LORD Corporation
Chemical Welding for Pipeline Repairs
CRUG Conference 2015

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Lord Corporation

- 20+ years
- Automotive Market
- Chemically weld, instead of welding

LORD Ask Us How™

LORD structural adhesives chemically weld:

Heavy Duty Class 6-8 Truck/Trailer Assembly

Commercial & Military Aircraft Assembly

>50-million OEM Vehicles

Armored Personnel Carriers & Weapon Systems Armor Assembly

- ✓ LORD Structural Adhesives **Chemically Weld** High-Value Assets
- ✓ Vehicles: on and off road
- ✓ Require Maximum Strength and Long-Term Durability

Oil & Gas Pipeline Repair

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1 Current State

Pipeline Repair

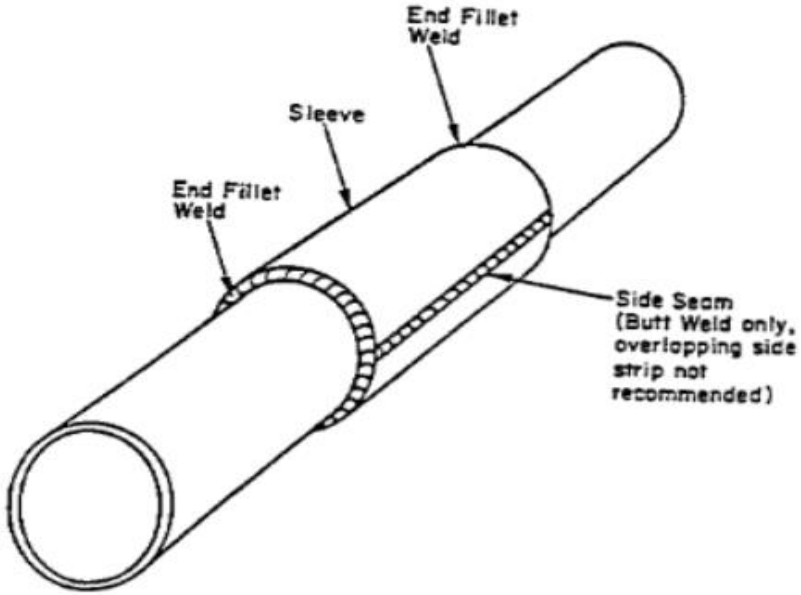
Frequent Questions:

1. Is it a **Type A** (reinforcement), **or Type B** (pressure retaining) repair?

2. Will line need to be **shutdown, or, line pressure reduced**?

3. Will residual stress from welding **have a negative impact on aging pipeline**?

Traditional Welded Repair



- Welding:
  - Is only applied to perimeter of the sleeve
  - Creates a hot spot for rust and corrosion
  - Molecularly changes the integrity of the steel
  - Requires certified welders
  - Can be hazardous

Welding Incidents

Industry best practices do not guarantee a safe repair.

Consequence	2014
Fatalities	19
Injuries	96
Property Damage	$292.6 Million

Reference: Pipeline and Hazardous Materials Safety Administration

2 Chemical Welding

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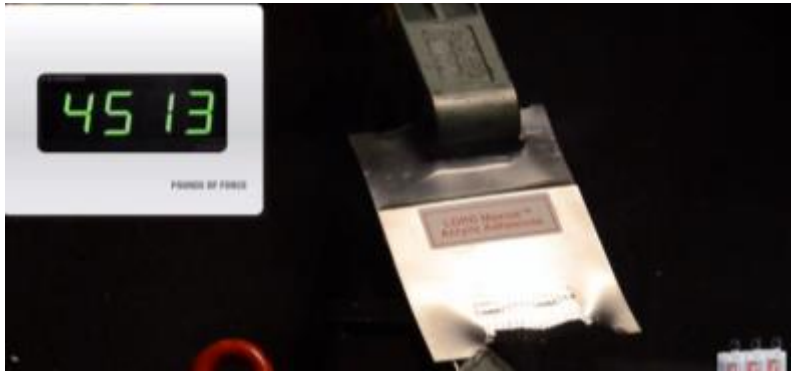
What is Chemical Welding?

The adhesion and chemical cross-linking of two substrates using structural adhesives that meet or exceed the strength requirements of welding alone.

Actual Example:

'Tug-of-war' between traditionally welded plates and LORD-Chemically Welded plates: Traditionally welded plates failed at 1056 lbs of force



'Tug-of-war' between Chemically Welded plates using LORD structural adhesives: Substrate failure before Chemically Welded Joint even deforms

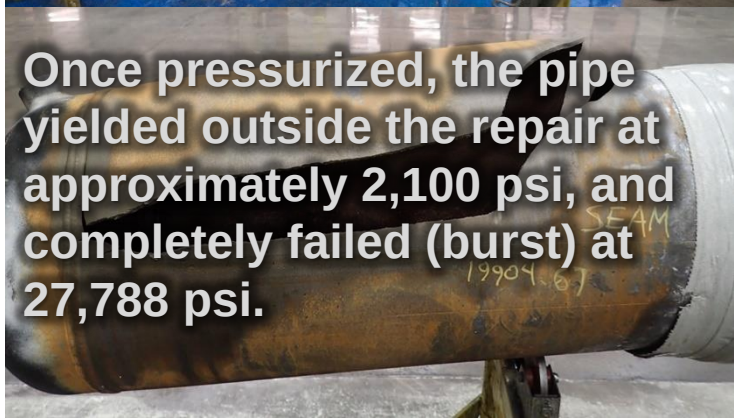
Chemically Welded Repair

Procedure

- Once the half-sleeves have been fixtured in place, the repair is put into compression
- After 2 hours a composite wrap (fiberglass cloth and resin) is installed (belt and suspenders)

Benefits of Chemical Weld

- Complete mating surface is chemically welded
- No heat affect zone
- No possibility of burn through
- No possibility of causing hydrogen cracks
- No worries about inside pipe temperature
- No worries about carbon fiber interfering with cathodic protection
- High degree of safety for workers
- No reduction in product flow
- Environmentally friendly



Chemical Welding vs. Traditional Welding

1. Greater throughput → adhesive is applied faster than a continuously welded seam.

2. Greater strength → load is evenly distributed across continuously cross-linked substrates. No residual stresses, like with welding.

3. Greater durability → welds are prone to moisture ingress (corrosion), and fracture with vibration. LORD Structural adhesives are engineered to prevent moisture and vibration induced cracking; ensuring long-term durability.

4. Greater labor flexibility → welding is an expensive alternative, with fewer qualified welders. Structural adhesives can be dispensed with relatively little training; allowing bottle-neck resolution in labor-intensive processes.

5. Increased safety → no flame source to ignite source materials (contaminants or product).

ComposiSleeve

- Reduces the cost of a repair by ~50%

Repair Type	Labor	Equipment	Material	Non-Destructive Test	Total
ComposiSleeve	$1,082	$129	$1,289	$0	**$2,500**
Type B Welded Sleeve	$3,100	$200	$1,125	$1,200	**$5,625**

"Last year [one] company paid 60 welders more than $150,000 and two of them over $200,000."

THE WALL STREET JOURNAL. WSJ

- Pipelines — and welders — are getting older
- Pipeline infrastructure continues to grow (more to maintain with fewer qualified welders)

3 Chemical Welding in Pipeline Repair

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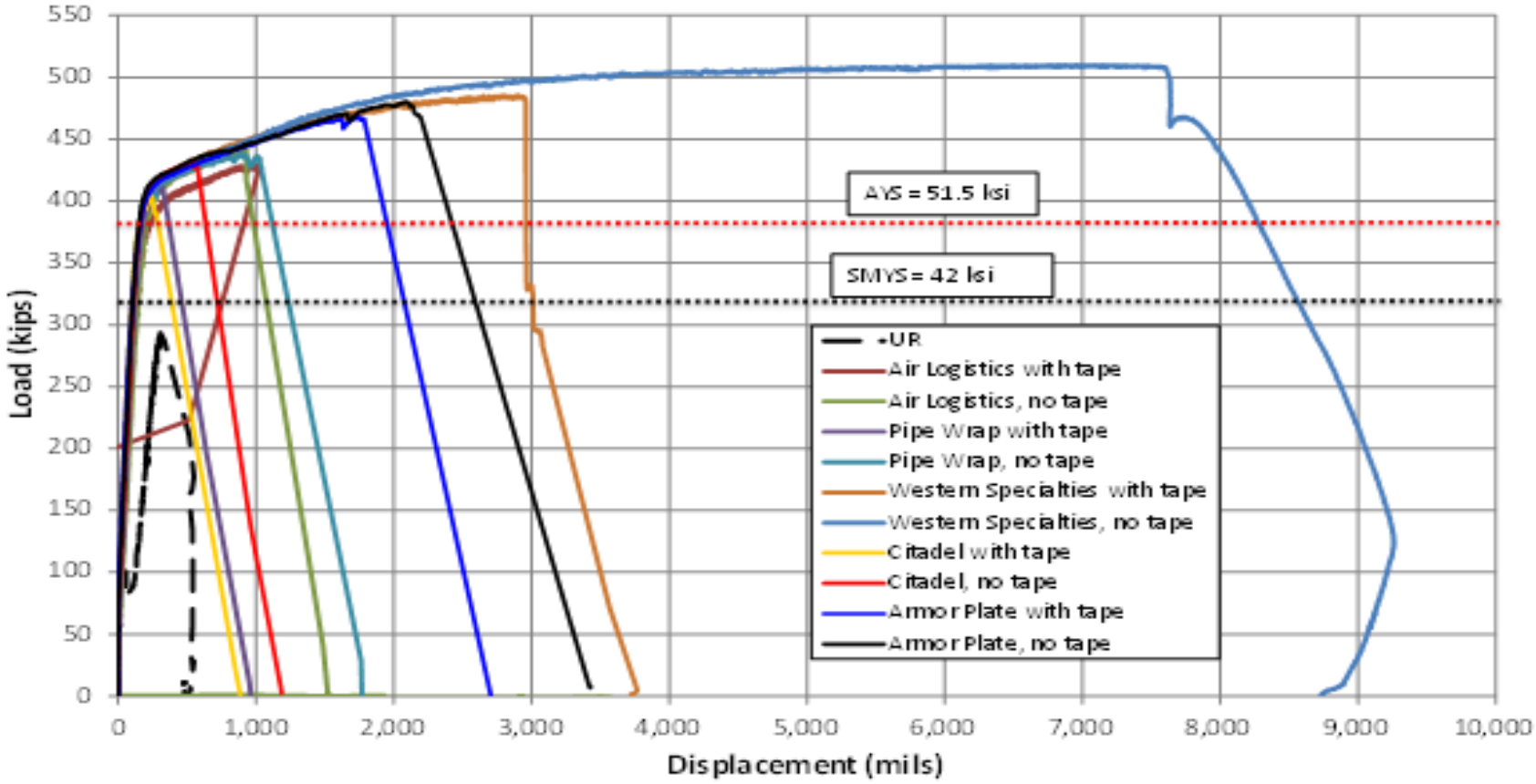
Tension Test Results



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