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**Availability:** ISIS

**Major System:** ENGINES

**Current Language:** English

**Other Languages:** NONE

**Viewed:** 15089

**Document ID:** IK1201012

**Revision:** 9

**Created:** 11/11/2013

**Last Modified:** 9/16/2015

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Coding Information

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**Title:** SPN 731 FMI 16 Knock Detected: Cylinder Acceleration above Normal

**Applies To:** All 2010 MF 11/13, 2013+ N13 Big Bore Engines with the latest 3.15 Software Level (Calibration ID xxxxARxx or higher)

## CHANGE LOG

09/16/2015 - Updated related fault codes references.  
 01/02/2015 - Fixed link in Step 8, IK1200646  
 11/19/2014 - Update Repair Procedure and Diagnostics. Remove FMI 18 now located at IK1201209

## DESCRIPTION

This document will guide the user through diagnostics and repair procedures for SPN 731 FMI 16. It is important to thoroughly review the document as serious engine damage can occur if warnings are not heeded. As such, safeguards had been included in certain calibrations to prevent engine restart after the codes have been set.

**NOTE:** An interview with the driver of the unit at the time of the fault code setting is critical with assisting in the troubleshooting process.

**Common questions:**

- Was the vehicle in motion
- Was the unit in PTO
- Has this truck been down for major repairs recently

## SYMPTOMS

**Diagnostic Trouble Codes:**

DTC/Light	Description
SPN 731 FMI 16 (link to SARP)	Knock Detected: Cylinder Acceleration Above Normal

**Customer Observations or Concerns:**

- Red Stop Lamp with audible alarm
- Engine self shut-down
- Inability to restart engine
- Unrequested engine acceleration

**Fault Code Entry Conditions:**

731-16 Knock Detected: Cylinder Acceleration Above Normal		
Condition / Description	Setting Criteria	Enable Conditions / Values
The use of the CKP (Crankshaft position) sensor to monitor	An increase in crankshaft velocity without an increase in command	<ul style="list-style-type: none"> <li>• Vehicle Speed = 0</li> <li>• Engine speed &gt; 500 RPM</li> <li>• Accelerator pedal = 0%</li> <li>• Manual Transmission Clutch Pedal = Not Depressed</li> </ul>

power cylinder velocity		<ul style="list-style-type: none"> <li>• Coolant temperature is between -9 deg. C and 120 deg. C (15 deg. F and 248 deg. F)</li> <li>• Monitor enabled During Operating modes (Listed Below) Normal Operation</li> <li>• Stationary Regeneration</li> <li>• High Altitude</li> <li>• Medium Altitude</li> <li>• Sea Level</li> <li>• PTO</li> <li>• No Active Faults with (Listed Below)                             <ul style="list-style-type: none"> <li>◦ Coolant Temperature Sensor Faults</li> <li>◦ Clutch Switch Faults</li> <li>◦ Vehicle Speed Sensor Faults</li> </ul> </li> </ul>
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**Related Fault Codes:**

SPN	FMI	Description	Diagnostic Path
190	0	Engine Overspeed Most Sever Level	Reference IKnow <a href="#">IK1201048</a>
190	11	Engine Overspeed Vehicle Event	Continue with 731 diagnostics
190	15	Engine Overspeed Detected	Continue with 731 diagnostics
1322	31	Misfire - Multiple Cylinders	Reference Diagnostic Manual
132x	31	Misfire - Cylinder X(1-6)	Reference Diagnostic Manual
731	18	Knock Detected: Unexpected Fueling Without Demand	Reference <a href="#">IK1201209</a>

**SPECIAL TOOLS / SOFTWARE**

Tool Description	Tool Number	Comments	Instructions
Electronic Service Tool		ServiceMaxx, EZ Tech, ect	
Flywheel Timing Tool	Fabricated Tool	If necessary	Below

**Flywheel Timing Tool Assembly:**

Parts

- M6 x 25mm Bolt (15mm-30mm will work)
- 2" x 1" Clear Hard Plastic
- 1/4" drill bit
- Digital Caliper or equivalent
- Fine Tip Marker

Instructions

- 1) Drill a 1/4" hole, centered at one end of the clear plastic
- 2) Thread the M6 bolt through the hole
- 3) Measure 1.300 inches from the edge of the bolt using digital caliper and mark a line on the plastic
- 4) With the bolt-free end facing away, mark the right edge of the plastic with a marker, as shown in **Figure 1**



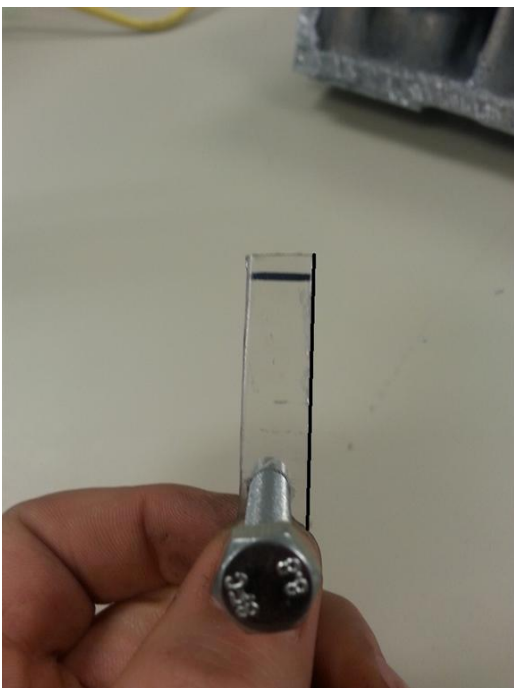


Figure 1: Flywheel Timing Tool

## SERVICE PARTS INFORMATION

Kit Description	Part Number	Quantity Required	Notes
Kit, HP Turbo Cartridge	2511792C91	1	Cartridge should be used unless guided to replace complete turbo by IKnow <a href="#">IK1200909</a>
Turbocharger Ass Hi Press 11L	3005698C9x	1	Cartridge should be used from complete unless guided to replace complete turbo by IKnow <a href="#">IK1200909</a>
Tube Assembly, Oil Supply	3018397C9x	1	Updated line
Kit, Turbo Supply Line Fitting	2512772C9x	1	Kit is needed if not equipped with new line prior to repair.
Prostar 122 Heater Hose Routin	2513145C91	1	Kit is needed if not equipped with new line prior to repair.
O-Ring, #118 0.862"x0.965"	1820907C2	1	If necessary
Kit, Flywheel 15.5 inch	7090698C91	1	For Manual Transmission

## DIAGNOSTIC STEPS

### Diagnostics for 731-16 Knock Detected: Cylinder Acceleration above Normal

Step	Action	Decision
1	<b>Inspect for oil in the Intake</b>  Remove boost air piping at the outlet of the turbo and outlet of the CAC. Inspect piping for large amounts of oil.  Is there a significant amount of oil present in the boost air piping?	<b>Yes.</b> Proceed to <b>Step 2</b>
		<b>No.</b> Proceed to <b>Step 3</b>
2	<b>Perform the following repairs:</b> <ul style="list-style-type: none"> <li>Replace Turbo Center Section (Refer to TSI <a href="#">13-12-05R1</a> for procedure).</li> </ul>	Go to <b>Step 8</b>

	<ul style="list-style-type: none"> <li>• Clean CAC (Refer to TSI-<a href="#">13-12-17R1</a>)</li> <li>• Verify that oil has not reached the DOC. If it has the DOC and DPF need to be removed to drain. (Refer to Open TSI's and Service Manual for procedure).</li> <li>• iApprove will need to be started and pictures are required for the inlet/outlet of the DOC (Diesel Oxidation Catalyst) and DPF (Diesel Particulate Filter). Location of the iApprove on the Vehicle Information Page, iApprove Tab</li> </ul> <p><b>Note: Verify the engine will bar over by hand before starting when repairs are complete.</b></p> <p>Note: None of the above repairs require pre-approval.</p>	
Step	Action	Decision
3	<b>Verify concern</b> Does the engine have a misfire or run rough?	<b>Yes.</b> Continue to Step 6.
		<b>No.</b> Proceed to Step 4.
Step	Action	Decision
4	<b>Review repair history</b> Interview driver and look up past repair history per Service Portal home page/warranty tab. Has the engine had any major engine repairs (Cylinder head, Pistons, rods, injectors)?	<b>Yes.</b> Proceed to Step 8.
		<b>No.</b> Proceed to Step 5.
Step	Action	Decision
5	<b>Review for mis-machined flywheel</b> Vehicle build dates within 8/1/2011 and 11/1/2011 are subject to a possible flywheel machining issue. Is the vehicle build date with in this range?	<b>Yes.</b> Proceed to Step 6.
		<b>No.</b> Proceed to Step 7.
Step	Action	Decision
6	<b>Check flywheel timing</b> Reference "Special Tools" for instructions on how build the <a href="#">Flywheel Timing Tool</a> . Reference "Test Procedures," <a href="#">Flywheel Timing Procedure</a> for timing mark inspection instructions Are the flywheel timing marks correct per the tool?	<b>Yes.</b> Proceed to Step 7.
		<b>No.</b> Replace the flywheel. Once repairs are complete proceed to Step 8.
Step	Action	Decision
7	<b>Perform cylinder balance testing</b> Reference Test Procedures > <a href="#">Cylinder Balance Procedure</a> for instructions. Are all the Crankshaft Angular Velocity values running close together?	<b>Yes.</b> Diagnostics complete
		<b>No.</b> Test for an internal engine issue Possible causes: <ul style="list-style-type: none"> <li>• Valve Adjustment out of Spec.</li> <li>• Sticking Intake Valves (reference IKnow article <a href="#">IK1201124</a>)</li> <li>• Internal engine loss of compression</li> </ul> After repairs are complete proceed to Step 8.
Step	Action	Decision
8	<b>Perform flywheel relearn procedure</b> <ul style="list-style-type: none"> <li>• Follow iKnow Article <a href="#">IK1200646</a> for procedure.</li> <li>• Once completed retest for the fault code.</li> </ul> Did the fault code return?	<b>Yes.</b> Proceed to Step 7.
		<b>No.</b> Diagnostics complete.

## TEST PROCEDURES

### Cylinder Balance Procedure:

1. Open EST (Engine Service Tool)
2. Connect to the engine
3. Go to Test/ KOER Test/ Cylinder Balance

4. Start the Engine and allow the Cylinder (x) Crankshaft Angular Velocity Data Values to stabilize.
5. Slowly accelerate the engine up to 1500 rpm keeping Actual Engine Torque (#2 in example below) below 150 lb/ft. Run engine at 1500 RPM for 5 min.
6. Referencing the values (#1 in example below). Locate the Cylinder (s) that are running out side or higher than the rest.

Example:

- Cylinder 1 - Value: 0.7
- Cylinder 2 - Value: -0.1
- Cylinder 3 - Value: -0.2
- Cylinder 4 - Value: -0.2
- Cylinder 5 - Value: -0.2
- Cylinder 6 - Value: -0.2

Cylinder 1 is reading the highest and is not consistent with other 5 cylinders that is the suspected cylinder causing the fault.

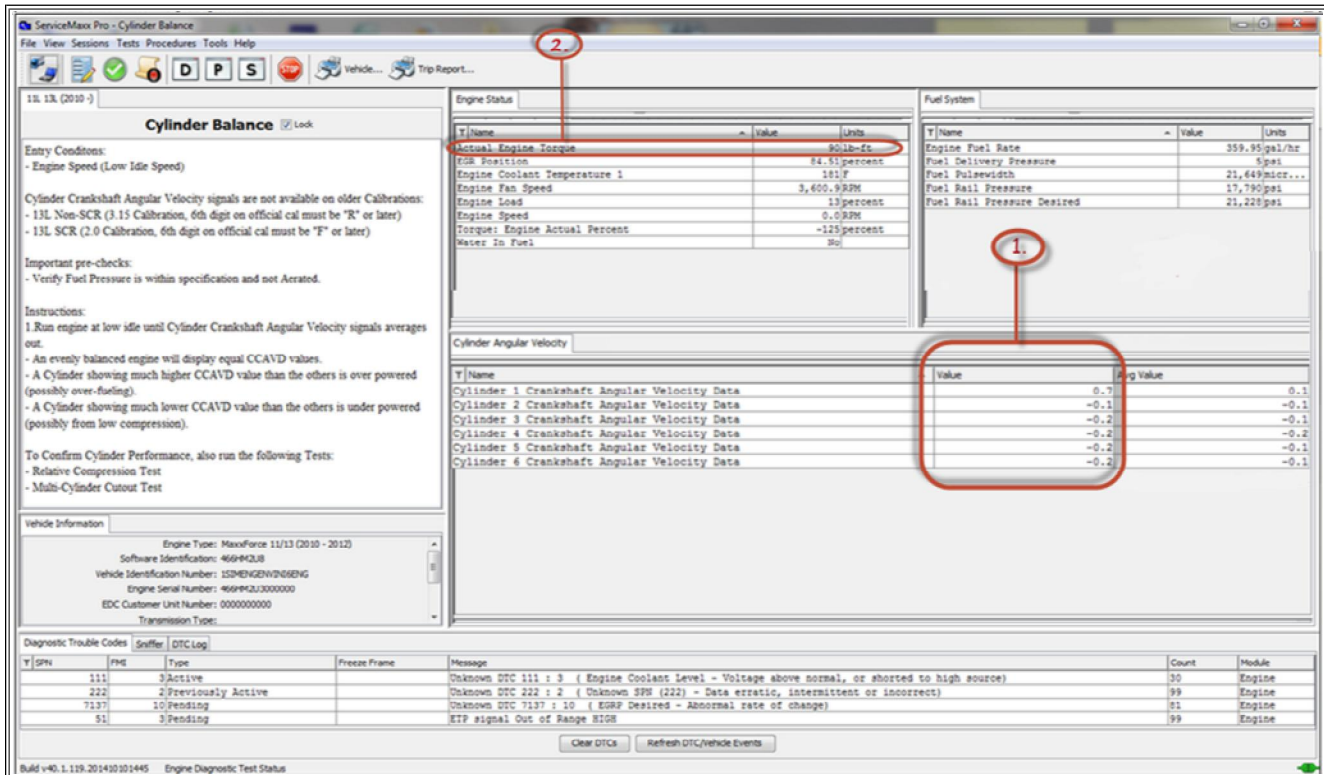


Figure 5. Screen Shot of Cylinder Balance Session

- Item 1: Cylinder (x) Crankshaft Angular Velocity Data - Values
- Item 2: Actual Engine Torque Value

**Flywheel Timing Procedure:**

1. Use a 7mm socket to remove the two screws securing the flywheel housing cover
2. Remove the plastic cover (use caution to ensure plastic tabs are not damaged)
3. Rotate the flywheel so the timing mark is visible in the window
4. Place the gauge (with marked edge towards ring gear) and pin in hole closest to the timing mark (bottom, next to timing hole).
5. Verify the timing mark aligns with the mark on the tool





**Figure 2: Flywheel Timing Tool Installed**

Note: Tool is angled away to show flywheel timing mark, relative to the tool mark.

## **WARRANTY INFORMATION**

### **Warranty Claim Coding:**

Step 1

<b>Group:</b>	12000 - Engine
<b>Noun:</b>	135 - Twin Turbo (High Pressure)

Steps 2-5

<b>Group:</b>	12000 - Engine
<b>Noun:</b>	Code to repairs made

### **Standard Repair Times:**

Step	Description	Chassis	Engine	SRT	Hours
1/2	Visual Inspection	ProStar+ 113/122	2010+ MF 11/13, 2013+ N13	<a href="#">R12-2117U</a>	0.3
		Transtar (8600)	2010+ MF 11/13, 2013+ N13	<a href="#">Q12-2117U</a>	0.3
		WorkStar	2010+ MF 11/13, 2013+ N13	<a href="#">N12-2117U</a>	0.3
		PayStar (5000)	2010+ MF 11/13, 2013+ N13	<a href="#">T12-2117U</a>	0.3
1	Turbo Center Section (Cartridge) Removal and Installation	ProStar+ 113/122	2010+ MF 11/13, 2013+ N13	<a href="#">R12-6135U-21</a>	2.3

		Transtar (8600)	2010+ MF 11/13, 2013+ N13	<a href="#">Q12-6135U-21</a>	2.3
		WorkStar	2010+ MF 11/13, 2013+ N13	<a href="#">N12-6135U-21</a>	2.3
		PayStar (5000)	2010+ MF 11/13, 2013+ N13	<a href="#">T12-6135U-21</a>	2.3
1	CAC Cleaning	All	2010+ MF 11/13, 2013+ N13	<a href="#">A09-3925A</a>	1.1
1	Calibration Update	All	2010+ MF 11/13, 2013+ N13	<a href="#">A12-3510A-20</a>	0.5
1	DOC/DPF Removal and Inspection	Horizontal Aftertreatment	2010+ MF 11/13, 2013+ N13	<a href="#">A12-4901</a>	0.9
		Vertical Aftertreatment	2010+ MF 11/13, 2013+ N13	<a href="#">A12-4903</a>	1.0
Tool	Flywheel Timing Tool Fabrication	All	2010+ MF 11/13, 2013+ N13	T-Time	0.5
5	Flywheel Timing Check	All	2010+ MF 11/13, 2013+ N13	T-Time	0.5
6/7	Electronic Service Tool Testing	All	2010+ MF 11/13, 2013+ N13	T-Time	0.3

[SRT Manual](#)

## **OTHER RESOURCES**

[2010 MaxxForce 11/13 Resource Center \(IK1200548\)](#)

[2010 MaxxForce 11/13 Diagnostic Manual](#)

[2010 MaxxForce 11/13 Service Manual](#)

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