



INNOVA
Drilling & Intervention

Casing Standoff Quick Start Guide

Rev 1.3

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1.0 - Introduction

This document will deal with the Casing Standoff calculation within Innova Engineering's Torque & Drag Module and will detail the steps required to run this calculation.

The casing standoff calculation uses the data input by the user and calculates either:

- The casing standoff based upon a given centralizer spacing entered by the user, or
- The required centraliser spacing to achieve the users desired standoff. Based upon the minimum step value selected by the user the optimum centraliser spacing will also be calculated.

2.0 - Setup

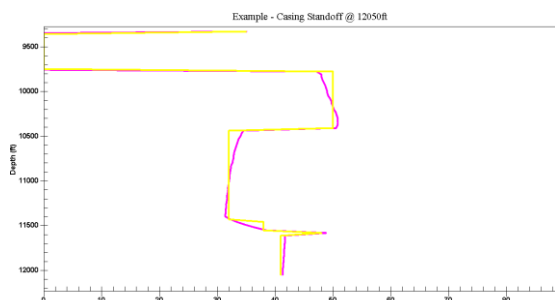
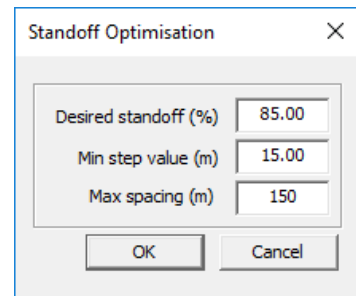
In order to run the casing standoff calculation, a Torque and Drag calculation needs to be run. For T&D setup, refer to the Torque & Drag Quick Start Guide.

3.0 - Required Inputs

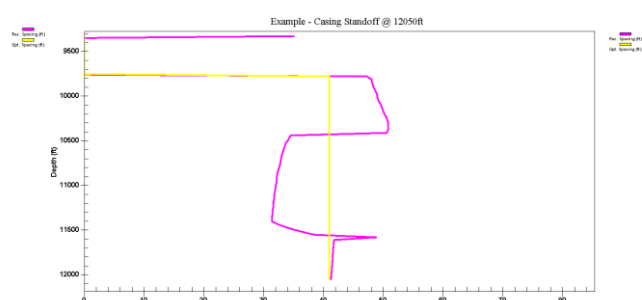
Over and above the standard Torque & Drag inputs, the following inputs are required.

In the **Tools Menu** select - **Standoff Optimisation Parameters**

- **Desired Standoff:** This is the standoff which will be calculated when **Optimise Standoff** is selected in the Torque and Drag section of the Engineering Parameters tab on the main user interface
- **Min Step Value:** The minimum step value between one optimum spacing and the next. Engineering looks at the **Required Spacing** values which provide the **desired standoff**, and groups similar values (which land within the step range) together to provide a single **Optimum Spacing** output for each of these points. This is basically a smoothing parameter. Larger step values encompass more of the optimum spacing values providing more of a smoothing effect.
- **Max Spacing:** The spacing value above which no centralisers will be recommended. This affects the Centralizer Spacing Summary in the Standoff Summary Report.



Min Step Value = 5



Min Step Value = 100

In the above charts the yellow line represents the **Optimum Spacing** and the pink line is the **Required Spacing** (achieves the **Desired Standoff** exactly). These examples show the difference in the Optimum Spacing when different minimum step values (5 and 100) are entered.

In the **Options Menu**, select **Torque and Drag Model**. If running bow spring centralizers, the user can select the option to **Include Bow Spring Force** within the torque and drag calculation. Note that if a bow spring force has been entered in the casing component details, this will be included in the casing standoff calculation regardless of what is selected here.

In the **Drill String, Well Geometry & Fluids** Tab, for each casing selected, in the component details, the user has the following centralizer inputs available:

- Centralizer Spacing:** The distance between Centralizers. If centralisers are only run across a certain interval, then the casing should be entered as separate sections in the string. **NOTE:** this value is ignored when Optimised Standoff is selected. This is a **required** input for the casing standoff calculation when Optimise Standoff is not selected.
- Centralizer OD:** The Outside Diameter of the Centralizer. For bowspring centralisers the OD input may be larger than the ID of the hole This is a **required** input for the casing standoff calculation.
- Centralizer Length:** The length of the centralizer blade which contacts the wellbore. This input is **not used** in the standoff calculation but is used for hydraulics.
- Centralizer Blade Width:** The width of the individual centralizer blades. This input is **not used** in the standoff calculation but is used for hydraulics.
- Centralizer Blade Count:** The number of blades on the stabilizer. This is **not used** in the standoff calculation but is used for hydraulics.
- Bowspring Restoring Force:** The Force exerted by a centralizer against the casing to keep it away from the wellbore wall. This input is used in the standoff calculation to determine how much the bow spring centralizer has deformed for a given side force. The centralizer will never compress more than the body OD. The higher the side force the more deformation of the centralizer. If nothing is entered for the restoring force it is assumed that the centralizer is rigid. In the scenario where the include bow spring force option is selected and the running force cell is left empty, this value will be used for the running force in the T&D calculation of the PU, SO and reaming values.
- Centralizer body OD:** The OD of the body of the centralizer. This is **not used** in the standoff calculation but is used for hydraulics. It is also used to calculate percentage compression of a bow spring stabiliser, which can affect the T&D results.
- Running Force:** The maximum force required to insert a centralizer into a specified wellbore diameter. This input is **not used** in the standoff calculation but is used for T&D. If entered, this value will supersede the bowspring restoring force in the T&D calculation. The running force will be applied to the pickup, slack-off and reaming values and will increase / decrease with the well bore size. Running force is not applied to the T&D calculation until the compression

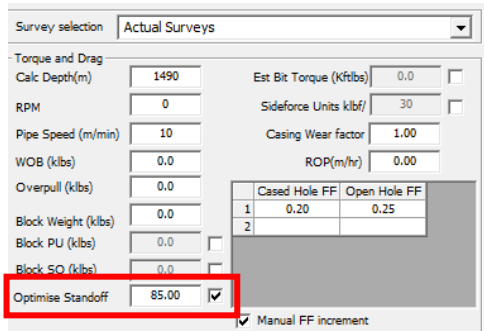
Component Details	BHA Weight (Buoyed)
Centralizer Spacing (ft)	
Centralizer OD (in)	
Centralizer Length (in)	
Centralizer blade width (in)	
Centralizer blade count	
Internal Fluid Wt	
Tensile Yield (klbs)	
Torsional Yield (kftlbs)	
Burst (psi)	
Collapse (psi)	
Bowspring restoring force (klbs)	
Centralizer Body OD (in)	
Friction Reduction %	
Running force (klbs)	
Centralizer Type	
Running Force Restrict. ID (in)	

of the centralizer is greater than 50% and will gradually increase as the compression increases from 50% to 100%.

- **Centralizer Type:** The user can manually enter the centralizer type and make / model here. This is not used in any calculations.
- **Running Force Restrict. ID:** The restriction ID that 100% of the running force will be utilised in T&D calculation. When no value is entered here, the program will apply the running force to the T&D calculations based on the the amount of compression experienced by the bowspring centralizer at any given point in the wellbore. The more the centralizer is compressed, the higher the percentage of the running force which is applied. If the user enters a value here, the program will apply the maximum running force over any part of the wellbore where the ID is the same or less regardless of the compression. For example, Running Force = 2.1klbs, Running Force Restrict. ID = 8". Any points in the well geometry that this component passes through with an ID less than or equal to 8" will have 2.1klbs of running force applied to the T&D calculation. Any part of the wellbore where the ID is greater than the value entered here will just be treated in the usual way.

In the Engineering Parameters tab the user can choose:

- **Optimise Standoff:** This will override the centralizer spacing selected in casing component details, and output the spacing required to achieve the desired standoff

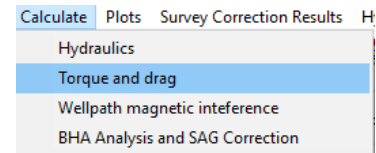
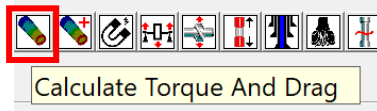
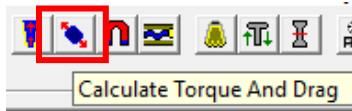


The screenshot shows the 'Engineering Parameters' dialog box. The 'Survey selection' dropdown is set to 'Actual Surveys'. The 'Torque and Drag' section includes fields for Calc Depth (m), RPM, Pipe Speed (m/min), WOB (klbs), Overpull (klbs), Block Weight (klbs), Block PU (klbs), and Block SO (klbs). The 'Est Bit Torque (klbs)' field is set to 0.0. The 'Sideforce Units klbf' field is set to 30. The 'Casing Wear factor' is set to 1.00. The 'ROP (m/hr)' field is set to 0.00. The 'Cased Hole FF' and 'Open Hole FF' table shows values for two points. The 'Optimise Standoff' checkbox is checked and highlighted with a red box, with the value '85.00' entered in the adjacent field. The 'Manual FF increment' checkbox is also checked.

Point to Note: Optimised Standoff and Desired Standoff (in the Standoff Optimisation Parameters dialog) are linked. When the user changes the value in either of these boxes, it auto updates in the other.

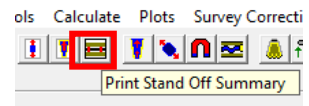
4.0 - Running the Calculation

In order to generate the Casing Stand Off output, the user must run a Torque & Drag calculation. To do this, select either the icon displayed below (low and high resolution icons), or select **Calculate - Torque and Drag**.

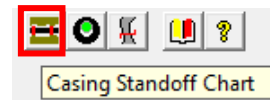


5.0 - Outputs

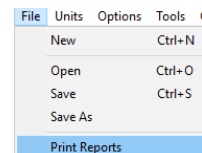
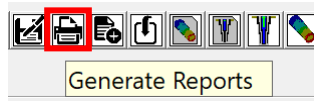
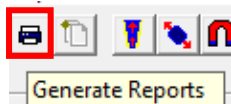
Once the calculation has been run, the **Stand Off summary** report can be viewed by selecting the icon from the toolbar at the top of the screen. This report can be saved as a pdf.



The Casing Standoff Chart is available directly from the toolbar on the main screen.



The report can also be generated by selecting "File" - "Print Reports" or selecting the icon on the toolbar.

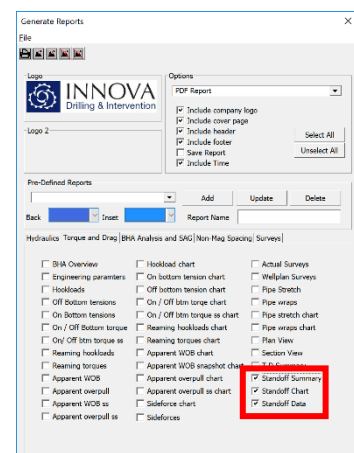


The three report options for Casing Stand Off can be found on the T&D tab at the bottom right:

- **Standoff Summary:** This is the Report
- **Standoff Chart:** A graphical representation of the results
- **Standoff Data:** Base data used to generate the plots.

The report can be generated either as **excel** or **pdf**.

Note that when excel is selected the summary and chart selections will be greyed out as these can only be output as pdf.



5.1 – Standoff Summary Report

The standoff summary report is generated at the click of a button and contains the following:

- Centralizer spacing summary
- Drill string summary
- Centralizer stand-off results
- Standoff chart
- Side forces / centralizer forces chart
- Hookload chart

Stand Off Summary

Project Details		
Project: Casing Standoff Example		
Description: 13.75" Liner		

Stand Off Optimisation		
Optimisation enabled: Yes		
Optimal Standoff (%):60		
Minimum Step value (UsFt):15.00		
Maximum Spacing (UsFt):400.00		

Wellbore Geometry				
Type	MD (Usft)	TVD (Usft)	ID (in)	OD (in)
Riser	5401.055	5400.77	14.750	23.000
Casing	5671.058	5670.78	19.000	22.000
Casing	16800.171	16016.96	14.600	16.200
Open Hole	20900.00	19502.90	16.500	16.5

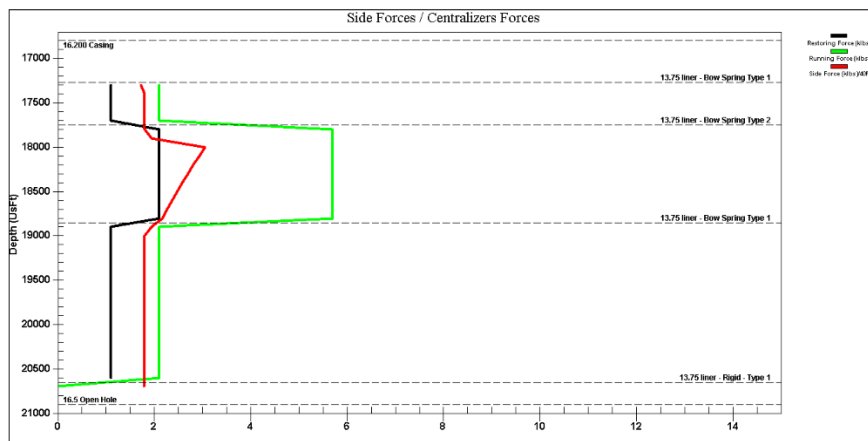
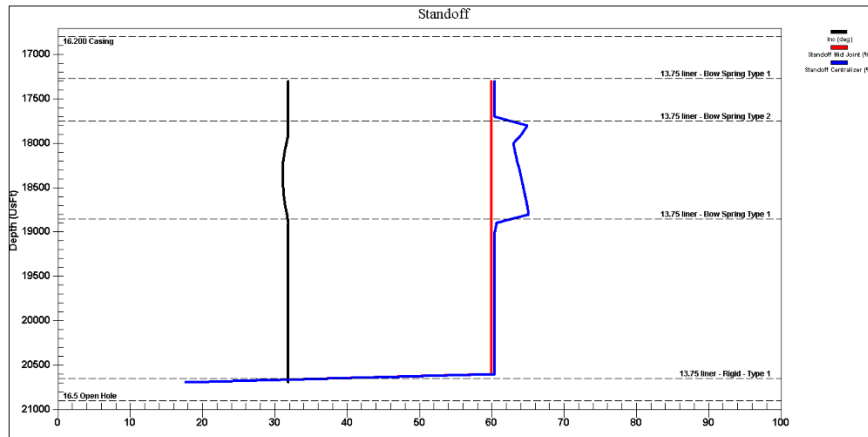
Fluid Details	
Mud Weight: 11.5ppg	
PV: 21	
YP: 17	

Centraliser Spacing Summary					
Centraliser Type	Centraliser OD (in)	Centraliser Spacing (Usft)	Depth From (Usft)	Depth To (Usft)	Restoring Force (klbs)
Rigid - Type 1	14.250	0	20600.00	20695.000	Rigid
Bow Spring Type	117.000	25	18800.00	20600.00	1.100
Bow Spring Type	218.250	42	17700.00	18800.00	2.100
Bow Spring Type	117.000	25	17272.000	17700.00	1.100

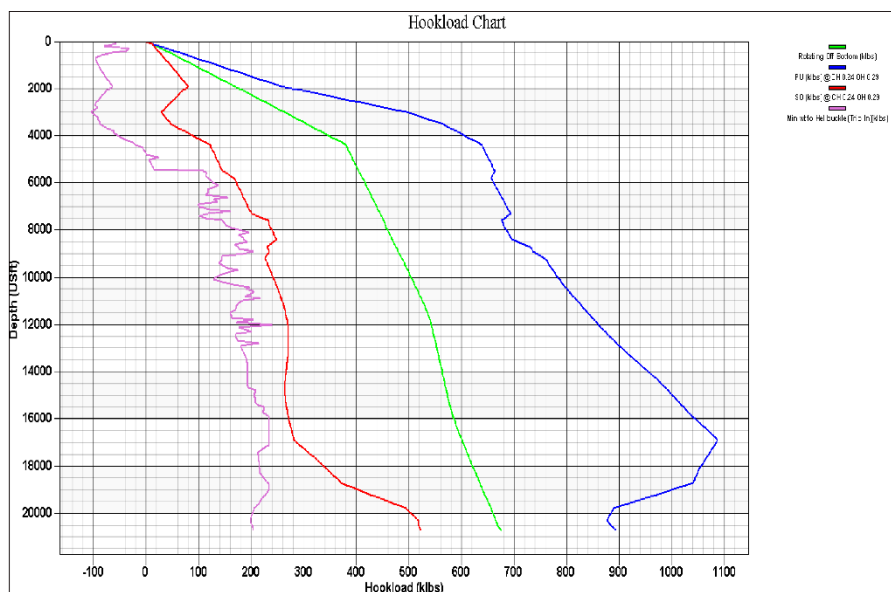
Drill String Summary								
Description	OD (in)	ID (in)	TJ OD (in)	TJ ID (in)	Weight (lb/ft)	Length (Usft)	Total Length (Usft)	
13.75 liner	13.750	12.336	14.150	12.325	98.500	43.000	43.00	Steel
13.75 liner	13.750	12.336	14.150	12.325	98.500	1800.000	1843.00	Steel
13.75 liner	13.750	12.336	14.150	12.325	98.500	1100.000	2943.00	Steel
13.75 liner	13.750	12.336	14.150	12.325	98.500	480.000	3423.00	Steel
13.75 liner	13.750	12.336	14.150	12.325	98.500	990.000	4413.00	Steel
6.625 S-135 IEU(25.2lb/ft) Drill P	6.625	5.965	8.000	5.000	27.150	16487.000	20900.00	Steel

Centralizer Stand Off Results									
Depth	Inc	Stand Off	Stand Off	Spacing	Restore Force	Running Force	Side Force	Cent OD	Type
(UsFt)	(°)	Mid Jnt (%)	Cent (%)	(UsFt)	(klbs)	(klbs)	(klbs)	(in)	
17300.00	31.89	60.0	60.4	27.18	1.10	2.10	1.72	17.000	Bow Spring Type 1
17400.00	31.89	60.0	60.4	25.98	1.10	2.10	1.80	17.000	Bow Spring Type 1
17500.00	31.89	60.0	60.4	25.98	1.10	2.10	1.80	17.000	Bow Spring Type 1
17600.00	31.89	60.0	60.4	25.98	1.10	2.10	1.80	17.000	Bow Spring Type 1
17700.00	31.89	60.0	60.4	25.98	1.10	2.10	1.80	17.000	Bow Spring Type 1
17800.00	31.89	60.0	64.9	51.07	2.10	5.70	1.80	18.250	Bow Spring Type 2
17900.00	31.83	60.0	64.1	48.40	2.10	5.70	1.95	18.250	Bow Spring Type 2
18000.00	31.55	60.0	63.0	31.88	2.10	5.70	3.05	18.250	Bow Spring Type 2
18100.00	31.34	60.0	63.2	33.01	2.10	5.70	2.93	18.250	Bow Spring Type 2
18200.00	31.19	60.0	63.5	34.21	2.10	5.70	2.80	18.250	Bow Spring Type 2
18300.00	31.11	60.0	63.8	35.37	2.10	5.70	2.69	18.250	Bow Spring Type 2
18400.00	31.08	60.0	64.1	36.59	2.10	5.70	2.58	18.250	Bow Spring Type 2
18500.00	31.12	60.0	64.4	37.94	2.10	5.70	2.47	18.250	Bow Spring Type 2
18600.00	31.24	60.0	64.6	39.39	2.10	5.70	2.36	18.250	Bow Spring Type 2
18700.00	31.41	60.0	64.9	40.84	2.10	5.70	2.26	18.250	Bow Spring Type 2
18800.00	31.65	60.0	65.1	42.24	2.10	5.70	2.17	18.250	Bow Spring Type 2
18900.00	31.89	60.0	60.7	23.76	1.10	2.10	1.95	17.000	Bow Spring Type 1
19000.00	31.89	60.0	60.4	25.98	1.10	2.10	1.80	17.000	Bow Spring Type 1
19100.00	31.89	60.0	60.4	25.98	1.10	2.10	1.80	17.000	Bow Spring Type 1
19200.00	31.89	60.0	60.4	25.98	1.10	2.10	1.80	17.000	Bow Spring Type 1

Depth (UsFt)	Inc (°)	Stand Off Mid Jnt (%)	Stand Off Cent (%)	Spacing (UsFt)	Restore Force (klbs)	Running Force (klbs)	Side Force (klbs)	Cent OD (in)	Type
20600.00	31.89	60.0	60.4	25.96	1.10	2.10	1.80	17.000	Bow Spring Type 1
20695.00	31.89	17.6	17.6	0.00		0.00	1.78	14.250	Rigid - Type 1



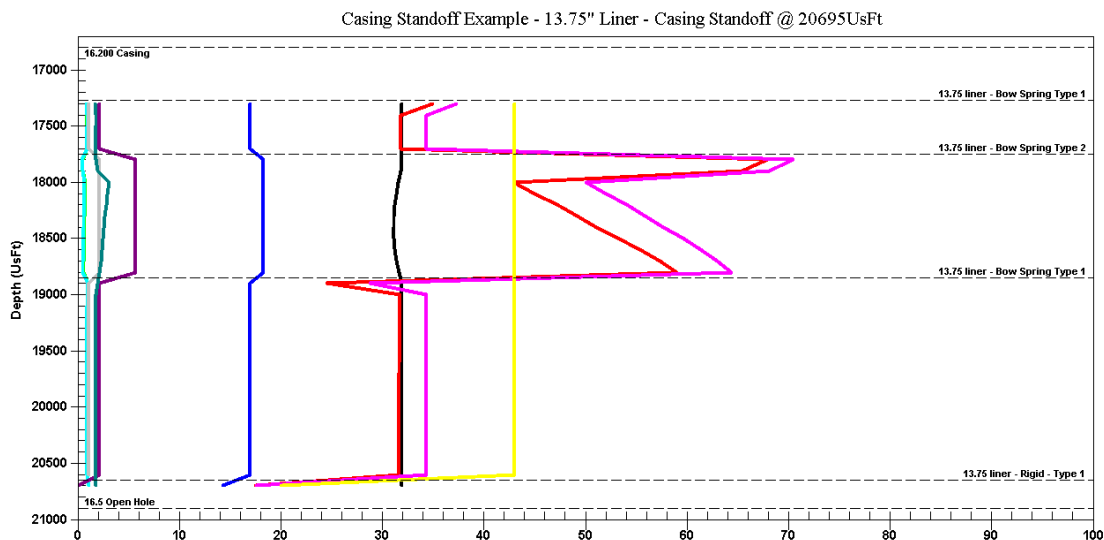
Stand Off Summary



5.2 - Casing Standoff Chart

The casing standoff chart is a snapshot chart which provides outputs for each point in the string from surface to the calculated depth.

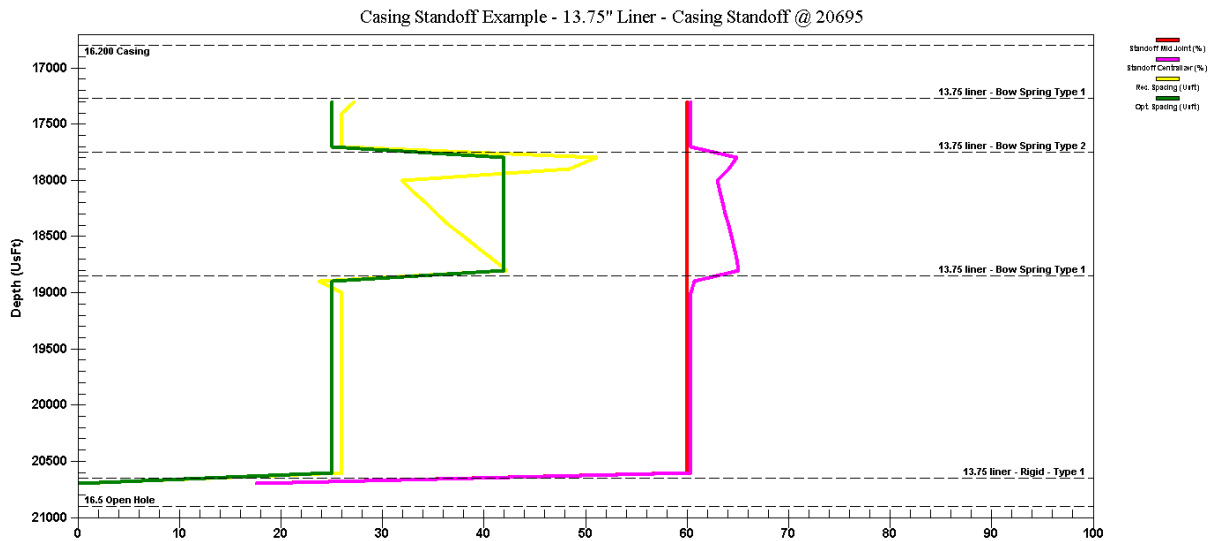
5.2.1 - Without Optimised Standoff



If **Optimise Standoff** has **NOT** been selected when the torque and drag calculation is run, the standoff chart will look like the above.

- **Inc:** Inclination
- **Cent OD:** Centralizer Outside Diameter
- **Deflection Mid Joint:** Deflection of the casing between 2 centralizers.
- **Deflection Centralizer:** Deflection of casing at the centralizer.
- **Standoff Mid Joint:** This is calculated as follows $(1 - (\text{Deflection Mid Joint} / ((\text{Hole ID} - \text{Casing OD})/2))) * 100$. It is effectively the percentage deflection from well bore centre. If the casing is centralised perfectly the standoff is 100%
- **Standoff Centralizer:** The Percentage Standoff at the Centralizer. This is calculated as follows $(1 - (\text{Deflection Centralizer} / ((\text{Hole ID} - \text{Casing OD})/2))) * 100$.
- **Cent Spacing:** The centralizer spacing as entered by the user in the component details section of the drill string editor (This line will **NOT** be present if Optimise Standoff is selected in the Torque and Drag section of the Engineering Parameters tab on the main user interface).
- **Restoring Force:** The restoring force of the bow spring centralizer which has been entered in the component details section of the drill string tab.
- **Running Force:** The running force of the bow spring centralizer which has been entered in the component details section of the drill string tab.
- **Side Force:** The side force exerted on the casing.

5.2.2 - With Optimised Standoff



If **Optimise Standoff** has been selected (in the above this has been set at **60%**), when the torque and drag calculation is run, the standoff chart will have the addition of an Optimum Spacing line, and the Centralizer Spacing line becomes the Recommended Spacing line.

- **Rec Spacing:** Recommended Spacing, calculated based on the Optimise standoff value (This line will **NOT** be present if Optimise Standoff is not selected)
- **Opt Spacing:** This is the optimum spacing which applies the maximum step value to the Recommended Spacing (This line will **NOT** be present if Optimise Standoff is not selected).

All the other lines described in **Section 5.1.1 - Without Optimised Standoff**, are also available to be displayed in this chart if required.