



XIV. Inspection program QM-SPLINE

XIV.1. Introduction

The program QM-SPLINE serves as a computer support program for the inspection of involute and straight sided spline gauges according to different national standards (see the list), respective according to customised factory standards.

NOTE: At time the program is exclusively designed to measure and evaluate a **"Two-point" measurement over or between pins** for the different types of gages for external and internal splines **to check the gauges actual "space width" or "tooth thickness"!** The measurement of "Major diameter", "Form diameter", "Minor diameter" or other gauge parameters is not a part of this program!

The use of the program itself, however, requires little knowledge of computers. An extensive help text as well as the integration of thorough safety measures ensures quick a simple operation of the program.

Measurement data can be entered directly from a connected measuring device or from the keyboard. The program does calculate the nominal **measures over or between two pins** in dependance of the pin diameter selected and compares it with the actual measures. The evaluation results can be re-produced on the screen and/or the printer. Tolerance excesses will be shown.

The following standards form the basis of the evaluation:

- Involute spline gauges acc. to DIN 8140, October 1991
- Involute spline gauges acc. to DIN 5482; March 1973
- Straight sided spline gauges acc. to DIN 5481; Januar 1952
- Involute spline gauges acc. to ANSI B92.1-1996 and ANSI B92.2M-1980 (under preparation!)
- Involute spline gauges acc. to factory standards (entering tooth thickness or space width).

The program QM-SPLINE can be started directly out of the database program QM-MANAQ - also offered by L&W GmbH - and provided with initial data (such as ID-number and Gauge designation).

In this case the inspection results are directly transmitted back to the database. See section XIV.6 giving some special notes about the usage of program QM-SPLINE together with the database program.

XIV.2. Program start

You can start the QM-SPLINE program directly from the QMSOFT-command-Shell (click the corresponded symbol in the shell). The other way is to start the program through the WINDOWS explorer (WINDOWS 2000 or XP ...).

Especially at the first start of the program you should check some basic parameters of the program. See the next section for this.

XIV.3. Program settings

Working with the program you should make different settings to define the program environment and especially program conditions. Use the menu "Settings" to do this.

XIV.3.1. Settings | General settings

Using this option you have the following registers to change program settings:

Register „General“

Here you can choose the program language, switch on/off the help text and set the default source for the measuring values.

Using the option "Save certificates automatically" any calibration certificate will be saved into the "Certificate directory" (see register "directories"). The file name will be created by using of the gauges identity number or the entered certificate number. You can set if you want to save the certificate as "RTF", "PDF",... file format.

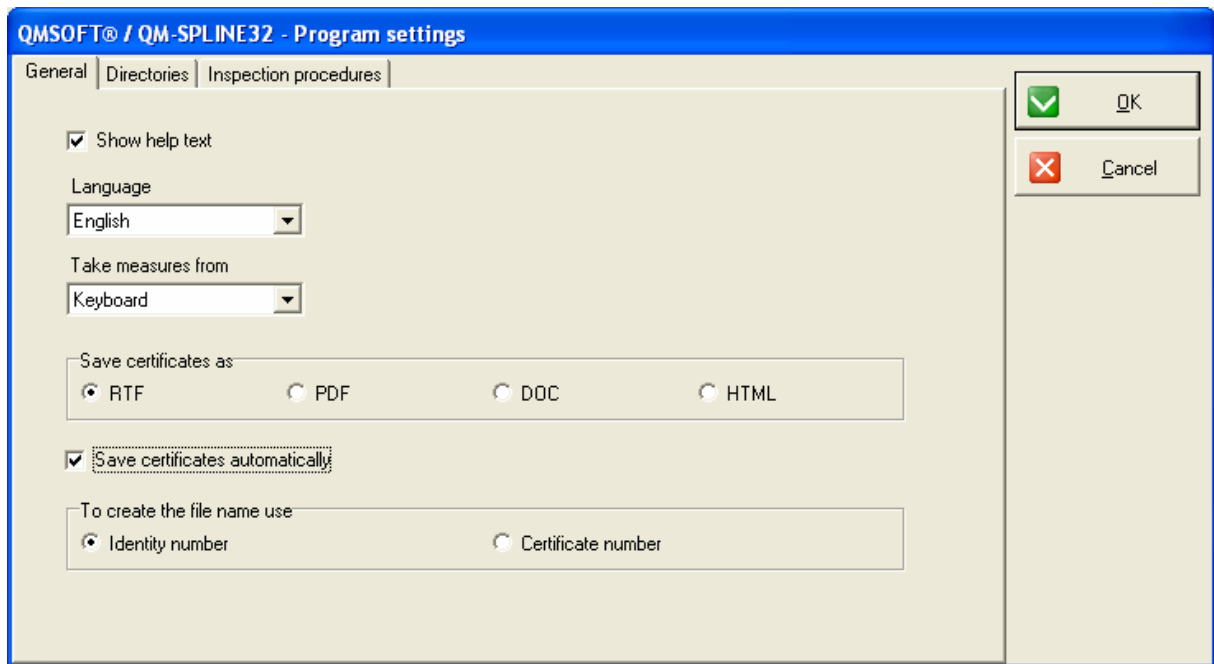


Figure: General program settings

Register „Inspection procedures“

Here you can enter for each gauge type a reference to a corresponded text file including the inspection procedure as a text.

Enter your own text for the procedures here!

Register „Directories“

For some functions (indicating of measuring values; creation and edit of certificate layouts) external programs will be used. Here you have to enter the directory where the corresponded program can be found.

While doing the program installation all directories will be set to a correct value !

ATTENTION: Make sure that this entries are correct. Errors while operating the program may be caused by incorrect settings in the screen "Directories".

XIV.3.2. Settings | Inspection conditions

Here you can set some general conditions for the spline gauge inspection and also the number of readings you want to use.

XIV.3.2.1. Inspection conditions | General settings

The screenshot shows a software window titled "QMSOFT® / QM-SPLINE32 - Inspection conditions". It has a tabbed interface with the following tabs: "General", "Ring gauges", "Plug gauges", "Double sided plug gauges", "Master plugs", and "External, Internal spline". The "General" tab is selected. Inside the "General" tab, there is a section titled "Type of inspection" with a dropdown menu currently set to "Incoming inspection". Below this, there is a section titled "Default certificate layout for" with two rows: "metric measurements" and "inch measurements". Both rows have a dropdown menu set to "QMSpline32_English". At the bottom of the dialog, there are two buttons: "OK" (with a green checkmark icon) and "Cancel" (with a red X icon).

Figure: Inspection conditions – general settings

Set the following parameters:

Type of inspection:

Select "Periodical.." or "Incoming inspection".

Save inspection record as:

Here you can enter a default file name which will be used to save an inspection certificate after finishing a gauges inspection.

Default certificate layout file:

Enter here the name and directory for the certificate layout files you want to use to create your calibration certificates. For "mm" and "inch" measurements different files can be used.

NOTE: Because the program will be installed to support different languages you will find several "L32" files in the related directory.

XIV.3.2.2. Inspection conditions for the different types of gauges

There are different registers to set special conditions for the different types of gauges. The parameters you can set at any register are very similar, so we will explain here only one of it.

Register “Double sided plug gauges”

QM-SPLINE / Inspection conditions		
General	Ring gauges	Plug gauges
Double sided plug gauges		Master plugs
		External, Internal spline
	GO side	NO GO side
No. of measuring planes	2	2
Measures per plane	1	1
Inspection period	1	Year(s)
<input type="button" value="OK"/>		<input type="button" value="Cancel"/>

Figure: Inspection conditions for “Double sided” – GO / NO GO plug gauges

The following parameters are divided in “GO” and “NO GO”.

- Number of meas. planes:** Enter the number of planes where you want to measure the plug gauge.
- Meas. values for each plane:** Enter the number of measures for each measuring plane. A usual number is “2”. This means after measuring one diameter in the given measuring planes you should turn the plug gauge around 90 Degrees and repeat the measurement(s).
- Inspection period:** Enter a default “Inspection period” to calculate the date for the next inspection. This can be print on the certificate. If the program is called from the database the “Next inspection date” value from the database will be used.

XIV.3.3. Certificate layout files

The program gives you the possibility to customise the layout of your calibration certificates. The layout this certificates is based on the so called " certificate layout file " (template). This file contains all information about the form of the certificate and the values should appear in this. By editing this certificate layout file you can change the layout. Saving this file with another file name give you the possibility to work with different record layouts.

All certificate layout files you have created will be saved in the selected directory (see program settings). These files have the extension ".L32".

Using the option "**Certificate layouts / Show / edit a certificate layout**" you can load an existing certificate layout file into the editor program.

ATTENTION: Do not open a certificate layout file ("L32" extension) directly with the QMSOFT editor or with any other program ! In this case the program depended fields will be removed !!

A certificate layout file is consisting of three different types of information:

- "**normal**" text: is text information just like in a known text processing application; you can change the text as you want and you can set the different text parameters;
- "**Placeholders**" ("Fields"): a "Field" is including a variable information about the gauge, the measuring process or the measuring environment. A "field" will be fulfilled with the actual information while executing the program. Editing a certificate layout file you can change "field" positions, delete "fields" (if you do not need the related information) and insert new "fields". To insert a new "field" in your certificate layout use the menu "Insert | Fields". Using this menu you can also see all available "Fields" and the related information. For numerical fields you can set the number of decimal points using the menu "Insert | Fields".
- "**Line conditions**": A line condition gives you the possibility to control the certificate layout in dependence of different program situations. A text or field following to an line condition will be print out on the certificate only if the condition is "true". For example you can print a special text only if an "External measurement" was done. Please open an existing certificate layout and see the comments for the "Line conditions" available.

XIV.3.3.1 The usage of "Place holders" (fields):

To insert a new "Place holder" in your certificate layout use the menu "**Insert / Fields**". Using this menu you can also see all available "Place holders" (Fields) and the related information. The fields are grouped to different categories (e.g. Gauge nominal values). If you select a field (click on it) you can see the field designation.

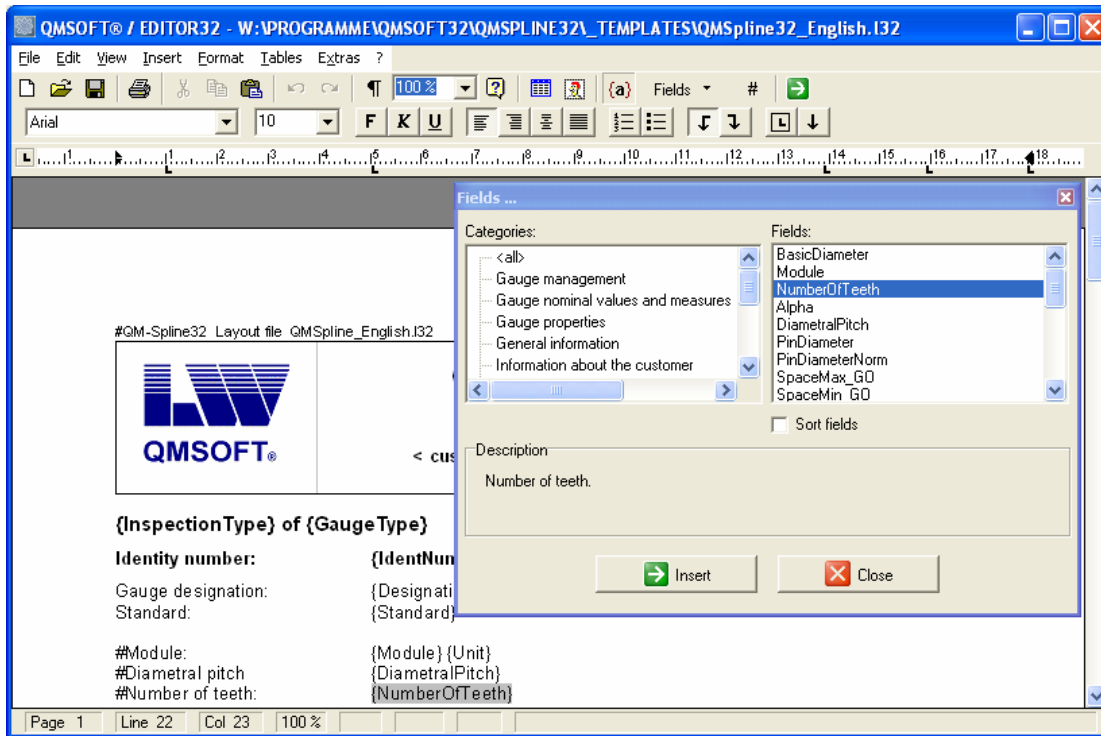
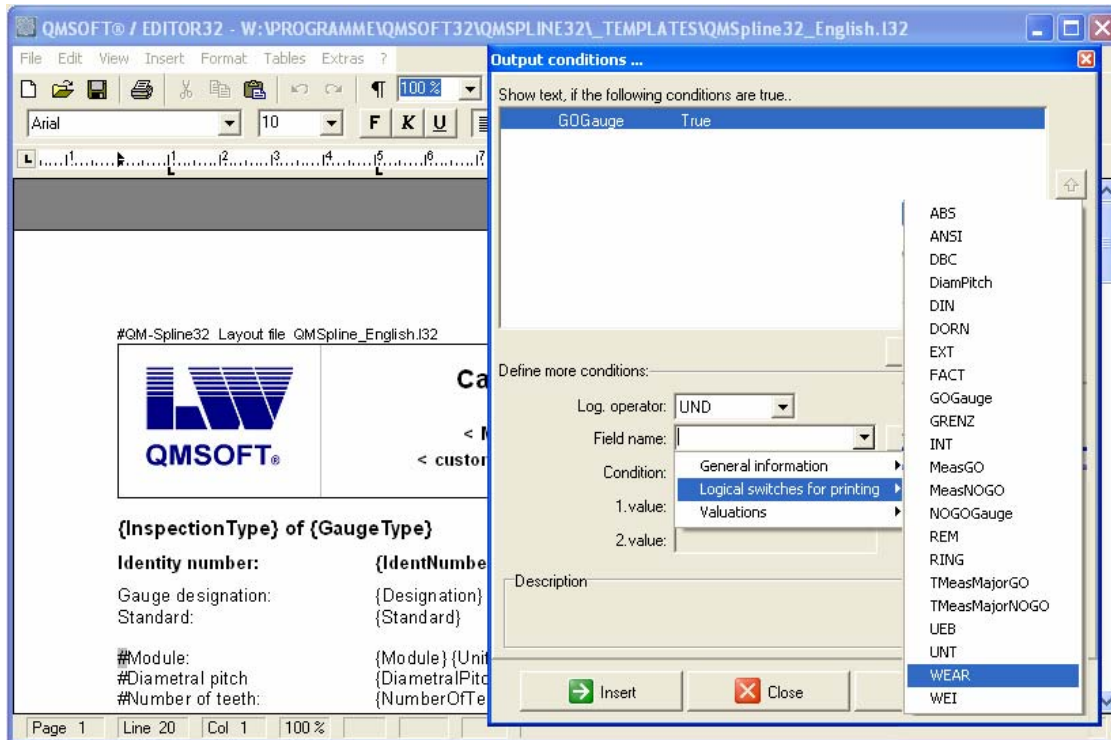


Figure: using "Fields" in a certificate layout

XIV.3.3.2 The usage of "Text conditions":

Use the menu **"Insert / Line conditions"** to show the conditions available (see figure). Select a condition in the shown list to get there description. Use the "Insert" button to insert the selected condition in your certificate layout.

Note: A "Line condition" is not restricted to one line in your layout. The condition is active until a new "Line condition" is defined or an "empty" condition is set. The text after an "empty" condition will appear on your certificate in any cases.



XIV.4. The calibration process

XIV.4.1. Select gauge type and standard / Entering of parameters

Before starting an inspection at first you have to select the Gauge type you want to inspect and the related standard.

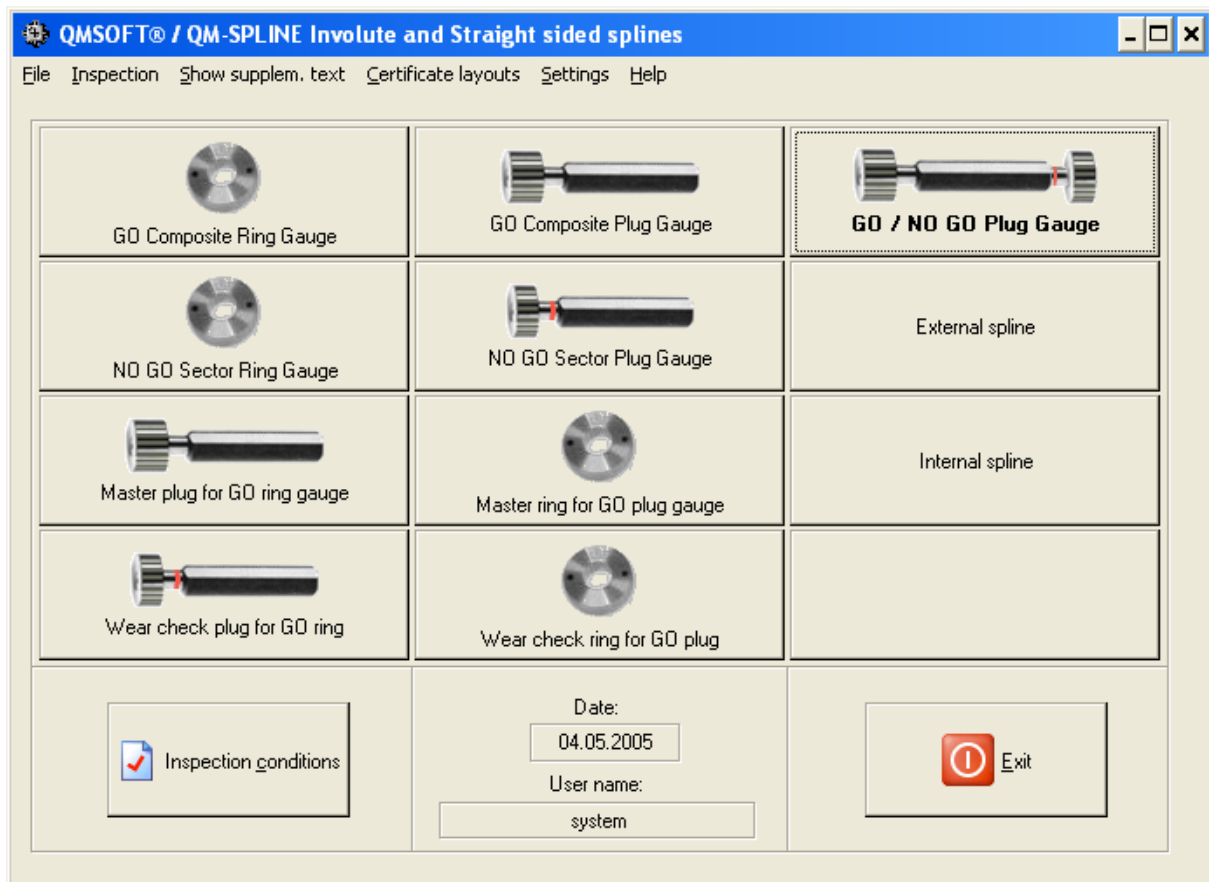


Figure: Select the type of gauge you want to inspect

In case that the parameters you have to enter does depend on the standard selected, select the standard now.

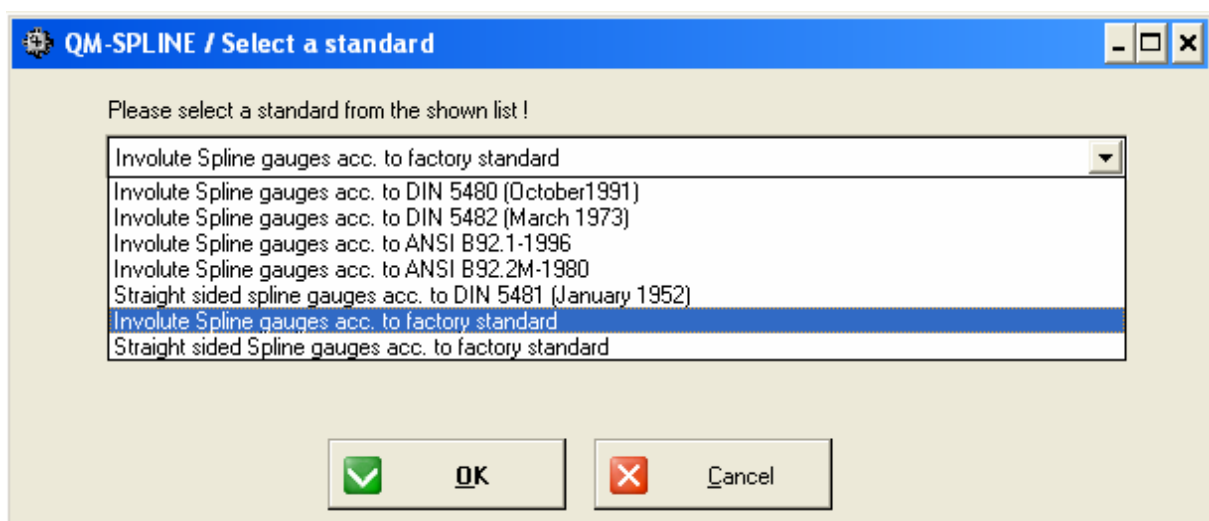


Figure: Selecting the standard

Note: At time not all standards are available. If the "space width" or "tooth thickness" of a gauge is known you can use the option "Factory standard" to calculate the "over pins" or "between pins" measures for it!

Now before starting the inspection, a series of parameters has to be entered that describe the gauge. The input of the parameters is done in a separate dialog box with a corresponding number of input fields.

XIV.4.1.1. Gauge parameters acc. to DIN 5480

Gauge type: GO Composite Plug Gauge

Gauge identity number: 09999
Unit: Metric
Values acc. to: DIN 5480 : 1991
Pressure angle: 30 Grad

Short designation: GD
Base diameter: 60,00 mm
Fit class: H
Module: 2
Tolerance class: 9
Number of teeth: 28
Gauge tolerance class (LQ): 4

Gauge designation:

Reading limits for measurement over two pins or balls:

Suggested pin diameter acc. to DIN: 0,0000 mm
Customer selected pin diameter:
New gauge: 0,0000 mm
NO GO value - new gauge: 0,0000 mm
Wear limit: 0,0000 mm

Buttons: Calculate meas. [F7], Inspection conditions, Inspection procedure, Cancel, Continue

Figure: Entering of spline gauge parameters acc. to DIN 5480

- Identity number:** This field is used to establish an identity for the gauge by entering a number. This number will be noted in the record.
- Unit:** Select the unit ("mm" or "inch") for the measurement.
- Pressure angle:** The pressure angle is always 30 Degree for this standard.
- Base diameter:** Enter the gauges "Base diameter". Usually you will find it at the gauges designation.
- Module:** Select a module from the shown list. The program will give you an error message if the module selected does not correspond with the entered base diameter.
- Number of teeth:** Usually the number of teeth is given by the combination of "Base diameter" and "Module". Therefore after entering of this parameters the number of teeth will be set automatically. If you change the presetted number of teeth the program will check if it is a valid number according to DIN 5480.
- Fit class:** Select the given class of fit.

Tolerance class: Select the product tolerance class. Class “9” is the default value.

Gauge tolerance class: Select the gauge tolerance class. Class “4” is the default value.

Now you have all necessary parameters you need to calculate the readings over pins.

The “**Gauge designation**” you have not to enter. It will be set in accordance to the entered parameter and the DIN 5480 after the calculation of the readings over pins.

Pin diameter: There are two fields where you can show or enter a pin diameter.

Suggested pin diameter acc. to DIN: This diameter can not be changed by the program user. It will show you, after the calculation, the pin diameter which is suggested by the DIN 5480 standard. If you do not enter a “Customer selected pin diameter” this diameter will be used for the calculation of the measures over (or between) pins.

Customer selected pin diameter: If you want to use a pin diameter which does differ from the diameter recommended by the DIN standard, then enter this diameter here. The program will check if the diameter you have entered is in a valid range to calculate the measures. Otherwise you will get an error message.

XIV.4.1.2. Gauge parameters for gauges according to “Factory standard”

If you want to inspect a gauge where the parameters are not in accordance to one of the implemented standards you get the following dialogue window.

Gauge type: GO Composite Ring Gauge Spline gauges acc. to factory standard

Gauge identity number: 88999
 Gauge designation: W30x14 Z20
 Unit: Inch

Short designation: GR
 Pressure angle: 30,0
 Number of teeth: 20

☐ Module ☒ Diametral Pitch
 0,050000 inch 20,0

Nominal values for tooth thickness / space width

Minimum circular space width: 0,078200 inch
 Maximum circular space width: 0,078400 inch
 Wear limit - circular space width: 0,078500 inch

Customer selected pin diameter: 0,085000 inch
 Recommended diameter: 0,0864 inch

Reading limits for measurement over two pins or balls:
 New gauge: 0,000000 inch
 NO GO value - new gauge: 0,000000 inch
 Wear limit: 0,000000 inch

→ Calculate meas. [F7] Inspection conditions Inspection procedure
 Cancel Continue

Figure: Entering of parameters for involute spline gauges acc. to factory standard

In case that a spline gauge may be defined by various parameters we have restricted the number of parameters at the minimum required.

Identity number: This field is used to establish an identity for the gauge by entering a number. This number will be noted in the record.

Gauge designation: Enter the gauge designation at the same way as given on the gauge.

Unit: Select the unit ("mm" or "inch") for the measurement.

Pressure angle: Enter the pressure angle.

Number of teeth: Enter here the number of teeth

Module OR Diametral pitch: Select here if you want to enter the "**Module**" or the "**Diametral pitch**". If you enter the "Diametral pitch" the related module will be calculated automatically.

Module: Enter the gauges "Module" if you enter the "Diametral pitch" the module will be set automatically.

Diametral pitch: Enter the "Diametral pitch".

Values for space width or tooth thickness: Enter the limits for the gauges space width (or tooth thickness). You can also calculate only one measure between (or over) pins if you have only the maximum or minimum limit of the space width.

Pin diameters:

Recommended diameter: Based on the entered gauge values the program will show you an "Recommended diameter". This recommendation may be used to select the actual used pin diameter.

Customer selected pin diameter: Enter the pin diameter you will use to calculate the measurements between (or over) the pins.

The "**Calculate..**" button will perform the calculation of the measurement in relation to the entered parameters. If the button is disabled (no Green arrow is shown) then the parameters are not complete.

If an "**Calculation error**" does appear the entered pin diameter is not usable for this gauge and/or the space with (or tooth thickness) you have entered does not correspond with the Diametral pitch (module) or the number of teeth. In this case check the parameter and correct it.

XIV.4.2. The measuring method

The most usual method to determine the actual space width or the actual tooth thickness of a gauge is the measurement with pins. This measurements give us a simple and effective way for the analytical inspection of splines.

NOTE: This measurements do not determine the fit between mating parts!

XIV.4.2.1. External measurements – measurement over pins

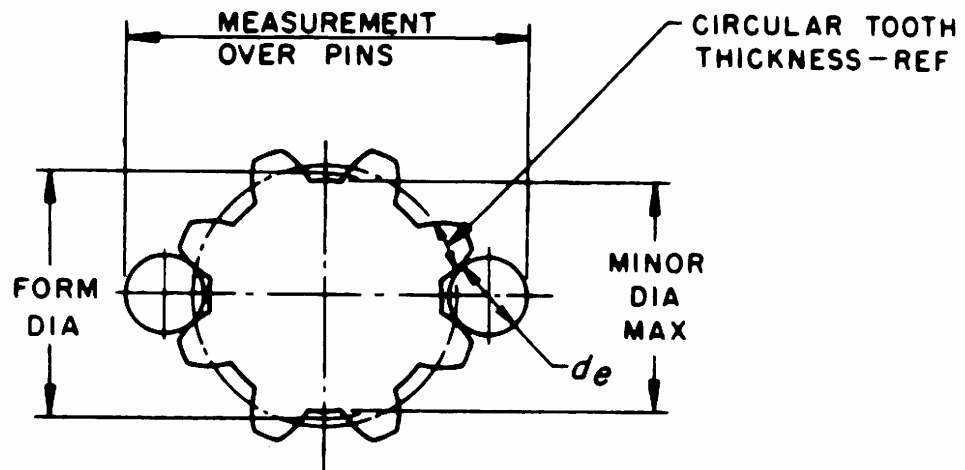
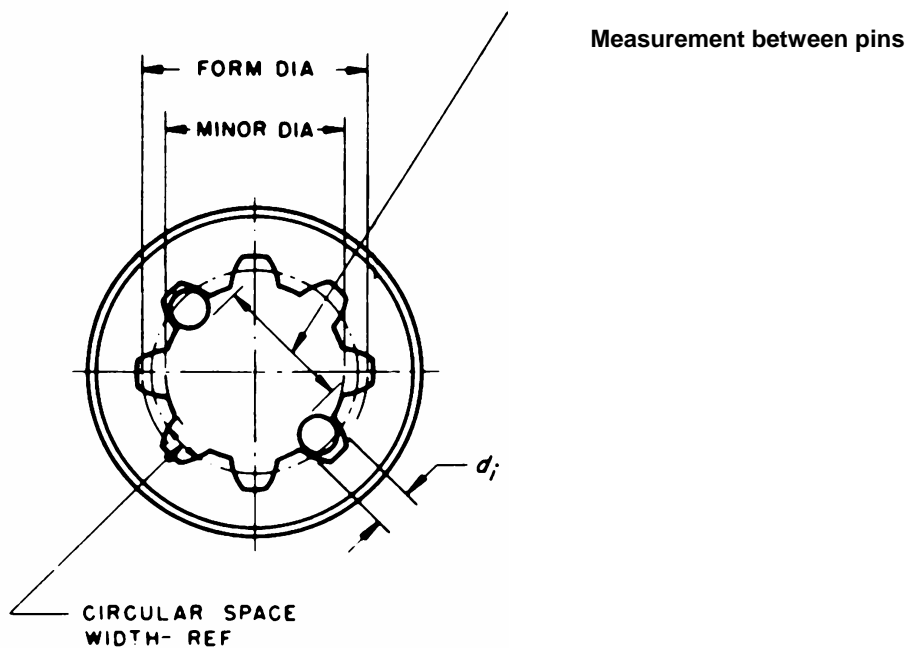


Figure: Measurement over two pins

XIV.4.2.2. External measurements – measurement between pins



XIV.4.3.Entering measuring values

Measurement values are always entered in a sequence of measurement values 1 to n for gauge position 1 (corresponding with measuring plane 1 to n), measurement value 1 to n for gauge position 2 etc. Measuring double sided GO/NO GO plugs is done first on the GO - side of gauge and then on the NO GO side.

	1. Measure	Tolerance field	2. Measure	Tolerance field
1. Measuring plane	45,1400 mm	-----x-----		
2. Measuring plane	45,1432 mm	-----x-----		
3. Measuring plane				

Pin diameter: 4,50000

Reading limits - over pins: lower 45,13680 mm, upper 45,14760 mm

QMSOFT® / RS232DRV Indication program...
 File Settings General settings Help
 External measurement diff ACTIV
 45.1432 mm
 NEG SET
 [Red Power Button]

Figure: Entering of measuring readings

The program will show you the "Reading limits" for the current measurement. So you can see if a measurement is inside the tolerance before taking over the value from the measuring device.

Inspecting internal splines the program will show you the reading limits between pins and additional the limits for the readings over pins (or balls).

The measuring will be supported by a graphic display showing the measured value in the gauge tolerance field.

If you want to take over measuring values from an Online connected measuring machine, press the "Online" Button to start the indication program.

ATTENTION: Use the menu option "Settings | General Settings" to set the "Transfer measuring values from.." (Register "General") to the option "Online". Please check, that in the register "Directories" the correct "Indication device" is selected.

XIV.5. Output of results

After entry of the measurement data has been completed, the screen "*End of inspection*" will appear.

QMSOFT® / QM-SPLINE32 - valuation of measurement

Certificate number <input type="text" value="2006-08-23-0023"/>	Certificate layout <input type="text" value="QMSpline32_English"/>
Customer name <input type="text" value="Flintstone & Son"/>	<input type="button" value="Edit the certificate layout"/> <input type="button" value="Show certificate"/> <input type="button" value="Print certificate"/>
Valuation <input type="text" value="in tolerance"/>	
Notes <div style="border: 1px solid gray; height: 60px; width: 100%;"></div>	
Date of inspection <input type="text" value="22.08.2006"/>	Next inspection date <input type="text" value="30.12.2007"/>
Operator <input type="text" value="Smith"/>	

Figure: End of inspection – show/print certificate

If the inspection is finished you get the screen shown above. The summary result of the inspection is shown. Here you can enter the name of the customer, the date for the next inspection and also some remarks to the inspection.

Before creating the calibration certificate you can change the "certificate layout" file will be used. To start the output of the results press the "Show certificate" button.

All functions for the editing and the output of calibration certificates will be controlled by the EDITOR - program. See the manual of this program to see how to operate this.

XIV.6. The usage of the program QM-SPLINE with the Gauge management system

In the field of spline gauges there does exist a various number of standards and different forms of gauges. To minimize the number of Gauge types which are necessary to describe the different forms of gauges inside the database we decided to keep only a minimum information in the database to make a general description of the gauge.

Figure: Basic data for a Spline gauge in the database

The data in the database (except the general data existing for any type of gauge) are:

- the nominal size or "Base diameter"; for DIN 5481 and DIN 5482 it is the "Profil designation" for example "17x20"
- the standard (most important information before to start the QM-SPLINE program)
- the Gauge designation acc. to the standard:
this information will be given back from the QM-SPLINE program when inspecting a gauge the first time (see the next figure);
- Ball / Pin diameter:
usually the pin diameter has to be selected inside the QM-SPLINE program when you perform the first measurement; the diameter used for the measurement will be come back from the QM-SPLINE program and will be saved there;

To make a first inspection for a spline gauge follow this steps:

- enter the gauge into the database; the information to describe it are only the "Base diameter" and the "Standard" (except the general information like Identity number ...);
- call the QM-SPLINE program by executing a gauge inspection (see also Page III-9 in the QM-MANAG manual);
- enter all specific data to describe the gauge inside the QM-SPLINE program (for example as described at page XIV-7) and continue the measurement;
- close the QM-SPLINE program and continue to the database;

You will now get your measuring results back into the database. In case that the nominal "readings over (or between) pins" does depend from the used pin diameter, the readings over (between) pins are also a part of the "measuring results".

Additional to the measuring results the program will add information to the gauges "Basic data" as shown in the next figure.

The screenshot shows a software window titled "[GO plug gauge for internal splines], [SPL_334], [50]". It contains two main data entry sections:

- General basic data:**
 - Gauge type: GO plug gauge for internal splines
 - Identity number: SPL_334
 - Nominal size/Range: 50
 - Gauge status: usable (highlighted in green)
 - First entry on: 11.01.2005
- Type specific basic data:**
 - Nominal size (Base diameter): 50
 - Standard: DIN 5480 (Involute spline gauges)
 - Gauge designation acc. to the standard: DIN 5480 - GD 50 x 3 x 30 x 15 x 9H - LQ 4
 - Ball- / Roll- diameter (customer selected / last measurement): 6.0000 mm

Figure: Basic data for a Spline gauge after performing the first inspection

You can see that the "Gauge designation acc. to the standard" is now filled with the complete information to describe the gauge. When you has to execute the next inspection all informations about the gauge like "pitch", "number of teeth", "Tolerance field"... are now available for the QM-SPLINE program.

The pin diameter used for the last measurement will also be used for the next measurement (except the case that you change it).

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