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# USNG Magnetic Declination Diagram Web Service

Instructions on how to use service to create diagram

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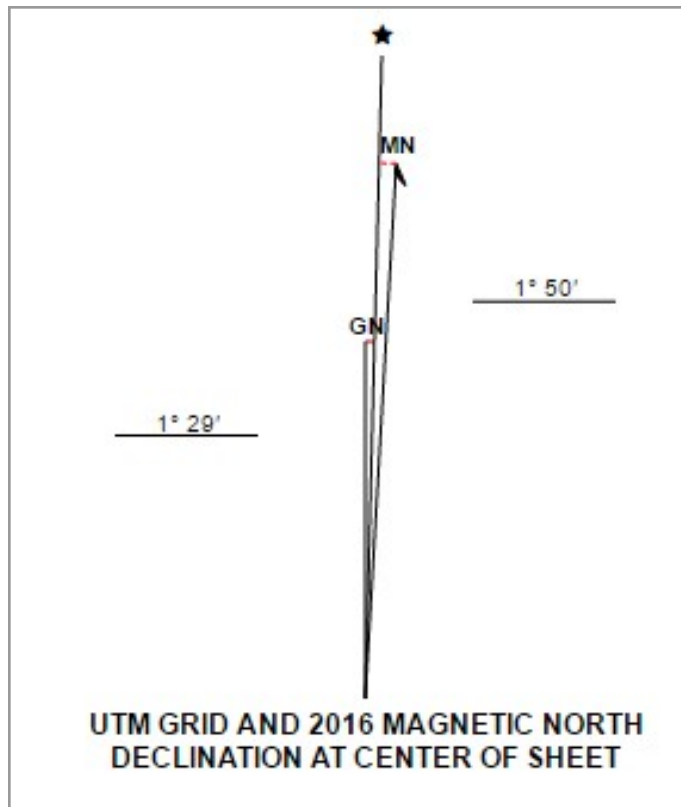
[www.sharedgeo.org](http://www.sharedgeo.org)

2016-2020

# Introduction

The U.S. National Grid (USNG) is a standardized grid reference system that is seamless across jurisdictional boundaries and allows for pinpointing exact locations. As the simplest of all Common Operating Picture systems, it is particularly helpful in emergency situations. Learn more at [www.usngcenter.org](http://www.usngcenter.org).

The standards for use and map creation with USNG are detailed in the Federal Geographic Data Committee (FGDC)'s USNG Standard ([FGDC-STD-011-2001](http://www.fgdl.gov/FGDC-STD-011-2001)). The standard states that USNG maps should include a magnetic declination arrow. A magnetic declination arrow is a group of three arrows: one showing True North (with the star), one showing Grid North (GN) and one showing the Magnetic Declination or North (MN). On traditional USGS Topo series maps, the map is aligned with the principal arrow (with the star) whereas on a USNG map, the map is aligned with grid north. The diagram below shows the USNG usage of a magnetic declination diagram and the associated text indicating the year the diagram was created.



# Magnetic Declination Diagram Web Service

USNG maps are often created as a series. For example, a mapbook may contain a series of maps that covers a city or fire response area. A state may produce a series of 1:24,000 scale maps to cover the whole state. In both these examples, hundreds or thousands of maps may be created and this is usually accomplished by using an automated map creation tool.

When creating automated USNG map series, the **Magnetic Declination Diagram Web Service** can be used to include an accurate magnetic declination diagram for each map created. The map service URL and parameters are described below. Also, you can learn more at:

<https://mdd.sharedgeo.org>

## Map Service Example URL

`https://mdd.sharedgeo.org/mdd-gen?date=2020.64&lat=40.3246&lon=-91.4109&zone=15&of=png`

The URL is comprised of several parts: the URL to the service (<https://usngapp.org/mdd-gen?>) followed by 4 parameter and value pairs (separated by '&'). Note that the parameters and values must include '=' between the pairs.

Parameter	Example Value	Description
date	2020.64	Decimal Year (learn more about decimal dates here: <a href="https://en.wikipedia.org/wiki/Decimal_time">https://en.wikipedia.org/wiki/Decimal_time</a> )
lat	40.3246	Latitude value in decimal degrees, with 4 decimals
lon	-91.4109	Longitude value (note negative, for west) in decimal degrees, with 4 decimals
zone	15	UTM Zone (number only)
of	png	Output format. Options are: png or svg This parameter and value pair are optional. If not included, png is the default output format.

# Example Use Case: Using USNG Service in ArcMap Data Driven Pages

Using Esri's ArcMap, automated map series creation can be accomplished using Data Driven Pages. The instructions below show how to incorporate the **Magnetic Declination Diagram Web Service** into Data Driven pages.

## Set up data fields

When creating USNG maps, a common way to create them is to use a polygon dataset of the USNG map extent areas as the "index" layer that drives the Data Driven Pages.

To create and use the magnetic declination diagram web service for each of the USNG map extent polygons, a field containing the URL, specific to that USNG map extent area, must be added to the index layer dataset. In addition, the "building block" of the URL can also be added as attribute table fields to the dataset. Below is a list of suggested field names, types and descriptions to add to the Data Driven layer's Attribute Table.

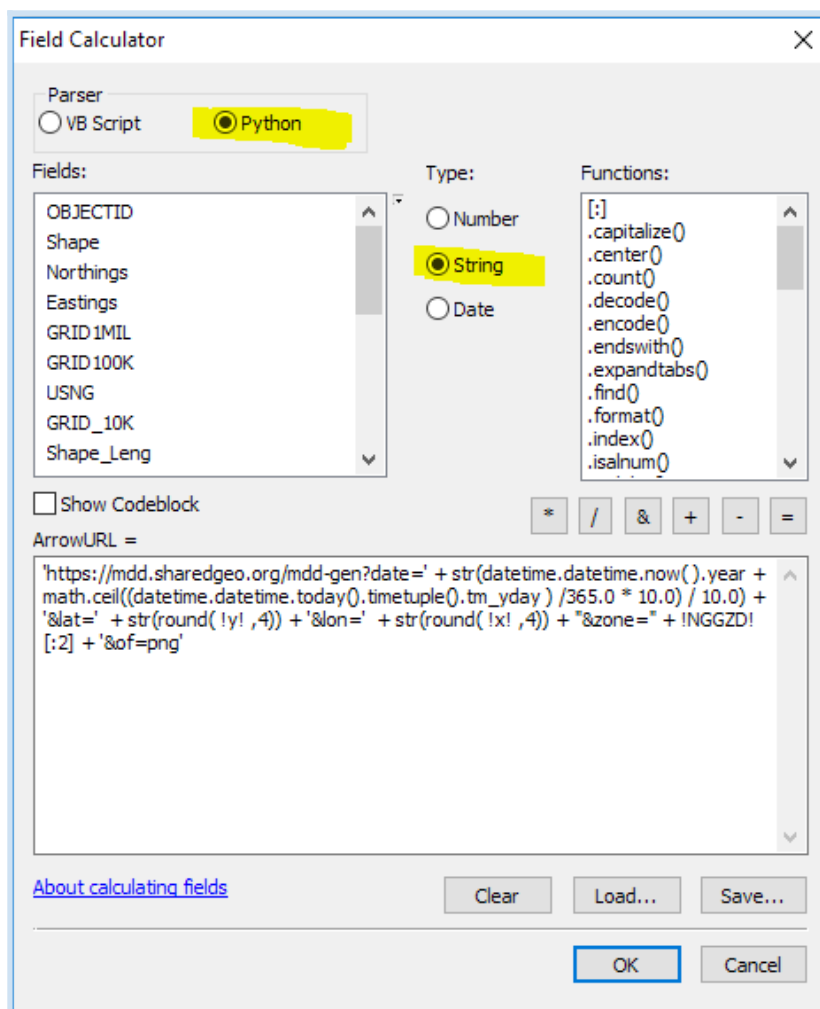
Field Name	Field Type	Example Value	Description
ArrowURL	Text - 100 characters	<a href="https://mdd.sharedgeo.org/mdd-gen?date=2020.64&amp;lat=40.3246&amp;lon=-91.4109&amp;zone=15&amp;of=png/">https://mdd.sharedgeo.org/mdd-gen?date=2020.64&amp;lat=40.3246&amp;lon=-91.4109&amp;zone=15&amp;of=png/</a>	Field to contain the URL to call the Magnetic Declination Diagram web service. (See calculation info below.)
x	Double	-91.410941	Longitude Building block field required to fill contents of the ArrowURL field. X coordinate of center point of USNG map extent. Note that the calculation will truncate the longitude to 4 decimal places in the URL string.
y	Double	40.324629	Latitude Building block field required to fill contents of the ArrowURL field. Y coordinate of center point of USNG map extent. Note that the calculation will truncate the latitude coordinate to 4 decimal places in the URL string.
NGGZD	Text - 3 characters	15T	Grid Zone Building block field required to fill contents of the ArrowURL field. Note that the calculation just takes the first 2 characters (15) and adds them to the URL string.

## Calculating the “ArrowURL” Field

The URL stored in the “ArrowURL” field can be updated using the ArcMap Attribute Table Field Calculator. **This URL must be updated before creating new maps because the declination diagram changes based on the date.**

Two Field Calculator options are provided below. The first is a more complicated calculation that can be cut and pasted verbatim, and the second is a simpler calculation, but will require some updating. Note that both these calculations require the following fields to be included in the table: x, y and NGGZD (just substitute the field names if different field names are used).

Note that when using the Field Calculator for either expression, use the Python Parser and Type String (see highlighted areas in graphic below), otherwise Field Calculator error may occur.



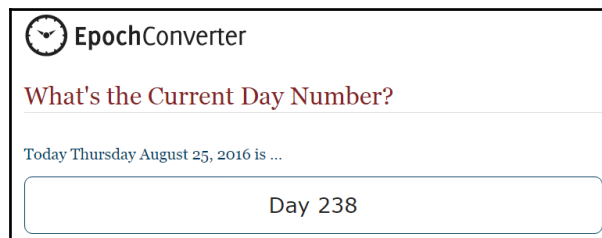
## Process 1 - More Complicated Calculation: Requires No Updating

```
'https://mdd.sharedgeo.org/mdd-gen?date=' + str(datetime.datetime.now(
).year + math.ceil((datetime.datetime.today().timetuple().tm_yday )
/365.0 * 10.0) / 10.0) + '&lat=' + str(round( !y! ,4)) + '&lon=' +
str(round( !x! ,4)) + "&zone=" + !NGGZD![:2] + '&of=png'
```

## Process 2 - Less Complicated: Requires Updating

First go to <http://www.epochconverter.com/daynumbers> and find out what the current day is for the day you will create the maps. For example, August 25 would be 238.

Next, use the following expression in the Field Calculator and substitute the items in red with the appropriate values. In this expression 2016 should be the current year and 195 should be the current day number, so I'd need to substitute 195 with 238.



```
'https://mdd.sharedgeo.org/mdd-gen?date=' + str(2020 +
round(195/365.25,2)) + '&lat=' + str(round( !y! ,4))+ '&lon=' +
str(round( !x! ,4)) + "&zone=" + !NGGZD![:2] + '&of=png'
```

## Review Calculation Results

The calculation will populate the ArrowURL field and the value that should change is the decimal date (highlighted below in yellow), according to the day on which the map layout series are created.

ArrowURL
<a href="https://mdd.sharedgeo.org/mdd-gen?date=2017.1&amp;lat=41.6092&amp;lon=-93.4741&amp;zone=15&amp;of=png">https://mdd.sharedgeo.org/mdd-gen?date=2017.1&amp;lat=41.6092&amp;lon=-93.4741&amp;zone=15&amp;of=png</a>
<a href="https://mdd.sharedgeo.org/mdd-gen?date=2017.1&amp;lat=41.6093&amp;lon=-93.4621&amp;zone=15&amp;of=png">https://mdd.sharedgeo.org/mdd-gen?date=2017.1&amp;lat=41.6093&amp;lon=-93.4621&amp;zone=15&amp;of=png</a>
<a href="https://mdd.sharedgeo.org/mdd-gen?date=2017.1&amp;lat=41.6093&amp;lon=-93.4501&amp;zone=15&amp;of=png">https://mdd.sharedgeo.org/mdd-gen?date=2017.1&amp;lat=41.6093&amp;lon=-93.4501&amp;zone=15&amp;of=png</a>
<a href="https://mdd.sharedgeo.org/mdd-gen?date=2017.1&amp;lat=41.6631&amp;lon=-93.5105&amp;zone=15&amp;of=png">https://mdd.sharedgeo.org/mdd-gen?date=2017.1&amp;lat=41.6631&amp;lon=-93.5105&amp;zone=15&amp;of=png</a>
<a href="https://mdd.sharedgeo.org/mdd-gen?date=2017.1&amp;lat=41.6632&amp;lon=-93.4985&amp;zone=15&amp;of=png">https://mdd.sharedgeo.org/mdd-gen?date=2017.1&amp;lat=41.6632&amp;lon=-93.4985&amp;zone=15&amp;of=png</a>
<a href="https://mdd.sharedgeo.org/mdd-gen?date=2017.1&amp;lat=41.6632&amp;lon=-93.4865&amp;zone=15&amp;of=png">https://mdd.sharedgeo.org/mdd-gen?date=2017.1&amp;lat=41.6632&amp;lon=-93.4865&amp;zone=15&amp;of=png</a>
<a href="https://mdd.sharedgeo.org/mdd-gen?date=2017.1&amp;lat=41.6633&amp;lon=-93.4745&amp;zone=15&amp;of=png">https://mdd.sharedgeo.org/mdd-gen?date=2017.1&amp;lat=41.6633&amp;lon=-93.4745&amp;zone=15&amp;of=png</a>

## Set up Data Driven Pages to Include Magnetic Declination Diagram

After the “ArrowURL” has been created and populated in the dataset’s Attribute Table, the magnetic declination diagram can be added to the ArcMap Layout as follows:

- In the Layout view, from the Insert menu, select “Insert Picture”
- Select any temporary picture to load into the map and position this where you would like the magnetic declination diagram to be located.
- Next right-click the picture and select “Properties” to open the picture properties (see example below)
  - Under the Picture Tab, change Source to “Simple path from Data Driven Pages”
  - Select the “ArrowURL” field from the Index layer field list.
  - Click “Apply” or “OK” to save changes
- When the Data Driven Pages maps are recreated, the declination diagram will change for each map based on the URL from the dataset.

### Notes:

- Internet access must be available for this to function.
- It is recommend to create a subset of data driven pages to test the magnetic declination diagram is functioning correctly before running a batch of several hundred maps, that may take several hours to complete.

