

# DETERMINATION OF OPTIMUM AMBIENT TEMPERATURE RE- TORQUE DWELL PERIOD FOR PTFE BASED GASKETS

2006 ASME Pressure Vessels and Piping  
Conference

James E.B. Frew  
Jerry Waterland

Virginia Sealing Products, Inc.  
Hopewell, VA USA



**ANHYDROUS AMMONIA**  
**INHALATION HAZARD**

DOT 105J300V  
SAFETY VALVE 247.5 PSI  
TESTED 2000 TXXV DUE 2005  
TANK 300 PSI  
TESTED 2000 TXXV DUE 2010

Railroad Tank Cars- Primary Focus Of Study

>500,000 PTFE Gasketed Connections In Service In U.S

Assortment of standard & non-standard flanges

Unique Operational Issues:

Vibration, Harmonic Frequencies, Impact



## PTFE Based Gasket Materials

- 1) Required depending upon the commodity
- 2) Known initial creep relaxation behavior
- 3) Post assembly, 24 hour re-torque dwell period specified



## 24 Hour Re-Torque:

Delays Car Repair Completion

Reduces Repair Shop Throughput

Increases Repair Costs, Impacts Car Availability

*Huge Economic & Availability Impact For Shorter Re-Torque Dwell*



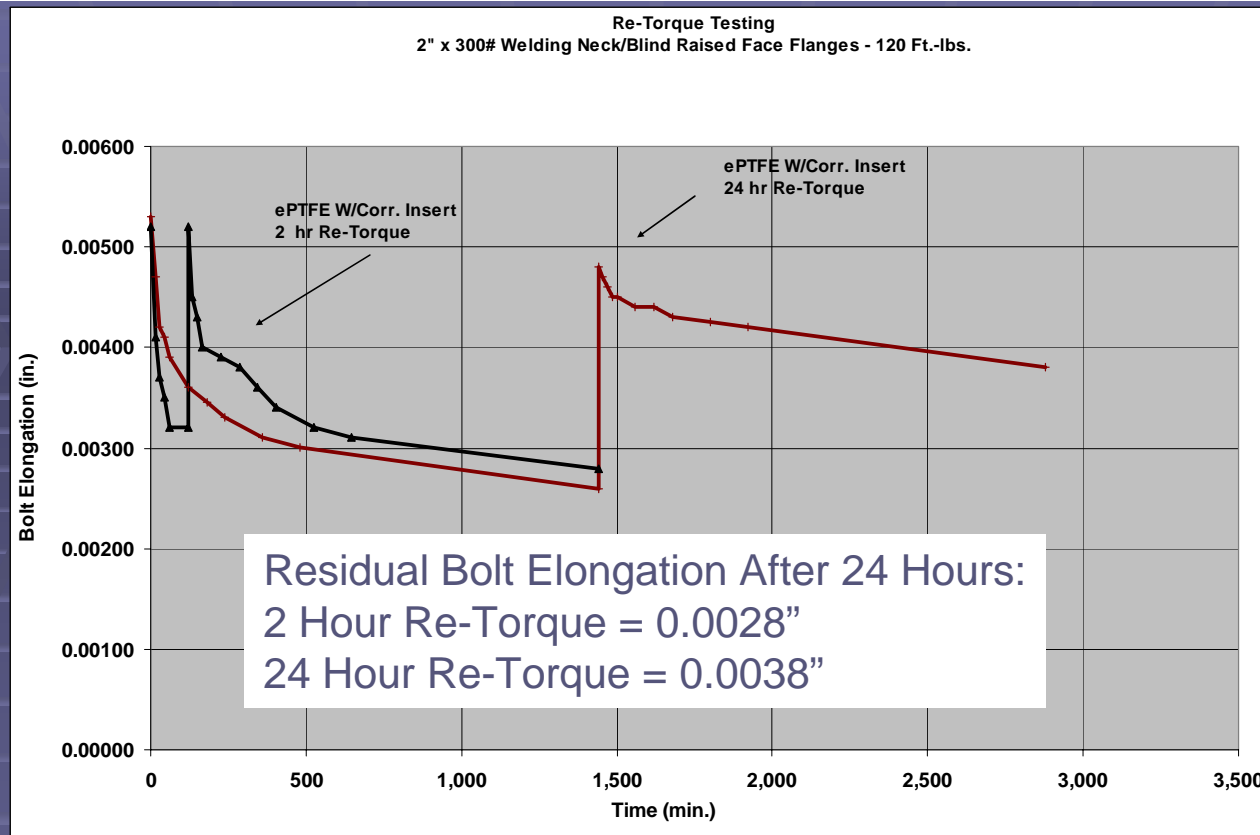
Potential Consequences If Post Assembly Re-Torque Is Not Performed:

Loose Bolts

(Ft-Pound Definition)

NARs (Non-Accidental Releases)

Fines/Penalties



### Study conducted to determine:

- 1) Specific re-torque requirements and characteristics of various PTFE based gasket materials used within Railcar Fleets
- 2) Potential identification of a suitable shorter re-torque dwell period  
This study focused on a 2-hour re-torque dwell period

### Analysis:

Comparison Of Residual Bolt Load After  
2 Hour and 24 Hour Re-Torque Dwell Periods

# PTFE Based Materials Evaluated In This Study

- Virgin, skived
- White, glass filled, skived
- Blue, glass filled, skived
- HS-10 Process Barium Sulphate filled
- HS-10 Process micro-cellular
- 1<sup>st</sup> generation expanded
- 2<sup>nd</sup> generation expanded
- 1<sup>st</sup> generation expanded, with corrugated insert

## Text Fixture Used For Study



NPS 2 x 300 WN/Blind Flanges

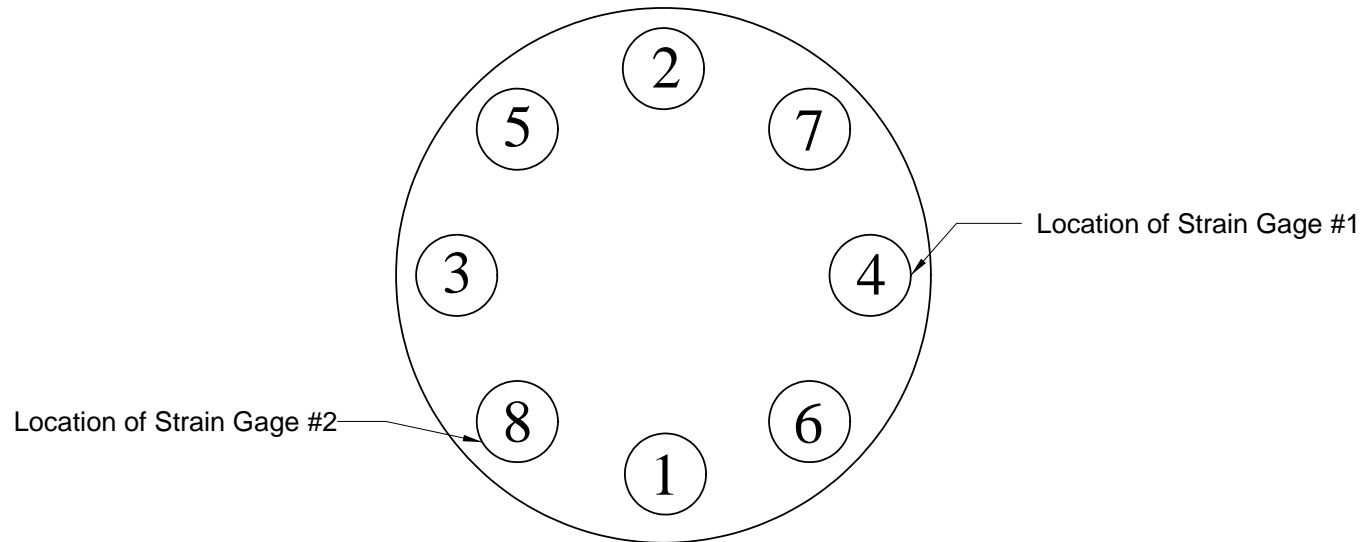
Strain-Gauged Bolts

Assembly Torque = 120 ft-lb (lubricated)  
15.8 ksi gasket assembly stress

Fixture Selected To Simulate Rigidity,  
Active Bolt Length, Bolt Stretch, and  
Gasket Stress Of Many Auxiliary  
Connections On Pressure Cars

# Fixture Assembly Procedure and Location Of Strain-Gauged Bolts

VSP Assembly Procedure for Gasket Material Re-Torque Testing - 07/01/05



- 1.) Make Sure all Bearing Surfaces are Lubricated before Each Application
- 2.) Snug all Bolts
- 3.) 1st Pass, Follow Star Pattern Sequence with Torque Set at 30 ft-lbs
- 4.) 2nd Pass, Follow Star Pattern Sequence with Torque Set at 60 ft-lbs
- 5.) 3rd Pass, Follow Star Pattern Sequence with Torque Set at 90 ft-lbs
- 6.) 4th Pass, Follow Star Pattern Sequence with Torque Set at 120 ft-lbs
- 7.) 5th Pass, Rotational Pass with Torque Set at 120 ft-lbs, No Overlap
- 8.) Record Data on Excel Spread Sheet at appropriate times
- 9.) ReTorque at either 24 Hr or 2 Hr, with a single rotational pass
- 10.) Continue Recording Data on Excel Spread Sheet at appropriate times

## Sample Data Sheet

24hr Retorque Expanded PTFE #1			
Time (min.)	Dial # 1	Dial # 2	Average
0	0.00450	0.00450	0.00450
15	0.00430	0.00420	0.00425
30	0.00420	0.00410	0.00415
45	0.00410	0.00410	0.00410
60	0.00408	0.00405	0.00407
120	0.00395	0.00400	0.00398
180	0.00388	0.00390	0.00389
240	0.00380	0.00385	0.00383
720	0.00370	0.00370	0.00370
1,440	0.00368	0.00369	0.00369
1,441	0.00410	0.00410	0.00410
1,455	0.00408	0.00406	0.00407
1,470	0.00407	0.00404	0.00406
1,485	0.00405	0.00400	0.00403
1,500	0.00405	0.00400	0.00403
1,560	0.00402	0.00395	0.00399
1,620	0.00400	0.00392	0.00396
1,680	0.00398	0.00391	0.00395
1,800	0.00395	0.00390	0.00393
2,460	0.00390	0.00380	0.00385
2,880	0.00390	0.00380	0.00385

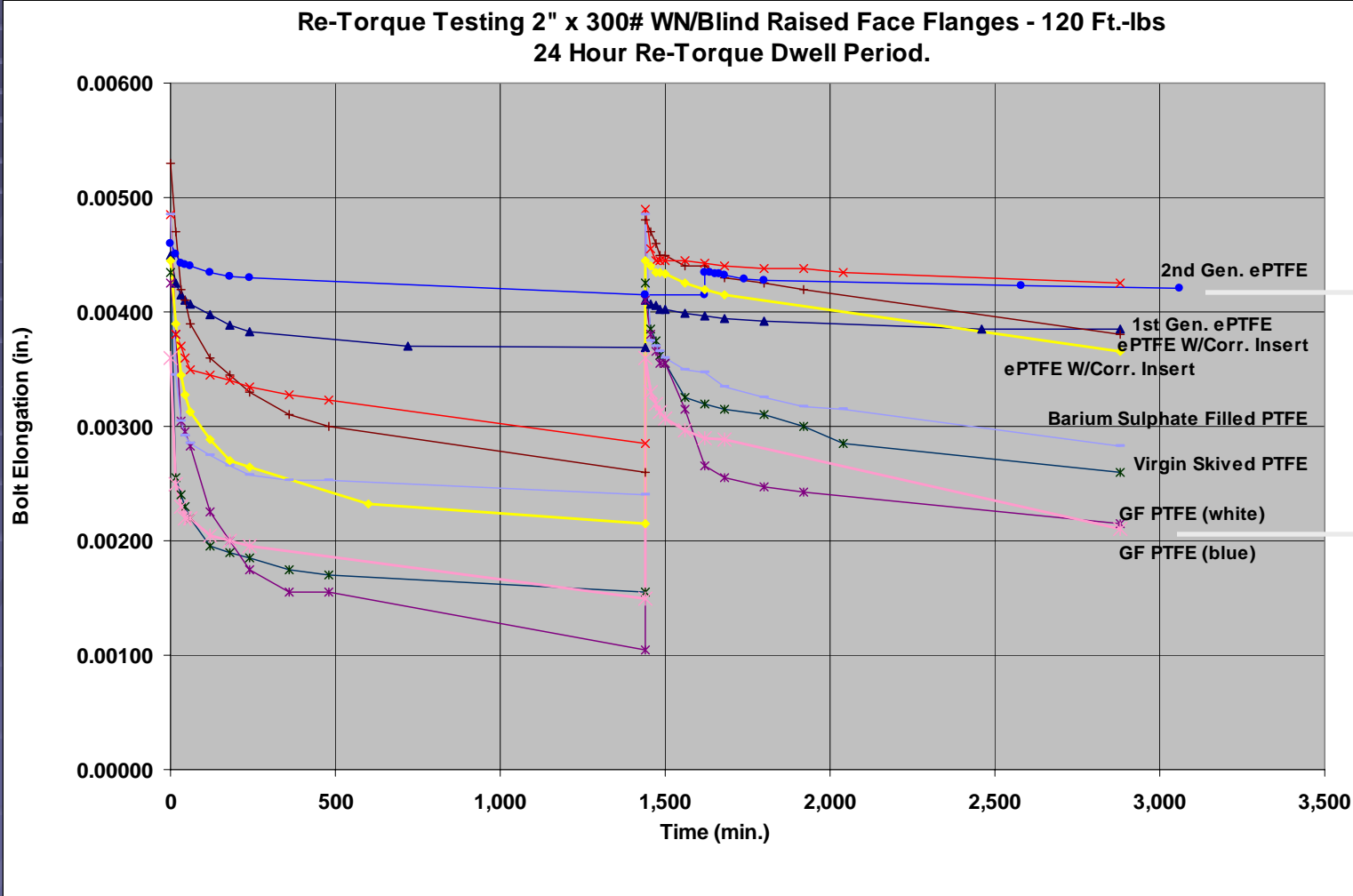
Each Gasket Tested Twice @  
Each Re-Torque Dwell Period

Residual Bolt Elongation Recorded  
Periodically During Test

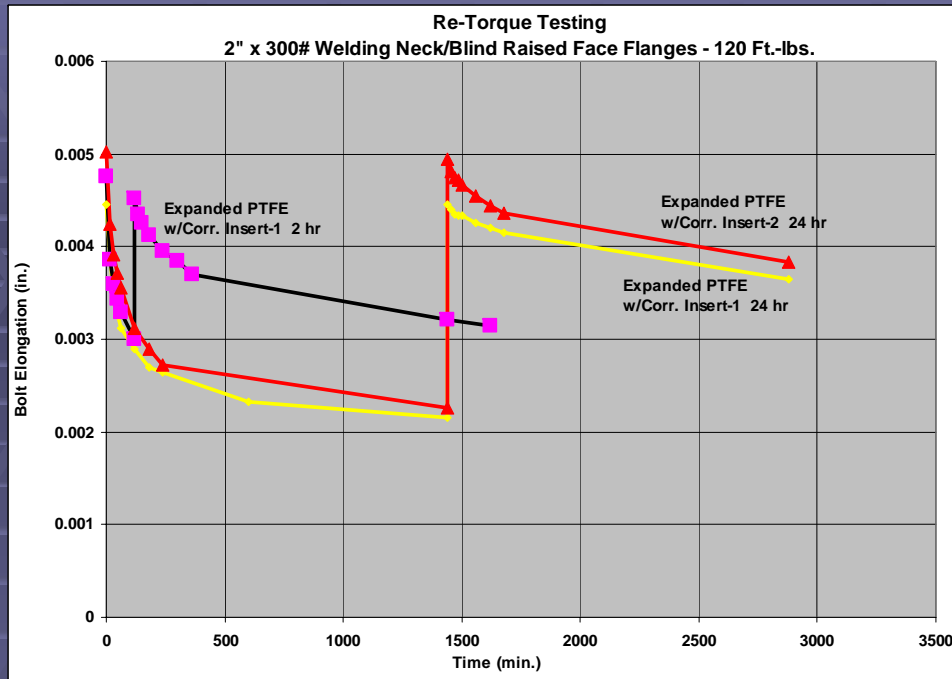
Bolt Elongation Measurements Were  
Averaged For Analysis

Test Duration: 24 Hours Beyond Re-Torque

# Data Summary: All Materials, 24 Hour Re-Torque Dwell Period

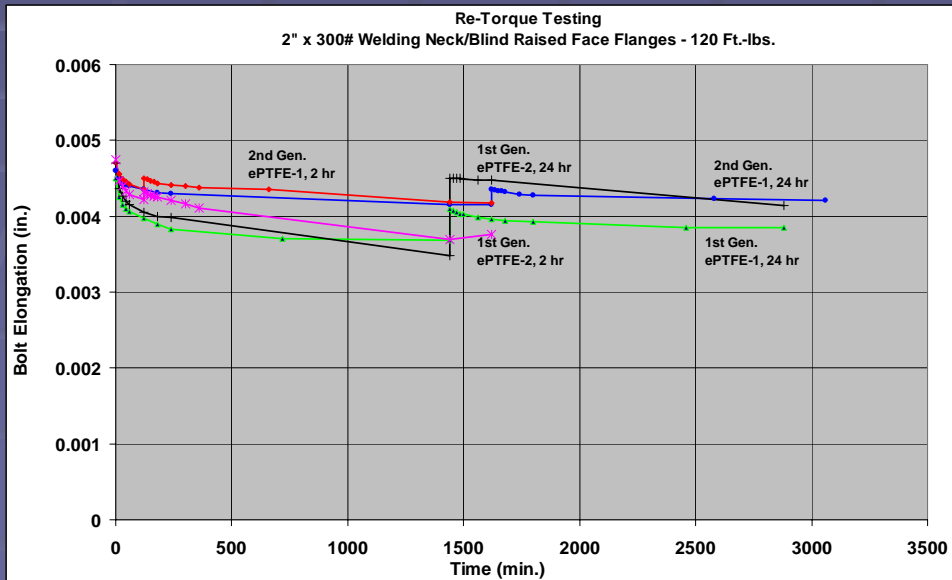


Note The Broad Range Of Final Bolt Elongation (Residual Load)



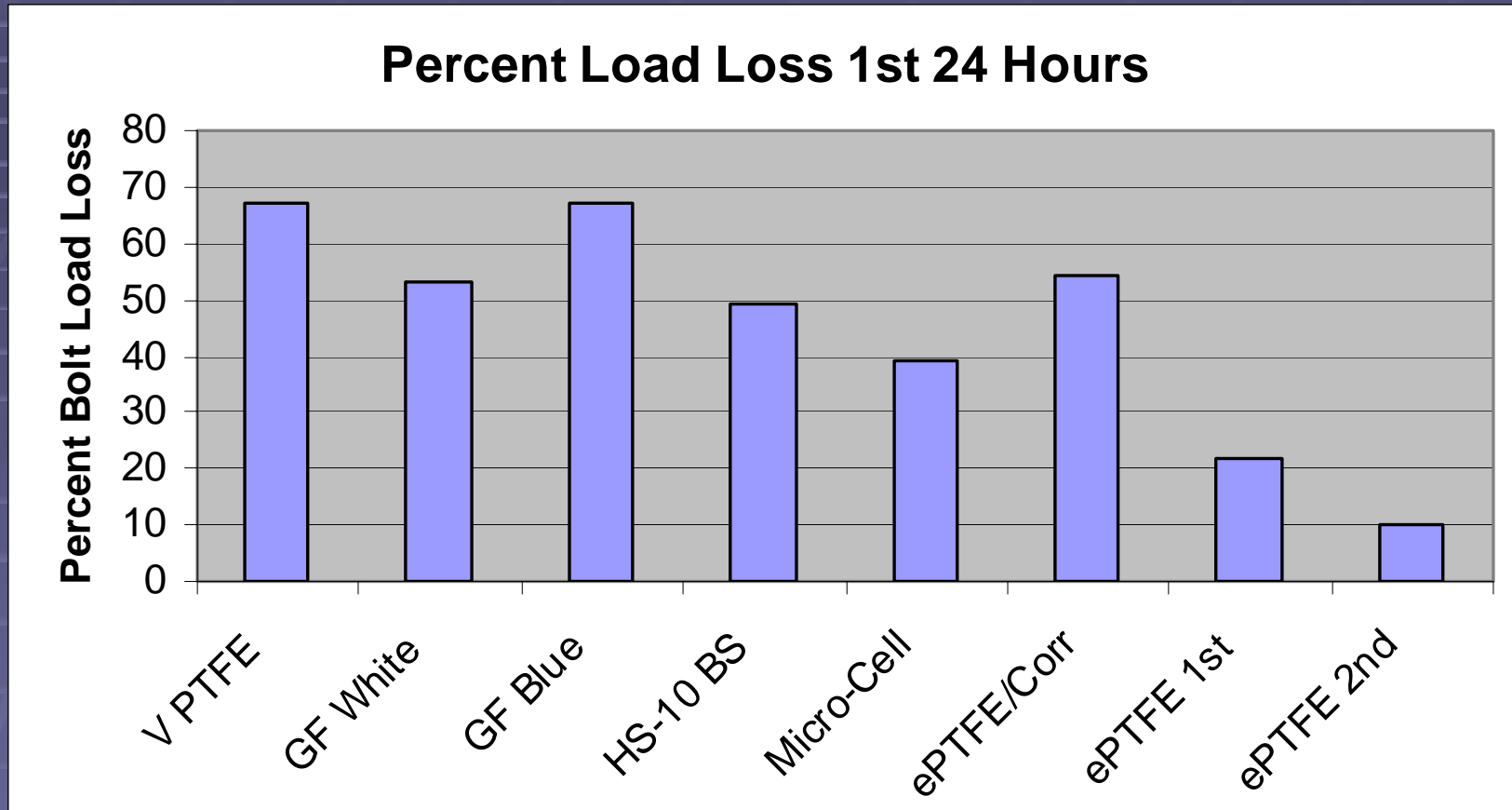
## Different Behaviors Noticed:

Residual Elongation After 2 Hour  
Re-Torque Dwell Period  
Noticeably Less Than After  
24 Hour Re-Torque Dwell Period

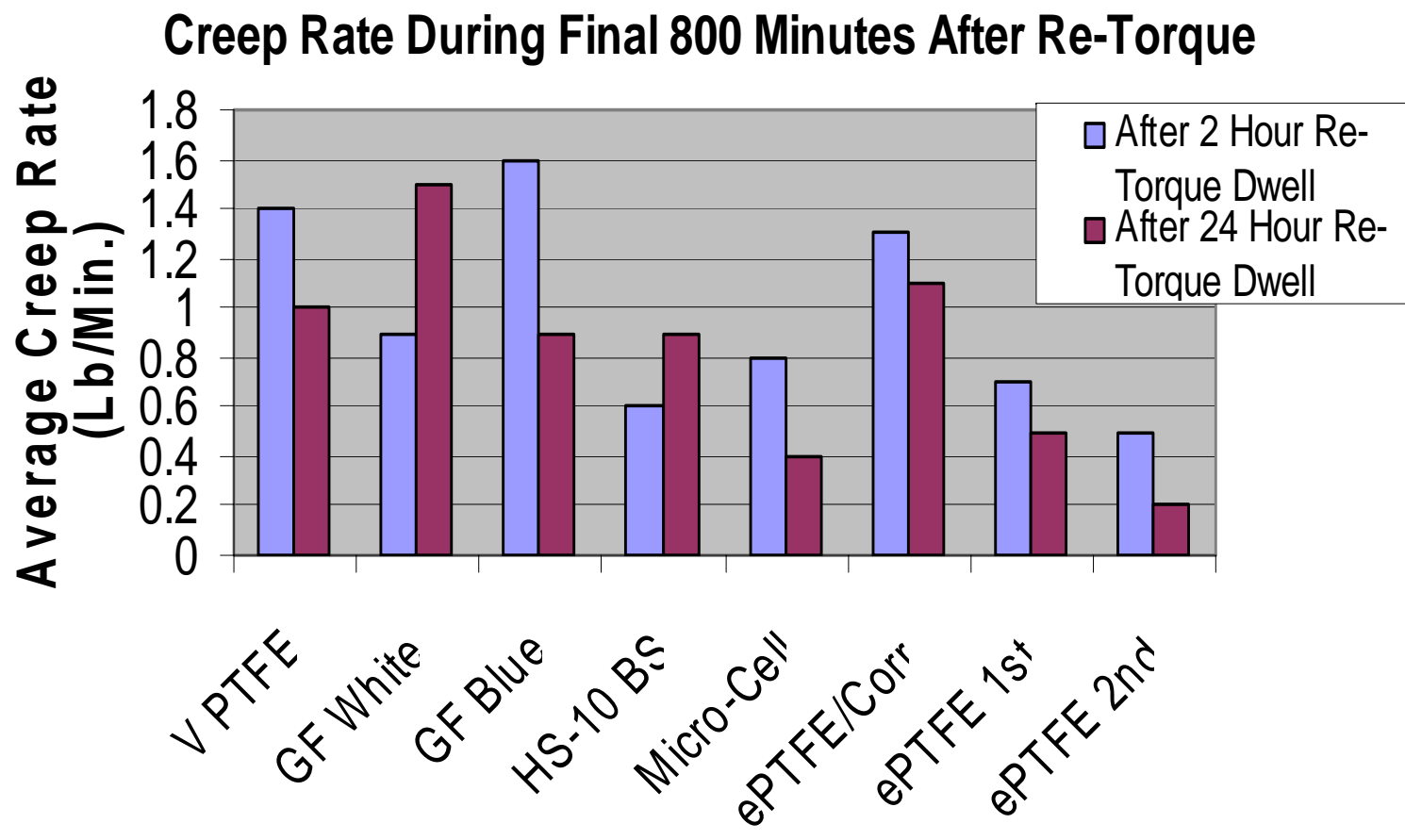


Residual Elongation After 2 Hour  
Re-Torque Dwell Period  
Equivalent To 24 Hour  
Re-Torque Dwell Period

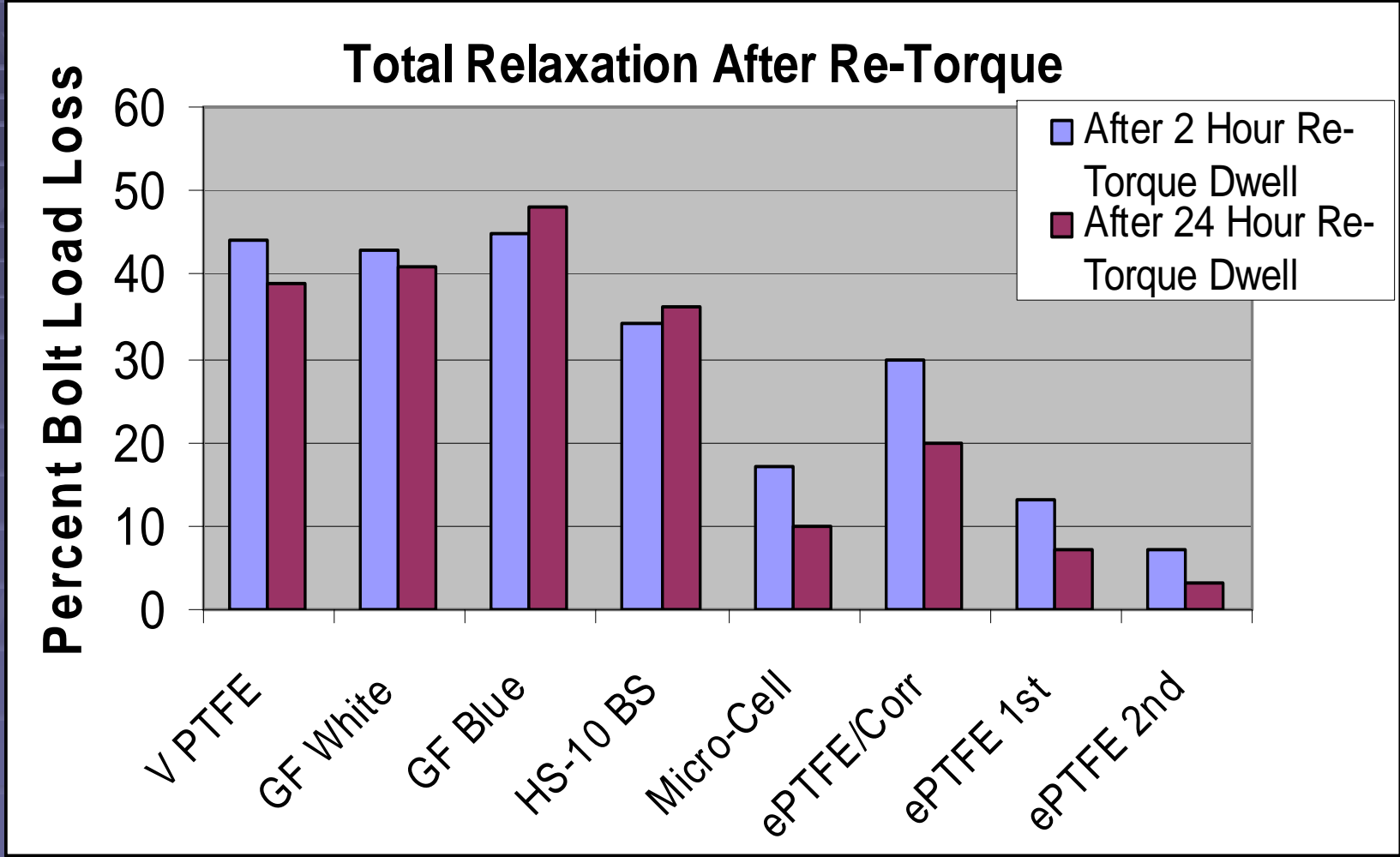
# Load Loss Prior To 1<sup>st</sup> Re-Torque



Key Indicator Of Which Material Types Truly REQUIRE A Re-Torque



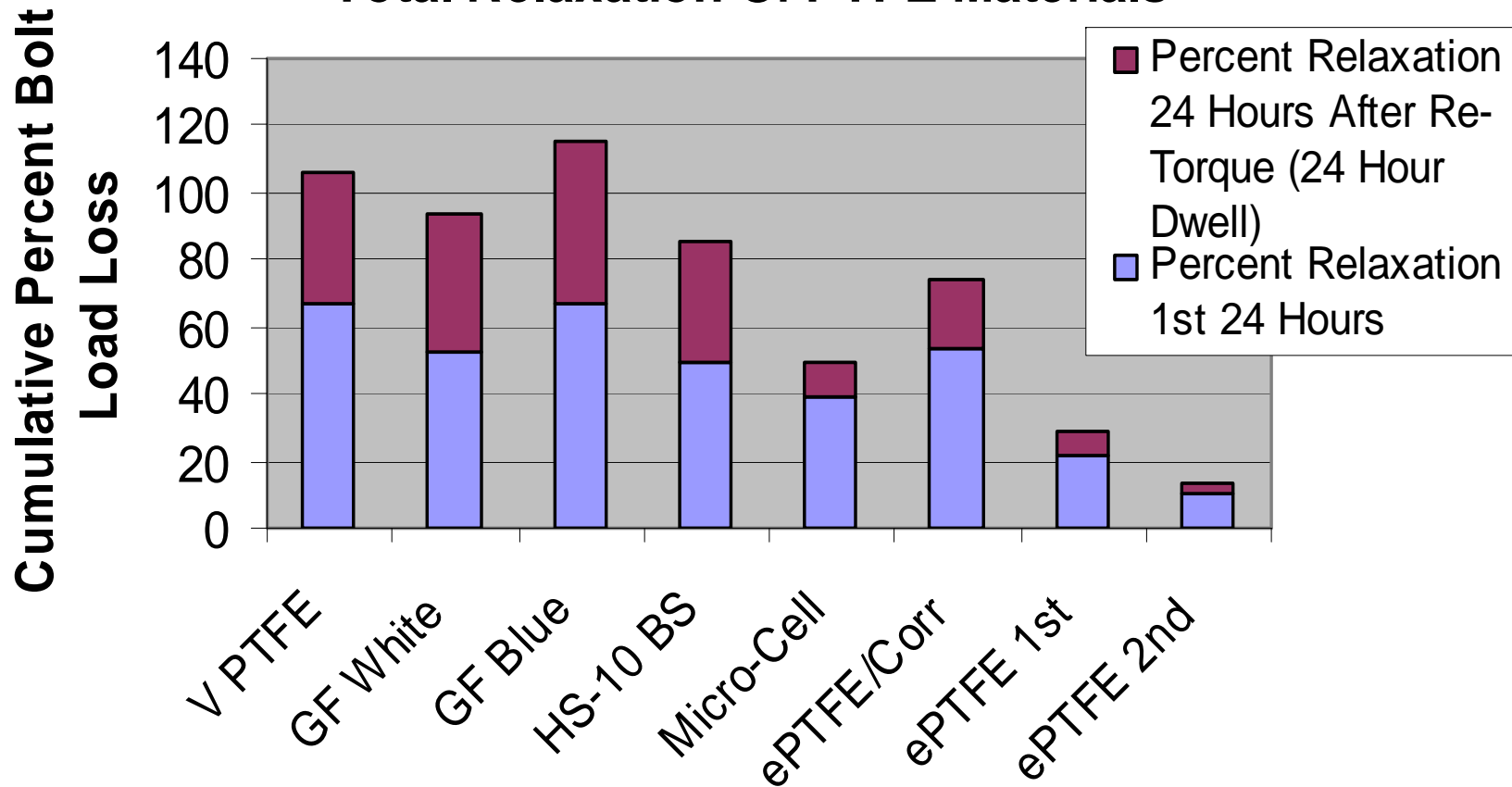
Key Indicator Of The Effect Of Dwell Period  
On The Material's CREEP RATE



An Indicator Of The Residual CREEP POTENTIAL Remaining  
In The Material After Each Dwell Period

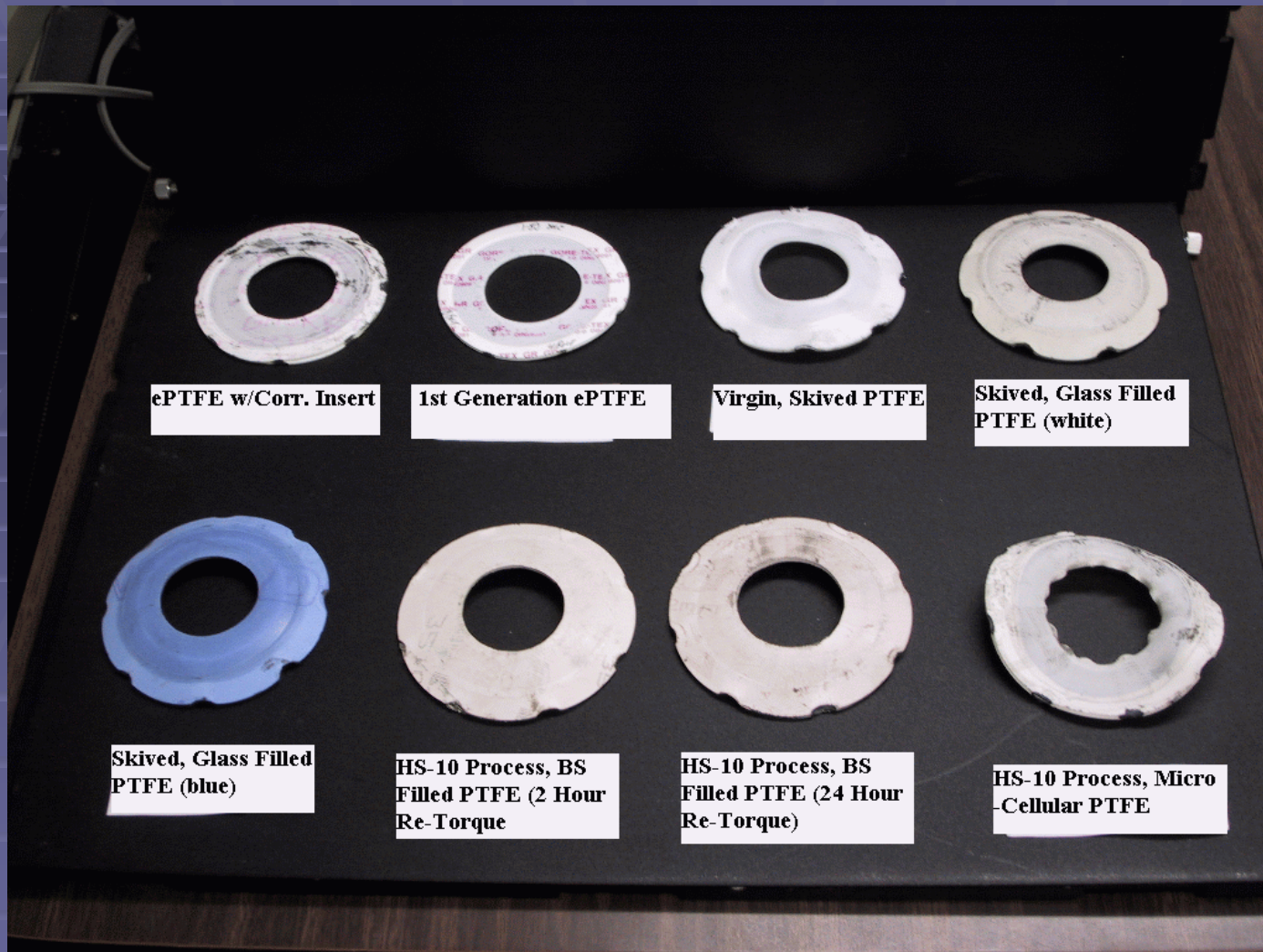
# Cumulative Load Loss Before and After 24 Hour Re-Torque Dwell Period

## Total Relaxation Of PTFE Materials



An Indicator Of The Material's CREEP STABILITY and RE-TORQUE & DWELL PERIOD EFFECTIVENESS

# Post-Test Visual Analysis Of Gaskets



**Creep Rate Stability, and Need For Re-Torque  
Conclusions Are Supported By The Visual Condition  
(physical flow) Of The Gaskets**

## Conclusions:

- 1) All materials tested, with the exception of expanded PTFE, exhibit significant relaxation and should be re-torqued after assembly
- 2) A two hour re-torque dwell period appears inadequate for half of the materials tested
- 3) A two hour re-torque dwell period appears suitable for the following materials:
  - White, Glass Filled, Skived PTFE
  - HS-10 Process, Barium Sulphate Filled PTFE
  - Expanded PTFE w/ Corrugated Insert
  - 1<sup>st</sup> Generation Expanded PTFE

## Future Studies:

- 1) Four hour and eight hour re-torque dwell periods
- 2) Different flange stiffness
- 2) Longer duration after re-torque
- 3) Lower initial assembly stress