

Tutorial Series

Shaft Systems – Starter 2-Stage Gearbox

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1. Foreword 1.1 Aim of the tutorial

This starter tutorial for the Shaft Calculation extension <u>MESYS Shaft Systems</u> aims to familiarize users with the functionalities and provide an initial impression of its computational capabilities in analysing aspects related to the use of parallel shafts.

As a limitation, only topics and settings are mentioned or dealt with here, that are appropriate for an assumed familiarity with the product and the exercise content. Please do not hesitate to contact <u>MESYS</u> if you have any questions when using the software.

1.2 Software Version

This tutorial was created with MESYS Shaft Calculation version 12-2024 from 11.02.2025.

1.3 Notes

A blue arrow indicates a request to the reader. A green arrow indicates a conclusion or effect.

2. MESYS Shaft Systems

2.1 General

To get an idea of the possibilities of MESYS shaft systems, we invite you to visit the MESYS website at the specific address for <u>Shaft Systems</u>.



Please consult the corresponding articles on shafts or gears under Home/Downloads/Categories, as illustrated in Figure 2:





2.2 Description



MESYS Shaft Systems is a software extension to MESYS Shaft Calculation. This makes it possible to display parallel and coaxial shafts in groups and to assign further relationships, connections, conditions or loads to them. This makes it possible to analyse the general dynamic and static states of a gear system or specific resulting bearing states.

With an additional license, gear calculations (<u>Cylindrical gear pairs</u>) based on corresponding standards (ISO 21771-1 / ISO 6336) can be carried out.



Figure 4

3. Software Manual 3.1 Online-Manual

The software onlinemanual can be accessed via the user interface by selecting the "Help" menu under "Manual F1" (Fig. 5).

You can open the online manual locally at any time with position-specific content directly via your F1 keyboard or find it via the website.



3.2 Manual as PDF

The software manual can also be found as a PDF file in the main languages within the MESYS installation directory (Figure 6).

File Home Share	View			
\leftrightarrow \rightarrow \checkmark \uparrow \square \rightarrow This P	C > Local Disk (C:) > Mesys 12-2024			
	Name	Date modified	Туре	Size
> 📌 Quick access	MesysHertz64.exe	11/02/2025 16:46	Application	42,710 KB
🗸 🛄 This PC	🚰 MesysManual.exe	11/02/2025 16:46	Application	24,932 KB
3D Objects	Te MESYS-Manual.pdf	11/02/2025 10:22	PDF Document	14,142 KB
> Deckton	i MesysManual-DE.exe	11/02/2025 16:46	Application	24,890 KB
> Desktop	Te MESYS-Manual-DE.pdf	11/02/2025 16:43	PDF Document	14,080 KB
> Documents	MesysManual-JA.exe	11/02/2025 16:46	Application	24,822 KB
> 👆 Downloads	MESYS-Manual-JA.pdf	11/02/2025 10:30	PDF Document	11,462 KB
> 🁌 Music	MesysManual-KO.exe	11/02/2025 16:46	Application	24,983 KB
> 📰 Pictures	MESYS-Manual-KO.pdf	10/02/2025 08:46	PDF Document	11,286 KB
> 😽 Videos	MesysRBC64.exe	11/02/2025 16:46	Application	46,888 KB
> Han Local Disk (C)	MesysReport64.dll	11/02/2025 16:47	Application exten	370 KB
>	MesysShaft64.exe	11/02/2025 16:46	Application	59,980 KB

· Inner and outer geometry can be defined independently

Figure 6

MESYS Axial-Radial-Rollerbearings



4. Project of a Shaft System 4.1 Content of the tutorial

An existing 2-stage reduction gearbox is to be used in a new application and its suitability is therefore to be tested. For this common task, MESYS shaft systems are to be used to investigate its suitability and to find the potential for spatial optimization.



Figure 7

4.2 Initial situation

The current 2-stage gearbox, consisting of 3 shafts, is allegedly defined as follow:



Shaft	Element	Name	Position X	Parameter Table 1
Shaft 1	Coupling	Input	10	Mx = 20Nm
	Gear	V1	85	mn=1, α=20, b=20, z=25
	Rolling bearing	B1	60	Deep groove ball bearing 6204
	Rolling bearing	B2	140	Deep groove ball bearing 6204
Shaft 2	Gear	V2	35	mn=1, α=20, b=20, z=60
	Gear	V3	65	mn=1.5, α=20, b=25, z=20
	Rolling bearing	B3	10	Deep groove ball bearing 6205
	Rolling bearing	B4	90	Deep groove ball bearing 6205
Shaft 3	Gear	V4	65	mn=1.5, α=20, b=25, z=50
	Rolling bearing	B5	10	Deep groove ball bearing 6206
	Rolling bearing	B6	90	Deep groove ball bearing 6206
	Reaction coupling	Output	140	



4.3 Modelling

4.3.1 Creating the File

The first step is to analyse the existing gearbox in the current configuration and with the current loads.

 \rightarrow

Start the MESYS shaft calculation or open a new file via the "New" icon or the File menu item and select 'New' (Figure 8)

The project for the shaft calculation can be given a name and a description under 'System' (Figure 9).



Figure 8



4.3.2 Group

Separate groups are required to calculate parallel shafts.



Please assign 3 groups via the context menu.

Please assign one shaft each and assign the corresponding names (Figure 12).

Graphics Extras File Calculation Report Help Shafts Add Group Group 🗋 🗁 💾 🍕 Group 2 Add Coaxial Group Add Planetary Group Group 3 System Positioning Add elastic part as housin System Import shaft system Shaft Export shaft system Add Group Group 1 Export geometry Add Coaxial Group Group 2 Sort groups and shafts Group 3 Add Planetary Group Cylindrical gearbox Add s ositioning Planetary gearbox Add elastic part as housing Figure 10 Figure 11

Please note that you can alternatively assign a ready to use 'Cylindrical gearbox' system via the context menu on 'Shafts' (Figure 11).







Check and compare your shaft geometry with section <u>4.3 Initial Situation</u> by hovering the mouse over the interested shaft segment for a moment (Figure 13).

4.3.3 Rolling Bearing

4.5.5.1 5000000		
File Calculation Report Gra	phics Extras Help	
🗋 🗁 💾 🚳 🐻	.	
System B System Shafts Group 1 Shaft 1 Group 2 Shaft 2 Group 3 Shaft 3 Bearings Bearing Positioning Gear connections	Select 'Shaft 1' in the system tree, right with ' ' and select the type 'Rolling bearing' in the dropdown on the right.	assign an element under the 'Supports' tab on the
	General Geometry Loading Supports Section Rolling bearing x=0mm, 'Bearing'	Rolling bearing Support Rolling bearing
General Geometry Load	ng Supports Sections Settings	
Rolling bearing x=60mm, 'B1.1 Name th into pos	ne rolling bearing and bring it	Rolling bearing Image: Name B1.1 Position x 60 mm
Figure 14		Type Deep groove ball bearing

From here, the rolling bearing module for a specific bearing selection can be accessed via the ' + button at the bottom right, via a window, or in the system tree directly via the representative designation 'B1.1' now shown here (Figure 15).





General Bearing geome	try Bearing configuration	on Ma	terial and Lu	brication	Loadin	g Track roller
Deep groove ball bearing					~ 🔶	Select bearing from database
Inner diameter		d	20	m	m 🛟 🗠	Dynamic load rating
Outer diameter		D	47	m	m 🔂 🖸	Static load rating COr 0 kN
Manufacturer	name	di (mm] De [mm]	B [mm]	C [kN] ^	Fatigue load limit Cur 0 kN
SKF *6204-2ZN	IR	20	47	14	13.5	Bearing clearance User input as operating clearan.
SKF *6204-22		20	4/	14	13.5	
SKF *6204-2RS	L	20	4/	14	13.5	
SKF "0204-2RS	H/VA947	20	47	14	13,5	
SVE \$6204-2RS	E/C5GIN7	20	47	14	12.5	Under the 'Bearing geometry' tab, as-
SKF *6204-2RS	E/C3GIN7	20	47	14	13.5	sign a 'Deep groove ball bearing' under
GMN HY 6204	1/050147	20	47	14	13.9	the specification 'Select bearing from
GMN 6204		20	47	14	13.9	database'. Select generic bearings with
Generic 6204		20	47	14	1	the designation from Table 1
<					>	Figure 16
File Calculation Report	Graphics Extras Help	0				
🗋 🗁 💾 🚳 属						
ystem 🗗						
System						
✓ Sharts ✓ Group 1					16	
Shaft 1						
Shaft 2						
✓ Group 3 Shaft 3						
✓ Bearings R1 1 'Generic			_			
B1.2 'Generic	General Geometry	Loadin	g Supp	orts S	ections	Settings
> Gear connections	Rolling bearing x=60m	nm, 'B1.1'				Rolling bearing
	Nothing Dearing x= 140	nin, 01.2				Position x 140 mm 🧔 🔿
						Type Deep groove ball bearing (Generic 6204)
						Shaft connected to inner ring v
	For the	3 sha	afts, d	esig	n the	respec-
	tive righ	t-har	nd bea	aring	as a t	'Geometry, Material, Temperature, Lubrication' is connected
	boar	ing o	nd do	activ		Use extended calculation model
	Deal	iiig a	nu ue	activ		Shaft is supported radially
	sup	port	as sh	own	on th	e right.
Figure 17						L. Shart is supported axially to the right
For the such as like to calcula	e purposes o s 'bearing cle refer you to tion.	of thi earan the S	s tuto ce' or Starte	orial, rela r Tu	plea ated f torial	se leave bearing settings its untouched. We would Basics for rolling bearing
Assigr and as	the remaini sign the corre	ing ro espoi	olling nding	bea nam	rings nes.	for all shafts (Figure 18)
1.3.3.2 Lubrica	nt					
	accian tha lu	hrica	nt (E:	a	101.	
File Calculation Report Graph	hics Extras Help	DITC	ווונ (דו	gure	19).	
System 🗗	mesus	5				Shaft Calculation Figure 1
✓ Shafts > Group 1	ingineering Consulting Software					
> Group 2 > Group 3	Project name 2-Stage G	Gearbox				
✓ Bearings B1.1 'Generic 6204'	Calculation description Starter Tu	itorial Shaft S	Systems			
B1.2 'Generic 6204' B2.1 'Generic 6205'	Settings Lubrication Dis	play settings				
B2.2 'Generic 6205'	ISO VG 100 mineral oil					Of lubrication without on-line filter ISO4406 -/17/14 Figure 19



4.3.4 Gearings

4.3.4.1 Cylindrical gears

Select Shaft 1 in the System tree, assign an element under the 'Load' tab with ' 💠 ' and select the 'Spur gear' type in the dropdown on the right (Figure 20).



Complete all gearing parameters for the remaining shafts (Fig. 21).



The gears are not aligned with each other (Figure 23).



Figure 24

4.3.4.2 Gear connections

In the next step, the gearings must be assigned and brought into engagement. The 'Gear connections' window can be accessed under the system tree (Figure 25).

Gear connections

File Calculation Report Gra	phics Extras Help						S.					
🗋 🗁 💾 🚳 📑 🔚	¢.											
System 🗗	 Cylindrical gear pairs 	T1 [Nm]	T2 [Nm]	SF1	SF2	SH1	SH2	wmax/wavg		_		B
✓ System	GearPair	-	-								2	
✓ Shafts	GearPair	-										
✓ Group 1	Planetary gear sets	T1 [Nm]	T2 [Nm]	T3 [Nm]	SF1	SF2	SF3	SH1	SH2	SH3		
Shaft 1	Bevel gear pairs	T1 [Nm]	T2 [Nm]	SF1	SF2	SH1	SH2					
✓ Group 2	Worm gears	T1 [Nm]	T2 [Nm]	SF	SH	SW	ST	SB				
Shaft 2	Couplings	T1 [Nm]	T2 [Nm]									
✓ Group 3	Belt connections	Smin	Fmin [N]									
Shaft 3												
✓ Bearings												
B1.1 'Generic 6204'												
B1.2 'Generic 6204'	0.01											x
B2.1 'Generic 6205'	Shaft											EZ
B2.2 'Generic 6205'	Shaft 2											z, 1
B3.1 'Generic 6206'												z
B3.2 'Generic 6206'	P [W]											<u> </u>
Positioning												z×
Gear connections	n1 [rpm]											17x

Activate 2 gear pairs ('GearPair') using the ' 💠 ' button, as shown in Figure 23.

The shafts and gears in contact can be defined here, and the basic data for the gear pair is displayed. In addition to the individual shaft inputs, the gear data can also be modified in this window. However, through this connection, the data for both gears can be adjusted simultaneously (Fig. 26).

Connect the two gear pairs as shown in Figure 26 and select appropriate colours for them.

iearPair 1						GearPair 2						
	Color		Color				C	olor		Co	lor	
Shaft	Welle 1	~	Welle 2	~]	Shaft	Welle 2		~	Welle 3		~
Gear	V1	~	V2	~		Gear	V3		~	V4		~
Position	85		35		mm	Position	65			65		mm
Number of teeth	25		60			Number of teeth	20			50		
Width	20		20		mm	Width	25			25		mm
Profile shift coefficient	0		-6.48191E-15			Profile shift coefficient	0			0		
Normal module	mr	1	mm			Normal module		mn	1.5	r	nm	
Normal pressure angle	α _n	20	•			Normal pressure angle		α _n	20	•		
Helix angle	β	0	•			Helix angle		β	0	•		
Helix direction	Spur gear	~	Spur gear	v		Helix direction	Spur gea	ır	~	Spur gear		~
Center distance	а	0	mm			Center distance		а	0	r	nm	

Figure 23

Figure 25





Leave the remaining gear-specific parameters and calculation modes unchanged for the scope of this tutorial.

A series of input and output fields refer to parameters for the design of gearing. For general gear calculations, we are happy to refer to specific training materials.

At this point, the <u>coordinates of all groups</u> are still set to zero. In the right-hand window of the gear connection dialog, all groups are there-fore displayed at the coordinate origin (Figure 27).

4.3.4.3 Positioning of the Gearings

The groups should now be aligned relative to Group 1 according to the gear connections. The 'Positioning' window can be activated under the

system tree (Figure 28). Positioning can be carried out based on various criteria, such as the relationship between gears or groups.



As a result, the groups have now been aligned, which can also be called up in the right-hand window of the 'Gear connections', 'Positioning' and also in the window for 'Shafts' via the System tree (Figure 29).



The <u>coordinates of the groups</u> or shafts can also be viewed numerically via the Group 1-3 system tree and then by selecting the 'Group' tab on the far right.

4.3.5 Correction

Figure 29 also shows that the shafts are positioned too close to each other and the roller bearings collide. For the purposes of the tutorial, let's assume that the documentation of the gearing of the analysed gearbox was incorrect. We therefore correct the module in the two gearings in a suitable manner (Figure 30).

Correct the module for V2 & V2 to 1.25 and for V3 & V4 to 1.75.

Name V1					Name V2					
Position	x	85	mm	(Position	x	35	m	m 🗇	4
Width		1	b 20	mm	Width		ł	20		m
Number of teeth		1	25		Number of teeth		z	60		
Normal module		,	mn 1.25	mm	Normal module		r	nn 1.2	5	m
				1				3		-
Name V3	x	65	mm	•	Name V4	x	65	m	m (=	
Name <mark>V3</mark> Position Width	x	65	mm 25	* * mm	Name V4 Position Width	x	65	m	m	m
Name <mark>V3</mark> Position Width Number of teeth	x	65	mm 25 z 20	*	Name V4 Position Width Number of teeth	x	65	m 25 50	m 👍	







The correction for the gearing and subsequent positioning was successfully carried out (Figure 31).

4.3.6 Load

4.3.5.1 Torque

The designed input torque for the current gearbox according to $\underline{\text{Table}}$ <u>1</u> is 20 Nm.

Select 'Shaft 1' in the system tree, assign an element under the 'Loading' tab with '
 ' and select the type "Clutch' from the dropdown on the right (Figure 32). Assign the corresponding name.





The direction of torque can be defined either by its sign or by selecting 'Shaft is driven' / 'Shaft is driving'. Leave this at 'Own input'.

Select 'Shaft 3' in the system tree, assign an element under the 'Supports' tab with ' + and select the type 'Coupling for reaction torque' from the dropdown on the right (Figure 33). Assign the corresponding name.

-				Figure 33
File Calculation Report Grap	ohics Extras Help			
🗋 🗁 💾 🚳 遇 🔚	5			
System B System Shafts Group 1 Shaft 1 Group 2 Shaft 2 Group 3 Shaft 3 Bl.1 'Generic 6204'	General Geometry Loading Supports	Sections Settions		ନ୍ ହ ଭ ଭ ଶ ଶ *
B1.2 'Generic 6204' B2.1 'Generic 6205' B2.2 'Generic 6205' B3.1 'Generic 6206' B3.2 'Generic 6206' Positioning ♥ Gear connections V1-V2	Rolling bearing x=10mm, 'B3.1' Rolling bearing x=90mm, 'B3.2' Coupling reaction moment x=140mm, 'Reaction	n coupling'	Coupling for reaction torque Image: Coupling for reaction coupling Image: Coupling for reaction coupling	x 140 mm (=) b 0 mm

Please note that the display width of a coupling, as well as its activation in modal analysis for the 'Coupling for reaction torque', has no relevance for this calculation.

4.3.6.2 Rotational speed

Before the calculation can be activated, the gearbox should be assigned the usual input speed.



Select 'Shaft 1' in the system tree

and assign a speed of 1000 rpm

under the 'General' tab (Figure

This concludes the input of the

representation of this gearbox.

parameters for the mathematical

34).

4.3.7 Optimisation



It is assumed that, within the scope of the preceding task, the total height of the gearbox needs to be limited due to spatial

constraints in the application. One possible approach could be relocating Group 2 and Group 3.





The optimisation to save vertical space was successful (Figure 42).

Figure 42

Group 1



5. Calculation

5.1 Settings

For gear calculations, the "required service life H" should be defined in the 'Settings' window of the system tree/system if possible (Figure 43). This value is considered not only in the evaluation of the gearing but also in the calculation of shaft strength according to DIN 743. For further information, please refer to the manual under <u>Required Life</u> and <u>Strength Calculation</u>.

File Calculation Report Gra	aphics Extras Help			
🗋 🗁 💾 🔇 📑 🕯				
System 🗗	MOCUE			
✓ System	1116202	Shaf	t Calculation	
✓ Shafts	Engineering Consulting Software AG			
✓ Group 1				
Shaft 1	Project name 2-Stage Gearbox			
✓ Group 2				
Shaft 2	Calculation description Starter Tutorial Shaft Systems			
✓ Group 3	Cattings Lubrication Disclassical			
Shaft 3	Settings Lubrication Display settings			
Bearings B1.1 'Generic 6204'	Consider weight	🕂 Housing r	material Steel	~ 🔶
B1.2 'Generic 6204'	Angle for weight	β _w -90 Housing t	emperature	T _h 20 *C
B2.2 'Generic 6205'	Calculate natural frequencies	Required	ife	H 20000 h
B3.1 'Generic 6206' B3.2 'Generic 6206'	Consider gyroscopic effect	😔 Bearing re	liability	S 90 %
Positioning	Maximum frequency	f _{max} 1000 Hz Strength c	alculation	Infinite life according DIN 743 $\qquad \lor$
V1-V2	Consider gears as stiffness	Increase shaft diameter \sim	sition	Definition for each bearing \checkmark
V3-V4	Consider gears as point load	Gear is load only	mations	According Hutchinson
		Increase shaft diameter		-
	Consider housing stiffness	3D-model using central nodes	er nonlinear shaft model	
		3D-model		Figure 42
		3D-model with teeth		Figure 43
		L	4	

Additionally, a selection should be made for the possible settings under "Consider gears as stiffness" (Figure 43). For example, when selecting 'Increase shaft diameter', the shaft diameter is automatically increased to the root circle diameter plus 0.4 * module. For the root diameter a dedendum of the reference profile of 1.25 is assumed. Please refer to the manual under <u>Consider gears as stiffness</u> for further details on the corresponding settings.

5.2 Calculation step

The calculation step can be carried out via the menu item 'Calculation'/Calculate', directly via the icon under the ribbon or simply by pressing F5.

File	Cal	culation	Report	Graphics	Extras	н
	9	Calcula	te		F	5

Please start the calculation.

Pay attention to the green tick at the bottom right, which confirms the consistency of the calculation step.

6 Results

6.1 Overview

The 'Result overview' at the bottom of the window shows the most important results (Figure 44). Its contents can be configured as required via the menu Extras / Result overview.

Result overview			
Minimal bearing reference life	minL10rh 11032.4 h Minimal bearing modified reference life	minLnmrh 2269.89 h	Minimal static safety for bearings (ISO 17956) minS0eff 4.20323
Maximal equivalent stress	maxSigV 67.7519 MPa Minimal root safety for gears	minGearSF 2.59302	Minimal flank safety for gears minGearSH 0.977094
Maximal displacement in radial direction	maxUr 0.0232341 mm Maximal displacement in x	maxUx 0.00340038 mr	n

Figure 44

8

 It becomes evident that by selecting a higher synthetic viscosity and cleanliness class for the lubricant, the modified reference service life (Figure 45) could be significantly increased to the <u>value H</u>.



		ISO VG 460 sy	nthetic oil			\sim Oil lubrication without on-line filter ISO4406 -/15/12					
Result overview											
Minimal bearing reference life	minL10rh 110	032.4 h	Minimal bearing modified reference life	minLnmrh [31996.5 h	Minimal statio	safety for bearings	(ISO 17956) minS0eff 4.20323			
Maximal equivalent stress	maxSigV 67.7	.7519 MPa	Minimal root safety for gears	minGearSF	2.59302	Minimal flank	safety for gears	minGearSH 1.08441			
Maximal displacement in radial direction	maxUr 0.02	0232341 mm	Maximal displacement in x	maxUx	0.00340038 m	nm					

Figure 45

The results overview also displays results depending on the activated license. In the present example calculation, the gear calculation was activated, even though the corresponding inputs were not edited.

1.03106

Kw

κ,

1

Кна 1.25

Semin 1.4

1

Tip relief

Root relief

Surface roughness flank

Web thickness

Number of meshe

Reversed bending

Mean stress influence factor

Life factor limit for 10¹⁰ cycles

Life factor limit for 1010 cycles

Flank modification (f7Ca)

Contact pattern

Surface roughness root

If the need arises to use the license for spur gear calculation, the gear calculation can be activated as shown in Figure 46 and evaluated based on the relevant input and output data. We would like to refer to additional literature or the manual under <u>Gear connections</u> for further details.

6.2 Overview of Gear Connections

General Geometry

Dynamic factor

Mesh load factor

Face load coefficient

Limited pitting allowable

Required safety factor root

Required safety factor flank

Profile modifications compensate deflections

6.2.1 Gear calculation

System

System Shafts

Group 1

Group 3 Shaft 3

Shaft 1 Group 2 Shaft 2

Bearings B1.1 'Generic 6204

B1.2 'Generic 6204'

B2.1 'Generic 6205' B2.2 'Generic 6205'

B3.1 'Generic 6206

B3.2 'Generic 6206 Positioning

Gear connections

V1-V2 V3-V4

Figure 47

The gear calculation can be opened by selecting the gear pair in the system tree under Gear connections (Figure 47). The gear parameters can be edited here, and upon closing the gear calculation, the inputs will be read back into the system.

Reference profile Details for strength

	Co	lor			Color		
Shaft	Shaft 1		~	Shaft 2		~	
Gear	V1		~	V2		\sim	
Position	85			35			mm
Number of teeth	25			60			
Width	20			20			mm
Profile shift coefficien	it 0			0			
Normal module		mn	1.25	5	mm		
Normal pressure angle		an	20		•		
Helix angle		β	0]•		
Helix direction	Spur gear		~	Spur ge	ar	\sim	
Center distance	а	53.125		mm			
Circumferential backl	j.	0.1		mm			
Gear mesh stiffness		cγ	20		N/mm/	μm	*
Efficiency		n	100		%		

C. 0

C_f 0

R_{zH} 6

R_z, 18

b, 0

N_M 1

YM

Z_{NTim} 0.85

No

1

Y_{NTim} 0.85

None

Unproven

0

0

6

18

0

1

1

0.85

0.85

~ No

μm

um

um

μm

mm

~

6.2.2 Results of gear calculation

In the 'Gear connections' window (Figure 48), the torques, safety factors for bending strength and pitting resistance (SF / SH), as well as the maximum and average load distribution across the face width (wmax / wavg) according to ISO 6336 are displayed for each gearing.

In the lower window, performance data, geometric data, and profile shift factors (x1 / x2) are displayed.

Helix modification					None				~	
System P										
System 1	✓ Cylind	rical gear	pairs T1 [l	Nm] T2 [Nm]	SF1	SF2	SH1	SH2	wmax/wavg	
 System Shaftr 	V1	-V2	2	0.00 48.00	2.65	2.77	1.22	1.31	1.10	
× Group 1	V3	-V4	-4	8.00 -120.00	2.09	2.82	1.08	1.20	1.40	
Shaff 1	Planet	ary gear se	ets II[T11	Nmj iz (inmj Nasil To (Nasil	13 [IVM]	551	5F2	515	211	
× Group 2	Bever	jear pairs	71.0	Nmj iz (Nmj Nmj T2 (Nmj	201	362	511	302	CD.	
Shaft 2	worm	gears	T1 ()	Nmj 12 (Nmj Nmj 12 (Nmj	55	21	244	51	DC	
Y Group 3	Palt co	ngs	. Cani	ning iz (Ning						
Shaft 3	Delt Co	mections	s smi	n rmin(N)						
✓ Bearings										
B1.1 'Generic 6204'										
B1.2 'Generic 6204'										
B2.1 'Generic 6205'		V1-V2	V3-V4							
B2.2 'Generic 6205'	Shaft 1	Shaft 1	Shaft 2							
B3.1 'Generic 6206'										
B3.2 'Generic 6206'	Shaft 2	Shaft 2	Shaft 3							
Positioning	P [W]	2094.4	2094.4							
Gear connections	· ·									
V1-V2	n1 [rpm]	1000	-416.667							
V3-V4	n2 [rpm]	-416.667	166.667							
	- topolog									
	u	2.400	2.500							
	a [mm]	53,125	61.25							
	a fuund		0.1125							
	mn [mm]	1.25	1.75							
	alaba [°]	20,0000	20,0000							
	aibua []	20.0000	20.0000							
	beta [°]	0.0000	0.0000							
		25	20							
	z1	20	20							
	z2	60	50							
	×1	0.000	0.000							
Figure 49	x2	0.000	0.000							
rigui e 48								- 11		



6.3 Load spectrum

A load spectrum can be entered via the system window under the Settings tab. This allows access to the corresponding input window through the system tree. For more details, please refer to our <u>Shaft Starter Tutorial</u> or the manual under <u>Calculation with load spectrum</u>.

Consider load spectrum

6.4 Graphical Representation of Results

6.4.1 Specific

In addition to numerous other graphics available under the Graphics menu for evaluating the gearing, the line load and gap width over position for the current calculation are shown below (Figure 49).



Fn: Normal force

Fht[.]

Force in the transverse plane (here Fbt = Fn)

The gap width indicates the distance between the flanks if the load transfer were to occur at a single point. In the present case, a flank line correction based on a maximum gap width of 0.45 μ m would not be economically justifiable.

The diagrams (Figure 49) were generated using the <u>Increase shaft diameter</u> setting. Tooth engagement stiffness, shaft stiffness, and bearing stiffness influence these diagrams. Additionally, manufacturing errors and housing stiffness also affect the real gearbox.

6.4.2 Graphics Menu

A large selection of graphical result visualisations is available via the 'Graphics' menu (Figure 50).





The graphics can be docked to the main programme interface with the current outputs and are automatically updated after each calculation (Fig. 51). Drag the graphics into the results overview or under the menu bar.



Figure 51

6.4.3 Export



MESYS wünscht Ihnen eine lehrreiche und gewinnbringende Erfahrung mit unseren Tutorials. Bitte wenden Sie sich bei Unklarheiten, Anregungen oder Fragen, ungehindert an <u>info@mesys.ch</u>.