PC-DMIS Gear Manual

For PC-DMIS Gear 2.4

By Wilcox Associates, Inc.

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PC-DMIS for Windows version 4.0 and beyond uses a free, open source package called lp_solve (or lpsolve) that is distributed under the GNU lesser general public license (LGPL).

```
lpsolve citation data
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Description: Open source (Mixed-Integer) Linear Programming system
Language: Multi-platform, pure ANSI C / POSIX source code, Lex/Yacc based parsing
Official name: lp_solve (alternatively lpsolve)
Release data: Version 5.1.0.0 dated 1 May 2004
Co-developers: Michel Berkelaar, Kjell Eikland, Peter Notebaert
License terms: GNU LGPL (Lesser General Public License)
Citation policy: General references as per LGPL
Module specific references as specified therein
You can get this package from:
http://groups.yahoo.com/group/lp_solve/
```

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PC-DMIS Gear 2.4: 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 straightforward measurement experience. Measurement results are displayed graphically using the new Gear Report window.

New! PC-DMIS Gear version 2.1 and higher 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 help file covers the following topics:

- Getting Started
- PC-DMIS Gear: User Interface
- Parameters for Cylinder Gears
- Parameters for Bevel Gears
- Appendix A: Using the Gear Report Window

Important! For gear terminology that is used throughout this help file 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 for each 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 :

Parameters for Cylinder 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:** When programming your portlock, if neither of these options are selected in your portlock, PC-DMIS Gear installation will be blocked and an 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 onto WAI's web site (www.wilcoxassoc.com) and follow the links where PC-DMIS Gear is discussed. Download the .zip file into a specified directory on your hard drive.
4. Extract the contents of the zip file to a temporary directory on your hard drive.
5. Install PC-DMIS Gear by double-clicking the setup.exe file.
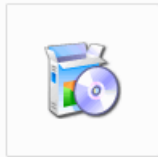
setup.exe

6. An installation wizard appears that will guide you through the installation process.
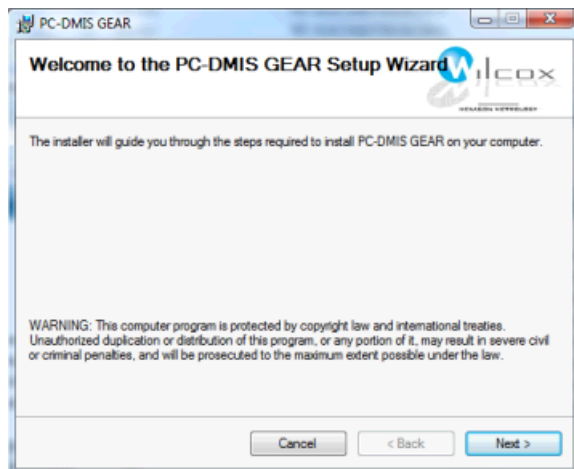
PC-DMIS GEAR Setup Wizard

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. If this is the first time the Gear application is run, it will start in Programmer Mode as shown below.
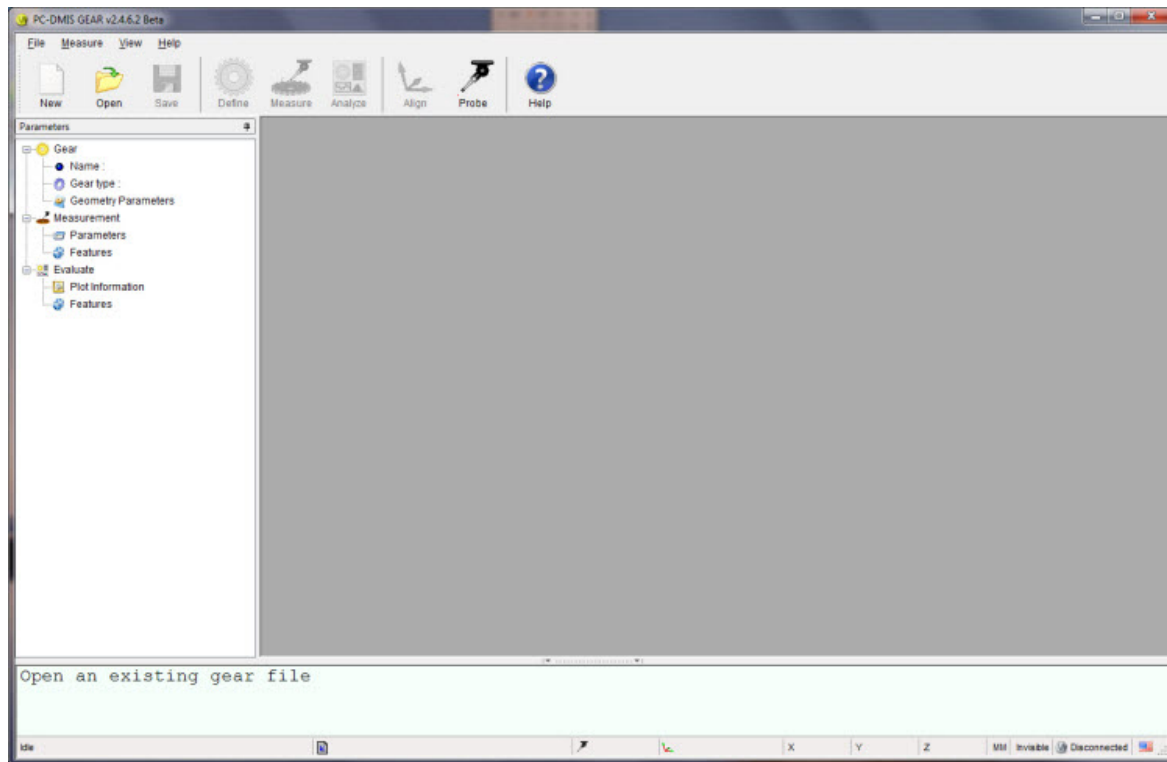
The Programmer Mode will be used to:

- Define the basic parameters for a gear.

- Drive PC-DMIS to measure the gear.

- Evaluate the measured data and create graphic report.

Note: There are two modes that Gear can run in: Programmer Mode (shown above) and Operator Mode. Gear will start in the mode it was in when last shut down. Operator Mode is currently functional for Cylinder Gear inspections only.

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 (or pressing F5)** 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
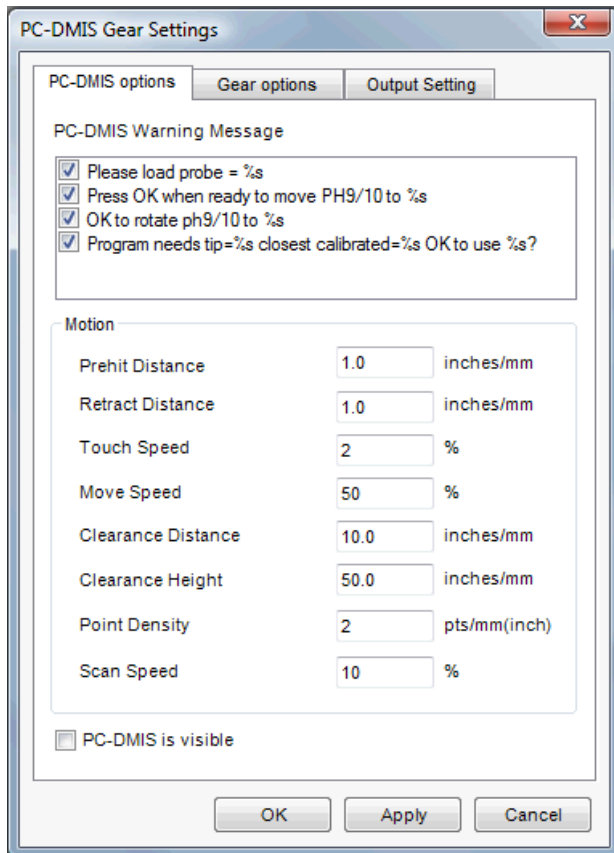
PC-DMIS Gear Settings dialog box - PC-DMIS options tab

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: D**etermines 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 . 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).

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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
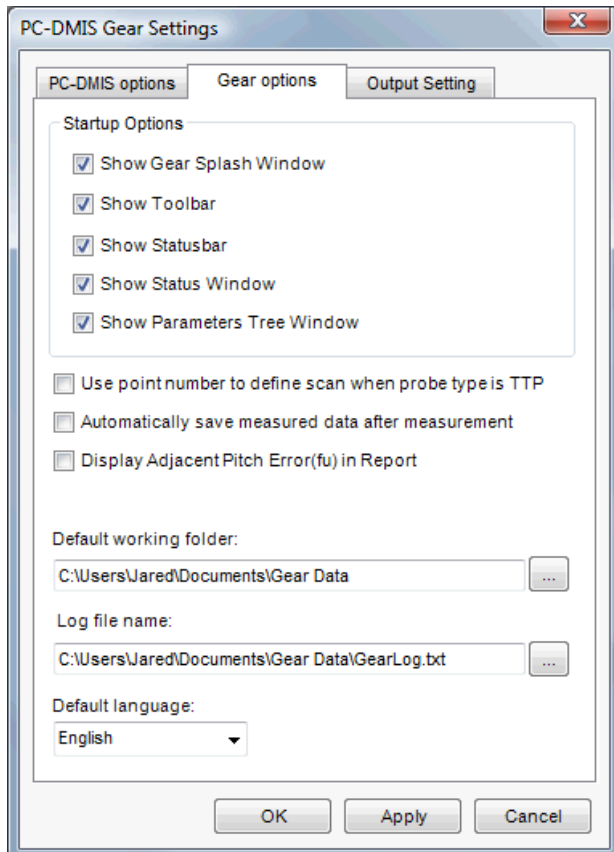
PC-DMIS Gear Settings dialog box - Gear options tab

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.

Use point number to define scan when probe type is TTP: This check box determines whether or not PC-DMIS Gear uses a point number when scanning with a touch-trigger probe (TTP). When marked, the **Points Number** box in the **Scan Setting** dialog box becomes available. This lets you input the total number of points to use when performing a scan. When cleared, PC-DMIS Gear will use a **Point Density** value to define the number of scan points per mm. See the "Defining Scan Settings" topic.

Automatically save measured data after measurement: This check box determines whether or not PC-DMIS Gear automatically saves the measured data to a measured data file (.mes file) each time a measurement finishes. If marked, it uses a filename format of "Gear Name" + Date + Time for the .mes file. You can also manually export and import .mes files by selecting **File | Export | Measured Data** or **File | Import | Measured Data**. If cleared, PC-DMIS Gear will not generate a .mes file.

Display Adjacent Pitch Error (fu) in Report: This check box determines whether or not the Adjacent Pitch Error Curve is included in the report. If marked this appears as an additional page in the Gear Report window. See "Appendix A: Using the Gear Report Window".

Default working folder: 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.

Output Setting
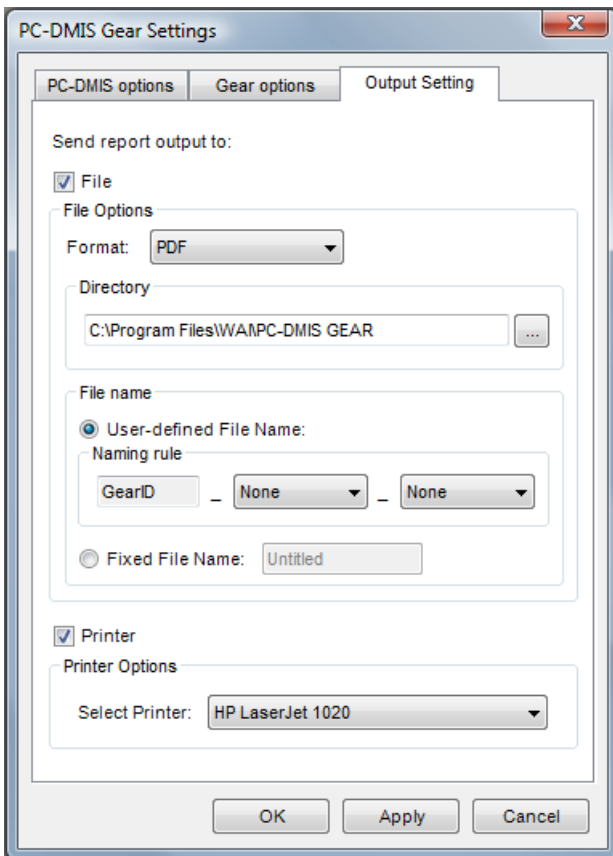
PC-DMIS Gear Settings dialog box - Output Setting tab

Send report Output to - This tab lets you define the output type and location for any generated reports. You can choose to send reports to a file and to a printer.

File - Marking this check box will send reports as a file to a directory defined by the **Directory** field. The file type is an electronic image file defined by the **Format** drop down list. The **File Name** area defines whether or not to use a static file name (a **Fixed File Name**) or to use a file name based off of a user-defined **Naming rule**. Using a naming rule, the file name is comprised of one to three segments: first, the GearID is set and present in your filename; second, you can either choose the serial number or the date and time; and third, you can choose either the serial number of the date and time, whichever wasn't used in the second segment.

Printer - Marking this check box will send reports to a printer defined in the **Select Printer** drop-down list.

Step 4: Create or Open a Gear File

To Create a New Gear File:
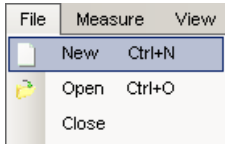
Select ... ![File menu showing New Ctrl+N, Open Ctrl+O, Close] or click ... ![New toolbar icon] ... to open the **Create new file** dialog box.	Open the **Create new file** dialog box by selecting the **File | New** menu option. You can also open this dialog box by clicking the **New** toolbar icon.
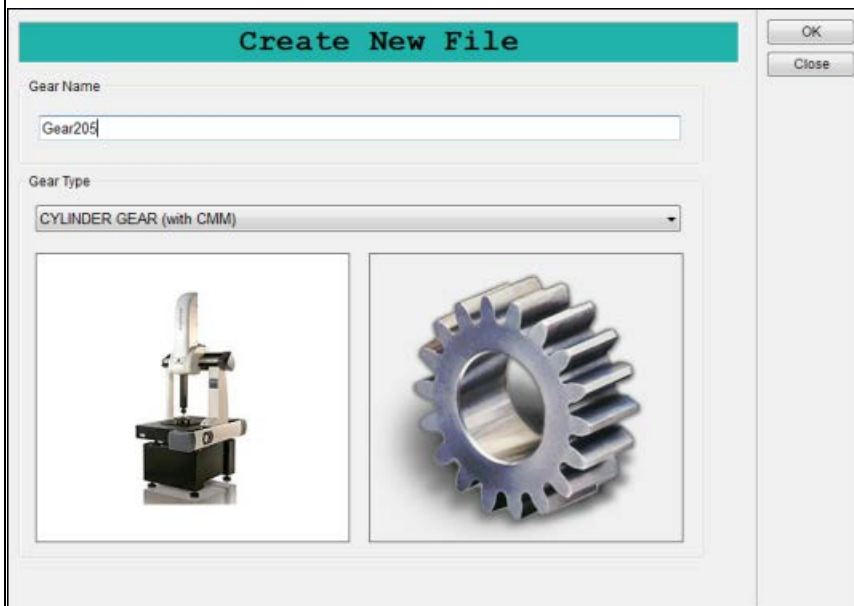
- Type the name of the new gear file in the **Gear Name** box. If the file already exists, you will be prompted to verify that you want to overwrite the old file.

- Select the machine type you'll use and the type of gear you'll measure from the **Gear Type** list. The options include:

BEVEL GEAR (with CMM)

CYLINDER GEAR (with CMM)

CYLINDER GEAR (with vision machine)

- If you don't see an expected option in this list, your hardware key (portlock) may not support that option. Contact your sales representative for information on how to proceed.

- Click **OK** to create a new PC-DMIS Gear file or **Cancel** to close without saving. If you click **OK**, PC-DMIS Gear opens the **Gear Parameters Definition** dialog box to complete your definition. See "Defining a Cylinder Gear" or "Defining a Bevel Gear".

To Open an Existing Gear File:
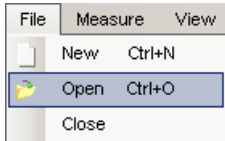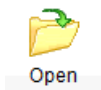
Select ... or click ... to open the **Open a PC-DMIS Gear file** dialog box.	Open the **Open a PC-DMIS Gear file** dialog box by selecting the **File	Open** menu option. You can also open this dialog box by clicking the **Open** toolbar icon. You can open the PC-DMIS Gear file to use and analyze gear data without re-measuring the gear.
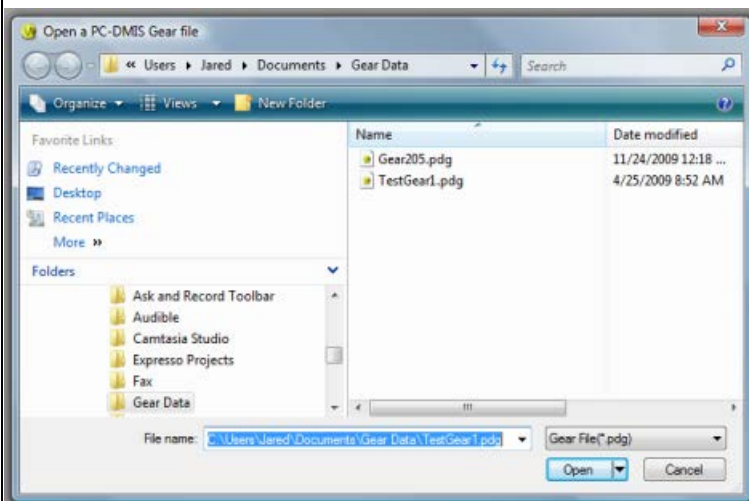
Browse to and select the needed PC-DMIS Gear (*.pdg) file and click **Open**.

Step 5: Calibrate Probes

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

To calibrate your probe:

1. Select the **Measure | Probe Calibration** menu option...
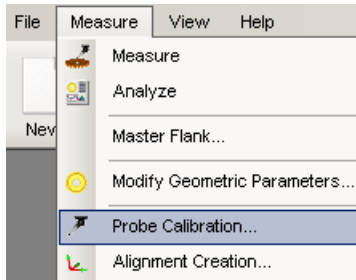
... or the **Probe** toolbar icon...
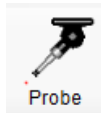
... to launch PC-DMIS in the background and use a **Save As** dialog box to navigate to a desired probe file.
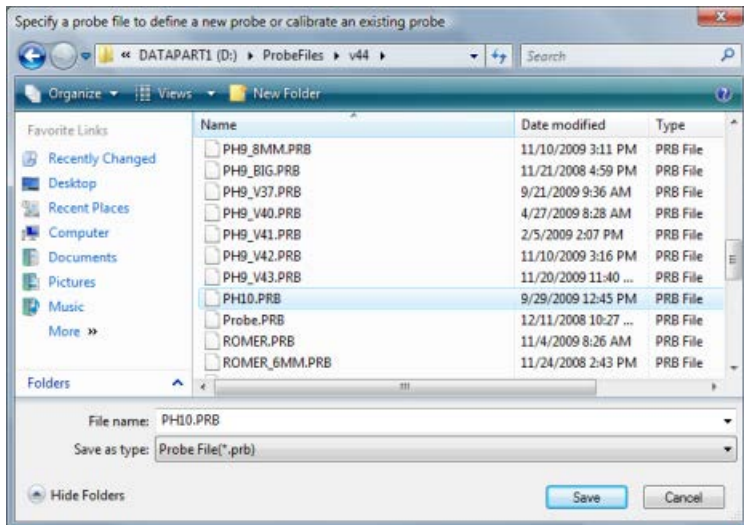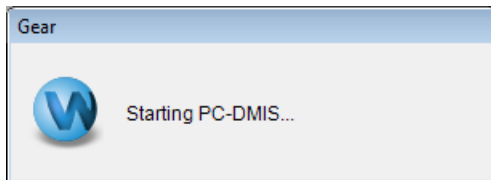
2. Browse to and select an existing probe file (*.prb) or type the **File name** to define a new probe file. When you click **Save**, PC-DMIS Gear will open the PC-DMIS **Probe Utilities** dialog box.
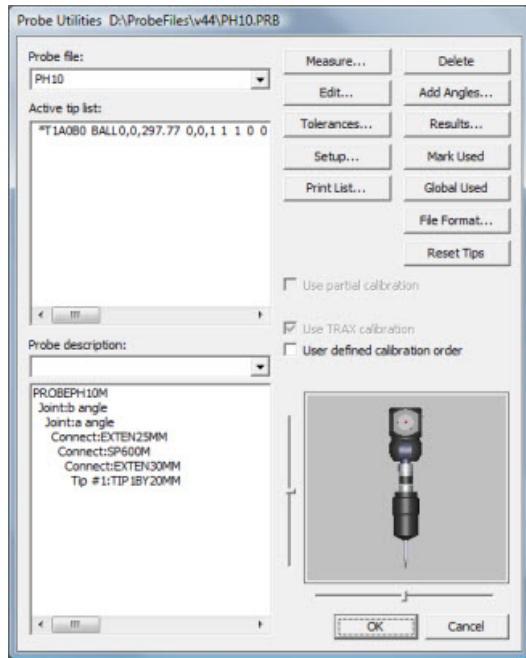
3. From the **Probe Utilities** dialog box you can then define and then use the **Measure...** button to calibrate your probe. If needed, see the core PC-DMIS for information on calibrating probes.

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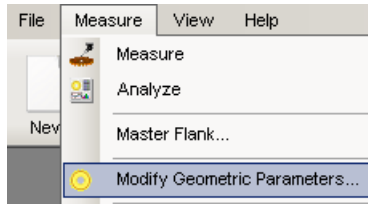
   ... or the **Define** toolbar icon...

   ... 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:

   - **Cylinder Gear:** See "Defining a Cylinder 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...
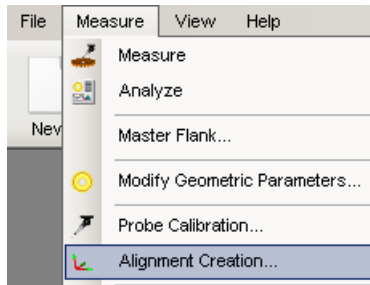
... or the **Align** toolbar icon...

... 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:

   - **Cylinder Gear:** See "Aligning a Cylinder Gear - CMM" for a CMM or "Aligning a Cylinder Gear - Vision Machine" for a vision system.

   - **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 **OK** to begin the Alignment Wizard. You are prompted whether of not you are ready to start measurement.

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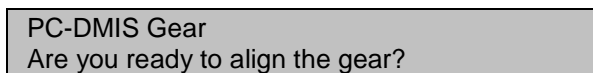
5. Click **Yes** to continue measurement, using the Alignment Wizard. PC-DMIS launches in the background to execute each of the measurements. The steps provided by the Alignment Wizard will vary depending on the gear type and the parameters specified.

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 or root cone measurement.
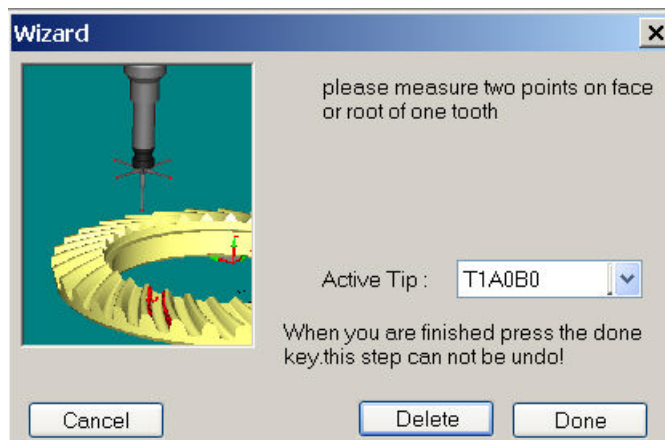
Wizard showing an example of an accuracy alignment

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 the **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 you have taken is not good enough for a needed feature, the software will prompt you to measure it again. You can click **OK** and continue.

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

Execution
Please move the probe to a safe position, the program will execute automatically!

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

Message
Alignment build successfully!

14. The gear alignment is now complete.

For more information on Alignment Parameters see the following topics:

Cylinder Gear Alignment - See "Aligning a Cylinder Gear - CMM" for a CMM or "Aligning a Cylinder Gear - Vision Machine" for a vision system.

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

Step 8: Measure the Master Flank
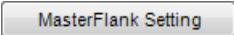
This step is only needed when working with bevel gears. If you did not provide a Master Flank file during the "Step 6: Define Gear Parameters", you will need to measure the Master Flank to create a Master Flank file. Otherwise, you can skip to the next step and "Measure a Gear".

To measure the Master Flank:

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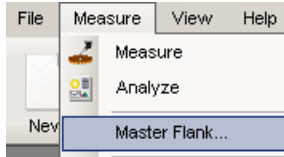
   ... to open the **Gear Measurement Setup** dialog box. This dialog box is the same dialog box that is used in "Step 9: Measure a Gear" except for the additional **MasterFlank Setting** button, which allows you to set Master Flank parameters.

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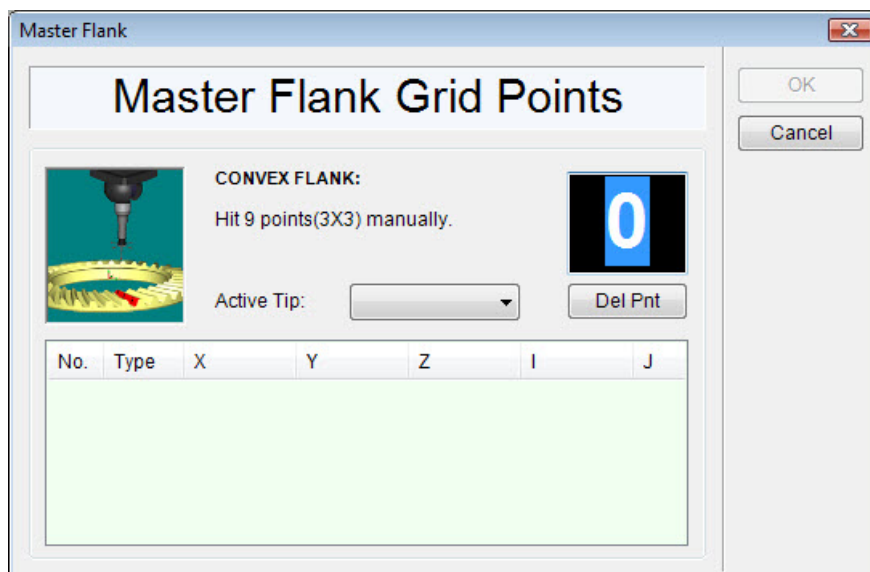
6. Select the **Active Tip** that will be used to measure the specified hits. Follow the instructions and measure the specified hits to establish the Master Flank. The left and right flanks of a gear are defined as shown in the image below.
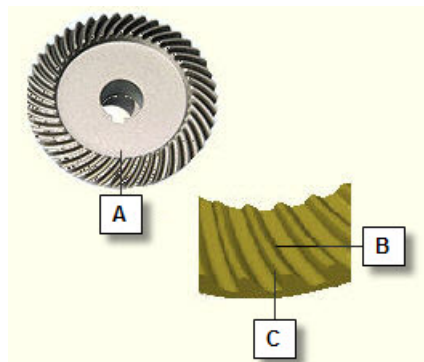
A - Gear
B - Left
C - Right

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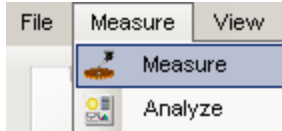
   ... or the **Measure** toolbar icon...

   ... 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:

   - **Cylinder Gear:** See "Editing Measurement Parameters for Cylinder 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. When PC-DMIS is ready to execute, it will provide a Yes/No message box asking if you are ready to start measurement.

5. Click **Yes** when ready. The gear part program opens in the instance of PC-DMIS running in the background and another Yes/No message box informs you that automatic operations are ready to begin. It then prompts you to move the probe to safe location above the gear.

6. Move the probe to a safe location and then click **OK**. The **Execute** dialog box appears.
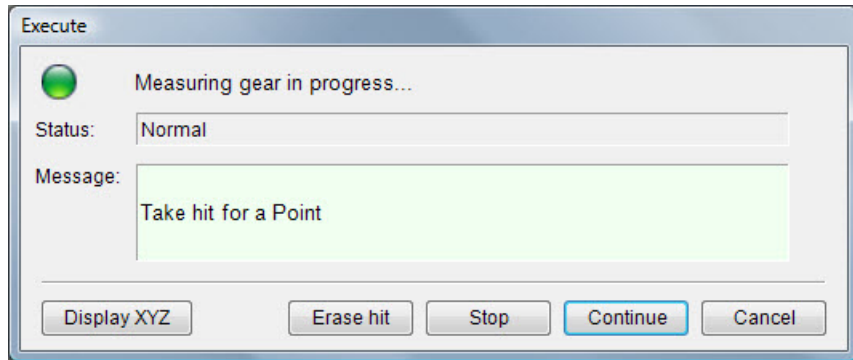
7. Follow the instructions in the **Execute** dialog box and take two manual hits on each flank of one tooth. Click **Erase Hit** to remove the last hit if needed.

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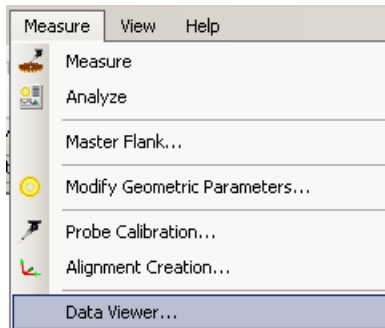
... to open the **Data Viewer** dialog box. The available options will vary depending on the type of gear that you are defining.

Data Viewer dialog box

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

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

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

    - **Cylinder 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:

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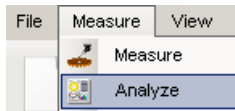
... or the **Analyze** toolbar icon...
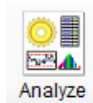
... to open the **Analysis Setup** dialog box. The available options and plot information will vary depending on the type of gear that you are defining.

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

- **Cylinder Gear:** See "Analyzing a Cylinder Gear - CMM" for CMM or "Analyze a Cylinder Gear - Vision Machine" for vision systems.
- **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:
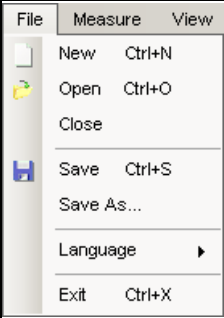
- Menu Options
- Operator Mode
- PC-DMIS Gear Toolbar
- Parameters Tree Window
- Status Window
- Status Bar
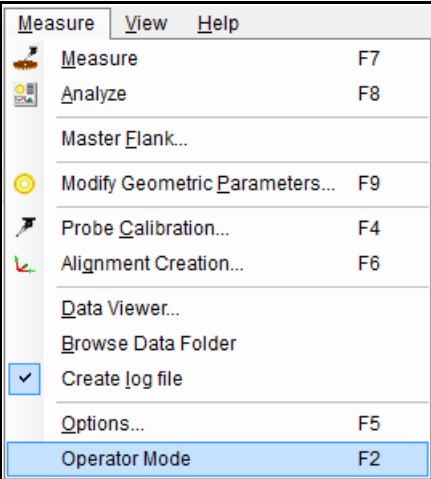
Menu Options

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

File Menu
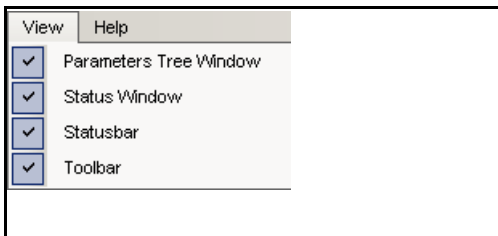
File menu screenshot showing: New Ctrl+N, Open Ctrl+O, Close, Save Ctrl+S, Save As..., Language ▶, Exit Ctrl+X	• **New:** Create a new PC-DMIS Gear file. • **Open:** Open an existing PC-DMIS Gear file. You will be prompted to save your work before the current file is closed and the selected file is opened. • **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
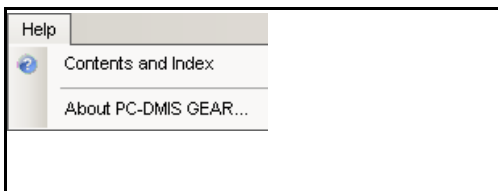
Measure menu screenshot showing: Measure F7, Analyze F8, Master Flank..., Modify Geometric Parameters... F9, Probe Calibration... F4, Alignment Creation... F6, Data Viewer..., Browse Data Folder, ✓ Create log file, Options... F5, Operator Mode F2	• **Measure:** Measure your gear. See "Editing Measurement Parameters for Cylinder Gears" or "Editing Measurement Parameters for Bevel Gears". • **Analyze:** Analyze the measured results for your gear. See "Analyzing a Cylinder 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 Cylinder 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 Cylinder 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". • **Operator Mode:** Used to create a shortcut in the Gear window that can be used to measure the gear, auto-evaluate the data and create a report. See User Interface	Operator Mode for more details.

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.

Operator Mode

Note: Operator Mode is currently functional for Cylinder Gear inspections only.

Starting Operator Mode

When PC-DMIS GEAR starts, the Gear Programmer Mode main window will be displayed. Select **Measure | Operator Mode** (or press the F2 key) to display the main window for Operator Mode.

Measure	View	Help	
Measure			F7
Analyze			F8
Master Flank...			
Modify Geometric Parameters...			F9
Probe Calibration...			F4
Alignment Creation...			F6
Data Viewer...			
Browse Data Folder			
✓ Create log file			
Options...			F5
Operator Mode			F2
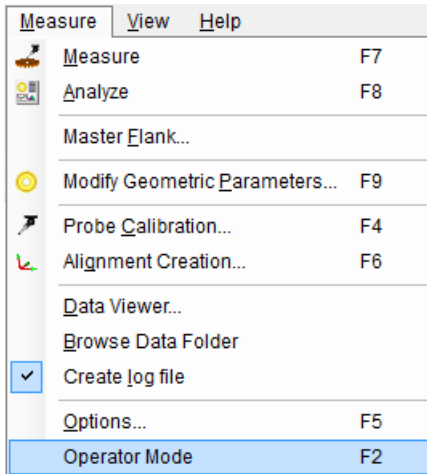
The screen will change from Programmer Mode to Operator Mode as shown below.
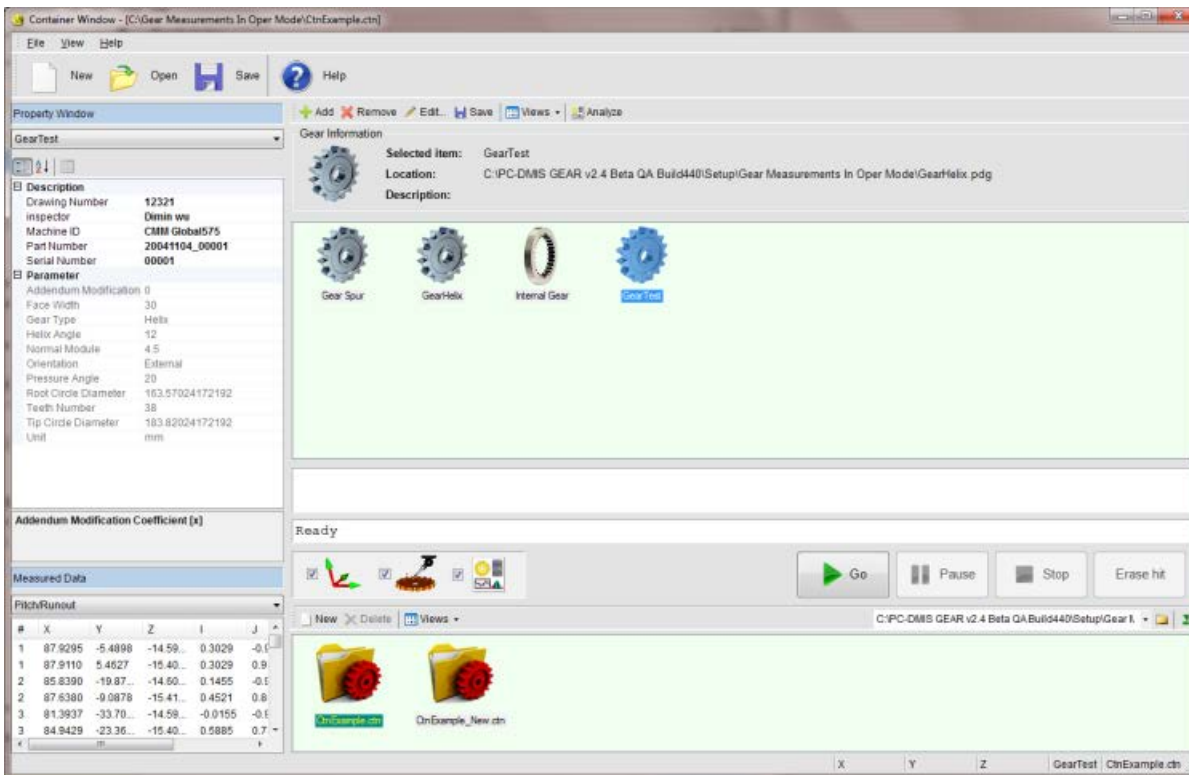
Operator Mode screen

PC-DMIS GEAR - Operator Mode

Now Gear has two different modes – **Programmer Mode** and **Operator Mode**:

Operator Mode is designed to make GEAR easier to use. In Operator Mode you can create a shortcut icon in the Measurement/Evaluate Panel. Once this is done, the operator can:

- Double-click the shortcut icon to start a measurement sequence.
- Auto-evaluate the data once the gear is finished being measured and generate a report.

Note: Before using Operator Mode, a gear file should already be created by the programmer in Programmer Mode with all parameters correctly set.

Properties Window – The Property Window is located in the upper-left of the Operator Mode screen. When the operator double-clicks a Gear icon in the Measure/Evaluate Panel, basic parameters of the selected gear are displayed in the Property Window. Property fields in the Property Window that are not grayed out can be changed, such as the **Drawing Number**, **inspector** and **Machine ID** fields as shown in the above image.

Note: Most of the parameters are read-only and cannot be changed by the operator. However, some settings for the report header can be edited, for example, Drawing Number, Inspector Name, Part Number etc.

Measured Data – The Measured Data area is located in the lower-left of the Operator Mode screen and contains all measured data. The user can select to view the measured data of **Pitch/Runout**, **Profile** or **Helix/Lead**.

Measure/Evaluate Panel – The Measure/Evaluate Panel is located in the upper-right of the Operator Mode screen. The user can add a new gear icon, remove an existing icon or edit the parameters of an existing gear icon. The data will be save in a container file with a .ctn extension. A container file is a Gear data file used to store and organize different gear configuration files. The user can create as many container files as needed and within each container file there may be many gear measurement configuration files available. When double-clicking a container file icon, the measurement configuration files will be displayed as gear icons in the Measure/Evaluate Panel location.

The following buttons are available to the user and are located along the top of the Measure/Evaluate Panel:

- **Add** - Adds a new gear configuration file to the selected container file.

- **Remove** - Removes the selected gear configuration file from the selected container file.

- **Edit** - Edit basic information related to the selected gear measurement configuration file.

- **Save** - Save any changes made to the selected gear measurement configuration file.

- **Views** - View the gear measurement configuration files as Large Icons, Small Icons, List view, Detail view or Tile view.

- **Analyze** - Displays an Analysis Report of the current Gear data. The report window provide a number of tools to view and print out.

Double-clicking a gear icon will display a control bar just below the Measure/Evaluate Panel as shown below.
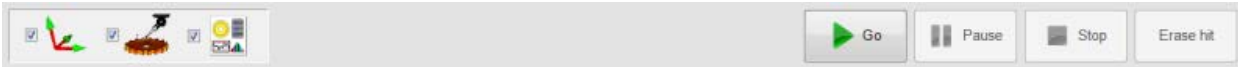
Select any of the operation checkboxes on the left and then click on the **Go** button on the right to perform the selected operation(s). The actions that can be performed are (from left to right) **Align Gear** (see Create an Alignment), **Measure Gear** (see Measure a Gear) and **Analyze Gear** (see Analyze a Gear). The operator can click on the **Pause or Stop** buttons during an operation to perform the indicated action or click on the **Erase hit** button to delete the results of the last measurement.

Container Panel – The container panel is located in the lower-right of the Operator Mode screen. The user can specify a folder on a hard drive where container files can be loaded from and stored to. Each time Gear starts up, it will search this folder to load the container files and display them in this area for the user to access. When the user double-clicks a container icon it will display its contents in this area. Click on the green down arrow located in the upper-right corner of this section to hide the Container Panel.

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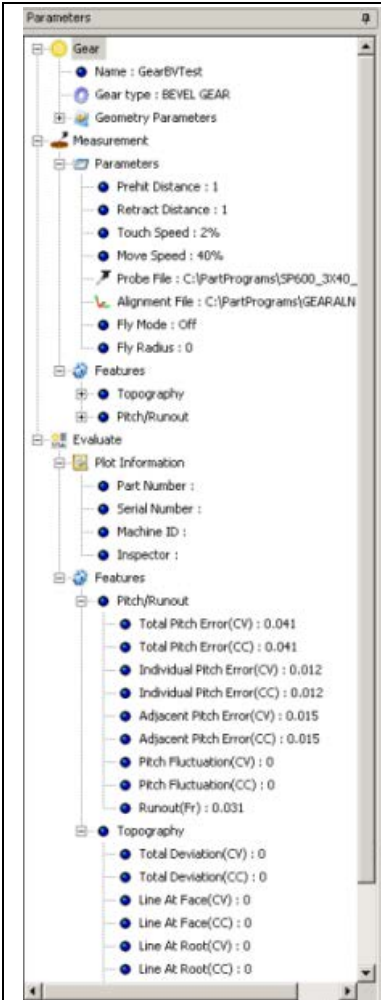
The **Parameters Tree Window** is a read-only window used to display the detailed information of selected parameters. This window is only for reference; you cannot modify it. It provides information for three core areas: "Gear", "Measurement", and "Evaluate".

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

 If the window is collapsed against the left side of the screen, hover your mouse over the **Parameters** button to expand the window momentarily. To have it stay open but still remain on top of the application, click on the **Parameters** button.
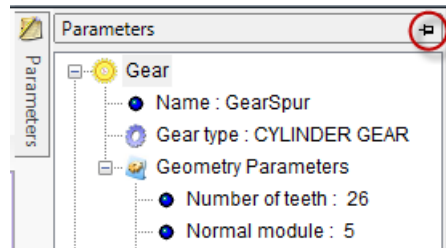
 Click the thumbtack icon to anchor the **Parameters** window to the left side of the screen so it stays open but doesn't float on top of whatever is displaying in the main area.

If the window is already anchored to the left side of the screen, clicking the thumbtack icon will collapse the window to the left side of the screen, placing it in the floating, but attached state.

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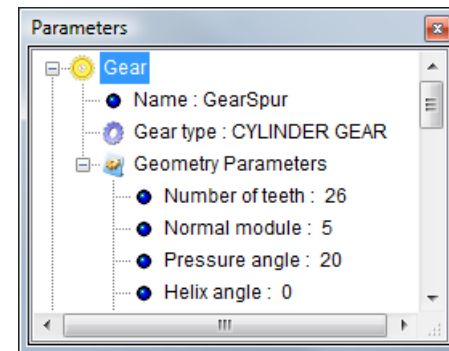
Click the **X** in the corner to close this window.

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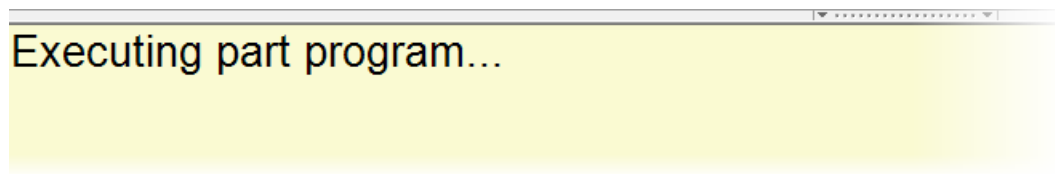
The Status Window dynamically describes the process messages or gives prompts during your measurement. You can collapse and expand this window by clicking the **up** or **down** buttons in the middle of the top border of this window.

To show or hide the status window select **View | Status Window**.

Status Bar
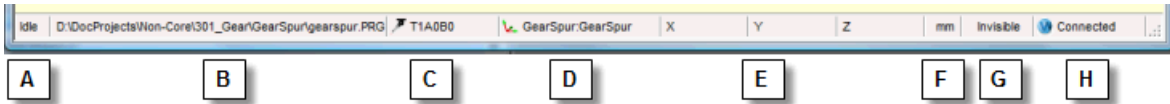
The **Status Bar** does the following:

A. Provides status information

B. Displays the current part program

C. Displays the current probe file

D. Displays the name of the current alignment.

E. Displays the XYZ coordinates of your probe. You can also view XYZ coordinate data within the **Execute** dialog box by clicking the **Display XYZ** button.

F. Displays the units of the current part program (mm or inch).

G. Displays the visibility status of PC-DMIS. You can control the visibility of PC-DMIS by clicking the **Invisible** or **Visible** text in the status bar.

H. Displays connection information to PC-DMIS. It displays "Connected" when PC-DMIS runs in the background. It displays "Disconnected" when PC-DMIS is not running or if PC-DMIS is already running before you launch PC-DMIS Gear.

Parameters for Cylinder Gears (Spur or Helical)

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

- Defining a Cylinder Gear

- Aligning a Cylinder Gear for a CMM

- Aligning a Cylinder Gear for a Vision Machine

- Editing Measurement Parameters for Cylinder Gears

- Analyzing a Cylinder Gear

Defining a Cylinder Gear

The **Gear Definition** dialog box provides relevant measurement parameters for cylinder 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.

Once you have created or opened a cylinder 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 cylinder 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.
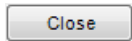
This button will close the **Gear Definition** dialog box without saving changes.

These buttons will let you preform other operations once your gear has been defined:

When working with cylinder 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 cylinder gears

Gear Parameters Area

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

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

Normal pressure angle: Please consult the appropriate gear standard for the definition of this parameter.

Face width [b]: This box specifies the width along the face of the gear tooth. It is always a positive number. See A in the diagram below.
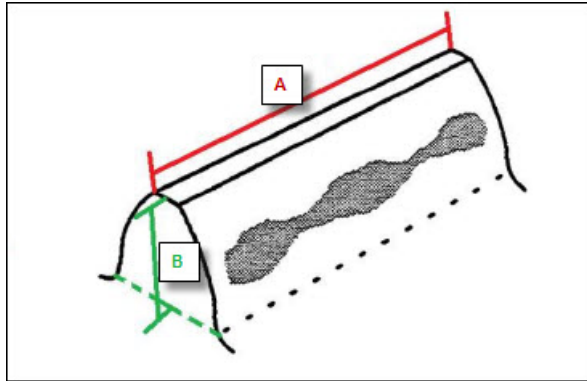
A - Face Width
B - Tooth Height

Addendum modification coefficient [x]: Please consult the appropriate gear standard for the definition of this parameter.

Gear Area

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 Area

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

Flank Direction Area

The options in this area define the flank direction of the gear:

Straight: Select this if it is a spur gear.

Left: Select this if it is a left-handed helical gear.

Right: Select this if it is a right-handed helical gear.

Helix Angle Area

This area contains options that define the angle of the **helix** of the gear.

Complete Gear Area

Select whether or not the gear is a complete gear. Choosing **Yes**, means the gear is a complete gear all the way around. Choosing **No** means the gear is an incomplete (or segmented) gear. For segmented gears, the **Incomplete gear definition** area becomes available for selection.

Incomplete gear definition Area

This area is available for selection if you have an incomplete (or segmented gear). Using the box, you can type values to define the ranges of tooth segments available for this type of gear. Alternately, you can use the **...** button to define the segmented gear using the resulting **Edit** dialog box. To delete an existing segment list, highlight the data that needs to be removed and press **Delete**.

Quality Standard and Grade Area

The options in this area define the standard used to create the gear and the standard against which you will measure the gear. The standard number is shown after gear standard type, for example, AGMA 2000-a88. Choose from the **AGMA**, **DIN**, **ISO** or **JIS** gear standard and specify the **Grade** for the selected standard.

> **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 incomplete gear shown below would be defined as having 36 teeth rather than the 18 teeth (six teeth in three actual segments) that actually exist.

Example of a Segmented Gear

For example, to define the above segmented gear, after first defining 36 teeth, you would add six segments of six teeth each for a complete gear. You would then select and clear the missing segments and end with three segments of 18 teeth with values something like this:
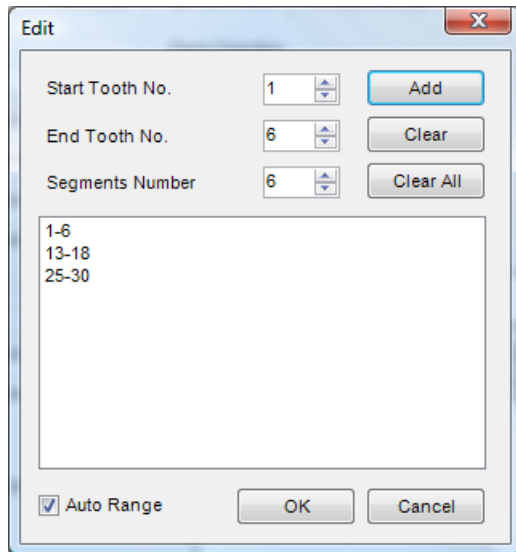
The Edit (segment) dialog box shows a range of three segments of six teeth each, making a total of 18 teeth. Notice that the teeth segments ranging from 7-12, 19-24, and 31-36 were cleared from the list to reflect the three incomplete or missing segments

When you click **OK**, the teeth segments appear in the **Tooth** box.
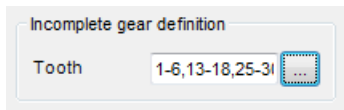
There are two ways to generate the segment list:

- **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 cylinder gears

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.

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 (%): 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 Cumulative k teeth Pitch Error (*Fpk*): This provides the allowable cumulative pitch deviation (the arc distance) from one tooth to the number K tooth. Please see the appropriate gear standard for a complete definition of this value.

Tolerance for Individual Pitch Error (*fpt*): 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 for 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 for 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.

 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.

Evaluate Dimension over balls: This check box determines whether or not dimensions are evaluated over imaginary measuring balls (or pins). For an external gear, the dimension over balls is the largest external dimension over the imaginary measuring balls. For an internal gear, it is the smallest internal dimension between the imaginary measuring balls of diameter and in contact with flanks in two spaces at the maximum possible separation from each other on the gear. The centers of the imaginary measuring balls must be located in the same transverse section of the gear.

Note: A gear with an even number of teeth, would use two balls (or pins), whereas a gear with an odd number of teeth would use three.

Example of two measuring pins on both external and internal gears with an even number of teeth
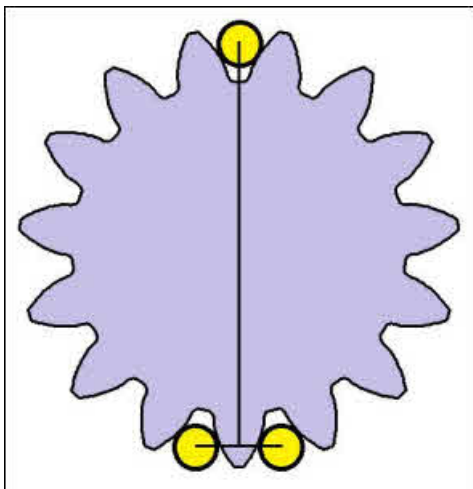
Example of three measuring balls (or pins) on an external gear with an odd number of teeth

45

Dimension over balls

Ball size: This is the size of the ball over which the minimum dimension over balls (Min) and maximum dimension over balls (Max) 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.

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

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

Evaluate Tooth thickness/space width: This check box determines whether or not PC-DMIS Gear evaluates the tooth's thickness and the width of the space between teeth.

Tooth thickness/space width

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.

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.

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.

Evaluate Span over teeth: This determines whether or not PC-DMIS Gear evaluates Span measurements over multiple teeth. From the AGMA standard, a span measurement measures the distance across multiple teeth along a line tangent to the base cylinder used to determine tooth thickness. See the gear standard for additional information.

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.

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.

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.

Report Setting Area

Draw Grid Line: This check box determines whether or not grid lines are displayed in the report. Grid lines act as a ruler of sorts, indicating in the report how large the deviation is.

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 cylinder gears

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.

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

Edit tooth list 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.

Profile on left or right flank: This list lets you specify the flank to measure. Available options are: Left, Right, and Both.

- For an external gear imagine you are standing on the center of the gear and looking forward at the gear's tooth. The left flank is on the left side of the tooth and the right flank is on the right side of the tooth.
- For an internal gear, imagine you are standing in the center of the hole and are looking at a space between two teeth. The left flank is on the left side of that space and the right flank is on the right side.

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. (*fHα*): 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. (*Fα*): 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. (*ffα*): 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 (*Vφ*): 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.

[Calculate Tol.] 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.

Report Setting

Draw K-Chart: This check box determines whether or not the Tolerance K-Chart appears in the report. For a definition of the K-Chart, consult the gear standard.

Draw Grid Line: This check box determines whether or not grid lines are displayed in the report. Grid lines act as a ruler of sorts, indicating in the report how large the deviation is.

Define K-Chart: This button lets you define the parameters of the K-Chart for profile and helix/lead. See the "Define K-Chart" topic.

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 cylinder gears

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.

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 list 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.

Helices on left or right flank: This list lets you specify the flank to measure. Available options are: **Left**, **Right**, and **Both**.

- For an external gear imagine you are standing on the center of the gear and looking forward at the gear's tooth. The left flank is on the left side of the tooth and the right flank is on the right side of the tooth.
- For an internal gear, imagine you are standing in the center of the hole and are looking at a space between two teeth. The left flank is on the left side of that space and the right flank is on the right side.

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. (*fHβ*): 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. (*Fβ*): 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. (*ffβ*): 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 (Vψ): 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.

[Calculate Tol.] 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.

Report Setting

Draw K-Chart: This check box determines whether or not the Tolerance K-Chart appears in the report. For a definition of the K-Chart, consult the gear standard.

Draw Grid Line: This check box determines whether or not grid lines are displayed in the report. Grid lines act as a ruler of sorts, indicating in the report how large the deviation is.

Define K-Chart: This button lets you define the parameters of the K-Chart for profile and helix/lead. See the "Define K-Chart" topic.

Tip/Root Circle 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 Circle tab for cylinder 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:

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 Circle** tab. *Tip/Root* measurement is optional.

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 list 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.

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.
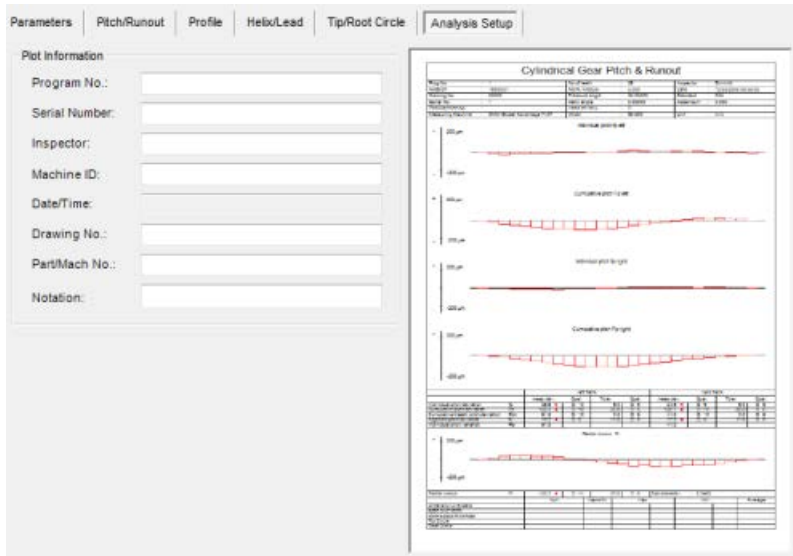
Gear Definition dialog box – Analysis Setup tab for cylinder gears

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

Define K-Chart for Profile or Helix/Lead
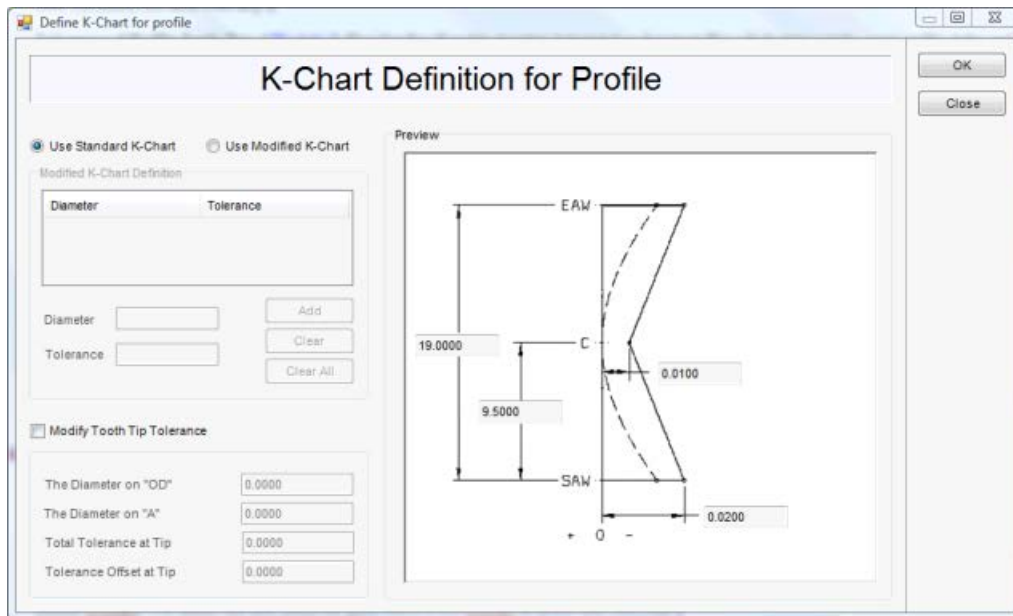
Define K-Chart dialog box

This dialog box appears when you click the **Define K-Chart** button from the **Profile** or **Helix/Lead** tabs. You can use this dialog box to define the type of K-Chart (standard or modified) and to modify tooth tip tolerance values.

If you use a modified K-Chart the **Modified K-Chart Definition** area becomes enabled so you can add in your own diameters and tolerance values. The **Preview** area also changes to include additional display fields. Any customized diameters or tolerances appear in the **Preview** area.

For a definition of the K-Chart and more complete information, consult the gear standard.

Dialog Box Items

Use Standard K-Chart: This uses a standard K-Chart. See the gear standard for more information.

Use Modified K-Chart: Sometimes you have some specific requirements for the K-Chart and you need to change from the standard K-Chart. In this case, this check box makes custom modification of the K-Chat available. See the gear standard for more information.

Modified K-Chart Definition Area: This area contains items to help you work with a modified K-Chart. It allows you to define a corner point in your K-Chart by specifying a diameter and tolerance pair. In the K-Chart diagram in this dialog box, the tolerance is in the X axis and the diamter is in the Y axis. You need to add in many tolerance and diameter pairs (corner points) into the K-Chart.

  Diameter: This is the radial position to define the tolerance.

  Tolerance: This is the tolerance value in the position of some "Diameter".

  Add: This adds a diameter and tolerance pair (a corner point) in the modified K-Chart. Values should be within the **Start of Evaluation** Range (near root) and the **End of Evaluation Range (near tip)** values of located in the

Evaluation area of the **Profile** or **Helix/Lead** tab. If you enter values that are out of range, a message box will let you know.

Clear: This clears the selected diameter and tolerance pair.

Clear All: This clears all the diameter and tolerance pairs defined in the list box.

Modify Tooth Tip Tolerance: Sometimes you need to measure a tip-relief gear. Marking this check box lets you redefine the shape in the tip area of the tooth. You must select **the Use Standard K-Chart** option button to use this check box.

The Diameter on "OD": This defines the diameter for "OD" shown on the right side of the diagram. This item becomes enabled only if you mark **Modify Tooth Tip Tolerance**.

The Diameter on "A": This defines the diameter for "A" shown on the right side of the diagram. This item becomes enabled only if you mark **Modify Tooth Tip Tolerance**.

Total Tolerance at Tip: This defines the total tolerance at tip areas. This item becomes enabled only if you mark **Modify Tooth Tip Tolerance**.

Tolerance Offsets at Tip: This defines the tolerance offset value at tip areas. This item becomes enabled only if you mark **Modify Tooth Tip Tolerance**.

Preview Area: A diagram of the K-Chart is displayed here and is modified when you change K-Chart parameters. This lets you preview changes made.

Aligning a Cylinder Gear for a CMM

The **Align Gear** dialog box allows you to edit relevant alignment parameters for cylinder gears on a CMM 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

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.
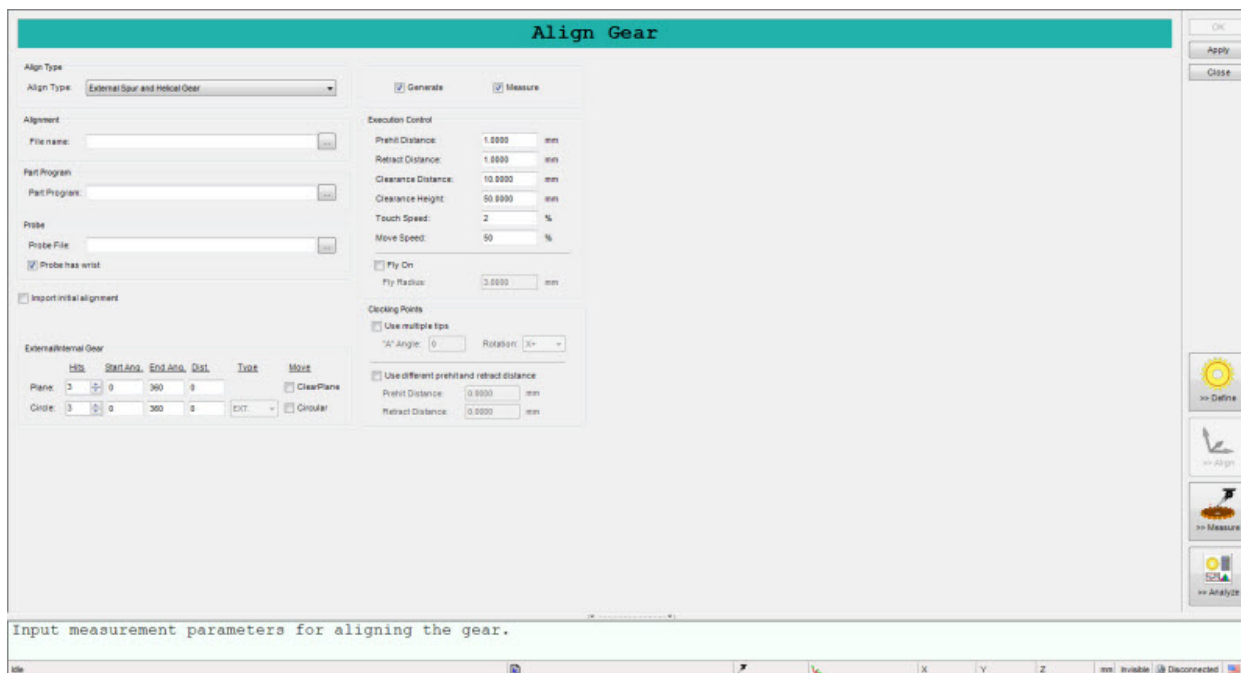
Align Gear dialog box for a CMM

Align Type Area

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.

Alignment Area

File name: 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 [...] to select the Align file to use for the alignment. The pathway to this alignment file will appear in the **Align File** box.

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 [...] to select the **Part Program** file. The path to this probe file will appear in the **Part Program** 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 [...] to select the probe file to use for the alignment. The pathway to this probe file will appear in the **Probe File** box.

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.

Import Initial Alignment: This check box shows or hides the **Initial Alignment** area. If enabled, **the External/Internal Gear** area (or **External Gear with Shaft** area) is hidden and the **Initial Alignment** area appears in its place. You can then import an initial alignment file that was previously created manually inside of PC-DMIS. This provides you with additional freedom to do custom gear alignments.

When creating this initial alignment inside of PC-DMIS, you only need to define the primary axis of the gear and the origin of the coordinate system. You can leave the rotation of X and Y axes free. Save the alignment as a an alignment file(*.aln) and then load this alignment into the **Initial Alignment** area discussed below. If **Import Initial Alignment** check box remains marked during measurement, PC-DMIS Gear will import this alignment and recall it at the beginning of the part program. PC-DMIS Gear will then write commands to measure the two clocking points only.

Initial Alignment Area

This area provides you with a **File name** box and a browse button [...] to specify a predefined initial alignment (.aln) file.

External/Internal Gear Area

This area appears if the **Align Type** is either **External Spur** or **Internal Spur Gear**. In addition, to view this area, the **Import Initial Alignment** check box should be cleared.

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 predefined "External Spur and Helical" and "Internal Spur" 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.

ClearPlane: Located under the Move heading, this check box determines whether or not the software moves the probe up to the clearance plane between each hit on the plane. The clearance plane height is defined by the **Clearance Height** box in the **Execution Control** area.

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. This only becomes available **for Internal Spur Gear** alignment types.

Circular: Located under the Move heading, this check box determines whether or not the software moves the probe along a circular path between each hit of the circle.

Shaft Gear Area

This area appears if **Align Type** is set to **External Gear with Shaft**. In addition, to view this area, the **Import Initial Alignment** check box should be cleared.

Cylinder: If you choose to execute a DCC alignment and are using the **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.

Use multiple tips to measure outer cylinder: This check box determines whether or PC-DMIS Gear will use multiple tips when measuring outer cylinder in DCC. If marked, the software will find the best tip in the current probe to measure the cylinder by matching the given A angle.

Use multiple tips to measure Z Point: This check box determines whether or not PC-DMS Gear will use multiple tips to measure the Z-Point. During execution, the software will find and rotate to the best tip to measure the Z point. If cleared, it will always use the tip with the shank IJK vector of 0,0,1.

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 .

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.

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.

Clocking Points Area

Use multiple tips: Use this check box 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: This check box is only available if you first select **External Gear with Shaft** as the **Align Type**. Use this check box 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: This check box is only available if you first select **External Gear with Shaft** as the **Align Type**. Use this check box 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.

Rotation: This drop-down list specifies where to take the clocking point: X+, X-, Y+ or Y- (or in other words at the three o'clock, nine o'clock, twelve o'clock clock and six o'clock positions). According to the selected rotation, the probe will be changed to fit for the position if you selected the **Use multiple tips** check box.

Use different prehit and retract distance: If you mark this check box, the **Prehit** and **Retract Distance** boxes are enabled so you can type in different distance values for PC-DMIS to use before taking a hit (prehit) and after a hit has been taken (retract). If the check box is not selected, PC-DMIS Gear will use the value of prehit and retract defined in the **Execution Controls** area of this dialog box.

Prehit Distance: This box defines the overridden prehit distance for clocking points.

Retract Distance: This box defines the overridden retract distance for clocking points.

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

Generate: This determines whether or not a part program is generated as part of the alignment process. If this is selected PC-DMIS Gear will create a new part program, otherwise it will open the part program defined in the **Part Program** area.

Create Launches PC-DMIS and begins the alignment process. If **Generate** is marked PC-DMIS will generate 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.

Aligning a Cylinder Gear for a Vision Machine

The **Align Gear** dialog box allows you to edit relevant alignment parameters for cylinder gears on a Vision Machine system.

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.
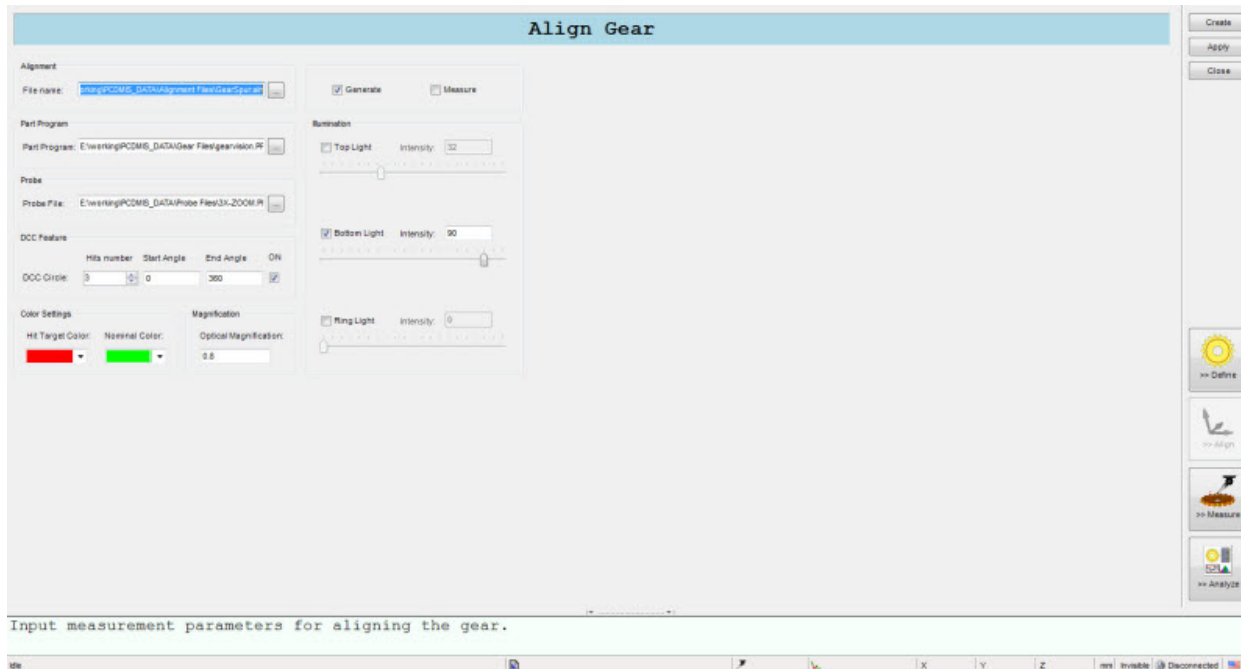
Align Gear dialog box for a Vision Machine

Alignment Area

> **File name:** 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 ⬚ to select the Align file to use for the alignment. The pathway to this alignment file will appear in the **Align File** box.

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 ⬚ to select the **Part Program** file. The path to this probe file will appear in the **Part Program** 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 ⬚ to select the probe file to use for the alignment. The pathway to this probe file will appear in the **Probe File** box.

DCC Feature Area

This area provides you with controls and input fields to set the **DCC Feature** parameters.

DCC Circle

- **Hits number:** Use the **UP** and **DOWN** arrows to set the **Hits number** which determines the number of read points the Vision System's camera will perform on the part.

- **Start Angle:** This determines the polar coordinate 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.

- **ON:** Turns the **DCC Circle** alignment parameters on if this check box is checked.

Color Area

- **Hit Target Color:** Defines the color each hit point that is read will be displayed in. Use the drop-down list to select the desired color for the Hit Target Color.

- **Nominal Color:** Defines the color of the Nominal value for each inspection point will be displayed in. Use the drop-down list to select the desired color for the Nominal Color.

Magnification Area

Optical Magnification: Defines the Optical Magnification of the vision system being used.

Illumination Area
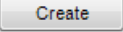
Use this area to select the appropriate lighting being used for part feature illumination during inspections.

- **Top Light:** Click on the Top Light check box if the part feature illumination is being done from the top.

- **Bottom Light:** Click on the Bottom Light check box if the part feature illumination is being done from the bottom.

- **Ring Light:** Click on the Ring Light check box if the part feature illumination is being done using a ring light.

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

Generate: This determines whether or not a part program is generated as part of the alignment process. If this is selected PC-DMIS Gear will create a new part program, otherwise it will open the part program defined in the **Part Program** area.

Create Launches PC-DMIS and begins the alignment process. If **Generate** is marked PC-DMIS will generate 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 Cylinder 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.

Before measuring, ensure that you have first:

- [Defined your probe](#)
- [Calibrated your probe](#)
- [Defined gear parameters](#)
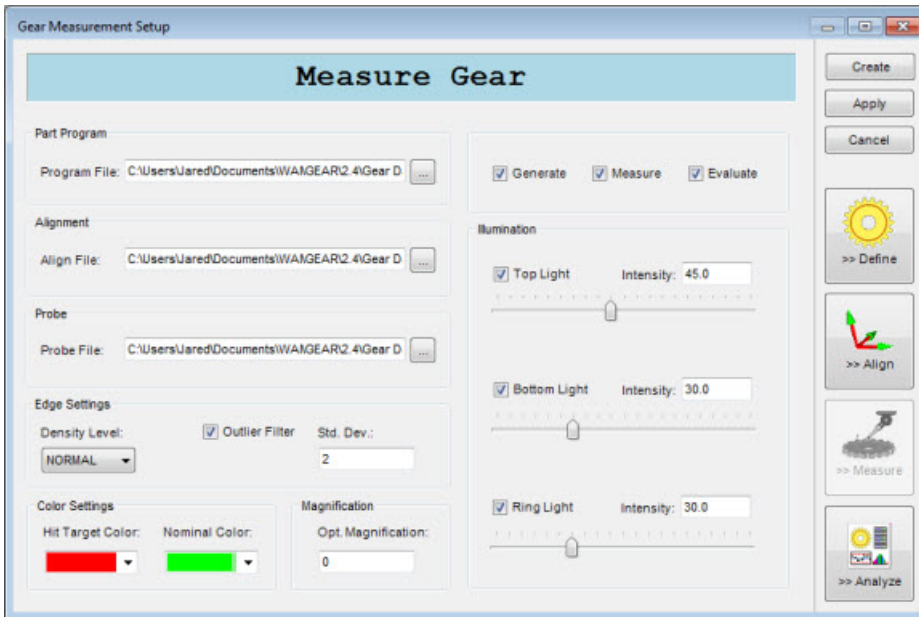- [Created an alignment](#)

See either ["CMM: Gear Measurement Setup"](#) or ["Vision: Gear Measurement Setup"](#) depending on your selected machine type.

Vision: Gear Measurement Setup

Gear Measurement Setup dialog box

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

[...] to select the part program file. The path to this probe file will appear in the **Part program name** box.

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 .

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.

Edge Settings Area

Density Level: This list lets you define the density type when detecting the edge of a feature. It has three options:

- **Low -** Returns a minimal number of points (one point for every 10 pixels). Use this density type if your feature form doesn't change much in this area, or isn't a critical area of your part.

- **Normal -** Returns the default number of points (one point for every 4 pixels) for that feature type.

- **High -** Returns the maximum number of points (one point per pixel). Use this density type if your feature form changes drastically in this area or is considered a critical area of your part.

Outlier Filter: This check box determines whether or not outlier filtering is required for this target.

Std. Dev.: This box defines the standard deviation of a point. This is the distance a point needs to be away from the other points to make it considered to be an outlier.

Color Settings Area

Hit Target Color: This list allows you to select the color used for most of the overlayed graphics and text on the **Live View** tab. This affects probe hits, targets, gages, as well as textual information for FOV coordinates, magnification, and focus. The default color is red.

Nominal Color: This list allows you to select the color used for the nominal line in the targets on the **Live View** tab.

Magnification Area

Opt. Magnification: This determines the optical magnification percentage to use when measuring.

Generate: PC-DMIS will generate your part program, but will not measure unless the **Measure** check box is marked.

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.

Evaluate: 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.

Illumination Area

This area controls the illumination used for the different styles of lamps. Each lamp has its own check box, slider bar and corresponding **Intensity** box.

The check boxes control whether the respective lamp is switched on or off during a measurement. The slider bar and the corresponding box sets the intensity of that lamp.

The available lamps are:

Top Light - This lamp is an on-axis lamp that is directed through the optical path. It can provide better edge and feature visibility on some parts than other light sources that illuminate from above because the light source isn't as diffused. Since it shines parallel to the optics, it's also easier to see into holes.

Bottom Light - This lamp illuminates from under the stage. It creates a silhouette of the part to be viewed.

Ring Light - This is a multi-bulb lamp that illuminates from above. This lamp is normally composed of an array of LED lights arranged in concentric rings or circles.

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

Information
Are you ready to start measurement?

Click **Yes** to have PC-DMIS run your part program automatically or click **No** to Cancel.

Once the measurement process starts, PC-DMIS Gear will open the **Execute** dialog box. Follow the instructions in the **Execute** dialog box to proceed. See "The Execute Dialog Box" topic.

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

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

CMM: Gear Measurement Setup

Gear Measurement Setup dialog box

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

to select the part program file. The path to this probe file will appear in the **Part program name** box.

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 .

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 area).

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.

Generate: PC-DMIS will generate your part program, but will not measure unless the **Measure** check box is marked.

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.

Evaluate: 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.

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 .

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.

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.

Scan Setting... Click this button to define the scan settings using the **Scan Setting** dialog box. See "Defining Scan Settings".

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

> **Information**
> Are you ready to start
> measurement?

Click **Yes** to have PC-DMIS run your part program automatically or click **No** to Cancel.

Once the measurement process starts, PC-DMIS Gear will open the **Execute** dialog box. Follow the instructions in the **Execute** dialog box to proceed. See "The Execute Dialog Box" topic.

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

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

Defining Scan Settings

Scan Setting dialog box

The **Scan Setting** dialog box appears when you click the **Scan Setting...** button from the **Gear Measurement Setup** dialog box.

Profile Area

Point Density: Determines the amount of allowable hits per mm that will be created during a Profile scan.

Scan Speed: 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.

Helix/Lead Area

Point Density: Determines the amount of allowable hits per mm that will be created during a Helix/Lead scan.

Scan Speed: 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.

Boundary Area

Boundary Type: Boundary types are described in the "Boundary Type area" topic of the Core PC-DMIS help file. 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 help file 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**.

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.

The Execute Dialog Box

This dialog box appears when the gear measurement process interfaces with PC-DMIS and begins measuring the gear.
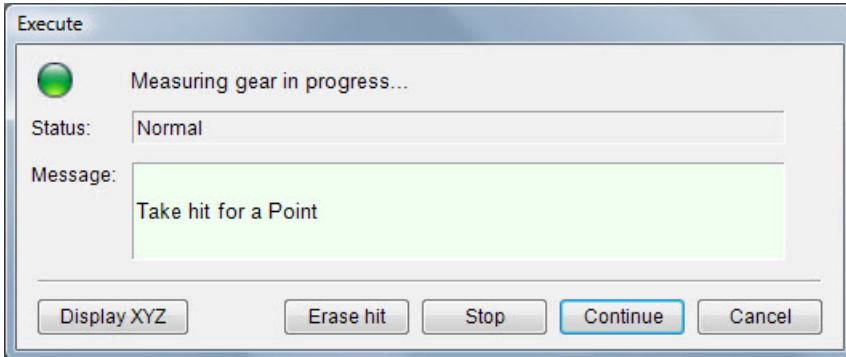
Execute dialog box

It contains the following items:

Status: This area and the colored icon above it indicate the status of the measurement process. A green icon means execution is proceeding normally. A red icon means there's an error or execution has been stopped manually.

Message: This displays instructions and other messages regarding the current measurement process.

Display XYZ: This button displays a digital readout of the XYZ location of the probe during the measurement process:
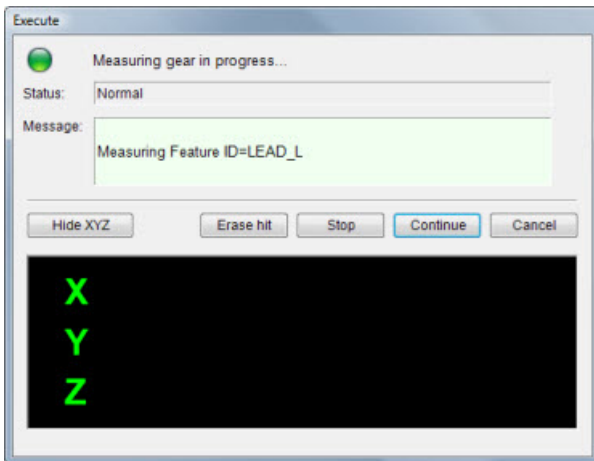
Execute dialog box showing the XYZ information

Hide XYZ: This button hides the digital readout of the probe's XYZ location.

Erase hit: To remove the current hit, simply click the **Erase Hit** button. Most CMM jog boxes have a button assigned to erasing the last hit. Pressing that button on the CMM's jog box while in Execute mode, produces the same result as clicking the **Erase Hit** button on the dialog box.

Stop: This command button halts the probe at its current position and suspends execution of the part program. This option will not stop the part program execution if the current move is a PH9 orientation change. The program will stop after the PH9 has stopped.

Continue: This button allows you to resume execution of a part program halted by a CMM motion error, or the **Stop** button.

Cancel: This cancels the measurement process and closes the **Execute** dialog box.

Analyzing a Cylinder Gear

The **Analyze** 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).
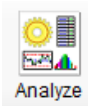
Clicking the **Analyze** button or selecting the **Measure | Analyze** menu option displays the **Analyze** dialog box.

Analyze 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.

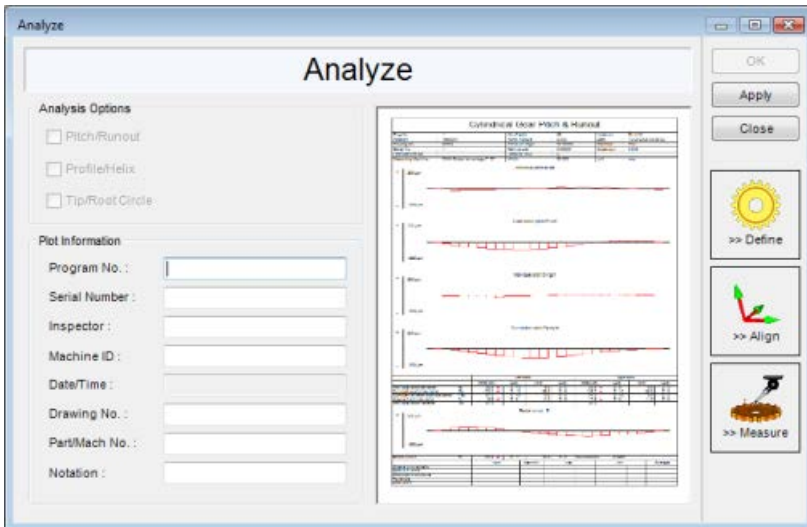**Tip/Root Circle:** This check box determines whether or not PC-DMIS Gear should add the deviation into tip or root circle items on the bottom of the Pitch/Runout report. This option is only available if the user measured the tip and root circles. Click **Parameters** to change the options for the Tip/Root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

OK 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".

Close 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

(A) Deviation values are indicated in microns. (B) Red arrow indicates out of tolerance value. Values which have no value when calculated through the Quality standard and grade in tolerance area are indicated with XX.

Cylindrical Gear Pitch & Runout

Prog.No.	:	20041104_00001	No.of teeth	:	26	Inspector	:	Diminwu
Notation	:	Spiral Bevel Gear Test Result	Normal module	:	5.000	Date	:	
Drawing No.	:		Pressure angle	:	20.00000	Standard	:	DIN
Serial No.	:	00001	Helix angle	:	0.00000			
Part/Machine/No.	:		Hand of Helix	:	S			
Measuring Machine	:	CMM Global 575	Width	:	30.000	Unit	:	mm

		left flank				right flank			
		meas.dev.	Qual.	Toler.	Qual.	meas.dev.	Qual.	Toler.	Qual.
Individual pitch deviation	fp	9.3 ◄	D 7	4.5	D 4	4.0	D 4	4.5	D 4
Cumulative pitch deviation	Fp	15.6	D 4	18.0	D 4	16.2	D 4	18.0	D 4
Adjacent pitch deviation	fu	12.8 ◄	D 7	5.5	D 4	3.3	D 3	5.5	D 4
Individual pitch variation	Rp	12.8				6.5			

Radial runout	Fr	11.9	D 4		12.0	D 4	Ball diameter	8.5817	
		nom	max-min	max			min		Average
dimension overballs		(0.0000,0.0000)	0.0060	163.1898 ◄	(4,4)	163.1838 ◄	(9,9)	163.1866 ◄
tooth/space thickness			0.0132	7.8346	5	7.8214 ◄	16	7.8285
Tip Circle		(141.0100,140.9900)	0.0009	140.9993		140.9984		140.9988
Root Circle		(117.2100,117.1900)	0.0792	117.2946 ◄		117.2154 ◄		117.2528 ◄

Sample Profile & Helix Measurement Analysis

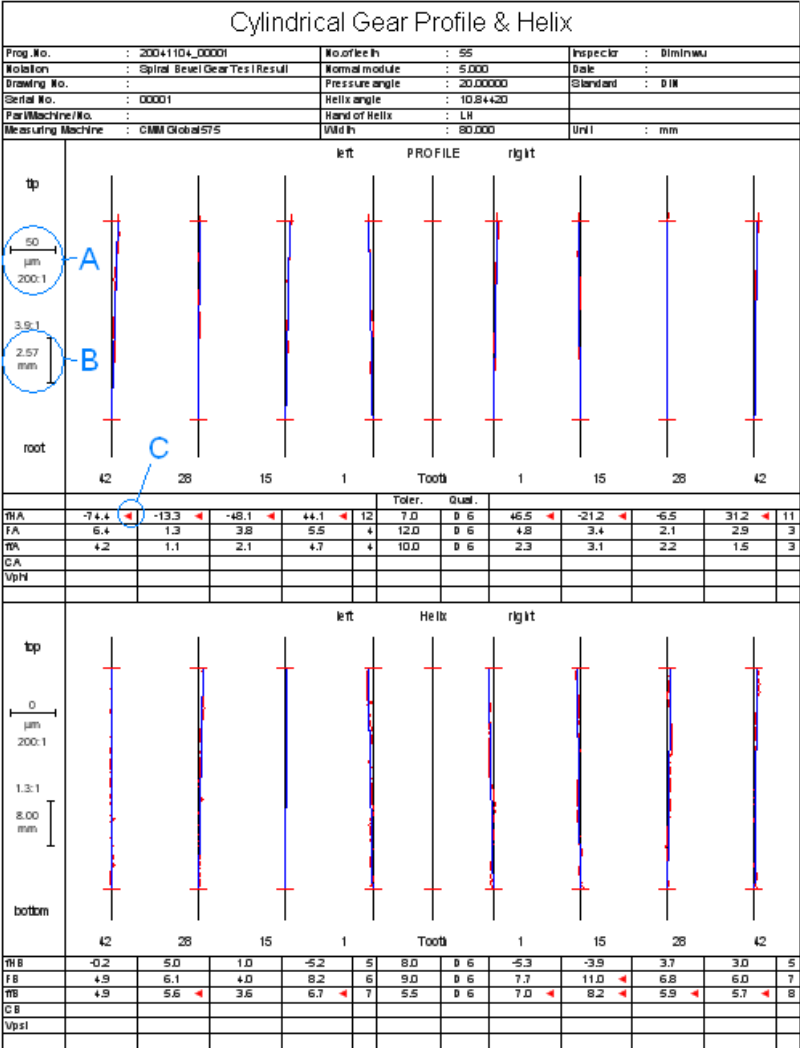(A) Deviation values are indicated in microns. (B) Deviation values are indicated in millimeters. (C) Red arrow indicates out of tolerance value. Values which have no value when calculated through the Quality standard and grade in tolerance area are indicated with XX.

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" 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
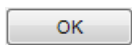
Defining a Bevel Gear

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.

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 Cylinder Gear" when working with cylinder 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.
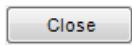
This button will close the **Gear Definition** dialog box without saving changes.

These buttons will let you preform other operations once your gear has been defined:

When working with cylinder 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 or **Diametrical pitch:** Please consult the appropriate gear standard for the definition of this parameter. The heading for this box changes between "Diametrical Pitch" (for Inch) and "Normal Module" (for 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.

Tooth Width: Defines the width of the tooth.

Gear Type: Select either "Gear" or "Pinion" as depicted below.
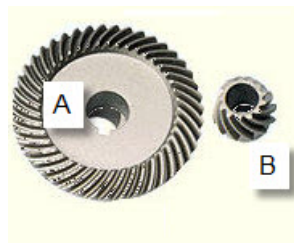
***A** - Gear*
***B** - Pinion*

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.

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.

Master Flank Area

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 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.

Quality Standard and Grade Area

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 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

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.

Pitch Point Definition Area

Pitch Point Definition: Define pitch point's location on each flank using Type A (Master Grid) or Type B (Radius and Z Coordinate). Use Type A to find the specified pitch point from grid points in master flank data by specifying row and column numbers. Use Type B by inputting radius and z coordinate to calculate the pitch point by piercing the circle into the surface defined by master flank data.

Type A: Master Grid 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.

Type B: Radius and Z Coordinate

Radius of Pitch Point: Type the radius of the pitch point. Gear calculates pitch points on each flank by piercing the circle with the master flank surface.

Z Coordinate of Pitch Point: Type the Z coordinate of the pitch point. Gear calculates pitch points on each flank by piercing the circle with the master flank surface.

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) Area

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

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

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

Evaluate Tooth Thickness: When this check box is selected, Gear will evaluate chord tooth thickness and output the result in the report. The tooth thickness is evaluated with actual pitch points.

Chord Tooth Thickness Area

Nominal: Type the nominal value of chord tooth thickness.

Max: Type the maximum value of tooth thickness.

Min: Type the minimum value of tooth thickness.

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.
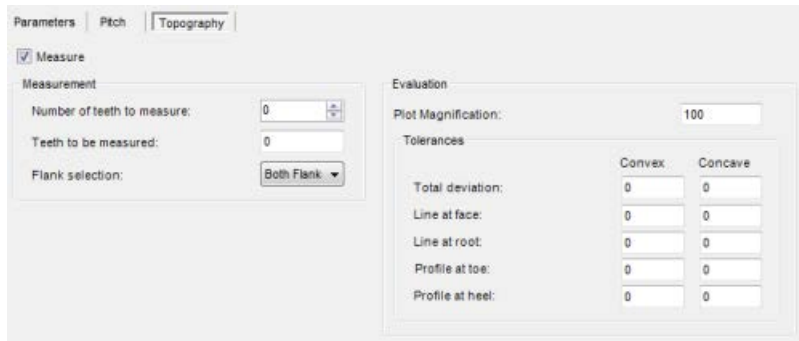
Gear Definition dialog box – Topography tab for bevel gears

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.

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.
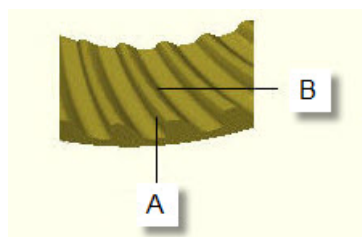
A *- Convex*
B *- Concave*

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 Area

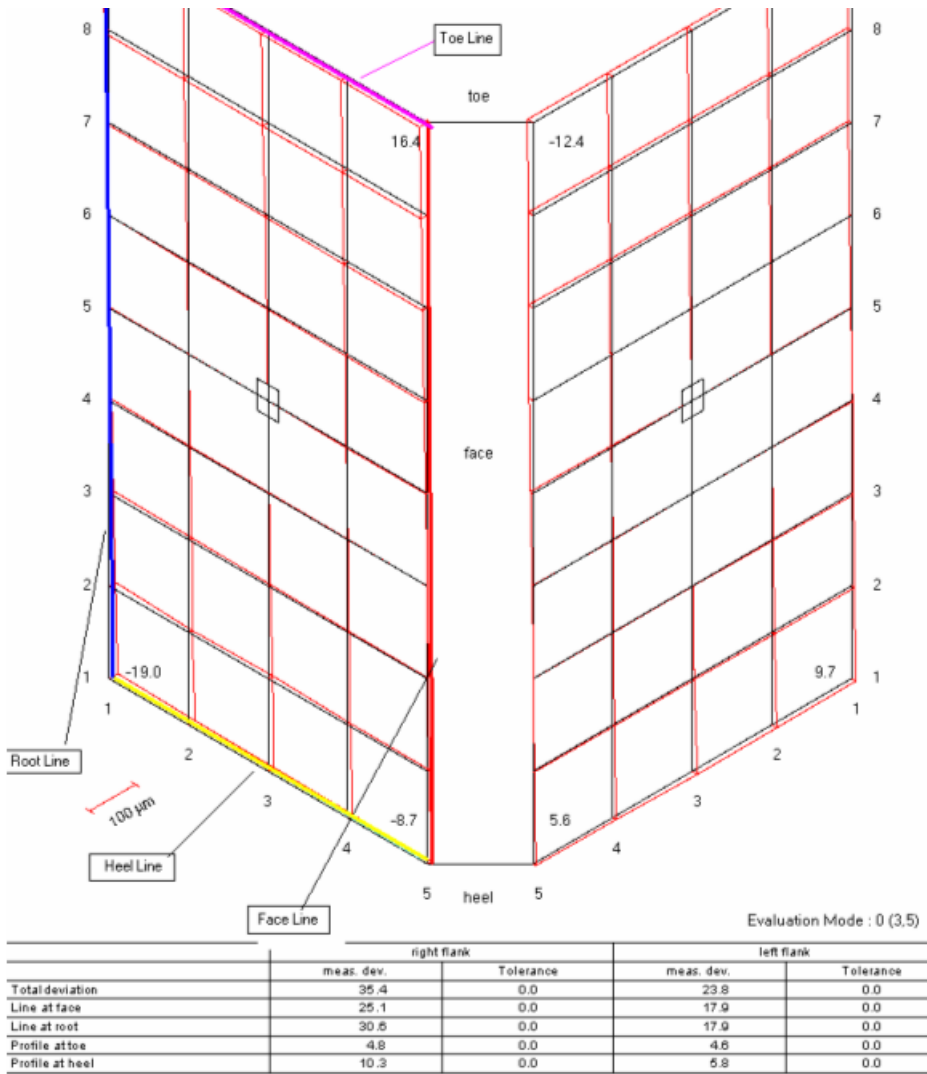**Total deviation:** Defines the total tolerance for all grid points.

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.

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	30.5	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.

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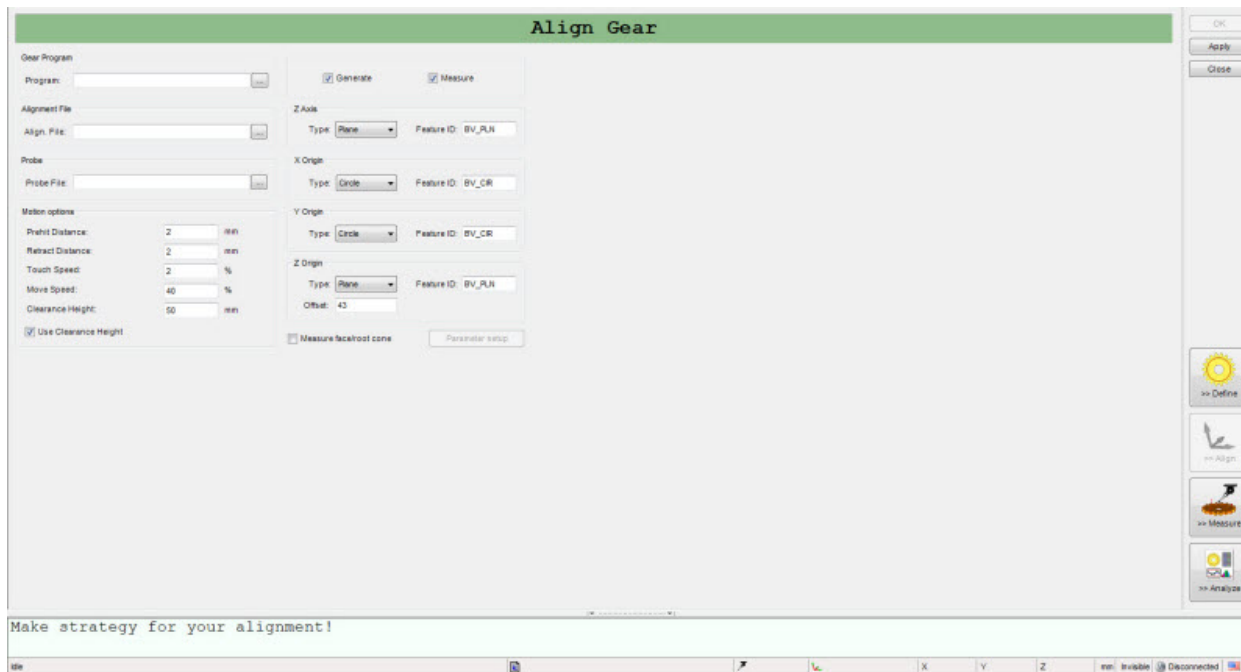
Align gear for Bevel Gear dialog screen

Measure Select this option to measure the alignment in DCC mode when the **Create** button is clicked.

Generate: This determines whether or not a part program is generated as part of the alignment process. If this is selected PC-DMIS Gear will create a new part program, otherwise it will open the part program defined in the **Part Program** area.

Measure face/root cone: Select this option if you want to create the alignment accurately by face/root cone. The **Parameter setup** dialog box becomes available for selection.

Parameter setup: This button displays the **Parameters of the Face/Root Cone measurement** dialog box. See the "Face or Root Cone Measurement Parameters" topic for more information on the **Parameter setup**.

Gear Program Area

Program: This defines the Gear Program to generate (if the **Generate** check box is marked) or open (if the **Generate** check box is cleared).

Alignment File Area

Align. 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 [...] to select the Align file to use for the alignment. The path to this alignment file will appear in the **Align. File** box.

Probe Area

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 [...] 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.
>
>

Motion options 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 .

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.

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.

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

Z Axis Area

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

X Origin Area

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

Y Origin Area

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

Z Origin Area

    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.

    Create 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

Parameters of the Face/Root Cone measurement

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 Cone** 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 **Align gear** dialog box, click **OK**. Click **Cancel** to close without saving changes.

# Editing Measurement Parameters for Bevel 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.

Before measuring, ensure that you have first:

- Defined your probe
- Calibrated your probe
- Defined gear parameters
- Created an alignment
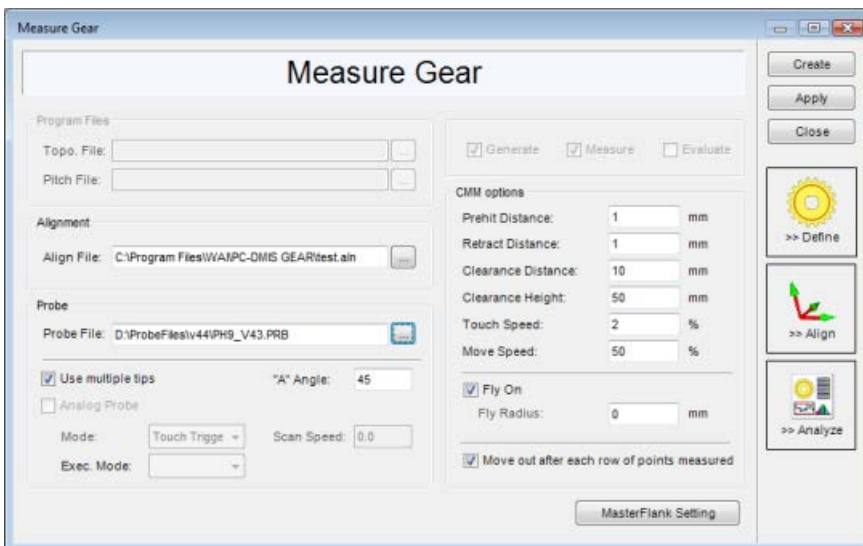
Program Files Area

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.

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 .

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.

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.

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

Exec. Mode: 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.

Evaluate: 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.

Generate: 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.

Measure: 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.

CMM options Area

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.

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.

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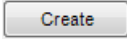
Fly Radius: Determines the radial distance of the arc path along which the probe will travel between move points.

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.
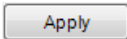

[MasterFlank Setting] ..Click **Master/Flank Setting** to open the **Master Flank Parameters** dialog box to define Master Flank parameters. See "Defining Master Flank Data".

[Create] Click **Create** 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.

> **Information**
> Are you ready to start
> measurement?

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

PC-DMIS Gear will open the **Execute** dialog box. Follow the instructions in the **Execute** dialog box to proceed. See the "The Execute Dialog Box" topic described under "Parameters for Cylinder Gears".

[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.

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 flank (**CC Flank**), the convex flank (**CV Flank**), 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 D in the example below (the dotted green horizontal lines).

Number of columns: Specify the number of lines parallel to the tooth profile. A minimum of 4 is required for this value. See B in the example below (the solid black vertical lines).

Line index of Reference Point: Provides the line at which the reference point is located where it intersects the column index. See C in 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 C the example below.
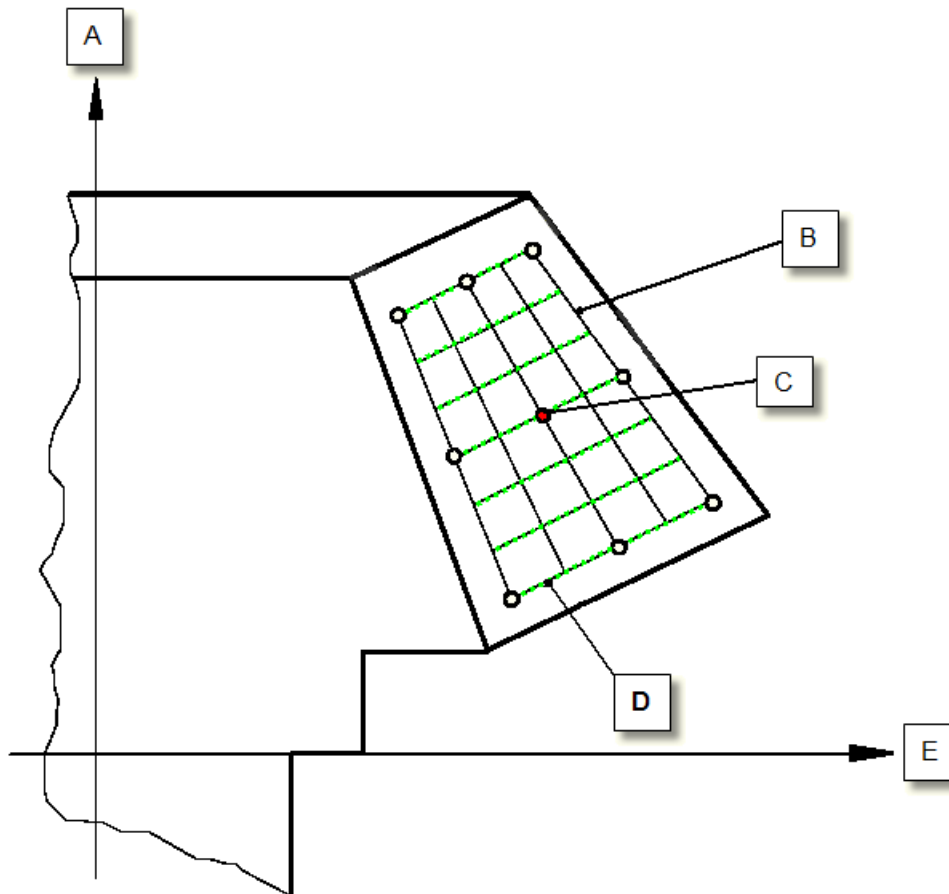
Example showing how points are to be measured on the Master Flank
A - Positive Z axis
B - Columns parallel to the tooth profile
C - Reference point (line index=4, column index=3)
D - Lines parallel to the tip of the tooth
E - XY plane

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.
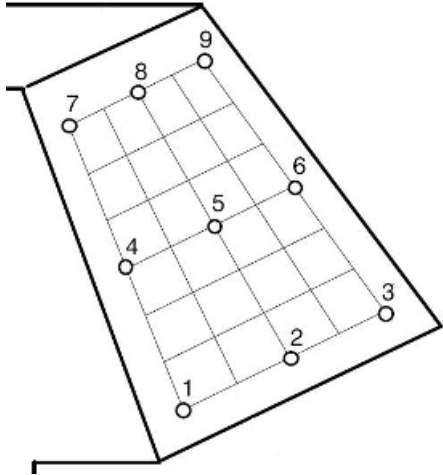

2. Beginning near the root area of the flank, measure a row of three hits from the inside diameter (ID) to the outside diameter (OD) of the flank. Continue by measuring a second row of hits from the ID toward the OD, near the middle of the flank. Finally, measure the last row of hits along the top edge (near the tip/gear face) from the ID toward the OD. This determines the material direction.

3. You must establish a clearance position before measuring the first point and all further measurements can be taken without a clearance position.

4. 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.

5. 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.

6. The measurement of the master flank is then executed in two automatic runs.

7. 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 **Analyze** 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).
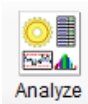
Clicking the **Analyze** button or selecting the **Measure | Analyze** menu option displays the **Analyze** dialog box.
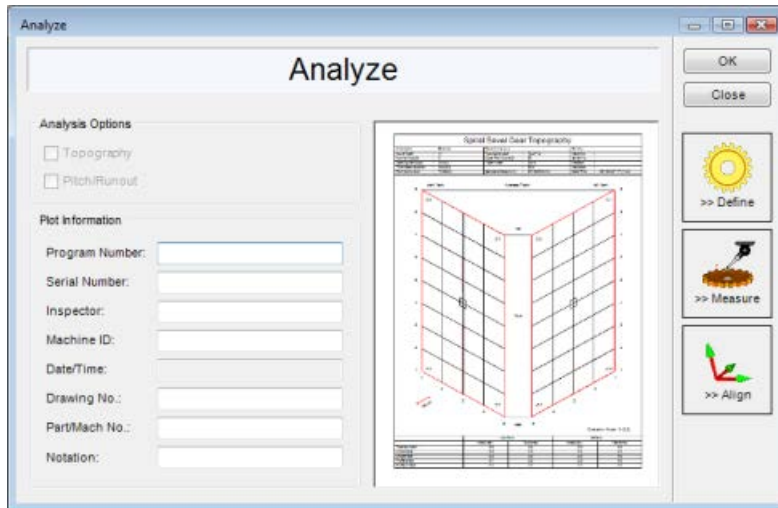
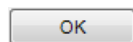*Analyze dialog box*

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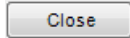
Pitch Runout: Select this option for Pitch/Runout output to be created. Click **Parameters** to make changes to the Pitch/Runout Parameters. See "Defining Pitch/Runout Data".

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.

OK 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".

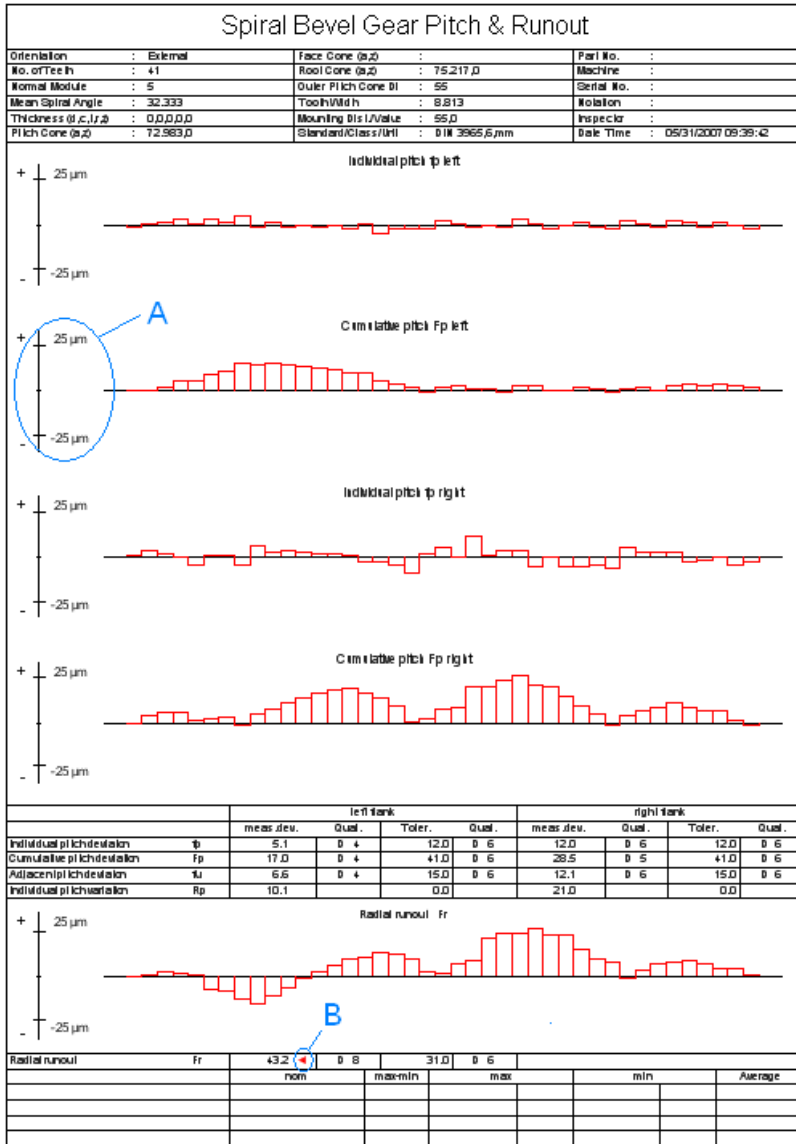**Close** Clicking this button closes the **Analysis Setup** dialog box.

> **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.

(A) Deviation values are indicated in microns. (B) Red arrow indicates out of tolerance value. Values which have no value when calculated through the Quality standard and grade in tolerance area are indicated with XX.

Spiral Bevel Gear Pitch & Runout

Orientation	:	External	Face Cone (a,z)	:		Part No.	:	
No. of Teeth	:	41	Root Cone (a,z)	:	75.217,0	Machine	:	
Normal Module	:	5	Outer Pitch Cone Di	:	55	Serial No.	:	
Mean Spiral Angle	:	32.333	Tooth Width	:	8.813	Notation	:	
Thickness (t,c,l,r,a)	:	0,0,0,0,0	Mounting Dist./Value	:	95,0	Inspector	:	
Pitch Cone (a,z)	:	72.983,0	Standard/Class/Unit	:	DIN 3965,6,mm	Date Time	:	05/31/2007 09:39:42

Individual pitch fp left

Cumulative pitch Fp left

A

Individual pitch fp right

Cumulative pitch Fp right

| | | left flank | | | | right flank | | | |
		meas.dev.	Qual.	Toler.	Qual.	meas.dev.	Qual.	Toler.	Qual.
Individual pitch deviation	fp	5.1	D 4	12.0	D 6	12.0	D 6	12.0	D 6
Cumulative pitch deviation	Fp	17.0	D 4	41.0	D 6	28.5	D 5	41.0	D 6
Adjacent pitch deviation	fu	6.6	D 4	15.0	D 6	12.1	D 6	15.0	D 6
Individual pitch variation	Rp	10.1		0.0		21.0		0.0	

Radial runout Fr

B

Radial runout	Fr	43.2	D 8	31.0	D 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.

(A) Deviation values are indicated in microns. Values which have no value when calculated through the Quality standard and grade in tolerance area are indicated with XX.
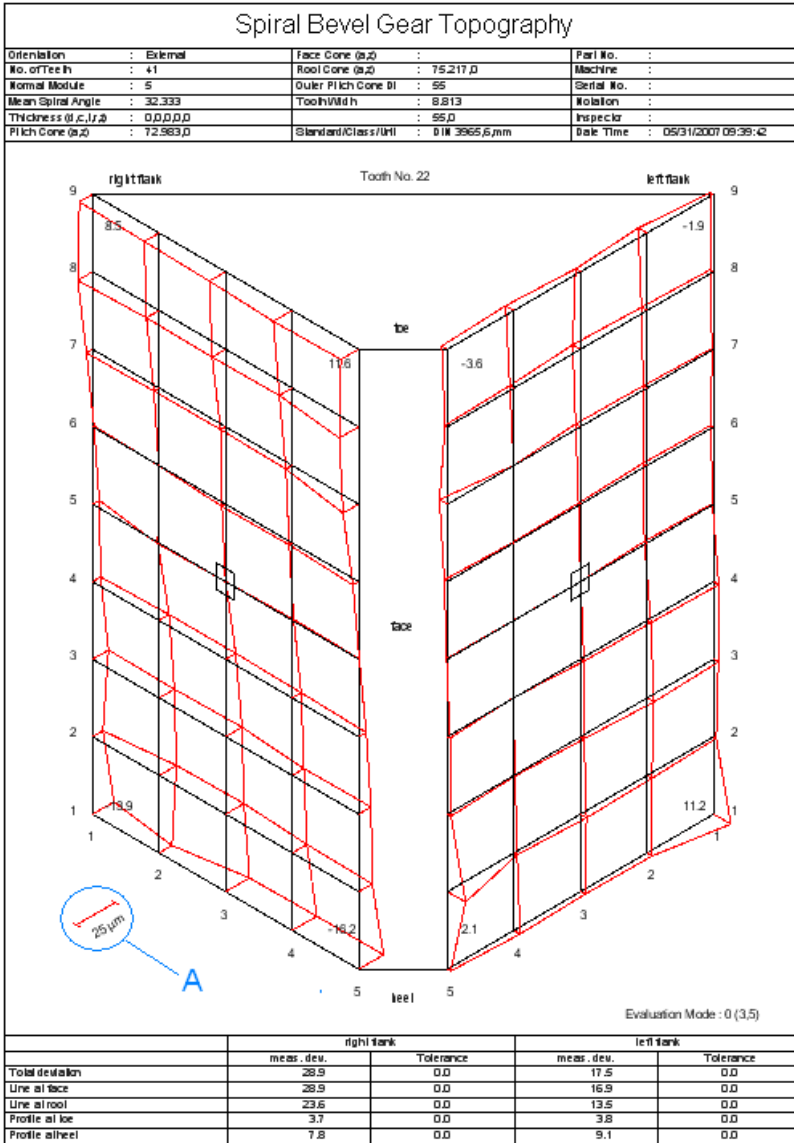
Using the Gear Report Window

About the Gear Report Window

Understanding the User Interface

Using Right-Click Menus

About the Gear Report Window

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

Note: The Gear Report window is based around the Quindos PageViewer application. This means you may find many options or properties that are exposed to view or available for edit in the Gear Report window that don't have anything to do with PC-DMIS Gear. The options related to PC-DMIS Gear are collected in the **Output** tab of the **Settings** dialog box (**Tools | Settings**), and for most uses you should specify desired output options there. The software will then set the appropriate option(s) safely internally in the Gear Report window. For this reason, many Gear Report window options are not covered in this documentation.

To Access the Gear Report Window:

1. Click the **Analyze** button from the toolbar to access the **Analyze** dialog box.
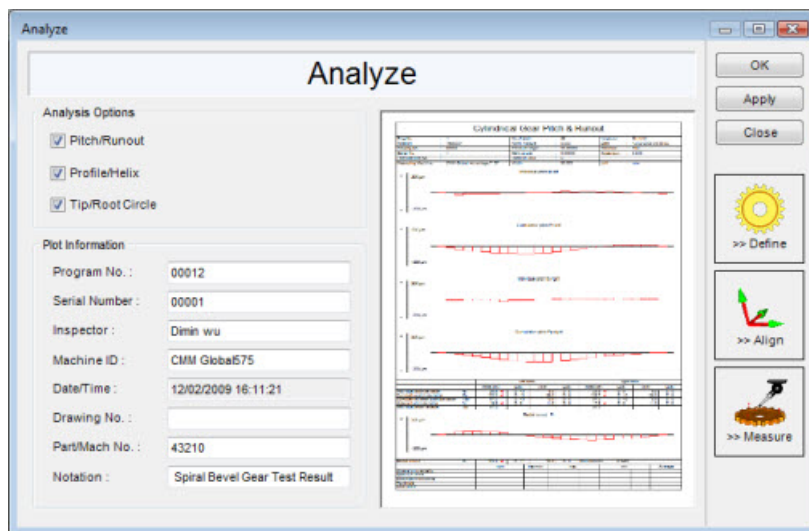
2. Fill out the dialog box as needed, and click **OK**. See "Analyzing a Cylinder Gear" or "Analyzing a Bevel Gear" for information on this dialog box. PC-DMIS Gear displays the Gear Report Window and loads a pre-designed XML file to display information in the display area:
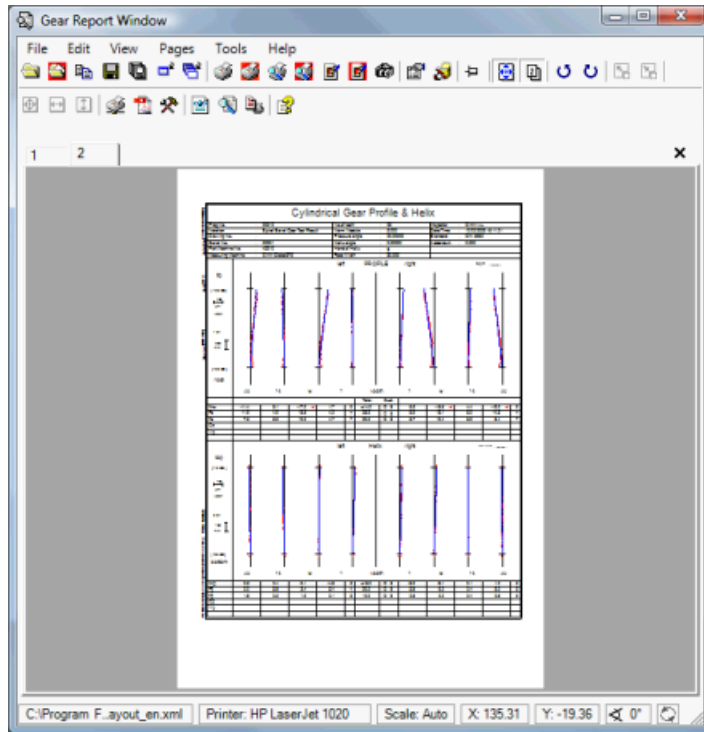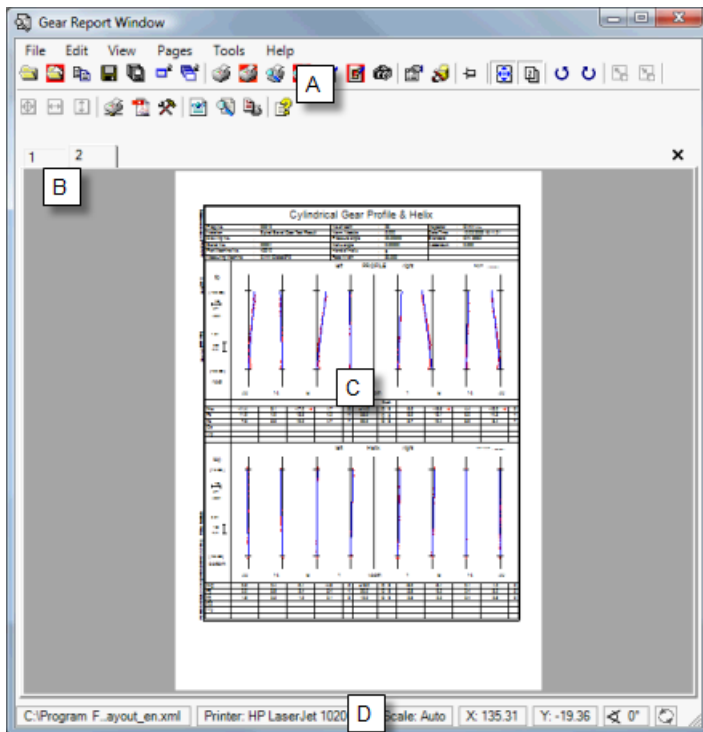
The Gear Report Window Showing a Report

3. For each subsequent time that analysis data is sent from PC-DMIS Gear, new report tabs are added to the Gear Report Window. Current reports from the same gear measurement data are not overwritten.

Understanding the User Interface

A. The Menus and Toolbars

B. The Page Tabs

C. The Display Area

D. The Status Bar

The Menus and Toolbar

The toolbar icons display a quick-access icon for the various menu items. Since the toolbar icons and the menu items perform the same tasks, only the toolbar icons are documented here:

Available Toolbar Icons

1. **Open:** Opens one or more XML reports in a format viewable within the Gear Report window. The target directory can be set using the **Tools | Settings** menu item.

2. **Open in Container:** This displays **a File Open** dialog box letting you choose a file to print. Multiple selections (XML, ZIP, and HPGL) will be opened in a single tab page. The target directory can be set using the **Tools | Settings** menu item.

3. **Copy:** Makes a copy of the current page and adds it as a new tab page.

4. **Save:** Saves the current page. You can save the report as an XML file, or as an archived ZIP file. This displays the **Save Page(s)** dialog box.

5. **Save All:** This acts the same as **Save** above but it saves all the report's pages.

6. **Close:** This closes the current tab page in the report.

7. **Close All:** This closes all the tab pages in the report.

8. **Print:** This prints the current tab page.

9. **Print All:** This prints all the tab pages in the report.

10. **Preview:** This opens up the **Print preview** dialog box for the current tab page.

11. **Preview All:** This opens up the **Print preview** dialog box for the current tab page. You can then preview other pages within the dialog box.

12. **Export as Image:** This exports the current tab page as an image. It opens up the **Export Page(s)** dialog box.

13. **Export All:** This functions the same as the **Export as Image** icon except that it exports all the tabs as images.

14. **Export Snapshot:** This functions nearly identically to **Export as Image** except that it takes a screen capture of the current tab page as an image. So, it will include the entire display area, including the gray areas.

15. **Properties:** This lets you modify properties for the current report page.

16. **Edit Aliases:** This displays the **Edit Aliases** dialog box. This dialog box can be used to modify the display of text labels and other elements on the report. Simply click on applicable entries from the expanded tree view and where desired modify the text.

17. **Always on Top:** This keeps the Gear Report window always on top of other windows that are displayed.

18. **Autoscale:** This icon defines whether or not the current page is displayed in Autoscale mode. If this icon is depressed, auto scale is enabled and PC-DMIS Gear automatically scales that page so that it fits into the constraints of the window, even if the window is re-sized.

19. **Double Buffering:** This toggles double-buffering on or off which, depending on your computer system, may help avoid screen flickering.

20. **Rotate Left:** This rotates the report to the left by 90 degrees.

21. **Rotate Right:** This rotates the report to the right by 90 degrees.

22. **Zoom In:** This zooms in on the part. The **Autoscale** icon must be turned off for this to be available for selection.

23. **Zoom Out:** This zooms out on the part. The **Autoscale** icon must be turned off for this to be available for selection.

24. **Best Fit:** This functions as if you had done a one-time **Autoscale** to fit the content within the constraints of the window. The **Autoscale** icon must be turned off for this to be available for selection.

25. **Fit to Width:** This sizes the report to fit within the width of the window. The **Autoscale** icon must be turned off for this to be available for selection.

26. **Fit to Height:** This sizes the report to fit within the height of the window. The **Autoscale** icon must be turned off for this to be available for selection.

27. **Printer:** This opens up the standard **Print** dialog box allowing you to define your printer.

28. **PDF Creator Settings:** This displays an **Options** dialog box that lets you set options for PDF output using the PDF Creator that is installed with PC-DMIS Gear. Press F1 with the **Options** dialog box open to access PDF Creator's help file.

29. **Settings:** This displays the **Settings...** dialog box, allowing you to define settings used for the Gear Report window.

30. **XML Listing:** This switches the display of the report between the normal report view and a read-only text view of the report's XML file.

31. **Search:** This becomes enabled when XML Listing is used. It allows you to search for text within the XML view of the report.

32. **XML Layout Style:** This allows you to change the formatting and colors when the XML code is displayed when viewing the report using **XML Listing**.

33. **Plot Commands:** This displays the PlotCommands help file. PC-DMIS Gear uses plot commands internally to communicate with Plot Server (a common reporting tool). Many functions, however, are not used by PC-DMIS Gear.

To configure the toolbar, right-click on it, and choose **Toolbar**. See "Using Right-Click Menus" for more information.
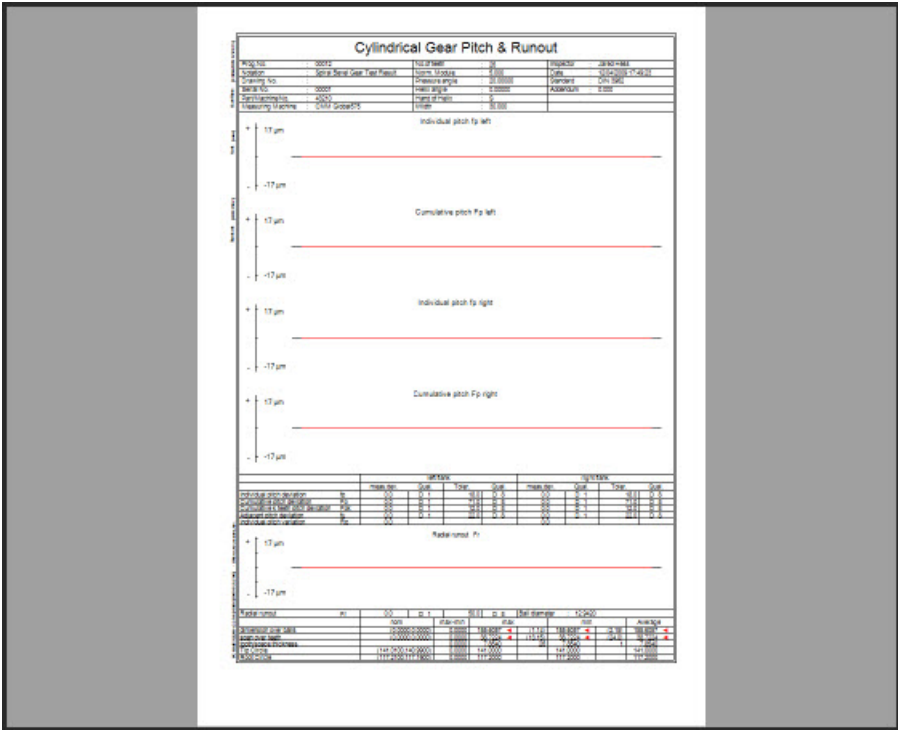
The Page Tabs
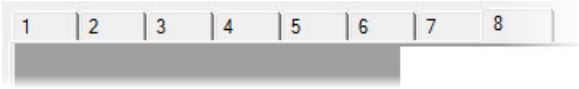
Clicking on a page tab allows you to easily view that page in a report. Note that if you run the **Analyze** process more than once for your current PC-DMIS Gear session, new page tabs will be appended to existing page tabs.

You can right-click on a page tab to perform different operations for that page. See the "Using Right-Click Menus" for more information.
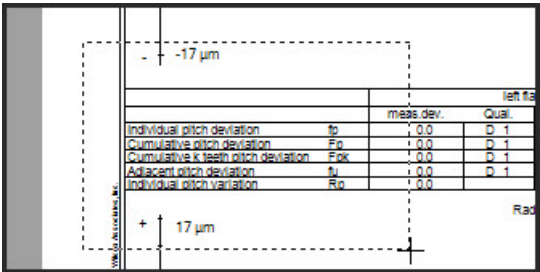
The Display Area

The Gear Report Window's Display Area Showing a Sample Report Page

The Display Area shows the report information from the XML file you loaded or from the most recent analysis. These appear as multiple pages. See "The Page Tabs".

By default, the Display Area automatically sizes a report's page to fit within the constraints of the window by using the **Autoscale** toolbar icon. However you can change the zoom scale for a page by turning off auto scaling and instead manually zooming in or out using the toolbar icons. You can also click and drag a box on a portion of the report to zoom in on that report:

In addition, various shortcut menu items allow you to perform different operations on the Display Area. See the "Using Right-Click Menus" for more information.

The Status Bar

The status bar displays status information about your report.
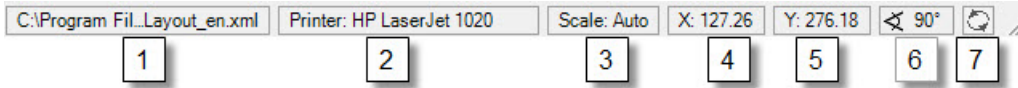
1. This field shows the file name and pathway pointing to the current report file.

2. This displays the current printer that will be used for printing report pages.

3. This defines the current scale factor for the current page. The text "Auto" means that the **Autoscale** mode icon is enabled.

4. This shows the X position of the mouse pointer on the Display Area.

5. This shows the Y position of the mouse pointer on the Display Area.

6. This shows the orientation of the current page. 0 degrees means the page hasn't been rotated to the left or the right.

7. This shows the actual utilization of the Gear Report window. Usually it shows "Busy".

Using Shortcut Menus

This topic discusses the different right-click shortcut menus available.

Toolbar Icon Shortcut Menu

Right-click on an icon on the toolbar and choose **Toolbar...**

The Gear Report window will display a **Configure Toolbar...** dialog box.
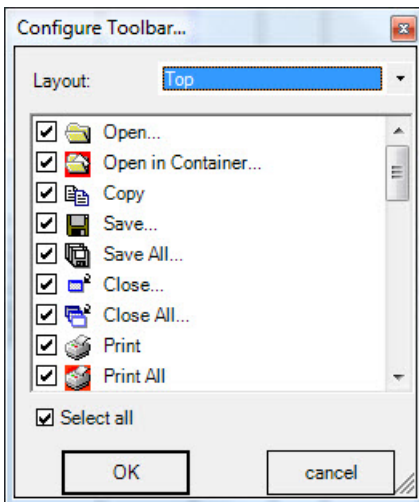

Configure Toolbar dialog box

This dialog box lets you determine the toolbar icons that will appear on the toolbar by marking or clearing desired check boxes. You can also define where the toolbar appears on the screen when the Gear Report window is visible. Available positions are contained in the **Layout** list: **Top**, **Left**, **Right**, or **Bottom**.

Toolbar Empty Space Shortcut Menu

Right-click on the empty space in the toolbar area below the actual toolbar itself or in the status bar area, and the Gear Report window will display a small **Open...** menu item.
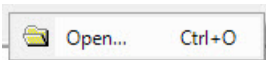
Clicking this will display an **Open** dialog box, allowing you to choose an XML report to open. This acts the same as if you had clicked the **Open** icon from the toolbar. See "The Menus and Toolbars".

Page Tabs Shortcut Menu

Right-click on the page tabs and this shortcut menu appears:

💾	Save...	Ctrl+S
⬛	Close...	Ctrl+Q
🖨	Print	Ctrl+P
📄	Export as Image...	Ctrl+E
📷	Export Snapshot...	Ctrl+Ins
📃	Xml Listing	Ctrl+L
📑	Properties...	Ctrl+I
📇	Edit Aliases...	Ctrl+M
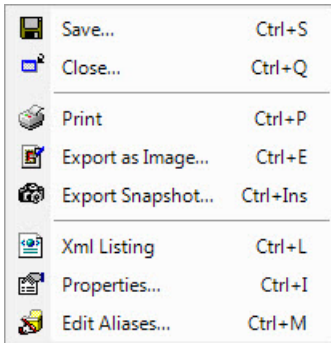
Save: Saves the current page.

Close: Closes the current page.

Print: Prints the current page.

Export as Image: Exports the current page as an image.

Export Snapshot: Exports the current page as a snapshot.

Xml Listing: Displays the current page in XML.

Properties: Displays the **Properties** dialog box for the current page.

Edit Aliases: Defines aliases for the current page.

For information on these items, see the appropriate toolbar icon in "The Menus and Toolbars" topic.

Display Area Shortcut Menu

Right-click on the main display area of the Gear Report window and the following shortcut menu appears:

🔳	Autoscale	Ctrl+A
🔲	Double Buffering	Ctrl+D
↺	Rotate Left	F3
↻	Rotate Right	F4
🔍	Zoom In	F5
🔍	Zoom Out	F6
	Set Zoom Factor...	
⊞	Best Fit	Ctrl+B
↔	Fit to Width	Ctrl+W
↕	Fit to Height	Ctrl+H
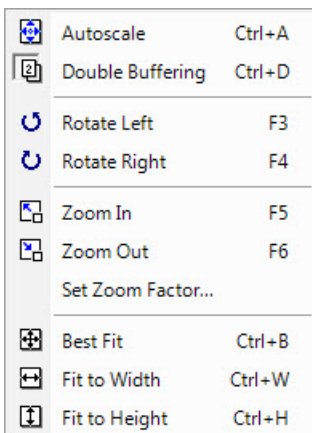
Autoscale: Enables auto scaling to always automatically scale the report's height and width to fit within the window.

Double Buffering: This toggles double-buffering on or off which, depending on your computer system, may help avoid screen flickering.

Rotate Left: Rotates the page left 90 degrees.

Rotate Right: Rotates the page right 90 degrees.

Zoom In: Zooms in on the report. This is available for selection if **Autoscale** is disabled.

Zoom Out: Zooms out of the report. This is available for selection if **Autoscale** is disabled.

Set Zoom Factor: Zooms in on or out of the report to the defined percentage. This is available for selection if **Autoscale** is disabled.

Best Fit: Performs a one time auto scale of the report scaling the width and the height to fit within the window. This is available for selection if **Autoscale** is disabled.

Fit to Width: Scales the report to fit the width of the window. This is available for selection if **Autoscale** is disabled.

Fit to Height: Scales the report to fit the height of the window. This is available for selection if **Autoscale** is disabled.

For information on these items, see the appropriate toolbar icon in "The Menus and Toolbars" topic.

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