Keys to Successful Wire Feeding in Automated Applications

Welcome!

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Keys to Successful Wire Feeding in Automated Applications

Panelists

Jason Woolley,
Key Accounts
Laser Group Manager

Jay Flowers,
Key Accounts Manager

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Keys to Successful Wire Feeding in Automated Applications

Wire Feeding Basics - What to Know?

- **Standard Set up**
  - ARC Applications
  - Laser Applications
- **Hardware**
  - Wire source to contact tip
  - Establishing a baseline
- **Maintenance & Troubleshooting**
  - Typical problems encountered
  - Ways to address them (root cause)

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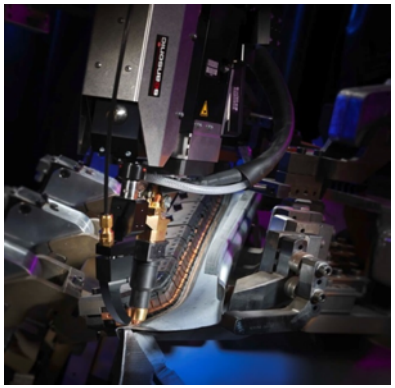
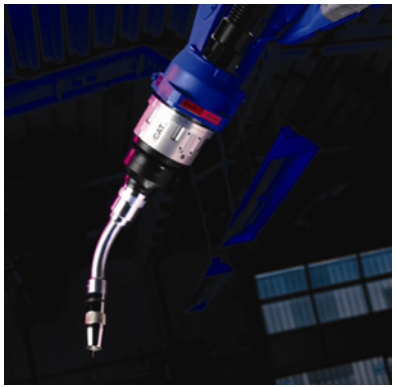
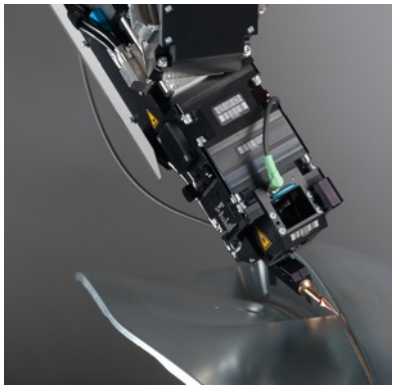
Wire Feeding Basics – Where is it Applied in Automation?

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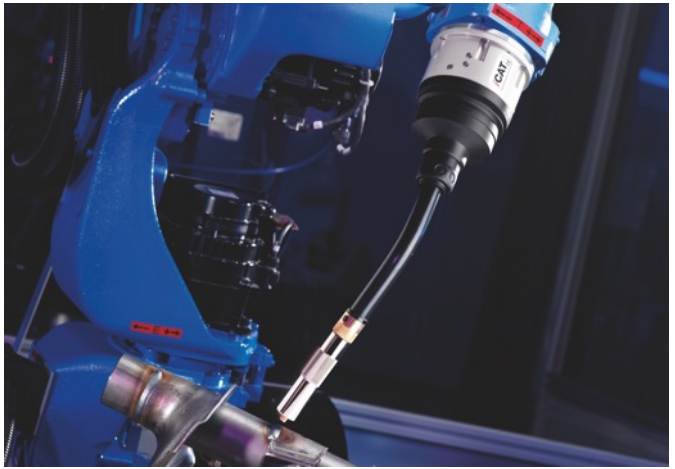
Process Description – Influencers for Quality

Laser	• Wave length • Beam profile • E-density/Focus size • Beam to wire position
Arc	• Amperage • Voltage • Torch angle • Travel speed
Parts	• Base material • Gap size • Bending radiuses • Surface quality
Wire	• Accuracy (+/-5%) • Diameter (0,8-1,6mm) • Surface/Quality • Cable management

Wire feeding is very small, but critical part of a complicated puzzle



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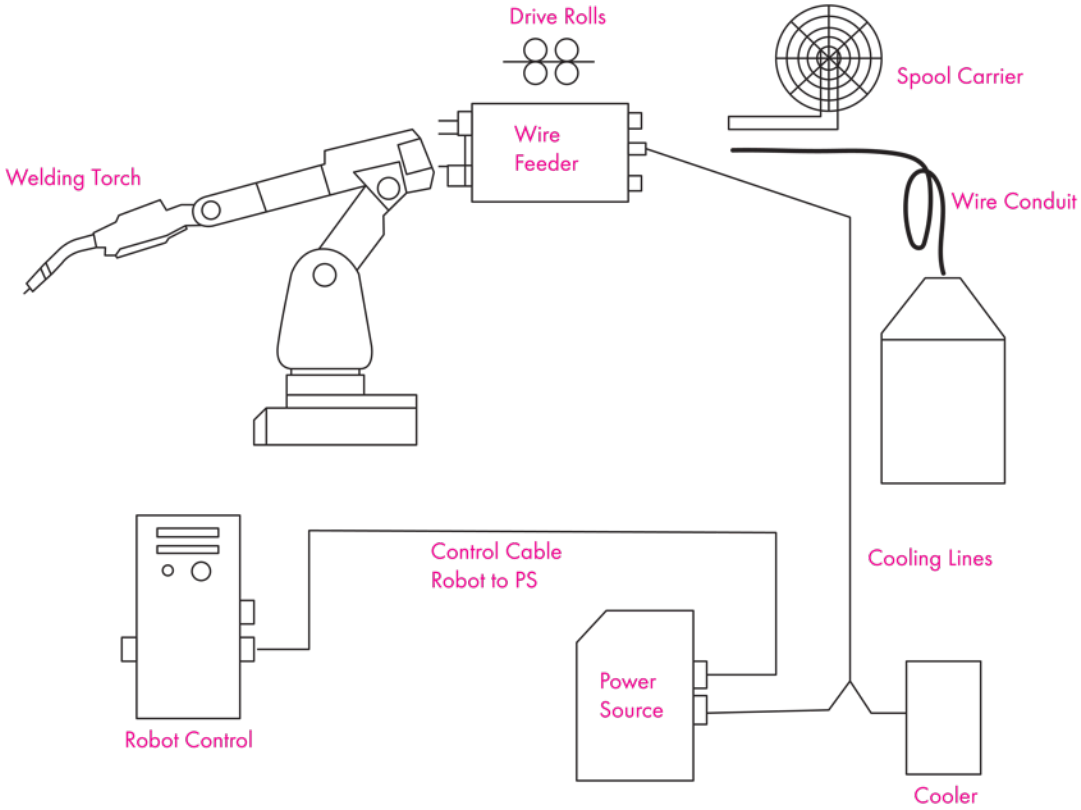
System Description – Typical ARC Process



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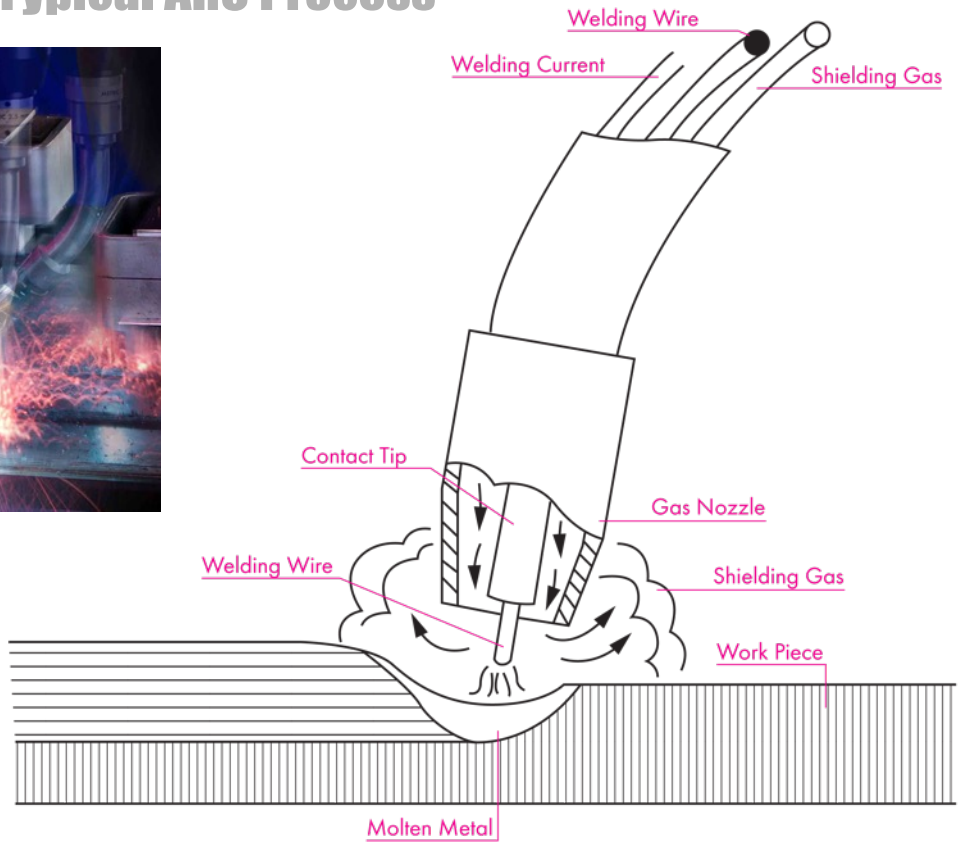
System Description – Typical ARC Process



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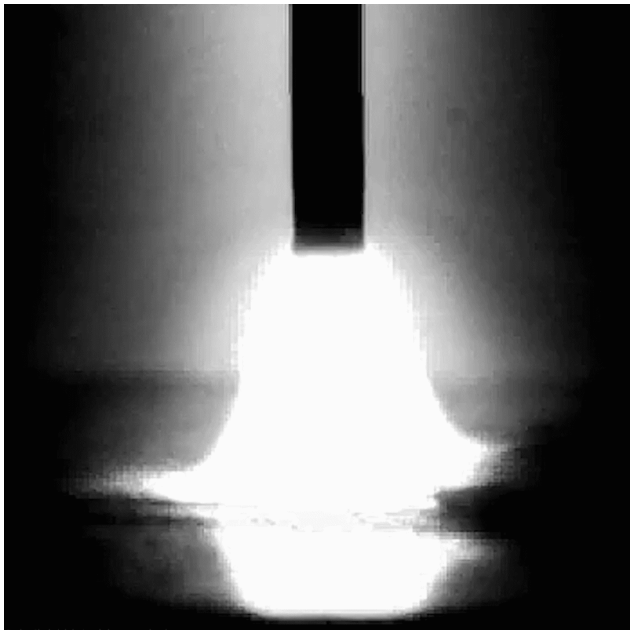
ARC Processes – Why Are They Special?



Pulse Transfer

Short Circuit Transfer

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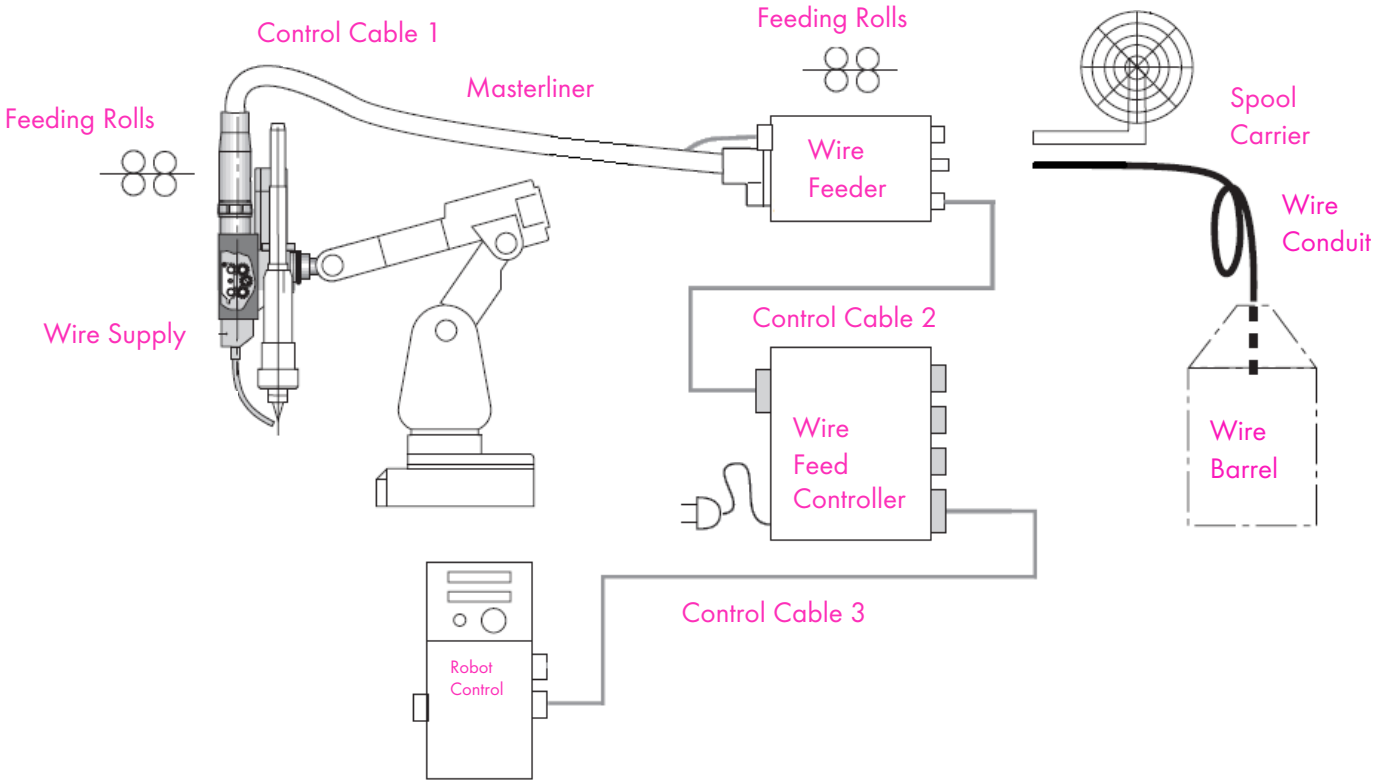
System Description – TIG/Plasma/Laser Processes



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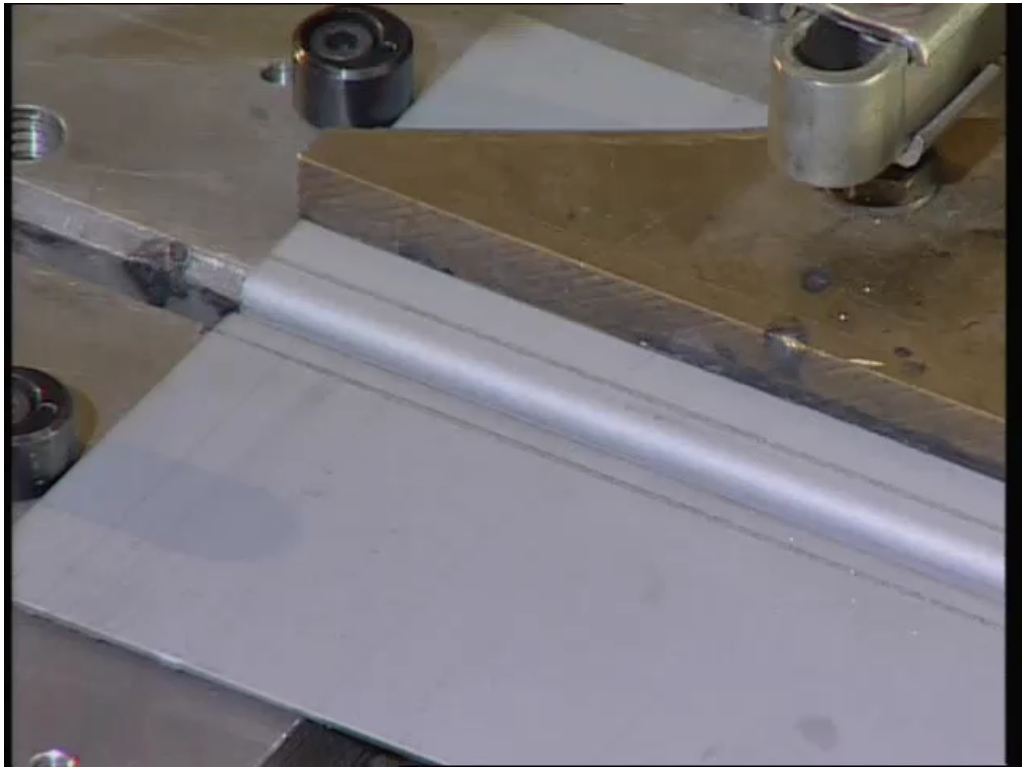
Laser Processes – Why Are They Special?



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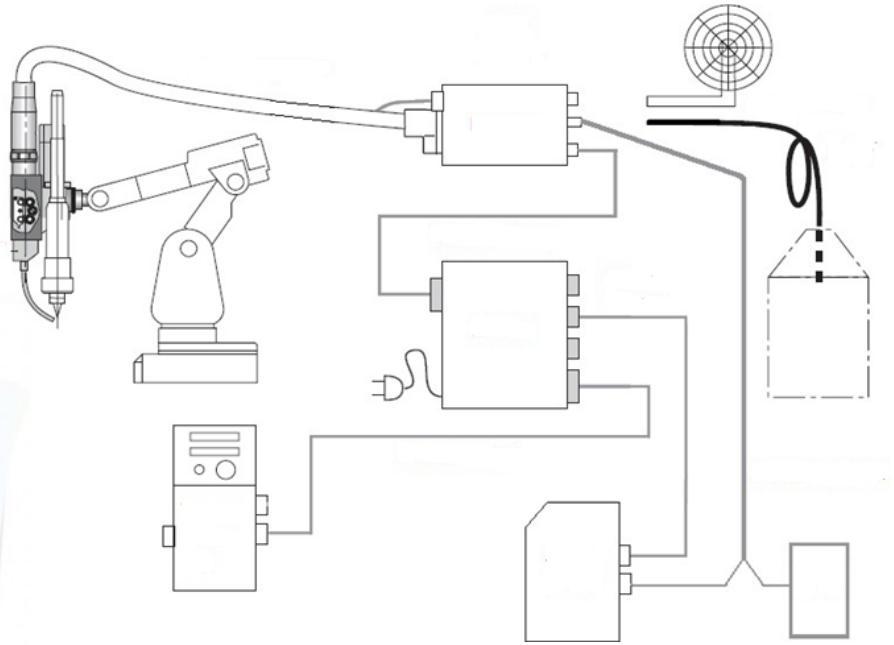
System Description – Individual Components



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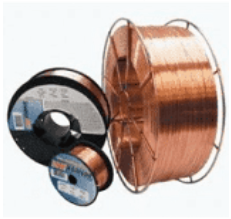
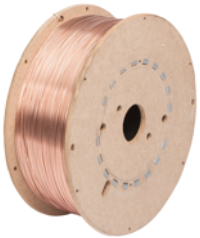
System Description – Wire Delivery Options





Drum Fed wire

- Less Frequent change
- Helix of wire (twist)
- Harder to handle

Spool Fed wire

- More Frequent change
- Cast of wire (bend)
- Easier to handle

The manner in which the wire is supplied directly impacts how the wire feeds through the system and into the process

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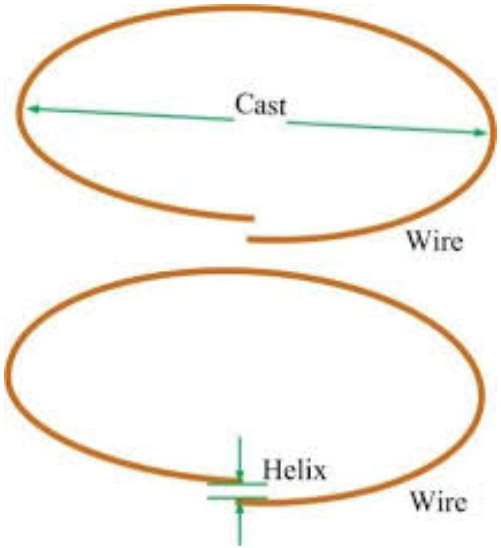
System Description – Properties of Welding Wire (Cast vs Helix)

Wire Cast – the diameter of the circle the **wire** forms when it's cut from a spool and laid on a flat surface

Wire Helix – the vertical height from the flat surface



	Drum	Spool
Cast	Fairly constant	Changes closer to center of spool as diameter decreases.
Helix	Can vary from drum to drum. Shows up as a "twist" in the wire	Fairly constant

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System Description – Peripherals (Wire Boosters & Straighteners)

Wire Boosters

Pneumatic
Clutch based

Wire Straighteners

Electronic
Automation ready

- Wire straighteners can be added to system to help address cast / helix issues that can impede smooth feeding
- Boosters are utilized to help support pushing wire over longer distances. They range from simple pneumatic to advanced electronic controls / recording.

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System Description – Wire Feed Options (Single or Dual Drive)

Main Wire Feeders

Support Feeders

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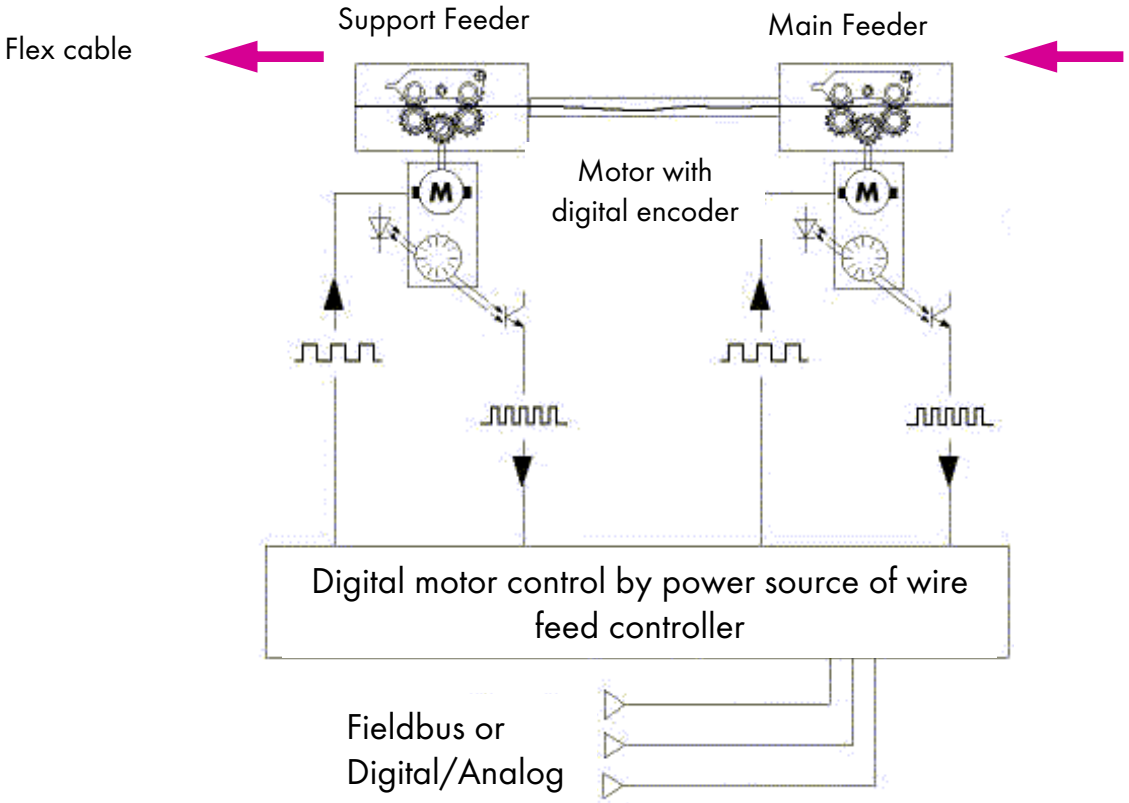
System Description – Peripherals (Wire Boosters & Straighteners)



- **Choice dependent on level of quality needed...**

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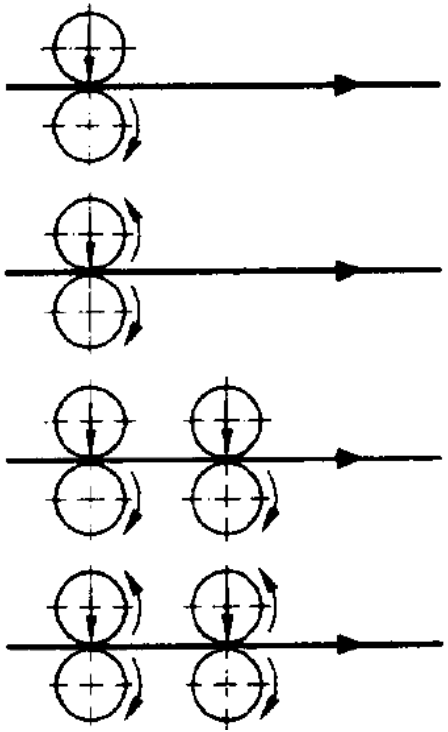
System Description – Drive Concepts



1+1 Roll Drive
1 Pressure + 1 Drive Roll

2 Roll Drive
1 Pressure Roll (driven) + 1 Drive Roll

2+2 Roll Drive
2 Pressure Rolls + 2 Drive Rolls

4 Roll Drive
2 Pressure Rolls (driven) + 2 Drive Rolls (Driven)

- In laser technology, accurate wire feeding must avoid both wire and drive roll slippage. This slippage is reduced the most utilizing 4 wheel drive.

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System Description – Drive Rolls

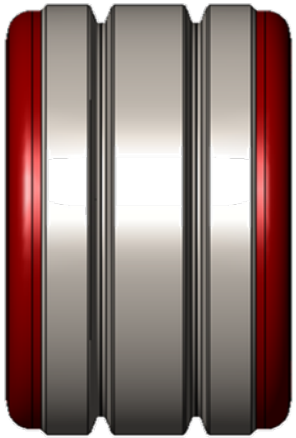
V-Groove for Steel and CUSI wires

Pressure for Steel and CUSI wires

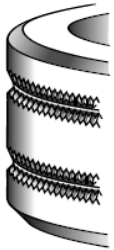
Typically used in combination with V-Groove rolls only

U-Groove for Aluminum based wires

Wire size must match roll for optimal operation



- In cases where long feed lengths are required, sometimes adding knurl to drive rolls can give better grip…be careful how you set up pressure on the drive rolls as it may affect the surface of the wire.



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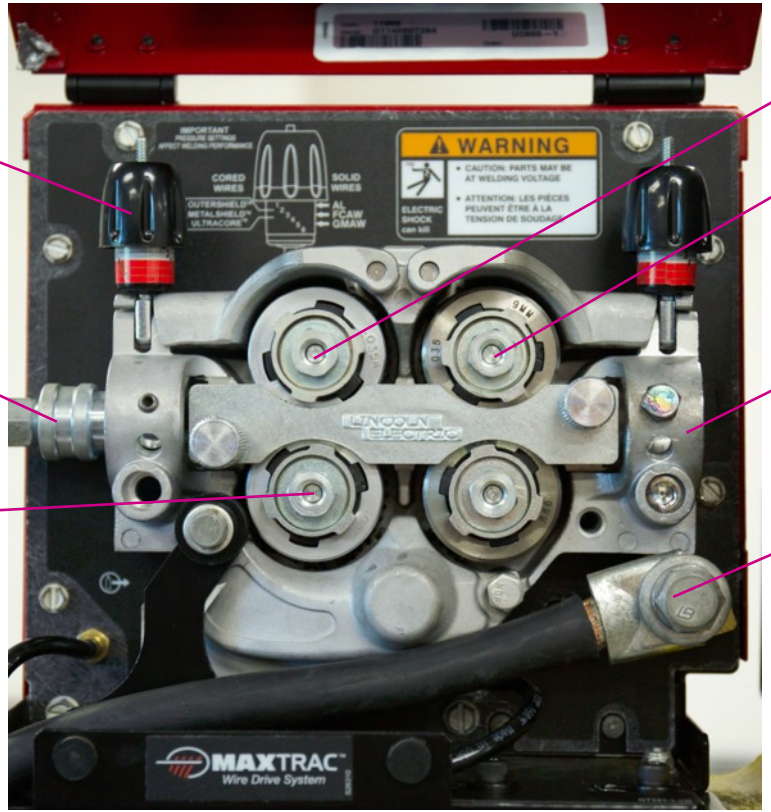
System Description – Main Drive



Picture – Lincoln Electric 4R220 Feeder

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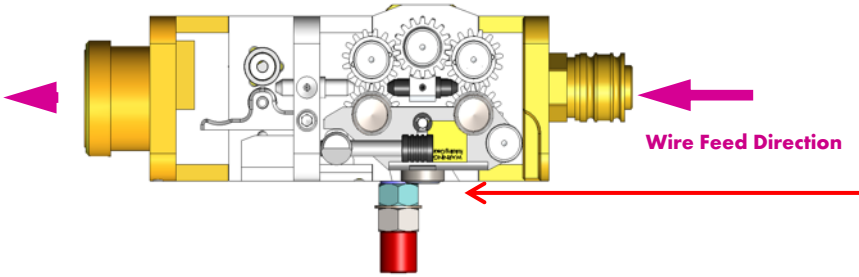
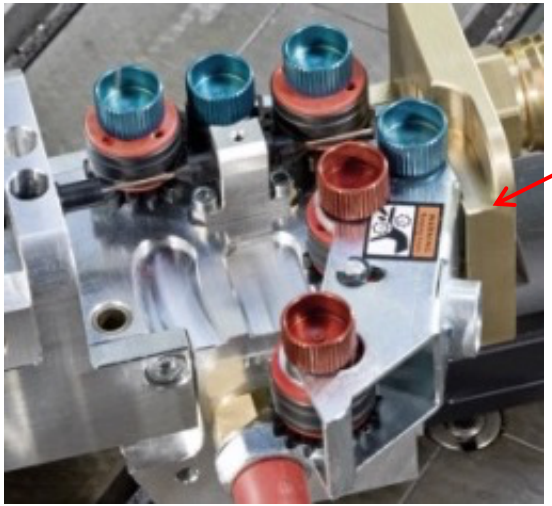
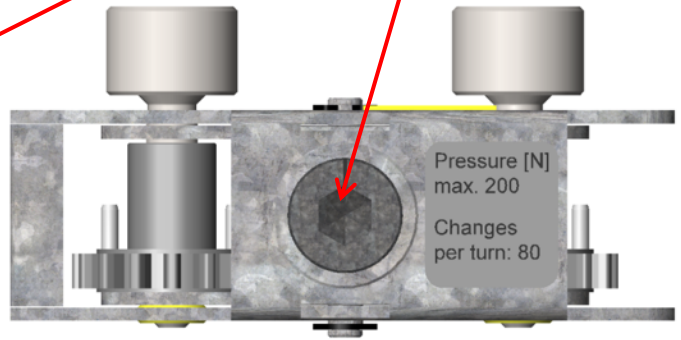
System Description – Support Drive



Wire Feed Direction

Rocker Arm provides mechanical pressure to drive rollers





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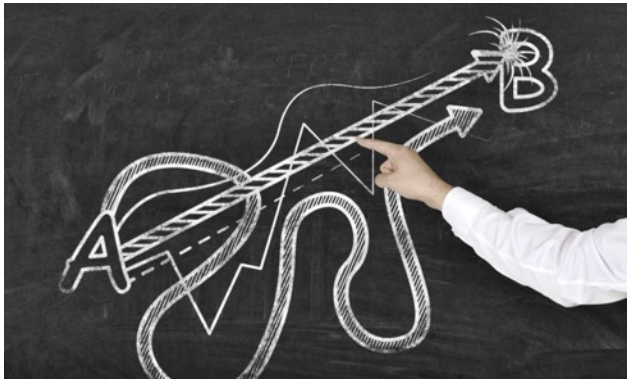
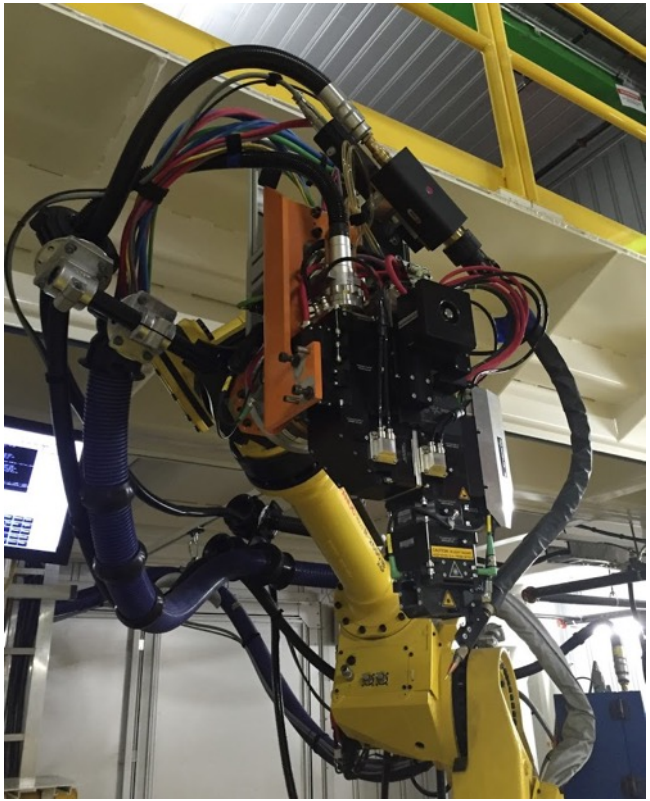
Keys to Successful Wire Feeding in Automated Applications

System Description – Wire Conduits



Shortest Distance between 2 points is a straight line

Dress out of torch cable / wire feed conduits critical to ensure the smoothest feeding of wire



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System Description – Wire Conduits – Drum to Feeder

Standard Wire Conduit

Reduce Friction with Wheels

Master Liner

- Non conductive portion of feeding process – ARC or Laser

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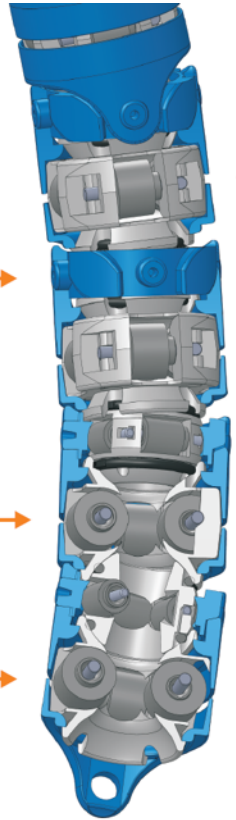
System Description – Wire Conduits

special patented construction:
enables all roll assemblies to freely rotate and allows the dynamic mechanical relief of any tension built on conduit by robot or manual sharp movements.



stainless steel roll axles:
to prevent rust even in the event of moisture penetrating the conduit or with ultrasonic washing.

GUIDING ROLL ASSEMBLY:
these rolls are only engaged when the wire is being inserted.**Spacing between rolls: 6.00 mm (0.236”)**

PULLING ROLL ASSEMBLY:
these rolls are only engaged while the wire is being pulled through the conduit.
Spacing between rolls: 5.20mm (0.204”)

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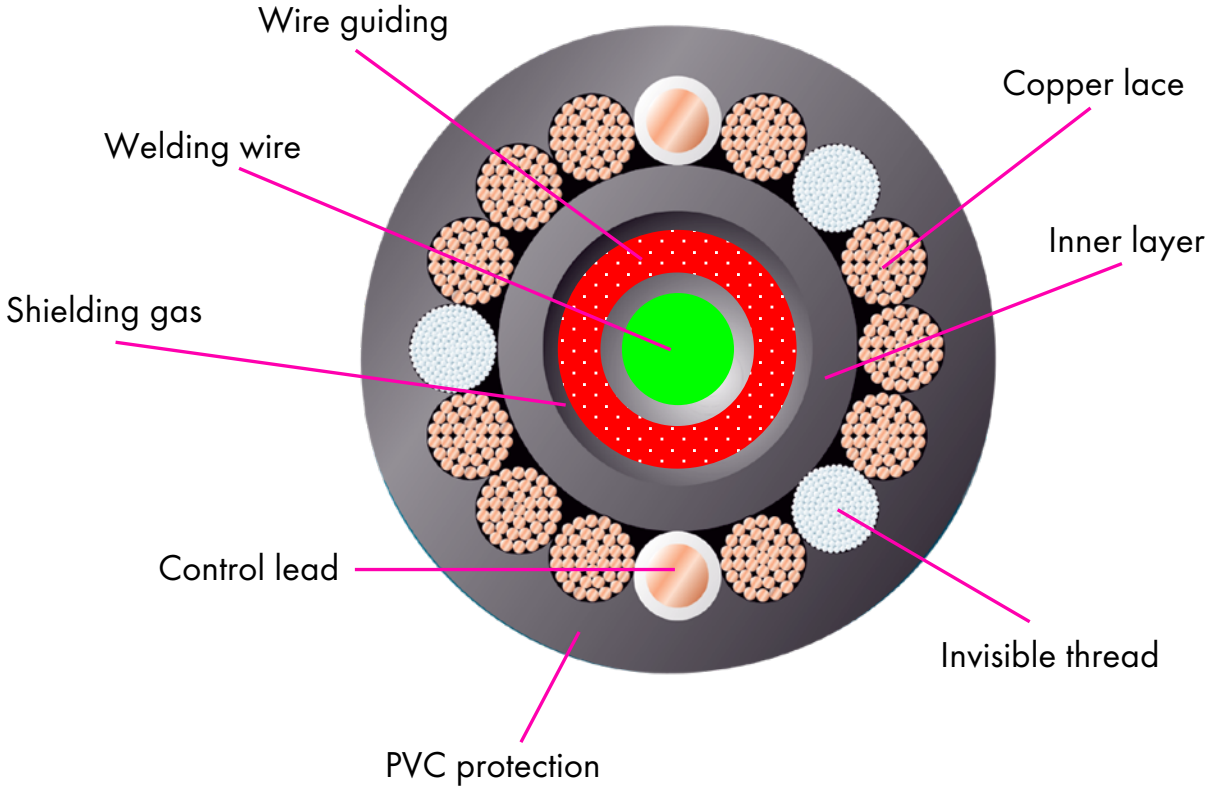
System Description – Wire Conduits (GMAW)



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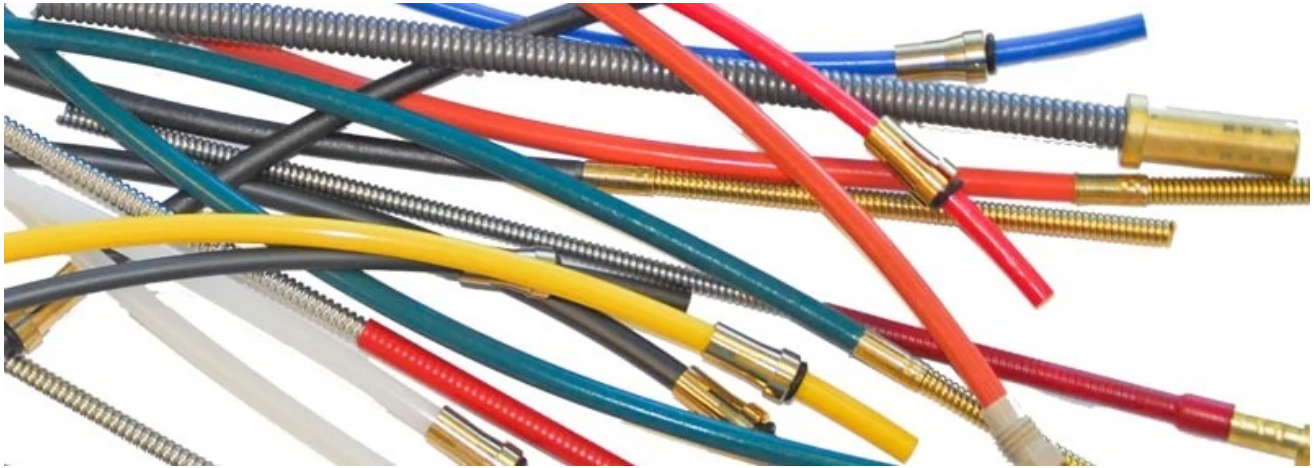
System Description – Wire Conduits (GMAW)



- Made of steel or plastic
- Guides the welding wire through the cable assembly
- Many types

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System Description – Power Cable Liners/Conduits

Liner Material		Abrasion Resistance	Wire Type	Temp Range	Comments
Metal Wound	Steel	Best	Steel	High Temp	
	Brass	Best	All	Med Temp	
	Stainless steel w/plastic insulation.	Best	All hard wires	High Temp	
Plastics	PTFE = Teflon	Better	All wire types	Med Temp	190°C-260°C temp range
	C-TFE = Carbon infused Teflon	Better	Stainless, Fluxcore, Aluminum E5356	High Temp	260°C-300°C temp range
	PA = Polyamide is a carbon filled nylon	Good	All wire types	Low Temp	125°C temp
	BPL Petrol = High density Teflon	Good	All wire types	Med to High	190°C-260°C temp range
	PE = Polyethylene	Good	All wire types	Low Temp	80-100°C temp range

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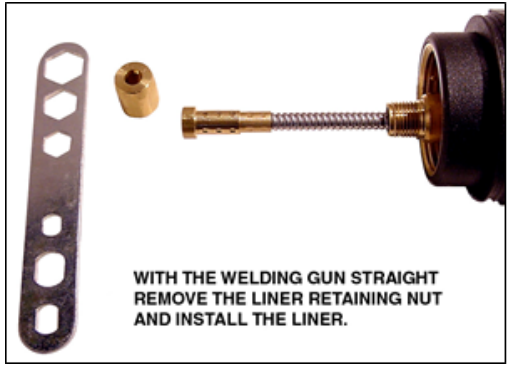
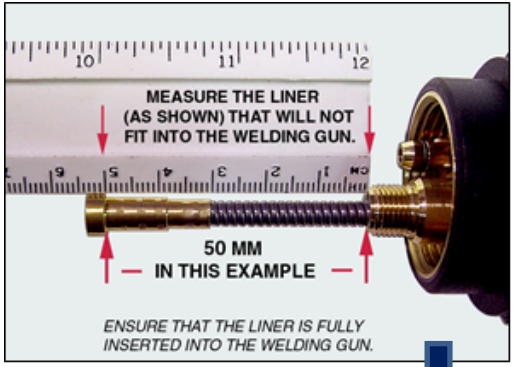
System Description – Proper Procedure for Cutting a Power Cable Liner

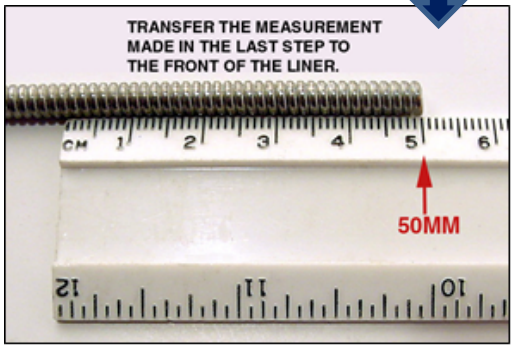
Step 1



Step 2



Step 3



Step 4

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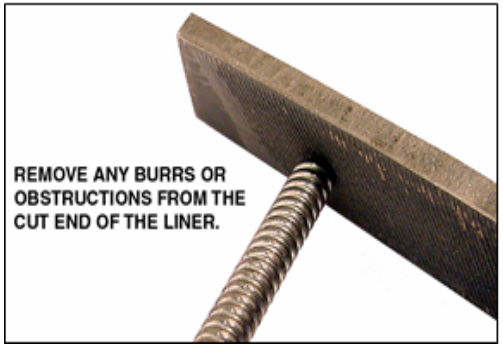
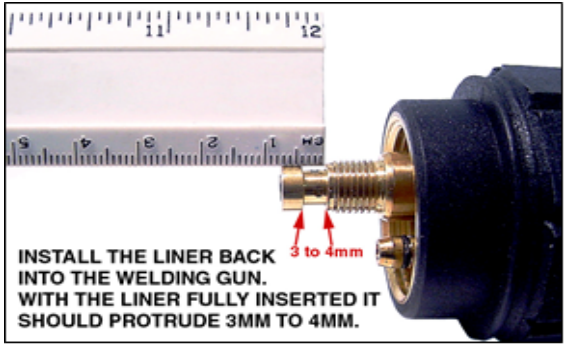
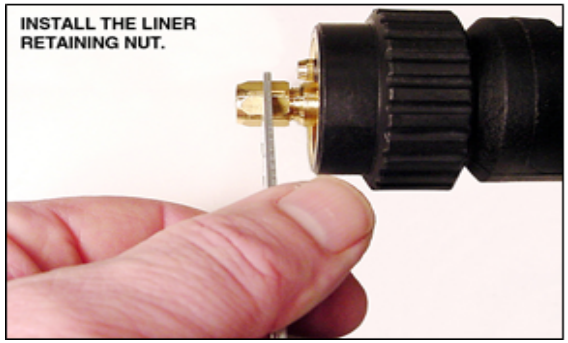
System Description – Proper Procedure for Cutting a Power Cable Liner

Step 5



Step 6





Step 7

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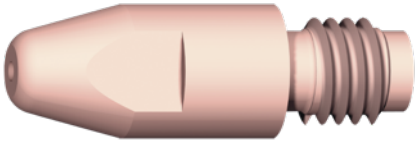
System Description – Contact Tips

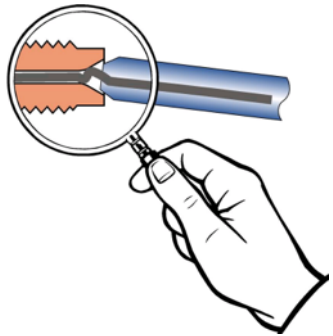
Requirements to contact tips:

- High war resistance
- Good heat transfer
- High heat resistance
- High electric conductivity

Two contact tips, that can face these requirements: E-Cu, CuCrZr

(acc. to BINZEL standard)	**E-Cu**	**CuCrZr**
Electric Conductivity 20°C (m/ ohm x mm2)	>/= 57	>/= 43
Heat Transfer at 20°C (w/ m x k)	>/= 386	>/= 320
Hardness (HV)	~ 125	~ 165
Softens at	~ 260°C	~ 500°C





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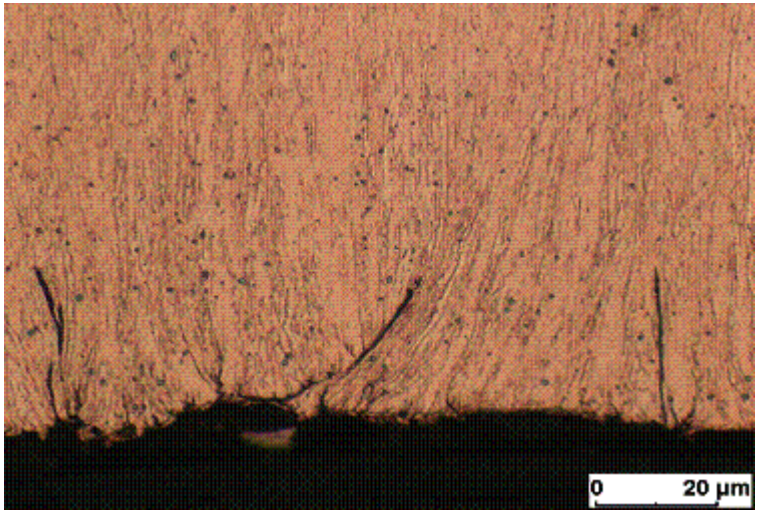
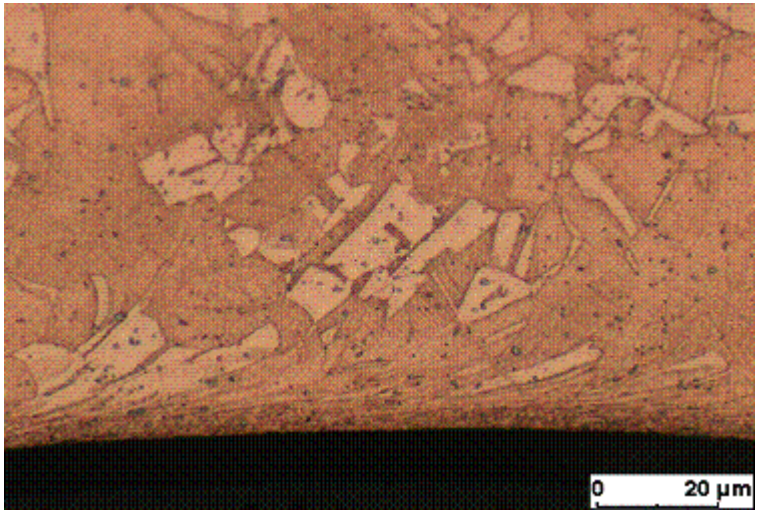
System Description – Contact Tips

- Contact tips produced by the production process high-speed deep-drilling have smaller tolerances and smoother bore surfaces than contact tips out of drawn material



Precision drawn



Deep-drilled

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Questions to Ask Yourself

Welding Wire

- What are the cast / helix measurement of the wire? Do they meet spec?
- Is problem occurring towards bottom of drum / core of spool? (cast, helix, amount left on spool or in drum, tangling)?
- Is it pulling freely off of the spool or out of the drum?
- Does the wire tangle upon discharge?

Drive Rolls

- Am I using the correct drive rolls for the wire diameter I am running
- Are my drive rolls set up correctly (too much tension, not enough)?
    - Is wire slipping when drive rolls are turning?
    - Do you have a “birds nest” at the wire feeder (drive rolls, exit)?

Liners

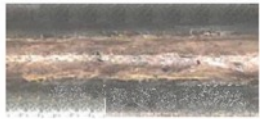
- Am I using the correct liner for the material I am feeding?
- What is it’s condition? Has it been changed recently? Is it oval or cut?
- Have I installed the liner correctly (length, etc.)
- Is my wire drag (at the contact tip) in the acceptable range?

Contact Tips

- Am I using the correct contact tip (material, size,...)
- Is there good continuity of wire guiding throughout entire system (guides, gaps, other)
- When was the last time the contact tip was changed

Keys to Successful Wire Feeding in Automated Applications

Erratic Wire Feed

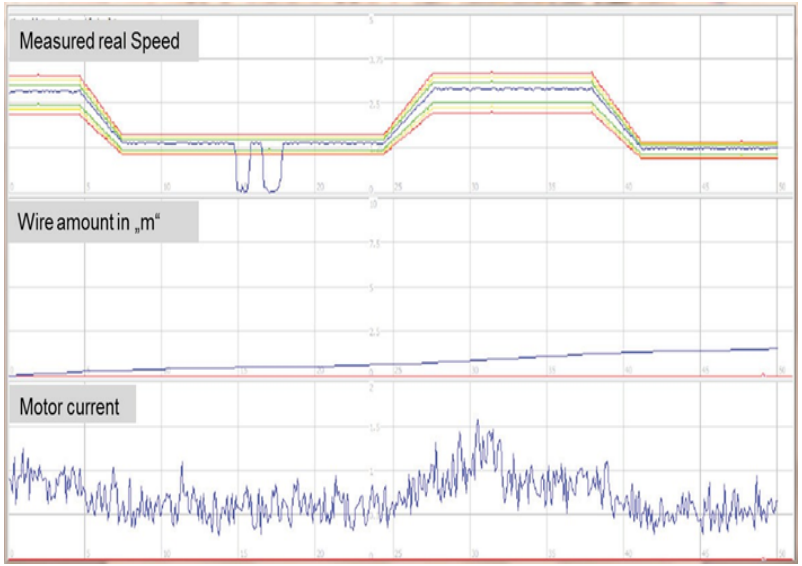



overheated, Pores not related to feeding.


optical ok, good feeding condition.


small failure on the side. Part problem (gap)
Typical not related to feeding.


Improper wire feeding or misalignment....



- If going strictly off of appearance, only the most likely causes can be identified.
- To pinpoint the cause of erratic wire feed issues, having actual data from the process (e.g. real wire feed speed, length of wire fed) is extremely valuable.
- This data will help you pin point some root causes.

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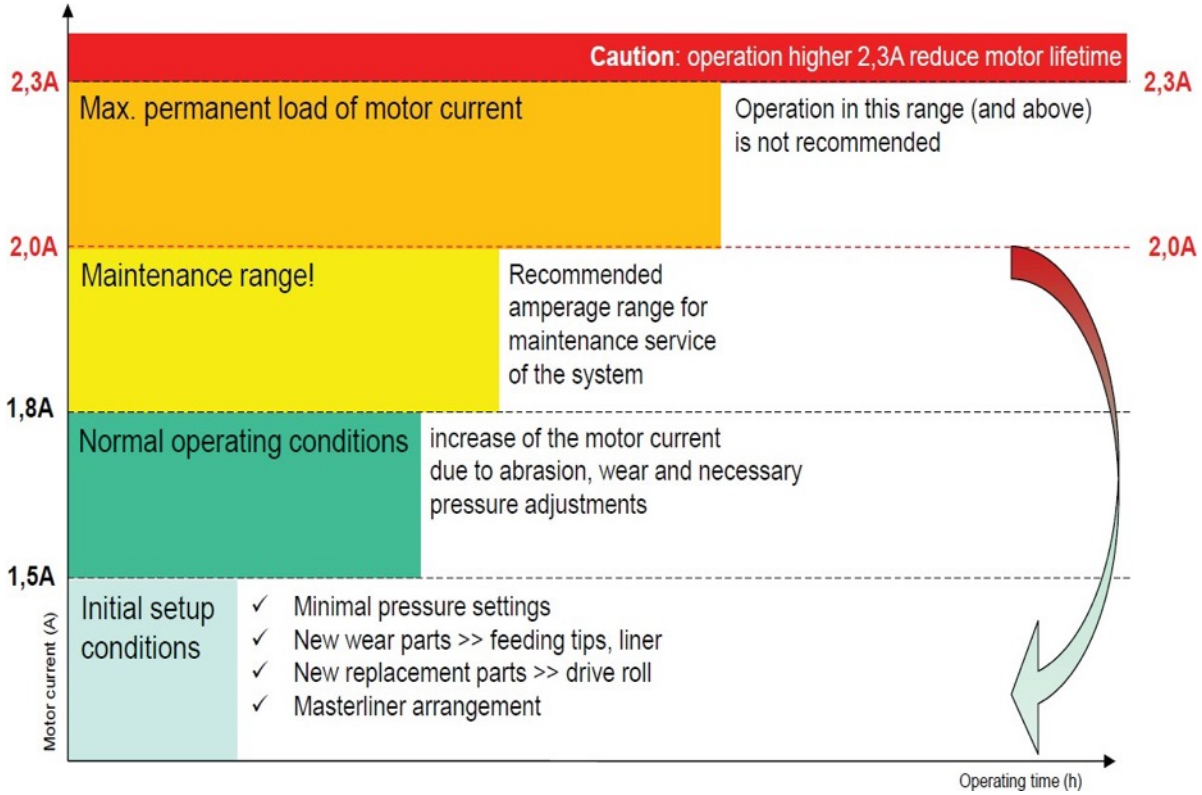
Motor Current



- Baseline values for motor current can help quickly predict when issues may arise. As motor current increases over time, this is good indication that wear is present within the system as the motor is working harder to maintain output.

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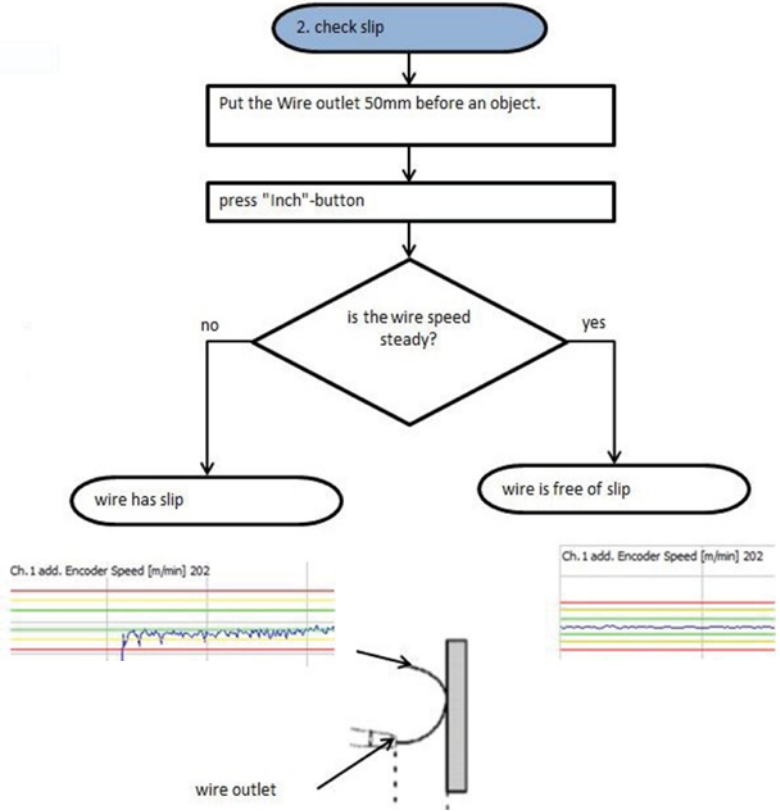
Keys to Successful Wire Feeding in Automated Applications

Wire Slippage



- **Key point**
  - Only required is enough pressure on your drive rolls to overcome a moderate amount of resistance.

- Too much pressure on your drive rolls can cause a number of other issues (wire deformation, increased wear on components, etc.)

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Pull Force

Check Wire Pull Force with rocker arms open

Wire Pull Force < 15lbs

- Using a force gauge (digital or manual) perform a pull test on the wire. disengage all drive rolls. create a small loop in the wire and attach the force gauge to it. Pull at a steady rate in the direction coaxial to the outlet of the contact tip.
- While pulling take note of the maximum pull force. If it is above 20 lbs while connected to a spool or 10 lbs for a drum, use the following flowchart to pinpoint any areas of increased drag.
- Typical pulling force required to pull wire through 2-drive system with 40 foot total distance (tip to wire) should vary between 1.5 to 5 lbs depending on configuration.

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Wire Drag

Wire drag above acceptable range

Open up drive rolls on wire feeder(s)

Make sure wire brake is off and check wire spool or drum for issues

Pull wire from tip roughly 3 inches and bend hook to end of wire

Connect “fish scale” to end of wire and pull directly in line with contact tip

Measure force required to pull wire through entire system

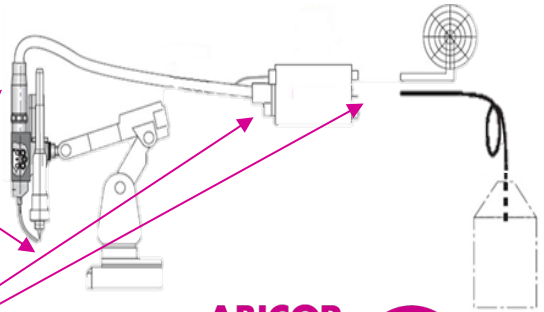
Record Value

Disconnect torch package from the wire feeder. Cut wire and bend hook to end of wire. Repeat pull test

Record Value

Repeat again at next wire feeder if applicable

Record Value



Creating baseline values at each break in the system provides foundation for quick determination of root cause when issues arise with ability to quickly react, address corrective actions, and maintain operations.

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Summary

- Packaging of wire changes how wire feeds
- Smooth release of wire to system critical
- Low friction liners can greatly reduce drag
- Limit aggressive bends to cables and conduits (200 mm bend radius or greater), route as straight as possible.
- Proper material of liner as well as proper installation (length, cut quality, overall fit, compression)
- Close any gap possible – eliminate spaces where wire is not cleanly supported.
- Match drive rolls to wire type and diameter
- Proper mechanical setup (drive roll pressure) avoids wire slip or possible damage to wire
- Real time speed and drive monitoring key to understanding process
- Quality of contact tip can directly influence feedability.

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