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DEMAGNETIZING SPECIALISTS

MAGNITIZATION PROBLEMS

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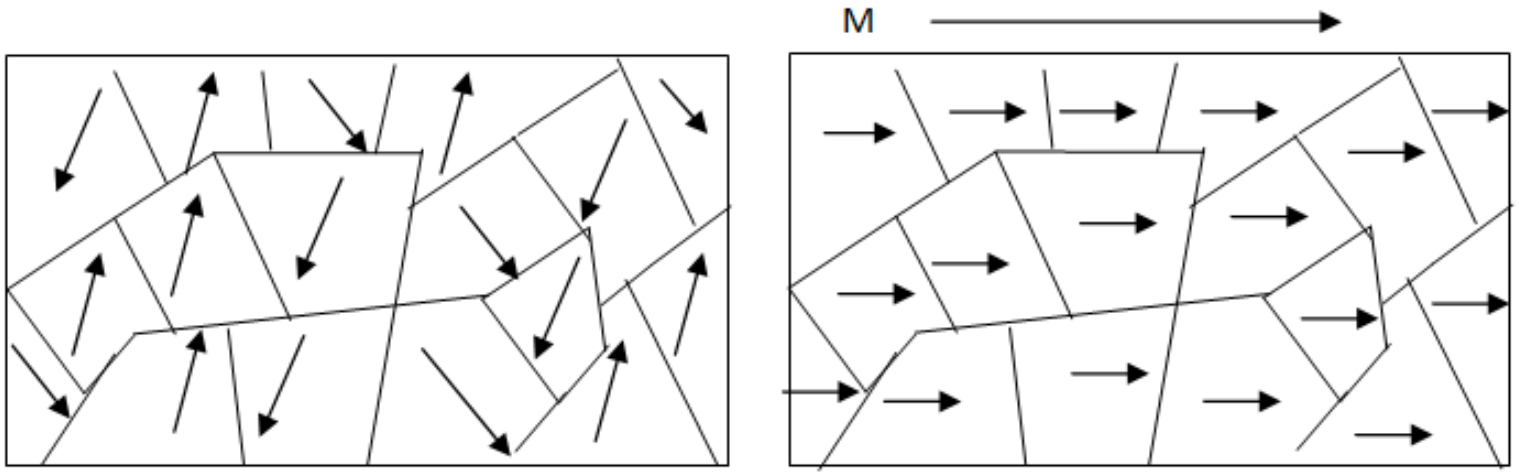
MAGNETISM

Ferromagnetism

- Ferromagnetic materials exhibit a long-range ordering phenomenon at the atomic level which causes the unpaired electron spins to line up parallel with each other in a region called a domain.



A. Random domain orientation

B. After magnetization

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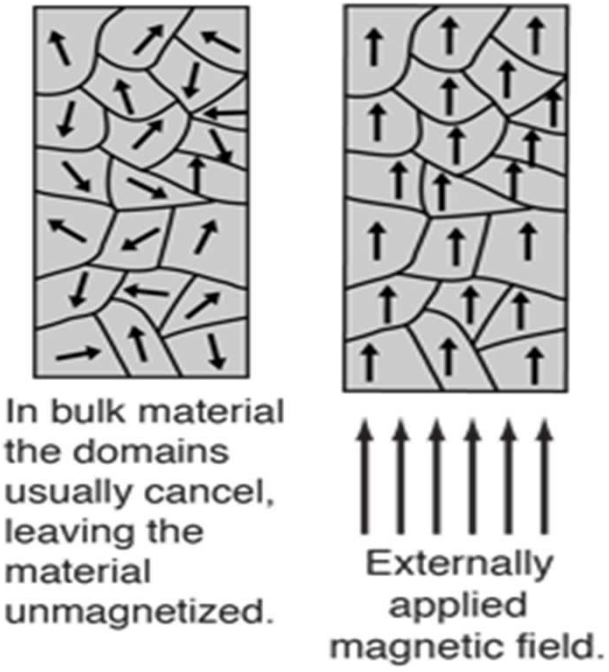
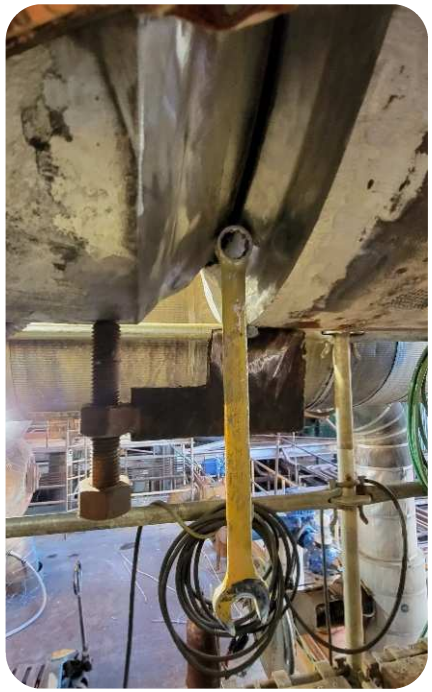
MAGNETISM

Magnetic Domain

- The microscopic ordering of electron spins characteristic of ferromagnetic materials leads to the formation of regions of magnetic alignment called domains.





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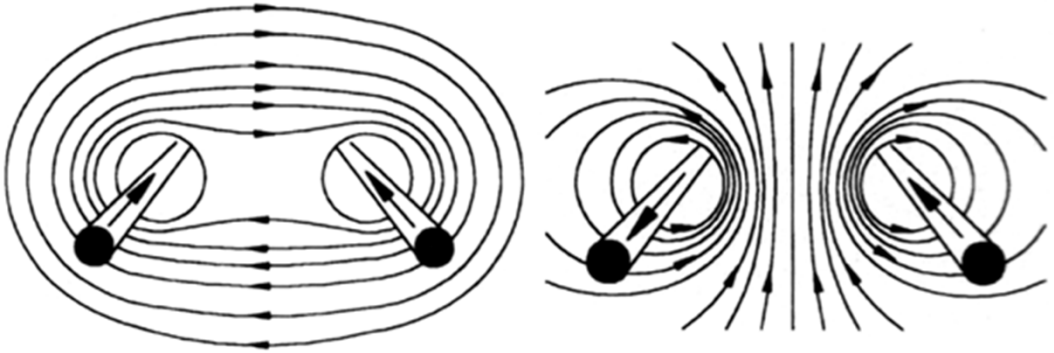
MAGNETISM

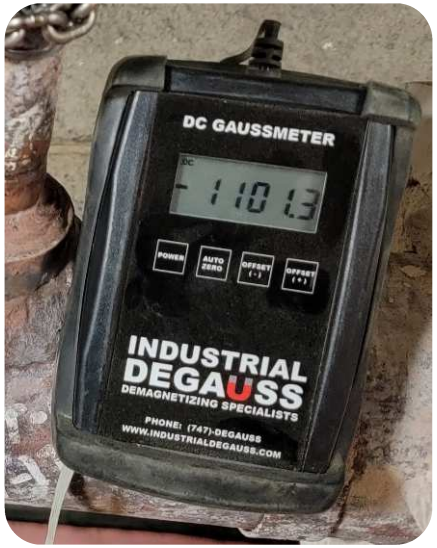
Flux Lines

- A magnetic field can be represented by lines of induction or flux lines. These invisible lines are produced by magnetized material or by electrical currents.



Gauss

- The magnetic flux density.
  - Number of flux lines per square cm
  - Described in magnitude and direction



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MAGNETISM

Gauss

- The magnetic flux density.
  - Number of flux lines per square cm
  - Described in magnitude and direction

Gauss Meter

- Measure magnetic flux density in units of gauss with a positive or negative numeric reading.
- Most meters utilize a probe that works on the "Hall Effect."

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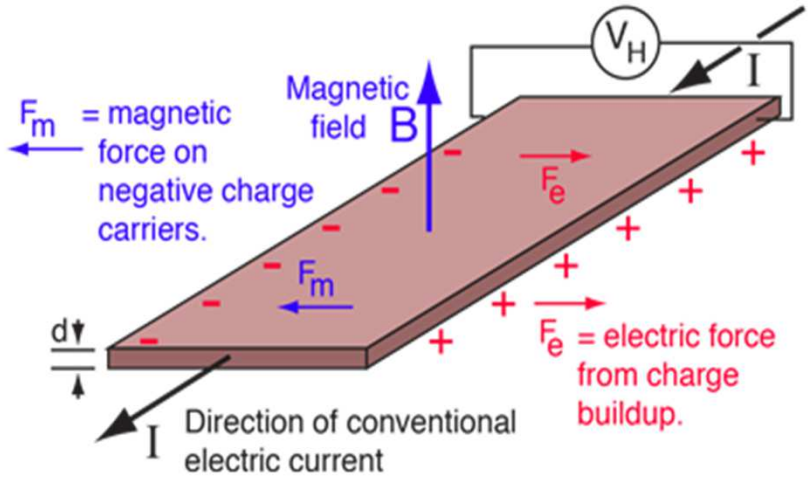
MAGNETISM

Hall Effect

- If an electric current flows through a conductor in a magnetic field, the magnetic field exerts a transverse force on the moving charge carriers which tends to push them to one side of the conductor.

- A buildup of charge at the sides of the conductors will balance this magnetic influence, producing a measurable voltage between the two sides of the conductor.

  – One side of the material will see more electrons than the other, so a potential difference (voltage) will appear across the material at right angles to both the magnetic field from the permanent magnet and the flow of current.



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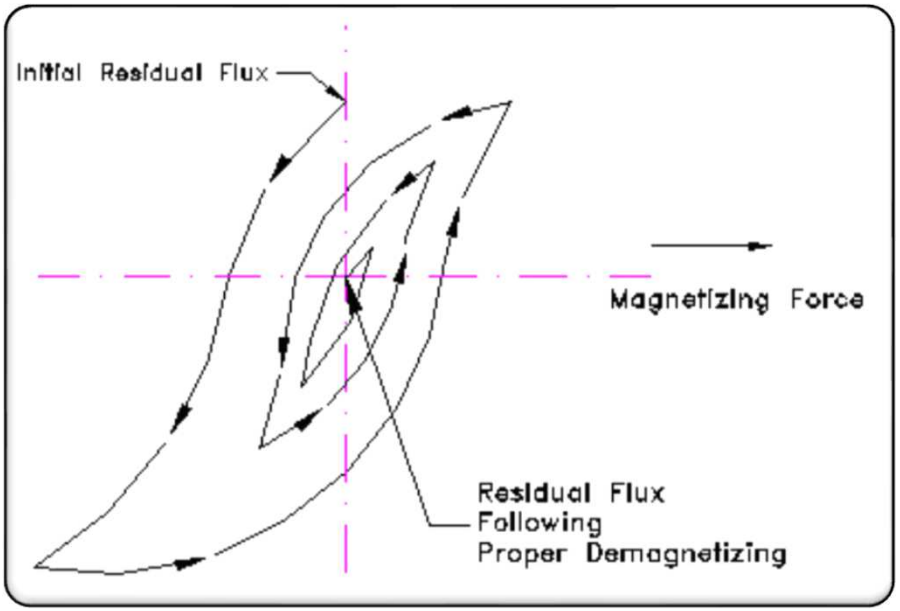
MAGNETISM

Hysteresis Curve

- When a ferromagnetic material is magnetized in one direction, it will not relax back to zero magnetization when the imposed magnetizing field is removed.
  - It must be driven back to zero by a field in the opposite direction with some energy.

- If an alternating magnetic field is applied to the material, its magnetization will trace out a hysteresis loop.
  - The lack of retrace ability of the magnetization curve is the property called hysteresis and it is related to the existence of magnetic domains in the material.



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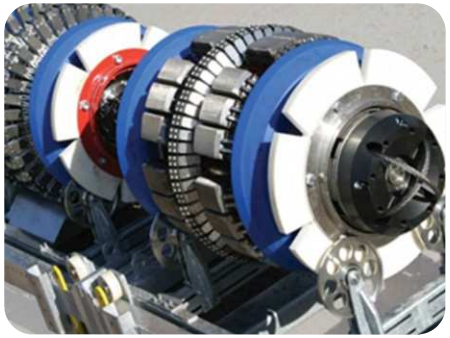
HOW MAGNETISM OCCURS

Pipelines

There are many causes of residual magnetism in pipes:

- Magnetic fields induced during pipe manufacturing and coating processes.
- Handling of pipe using magnetic tongs.
- Transporting of pipes, particularly in and around overhead power lines.
- Movement of pipe with respect to the earth's magnetic field can induce residual magnetism in pipes.
- MFL Tools : Magnetic Flux Leakage



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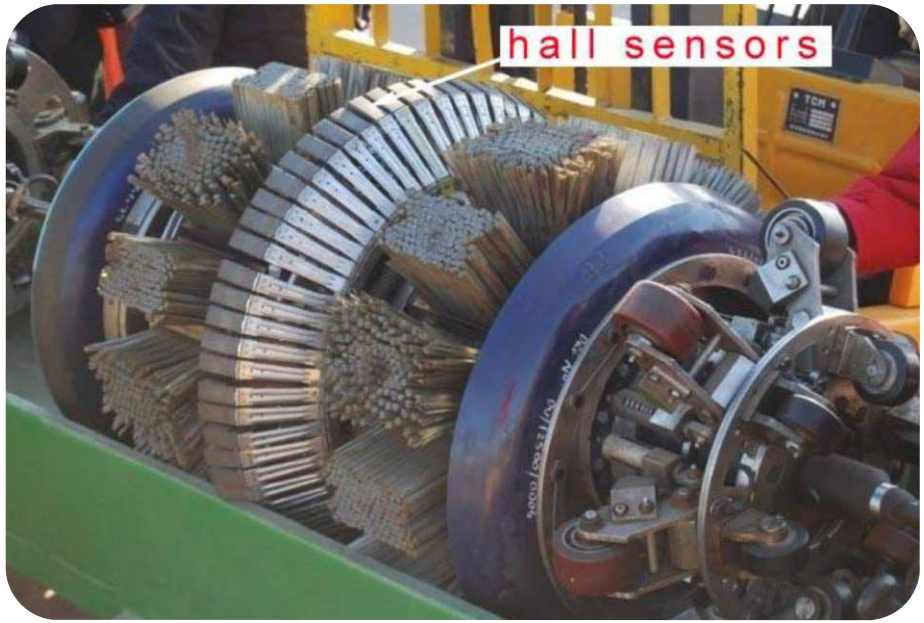
HOW MAGNETISM OCCURS

Pipelines – MFL Tools

The basic principle behind MFL involves magnetizing a ferrous metal object to saturation level with a powerful magnetic field.

- High magnetization levels are required to differentiate corrosion from other pipeline features such as hard spots, stress and strain variations and to minimize the effects of remnant magnetization.



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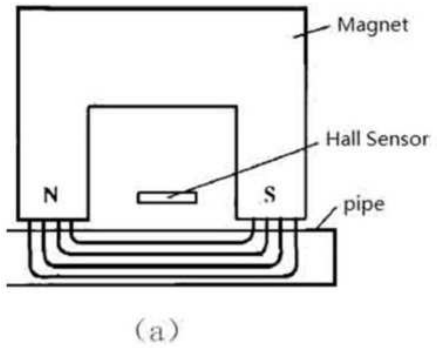
HOW MAGNETISM OCCURS

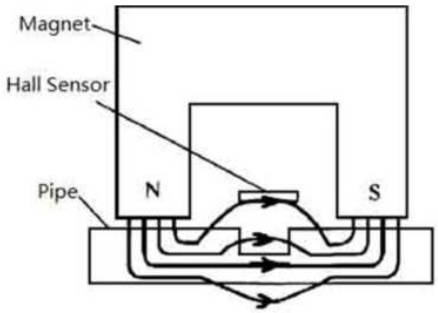
Pipelines

- If there is NO DEFECT in the material, most magnetic flux lines will pass through the inside of the ferromagnetic material.



(a)

- If there is a DEFECT in the pipe wall, magnetic flux lines will be bent, some will leak out of the material surface, and a magnetic leakage field will form at the defect area.
  - The magnetic permeability of the defect site is much smaller than that of the ferromagnetic material itself, magnetic resistance will increase in the defect area, so the magnetic field in the region is distorted.



(b)

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HOW MAGNETISM OCCURS

Rotating Machinery

- Many times in the course of manufacturing, a part comes in contact with more or less strong magnetic fields of random polarity.
    - These magnetic effects tend to imprint fine poles on the part surface

- Magnetic handling equipment, tools, collets, cutting tools, clamping devices, or induced magnetic fields continue to magnetize or to change locally the polarity of the part.

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HOW MAGNETISM OCCURS

Rotating Machinery

- Magnetism increases significantly in the assembled machine where the magnetic material provides a good closed path for the magnetism and the air gaps between parts are reduced considerably.
  - This combination can set up conditions for generation of notable stray voltages and the circulation of damaging currents.
    - The deterioration of bearings, seals, gears, couplings and journals has been attributed to electrical currents in machinery.



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WELDING PROBLEMS

ARC BLOW

Magnetic Arc Blow – Significant levels of magnetism are present in the material being welded. The interaction between the magnetic field and the welding arc causes the arc to be deflected sideways with subsequent disturbance of the weld pool.

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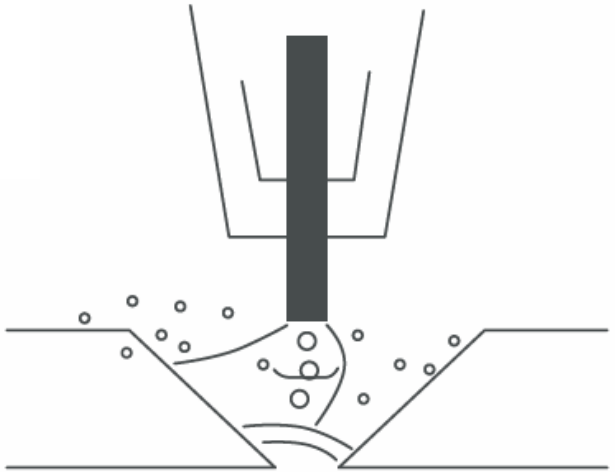
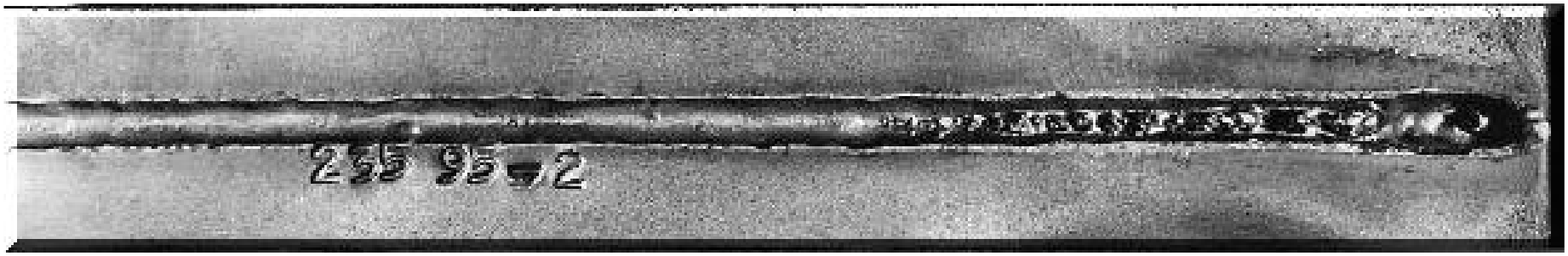
WELDING PROBLEMS

ARC BLOW

When the arc stream does not follow the shortest path between the electrode and the workpiece and deflects from the direction of travel or pulls to one side.

- Possible introduction of defects in the weld
- Increase in time required to complete weld
- Excessive weld splatter
- Incomplete fusion
- Porosity





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WELDING PROBLEMS

ARC BLOW

- In practice, it is the root weld that gives the most trouble, because as the weld progresses, a degree of magnetic shunting takes place and a field that would have appeared in the weld preparation is routed through the weld metal of the root pass.
  - Any problems encountered will increase the amount of grinding and welding time for the crew and in turn increase the time spent on the job.

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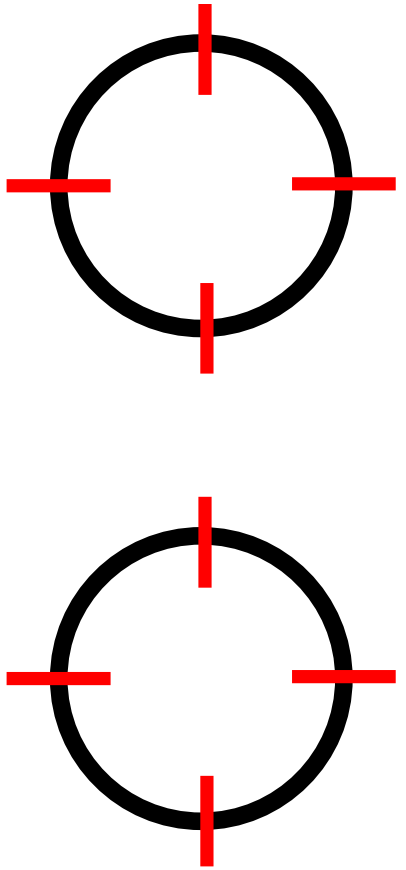
STANDARDS

API 5L: Specifications for Line Pipe

The requirements apply only to testing within the pipe manufacturing facility. Measurements of residual magnetism on pipe, subsequent to leaving the pipe manufacturing facility, may be affected by procedures and conditions imposed on the pipe during and after shipment.

- Measurements made using a Hall-effect gauss meter
- Measurements made on each end of a pipe
  - The average of the four readings shall not exceed 30 gauss
  - No one reading shall exceed 35 gauss
  - Any pipe that does not meet the requirements, shall be considered defective.
- Measurements made on pipe in stacks or bundles are not considered valid.



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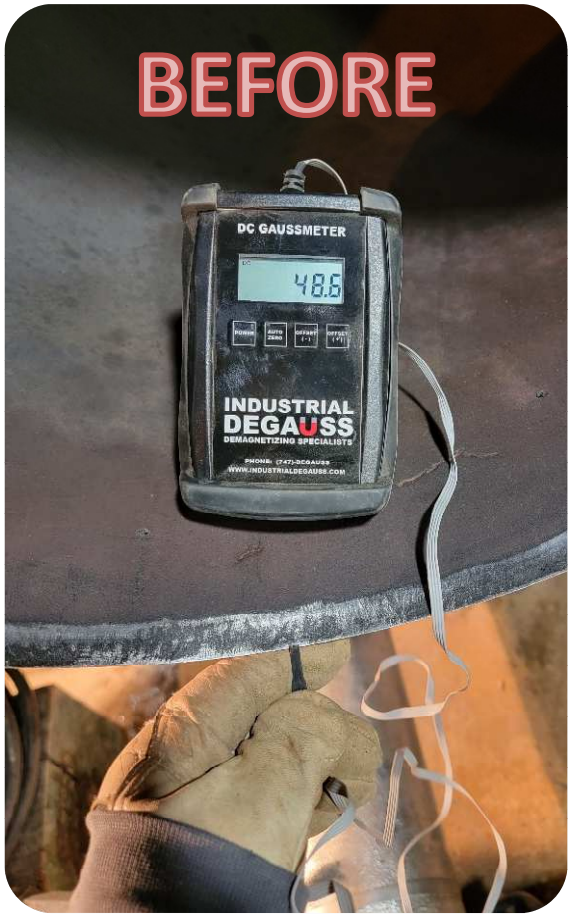
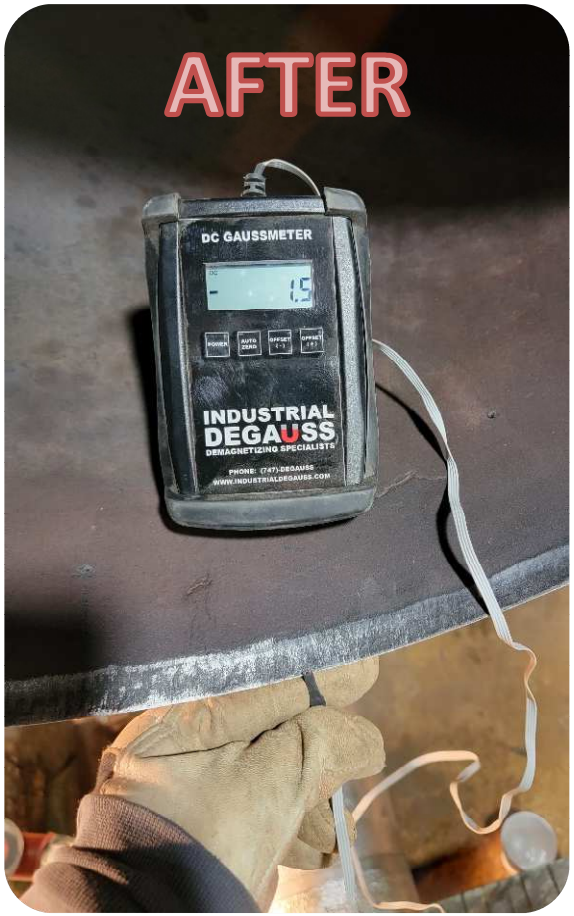
CURRENT STANDARDS

Industry Standards

- 20+ gauss (2mT) – Disruption in welding Arc
- 40+ gauss (4mT) – Arc Blow will be a problem
- Below 10 gauss – Aim for Degaussing





* There is not a current standard for magnetism levels and welding on existing pipe.

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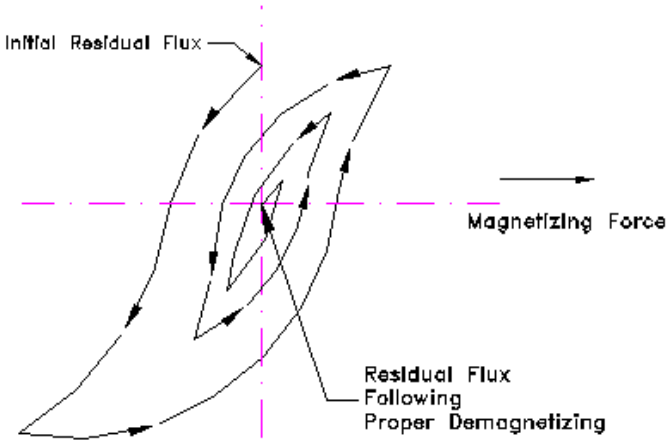
DEGAUSSING

The procedure for demagnetizing, or degaussing, a piece of steel to remove its residual magnetism consists of repeatedly applying a reversing, and gradually reduced, imposed magnetic force (MMF).

- The process produces cyclically diminishing residual field levels and, if done properly, terminates at the origin, which is the point of zero magnetism.



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Measurements

Fields that pass perpendicular to the face of the Hall Effect semiconductor are measured.

- Digital meters will give you a numeric value and a positive or negative symbol.
- Analog meters with a zero center scale will read to the left or right of zero.

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Measurements – Rotating Machinery

- The process of measuring magnetic fields requires careful judgment as to where the most meaningful readings can be obtained.
  - On fully assembled machines, the pickup site selections are somewhat restricted.
    - Readings on shaft ends, coupling hubs, gear teeth, foot mountings and pipe flanges are important.
  - On disassembled machines, magnetism should be measured on new and reworked parts as they are assembled, and of the assemblies themselves, especially in critical areas such as bearings, seals, gears, etc.

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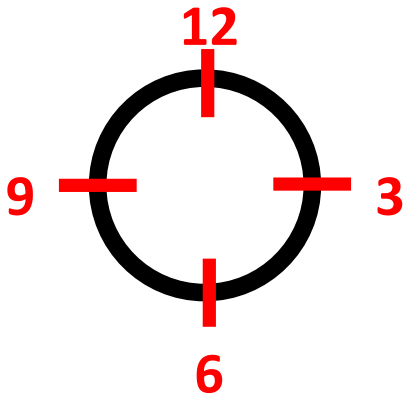
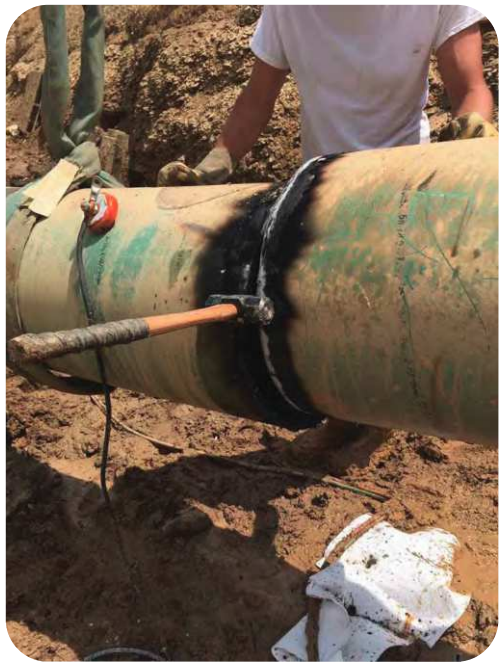
Measurements – Pipelines

- Using a Hall Effect Meter : Take and record readings at
  - 12,3,6 and 9 o'clock
  - Looking for readings under 30 gauss
- Take readings on clean beveled pipe end





- Typical readings after a smart pig can be 100+ gauss.
  - Recent job: 34" Gas Transmission Line : 600+ Gauss

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Reducing Magnetism – Pipelines

Prior to Welding

- Individual pipes can be demagnetized to an acceptable level, but when they are butted together to start the welding process, the magnetic field can increase by a factor of 10

During Welding

- Only way to account for variations in the level and polarity of the magnetic field which occur during welding

The hardware used for degaussing consists of a power supply and electrical coils that are used to generate magnetic fields.

- Strong fields can be obtained with a few turns carrying high currents, or many turns carrying low current.

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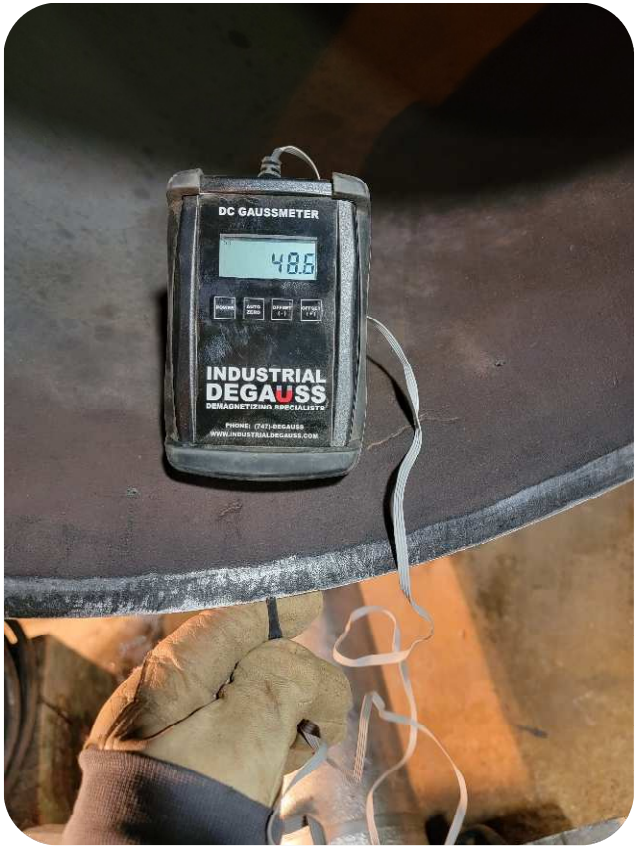
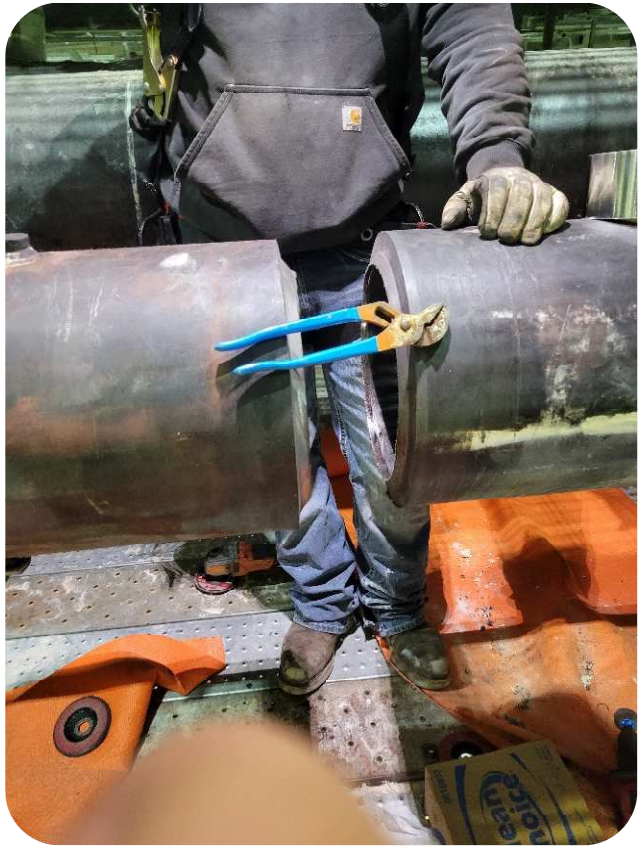


IN RACK



BRIDGING

FITTED

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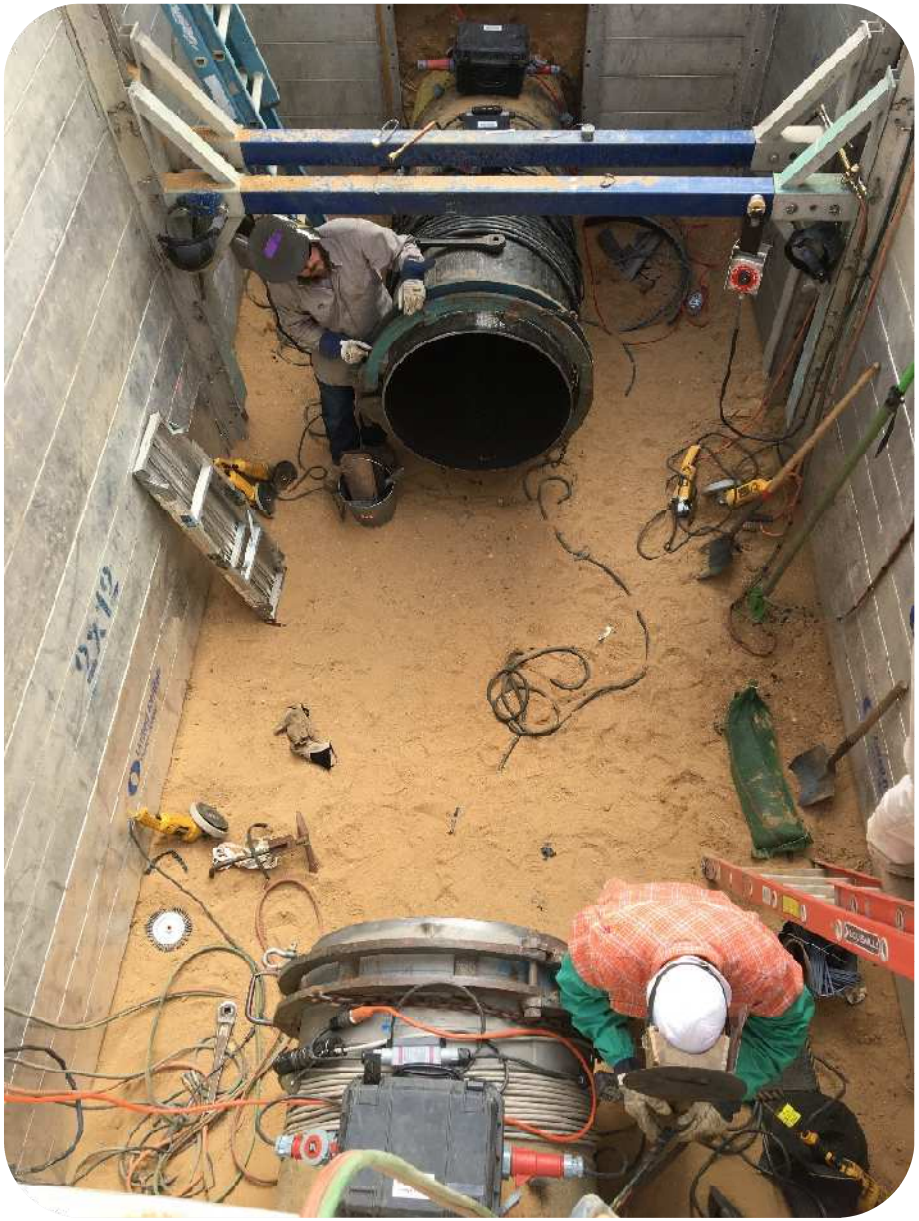

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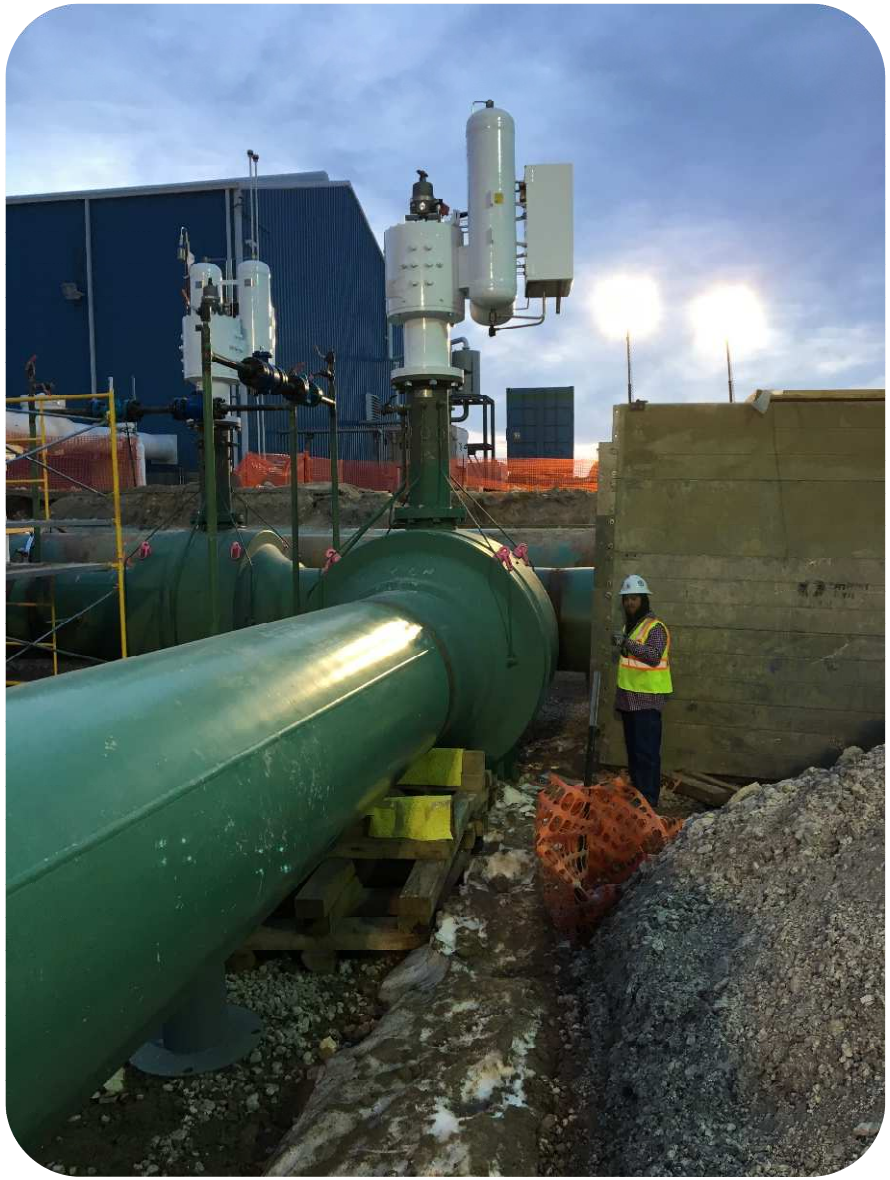

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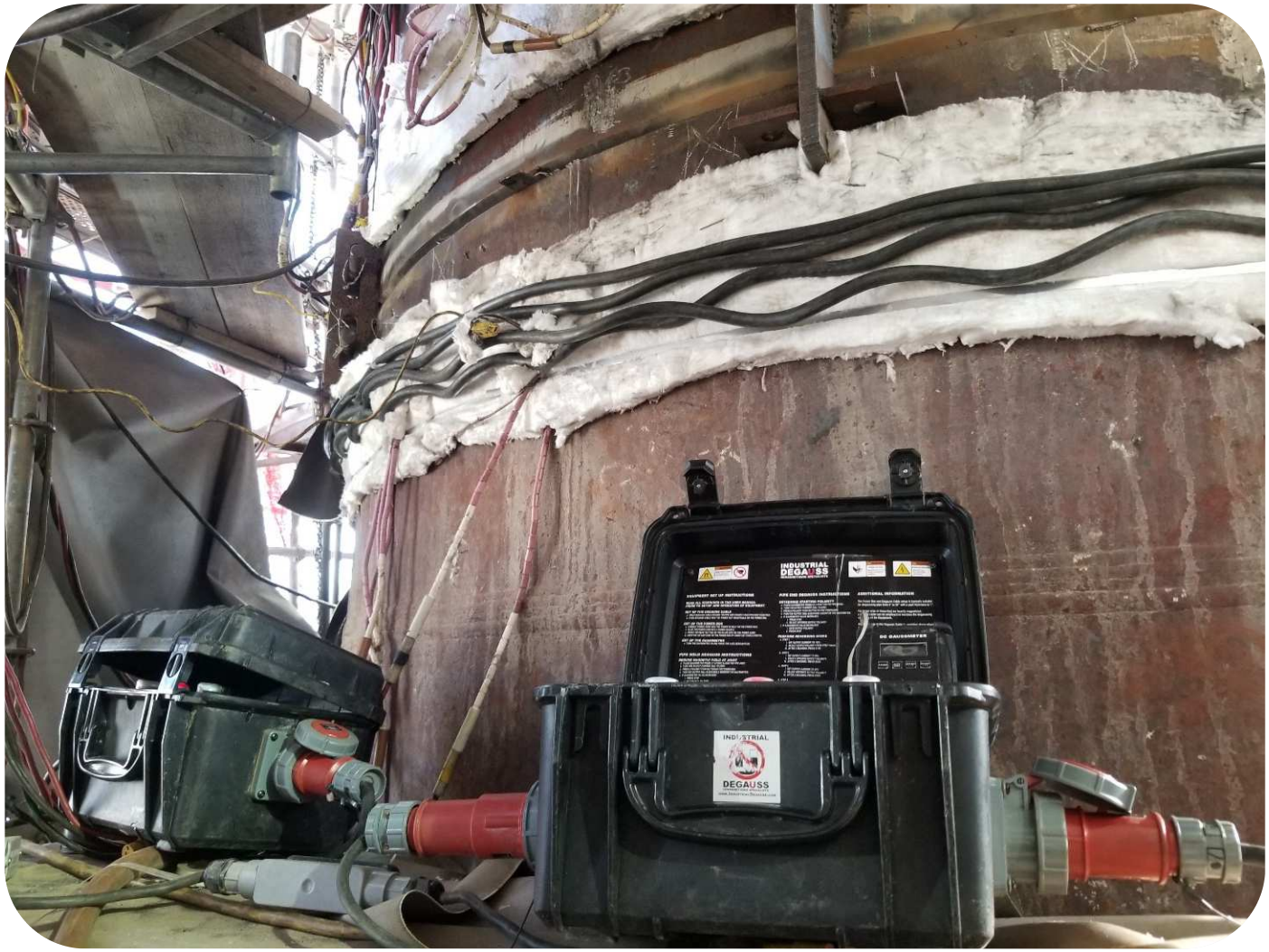

CITGO REACTOR VESSEL – 1500 GAUSS

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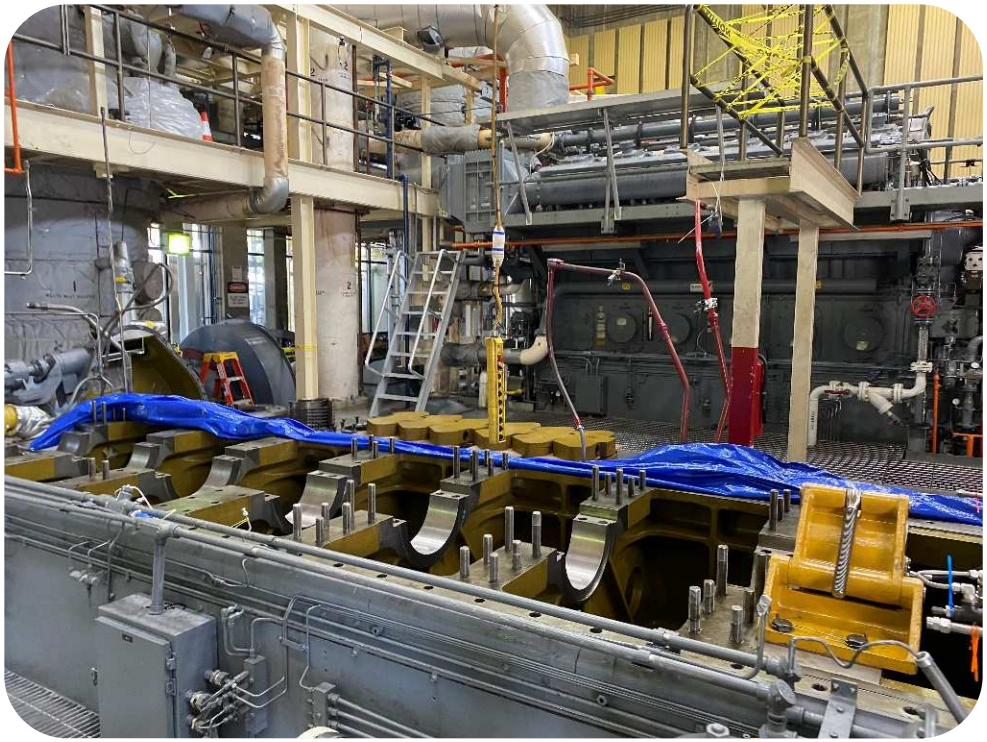

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