SKF Microlog Frequency Response Function (FRF) Module

Selecting the correct hammer and hammer tip for Frequency Response Function testing

Selecting the correct hammer for FRF testing

Hammer model selection involves determining the size and mass of the hammer, which will provide the force amplitude and frequency content required for proper excitation of the structure under test. Each hammer's corresponding frequency response plots indicate the frequency content of the force impulse that can be achieved using the variety of supplied tips. An extender mass, supplied with most hammers, allows further tuning by concentrating more energy at lower frequencies. The hammer for the CMAC 5056, CMAC 5057 and CMAC 5058 kits has been selected as it offers the best options for general use.

Note: For more advice, please contact Paul Edwards of CMC Livingston at Paul.edwards@skf.com or +44 1752 316202.

Alternative hammers available

The CMAC 5056, CMAC 5057 and CMAC 5058 hammer kits contain the hammer shown in **Figure 1** (shown with mass extender connected).

Figure 1. Hammer with mass extender and black tip.

Hammer tips supplied

The CMAC 5056, CMAC 5057 and CMAC 5058 hammer kits are supplied with four different hammer tips to excite different frequencies:

- Hard hammer tip 
- Medium hammer tip (white or blue) 
- Soft hammer tip (black) 
- Super soft hammer tip (red) 

Note: Details on how to select the correct tip can be found later in this application note.

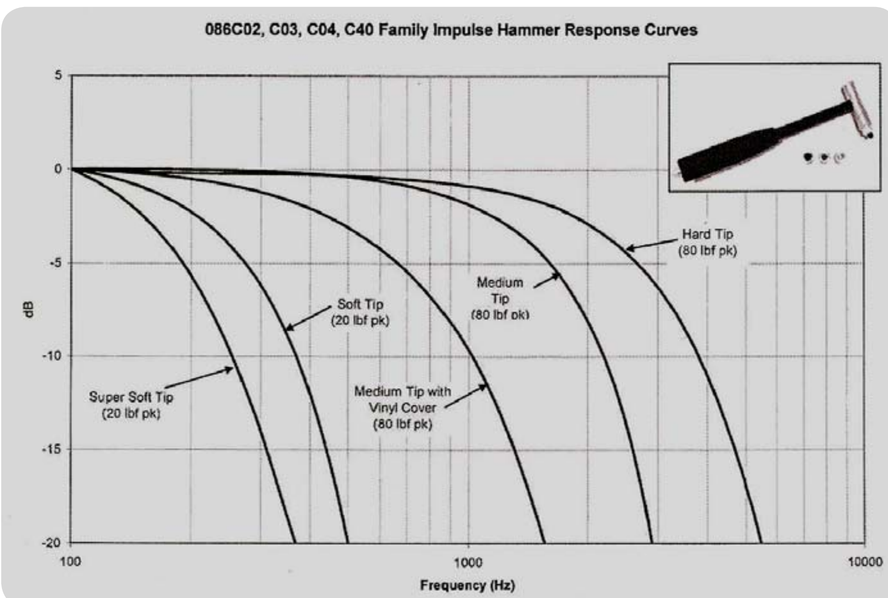

Figure 2. Impulse hammer response curves (CMAC 5056, CMAC 5057 and CMAC 5058 hammers).

Alternative hammer options

- **Mini, pencil-sized** (**Figure 3**), for testing very light structures such as compressor blades, disk drives, sheet metal parts and printed circuit boards at medium to very high frequencies.

Figure 3. Mini, pencil-sized hammers.

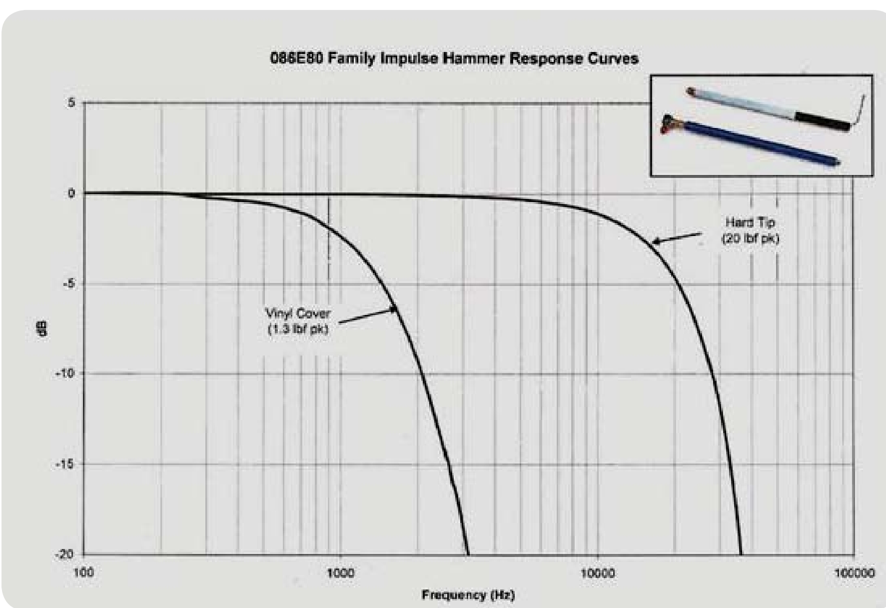

Figure 4. Impulse hammer response curves (mini, pencil-sized hammers).

- **Small sledge** (**Figure 5**), tests medium to heavy structures such as tool foundations and storage tanks at low to medium frequencies.

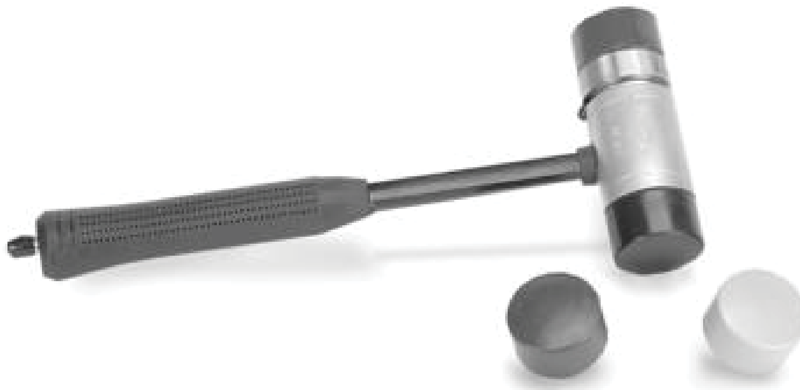

Figure 5. Small sledge hammer.

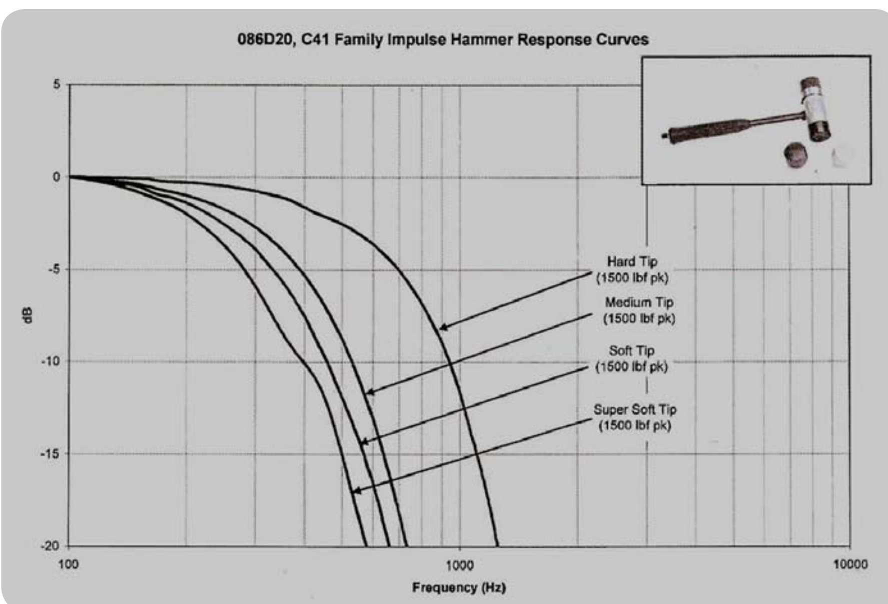

Figure 6. Impulse hammer response curves (small sledge hammers).

- **Large sledge** (**Figure 7**), tests very heavy structures such as buildings, locomotives, ships and foundations at low to very low frequencies.

Figure 7. Large sledge hammer.

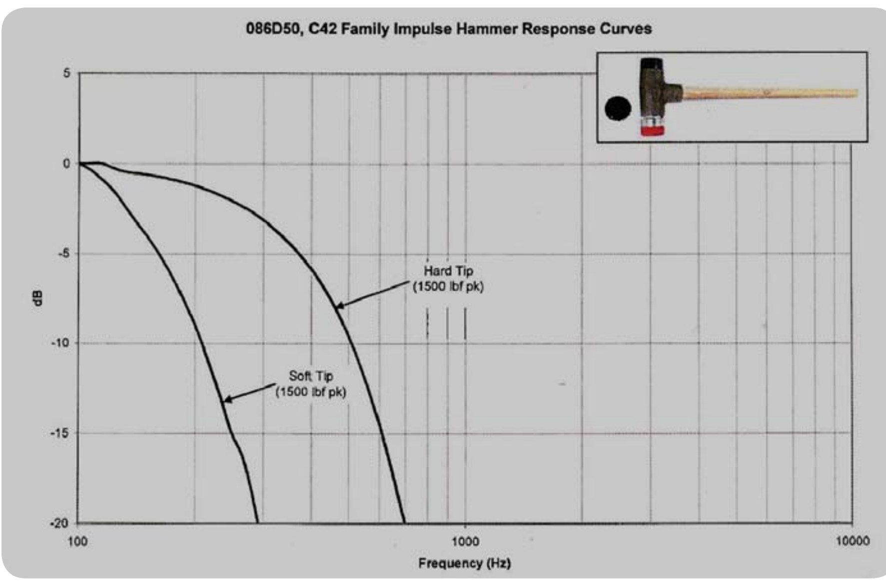

Figure 8. Impulse hammer response curves (large sledge hammers).

Precautions

Although hammers are very rugged in construction, damage can result from misuse. When observed, the following precautions can ensure long life and accurate data:

- Do not attempt to dismantle the sensor element from the hammer structure. All service should be performed at the factory.
- Never generate more than five times the rated impact force range with any hammer. Generally, observe the force rating for 5 V output. Excessive impact force may destroy the built-in miniature electronics.
- Never strike an object without an impact tip properly installed in front of the force-sensing element. Damaging the precision-lapped surface of the hammer sensor can affect its behavior.
- During testing, periodically check and tighten the tip, extender and cable connections to ensure continued proper operation. Machined flats in the tips and extender facilitate tightening and removal.
- Do not apply voltage to the unit without constant current protection.
- Do not apply more than 20 mA of current.
- Do not exceed 30 V supply voltage.
- Do not subject units to temperatures above 120° C *(250 °F)*.

Selecting the correct hammer tip

Hammer tip types

Selecting the correct tip is vital to get good quality data, so "How do we determine which tip to use?" As a rule of thumb, we say that when the excitation frequency drops by 3 dB, we have reached the Fmax for that particular tip. To work out which tip to use, we use the Bump Test module to check what Fmax the tip will excite versus the Fmax we will be selecting in the FRF module. For this test, there is no accelerometer used; the hammer is connected to CH1.

SKF Bump Test module set up

- **Step 1:** Connect the hammer to CH1.
- **Step 2:** Attach a tip.
- **Step 3:** Press **Start**.
- **Step 4:** Hit the structure.

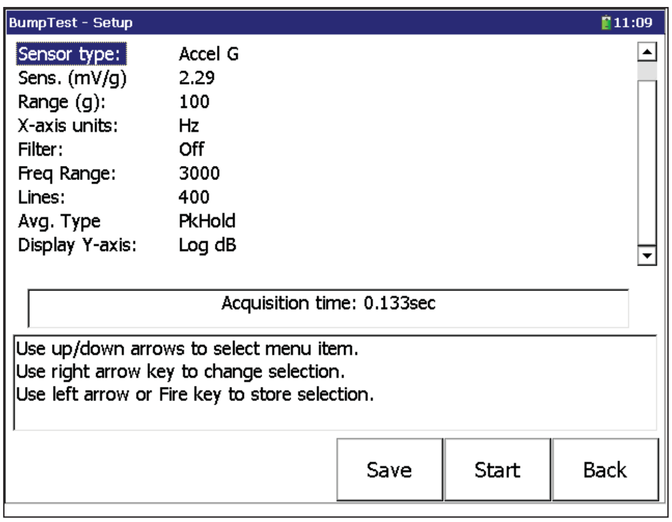

Figure 9. Bump Test – Setup screen.

Leave the **Sensor type** as **Accel G**, even though we have a hammer connected, and select the Fmax for the structure you will be testing.

Bump Test module result

Your result will look somewhat like the following:

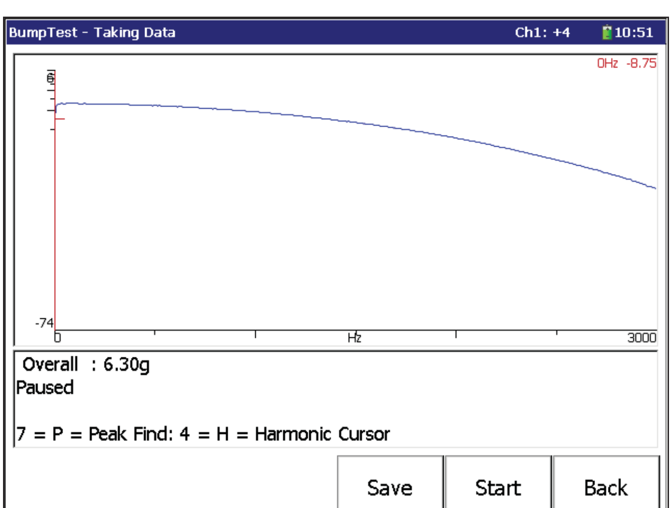

Figure 10. Bump Test – Taking Data screen.

Checking the Fmax for the tip

Move the cursor to a position where it is still on the flat part of the curve and read off the amplitude.

Figure 11. Bump Test – Taking Data screen.

Move the cursor to the right until the amplitude has dropped by 3 dB. The Fmax shown is then the maximum frequency that particular tip can be used to. In the example in **Figure 12**, the Fmax for the tip is 1.088 kHz.

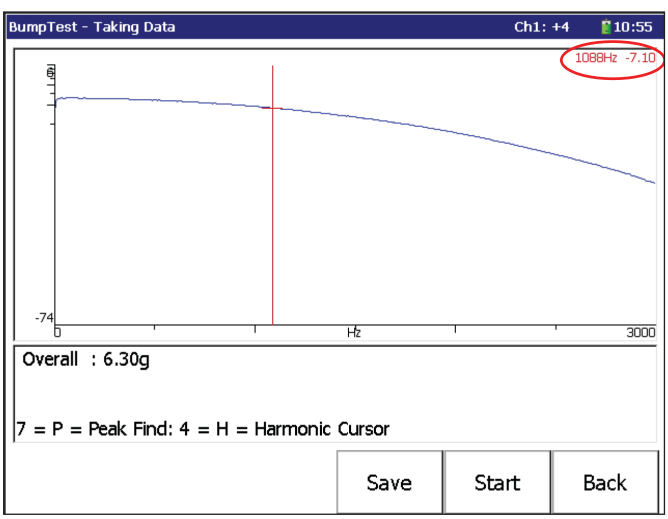

Figure 12. Bump Test – Taking Data screen.

If the desired Fmax has not been achieved, replace the tip with a harder one and repeat the test.

Considerations for the soft and super soft tips

When using the soft or super soft tips, you may not be able to impart enough energy into the system to excite the desired frequencies.

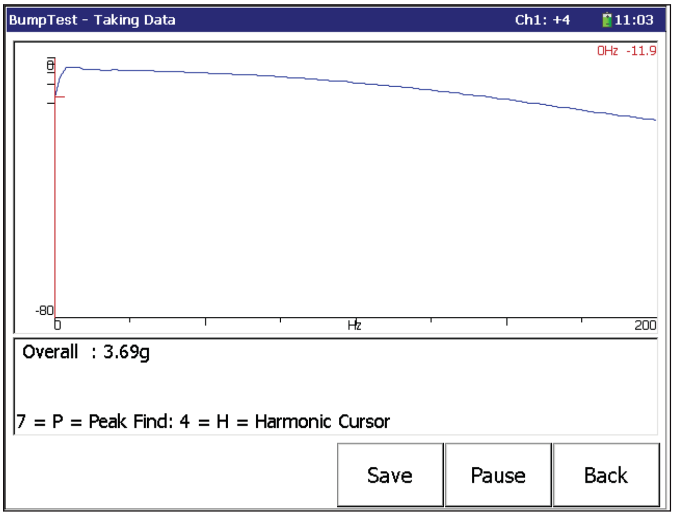

Figure 13. Bump Test – Taking Data screen.

In this case, you will need a bigger hammer! This is achieved by attaching the mass extender to the back of the hammer.

Figure 14. Mass extender.

Please contact:

SKF USA Inc.
Condition Monitoring Center – San Diego
5271 Viewridge Court · San Diego, California 92123 USA
Tel: +1 858-496-3400 · Fax: +1 858 496-3531

Web: www.skf.com/cm

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