be included in this guide. The two authoritative references for decoding of remarks are Federal Meteorological Handbook #1 at www.ofcm.gov and World Meteorological Publication No. 306 at www.wmo.int.

   If the data is missing it is set to empty.

Upper air elements

This section explains elements in the upper air table.

1. Year (keyed value)
smallint unsigned, default value 1901
The observation year in whole years (4 digits), using the UTC time zone, rounded to the nearest hour.

2. Month (keyed value)
smallint unsigned, default value 1
The observation month in whole months (4 digits), using the UTC time zone, rounded to the nearest hour.

3. Day (keyed value)
smallint unsigned, default value 1
The observation day in whole days of the month, using the UTC time zone, rounded to the nearest hour.

4. Hour (keyed value)
smallint unsigned, default value 0
The observation hour in whole hours (4 digits), using the UTC time zone, rounded to the nearest hour. See "Observation Time" below for obtaining the minute value.

5. Lat (keyed value)
decimal(6,3), default value -9999
The latitude in whole hundreds of degrees. Negative latitudes are in the southern hemisphere. If the latitude could not be determined, -9999 is used.

6. Lon (keyed value)
decimal(6,3), default value -9999
The longitude in whole hundreds of degrees. Negative longitudes are in the western hemisphere (which includes the U.S.). If the latitude could not be determined, -9999 is used.

7. Level (keyed value)
smallint signed, default value -9999
Indicates the applicable pressure level for the height, temperature, dewpoint, wind speed, and wind direction in this record. This is expressed in millibars and is usually 100, 150, 200, 250, 300, 400, 500, 700, 850, 925, 1000, or a surface value. Missing data is not applicable as it creates an invalid meteorological field.

8. Elevation
smallint signed, default value -9999
Elevation of observation station above MSL.

9. Icao
type: char(4), default value ''
The identifier is the station's International Civil Aviation Organization (ICAO) (4-letter) identifier. For conterminous U.S. locations it begins with "K". For dates before 1996, these are estimated by crossreferencing NWS WBAN tables, since ICAO indicators did not exist for many U.S. stations until the 1990s, and in some cases no ICAO exists. For dates 1996 onward they are taken directly from the surface observations.

10. Faa
type: char(3), default value ''
The identifier is the station's Federal Aviation Administration (FAA) (3-letter) identifier. This is not simply an ICAO with a K or P removed; for example in Alaska the ICAO for Anchorage is PAFA, while the FAA is FAI. For dates before 1996, they are taken directly from surface observations. For dates 1996 onward they are estimated by crossreferencing NWS WBAN tables.

11. Wmo
type: mediumint(8) unsigned, default value 0
This is the 5-digit World Meteorological Organization (WMO) numerical identifier for the station, as specified in WMO Pub 9A. They do not exist for minor observation sites. A valid WMO number is in the range 1 to 99999.

12. Wban
type: mediumint(8) unsigned, default value 0
Contains the station's National Weather Service WBAN number as a whole integer. Not all stations have a WBAN value. See www.ncdc.noaa.gov/oa/climate/surfaceinventories.html for further information on the use of this field. A valid WBAN number is in the range 1 to 99999.

13. Height
type: smallint, default value -9999
Contains the geopotential height in whole meters. Missing data is displayed as -9999.

14. Temperature
type: decimal(3,1), default value -9999
Contains the temperature value in decimal degrees Celsius to the nearest 0.1 deg. Missing data is displayed as -9999.

15. Dewpoint
type: decimal(3,1), default value -9999

Contains the dewpoint value in decimal degrees Celsius to the nearest 0.1 deg. Missing data is displayed as -9999.

16. WindDirection
smallint signed, default value -9999
Contains the wind direction in whole degrees. Missing data is displayed as -9999.

17. WindSpeed
smallint signed, default value -9999
Contains the wind speed in whole knots. Missing data is displayed as -9999.

18. Tropopause
smallint signed, default value -9999
Contains the tropopause level in millibars.

19. Tropopausequality
tinyint unsigned, default value 255
Information on the tropopause value.
>   7   Sufficient data was available to estimate it
>   11   Data was terminated; height is a best guess

20. Releasetime
smallint signed, default value -9999
Release time of the radiosonde in hhmm format. The hour may be missing a leading zero. Set to -9999 if unknown.

21. Source
tinyint unsigned, default value 255
Source of the data:
>   0   National Climatic Data Center (NCDC)
>   1   Environment Canada
>   2   National Severe Storms Forecast Center
>   3   GTS or FSL GTS
>   4   merge of NCDC and GTS data
>   10   TD-54 US Air Force radiosonde data

22. Sondetype
tinyint unsigned, default value 255
Manufacturer of radiosonde. See WMO Pub 306, Attachment I, Common Code Table C-2.
>   10   VIZ "A"
>   11   VIZ "B"
>   12   Space Data Corp
>   51   VIZ "B-2"
>   52   Vaisala RS80-57H

Table 1. WMO Weather Codes. This is prescribed by World Meteorological Organization Publication 306, Table 4677, ww, Present Weather.

00 Cloud development not observed or observable

01 Clouds dissolving or becoming less developed

02 State of sky on the whole unchanged during the past hour

03 Clouds generally forming or developing during the past hour

04 Visibility reduced by smoke haze

05 Haze

06 Widespread dust in suspension in the air, not raised by wind at or near the station at the time of observation.

07 Dust or sand raised by the wind at or near the station at the time of the observation, but no well-developed dust whirl(s), and no sandstorm seen

08 Well developed dust whirl(s) or sand whirl(s) seen at or near the station during the preceding hour or at the time of observation, but no duststorm or sandstorm

09 Duststorm or sandstorm within sight at the time of observation, or at the station during the preceding hour

10 Mist

11 Patches of shallow fog or ice fog, less than 2 m deep

12 More or less continuous shallow fog or ice fog, less than 2 m deep

13 Lightning visible, no thunder heard

14 Precipitation within sight, not reaching the ground or surface of sea

15 Precipitation within sight, reaching ground or the surface of the sea, but distant, i.e. estimated to be more than 5 km from the station

16 Precipitation within sight, reaching the ground or the surface of the sea, near to, but not at the station

17 Thunderstorm, but no precipitation at the time of observation

18 Wind squalls, at or near the station during the preceding hour or at time of observation

19 Funnel cloud, tornado, or waterspout, at or near the station during the preceding hour or at time of observation

20 Recent drizzle (not freezing) or snow grains

21 Recent rain (not freezing)

22 Recent snow

23 Recent rain and snow or ice pellets

24 Recent freezing drizzle or freezing rain

25 Recent shower(s) of rain

26 Recent shower(s) of snow, or of rain and snow

27 Recent shower(s) of hail, or of rain and hail

28 Recent fog or ice fog

29 Recent thunderstorm (with or without precipitation)

30 Slight or moderate duststorm or sandstorm - has decreased during the preceding hour

31 Slight or moderate duststorm or sandstorm - no appreciable change during the preceding hour

32 Slight or moderate duststorm or sandstorm - has begun or has increased during the preceding hour

33 Severe duststorm or sandstorm - has decreased during the preceding hour

34 Severe duststorm or sandstorm - no appreciable change during the preceding hour

35 Severe duststorm or sandstorm - has begun or has increased during the preceding hour

36 Slight or moderate blowing snow generally low (below eye level)

37 Heavy drifting snow generally low (below eye level)

38 Slight or moderate blowing snow generally high (above eye level)

39 Heavy drifting snow generally high (above eye level)

40 Fog or ice fog at a distance at the time of observation, but not at the station during the preceding hour, the fog or ice fog extending to a level above that of the observer

41 Fog or ice fog in patches

42 Fog or ice fog, sky visible has become thinner during the preceding hour

43 Fog or ice fog, sky invisible has become thinner during the preceding hour

44 Fog or ice fog, sky visible no appreciable change during the preceding hour

45 Fog or ice fog, sky invisible no appreciable change during the preceding hour

46 Fog or ice fog, sky visible has begun or has become thicker during the preceding hour

47 Fog or ice fog, sky invisible has begun or has become thicker during the preceding hour

48 Fog, depositing rime, sky visible

49 Fog, depositing rime, sky invisible

50 Drizzle, not freezing, intermittent slight at time of observation

51 Drizzle, not freezing, continuous slight at time of observation

52 Drizzle, not freezing, intermittent moderate at time of observation

53 Drizzle, not freezing, continuous moderate at time of observation

54 Drizzle, not freezing, intermittent heavy (dence) at time of observation

55 Drizzle, not freezing, continuous heavy (dence) at time of observation

56 Drizzle, freezing, slight

57 Drizzle, freezing, moderate or heavy (dence)

58 Drizzle and rain, slight

59 Drizzle and rain, moderate or heavy

60 Rain, not freezing, intermittent slight at time of observation

61 Rain, not freezing, continous slight at time of observation

62 Rain, not freezing, intermittent moderate at time of observation

63 Rain, not freezing, continuous moderate at time of observation

64 Rain, not freezing, intermittent heavy at time of observation

65 Rain, not freezing, continuous heavy at time of observation

66 Rain, freezing, slight

67 Rain, freezing, moderate or heavy

68 Rain, or drizzle and snow, slight

69 Rain, or drizzle and snow, moderate or heavy

70 Intermittent fall of snow flakes slight at time of observation

71 Continuous fall of snow flakes slight at time of observation

72 Intermittent fall of snow flakes moderate at time of observation

73 Continuous fall of snow flakes moderate at time of observation

74 Intermittent fall of snow flakes heavy at time of observation

75 Continuous fall of snow flakes heavy at time of observation

76 Ice prisms (with or without fog)

77 Snow grains (with or without fog)

78 Isolated starlike snow crystals (with or without fog)

79 Ice pellets, type (a)

80 Rain shower(s), slight

81 Rain shower(s), moderate or heavy

82 Rain shower(s), violent

83 Shower(s) of rain and snow mixed, slight

84 Shower(s) of rain and snow mixed, moderate or heavy

85 Snow shower(s), slight

86 Snow shower(s), moderate or heavy

87 Shower(s) of snow pellets or ice pellets, type (b), with or without rain or rain and snow mixed - slight

88 Shower(s) of snow pellets or ice pellets, type (b), with or without rain or rain and snow mixed - moderate or heavy

89 Shower(s) of hail*, with or without rain or rain and snow mixed, not associated with thunder - slight

90 Shower(s) of hail*, with or without rain or rain and snow mixed, not associated with thunder - moderate or heavy

91 Slight rain at time of observation - thunderstorm during the preceding hour but not at time of observation

92 Moderate or heavy rain at time of observation - thunderstorm during the preceding hour but not at time of observation

93 Slight snow, or rain and snow mixed or hail** at time of observation - thunderstorm during the preceding hour but not at time of observation

94 Moderate or heavy snow, or rain and snow mixed or hail** at time of observation - thunderstorm during the preceding hour but not at time of observation

95 Thunderstorm, slight or moderate, without hail**, but with rain and/or snow at time of observation - thunderstorm at time of observation

96 Thunderstorm, slight or moderate, with hail** at time of observation - thunderstorm at time of observation

97 Thunderstorm, heavy, without hail**, but with rain and/or snow at time of observation - thunderstorm at time of observation

98 Thunderstorm combined with duststorm or sandstorm at time of observation - thunderstorm at time of observation

99 Thunderstorm, heavy, with hail** at time of observation - thunderstorm at time of observation   current or recent thunderstorm

Table 2. Supplementary Codes used to clarify weather types in Argon. These additional codes are needed because of differences in original reporting definitions. Searches should always be done on WMO Weather Code, not Supplementary Code.

100	unknown precipitation (UP)
101	volcanic ash (VA)
102	blowing spray (BLPY)
103	drifting dust (DRDU)
104	ice fog
107	rain/drizzle and snow, light
108	rain/drizzle and snow, moderate
109	rain/drizzle and snow, heavy
110	ice pellets, light (IP-)
111	ice pellets, moderate (IP)
112	ice pellets, heavy (IP+)
113	rain shower, light (RW-)
114	rain shower, moderate (RW)
115	rain shower, heavy (RW+)
116	rain-snow shower, light
117	rain-snow shower, moderate
118	rain-snow shower, heavy
119	snow shower, light (SW-)
120	snow shower, moderate (SW)
121	snow shower, heavy (SW+)
122	freezing drizzle, light (ZL-)
123	freezing drizzle, moderate (ZL)
124	freezing drizzle, heavy (ZL+)
125	freezing rain, light (ZR-)
126	freezing rain, moderate (ZR)
127	freezing rain, heavy (ZR+)
128	freezing and frozen precipitation, any combination
129	rain/drizzle and ice pellets (all intensities)
130	rain/drizzle and snow (all intensities)
131	snow or snow pellets or snow grains, light
132	snow or snow pellets or snow grains, moderate
133	snow or snow pellets or snow grains, heavy
134	snow pellets, light (SP-)
135	snow pellets, moderate (SP)
136	snow pellets, heavy (SP+)
137	snow grains, light (SG-)
138	snow grains, moderate (SG)
139	snow grains, heavy (SG+)
140	blowing dust (BD)
141	blowing sand (BS)

Statistics

These are rough statistics that were generated at the time of this manual being printed, and may not be representative of updated data in your Argon database.

Total database size
Records: 1.81 billion
Data size: 154.1 GB
Contents: 1930 through 2014 (drives may contain newer data)
Coverage: North America
Engine: MyISAM 10, dynamic

Surface database
Records: 844 million
Data size: 101.2 GB

Surfaceshort database
Records: 776 million
Data size: 40.5 GB

Upper database
Records: 261 million
Data size: 12.4 GB