



ZEON CHEMICALS L.P.

**Presented to the Ft. Wayne
Rubber Group**

04/20/06



HIGH-TEMPERATURE ACRYLIC RUBBER

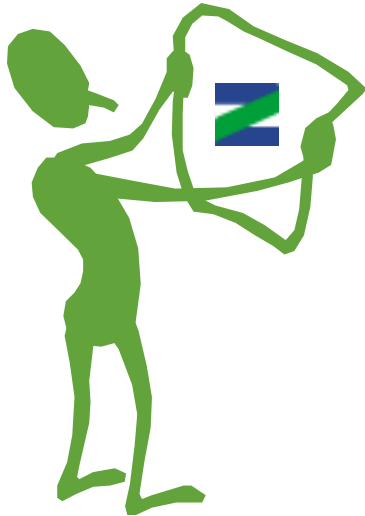
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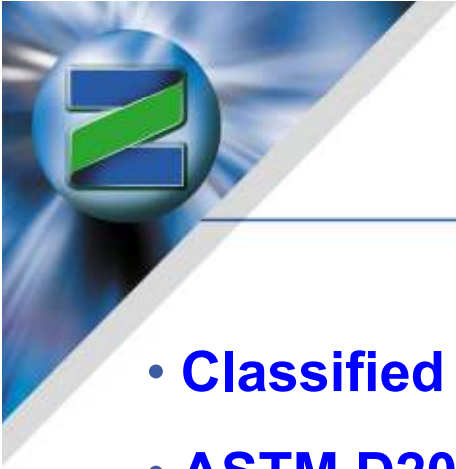




WHAT'S IN STORE FOR THIS AFTERNOON

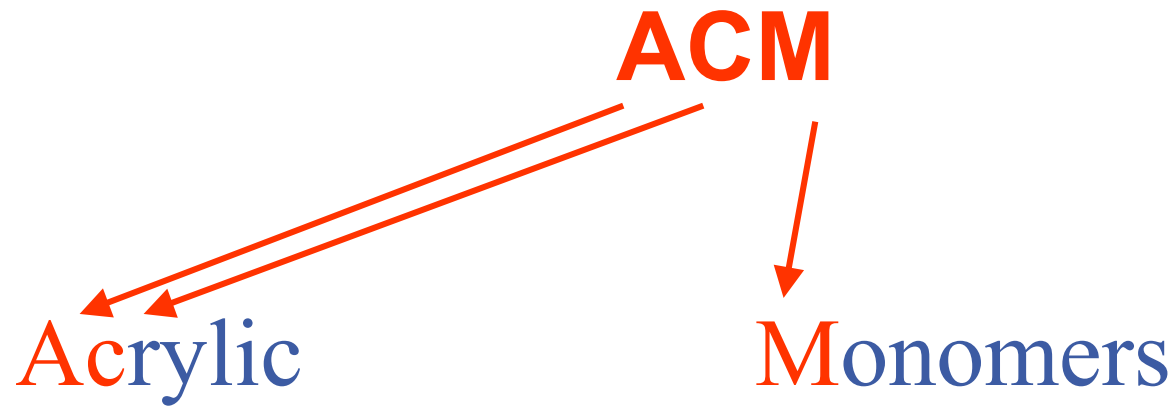


- **Quick** background/history
 - General applications
- Comparison of HT-ACM to standard grades
- **How to** calculate heat resistance
 - HT-ACMs
- **Why** use HT-ACM?
 - Current applications
- **Conclusions**



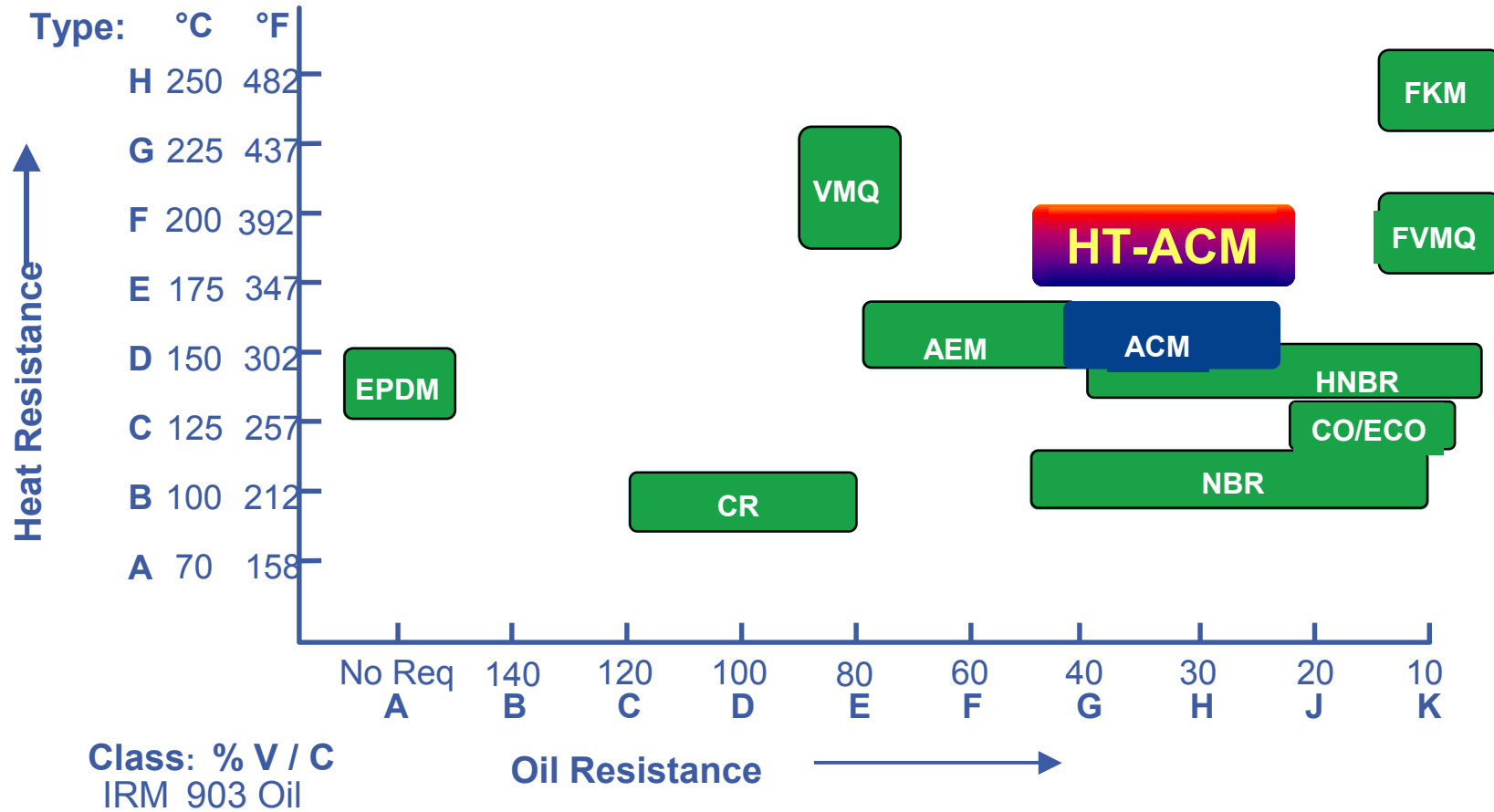
INTRODUCTION

- Classified as **high temperature and oil resistant polymers**
- ASTM D2000/SAE J200 classifies Polyacrylate as **DF, DH, and EH**
- ASTM designation for Polyacrylate is **ACM**.





CLASSIFICATION: ASTM D2000/SAE J200



ACM Compounds





POLYACRYLIC APPLICATIONS

- **Gasket**

- Oil Pan/Valve Cover
- Oil Filter

- **Hose**

- Turbo Diesel
- Engine Oil/Transmission Oil Cooler
- Emission Control
- Auto Air Duct



POLYACRYLIC APPLICATIONS (CONT.)

- **Seals**

 - Rotary Shaft

 - Valve Stem

 - Transmission Lip

 - Bonded Piston

- **Other**

 - CV Boots

 - O-Rings

 - Adhesives

 - Binders-Explosive/Propellant (Air Bags)

 - Cork, Flex Magnet



POLYACRYLIC APPLICATIONS (CONT.)

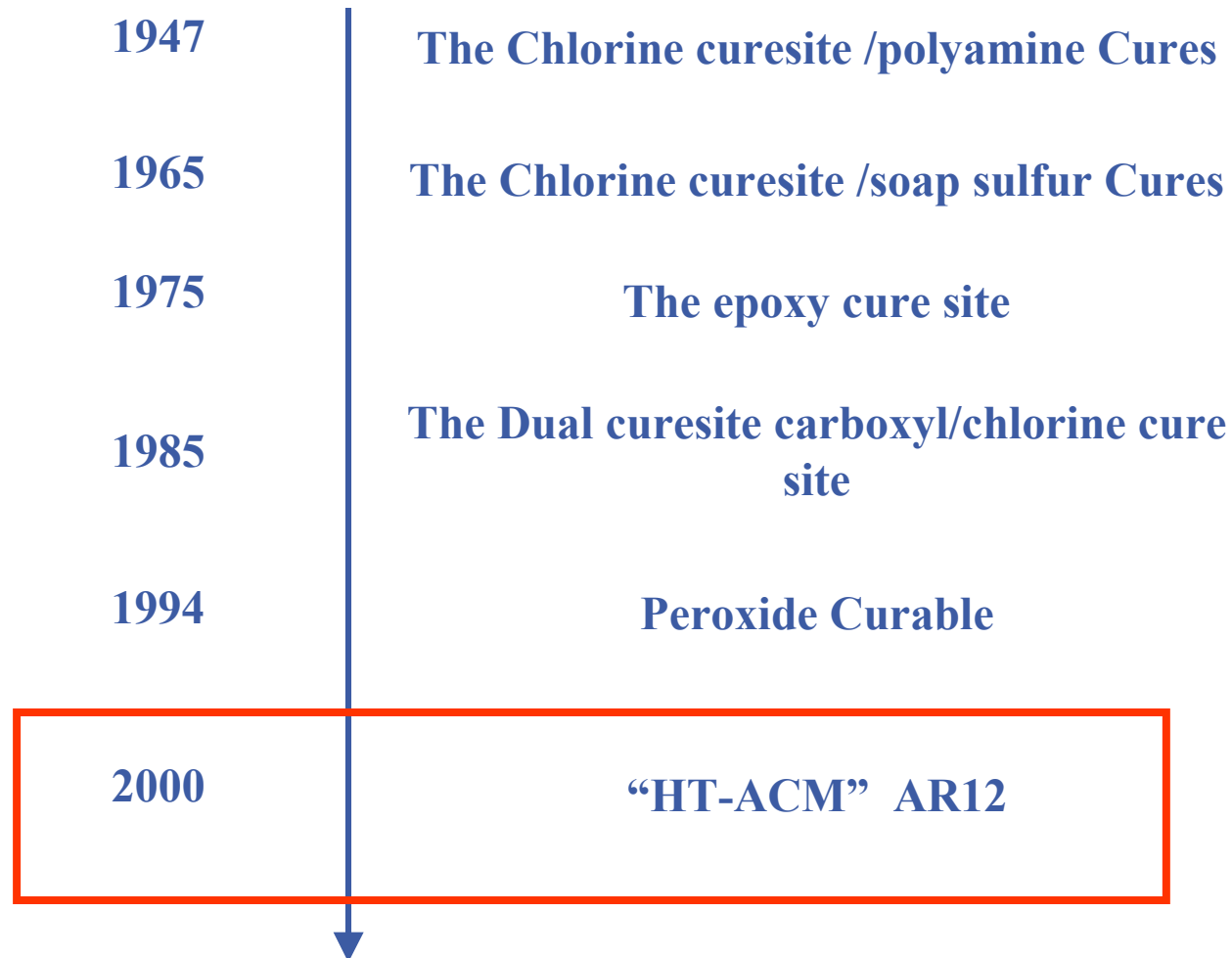
- **ACM compounds ARE NOT recommended for uses in applications that require:**
 - **Fuel (Gasoline) Resistance**
 - **Water Resistance**
 - **Acid/Base Resistance**

History of ACMs





Evolution of ACM Elastomers





Evolution of ACM Elastomers

1947

The Chlorine curesite /polyamine Cures

1965

The Chlorine curesite /soap sulfur Cures

1975

The epoxy cure site

1985

The Dual curesite carboxyl/chlorine cure
site

1994

Peroxide Curable

2000

“HT-ACM” – AR12

2004

“HT-ACM” –
Next Generation Improved
Heat Resistance

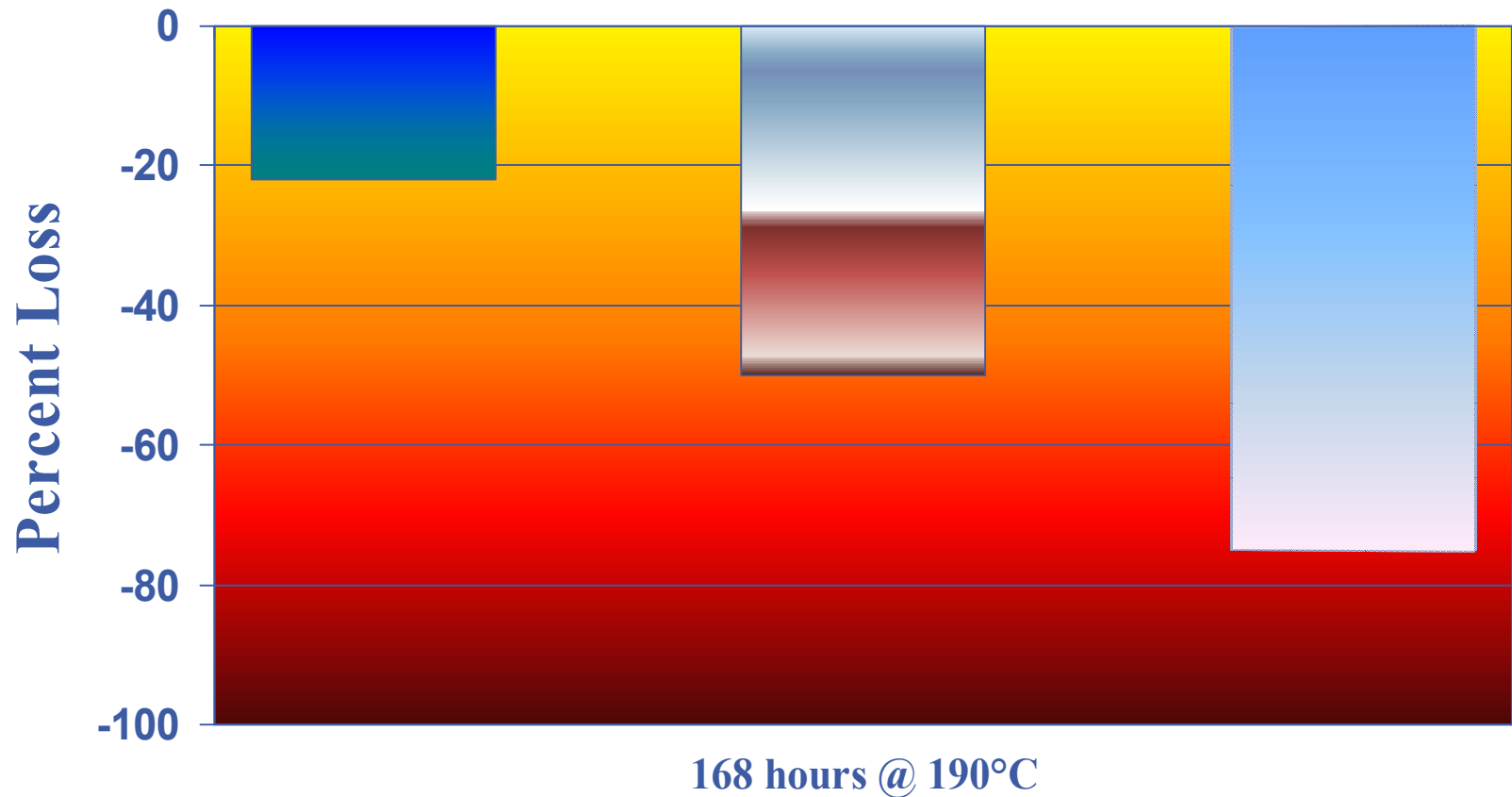
HyTemp AR212HR



Comparison of AR212HR to standard grades of ACM



TENSILE CHANGE COMPARISON OF HOSE TYPE ACMS

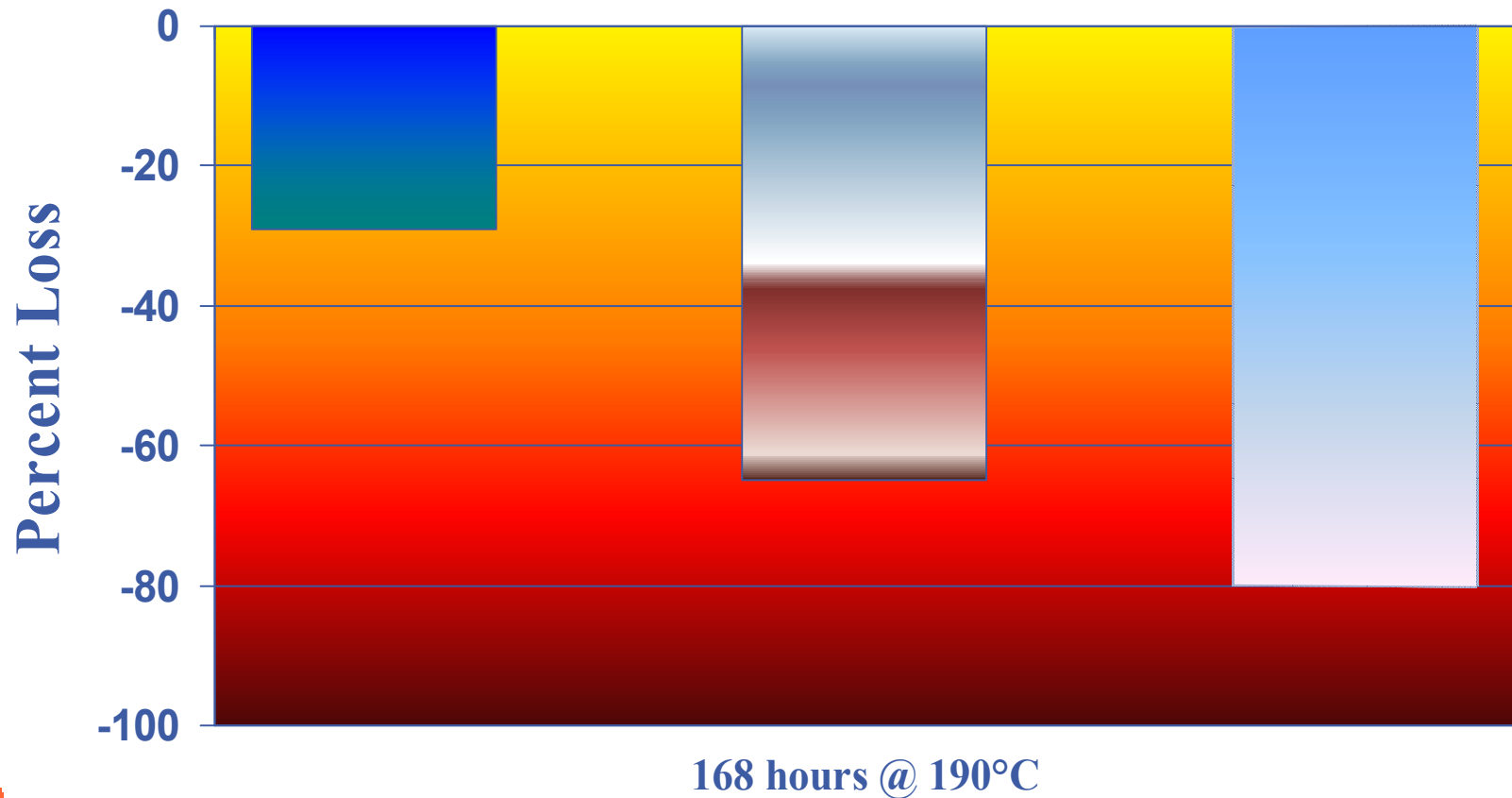


■ HyTemp AR212HR ■ Nipol AR72HF ■ HyTemp 4052



ELONGATION CHANGE

COMPARISON OF HOSE TYPE ACMs



■ HyTemp AR212HR ■ Nipol AR72HF ■ HyTemp 4052



CONCLUSIONS

- HyTemp AR212HR has superior Tensile retention over standard ACMs
- HyTemp AR212HR has superior Elongation retention over standard ACMs
- Basically better heat resistance

Heat Resistance of HT- ACMs



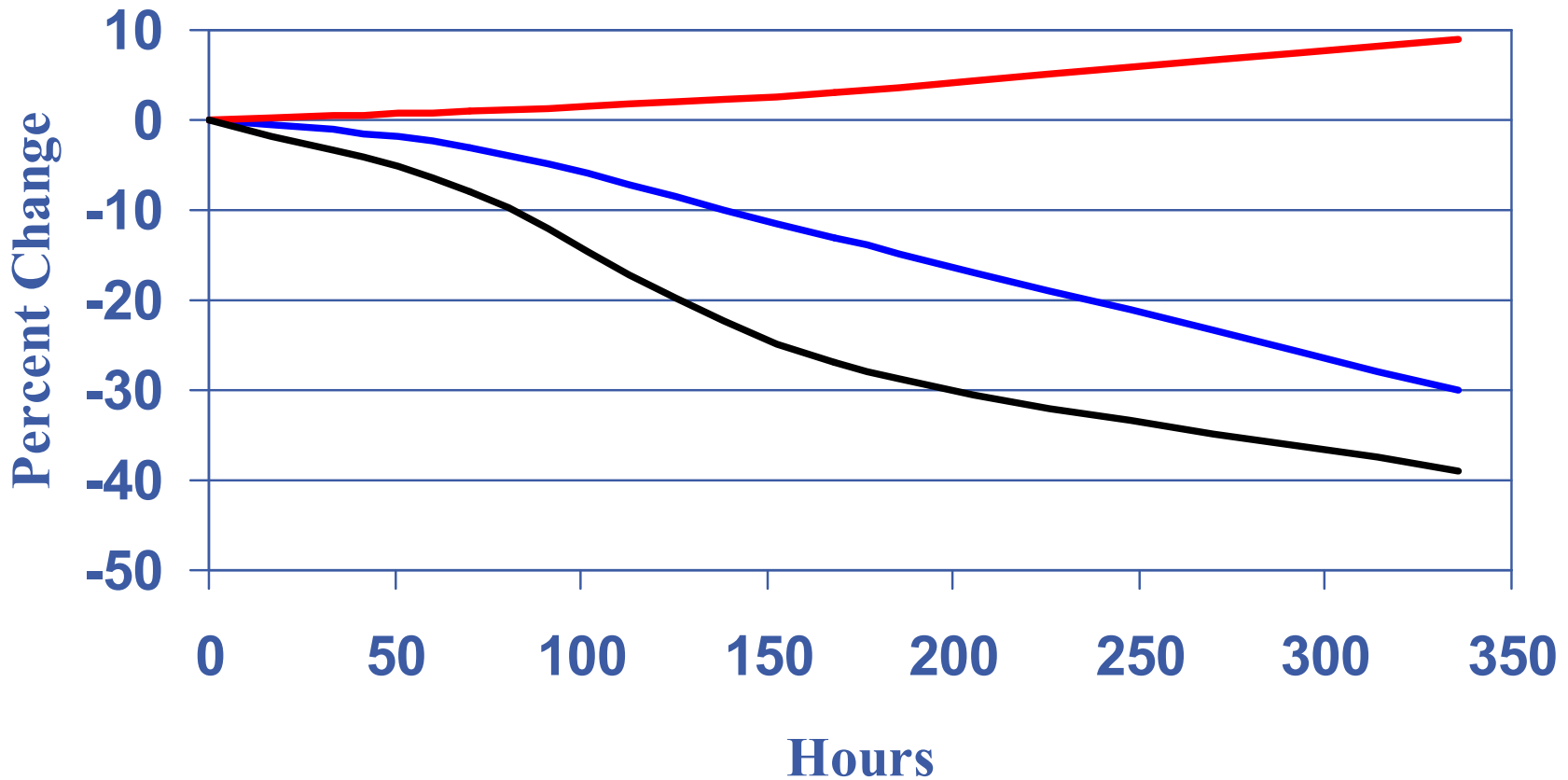


METHOD

- AR12, AR14 and AR212HR compounds were evaluated
- Original properties measured
- Samples aged at 3 different temperatures
 - 190°C
 - 175°C
 - 150°C
- Tensile and % Elongation loss were graphed
- Aged properties were evaluated to the –50% standard set by the SAE definition



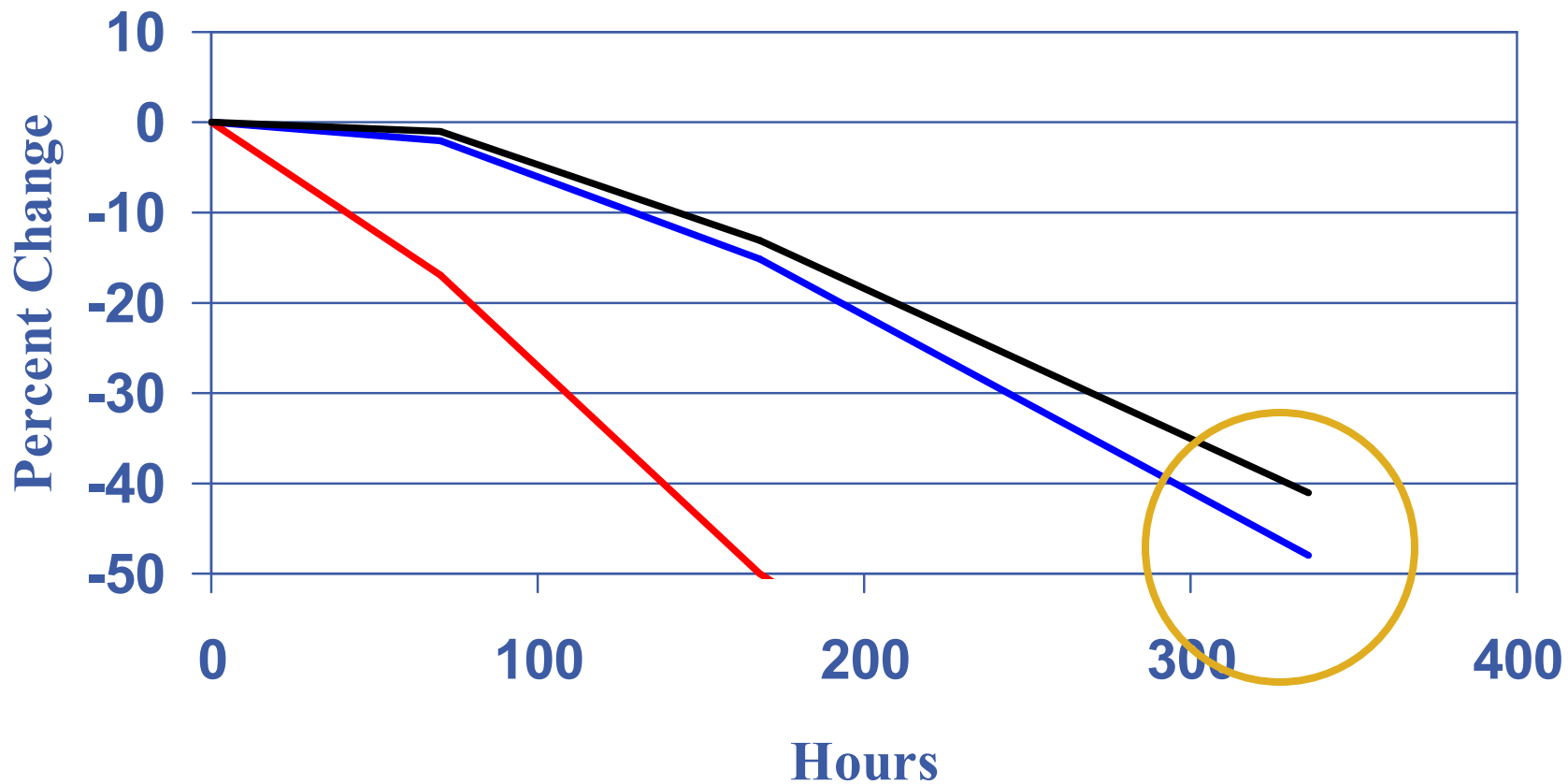
TENSILE CHANGE 190°C



— AR12 — AR14 — AR212HR



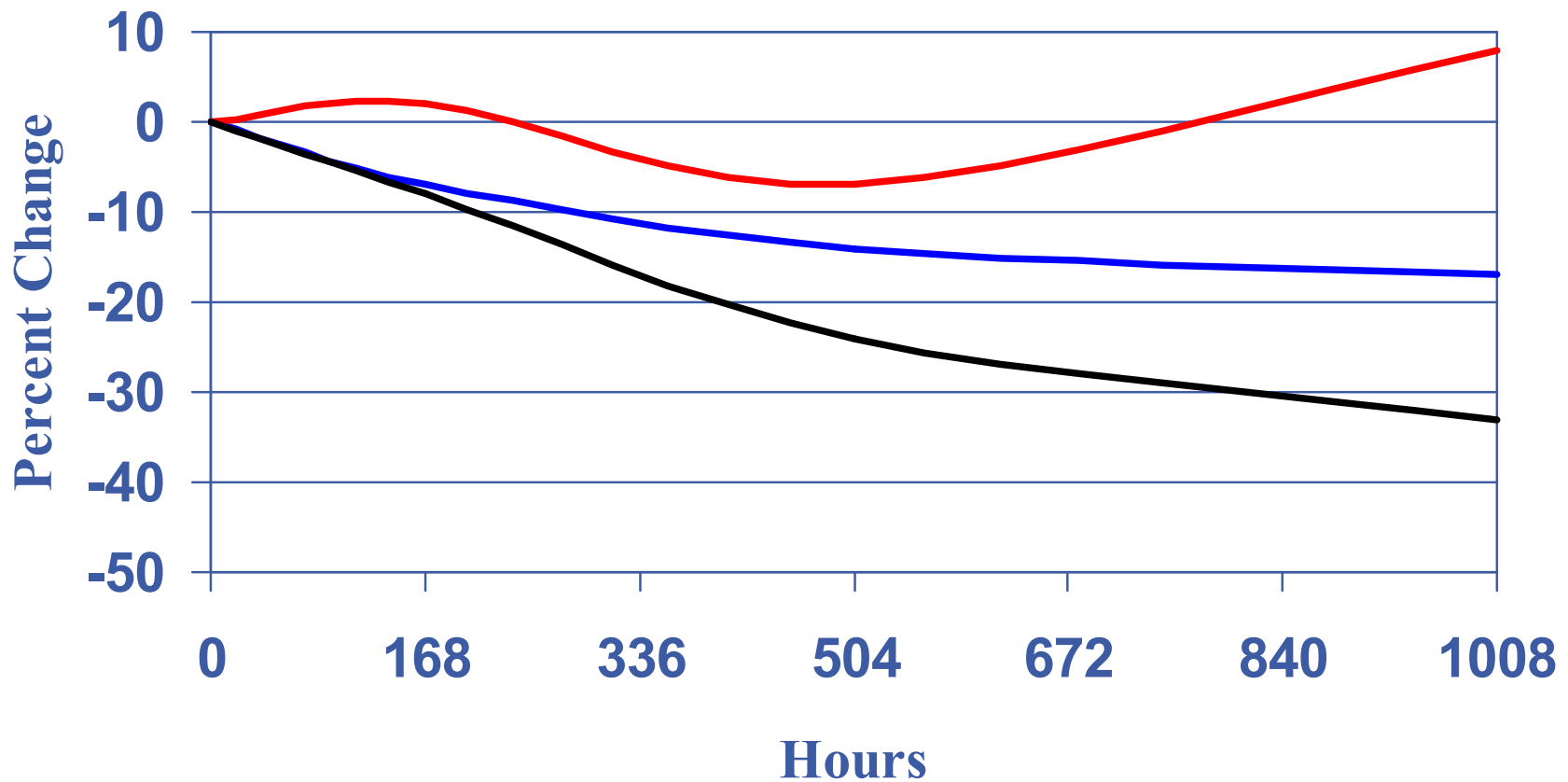
% ELONGATION CHANGE 190°C



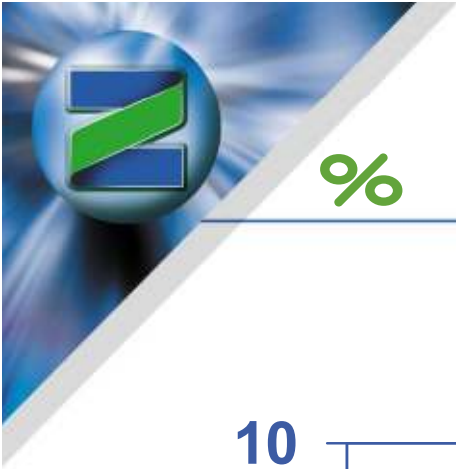
— AR12 — AR14 — AR212HR



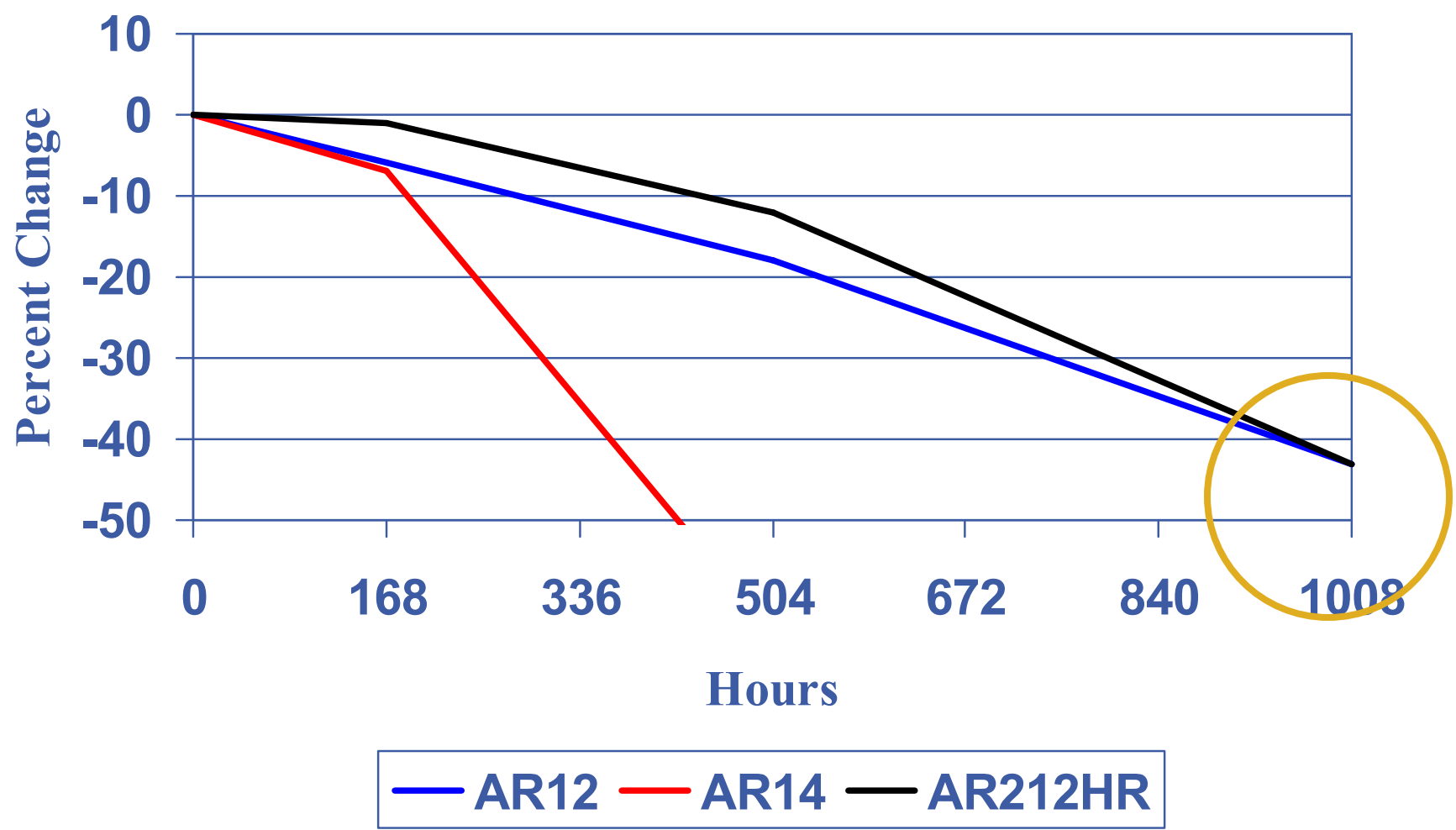
TENSILE CHANGE 175°C



— AR12 — AR14 — AR212HR



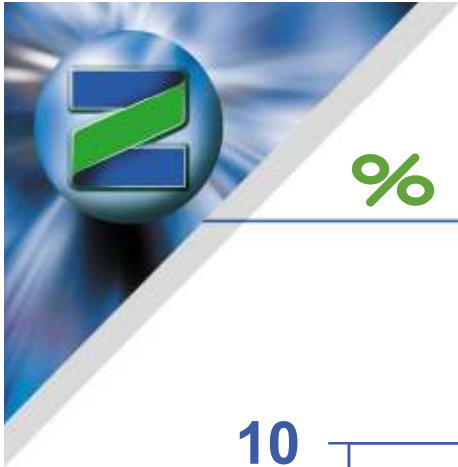
% ELONGATION CHANGE 175°C



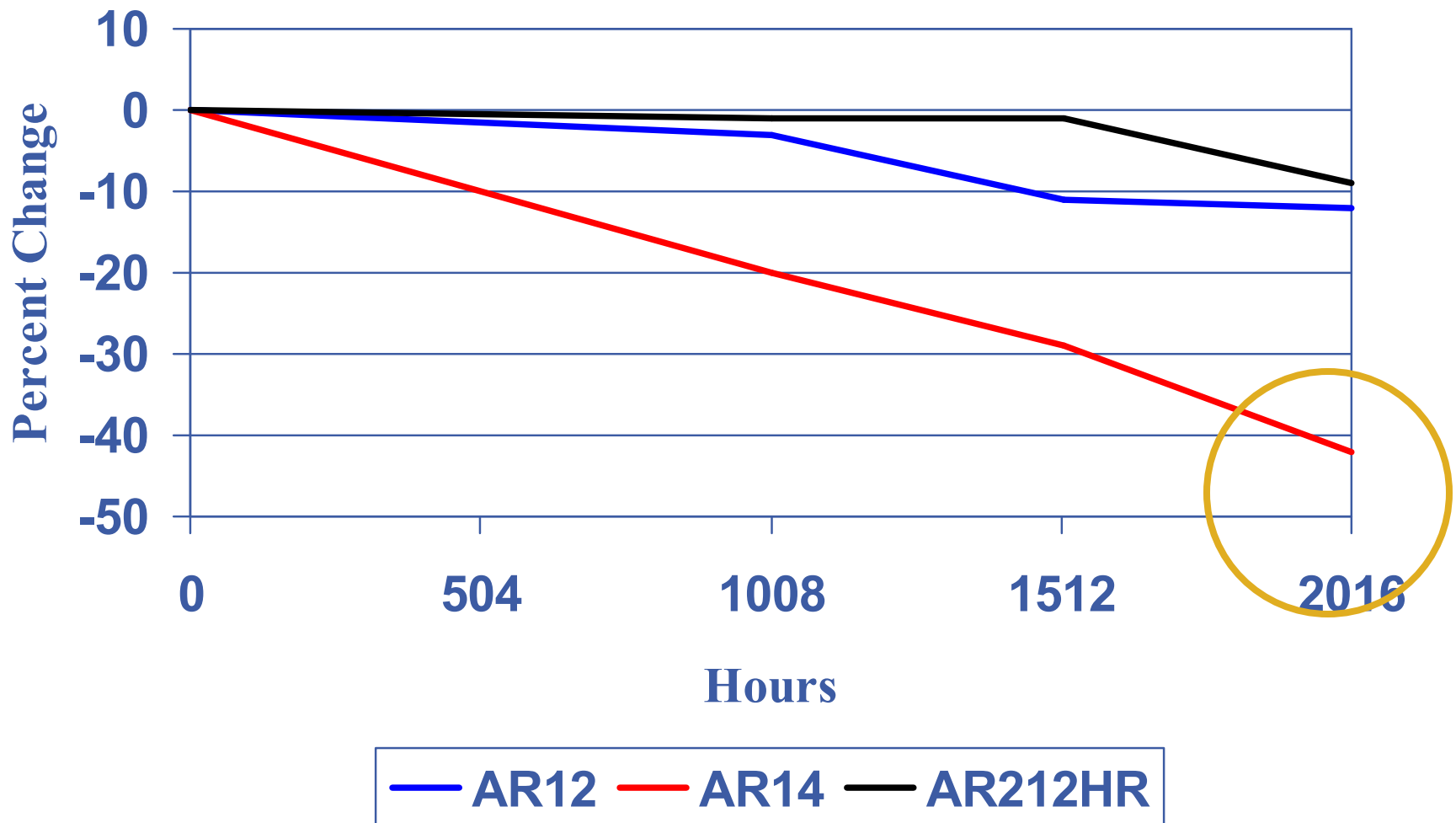


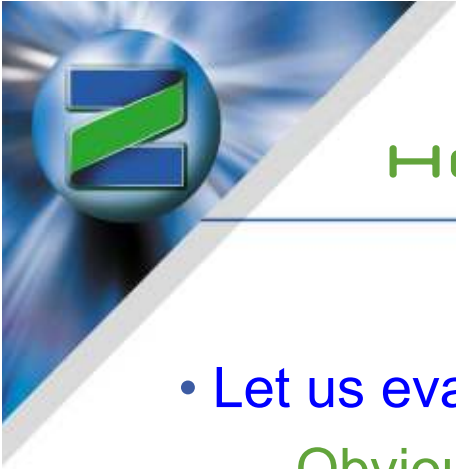
SUMMARY

- Elongation loss is greater than the % Tensile loss
- % Elongation loss
 - Determines the heat resistance as defined by the SAE standard



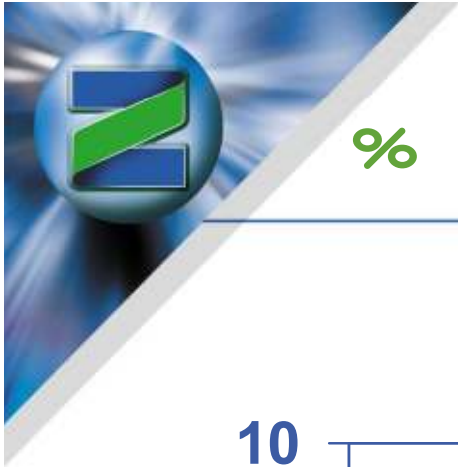
% ELONGATION CHANGE 150°C



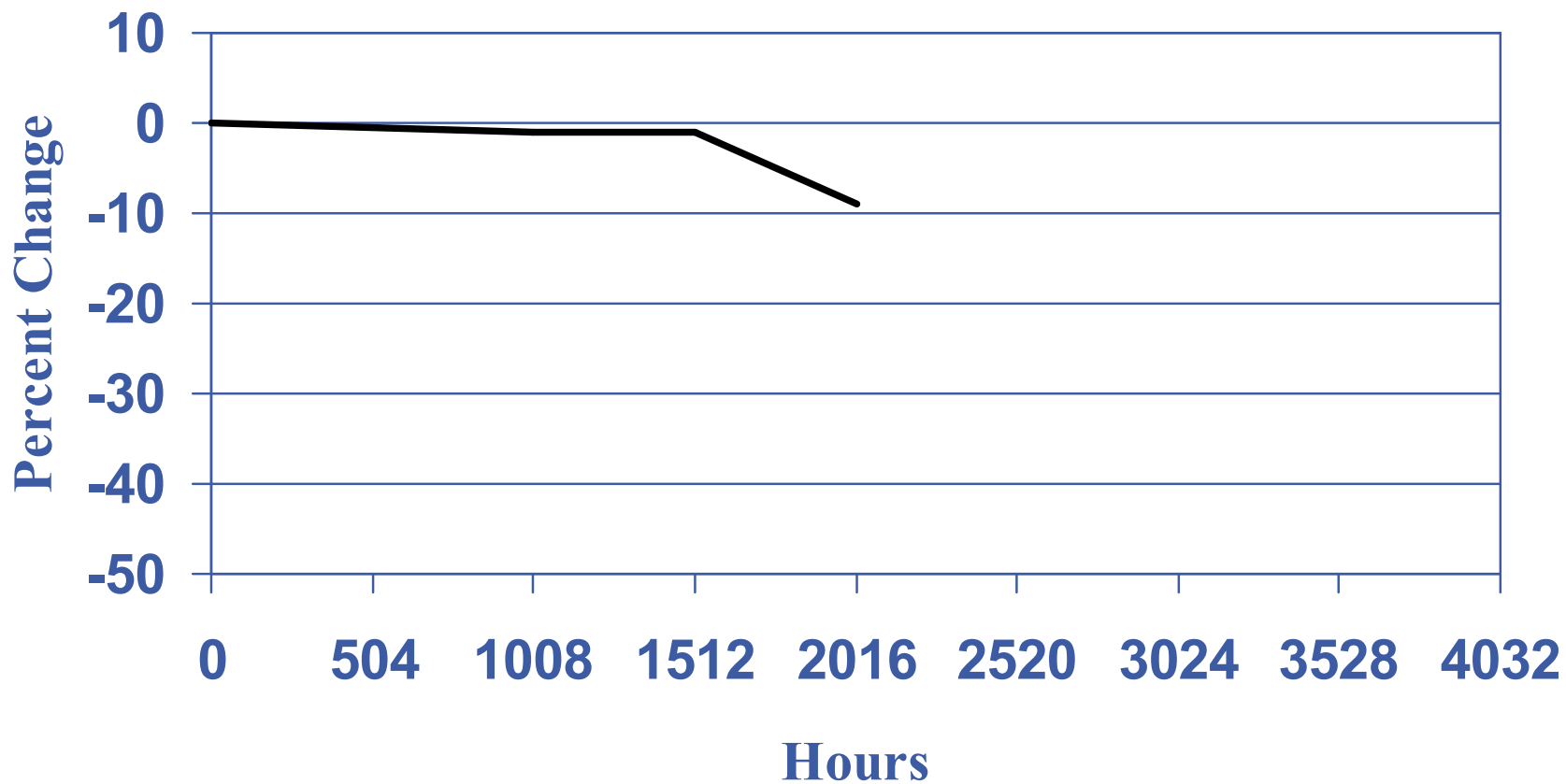


HOW TO MEASURE HEAT RESISTANCE

- Let us evaluate the HyTemp AR212HR in greater detail
 - Obviously the % elongation does not reach –50%
 - in a reasonable time frame



% ELONGATION CHANGE 150°C

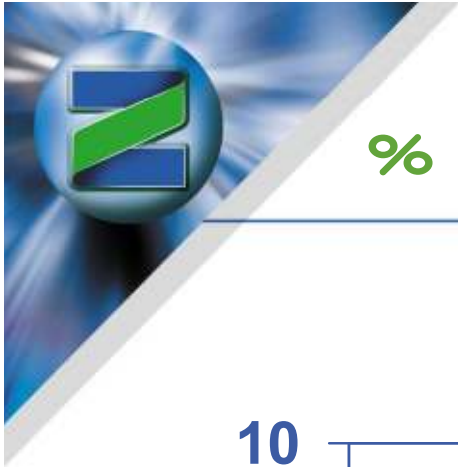


— AR212HR

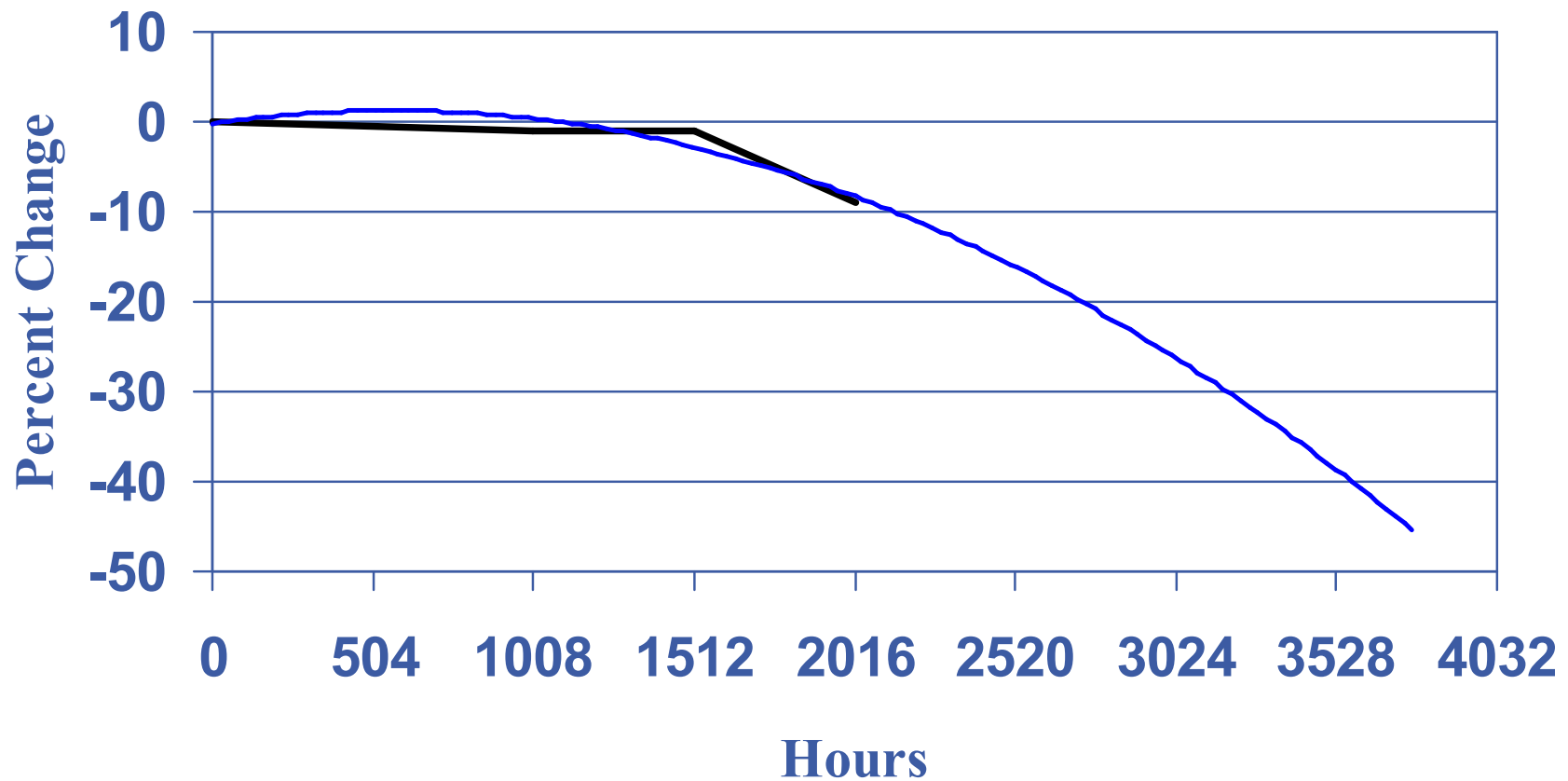


HOW TO MEASURE HEAT RESISTANCE

- Let us evaluate the HyTemp AR212HR in greater detail
 - Obviously the % elongation does not reach -50%
 - in a reasonable time frame
 - We can develop an equation to model the decay of this property



% ELONGATION CHANGE 150°C



— AR212HR — AR212HR Trend

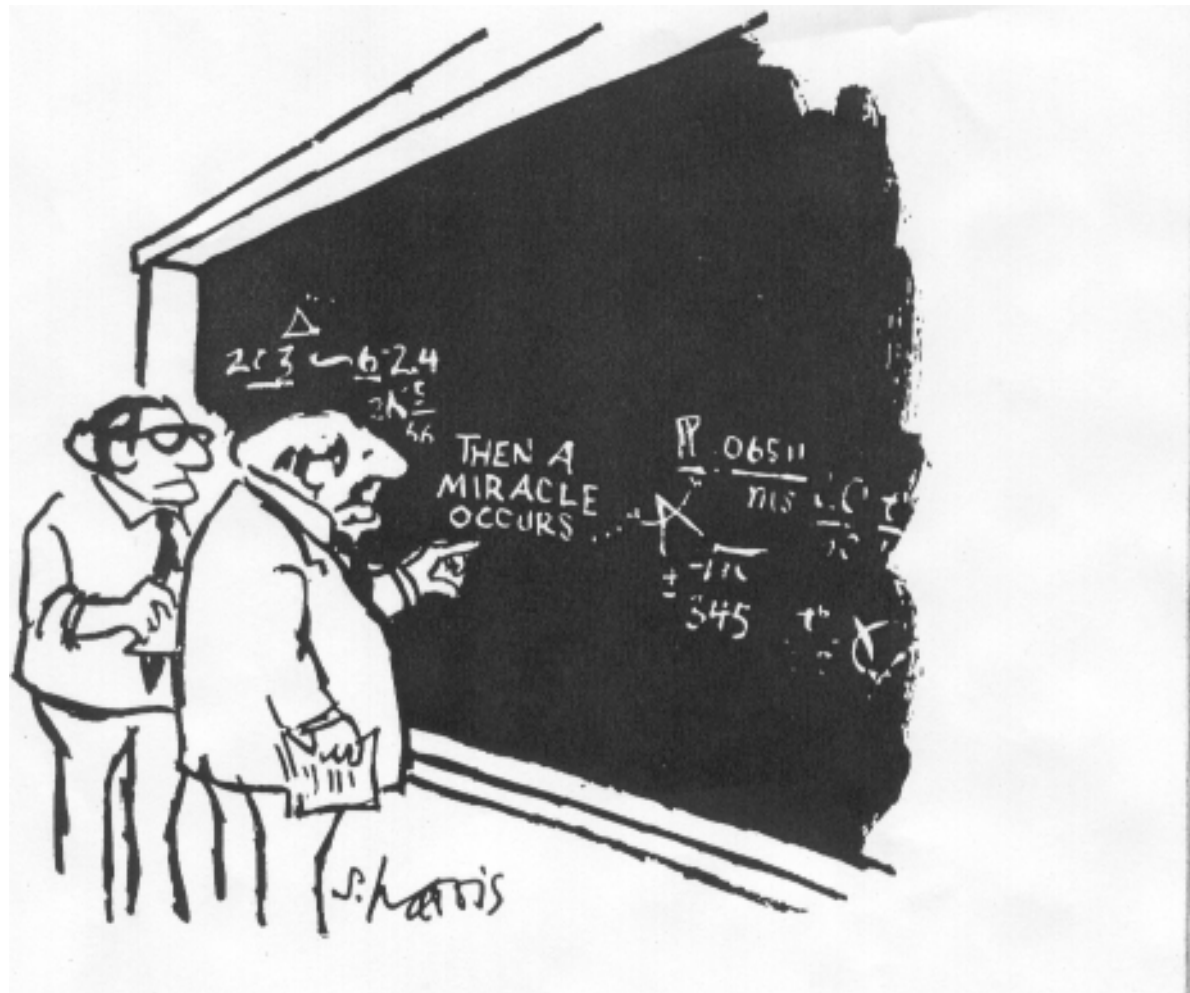


HOW TO MEASURE HEAT RESISTANCE

- Let us evaluate the HyTemp AR212HR in greater detail
 - Obviously the % elongation does not reach –50%
 - in a reasonable time frame
 - We can develop an equation to model the decay of this property
 - The time to 50% property loss is calculated by:
 - The following Method



SOME HIGH POWER MATH





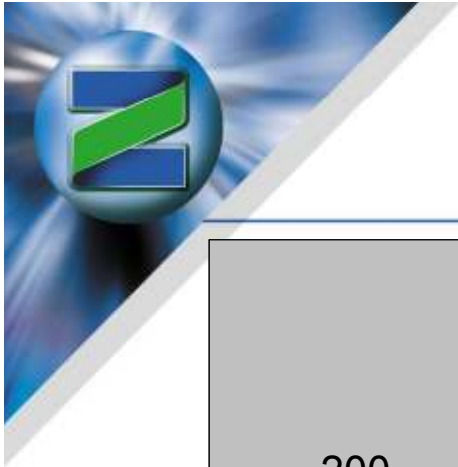
HOW TO MEASURE HEAT RESISTANCE

- Let us evaluate the HyTemp AR212HR in greater detail
 - Obviously the % elongation does not reach –50%
 - in a reasonable time frame
 - We can develop an equation to model the decay of this property
 - The time to 50% property loss is calculated by:
 - The following Method
 - The time to 50 %0 at each of the test temperatures were calculated and graphed

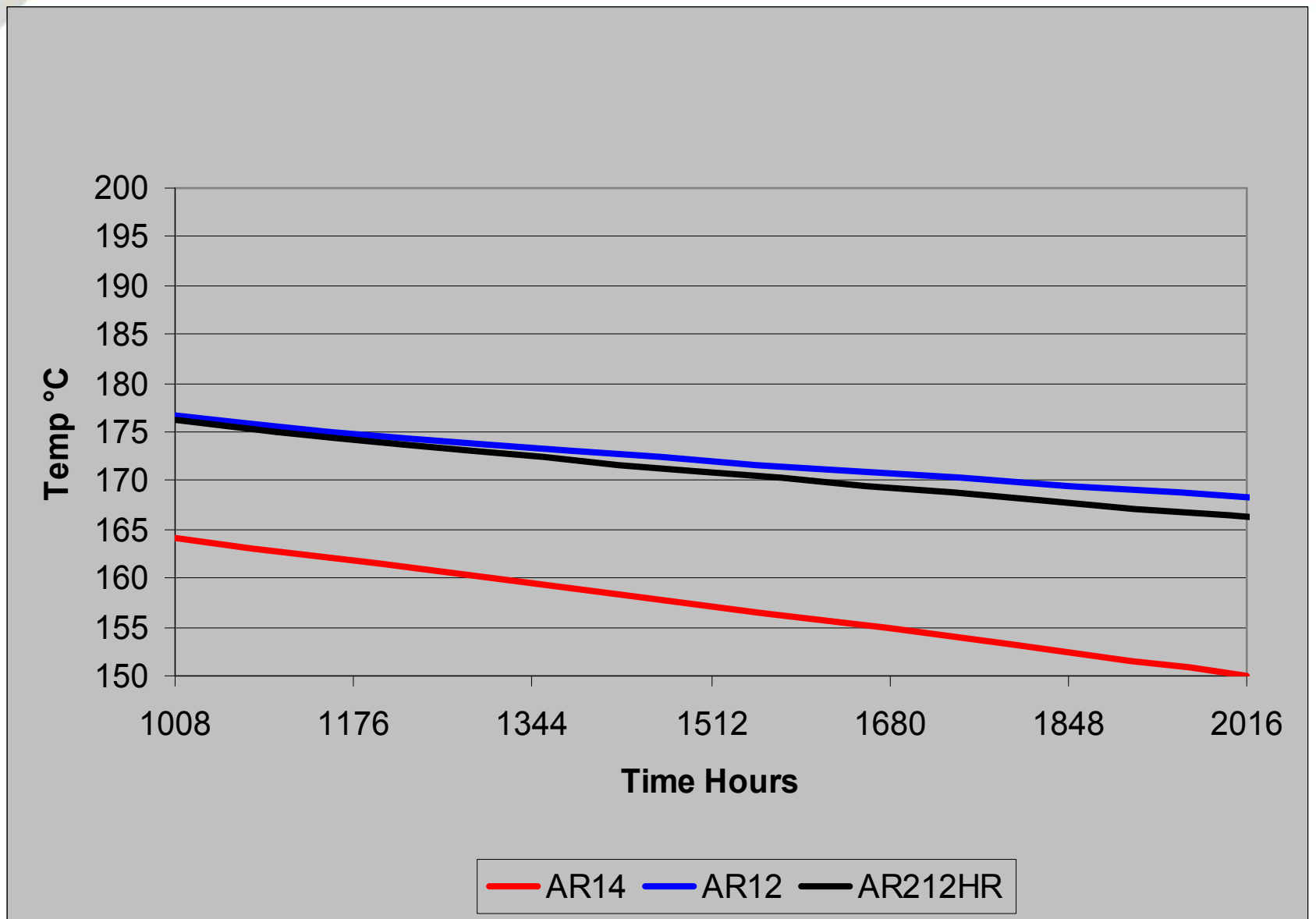


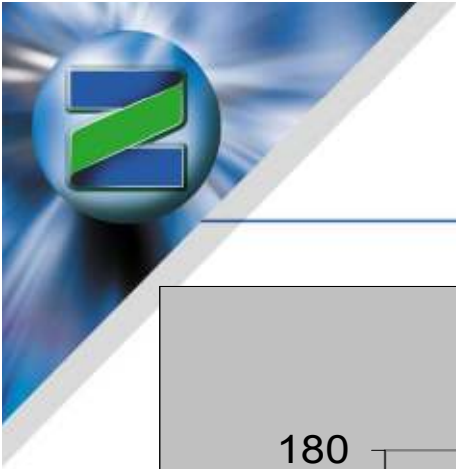
HEAT RESISTANCE MEASUREMENT CONTINUED

- An Arrhenius plot was developed
 - A log- log plot of time vs. absolute temperature (K)
 - Excellent fit was obtained
 - R^2 values $> .95$
 - However the real world does not familiar with °K
 - A graph of time vs. temperature was constructed from the log-log plot

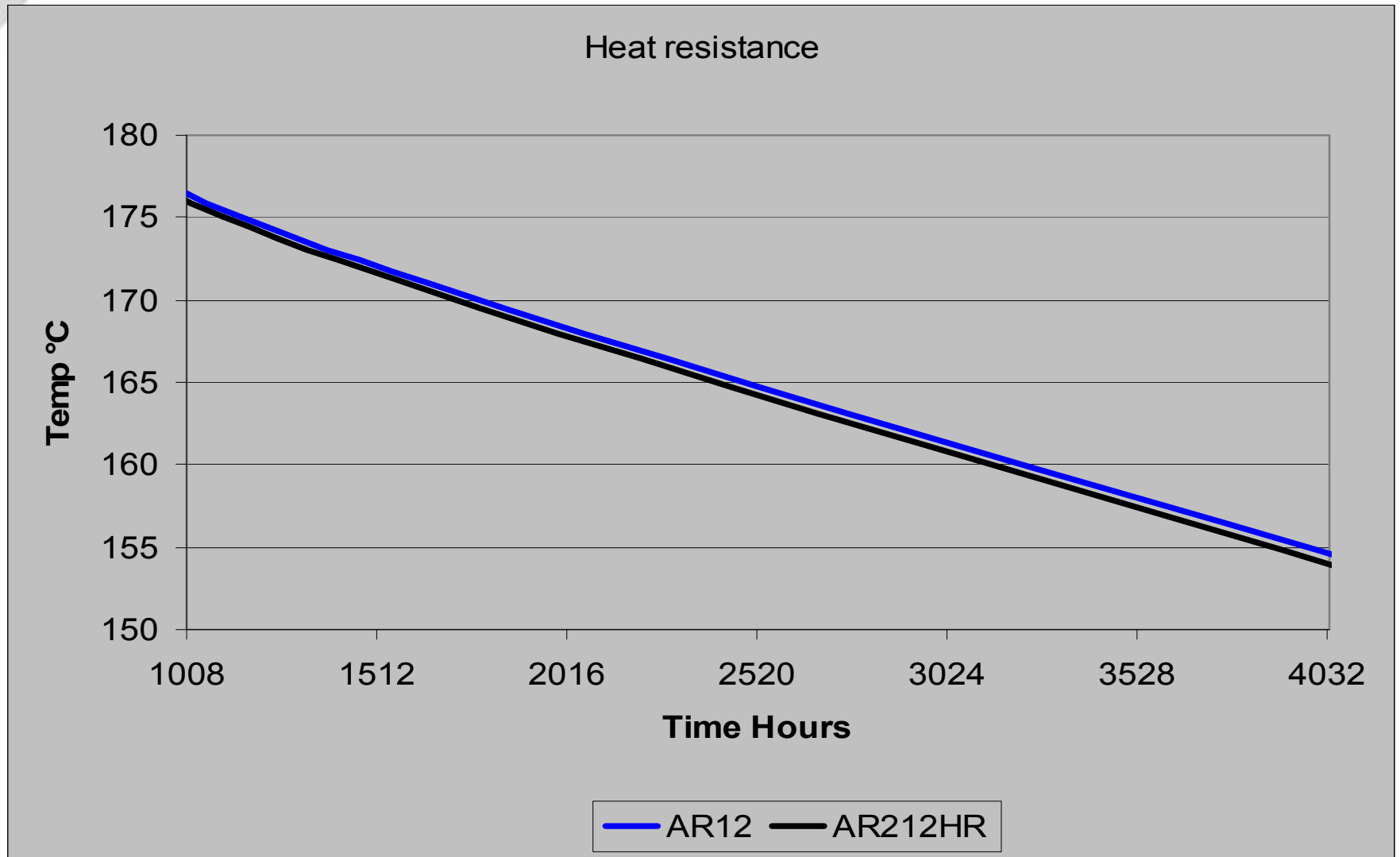


HEAT RESISTANCE





HEAT RESISTANCE OF HYTEMP HT-ACMS



Why use HT-ACM ?





WHY “HT-ACM HR”?



- Better retention of physical properties after aging
- Higher heat resistance
- Greatly improved compressive properties



APPLICATIONS FOR HT-ACMS

- AR12, AR14
 - Fast curing
 - Injection Moldable
 - Ideally suited for
 - Engine gaskets
 - Transmission gaskets
 - Seals



NEW APPLICATIONS

- Turbo Diesel Injection Hose



ZEON HT-ACM - APPLICATIONS

Continuous Temperature Resistance to 175C / Peak Resistance 190 to 200C



Hot Side Charged Air Hoses
HT- TDI Hose / CAC Hose



Molded Isolators / Seals
from Intake to Turbo



Cold Side Charged Air Hoses
TDI Hose / CAC Hose

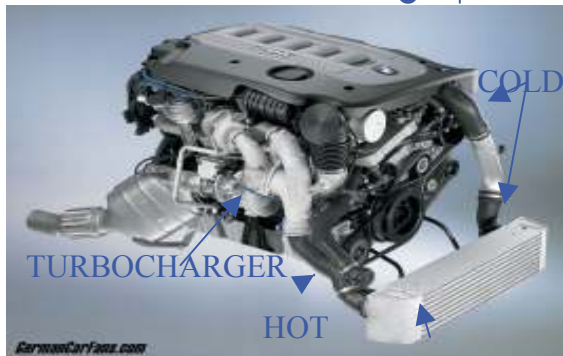
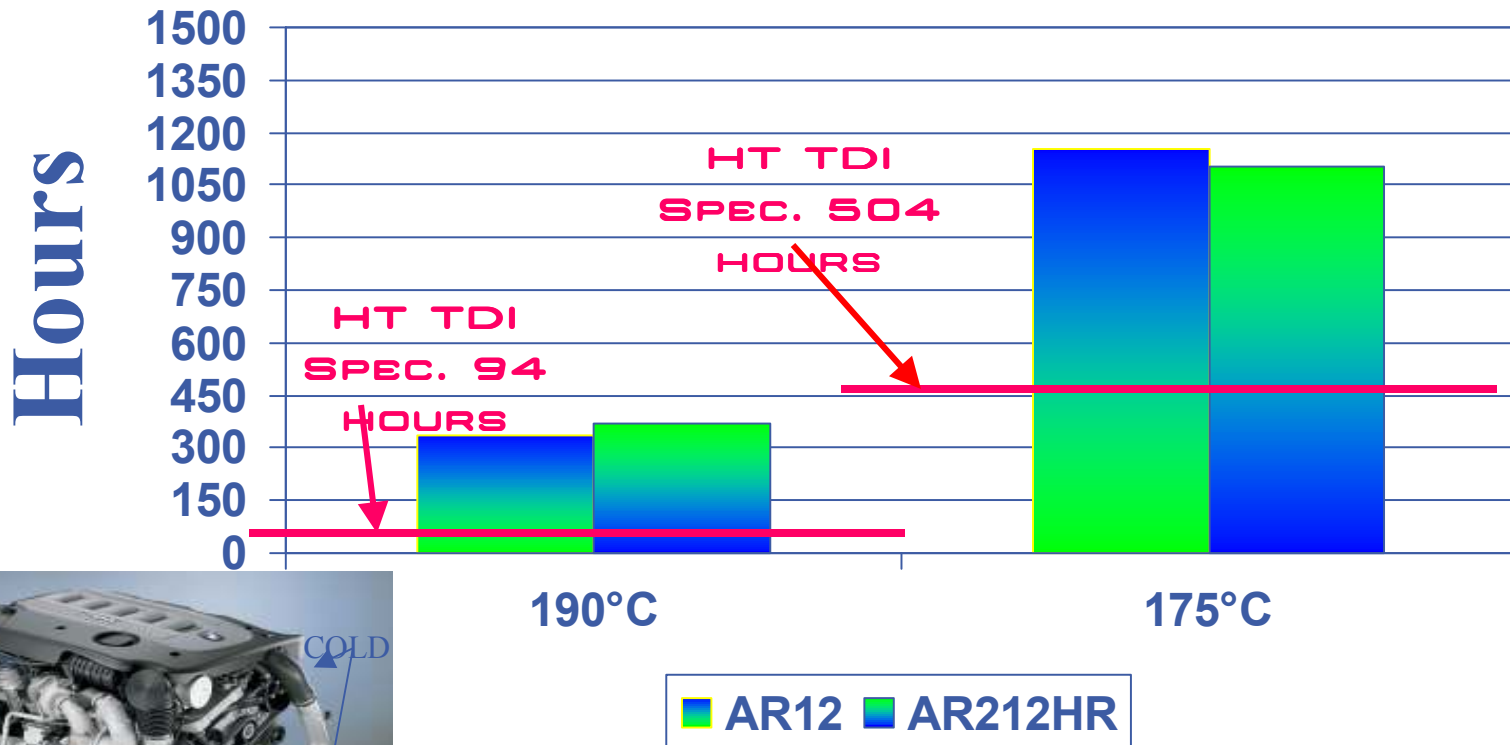


Gaskets & other Seals



HEAT RESISTANCE OF HYTEMP HT-ACMS

DEFINED BY THE TIME AT WHICH, AT A GIVEN TEMPERATURE,
50% LOSS IN EITHER TENSILE OR ELONGATION IS REACHED



Charge Air Cooler

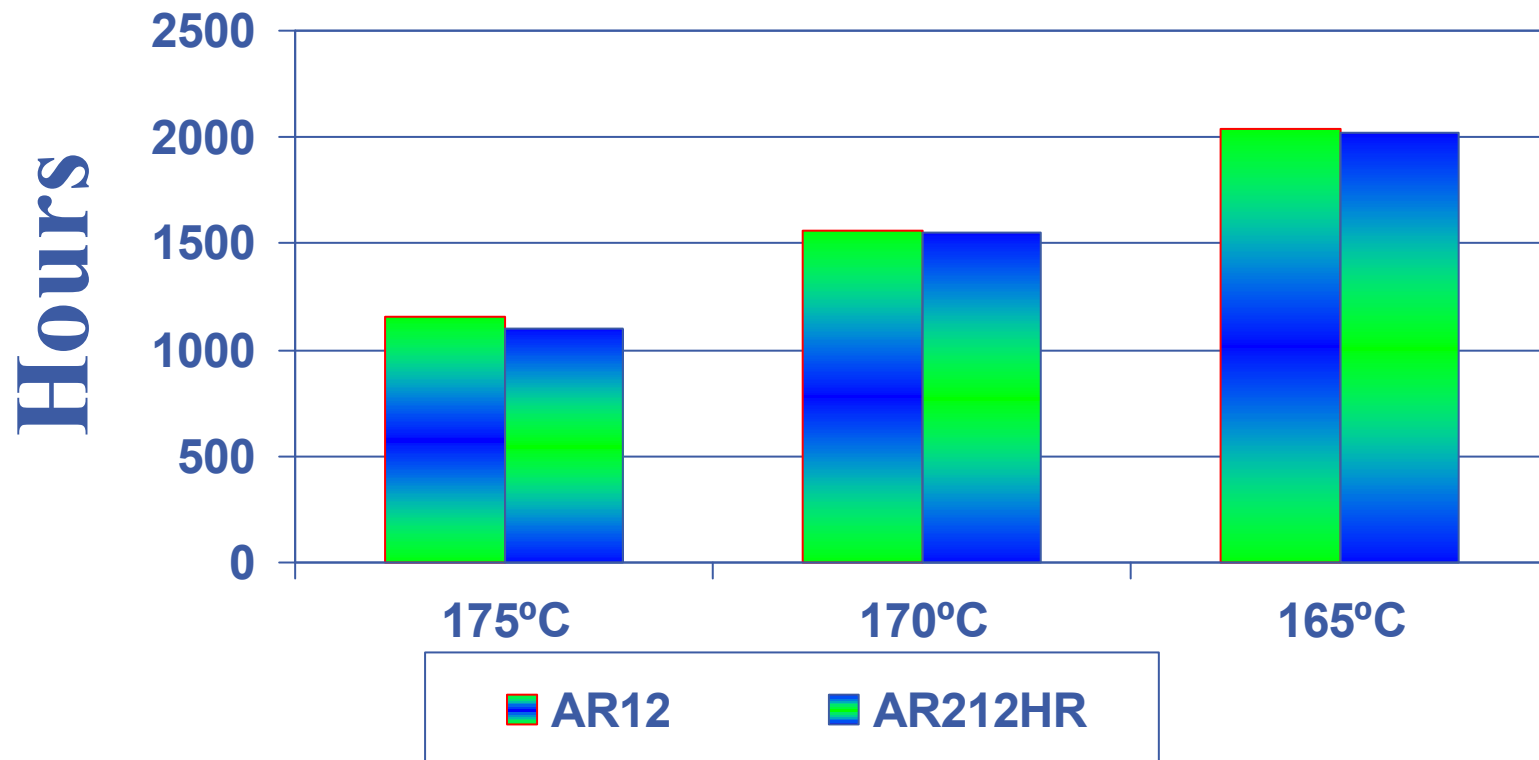


APPLICATIONS

- Turbo Diesel Injection Hose
- High Temperature Transmission Oil Cooler Hose
- High Temperature Oil Cooler Hose
- High Temperature Fuel line cover
 - (ACM is not Fuel gasoline resistant)
- Or if you have an application with the following heat resistance is required



HEAT RESISTANCE OF HYTEMP HT-ACMS SAE DEFINITION





CONCLUSIONS

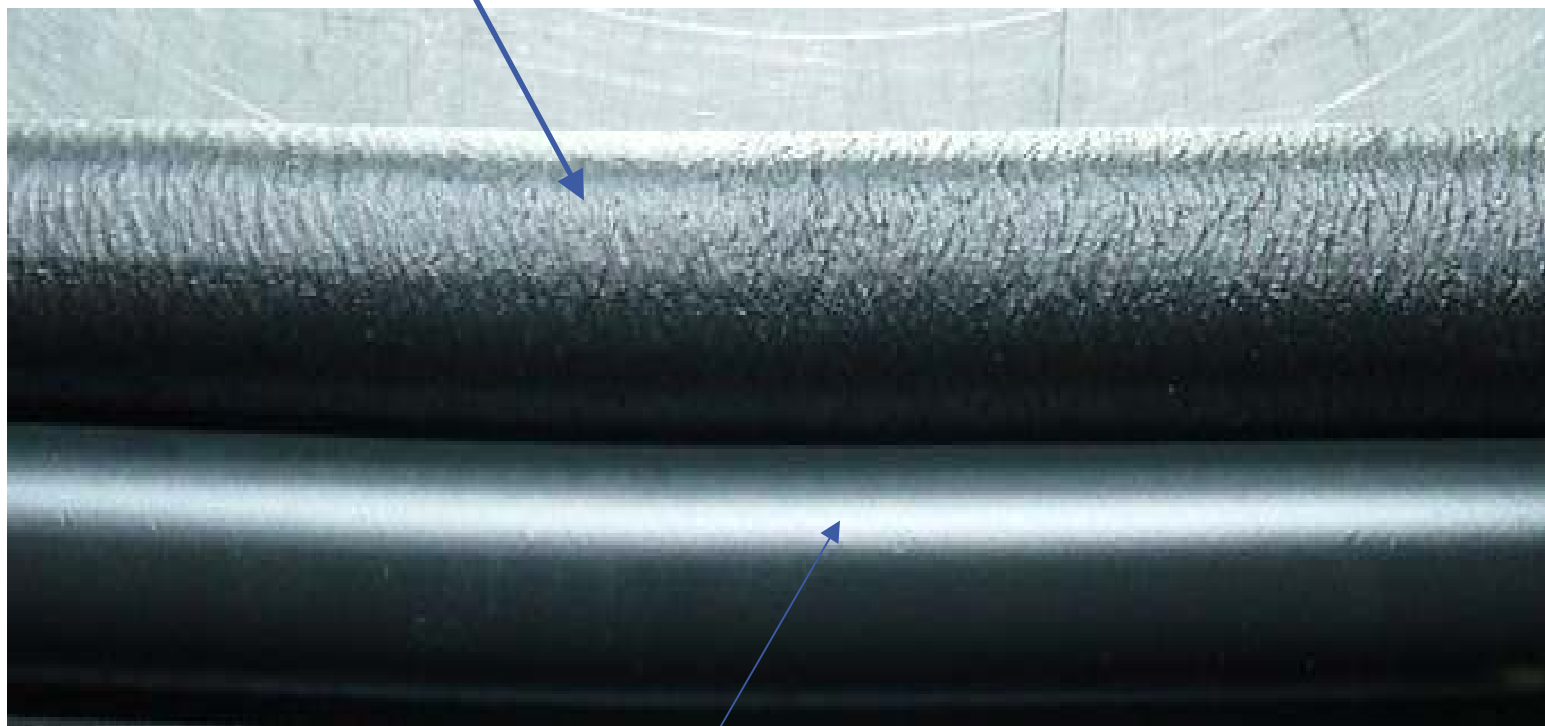
- AR 12 is for molded applications
- AR212HR is for extrusion applications



RESULTS

LAB EXTRUDED 58 SHORE A COMPOUNDS

AR 12



AR 212HR



RESULTS

INDUSTRIAL EXTRUSION -
58 SHORE A COMPOUND



AR 212HR



QUESTIONS

