Description

This document includes a requirements list for the Wyman-Gordon Houston (WGH) Draw Bench iOS app.

App Version

1.0

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Purpose

This app is intended to help minimize loss of time, reduce the chance for pipe scraping, and make R&D testing more efficient and valuable.

It is often necessary to make sure that drawn pipe specs meet customer requirements. Currently, when conducting R&D tests, data is written down on a notepad and handled after the tests are done. This iPhone app will allow for on-site calculations of %RA, drawn lengths, and wall average. On-site critical information makes engineers aware of premature issues in the drawing process, which, in turn, allows for quick decision making, corrections, and capital savings. The OCTG pipe sales personnel will be able to make use of the weight per foot calculator when putting together a quote for a customer. Potentially, other PCC companies, such as SMC and Rollmet, will also make use of the app.

Features

This app will show the input and output values on one screen, making it easy to verify input and output values simultaneously. All of these calculations could be done with a simple calculator, but it is difficult to keep track and make sure the correct data and equation are used. This app will quickly help predict if a pipe will make mechanical properties, make length, and even calculate the weight per foot of a pipe.

App Details

The app will calculate several different values from different user inputs. The calculated values will be useful in quickly gathering vital draw bench information. Version 1.0 will be used and tested at the WGH draw-bench and eventually distributed to other PCC sister companies.

The app will be fairly easy to use and will have an “about” page.
The app will

- calculate pipe weight per foot,
- calculate pipe percent reduction of area (%RA) using tube cross-sectional areas,
- calculate pipe percent reduction of area (%RA) using the 1-1 measurements,
- calculate pipe average wall, min and max (2-value average),
- calculate pipe average wall, four positions (4-value average),

- estimate pipe drawn length, and
- estimate the required pipe extrusion length.

The main screen/view will contain a list of the types of calculations. Each list item will take the user to the appropriate screen/view to perform the respective calculation. Each of the above calculations will have its own view and view controller. All calculation screens/views will contain "Share" and "Back" buttons to e-mail/message the calculated information to others and to return to the main screen/view, respectively.

Assumptions

Several assumptions are made in the value calculations.

The pipe is assumed to be perfectly straight, perfectly concentric, and have constant cross-sectional areas for the entire length the pipe in all of the function except for the "Calculate Wall Average" functions. This app also assumed that non-drawn (point/discarded) portions of pipe do not stretch/shrink during the drawing process. All of the calculations are theoretical and non-absolute.

The rest of this document describes the calculations this app will perform and the equations used to calculate the necessary information.

Calculate Weight per Foot

Required Inputs

- density
- OD
- wall or ID

Density

The user will be able to either select the alloy to determine the alloy density or enter a custom density value in pounds per cubic inches (lbs./in.^{3}).

- A drop-down menu or "pickers list" will allow the user to select the alloy. The density field will automatically fill in with the respective density value. The user will be able to change the value or input a custom density value if necessary.
- Table 1 lists a few alloys and their appropriate densities.

Table 1: Alloys and their respective density values

Alloy	Density [1] (lbs./in.^{3})
Alloy 028	0.290
Alloy 825	0.294
Alloy C-276	0.321
G-3	0.294
Super Duplex 25Cr	0.285
945X	0.296

OD

The user will enter the "OD" of the pipe in inches.

Wall or ID

The user will enter either the "wall" or "ID" of the pipe in inches. A segmented control will be used to specify the whether the input is a wall or an ID value.

The calculations used will accommodate to the selected inputs.

Optional Inputs

- SN/Job #

SN/Job

The app will have an input serial/job number field. This field will be optional (on version 1.0) and will not be used in the weight per foot calculation. This value will be used as a reference when sharing calculated values in screenshot/message/e-mail form.

Calculate "Weight per Foot" Button

Internal

When pressed, the "Calculate Weight per Foot" button will trigger the weight per foot calculations. The user inputs will be used to calculate weight per foot. The cross-sectional area will be calculated before calculating the weight per foot of the pipe.

$$a = \frac{(O^2 - I^2)}{4}\pi \qquad \text{Equation 1}$$

In Equation 1, a is the cross-sectional area of the pipe, O is the OD of the pipe, I is the ID of the pipe, and π is the "3.1415…" constant. Equation 2 will then be used to calculate weight per foot.

$$WPF = 12a\rho \qquad \text{Equation 2}$$

[1] The density values shown in Table 1 are identical to those published on the Special Metals Corp. (SMC) website.

In Equation 2, WPF is the weight per foot of the pipe, and ρ is the density of the alloy. This formula includes the inputs required above. If the user input the wall value instead of the ID value, then the ID value will be calculated with Equation 3 before calculating the cross-sectional area.

$$I = O - 2w \qquad \text{Equation 3}$$

In Equation 3, w is the wall value.
The cross-sectional area and weight per foot will appear on the view.

Output

- cross-sectional area (in.^{2}), 2 decimal places
- weight per foot (lbs./in.^{3}), 2 decimal places

Calculate Percent Reduction of Area (%RA), Original

Required Inputs

- initial OD
- initial Wall or ID
- final OD
- final Wall or ID

Initial OD and Final OD

The user will enter the "initial OD" and 'final OD" in inches.

Initial Wall or ID and Final Wall or ID

The user will enter the "initial wall or ID" and "final wall or ID" in inches. A segmented control will be used to specify whether the input is a wall or an ID value.

The calculations used will accommodate to the selected inputs.

Optional Inputs

- SN/Job #
- Side

SN/Job

The app will have an input serial/job number field. This field is optional (on version 1.0) and will not be used in the %RA calculation.

Side

The app will have an input "side" field. This field is optional (on version 1.0) and will not be used in the %RA calculation.

Both the SN/Job # and the side values will be used as references when sharing calculated values.

"Calculate %RA Button" Button

Internal

When pressed, the "Calculate %RA" button will trigger the %RA calculations. Equation 4 will be used to calculate %RA.

$$\%RA = \left(\frac{a_i - a_f}{a_i}\right) \times 100\ (\%) \qquad \text{Equation 4}$$

In Equation 4, a_i and a_f are the initial and final cross-sectional areas of the pipe, respectively. Each, initial and final, cross-sectional areas of the pipe will be calculated using Equation 1.
The calculated %RA will appear on the view.

Output

- calculated %RA (%), 2 decimal places

Calculate Percent Reduction of Area (%RA), 1-1 Stencil

Required Inputs

- initial 1-1 Stencil Length
- final 1-1 Stencil Length

Initial 1-1 Stencil Length

The user will enter the "initial 1-1 stencil length" in inches or feet. A segmented control will be used to specify the units.

Final 1-1 Stencil Length

The user will enter the "final 1-1 stencil length" in inches or feet. A segmented control will be used to specify the units.

The calculations used will accommodate for unit consistency.

Optional Inputs

- SN/job #
- side

SN/Job

The app will have an input serial/job number field. This field is optional (on version 1.0) and will not be used in the %RA calculation.

Side

The app will have an input "side" field. This field is optional (on version 1.0) and will not be used in the %RA calculation.

Both the SN/Job # and the side values will be used as references when sharing calculated values.

"Calculate %RA Button" Button

Internal

When pressed, the "Calculate %RA" button will trigger the %RA calculations. Equation 5 will use the two user inputs to calculate %RA.

$$\%RA = \left(1 - \frac{i}{f}\right) \times 100\ (\%) \qquad \text{Equation 5}$$

In Equation 5, i and f are the initial and final 1-1 stencil lengths, respectively. The calculated %RA will appear on the view.

Output

- calculated %RA (%), 2 decimal places

Calculate Wall Average, MIN/MAX

Required Inputs

- wall, MIN
- wall, MAX

Wall, MIN and Wall, MIN

The user will enter the "wall, MIN" and "wall, MAX" in inches.

Optional Inputs

- SN/Job #
- Side

SN/Job

The app will have a field to input the serial/job number of the pipe/s. This field is optional (on version 1.0) and will not be used in the wall average calculation.

Side

The app will have a "side" input field. This field is optional (on version 1.0) and will not be used in the wall average calculation.

Both the SN/Job # and the side values will be used as references when sharing calculated values.

"Calculate Wall Average" Button

Internal

When pressed, the "Calculate Wall Average" button will trigger the wall average calculations. The "Calculate Wall Average, MIN/MAX" button will perform a touch-up inside action. Equation 6 will average the two wall inputs with the following equation.

$$w_{avg,min/max} = \frac{(w_{min} + w_{max})}{2} \qquad \text{Equation 6}$$

In Equation 6, $w_{avg,min/max}$ is the MIN/MAX wall average, w_{min} is the minimum wall value and w_{max} is the maximum wall value.
The $w_{avg,min/max}$ will appear on the view.

Output

- wall average (in.), 3 decimal places

Calculate Wall Average, 4 Positions

Required Inputs

- wall, 12:00 o'clock
- wall, 3:00 o'clock
- wall, 6:00 o'clock
- wall, 9:00 o'clock

Walls

- The user will enter all four wall values in inches.

Optional Inputs

- SN/Job #
- Side

SN/Job

The app will have a field to input the serial/job number of the pipe/s. This field is optional (on version 1.0) and will not be used in the wall average calculation.

Side

The app will have a "side" input field. This field is optional (on version 1.0) and will not be used in the wall average calculation.

Both the SN/Job # and the side values will be used as references when sharing calculated values.

"Calculate Wall Average" Button

Internal

When pressed, the "Calculate Wall Average" button will trigger the wall average calculations. Equation 7 will average the two wall inputs with the following equation.

$$w_{avg,4} = \frac{(w_{12} + w_3 + w_6 + w_9)}{4} \qquad \text{Equation 7}$$

In Equation 7, $w_{avg,4}$ is the 4 position wall average. w_{12}, w_3, w_6, and w_9 are the 12:00, 3:00, 6:00 and 9:00 wall values, respectively.
The $w_{avg,4}$ will appear on the view.

Output

- wall average (in.), 3 decimal places

Estimate Drawn Length

Required Inputs

- initial length
- %RA
- point/discarded length

Initial Length

The user will enter the "initial length" in inches or feet. A segmented control will be used to specify the units.

%RA

The user will enter the "%RA" as a %.

Point/Discarded Length

The user will enter the "point/discarded length" in inches or feet. A segmented control will be used to specify the units.

The calculations used will accommodate for unit consistency.

Optional Inputs

- SN/Job #

SN/Job

The app will have an input serial/job number field. This field is optional (on version 1.0) and will not be used in the weight per foot calculation. This value will be used as a reference when sharing calculated values in screenshot/message/e-mail form.

"Estimate Drawn Length" Button

Internal

When pressed, the "Estimate Drawn Length" button will trigger the drawn length calculations. Equation 8 will be used to estimate the drawn length.

$$L_f = \frac{L_i - L_p}{1 - \left(\frac{\%RA}{100}\right)} \qquad \textbf{Equation 8}$$

In Equation 10, L_i, L_f, and L_p are the initial, drawn, and point/discarded pipe lengths, respectively. The total length (L_T) of the pipe will be estimated using Equation 9.

$$L_T = L_f + L_p \qquad \textbf{Equation 9}$$

It will be assumed that the point/discarded pipe length (L_p) does not change in the drawing process.

The estimated drawn length and the total pipe length will appear on the view.

Output

- estimated drawn length (ft. and in.), 2 and 1 decimal place, respectively
- total pipe length (ft. and in.), 2 and 1 decimal place, respectively

Estimate Required Extrusion Length

Required Inputs

- minimum and/or maximum required drawn lengths
- %RA
- point/discarded length

Min and/or Max Length

The user will enter the "min" and/or "max" required drawn lengths in inches or feet. A segmented control will be used to specify the units. Both, min and max, or just one of the two extrusion length limits can be estimated.

%RA

The user will enter the "%RA" as a %.

Point/Discarded Length

The user will enter the "point/discarded length" in inches or feet. A segmented control will be used to specify the units.

The calculations used will accommodate for unit consistency.

Optional Inputs

- SN/Job #

SN/Job

The app will have an input serial/job number field. This field is optional (on version 1.0) and will not be used in the weight per foot calculation. This value will be used as a reference when sharing calculated values in screenshot/message/e-mail form.

"Estimate Required Extrusion Length" Button

Internal

When pressed, the "Estimate Required Extrusion Length" button will trigger the extrusion length requirements calculations. Equation 10 and Equation 11 will be used to estimate the required extrusion lengths.

$$L_{e,min} = L_{f,min} \times \left(1 - \frac{\%RA}{100}\right) + L_p \qquad \text{Equation 10}$$

In Equation 10, $L_{e,min}$ and $L_{f,min}$, are the minimum required extrusion and drawn lengths, respectively.

$$L_{e,max} = L_{f,max} \times \left(1 - \frac{\%RA}{100}\right) + L_p \qquad \text{Equation 11}$$

In Equation 11, $L_{e,max}$ and $L_{f,max}$, are the maximum required extrusion and drawn lengths, respectively. As in the "Estimate Drawn Length" function, L_p is assumed constant.
The estimated required min and/or max lengths will appear on the view.

Output

- estimated required min extrusion length (ft. and in.), 2 and 1 decimal places, respectively
- (and/or) estimated required max extrusion length (ft. and in.), 2 and 1 decimal places, respectively

References

The equations used in this app are the ones used at the WGH draw bench.

Future App Improvements

The following consists of a list of possible future version app improvements.

- implementation of double drawn calculation
  - estimation of drawn lengths
  - estimation of necessary extrusion lengths
- storing of input and output data into a database accessible to several different users
  - APEX implementation

Approval

WGH IT Manager (Print & Sign): _____ / _____ Date: _____

Draw Bench Engineer (Print & Sign): _____ / _____ Date: _____