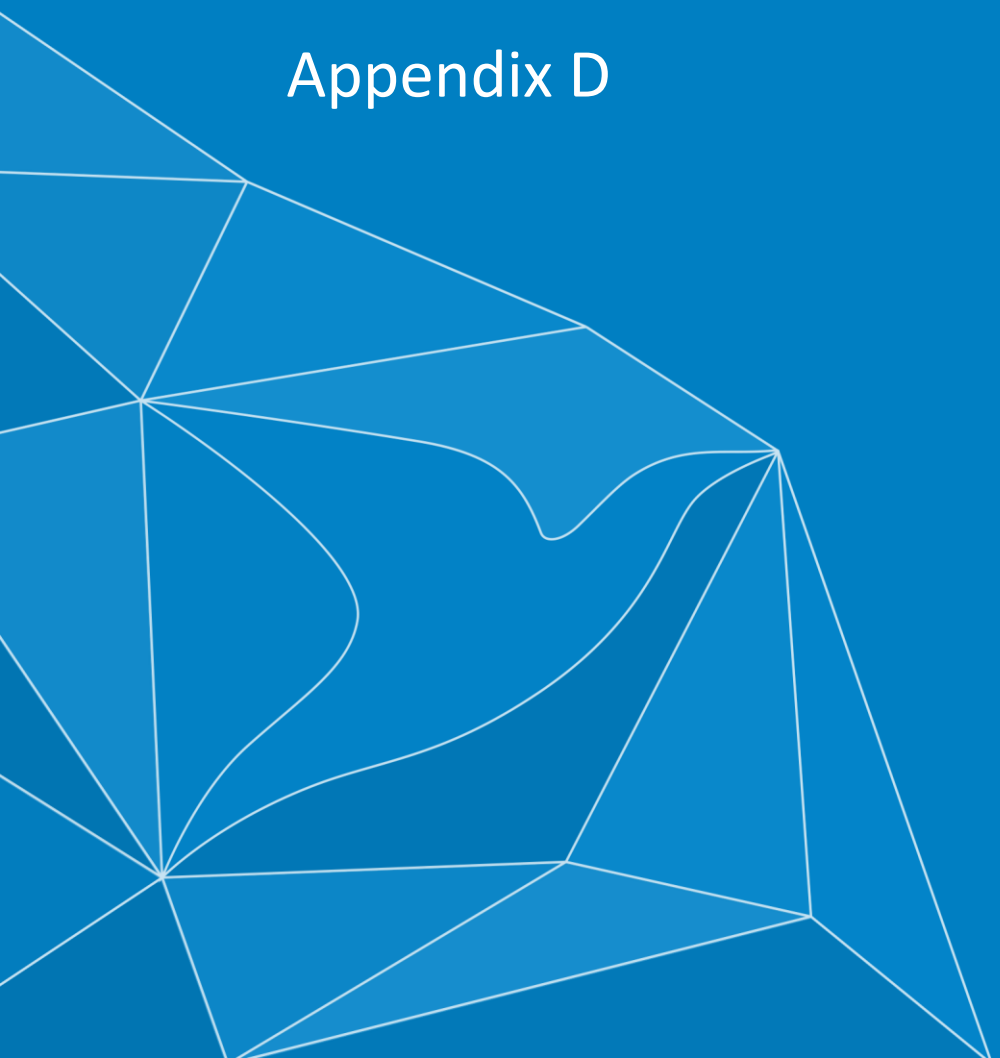
EASA
European Aviation Safety Agency

Report EASA.2012.07

Research Project:

HELMGOP II
Helicopter Main Gearbox Loss of Oil Performance Optimisation

Appendix D



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APPENDIX D – TEMPERATURE PROFILES AND RATES OF TEMPERATURE CHANGE FOR MGB TEST PHASES/SETS

1. Phase 1 – Partial Commissioning Tests (No Load)

1.1 Normal Lubrication Condition

The temperature profiles and rates of temperature change of the MGB under normal lubrication condition and no load are shown in Figures D.1 to D.10.

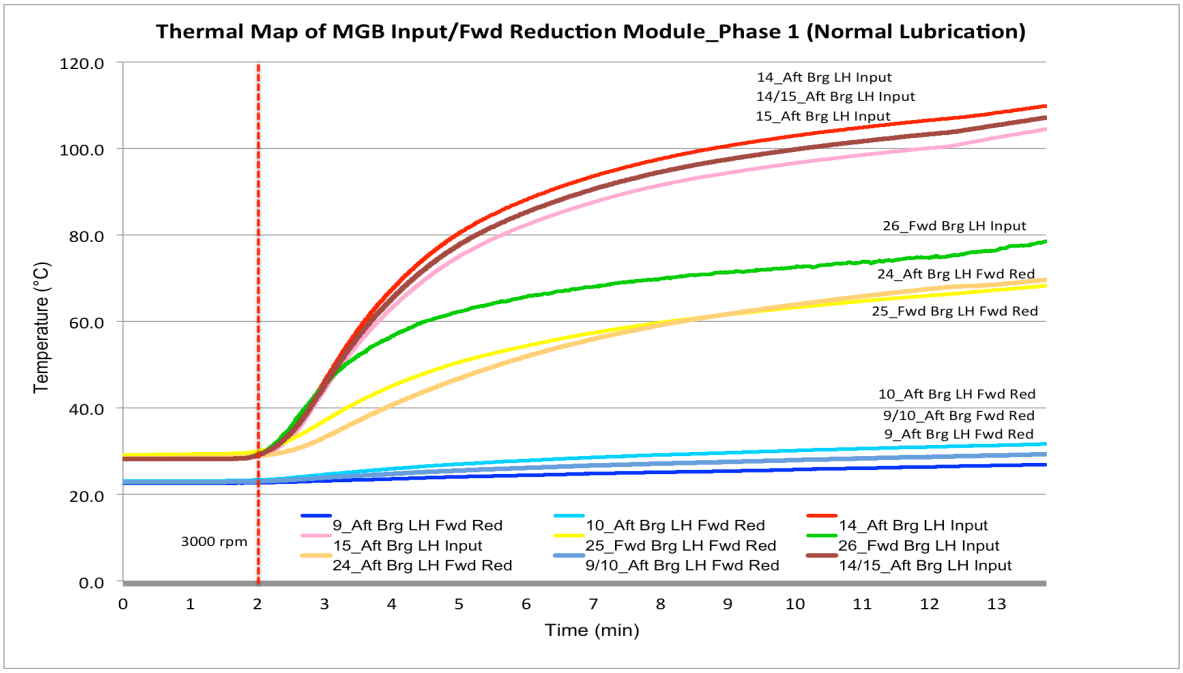

Figure D.1 Temperature Profile of Fwd Reduction Module at Normal Lubrication Condition and No Load (Source: Author)

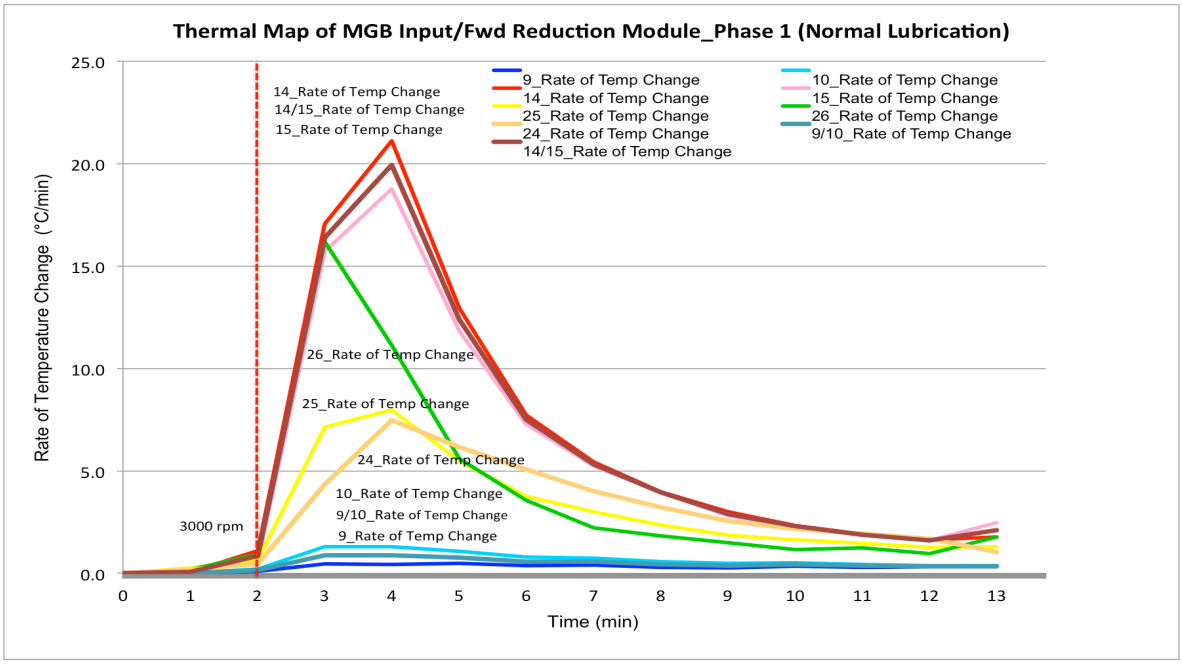

Figure D.2 Rate of Temperature Change of Fwd Reduction Module at Normal Lubrication Condition and No Load (Source: Author)

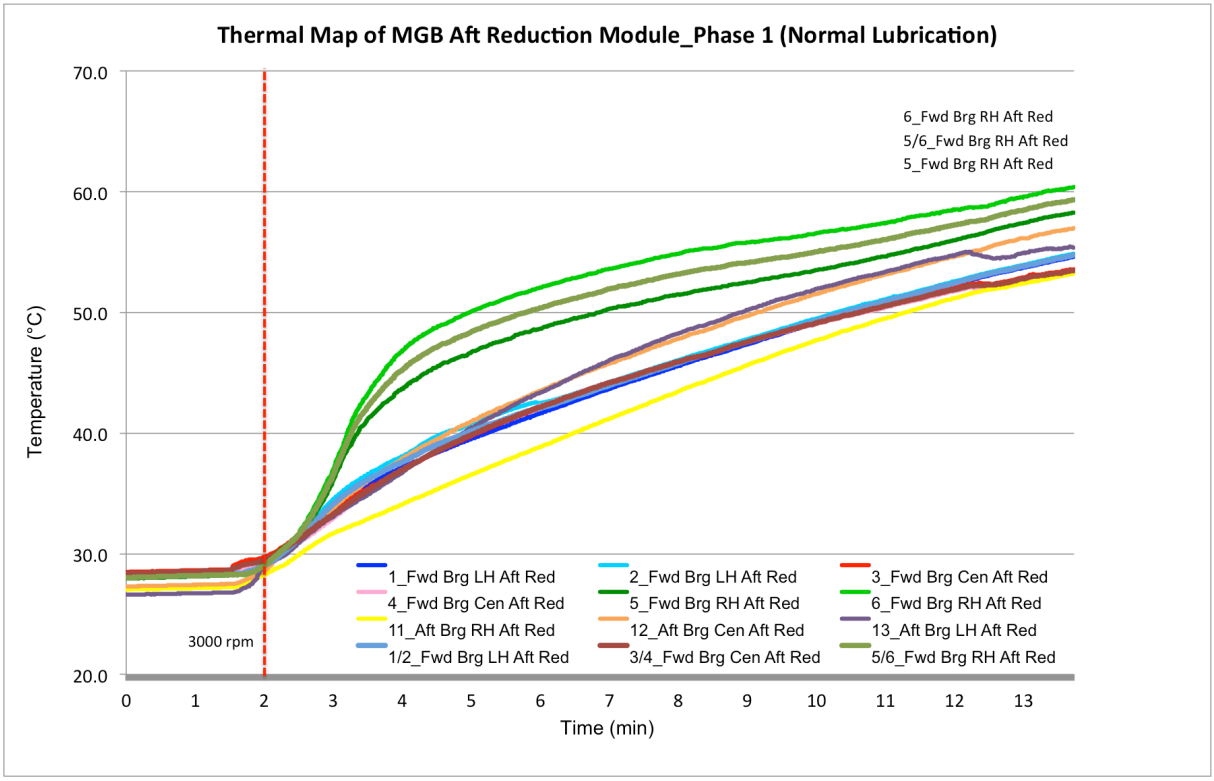

Figure D.3 Temperature Profile of Aft Reduction Module at Normal Lubrication Condition and No Load (Source: Author)

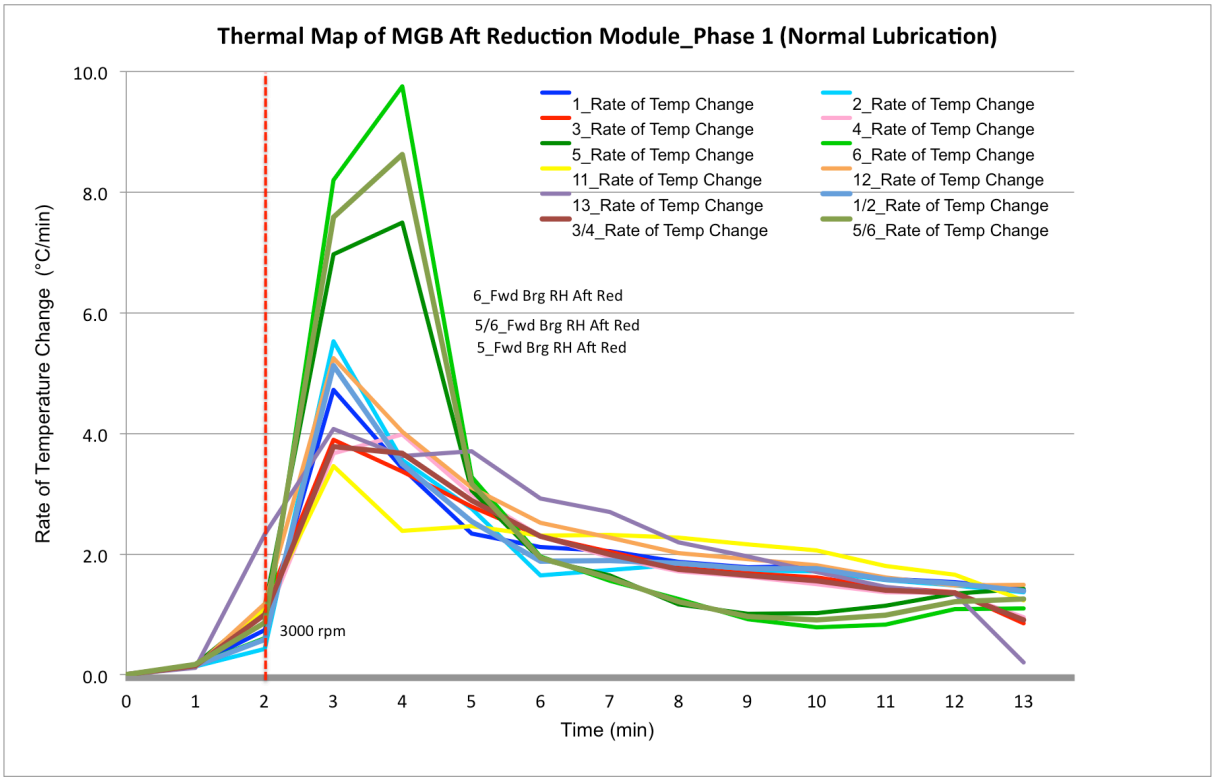

Figure D.4 Rate of Temperature Change of Aft Reduction Module at Normal Lubrication Condition and No Load (Source: Author)

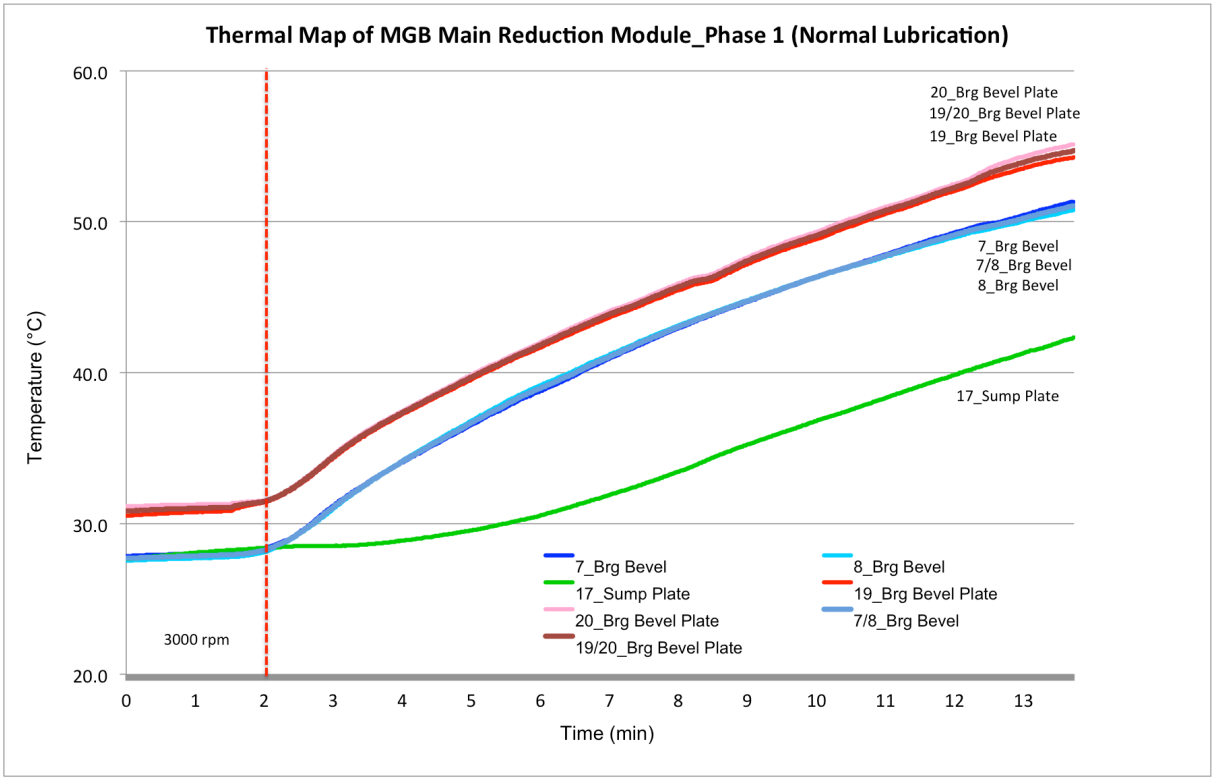

Figure D.5 Temperature Profile of Main Reduction Module at Normal Lubrication Condition and No Load (Source: Author)

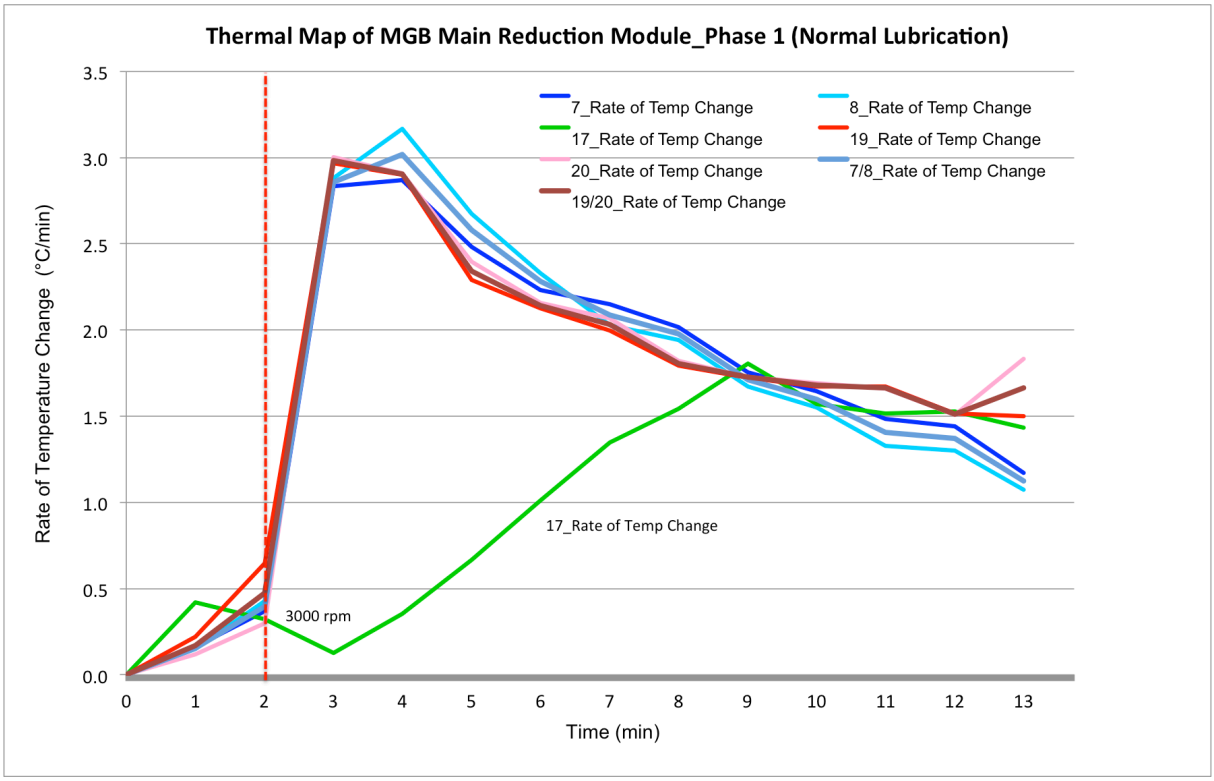

Figure D.6 Rate of Temperature Change of Main Reduction Module at Normal Lubrication Condition and No Load (Source: Author)

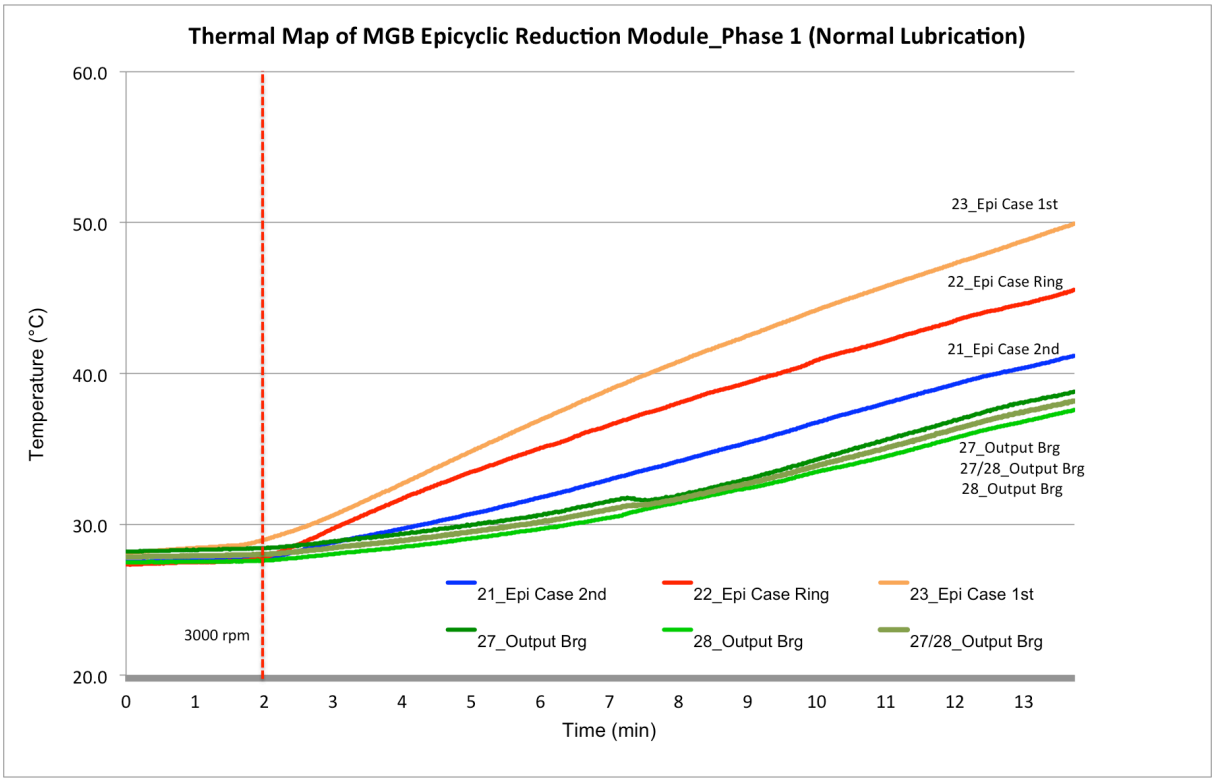

Figure D.7 Temperature Profile of Epicyclic Reduction Module at Normal Lubrication Condition and No Load (Source: Author)

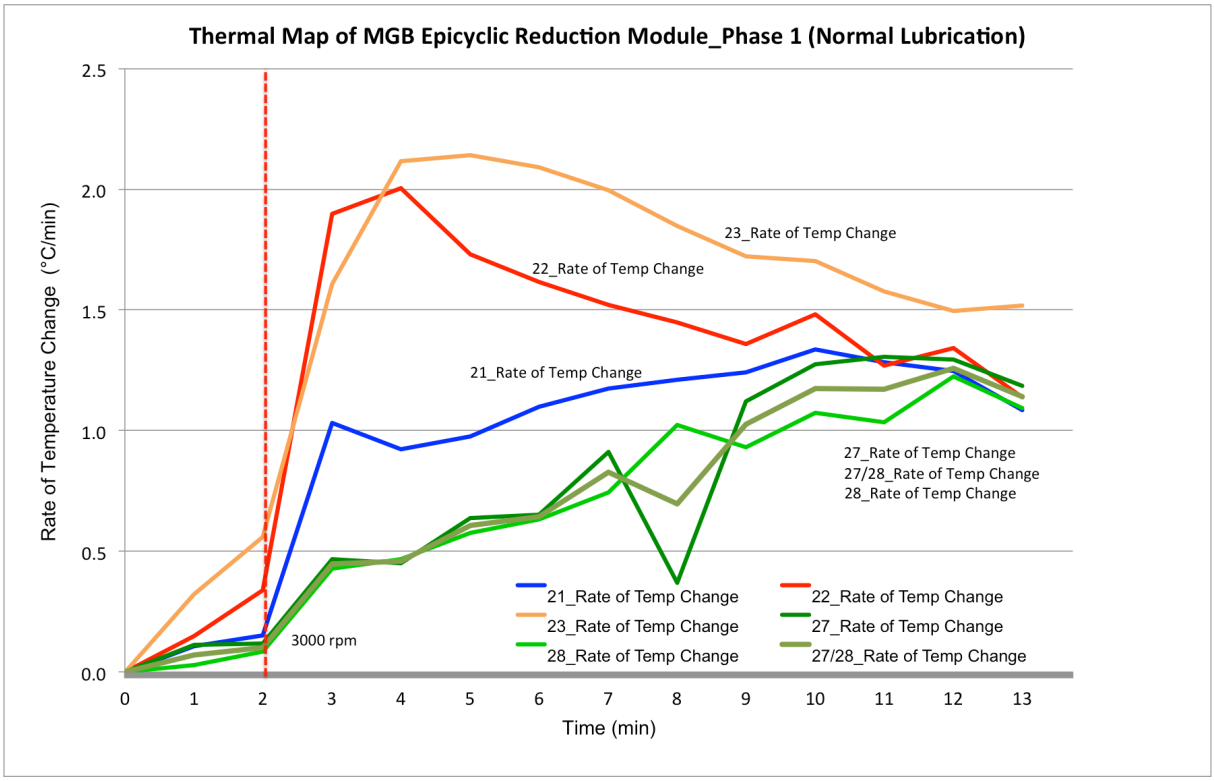

Figure D.8 Rate of Temperature Change of Epicyclic Reduction Module at Normal Lubrication Condition and No Load (Source: Author)

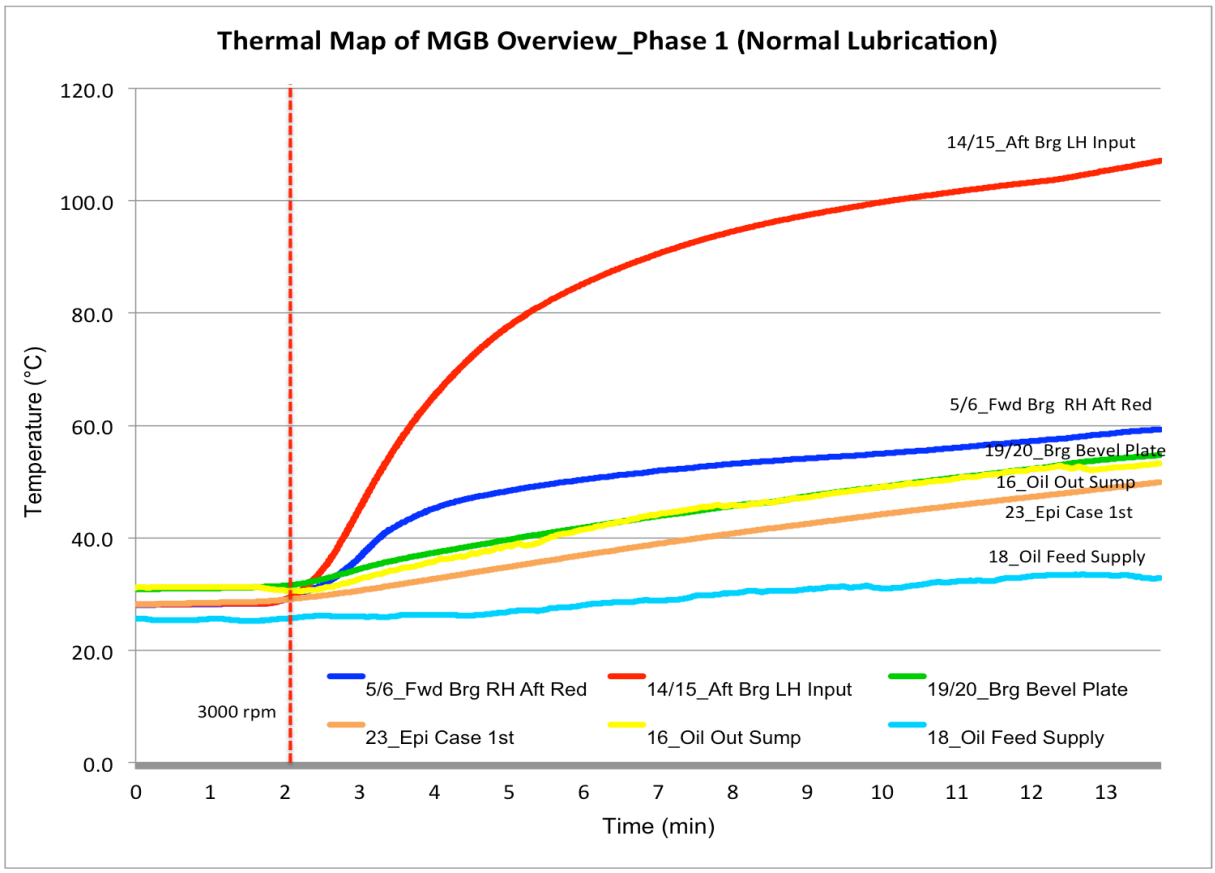

Figure D.9 Temperature Profile Overview at Normal Lubrication Condition and No Load (Source: Author)

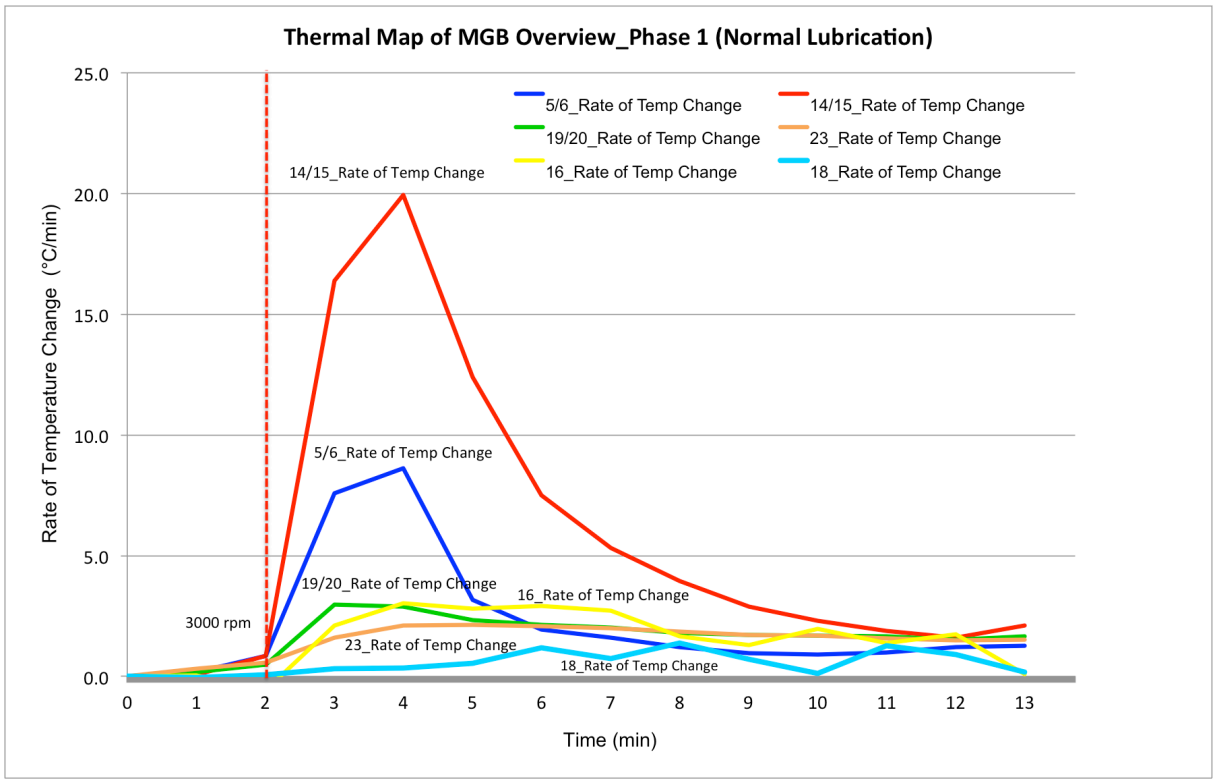

Figure D.10 Rate of Temperature Change Overview at Normal Lubrication Condition and No Load (Source: Author)

1.2 "Oil-Off" Condition

The temperature profiles and rates of temperature change of the MGB under "oil-off" condition and no load are shown in Figures D.11 to D.20.

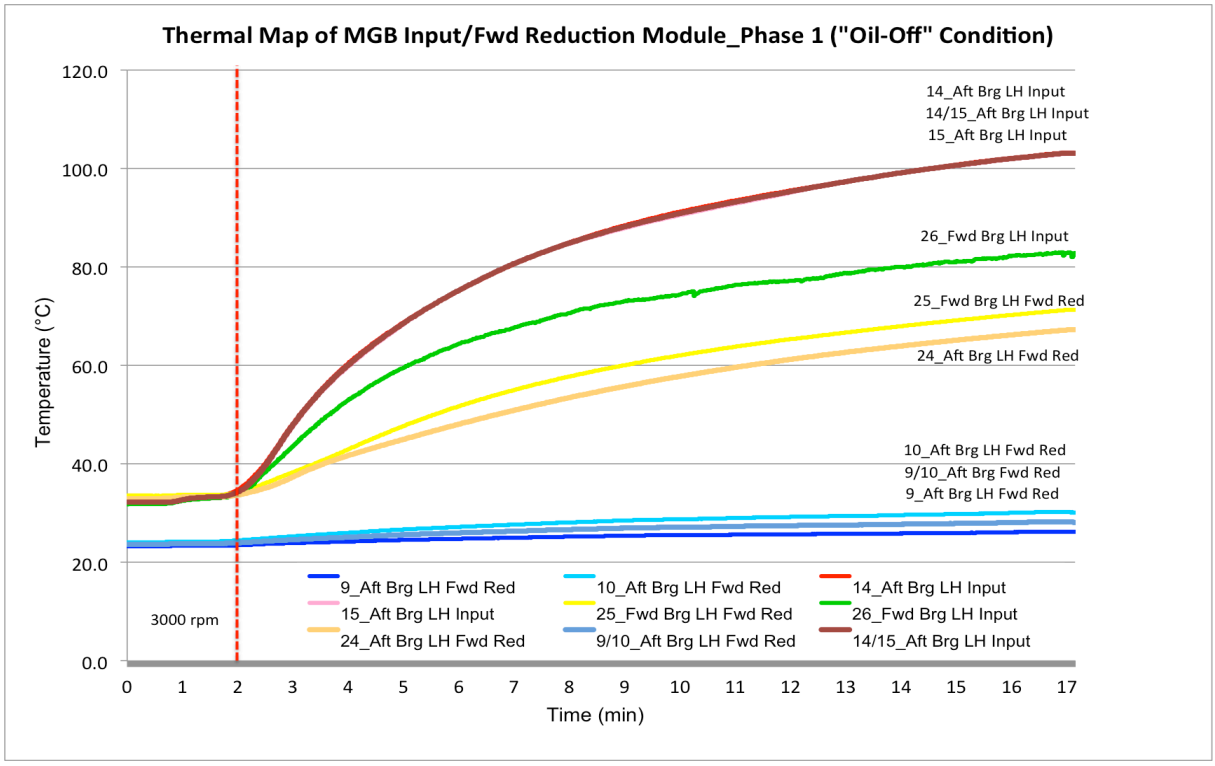

Figure D.11 Temperature Profile of Fwd Reduction Module at "Oil-Off" Condition and No Load (Source: Author)

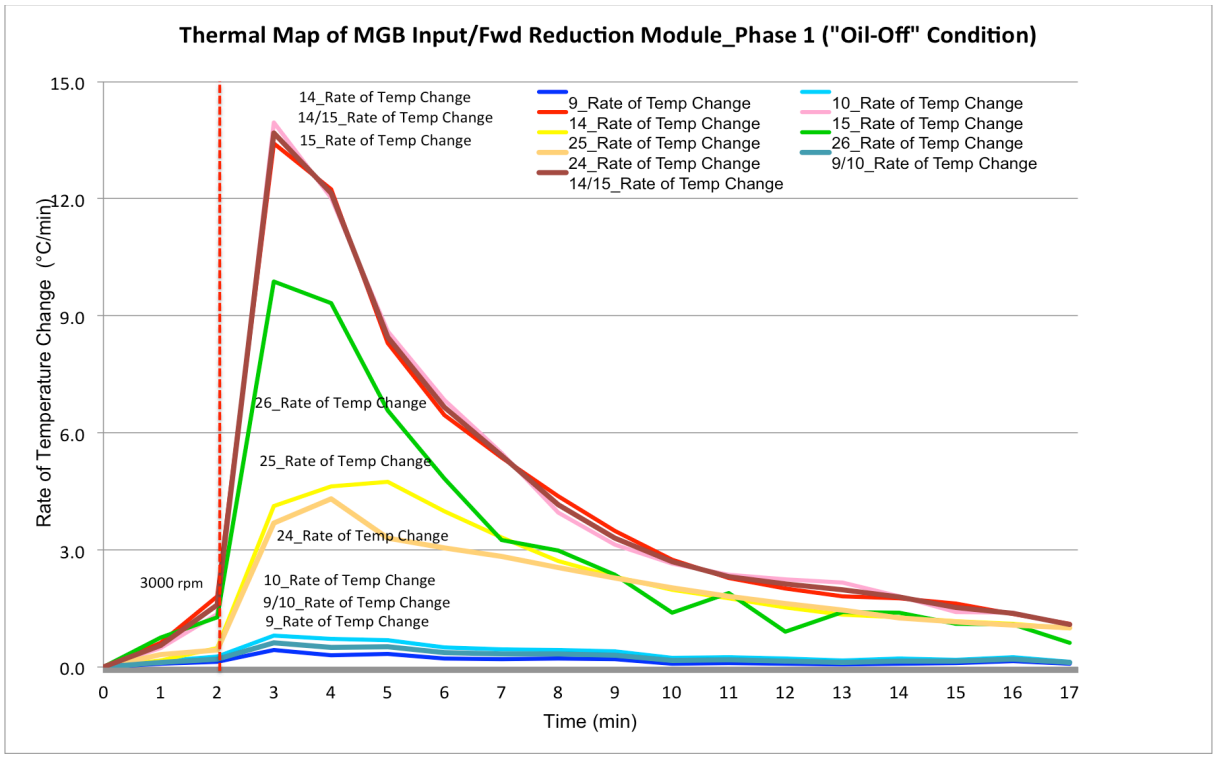

Figure D.12 Rate of Temperature Change of Fwd Reduction Module at "Oil-Off" Condition and No Load (Source: Author)

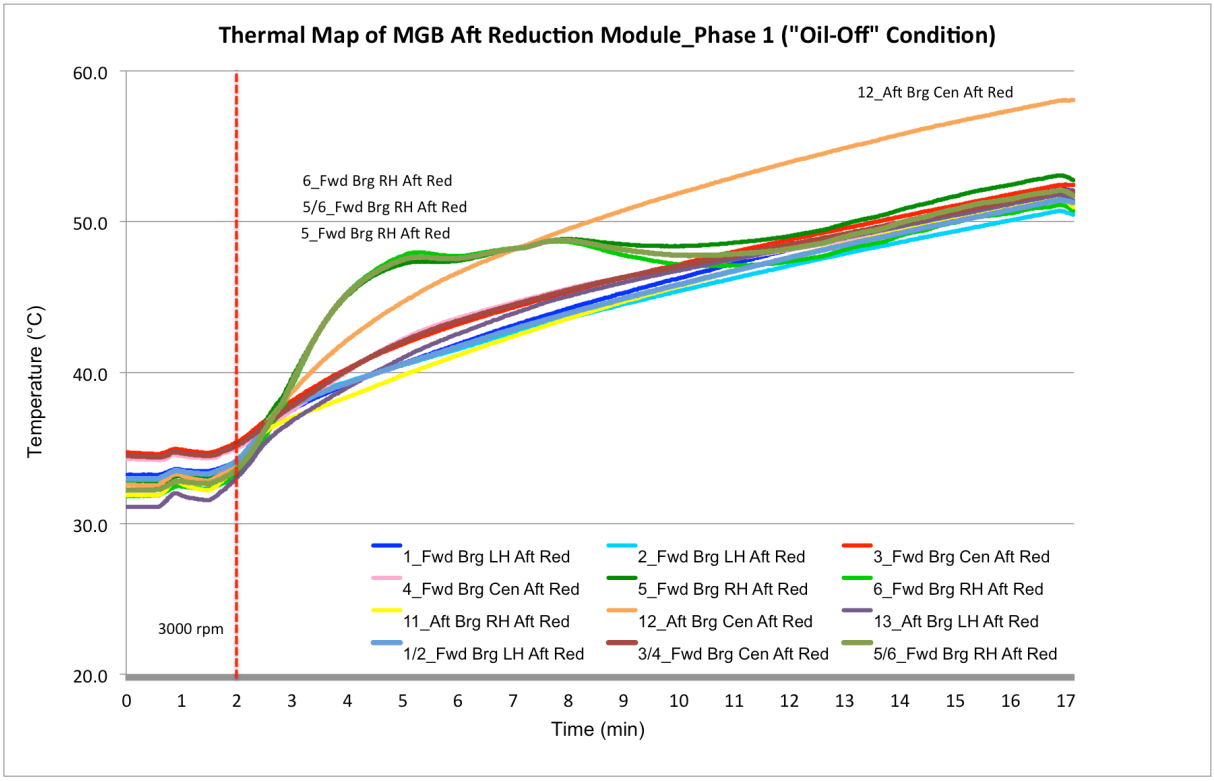

Figure D.13 Temperature Profile of Aft Reduction Module at "Oil-Off" Condition and No Load (Source: Author)

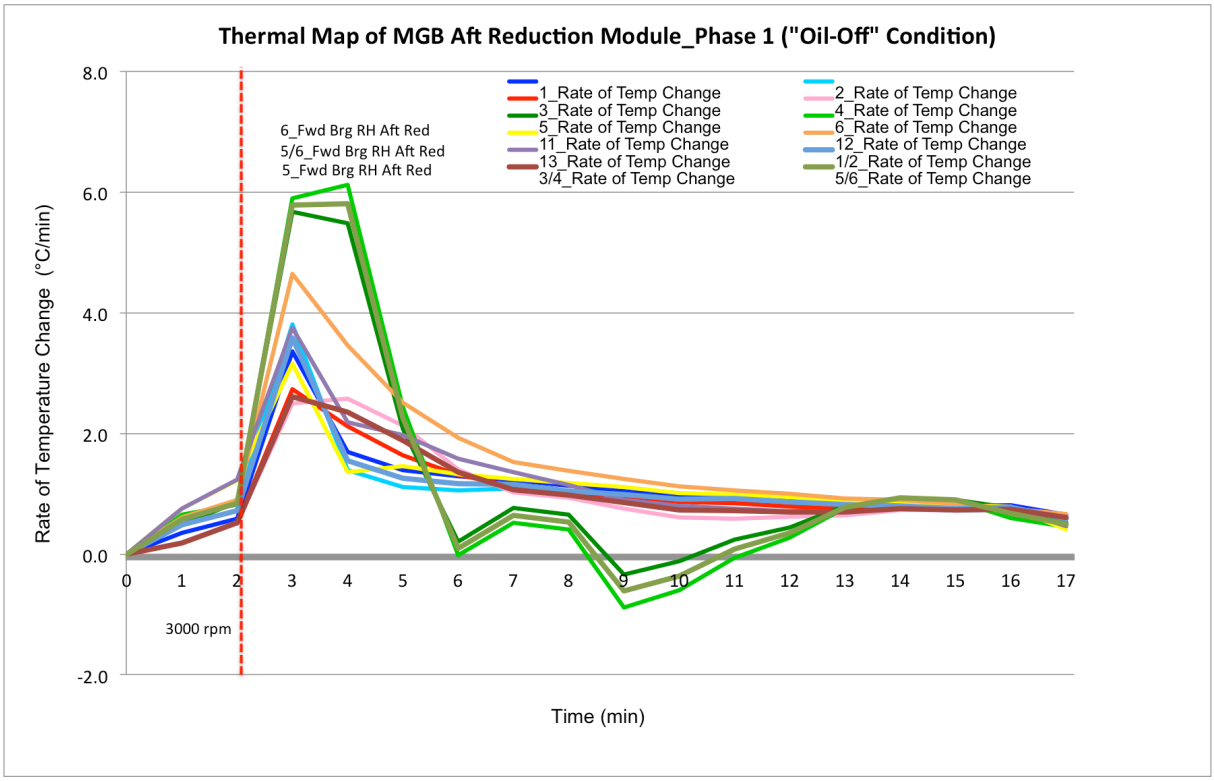

Figure D.14 Rate of Temperature Change of Aft Reduction Module at "Oil-Off" Condition and No Load (Source: Author)

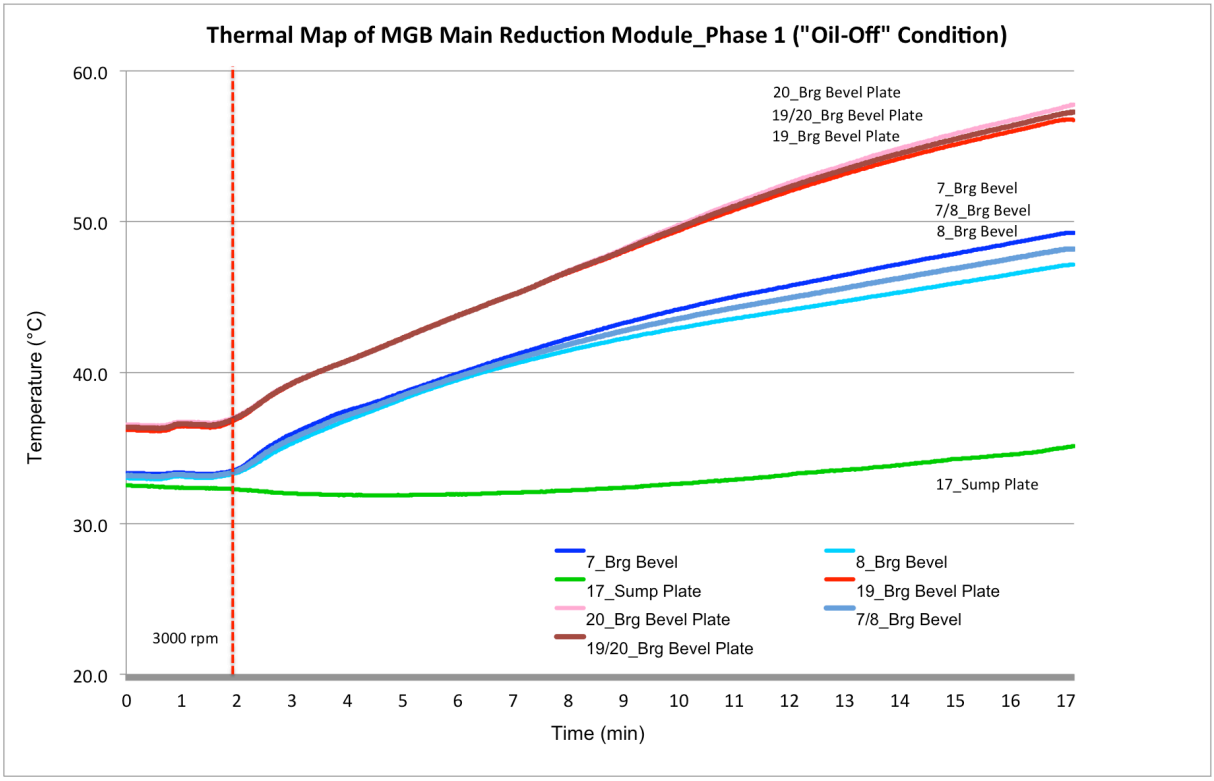

Figure D.15 Temperature Profile of Main Reduction Module at "Oil-Off" Condition and No Load (Source: Author)

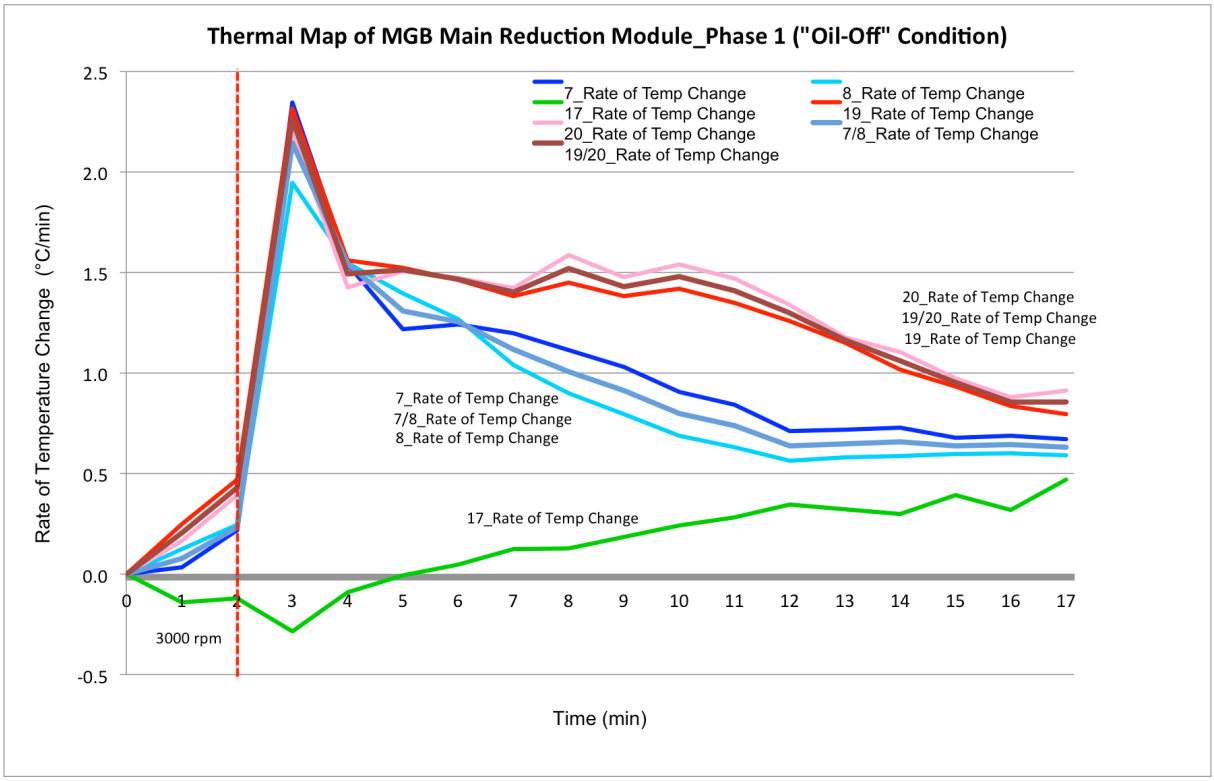

Figure D.16 Rate of Temperature Change of Main Reduction Module at "Oil-Off" Condition and No Load (Source: Author)

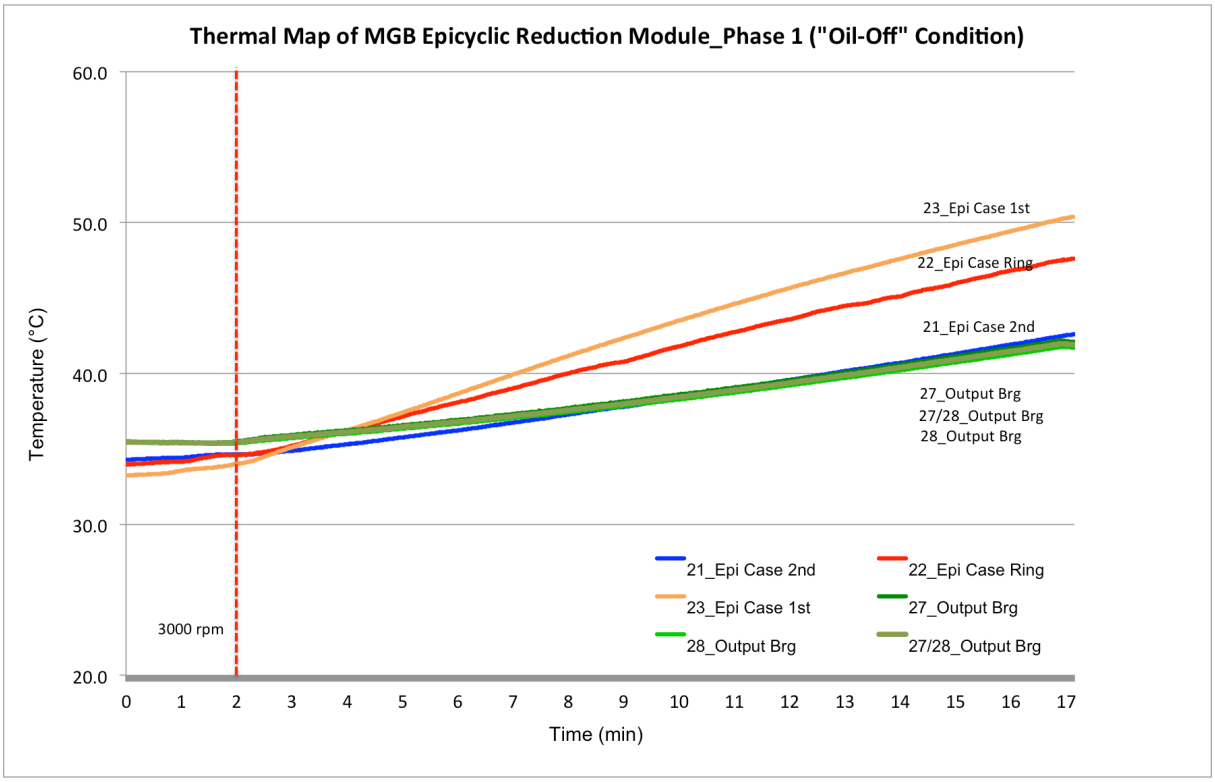

Figure D.17 Temperature Profile of Epicyclic Reduction Module at “Oil-Off” Condition and No Load (Source: Author)

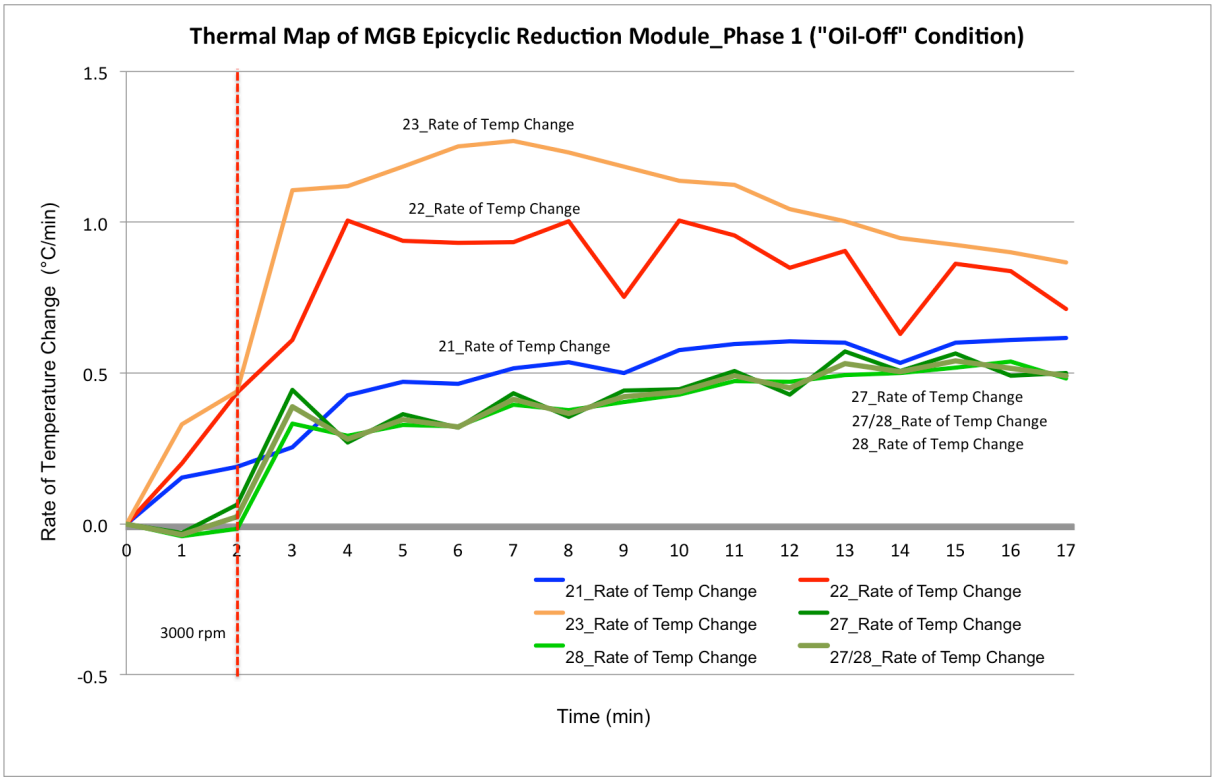

Figure D.18 Rate of Temperature Change of Epicyclic Reduction Module at “Oil-Off” Condition and No Load (Source: Author)

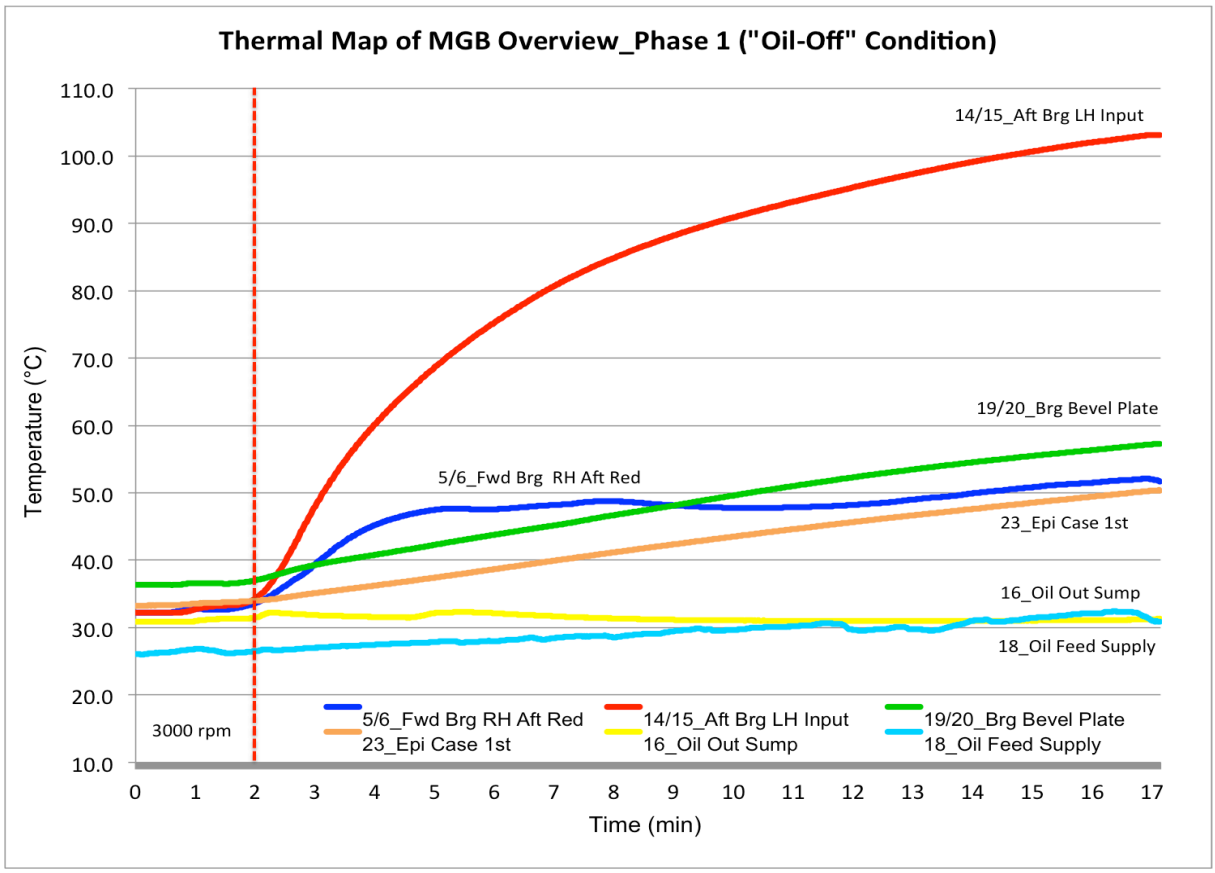

Figure D.19 Temperature Profile Overview at “Oil-Off” Condition and No Load (Source: Author)

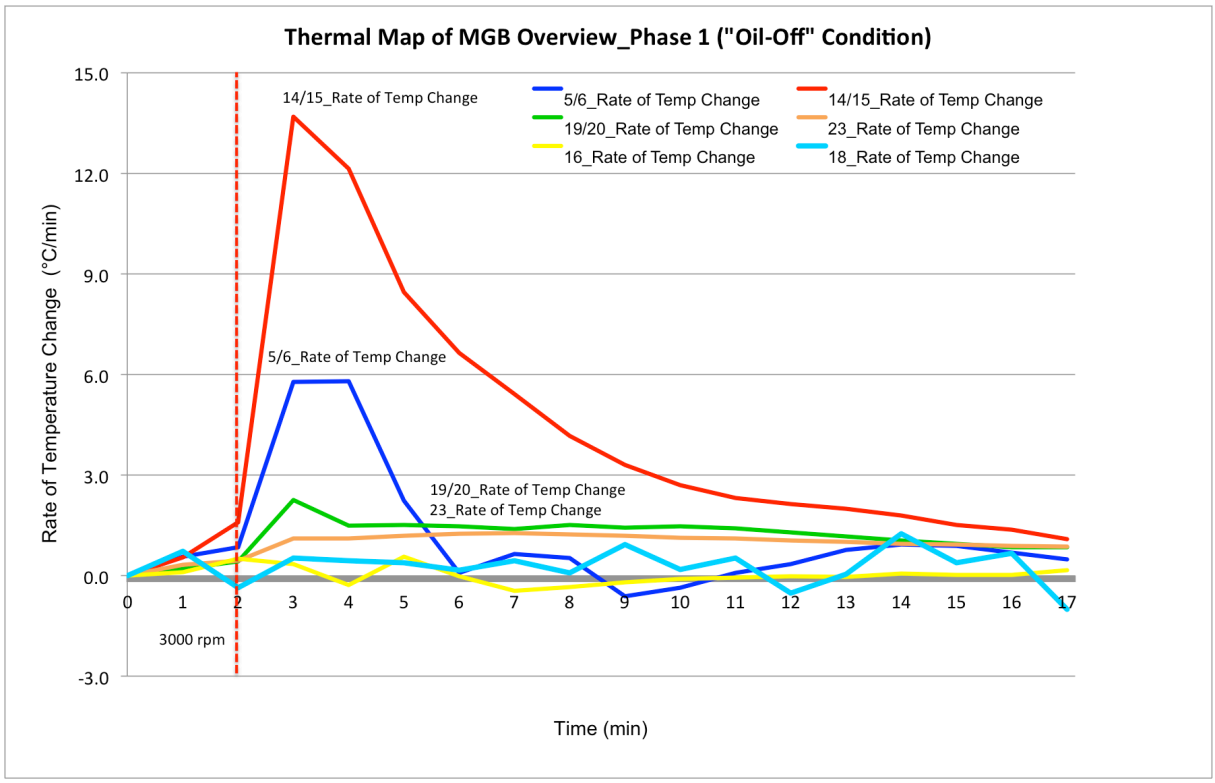

Figure D.20 Rate of Temperature Change Overview at “Oil-Off” Condition and No Load (Source: Author)

1.3 Thioether Mist Lubrication

The temperature profiles and rates of temperature change of the MGB under thioether mist lubrication and no load are shown in Figures D.21 to D.30.

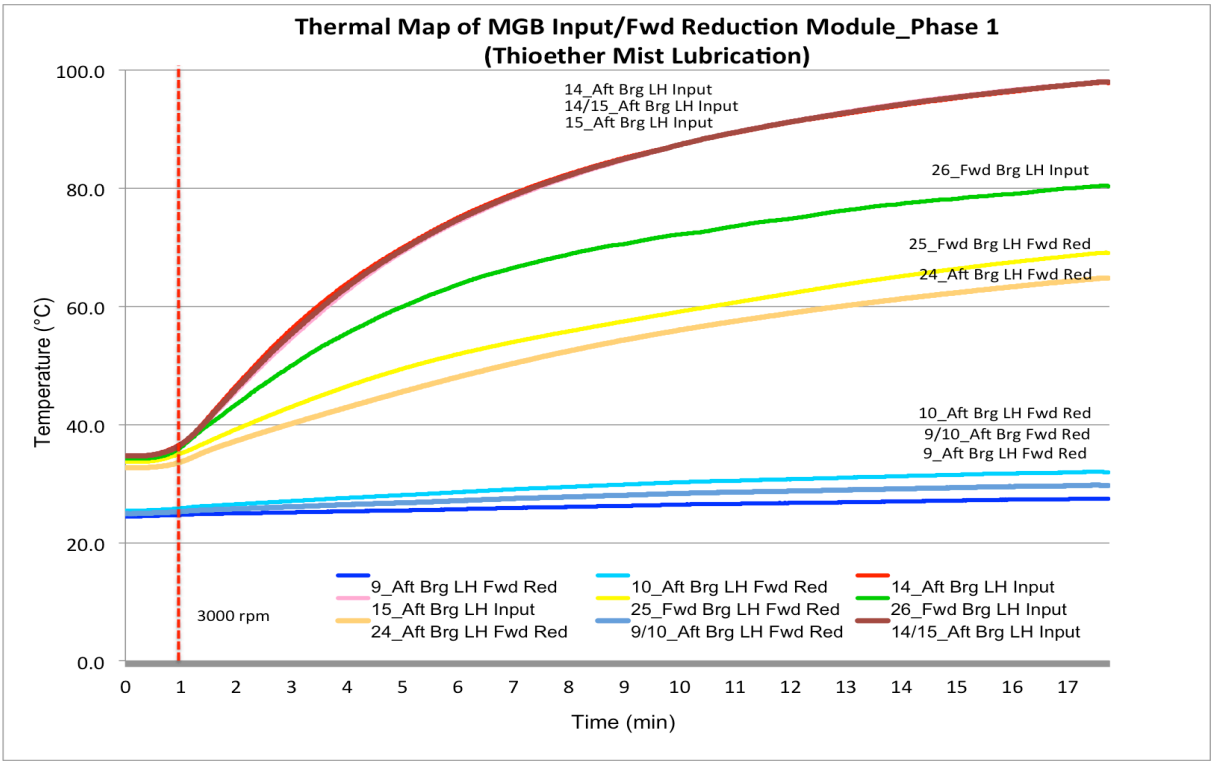

Figure D.21 Temperature Profile of Fwd Reduction Module at Thioether Mist Lubrication and No Load (Source: Author)

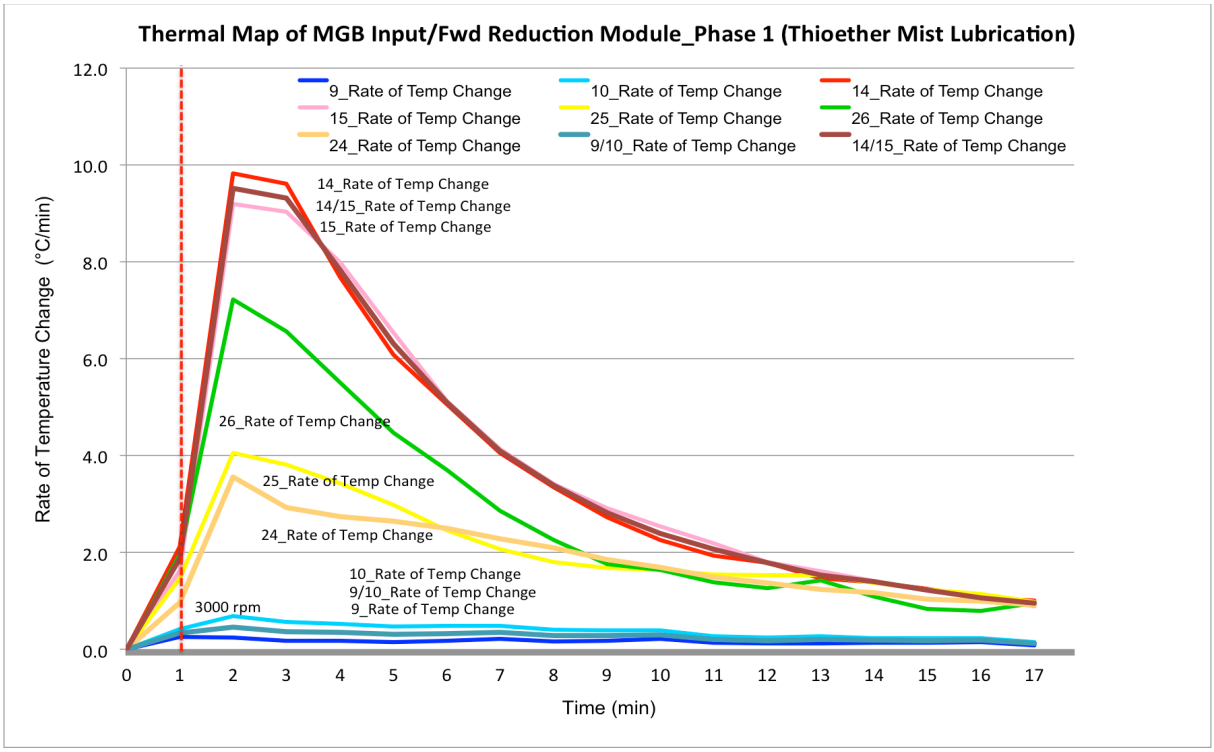

Figure D.22 Rate of Temperature Change of Fwd Reduction Module at Thioether Mist Lubrication and No Load (Source: Author)

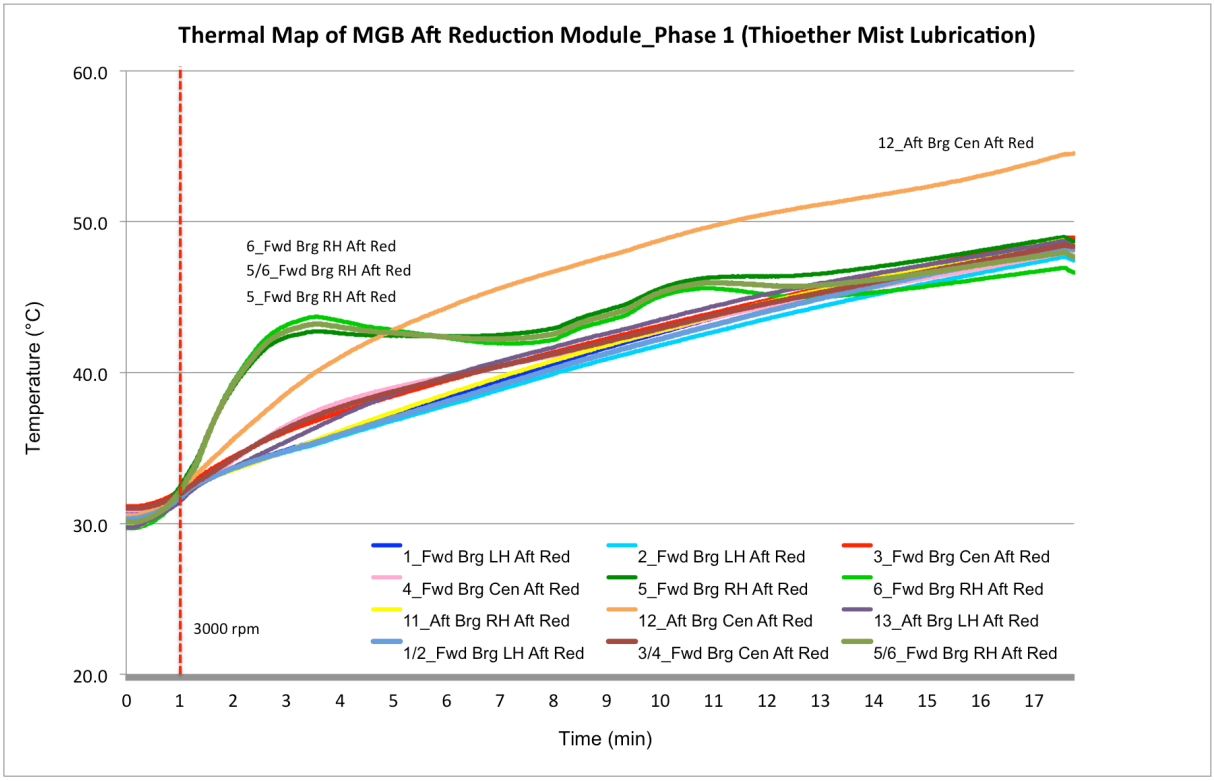

Figure D.23 Temperature Profile of Aft Reduction Module at Thioether Mist Lubrication and No Load (Source: Author)

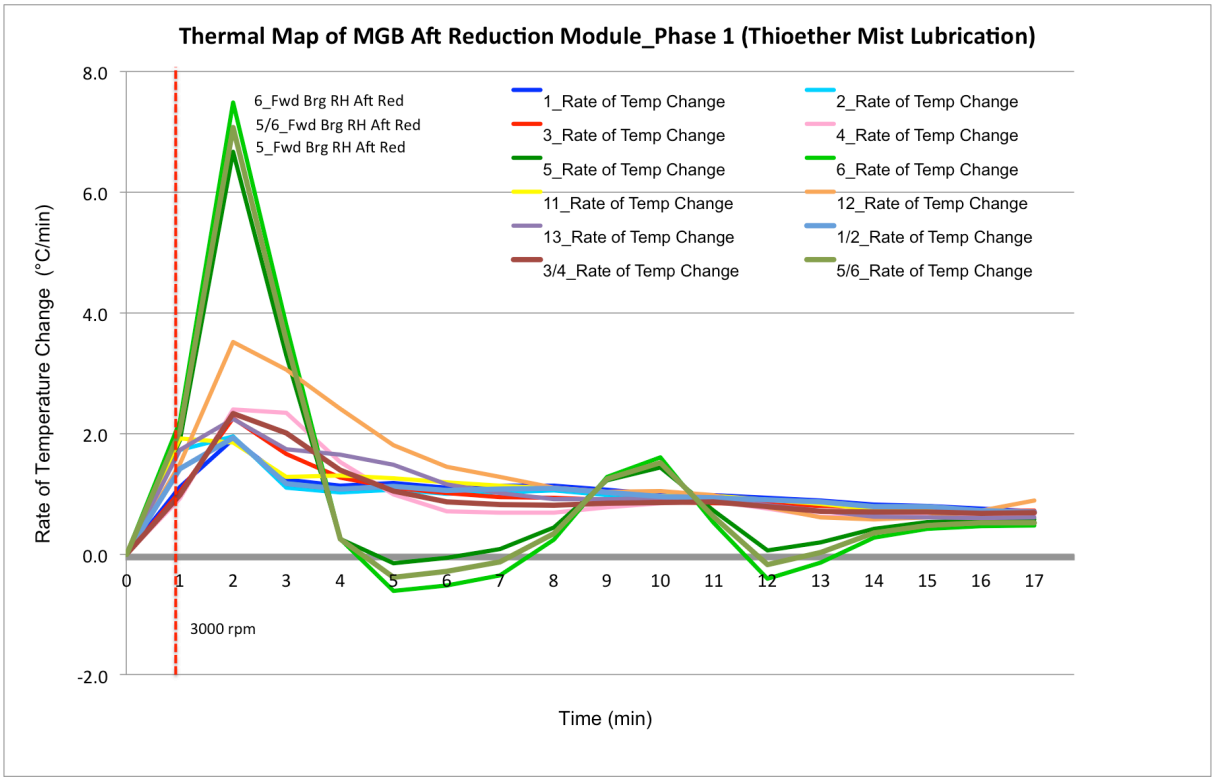

Figure D.24 Rate of Temperature Change of Aft Reduction Module at Thioether Mist Lubrication and No Load (Source: Author)

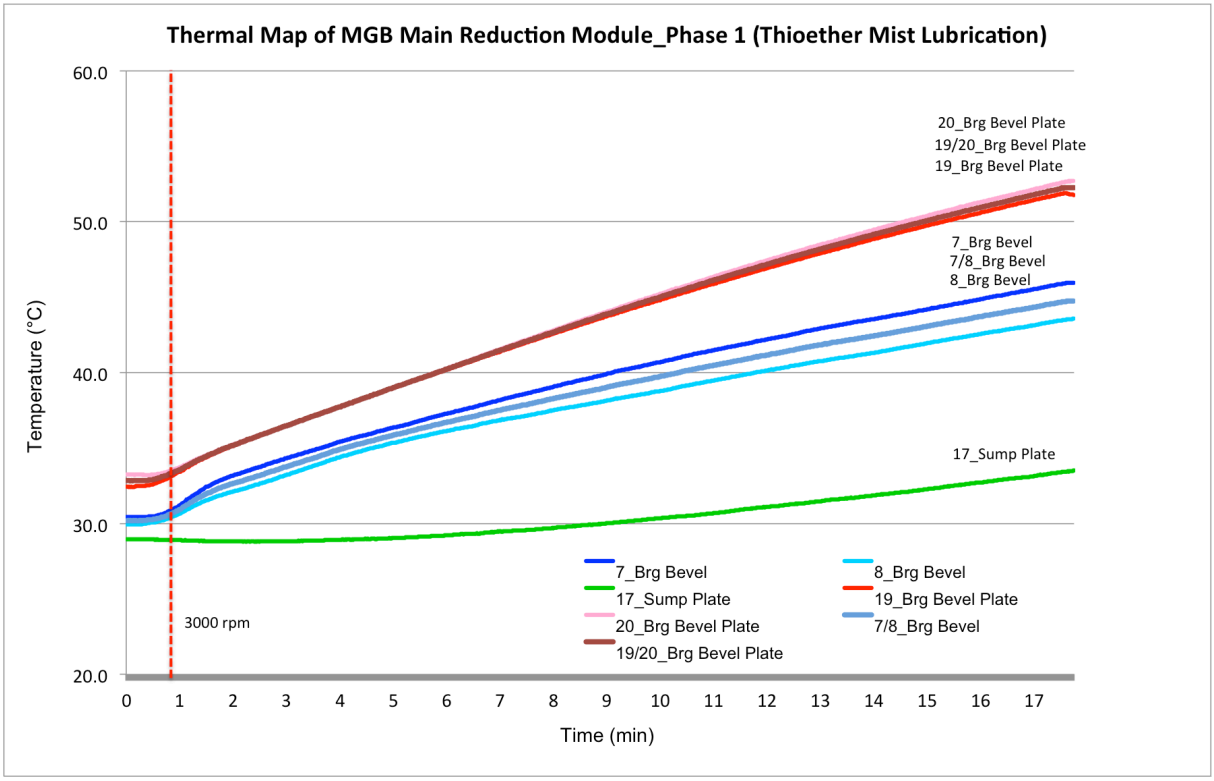

Figure D.25 Temperature Profile of Main Reduction Module at Thioether Mist Lubrication and No Load (Source: Author)

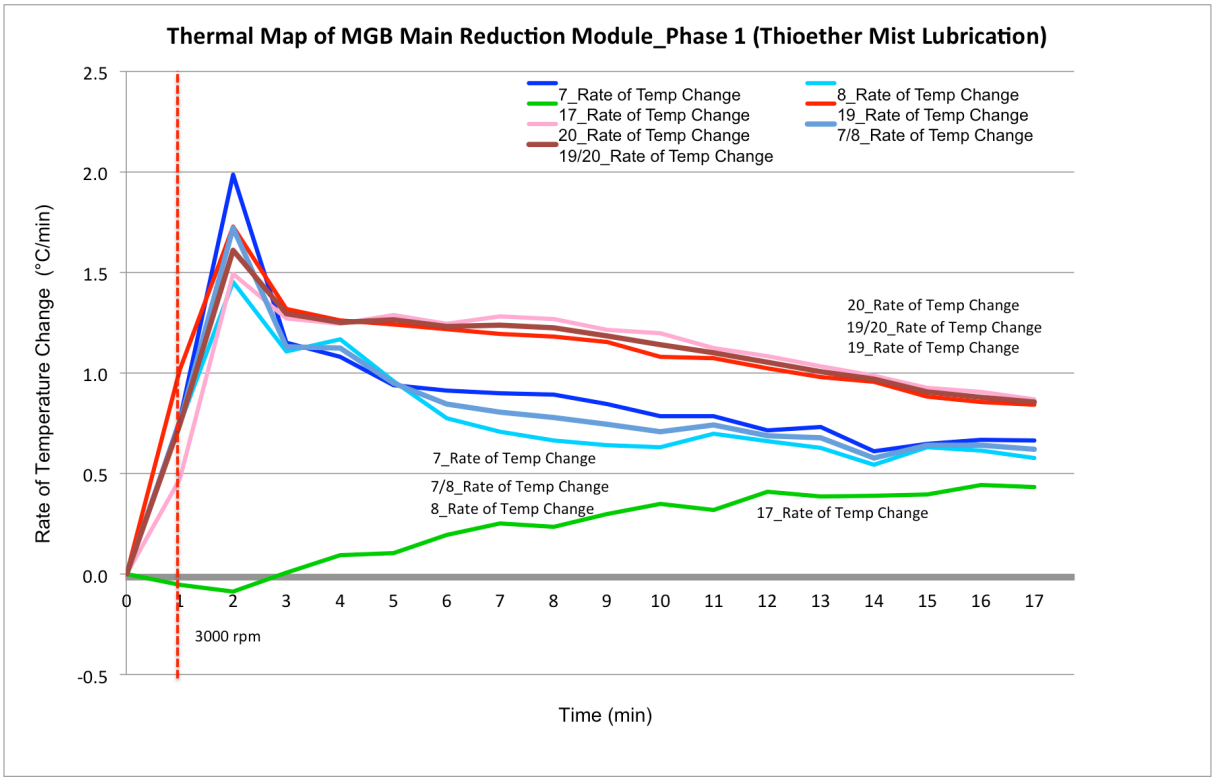

Figure D.26 Rate of Temperature Change of Main Reduction Module at Thioether Mist Lubrication and No Load (Source: Author)

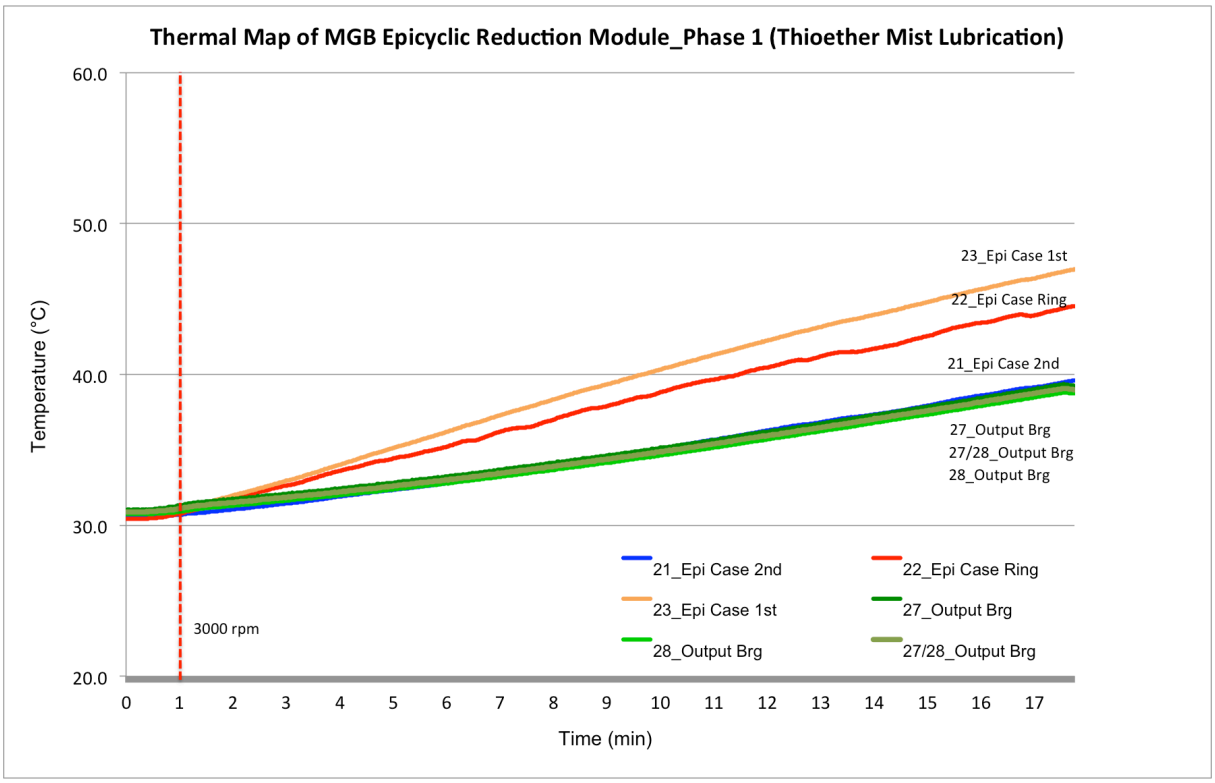

Figure D.27 Temperature Profile of Epicyclic Reduction Module at Thioether Mist Lubrication and No Load (Source: Author)

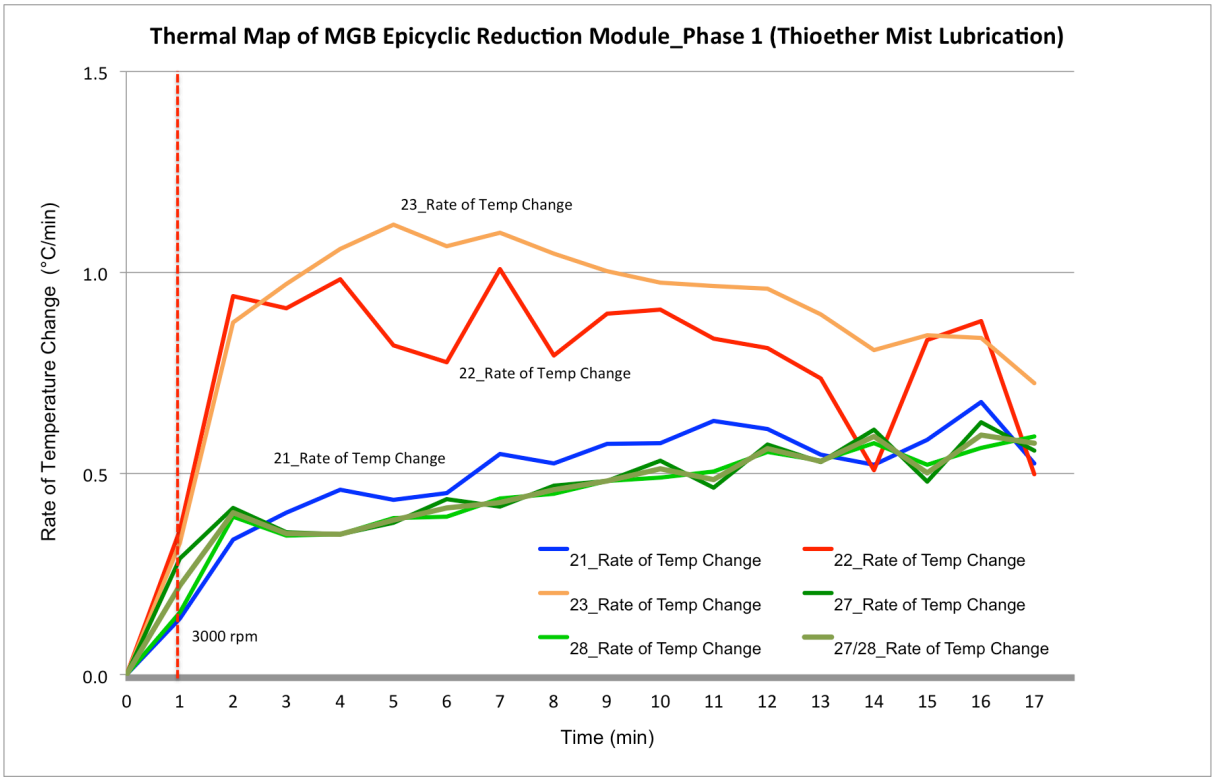

Figure D.28 Rate of Temperature Change of Epicyclic Reduction Module at Thioether Mist Lubrication and No Load (Source: Author)

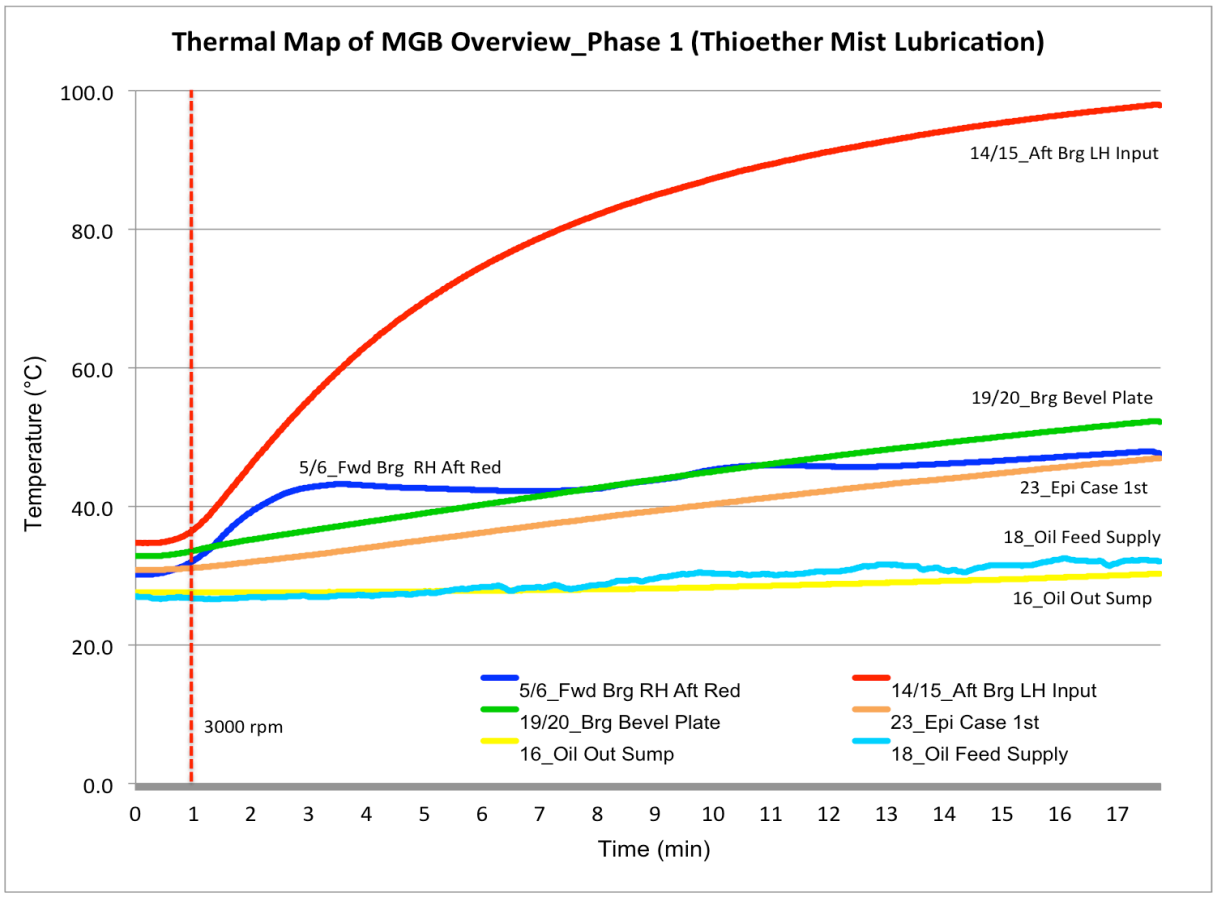

Figure D.29 Temperature Profile Overview at Thioether Mist Lubrication and No Load (Source: Author)

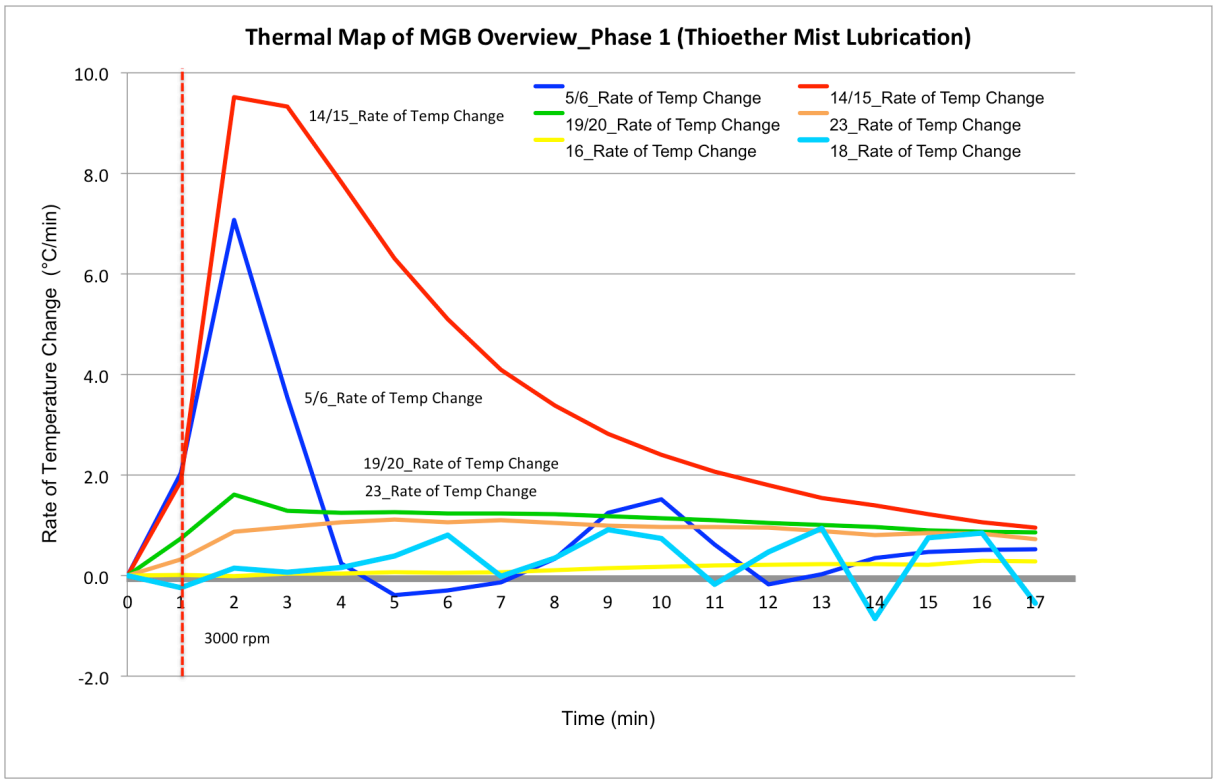

Figure D.30 Rate of Temperature Change Overview at Thioether Mist Lubrication and No Load (Source: Author)

2. Phase 2 – Full Commissioning Test (Progressive Loading)

The temperature profiles and rates of temperature change of the MGB under normal lubrication condition and progressive loading are shown in Figures D.31 to D.40.

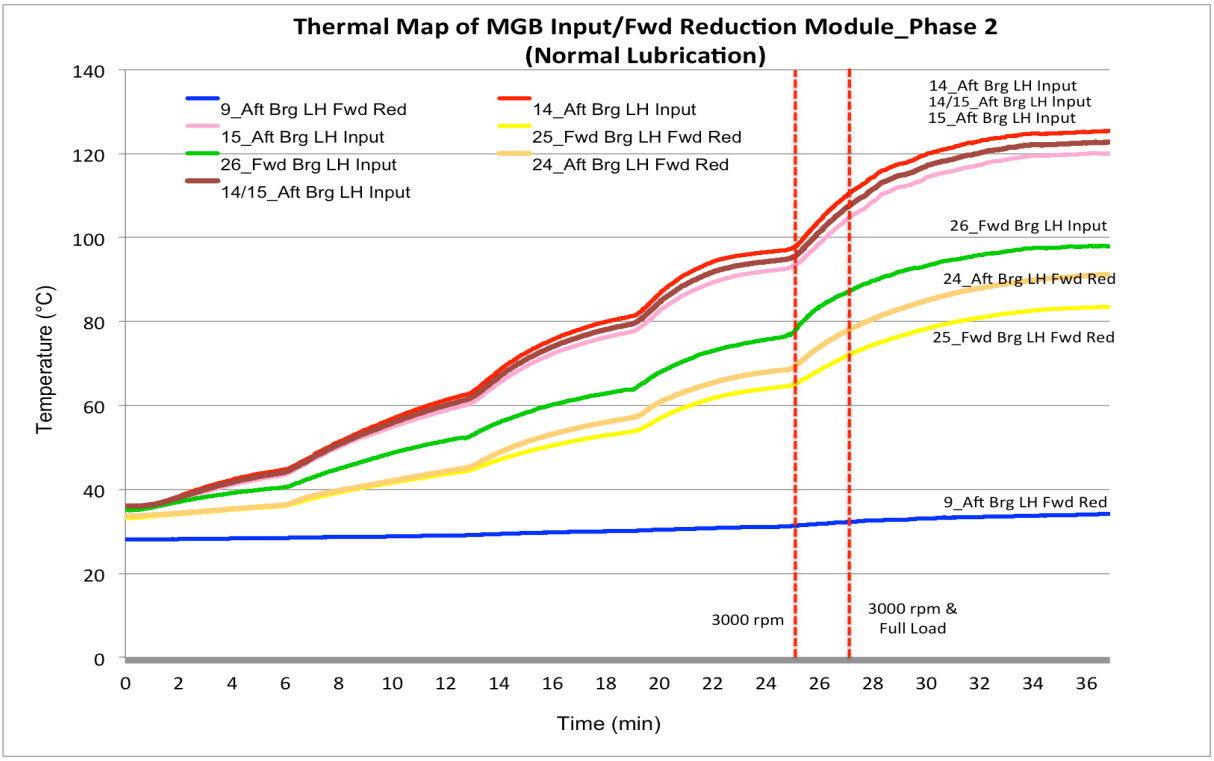

Figure D.31 Temperature Profile of Fwd Reduction Module at Normal Lubrication Condition and Progressive Loading (Source: Author)

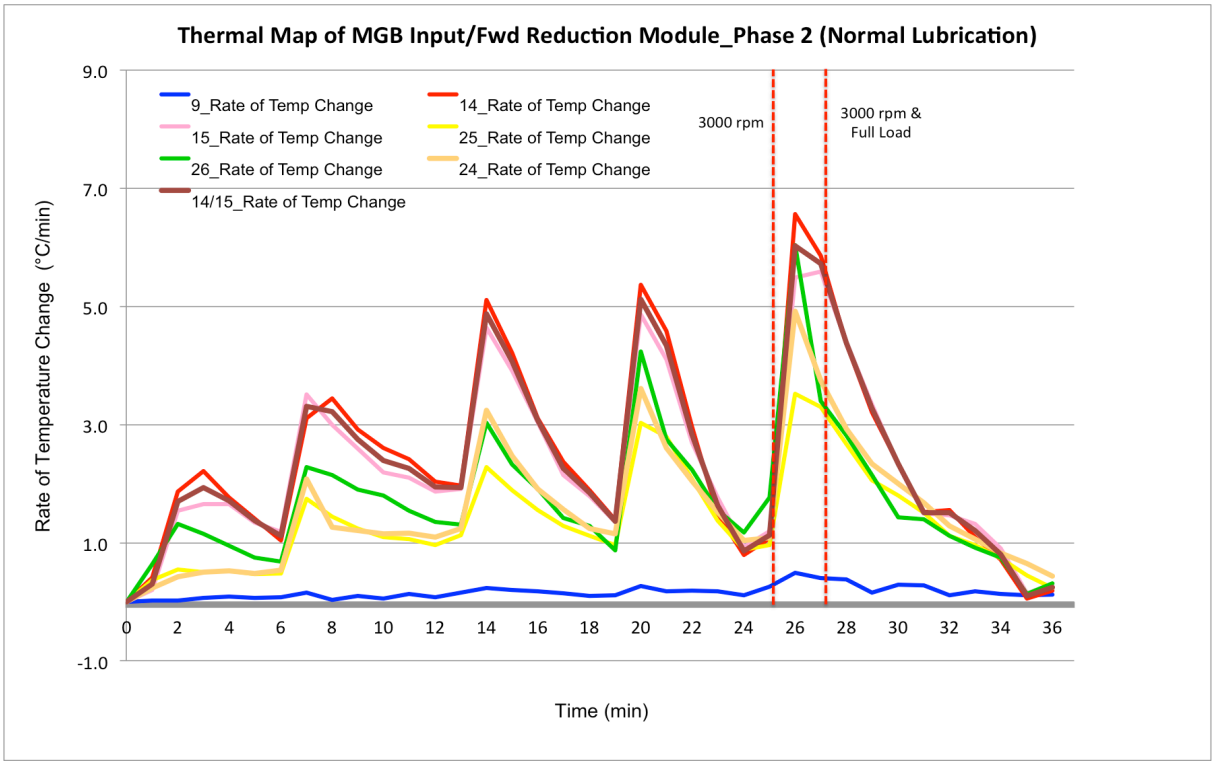

Figure D.32 Rate of Temperature Change of Fwd Reduction Module at Normal Lubrication Condition and Progressive Loading (Source: Author)

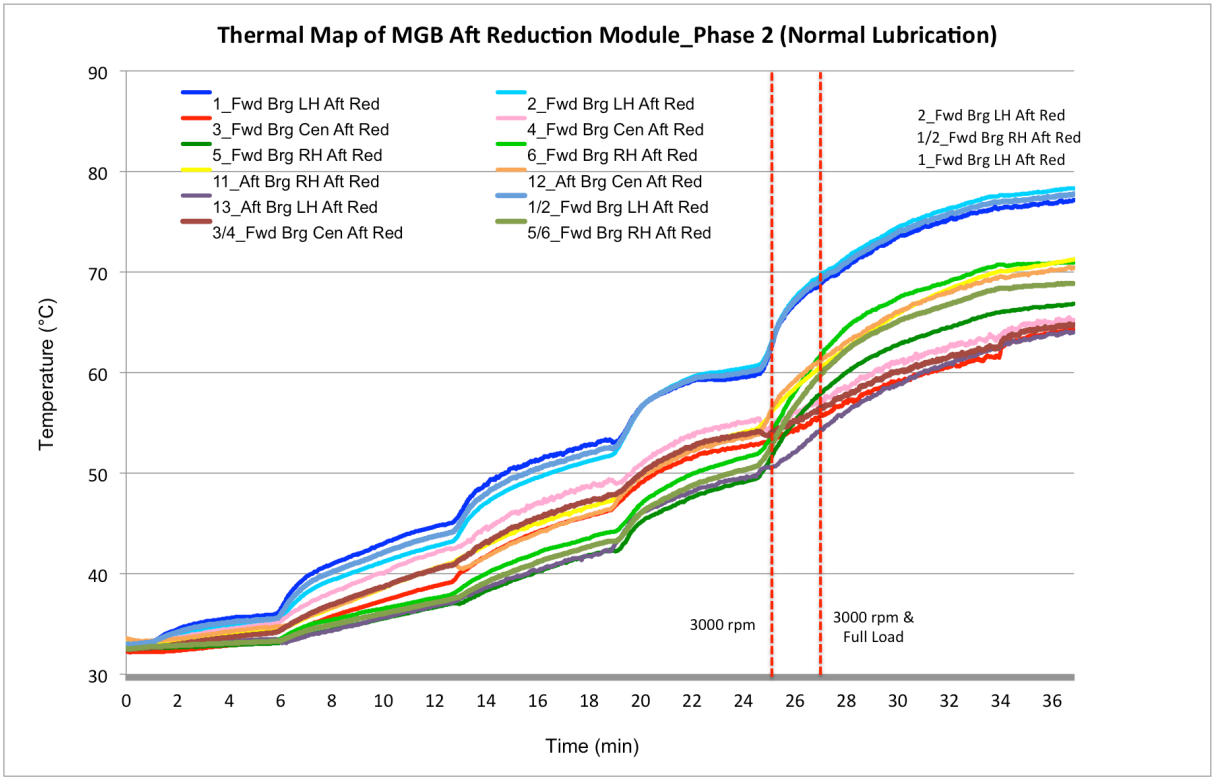

Figure D.33 Temperature Profile of Aft Reduction Module at Normal Lubrication Condition and Progressive Loading (Source: Author)

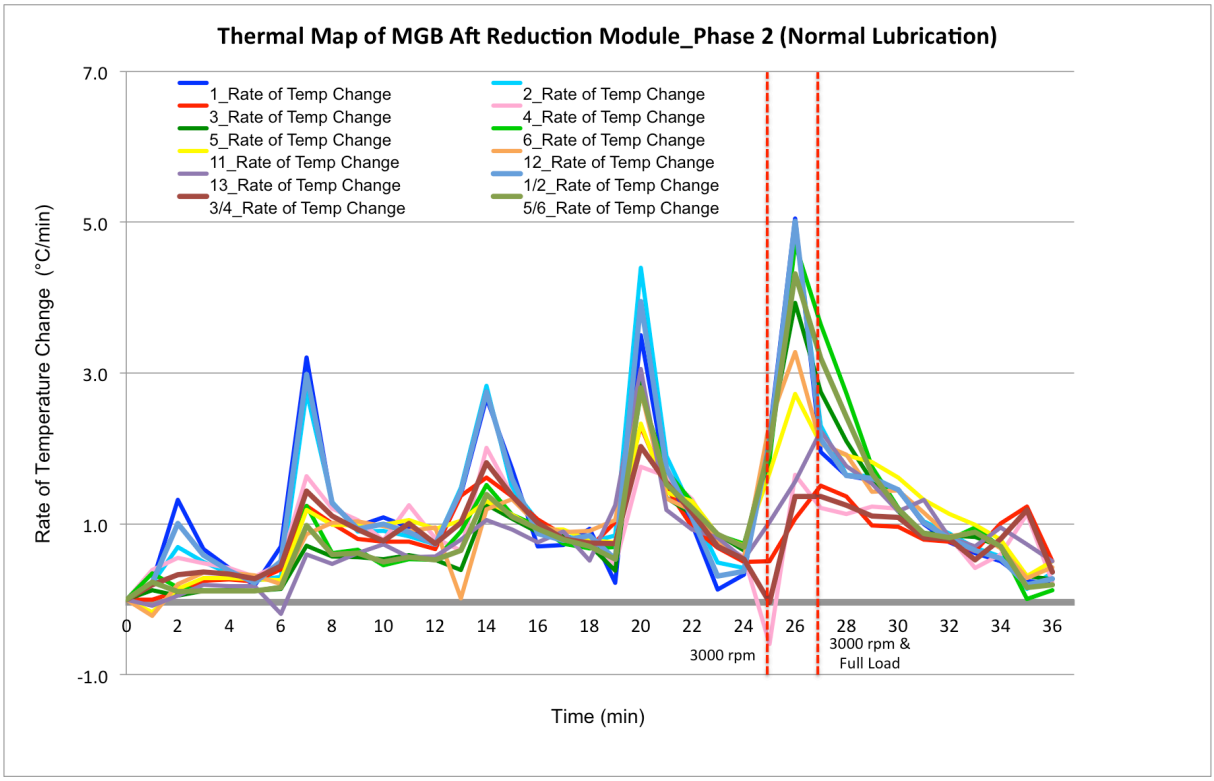

Figure D.34 Rate of Temperature Change of Aft Reduction Module at Normal Lubrication Condition and Progressive Loading (Source: Author)

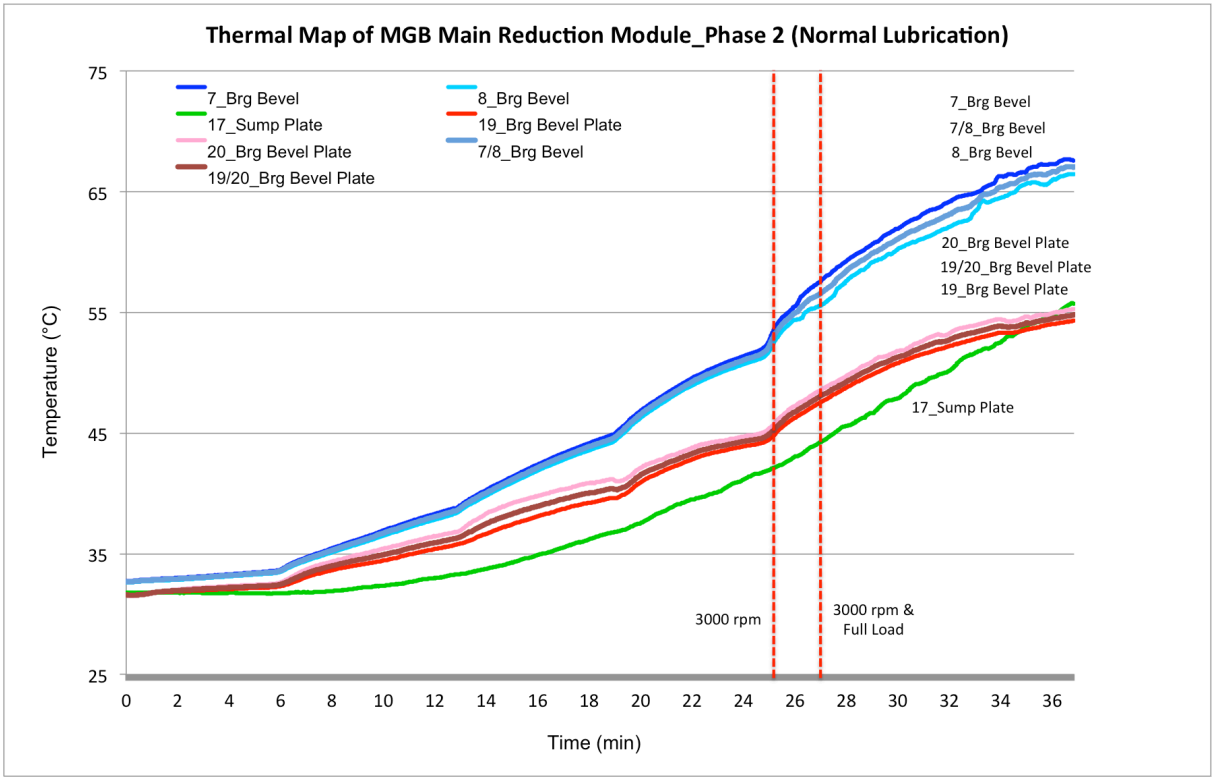

Figure D.35 Temperature Profile of Main Reduction Module at Normal Lubrication Condition and Progressive Loading (Source: Author)

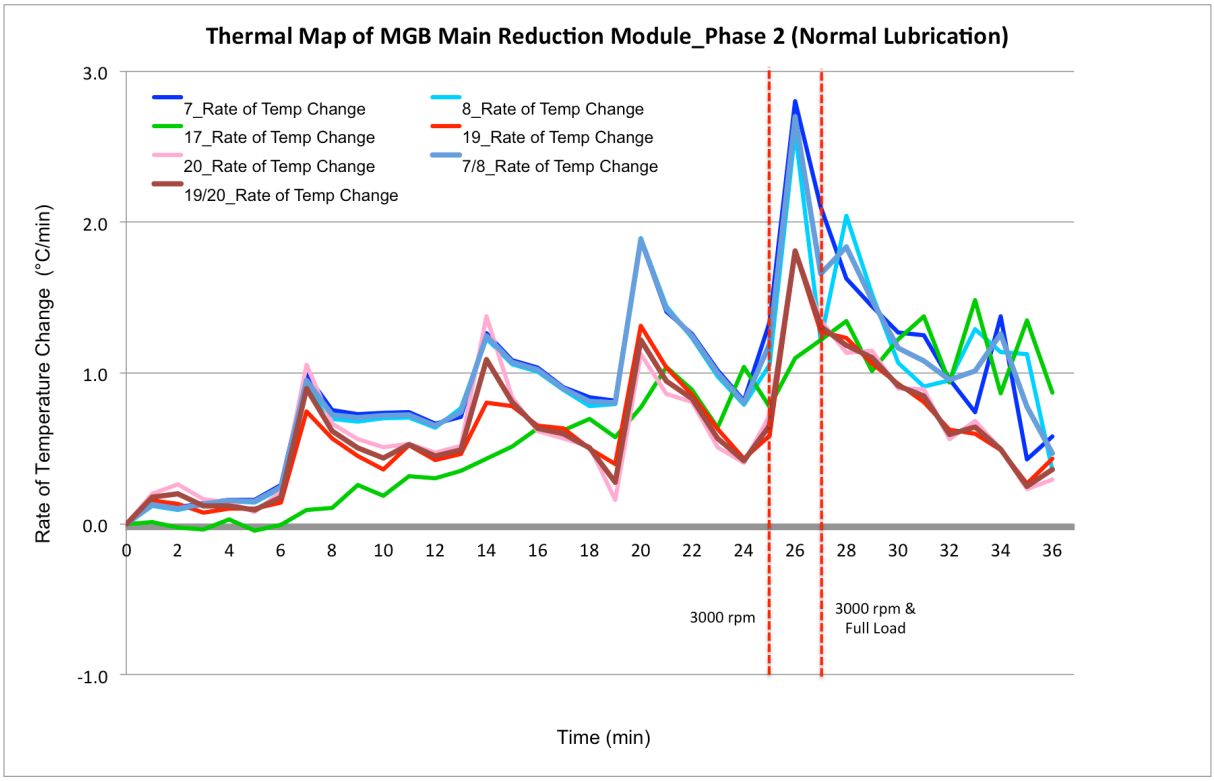

Figure D.36 Rate of Temperature Change of Main Reduction Module at Normal Lubrication Condition and Progressive Loading (Source: Author)

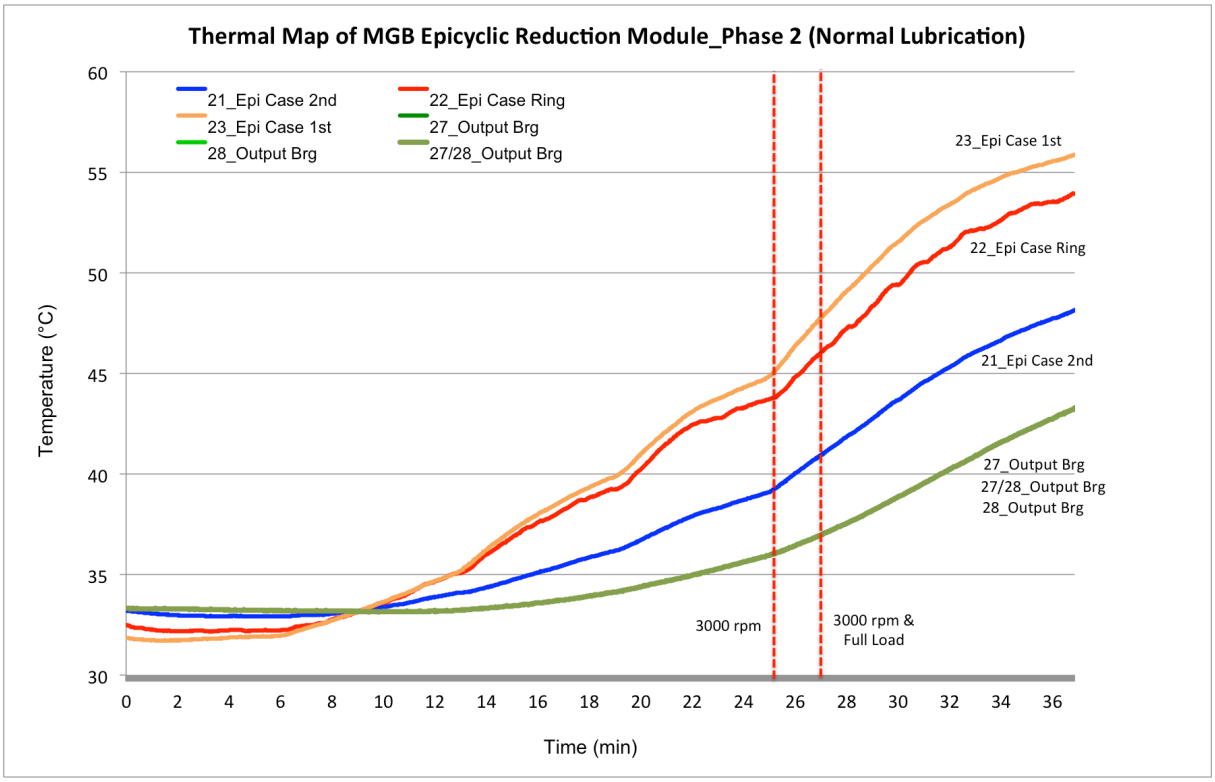

Figure D.37 Temperature Profile of Epicyclic Reduction Module at Normal Lubrication Condition and Progressive Loading (Source: Author)

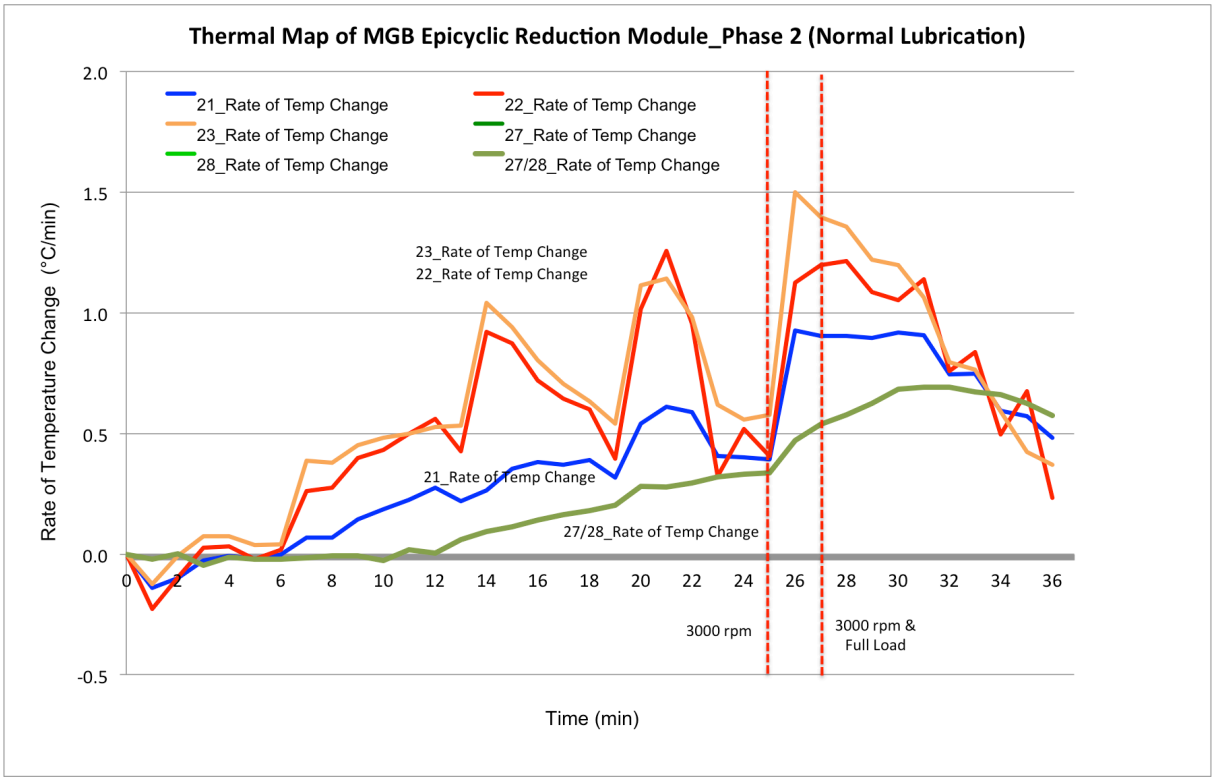

Figure D.38 Rate of Temperature Change of Epicyclic Reduction Module at Normal Lubrication Condition and Progressive Loading (Source: Author)

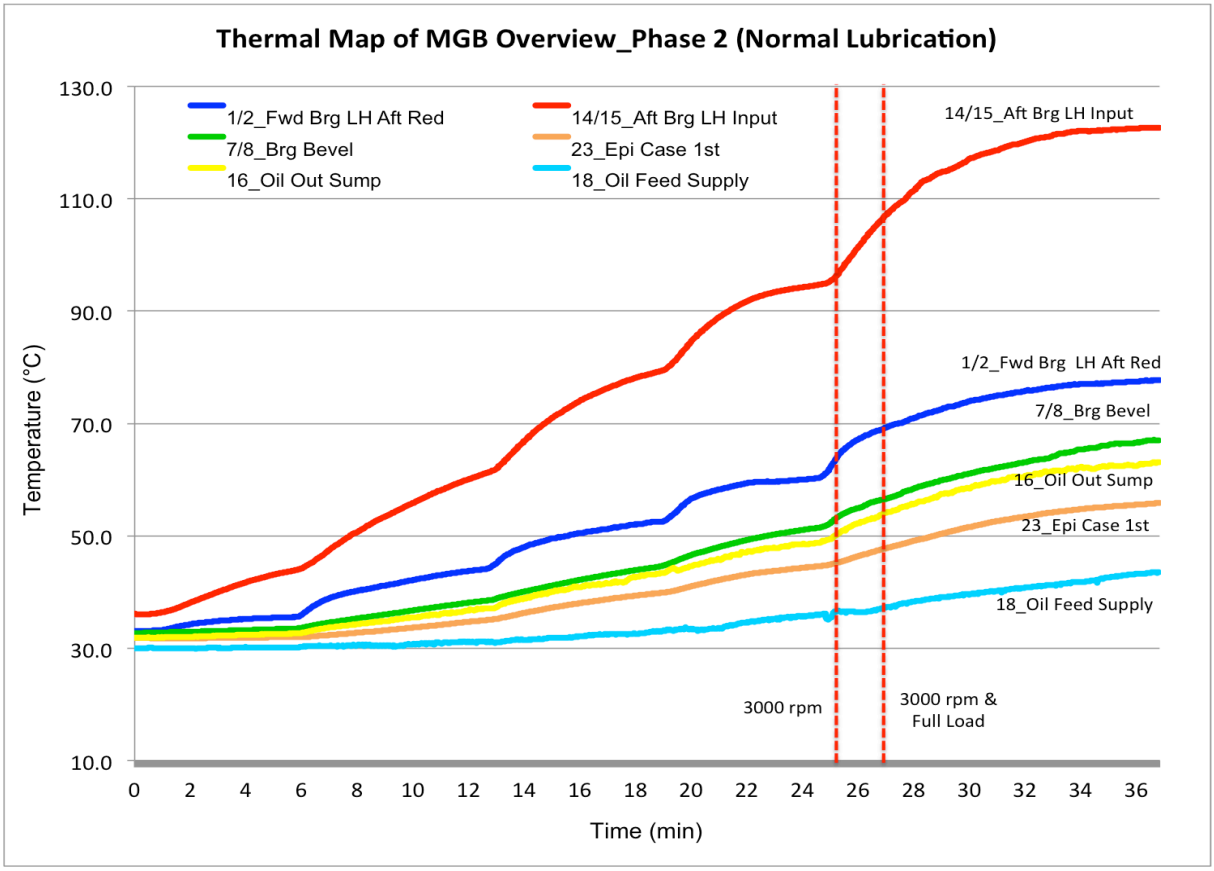

Figure D.39 Temperature Profile Overview at Normal Lubrication Condition and Progressive Loading (Source: Author)

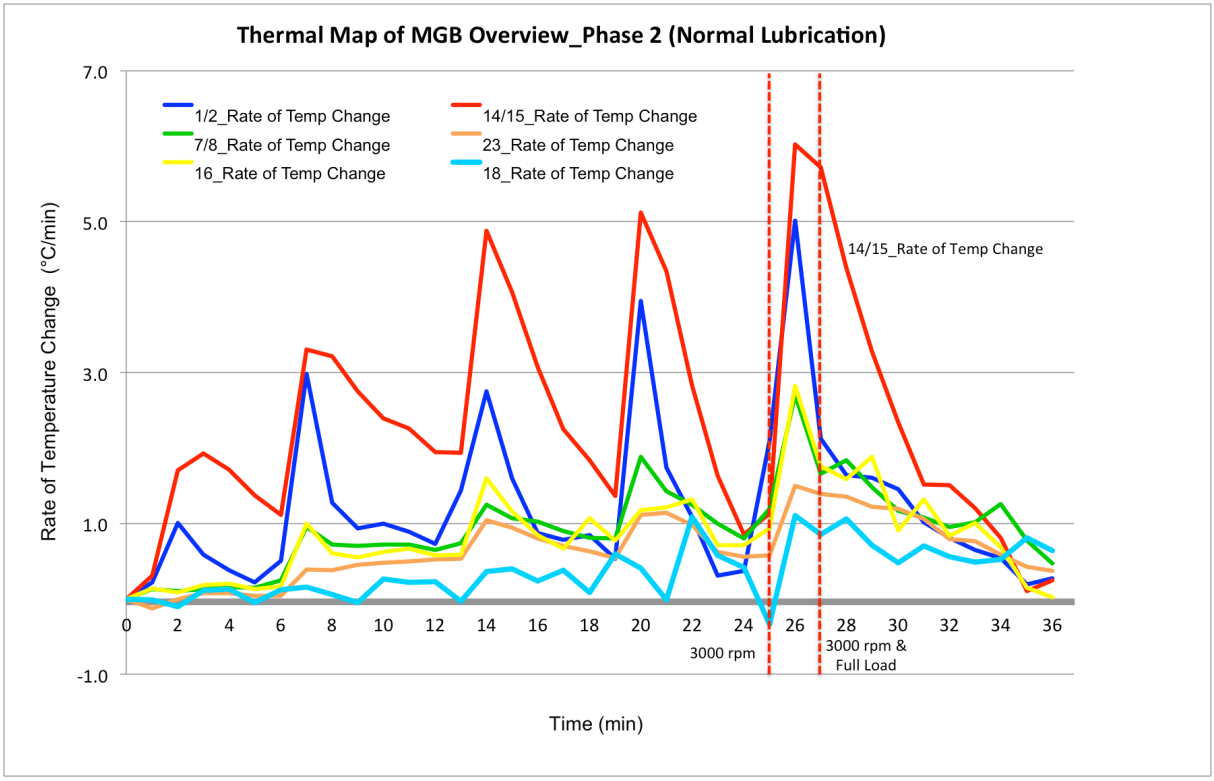

Figure D.40 Rate of Temperature Change Overview at Normal Lubrication Condition and Progressive Loading (Source: Author)

3. Phase 3 – Full Commissioning Tests (Full Load)

3.1 "Oil-Off" Condition

The temperature profiles and rates of temperature change of the MGB under "Oil-Off" condition and full load are shown in Figures D.41 to D.50.

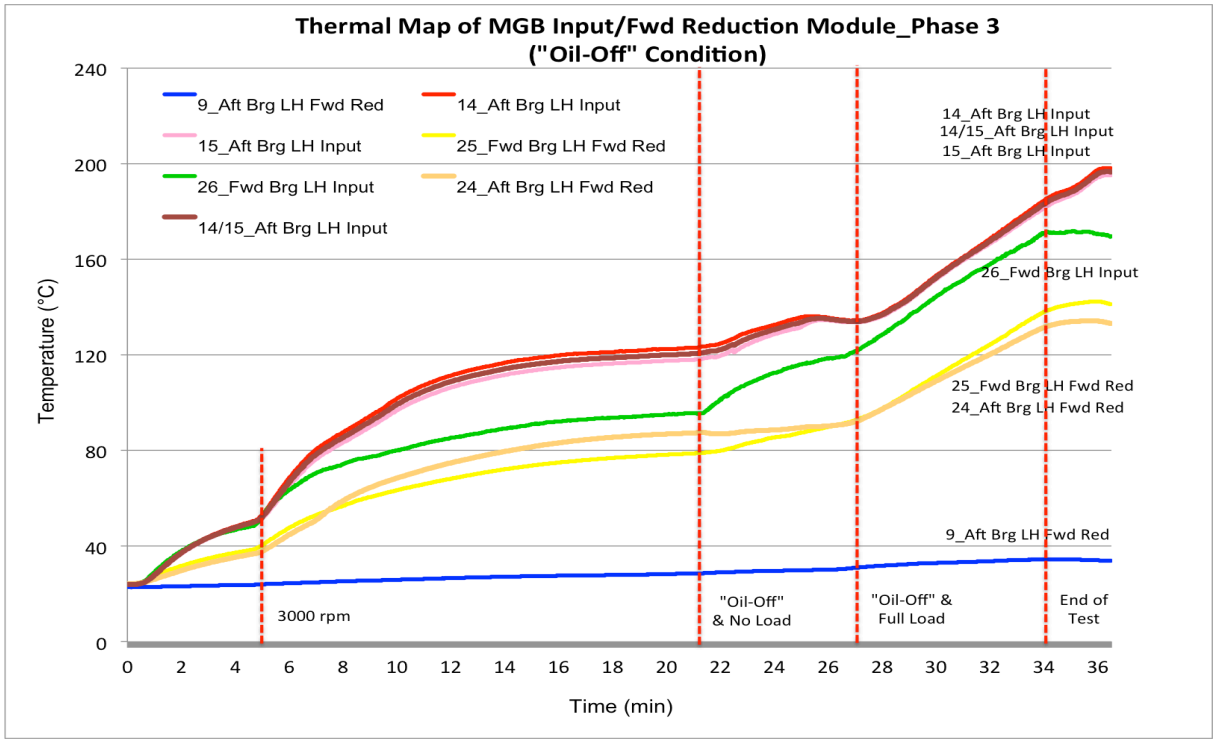

Figure D.41 Temperature Profile of Fwd Reduction Module at "Oil-Off" Condition and Full Load (Source: Author)

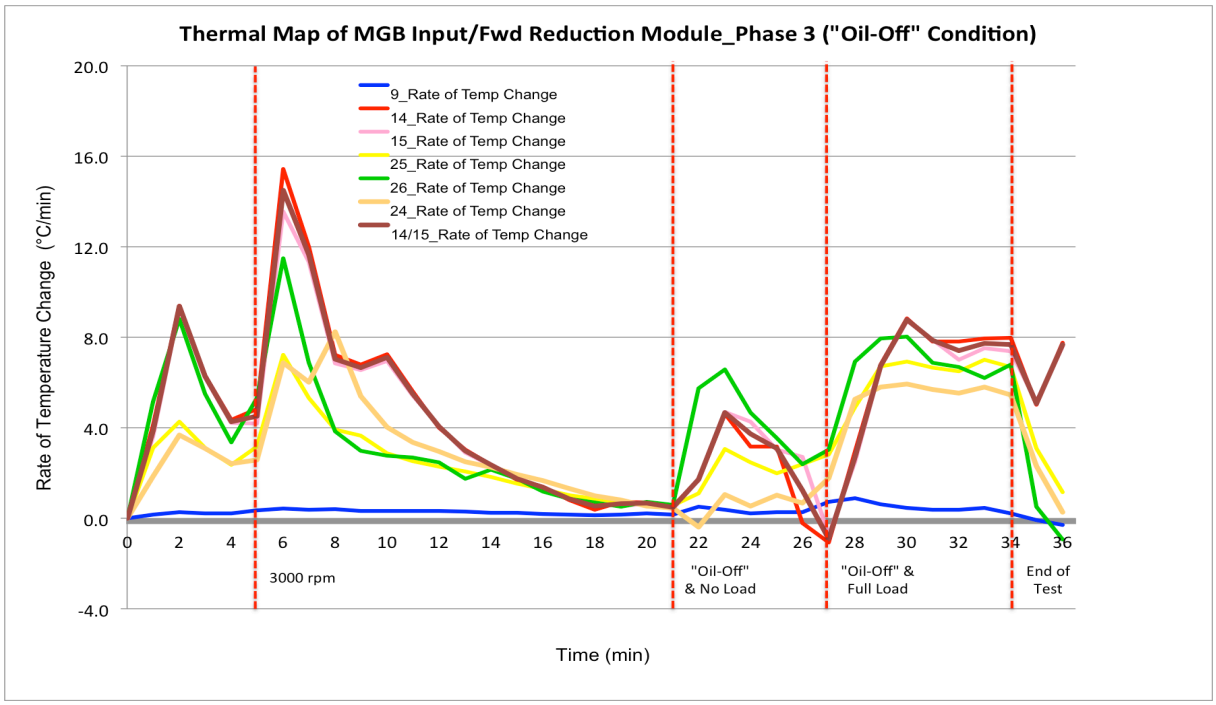

Figure D.42 Rate of Temperature Change of Fwd Reduction Module at "Oil-Off" Condition and Full Load (Source: Author)

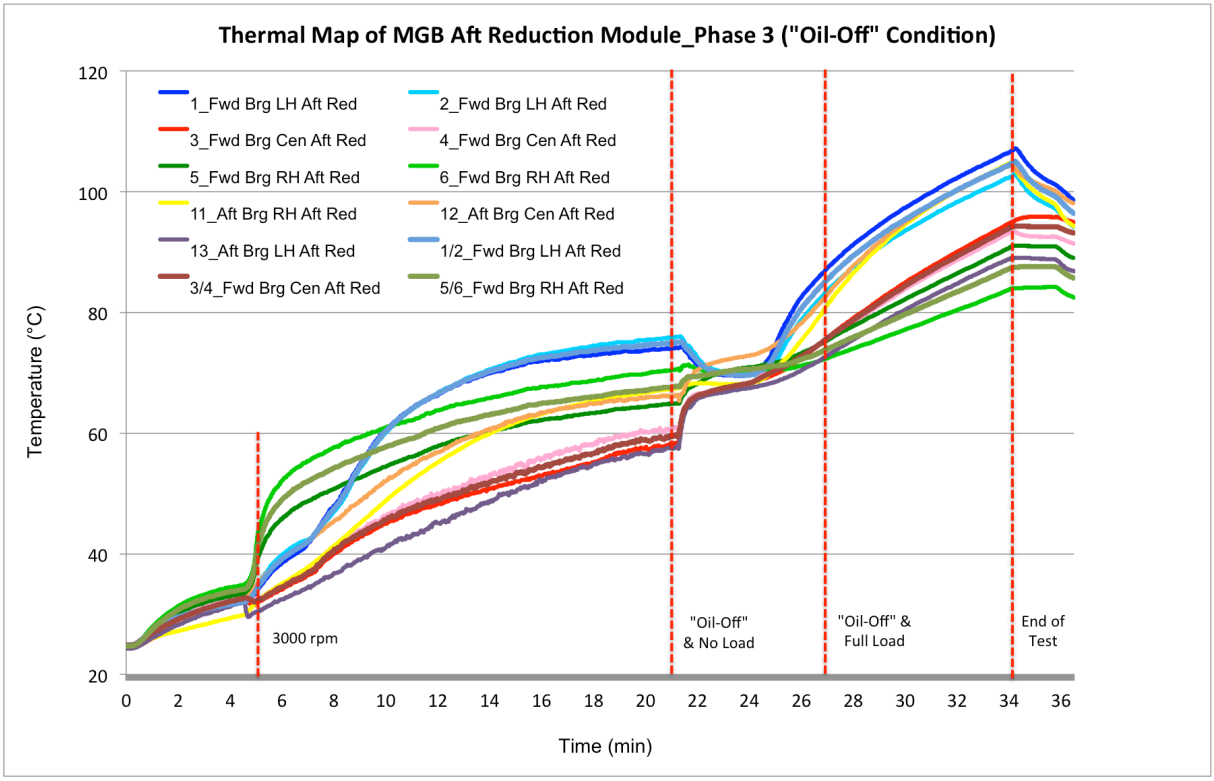

Figure D.43 Temperature Profile of Aft Reduction Module at “Oil-Off” Condition and Full Load (Source: Author)

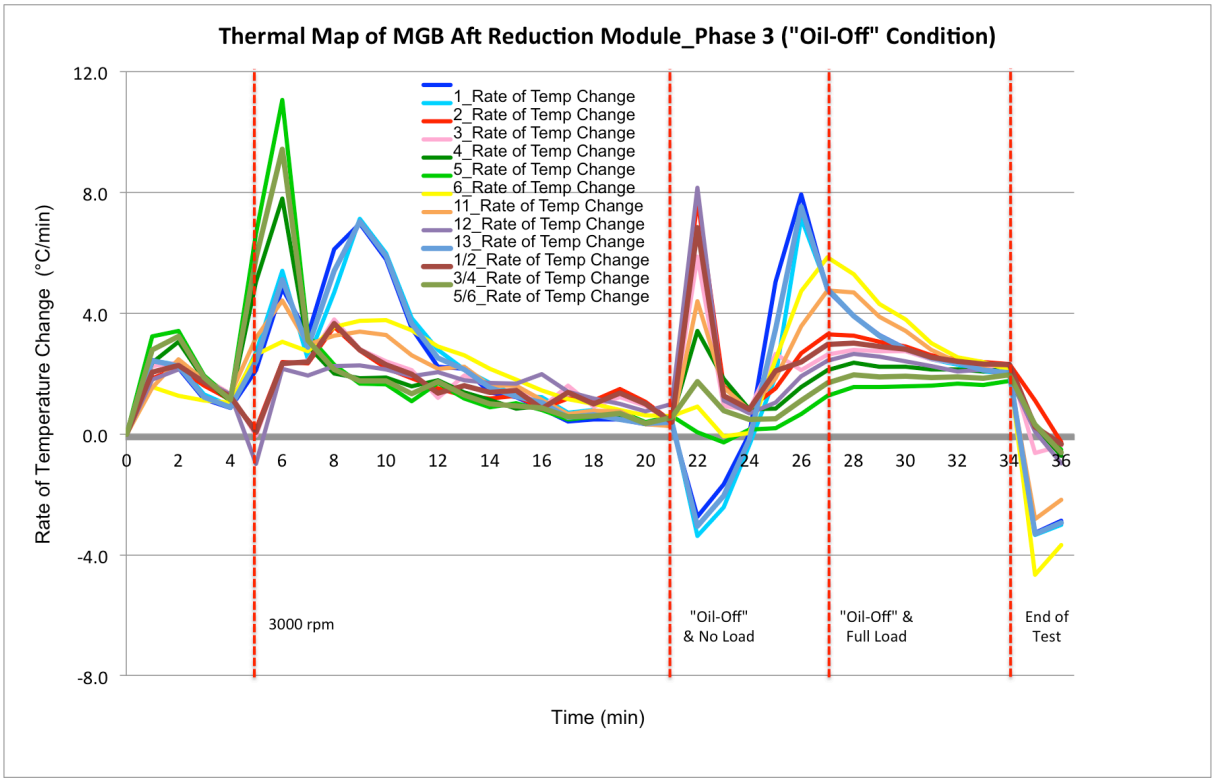

Figure D.44 Rate of Temperature Change of Aft Reduction Module at “Oil-Off” Condition and Full Load (Source: Author)

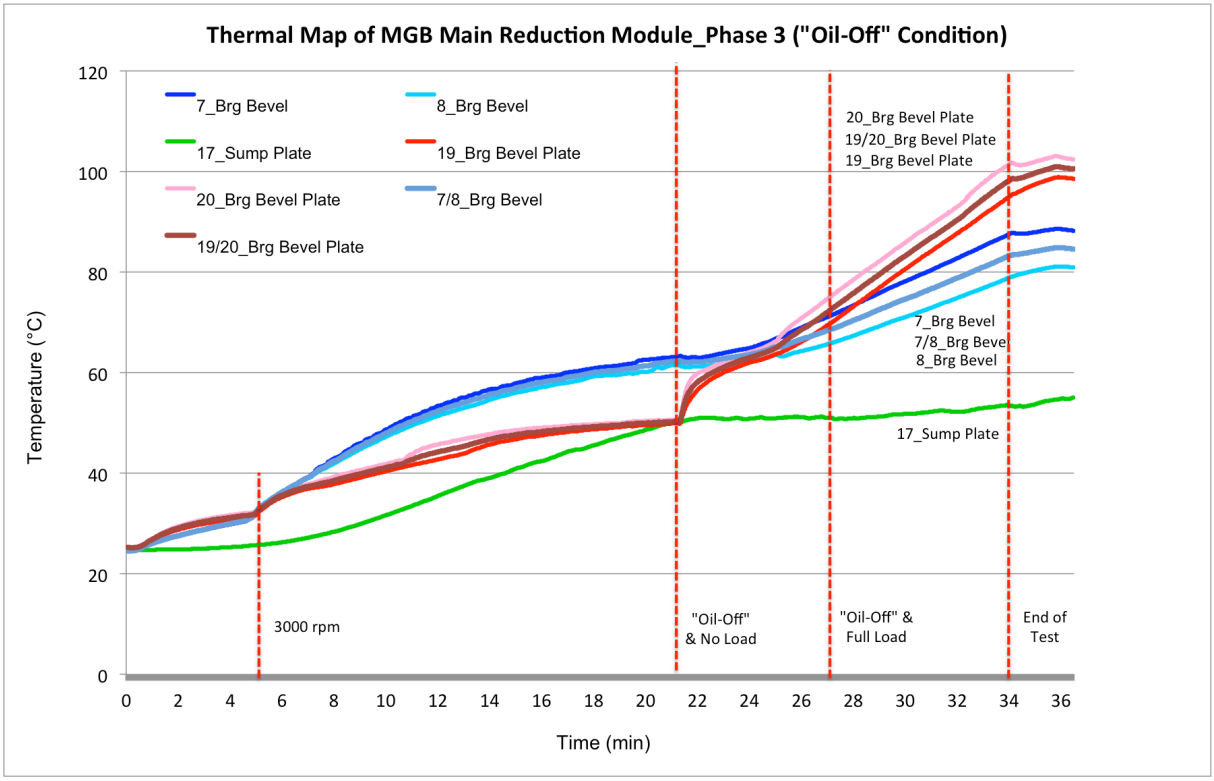

Figure D.45 Temperature Profile of Main Reduction Module at “Oil-Off” Condition and Full Load (Source: Author)

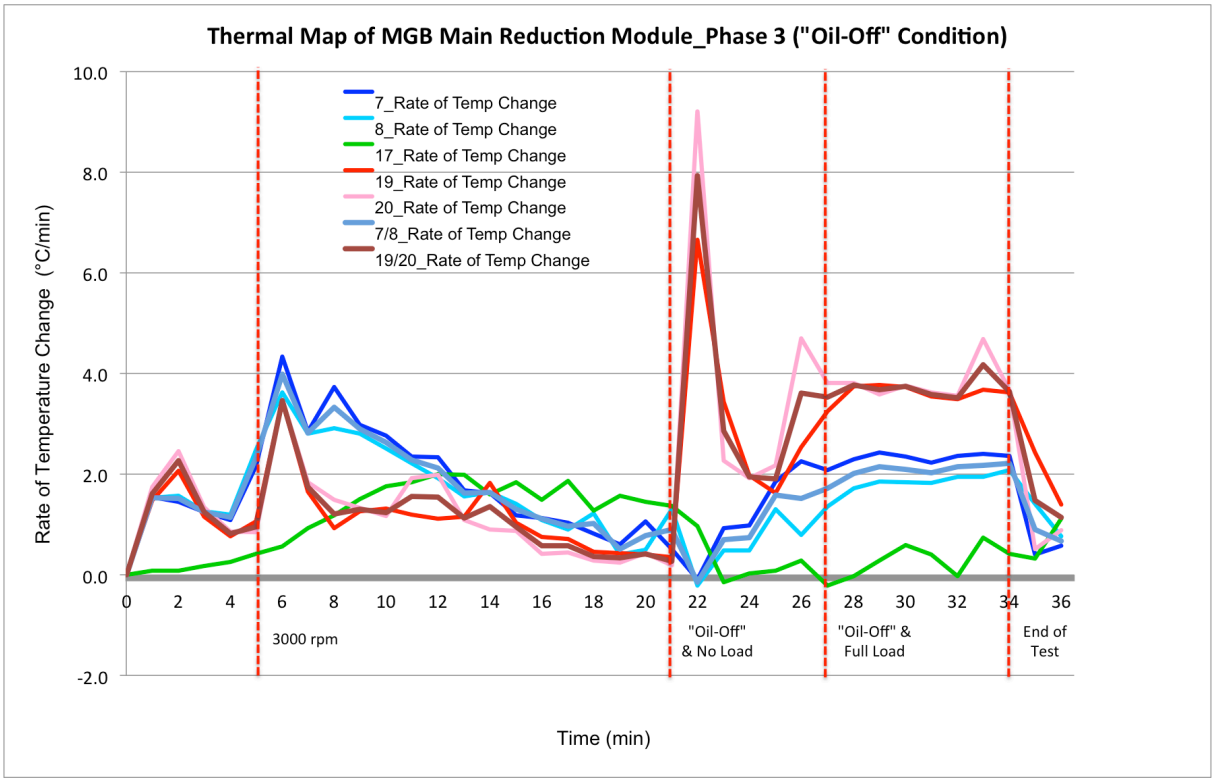

Figure D.46 Rate of Temperature Change of Main Reduction Module at “Oil-Off” Condition and Full Load (Source: Author)

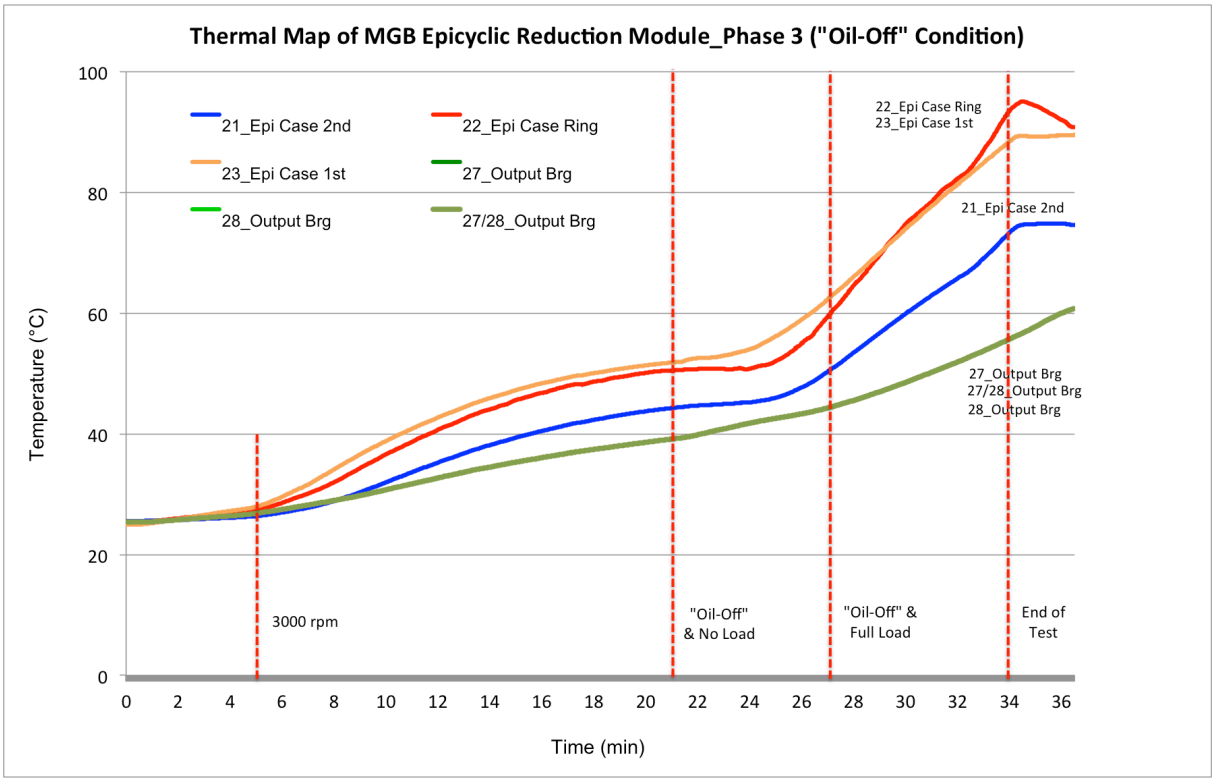

Figure D.47 Temperature Profile of Epicyclic Reduction Module at “Oil-Off” Condition and Full Load (Source: Author)

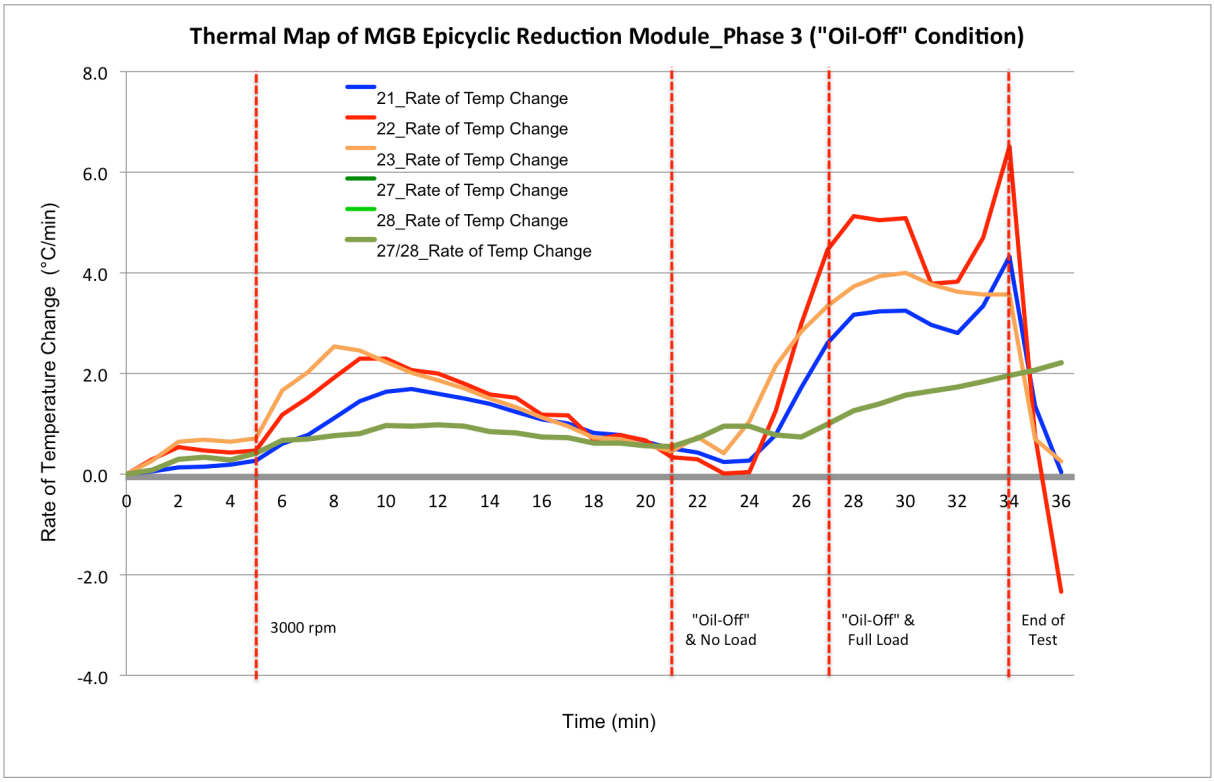

Figure D.48 Rate of Temperature Change of Epicyclic Reduction Module at “Oil-Off” Condition and Full Load (Source: Author)

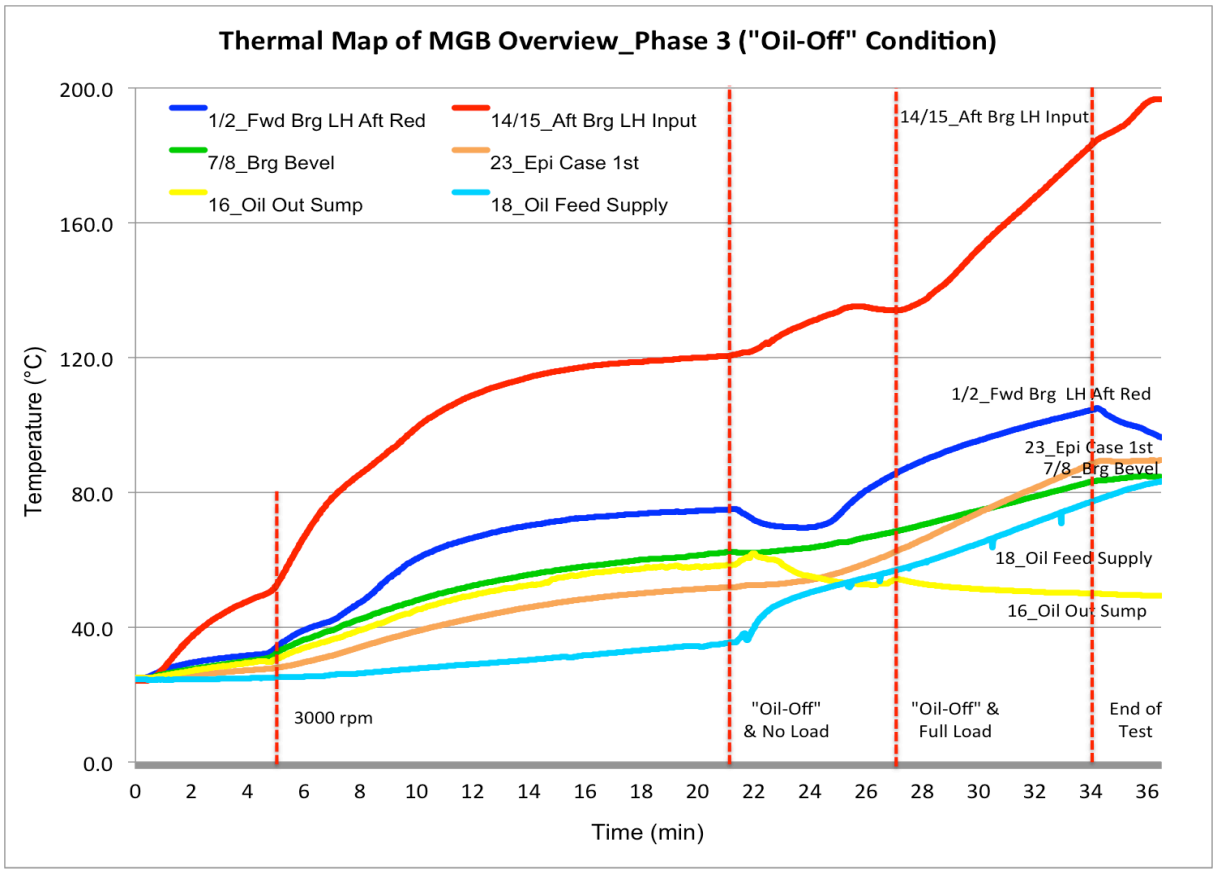

Figure D.49 Temperature Profile Overview at “Oil-Off” Condition and Full Load (Source: Author)

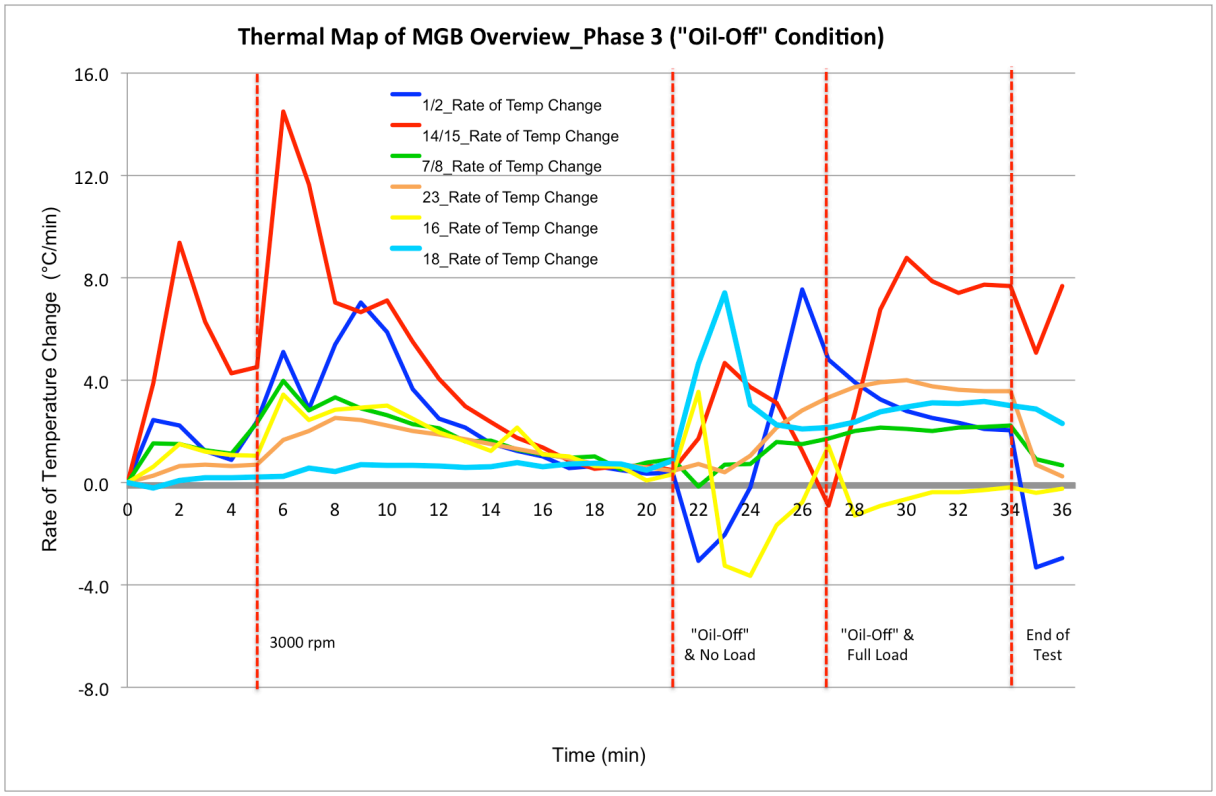

Figure D.50 Rate of Temperature Change Overview at “Oil-Off” Condition and Full Load (Source: Author)

3.2 Thioether Mist Lubrication

The temperature profiles and rates of temperature change of the MGB under thioether mist lubrication and full load are shown in Figures D.51 to D.60.

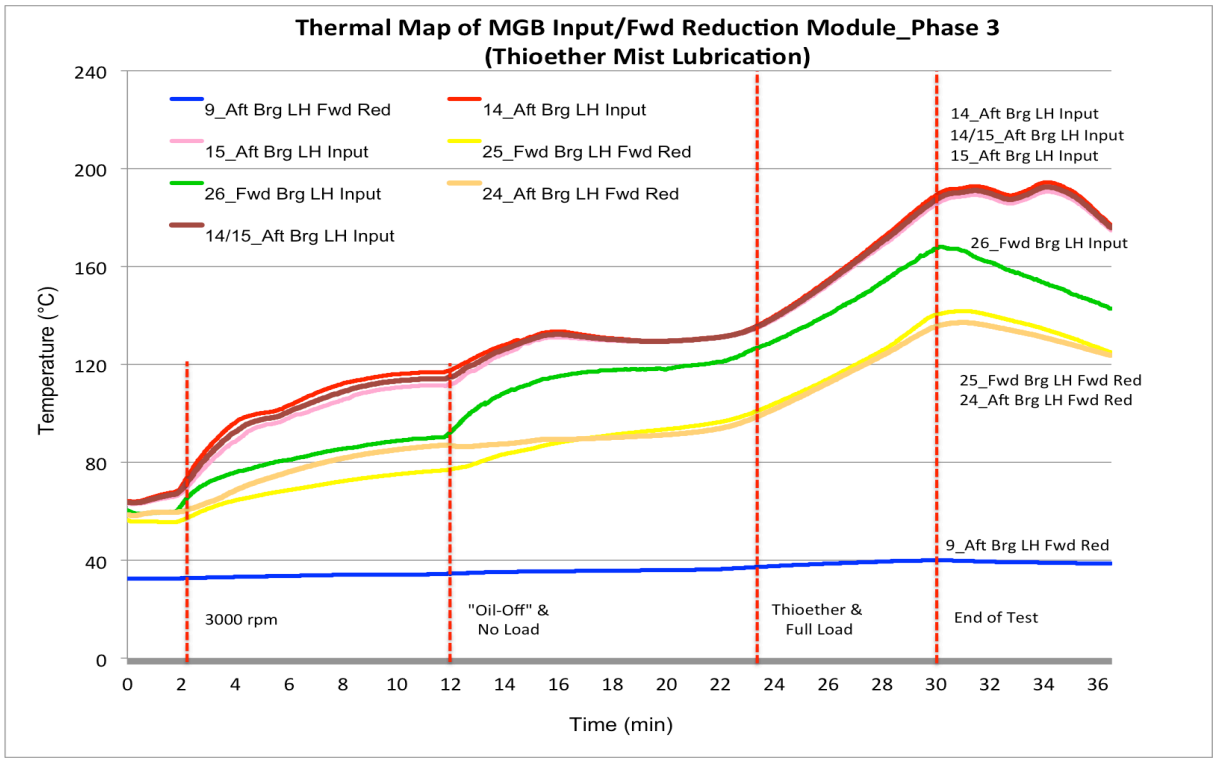

Figure D.51 Temperature Profile of Fwd Reduction Module at Thioether Mist Lubrication and Full Load (Source: Author)

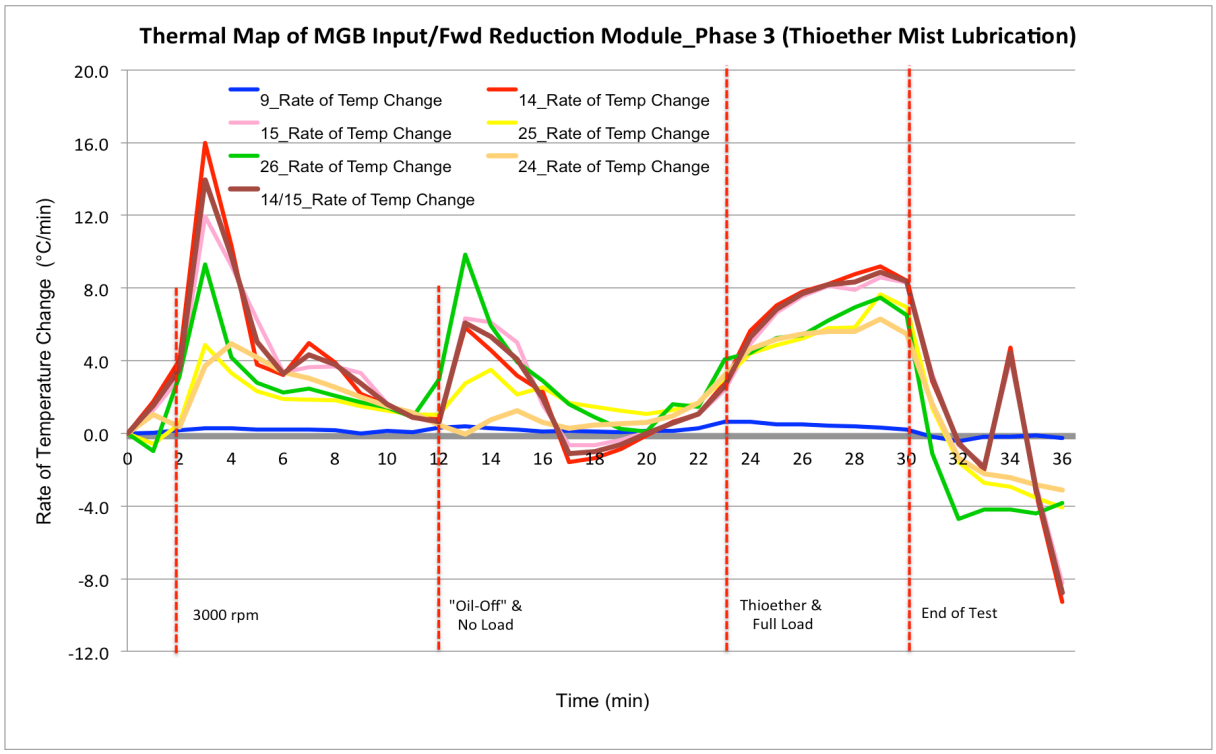

Figure D.52 Rate of Temperature Change of Fwd Reduction Module at Thioether Mist Lubrication and Full Load (Source: Author)

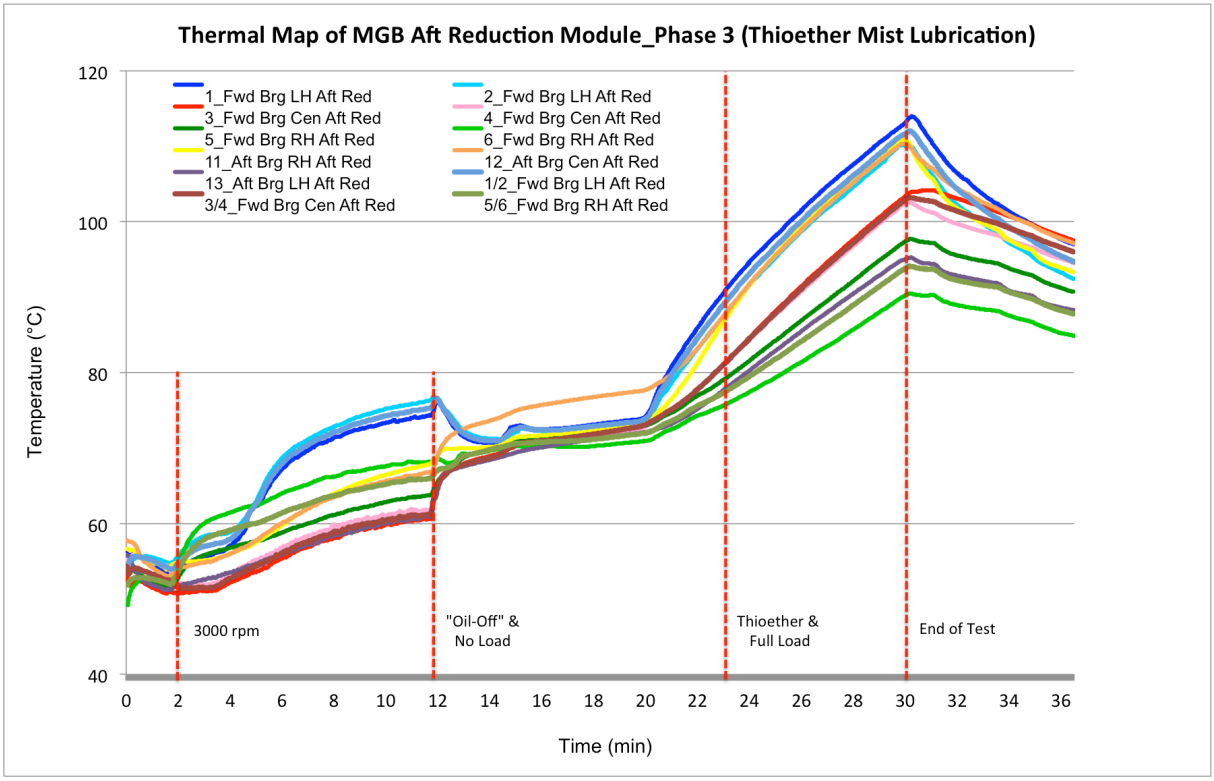

Figure D.53 Temperature Profile of Aft Reduction Module at Thioether Mist Lubrication and Full Load (Source: Author)

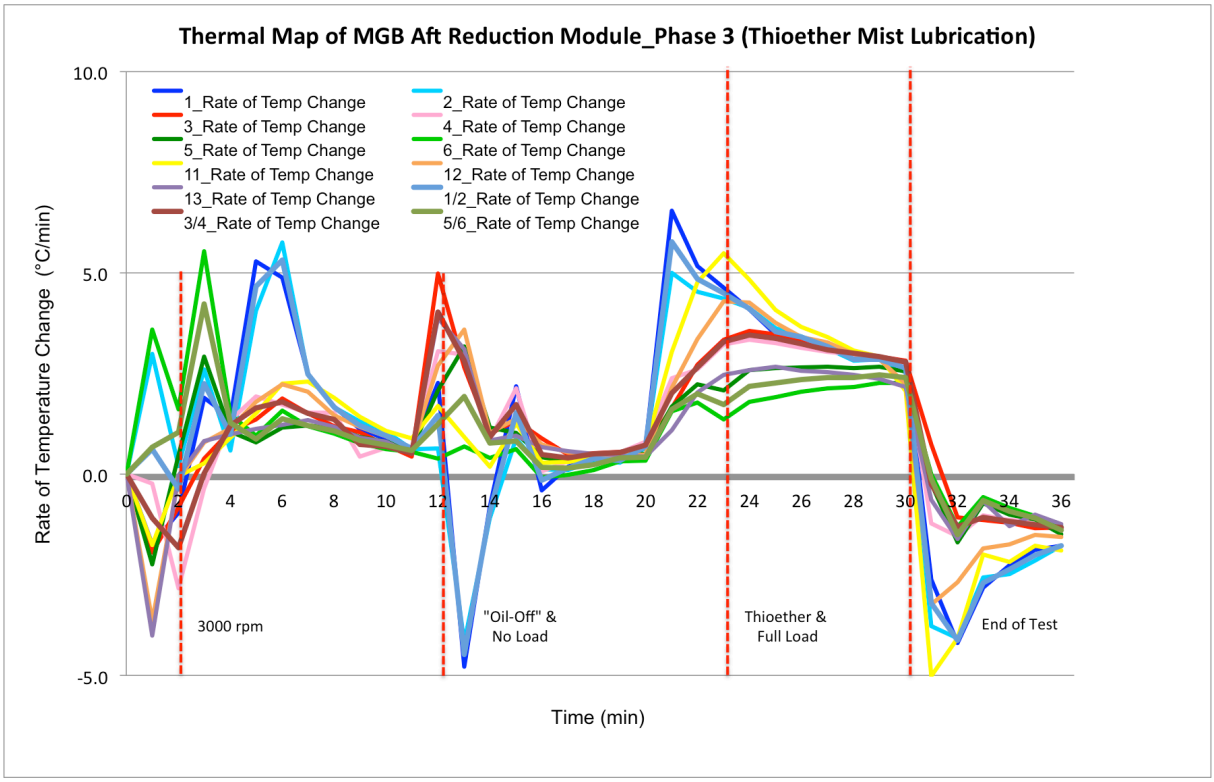

Figure D.54 Rate of Temperature Change of Aft Reduction Module at Thioether Mist Lubrication and Full Load (Source: Author)

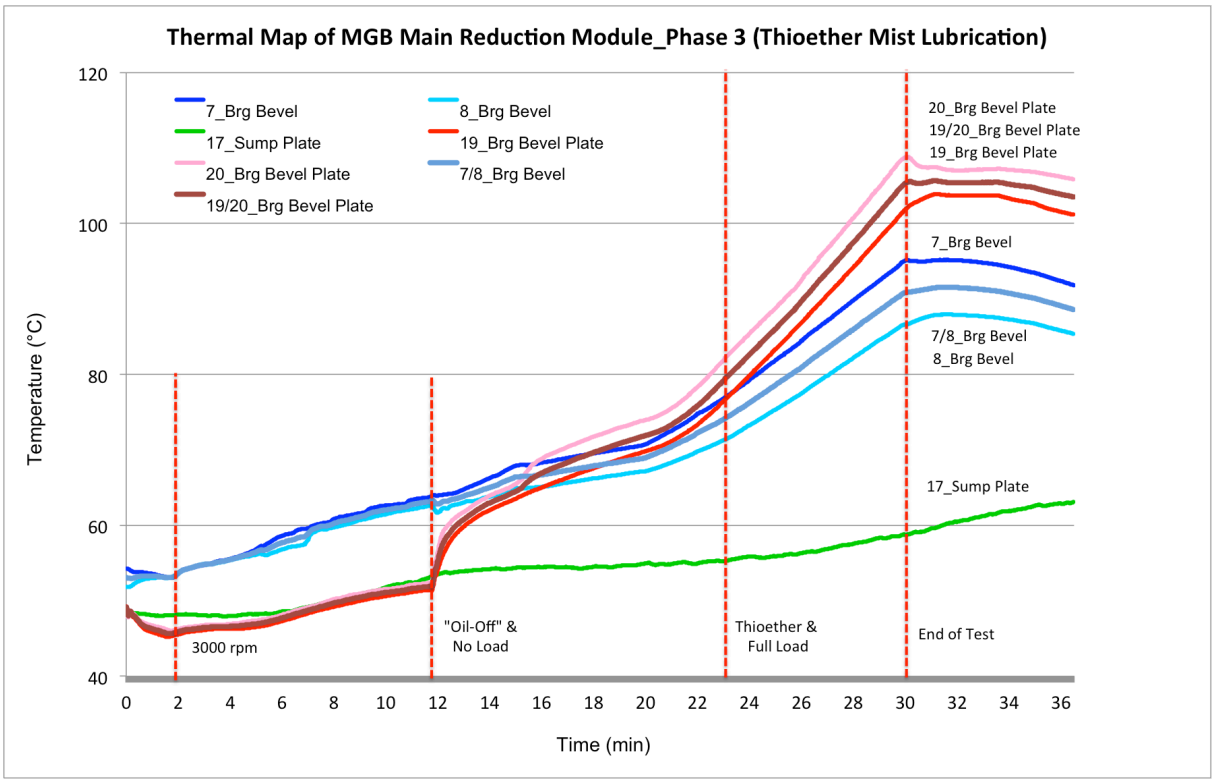

Figure D.55 Temperature Profile of Main Reduction Module at Thioether Mist Lubrication and Full Load (Source: Author)

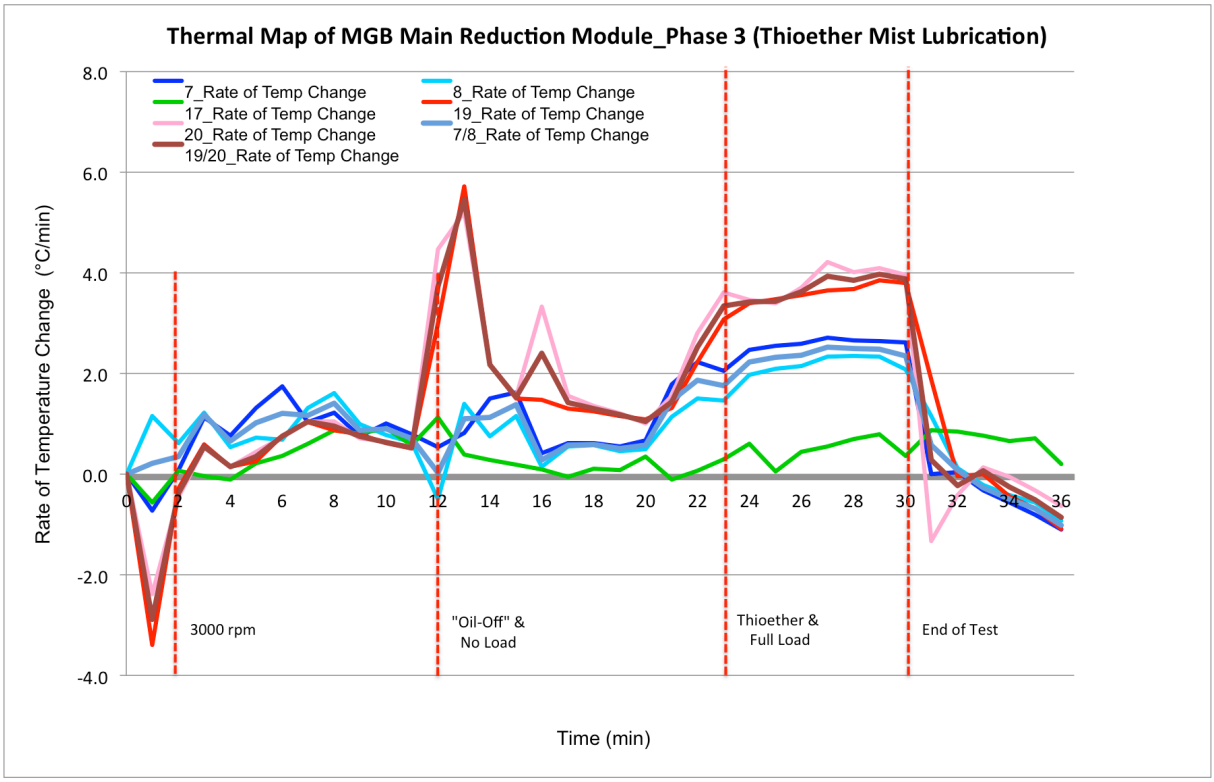

Figure D.56 Rate of Temperature Change of Main Reduction Module at Thioether Mist Lubrication and Full Load (Source: Author)

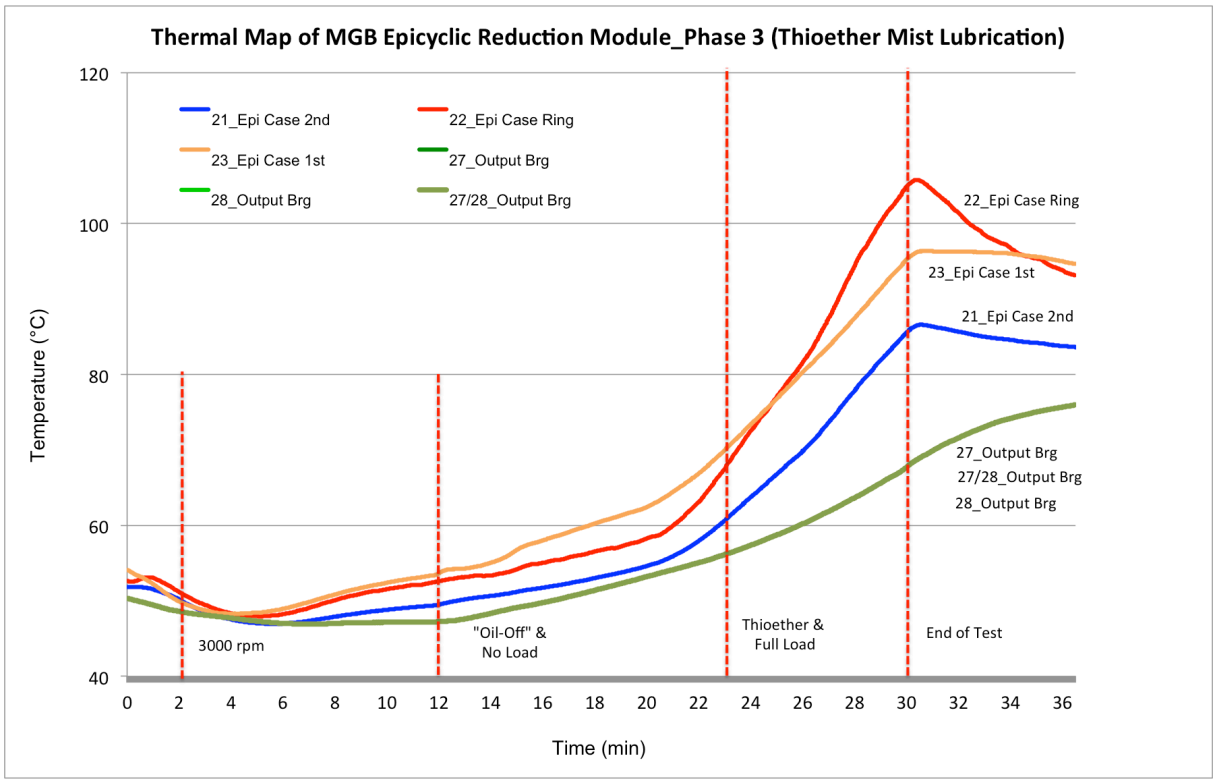

Figure D.57 Temperature Profile of Epicyclic Reduction Module at Thioether Mist Lubrication and Full Load (Source: Author)

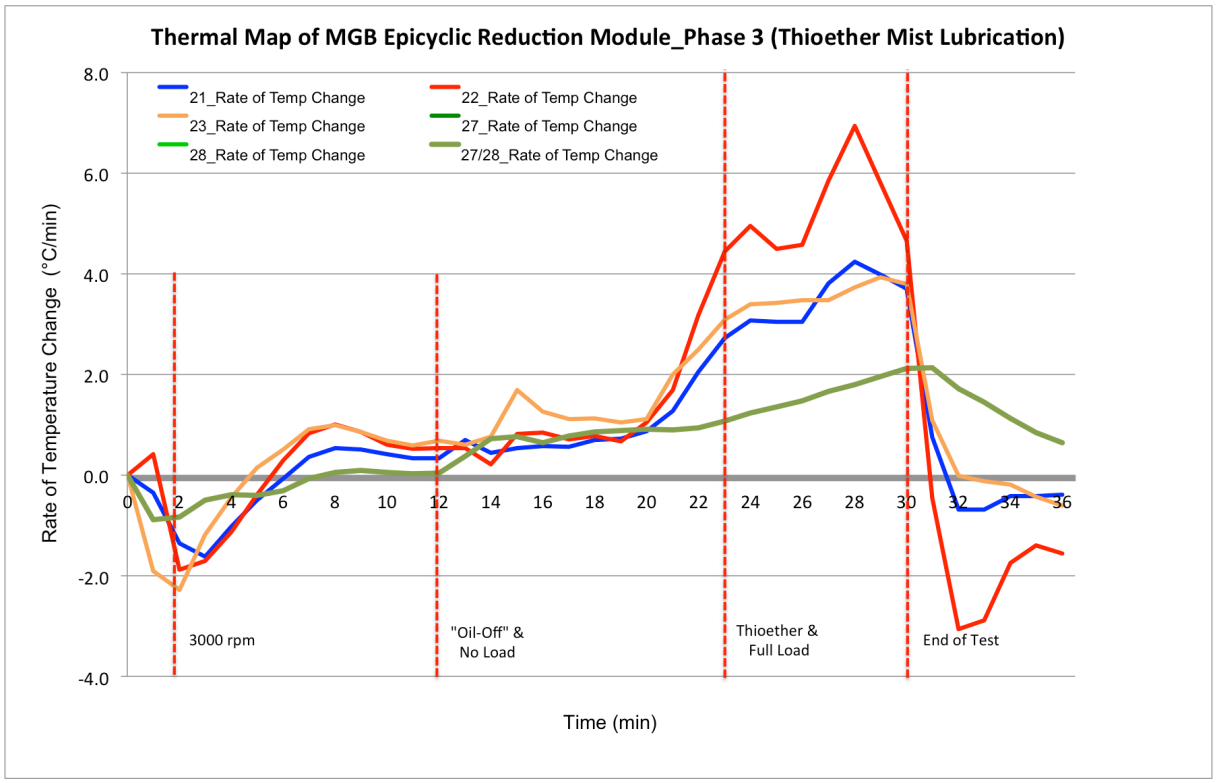

Figure D.58 Rate of Temperature Change of Epicyclic Reduction Module at Thioether Mist Lubrication and Full Load (Source: Author)

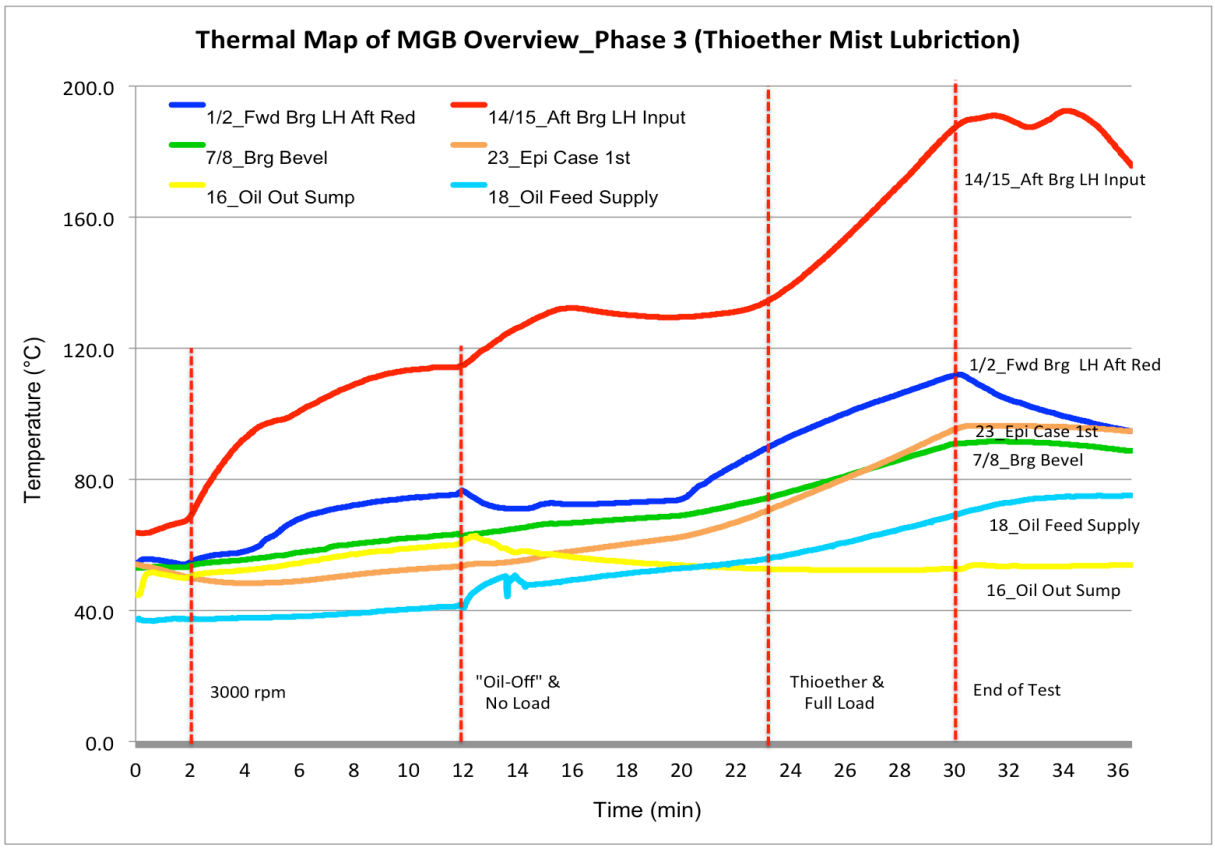

Figure D.59 Temperature Profile Overview at Thioether Mist Lubrication and Full Load (Source: Author)

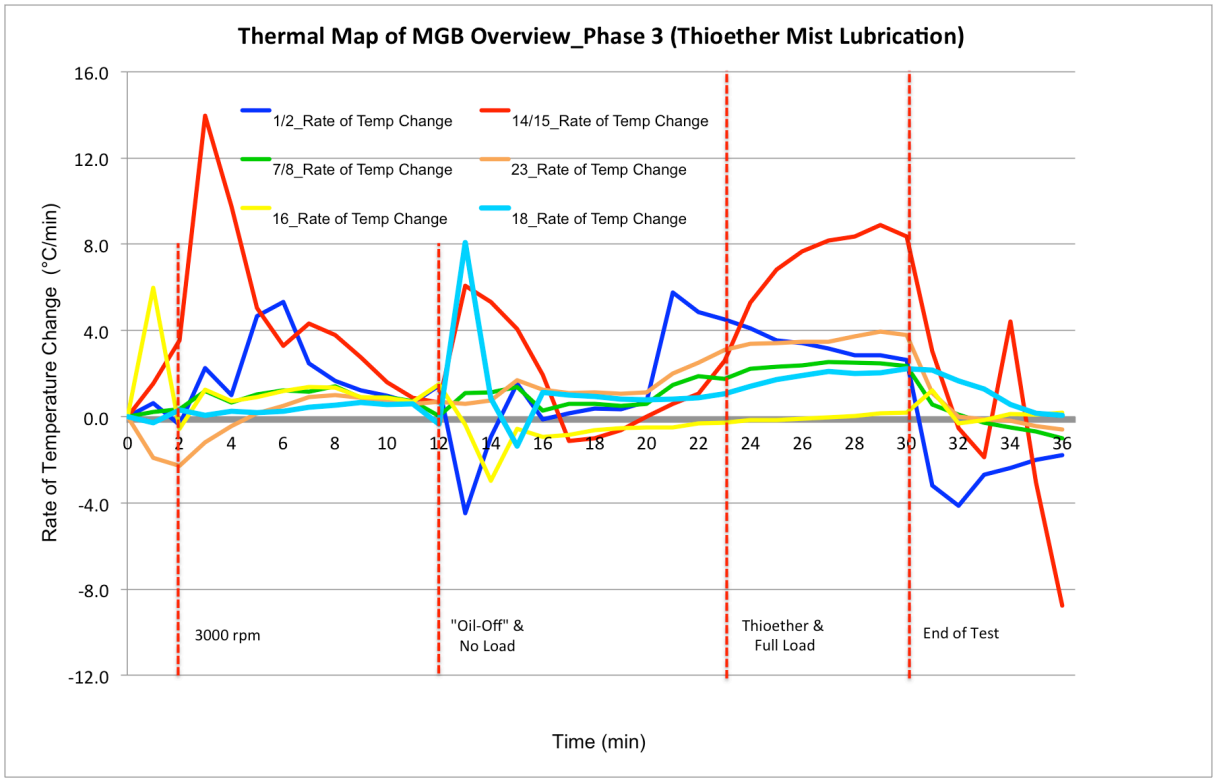

Figure D.60 Rate of Temperature Change Overview at Thioether Mist Lubrication and Full Load (Source: Author)

3.3 “Dry Gears” Condition

The temperature profiles and rates of temperature change of the MGB under “Dry Gears” condition and full load are shown in Figures D.61 to D.70.

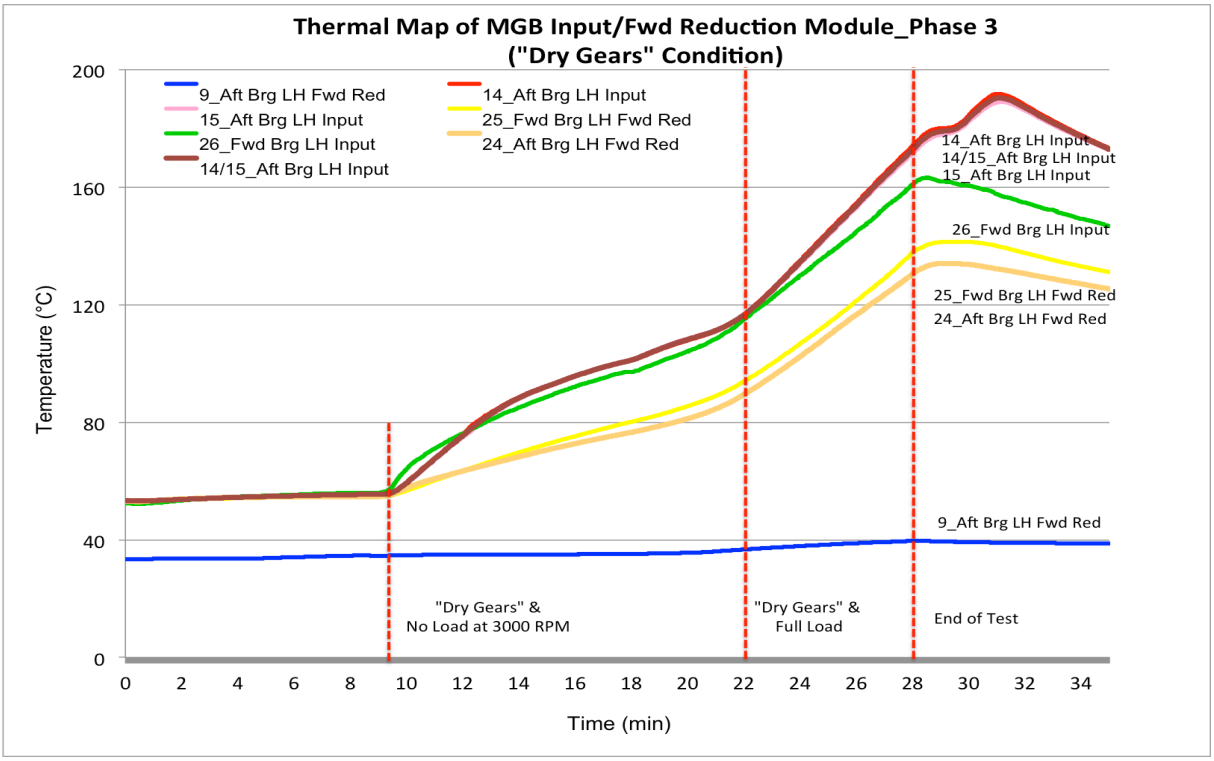

Figure D.61 Temperature Profile of Fwd Reduction Module at “Dry Gears” Condition and Full Load (Source: Author)

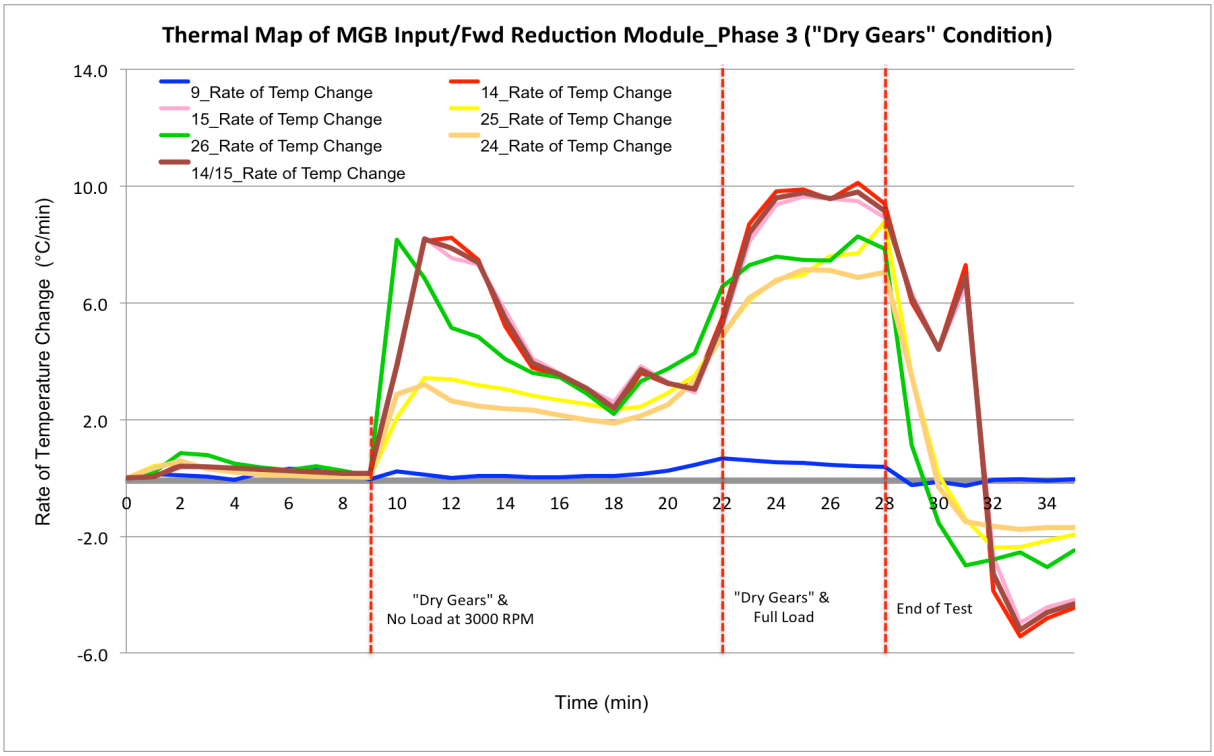

Figure D.62 Rate of Temperature Change of Fwd Reduction Module at “Dry Gears” Condition and Full Load (Source: Author)

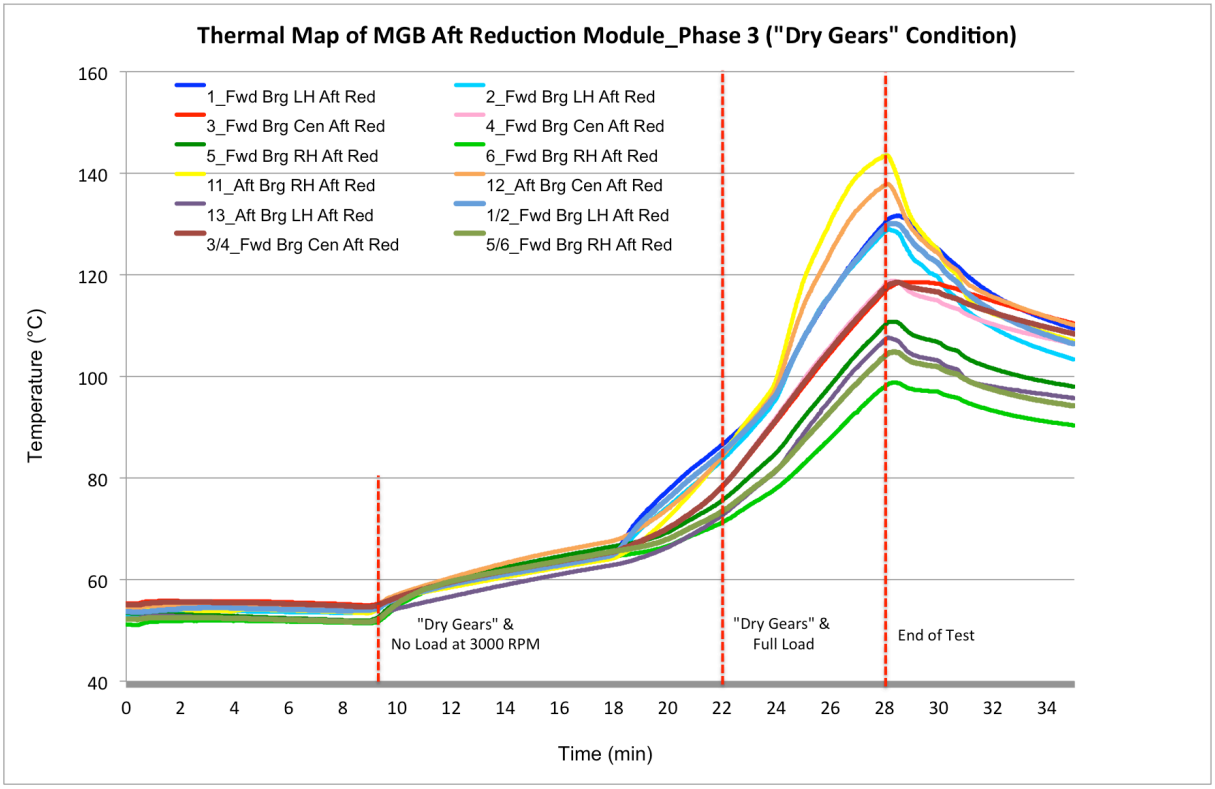

Figure D.63 Temperature Profile of Aft Reduction Module at “Dry Gears” Condition and Full Load (Source: Author)

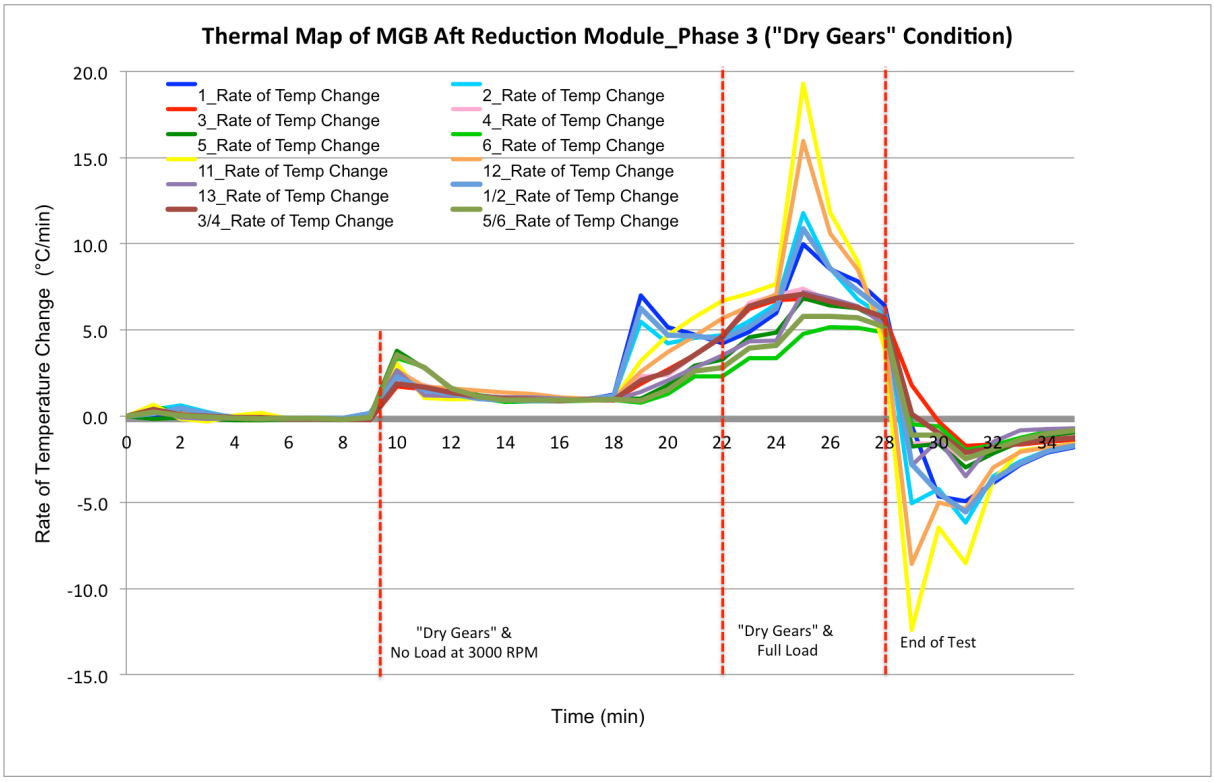

Figure D.64 Rate of Temperature Change of Aft Reduction Module at “Dry Gears” Condition and Full Load (Source: Author)

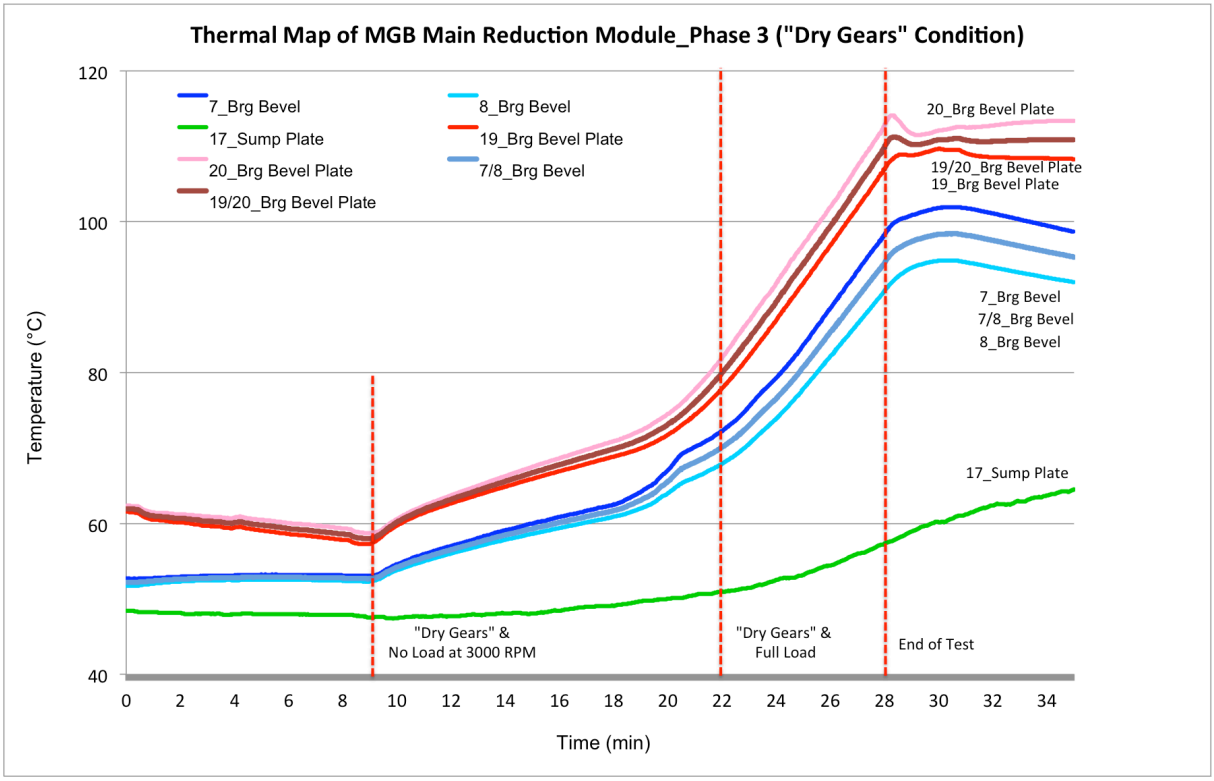

Figure D.65 Temperature Profile of Main Reduction Module at “Dry Gears” Condition and Full Load (Source: Author)

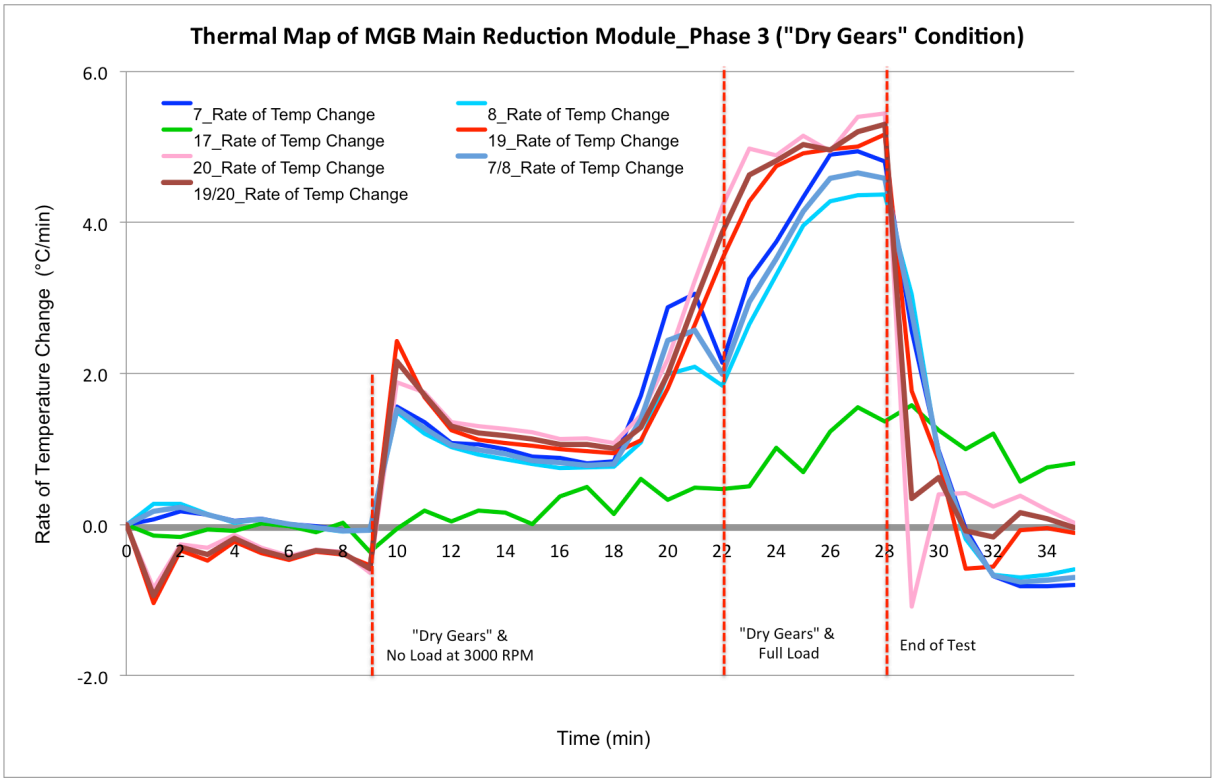

Figure D.66 Rate of Temperature Change of Main Reduction Module at “Dry Gears” Condition and Full Load (Source: Author)

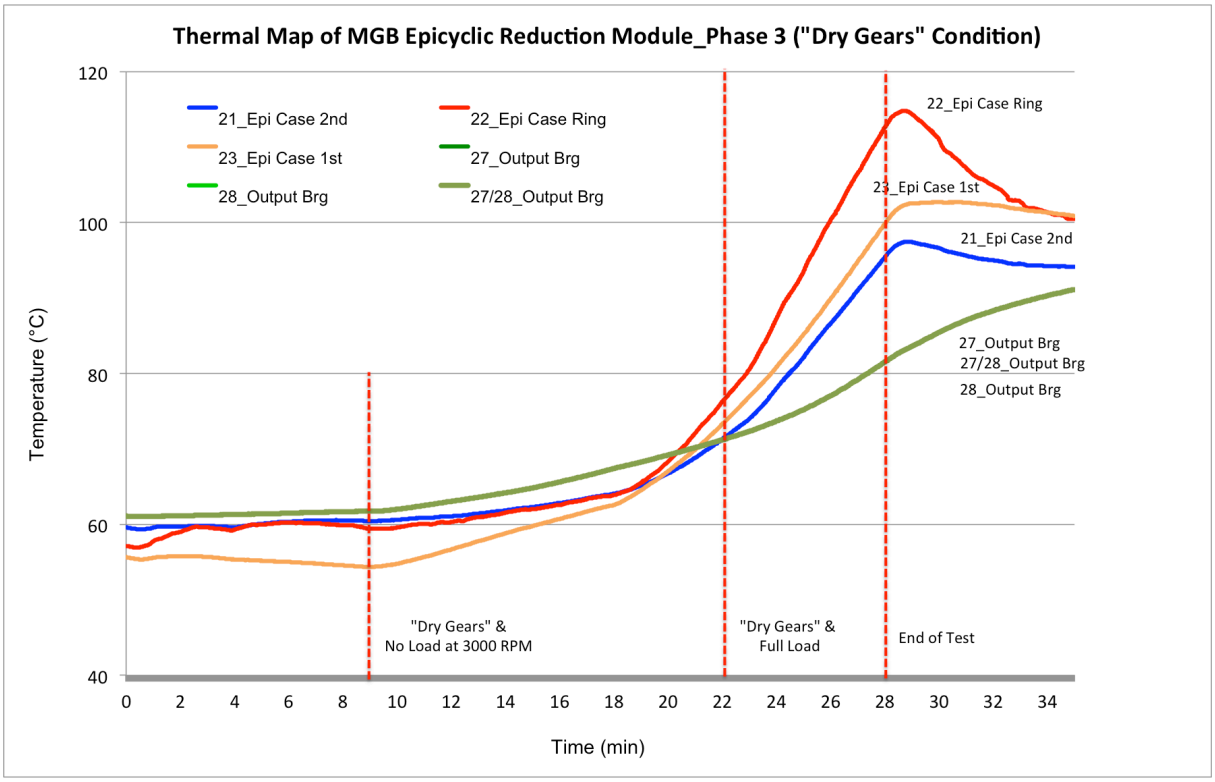

Figure D.67 Temperature Profile of Epicyclic Reduction Module at "Dry Gears" Condition and Full Load (Source: Author)

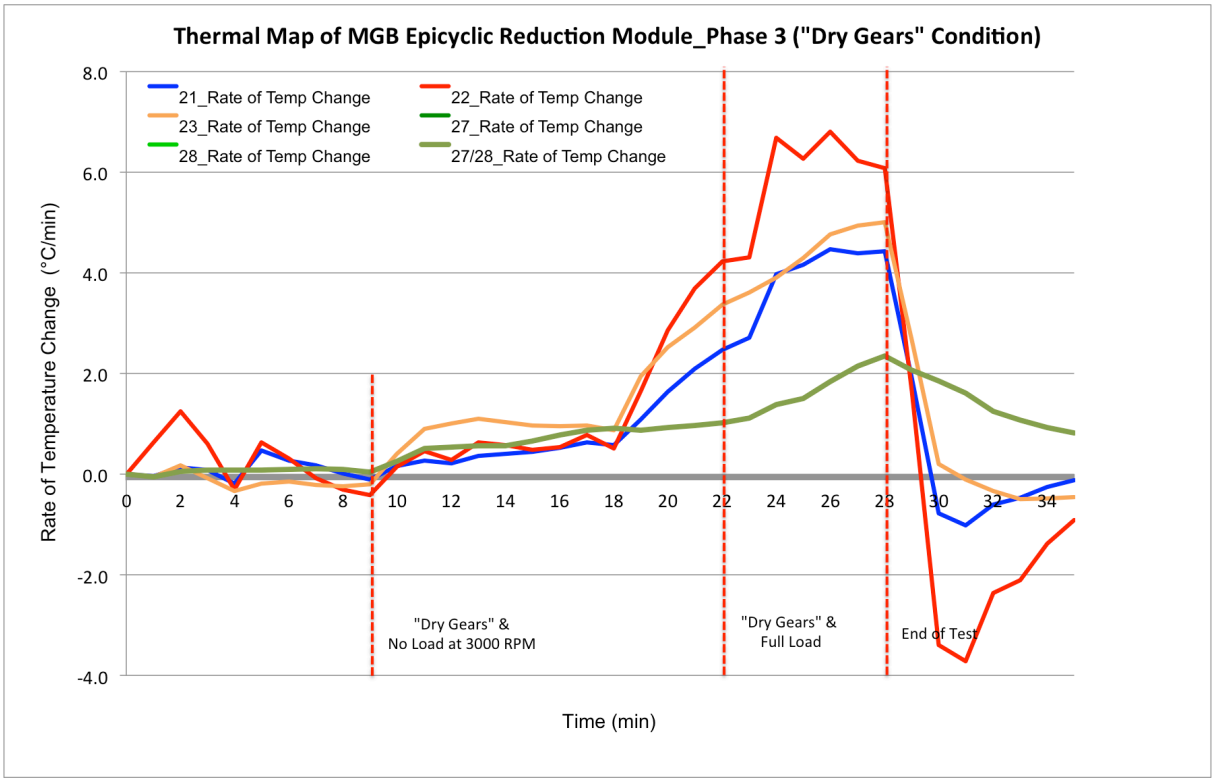

Figure D.68 Rate of Temperature Change of Epicyclic Reduction Module at "Dry Gears" Condition and Full Load (Source: Author)

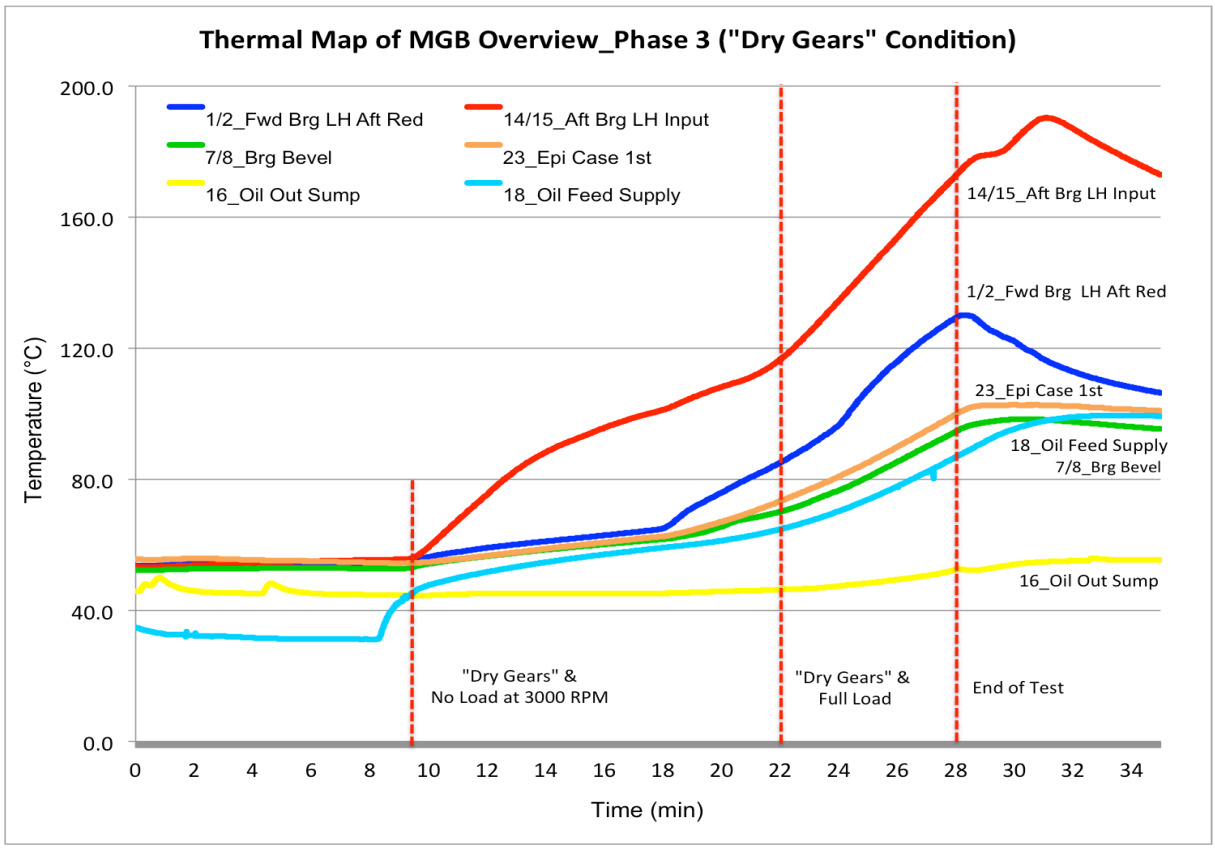

Figure D.69 Temperature Profile Overview at “Dry Gears” Condition and Full Load (Source: Author)

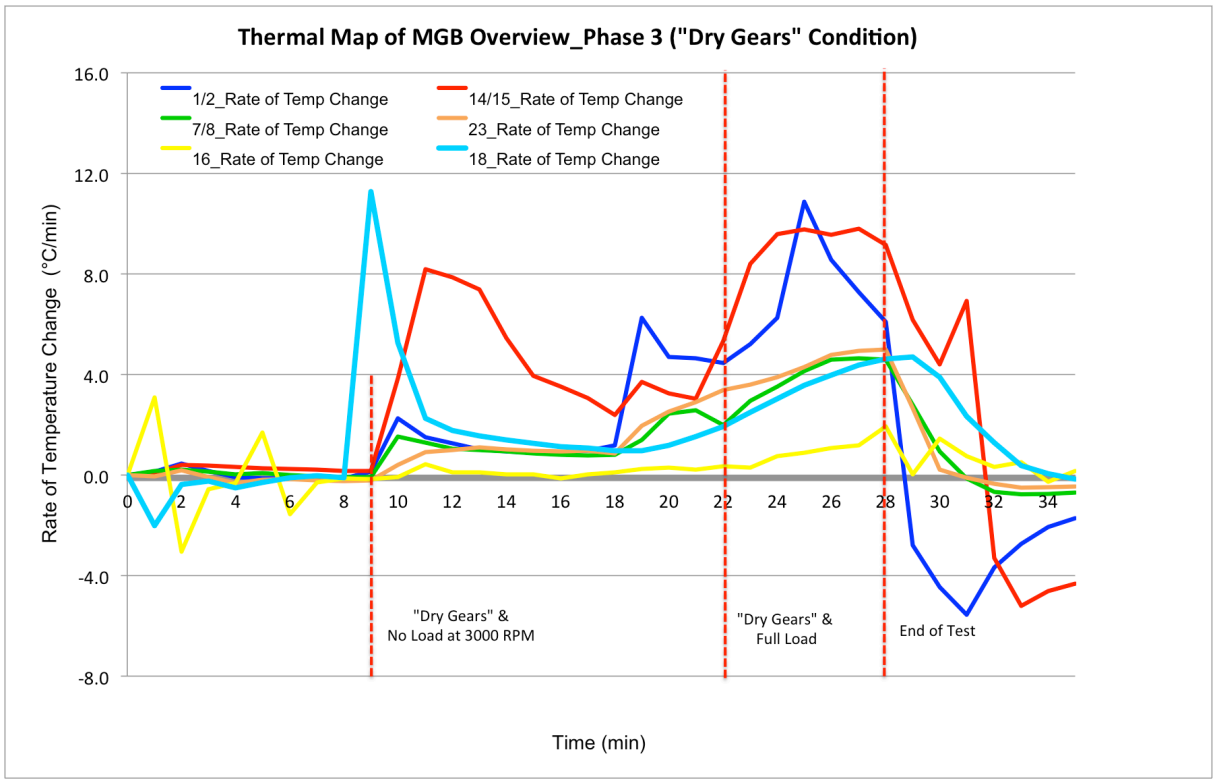

Figure D.70 Rate of Temperature Change Overview at “Dry Gears” Condition and Full Load (Source: Author)

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