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# Converting Between Clock Positions, Degrees, and Metric or Imperial Measurements Using Standard Equations or Microsoft Excel

Presented by

**Jeffrey Browning**

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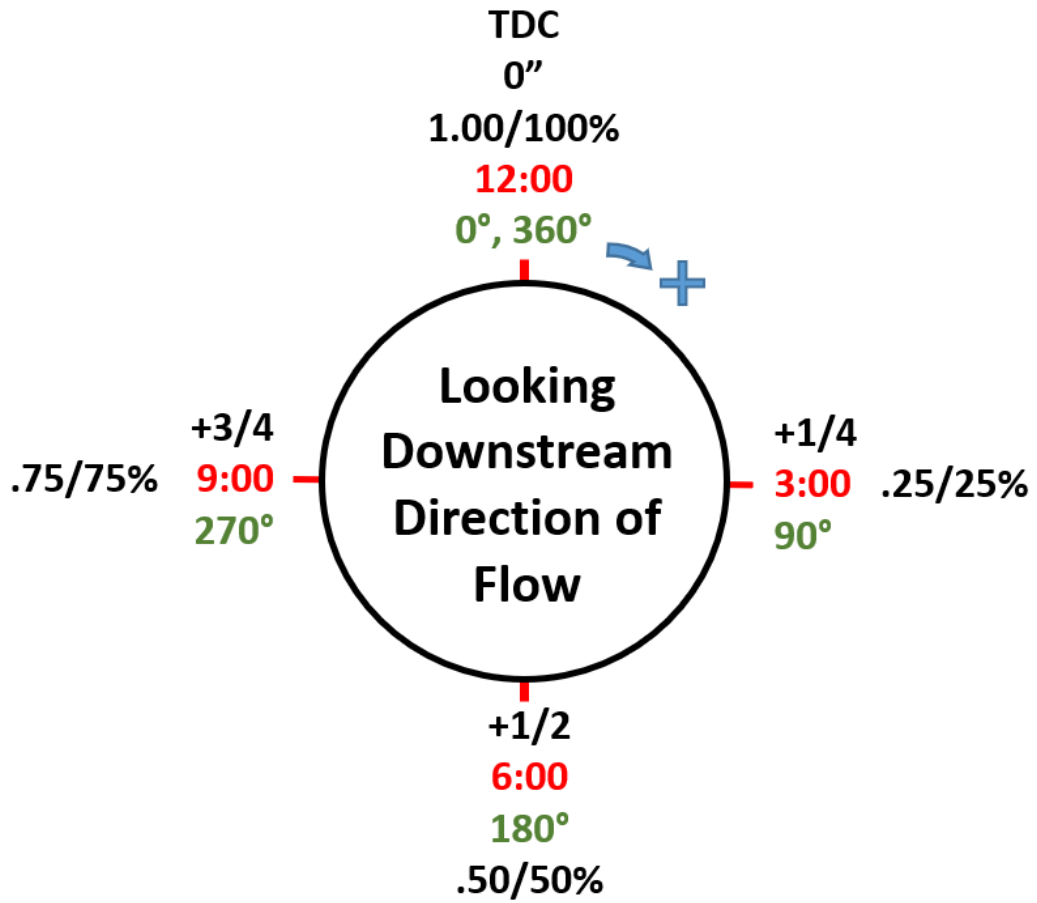
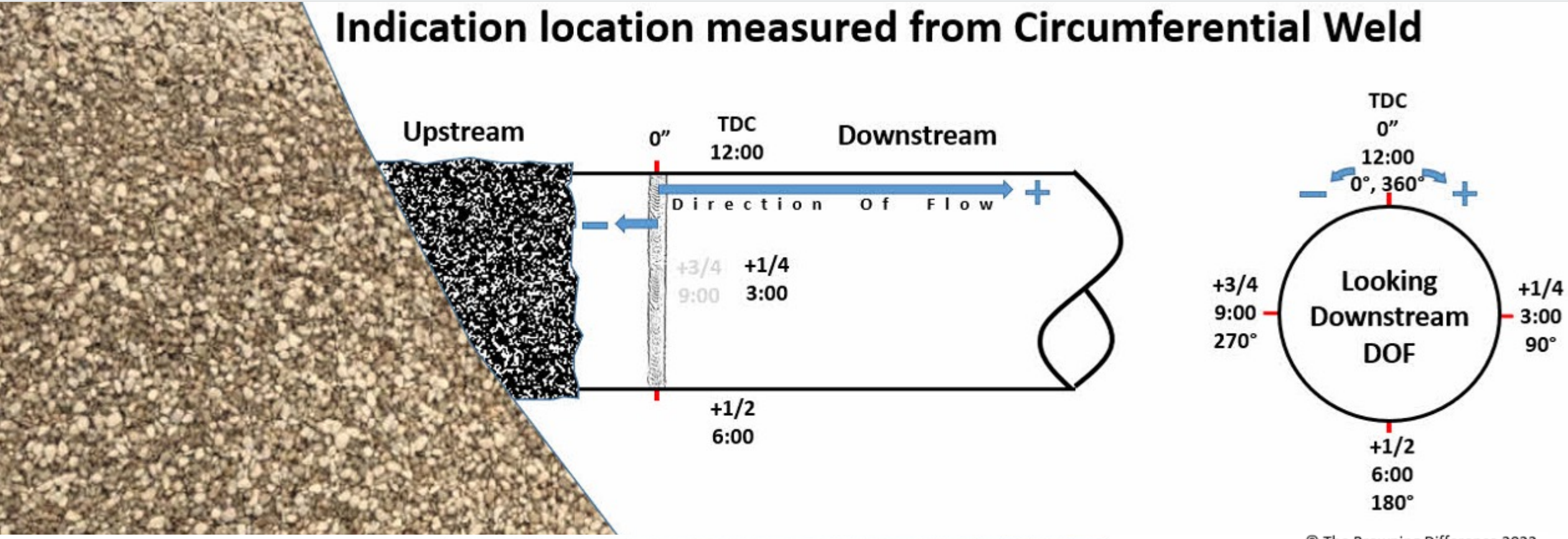
# Converting between Clock Positions, Degrees, and Metric or Imperial Measurements Using Standard Equations or Microsoft Excel






# Scope

Pipe inspection, specifically in-line inspection (ILI) validation work, requires an understanding of how to locate and mark a part with the area where the tool data indicates an anomaly. In direct assessment of an anomaly, the location of what is found must also be determined and reported.

Depending on the ILI tool type and vendor, the circumferential location of a call may be given in a clock position or degrees (typically measured “clockwise”, looking at the direction of flow, unless otherwise specified) and may need to be converted. This article will explain the basis for conversion between clock, degrees, and physical measurement, and how Microsoft Excel® quantifies clock as a value, which is then used to formulate the desired conversions.

# Midstream ILI Validation

- In Line Inspection tool – Smart Pig Tool Vendor reports an anomaly
- Pipeline owner/operator identifies anomalies to assess as part of their integrity plan
- Often a rehabilitation campaign is created to assess if repairs are required

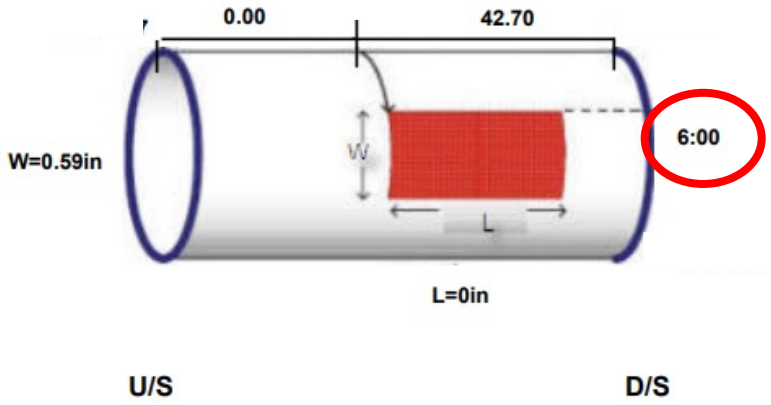
# Midstream ILI Validation

- NDE Technician is provided with dig sheets containing information about the anomalies to be assessed

- Technician must verify the location of the tool call often by comparing the joint length(s), orientation of longseams, direction of tool run vs. established direction of flow, etc.

# Midstream ILI Validation

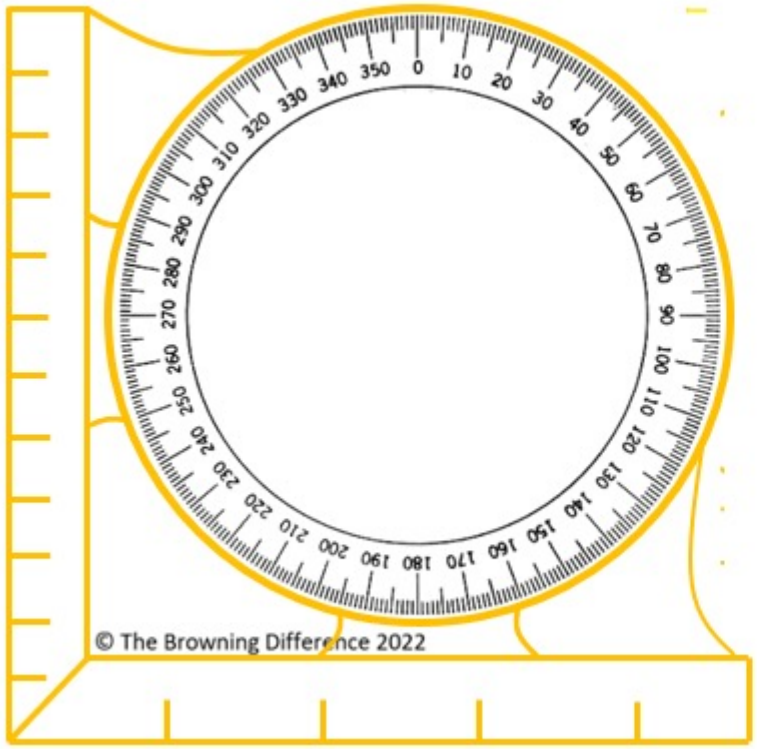
- The Dig Sheet contains most vital information, including **orientation** of the anomaly
- Diagrams are also provided as visual aid
- In the examples to right, the "target feature" **orientation** starts at 6:00



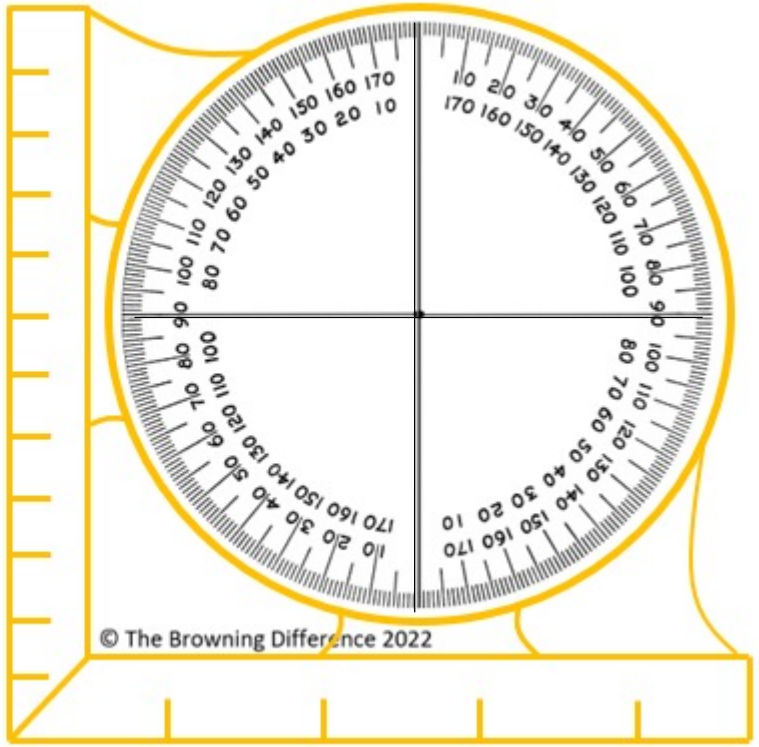

| Length (in) | Width (in) | Orientation | Dist US Weld (ft) | Dist DS Weld (ft) |
|---|---|---|---|---|
| 0.50 | 0.01 | 5:15 | 41 | 0.01 |
| | | | | |
| 0.45 | 0.59 | 6:00 | 0.00 | 42.70 |
| | | | | |
| 0.62 | 1.40 | 1:45 | 0.22 | 42.48 |
| 0.79 | 0.64 | 11:00 | 2.70 | 40.00 |
| | | | | |

TBDif

# Finding orientation



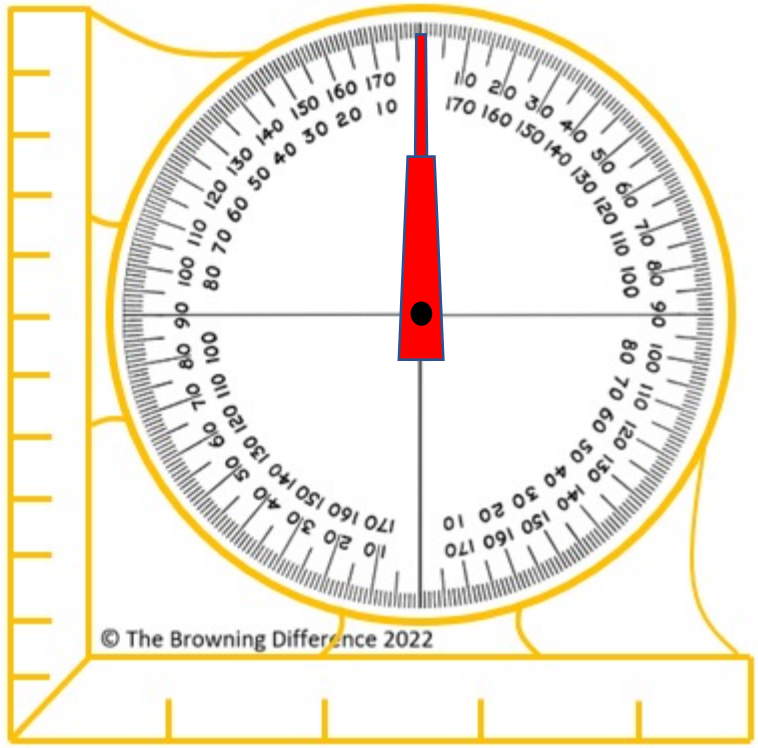

Angle Finder with 360° Scale




Angle Finder with 2 quadrant Scale

# Finding orientation

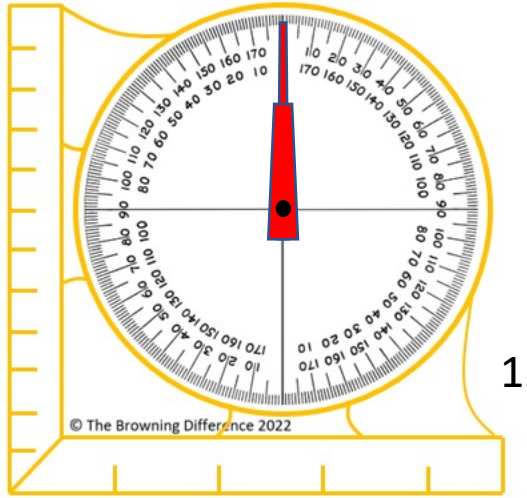
- **The angle finder, aka clinometer, inclinometer, danglometer, etc. may be used to measure degrees**



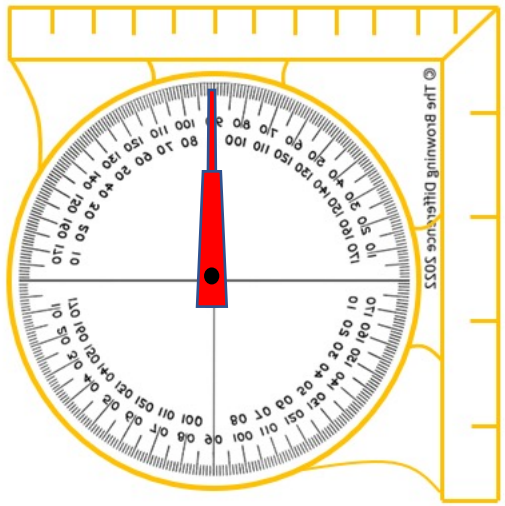
# Finding orientation

- The angle finder, aka clinometer, inclinometer, danglometer, etc. may be used to measure degrees

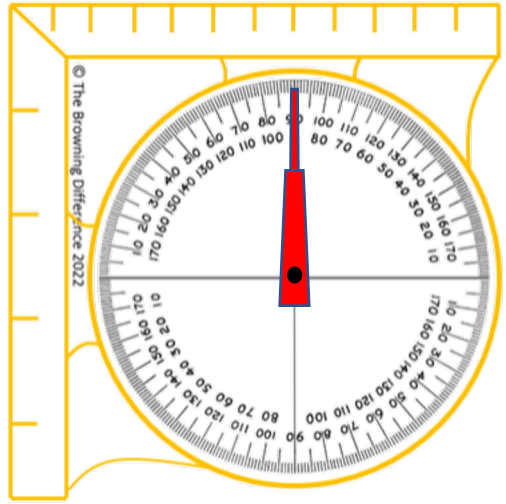
- It's important to know if the device is facing upstream or downstream




12:00




9:00

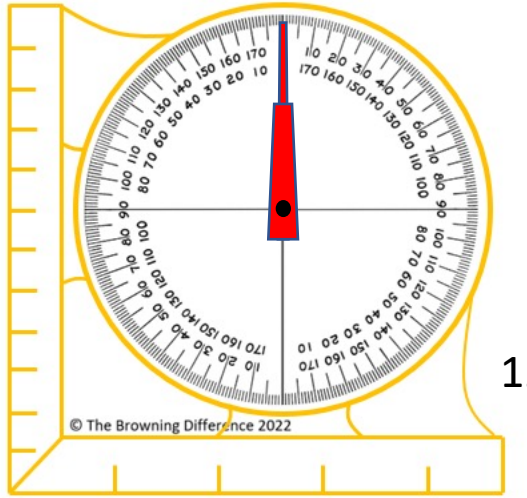



3:00

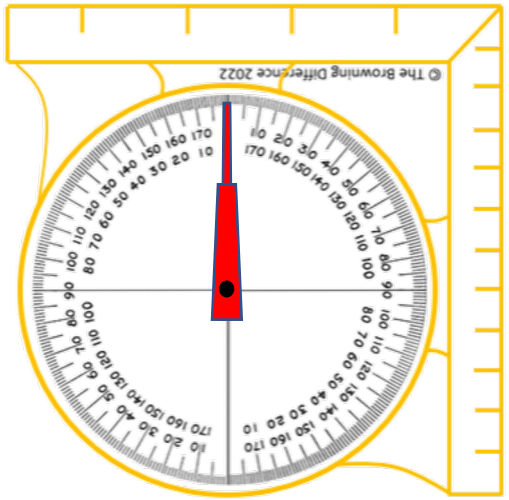
Face Pointing Upstream

# Finding orientation

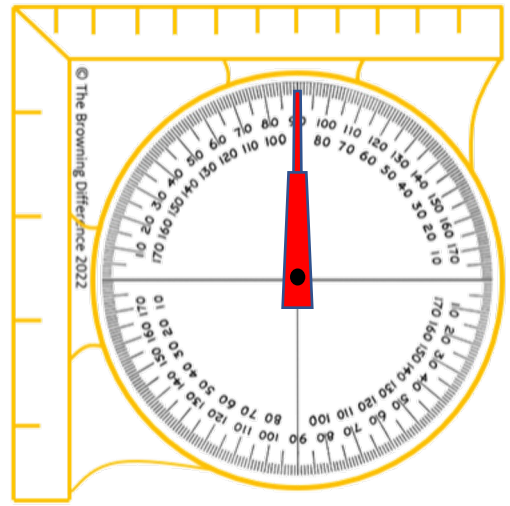
- The angle finder, aka clinometer, inclinometer, danglometer, etc. may be used to measure degrees
- It's important to know if the device is facing upstream or downstream
- Technician must be familiar with how to calculate the degrees position using the device.




12:00




9:00




3:00

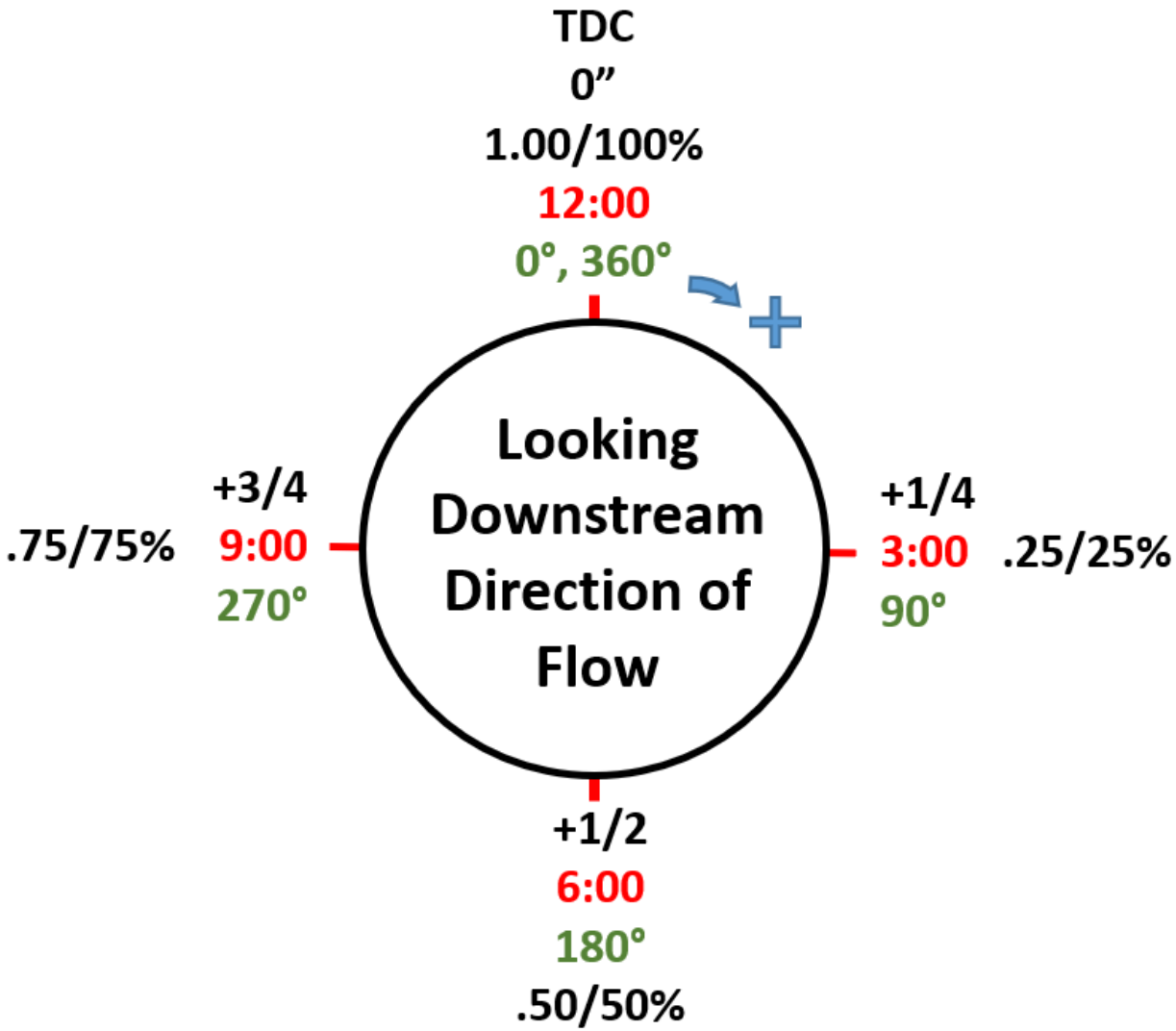
Face Pointing Upstream, Technician Looking Downstream

# Finding Orientation

- Another option is to physically measure the circumferential location with a flexible tape
- Conversions are required from clock to know the measurement to make

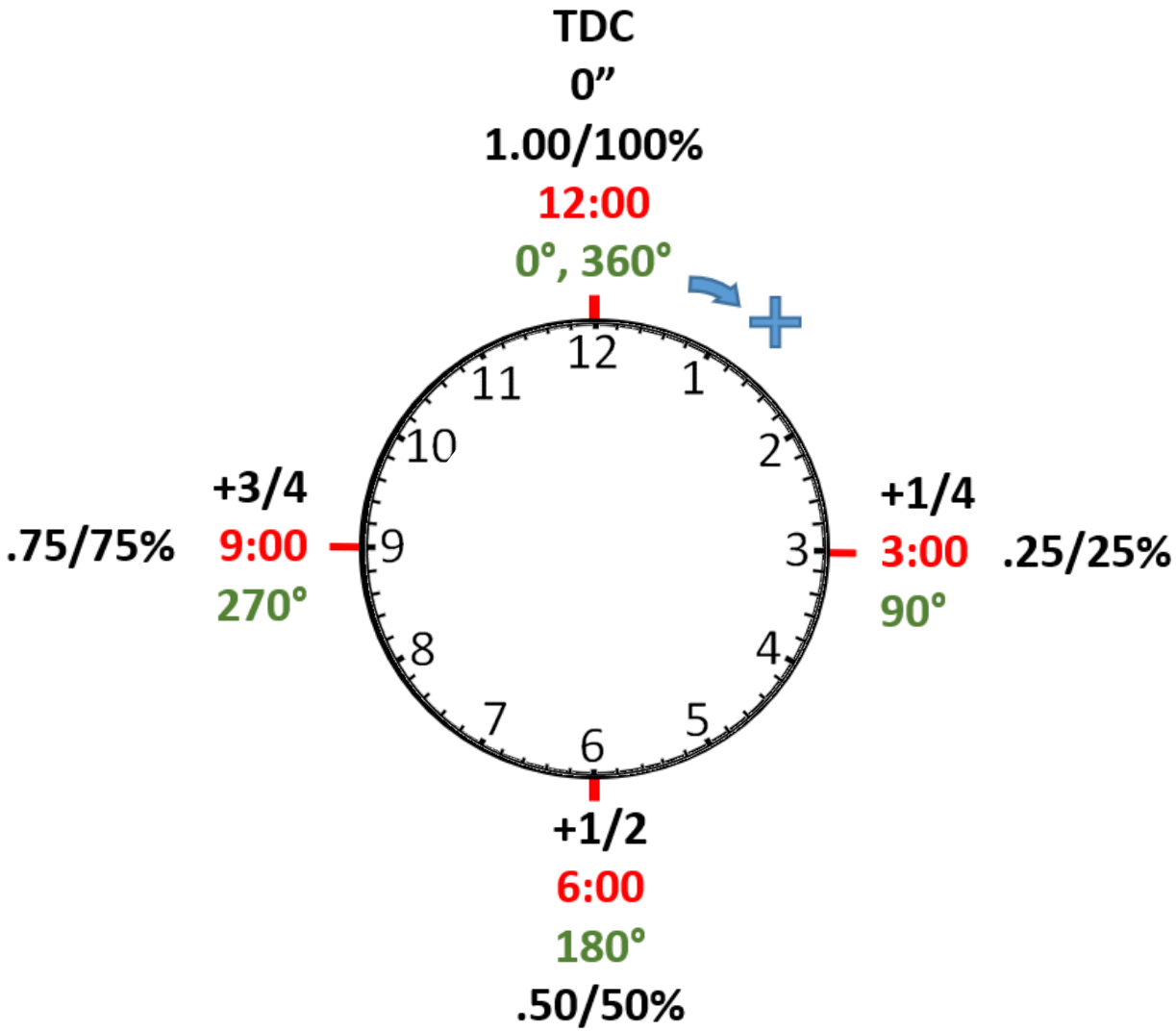
# What is clock?

- Unit of measure on a circle
- Evenly divided into Hour units
- Each Hour unit subdivided into 60 even minute units



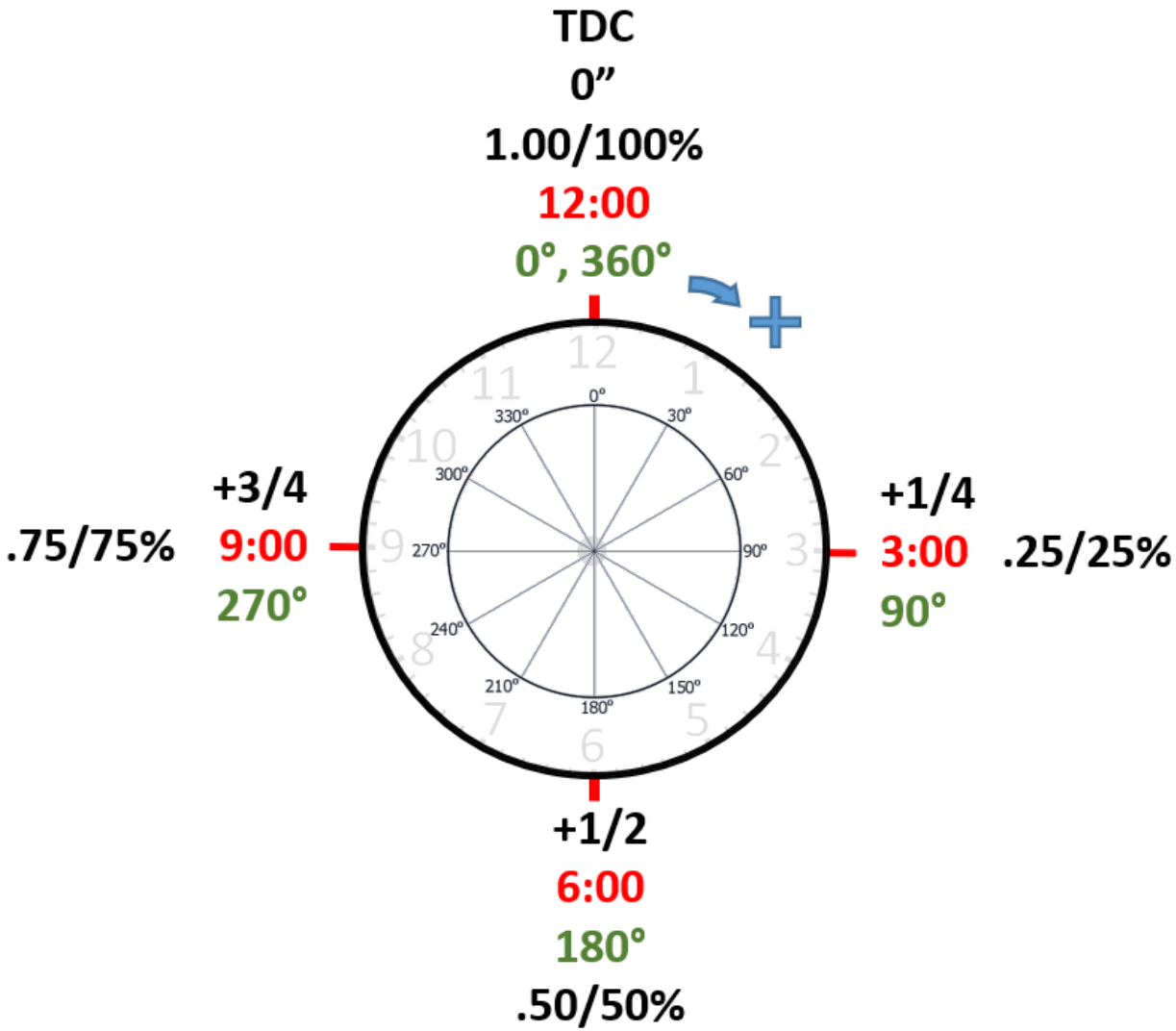
# What is clock?

- Unit of measure on a circle
- Evenly divided into Hour units
- Each Hour unit subdivided into 60 even minute units
- **12-hour clock is used for position measurement purposes**



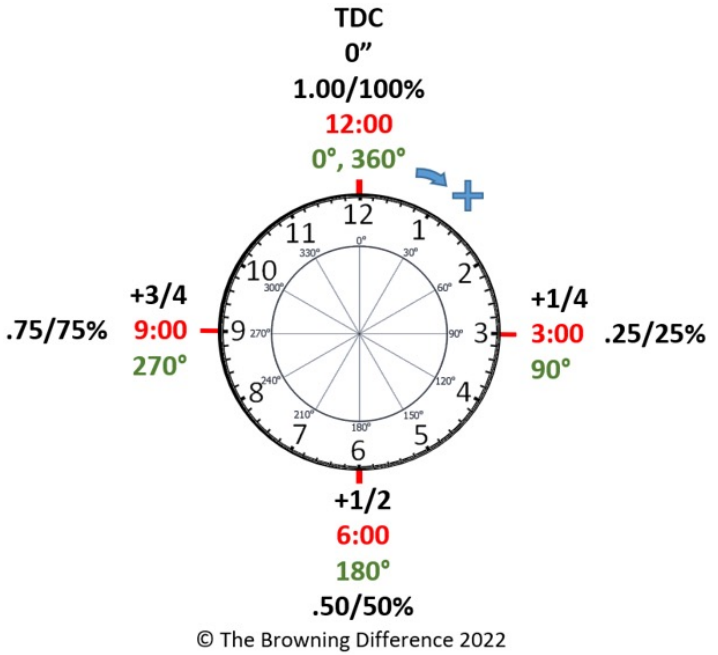
# What are Degrees?

- Unit of measure on a circle
- Evenly divided into 360 degrees
- whole degrees subdivided into fraction of degree
- Degrees measured around the circumference, but representative of angles from centerpoint in relation to 0°



# What is a Physical Measurement?

- Unit of measure taken with a measuring device
- Metric, Standard, Decimal, etc.
- Must determine Top Dead Center or other starting point
- To convert, full circumference must be known



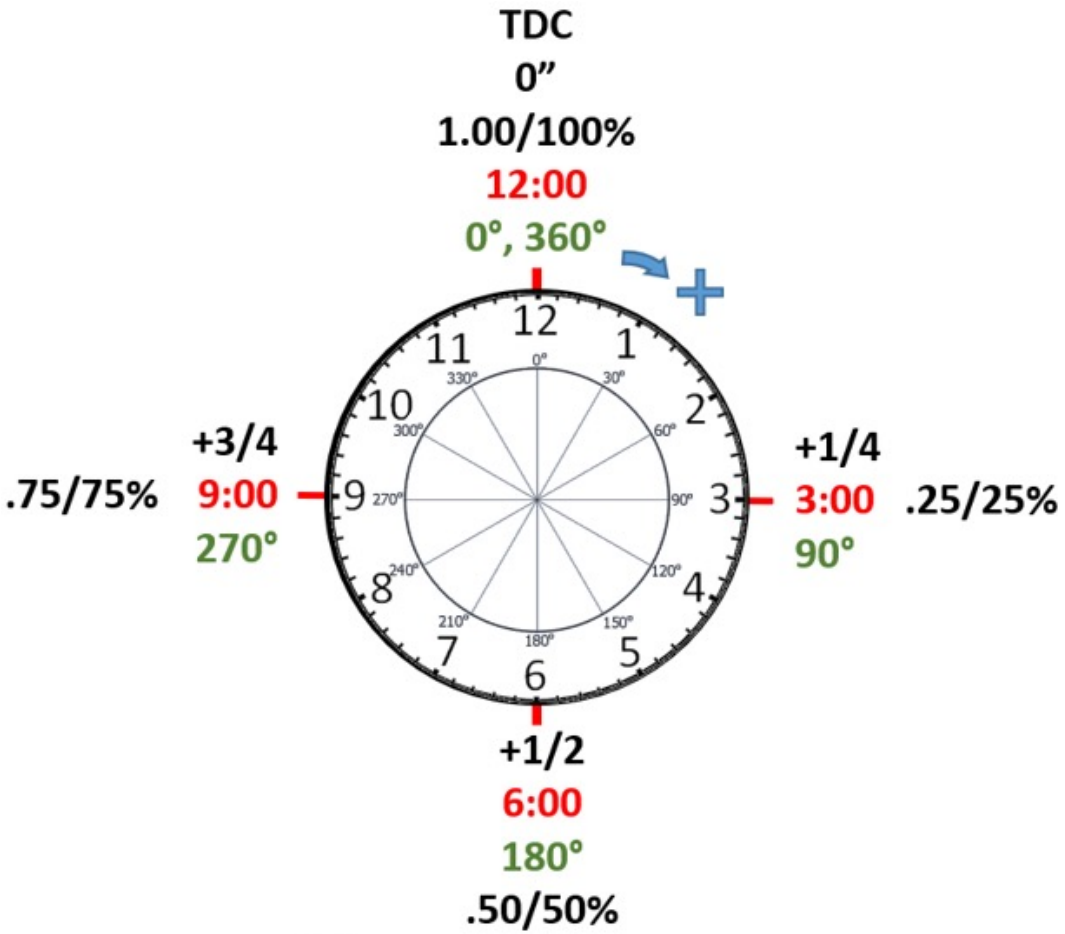

39.5” Circumference

# The Relationship

**Clock**

**Degrees**

**Physical Measurement?**



# What is Clock?

Clock is a unit of measurement on a circle, which is evenly divided into 12 units, with each unit equaling a value of one hour. Each hour is evenly divided into 60 sub-units, with each sub-unit equaling one minute. For the discussed purpose here, a given value in clock will be equivalent to a time value on a 12-hour clock.

For a quick understanding of this, note that if you look at a clock face, 6:00 is at the bottom extent of the circle, 12:00 the top, 3:00 the right, and 9:00 the left. Twelve hours of 60 min each means there are 720 min in the 12-hour clock. This will be important to remember.

# What are Degrees?

When given in degrees, a location on a circle is represented by 360 evenly divided units, usually measured from top dead center (0 in., or 12:00), or a designated reference point. In some cases, whole value degrees are sufficient. However, if a sub-unit is required, it can be designated as a decimal place value in tenths or hundredths. If exact conversions are needed when calculating between clock and degrees or physical measurement, then you should use a sub-unit value of whole angles.

# What is a Physical Measurement?

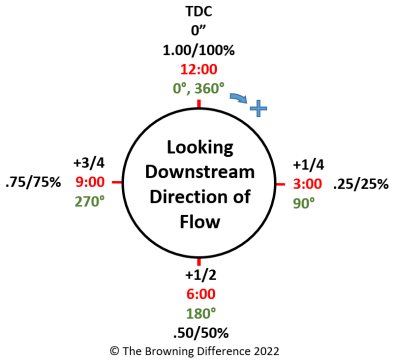
An equivalent to clock and degrees can be physically measured on a pipe, or circle. A physical measurement is *in relation to the full circumference*, to be accurately converted to either clock or degrees.

# What is a Common Conversion Value?

All three of these measuring techniques can be easily converted by calculating the common value of percentage. If a given measurement is formulated as a percentage of the full circle, then the logic of conversions starts to become apparent.

Since percentage is represented as a sub-unit of the whole number 1, we know that 0.50 = 50%.

We have now established the groundwork for making conversions. Consider the relationship of different measurement techniques in this diagram.



# The Relationship

Clock

Degrees

Physical

Measurement?

## Percentage

as decimal or % values

# Quick Conversions

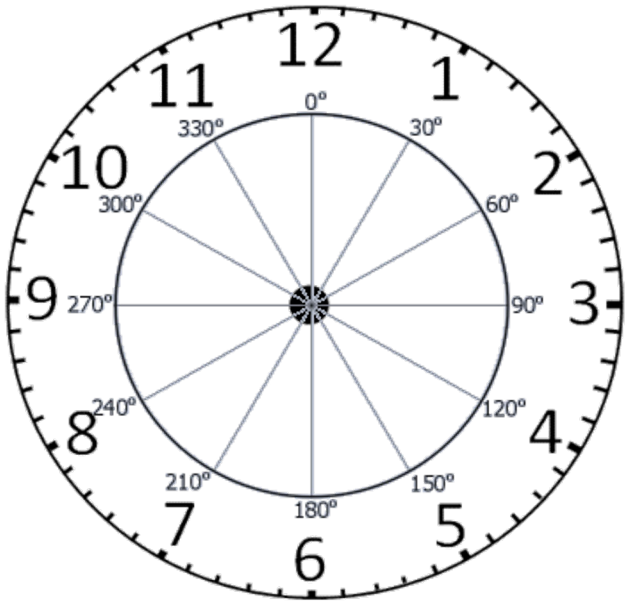
While calculating percentage is an excellent method for formulating conversions, there is also a need for quick calculations that are field ready. Let's explore a few of these relationships.

Consider there are 720 min in the 12-hour clock and 360° around a circle.

360 is exactly half of 720, which means that every **2 min is equal to 1°**.

**TDC**
**720 Minutes**
**360°**

**540 Min**
**270°**




**180 Min**
**90°**

**360 Min**
**180°**

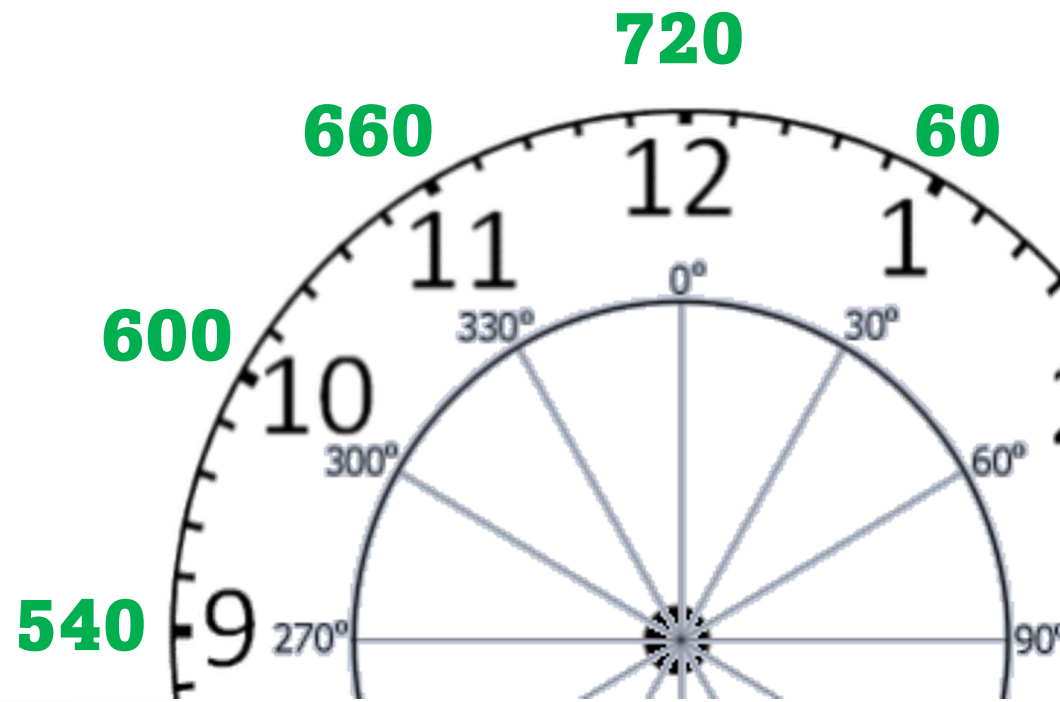
***2 Minutes = 1 Degree***

# Quick Conversions

***2 Minutes = 1 Degrees***

***60 Minutes = 30 Degrees***

***720 Minutes = 360 Degrees***



## *Converting Clock to Degrees*

6:45 is equal to (6:00 = 6 x 60 = 360 min) + 45 min = 405 min

Since every 2 min is 1°, 405 divided by 2, equals 202.5°.

## *Converting back from Degrees to Clock*

202.5° x 2 = 405 min

This can be solved in two ways:

- 405 min ÷ 60 = 6 hours with a remainder of 45 min
  **(Use the whole number and subtract the remainder of the min e.g. (60 min x 6 hours = 360 min, 405 min – 360 min = 45 min)**; or
- 405 min ÷ 60 = 6 hours and 0.75 hours,
  0.75 is 75% of 60 sub-units (minutes)
  0.75 x 60 = 45
  6 hours and 45 min = 6:45


**6:45**
**405 minutes**
**202.5°**

**6:45**
**405 minutes**
**202.5°**

***2 Minutes = 1 Degree***

## *Converting Physical Measurement Back to Clock*

You have measured from top dead center, clockwise looking direction of flow, 35.325" on a 20" diameter pipe:

- 35.325 in. ÷ 62.8 in. = 0.5625 (56.25%)
  0.5625 x 720 min = 405 min

See the two ways outlined above to convert minutes to hours: minutes

## *Converting Using Percentage*

Any conversion can be made as a percentage by dividing the measurement by the full circle value.

- Clock: 405 min ÷ 720 min = 0.5625 (56.25%)
- Degrees: 202.5 ° ÷ 360° = 0.5625 (56.25%)
- Physical measurement: 35.325 in. ÷ 62.8 in. = 0.5625 (56.25%)


**6:45** *of* **12:00**

**405 minutes** *of* **720 minutes**

**202.5°** *of* **360°**

***2 Minutes = 1 Degree***

| | | |
|---|---|---|
| **6:45** | *of* | **12:00** |
| **405 minutes** | *of* | **720 minutes** |
| **202.5°** | *of* | **360°** |


***"All Equal the Same Percentage"***

***2 Minutes = 1 Degree***

6:45 / 12:00

405 minutes / 720 minutes

202.5° / 360°


6:45 ÷ 12:00

405 ÷ 720 = .5625

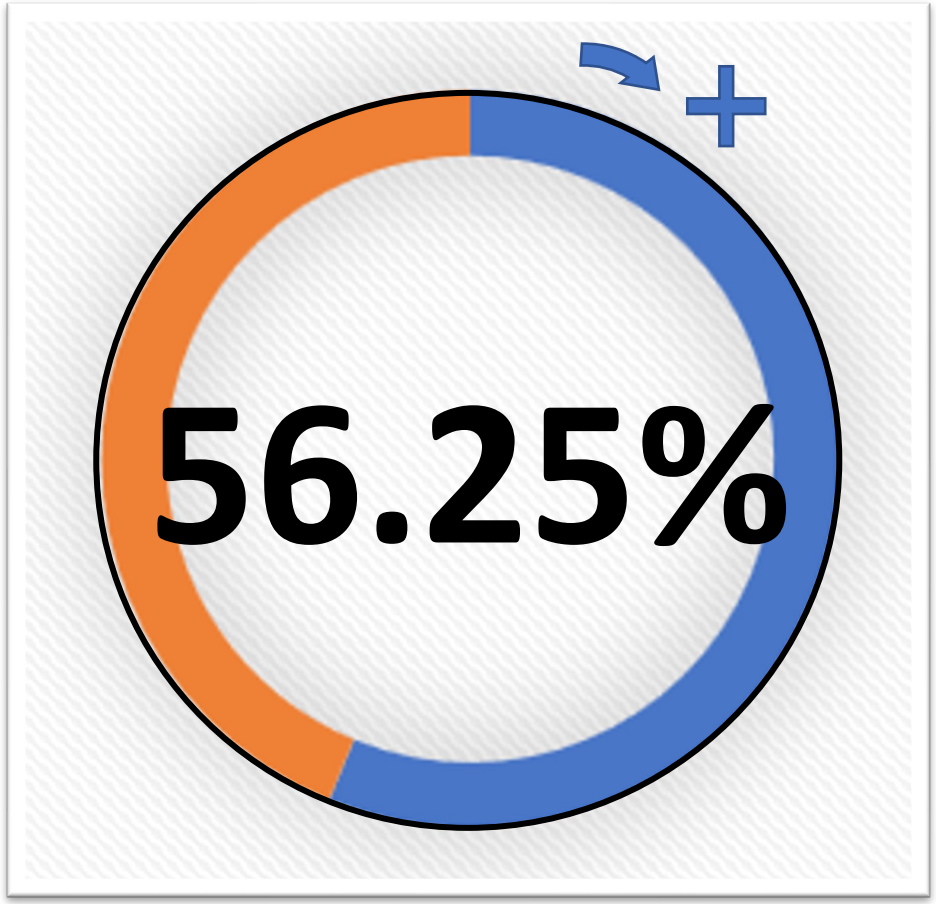
202.5° ÷ 360°

***"All Equal the Same Percentage"***

***2 Minutes = 1 Degree***

6:45 ÷ 12:00
405 ÷ 720
202.5° ÷ 360°

= .5625




*2 Minutes = 1 Degree*

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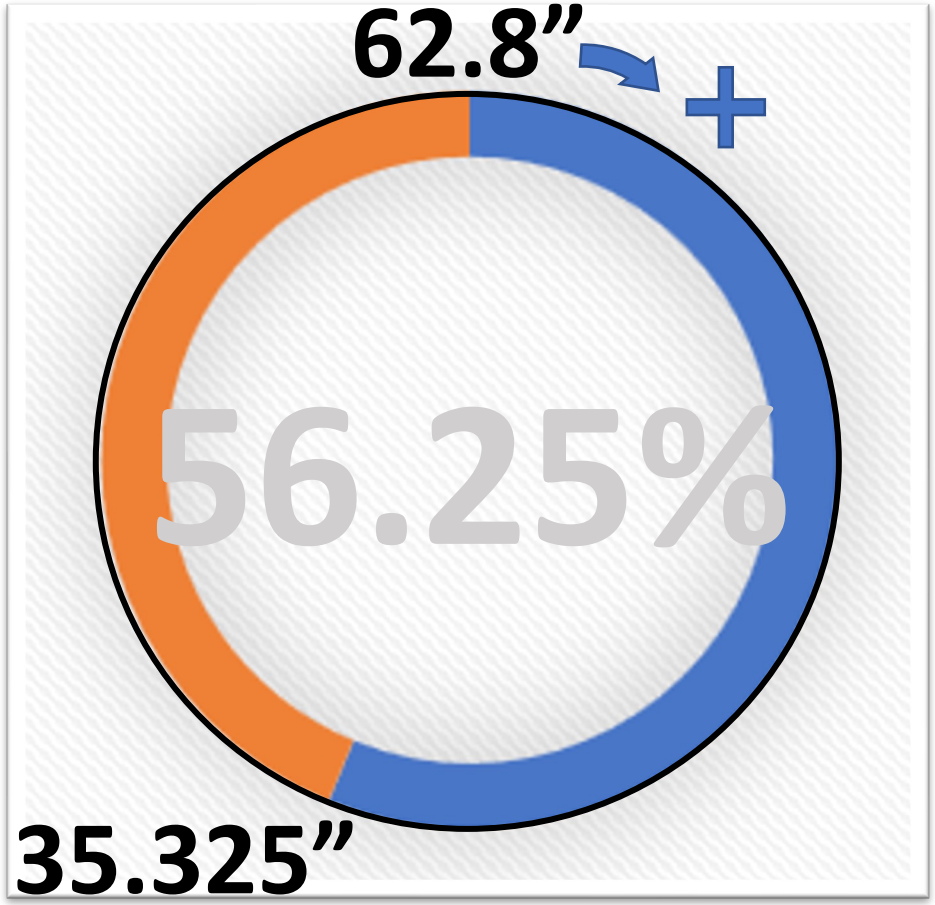
See the two ways outlined above to convert minutes to hours: minutes

**56.25% x 62.8"**

**=35.325"**




***2 Minutes = 1 Degree***

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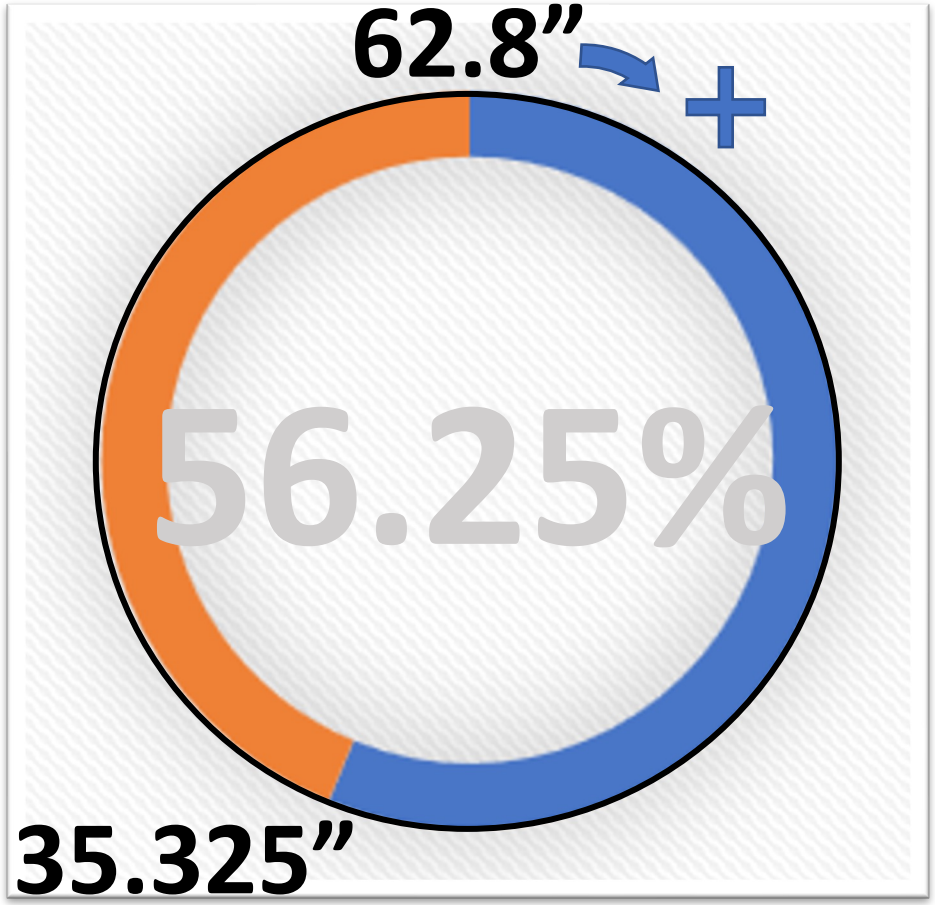
See the two ways outlined above to convert minutes to hours: minutes

56.25% x 62.8"

=35.325"

**35.325" ÷ 62.8"**

**= .5625**




***2 Minutes = 1 Degree***

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  0.5625 x 720 min = 405 min

See the two ways outlined above to convert minutes to hours: minutes

56.25% x 62.8"

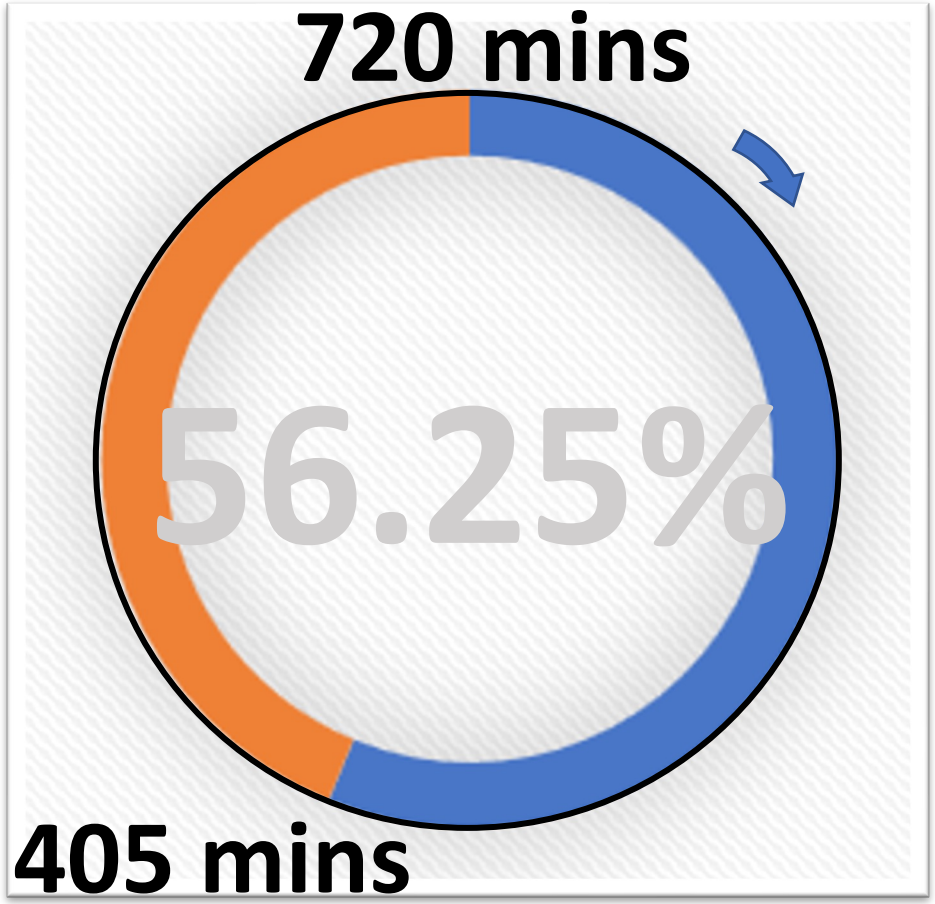
=35.325"

35.325" ÷ 62.8"

= .5625

**.5625 x 720 minutes**

**= 405 minutes**




***2 Minutes = 1 Degree***

56.25% x 62.8”

=35.325”

35.325” ÷ 62.8”

= .5625

.5625 x 720 minutes

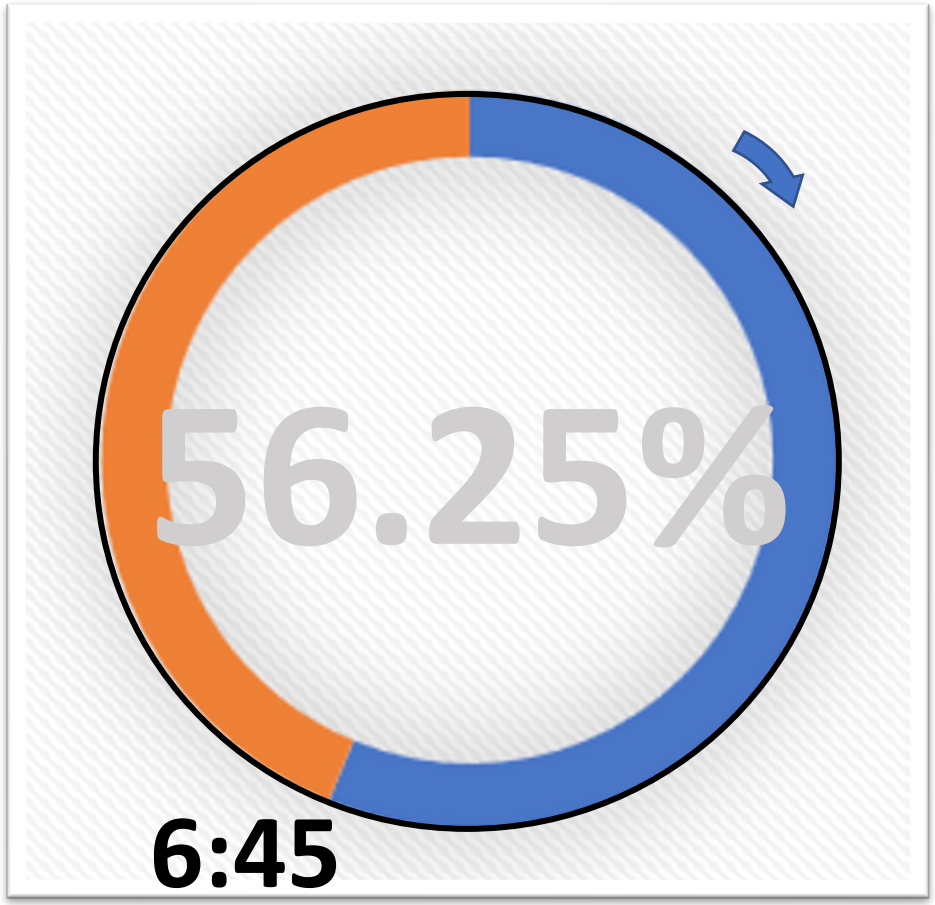
= 405 minutes

**405 minutes ÷ 60 minutes**

**= 6Hrs + .75Hrs**

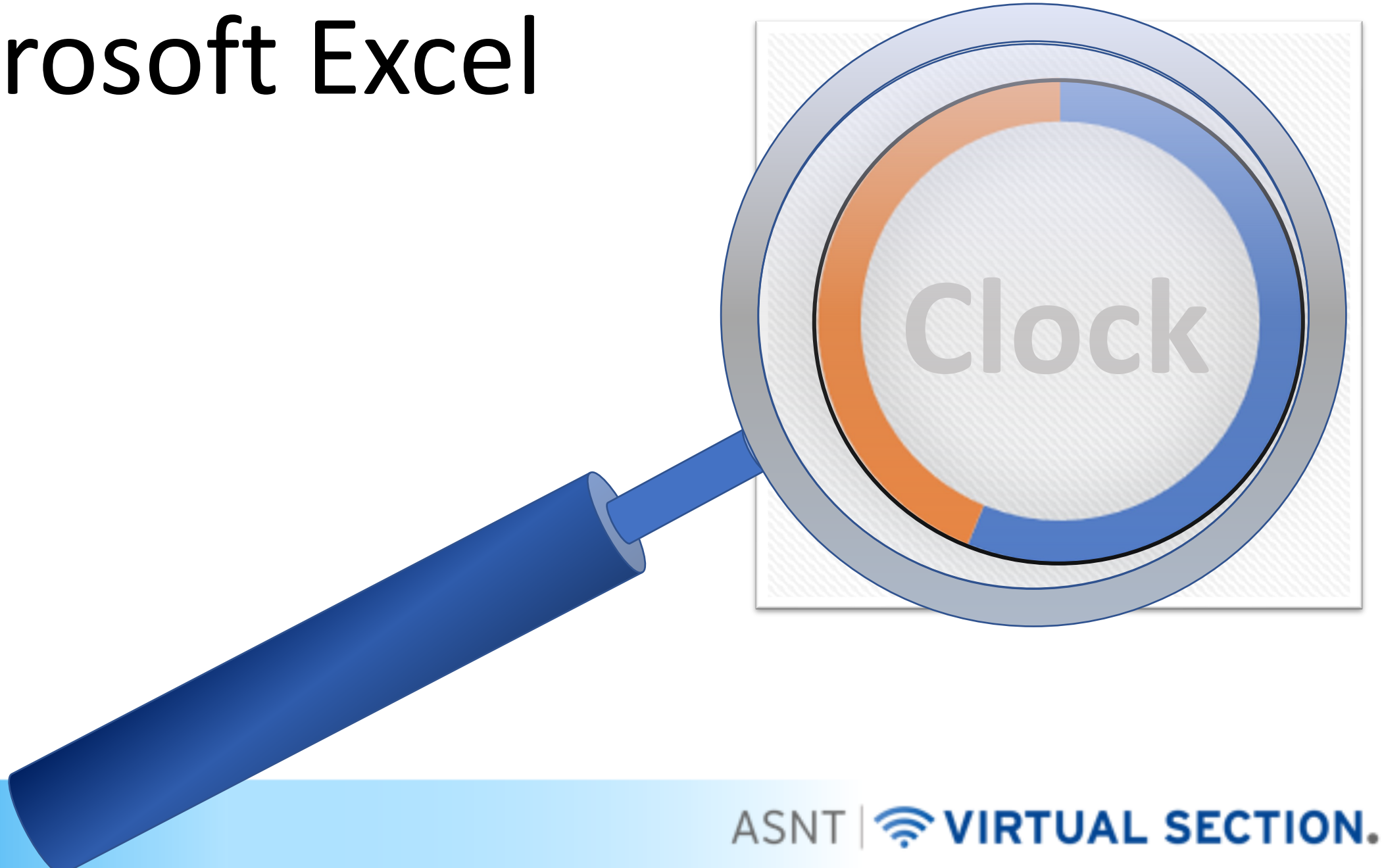
**.75 X 60 mins = 45 mins**

# =6:45




***2 Minutes = 1 Degree***

# Microsoft Excel



# Microsoft Excel

*Excel calculates a circle as a 24 hour clock*

***24 Hour Clock = 1***
***12 Hour Clock = .5***

*The value of 1 Hour*

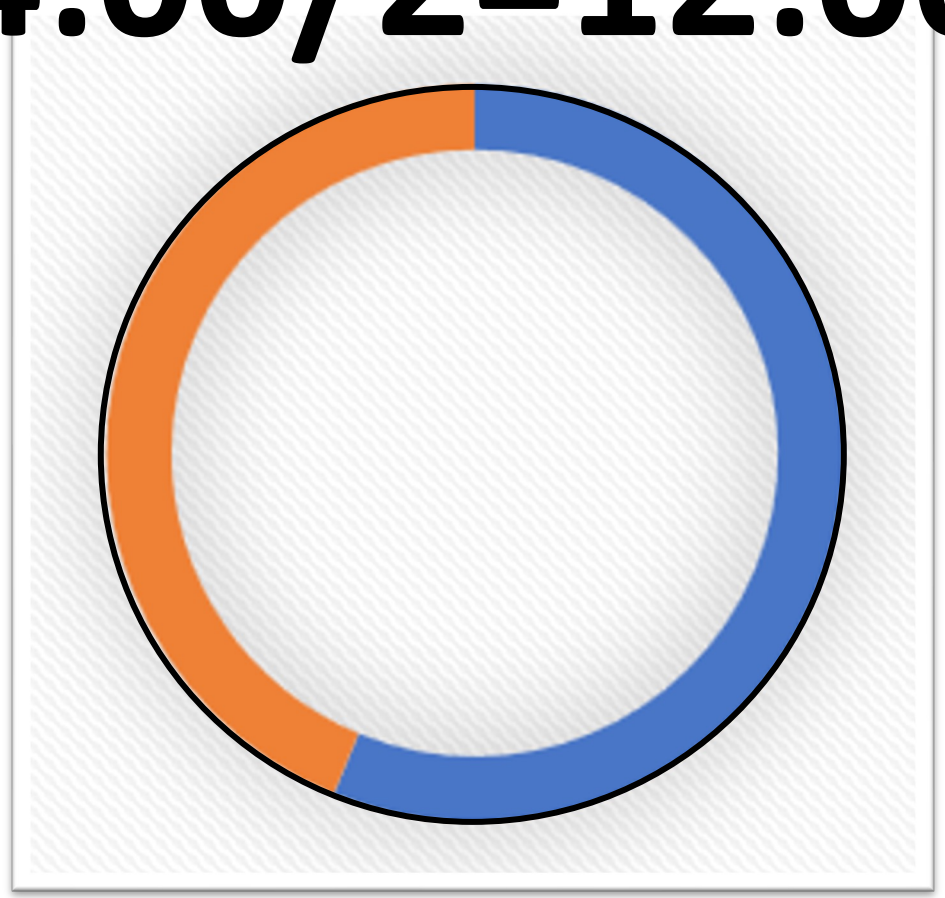
**1:00 ÷ 12:00 = .08333**

**.08333 x .5 = .041667,** or

**1:00 ÷ 24:00 = .041667**

# Microsoft Excel

**24:00/2=12:00**



**The important thing to know**

**12hr clock = .5**

**To convert, divide by 2**

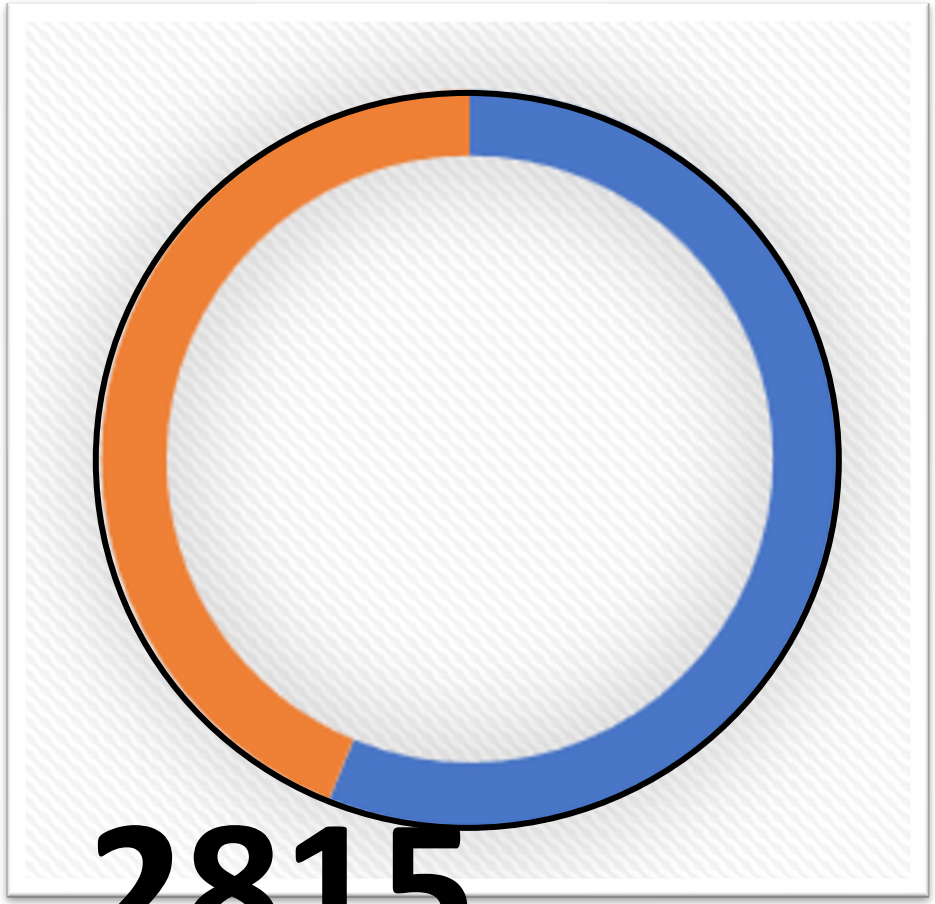
# Microsoft Excel

**The numerical value of 6:45**

*<u>Percentage</u> divided by 2*

**.5625 x .5 = .2815**

**.5625 ÷ 2 = .2815**



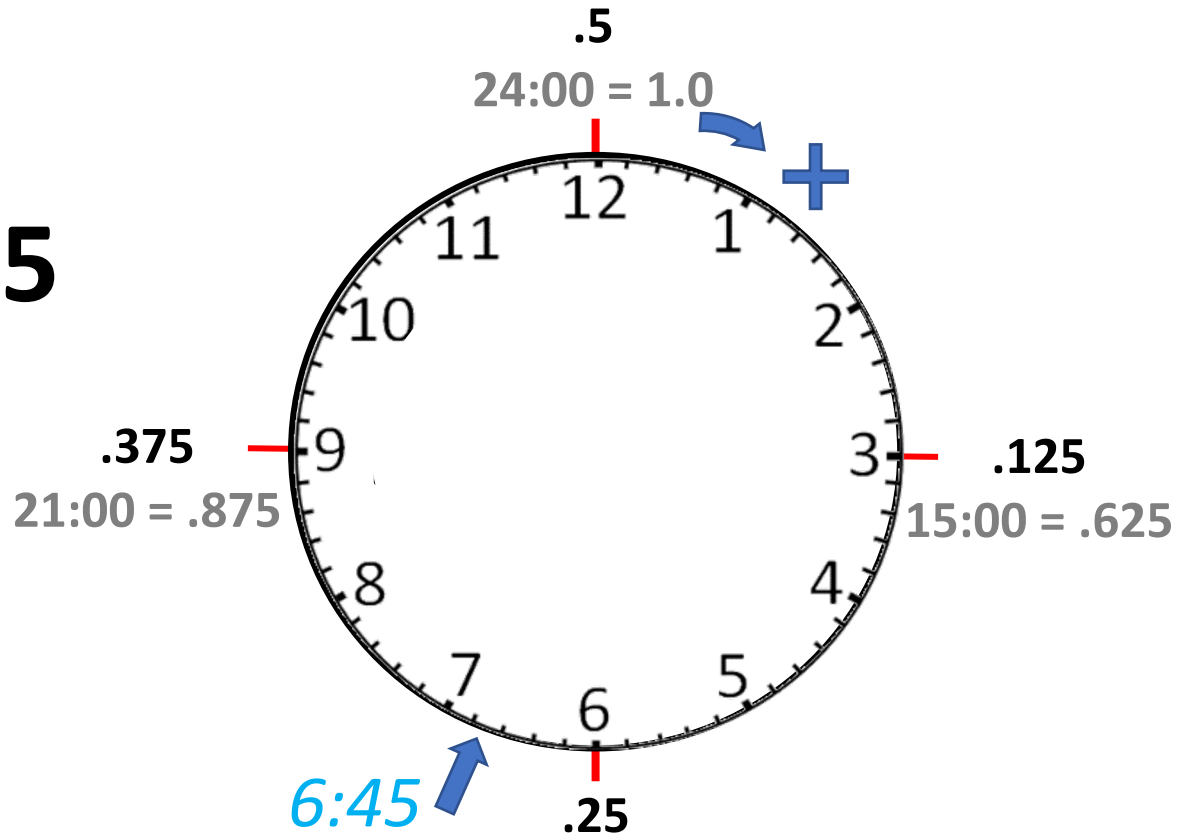
**.2815**

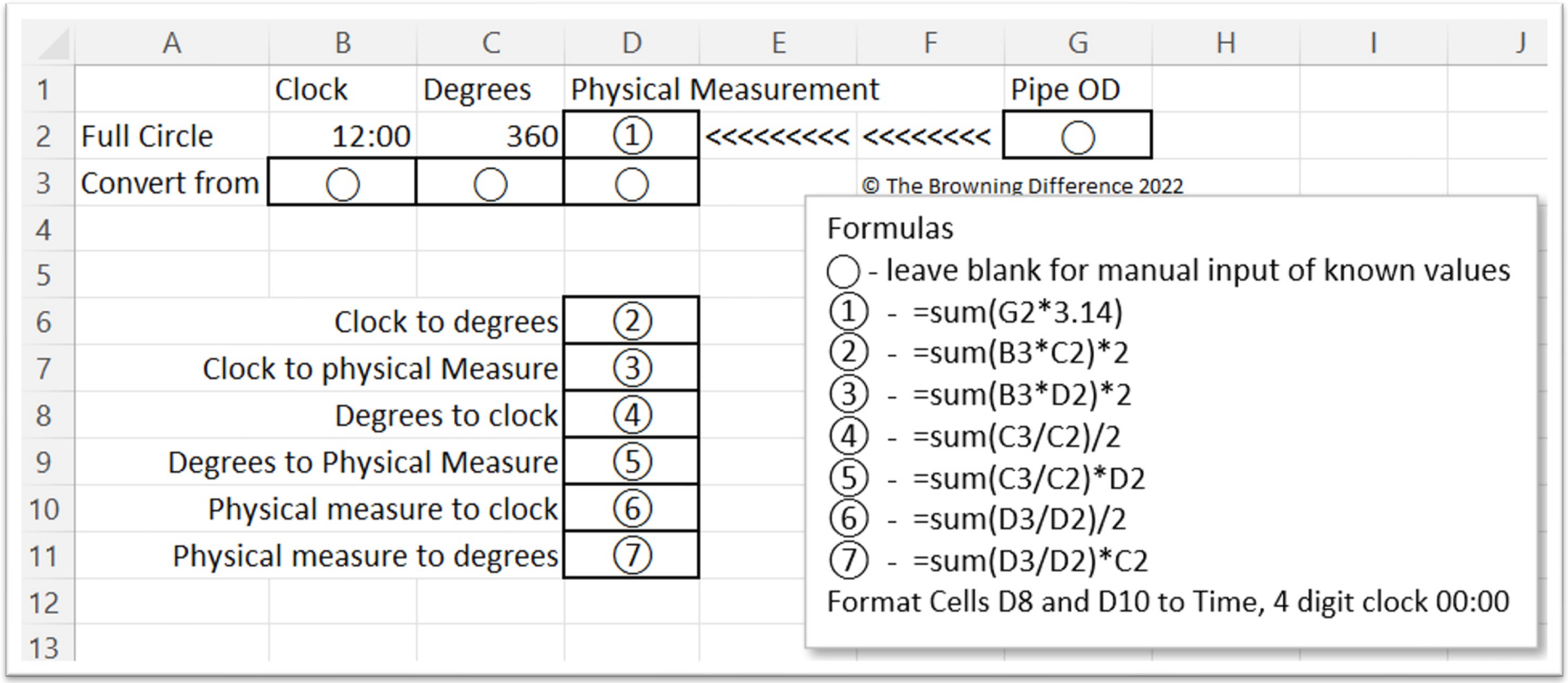
# Microsoft Excel

## The numerical value of 6:45

*Percentage divided by 2*

*The value can also be considered as a percentage of the 24 Hour Clock*





| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | Clock | Degrees | Physical Measurement | | | Pipe OD | | | |
| 2 | Full Circle | 12:00 | 360 | ① | <<<<<<<<< | <<<<<<<< | ◯ | | | |
| 3 | Convert from | ◯ | ◯ | ◯ | | | | | | |
| 4 | | | | | | | | | | |
| 5 | | | | | | | | | | |
| 6 | | | Clock to degrees | ② | | | | | | |
| 7 | | | Clock to physical Measure | ③ | | | | | | |
| 8 | | | Degrees to clock | ④ | | | | | | |
| 9 | | | Degrees to Physical Measure | ⑤ | | | | | | |
| 10 | | | Physical measure to clock | ⑥ | | | | | | |
| 11 | | | Physical measure to degrees | ⑦ | | | | | | |
| 12 | | | | | | | | | | |
| 13 | | | | | | | | | | |



Formulas

◯ - leave blank for manual input of known values

① - =sum(G2*3.14)

② - =sum(B3*C2)*2

③ - =sum(B3*D2)*2

④ - =sum(C3/C2)/2

⑤ - =sum(C3/C2)*D2

⑥ - =sum(D3/D2)/2

⑦ - =sum(D3/D2)*C2

Format Cells D8 and D10 to Time, 4 digit clock 00:00

**As seen in the examples above, converting from 24 hr to 12 hr clock requires mulitiplying or dividing by 2**

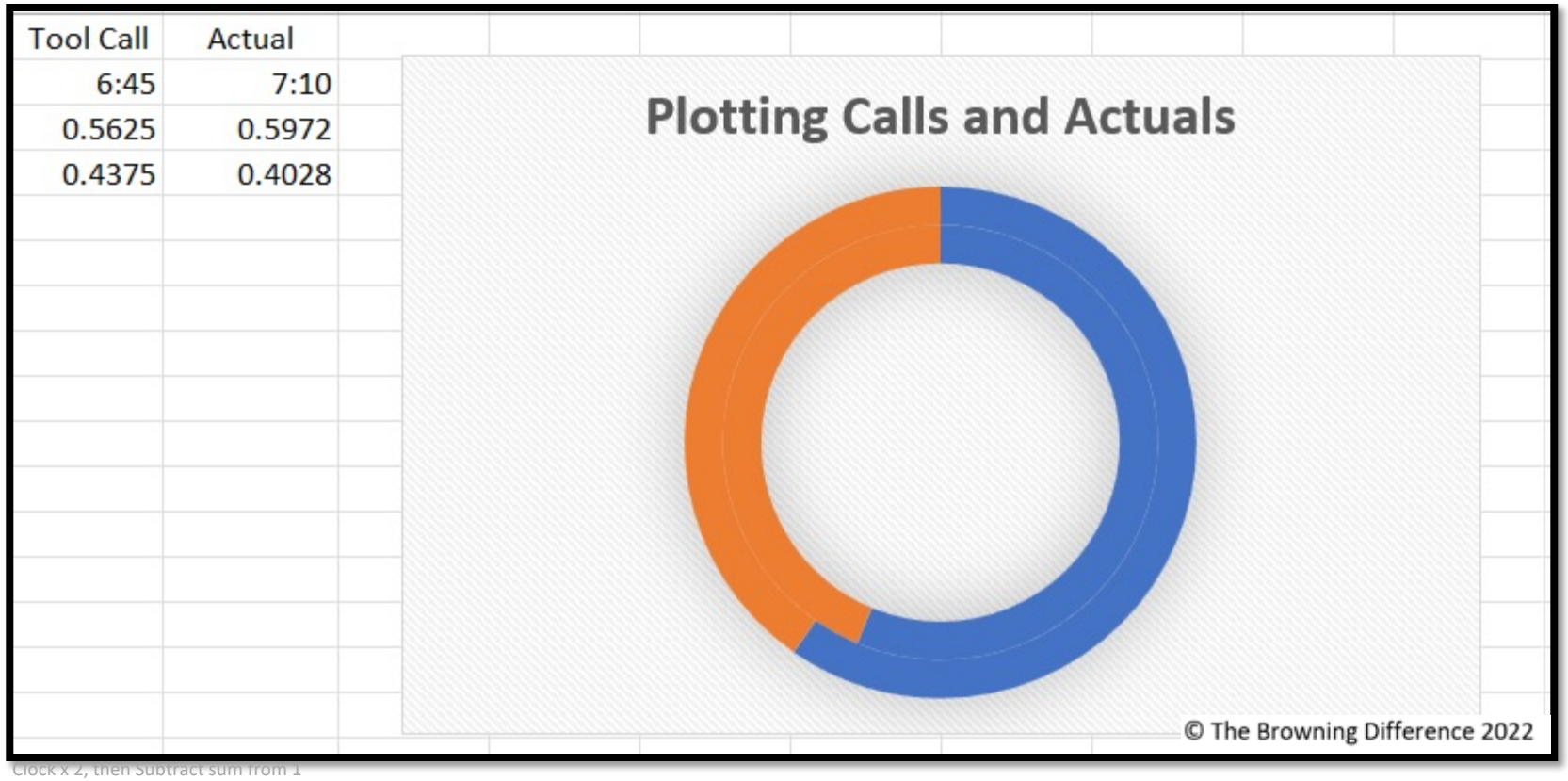
# Microsoft Excel Challenge

There are two clock positions plotted on the pie graph. Each of the two clock positions requires two known values calculated by very simple formulas. Duplicate the Pie Chart below and post the two formulas you used in the comments for this presentation on the ASNT website.

Formula 1 →

Formula 2 →

| Tool Call | Actual |
|---|---|
| 6:45 | 7:10 |
| 0.5625 | 0.5972 |
| 0.4375 | 0.4028 |




Clock x 2, then Subtract sum from 1