



Technical Bulletin

HOW TO USE DESIGN FLEX[®] PRO[™]

**Design
Flex[®] Pro[™]**

Program Version at time of print is 2.06

HOW TO USE DESIGN FLEX[®] PRO[™]

Design Flex[®] Pro[™] is a belt drive selection tool for design engineers, maintenance engineers, and power transmission distributors.

In this technical bulletin the following Design Flex[®] Pro[™] topics will be covered:

- > Designing a new belt drive
- > Checking a current drive design for capacity and tensioning information
- > Suggested options for an application
- > Drive detail report explanation
- > Design Flex[®] Pro[™] troubleshooting

In addition to designing belt drives, Design Flex[®] Pro[™] may be used to:

- > Determine proper belt installation tension
- > Calculate belt pull
- > Determine the belt power transmission capacity
- > Estimate the energy savings of a synchronous belt drive compared to a V-belt drive
- > Estimate the cost saving of replacing roller chain with a Poly Chain[®] GT[®] belt drive

The features of Design Flex[®] Pro[™] are explored in detail below. Miscellaneous user tips are also provided.

NEW DRIVE DESIGN – DESIGNING A BELT DRIVE

When designing a belt drive using Design Flex® Pro™ there is both mandatory and optional information inputs. The screen shot below shows the necessary information.

Required Information for Drive Design:

1. Desired belt type
2. Motor Power and RPM
3. Motor Frame & Gearbox information (if belt drive will be located on the output shaft of a gearbox)
4. Service Factor
5. Desired DriveN pulley RPM (Nominal) or Speed Ratio
6. Center Distance between shafts (Nominal)

Optional

- 7 & 8. Restrictions

1st Number =
Program Version

Product Market:
Europe or North America

A. Click on the **Design** button to view the possible drive configurations and report.

User Tips:

- > **Multiple belt type options:** Checking more than one belt type or section (e.g. SPB) box will provide solutions for each of these if suitable designs exist to meet the input criteria.
- > **Motor power drop-down box:** Select a standard motor power and then use the Motor Frame drop-down box to have the driver shaft diameter and length automatically entered.

> **Drive Service Factor help button:** This assists in assigning a service factor based on drive characteristics and the hours of service per day.

> **Motor efficiency:** This value is used as part of the energy saving calculations of a synchronous belt drive compared to a V-belt drive.

> **Shaft diameters:** Although they aren't required to find possible drive solutions, knowing the shaft diameters can often be very useful. This is because you need to make sure the pulleys/sprockets used in the design can accommodate these shaft sizes.

> **Can't find the belt type or cross section you're after?** You may need to change between our product markets, Europe or North America. To alternate between them click on Tools > Options and then select the appropriate product market.

Example:

After entering the below information into the main input screen and clicking the **Design** button we get the following Solution Summary.

Belt Type: 8MGT Poly Chain GT Carbon
Motor Power & RPM: 22kW @ 1500rpm
Service Factor: 1.6

Required DriveN Speed: 2000rpm
DriveN, Max O.D.: 100mm
Centre Distance: 800mm

Selected	!	Prod Line	Belt	DriveR (Grooves)	DriveN (Grooves)	dN RPM	Δ RPM	ODR	Rel. Cost ▲	CD (mm)	Δ CD (mm)	Belt Pull (kg)	Width (mm)
<input type="checkbox"/>		Poly Chain Carbon	8MGTC-1792-36	34	25	2,040.0	40	1.0	1.0	778	-22	424	46
<input type="checkbox"/>		Poly Chain Carbon	8MGTC-1792-36	36	28	1,928.6	-71	1.1	1.1	768	-32	401	46
<input type="checkbox"/>		Poly Chain Carbon	8MGTC-1792-36	38	28	2,035.7	36	1.2	1.1	764	-36	380	46
<input type="checkbox"/>		Poly Chain Carbon	8MGTC-2000-36	40	30	2,000.0	0	1.3	1.2	860	60	361	46
<input type="checkbox"/>		Poly Chain Carbon	8MGTC-2000-36	45	34	1,985.3	-15	1.6	1.2	842	42	320	46

Design Flex® Pro™ has found 5 drive options which meet the input parameters. The above results are in order of relative cost as signified by the red triangle in the column heading. You can click on other column headings to sort the results by that column value, increasing or decreasing (triangle points up for increasing and down for decreasing).

Double-click on a row to display the Drive Detail Report for that drive configuration.

DriveR (teeth) & DriveN (teeth): Size of sprockets (pulleys for V-belt drives).

DN RPM: DriveN Speed for this drive configuration.

Δ RPM: Difference in RPM between the requested DN speed and actual.

ODR: Over Design Ratio provides a quick reference to how the Rated Power of the drive compares to what is actually required. An ODR of 1 provides the most efficient and cost effective solution.

Rel. Cost: Comparison of drive costs.

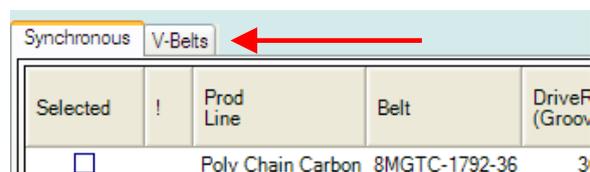
CD: Centre Distance of the drive.

Δ CD: Difference in CD between the requested CD and actual.

Belt Pull: Dynamic Shaft Load minus pulley weights.

Width: Maximum width of sprocket/pulleys.

Note: If you have both a V-belt and synchronous belt type selected you will see two tabs on the Solution Summary Screen.



CHECKING A CURRENT DRIVE DESIGN FOR CAPACITY AND TENSIONING INFORMATION

The below screen shot shows the following drive details after being entered in:

Current Drive Example:

Belts: 6x SPA2360 Gates Super HC
Motor Power & RPM: 30kW @ 1440rpm
Service Factor: 1.3

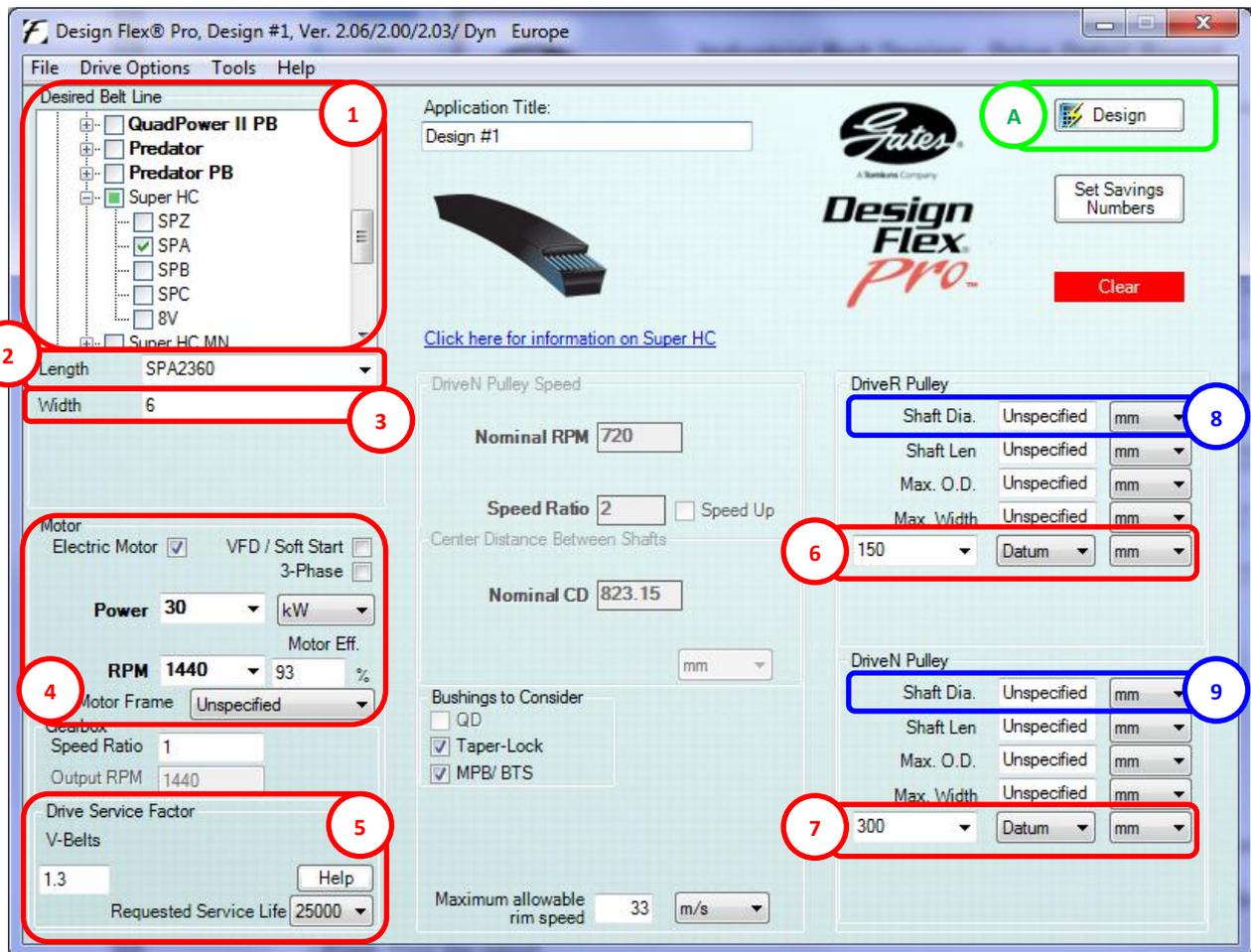
DriveR: SPA150/6 Pulley
DriveN: SPA300/6 Pulley

Required Information for Drive Design:

1. Select Current Belt Cross Section or Profile
2. Select Current Belt Length
3. Select Enter the Current No or width of Belts
4. Select Enter the Current Input/Motor Conditions
5. Enter desired Service Factor
6. Select Enter the DriveR Pulley Size
7. Select Enter the DriveN Pulley Size

Optional

8. Enter the DriveR Shaft Size
9. Enter the DriveR Shaft Size)



Recommended Solution		Entered Drive											
Selected	!	Prod Line	Belt	DriveR (mm)	DriveN (mm)	dN RPM	Δ RPM	ODR	Rel. Cost ▲	CD (mm)	Δ CD (mm)	Belt Pull (kg)	Width (mm)
<input type="checkbox"/>		Super HC	6-SPA2360	150	300	720.0	0	1.0	1.0	823	0	422	N/A

> **Entered Drive Tab:** This shows the drive details based on your inputs. Double-click on the drive option to show its Drive Detail Report.

Recommended Solution		Entered Drive											
Selected	!	Prod Line	Belt	DriveR (mm)	DriveN (mm)	dN RPM	Δ RPM	ODR	Rel. Cost ▲	CD (mm)	Δ CD (mm)	Belt Pull (kg)	Width (mm)
<input type="checkbox"/>		Super HC	3-SPA2360	SPA 150.00	SPA 300.00	720.0	0	0.5	1.0	823	0	422	44

User Tips:

- > Saving drive detail reports in PDF format (Print to File) is very useful for storing and/or emailing them to customers. Using relevant file names makes finding them easier in the future.
- > To speed up naming the PDF files click on the Customer Information button and copy (CTRL-C) the Application Title text. Now click on Print to File button and paste (CTRL-V) this text into the File Name field. This also keeps the file name and Application Title consistent.

Customer Information

Application Title:

First/Last Name:

E-Mail Address:

Save

Cancel

SUGGESTED OPTIONS FOR AN APPLICATION

The below screen shot shows the following application details after being entered in:

Application Example:

Application: Pump

Motor Power & RPM: 55kW @ 1465rpm

Centre Distance: 1200mm

DriveR Shaft Diameter: 40mm

Environment: Clean, minimal dirt/dust

Belts: V-Belt (XPA) or Synchronous (8MGT Carbon)

Required DriveN Speed: 2250rpm

Service Factor: 1.3 (V-belt) & 1.6 (Synch)

DriveN Shaft Diameter: 35mm

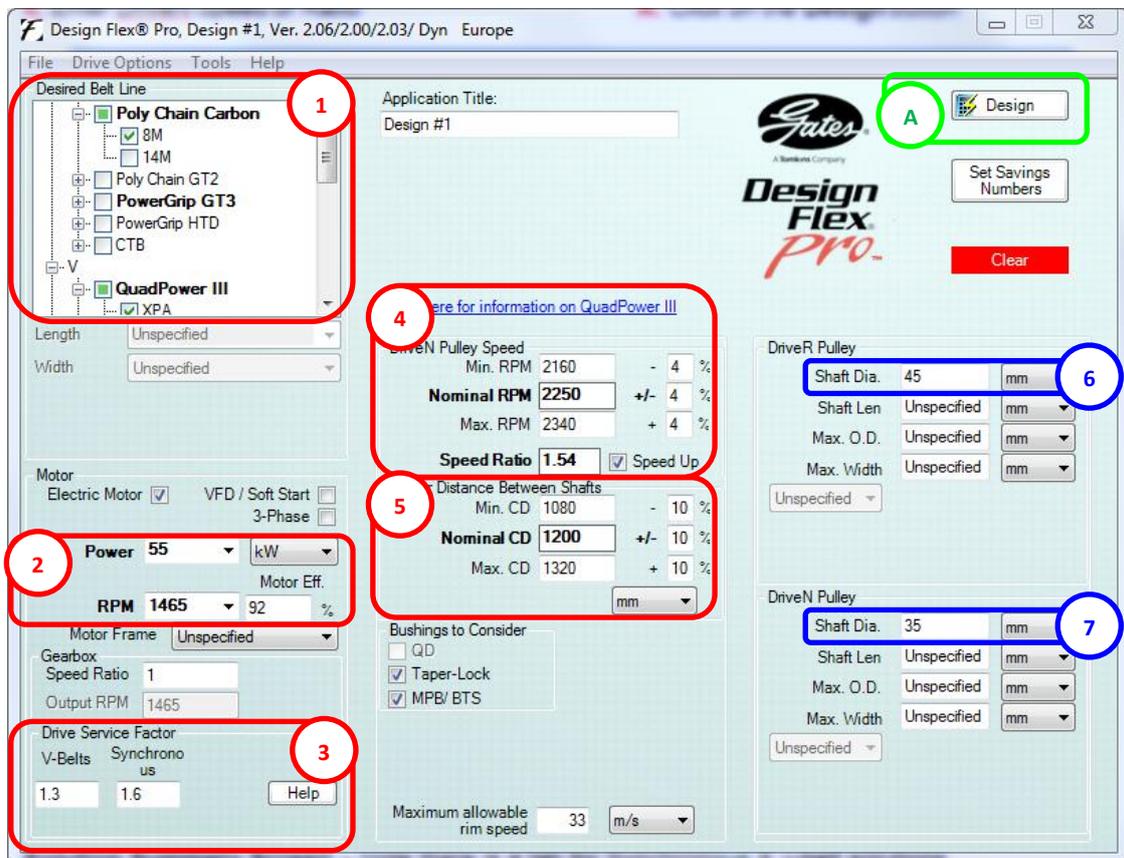
Required Information for Drive Design:

1. Select One/ Multiple Belt Cross Sections or Profiles
2. Select/ Enter the Current Input/Motor Conditions
3. Enter desired Service Factors (V-& Synch Belts)
4. Enter DriveN Speed or Ratio
5. Enter Centre Distance

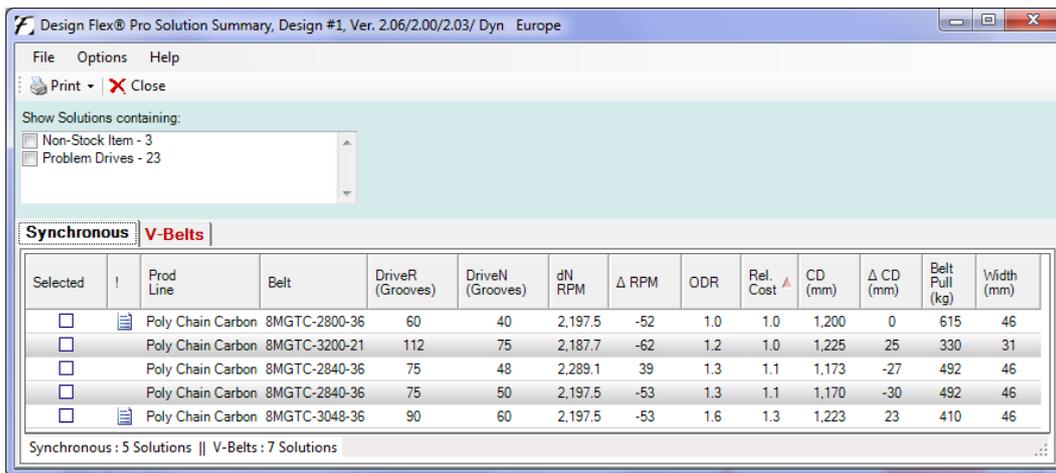
Optional

6. Enter the DriveR Shaft Size
7. Enter the DriveN Shaft Size

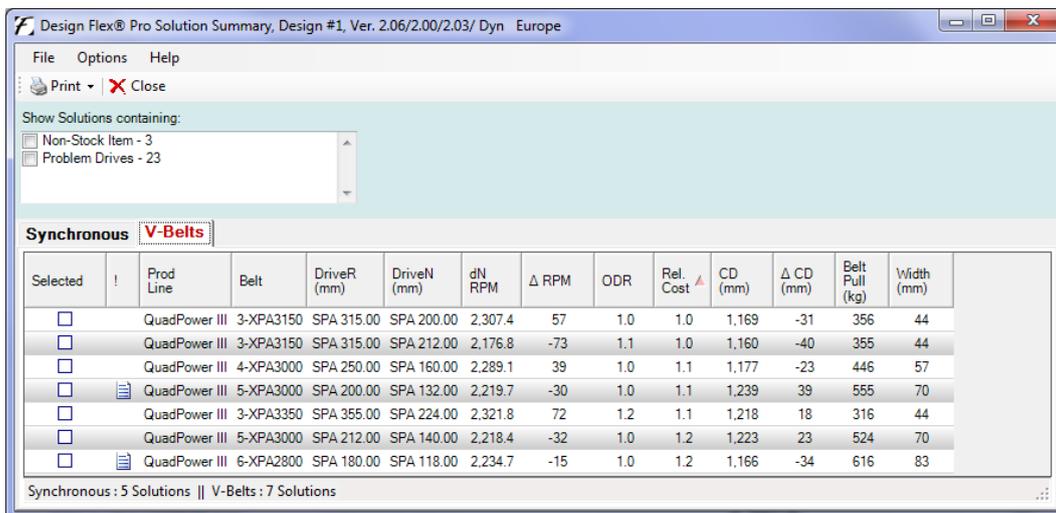
A. Click on the **Design** button



Solution Summary Screen – Note there is a tab for Synchronous & V-belt solutions



Click the tab to show the options



You can choose to print a number of selections by clicking on the white box next to the options that seem suitable. You then click on the Print button and print either the Selected Drives or All Drives. Below is the resulting Summary Report page for All Drives.



Industrial Belt Design - Summary Report

Design Flex® Pro by the Gates Corporation

Designed For:

Application: **Design #1**

Provided By: Phillip Aitken
Gates Australia
1-15 Hydrive Close
Dandenong South, Victoria 3175
Australia
paitken@gates.com
03 9797 9643 Phone

INPUT

Drive Information

Speed Ratio: 1.54 Up
Input Load: 55 kW, Efficiency: 92.00 %
S.F. (VB/SB): 1.30 / 1.60
Design Power (VB/SB): 95.88 kW / 118.01 kW
Center Distance: 1200 mm +/-10%

DriveR 1465.0
DriveN 2250.0 +/-4%

Maximum Rim Speed: 33 m/s
Shaft Diameter: 45 mm
Bushings Checked: TL
Belts Checked: Poly Chain Carbon, QuadPower III
Single Belts, PowerBand, Electric Motor

SOLUTIONS

7 V and 5 Sync solutions were found. Sorted by Rel. Cost. All solutions printed.

DriveR		DriveN		Belt		Center Dist.			Tensioning			Belt Pull (N)	Over Des. Ratio	Rel. Cost	Notes			
Tlth/Grv (mm)	Dia Bush	Tlth/Grv (mm)	Dia Bush	Prod Line	Part Number	Ideal (mm)	Inst. (mm)	Takeup (mm)	Belt Defl. (mm)	New (kg)	Used (kg)							
60	152.8	2517	40	101.9	2012	2197.5	PCC	8MGTC-2800-36	1199.7	1162.4	1201.0	18.74	23	18	6034	0.96	1.0	1
112	285.2	2517	75	191.0	2517	2187.7	PCC	8MGTC-3200-21	1225.1	1199.2	1226.4	19.13	13	9.7	3232	1.22	1.0	
75	191.0	3020	48	122.2	2012	2289.1	PCC	8MGTC-2840-36	1173.5	1136.2	1174.8	18.33	19	15	4827	1.26	1.1	
75	191.0	3020	60	127.3	2012	2197.5	PCC	8MGTC-2840-36	1169.6	1132.2	1170.8	18.27	19	15	4827	1.28	1.1	
90	229.2	3020	60	152.8	2517	2197.5	PCC	8MGTC-3048-36	1223.4	1197.5	1224.7	19.11	16	13	4022	1.61	1.3	2
	315.0	3020		200.0	2517	2307.4	QPIII	3-XPA3150	1169.1	1144.1	1214.1	11.68	3.6	3.1	3487	1.03	1.0	
	315.0	3020		212.0	2517	2176.8	QPIII	3-XPA3150	1160.0	1135.0	1205.0	11.59	3.5	3.1	3480	1.05	1.0	
	250.0	3020		160.0	2517	2289.1	QPIII	4-XPA3000	1177.1	1152.1	1222.1	11.76	3.3	2.8	4373	1.03	1.1	
	200.0	3020		132.0	2517	2219.7	QPIII	5-XPA3000	1238.8	1213.8	1263.8	12.38	3.2	2.8	5441	0.97	1.1	1
	355.0	3020		224.0	2517	2321.8	QPIII	3-XPA3350	1218.5	1193.5	1263.5	12.17	3.2	2.8	3100	1.19	1.1	
	212.0	3020		140	2517	2218.4	QPIII	5-XPA3000	1223.0	1198.0	1268.0	12.22	3.0	2.6	5138	1.05	1.2	
	180.0	3020		118.0	2012	2234.7	QPIII	6-XPA2800	1165.5	1140.5	1210.5	11.65	3.0	2.6	6044	0.97	1.2	1

NOTES

¹ The drive power rating is slightly less than the requested design power. Review design requirements.
² Flanging both pulleys may be necessary for proper belt tracking.

- Design Flex Drive Solutions assume Gates products and are not applicable to non-Gates products.
- products are not intended for use in any application where the failure of the product to perform could cause injury or death. This includes use on aircraft propeller or rotor drive systems or other in-flight systems necessary for safe flight.

Input Section:

INPUT	Drive Information	DriveR	DriveN
Known Belt:	Poly Chain Carbon - 8MGTC-2000 - 12.00 mm	Known Size:	40 Grooves
Speed Ratio:	2.00 Down	RPM:	1470.0
Input Load:	11 kW, Efficiency: 92.00 %	Maximum Rim Speed:	33 m/s
Service Factor:	1.6	Bushings Checked:	TL
Design Power:	17.6 kW	Belts Checked:	Poly Chain Carbon
Center Distance:	758.3 mm		Electric Motor

Known Belt: Belt type and size that was selected.

Speed Ratio: Desired change in speed expressed as a ratio of the larger diameter pulley to the smaller diameter pulley. The term “Up” is used if the final desired driveN speed is faster than that of the original input speed. The term “Down” is used if the final desired driven speed is slower than that of the original input speed.

Input Load: Name plate load rating or load capacity of the prime mover or power source.

Service Factor: Multiplier used to account for drive design characteristics such as daily run time, shock or impulse loading, and motor starting characteristics.

Design Power: Input load multiplied by the Service Factor. Design Flex[®] Pro[™] uses Design Power to size belt drive systems.

Centre Distance: Minimum and maximum distance from the centre of the driveR to the centre of the driveN shaft.

RPM: Rotational speed of the driveR shaft, and the desired rotational speed of the driveN shaft.

Maximum Rim Speed: Maximum allowable linear speed at the outer rim of the pulleys. The default maximum for Gates stock components is 40 meters per second (m/s). The default is 33m/s.

Bushings Checked: Indicates specific user selected bushing family types. The default is “Any”.

Belts Checked: Indicates specific user selected belt types for Design Flex[®] Pro[™] to use in the drive design process.

Selected Drive Section:

INPUT	Drive Information	DriveR	DriveN
Known Belt:	Poly Chain Carbon - 8MGTC-2000 - 12.00 mm	Known Size:	40 Grooves
Speed Ratio:	2.00 Down	RPM:	1470.0
Input Load:	11 kW, Efficiency: 92.00 %	Maximum Rim Speed:	33 m/s
Service Factor:	1.6	Bushings Checked:	TL
Design Power:	17.6 kW	Belts Checked:	Poly Chain Carbon
Center Distance:	758.3 mm		Electric Motor

Belt Type: Specifies the belt type used in the selected drive.

Speed Ratio: Calculated speed change expressed as a ratio of the selected larger diameter pulley to the selected smaller diameter pulley.

dN RPM: Calculated rotational speed of the selected driveN shaft, based on the calculated speed ratio and input rotational speed.

Rated Load: Calculated load capacity of the selected drive based on the smaller diameter pulley. Rated Load will be highlighted in Red if it is less than the Design Power.

Belt Pull: The vectoral addition of tight and slack side belt span tensions based on input load (not design load). It represents the magnitude of pull that belt drives are expected to exert on shafts while transmitting input loads. The Belt Pull calculation assumes belts are pretensioned to the ideal level, which assumes a dynamic tension ratio of 5:1 for V-belt drives and 8:1 for synchronous belt drives. Belt pull is not equivalent to shaft load, as shaft load includes the added contribution of pulley weight.

Center Distance: Calculated distance between shaft centers of the selected drive, using nominal pulley and belt dimensions.

Install/Take-up Range: Calculated distance between shaft centers of the selected drive including recommended maximum and minimum allowances for belt installation and tensioning.

Tension Section:

TENSION			
	New Belt	Used Belt	
Rib/Strand Deflection Distance:	11.82 mm	11.82 mm	When planning to re-install used belts, measure and record the tension before removing and re-install at the recorded tension.
Rib/Strand Deflection Force:	6.7 to 7.2 kg	5.0 to 5.6 kg	
Sonic Tension Meter			
Belt Frequency:	85 to 89 Hz	73 to 77 Hz	
505C/507C Model STM Settings: Weight: 4.7g/m, Width: 12mm/#R, Span: 757mm			

Rib/Strand Deflection Distance: Calculated value based on a deflection distance of 1 mm per 100mm of belt span length.

Rib/Strand Deflection Force: Force required to deflect the belt span (at mid-point) the calculated deflection distance based on the recommended Static Tension (per rib/strand).

User Tips:

- Divide a Deflection Force in Newtons (N) by 9.81 to convert it to kilograms (kg). Another option is to have the Design Report display the Deflection Force in kilograms. To achieve this select 'Tools' and then 'Units of Measure...' from the top menu on the front screen. You can then select 'New' from the 'Name' box at the top and type a new name. Change the Deflection Force listed under Force Units from N to kg.

Belt Frequency: Static Tension (per rib/strand) expressed in frequency units (Hz).

505C/507C Model Settings: Values required to use the Gates Sonic Tension Meter (either model 505C or 507C) to measure Static Tension.

Notes Section:

TENSION			
	New Belt	Used Belt	
Rib/Strand Deflection Distance:	11.82 mm	11.82 mm	When planning to re-install used belts, measure and record the tension before removing and re-install at the recorded tension.
Rib/Strand Deflection Force:	6.7 to 7.2 kg	5.0 to 5.6 kg	
Sonic Tension Meter			
Belt Frequency:	85 to 89 Hz	73 to 77 Hz	
505C/507C Model STM Settings: Weight: 4.7g/m, Width: 12mm/#R, Span: 757mm			

This section will advise of any issues in meeting the input data. E.g. The DriveR pulley maximum bore is less than the shaft diameter specified. Please consider these notes before finalising your design.

The bottom of the report states the date and version of the program at the time of producing this report. Check the version of customer drive reports to make sure that they are using the latest version.

Design Flex[®] Pro[™] is a simple yet powerful drive design tool. With a greater understanding of the output content, users are able to make better drive selections. In addition, an improved understanding of the engineering calculations will enable a deeper understanding of the influence on other drive system components.

Design Flex[®] Pro[™] is available to download for free from www.gates.com/designflex.

DESIGN FLEX® PRO™ – TROUBLE SHOOTING

Type Initiator and Error 1303 message explanations. Both are rights issues. Error 1303 is caused by a more “locked down” system than the Type Initiator error. However the fix is usually the same for both. So make sure you download the software from the links below.

This is an issue with the Windows security center and installing required Microsoft files which should be there – but aren't. Here's our standard response on this:

Design Flex® Pro™ runs on the following versions of Windows - XP, Vista, Windows 7, Windows 8 – in both 32 and 64 bit modes. However, the Windows Security Center and/or Corporate IT/IS departments often prevent successful installation because Design Flex® Pro™ relies on required Microsoft System files which Microsoft states are part of all standard installs, but do not seem to make it into many actual installations. The Security Center or Security Policies prevents our installer from installing these necessary system files.

Type Initiator error:

Design Flex® Pro™ is tested and operates on:

- > Windows 8
- > Windows 7 32 and 64– all service packs
- > Vista 32 and 64 – all service packs
- > XP 32 and 64 – all service packs

We see the type initiator error in two cases:

- > A prior version was installed on a computer by a different person or the person performing the install's rights have changed. The person running the install then does not have permission to over-write all the files – we haven't figured out yet why they can over-write some files and not others. This results in a partial install.
- > The person performing the install has restricted rights not allowing them to run an install which then runs a system-level install. When the Gates program detects that there are missing Microsoft support files, it calls a web-based Microsoft installer to install them. Some security center rights prevent this from working.

The easiest way – but doesn't always solve issues related to the first case - to get past this error is to verify that the installers for the Microsoft Dot Net Framework and the Microsoft Runtime Support files ran. To do this:

- > Install the Dot Net Framework 4.0 from:
<http://www.microsoft.com/downloads/en/details.aspx?FamilyID=9CFB2D51-5FF4-4491-B0E5-B386F32C0992>
- > Install the version 10 Runtimes from:
<http://www.microsoft.com/downloads/en/details.aspx?FamilyID=A7B7A05E-6DE6-4D3A-A423-37BF0912DB84>

Test the Design program – if it works, everything is good and you are done. Otherwise, we have to remove the traces of an older install so that we can fully install the new program.

To do that:

- > Go to Start-Control Panel-Add/Remove programs and un-install DFPro Std
- > Go to C:\Program Files\Gates Corporation and delete the entire Design Flex Pro folder
 - > This would be C:\Program Files (x86)\Gates Corporation on Windows 7-64.
 - > This does not remove any user information or files
- > Re-install the Design Flex® Pro™ software

As mentioned there are no compatibility issues with running Design Flex® Pro™ on Windows 7. You can run into issues if you go to www.gates.com/designflex and select Run. You are best to Save the file to your computer in a location you can easily find it, eg the Desktop.

Once it has finished downloading, right click on the install file and then click on **Run as administrator.**

