IEEE C57.91

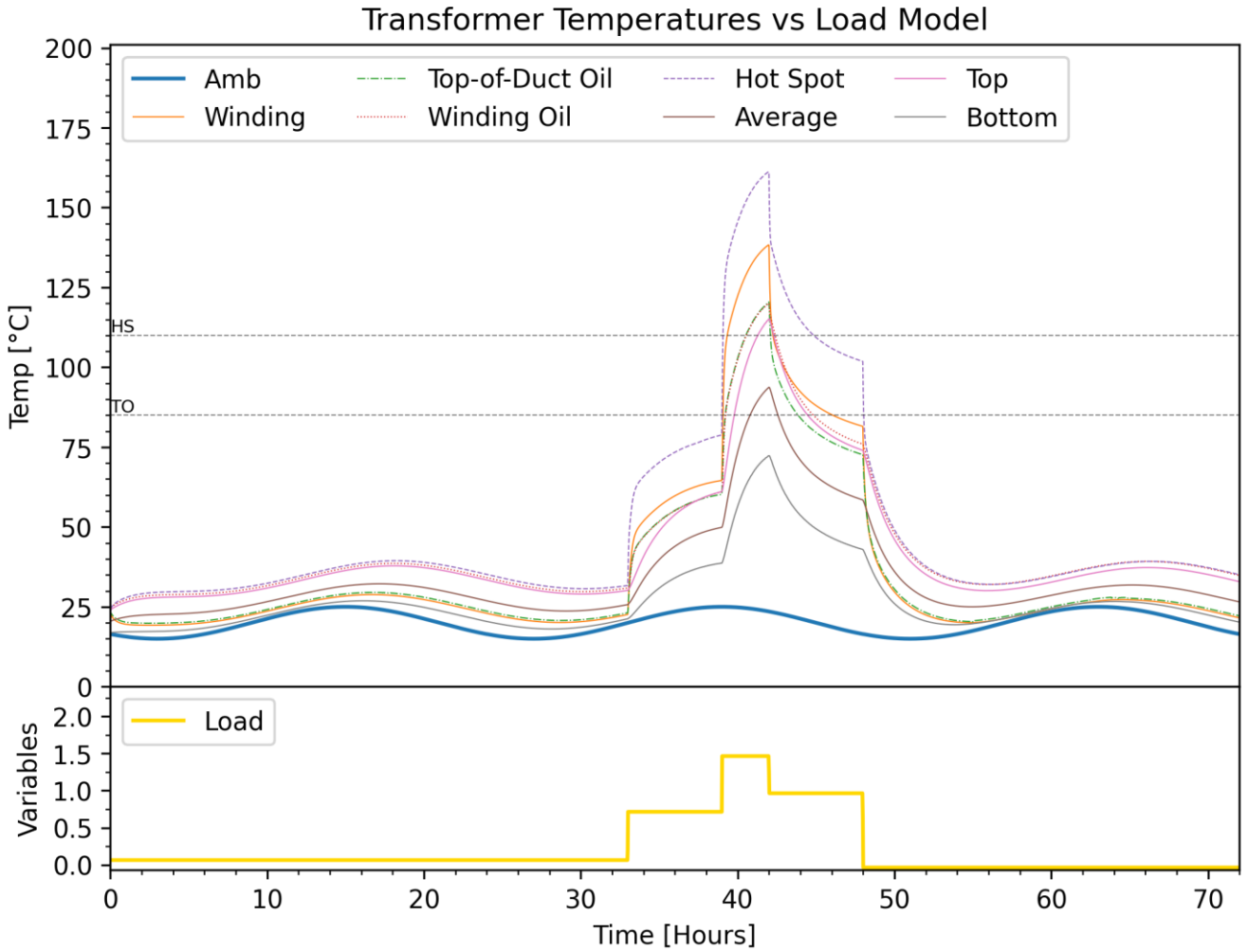
Organization of code

- Transformer Class:
  - Holds transformer thermal properties.
- Load-Conditions Class:
  - Ambient temperature
  - Load
  - Cooling system
  - Energized state
- Series of methods can be applied given combination of the two classes.
- Functional form:
  - For one transformer, run X number of load conditions, etc.
  - All temperatures plotted versus time
  - Extract desired thermal quantities (hot spot, top oil temperatures)
- TBD: Automate extracting desired quantities
  - Time to rated temperature
  - Table of acceptable loading given rated temperature, %RUL constraint, etc.

Code

- TBD open source python code (see options from IEEE)
  - Differential equations not easily solved in Excel (VBA), higher level language is easier.
- Annex G and Clause 7 solved with Runge-Kutta 4-5.
  - Can also be solved with finite difference method, but RK45 seems better in tests
  - Using RK45 consistent with general thermal modeling practices.
- Code validated on one transformer
  - Would be nice to have more

Output



Cooling System: ONAN	Winding Material: COPPER	Fluid Type: OIL
Rated $T_{ambient}$: 30.0	Rated $T_{windings}$: 93.0	Rated $T_{hotspot}$: 110.0
Height of Hotspot: 1.0	Energy of Hotspot: 1.0	Winding Timing: 5.0
$P_{winding}$: 51690.0	P_{eddy} : 0.0	P_{stray} : 21078.0
P_{core} : 36986.0	$P_{core\ overexcited}$: 36986.0	

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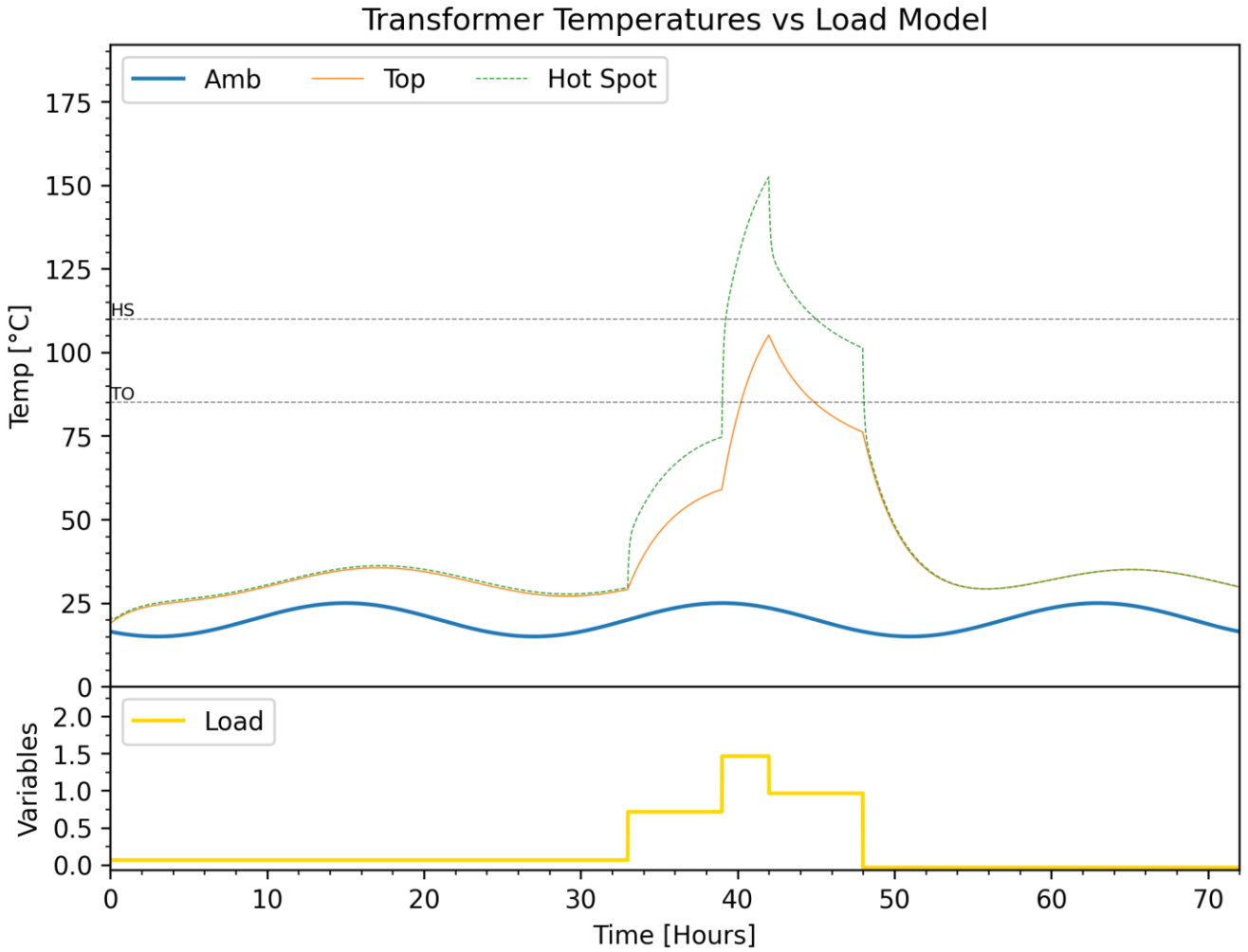

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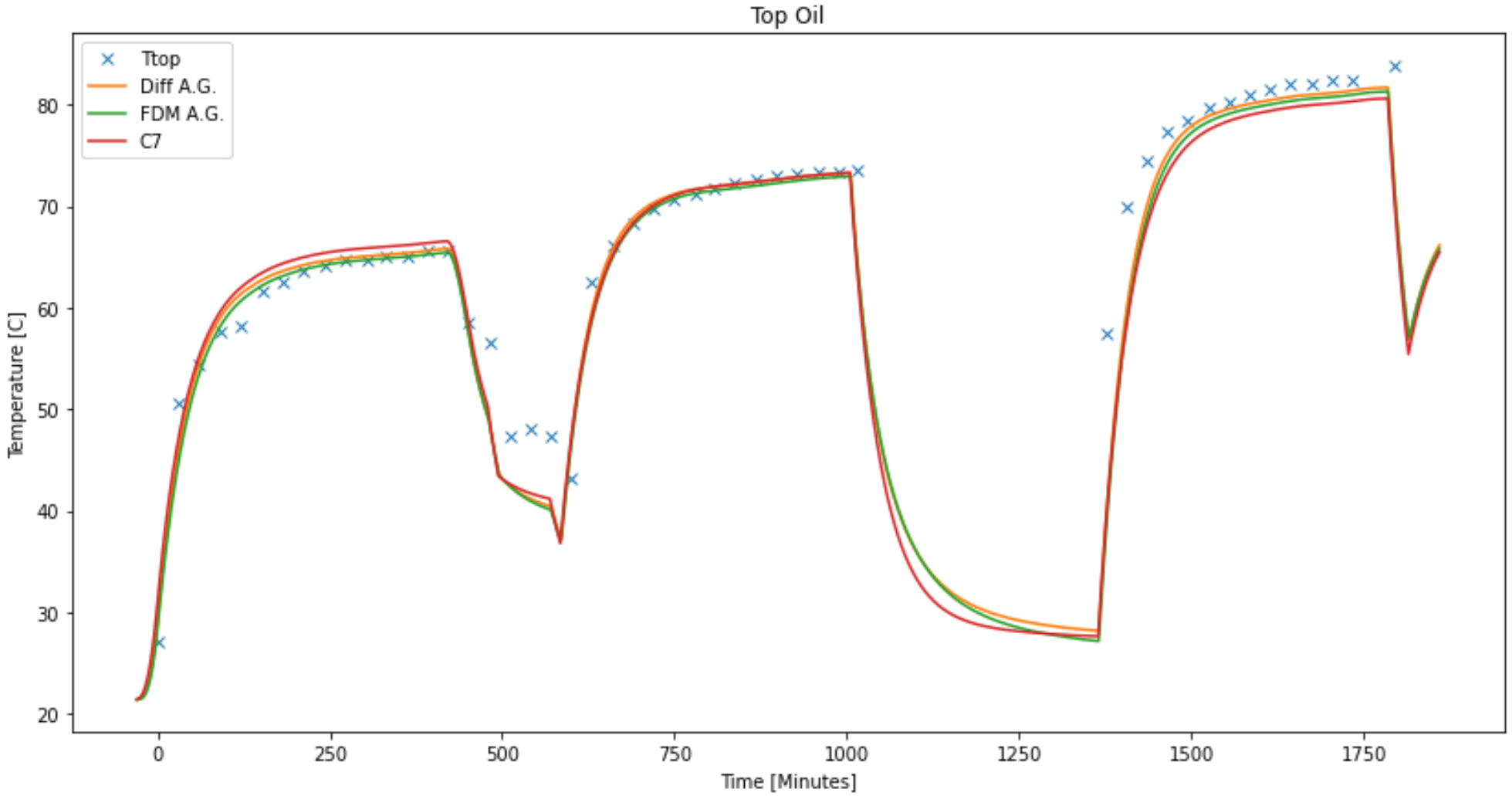
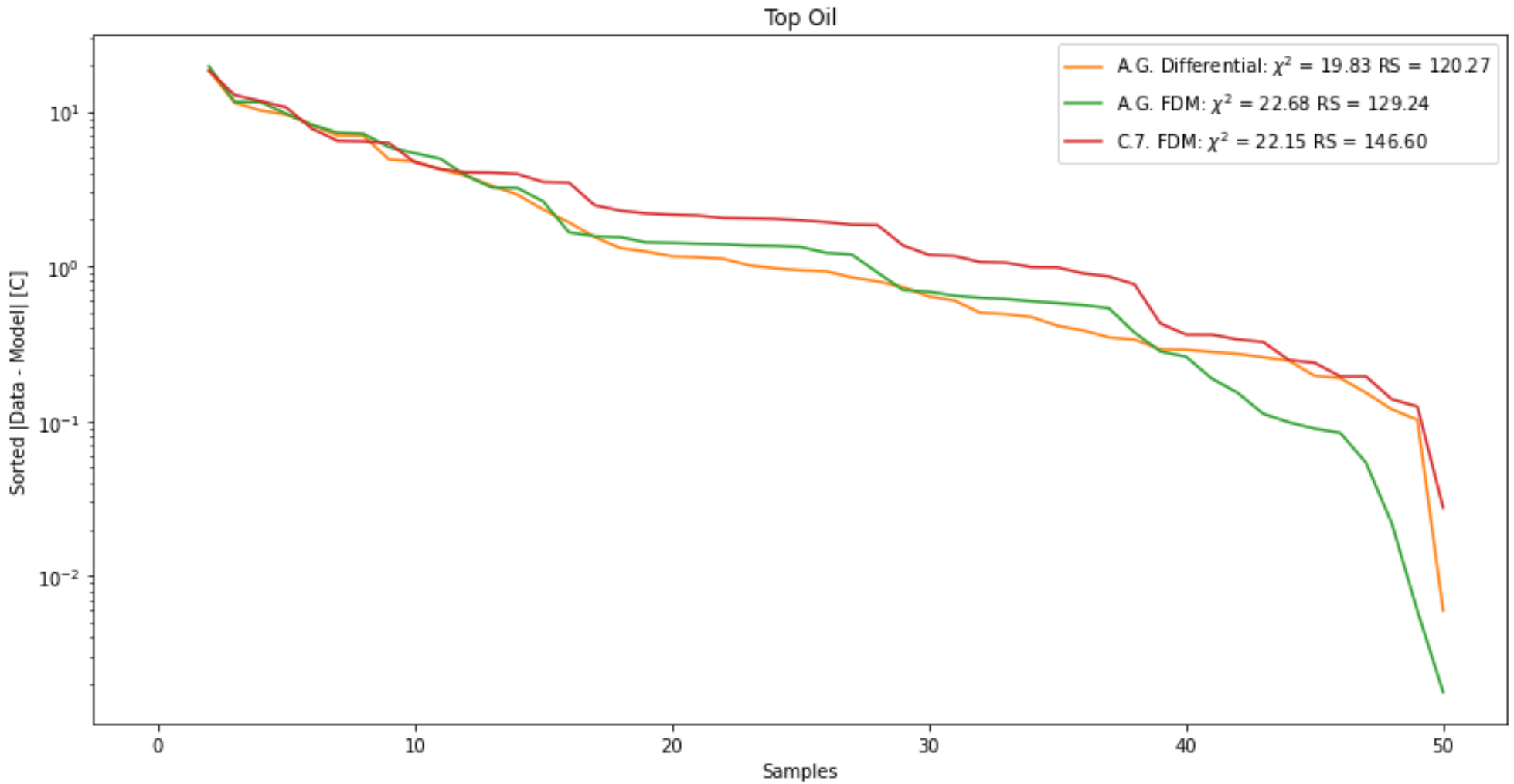
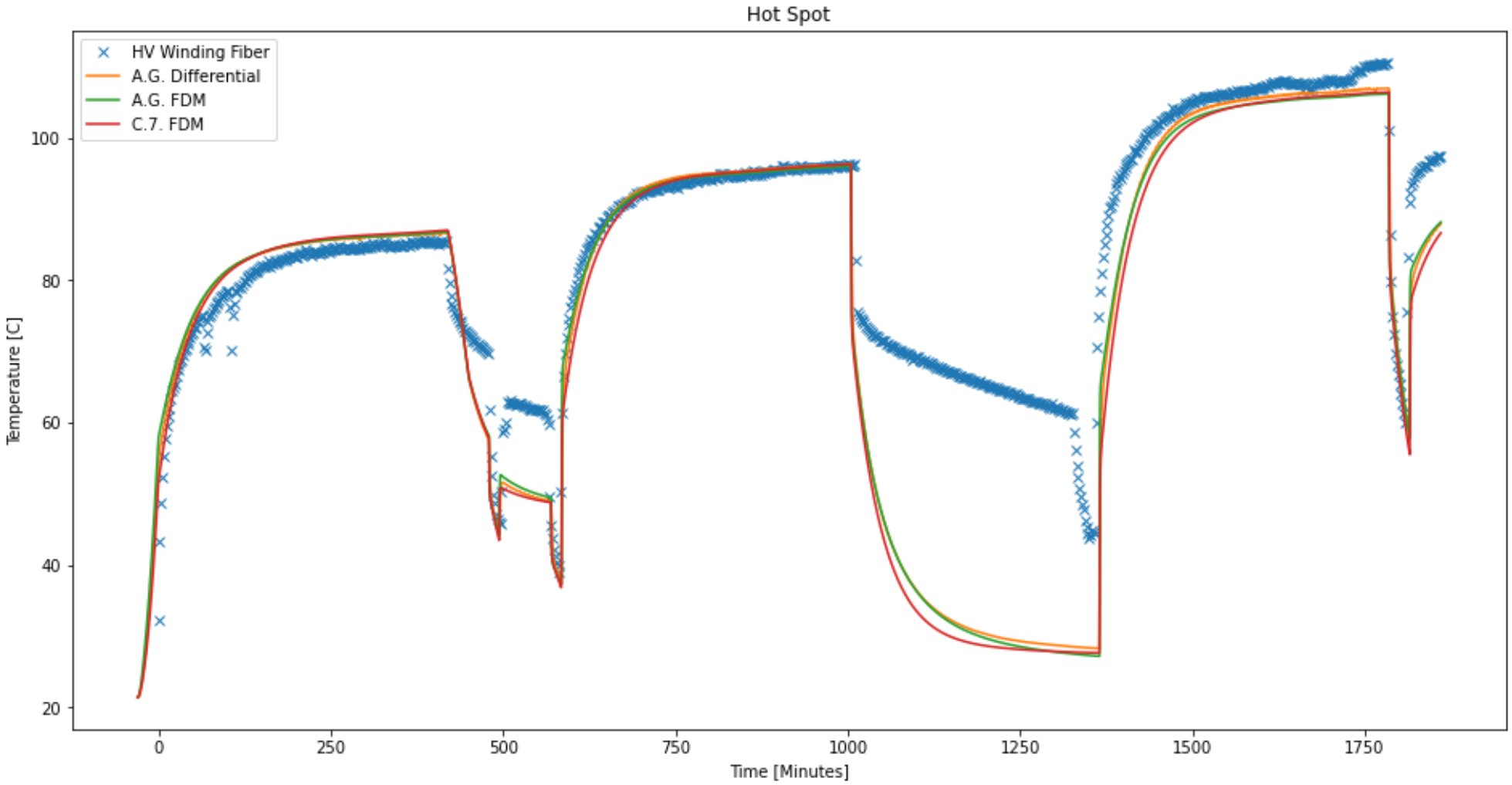
Top oil temperature



Top oil residual



Hot spot temperature



Hot spot residual