PC-DMIS Gear

Measurement Tool for Spur, Helical and Bevel Gears

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PC-DMIS Gear

PC-DMIS Gear: Introduction

PC-DMIS™ Gear is a completely independent software package that, through automation, uses PC-DMIS 4.1 or higher to measure External Spur, Helical, Internal Spur and Bevel gears. PC-DMIS Gear is designed for simplicity and to give you a straight forward measurement experience. Measurement results are displayed graphically using Quindos PageViewer.

New! PC-DMIS Gear version 2.1 combines the capability that was previously accomplished using two separate applications: *PC-DMIS Gear* (external and internal spur, helical gears) and *Spiral Bevel Gear* (bevel gears).

This document covers the following topics:

- Getting Started
- PC-DMIS Gear: User Interface
- Parameters for Spur and Helical Gears
- Parameters for Bevel Gears
- Appendix A: Using Quindos PageViewer

Important! For gear terminology that is used throughout this document that may be unclear, consult the appropriate gear standard for detailed information. The four widely-used gear standards are AGMA 2000-A88, DIN 3962, JIS B 1702 and ISO 1328. While similar, they also differ from each other. Because of their differences this documentation cannot cover the details of these standards. You will need to know the information about your particular standard in order to measure your gear and properly analyze your data. For example, the "ANSI/AGMA Standard 1012-F90; Gear Nomenclature, Definitions with Terms and Symbols" could be used for reference.

Getting Started

To begin using PC-DMIS Gear, complete the following steps:

Step 1: Install PC-DMIS Gear

Step 2: Launch PC-DMIS Gear

Step 3: Modify PC-DMIS Gear Settings

Step 4: Create or Open a Gear File

Step 5: Calibrate Probes

Step 6: Define Gear Parameters

Step 7: Create an Alignment

Step 8: Measure the Master Flank (only used for bevel gears)

Step 9: Measure a Gear

Step 10: Review Measured Data

Step 11: Analyze a Gear

Depending on your gear type, review the following chapters:

Parameters for Spur and Helical Gears

Parameters for Bevel Gears

Step 1: Install PC-DMIS Gear

To install PC-DMIS Gear:

1. Make sure you have a portlock attached to the serial (printer) port of your computer. Some newer portlocks may attach to your USB port. Your portlock must be programmed with the **Gear** and/or the **Spiral Bevel Gear** option in order to install PC-DMIS Gear.

   Note: If neither of these options are selected in your portlock, PC-DMIS Gear installation will be blocked and a error message will be displayed. If only one of these options is selected, then only that gear module will be available in PC-DMIS Gear.

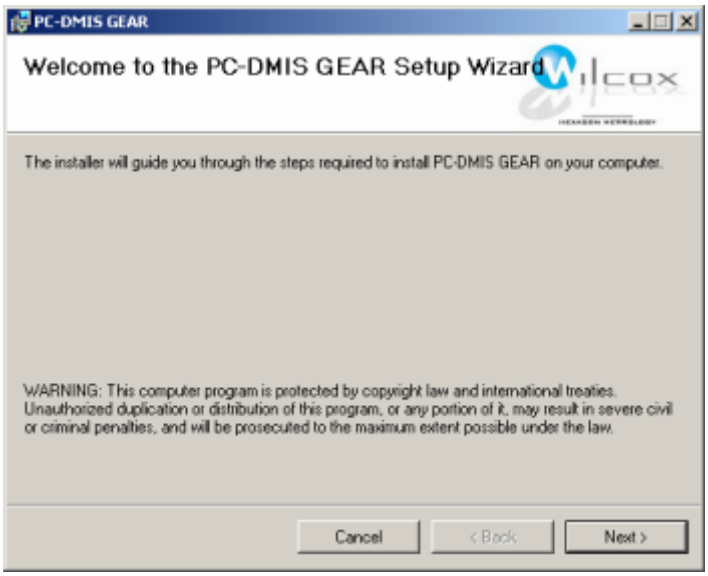
2. If PC-DMIS 4.1 or later is not already installed, follow your PC-DMIS installation guide to install it.

   Note: For PC-DMIS 4.2 and later, you will be prompted to install PC-DMIS Gear as part of the PC-DMIS installation process if either the **Gear** or the **Spiral Bevel Gear** option is selected in your portlock settings. Hereby there is no need to download the PC-DMIS Gear ZIP file from the Wilcox FTP site.

3. If PC-DMIS Gear was not installed during PC-DMIS installation as noted above, log on to the Wilcox ftp site: ftp.wilcoxassoc.com. Browse to the PCDMISGEAR directory. Download PCDMISGEAR.ZIP into a specified directory on your hard drive.
4. Extract the contents of the ZIP file to a specified directory on your hard drive.

5. Install PC-DMIS Gear by double-clicking the setup.exe file.

6. An installation wizard appears that will guide you through the installation process.



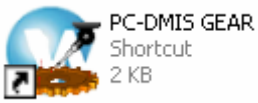
PC-DMIS GEAR Setup Wizard

7. Follow the on-screen instructions to install PC-DMIS Gear. By default the setup application will install PC-DMIS Gear to the **C:\Program Files\WAI\PC-DMIS GEAR <current version>** directory.

Step 2: Launch PC-DMIS Gear

To launch PC-DMIS Gear:

1. Double-click the **PC-DMIS Gear** shortcut icon on the desktop or select **Start | Programs | PC-DMIS GEAR** and then select the **PC-DMIS Gear** shortcut icon.



2. The **PC-DMIS Gear** application appears.

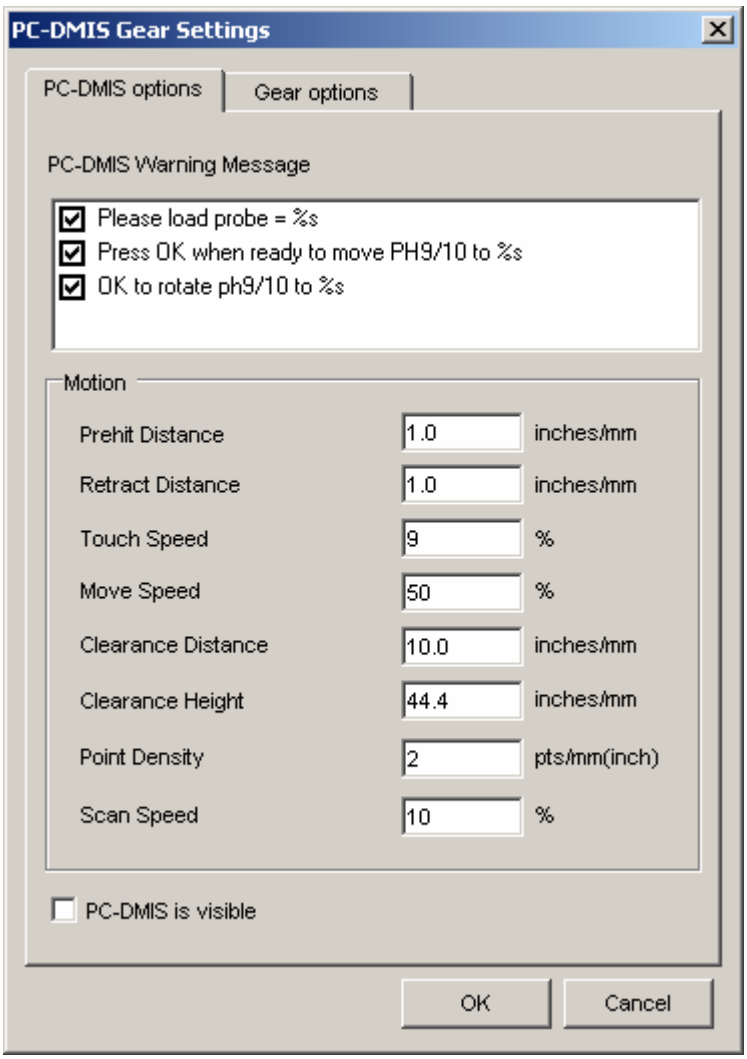
Note: Your portlock must be programmed with the **Gear** and/or the **Spiral Bevel Gear** option in order to run PC-DMIS Gear. Gear modules (Gear or Spiral Bevel Gear) will be available in PC-DMIS Gear according to your portlock settings.

Step 3: Modify PC-DMIS Gear Settings

From the **PC-DMIS Gear Settings** dialog box you can alter the general options for PC-DMIS Gear and PC-DMIS operation.

Clicking the **Measure | Options** menu option displays the **PC-DMIS Gear Settings** dialog box. Click **OK** to save your changes or **Cancel** to close the dialog box without saving.

PC-DMIS Options



PC-DMIS Gear Settings dialog box - PC-DMIS options tab

Items available from this tab provide general settings which determine how PC-DMIS displays warnings, controls the motion of your measuring machine, and PC-DMIS application visibility.

PC-DMIS Warning Message: Enable or disable various PC-DMIS warnings. Warnings with a check mark will be displayed when the associated PC-DMIS procedure warrants it.

Prehit Distance: Determines the distance from the theoretical point that the machine changes from **Move Speed** to the slower **Touch Speed**. For further information on any of

these values consult the main PC-DMIS manual. Distance is given in current part units (inch or millimeters).

Retract Distance: This value determines the distance away from the measured point location that the machine changes from **Touch Speed** to the quicker **Move Speed**. Distance is given in current part units (inch or millimeters).

Touch Speed: This value determines the speed the machine will move when it reaches the **Prehit Distance** for the current measurement point. The value that is entered is a percentage of the maximum machine speed.

Move Speed: This value determines the speed the machine will move when moving around the gear. The value that is entered is a percentage of the maximum machine speed.

Clearance Distance: This value determines the distance the probe will retract in the XY direction. Distance is given in current part units (inch or millimeters).

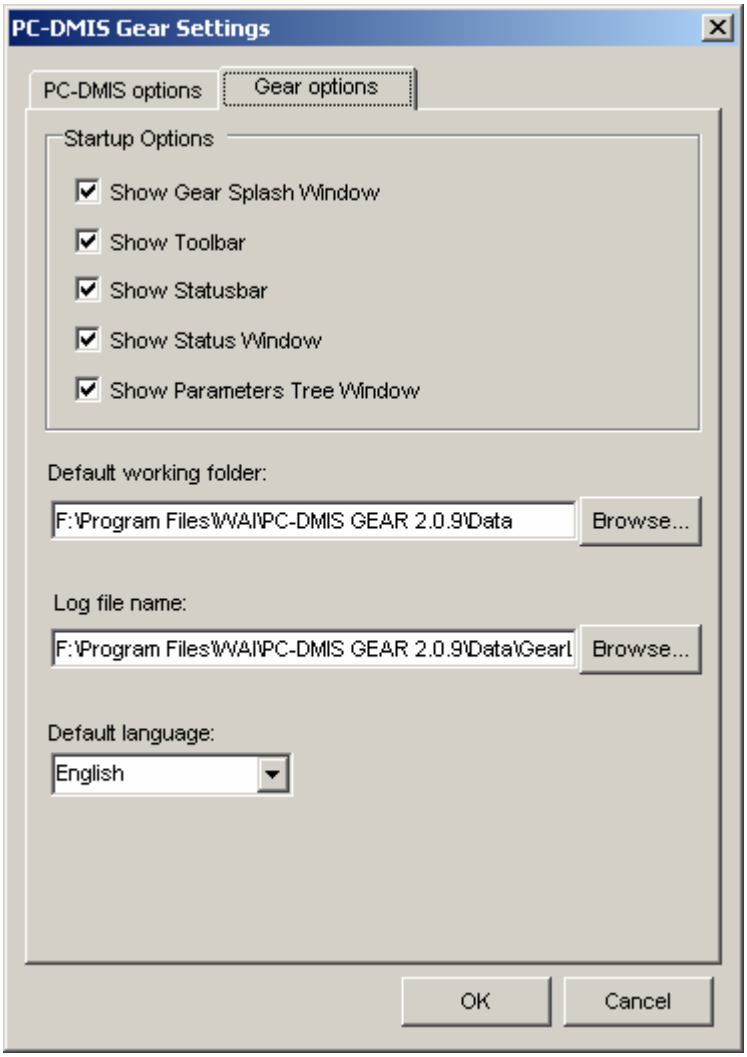
Clearance Height: This value determines the distance the probe will retract in the Z direction. Distance is given in current part units (inch or millimeters).

Point Density: Determines the amount of allowable hits that will be created during a scan. Values are given in terms of points per inch or millimeter depending on part units.

Scan Speed: Allows you change the speed at which the CMM will scan you gear. The value that is entered is a percentage of the maximum machine speed. This is only used for an **Analog Scan** type.

PC-DMIS is visible: This option lets you specify whether or not PC-DMIS is visible during PC-DMIS Gear execution of probe qualification, gear alignment, and gear measurement. Until you become comfortable with PC-DMIS Gear and how it interfaces with PC-DMIS, select this option to have PC-DMIS visible.

Gear Options



PC-DMIS Gear Settings dialog box - Gear options tab

Startup Options - When you first startup PC-DMIS Gear, the following five elements will be displayed as selected.

Show Gear Splash Window: The PC-DMIS Gear *Splash Window* is displayed when you first launch PC-DMIS Gear. An example of the splash window is shown in the "PC-DMIS Gear: Introduction" topic.

Show Toolbar: When selected, the PC-DMIS Gear *Toolbar* is displayed.

Show Statusbar: When selected, the PC-DMIS Gear *Statusbar* is displayed.

Show Status Window: When selected, the PC-DMIS Gear *Status Window* is displayed.

Show Parameters Tree Window: When selected, the PC-DMIS Gear *Parameters Tree Window* is displayed.

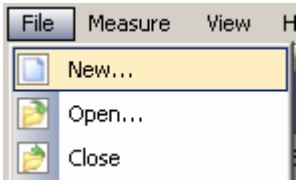
Default working directory: Provides the default location to which gear files are saved. By default, this is the "Data" directory in the PC-DMIS Gear install directory.

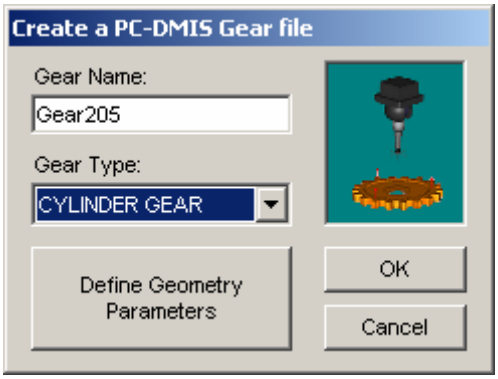
Log file name: Provides the default location and file name to which log data will be saved. By default, this file is named GearLog.txt and is saved in the Data directory in the PC-DMIS Gear install directory.

Default language: Allows you to specify the default interface language (English or Chinese) for the PC-DMIS Gear application.

Step 4: Create or Open a Gear File

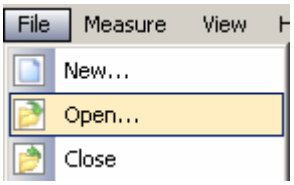
To create a new gear file:

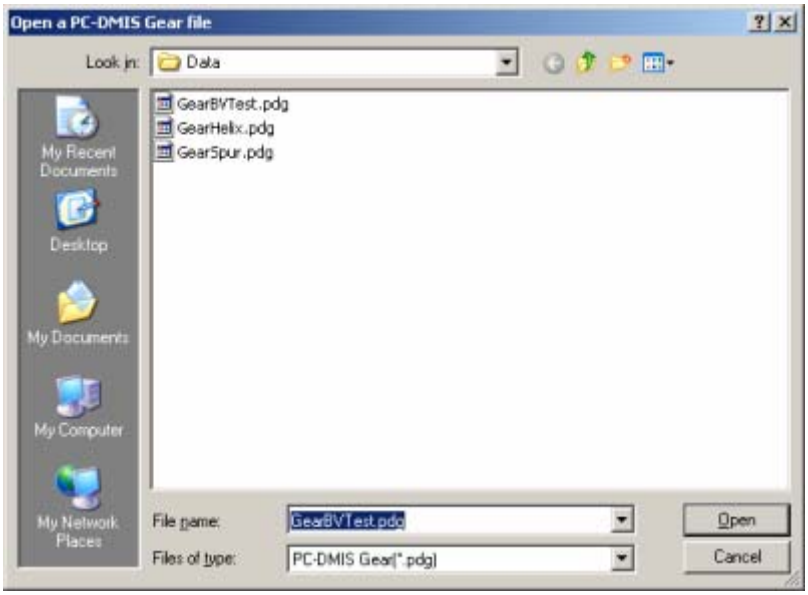
Select ...  or click ... to open the **Create a PC-DMIS Gear file** dialog box.	Open the **Create a PC-DMIS Gear file** dialog box by selecting the **File | New** menu option. You can also open this dialog box by clicking the **New** toolbar icon.



- Type the name of the new gear file in the **Gear Name** box. If the file already exists you will be prompted to verify that you want to overwrite the old file.
- Select the **Gear Type**: Either CYLINDER GEAR (spur or helical gear) or BEVEL GEAR.
- You can also click **Define Geometry Parameters** to provide the geometry parameters for your gear. See "Defining a Spur or Helical Gear" or "Defining a Bevel Gear".
- Click **OK** to create a new PC-DMIS Gear file or **Cancel** to close without saving.

To Open an Existing Gear File:

Select ...  or click ... to open the **Open a PC-DMIS Gear file** dialog box.	Open the **Open a PC-DMIS Gear file** dialog box by selecting the **File | Open** menu option. You can also open this dialog box by clicking the **Open** toolbar icon. You can open the PC-DMIS Gear file to use and analyze gear data without re-measuring the gear.



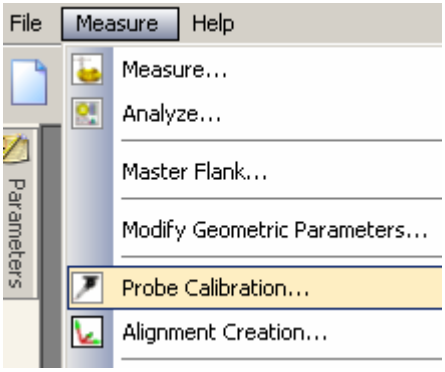
Browse to and select the needed PC-DMIS Gear (*.pdg) file and click **Open**.

Step 5: Calibrate Probes

In order to create alignments of measure your gear, you must first calibrate your probe.

To calibrate your probe:

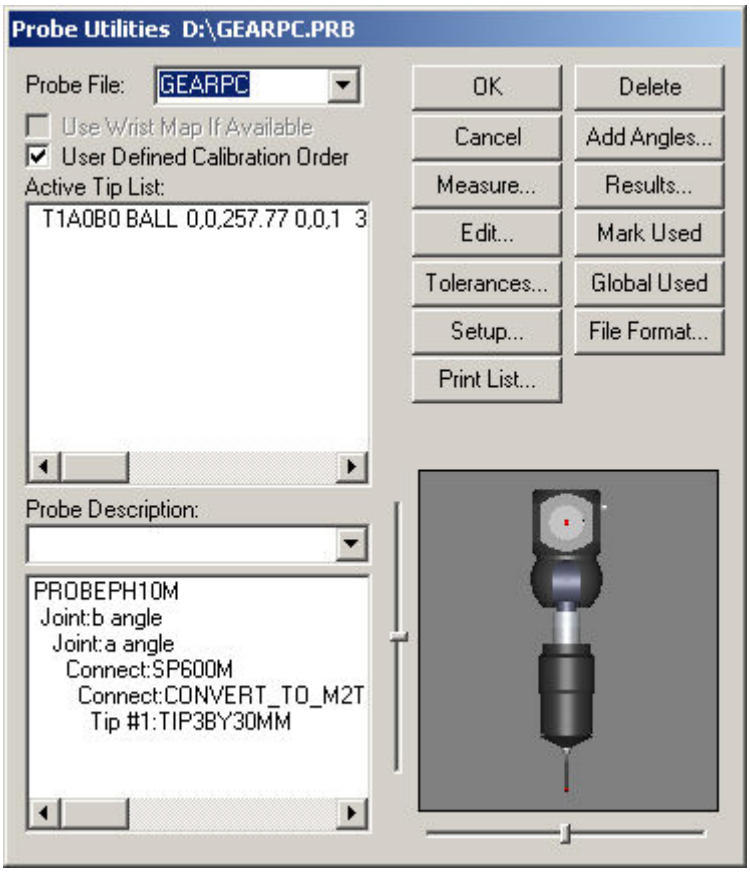
1. Select the **Measure | Probe Calibration** menu option...



... or the **Probe** toolbar icon...

... to open a **Save As** dialog box. PC-DMIS launches in the background.

2. Browse to and select an existing probe file (*.prb) or type the **File name** to define a new probe file. When you click **Save**, PC-DMIS Gear will open the PC-DMIS **Probe Utilities** dialog box.



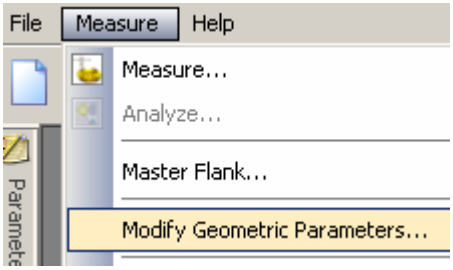
3. From the **Probe Utilities** dialog box you can then define and calibrate your probe. If needed, see the core PC-DMIS documentation for information on calibrating probes.
4. Click **OK** when you have finished the probe calibration.

Step 6: Define Gear Parameters

Once you have created a new file or opened an existing file, you can modify the geometric parameters for your gear file.

To define gear parameters:

1. Select the **Measure | Modify Geometric Parameters** menu option...



... or the **Define** toolbar icon...

... to open the **Gear Definition** dialog box. The available values will vary depending on the type of gear that you are defining.

2. Make the needed changes to the values in the dialog box according to your gear type:

   - **Spur or Helical Gear:** See "Defining a Spur or Helical Gear".
   - **Bevel Gear:** See "Defining a Bevel Gear".

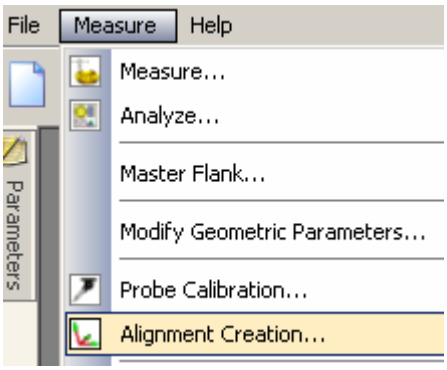
3. Click **Apply** to update the changes that have been made, click **OK** to save any changes and close the dialog box, or **Cancel** to close without saving changes.

Step 7: Create an Alignment

Prior to measuring your gear, you need to create an alignment.

To create an alignment:

1. Select the **Measure | Alignment Creation** menu option...



... or the **Align** toolbar icon...

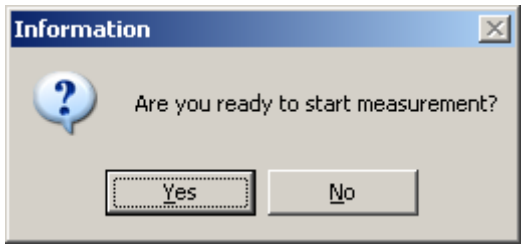
... to open the **Align Gear** dialog box. The available values will vary depending on the type of gear that you are defining.

2. Make the needed changes to the values in the dialog box according to your gear type:

   - **Spur or Helical Gear:** See "Aligning a Spur or Helical Gear".
   - **Bevel Gear:** See "Aligning a Bevel Gear".

3. Click **Apply** to save any changes, or **Close** to close the dialog box without saving.

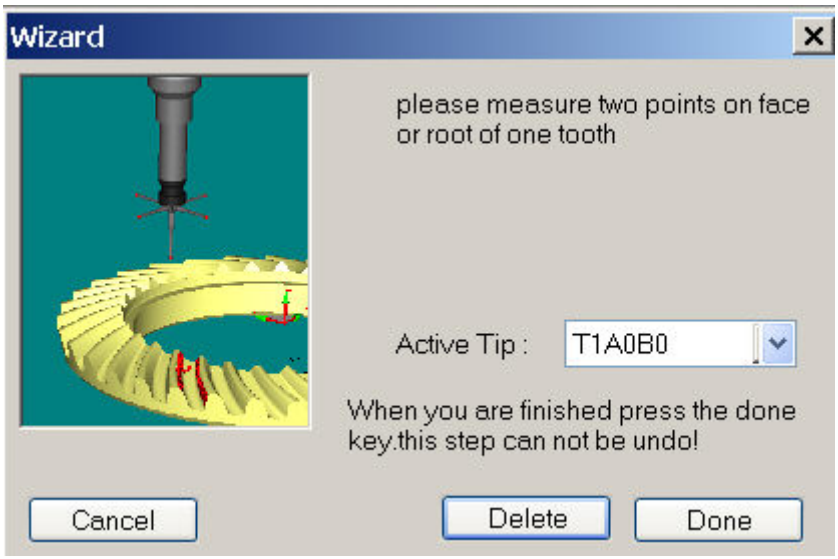
4. Click **Measure** to begin the Alignment Wizard. You are prompted whether of not you are ready to start measurement.



5. Click **Yes** to continue measurement, using the Alignment Wizard. PC-DMIS launches in the background to execute each of the measurements. The steps provided by the Alignment Wizard will vary depending on the gear type and the parameters specified.

Example from the Alignment Wizard

6. Skip to step 7 if you have NOT selected the **Face or Root Cone Measurement** option from the **Align Gear** dialog box for bevel gears (see "Aligning a Bevel Gear"). Otherwise, with this option selected, PC-DMIS Gear will also perform an accuracy alignment along with the basic gear alignment. Some blueprints require a more accurate alignment that is created using a face/root cone.



Wizard showing and example of and accuracy alignment

Follow these steps in the **Wizard** to complete the accuracy alignment:

a) Select the **Active Tip** that will be used to measure the two points.
b) Measure two points on the face or root of one tooth. You will always need to take 2 hits on the face/root cone of the bevel gear.
c) Click **Delete** to delete the points that were just taken, if you are not satisfied with the result.
d) Click **Done** to measure the face/root cone. The PC-DMIS part program for face/root cone will be built automatically.

Important: *The alignment can not be undone after you click* ***Done*** *button.*

7. Follow the instructions given in the **Wizard** and measure the specified features to establish the alignment.
8. For each feature, select the **Active Tip** that will be used to measure the feature.
9. When each feature has been measured, click **Next**. You will be directed to measure the next feature.
10. If you are not satisfied with the step that you just completed you can click **Back** to go to the last step. Also, before you go to the next step the **Back** button will display as **Delete**; click it to delete the feature you just measured.

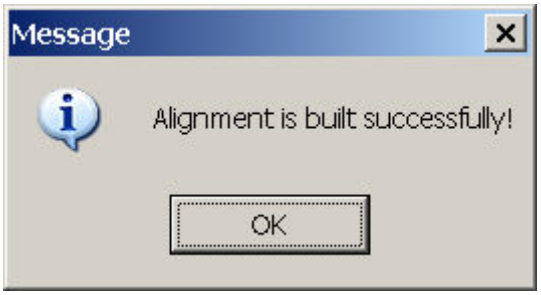
Note: During measurement, if the hit point you have taken is not good enough to fit a feature needed, the software will warn you to remeasure it. You can click **OK** and continue.

11. If you are not satisfied with a hit, click **Del Hit** to remove the last hit.

Note: The last step can always be undone!

12. After you have measured all alignment features this **Execution** box will appear. Click **Cancel** to cancel the auto measure or click **OK** to proceed with the measurement.

14. When automatic alignment process has completed the following message box will appear.



15. The gear alignment is now complete.

For more information on Alignment Parameters see the following topics:

Spur or Helical Gear Alignment - See "Aligning a Spur or Helical Gear".

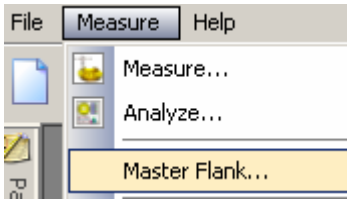
Bevel Gear Alignment - See "Aligning a Bevel Gear".

Step 8: Measure the Master Flank

This step is only needed when working with bevel gears. If you did not provide a Master Flank file during the "Step 6: Define Gear Parameters", you will need to measure the Master Flank to create a Master Flank file. Otherwise, you can skip to the next step and "Measure a Gear".

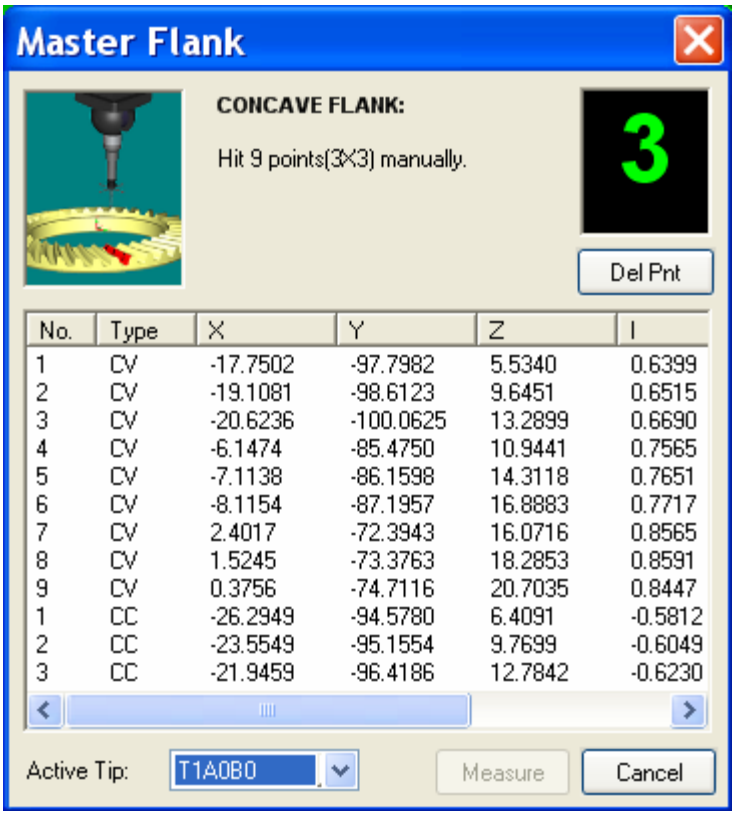
To measure the Master Flank:

1. Select the **Measure | Master Flank** menu option...

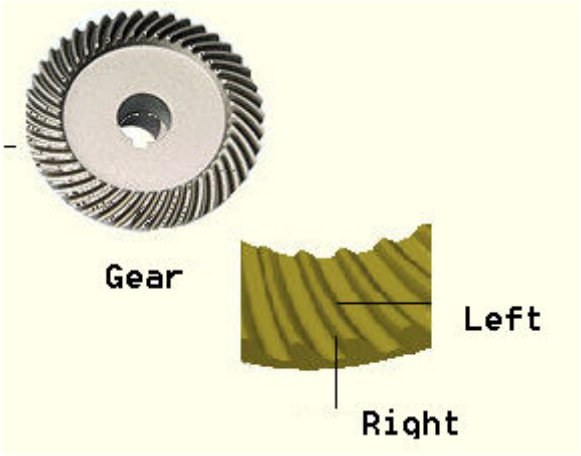


... to open the **Gear Measurment Setup** dialog box. This dialog box is the same dialog box that is used in "Step 9: Measure a Gear" except for the additional **MasterFlank Setting** button, which allows you to set Master Flank parameters.

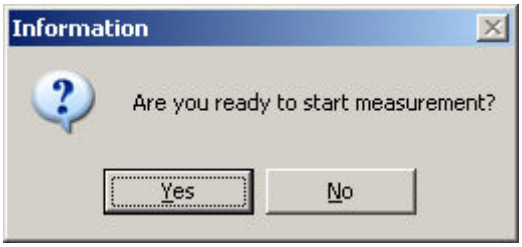
2. Make the needed changes to the values in the **Gear Measurement Setup** dialog box. See the "Editing Measurement Parameters for Bevel Gears" topic for more information on the available options.
3. Click MasterFlank Setting to edit the Master Flank data. See the "Defining Master Flank Data" topic. Edit the values of the **Master Flank Parameters** dialog box as needed.
4. Click **OK** to save any changes that you have made, or **Cancel** to exit without saving your changes.
5. Click **Measure** to begin the **Master Flank Measurement** wizard. PC-DMIS launches in the background to execute each of the measurements.



6. Select the **Active Tip** that will be used to measure the specified hits. Follow the instructions and measure the specified hits to establish the Master Flank. The left and right flanks of a gear are defined as shown in the image below.



7. If you are not satisfied with a hit, click **Del Pnt** to remove the last hit.
8. When you have finished taking hits, click **Measure**. The software will create a program and take 5*9 points on each flank automatically. You will be prompted to start measurement.



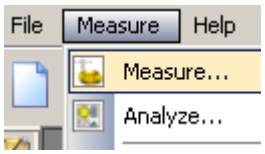
9. Click **Yes** to start and **No** to cancel. PC-DMIS will run your part program automatically.

Step 9: Measure a Gear

This step discusses the process to perform general gear measurement.

To measure a gear:

1. Select the **Measure | Measure** menu option...



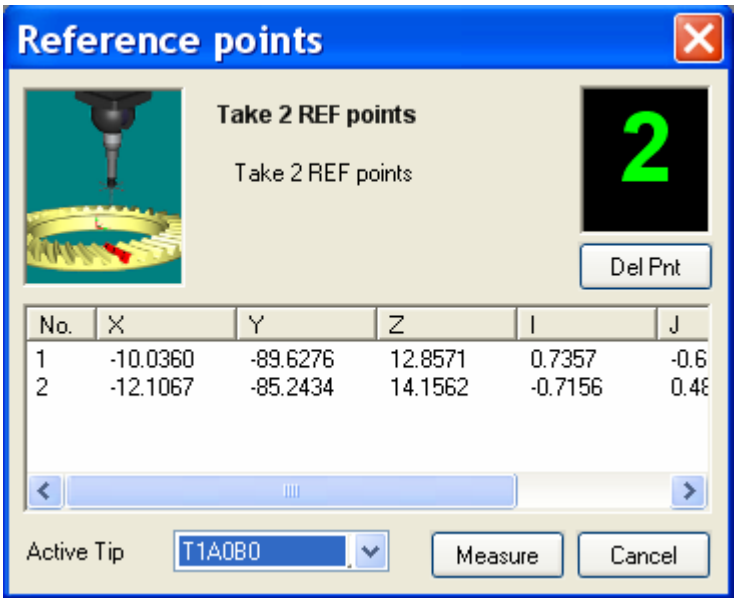
... or the **Measure** toolbar icon...

... to open the **Gear Measurement Setup** dialog box. The available values will vary depending on the type of gear that you are defining.

2. Make the needed changes to the values in the dialog box according to your gear type:

   - **Spur or Helical Gear:** See "Editing Measurement Parameters for Spur or Helical Gears".
   - **Bevel Gear:** See "Editing Measurement Parameters for Bevel Gears".

3. Click **Apply** to save any changes that you have made, or **Close** to exit without saving your changes.
4. Click **Measure** to begin the gear measurement process. PC-DMIS launches in the background to execute each of the measurements.



5. Follow the instructions and take two manual hits on each flank of one tooth. Click **Del Pnt** to remove the last hit.

Note: Reference points (clocking points) can be taken in ANY order on the tooth or in the gap between the teeth, and it doesn't matter if hits are taken clockwise or not.

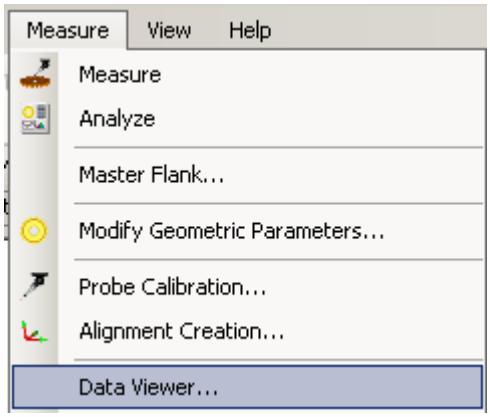
6. Select the **Active Tip** and click **Measure** (or click **Cancel** to cancel gear measurement). PC-DMIS will create a part program and measure your gear automatically.

Step 10: Review Measured Data

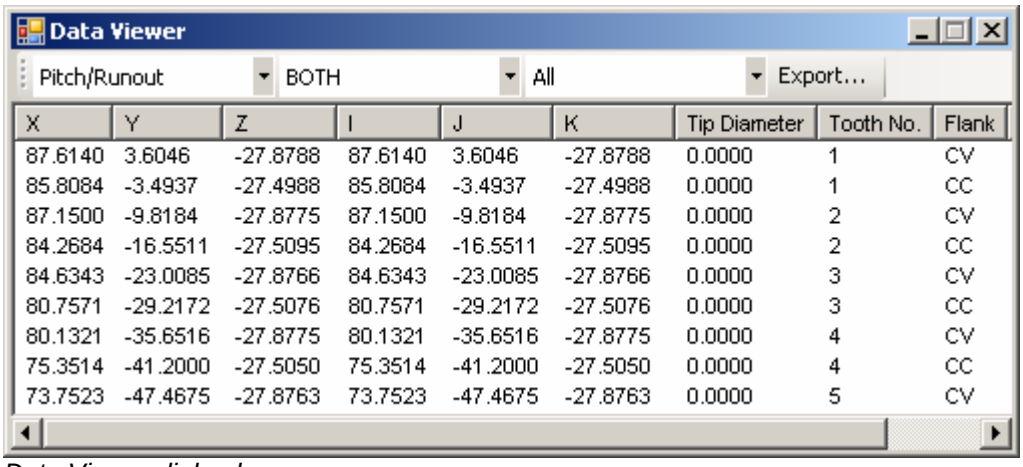
Once a gear has been measured you can review the actual measured data and export to a tab delimited text file using the **Data Viewer** dialog box.

To review measured data:

1. Select the **Measure | Data Viewer** menu option...



... to open the **Data Viewer** dialog box. The available options will vary depending on the type of gear that you are defining.



X	Y	Z	I	J	K	Tip Diameter	Tooth No.	Flank
87.6140	3.6046	-27.8788	87.6140	3.6046	-27.8788	0.0000	1	CV
85.8084	-3.4937	-27.4988	85.8084	-3.4937	-27.4988	0.0000	1	CC
87.1500	-9.8184	-27.8775	87.1500	-9.8184	-27.8775	0.0000	2	CV
84.2684	-16.5511	-27.5095	84.2684	-16.5511	-27.5095	0.0000	2	CC
84.6343	-23.0085	-27.8766	84.6343	-23.0085	-27.8766	0.0000	3	CV
80.7571	-29.2172	-27.5076	80.7571	-29.2172	-27.5076	0.0000	3	CC
80.1321	-35.6516	-27.8775	80.1321	-35.6516	-27.8775	0.0000	4	CV
75.3514	-41.2000	-27.5050	75.3514	-41.2000	-27.5050	0.0000	4	CC
73.7523	-47.4675	-27.8763	73.7523	-47.4675	-27.8763	0.0000	5	CV

Data Viewer dialog box

2. Select the feature type for the report data to be reviewed:

   - **Spur or Helical Gears:** Pitch/Runout or Topography
   - **Bevel Gears:** Pitch/Runout, Profile, or Helix/Lead

3. Select the tooth side (flank side in the case of bevel gears) to be reviewed:

   - **Spur or Helical Gears:** BOTH, LEFT or RIGHT
   - **Bevel Gears:** BOTH, CV (Convex side) or CC (Concave side)

4. Select an individual tooth from the drop-down list that you would like to review or select **ALL** to review all the measured teeth.
5. Review the data as displayed in the **XYZIJK** columns. The **Tip Diameter**, **Tooth No.**, and **Flank** are also displayed.
6. Click **Export** to open the **Save As** dialog box. Type the **File name** of the text file to which data will be exported.
7. Click **Save** to export the measured gear data as displayed in the **Data Viewer** dialog box.

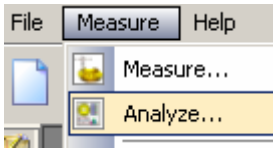
Step 11: Analyze a Gear

Once you have finished measuring your gear, you can analyze the data and create reports:

- **Spur or Helical Gear:** Pitch/Runout, Profile/Helix or Tip/Root Circle reports
- **Bevel Gear:** Pitch/Runout or Topography reports

To create a report:

1. Select the **Measure | Analyze** menu option...



... or the **Analyze** toolbar icon...

... to open the **Analysis Setup** dialog box. The available options and plot information will vary depending on the type of gear that you are defining.

2. Make the needed changes to the parameters in the dialog box according to your gear type:

    - **Spur or Helical Gear:** See "Analyzing a Spur or Helical Gear".
    - **Bevel Gear:** See "Analyzing a Bevel Gear".

3. Provide **Plot Information** that will be included in the header of your report.
4. Click **Analyze**, or click **Cancel** to abort report creation.

Once you click **Create Report**, the measurement data is spooled to the **Quindos PageViewer** application where you can view and print your report(s). See "Appendix A: Using Quindos PageViewer".

Important! Quindos PageViewer depends on PC-DMIS Gear being open. If you close PC-DMIS Gear, Quindos PageViewer and any open analysis reports will also close.

PC-DMIS Gear: User Interface

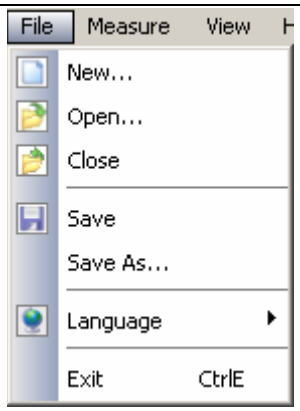
User interface elements for PC-DMIS Gear are discussed in the following topics:

- Menu Options
- PC-DMIS Gear Toolbar
- Parameters Tree Window
- Status Window
- Status Bar

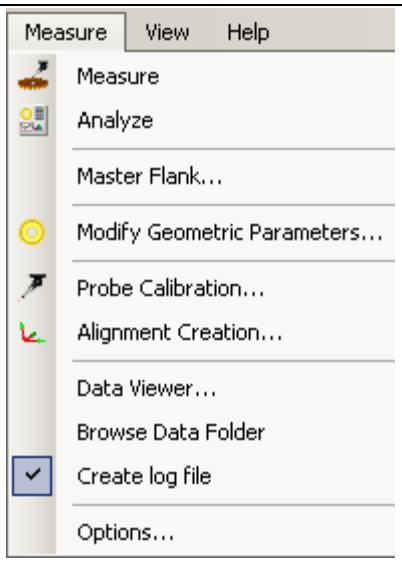
Menu Options

The following menu options are available in PC-DMIS Gear:

File Menu

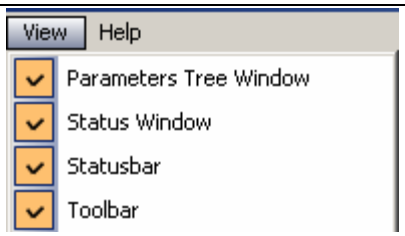
	• **New:** Create a new PC-DMIS Gear file. • **Open:** Open an existing PC-DMIS Gear file. You will be prompted to save your work before the current file is closed and the selected file is opened. • **Close:** Close the current PC-DMIS Gear file. • **Save:** Save the current PC-DMIS Gear file with the current file name and file type (*.pdg). • **Save as:** Save the current PC-DMIS Gear file with a specified name. • **Language:** Select the language that will be used for the PC-DMIS Gear application. • **Exit:** Closes PC-DMIS Gear. Exiting PC-DMIS will also close the Quindos PageViewer application with any open analysis reports.

Measure Menu



- **Measure:** Measure your gear. See "Editing Measurement Parameters for Spur or Helical Gears" or "Editing Measurement Parameters for Bevel Gears".
- **Analyze:** Analyze the measured results for your gear. See "Analyzing a Spur or Helical Gear" or "Analyzing a Bevel Gear".
- **Master Flank:** Measure the Master Flank to create a Gleason file. See "Defining Master Flank Data".
- **Modify Geometric Parameters:** Set geometry parameters for your gear. See "Defining a Spur or Helical Gear" or "Defining a Bevel Gear".
- **Probe Calibration:** Calibrate your Probe. See "Step 5: Calibrate Probes".
- **Alignment Creation:** Create alignment for the gear you want to measure. See "Aligning a Spur or Helical Gear" or "Aligning a Bevel Gear".
- **Data Viewer:** View the nominal and actual data for your measured gear. See "Step 10: Review Measured Data".
- **Browse Data Folder:** Open the **Data** folder inside the PC-DMIS Gear install directory.
- **Create Log File:** Selecting this option will cause debug information to be collected for troubleshooting problems. Debug information is stored in the file specified by the **Log file name** value in the **PC-DMIS Gear Settings** dialog box. By default, debug data is stored in the data\GearLog.txt file in the PC-DMIS Gear install directory. See "Step 3: Modify PC-DMIS Gear Settings".
- **Options:** Allows you to set general PC-DMIS Gear parameters. See "Step 3: Modify PC-DMIS Gear Settings".

View Menu

	• **View Menu Items:** Toggles the display of the respective PC-DMIS Gear application elements: **Parameters Tree Window**, **Status Window**, **Statusbar**, & **Toolbar**. The default status for these application elements can be set from the "PC-DMIS Gear Settings" dialog box.

Help Menu

	• **Contents and Index:** Open the PC-DMIS Gear help file. • **About PC-DMIS GEAR:** Displays information about your version of PC-DMIS Gear.

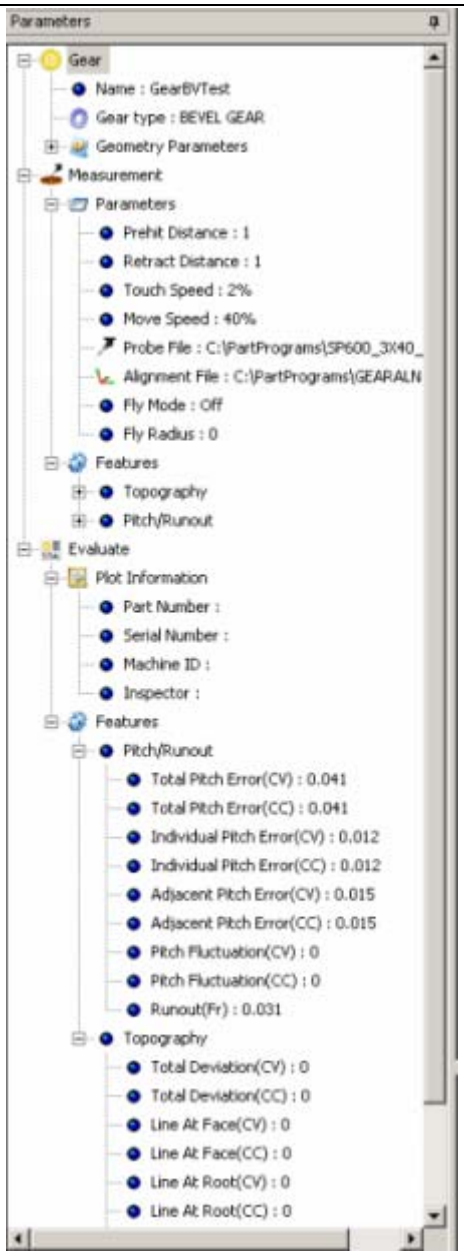
Gear Toolbar

Gear Toolbar

The **Gear Toolbar** has all the functionality you need to in one convenient, easy to use location. This toolbar lets you perform the following functions:

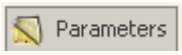
- **New** – Creates a new PC-DMIS Gear file (*.pdg). This can be either a CYLINDER GEAR or a BEVEL GEAR. See "Step 4: Create or Open a Gear File".
- **Open** – Allows you to select an existing PC-DMIS Gear file from the **Open** dialog box. See “Step 4: Create or Open a Gear File”.
- **Save** – Allows you to save your PC-DMIS Gear file using the **Save As** dialog box.
- **Define** – Defines the gear you will measure. See “Step 6: Define Gear Parameters”.
- **Measure** – Uses PC-DMIS in the background to perform the actual gear measurement. See “Step 9: Measure a Gear”.
- **Analyze** – Analyzes the gear measurement, providing statistical data. See “Step 11: Analyze a Gear”.
- **Probe** – Defines and calibrates any probes you plan on using to align or measure the gear. See “Step 5: Calibrate Probes”.
- **Align** – Aligns the selected gear to your measuring machine. See “Step 7: Create an Alignment”.
- **Help** – Opens the PC-DMIS Gear help file.

Parameters Tree Window



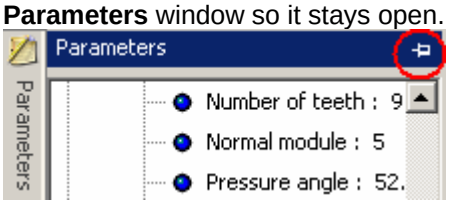
The **Parameters Tree Window** is only used to display the detailed information for parameters. It is only a reference and you cannot modify it. This provides information for three core areas: "Gear", "Measurement", and "Evaluate".

To hide or show the **Parameters Tree Window** select the **View | Parameters Tree Window** menu option.

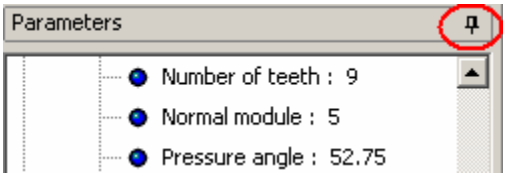
Click 

to open the **Parameters** window.

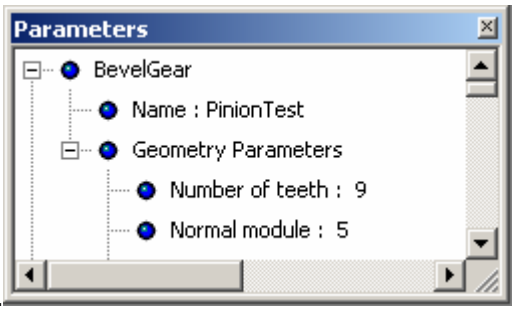
Click the thumbtack icon to anchor the **Parameters** window so it stays open.



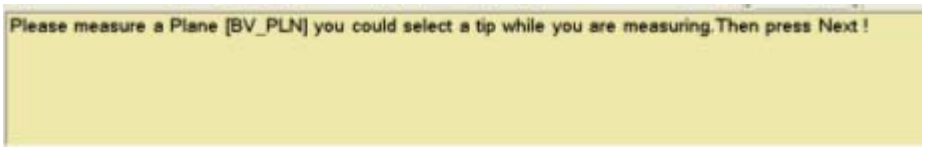
Likewise, click the black thumbtack icon to close the **Parameters** window.



You can also click and grab the title bar of the fixed **Parameters** window to cause it to float above the main window. In this way you can size and position the window wherever you want. You can also dock this window to the any side of the main PC-DMIS Gear window by dragging it to the desired position. Click the **X** in the corner to close this window.



Status Window

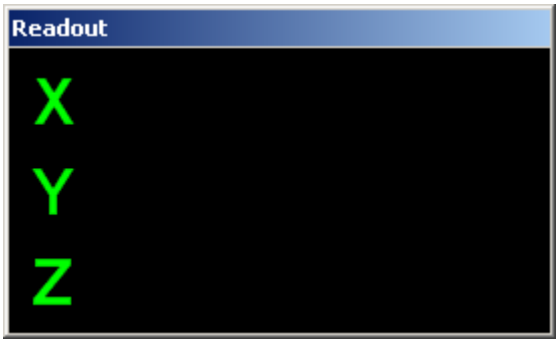


The Status Window dynamically describes the process messages or gives prompts during your measurement. You can open and close this window by clicking the **up** or **down** buttons in the middle of the top border of this window.

Status Bar

The **Status Bar** does the following:

- Provides status information
- Displays the name of the current active part program in PC-DMIS.
- You can control the visibility of PC-DMIS by clicking the **INVISIBLE** or **VISIBLE** button in the status bar.
- Displays the units of the current part program (MM or INCH).
- Displays the XYZ coordinates of your probe. You can also click anywhere in the XYZ area to open a **Readout** window. To close the **Readout** window, just click in the XYZ area again.



Parameters for Spur and Helical Gears

This section provides detailed information for the parameters that are used when measuring and analyzing spur or helical gears. See the "Getting Started" chapter for the steps for using PC-DMIS Gear. The following topics provide information for spur and helical gears:

- Defining a Spur or Helical Gear
- Aligning a Spur or Helical Gear
- Editing Measurement Parameters for Spur or Helical Gears
- Analyzing a Spur or Helical Gear

Defining a Spur or Helical Gear

The **Gear Definition** dialog box provides relevant measurement parameters for spur or helical gears. PC-DMIS Gear uses these parameters to create the PC-DMIS part program. The part program will then measure and collect the data to be analyzed.

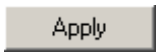
Define

Once you have created or opened a spur or helical gear file, clicking the **Define** button or selecting the **Measure | Modify Geometric Parameters** menu option displays the **Gear Definition** dialog box.

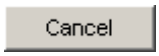
The **Gear Definition** dialog box has six tabs which represent the possible aspects of measurement when you are working with a spur or helical gear (see "Defining a Bevel Gear" when working with bevel gears). Only the Pitch and Runout measurements are required; all other measurements are optional.

According to the changes made in the **Gear Definition** dialog box, use the following controls as described:

This button will close the **Gear Definition** dialog box and apply any changes that you have made.



This button will apply any changes that you have made in the **Gear Definition** dialog box while leaving the dialog box open.



This button will close the **Gear Definition** dialog box without saving changes.

When working with spur of helical gears review the parameters for each of the six tabs of the **Gear Definition** dialog box:

- Parameters Tab
- Pitch/Runout Tab
- Profile Tab
- Helix/Lead Tab
- Tip/Root Tab
- Analysis Setup Tab

Parameters Tab

This tab defines the general gear parameters used for measurement. PC-DMIS Gear requires these parameters to perform accurate measurements. Most of these values can be found in the drawing for the gear. If some of parameters are not provided from the drawing or if their value does not yet correspond to the drawing, the corresponding value can be estimated in order to make the measurement possible.

Gear Definition dialog box – Parameters tab for spur or helical gears

Number of Teeth: This box specifies the number of teeth around the gear.

Normal Diametrical Pitch (INCH)/Norm Module (MM): Please consult the appropriate gear standard for the definition of this parameter. The heading for this box changes between “Normal Diametrical Pitch (Inch)” and “Norm Module (MM)” depending on whether you selected **Inch** or **MM** as your unit of measurement.

Pressure Angle: Please consult the appropriate gear standard for the definition of this parameter.

Addendum Modifier: Please consult the appropriate gear standard for the definition of this parameter.

Face Width: This box specifies the width from the top of a single gear tooth to the bottom of the same gear tooth. It is always a positive number.

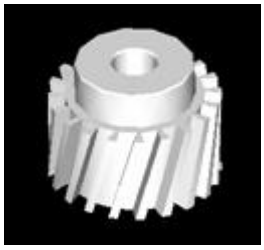
Tip Diameter: This box specifies the diameter of the gear as represented by a circle passing through the tips of each tooth.

Root Diameter: This box specifies the diameter of the gear as represented by a circle passing through the root locations of each tooth.

Gear Orientation: The options in this area allow you to specify whether the gear is **External** (teeth on the outside) or **Internal** (teeth on the inside).

Units: The **Inch** and **MM** options define the units of measurement to use in the created part program and for any typed distance values in PC-DMIS Gear.

Helix Angle: This area contains options that define the orientation and angle of the helix of the gear. If you are measuring a spur gear, you would select the **S** option. **S** stands for Spur. **RH** stands for right hand. **LH** stands for left hand. If you choose either **RH** or **LH**, you must also specify the **Angle** of the helix.

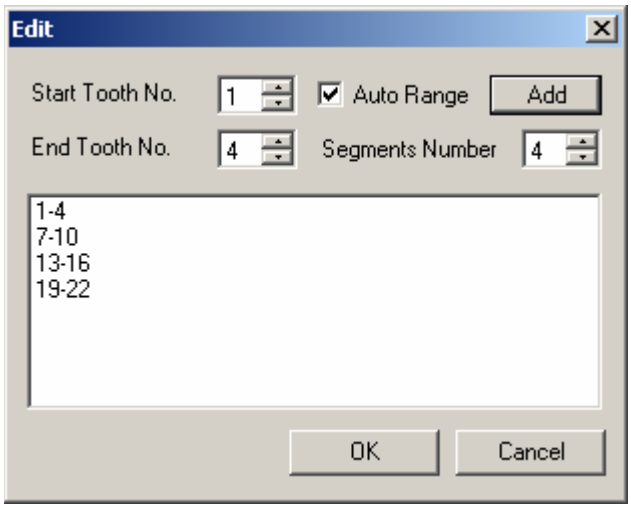


Right Hand Helix

Left Hand Helix

Quality Standard and Grade: The options in this area define the standard used to create the gear and the standard against which you will measure the gear. Choose from the AGMA, DIN, ISO or JIS gear standard and specify the **Grade** for the selected standard.

Segment Gear: Select the **Segment Gear** option to define parameters for a segmented gear. Click **Edit** to define the segmented gear using the **Edit** dialog box. To delete an existing segment list, highlight the data that needs to be removed and press **Delete**.



Edit (segment) dialog box

Note: The **Number of Teeth** represents all the teeth that would be present around the gear if there were no gaps in the tooth pattern. Hence, the purpose of defining segmented gears is to remove the gaps from consideration for measurement. The gear shown below would be defined as having 36 teeth rather than the 18 teeth that actually exist.

Example of a Segmented Gear

There are two ways to generate the segment list:

- **Using "Auto Range"**: When checked, all segments of teeth will be calculated according to **Number of Teeth** (as specified from the Parameters tab) **Start Tooth No.**, **End Tooth No.** and **Segments Number**. For example, you could do the following for a gear with 26 teeth:

    1. Select **Auto Range** to automatically define gear segments.
    2. Type *4* for the **Segment Number** value, which means the all teeth will be divided equally into 4 parts.
    3. Type *1* for the **Start Tooth No.** value, and type *4* for the **End Tooth No.** value. This will measure tooth #1, #2, #3, #4 in every section (since we are working with 26 teeth divided by 4 segments, there should be 6 teeth in every section) and tooth #5, and #6 are not measured.
    4. Click **Add**, to populate the segment list. You will see the result is "1-4", "7-10", "13-16" and "19-22". This defines the teeth to be measured. You may need to experiment with this method to get the desired result.
    5. Click **OK** to save the segment list or **Cancel** to close without saving your changes.

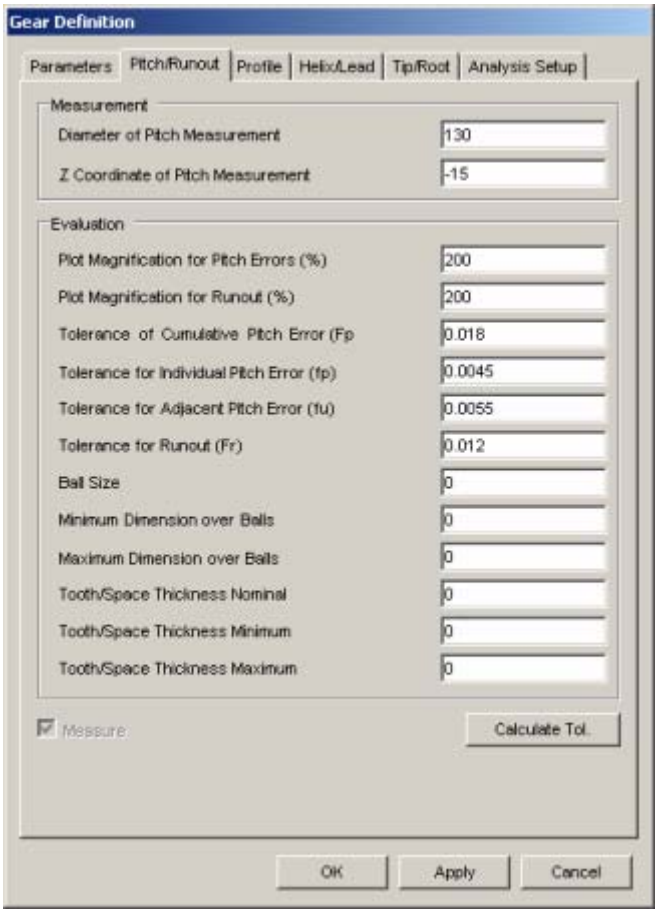
- **Manually adding segment ranges**: When **Auto Range** is unchecked, you can add segments manually. **Segments Number** is disabled in this case, and you need to specify **Start Tooth No.** and **End Tooth No.**, and then click **Add** to add the defined segment to list. Continue this process until each segment is defined. For example, you could do the following for a gear with 26 teeth:

    1. Deselect **Auto Range** to manually define gear segments.
    2. Type *1* for the **Start Tooth No.** value, and type *4* for the **End Tooth No.** value.
    3. Click **Add** to add the segment "1-4" to the list.

4. Repeat steps 1 and 2 for the ranges "7-10", "13-16", and "19-22". This completes that same list that was created in the Auto Range example.
5. Click **OK** to save the segment list or **Cancel** to close without saving your changes.

Pitch/Runout Tab

This tab lets you specify the required data for the measurement of the *Pitch* and *Runout* as well as the analysis parameters for each measurement. The two boxes in the **Measurement** area are required. Every time you use PC-DMIS Gear to measure, it will also measure the *Pitch* and *Runout*.



Gear Definition dialog box – Pitch/Runout tab for spur or helical gears

Measurement Area

Diameter of Pitch Measurement: This is the diameter at which the pitch point measurements will be taken. This value isn't necessarily the same as the Pitch Circle Diameter defined in your gear standard, although it usually is.

Z Coordinate of Pitch Measurement: This value is the Z coordinate value where the pitch points should be measured. This value is usually negative.

Evaluation Area

Plot Magnification for Pitch Errors (%): This value is a percentage that all Pitch errors will be magnified by for display in the analysis.

Plot Magnification for Runout Errors (%): This value is a percentage that all Runout errors will be magnified by for display in the analysis.

Tolerance of Cumulative pitch error (*Fp*): Provides the allowable *cumulative* pitch deviation of all flanks of a gear. Please see the appropriate gear standard for a definition of this value.

Tolerance of Individual pitch error (*fp*): Provides the allowable deviation between the actual measured pitch value between any adjacent teeth and the theoretical circular pitch at the central cone distance. Please see the appropriate gear standard for a definition of this value.

Tolerance of Adjacent pitch error (*fu*): Provides the allowable deviation between the actual measured values of two consecutive transverse pitches of right or left flanks. Please see the appropriate gear standard for a definition of this value.

Tolerance of Runout (*Fr)*: Provides the maximum allowable amount of tooth runout in the radial direction. Please see the appropriate gear standard for a detailed definition of this value.

***Ball* size:** This is the size of the ball over which the **Minimum Dimension over Balls** and **Maximum Dimension over Balls** is measured. Please see the appropriate gear standard for an explanation of how this is measured. If you leave this value at zero, PC-DMIS Gear calculates the needed ball size, during analysis, based on the ball size that would make contact with both teeth at the pitch diameter if placed in the gap between teeth.

Minimum Dimension over Balls: Please see the appropriate standard for a definition of this value.

Maximum Dimension over Balls: Please see the appropriate standard for a definition of this value.

Tooth/Space Thickness Nominal: Provides the nominal distance from one side of the tooth to the other side of the tooth at the pitch diameter. Please see the appropriate standard for a definition of this value.

Tooth/Space Thickness Minimum: Provides the minimum allowable distance from one side of the tooth to the other side of the tooth at the pitch diameter. Please see the appropriate standard for a definition of this value.

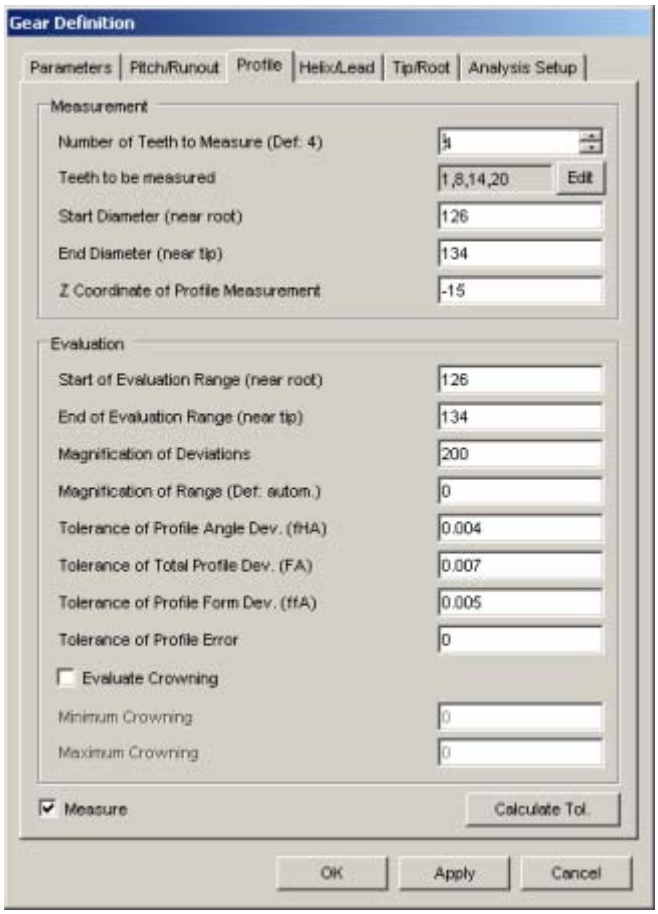
Tooth/Space Thickness Maximum: Provides the maximum allowable distance from one side of the tooth to the other side of the tooth at the pitch diameter. Please see the appropriate standard for a definition of this value.

Measure: When this check box is selected, the pitch/runout for the gear will be measured during the measurement process based on the parameters defined on the **Pitch/Runout** tab.

Calculate Tols This button causes PC-DMIS Gear to use the values input on this tab as well as the **Parameters** tab to calculate the tolerances of the Pitch and Runout based on the standard specified.

Profile Tab

This tab lets you specify the required data for the measurement of the *Profile* as well as the analysis parameters for each measurement. Profile measurement is optional; if you don't want to measure the profile, deselect the **Measure** option.

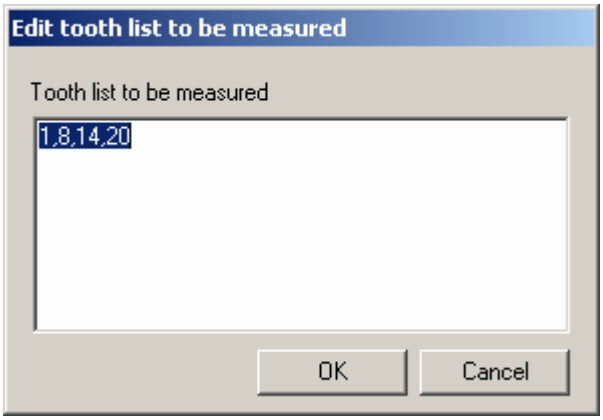


Gear Definition dialog box – Profile tab for spur or helical gears

Measurement Area

Number of Teeth to Measure: This value is the number of teeth of the gear on which you want to measure the profile. The teeth measured will be as close to equally spaced around the gear as possible starting with tooth #1. The default value is 4. Increasing or decreasing this value, will update the **Teeth to be measured** list according to the **Number of Teeth** specified on the Parameters tab.

Teeth to be measured: Click **Edit** to open the **Edit Tooth list to be measured** dialog box.



Edit tooth to be measured dialog box

Create the tooth list by typing each tooth number that will be included separated by a comma. The number of teeth listed should be the same as the **Number of Teeth to Measure** value. For example, if you want to measure the profile for Tooth #1, #8, #14, and #20 just input 1,8,14,20 in this edit box. This value will not affect segmented gears; however, be sure not to define a non-existing tooth number. Click **OK** to save the tooth list or **Cancel** to close without saving.

Start Diameter (near root): This value is the diameter of the circle which represents where the profile scan should start.

End Diameter (near tip): This value is the diameter of the circle which represents where the profile scan should end.

Z Coordinate of Profile Measurement: This is the Z coordinate value where the profile should be measured. This value is normally negative but positive values are allowed. This is not a depth value.

Evaluation Area

Start of Evaluation Range (near root): This diameter value determines where on the profile scan you want to begin the evaluation. You should use a value slightly larger than the profile start diameter value.

End of Evaluation Range (near tip): This diameter value determines where on the profile scan you want to end the evaluation. You should use a value slightly smaller than the profile end diameter value.

Magnification of Deviations: This value is a percentage that all errors will be magnified by for display in the analysis.

Magnification of Range (*Def. autom*): This value is percentage that all errors will be magnified by for display in the analysis. If you type a zero, PC-DMIS Gear calculates the value internally.

Tolerance of Profile Angle Dev. (*fHA*): Provides the allowable deviation between two design profiles which intersect the mean profile at the end points of the evaluation range. Please see the appropriate gear standard for a definition of this value.

Tolerance of Total Profile Dev. (*FA*): Provides the allowable deviation between two design profiles which enclose the actual profile over the evaluation range. Please see the appropriate gear standard for a definition of this value.

Tolerance of Profile Form Dev. (*ffA*): Provides the allowable deviation between two profiles parallel to the mean profile which enclose the actual profile over the evaluation range. Please see the appropriate gear standard for a definition of this value.

Tolerance of Profile Error: Please see the appropriate standard for a definition of this value. This value is for the AGMA gear standard only.

Evaluate *Crowning*: This value determines if crowning should be evaluated. If it is checked then crowning will be evaluated and if it is not checked then crowning will not be evaluated.

Minimum Crowning: Please see the appropriate gear standard for a definition of this value.

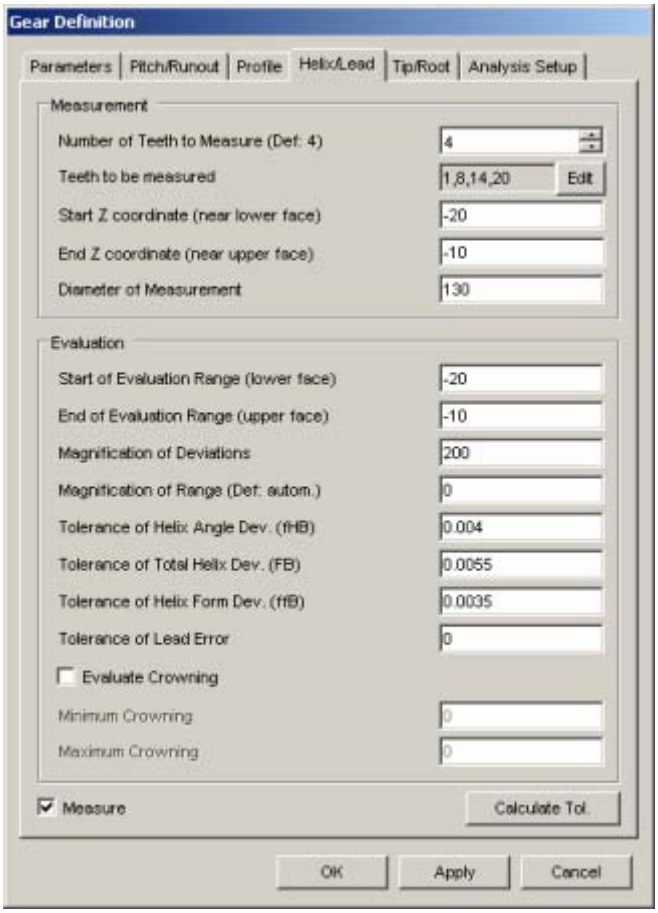
Maximum Crowning: Please see the appropriate gear standard for a definition of this value.

Measure: When this check box is selected, the gear profile will be measured during the measurement process based on the parameters defined on the **Profile** tab.

Calculate Tols This button causes PC-DMIS Gear to use the values input on this tab as well as the **Parameters** tab to calculate the tolerances of the *Pitch* and *Runout* based on the standard specified.

Helix/Lead Tab

This tab lets you specify the required data for the measurement of the *Helix/Lead* as well as the analysis parameters for each measurement. Helix/Lead measurement is optional; if you don't want to measure the Helix/Lead, deselect the **Measure it** option. All the values in the **Measurement Parameters** area are required for measurement.

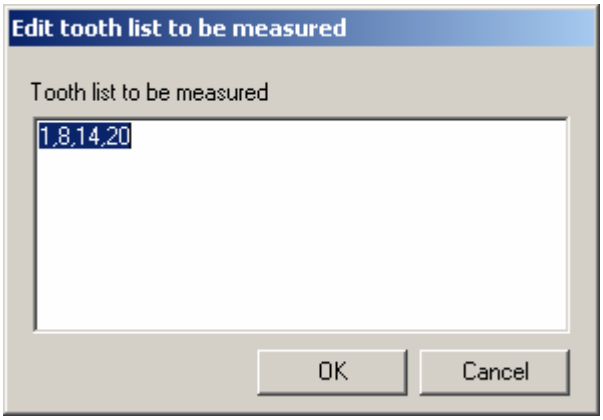


Gear Definition dialog box – Helix/Lead tab for spur or helical gears

Measurement Area

Number of Teeth to Measure: This value is the number of teeth of the gear on which you want to measure the Helix/Lead. The teeth measured will be as close to equally spaced around the gear as possible starting with tooth #1. The default value is 4.

Teeth to be measured: Click **Edit** to open the **Edit Tooth list to be measured** dialog box.



Edit tooth to be measured dialog box

Create the tooth list by typing each tooth number that will be included separated by a comma. The number of teeth listed should be the same as the **Number of Teeth to Measure** value. For example, if you want to measure the profile for Tooth #1, #8, #14, and #20 just input 1,8,14,20 in this edit box. This value will not affect segmented gears; however, be sure not to define a non-existing tooth number. Click **OK** to save the tooth list or **Cancel** to close without saving.

Start Z Coordinate (near lower face): This value is Z coordinate location where the Helix/Lead scan begins. The Helix/Lead scans always start at the bottom and move upward.

End Z Coordinate (near upper face): This value is Z coordinate location where the Helix/Lead scan ends. The Helix/Lead scans always start at the bottom and move upward.

Diameter of Measurement: This value is the Diameter at which the Helix/Lead scans are measured.

Evaluation Area

Start of Evaluation Range (lower face): This Z coordinate value represents where on the Helix/Lead scan you want to begin the evaluation. You should use a value slightly larger than the Helix/Lead **Start Z Coordinate** value.

End of Evaluation Range (upper face): This Z coordinate value represents where on the Helix/Lead scan you want to end the evaluation. You should use a value slightly smaller than the Helix/Lead **End Z Coordinate** value.

Magnification of Deviations: This value is a percentage that all errors will be magnified by for display in the analysis.

Magnification of Range (*Def. autom*): This value is percentage that all errors will be magnified by for display in the analysis. If you type a zero, PC-DMIS Gear calculates the value internally.

Tolerance of Helix/Lead Angle Dev. (*fHB*): Provides the allowable distance between two design helices which intersect the mean helix at the extremities of the evaluation range. Please see the appropriate gear standard for a definition of this value.

Tolerance of Total Helix/Lead Dev. (*FB*): Provides the allowable distance between two design helices which enclose the actual helix over the evaluation range. Please see the appropriate gear standard for a definition of this value.

Tolerance of Profile Form Dev. (*ffB*): Provides the allowable distance between the two design helices parallel to the mean helix which enclose the actual helix over the evaluation range. Please see the appropriate gear standard for a definition of this value.

Tolerance of Lead Error: Please see the appropriate standard for a definition of this value. This value is for the AGMA gear standard only.

Evaluate *Crowning*: This value determines if crowning should be evaluated. If it is check then crowning will be evaluated and if it is not checked then crowning will not be evaluated.

Minimum Crowning: Please see the appropriate standard for a definition of this value.

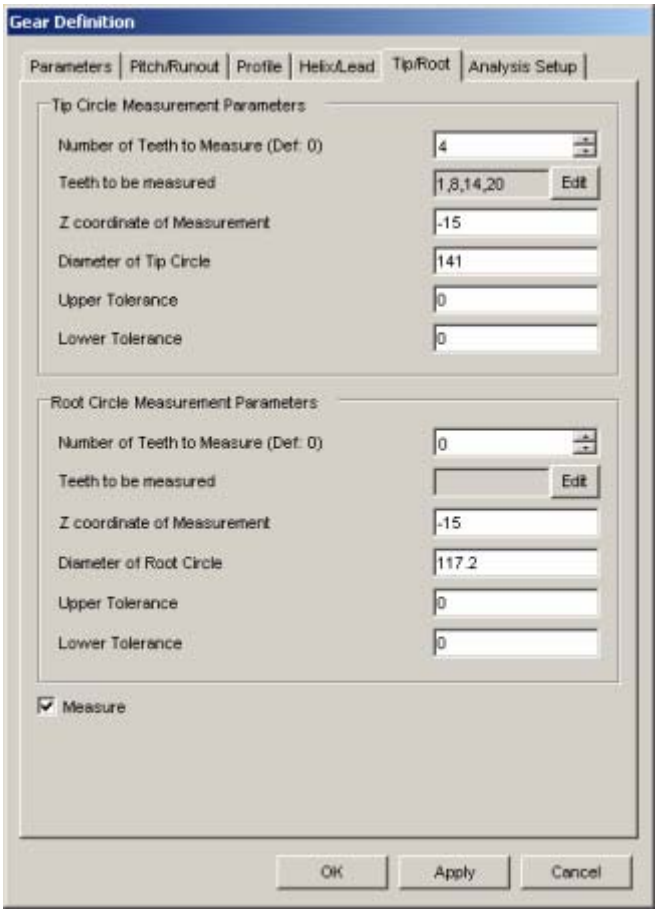
Maximum Crowning: Please see the appropriate standard for a definition of this value.

Measure: When this check box is selected, the Helix/Lead will be measured during the measurement process based on the parameters defined on the **Helix/Lead** tab.

Calculate Tols This button causes PC-DMIS Gear to use the values input on this tab as well as the **Parameters** tab to calculate the tolerances of the *Pitch* and *Runout* based on the standard specified.

Tip/Root Tab

This tab lets you specify the required data for the measurement of the *Tip circles* and *Root circles*. Tip/Root measurement is optional; if you don't want to measure the Tip/Root, deselect the **Measure** option. All the values in the **Measurement Parameters** areas are required for measurement.



Gear Definition dialog box – Tip/Root tab for spur or helical gears

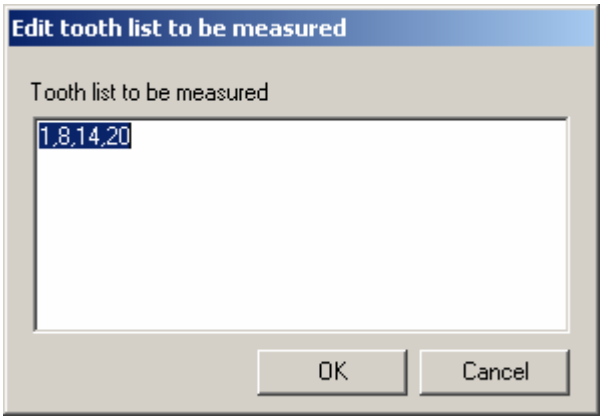
This tab contains two areas, the **Tip Circle Measurement Parameters** area and the **Root Circle Measurement Parameters** area. The definition of the boxes for both areas is given below:

Tip Circle Measurement Parameters Area

The Tip circle is the circle measured by taking points on the tips of teeth, For an external it is major diameter and for an internal gear it is minor diameter.

Number of Teeth to Measure: This value is the number of teeth of the gear on which you want to measure the Tip circle. The teeth measured will be as close to equally spaced around the gear as possible starting with tooth #1. Default value is 0. This value must be greater than 0 in order to select the **Measure** option that will actually cause Tip/Root measurement to be executed.

Teeth to be measured: Click **Edit** to open the **Edit Tooth list to be measured** dialog box.



Edit tooth to be measured dialog box

Create the tooth list by typing each tooth number that will be included separated by a comma. The number of teeth listed should be the same as the **Number of Teeth to Measure** value. For example, if you want to measure the profile for Tooth #1, #8, #14, and #20 just input 1,8,14,20 in this edit box. This value will not affect segmented gears; however, be sure not to define a non-existing tooth number. Click **OK** to save the tooth list or **Cancel** to close without saving.

Z Coordinate of Measurement: This is the Z coordinate value where the Tip points should be measured. This value is usually negative.

Diameter of Tip Circle: This value is the theoretical diameter of the Tip circle.

Upper Tolerance: This value is the upper tolerance for the diameter of the measured Tip circle.

Lower Tolerance: This value is the lower tolerance for the diameter of the measured Tip circle.

Important: It should be noted that the tip circle and root circle are virtually reversed for internal gears. The tip circle will be the smaller diameter and the root circle will be the larger diameter.

Root Circle Measurement Parameters Area

The Root circle is the circle measured by taking points on the root space between two adjacent gear teeth.

Number of Teeth to Measure: This value is the number of teeth of the gear on which you want to measure the Root circle. The teeth measured will be as close to equally spaced around the gear as possible starting with tooth #1. Default value is 0. This value must be greater than 0 in order to select the **Measure** option that will actually cause Tip/Root measurement to be executed.

Teeth to be measured: Click **Edit** to open the **Edit Tooth list to be measured** dialog box. See the value with the same name in the Tip Circle Measurement Parameters area above for an detailed description and example.

Z Coordinate of Measurement: This is the Z coordinate value where the Root points should be measured. This value is usually negative.

Diameter of Root Circle: This value is the theoretical diameter of the Root circle.

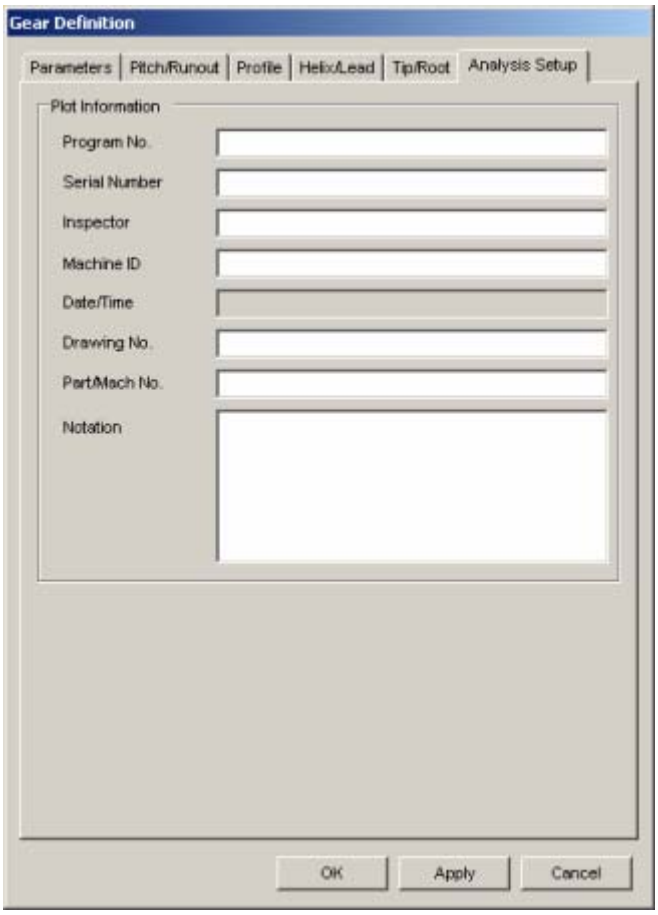
Upper Tolerance: This value is the upper tolerance for the diameter of the measured Root circle.

Lower Tolerance: This value is the lower tolerance for the diameter of the measured Root circle.

Measure: When this check box is selected, the Tip/Root will be measured during the measurement process based on the parameters defined on the **Tip/Root** tab. Tip/Root measurement is optional

Analysis Setup Tab

This tab allows you to specify plot information that will be included in the Analysis report. The plot information is included in the header for the report. Provide any applicable values.



Gear Definition dialog box – Analysis Setup tab for spur or helical gears

Plot Information: This area allows you to include general purpose information appear in your analysis report, such as:

- Program Number
- Serial Number
- Inspector
- Machine ID
- Date/Time
- Drawing No.
- Part/Mach No.
- Notation

Aligning a Spur or Helical Gear

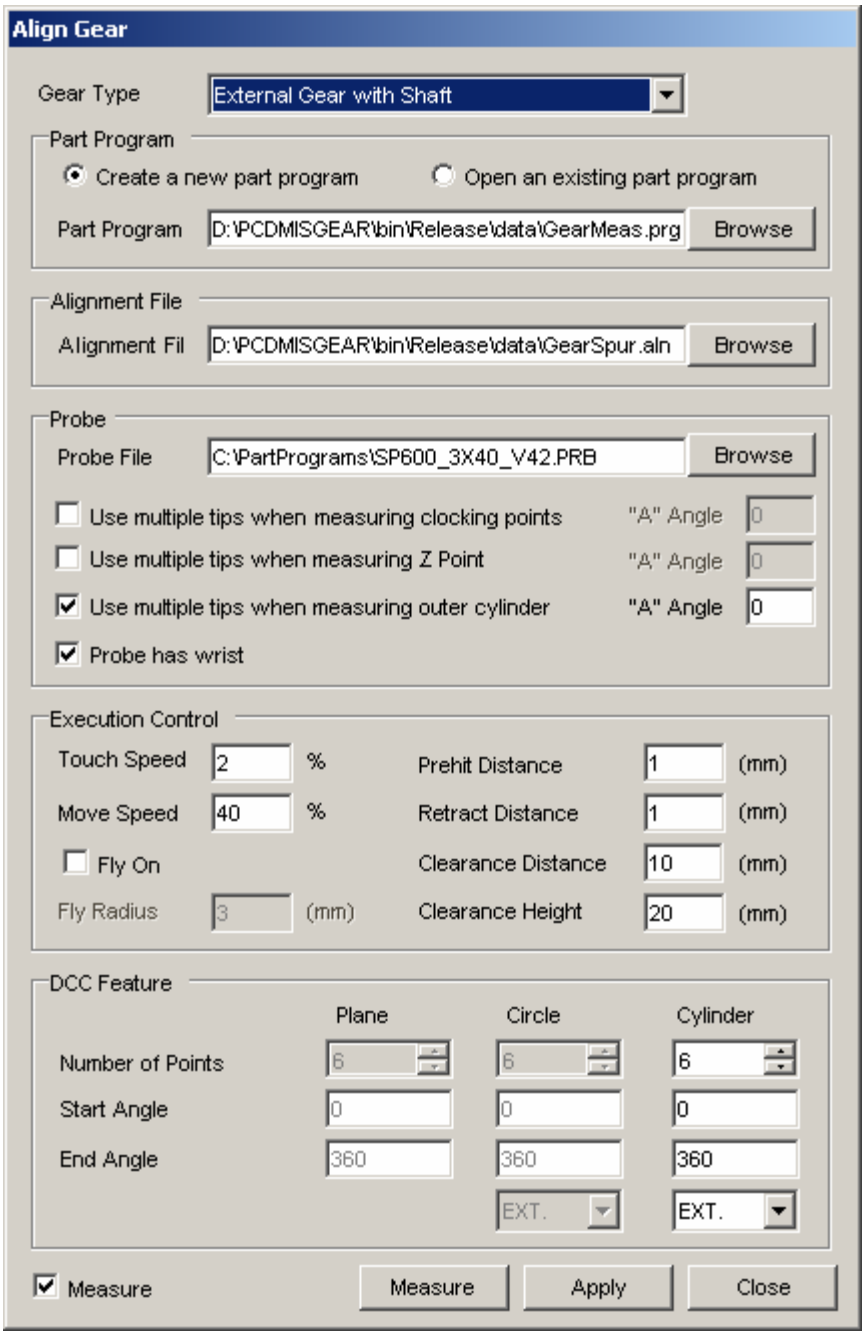
The **Align Gear** dialog box allows you to edit relevant alignment parameters for spur or helical gears including the choice one of three routines to align the gear you are about to measure. These include:

- External Spur and Helical Gear
- Internal Spur Gear
- External Gear With Shaft

Align

Clicking the **Align** button or selecting the **Measure | Alignment Creation** menu option displays the **Align Gear** dialog box.

You can also use an existing PC-DMIS part program to create the alignment, or you can create a custom alignment.



Align Gear dialog box

Gear Type

External Spur and Helical Gear: This option creates a complete PC-DMIS part program to measure the alignment of the External Spur and Helical gear. The alignment consists of a plane to level the alignment, a circle for the origin of the alignment, and two points for the *clocking* of the alignment. If you select the **DCC** option from the **Execution Mode** area, then the routine will also execute a DCC alignment on the gear.

Internal Spur Gear: This option creates a complete PC-DMIS part program to measure the alignment of an Internal Spur gear. The alignment consists of a plane to level the alignment,

a circle for the origin of the alignment, and two points for the clocking of the alignment. If you select the **DCC** option from the **Execution Mode** area, then the routine will also execute a DCC alignment on the gear.

External Gear with Shaft: This option creates a complete PC-DMIS part program to measure the alignment of an External with Shaft gear. The alignment consists of a cylinder to level the alignment and set the center origin, a point to define the Z axis zero location, and two points for the clocking of the alignment. If you select the **DCC** option from the **Execution Mode** area, then the routine will also execute a DCC alignment on the gear.

Part Program Area

Either you can **Create a new part program** or **Open an existing part program**. In either case, specify the name of **Part Program** by typing the path and name for part program or clicking Browse to select the **Part Program** file. The path to this probe file will appear in the **Part Program** box.

Alignment File Area

Alignment File: This box displays a complete path and filename to which the Alignment information will be written after execution. You can specify a different alignment file than that used for the actual gear measurement. Click Browse to select the Align file to use for the alignment. The pathway to this probe file will appear in the **Align File** box.

Probe Area

Probe File: This box displays a complete pathway to a *probe file* you select for the gear alignment. You can specify a different probe file than that used for the actual gear measurement. Click Browse to select the probe file to use for the alignment. The pathway to this probe file will appear in the **Probe File** box.

Use multiple tips when measuring clocking points: Use this checkbox to determine whether or not PC-DMIS Gear should use multiple tips of an indexing probe to measure the *clocking points* for your gear.

Use multiple tips when measuring Z point: Only available when "External Gear with Shaft" **Gear Type** is selected. Use this checkbox to determine whether or not PC-DMIS Gear should use multiple tips of an indexing probe to measure the *Z Point* of your gear.

Use multiple tips when measuring outer cylinder: Only available when "External Gear with Shaft" **Gear Type** is selected. Use this checkbox to determine whether or not PC-DMIS Gear should use multiple tips of an indexing probe to measure the *outer cylinder* of your gear.

“A” Angle boxes**:** If you selected any of the **Use Multiple Tips ...** options and your probe uses an indexing probe head, this value defines the “A” angle that will be used for the measurements. The “A” angle of the probe remains constant while the “B” angle rotates to the best tip angle for each tooth. If you use a star probe and you don’t want any probe head rotation, type zero into these boxes.

Probe has wrist: This check box lets you specify whether or not the probe configuration you are using contains a wrist. In PC-DMIS a probe configuration with a wrist uses the tip naming

format “T1AXBY” where X & Y are the angles of the wrist (i.e. T1A90B180). Without a wrist PC-DMIS uses “TIPX” where X is simply the TIP #. PC-DMIS Gear needs to know whether or not the probe has a wrist so that it uses the correct tip naming format.

Execution Controls Area

This area contains values that control the movement of the machine while executing the DCC portion of the alignment.

Touch Speed: This value determines the speed the machine will use when taking a point measurement or approaching the first point of an analog scan.

Move Speed: This value determines the speed the machine will use to move from point to point and to and from the clearance plane.

Fly On: Causes the probe motion to move in smooth circular moves. This option depends on the capability of the controller to execute circular moves.

Fly Radius: Determines the radial distance of the arc path along which the probe will travel between move points.

Prehit Distance: This value determines the distance from the theoretical point that the machine changes from Move Speed to the slower Touch Speed. For further information on any of these values consult the main PC-DMIS manual.

Retract Distance: The distance away from the measured point location that the machine changes from Touch Speed to the quicker Move Speed.

Clearance Distance: This value determines the distance the probe will retract in the XY direction.

Clearance Height: This box defines the clearance height used to measure the gear alignment and the clearance height used at the beginning and end of the gear measurement.

DCC Feature Area

DCC Plane: If you choose to execute a DCC alignment then PC-DMIS Gear will measure a DCC plane. This plane is defined by the following three values as well as the first point of the manual plane. The XY location of the first point of the manual plane from the manual alignment origin will define the radius of a circle of points which will be measured as a plane. This plane is only measured for the “External Spur and Helical” and “Internal Spur” canned alignments.

Number of Points: This determines the number of points that will be measured for the DCC plane.

Start Angle: This determines the polar coordinate location of the first point of the DCC plane. The angles are defined as 0 being equal to the clocking axis of the manual alignment and increasing as you move counter-clockwise around the center of the origin. Negative numbers are not allowed.

End Angle: This determines the location of the last point of the DCC plane. The angles are defined as 0 being equal to the clocking axis of the manual alignment and increasing

as you move counter-clockwise around the center of the origin. Negative numbers are not allowed.

DCC Circle: If you choose to execute a DCC alignment for the **Internal Spur Gear** alignment routine, then PC-DMIS Gear will measure a DCC Circle. This circle is defined by the following three values as well as the first point of the manual circle. The Z location of the first point of the manual circle from the manual alignment origin defines the depth of the DCC circle.

Number of Points: This determines the number of points that will be measured for the DCC circle.

Start Angle: This determines the location of the first point of the DCC circle. The angles are defined as 0 being equal to the clocking axis of the manual alignment and increasing as you move counter-clockwise around the center of the origin. Negative numbers are not allowed.

End Angle: This determines the location of the last point of the DCC circle. The angles are defined as 0 being equal to the clocking axis of the manual alignment and increasing as you move counter-clockwise around the center of the origin (Negative numbers are not allowed).

EXT./INT.: Select whether the circle is an external or internal circle.

DCC Cylinder: If you choose to execute a DCC alignment and are using the **External Gear with Shaft** or **External Gear as Shaft** alignment routines then a PC-DMIS Gear will measure a DCC cylinder. This cylinder is defined by the following three values as well as the first point of each of the two rows of the manual cylinder. The Z location of the first point and the fourth point of the manual cylinder from the manual alignment origin will define the depth and length of the DCC cylinder.

Number of Points: This determines the number of points to measure for each row of the DCC cylinder.

Start Angle: This determines the location of the first point of the DCC cylinder. The angles are defined as 0 being equal to the clocking axis of the manual alignment and increasing as you move counter-clockwise around the center of the origin. Negative numbers are not allowed.

End Angle: This determines the location of the last point of the DCC cylinder. The angles are defined as 0 being equal to the clocking axis of the manual alignment and increasing as you move counter-clockwise around the center of the origin. Negative numbers are not allowed.

EXT./INT.: Select whether the cylinder is an external or internal cylinder.

Measure: When this checkbox is selected, Gear will measure the alignment that is specified by the alignment parameters when you click the **Measure** button.

Launches PC-DMIS and begins the alignment process. If you have selected to **Create a new part program**, PC-DMIS will create the part program to accomplish the

alignment and then execute the new part program. Otherwise, it will execute the specified part program.

Apply Saves any changes that have been made in the **Gear Alignment** dialog box.

Close Closes the **Gear Alignment** dialog box and saves your changes.

Editing Measurement Parameters for Spur or Helical Gears

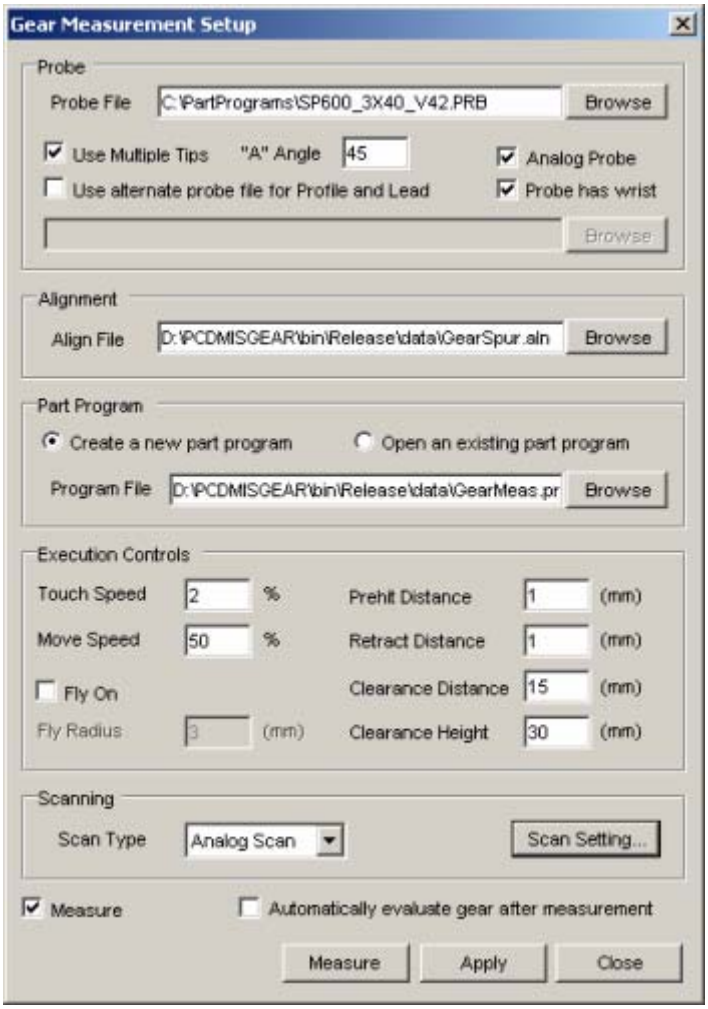
The **Gear Measurement Setup** dialog box allows you to edit the parameters and begin gear measurement.

Clicking the **Measure** button or selecting the **Measure | Measure** menu option displays the **Gear Measurement Setup** dialog box.

Measure

Before measuring ensure you have first:

- Defined your probe
- Calibrated your probe
- Defined gear parameters
- Created an alignment



Gear Measurement Setup dialog box

Probe Area

Probe File: The path in this box defines what probe file you want to use for the gear's measurement. Click the **Browse** button to navigate to and select the probe file to use for the gear's measurement.

Use Multiple Tips: This option determines whether or not PC-DMIS Gear should use multiple tips to measure your gear. If you have an indexing probe and you want to use more than one probe tip you should select this option.

Use alternate probe file for Profile and Lead: This check box lets you determine whether or not PC-DMIS Gear should use a different probe configuration for the Profile and Lead measurement than the probe configuration used for the *Pitch* measurements. If you select this check box the associated box and **Browse** button become enabled allowing you to select the appropriate probe file.

"A" Angle: If you selected **Use Multiple Tips** and your probe uses an indexing probe head, this value defines the "A" angle that will be used for the measurements. The "A" angle of the probe remains constant while the "B" angle rotates to the best tip angle for each tooth. If you use a star probe and you don't want any probe head rotation, type zero into this box.

Analog Probe: This check box tells the gear program whether or not you will use an analog probe head for the measurement. The type of scan used while measuring the *Profile* and *Helix*/Lead will be determined by this value. With an analog probe you can also select the **Scan Type** (see the Execution Controls are).

Probe has wrist: This check box lets you specify whether or not the probe configuration you are using contains a wrist. In PC-DMIS a probe configuration with a wrist uses the tip naming format "T1AXBY" where X & Y are the angles of the wrist (i.e. T1A90B180). Without a wrist PC-DMIS uses "TIPX" where X is simply the TIP #. PC-DMIS Gear needs to know whether or not the probe has a wrist so that it uses the correct tip naming format.

Alignment Area

Alignment File: This box lets you determine the alignment file to be recalled and used in the gear measurement program. By default, PC-DMIS Gear automatically selects the alignment you performed using the **Align Gear** icon. Use the **Browse** button to select the alignment file (file with an .aln filename extension). For more information on alignment files, see the topics on saving and recalling alignment files in the main PC-DMIS manual.

Part Program Area

Part Program: The **Create a new part program** and **Open an existing part program** options allow you specify whether PC-DMIS Gear should create a new PC-DMIS program to measure the gear or if it should use an existing PC-DMIS part program. Specify the name of part program by typing the path and name for part program or clicking Browse to select the part program file. The path to this probe file will appear in the **Part program name** box.

Execution Controls Area

Touch Speed: This value determines the speed the machine will move when it reaches the **Prehit Distance** for the current measurement point.

Move Speed: This value determines the speed the machine will move when moving around the gear.

Fly On: Causes the probe motion to move in smooth circular moves. This option depends on the capability of your controller being able to execute circular moves.

Fly Radius: Determines the radial distance of the arc path along which the probe will travel between move points.

Prehit Distance: This value determines the distance from the theoretical point that the machine changes from Move Speed to the slower Touch Speed. For further information on any of these values consult the main PC-DMIS manual.

Retract Distance: This value determines the distance away from the measured point location that the machine changes from Touch Speed to the quicker Move Speed.

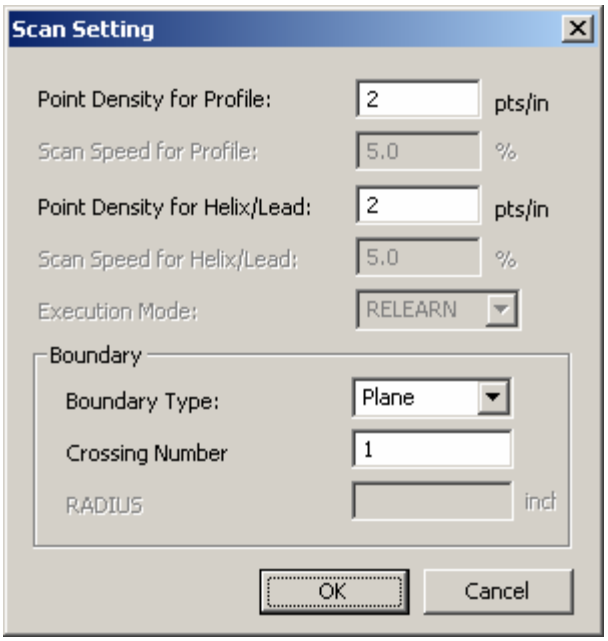
Clearance Distance: This value determines the distance the probe will retract in the XY direction.

Clearance Height: This value determines the distance the probe will retract in the Z direction.

Scanning Area

Scan Type: This option is used for analog probes (such as an SP600 probe). For an analog probe, you can scan profile and helix/lead in either **Touch Trigger** mode or **Analog Scan** mode.

Click this button to define the scan settings using the following dialog box:



Scan Setting dialog box

Point Density for Profile: Determines the amount of allowable hits that will be created during a Profile scan. Values is given in terms of points per inch.

Scan Speed for Profile: Allows you change the speed at which the CMM will scan the profile. The value that is entered is a percentage of the maximum machine speed. This is only used for an **Analog Scan** type.

Point Density for Helix/Lead: Determines the amount of allowable hits that will be created during a Helix/Lead scan. Values is given in terms of points per inch.

Scan Speed for Helix/Lead: Allows you change the speed at which the CMM will scan the helix/lead. The value that is entered is a percentage of the maximum machine speed. This is only used for an **Analog Scan** type.

Execution Mode: In **DEFINED** mode Gear will calculate all nominal scan points according to the gear parameters and insert them into the scan command. When executing the scan, PC-DMIS will pass through every point. In **RELEARN** mode, Gear will also calculate the nominal scan points, but when executing the scan, PC-DMIS will recalculate all scan points according to the start point, the end point and the scan direction. All learned measured data will replace the existing measured data. The Execution Mode options are only available for an **Analog Scan** mode.

Boundary Type: Boundary types are described in the "Boundary Type area" topic of the Core PC-DMIS manual. Select the needed boundary type from the drop-down list:

- Plane
- Sphere
- Cylinder
- Cone
- OldStyle

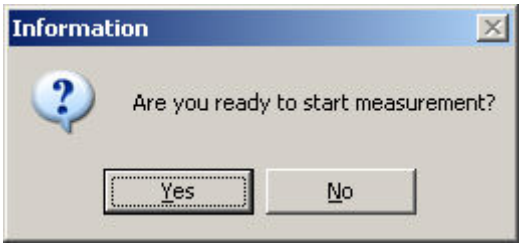
Crossing Number: Determines how many times a scan crosses the selected boundary type before stopping the scan. See the "Boundary Type area" topic of the Core PC-DMIS document for more information.

RADIUS or **ANGLE**: This value determines the radius for *Sphere* or *Cylinder* **Boundary Type** and the cone apex angle for a *Cone* **Boundary Type**.

Measure: When this option is selected, PC-DMIS Gear will generate and execute the part program to measure the gear. Otherwise, the part program will be created, but not executed.

Automatically evaluate gear after the measurement: When this option is selected, PC-DMIS Gear will automatically evaluate the gear and create a report as soon as the measurement is completed. Otherwise you will need to open the Analyze dialog box to evaluate the gear.

Measure Click **Measure** to begin the gear measurement process. All probing points and the machine movement is generated by PC-DMIS Bevel Gear. You will be prompted to start measurement.



Click **Yes** to start and **No** to Cancel. PC-DMIS will run your part program automatically.

Apply Saves any changes that have been made in the **Gear Measurement Setup** dialog box.

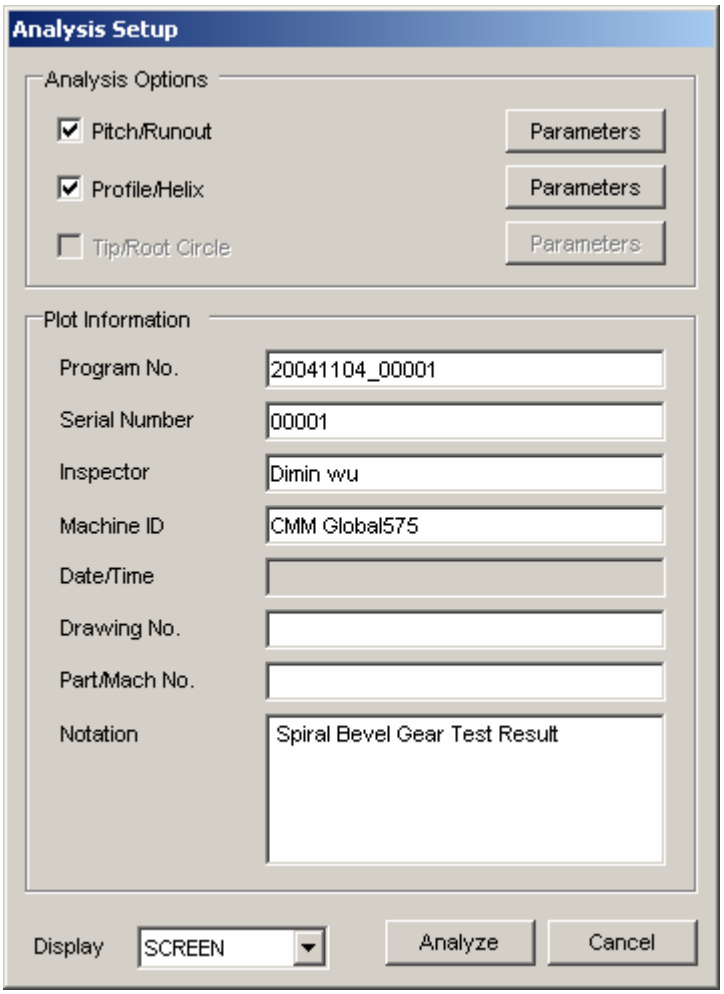
Close Closes the **Gear Measurement Setup dialog box** without saving your changes.

Analyzing a Spur or Helical Gear

The **Analysis Setup** dialog box allows you to define parameters and provide report information for analysis reports. Once you complete the gear measurement, you can use this dialog box to produce a graphical report of the measurement (see the sample reports below).

Clicking the **Analyze** button or selecting the **Measure | Analyze** menu option displays the **Analysis Setup** dialog box.

Analyze



Analysis Setup dialog box

Analysis Options Area

For each of the analysis options, measured data must exist in order to select the option for inclusion in the report.

> ***Pitch/Runout*:** This check box determines whether or not PC-DMIS Gear should produce a graphical report for Pitch and Runout. Click **Parameters** to change the options for the Pitch/Runout report. See the "Pitch/Runout Tab" topic.

***Profile/Helix*:** This check box determines whether or not PC-DMIS Gear should produce a graphical report for Profile and Helix. This option is only available if the user measured the profile and helix. Click **Parameters** to change the options for the Profile/Helix report. See the "Profile Tab" and "Helix/Lead Tab" topics.

Tip/Root Circle: This check box determines whether or not PC-DMIS Gear should add the deviation into tip or root circle items on the bottom of the Pitch/Runout report. This option is only available if the user measured the tip and root circles. Click **Parameters** to change the options for the Tip/Root elements of the Pitch/Runout report. See the "Tip/Root Tab" topic.

Plot Information Area

This area allows you to include general purpose information appear in your analysis report, such as: Program Number, Serial Number, Inspector, Machine ID, Date/Time, Drawing No., Part/Mach No. and Notation. This information will be included in the header of your report. The Date/Time value is supplied automatically based on the time of gear measurement.

Display: Select whether the report data is displayed on your SCREEN via the **Quindos PageViewer** application or is printed directly to your PRINTER using the **Quindos** print spooler.

Analyze Clicking this button creates the report based on the different options and values set in the **Analysis Setup** dialog box. It sends the report to the output device specified in the **Display** option. Measured data is spooled to the **Quindos PageViewer** application where you can view and print your report(s). See "Appendix A: Using Quindos PageViewer".

Cancel Clicking this button closes the **Analysis Setup** dialog box.

Important! Quindos PageViewer depends on PC-DMIS Gear being open. If you close PC-DMIS Gear, Quindos PageViewer and any open analysis reports will also close.

See the "Sample Pitch Runout Layout" and "Sample Profile & Helix Measurement Analysis" topic for examples of the spur gear reports that are created by PC-DMIS Gear.

How the Report Relates to the Measured Gear

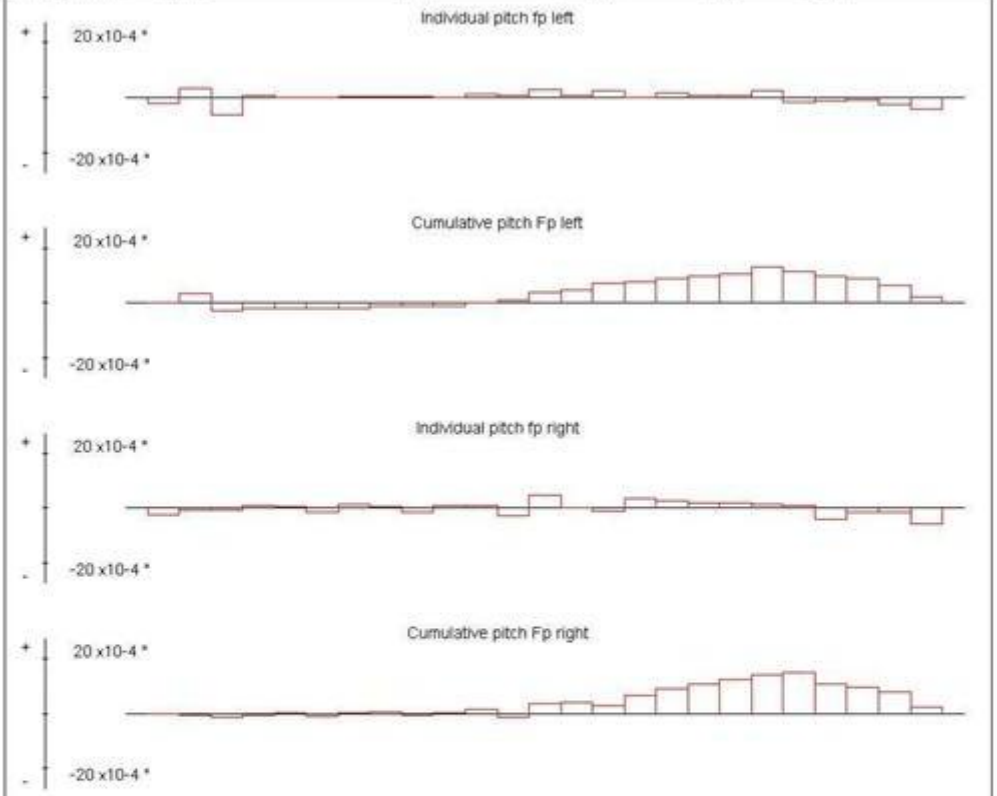
It is helpful to note the relation of how the teeth are numbered and what part of each tooth is considered left and right. Tooth #1 is the gear where measurement begins based upon the start angle. Subsequent teeth are numbered according to the order that measurements are taken.

The left and right sides of each tooth is based upon the gear as viewed from the center axis of the gear. That is also true for the left and right side of a gap.

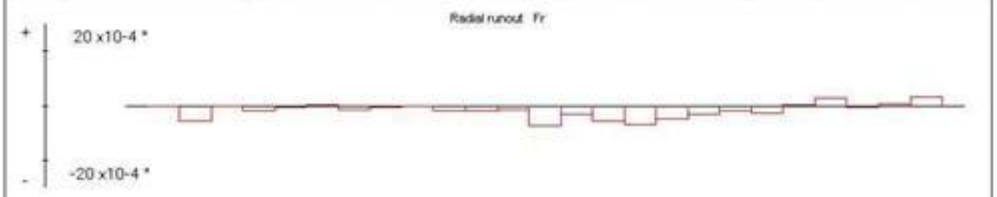
Sample Pitch Runout Layout

Cylindrical Gear Pitch & Runout

Prog.No.	:	No.of teeth	: 25	Inspector	: TT
Notation	: Test	Normal module	: 3.850	Date	: 3/30/2004 1:20:03 PM
Drawing No.	: none	Pressure angle	: 20.00000	Standard	: AGMA
Serial No.	: 001	Helix angle	: 17.41660		
Part/Machine/No.	: 123-456	Hand of Helix	: LH		
Measuring Machine	: ABC	Width	: 1.073	Unit	: Inch



		left flank				right flank			
		meas.dev.	Qua.	Toler.	Qual.	meas.dev.	Qual.	Toler.	Qual.
Individual pitch deviation	fp	6.1	A 9	20.0	A 8	5.5	A 9	20.0	A 8
Cumulative pitch deviation	Fp	15.4		30.0		16.3		30.0	
Adjacent pitch deviation	fu	12.1		20.0		7.8		20.0	
Individual pitch variation	Rp	9.6				10.4			



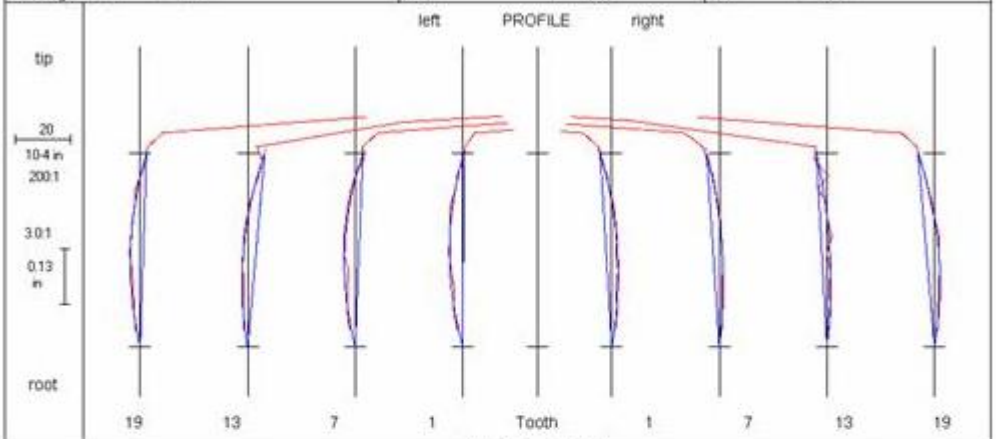
Radial runout	Fr	10.2	A 11	30.0	A 8	Ball diameter	: 0.3000

	nom	max-min	max		min		Average
dimension over balls	(3.3000, 3.2500)	0.0013	4.5325 ◄	(10, 22)	4.5312 ◄	(2, 15)	4.5320 ◄
tooth/space thickness	(0.2750, 0.2725)	0.0008	0.2741	21	0.2733	15	0.2738

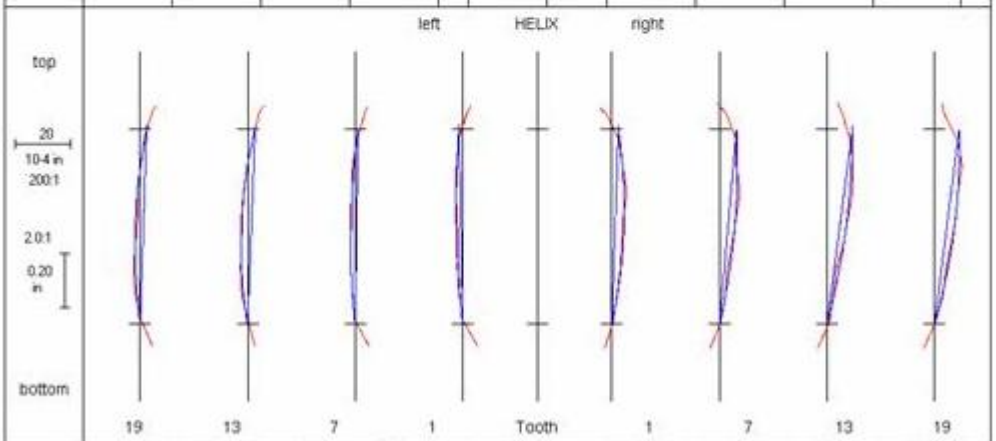
Sample Profile & Helix Measurement Analysis

Gear Profile & Helix

Prog.No.		No.of teeth	25	Inspector	TT
Notation	Test	Normal module	3.850	Date	3/30/2004 1:20:03 PM
Drawing No.	none	Pressure angle	20.00000	Standard	AGMA
Serial No.	001	Helix angle	17.41660		
Part/Machine/No.	123-456	Hand of Helix	LH		
Measuring Machine	ABC	Width	1.073	Unit	Inch



						Toler	Qual.					
fHA	-2.3	-6.1	-2.7	-0.4		10.0		-4.1	-4.5	-3.7	-5.9	
FA	5.6	6.7	6.8	5.0		20.0		6.0	5.4	5.9	6.5	
ffA	1.5	4.4	2.5	1.8		30.0		1.4	1.0	4.6	1.1	
CA	4.6 ◄	4.6 ◄	5.2 ◄	5.0 ◄		10.0/10.0		4.1 ◄	3.4 ◄	2.9 ◄	4.4 ◄	
Vphi	6.2	7.3	7.4	5.5	9	40.0	A 8	6.6	6.0	6.5	7.1	9



fHB	2.3	2.7	1.0	-1.4		30.0		2.4	6.2	9.2	8.8	
fB	39.4 ◄	39.9 ◄	40.5 ◄	40.9 ◄		30.0		39.8 ◄	42.2 ◄	45.6 ◄	43.9 ◄	
ffB	1.2	0.9	1.1	0.8		10.0		1.5	1.9	2.1	1.7	
CB	2.9 ◄	3.7 ◄	2.2 ◄	1.6 ◄		40.0/20.0		3.2 ◄	2.4 ◄	2.3 ◄	2.7 ◄	
Vpsi	4.0	4.7	2.9	2.8	8	35.0	A 8	5.1	7.0	8.5	9.7	XX

Parameters for Bevel Gears

This section provides detailed information for the parameters that are used when measuring and analyzing bevel gears. See the "Getting Started" chapter for the steps for using PC-DMIS Gear. The following topics provide information for bevel gears:

- Defining a Bevel Gear
- Aligning a Bevel Gear
- Editing Measurement Parameters for Bevel Gears
- Defining Master Flank Data
- Analyzing a Bevel Gear

Defining a Bevel Gear

The **Gear Definition** dialog box provides relevant measurement parameters for bevel gears. PC-DMIS Gear uses these parameters to create the PC-DMIS part program. The part program will then measure and collect the data to be analyzed.

Define

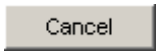
Once you have created or opened a bevel gear file, clicking the **Define** button or selecting the **Measure | Modify Geometric Parameters** menu option displays the **Gear Definition** dialog box.

The **Gear Definition** dialog box has three tabs which represent the possible aspects of measurement when you are working with a bevel gear (see "Defining a Spur or Helical Gear" when working with spur or helical gears).

According to the changes made in the **Gear Definition** dialog box, use the following controls as described:

This button will close the **Gear Definition** dialog box and apply any changes that you have made.

This button will apply any changes that you have made in the **Gear Definition** dialog box while leaving the dialog box open.



This button will close the **Gear Definition** dialog box without saving changes.

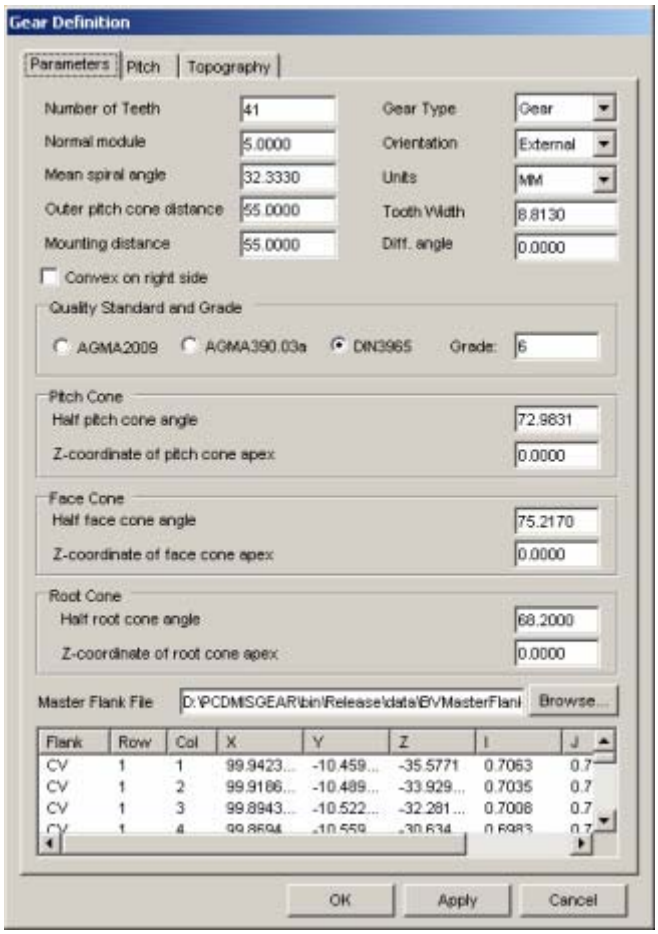
When working with spur of helical gears review the parameters for each of the three tabs of the **Gear Definition** dialog box:

- Parameters Tab
- Pitch Tab
- Topography Tab

Parameters Tab

This tab allows you to define the geometry for the gear that is to be measured. Most of these values can be found in the drawing for the gear. If some of parameters are not provided from the

drawing or if their value does not yet correspond to the drawing, the corresponding value can be estimated in order to make the measurement possible.



Gear Definition dialog box – Parameters tab for bevel gears

Edit the following values to define the gear geometry:

Number of Teeth: Provide the number of teeth for your gear.

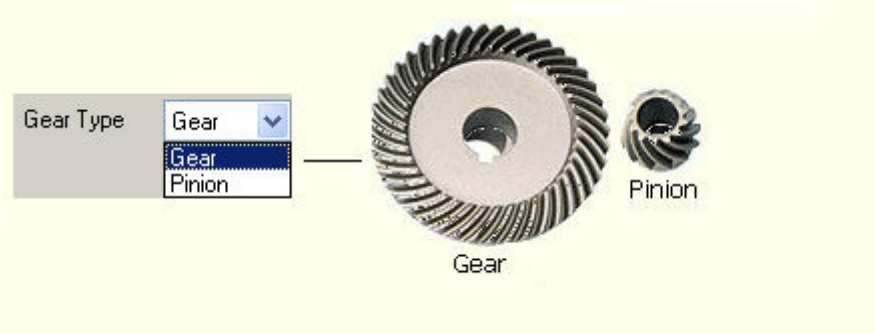
Normal Module(MM)/Diametrical Pitch(INCH): The heading for this box changes between "Diametrical Pitch (Inch)" and “Norm Module (MM)” depending on whether you selected **INCH** or **MM** as your unit of measurement. Normal Module or diametrical pitch should be defined as part of the gear specification.

Mean Spiral Angle: Determines the mean angle of the teeth.

Outer pitch cone distance: Provides the shortest distance from the original alignment to the pitch point along the pitch cone.

Mounting Distance: Provides the distance from the original alignment to the mounting point.

Gear Type: Select either "Gear" or "Pinion" as depicted below.



Orientation: Select **External** for gears where the teeth are on the outside of the gear, or **Internal** for gears where the teeth are on the inside of the gear.

Units: Select from either **INCH** or **MM** to define the units for your gear.

Tooth Width: Defines the width of the tooth.

Diff. Angle: Defines the angle difference from one tooth to the next.

Convex on right side: When this option is selected the right side of the gear teeth as viewed from the center of the gear is convex. If the convex side is on the left (see the large gear in the image below), then this option should not be selected.

Quality Standard and Grade: The options in this area define the standard used to create the gear and against which you will measure the gear. Choose from the AGMA2009, AGMA309.03a,or DIN3955 standard and specify the **Grade** for the selected standard. PC-DMIS Gear automatically determines the tolerances Fp, fp, fu and Fr from the given gear quality number and quality type and inserts these tolerances into the corresponding values. If you don't specify the gear quality the tolerances will not be determined.

Pitch Cone Area

Half pitch cone angle: Defines the half cone angle for the *pitch* cone.

Z-coordinate for pitch cone apex: The z-coordinate of the *pitch* cone apex is used to define the location of the pitch cone.

Face Cone Area

Half face cone angle: Defines the half cone angle for the *face* cone.

Z-coordinate of face cone apex: The z-coordinate of the *face* cone apex is used to define the location of the pitch cone.

Root Cone Area

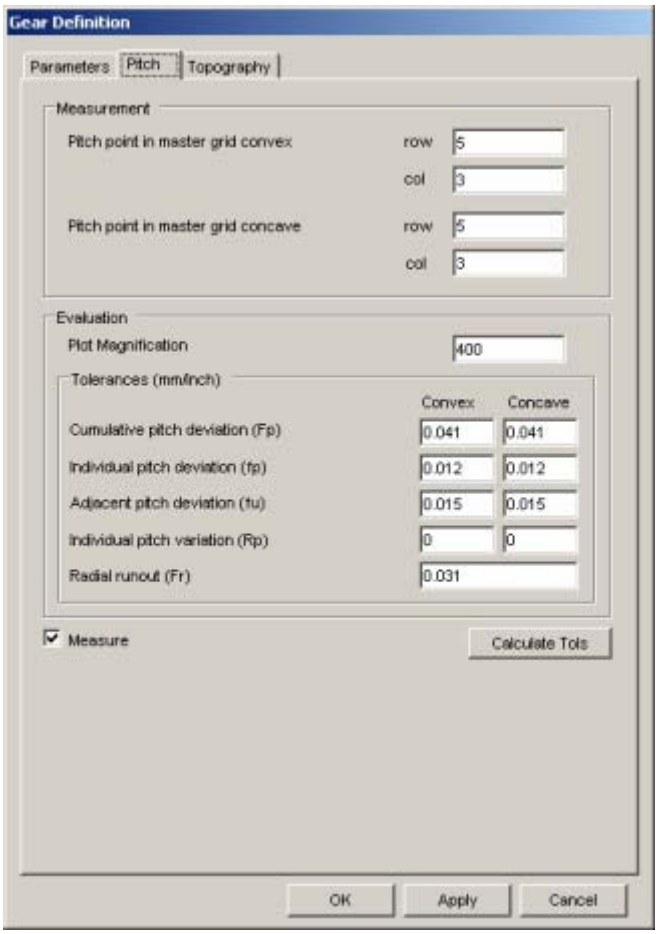
Half root cone angle: Defines the half cone angle for the *root* cone.

Z-coordinate of root cone apex: The z-coordinate of the *root* cone apex is used to define the location of the pitch cone.

Master Flank File: Browse to and select a previously created Master Flank file (*.dat). Master Flank data for the Flank, Row, Column, and XYZIJK data is displayed in the table below. If you do not select a file here you will need to define it using the **Measure | Master Flank** menu option. See "Step 7: Measure the Master Flank" for more information on creating Master Flank files.

Pitch Tab

This tab lets you specify the required data for the *Pitch* measurement of a bevel gear.



Gear Definition dialog box – Pitch tab for bevel gears

Measurement Area

Pitch point in master grid convex: Type the row and col (column) numbers for the pitch point of the master grid on the convex side. All probing points and machine paths are generated automatically by the program. The pitch point is the hit point where the CV flank is measured

Pitch point in master grid concave: Type the row and col (column) numbers for the pitch point of the master grid on the concave side. All probing points and machine paths are generated automatically by the program. The pitch point is the hit point where the CC flank is measured

Evaluation Area

Plot Magnification: This value is used to define magnification scale for the created report in plot server. If you specify ‘0’, the evaluation is carried out, but no plot output will be created; however, the evaluation parameters are stored in the measurement result.

Tolerances (mm/inch)

This section allows you to define the following tolerances for evaluating pitch and runout. Review your gear stand for a definition of each parameter.

- **Cumulative pitch deviation (Fp)**
- **Individual pitch deviation (fp)**
- **Adjacent pitch deviation (fu)**
- **Individual pitch deviation (Rp)**
- **Radial runout (Fr)**

Note: With the measured pitch points, a runout evaluation can also be executed.

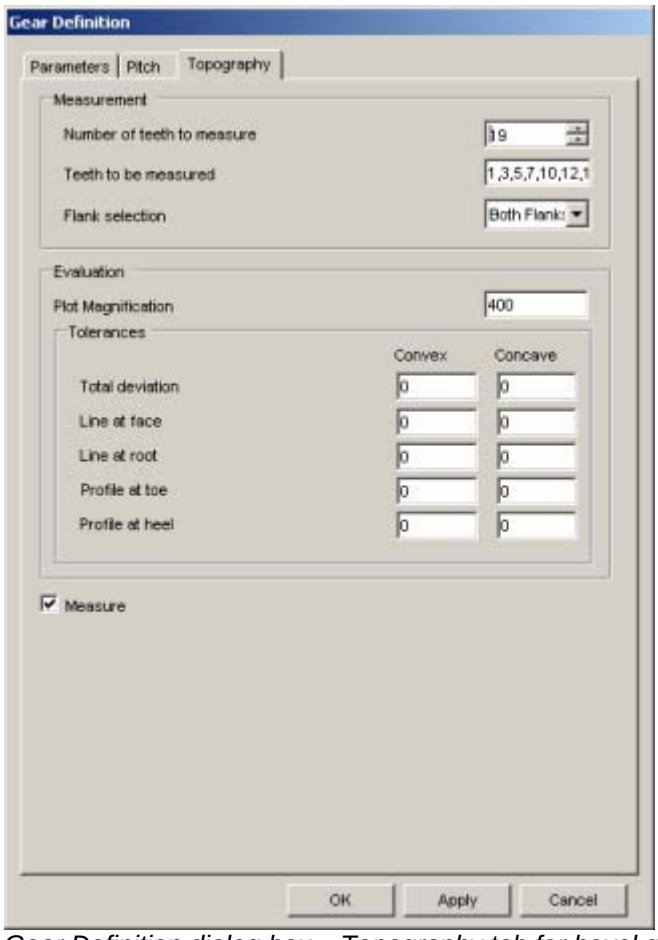
Measure: When this check box is selected, the pitch for the gear will be measured during the measurement process based on the parameters defined on the **Pitch** tab.

Calculate Tols: Click this button to calculate the Tolerances. If the gear quality was specified in the Geometry Parameters dialog box, the tolerances Fp, fp and fu are computed and automatically added to the Tolerance values according to the standard you selected. If no gear quality was specified, the tolerances will not be calculated.

Topography Tab

The **Topography** tab is used to define all values necessary for the description of topography measurement.

Topography measurement uses single point probing to take measurements. All probing points and the machine movement is generated automatically by PC-DMIS Gear.



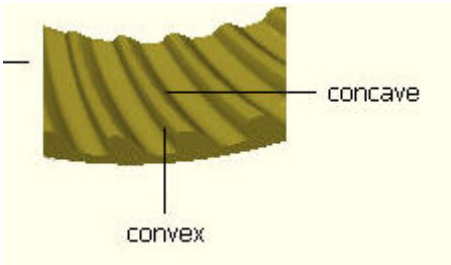
Gear Definition dialog box – Topography tab for bevel gears

Measurement Area

Number of teeth to measure: This value is the number of teeth for which topography will be measured. The teeth measured will be as close to equally spaced around the gear as possible starting with tooth #1. The default value is 4.

Teeth to be measured: This automatically lists the teeth that will be measured based on the **Number of teeth to measure** and the total **Number of Teeth** specified on the Parameters tab. This value is required. For example a value of 1,3,6,8 will measure tooth #1, #3, #6, and #8. You may also manually edit this list.

Flank selection: Select whether the **Concave Flanks**, **Convex Flanks** or **Both Flanks** will be measured.



Evaluation Area

Plot Magnification: This value is used to define magnification scale for the created report in the plot server. If you specify ‘0’, the evaluation is carried out, but no plot output will be created; however, the evaluation parameters are stored in the measurement result.

Tolerances

Total deviation: Defines the total tolerance for all grid points.

Line at face: Defines the tolerance for the face line.

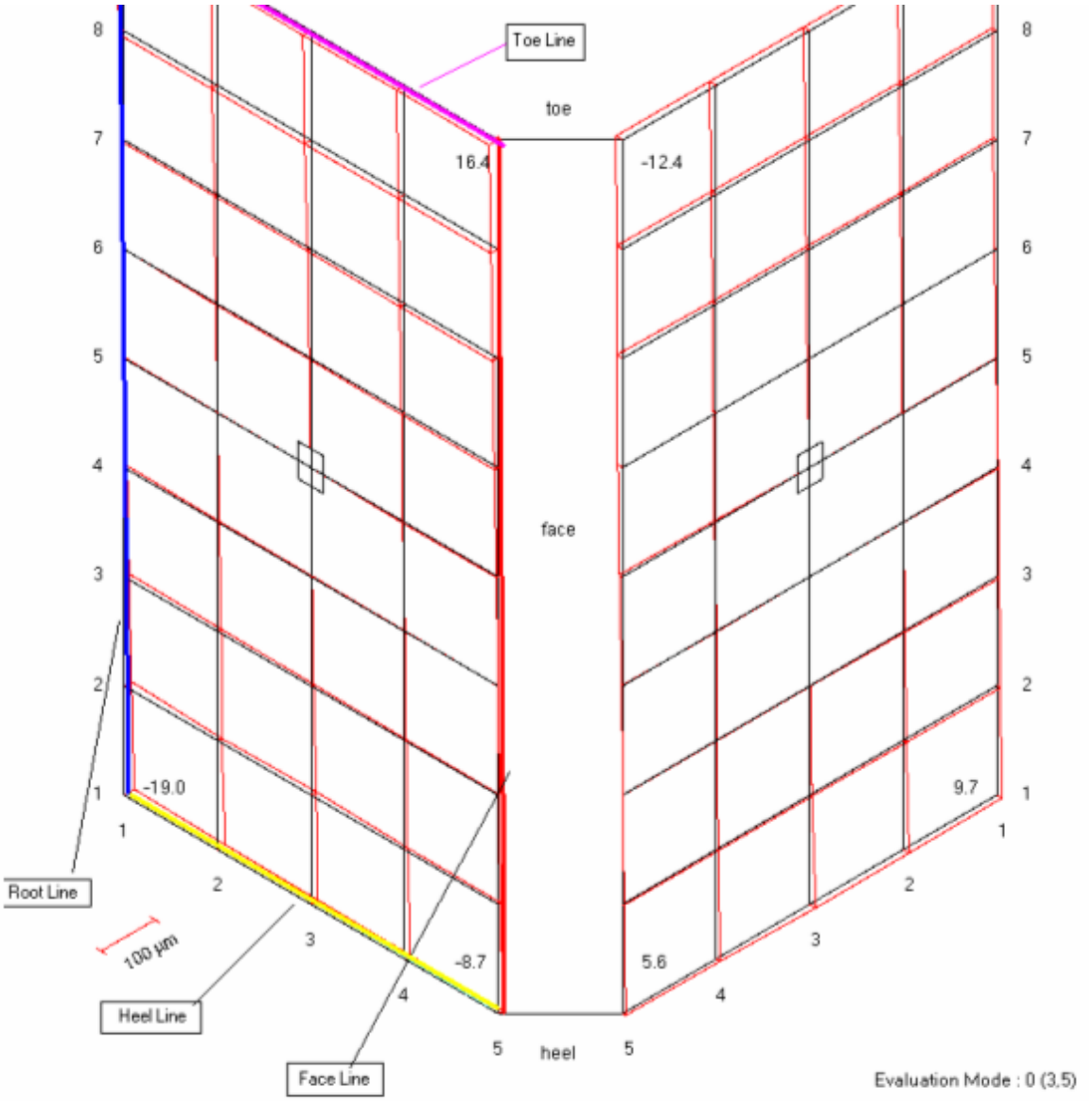
Line at root: Defines the tolerance for the root line.

Profile at toe: Defines the tolerance for the profile at the toe line.

Profile at heel: Defines the tolerance for the profile at the heel line.

Measure: When this check box is selected, the topography for the gear will be measured during the measurement process based on the parameters defined on the **Topography** tab.

The graphic below provides an example of the topography tolerances and shows how the tolerance values are reported in the footer.



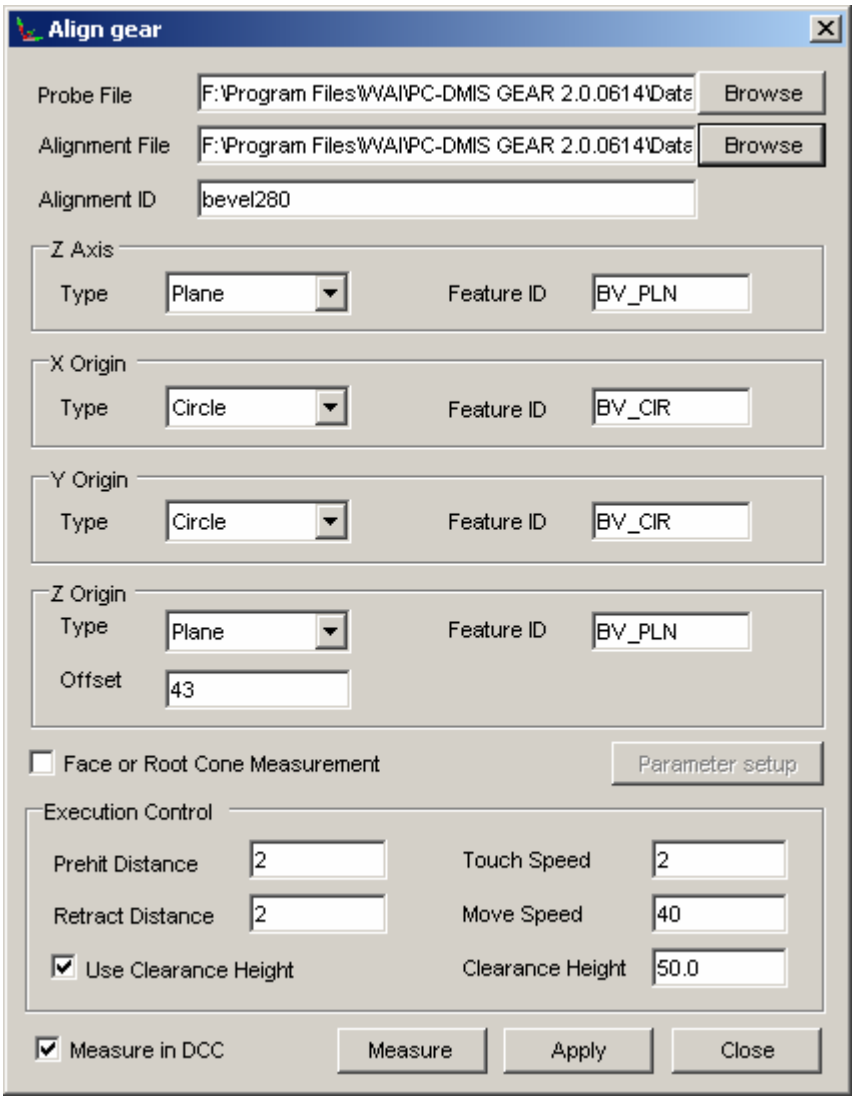
	right flank		left flank	
	meas. dev.	Tolerance	meas. dev.	Tolerance
Total deviation	35.4	0.0	23.8	0.0
Line at face	25.1	0.0	17.9	0.0
Line at root	30.6	0.0	17.9	0.0
Profile at toe	4.8	0.0	4.6	0.0
Profile at heel	10.3	0.0	5.8	0.0

Aligning a Bevel Gear

The **Align Gear** dialog box allows you to configure relevant alignment parameters for bevel gears. You can also use an existing PC-DMIS part program to create the alignment, or you can create a custom alignment.

Align

Clicking the **Align** button or selecting the **Measure | Alignment Creation** menu option displays the **Align Gear** dialog box.

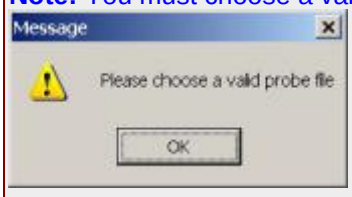


Align gear dialog box

To Create a Gear Alignment:

Probe File: This box displays a complete path to a *probe file* you select for the gear alignment. You can specify a different probe file than that used for the actual gear measurement. Click Browse to select the probe file to use for the alignment. The path to this probe file will appear in the **Probe File** box.

Note: You must choose a valid probe file, otherwise you will get a warning message.



Alignment File: This box displays a complete path and filename to which the Alignment information will be written after execution. You can specify a different alignment file than that used for the actual gear measurement. Click Browse to select the Align file to use for the alignment. The path to this probe file will appear in the **Align File** box.

Alignment ID: Displays the ID of the Alignment as specified by the **Alignment File**. This filed is read-only.

Z Axis: Specify the feature **Type** (Cylinder, Plane, Cone) for the **Z Axis** and change the **Feature ID** if needed.

X Origin: Specify the feature **Type** (Cylinder, Circle, Cone) for the **X Origin** and change the **Feature ID** if needed.

Y Origin: Specify the feature **Type** (Cylinder, Circle, Cone) for the **Y Origin** and change the **Feature ID** if needed.

Z Origin: Specify the feature **Type** (Plane, Circle, Point, Cone) for the **Z Origin** and change the **Feature ID** if needed. Also provide the **Offset** of the origin in the Z direction if needed. Normally the offset is the value of mounting distance.

Face or Root Cone Measurement: Select this option if you want to create the alignment accurately by face/root cone. See the "Face or Root Cone Measurement Parameters" topic for more information on the **Parameter setup.**

Execution Control Area

This area contains values that control the movement of the machine while executing the DCC portion of the alignment.

Prehit Distance: This value determines the distance from the theoretical point that the machine changes from Move Speed to the slower Touch Speed. For further information on any of these values consult the main PC-DMIS manual.

Retract Distance: The distance away from the measured point location that the machine changes from Touch Speed to the quicker Move Speed.

Touch Speed: This value determines the speed the machine will use when taking a point measurement or approaching the first point of an analog scan.

Move Speed: This value determines the speed the machine will use to move from point to point and to and from the clearance plane.

Use Clearance Height: When this option is selected, the clearance height will be used during alignment measurement.

Clearance Height: This box defines the clearance height used to measure the gear alignment and the clearance height used at the beginning and end of the gear measurement.

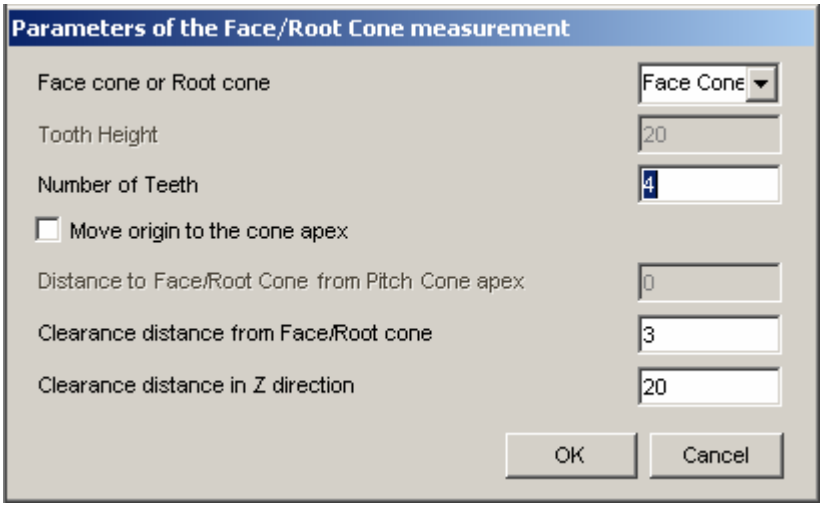
Measure in DCC: Select this option to execute the alignment in DCC mode.

Measure Launches PC-DMIS and begins the alignment process. If you have selected to **Create a new part program**, PC-DMIS will create the part program to accomplish the alignment and then execute the new part program. Otherwise, it will execute the specified part program.

Apply Saves any changes that have been made in the **Gear Alignment** dialog box.

Close Closes the **Gear Alignment** dialog box and saves your changes.

Face or Root Cone Measurement Parameters



To set the **Face/Root Parameters** for the measurement of cone:

1. Select whether you want to measure a **Face cone** or **Root cone**.
2. For a **Root** cone you must specify the probable **Tooth Height** (available to edit if Root is selected).
3. Define the **Number of Teeth** to measure.
4. If you want to move origin point to the cone apex check the **Move Origin point to the cone apex** option.
5. If you checked the **Move origin point to the cone apex**, you need to provide the **Distance to Face/Root Cone from Pitch Cone apex**.
6. Specify the **Clearance distance from Face/Root cone** for the distance you want the probe to retract after measuring each tooth.
7. Specify the **Clearance distance in Z direction** for the distance you want the probe to retract after measuring the entire face/root cone.
8. To accept the parameters and go back to **Create Alignment** dialog box, click **OK**. Click **Cancel** to close without saving changes.

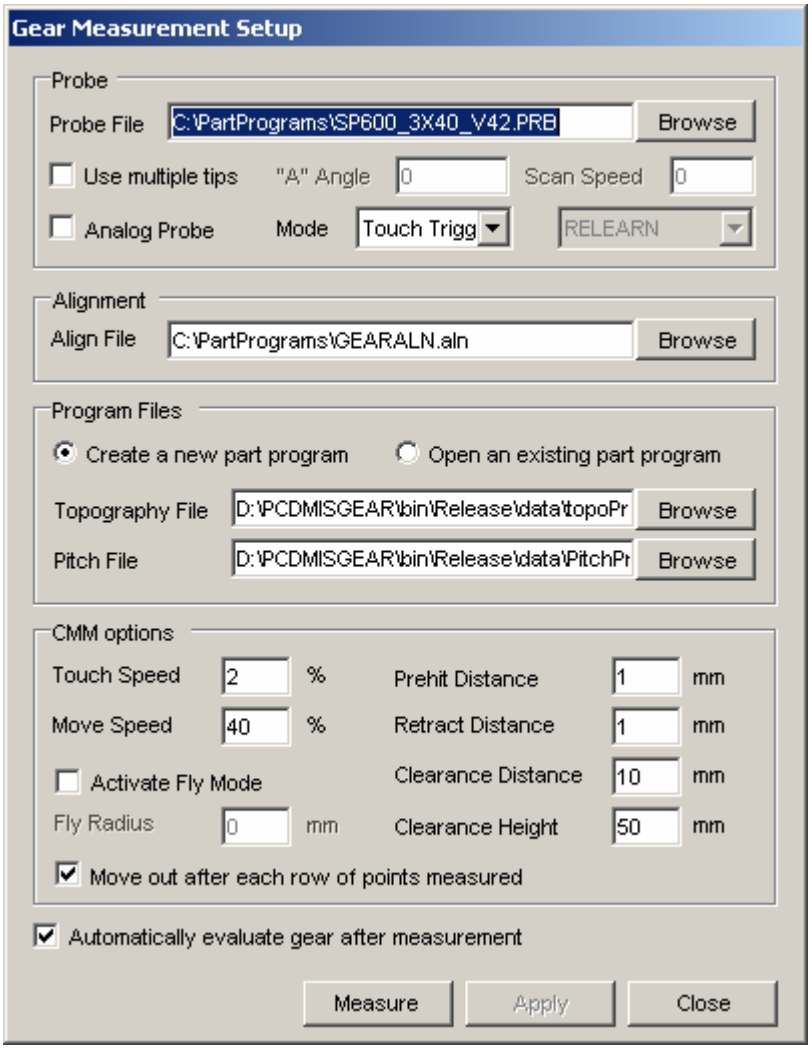
The **Gear Measurement Setup** dialog box allows you to edit the parameters and begin gear measurement.

Clicking the **Measure** button or selecting the **Measure | Measure** menu option displays the **Gear Measurement Setup** dialog box.

Measure

Before measuring ensure you have first:

- Defined your probe
- Calibrated your probe
- Defined gear parameters
- Created an alignment



Probe Area

Probe File: The path in this box defines what probe file you want to use for the gear's measurement. Click the **Browse** button to navigate to and select the probe file to use for the gear's measurement.

Use multiple tips: Select this option when using multiple tip angles to measure the gear, instead of single angle. For example, when you select **Use multiple tips**, and set **"A" Angle** to 90, PC-DMIS Gear will find all of A90BXX angles to measure the gear.

"A" Angle: Provides the "A" angle that will be used to determine the tips angles that will be used to measure your gear.

Scan Speed: Provides the speed at which **Analog Scans** will be performed.

Analog Probe: Select this option if you will be using an Analog Probe.

Mode: Select either **Touch Trigger** or **Analog Scan** to determine how measurement will be taken. The **Analog Scan** option is only available when the **Analog Probe** option is selected.

DEFINED/RELEARN option: In **DEFINED** mode Gear will calculate all nominal scan points according to the gear parameters and insert them into the scan command. When executing the scan, PC-DMIS will pass through every point. In **RELEARN** mode, Gear will also calculate the nominal scan points, but when executing the scan, PC-DMIS will recalculate all scan points according to the start point, the end point and the scan direction. All learned measured data will replace the existing measured data. The Execution Mode options are only available for an **Analog Scan** mode.

Alignment Area

Align File: This box lets you determine the alignment file to be recalled and used in the gear measurement program. By default, PC-DMIS Gear automatically selects the alignment you performed using the **Align Gear** icon. Use the **Browse** button to select the alignment file (file with an .aln filename extension). For more information on alignment files, see the topics on saving and recalling alignment files in the main PC-DMIS manual.

Program Files Area

Create a new part program: PC-DMIS Gear will create a new PC-DMIS program at the location(s) specified by in the **Topography File** and **Pitch File** fields. The part programs will be created in part based on the **Gear Measurement Setup** parameters.

Open an existing part program: PC-DMIS Gear will open the existing programs specified by the **Topography File** and **Pitch File** fields. Most of the options will be unavailable when this option is selected, since the parameters are already defined in the selected part program files. Using an existing part program allows you to measure the gear without needing to take time to generate programs again.

Topography File: The path in this box defines the location of the part program that will be created or opened for measuring topography. Click the **Browse** button to navigate to and select an existing part program or provide the path and file name to which a new part program file will be saved.

Pitch File: The path in this box defines the location of the part program that will be created or opened for measuring pitch. Click the **Browse** button to navigate to and select an existing part program or provide the path and file name to which a new part program file will be saved.

CMM Options Area

Touch Speed: Provides the speed at which the CMM takes hits. The value that is entered is a percentage of the maximum machine speed, and cannot exceed twenty percent.

Move Speed: Provides the point to point positioning speed of the CMM. The value that is entered is a percentage of the maximum machine speed. It can be set to any value between 1 and 100% of full machine speed.

Activate Fly Mode: If you select this option the CMM will move the probe around the part in a smooth and round motion. This option depends on the capability of your controller being able to execute circular moves.

Fly Radius: Determines the radial distance of the arc path along which the probe will travel between move points.

Move out after each row of points measured: This causes the probe to move out to the specified **Clearance distance** from the gear after each row has been measured.

Prehit Distance: Provides the distance away from the surface where PC-DMIS starts searching for the part.

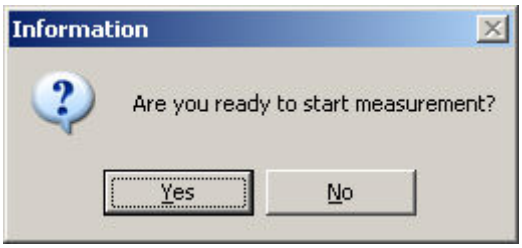
Retract Distance: Provides the distance the probe retracts from the surface after taking a hit.

Clearance Distance: Specifies the distance the probe will retract after measuring each flank.

Clearance Height: This determines the location above the gear that is considered safe for the probe to change angles.

Automatically evaluate gear after the measurement: When this option is selected, PC-DMIS Gear will automatically evaluate the gear and create a report as soon as the measurement is completed. Otherwise you will need to open the Analyze dialog box to evaluate the gear.

Click **Measure** to begin the gear measurement process. All probing points and the machine movement is generated by PC-DMIS Bevel Gear. You will be prompted to start measurement.



Click **Yes** to start and **No** to Cancel. PC-DMIS will run your part program automatically.

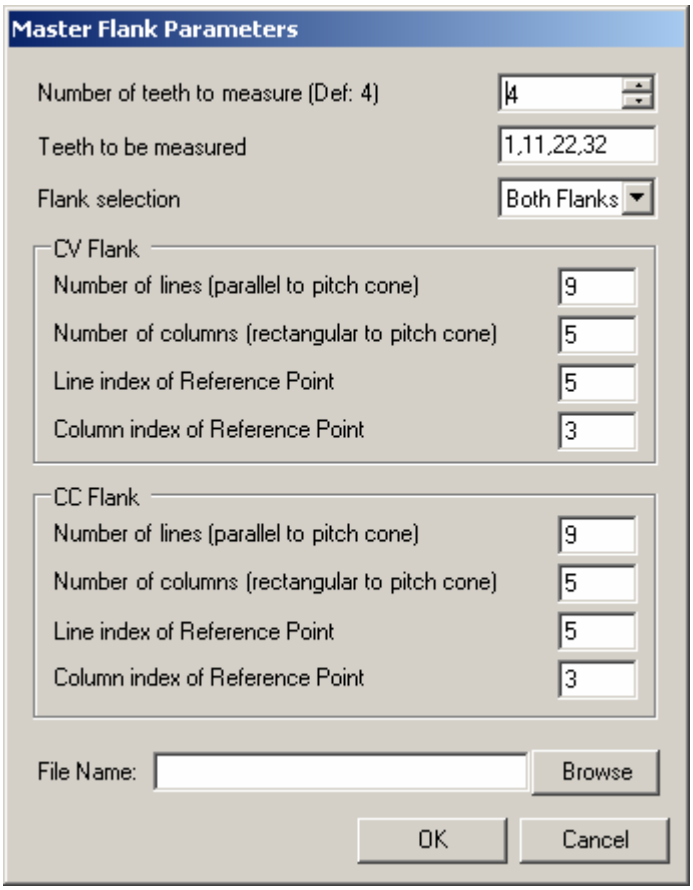
Saves any changes that have been made in the **Gear Measurement Setup** dialog box.

Closes the **Gear Measurement Setup dialog box** without saving your changes.

Defining Master Flank Data

The **Master Flank Parameters** dialog box, accessed from the **Gear Measurement Setup** dialog box, allows you to provides additional settings to measure a Master Flank of your bevel gear. If you don't have a Gleason File, you should measure the Master Flank before you measure your gear. The calculation of the Master Flank uses an average from all measured flanks.

Select the **Measure | Master Flank** menu option to open the **Gear Measurement Setup** dialog box which includes the **MasterFlank Setting** button.



Master Flank Parameters dialog box

Number of Teeth to Measure: Determines the number of teeth that will be measured to define the Master Flank. The teeth measured will be as close to equally spaced around the gear as possible starting with tooth #1. The default value is 4.

Teeth to be measured: This automatically lists the teeth that will be measured based on the **Number of Teeth to Measure** and the total **Number of Teeth** specified on the Parameters tab. This value is required. For example a value of 1,11,22,32 will measure tooth #1, #11, #22, and #32.

Flank selection: Select whether the **Concave Flanks**, **Convex Flanks** or **Both Flanks** will be measured.

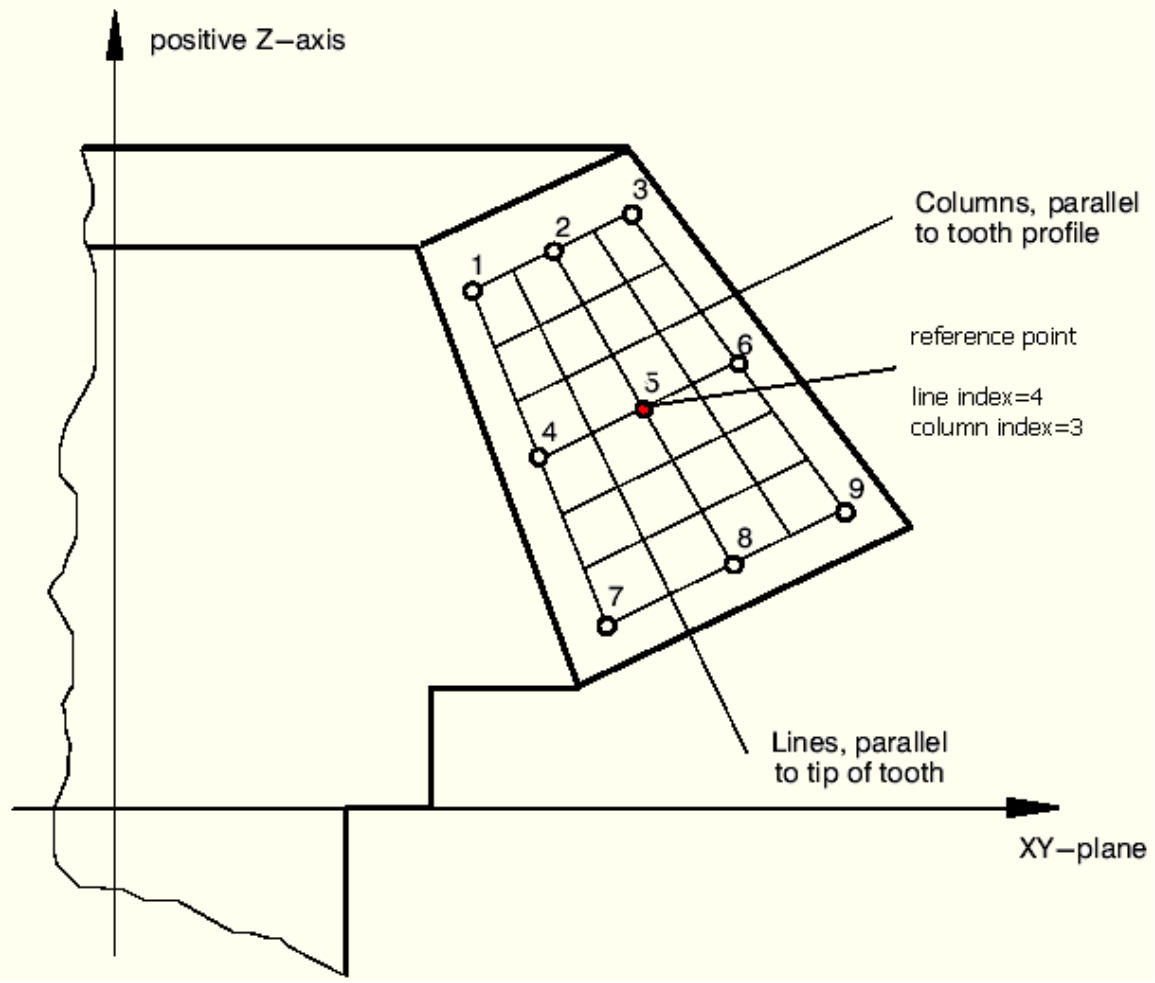
CV (Convex) Flank and CC (Concave) Flank Areas

Number of lines: Specify the number of lines parallel to the tip of the tooth. A minimum of 4 is required for this value. See the example below.

Number of columns: Specify the number of lines parallel to the tooth profile. A minimum of 4 is required for this value. See the example below.

Line index of Reference Point: Provides the line at which the reference point is located where it intersects the column index. See the example below.

Column index of Reference Point: Provides the column at which the reference point is located where it intersects the line index. See the example below.



Example showing how points are to be measured on the Master Flank

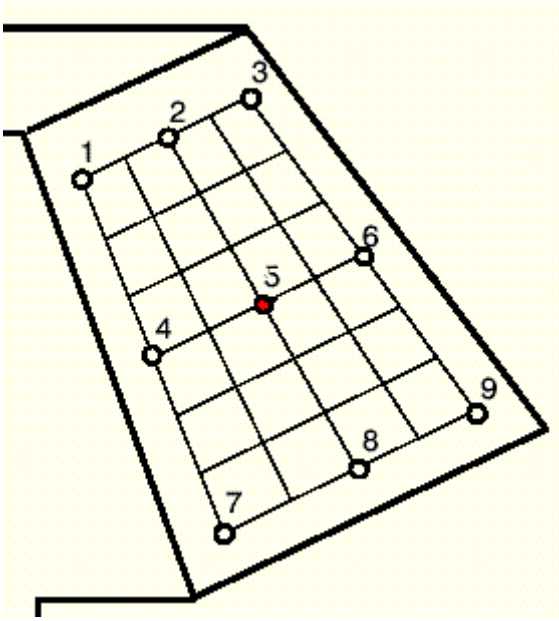
File Name: Click **Browse** to specify the location to which the Gleason-Formatted File will be saved. This opens a **Save As** dialog box. Type the name of the file in the **File Name** box and click **Save**. You may also type the path and file name in the **File Name** box.

Click **OK** to save your changes or **Cancel** to close the dialog box without saving

Master Flank Measurement

The following describes the process of measuring the Master Flank:

1. After all the parameters for the Master Flank have been set, and you have clicked **Measure**, you have to execute 9 manual hits in a specific order. These hits serve as a start value for the calculation of the probing points of the master grid to be measured and define the corner points of the grid.



2. Beginning at the root of the tooth in the direction to the tooth head, take three points, inside, in the middle and on the outside on the tooth (9 points total). This determines the material direction. You must establish a clearance position before measuring the first point and all further measurements can be taken without a clearance position.
3. PC-DMIS Gear computes the probing points for the measurement of the master grid according to the number of lines and columns based on the previously taken manual hits.
4. The points on the corner determine the size of the master grid. For the Computation of the grid points the program performs a linear interpolation of the Z coordinates and the radius according to the column and line numbers. The columns of the grid are parallel to the tooth profile and the lines are parallel to the tip of the tooth.
5. The measurement of the master flank is then executed in two automatic runs.
6. After the measurement, the program computes an average master from all measured master flanks. The computed grid points are stored in the element as NPT's in meandering columns in such a way that the first column lies inwards on the tooth flank (first point at the root) and the last column outwards.

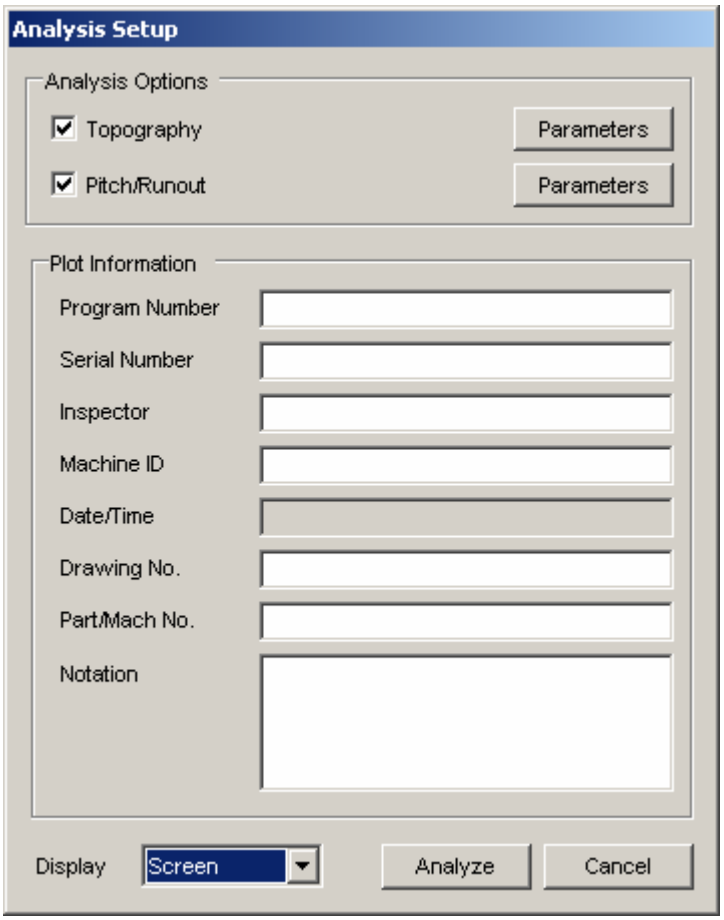
Note: This procedure will be executed on either the Convex, Concave or Both Flanks according to the **Flanks selection** value in the Master Flanks Parameter dialog box. See "Defining Master Flank Data".

Analyzing a Bevel Gear

The **Analysis Setup** dialog box allows you to define parameters and provide report information for analysis reports. Once you complete the gear measurement, you can use this dialog box to produce a graphical report of the measurement (see the sample reports below).

Analyze

Clicking the **Analyze** button or selecting the **Measure | Analyze** menu option displays the **Analysis Setup** dialog box.



Analysis Setup dialog box

Analysis Options Area

For each of the analysis options, measured data must exist in order to select the option for inclusion in the report.

Topopragh: Select this option for Topography output to be created. Click **Parameters** to make changes to the Topography Parameters. See "Defining Topography Data".

Pitch Runout: Select this option for Pitch/Runout output to be created. Click **Parameters** to make changes to the Pitch/Runout Parameters. See "Defining Pitch/Runout Data".

Plot Information Area

This area allows you to include general purpose information appear in your analysis report, such as: Program Number, Serial Number, Inspector, Machine ID, Date/Time, Drawing No., Part/Mach No. and Notation. This information will be included in the header of your report. The Date/Time value is supplied automatically based on the time of gear measurement.

Display: Select whether the report data is displayed on your SCREEN via the **Quindos PageViewer** application or is printed directly to your PRINTER using the **Quindos** print spooler.

Analyze Clicking this button creates the report based on the different options and values set in the **Analysis Setup** dialog box. It sends the report to the output device specified in the **Display** option. Measured data is spooled to the **Quindos PageViewer** application where you can view and print your report(s). See "Appendix A: Using Quindos PageViewer".

Cancel Clicking this button closes the **Analysis Setup** dialog box.

Important! Quindos PageViewer depends on PC-DMIS Gear being open. If you close PC-DMIS Gear, Quindos PageViewer and any open analysis reports will also close.

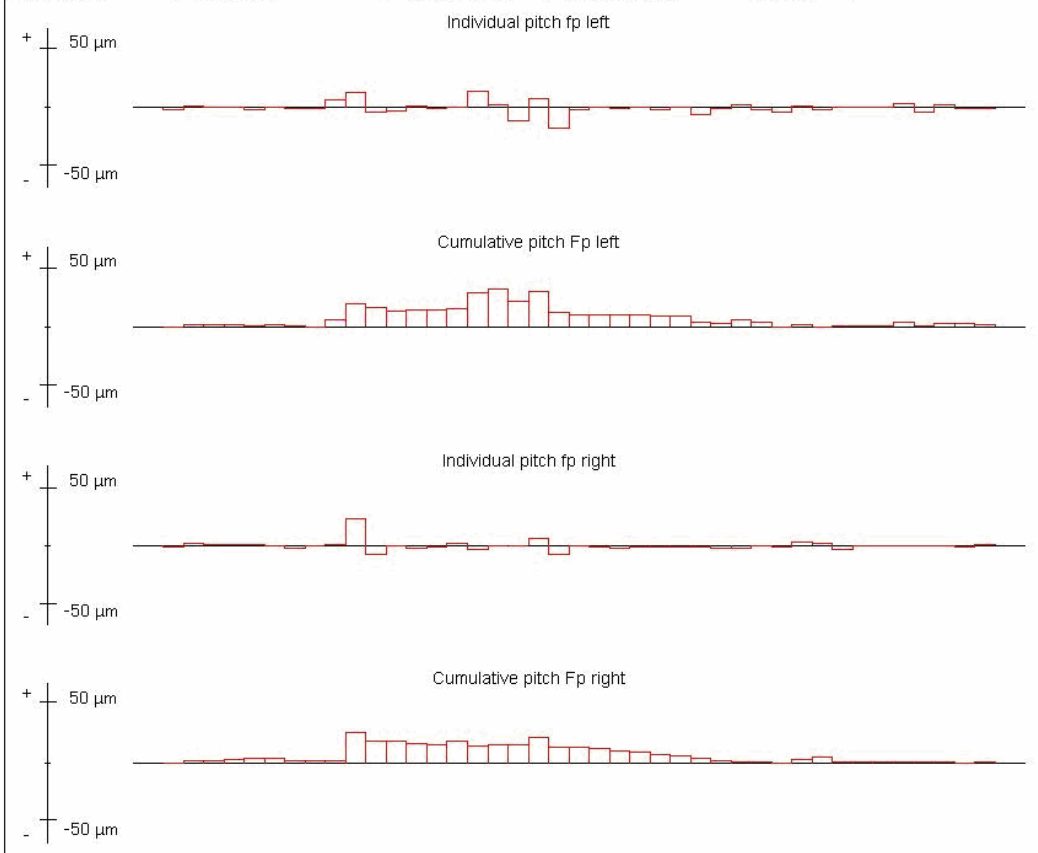
See the "Sample Pitch & Runout Report" and "Sample Topography Report" topic for examples of the bevel gear reports that are created by PC-DMIS Gear.

Sample Pitch & Runout Report

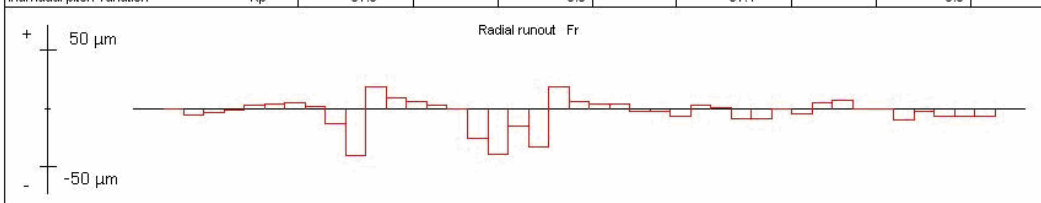
The Pitch/Runout report for the spiral bevel gear is represented in the form of a step curve. The evaluation corresponds to the typical plots of helical gears.

Spiral Bevel Gear Pitch & Runout

Orientation	: External	Face Cone (a,z)	:	Part No.	: 20041104_00001
No. of Teeth	: 41	Root Cone (a,z)	: 75.217,52.781	Machine	: CMM Global575
Normal Module	: 5	Outer Pitch Cone Di	: 55	Serial No.	: 00001
Meam Spiral Angle	: 32.3833	Tooth Width	: 8.813	Notation	: Spiral Bevel Gear Test Re
Thickness (d,c,t,r,z)	: 0,0,0,0,0	Mounting Dist./Value	: 55,-0.008	Inspector	: Dominic.wu
Pitch Cone (a,z)	: 72.983,52.753	Standard/Class/Unit	: AGMA 2009,6,mm	Date Time	:



		left flank				right flank			
		meas.dev.	Qual.	Toler.	Qual.	meas.dev.	Qual.	Toler.	Qual.
Individual pitch deviation	fp	17.7	B 8	0.0	B 6	23.6	B 9	0.0	B 6
Cumulative pitch deviation	Fp	32.2	B 7	0.0	B 6	26.2	B 6	0.0	B 6
Adjacent pitch deviation	fu	26.1		0.0		30.7		0.0	
Individual pitch variation	Rp	31.6		0.0		31.4		0.0	



Radial runout	Fr	59.3	B 9	0.0	B 6

	nom	max-min	max		min		Average

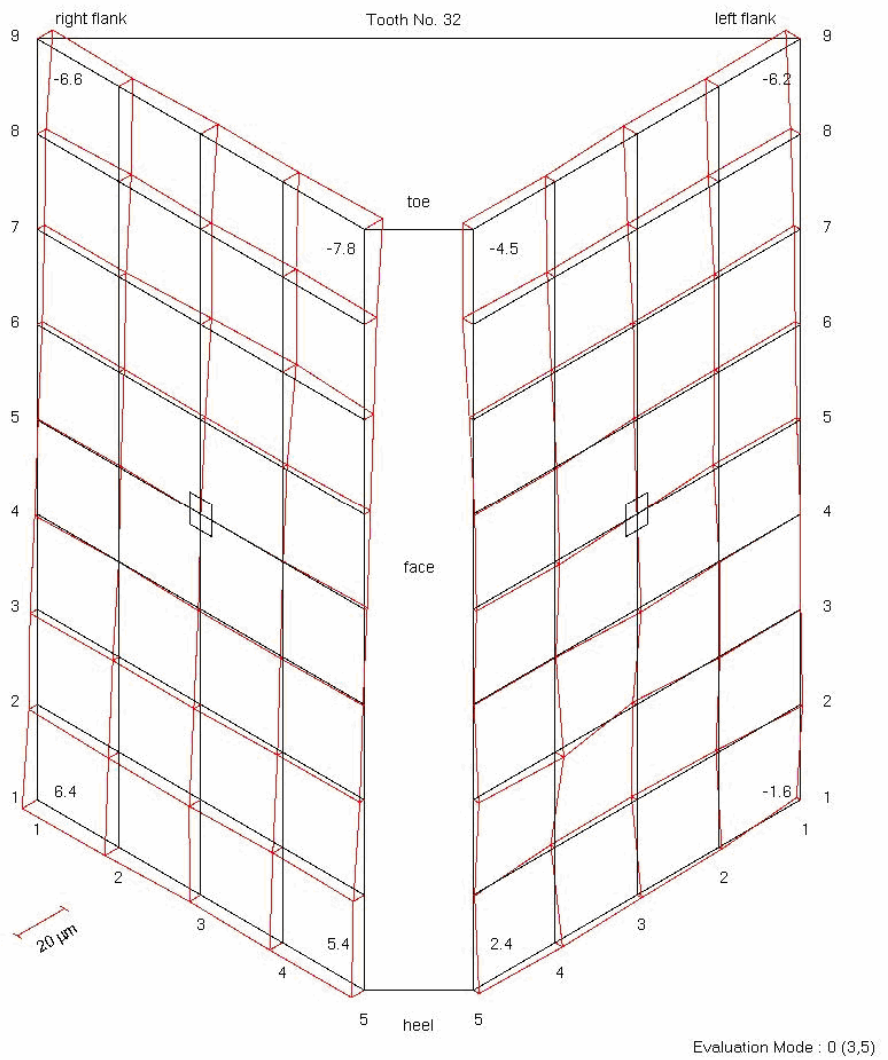
Sample Topography Report

The Topography report for the Spiral Bevel Gear provides the topographical image of the deviations as presented with the points arranged in grids on the tooth flanks. The deviations are shown vertically to the surface in true value.

The plotting display is chosen in such a way that you look on an external gear from the outside of the tooth or the gap. The +z axis is upward.

Spiral Bevel Gear Topography

Orientation	: External	Face Cone (a,z)	:	Part No.	:
No. of Teeth	: 41	Root Cone (a,z)	: 75.217,-2.095	Machine	:
Normal Module	: 5	Outer Pitch Cone Di	: 55	Serial No.	:
Mean Spiral Angle	: 32.4333	Tooth Width	: 8.813	Notation	:
Thickness (d,c,t,r,z)	: 0,0,0,0,0		: 55,-0.008	Inspector	:
Pitch Cone (a,z)	: 75.25,-3.52	Standard/Class/Unit	: AGMA 2009,6,mm	Date Time	: 12/13/2005 14:48:54



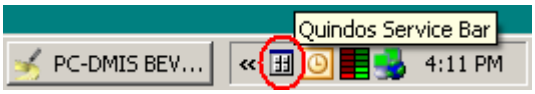
	right flank		left flank	
	meas. dev.	Tolerance	meas. dev.	Tolerance
Total deviation	14.2	0.0	9.9	0.0
Line at face	13.2	0.0	7.0	0.0
Line at root	13.0	0.0	7.1	0.0
Profile at toe	2.0	0.0	2.1	0.0
Profile at heel	1.6	0.0	4.8	0.0

Appendix A: Using Quindos PageViewer

Quindos PageViewer allows you to analyze and print the various reports that are created for measured gear data from PC-DMIS Gear. PageViewer is also installed as part of the PC-DMIS Gear install process. PageViewer uses XML code to create reports.

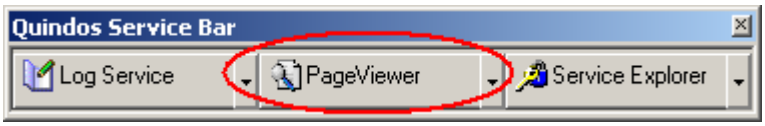
To Access PageViewer:

1. Click **Analyze** from the **Analysis Setup** dialog box of the PC-DMIS Gear application (see "Analyzing a Spur or Helical Gear" or "Analyzing a Bevel Gear". This will launch the **Quindos Service Bar**. For each subsequent time that analysis data is sent from PC-DMIS Gear to Quindos PageViewer new report tabs are added to Quindos PageViewer. Current reports from the same gear measurement data are not overwritten in Quindos PageViewer.
2. To open the **Quindos Service Bar** double-click the Icon located in the task bar.

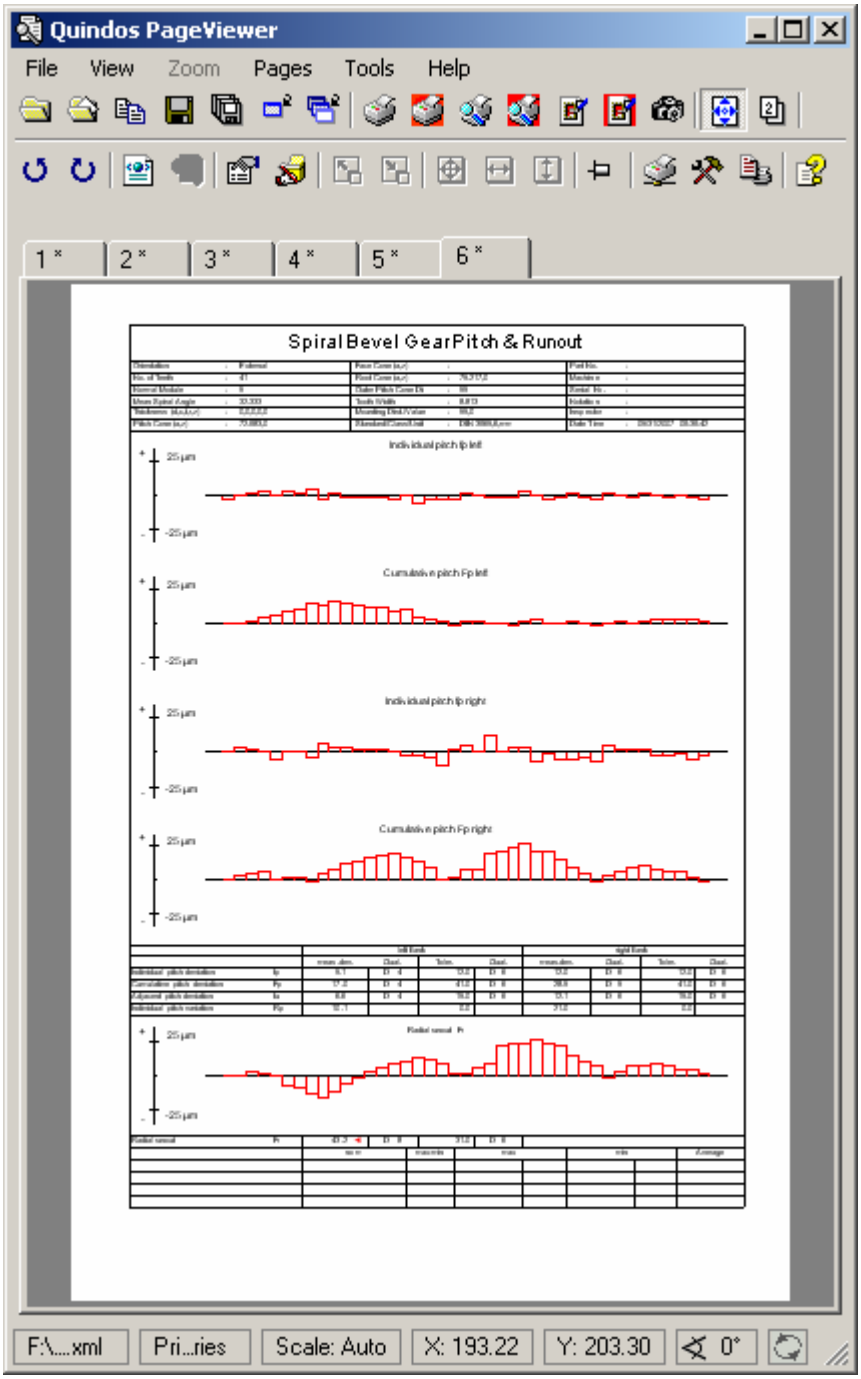


Note: You may also right-click the Icon in the task bar and select the **PageViewer** option to open the **Quindos PageViewer**.

3. Select the **PageViewer** button from the **Quindos Service Bar**...



...to launch **Quindos PageViewer**.



Important! Quindos PageViewer depends on PC-DMIS Gear being open. If you close PC-DMIS Gear, Quindos PageViewer and any open analysis reports will also close.

Glossary

B

Ball: This is the ball that fits in between the teeth and touches at or near the pitch diameter. Consult your gear standard for more information.

C

Clocking: Clocking sets the positive X axis of the alignment on the symmetry point of the two points. Using a clocking tooth to determine the X and Y axis for alignment, we need to take two clocking points on a tooth.

Crowning: This is defined in your gear standard.

Cylinder Gear: Also referred to as a spur geare

D

Def. autom: Default automatic calculation.

F

FA: FA is a symbol used by your gear standard. It specifies the distance between two design profiles which enclose the actual profile over the evaluation range. This is subject to the provisions of the fHA symbol. Please see the appropriate gear standard for a detailed definition of this value.

FB: FB is a symbol used by your gear standard. It specifies the distance between two design helices which enclose the actual helix over the evaluation range. Please see the appropriate gear standard for a detailed definition of this value.

ffA: ffA is a symbol used by your gear standard. It specifies the distance between two profiles parallel to the mean profile which enclose the actual profile over the evaluation range. Please see the appropriate gear standard for a detailed definition of this value.

ffB: ffB is a symbol used by your gear standard. It specifies the distance between the two design helices parallel to the mean helix which enclose the actual helix over the evaluation range. Please see the appropriate gear standard for a detailed definition of this value.

fHA: fHA is a symbol used by your gear standard. It specifies the distance between two design profiles which intersect the mean profile at the end points of the evaluation range. The profile angle deviation is positive when the mean profile rises from the design profile towards the nonmaterial side at the tooth tip; it is negative when the mean profile drops towards the material side at the tooth tip. Please see the appropriate gear standard for a detailed definition of this value.

fHB: fHB is a symbol used by your gear standard. It specifies the The distance between two design helices which intersect the mean helix at the extremities of the evaluation range. The helix angle deviation is positive when it increases the absolute value of the helix angle, and negative when it reduces it. In the case of spur gears, deviations are always positive. Their direction is identified by an index 'r' (in the sense of a right-hand thread), or 'l' (in the sense of a left-hand thread). Please see the appropriate gear standard for a detailed definition of this value.

Fp: Fp and fp are symbols used by your gear standard. They denote the individual (fp)deviation of the arc between two corresponding flanks or the cumulative (Fp) deviation of each calculated arc for the entire gear. Please see the appropriate gear standard for a detailed definition of this value.

Fr: Fr is a symbol used by your gear standard. It specifies the maximum amount of tooth runout in the radial direction, measured by indicating a pin or ball placed between two teeth at the central cone distance. This is the pitch cone runout. Please see the appropriate gear standard for a detailed definition of this value.

fu: fu is a symbol used by your gear standard. It specifies the deviation between the actual measured values of two consecutive transverse pitches of right or left flanks; it is equal to the difference between the transverse pitch deviations of two consecutive flanks.

G

Gear standard: The four widely-used gear standards are AGMA, DIN, ISO, and JIN. While similar, they also differ from each other. Because of their differences this documentation cannot cover the details of these standards. You will need to know the information about your particular standard in order to measure your gear and properly analyze your data.

H

Helix: This type of gear has angled teeth instead of the teeth being straight up and down like a spur gear.

Helix/Lead: It is a scan from the bottom to the top of the gear at the same radius from the center of the gear.

N

Normal Diametrical Pitch: The diametrical pitch corresponding to the normal circular pitch and calculated in the normal plane.

P

PC-DMIS Gear File: A PC-DMIS Gear file contains information that defines a spur or bevel gear inside PC-DMIS Gear. It also contains data from your last measurement. It has a “.pdg” filename extension.

Pitch: This can generally be considered as the "average" radius of the gear located between the Tip radius and the Root radius. Consult your gear standard for a detailed definitionof this term.

Probe File: A probe file defines your current probe configuration so that PC-DMIS Gear can understand and use it. The information is stored inside file with a .prb filename extension.

Profile: Consult your gear standard for a detailed definition of this term.

R

Runout: The Runout value can be determined theoretically by placing balls of a specified diameter into the gaps of each tooth. The center points of all spheres will form a circle. This circle is compared to the pitch diameter circle where the difference between the largest radius and the smallest radius is considered to be the runoutvalue. Consult your gear standard for a detailed definition of this term.

T

Tip/Root: The tip is the “peak” of a gear tooth. The root is the “valley”.

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