



USING SAMSON HIGH PERFORMANCE DYNEEMA FIBER MOORING LINES IN HOT CLIMATE

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THE STRONGEST NAME IN ROPE



OVERVIEW

- ***Qatar Environment***
- ***Effect of Temperature on Dyneema Fiber rope***
- ***Creep, High Ambient Temperature and Samson High Performance Mooring lines***
 - Model Study
 - Lab Testing
- ***Conclusions***

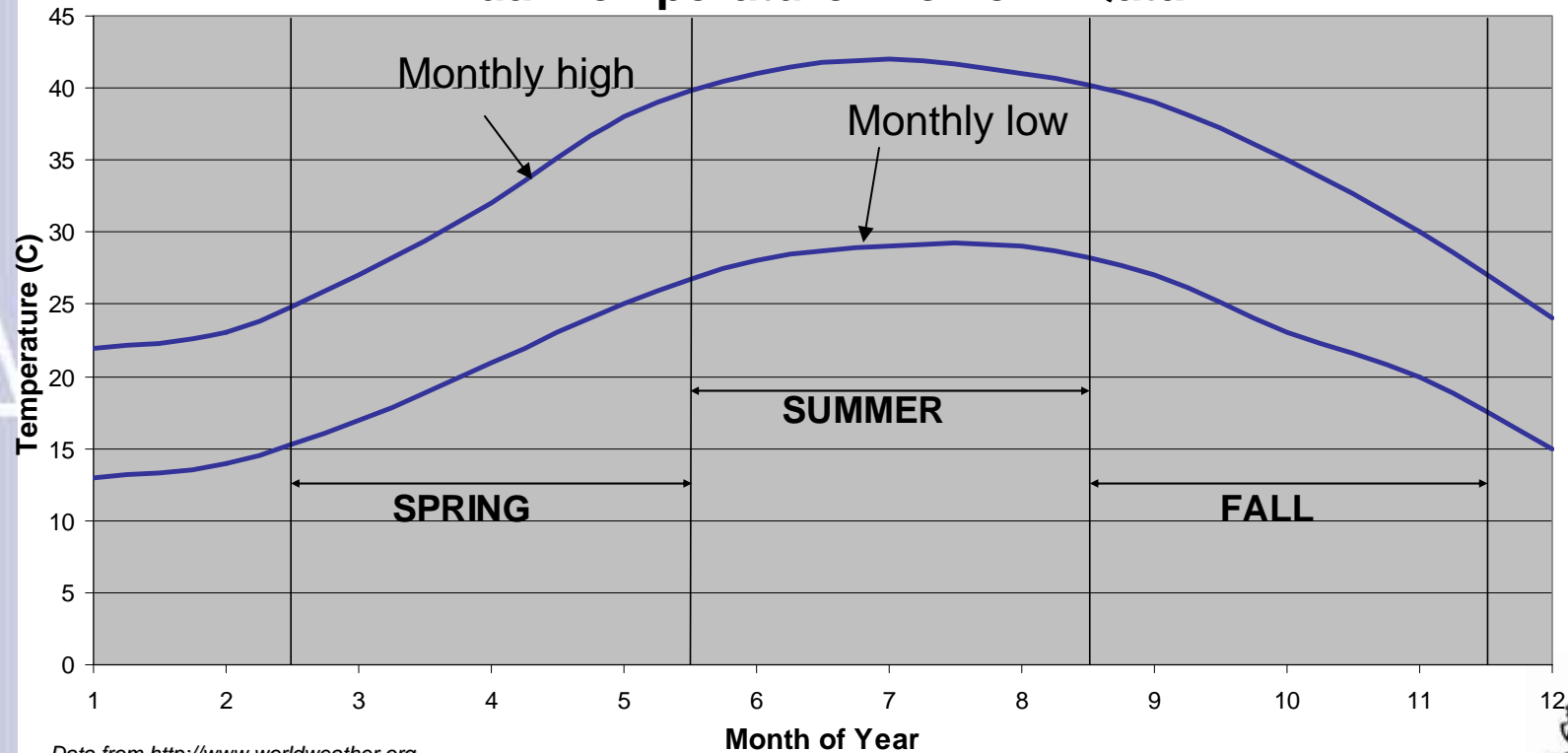


Qatar Environment

- **Hot Climate**

- Extreme high temperatures especially during Summer

Annual Temperature Profile in Qatar



Data from <http://www.worldweather.org>

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Samson High Performance Mooring Line at high ambient (50C) temperature

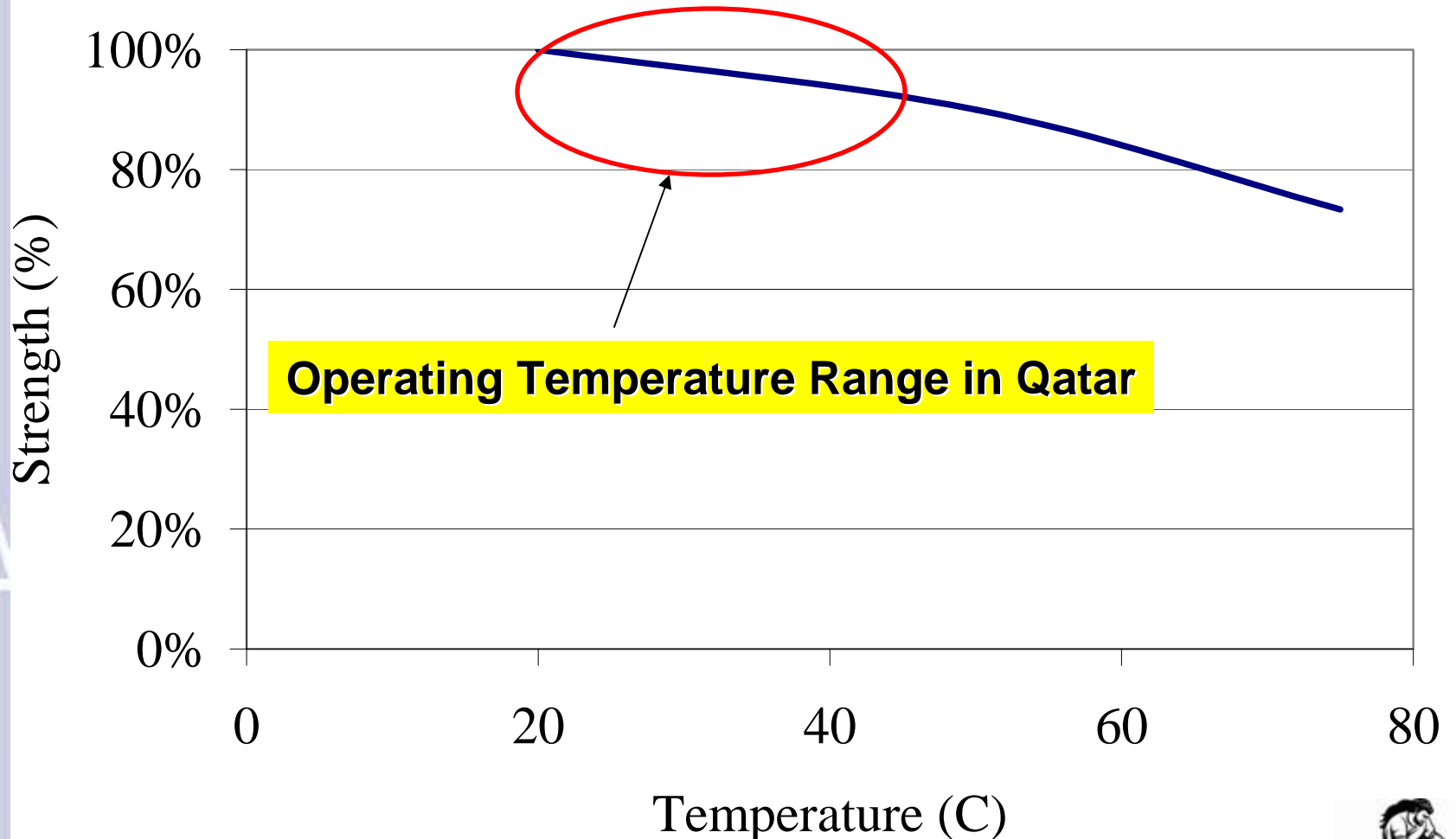
- ***Less than 10% rope strength reduction @50C***
- ***No permanent damage from hot environment***

- ***High temperature can promote CREEP, consequently leads to strength reduction***
 - Model study to predict rope behavior from generalized lab testing
 - Designed specific lab testing to simulate specific scenario



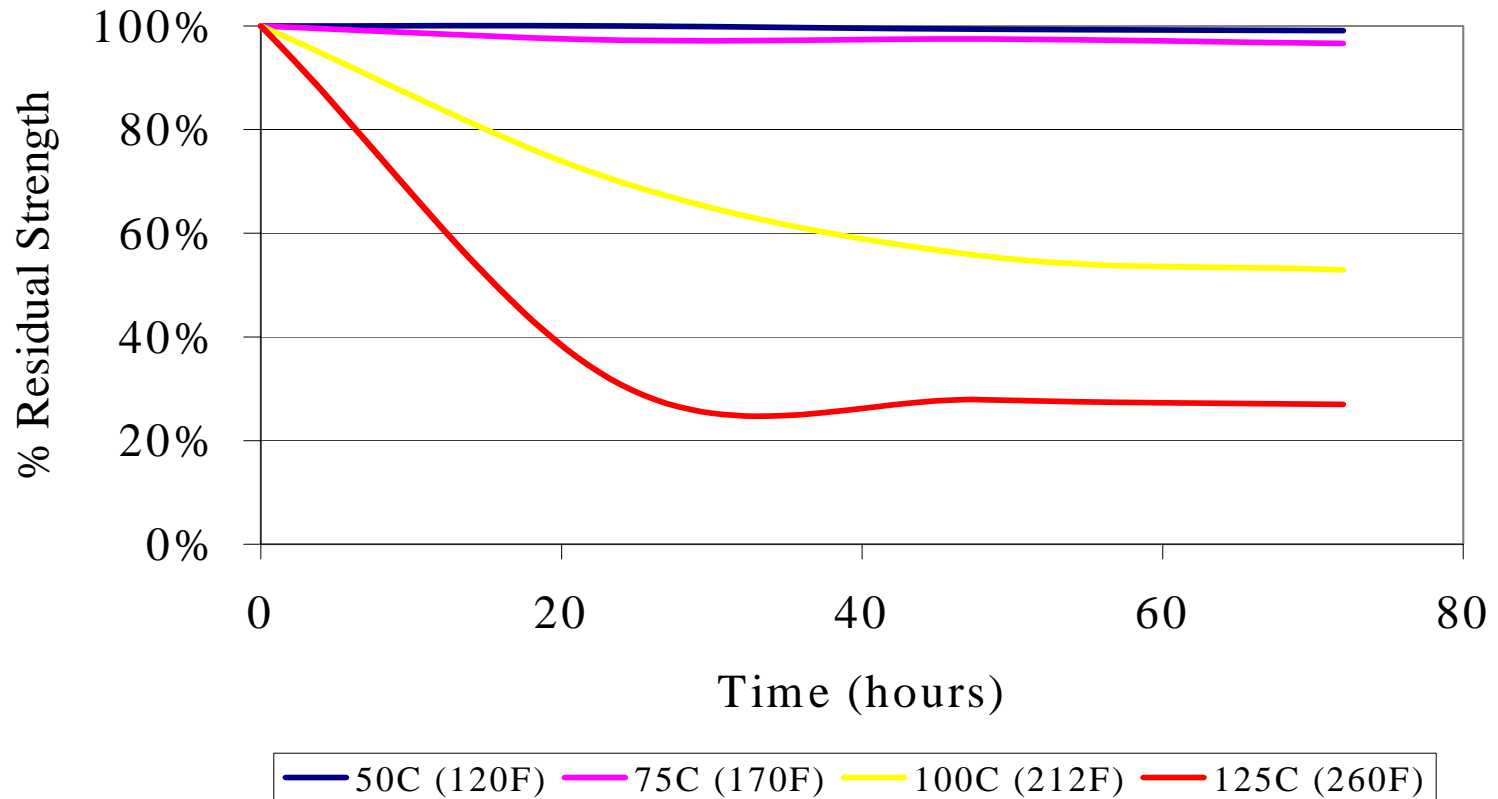


ROPE STRENGTH vs. TEMPERATURE





ROPE STRENGTH vs. TEMPERATURE



CREEP (n)

Elongation from constant loading that is not recoverable over time. Creep is strongly influenced by temperature and time at a given load for HMPE fiber.

Creep lifetime:

Time required for a material to fail from creep, under given specific conditions of time and tension.



Comment on Rope Efficiency and Yarn Testing

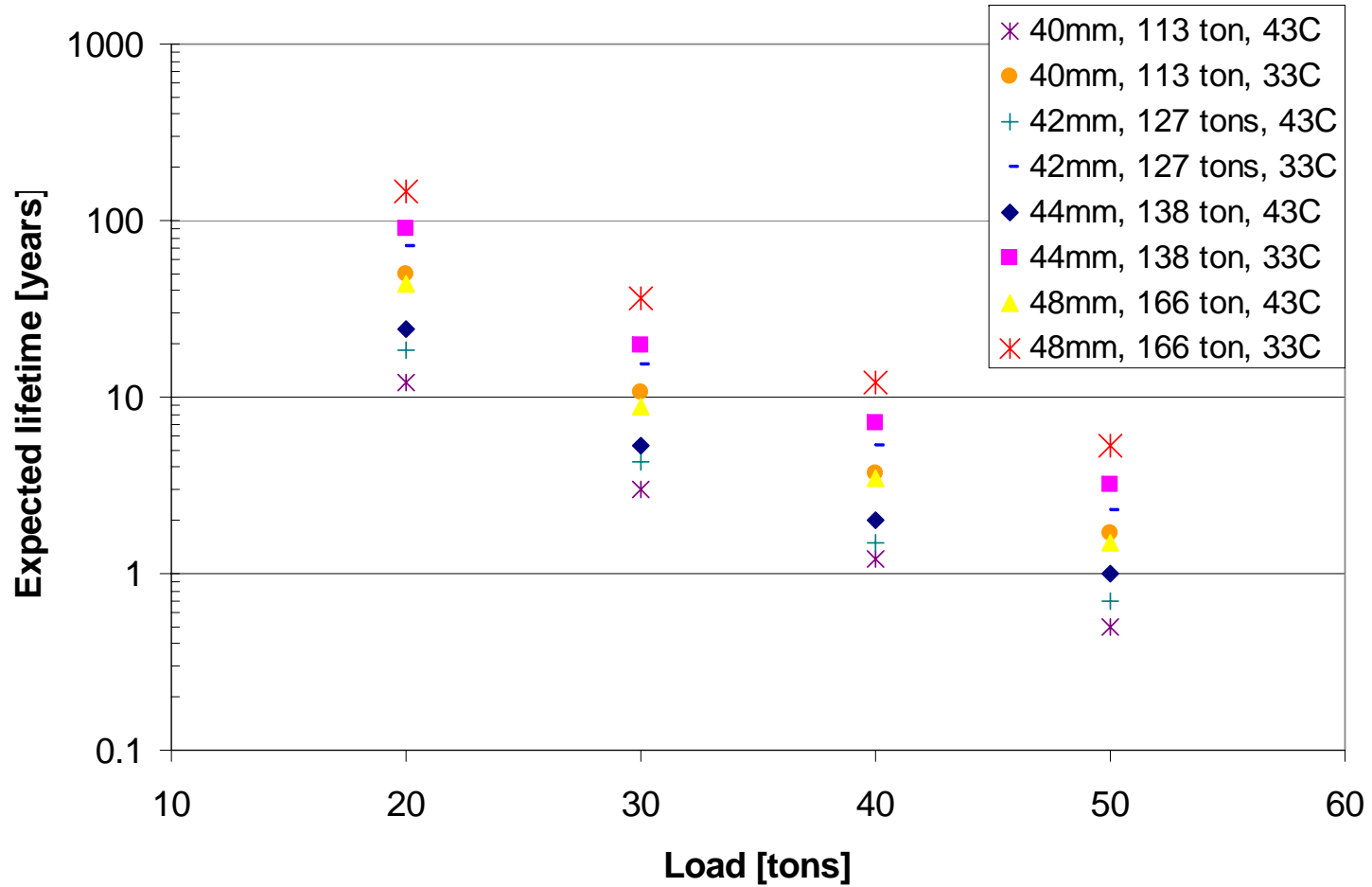
- Since the fibers in rope is not parallel to the axial direction of the rope, the yarn is not fully loaded
- Yarn tension at 20% yarn strength is equivalent to rope tension at 33% rope strength



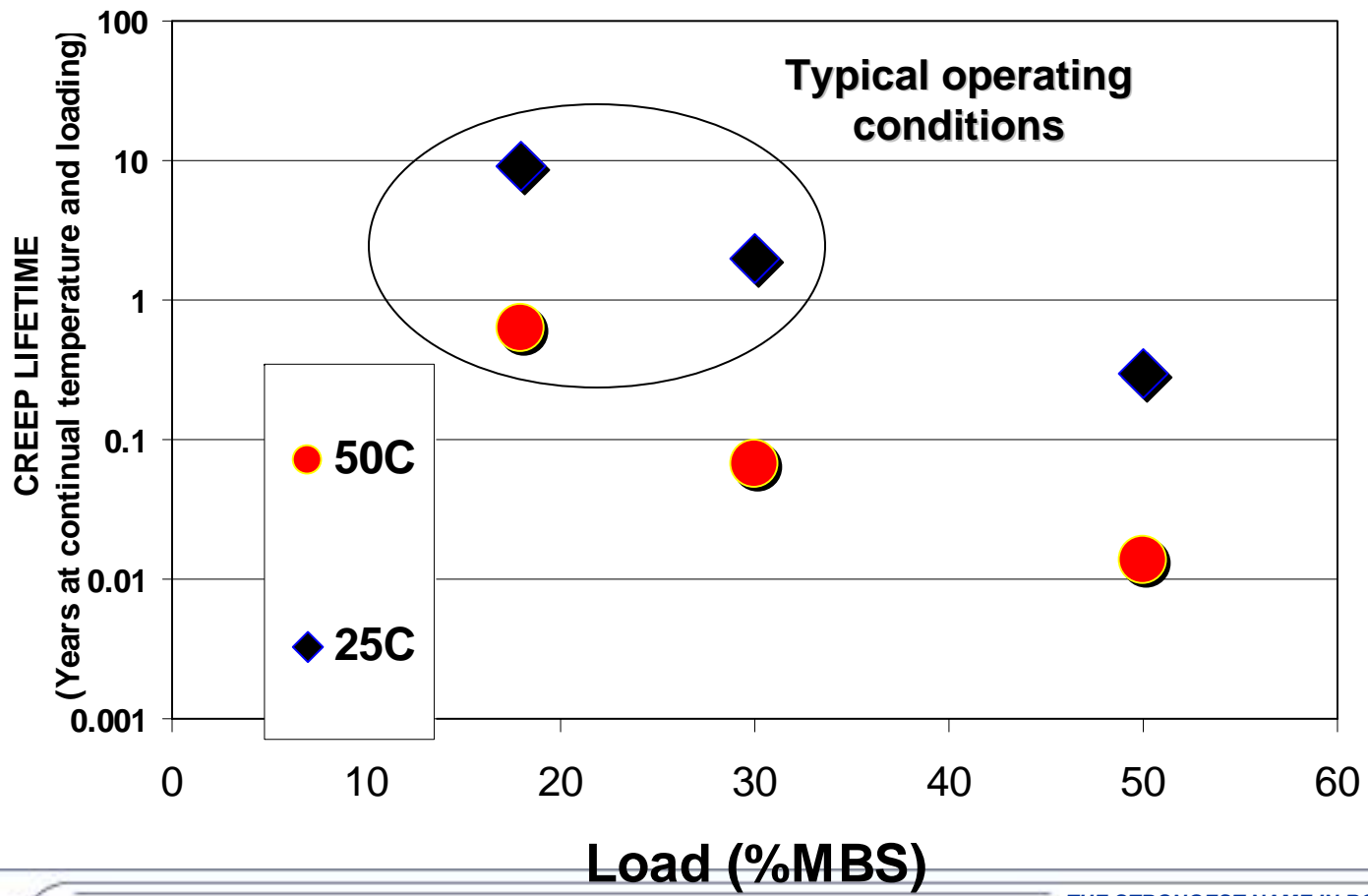


MODEL SIMULATION

EPX-75 mooring line



MODEL PREDICTION OF SAMSON MOORING LINE CREEP LIFETIME



MODEL STUDY CONCLUSION

- ***Creep is not a concern when proper rope is selected***
- ***Additional tests were conducted to***
 - Verify model validity
 - Determine rope strength at elevated temperature after mooring operations



Additional tests to

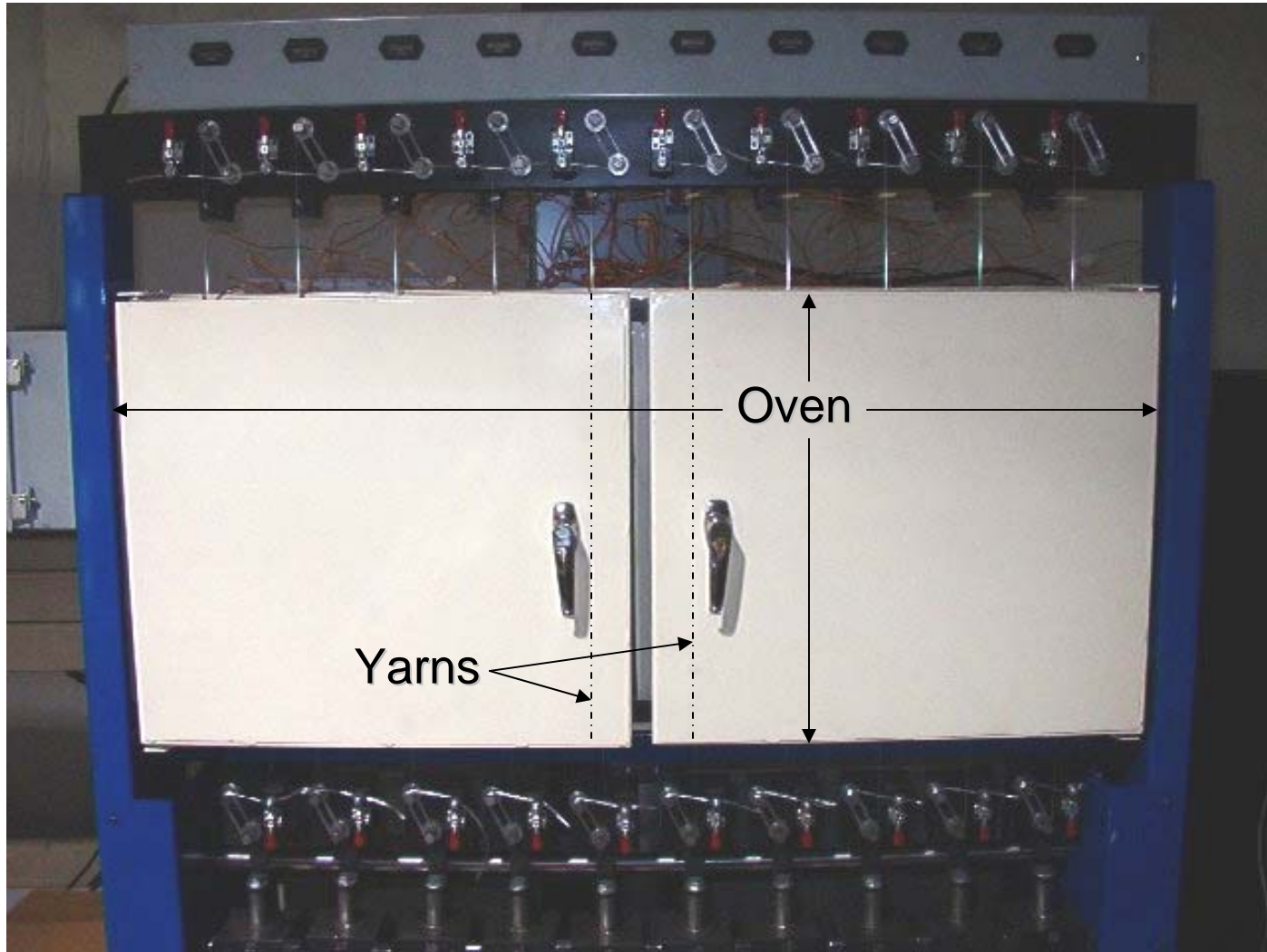
- **Verify model study**
- **Determine rope strength at elevated temperature after mooring operations**

- **Yarn strength = 100lb**
- **Different loading level at different temperatures**
- **Data to compare against model prediction**

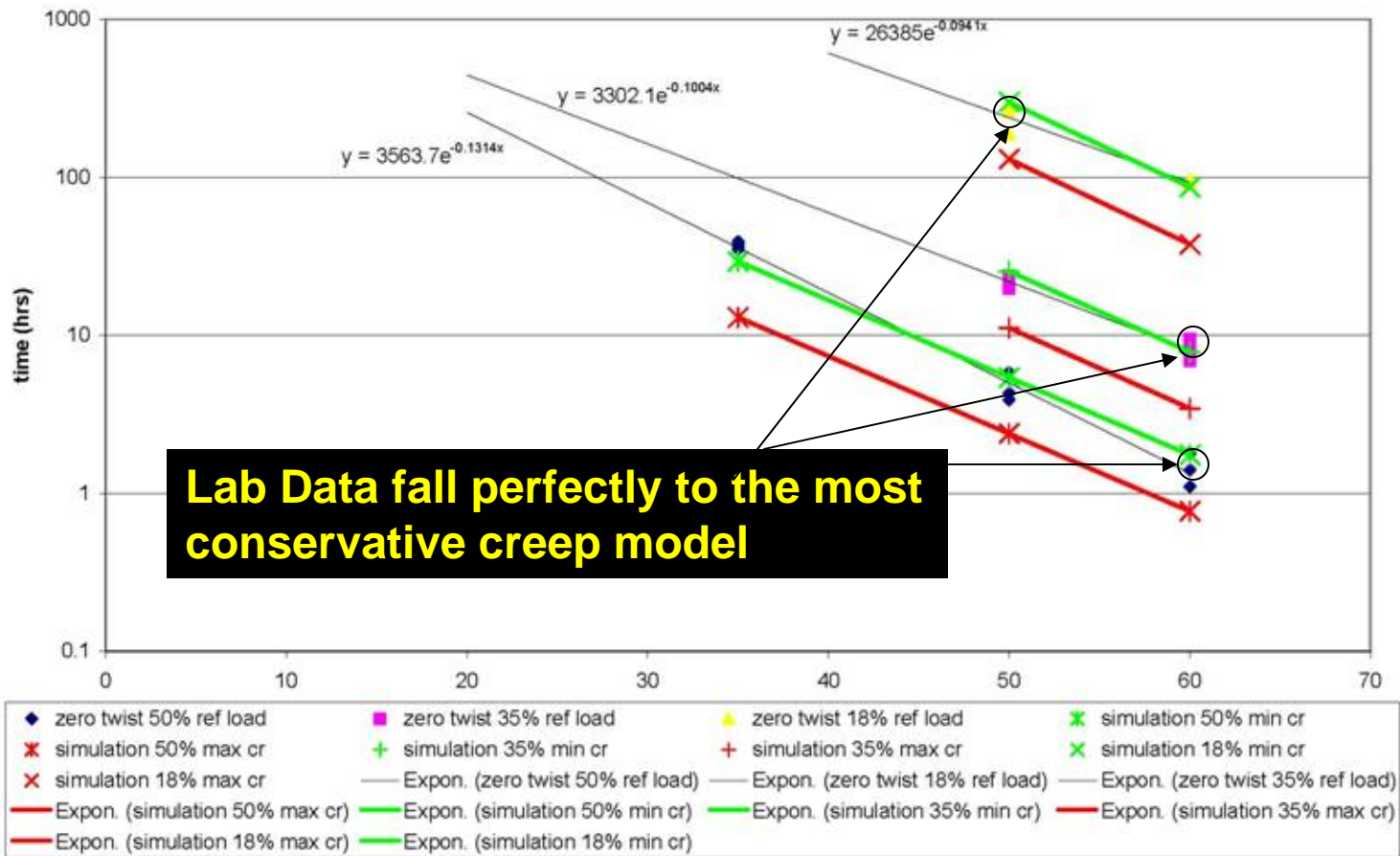
loading %, Temp C	18%	25%	35%
35C	Time To Fail		
50C			
60C			



SAMSON YARN OVEN TESTING



LAB DATA MATCH VERY WELL WITH MODEL PREDICTION – model estimation is in fact conservative



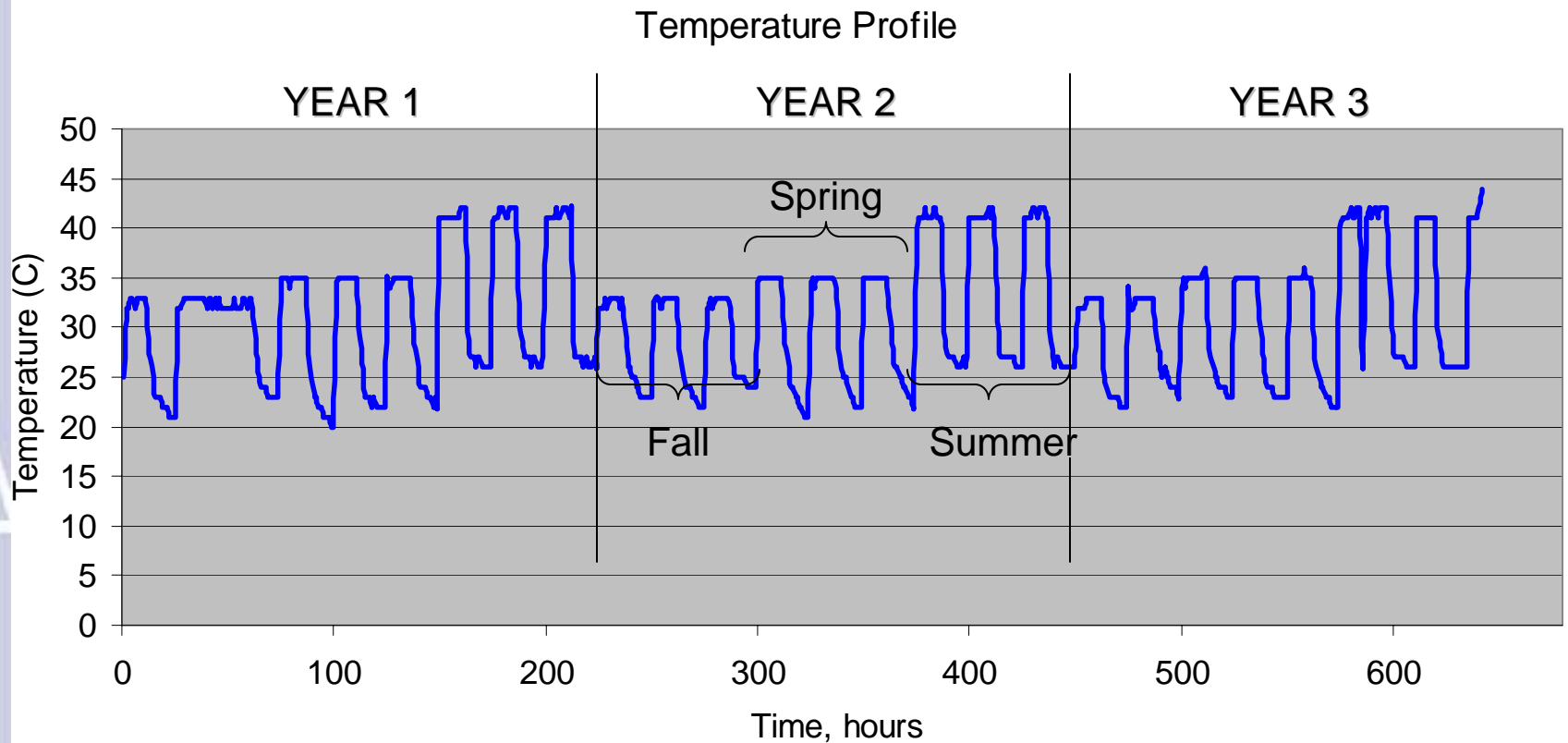
Additional tests to:

- Verify model study
- **Determine rope strength at elevated temperature after mooring operations**
 - Follow temperature profile/change for 3 years
 - Constant loading of 20% loading on yarn all the time
 - Testing yarn strength at 48C and the end of the thermal/mechanical fatigue



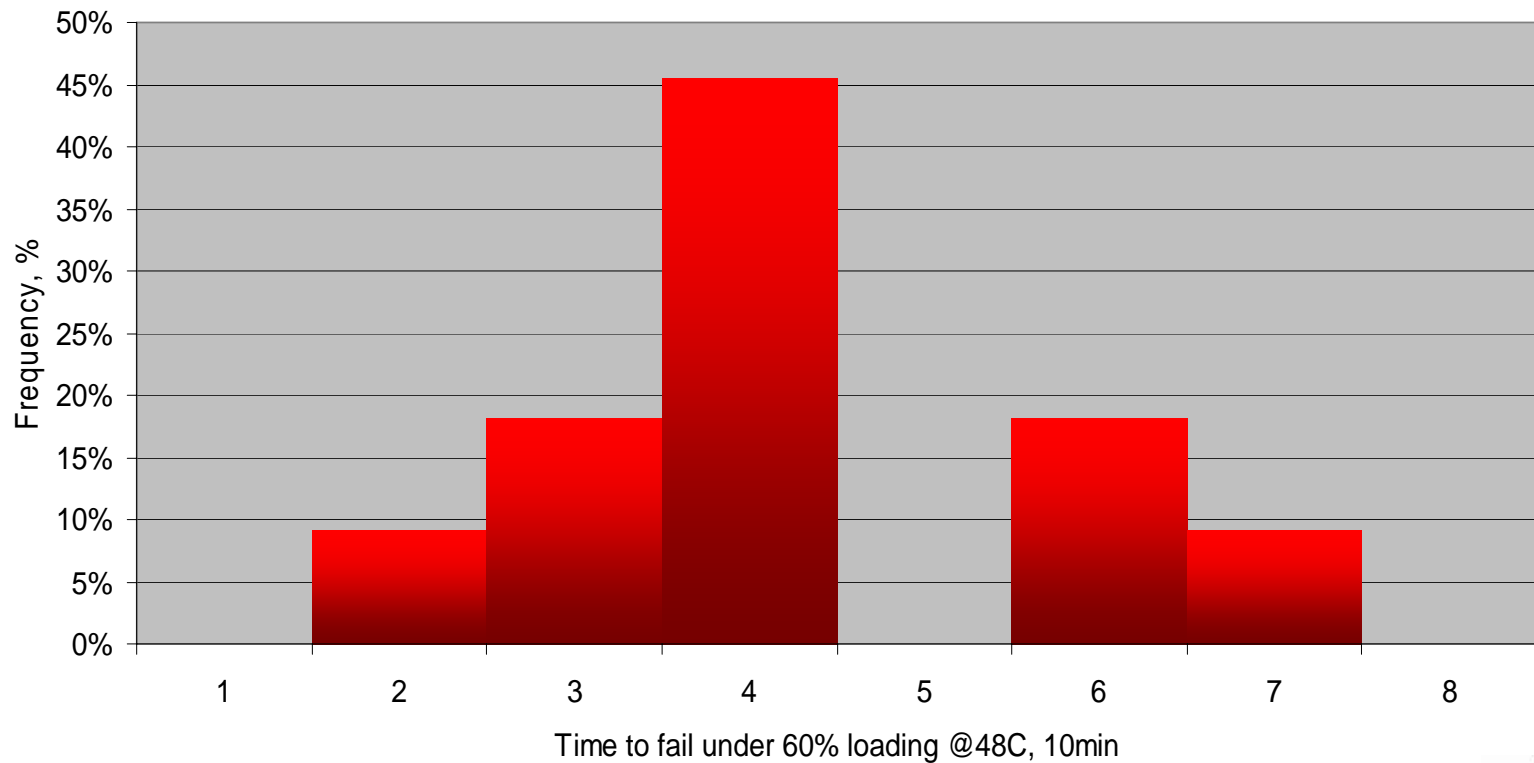


Simulating 3 years of mooring under tension of 20% MBL per temperature cycles shown below





Dyneema yarns retain at least 60% strength at 48°C after 3 years of mooring in a hot climate



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CONCLUSIONS

- ***Model predicts that creep is not a concern***
- ***Lab testing confirms model validity***
- ***Rope retains more than 60% MBS at 48C after 3 years with 33% constant tension***
- ***Developed unique methodology can be used to simulate different scenarios***



HEAT TRANSFER STUDY

- ***Dynamic of heat transfer from the ambient***
- ***Dynamic of heat transfer from contacting a hot surface***

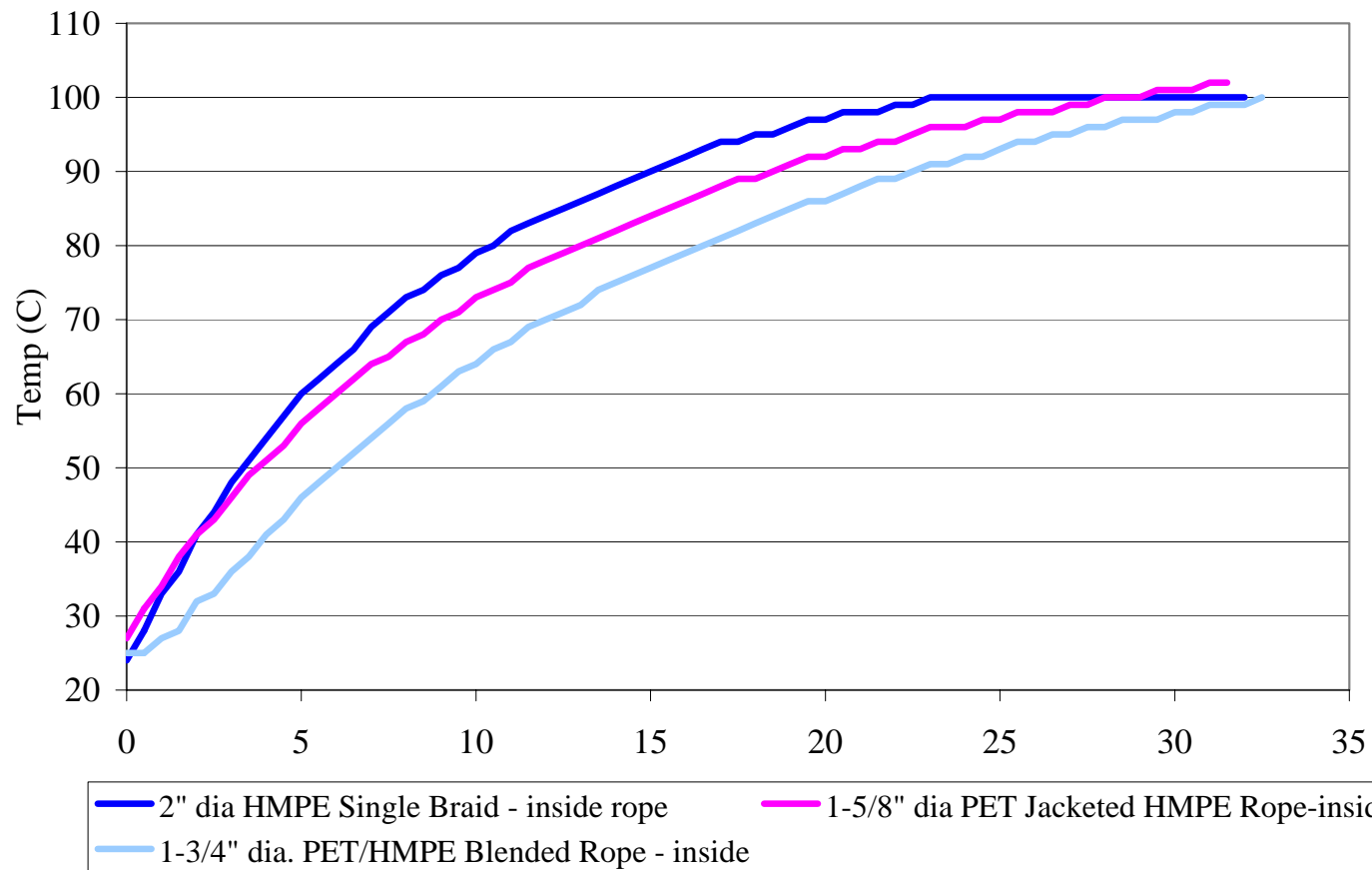




Heat from Ambient

20 – 30 min to equilibrium with environment

Heat Transfer:
Time to Equilibrium (< 30 minutes)

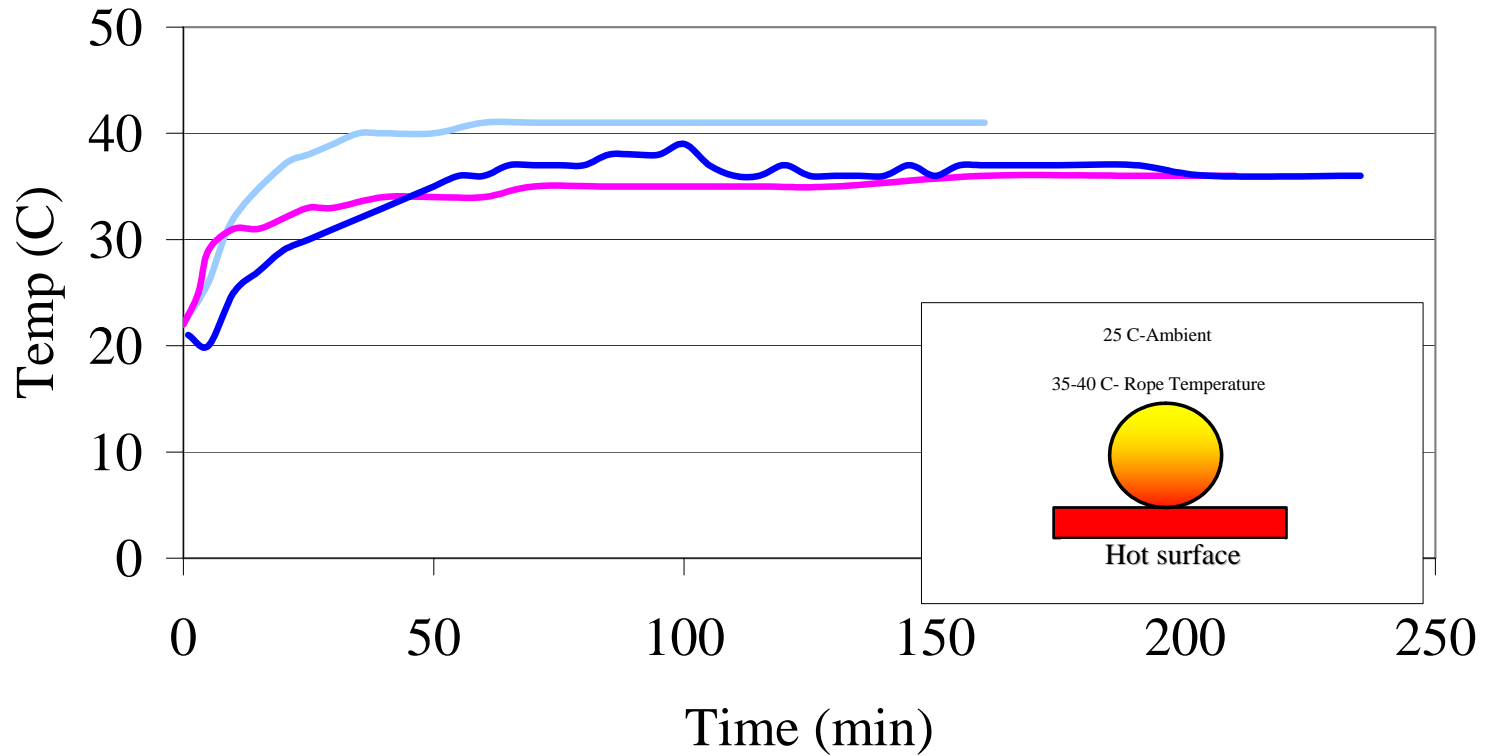




HEAT FROM CONTACTING A HOT SURFACE

Time to equilibrium <30 min

1-5/8" Rope on 70C hotplate



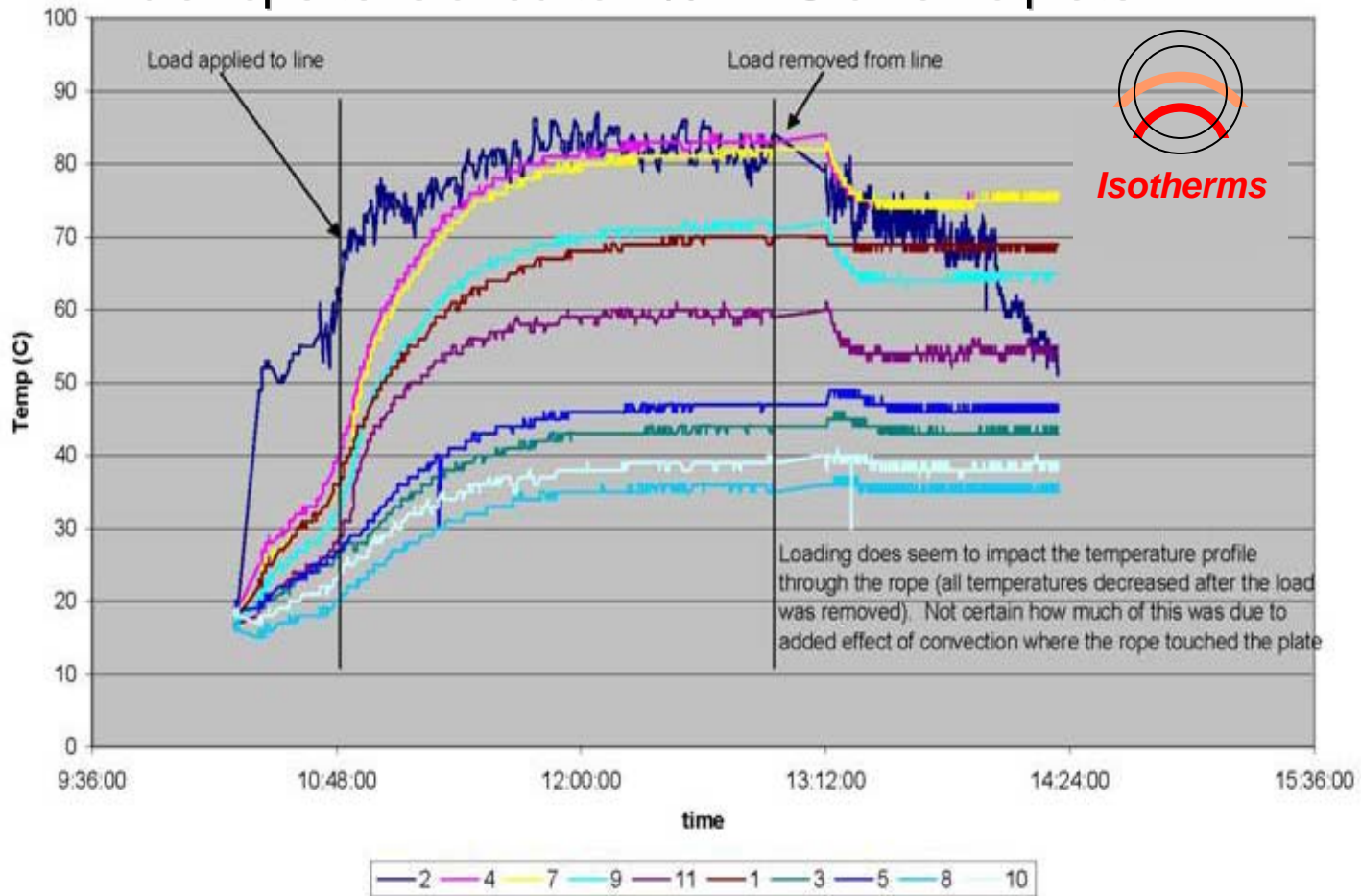
— 1-5/8" PET/HMPE Blended Rope — 1-5/8" PET Jacketed HMPE Rope
— 1-5/8" HMPE Single Braid





Temperature profile in rope when contacting a hot surface under tension

1" dia rope tensioned to 2% MBS on a hotplate



CONCLUSIONS FROM HEAT TRANSFER STUDY

- ***Rope will reach equilibrium with the ambient within 30 minutes***
- ***Only portion of the rope reaches the hot surface temperature***
- ***Overall all strength retention estimation***
 - 83% from contacting a 70C hot surface, considering minimum temperature of the rope is ambient (48C) and the temperature profile



CONCLUSIONS FROM HEAT TRANSFER STUDY AND SIMULATION

**3 years mooring @33% MBL + hot weather
= 60% strength or greater @48C**

**Contacting a 70C hot surface
= 83% strength @ 48C**

**Rope strength after 3 years mooring and
contacting a hot surface
= 50% strength or more @48C**



Additional protection from heat

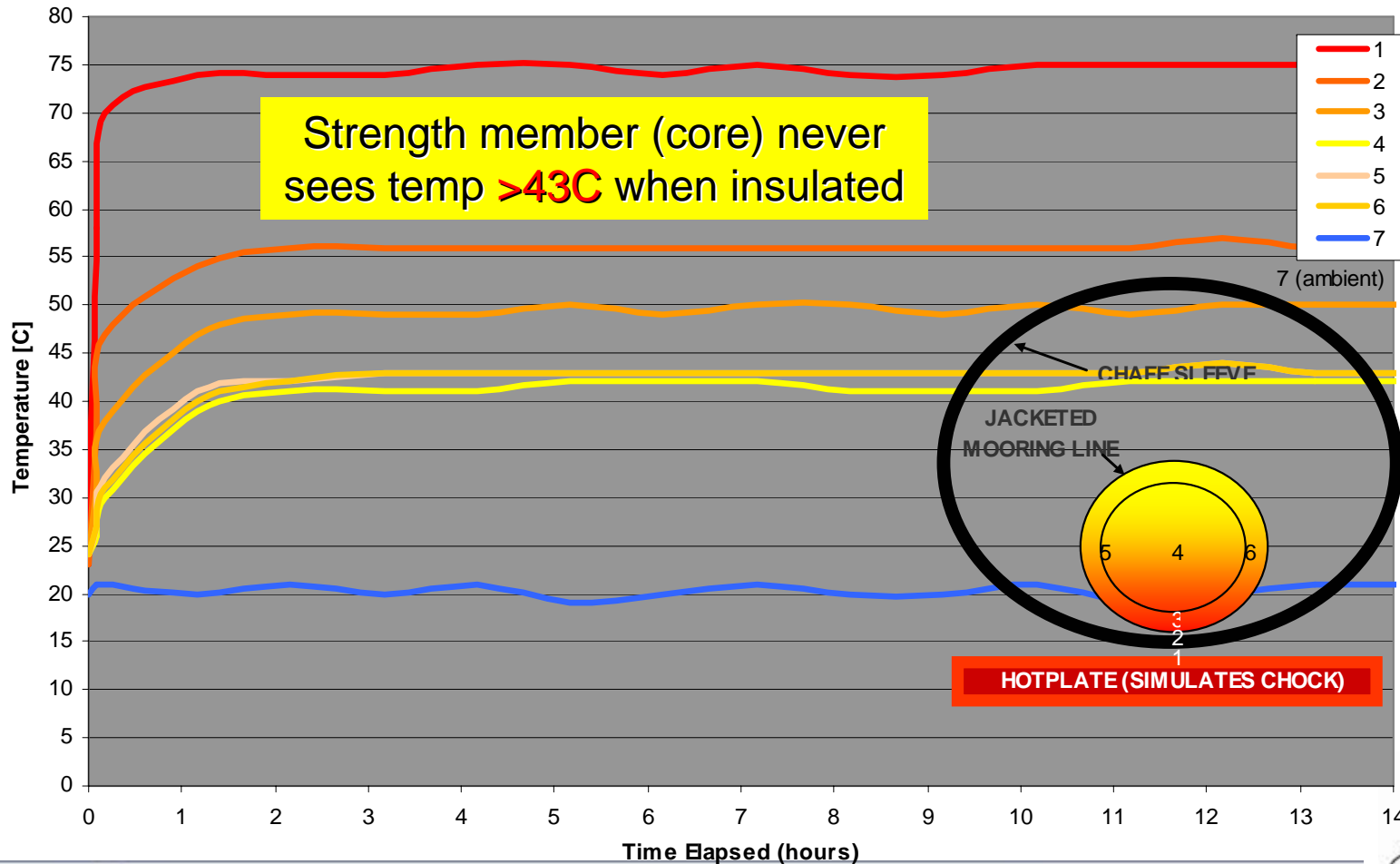
- ***Insulation technology can be used to protect the line from exposure to hot surface such as chock***





Technology to provide rope protection from both abrasion and heat conduction

Temperature Profile through a Jacketed Mooring Line with rubber backed chafe sleeve



SAITAN

Open discussion

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