Lightning & Over-Voltage Protection for Pipelines

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AGENDA

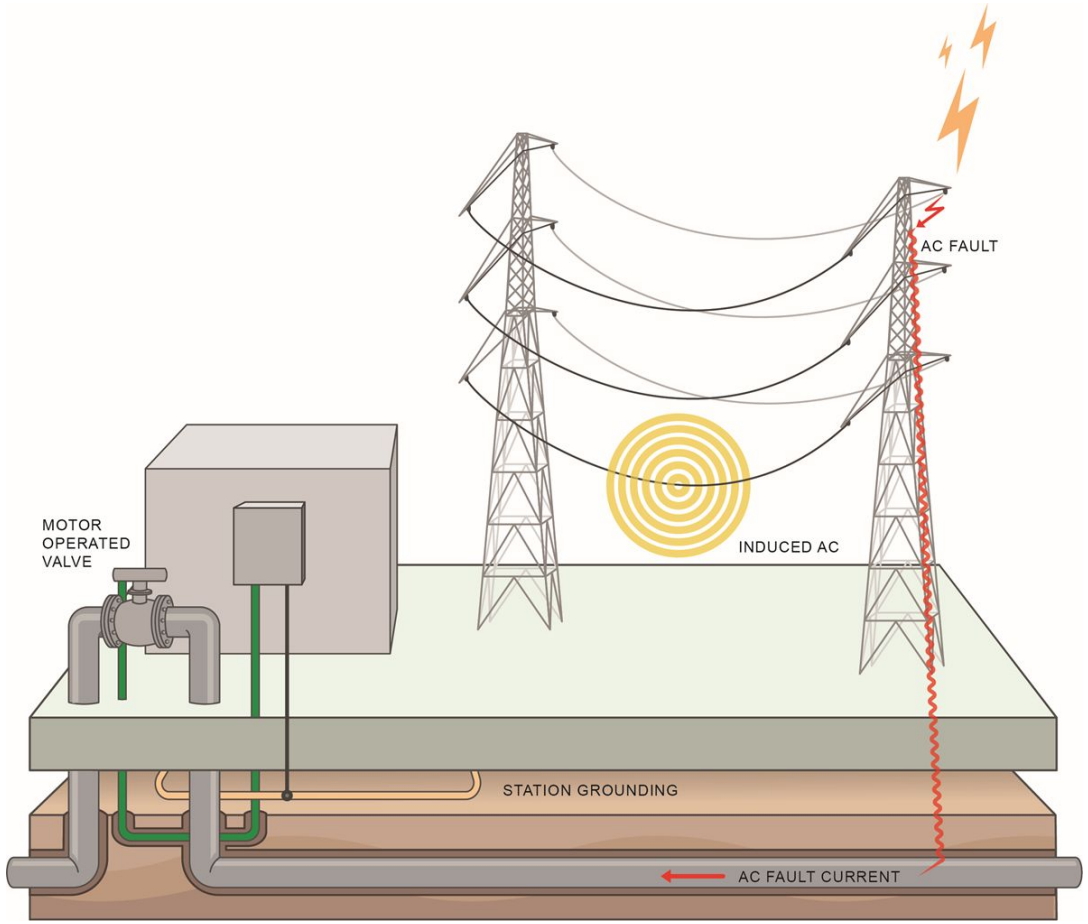
Over-Voltage Protection Topics

- Why is over-voltage protection needed?
- Isolation joint types
- Common protective devices
- Other over-voltage protection applications
- Device testing

PROTECTION NEEDED

Over-Voltage Hazards

- Lightning
- AC Faults
- Induced AC



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ISOLATION JOINTS

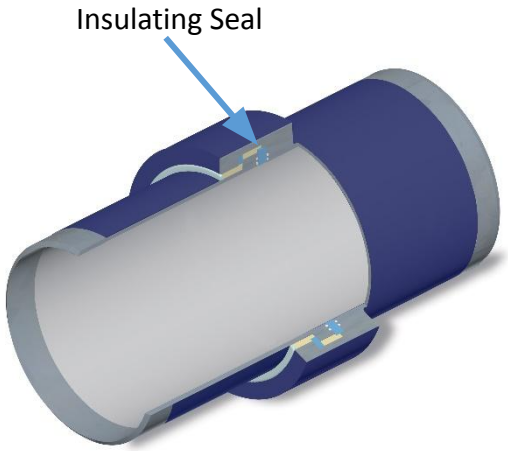
Function

- Prevent metallic contact
- Electrically isolate cathodic protection systems or from ground or other CP
- Isolate dissimilar metals
- Stray current control

ISOLATION JOINTS

Monolithic Joints

Withstand Voltage up to 15,000 V



Images courtesy of GPT Industries

ISOLATION JOINTS

Flanged Joints

Withstand Voltage 1,000 to 10,000 V

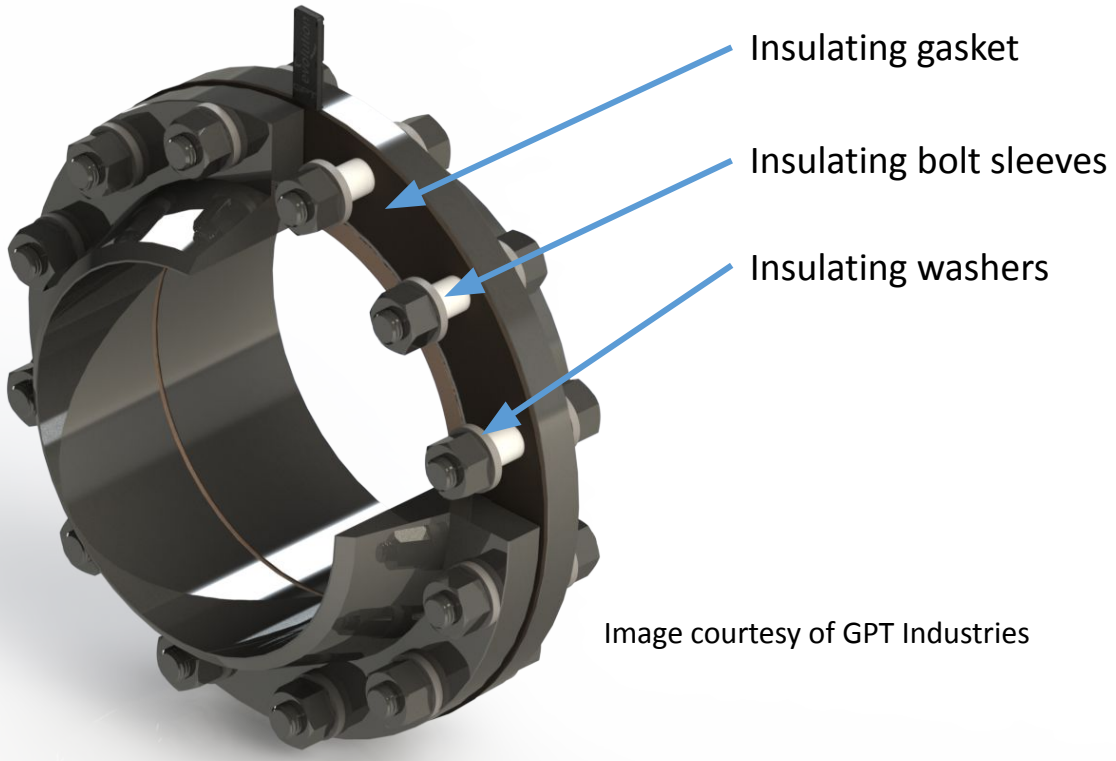
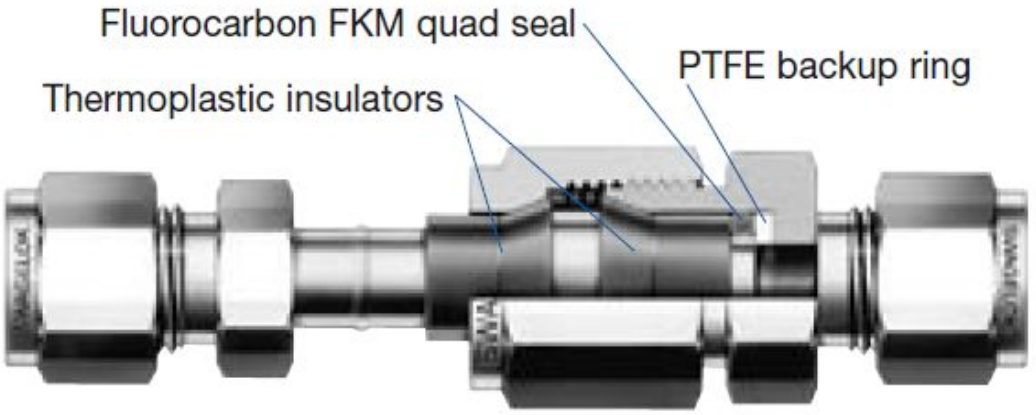


Image courtesy of GPT Industries

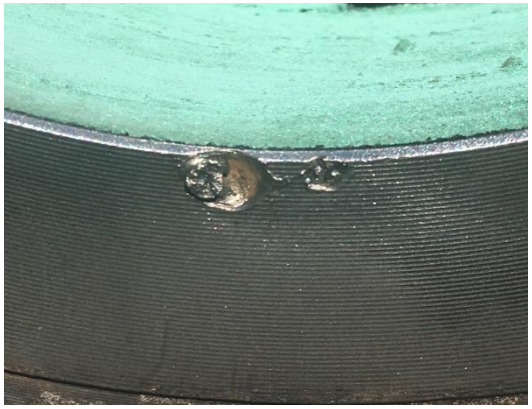
ISOLATION JOINTS

Insulated Fittings

Withstand Voltage 500 to 2,000 V



WHY PROTECT ISOLATION JOINTS?



Protect the Joint

- Provide low impedance path for current from lightning, AC faults, and induced AC
- Eliminate damage from arcing
- Eliminate risk of igniting product

Protect Personnel

- Minimize touch potential across the joint

WHY PROTECT ISOLATION JOINTS?

Regulations

- U.S. Pipeline Safety Regulations. 49 CFR 192.467 (e) and (f)
- NACE SP0177
- ISO 15589-1, section 7.3.3
- BS EN 50443:2011

49 CFR 192.467 (f)

(f) Where a pipeline is located in close proximity to electric transmission tower footings … it must be provided with protection against damage due to fault current or lightning, and protective measures must be taken at insulating devices.

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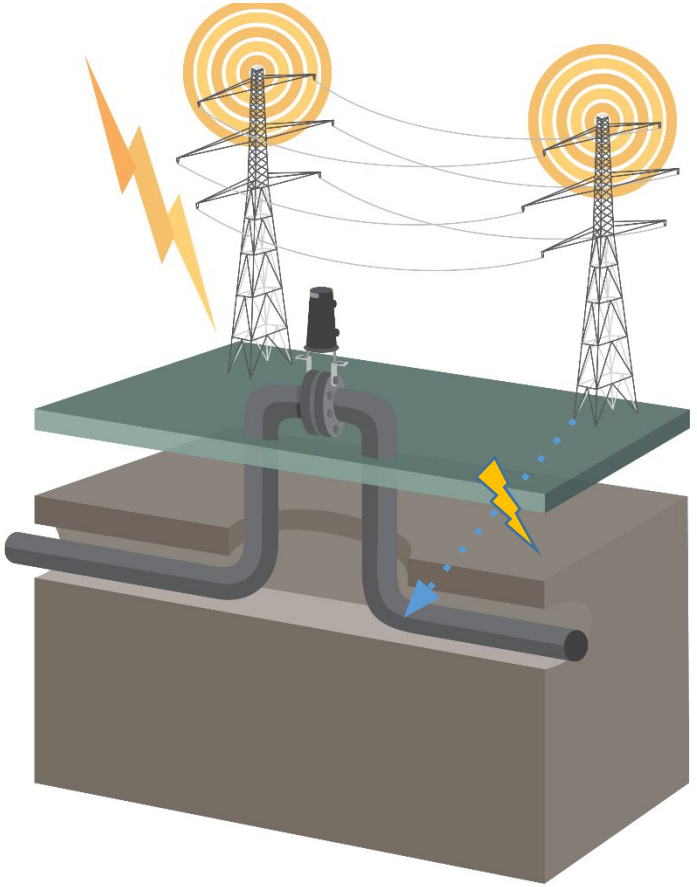
PROTECTION DEVICES

When Properly Protected

Lightning and fault current pass safely through device instead of arcing across joint



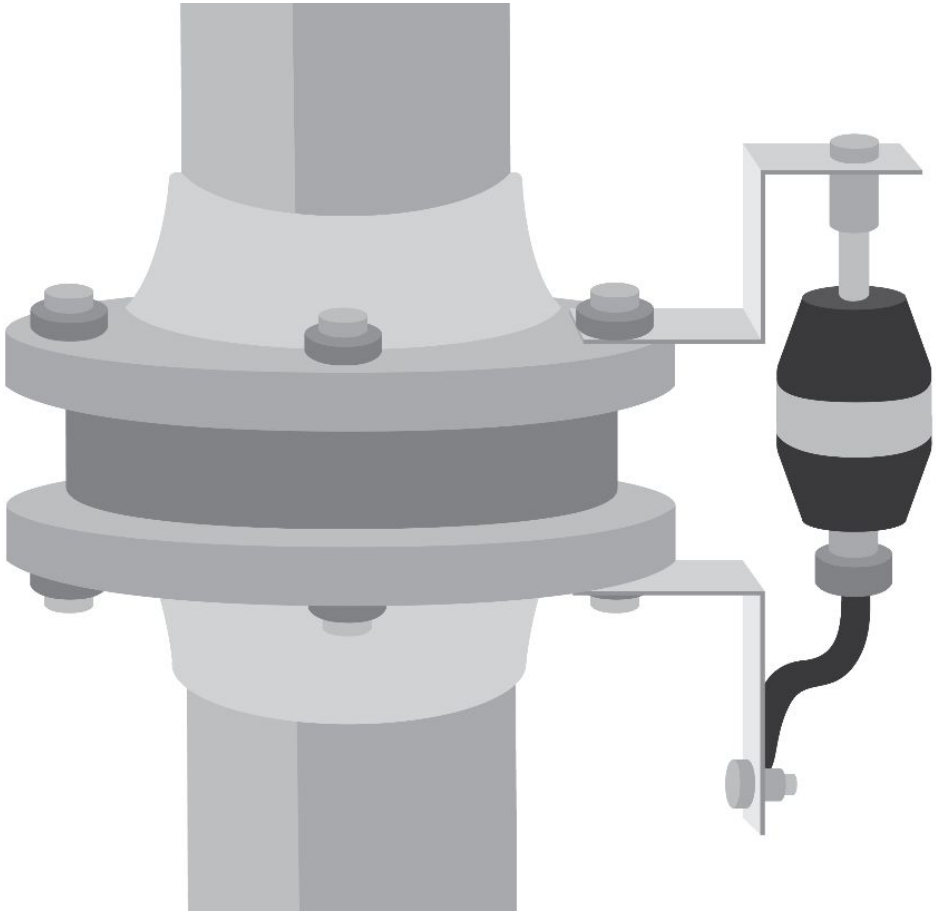
Common Types of Devices:

- Solid State Decouplers and Over Voltage Protectors
- Spark Gap Devices

PROTECTION DEVICES

Spark Gap Arrestors

- Current passes by arcing across internal electrodes
- High voltages required for conduction
- Provides lightning protection only
- Not rated for high energy AC faults
- Cannot be used for AC mitigation

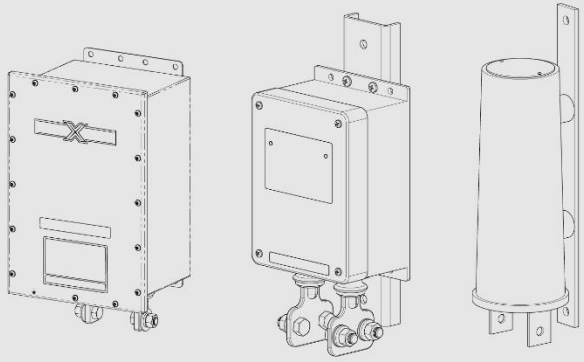
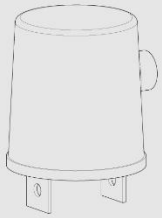
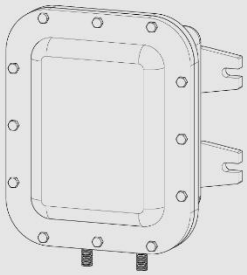
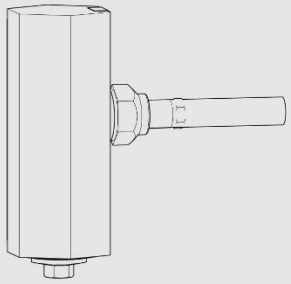


PROTECTION DEVICES

Solid-State Decouplers and Over Voltage Protectors

- Block low voltage DC
- Pass AC faults and lightning
- Maintain low voltages on pipeline
- Decouplers pass steady-state induced AC

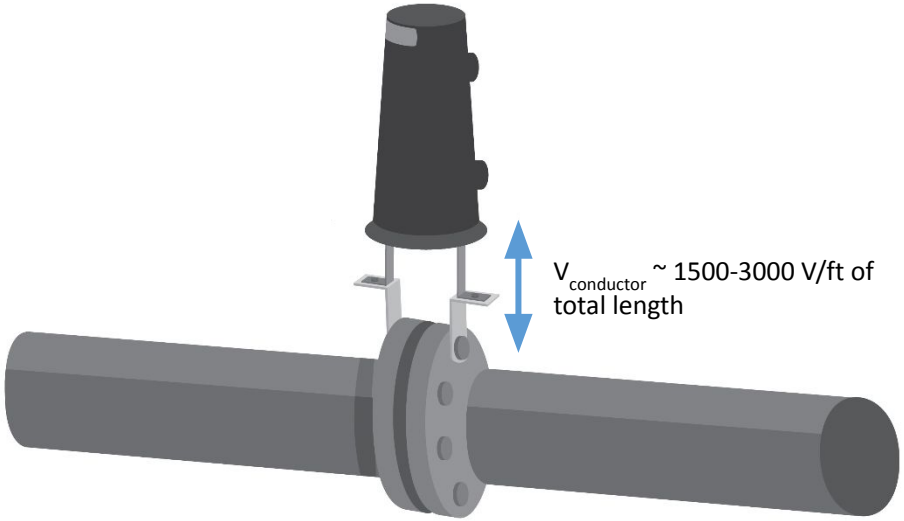
DEVICE SELECTION

	AC PRESENT – DECOUPLERS –	AC NOT PRESENT – OVER-VOLTAGE PROTECTORS –
c UL us DIV 2 Ex ZONE 2 IECEx ZONE 2		
c UL us DIV 1 Ex ZONE 1 IECEx ZONE 1		

INSTALLATION - BEST PRACTICES

Lightning and Conductor Length

For lightning protection, keep conductors as short as possible, ideally less than 12” (30 cm) long in total.



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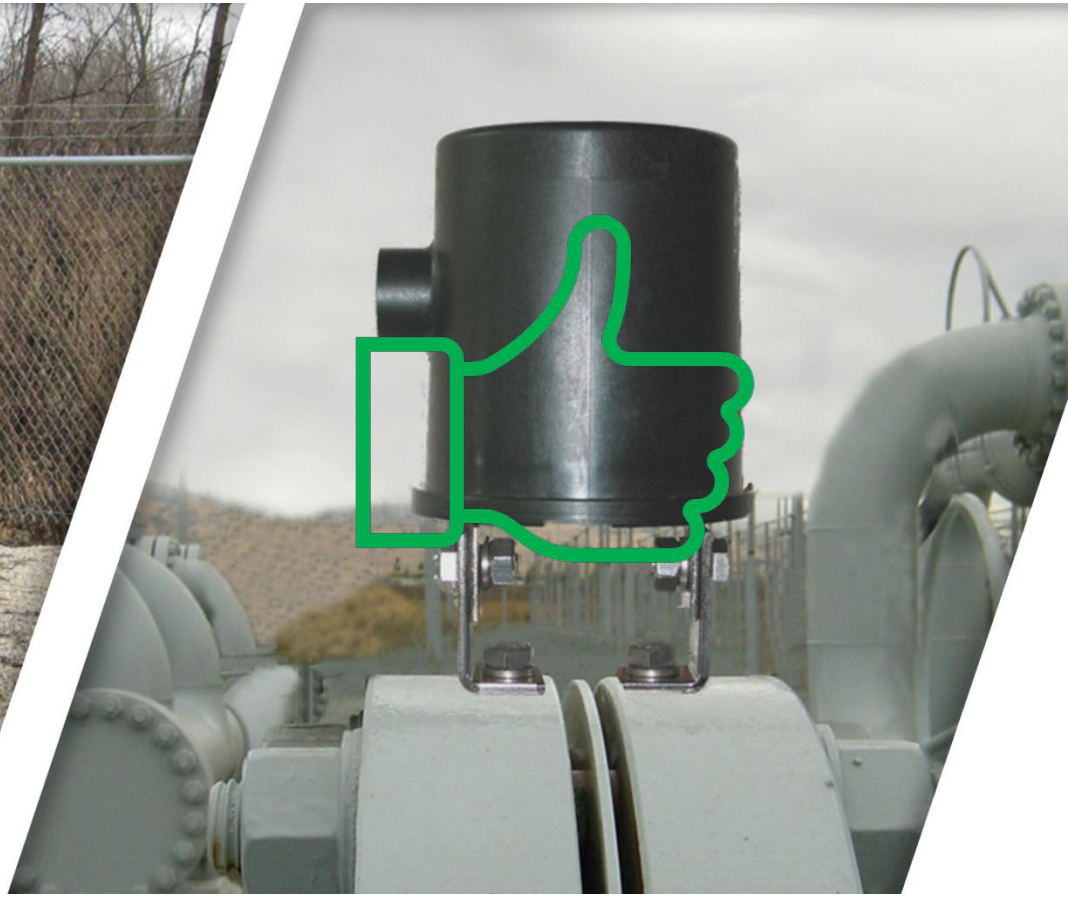
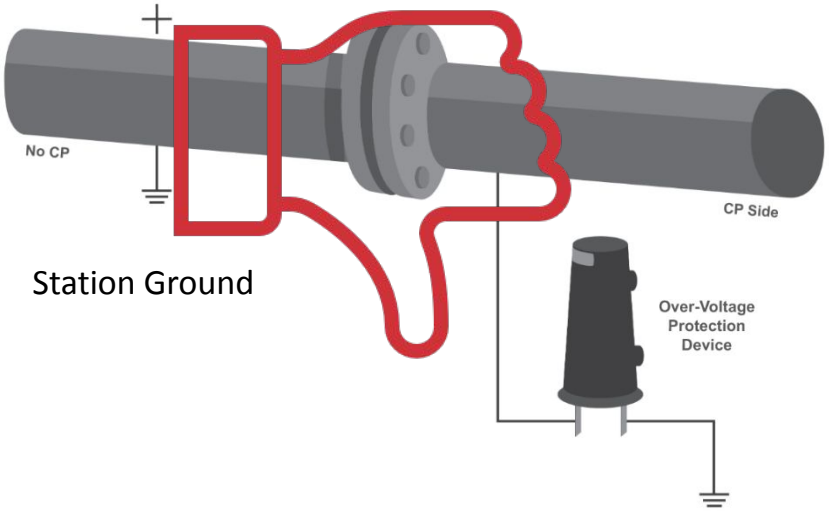
INSTALLATION - BEST PRACTICES

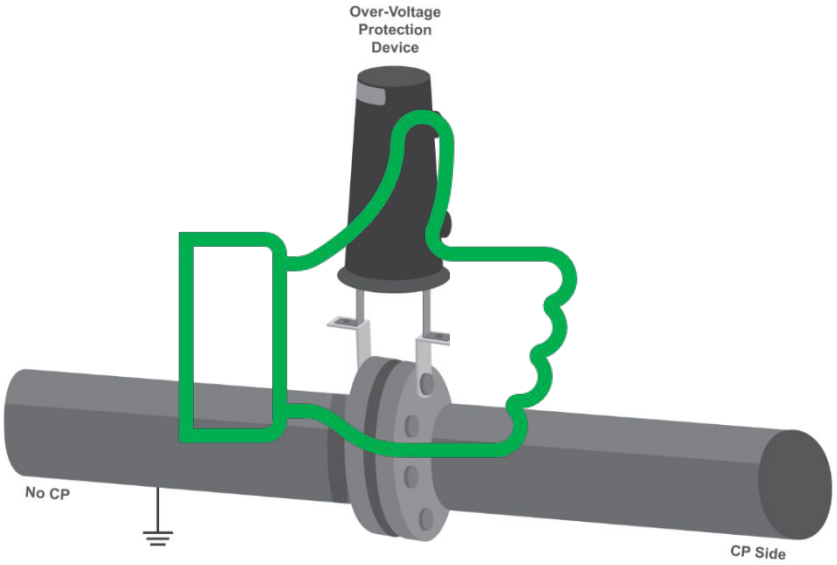


INSTALLATION - BEST PRACTICES

Connect the device across the isolation joint

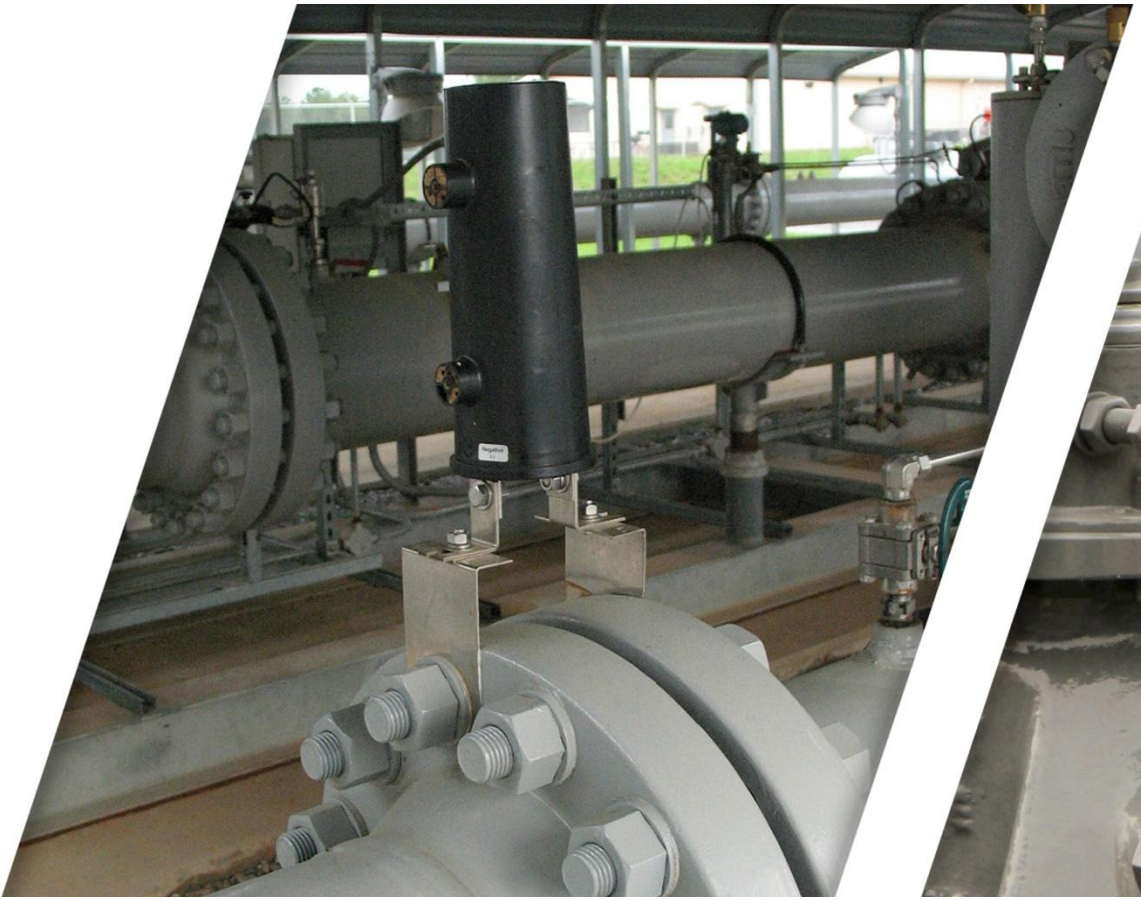


Station Ground



Station Ground

DEVICE MOUNTING EXAMPLES



Decoupler on flange bracket

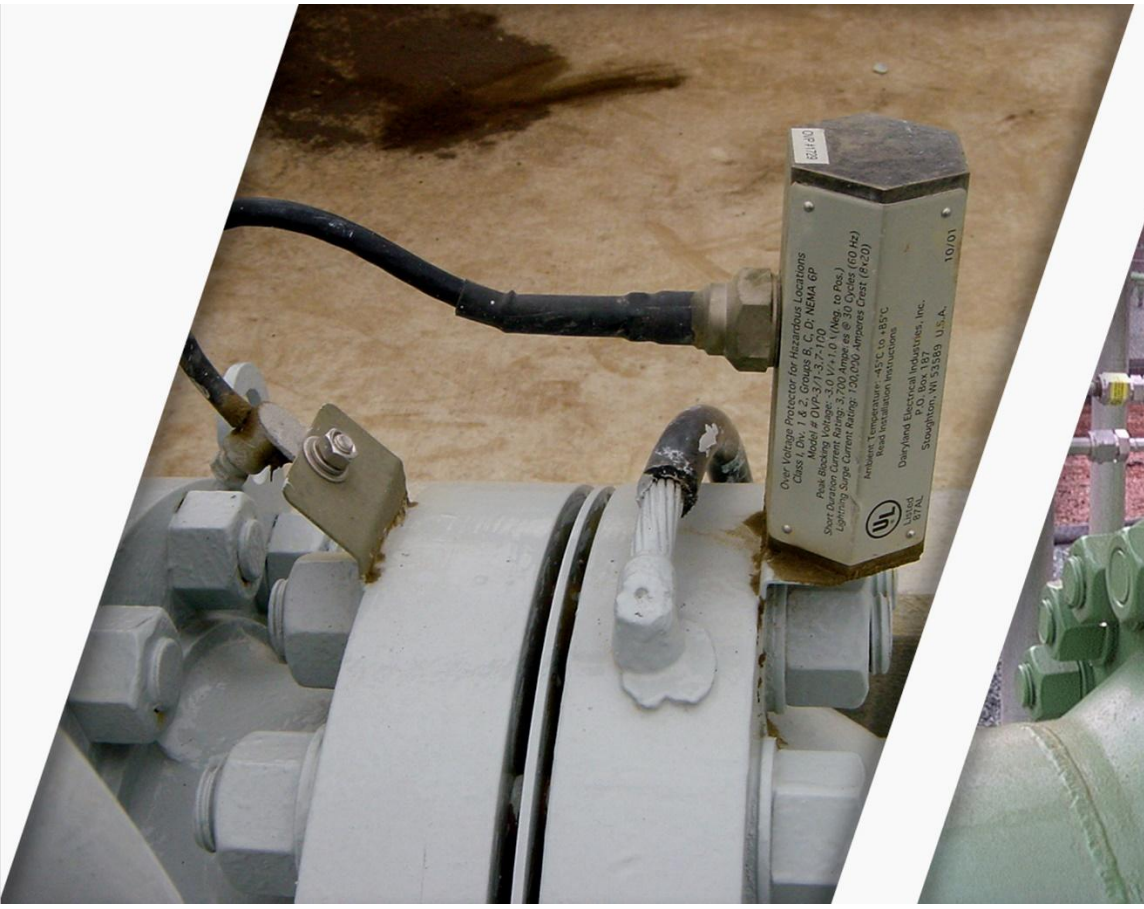
Decoupler on pin-brazed stud bracket

DEVICE MOUNTING EXAMPLES

Decoupler on flange bracket

Decoupler on post with flange tabs

DEVICE MOUNTING EXAMPLES



Over-voltage protector on flange bracket

Over-voltage protector on welded/brazed studs

DEVICE MOUNTING EXAMPLES

Decoupler on welded tabs

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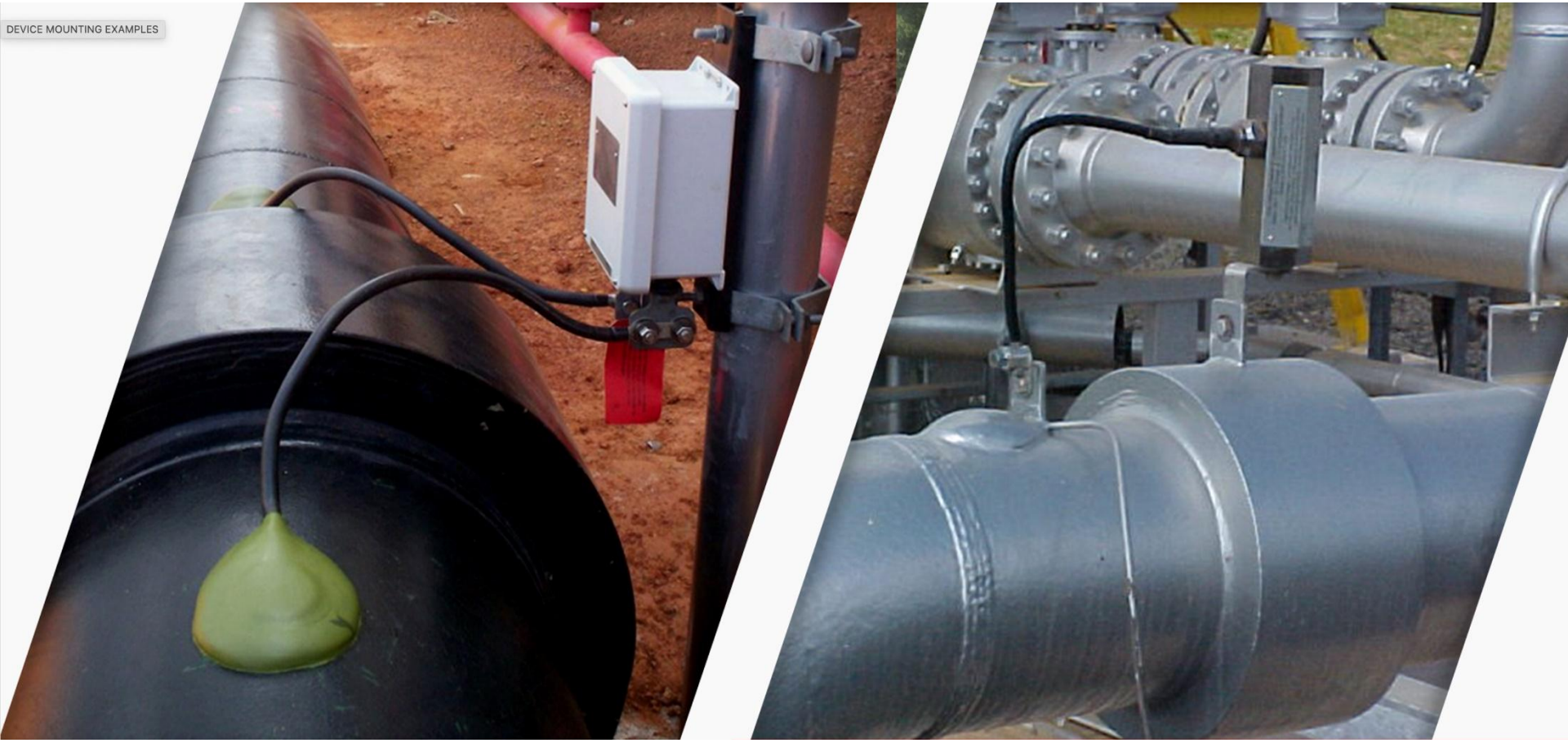
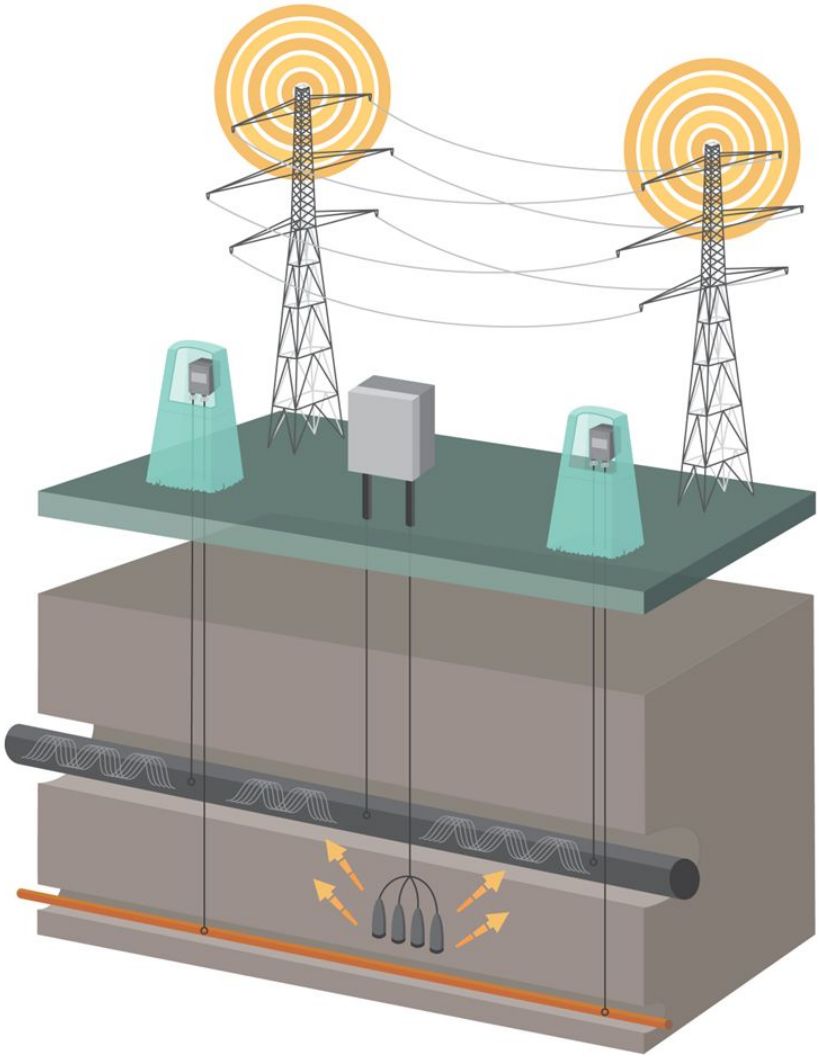
DEVICE MOUNTING EXAMPLES



AC MITIGATION

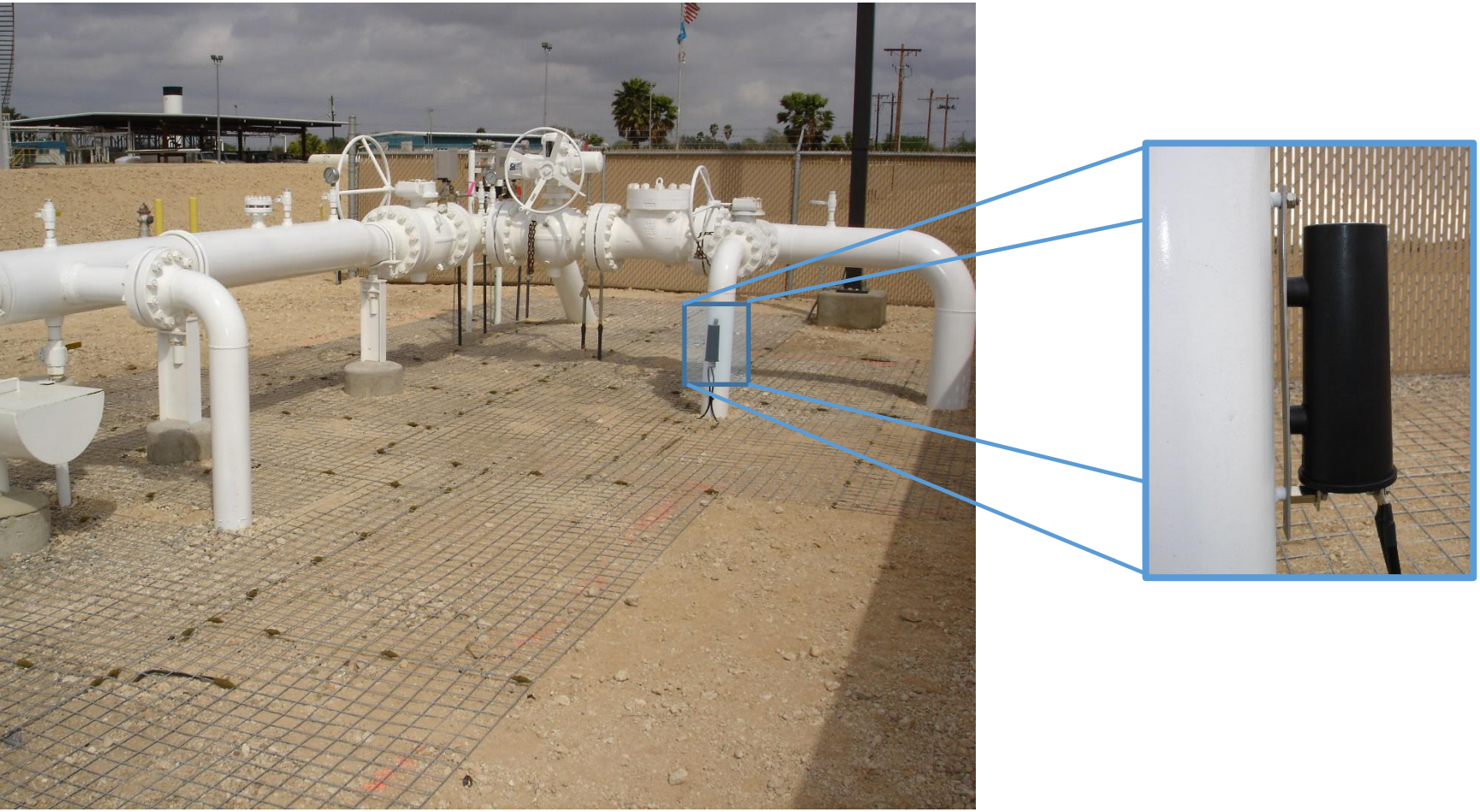
AC MITIGATION



ELECTRICAL DECOUPLING

Electric equipment isolation examples

GROUNDING MATS



Gradient control mat isolation example

FIELD TESTING

Isolation Joint Testing with an RF-IT:

- A decoupler will appear as a short to RF-IT testers
- Test the joint and decoupler separately
- Disconnect the decoupler from the joint, then test the decoupler with the ohm test
- Test the isolation joint using an RF-IT with the decoupler disconnected

Image courtesy of Tinker & Rasor

DIRECT DECOUPLER TEST

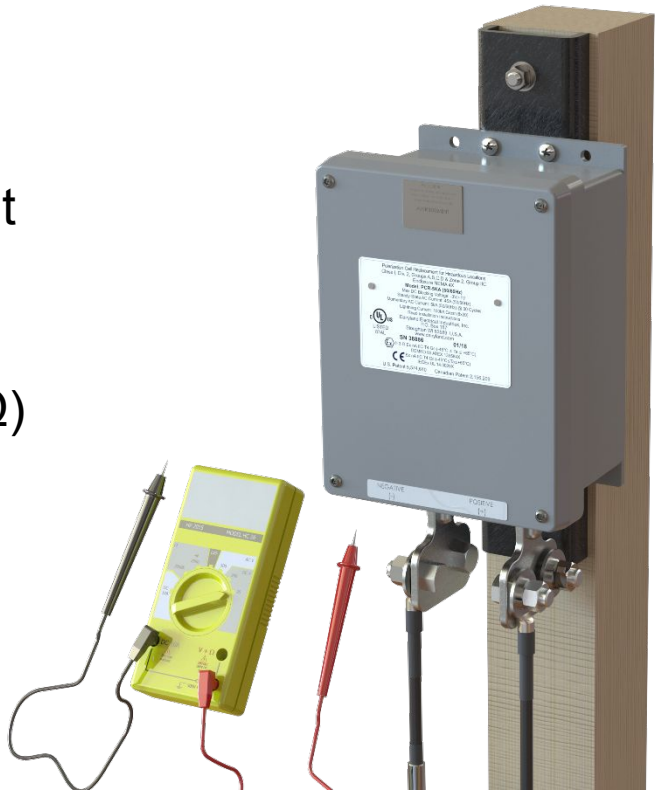
Resistance check

- Measured between terminals, device out of circuit
- Functional: Value increases from zero
- Non-functional: Fixed, low value (<< 1 Ω)

OVP-type products:

- Functional: Instant reading M Ω

Keep safety in mind when creating an open-circuit at a decoupler site!



Questions?
Contact Dairyland Electrical Industries

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