Machinery Bearing Tutorial

This tutorial teaches you how the Adams/Machinery Bearing module can be used to create a model of a bearing using the detailed method of type deep groove ball bearing single row. This also demonstrates how bearing module is being incorporated into other Adams/Machinery modules with ease.

This chapter includes the following sections:

- What You Will Create
- Creating Bearing Module
- Simulation
- Adams/PostProcessor Results

What You Will Create

During this tutorial, you will model a Planetary Gear Set (imported) consisting of Sun gear, Ring gear and Planetary gears mounted on the carrier. Bearing of method "Detailed" of type "Deep Groove Ball Bearing Single Row" is used to mount the Sun gear on the shaft. Impose motion is applied to the bearing. The bearing will transmit the motion to the Sun gear and to the shaft accordingly.



Figure 1 Bearing Module

Creating Bearing Module

In this section, you will create a Planetary Gear Set (imported) consisting of Sun gear, Ring gear and Planetary gears mounted on the carrier.

- 1. Start Adams 2013.2 \rightarrow AView \rightarrow Adams View.
- 2. From the welcome screen click Existing Model.



3. For the File Name browse and select the Planetary Gear set.cmd and click OK.

Open Existing Model	x
Open an Existing Model	
File Name hinery\examples\Planetary Gear Set.cmd	
Use File Directory as Working Directory	
Working Directory	
Echo Commands Update Screen	
Display Model Upon Completion	
On Error:	
C Continue Command C Ignore Command C Abort File	
OK Cance	<u>; </u>

- 4. Click the Machinery tab on the Adams/View ribbon.
- 5. From the **Bearing** container, click the **Create Bearing** icon.



6. The bearing creation wizard will launch. On the first page (Method) select Detailed from the Method option menu and click Next.

Create Bearing					×
Step 1 of 5	Method	Туре	٠	Geometry	•
Method	Detailed				
	A force is used to step based on the is based on user-s characteristic geo manufacturers. Th of the bearing com service life predict	represent the bearing. Sti positions and velocities a specified factors. Also, a l metry values for many cat is method provides a far n npliance than the complian ion based on industry sta	iffness is calcula at the bearing loc ibrary can be use talog bearings fro nore accurate rep nt method. It also ndards.	ted at every ation.Damping ed to lookup om several presentation o allows for	
≝ 			< <u>B</u> ac	k <u>N</u> ext >	Close

7. On the next page (**Type**) select **Deep Groove Ball Bearing Single Row** from the **Type** option menu and click **Next**.

p 2 of 5	Method	٠	Туре	•	Geometry	Þ
Ту	/pe Dee	p Groove Ball Bea	aring Single Row			
	A sir	gle row deep groo	we ball bearing			
				< <u>B</u> ack	Next >	Close

8. On the next page (**Geometry**) enter values for Bearing Location field as mentioned below. Select the bearing of your choice from the available manufacturer catalog by entering the diameter for **Bore** or **Hub**. For this example select **NSK** from the manufacturer list and enter the value **20** for bore diameter. Select **OWN INPUT** for bearing clearance and enter **-2um**. Accept the default values for the remaining fields and click **Next**.

4	Tupe			ometry		Connection		
	type			eometry	· · · ·	Connection		
Bearing Name	Bearing_1	<u>.</u>	Axis of Rotat	ion Global Z 💌	0.0,0.0,0.0	_		
Bearing Location	0.0.10		Bearing Geor	metry Scaling	· 1	•		
create Bearing	From D	atabase C	With User Input					
Miset X 0.0	Offset	Y 0.0	Offset Z	0.0 Misalignme	nt X 0.0	Misalign	ment Y 0.0	
onstraint RA	DIAL ONLY	-	Bearing Clear	ance OWN	INPUT •	2.0E-003		
							e e e e e e e e e e e e e e e e e e e	
lanufacturer	FAG	TIMKEN	NSK TS	SKF IT INA IT K	OYO T I	BC F F	(RW	
Diameter 20	Bore	Hub Availa	able Bearings :	NSK 6804 (d=20mm	D=32mm, B	=7mm)		•
Diameter 20 Show Geometry	Bore	Hub Availa	able Bearings:	NSK 6804 (d=20mm	D=32mm, B	=7mm)		•
iameter 20 Show Geometry	Bore	Hub Availa	able Bearings:	NSK 6804 (d=20mm	, D=32mm, B	=7mm)		•
Diameter 20 Show Geometry Ball Pitch Diamete	Bore	Hub Availa	able Bearings :	NSK 6804 (d=20mm	D=32mm, B Static Load	=7mm) I Rating	2470.0	•
biameter 20 Show Geometry Ball Pitch Diamete Inner Raceway Ra	Bore O	Hub Availa 26.0	able Bearings : Number of Ba : Ball Diameter	NSK 6804 (d=20mm alls 13.0 r (Dw) 3.490561658	D=32mm, B Static Load Fatigue Load	=7mm) I Rating ad Limit	2470.0	•
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iameter 20 Show Geometry Iall Pitch Diamete Iner Raceway Ra Duter Raceway Ra	r (Dpw) dius (ri) adius (ro)	Hub Availa 26.0 1.81509206 1.84999767	able Bearings : Number of Ba Ball Diameter Diametral Clear	NSK 6804 (d=20mm alls 13.0 r (Dw) 3.490561658 rance 2.0E-003	D=32mm, B Static Load Fatigue Loa Dynamic Lo	=7mm) I Rating ad Limit ad Rating <u>N</u> ext	2470.0 121.8496030 4000.0	lose
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9. On the next page (Connection) you define how the bearing is to be connected to the rest of the model. For this example, pick "Sungear" for shaft and "sun_gear_mtg" for housing which mount sungear to shaft. Provide angular velocity around the rotational axis as input for the motion using a step function via function builder as shown below by clicking the radio button **On** from the impose motion field. Choose **Both** for force display field. Accept the default values for the remaining fields and click **Next**:

•	Geom	etry	•	Con	nection	•	Completion)
Shaft	Sungear_Plan	et_set_ H	ousing	Sungear_M	Itg			
Impose Mo	otions	On C Of	I					
DoF	Туре	f(t	ime)	Disp. IC	Velo, IC			
Rot Z*	velo(time) =	▼ step(tin	ne,0,0,1 .	0.0				
Tra Z	free	•						
Force Disp	lay Both	•				1		
Axial Dam	ping Factor	0.1	 Radia	I Damping F	actor 0.1			
Bending D	amping Factor	0.1	Torsic	onal Dampin	n Factor User F	unction - 0	* time	
		1						
•		_					1	1 .
						< <u>B</u> ack	Next >	

10. The next page (**Completion**) informs you that all the information required for the bearing creation has been entered. Here, optionally save the content of the entire wizard to a file for re-use later by clicking the **Save** icon. Click **Finish** to create the bearing.

Step 5 of 5	ing					
4	Geometry-bearing	٠	Connections-bearing	•	Completion	•
Clic min	ck the finish button to creat nutes depending on the det	te the beari ail of the ge	ng as specified.Please note t cometry specifications	his may take	e a few	
•				< <u>B</u> ack	Einish	Close

11. From the Bearing container, click the **Bearing output** icon.

Machinery								
0, ¢	٢	° ©	69	° 0	69	0		
Gear	6 I.	B	elt	Ch	ain	Bearing	Cable	Motor

12. Pick the recently created bearing "Bearing_1" for the bearing name. Make sure **Service Life** from the detailed section is selected as it is available by default. Choose your lubricant properties from the available options in the **Lubricant Properties** section. For this example, choose **Oil** for lubricant type, **Other** for manufacturer, **Mobilgear 600 XP 220** for lubricants and click **OK**.

A Bearing Output
Bearing Name Bearing_1
Motion
Rotational
Displacement Velocity Acceleration
Translational
Displacement Velocity Acceleration
Bearing Forces
Force Torque
Radial Axial Bending Torsion
Detailed 🔽 Stiffness 🔽 Damping 🔽 Service Life
Lubricant Properties
Type 🖸 Oil O Grease Manufacturer Other 💌
Lubricants Mobilgear 600 XP 220
Temperature(C.) 55.0 Failure probability 10.0 %
Service life is predicted based on ISO/TS 16281. The curve points can be interpreted as the predicted bearing service life in hours under the speed and load conditions at that moment in the simulation.
OK Cancel

Simulation

Simulate your model for 2 seconds at 200 steps by clicking the **Interactive Simulation** icon from the **Simulate** container on the **Simulation** tab, entering the values shown below and clicking the **Start Simulation** button.



- 1. Modify the Bearing clearance (operating condition) value as follows:
 - a. From the graphics window right-click the Bearing ("Bearing_1") and select Modify.

- b. Accept the default options and values for Method and Type Page.
- c. In the **Geometry** page, modify the bearing clearance value from **-2um** to **-2.5um** as shown below.

4	Type	٠	Geometry-bear	ing •	Connections-	bearing
Bearing Name Bearing Location	Bearing_1	10.0	Axis of Rotation	ilobal Z 💌	0.0, 0.0, 0.0 1	
Create Bearing Offset X	From D	atabase C V Y 0.0	Vith User Input Offset Z 0.0	Misalignmer	nt X 0.0 Misalig	gnment Y 0.0
Diameter 20.0	@ Bore C	Hub Availat	ve Bearings : NSK (5804 (d=20mm,	D=32mm, B=7mm)	
Show Geometry						
Show Geometry Ball Pitch Diame	ter (Dpw)	26.0	Number of Balls	13.0	Static Load Rating	2470.0
Show Geometry Ball Pitch Diame nner Raceway R	ter (Dpw) ladius (ri)	26.0	Number of Balls Ball Diameter (Dw)	13.0 3.490561658	Static Load Rating Fatigue Load Limit	2470.0

- d. Accept the default options in the **Connection** page.
- e. In the next page (Completion) click Finish to complete the bearing modification.
- 2. Before running the simulation, rename the "Last_Run" to "XXXX.Bearing_W_Clearance_neg_2micrometer".



3. Now simulate your model for 2 seconds at 200 steps by clicking the **Interactive Simulation** icon from the **Simulate** container on the **Simulation** tab, entering the values shown below and clicking the **Start Simulation** button.



4. Switch to PostProcessor by clicking plotting icon from the Simulation Control.



Adams/PostProcessor Results

Explore the results in Adams/PostProcessor. Compare the results of the predicted bearing service life before and after modification as shown below by selecting the items highlighted in blue and then by clicking "Add Curves" button under various loading conditions.



The plot shows that the bearing operating condition (Input) is having significant influence on the bearing service life (output).