

IEEE P802.3cy

Greater than 10 Gb/s Electrical Automotive Ethernet PHY Task Force

**Link segment measurements with
temperature and aging**

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Update

- Latest measurement results referring to [neulinger_3cy_01_12_15_20](#)
- Insertion loss measurement with temperature exposure and intermediate results of aging

Used limit line for insertion loss (IL)

- Sedarat proposal, [sedarat_3cy_01_01_12_21](#)

$$\frac{6.5}{15} \times (0.002 \times f + 0.68 \times f^{0.45}) \quad f \text{ [MHz]}$$




Cable

- Shielded Differential Pair (SDP) - AWG26 (0.14 mm²)
- Designed for frequency range up to 9 GHz
- Differential impedance of 100 $\Omega \pm 5 \Omega$




Connector system

- Shielded differential connector system
- Designed for frequency range up to 15 GHz

Link segments

	Length	Inlines
	11	2
	7	0
	7	2

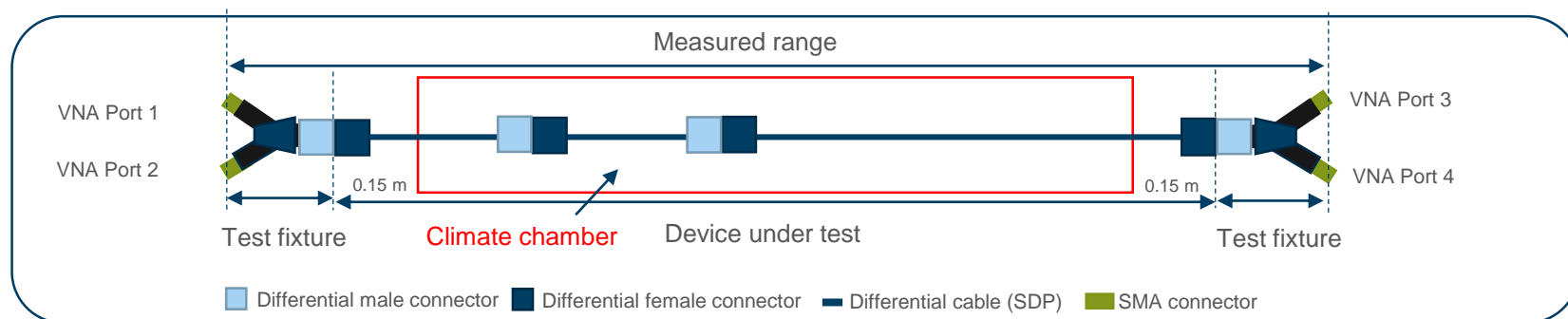
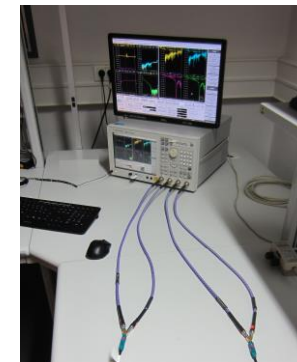
Same test samples as in
[neulinger_3cy_01_12_15_20](#)

-  Differential male connector
-  Differential female connector
-  Differential cable (SDP)

Settings

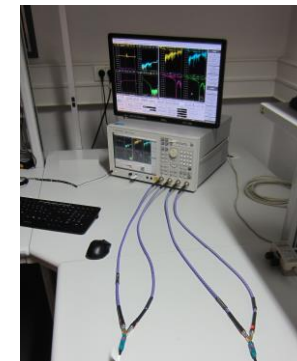
- Network analyzer: 20 GHz, test cables and calibration kit
- Fstart: 300 kHz, Fstop: 9 GHz, linear sweep
- Measurement Points: 1800, IF-Bandwidth: 1 kHz
- Use of precision test fixtures, losses not eliminated

Same settings as in [neulinger_3cy_01_12_15_20](#)



Aging

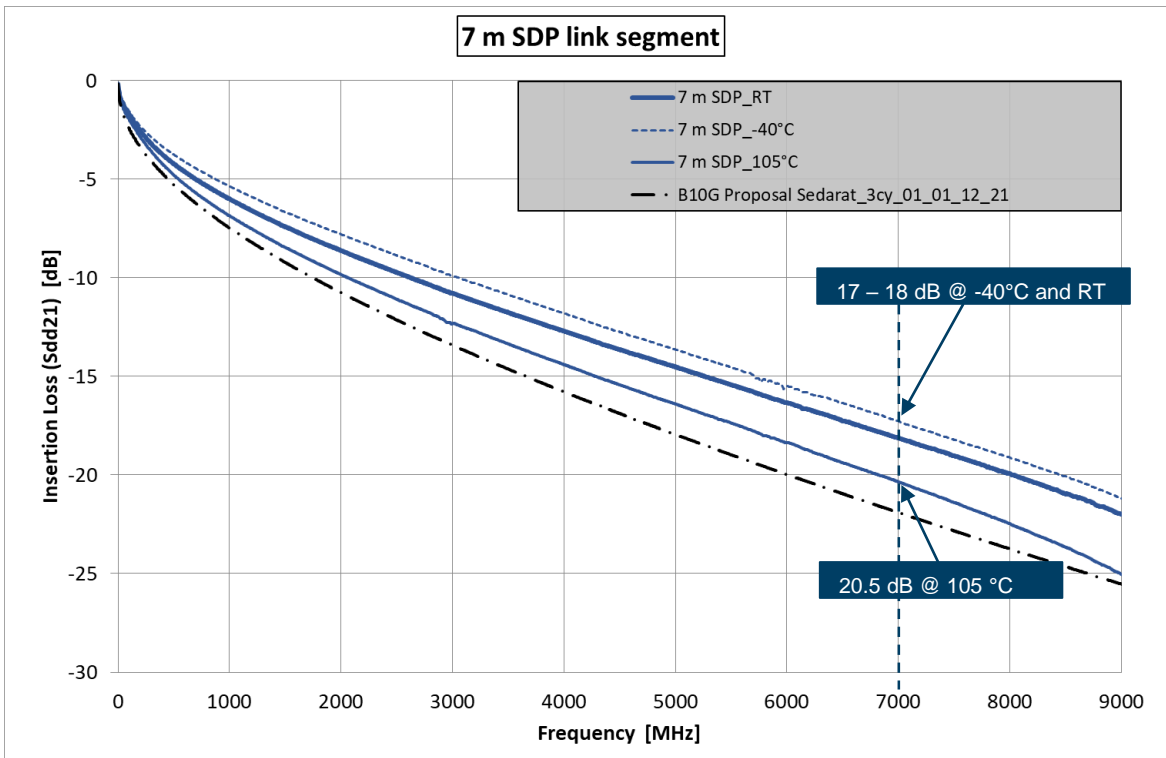
- Measurement in new condition
 - RT = 23°C
 - -40°C
 - RT = 23°C
 - 105°C
- } No aging, measurement after 60 min temperature exposure
- Long-term heat aging @ 105°C → Both ends of DUTs in climate chamber
 - Intermediate measurement after 620 h aging (~25 days)
 - RT = 23°C
 - -40°C
 - RT = 23°C
 - 105°C
- } Measurement after 60 min temperature exposure
- Further long-term heat aging @ 105°C



Measurement results for presentation

Link segment measurements

7 m – Insertion loss – new condition - temperature

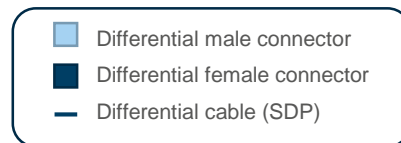


Topology:



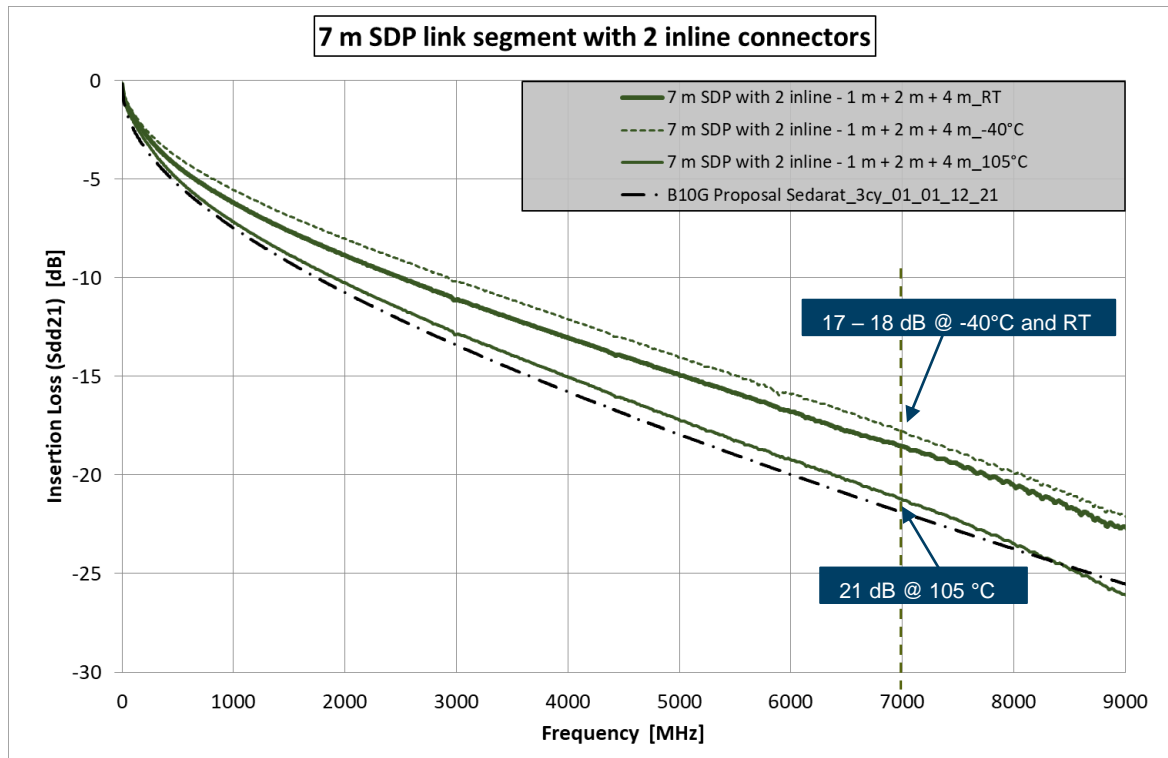
New condition:

- proposed Sedarat limit line is fulfilled



Link segment measurements

7 m – Insertion loss – new condition - temperature

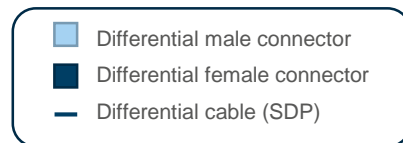


Topology:



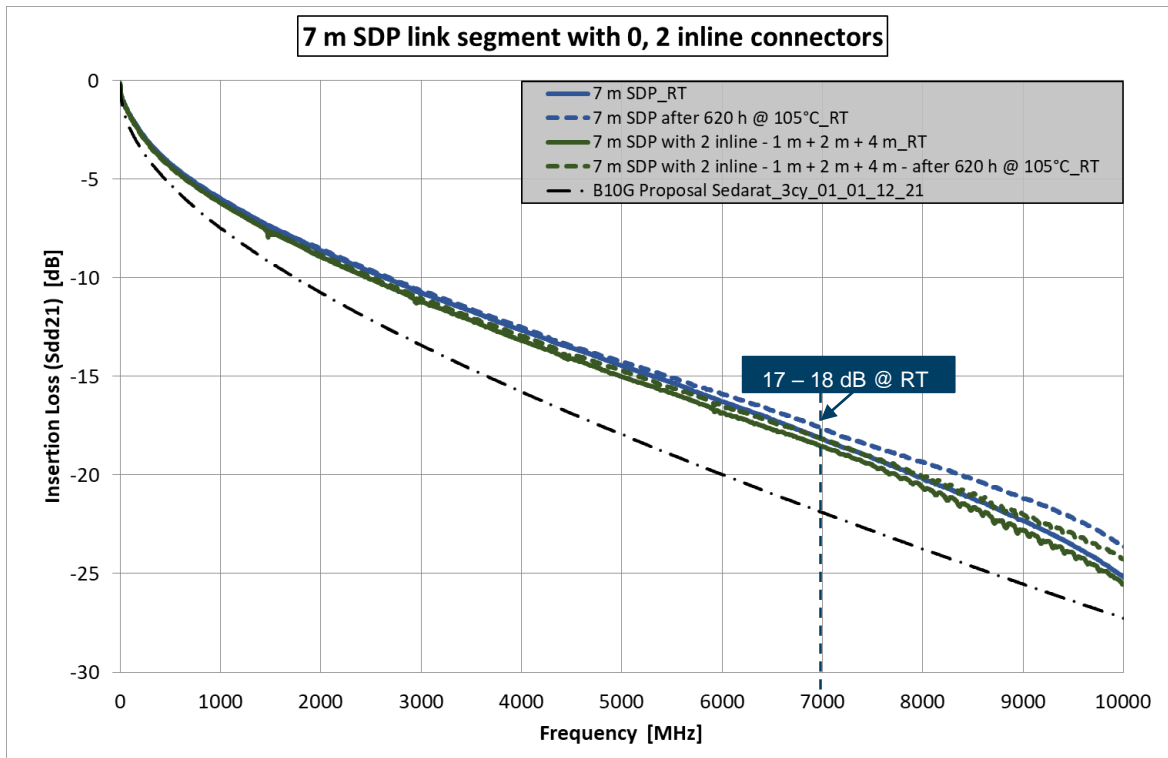
New condition:

- worst case: 7 m with 2 inline @ 105°C, the proposed Sedarat limit line calculated for 6.5 m is crossed

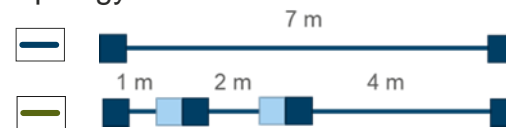


Link segment measurements

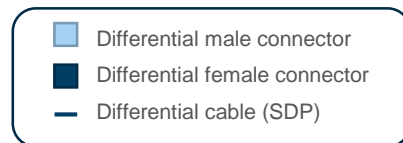
7 m – Insertion loss – new condition and long-term aging



Topology:

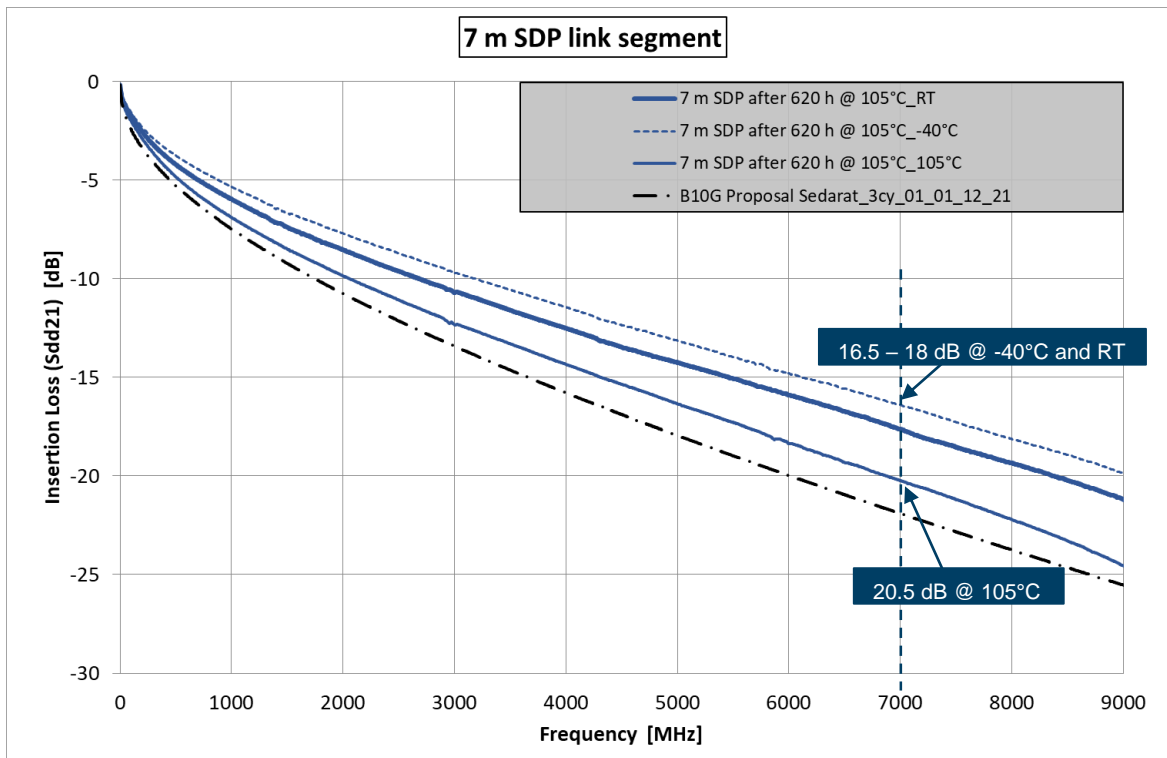


- New condition and aging show no significant change of IL



Link segment measurements

7 m – Insertion loss – long-term aging - temperature

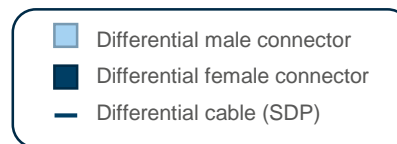


Topology:



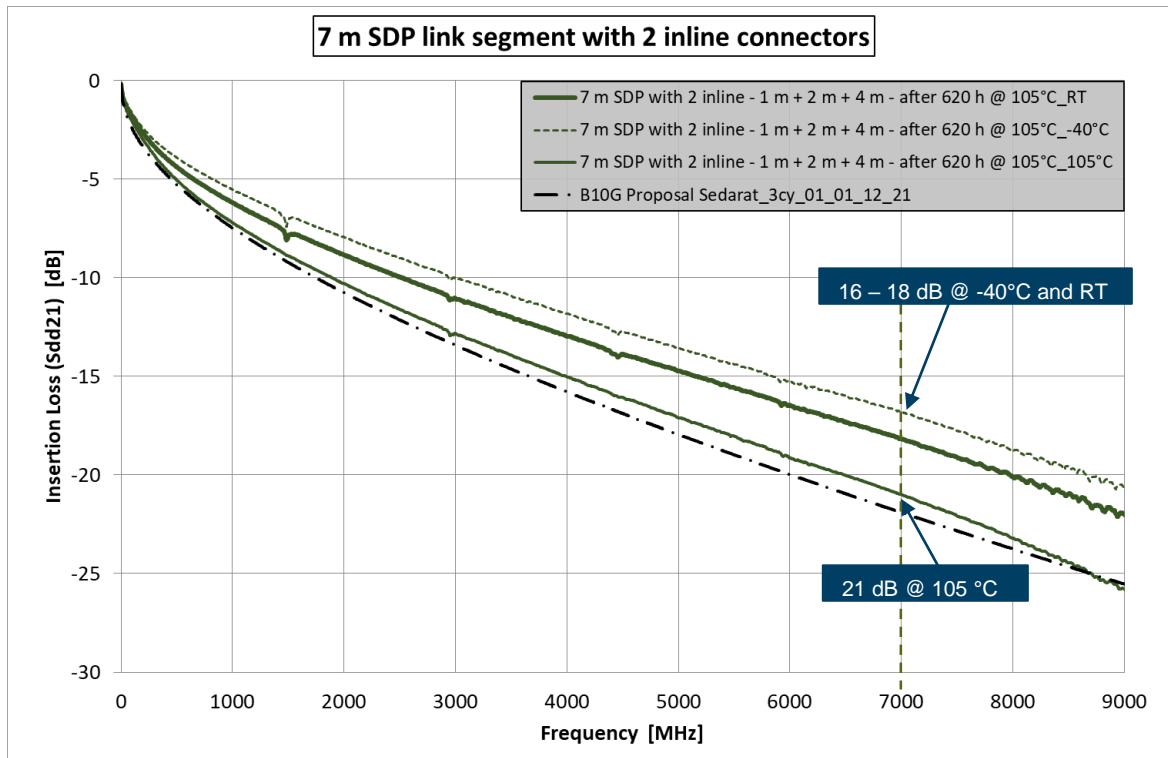
After 620 h aging:

- proposed Sedarat limit line is fulfilled



Link segment measurements

7 m – Insertion loss – long-term aging - temperature

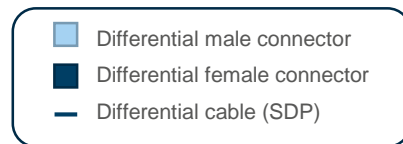


Topology:



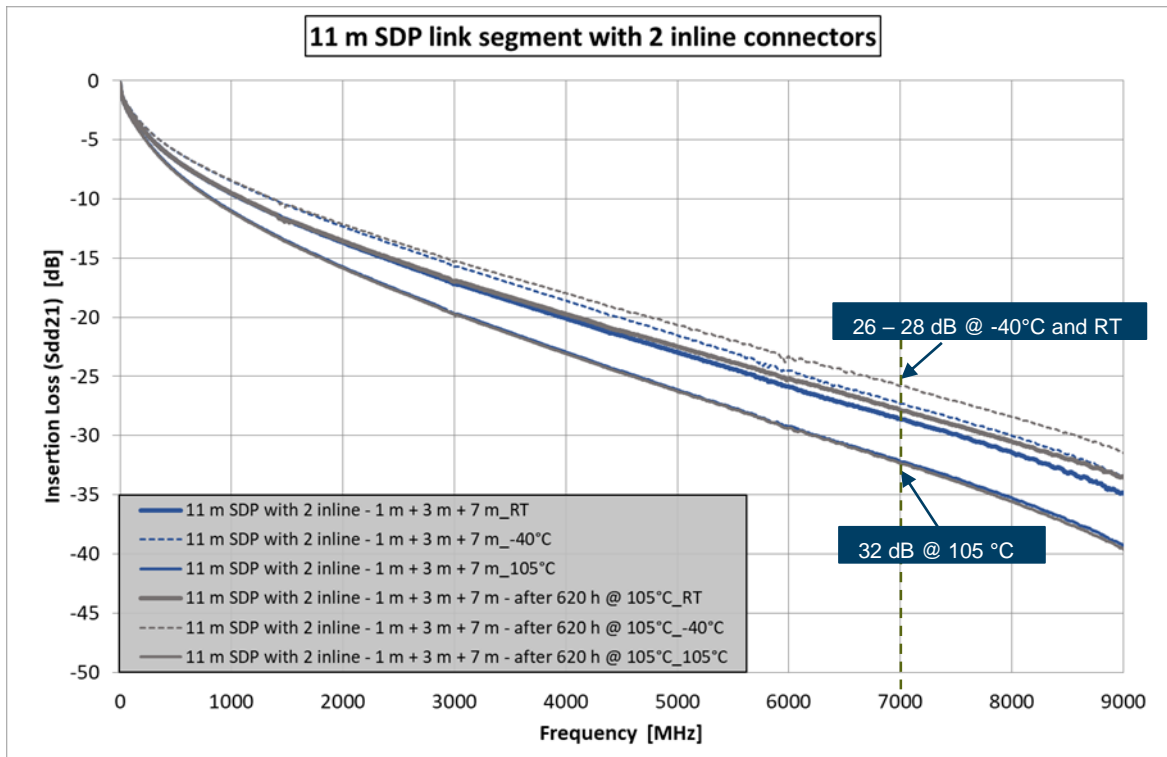
After 620 h aging:

- worst case: 7 m with 2 inline @ 105°C, the proposed Sedarat limit line calculated for 6.5 m is crossed



Link segment measurements

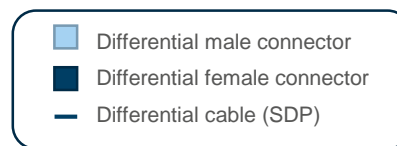
11 m – Insertion loss - new condition and long-term aging



Topology:



- New condition and aging show no significant change of IL
- 105°C significant influence on insertion loss



Conclusion

- Sedarat limit line [sedarat_3cy_01_01_12_21](#) is maximum for 7 m AWG 26 cable and manufactured link segments, margin for higher temperature and long-term aging included, (see also [BergnerCuestaDiBiaso_3cy_01a_01_19_21](#))
- SDP - AWG 26 cable is still in development → up to 10 GHz possible

Influence of temperature and aging

- Long-term aging has no significant effect on insertion loss behaviour (so far)
- High temperature has significant influence (IL @ Nyquist frequency: ~ RT + 4 dB)

11 m: limit line according to objectives

- Consideration of PHY complexity and now available components for link segment
- Higher IL budget or lower loss at relevant link segment components?



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