1.1 Fitted insertion loss

The fitted insertion loss $IL_{\text{fitted}}$ as a function of frequency $f$ is defined in Equation (1).

$$IL_{\text{fitted}}(f) = a_1 \sqrt{f} + a_2 f + a_4 f^2 \text{ dB}$$  \hspace{1cm} (1)

Given the cable assembly insertion loss $IL$ measured between TP1 and TP4 over $N$ frequencies $f_n$ spanning 50 MHz to 7500 MHz, the coefficients of the fitted insertion loss shall be calculated as follows.

Define the frequency matrix $F$ as shown in Equation (2).

$$F = \begin{bmatrix} \sqrt{f_1} & f_1 & f_1^2 \\ \sqrt{f_2} & f_2 & f_2^2 \\ \vdots & \vdots & \vdots \\ \sqrt{f_N} & f_N & f_N^2 \end{bmatrix}$$  \hspace{1cm} (2)

The polynomial coefficients $a_1$, $a_2$, and $a_4$ shall be calculated as shown in Equation (3).

$$\begin{bmatrix} a_1 \\ a_2 \\ a_4 \end{bmatrix} = (F^T F)^{-1} F^T IL$$  \hspace{1cm} (3)

In Equation (3), “T” denotes the matrix transpose operator and $IL$ is a column vector of the measured insertion loss values, $IL_{n}$ at each frequency $f_n$.

The cable assembly insertion loss shall satisfy the requirements defined in Table 1. The fitted insertion loss corresponding to the maximum insertion loss at 5.15625 GHz and the maximum allowed values of $a_1$, $a_2$, and $a_4$ is illustrated in Figure 1.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Condition</th>
<th>Units</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion loss at 5.15625 GHz</td>
<td>Max.</td>
<td>dB</td>
<td>17.04</td>
</tr>
<tr>
<td>Fitted insertion loss, $a_1$</td>
<td>Max.</td>
<td>dB/root-GHz</td>
<td>6.0</td>
</tr>
<tr>
<td>Fitted insertion loss, $a_2$</td>
<td>Max.</td>
<td>dB/GHz</td>
<td>1.0</td>
</tr>
<tr>
<td>Fitted insertion loss, $a_4$</td>
<td>Max.</td>
<td>dB/GHz$^2$</td>
<td>0.08</td>
</tr>
</tbody>
</table>

Note – The limit on the insertion loss at 5.15625 GHz prevents the coefficients $a_1$, $a_2$, and $a_4$ from having the maximum allowed values simultaneously.
1.2 Insertion loss deviation

The insertion loss deviation $ILD$ is the difference between the measured insertion $IL$ and the fitted insertion loss $IL_{fitted}$ as defined in Equation (4).

\[ ILD(f) = IL(f) - IL_{fitted}(f) \]  \hspace{1cm} (4)

The $ILD$ shall be within the region defined by Equation (5) and Equation (6) for all frequencies from 50 MHz to 7500 MHz.

\[ ILD(f) \geq ILD_{\text{min}}(f) = -0.7 - 0.0002f \text{ dB} \]  \hspace{1cm} (5)

\[ ILD(f) \leq ILD_{\text{max}}(f) = 0.7 + 0.0002f \text{ dB} \]  \hspace{1cm} (6)
1.3 Justification for proposed requirements (NOT FOR INCLUSION IN THE DRAFT)

![Graph showing SDD21 magnitude at fundamental (dB) with frequency (GHz) on the x-axis and insertion loss (dB) on the y-axis.]

- $a_1$ (dB/root-GHz)
- $a_4$ (dB/GHz²)

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IEEE P802.3ba Task Force