

SULZER

Sulzer Metco

16E / 16E-H / 16E-P Spray Gun Combustion Wire Spraying


Product Manual
MAN 96150 EN 01




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Intended Use

The 16E / 16E-H / 16E-P Spray Gun is a hand-held combustion thermal spray gun for applying flame spray coatings using metalizing wire. It is compatible with all commonly available combustion gas fuels including acetylene, hydrogen, propane, natural gas, and MAPP/MPS. The standard 16E is intended for most wires and gas fuels. The 16E-H is intended for feeding softer wires at a higher speeds. The 16E-P is specifically intended for use with propane.

See “Technical Data” on page 15 for detailed specifications.

Designation	Characteristics
16E 16E-H 16E-P	Standard wire gun High-speed wire gun Propane wire gun
Spray Process	Combustion wire
Compatibility:	
Spray Controllers	<ul style="list-style-type: none"> • 3AF • 3GF
Material Feeder	<ul style="list-style-type: none"> • 2W

Information About this Manual

The information in this manual is intended to ensure safe and optimal operation of the 16E / 16E-H / 16E-P Spray Gun.

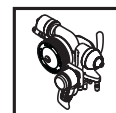
Keep this manual near your system.

Additional Documents

- 16E / 16E-H / 16E-P Spray Gun Parts List, PL 96151
- 16E / 16E-H / 16E-P Spray Gun Spray Parameters, PAR 96447

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DANGER

Do not use the 16E / 16E-H / 16E-P Spray Gun for any application or purpose other than that described in this manual. Improper use or application can result in equipment damage or personal injury.

Intended Audience

All personnel who work with the 16E / 16E-H / 16E-P Spray Gun shall be familiar with the material in this manual. The specific topics of interest are outlined in the table below.

Read the relevant chapters, especially chapter 1 Safety, before working with the 16E / 16E-H / 16E-P Spray Gun.

Chapter	Intended Audience
1 Safety	Everyone working with the spray gun
2 Product Description	Everyone working with the spray gun
3 Installation	Installation Engineers
4 Operation	Everyone working with the spray gun
5 Troubleshooting	Maintenance Engineers
6 Maintenance	Maintenance Engineers

Sulzer Metco reserves the right to make improvements to the 16E / 16E-H / 16E-P Spray Gun without prior notice.

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1 Safety

This chapter contains important safety information. Please read it prior to working with the spray process. Observe all safety regulations.

1.1 Safety Symbols

The following safety symbols may be found in Sulzer Metco documentation, such as technical manuals and product labeling, to alert the user to the presence of important operating instructions, safety considerations and special instructions. Whenever these symbols are encountered, the user should read, understand and proceed in accordance with the definition provided below.

General Information and Warnings



INFO

Presentation of general, but important information which must be read and understood prior to proceeding.



CAUTION

General hazard warning which can result in minor personal injury or minor damage to machinery.



WARNING

Warning of hazard which can result in severe personal injury or severe damage to machinery.



DANGER

Danger! Failure to comply can result in severe personal injuries or death.

Mandatory Requirements















Mandatory requirement not covered by other symbols.

Additional Symbols

Personal Protection

	Sound attenuating ear protection must be worn.		Hand protection must be worn.
	Respiratory protection must be worn.		Face protection (welding gear) must be worn.
	Protective clothing must be worn.		Eye protection must be worn.
	Head protection must be worn.		Protective footgear must be worn.
	Keep hands, hair, clothing and tools away from moving parts.		

Hazardous Materials and Conditions

	Explosion hazard, explosive material present.		Strong electromagnetic fields present.
	Flammable material or presence of high temperatures.		Poisonous substance present
	High voltage or risk of electric shock present.		High pressure warning.
	Ultraviolet, infra-red or other damaging light radiation present.		Warning of laser present.
	Noise hazard present.		Do not stack warning.
	Heavy weight present above.		Electrical ground is not present.



1.2 Authorized Use

This system is intended for the sole use of thermal coating of workpieces in atmosphere. The combustion and HVOF spray systems are designed and constructed in accordance with generally acknowledged safety regulations and codes. The combustion and HVOF spray guns must be used only for depositing thermal spray coatings following all guidelines specified herein, other supporting equipment manuals, and all applicable regulations and codes. Failure to do so may result in hazardous or unsafe conditions.

1.3 General Safety Regulations

Use of Sulzer Metco original spare parts is strongly recommended. Use of non-OEM parts may void Sulzer Metco's warranty and result in reduced performance of the equipment.

It is recommended that all personnel connected with thermal spraying become familiar with the safety practices outlined in this document as well as the established standards and regulations which have been set by local, state and federal health officials (e.g., OSHA). All regulations should be thoroughly read and understood to ensure proper compliance.

There are several basic precautions for thermal spraying which should always be observed. These include: good housekeeping, proper material/gas storage and handling practices, use and maintenance of equipment, operator training, sufficient exhausting of gases and fumes and personal protective equipment (clothing, ear, eyes and breathing (respirator) protection).

All personnel responsible for the safe use of this equipment must read and understand this instruction manual.

In addition, the operator of this equipment must receive personal instructions in its use. A thorough understanding of the operation, maintenance, and safety requirements of this equipment is required.

1.4 Specific Safety Regulations

Eye Protection

The combustion spray gun generates electromagnetic radiation in the form of visible light, infrared (radiant heat), and ultraviolet radiation. These types of radiation are hazardous and can cause burns or blindness in unprotected eyes.



WARNING

Do not use the 16E / 16E-H / 16E-P Spray Gun for any application or purpose other than that described in this manual. Improper use or application can result in equipment damage or personal injury.



DANGER

Wear suitable protective goggles.



WARNING
Noise emissions!
Wear ear protection!



DANGER
Respiratory protection
must be worn.



WARNING
Hazards generated by
the spray process!

Wear personal protec-
tive clothing.

Ear Protection

The noise emission of greater than 85 dB caused by the spray gun can damage hearing. Personal protective equipment in accordance with a hearing conservation program is necessary. The HVOF spray process can produce noise levels as high as 136 dB.

Ventilation and Exhaust

All thermal spray processes produce fumes and dust particles from the materials being sprayed. To avoid the effects of dust and fumes generated by spraying, a suitable spray booth and sufficient exhaust system are required. Proper installation, operation and maintenance are important for system performance and maintaining a safe working environment. For additional safety, dust collectors should be provided with blow-out or relief panels in case of explosion. All local, state, and national fire codes must be complied with when determining the location of the exhaust system. The exhaust duct of the ventilation system should be vented to the outside of the building.

The combustion and HVOF spray processes generate carbon dioxide, carbon monoxide, NOx, dust, and fumes that can damage the respiratory system or cause death. An adequate exhaust and ventilation system is required. A minimum air velocity of 90 m/min (300 ft/min) is recommended in the areas adjacent to the spray gun and the object being coated.

In addition to proper booth ventilation, appropriate personal respiratory equipment must always be used when the operator is near the spray process. An industrial hygienist should be consulted for recommendations on type and fit. Consult the Material Safety Data Sheet (MSDS) for the products being sprayed for specific information regarding chemical composition of the powder and Permissible Exposure Limits (PEL).

Personal Protection

Protect exposed skin from the dust, fumes, and heat, generated by the combustion and HVOF spray process.



Hazardous Materials

OSHA and groups such as the American Conference of Government Industrial Hygienists (ACGIH) and other government agencies have developed extensive lists of hazardous materials and have set workplace exposure limits. Inasmuch as standards change and new information becomes available from time to time, it is strongly recommended that the information contained in the Materials Safety Data Sheet (MSDS) be consulted for the latest, up to date information. There is also a considerable body of European standards that apply to the spraying of powders.

Electrical Power

All electrical installations must be made in accordance with local and national code requirements. All electrically powered equipment must always be properly grounded. For additional information concerning electrical installations refer to the National Electric Code (NFPA 70), or EN 60204-1, or applicable local electrical code.

Heat

The spray stream can heat up and ignite objects in the vicinity such as the walls of the sound proof cabin, or cables and hoses. Never aim the spray stream at people or objects other than the workpiece to be coated.



WARNING

High current and voltage!



DANGER

High temperatures!

Never aim the spray gun at people or flammable objects!

**DANGER**

Combustible gases present under pressure.

Compressed Gases

Local, state and federal regulations relative to in-building use and storage of gas cylinders should always be observed. The improper storage, handling or use of gas cylinders can result in a serious safety hazard. For additional information refer to NFPA 50, 50A, 51, 54, and 55 or other applicable local codes.

Oil or grease should never come into contact, or be used on, equipment which carries oxygen gas. Only approved lubricants should be used in these cases.

The manifolding of more than two gas tanks may be required to permit higher gas flows and longer spray times. Only approved pressure adjusting regulators should be used with each gas, and should never be over tightened or forced to make a connection. Gas regulator adjusting screws should be fully released prior to opening cylinder valves. Cylinder valves should be opened slowly to prevent surges that can damage other related equipment. When opening a gas cylinder, stand to the side of the pressure-reducing regulator, never in front of it.

It is dangerous and not recommended to use acetylene gas above 1.03 bar (15 psig). Consult the local country regulations for maximum allowable acetylene pressures.

The following guidelines should be followed when handling gas tanks:

- 1 Never drop tanks or knock tanks into one another. Some gases are unstable (e.g., acetylene) even when in the tanks.
- 2 Gas tanks should always be secured to a wall or other supporting fixture with chains or similar restraints even when the tanks are not in use as they can easily tip over.
- 3 Only transport tanks in proper carriers. Gas carts are designed to move tanks around, dollies are NOT. Do not attempt to carry or drag tanks
- 4 Never leave tanks in direct sunlight or extreme heat. Heat will cause the tank pressure to increase dramatically resulting in an unsafe situation.
- 5 Never smoke around tanks. Although no leak may be apparent, some gas could be leaking and may ignite.
- 6 Tanks should always remain upright. They are designed to be operated and transported in this position. If a tank is found lying on its side, carefully return the tank to its upright position. Allow the tank to remain upright for at least 30 minutes before attempting to use it.



- 7 If a tank has been stored outside in a cold environment, allow the tank to warm up at least one hour prior to use. A liquid tank (e.g., propylene) will require up to 4 hours to reach room temperature.
- 8 The caps on the gas tanks should be on at all times when the tank is not in use. The cap is used to protect the weakest part of the tank; that being the tank head.
- 9 Follow local guidelines and recommendations from the gas supplier for the allowable location of combustible gas tanks storage.

Gas Hoses and Piping

The gas supply installation must be carried out by qualified personnel and must comply with the regulatory requirements applicable to the location of the spray cell set-up.

Where large amounts of gas are required, the gas can be supplied from a tank or several manifolded gas tanks and piped into the spray booth. Gas piping should be constructed from stainless steel or other similar solid metal material. It is recommended that pipe connections should be welded or brazed. Gas piping should when possible, be laid above ground and on the outside of the building. Piping should not be laid in enclosed areas where gas leaks can accumulate, such as above ceiling tiles or behind walls. The piping installation must be checked for leaks and pressure tightness before putting it into service. The piping installation should be routinely checked for leaks when in service.

Gas hose must be protected from mechanical damage. Gas hoses should be routinely checked for loose connections, damage, and leaks. Old gas hoses that are dry or cracked should never be used. Hose connections should never be over tightened for this will cause the hose stem to collapse and restrict gas flow.

Flame spray guns or torches or any other object should never be hung on cylinder valves or regulators. This practice may result in a fire or explosion.

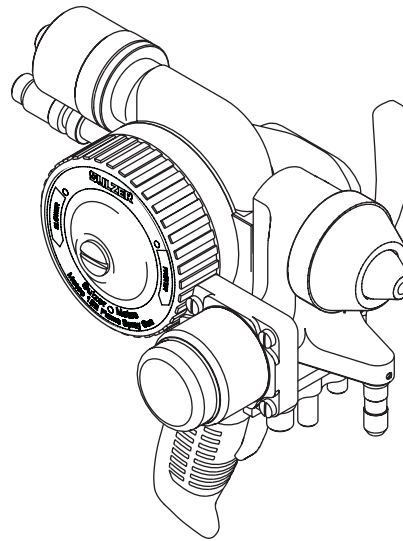
When spray work has been completed or the equipment is shut down (e.g., overnight, over a weekend), the gas supply should be turned off and all gases should be drained from the hoses and regulator adjusting screws backed out.



DANGER

Combustible gases present under pressure.

2 Product Description



16e_overview

The 16E / 16E-H / 16E-P Spray Gun is a hand-held, wire-fed, combustion thermal spray gun. The spray gun is capable of using all commonly available combustion fuel gases, with oxygen to produce flame sprayed coatings from Sulzer Metco metallizing wires. The spray gun is intended mainly for hand-held operation. A tool post on the front of the spray gun provides for machine or tool mounting.

There are three versions of the spray gun:

16E (Standard)

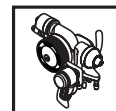
- 3.2 mm (1/8") and 2.3 mm (11 Ga.) wire
- Optional hardware available for wire size ranging from 4.8 mm (3/16") to 1.45 mm (15 Ga.)
- Standard fuel gas = acetylene
- Other fuel gas = propane (natural gas, MPS)

16E-H (High-Speed)

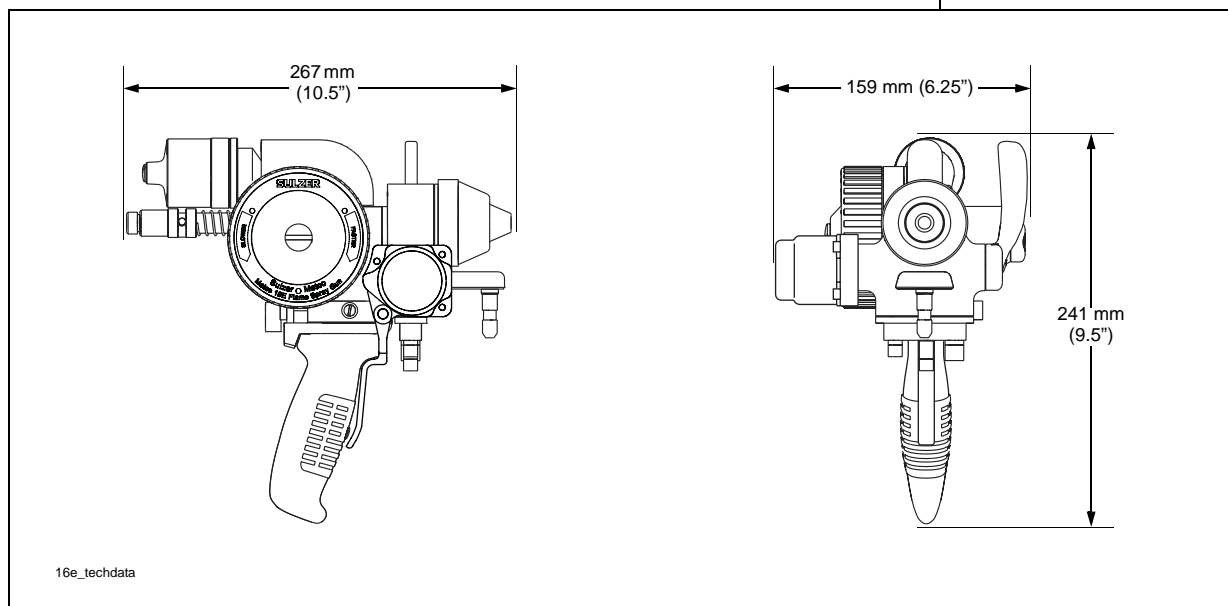
- 3.2 mm (1/8") and 4.8 mm (3/16") soft wire (such as babbitt, tin, zinc)
- Non load air cap
- Stepped down drive rolls
- High speed gear

16E-P (Propane)

- 3.2 mm (1/8") and 4.8 mm (3/16") wire
- Standard fuel gas = propane



2.1 Technical Data



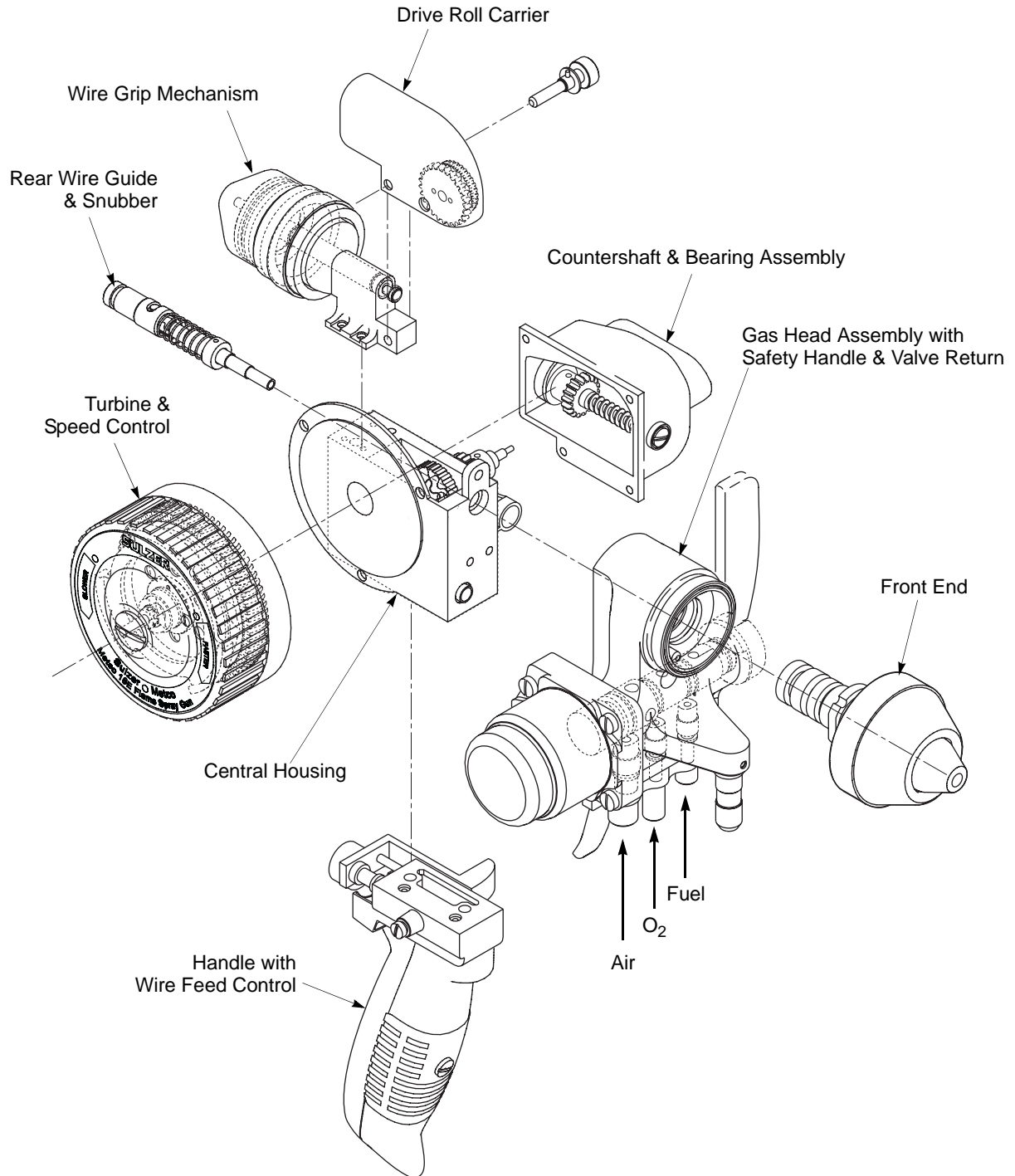
16e_techdata

16E / 16E-H / 16E-P Spray Gun

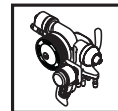
Feature / Requirement	SI Units	US Units
Weight	2.83 kg	6.25 lb
Wire Feed Rate: 16E / 16E-P 16E-H	0.6 – 4.6 m/min 1.4 – 11.7 m/min	2 ft/min – 15.1 ft/min 4.5 ft/min – 38.5 ft/min
Spray Distance	130 – 205 mm	5" – 8"
Compressed Air Requirements (Dried, Filtered, Oil-Free)	0.85 m ³ /min at 4.5 bar	30 CFM at 70 PSI
Process Gases: Oxygen Acetylene Propane MAPP (MPS) Hydrogen	3.45 bar at 85.4 NLPM 1.03 bar at 21.9 NLPM 3.45 bar at 18.4 NLPM 3.45 bar at 17.5 NLPM 1.72 bar at 92.0 NLPM	50 PSI at 195 SCFH) 15 PSI at 50 SCFH 50 PSI at 42 SCFH 50 PSI at 40 SCFH 25 PSI at 210 SCFH)
Wire Sizes: ¹	4.76 mm ² 3.97 mm 3.18 mm 3.06 mm 1.83 – 0.88 mm	3/16 in 5/32 in 1/8 in 11 gauge 15 – 20 gauge

1. All wire sizes cannot necessarily be used with all gases. See "Hardware Selection" on page 26.
2. Wire sizes are listed in SI units for reference only. Wires for the 16E / 16E-H / 16E-P Spray Gun are supplied in standard US units or average wire gauge (AWG).

2.2 Component Descriptions



16e_subassy



2.2.1 Gas Head Assembly

Supply hoses for air, oxygen and fuel gas connect to the hose block on the bottom of the gas head assembly. The gas head valve has three positions:

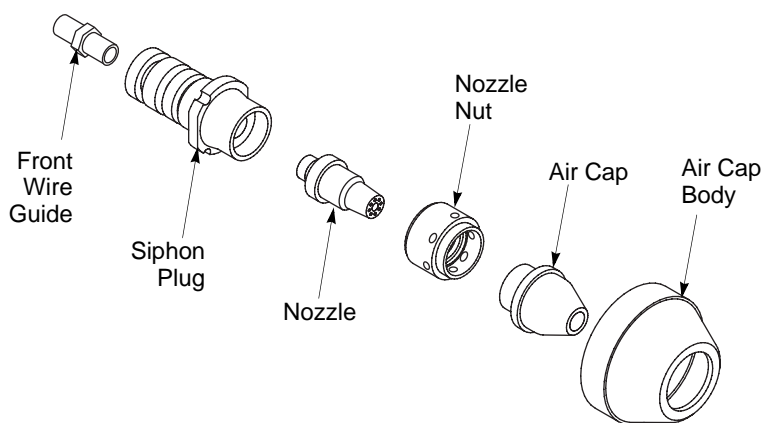
- **Closed / Forward** - All gases to the spray gun are shut off.
- **Lighting / 45°** - A detent in the valve handle indicates the exact position. In the lighting position, the valve allows only oxygen and fuel gas to flow to the nozzle. Air flow remains closed.
- **Run / Vertical** - Fuel gas and oxygen are set to the optimum levels to sustain combustion and air is supplied to the front end and wire drive components.

The gas head assembly features a safety handle and valve return spring. When the safety handle is released, the valve return will quickly close the gas head valve, extinguish the flame and stop the wire from feeding. *The safety handle shall not be overridden or defeated.*

The gas head assembly contains the spray gun front end hardware.

2.2.2 Front End

The front end hardware includes the front wire guide, siphon plug, nozzle, nozzle nut, air cap and air cap body. Wire is fed through the center of these parts.



16e_front_end

The front wire guide, siphon plug, nozzle and air cap are determined by the spraying application. (See "Hardware Selection" on page 26.)



WARNING DANGER

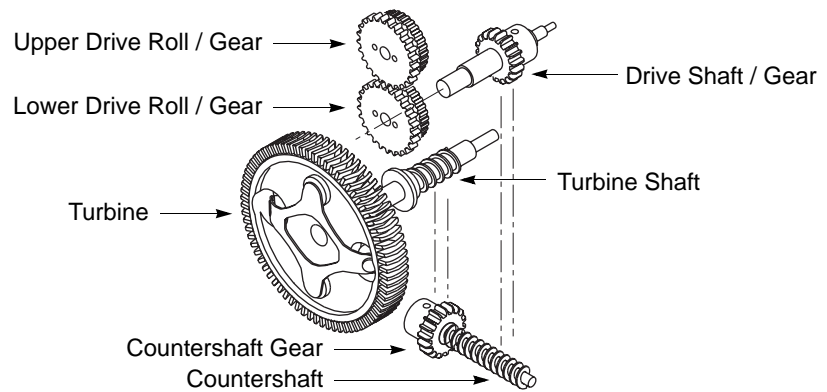
DO NOT attempt to override or defeat the safety handle. Doing so may result in personal injury and equipment damage. Local regulations may require the use of this safety feature.

2.2.3 Turbine and Speed Control

The turbine is air-driven and spins at a high rate of speed whenever air flow is present (i.e., gas head valve is in the run position). Turning the control ring decreases or increases pressure on the brake plate which allows the turbine to spin faster or slower, thus adjusting the wire feed rate.

2.2.4 Countershaft and Bearing Assembly

The following illustration shows the mechanical relationship between the countershaft, drive shaft, turbine shaft and drive roll gears.



16e_gearing

The turbine shaft meshes with the countershaft gear. This results in a reduction in turn ratio from the turbine shaft to the countershaft. The countershaft meshes with the drive shaft gear, resulting in a further reduction in turn ratio to the drive shaft and the lower drive roll and gear. The upper drive gear engages the lower drive gear only when wire is being fed. When the upper and lower drive gears engage, the upper and lower drive rollers grip and feed the wire.

Although the air turbine is light-weight and spins at very high speed (up to 30,000 RPM), the gear reduction results in a much lower speed and a much higher torque at the drive shaft. The reduction ratio through the shafts and gears is not important, except to note that the 16E-H (high-speed) gun has a different turbine shaft and countershaft gear for higher range of feed rate. Additionally, the upper and lower drive rolls and gears can be changed to accommodate different gauges of wires. (See “Hardware Selection” on page 26.)

The countershaft and bearing covers are gasket-sealed to the central housing and contain Gearlube oil. The oil is circulated through an oil pump by the motion of the countershaft and drive shaft gear.



2.2.5 Wire Grip Mechanism and Drive Roll Carrier

The wire grip mechanism is a piston that forces the drive roll carrier to grip and start feeding the wire. The piston is actuated by the wire feed valve on the handle. The turbine, countershaft and lower drive roll turn continuously whenever the gas head valve is in the run position. The wire grip mechanism forces the upper drive roll gear to engage the lower gear and grip the wire. *The adjustment screw at the back of the wire grip mechanism is factory-set and should not be changed.* A manual wire grip mechanism is optionally available. (See “14EWGM Manual Wire Grip Mechanism” on page 22.)

2.2.6 Handle and Wire Feed Control

The **WIRE FEED ON-OFF** control is an air valve that actuates the automatic wire grip mechanism. If the manual wire grip mechanism is installed, there is no wire feed control on the handle.

2.2.7 Rear Wire Guide and Snubber

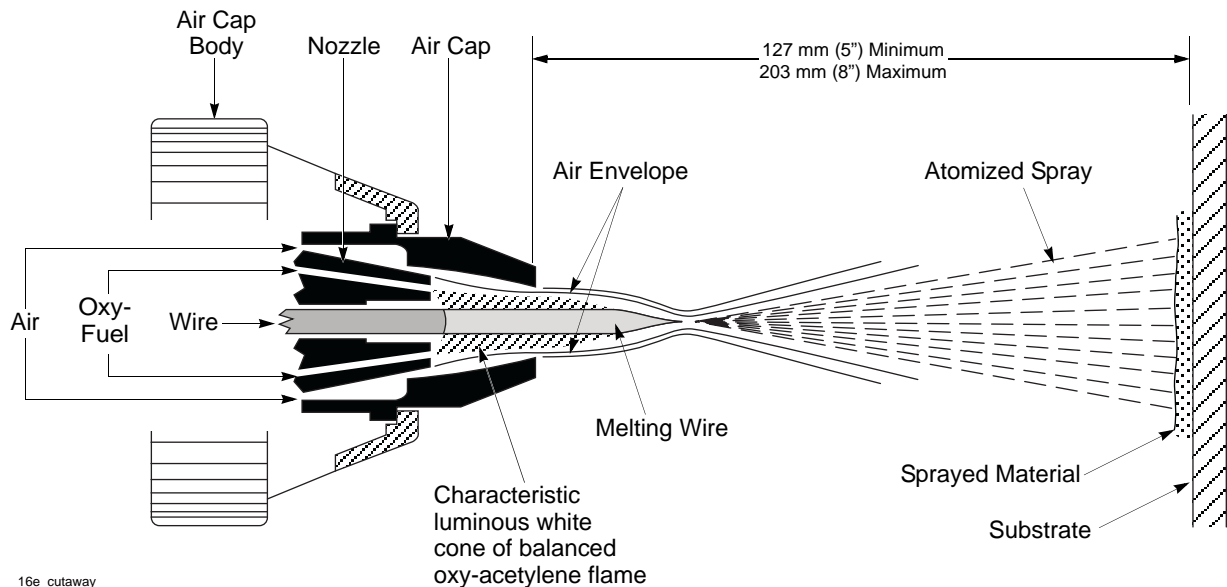
The snubber allows the wire only to feed forward and prevents the wire from being pulled out the back of the gun. The rear wire guide and snubber can be changed for different size wires. (See “Hardware Selection” on page 26.) A strain relief wire guide is also provided which should be used with brittle wires, such as Metco 405. The strain relief maintains a radius in the wire to help prevent the wire from breaking as it enters the gun.



DANGER

Always make sure the snubber is locked. If the wire is pulled out of the rear nozzle while the gun is lit, the fuel gas may flash back through the rear wire guide. Also, the wire end can be extremely sharp. If the wire comes out of the gun it can cause personal injury.

2.3 Principles of Operation



2.3.1 Mechanical Operation

Except for combustion, all functions of the spray gun are powered by air pressure and flow. Air pressure drives the turbine and wire drive mechanisms, enables the wire grip mechanism to feed the wire, cools the nozzle and air cap and propels the atomized material onto the workpiece surface. It is essential that proper air pressure and flow be maintained to the spray gun during operation.

Once the turbine is up to speed, the drive shaft and lower drive roll and gear are turning. The speed of the turbine is controlled by rotating the control ring as indicated (i.e., **FASTER, SLOWER**). Opening the wire feed valve on the handle actuates the wire grip mechanism. This engages the upper and lower drive gears to grip and feed the wire. The wire extends beyond the front of the air cap where it is fully melted and sprayed.

2.3.2 Combustion

The oxy-fuel gas does not have enough energy, even after combustion, to propel the melted material. When the spray gun is initially lit (with the gas head valve in the lighting position), there is no air flowing to the front end. Immediately after the gas is lit, the gas head valve is set to the run position. In the run position, the oxygen and combustion gases flow at optimum levels for sustained combustion and air flows to the air cap. The air flow to the air cap maintains an air envelope around the flame and the melting wire. The air envelope cools the front end parts, prevents loading of material on the air cap and propels the melted material onto the substrate.



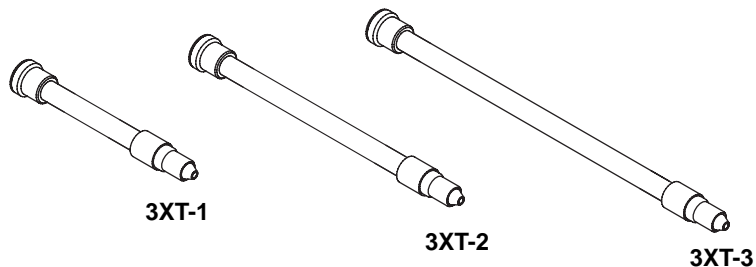
2.3.3 Wire Feeding

When wire feeding is stopped, the wire will melt to a point inside the air cap just beyond the nozzle face. This is the ideal position of the wire to resume feeding or for lighting the gun. Wire feeding should always be stopped before closing the gas head valve.

If the safety handle is released while wire is feeding, the flame will extinguish but the wire will not melt back to the proper point because the flame is also extinguished. The wire will extend beyond the air cap. Before relighting the gun, trim the wire and position the end to slightly beyond the nozzle (inside the air cap). Also remember to close the wire feed valve.

2.4 Spray Gun Options

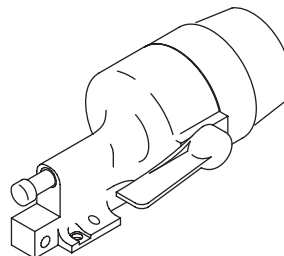
2.4.1 3XT Spray Gun Extensions



16e_3xt

Spray gun extensions are available in 305 mm (1'), 610 mm (2') and 915 mm (3') lengths. The spray gun extension directly replaces the spray gun's standard front end hardware and provides access to work-piece surfaces that otherwise cannot be reached. Some of the standard front end hardware is interchangeable with the extensions. Angular air caps are also available for spraying inner bore diameters. Refer to MAN 41526.

2.4.2 14EWGM Manual Wire Grip Mechanism



16e_14ewgm

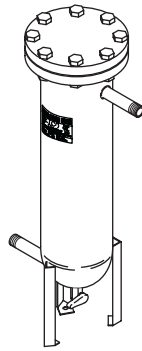
The manual wire grip mechanism replaces the standard automatic wire grip mechanism. If the manual wire grip mechanism is installed, there is no wire feed control on the handle. Refer to AI 43627.



2.5 Auxiliary Equipment

The 16E / 16E-H / 16E-P Spray Gun is the central component of the flame spray system. A complete flame spray system requires supporting equipment to control compressed air, oxygen and fuel gas, and to feed the metalizing wire.

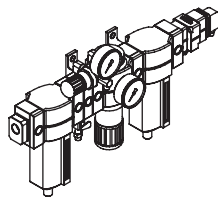
4AC Air Cleaner



16e_4ac

The 4AC Air Cleaner is used as the primary air filter for thermal spraying applications. It removes moisture, grease, oil, oil vapor and dirt from the compressed air supply line. Refer to MAN 73102.

6A Air Control Unit



16e_6a

The 6A Air Control Unit is a pressure regulator and filter for the air supply to the thermal spraying system. Refer to MAN 40400.

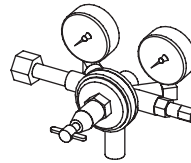
3AF Air Flowmeter



16e_3af

The 3AF Air Flowmeter controls and monitors the air flow to the thermal spraying system. Refer to MAN 82728.

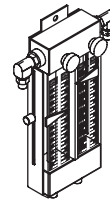
3GR Regulators



16e_3gr

The 3GRA, 3GRO and 3GRP regulators are used to control the gas pressure for acetylene, oxygen and propane supply tanks, respectively. Refer to AUX 73498.

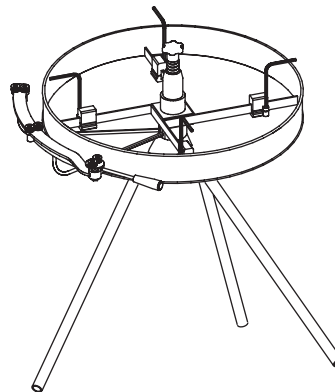
3GF Gas Flowmeter



16e_3gf

The 3GF Gas Flowmeter controls and monitors the oxygen and fuel gas flow rates to the combustion thermal spraying system. Refer to MAN 40367.

2W Wire Control Unit



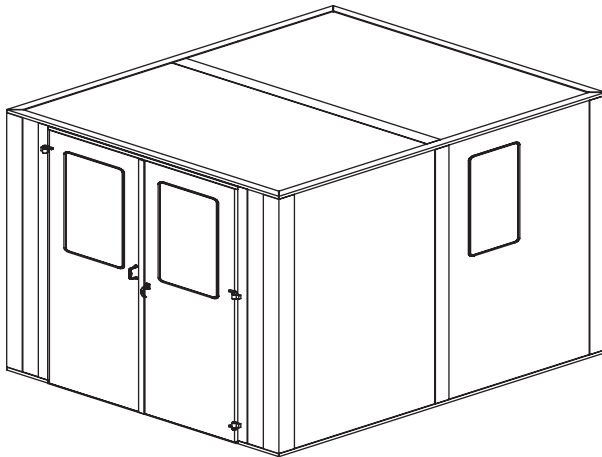
16e_2w

The 2W Wire Control Unit is a wire stand that holds a standard coil of bulk wire. The 2W straightens the wire as it uncoils, and feeds it to the gun under controlled tension. Refer to MAN 87875.

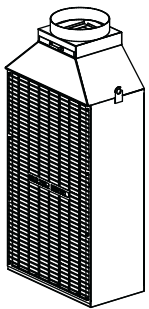


Spray Booth and Exhaust

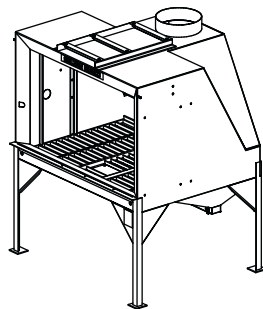
A fixed, permanent, indoor installation must include an exhaust hood or plenum, dust collector and a dedicated ventilation system. The installation might also include an acoustical spray booth and one or more manipulators such as a lathe, turntable or robot.



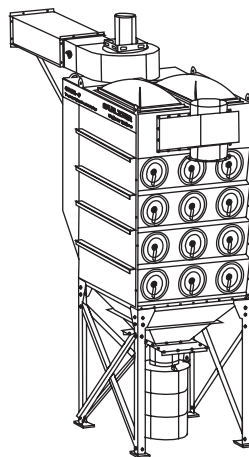
Acoustical Spray Booth



Exhaust Plenum



Exhaust Hood



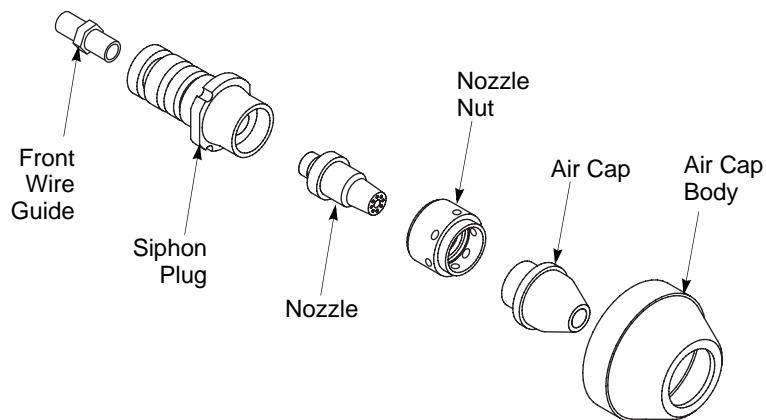
Dust Collector

16e_booth_vent

2.6 Hardware Selection

The 16E / 16E-H / 16E-P Spray Guns are supplied, standard, with hardware that will meet the needs of the most common combustion wire. The specific hardware requirements are determined by combustion gas, wire type, wire size, and conditions of use. This section provides an overview of the hardware available and its usage. More detailed selection criteria are contained in the spray parameters, PAR 96447. Order numbers for all parts are provided in the parts list, PL 96151.

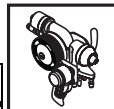
2.6.1 Front End Hardware



16e_front_end

Front end hardware selection is mainly determined by combustion gas, wire size, wire type and the duration of continuous spraying (e.g., part size).

- The standard hardware is intended for spraying large areas where the wire is continuously fed.
- Short-duration spraying (start-stop operation) may cause loading of material inside the air cap. Non-load air caps are intended to minimize material loading.
- Softer wire, with a lower melting point (e.g., babbitt, tin, etc.), may tend to “stick” in the nozzle during start-stop operation. Where recommended in the spray parameters, a non-load nozzle should always be used. The spray rate with a non-load nozzle will be somewhat less than with a standard nozzle.
- Fan spray air caps provide a broad, flat spray pattern and may be oriented horizontally, vertically or at any angle.
- All hardware configurations use the standard nozzle nut (12E6) and air cap body (11E1).
- For front wire guide selection, see “Wire Guides, Drive Rolls and Drive Gears” on page 29.



Siphon Plug / Nozzle / Air Cap Selection Chart

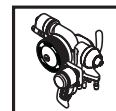
			Normal Spraying All Wire		Start-Stop Operation Aluminum & Zinc Alloys		Start-Stop Operation Babbit, Tin Low Melting-Point Alloys	
Fuel Gas	Wire Size	Siphon Plug	Nozzle	Air Cap	Nozzle	Non-Load Air Cap	Non-Load Nozzle	Non-Load Air Cap
Acetylene or Hydrogen	3/16 ¹	12E2-5 (1000259)	12E7-42 (1000285)	3K3-EA (1000666)	12E7-42 (1000285)	3K3-AH (1000662)	12E7-45 (1000287)	3K3-AH (1000662)
	5/32	12E2-5 (1000259)	14E7-51 (1004756)	3K3-EA (1000666)				
	1/8 ²	12E2-5 (1000259)	12E7-48 (1000290)	8E3-EC (1001570)	12E7-48 (1000290)	3K3-CH (1000664)	12E7-26 (1000273)	3K3-CH (1000664)
	11 Ga.	12E2-5 (1000259)	12E7-35 (1000280) or 12E7-41 ³ (1000284)	4E3-J (1000835)	12E7-35 (1000280)	3K3-JH (1000667)	12E7-36 (1000281)	3K3-JH (1000667)
	15 Ga.	12E2-7 (1000261)	12E7-29 (1000275)	4E3-M (1000836)	12E7-29 (1000275)	3K3-JH (1000667) or 3K3-MH (1000668)	12E7-30 (1000276)	3K3-JH (1000667) or 3K3-MH (1000668)
Propane or Natural Gas	3/16 ¹	12E2-6 (1000260)	12E7-43 (1000286)	3K3-EA (1000666)	12E7-43 (1000286)	3K3-AH (1000662)	12E7-46 (1000288)	3K3-AH (1000662)
	5/32	12E2-6 (1000260)	14E7-52 (1000320)	3K3-EA (1000666)				
	1/8 ²	12E2-6 (1000260)	12E7-49 (1000291)	8E3-EC (1001570)	12E7-49 (1000291)	3K3-CH (1000664)	12E7-27 (1000274)	3K3-CH (1000664)
	11 Ga.	12E2-6 (1000260)	12E7-37 (1000282)	4E3-J (1000835)	12E7-37 (1000282)	3K3-JH (1000667)	12E7-38 (1000283)	3K3-JH (1000667)
	15 Ga.	12E2-8 (1000262)	12E7-31 (1000277)	4E3-M (1000836)	12E7-31 (1000277)	3K3-JH (1000667) or 3K3-MH (1000668)	12E7-32 (1000278)	3K3-JH (1000667) or 3K3-MH (1000668)
MAPP	3/16 ¹	12E2-6 (1000260)	12E7-44 (1031129)	3K3-AM (1000663)	12E7-44 (1031129)		12E7-47 (1000289)	
	1/8 ²	12E2-6 (1000260)	12E7-25 (1000272)	8E3-EC (1001570)	12E7-25 (1000272)	3K3-CHM (1000665)	12E7-28 (1031126)	3K3-CHM (1000665)
	11 Ga.	12E2-6 (1000260)	12E7-39 (1004743)	4E3-J (1000835)	12E7-39 (1004743)		12E7-40 (1031128)	
	15 Ga.	12E2-8 (1000262)	12E7-33 (1000279)	4E3-J (1000835)	12E7-33 (1000279)		12E7-34 (1031127)	

Siphon Plug / Nozzle / Air Cap Selection Chart (Continued)								
			Normal Spraying All Wire		Start-Stop Operation Aluminum & Zinc Alloys		Start-Stop Operation Babbit, Tin Low Melting-Point Alloys	
Fuel Gas	Wire Size	Siphon Plug	Nozzle	Air Cap	Nozzle	Non-Load Air Cap	Non-Load Nozzle	Non-Load Air Cap
Manufactured Gas	3/16 ¹	12E2-5 (1000259)	12E7-43 (1000286)	3K3-EA (1000666)	12E7-43 (1000286)		12E7-46 (1000288)	
	1/8 ²	12E2-5 (1000259)	12E7-49 (1000291)	8E3-EC (1001570)	12E7-49 (1000291)		12E7-27 (1000274)	
	11 Ga.	12E2-5 (1000259)	12E7-37 (1000282)	4E3-J (1000835)	12E7-37 (1000282)		12E7-38 (1000283)	
	15 Ga.	12E2-7 (1000261)	12E7-31 (1000277)	4E3-M (1000836)	12E7-31 (1000277)		12E7-32 (1000278)	

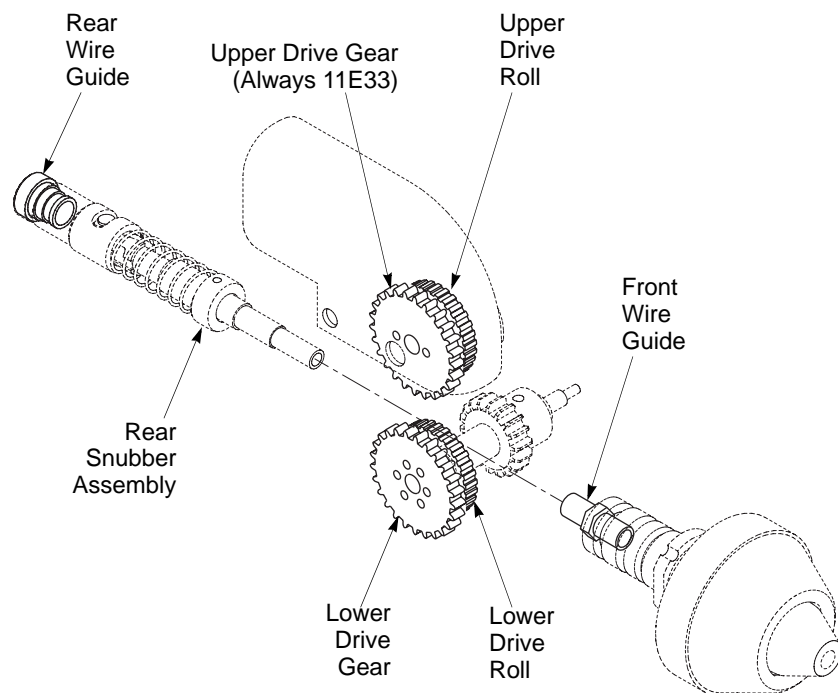
1. For fan spray, use air cap Y4-AB (1002414) with 3/16" wire.
2. For fan spray, use air cap 4E4-CD (1000841) with 1/8" wire.
3. Sprabond wire only.

Standard/Non-Loading Air Cap Equivalency Chart		
Standard Air Cap	Equivalent Non-Load Air Cap	
	Acetylene & Propane	MAPP
3K3-EA (1000666)	3K3-AH (1000662)	—
3K3-AM (1000663)	—	—
8E3-EC (1001570)	3K3-CH (1000664)	3K3-CHM (1000665)
4E3-J (1000835)	3K3-JH (1000667)	—
4E3-M (1000836)	3K3-JH (1000667) ¹	—
Y3-C (1002413)	3K3-CH (1000664)	3K3-CHM (1000665)

1. If a smaller spray pattern is desired, use 3K3-MH (1000668) instead of 3K3-JH. Operating pressure range of the gun will be reduced. Depending on wire being sprayed and spraying cycle, there may be tendency for some air cap loading.



2.6.2 Wire Guides, Drive Rolls and Drive Gears



16e_guides_rolls_gears

Selection of the wire guides, drive rolls and drive gears is determined by wire size. For all wires, the upper drive gear is the same (11E33).

Wire Size	Wire Guides		Drive Rolls		Lower Drive Gear ¹
	Front	Rear Snubber Assembly ²	Upper	Lower	
3/16, 1/8 & 5/32	11E23 (1000160)	11E118 (1000139)	11E32 (1000169)	5E35-316 (1001103)	5E36 (1001104)
1/8 & 11 Ga.	12E23-18 (1000258)	12E118-18 (1000247)	12E32-18 (1000264)	4E35-18 (1000832)	4E36 (1000833)
15 Ga.	12E23-15 (1000257)	14E118-15 (1000246)	12E32-18 (1000264)	4E35-15 (1000831)	4E36 (1000833)
18-20 Ga.	12E23-15 (1000257)	14E118-15 (1000246)	12E32-18G (1000265)	4E35-15 (1000831)	4E36 (1000833)

1. Use upper drive roll gear 11E33 (1000171) for all wires.
2. For individual parts that make up the rear wire guide and snubber assembly, refer to parts list, PL 96151.

3 Installation

- See “Technical Data” on page 15 for facility compressed air and gas requirements.
- Install and set up all auxiliary equipment in accordance with their instructions. (See “Auxiliary Equipment” on page 23.)
- Install, in the spray gun, the hardware required for the spraying application. Refer to the spray parameters, PAR 96447. See also, “Hardware Selection” on page 26 and “Maintenance” on page 41.

3.1 Exhaust System

Metal dust, fumes, and the fuel combustion products call for an effective exhaust and dust collection system. In production installations, if the spraying station is enclosed, make sure that there is enough opening for inlet air so that the exhaust system is not starved. Under some conditions, metal dusts can be quite hazardous. For this reason, the exhaust system should be laid out by an experienced engineer. For most installations, a dust collector especially designed for metallizing dust should be installed. Dust collectors designed primarily for other kinds of dust may be found to be very ineffective and, in some cases, dangerous, if used for metal dust.

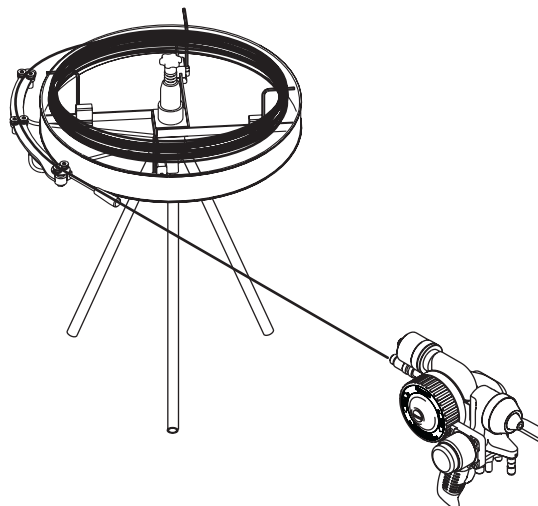
3.2 Wire Control Unit

The 2W Wire Control Unit should be located so that the feeding wire is as straight as possible as it enters the rear wire guide of the spray gun. If the spray gun is mounted on a stationary tool stand, place the 2W as close as practical. If the spray gun is to be hand-held or mounted on a lathe or other manipulating equipment, place the 2W back far enough to allow the wire to straighten as it feeds.



INFO

Always leave the original tag on the wire spool so that the wire can be identified.

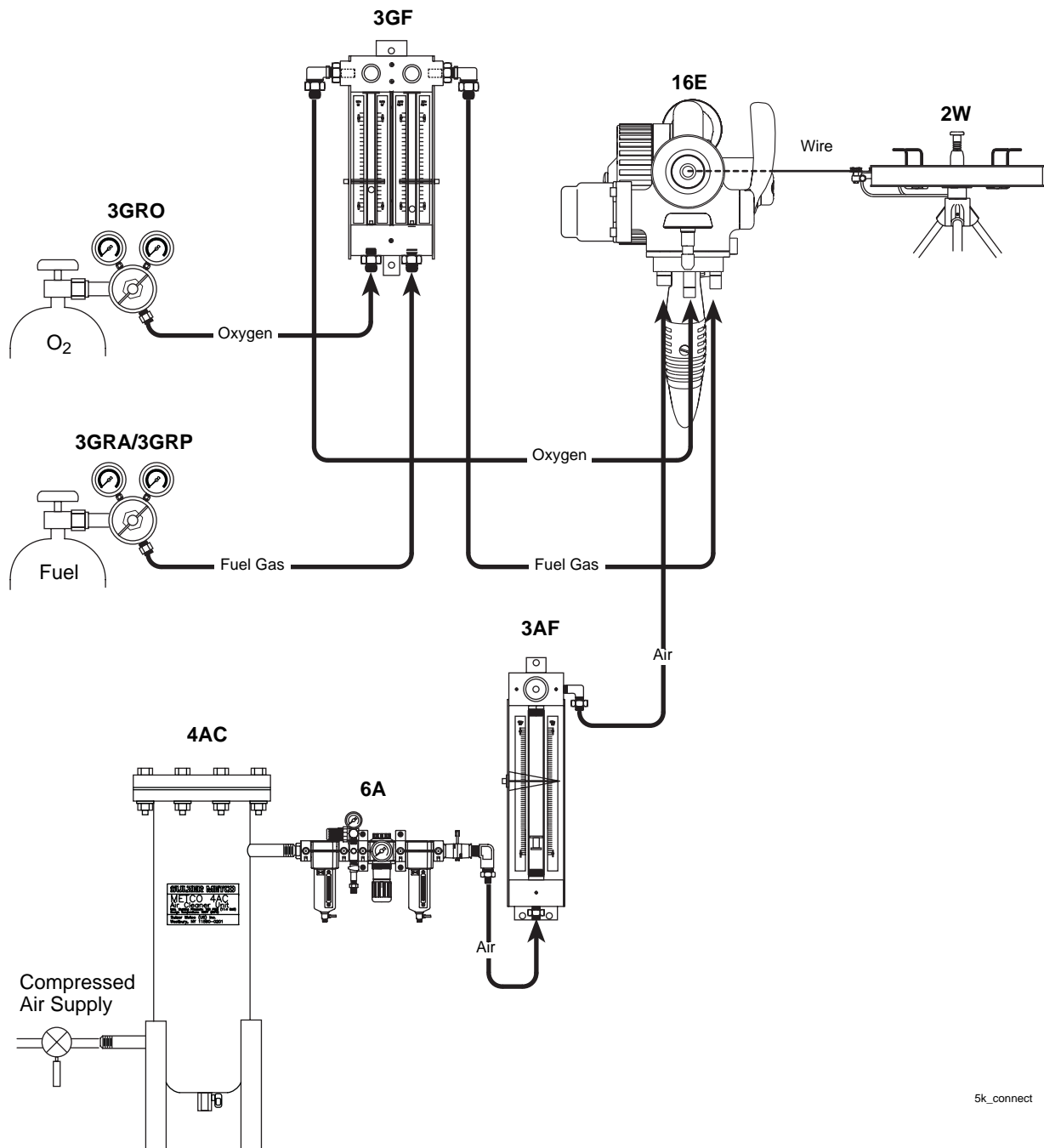


16e_wire_feed



3.3 Connection

A typical 16E / 16E-H / 16E-P Spray Gun installation is shown in the following illustration.



5k_connect

- For a complete list of available hose packages, refer to the parts list, PL 96151.
- Instructions for auxiliary equipment, identify the hoses that are required and optionally available for those components.

**CAUTION**

Always turn on exhaust system whenever venting gas.

**WARNING****FIRE HAZARD!**

Always make sure the hoses are free of oil or grease.

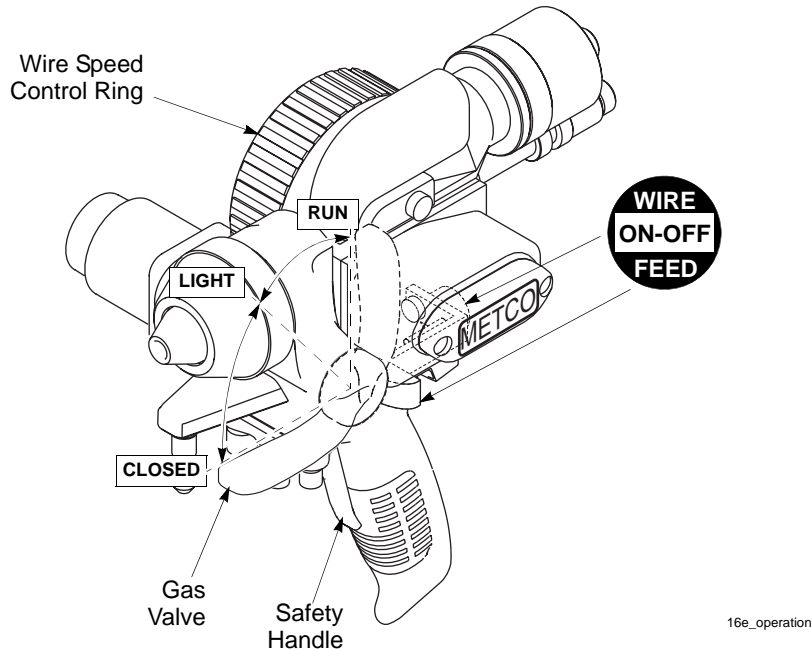
- By convention, fuel gas hoses and fittings have left-hand threads. All other hoses and fittings are right-handed.
1. Turn on exhaust system and blow out all hoses into exhaust hood or plenum using dried/filtered compressed air. Make sure there is no oil or dust in any of the hoses. Oil or grease in the hoses, especially the oxygen hose, can cause a fire.
 2. Connect all hoses to auxiliary equipment. Tighten all fittings firmly but do not overtighten.
 3. Connect oxygen hose to spray gun first. Then connect air and fuel gas hoses.
 4. One at a time, open gas supply valves and regulators. Check and correct for leaks. Use a non-residual leak check solution.
 5. Purge the spray gun: Open the air supply regulator and set the spray gun gas head valve to the full run position. Allow the gun to purge for approximately 5 seconds.

The system is installed and ready for operation.



4 Operation

4.1 Operating Controls



Gas Head Valve

The gas head valve has an automatic safety return which closes the gas valve whenever the safety handle is released. The gas head valve has three positions:

- **Closed** - All gases to the spray gun are shut off.
- **Lighting** - For lighting the gun only. A detent in the valve handle indicates the exact position. Always set the valve to the run position and engage the safety handle first before setting the valve to the lighting position. In the lighting position, the valve allows only oxygen and fuel gas to flow to the nozzle. Air flow remains off. After the gun is lit, the valve is immediately set to the run position. The safety handle must be held for the valve to remain in the lighting position.
- **Run** - Normal operating position for spraying. Fuel gas and oxygen are set to the optimum levels to sustain combustion. Air is supplied to the front end and to the mechanical wire drive components. The safety handle must be held for the valve to remain in the run position.

**INFO**

Engage the safety handle only when the gas head valve is in the run position.

Safety Handle

The safety handle keeps the gas head valve in the run or light position. Releasing it allows the gas head valve to close. Always start by moving the gas head valve to the full run position; then, engage the safety handle. With the safety handle engaged, the gas head valve is then operated manually and can be moved freely to any position.

Always release the safety handle to close the gas head valve and to shut off all gases to the spray gun. Wire feeding should be stopped before releasing the safety handle. If you release the safety handle while wire is feeding, the wire will stop but the flame will be extinguished at the same time and the wire will not be fully melted. It will extend beyond the front of the air cap. Before relighting the gun, close the wire feed valve, trim the wire and position it inside the air cap just beyond the nozzle face.

WIRE FEED ON-OFF Control

Alternate-action valve which starts and stops wire feeding. Applies air pressure to actuate the wire grip mechanism, causing the upper and lower drive rolls to grip and feed the wire. Wire feeding is possible only when the gas head valve is in the run position.

Wire Speed Control Ring

Varies the speed of the air turbine to control the wire feed rate. Turning the control ring in the **SLOWER** direction applies frictional pressure to a brake plate inside the turbine housing, slowing the turbine. Turning the control ring in the **FASTER** direction releases the brake allowing the turbine to spin more freely. The range of travel of the control ring is more than five full turns. The corresponding wire feed rate can be approximated, depending on the gearing of the gun model:

- **16E and 16E-P:**
0.6 – 4.6 meters per minute (2.0 – 15.1 feet per minute)
- **16E-H:**
1.4 – 11.7 meters per minute (4.5 – 38.5 feet per minute)



4.2 Operating Procedures

- Ensure that system installation (“Installation” on page 30) is complete.
- Be familiar with safety regulations under “Safety” on page 7 and always wear personal protective equipment (PPE).
- Turn on exhaust system and always keep spray gun aimed toward exhaust.

4.2.1 Setup

1. On rear wire guide and snubber, push forward and rotate snubber spring housing to its open/unlocked position.
2. Insert metalizing wire into rear wire guide. Guide wire through gun until it appears at front of air cap.
3. Release snubber so that wire is held in rear wire guide.
4. Turn on exhaust system.
5. Open compressed air supply valve and adjust 6A air regulator to pressure specified in spray parameters.
6. On spray gun, open gas head valve to run position. Air flows out of air cap and turbine begins spinning up.
7. Adjust 3AF flowmeter to value specified in spray parameters.
8. If the spray gun has not been used for a long time, rotate the speed control ring over its full range of travel (approximately 5 full turns).
9. Press **WIRE FEED ON-OFF** control to start wire feeding and measure wire feed rate.
 - a. If feed rate is not correct, adjust wire speed control ring **FASTER** or **SLOWER**.
 - b. Unlock snubber, reposition wire and check feed rate again.
 - c. Repeat until desired feed rate is obtained.
10. Close gas head valve (release safety handle).



WARNING

Hazards presented by the thermal spraying process include bright light, high noise levels (>85 dB), dust, fumes and excessive heat.

Turn on exhaust / ventilation system and wear personal protective equipment (PPE).



DANGER

Always make sure the snubber is locked. If the wire is pulled out of the rear nozzle while the gun is lit, the fuel gas may flash back through the rear wire guide. Also, the wire end can be extremely sharp. If the wire comes out of the gun it can cause personal injury.

**DANGER**

DO NOT light the gun without wire in the nozzle. This may cause a flashback through the rear wire guide and cause personal injury.

**DANGER**

If the gas head valve does not close within 1 second of releasing the safety handle, do not use the spray gun. Service the gas head valve.

4.2.2 Lighting

There must always be wire in the nozzle when lighting the gun. If not, the gun may flash back through the rear wire guide. The wire should extend just past the front of the nozzle but not into the opening of the air cap.

Read and become familiar with the lighting procedure before lighting the spray gun. When lighting the gun, keep the gun aimed toward the exhaust flow. When lighting the gun outside, if there is any wind, aim the gun in the direction of the wind.

1. Turn on exhaust system.
2. Open compressed air supply valve and adjust 6A Air Control Unit to pressure specified in spray parameters.
3. On spray gun, open gas head valve to run position and engage safety handle. Air flows out of air cap and turbine begins spinning up.
4. Adjust 3AF Air Flowmeter to value specified in spray parameters.
5. Release safety handle. *Gas head valve must close completely within 1 second, with no gas leakage.* If the gas head valve does not close within 1 second, do not use the spray gun. Service the gas head valve. (See "Gas Head Assembly" on page 51.)
6. Open fuel gas and oxygen tank valves.
7. Adjust fuel and oxygen 3GR regulators to pressures specified in spray parameters.
8. Open gas head valve to run position and engage safety handle. Gases flow out of air cap and turbine begins spinning up. Purge for at least 3 seconds.
9. Adjust 3GF Gas Flowmeter for oxygen and fuel values specified in spray parameters.
10. Check and readjust 3AF Air Flowmeter.
11. Set gas head valve to lighting position and light gun. With the spark lighter, create a spark near the front of the air cap.
 - *Immediately* set the gas head valve to the run position when the flame is lit.
 - If the gun does not light and you hear a "pop" inside the nozzle, *immediately release the safety handle or close the gas head valve.* The gun has flashed back. Shut off fuel and oxygen supplies and purge the gun with air before attempting to light the gun again. See "Troubleshooting" on page 38.



4.2.3 Spraying

Once the gun is lit and the turbine is up to speed, you may begin feeding wire and spraying. Make final adjustments to gas flows and pressures to obtain an optimal flame.

Adjust the wire feed to the highest rate that allows the wire to melt off and spray without spattering. Hold the gun 130 to 205 (5" - 8") mm from the surface being sprayed. Keep the gun aimed as perpendicular to the surface as possible. Hold hoses back from the work area while spraying.

Generally, you should stop wire feeding before releasing the safety handle or closing the gas head valve. If you release the safety handle while wire is feeding, the wire will stop but the flame will be extinguished at the same time and the wire will not be fully melted. It will extend beyond the front of the air cap. Before relighting the gun, close the wire feed valve, trim the wire and position it inside the air cap just beyond the nozzle face.

If you are finished spraying and you intend to remove the wire from the gun, you may release the safety while wire is feeding. This will leave the wire tapered and make it easier to remove from the gun. Trim the sharp tip of the wire before stowing the wire spool.

When spraying low-melting-point wires in occasional start/stop operation, the standard nozzles and air caps are satisfactory. However, frequent starts and stops may cause these parts to load with sprayed metal. If loading occurs or if the wire sticks in the nozzle, select non-load hardware as described under "Hardware Selection" on page 26.

4.2.4 Shutdown

When spraying operations are finished for the day (or for any extended period), shut down the system as follows:

1. Press **WIRE FEED ON-OFF** control to stop wire feeding.
2. Close gas head valve (release safety handle).
3. Close tank supply valves for oxygen and fuel.
4. Open gas head valve for 3-5 seconds to purge system.
5. Back out 3GRA and 3GRO regulator screws.
6. Close compressed air supply valve or shutoff valve on 6A Air Control Unit.
7. Unlock snubber, remove wire from rear wire guide and secure wire to 2W Wire Control Unit.



INFO

The spray parameters (PAR 96447) provide starting points for the materials listed. You may need to make adjustments to obtain the best results for your application.



INFO

Always leave the original tag on the wire spool so that the wire can be identified.

5 Troubleshooting

Where troubleshooting procedures call for disassembly, inspection, assembly and replacement of parts, see "Maintenance" on page 41.

5.1 Avoiding Trouble

- Most common problems are avoided by keeping the spray gun clean and lubricated. See "General Gun Care" on page 41.
- Inspection, cleaning, lubrication and regular maintenance will ensure the spray gun and its parts remain in good working order. See "Scheduled Maintenance" on page 44.
- Whenever the performance of the spray gun or the quality of the coating deteriorates, maintenance should be performed.
- Ensure the metalizing wire is clean and in good condition. Trim any wire that is bent, nicked or gouged before feeding it into the gun. Most wires have a light coating of lubricant to aid in feeding through the nozzle. Dust or dirt on the wire will accelerate wear of the nozzle and wire guides. Always leave the original tag on the wire spool so that the wire can be identified.

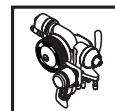
5.2 Difficult Lighting

Possible Causes:

- Damaged or dirty nozzle and/or siphon plug
- Damaged or loaded air cap
- Damaged or obstructed hoses
- Plugged valve core bleeder holes

Corrective Measures:

- Make sure that the nozzle and siphon plug are clean and undamaged.
- Turn fuel and oxygen tanks off, purge the system, screw out the regulator handles to shut off the gases, and then disconnect the hoses. Inspect hoses and gun fittings for dirt or other obstructions. Blow out the hoses before reconnecting them.
- Perform "Lighting Flow Check" on page 40.
- If the gun has been idle for some time, or after the valve has just been lubricated, work the valve on and off a few times with gases and air turned on before lighting. This will blow out any excess valve lubricant.



5.3 Flashback / Backfire

Symptom:

Gun will appear to go out or fail to light with a “pop” and will burn back in the siphon plug.

Possible Causes:

- Leak at the wire nozzle o-rings (see “Nozzles” on page 41)
- Worn nozzle
- Dirt in the nozzle jets
- Oversized or ragged jets
- Plugged siphon plug bleeder holes (see “Siphon Plug” on page 41)
- Leak at the siphon plug o-rings
- Use of wrong air cap or clogged/loaded air cap

Corrective Measures:

- Excessive backfire makes it necessary to clean the siphon plug and nozzles. It may also cause the nozzle nut to loosen.
- Replace damaged components.

5.4 Sticking Wire

Symptom:

Feeding stops

Possible Causes:

- Loading of soft wire
- Kinked or bent wire
- Metal shavings in the nozzle

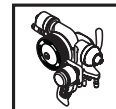
Corrective Measures:

- Select non-loading hardware. See “Hardware Selection” on page 26.
- If the wire melts into the end of the nozzle, it can usually be removed by twisting and forcing the wire through from the back with pliers.
- To reduce sticking due to kinks or bends, especially with hard wire, place the wire control unit so that the wire feeds straight to the gun. Do not overtighten the brake on the wire control unit.

5.5 Lighting Flow Check

Normal gas flow ranges with the gas head valve in the lighting position are given below. Flows lower than those shown indicate a possible blockage on a valve core bleeder port. Higher flows may mean a leaky valve seal.

Fuel Gas	Wire Size	Lighting Pressure				Lighting Flows (3GF Flowmeter Reading)			
		Oxygen		Fuel		Oxygen Scale		Acetylene Scale	
		bar	PSI	bar	PSI	NLPM	SCFH	NLPM	SCFH
Acetylene	3/16"	2.6	38	1	15	19 - 29	46 - 64	1½ - 2½	3 - 5
	1/8"	2.6	38	1	15	19 - 29	46 - 64	1½ - 2½	3 - 5
	11 ga.	1.7	25	1	15	15 - 22	36 - 50	1½ - 2½	3 - 5
	15 ga.	1.7	25	1	15	14 - 20	34 - 48	1½ - 2½	3 - 5
Propane	3/16"	2.9	42	2.6	38	24 - 32	55 - 72	2 - 3	4 - 7
	1/8"	3.2	47	2.9	42	24 - 32	55 - 72	2 - 3	4 - 7
	11 ga.	2.4	35	2.1	30	19 - 26	46 - 60	2 - 3	4 - 7
	15 ga.	2.1	30	2.1	30	17 - 24	40 - 55	2 - 3	4 - 7



6 Maintenance

6.1 General Gun Care

- Always keep the spray gun clean. Dirt, grit and metal dust in the mechanism will cause quick wear. Before lubrication or overhaul, wipe the gun thoroughly to remove all loose dirt.
- Use a clean work bench.
- When disassembling, replacing and assembling any parts that contain o-rings, inspect all o-rings. Check for wear, cuts, nicks and flat areas. Replace any o-ring that is not in very good condition. Apply a light coating of Krytox® lubricant to all o-rings before assembling. The lubricant is required to ensure a proper seal and makes assembly easier.
- Use only Krytox® on all o-rings. Do not use Sulzer Metco Valve-lube or Ringlube.
- Keep the teeth on the drive rolls clean by brushing with a wire brush. Blow out chips or shavings from the cavity in the central housing using compressed air.
- Use a small amount of Krytox® on the threads of the air cap body, nozzle nut, rear countershaft bearing retainer and control ring.

6.2 Siphon Plug

The siphon plug should be cleaned occasionally. Wipe out the grooves and clean out the holes with the proper size wires from the cleaning wire kit.

Do not wash the o-rings with cleaning solvent. Inspect them for damage and replace them if necessary. Do not stretch new o-rings more than necessary. Lubricate all o-rings with Krytox® before reassembling the siphon plug. Wipe any excess Krytox® off the plug.

6.3 Nozzles

Whenever a nozzle is put on the gun, the bore of the siphon plug should be wiped clean and a fresh film of Krytox® put on the nozzle o-rings. The nozzle nut must be tight on the siphon plug. Firm tightening by hand is sufficient. Overtightening the nozzle nut can cause damage.

The nozzle should be kept clean. To clean the nozzle, remove the nozzle o-rings and wash the nozzle in cleaning solvent. Clean jet holes with the proper size wire from the cleaning wire kit. From the back end, push the cleaning wire carefully into each jet hole. From the back end, blow out the holes with compressed air. Do not wash the o-rings with cleaning solvent. Inspect them for damage and replace them if necessary. Do not stretch new o-rings more than necessary. Lubricate o-



CAUTION

Observe all precautions related to the use of Krytox®.



WARNING

Damage!

Use only Krytox® on all o-rings in the 16E / 16E-H / 16E-P Spray Gun. Do not use Sulzer Metco Valvelube or Ringlube.



WARNING

Damage!

Do not use a drill bit or any other device which would enlarge holes! Do not rotate the cleaning wires in the holes!

**CAUTION**

When servicing the gas head valve, always follow instructions for disassembly under “Gas Head Assembly” on page 51 and assembly under “Gas Head Assembly” on page 65.

rings with Krytox® before reinstalling the nozzle. Wipe any excess Krytox® off the nozzle.

The bushing inside the nozzle is intended to fit the wire precisely. This prevents gas leakage and backfire. This bushing is a very durable alloy that resists fusing with wire metals (i.e., loading). The bushing will wear over time, requiring that the nozzle be replaced.

6.4 Gas Head Valve

Proper lubrication of the gas head valve is essential for operation of the safety handle and for a perfect seal of all gases. The valve core must always move freely and easily to all positions. If the gas head valve becomes stiff, fails to close within 1 second of releasing the safety handle or fails to seal completely, disassemble and clean the parts of the gas head assembly. Replace all o-rings and apply Krytox®.

Always remove the hose block and valve plungers before removing the valve core. One of the hose block mounting screws extends into a channel in the valve core to prevent the valve core from being removed while the hose block and valve plungers are installed.

When replacing the o-rings on the valve core, install the o-rings on the valve core dry. Then, apply a generous amount of Krytox® to the entire surface of the valve core. After servicing the valve core, purge the spray gun thoroughly to clear any lubricant from the valve passages.

The three valve plungers in the hose block have radiused faces to mate with the curvature of the valve core. The o-rings between the plungers and valve core are special. They must not be replaced with non-Sulzer Metco parts. Do not clean these o-rings with solvent. Over time, these o-rings will become curved and flat and should be replaced.

6.5 Countershaft / Bearing Lubrication

To lubricate a dry gun, use no more than 1 fluid oz (30 ml) of Sulzer Metco Gearlube to fill the gear case. To do this, remove the oil filler plug from the back of the central housing. Pour in the correct amount of Gearlube. With the gun upright and level, the lubricant should be visible at the bottom of the filler plug threads. Check level again after waiting a short time then install the filler plug and o-ring.



6.6 Hoses

The following hose conditions will cause problems:

- Obstructions in hoses will reduce the flow of oxygen and fuel gas and upset the flame balance. Blow out hoses with compressed air before connecting them.
- Make sure there is no oil or dust in the hoses. Oil or grease in the hoses, especially the oxygen hose, can cause a fire.
- In an old worn hose, the lining may come loose and plug up the hose. Inspect and replace damaged hoses.
- Do not overtighten hose fittings. If a hose fitting is overtightened, the stem in the male fitting may collapse. This reduces the flow of gases and causes the same problems as obstructions in the hoses.
- The gun-end connections of the two gas hoses are most likely to be damaged. If the hole in the stem is the correct size, the back of a #43 drill (.089" or 2.2 mm diameter) should slip easily into the stems at the gun end of the gas hoses.



**WARNING
FIRE HAZARD!**

Always make sure the hoses are free of oil or grease. Oil or grease in the hoses, especially the oxygen hose, can cause a fire.

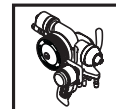
6.7 Scheduled Maintenance

This section provides information to help maximize service life and performance of the gun.

Speed and load of gun, frequency of lighting, temperature at which gun operates affect service frequency of the spray gun.

Service Plan

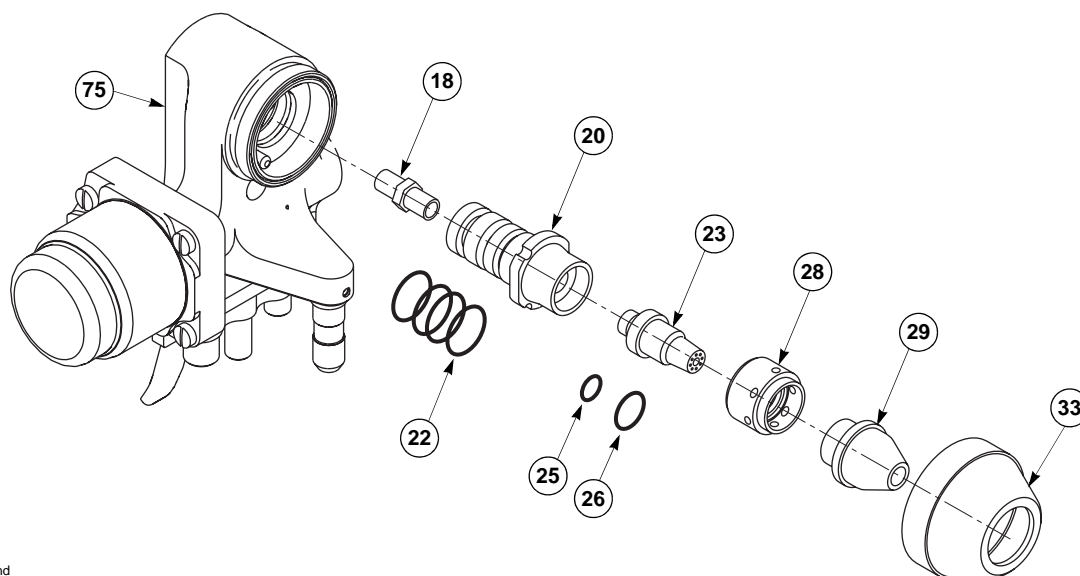
Operating hours				Activity	Tool
1000	200	40	8	Clean spray gun Check spray gun and gas supply hoses for damage	Clean durable cloth
1000	200	40	8	Clean drive rolls	Brush, compressed air
1000	200	40	8	Clean air cap, wipe out soot	
1000	200	40	8	Clean nozzle	Cleaning wire kit
1000	200	40		Clean siphon plug	Cleaning wire kit
1000	200	40		Oil upper drive roll bushing	2 drops
1000	200	40		Oil upper drive roll carrier hinge	1 drop
1000	200	40		Lube turbine cover bearing	Gearlube, 1.5mm strip
1000	200	40		Check lubricant in gear case	
1000	200			Clean turbine brake disc and shoe. Do not lube!	Cleaning solvent
1000	200			Clean and lubricate control ring thread	Krytox®
1000	200			Clean turbine shaft oil seal: - Wash contacting faces of bobbins and washers - Reassemble dry, except for a thin film Gearlube on bobbin O-rings	Cleaning solvent
1000				Clean and lubricate gas head valve	Krytox®
1000				Complete overhaul of spray gun ("Disassembly" on page 50 and "Assembly" on page 59)	



6.8 Replacing Common Parts

This section describes how to remove and install parts that may wear out from normal use and parts that are configurable for different spraying applications. (See “Hardware Selection” on page 26.) For complete overhaul of the spray gun, see “Disassembly” on page 50 and “Assembly” on page 59. For a complete list of replacement parts, refer to the parts list, PL.96151.

6.8.1 Front End Hardware



16e_frontend

Removal/Disassembly

1. Manually unscrew air cap body (33) from gas head assembly (75).
2. Remove air cap (29).
3. Using fingers only, carefully pull siphon plug assembly (18-28) straight out from gas head assembly (75).
4. Manually unscrew nozzle nut (28) from siphon plug (20).
5. Using fingers only, carefully pull nozzle (23) out from siphon plug (20).
6. Unscrew front wire guide (18) from siphon plug (20).

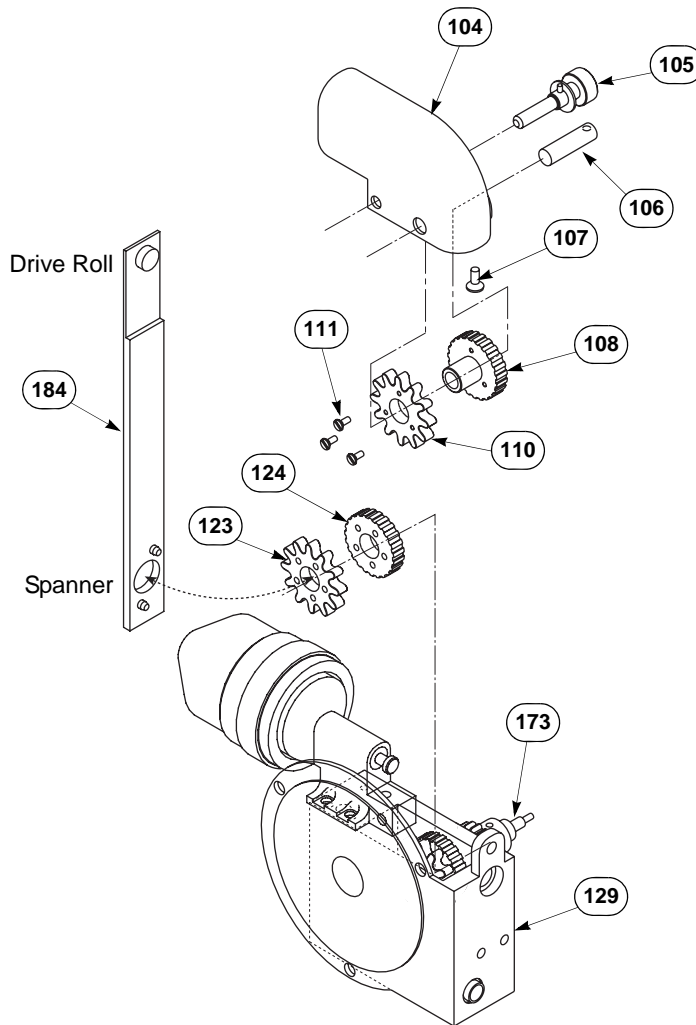
Assembly/Installation

1. Install four o-rings (22) on siphon plug (20).
2. Install two o-rings (25 and 26) on nozzle (23).
3. Apply a light coating of Krytox® lubricant to all o-rings.
4. Install front wire guide (18) on siphon plug (20).

5. Carefully press nozzle (23) into front of siphon plug (20). Be careful that nozzle o-rings are not twisted or torn and ensure that nozzle shoulder is flush with front of siphon plug.
6. Install nozzle nut (28) on siphon plug (20) and tighten firmly by hand.
7. Carefully press siphon plug assembly (18-28) into gas head assembly (75). Twist slightly and align cutouts in siphon plug flange with pins on gas head assembly. You should feel each siphon plug o-ring slip into the bore. The siphon plug is fully seated when the gas head pins extend slightly beyond the siphon plug flange.
8. Install air cap (29).
9. Install air cap body (33) on gas head assembly (75) and tighten firmly by hand.



6.8.2 Drive Rolls and Gears



16e_rolls_gears

Upper Drive Roll/Gear Removal/Disassembly

1. Press and turn pivot pin (105) clockwise and remove pivot pin.
2. Remove drive roll carrier (104) from spray gun.
3. Remove screw (107) and slide drive roll axle (105) out from drive roll carrier (104). Upper drive roll (108) and upper drive gear (110) will come out of drive roll carrier.
4. Remove three screws (111) securing upper drive roll (108) to upper drive gear (110).

Upper Drive Roll/Gear Assembly/Installation

1. Assemble upper drive roll (108) to upper drive gear (110) and secure with three screws (111).
2. Install upper drive roll (108) and upper drive gear (110) in drive roll carrier (104) and slide drive roll axle (105) through drive roll carrier and center of gear and roller.



INFO

Use upper drive roll gear 11E33 (1000171) for all hardware configurations.

**INFO**

The drive shaft and lower drive gear have left-hand threads.

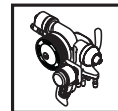
3. Install screw (107) through bottom of drive roll carrier (104) and thread into drive roll axle (105). Tighten screw securely.
4. Install drive roll carrier (104) on spray gun. Make sure that piston rod of drive roll mechanism engages groove in drive roll carrier.
5. Install pivot pin (105), press and turn counterclockwise to lock.

Lower Drive Roll/Gear Removal

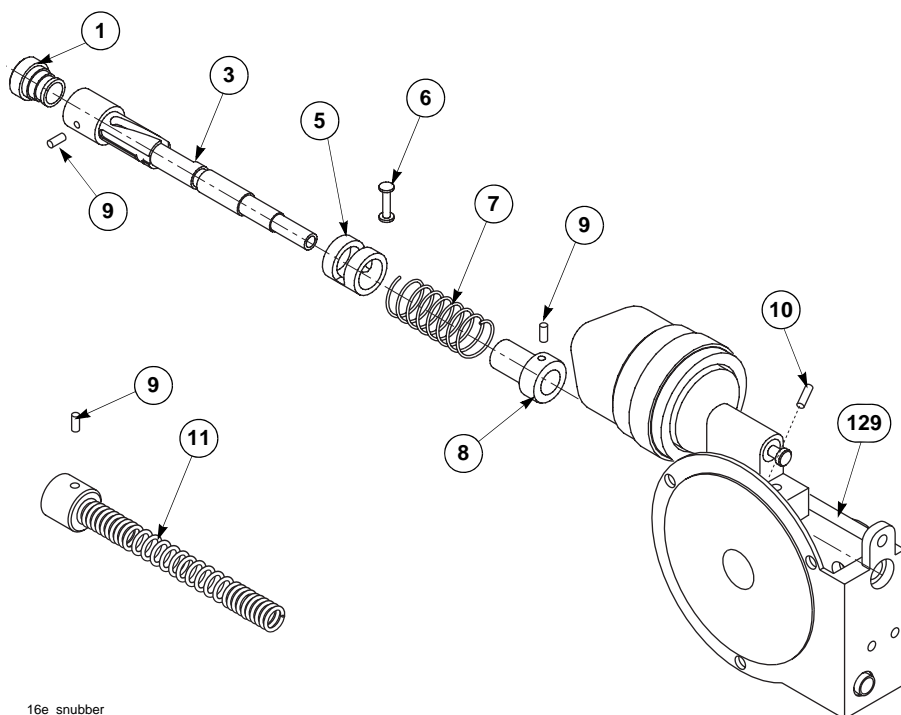
1. Using spanner tool (184) inside cavity of central housing (129), engage pins with holes in lower drive gear (123).
2. Loosen lower drive gear (123) from drive shaft (173) by turning gear *clockwise* (toward front of spray gun).
3. Once loose, manually unscrew lower drive gear (123) from drive shaft (173) and remove.
4. Repeat steps 1-3 for lower drive roll (124).

Lower Drive Roll/Gear Installation

1. Place lower drive roll (124) onto drive roll tool (184), reach inside cavity of central housing (129) and thread lower drive roll onto drive shaft (173).
2. Use fingers to thread lower drive roll onto drive shaft, *counter-clockwise*.
3. Using spanner tool (184), tighten lower drive roll (124) by turning roll *counter-clockwise* (toward rear of spray gun).
4. Repeat steps 1-3 for lower drive gear (123). Make sure the gear's extended shoulder faces the drive roll.



6.8.3 Rear Wire Guide and Snubber



16e_snubber

Removal/Disassembly

1. Remove set screw (9) and remove wire guide insert (1) (or strain relief assembly (11)).
2. Remove set screw (10) (from wire drive mechanism flange) and remove wire guide and snubber assembly (3-8) from central housing (129).
3. Remove set screw (9) and remove spring retainer (8) from wire guide snubber (3).
4. Disassemble wire guide snubber (3), snubber spring housing (5), roller (6) and compression spring (7).

Assembly/Installation

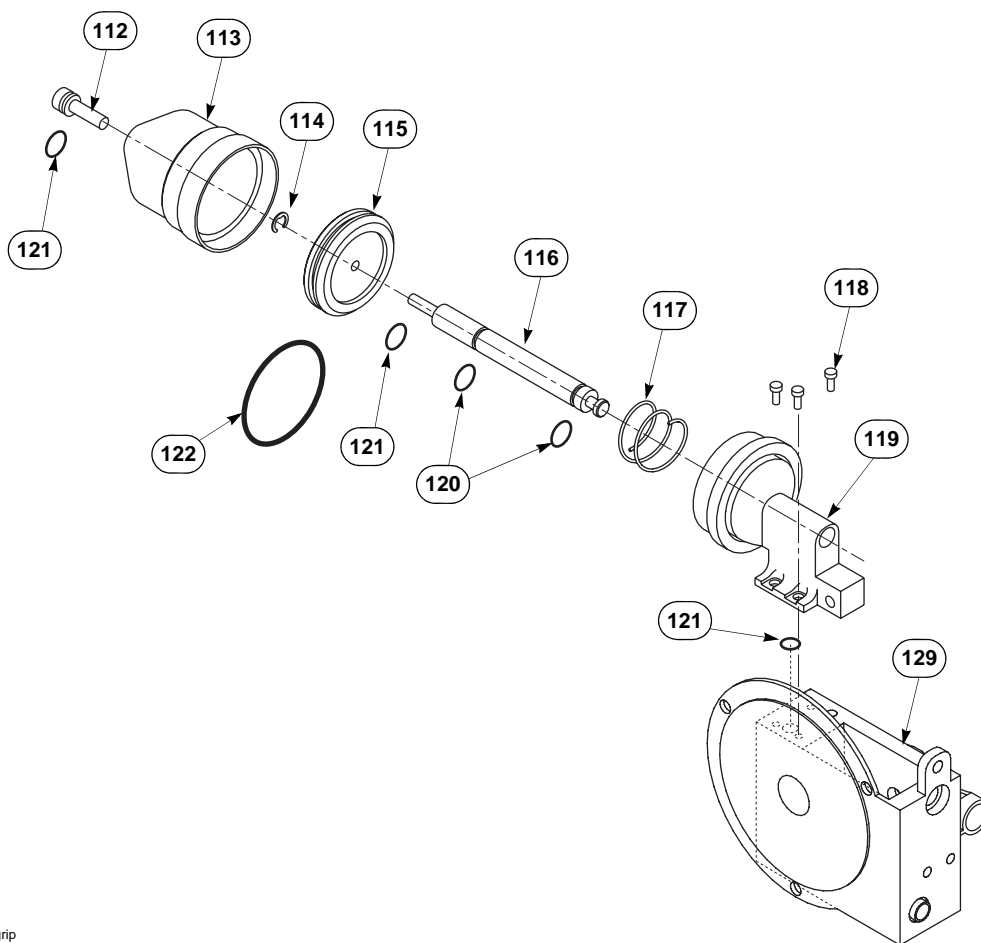
1. Assemble wire guide snubber (3), snubber spring housing (5), roller (6) and compression spring (7).
2. Install spring retainer (8) on wire guide snubber (3) and secure with set screw (9). Make sure set screw seats within channel in wire guide snubber.
3. Install wire guide and snubber assembly (3-8) in central housing (129) and secure with set screw (10). Make sure set screw seats in countersink in wire guide snubber.
4. Install wire guide insert (1) (or strain relief assembly (11)) in wire guide snubber (3) and secure with set screw (9). Make sure set screw seats in countersink in wire guide snubber.

6.9 Disassembly

Disassembly of the spray gun for service or overhaul can be done in any order except where noted. If a part must be removed for access, the prerequisite procedure is referenced.

6.9.1 Wire Grip Mechanism

1. Remove drive roll carrier. (See "Drive Rolls and Gears" on page 47.)
2. Remove three screws (118) securing wire grip mechanism to central housing (129) and remove wire grip mechanism.



16e_wire_grip



CAUTION

Do not remove or adjust screw on back of wire grip mechanism.

3. Unscrew and remove cylinder (113). *Do not remove or adjust screw (112) unless necessary to replace screw or o-ring (121).*
4. Pull piston assembly (114-116) out from support block (119) along with spring (117).
5. Remove retaining ring (114) from piston rod (116) and remove piston (115) from piston rod.

6.9.2 Gas Head Assembly

The gas head assembly may be completely disassembled and serviced without removing it from the spray gun. To remove the gas head assembly, remove one screw (86) and two screws (91) securing the gas head assembly to the central housing (129).

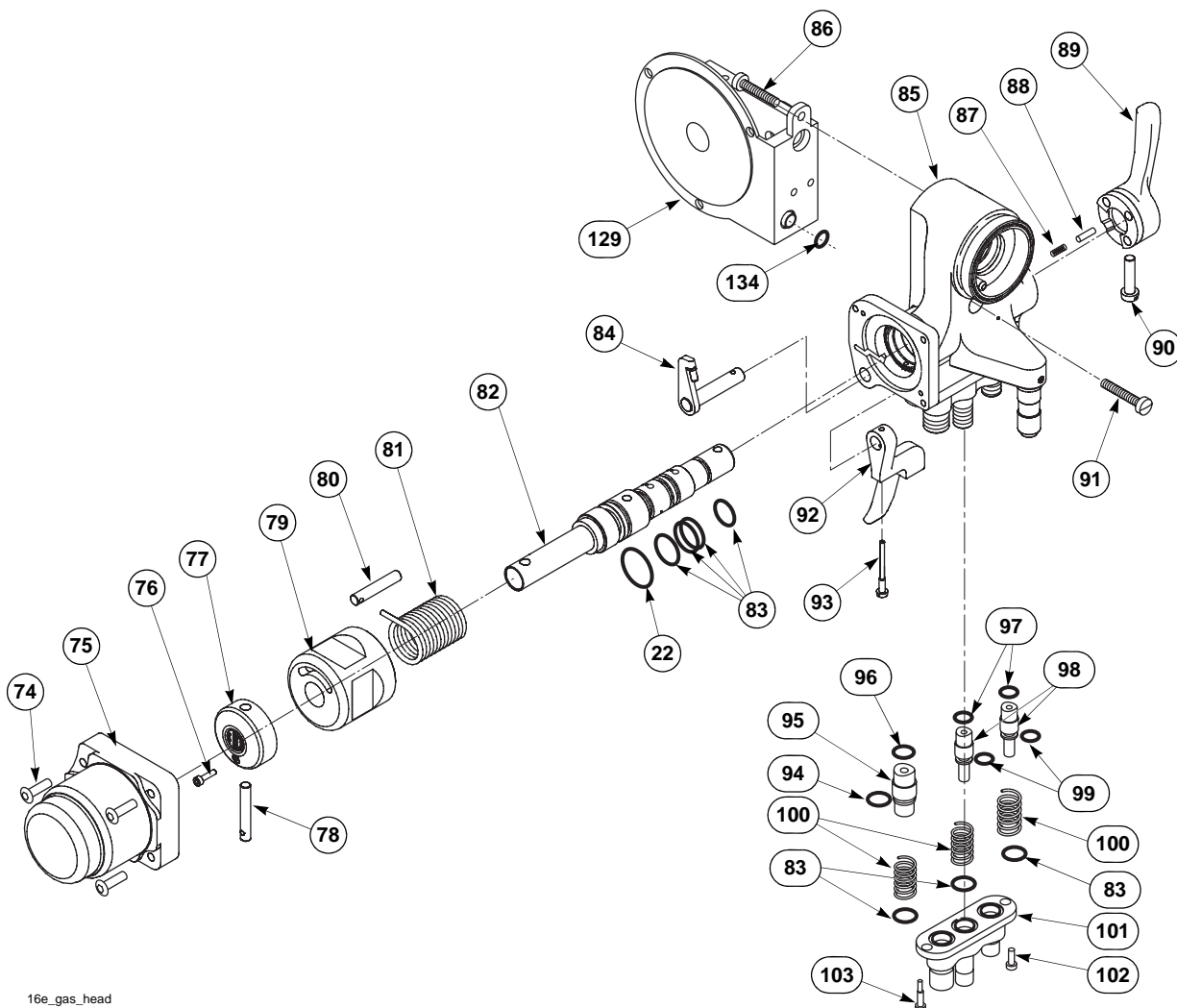
Do not remove the valve core without first removing the hose block and valve plungers. One hose block mounting screw (103) extends into a channel in the valve core (82) to prevent the valve core from being removed. If you remove the valve core with the valve plungers installed, the valve core, valve plungers (95,98) and o-rings (96,97) may be damaged.

1. Remove two screws (102 and 103) securing hose block (101) to gas head (85) and remove hose block from gas head.



CAUTION

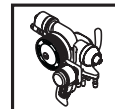
DO NOT remove the valve core without first removing the hose block and valve plungers. If the valve core is removed with the valve plungers installed, the gas valve will be damaged.



16e_gas_head

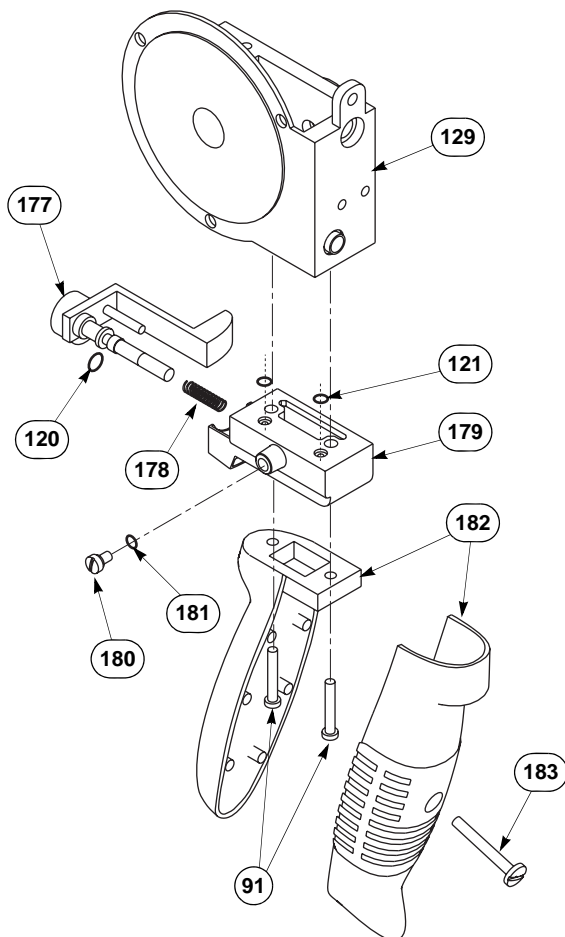
2. Remove compression springs, plungers and associated o-rings (83, 94-100) from gas head (85).

3. Remove three screws (74) securing torsion ring cover (75) and remove torsion ring cover.
4. Remove screw (76) from end cap (77) and end cap pin (78).
5. Carefully rotate torsion ring (79) counterclockwise, slightly, increasing tension on torsion spring (81).
6. Push end cap pin (78) out of end cap (77) and carefully release tension by allowing torsion ring (79) to rotate clockwise 1/2 turn.
7. Remove end cap (77), torsion ring (79), torsion spring (81) and spring bushing (80).
8. Remove screw (93) securing safety handle (92) to pawl and shaft assembly (84), slide out pawl and shaft assembly and remove safety handle.
9. Remove screw (90) securing valve handle (89) to valve core (82) and remove valve handle, compression spring (87) and detent pin (88).
10. Push valve core (82) out through right side of gas head subassembly (85).



6.9.3 Handle and Wire Feed Valve

1. Remove screw (183) securing front handle to rear handle (182) and remove front handle.



16e_handle

2. Remove two screws (91) securing rear handle (182) and wire feed valve assembly to central housing (129).
3. Remove cam follower (181) from valve block (179).
4. Remove valve shaft (177) and valve spring (178) from valve block (179).

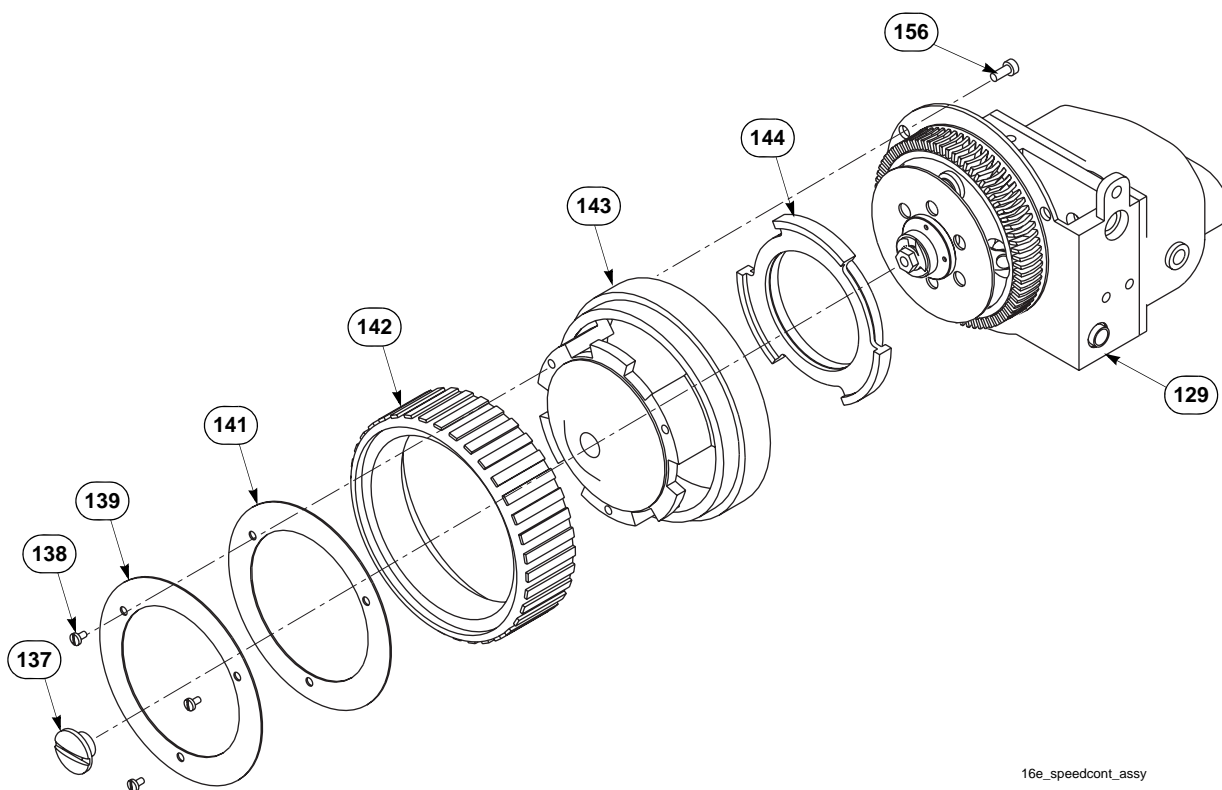
Accessing Lower Turbine Cover Screw

To access the lower screw for the turbine cover, the handle and wire feed valve do not need to be removed. Remove only the cam follower (181), valve shaft (177) and valve spring (178) from the valve block (179).

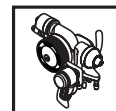
6.9.4 Speed Control and Turbine

Speed Control

1. Remove handle and wire feed valve (“Handle and Wire Feed Valve” on page 53) or wire feed valve shaft (“Accessing Lower Turbine Cover Screw” on page 53).
2. Remove three screws (156) securing speed control assembly (137-144) to central housing (129) and remove speed control assembly.

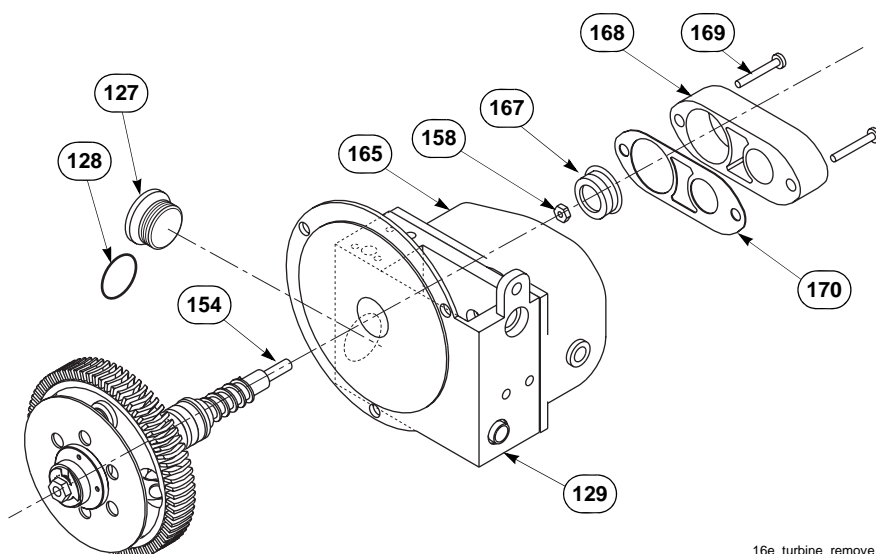


3. Rotate control ring (142) in **SLOWER** direction to unthread spider assembly (144) from control ring (142) until spider assembly can be removed.
4. Remove three screws (138) and disassemble nameplate (139), detent spring (141), control ring (142) and turbine cover (143).
5. Remove oil filter plug (137) from turbine cover (143).

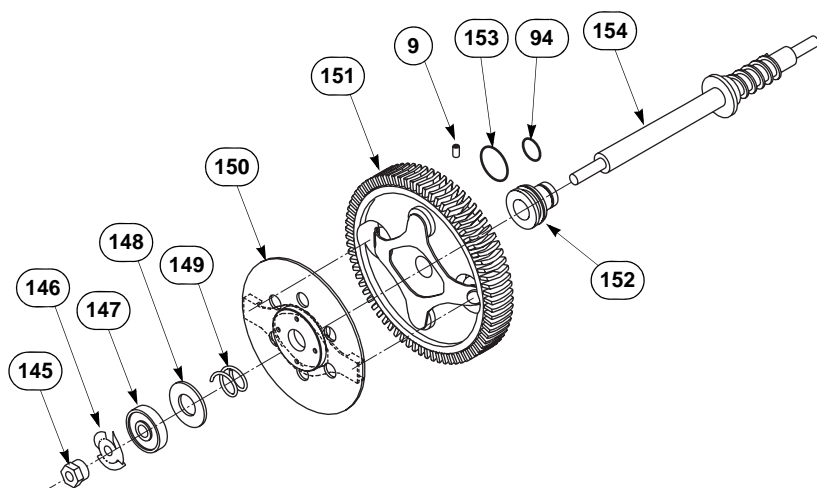


Turbine

1. Remove oil plug (127) from back of central housing (129) and drain oil from spray gun.



2. Remove two screws (169) securing bearing cover (168) to gear cover (165) and remove bearing cover, gasket (170) and bearing follower (167).
3. Remove nut (158) from turbine shaft (154) and remove turbine assembly (145-154) from central housing (129).

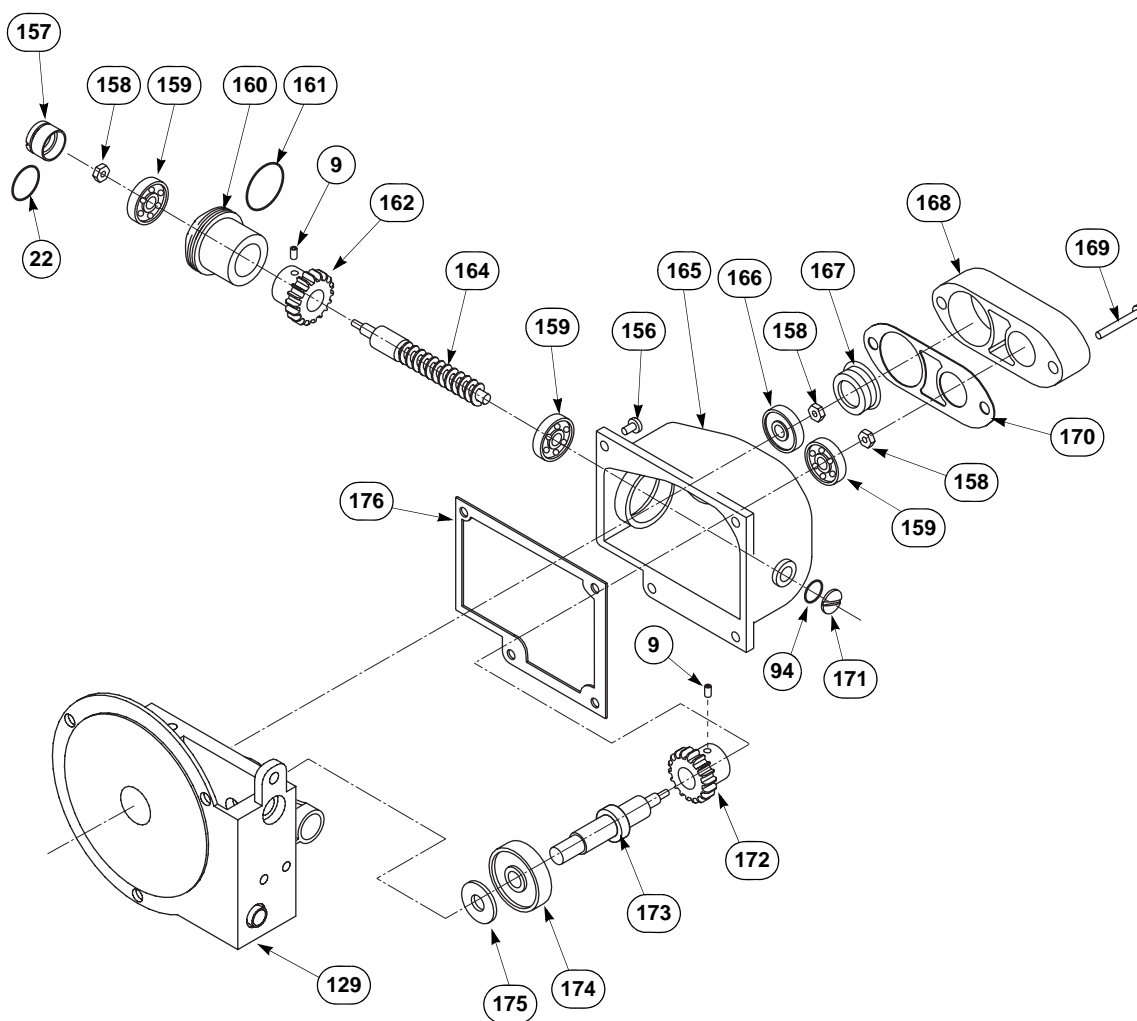


4. Remove shaft bearing retainer nut (145) from turbine shaft (154) and remove finger spring, bearing, washer, brake disc return spring and disc brake (146-150) from turbine shaft.
5. Remove set screw (9) securing turbine rotor (151) to turbine shaft (154) and remove turbine rotor from turbine shaft.
6. Slide turbine seal (152) off turbine shaft (154).

6.9.5 Countershaft, Drive Shaft and Bearings

All bearings are press-fit onto shafts and seats. When removing a bearing, press only on the inner race.

1. Remove drive roll carrier, lower drive roll and lower drive gear. (See "Drive Rolls and Gears" on page 47.)
2. Remove speed control and turbine assembly. (See "Speed Control and Turbine" on page 54.)
3. Unscrew countershaft bearing retainer (160) from gear cover (165).



16e_countershaft

4. Remove countershaft bearing retainer (160) along with countershaft plug (157), ball bearing (159), countershaft gear (162) and countershaft (164). (Ball bearing (159) at front of gear cover will remain in place.)



5. Remove countershaft plug (157) from countershaft bearing retainer (160).
6. Hold countershaft assembly (9, 162 & 164) with glove or cloth and remove nut (158) from countershaft (164). Disassemble countershaft bearing retainer (160) and ball bearing (159) from countershaft assembly.
7. Remove set screw (9) securing countershaft gear (162) to countershaft (164) and remove countershaft gear from countershaft.
8. Remove nut (158) from drive shaft (173).
9. Remove four screws securing gear cover (156) to central housing (129) and remove gear cover and gasket (176).
10. Remove plug (171) from front of gear cover (156).
11. Only if necessary for replacement, remove two ball bearings (159) and one bearing (166) from gear cover (156).
12. Remove drive shaft assembly (9, 172-174) and drive shaft seal (175) from central housing (129).
13. Disassemble drive shaft only if necessary to replace parts:
 - a. Remove set screw (9) securing drive shaft gear (172) to drive shaft (173) and remove drive shaft gear from drive shaft.
 - b. Remove bearing (174) from drive shaft (173) by pulling off from inner race of bearing.

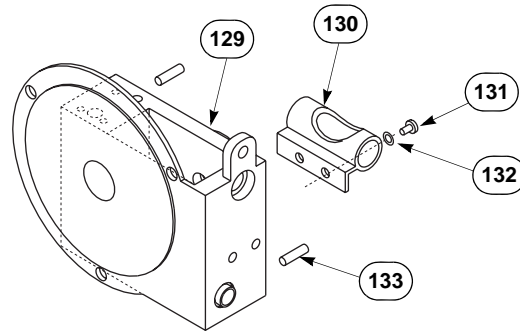


CAUTION

Do not remove housing pump from central housing.

6.9.6 Central Housing

The central housing assembly (129) should not be disassembled unless absolutely necessary to replace parts. The housing pump (130) requires critical alignment with the countershaft. This alignment can only be done properly by Sulzer Metco as part a factory overhaul.



16e_central_housing

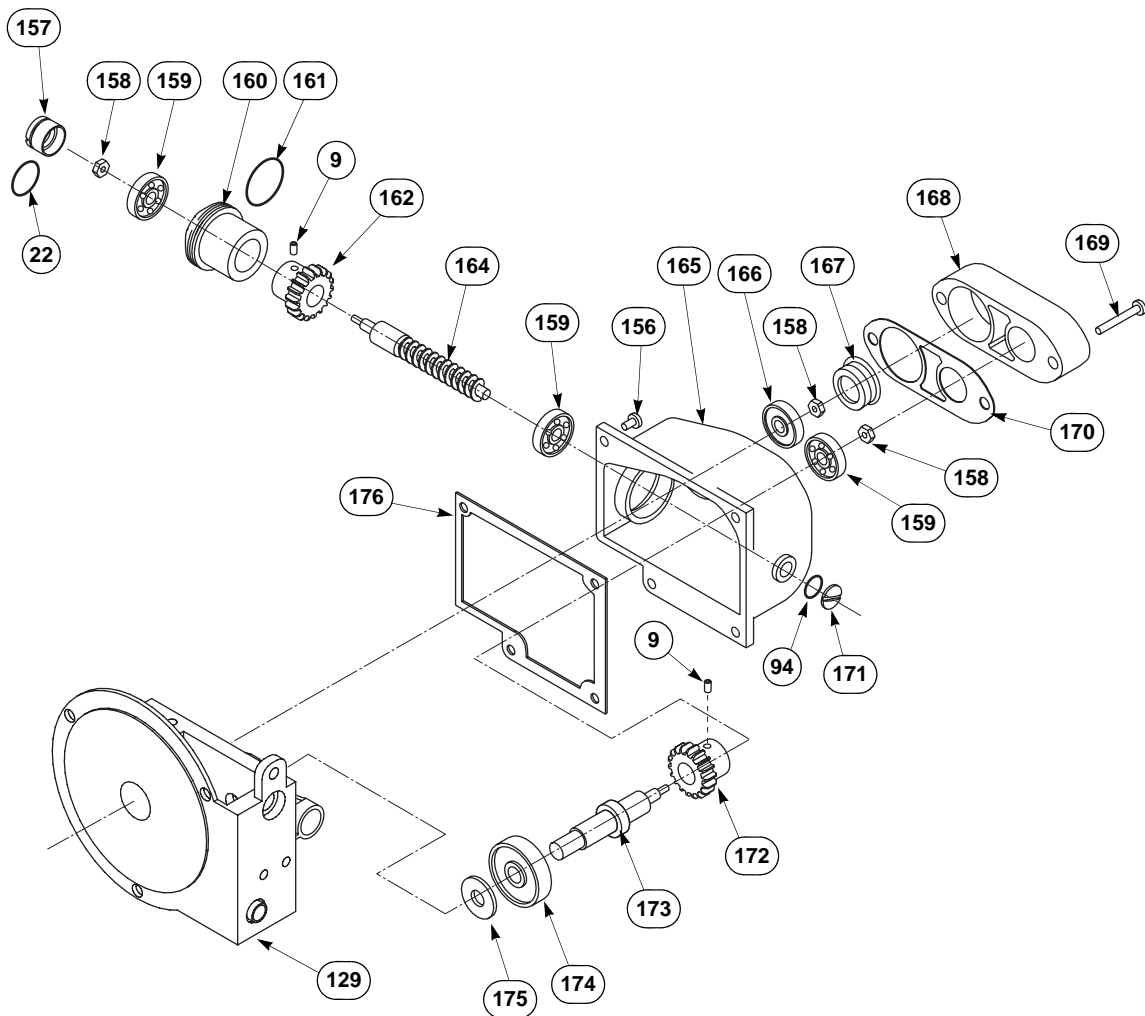


6.10 Assembly

Before assembly, clean and inspect all parts. Replace damaged or worn parts. Do not clean o-rings with solvent. Apply a light coating of Krytox® to all o-rings.

6.10.1 Countershaft, Drive Shaft and Bearings

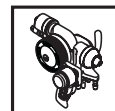
1. Assemble drive shaft:
 - a. Press bearing (174) onto drive shaft (173) up to bushing.
 - b. Install drive shaft gear (172) on drive shaft (173) with gear teeth against bushing and secure with set screw (9). Make sure set screw enters countersink on shaft.



16e_countershaft

2. Install drive shaft assembly (9, 172-174) and drive shaft seal (175) in central housing (129).
3. Press ball bearing (159) in inside front of gear cover (156).

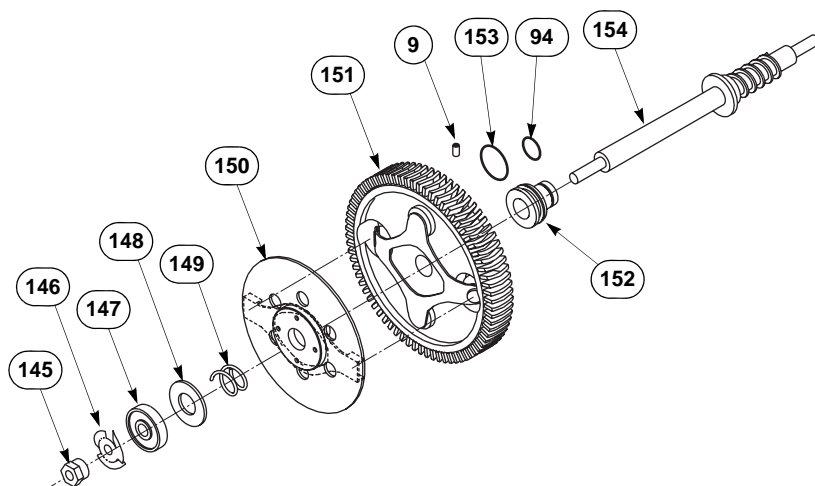
4. Install plug (171) and o-ring (94) in front of gear cover (156).
5. Apply gasket sealant (Loctite 587 Blue, or equivalent) to both sides of gasket (176).
6. Install gear cover (165) and gasket (176) on central housing (129) and secure with four screws (156). Torque screws to 4.38-4.61 k-m (38-40 lb-in).
7. Press ball bearing (159) onto drive shaft (173). Make flush with gear cover (156).
8. Install nut (158) on drive shaft (173).
9. Press bearing (166) into gear cover (156). Bearing should be fully recessed in gear cover.
10. Install countershaft gear (162) on countershaft (164) and secure with set screw (9). Make sure set screw enters countersink on shaft.
11. Install o-ring (161) on countershaft bearing retainer (160).
12. Assemble countershaft assembly (9, 162 & 164) and countershaft bearing retainer (160). Press ball bearing (159) onto countershaft assembly and secure with nut (158). Hold countershaft assembly with glove or cloth and tighten nut.
13. Install countershaft plug (157) with o-ring (22) in countershaft bearing retainer (160).
14. Install countershaft assembly (157-164) through rear of gear cover (165). Press countershaft into inner race of ball bearing at front of gear cover. Tighten countershaft bearing retainer.
15. Install turbine assembly. (See "Speed Control and Turbine" on page 61.)
16. Install drive roll carrier, lower drive roll and lower drive gear. (See "Drive Rolls and Gears" on page 47.)



6.10.2 Speed Control and Turbine

Turbine

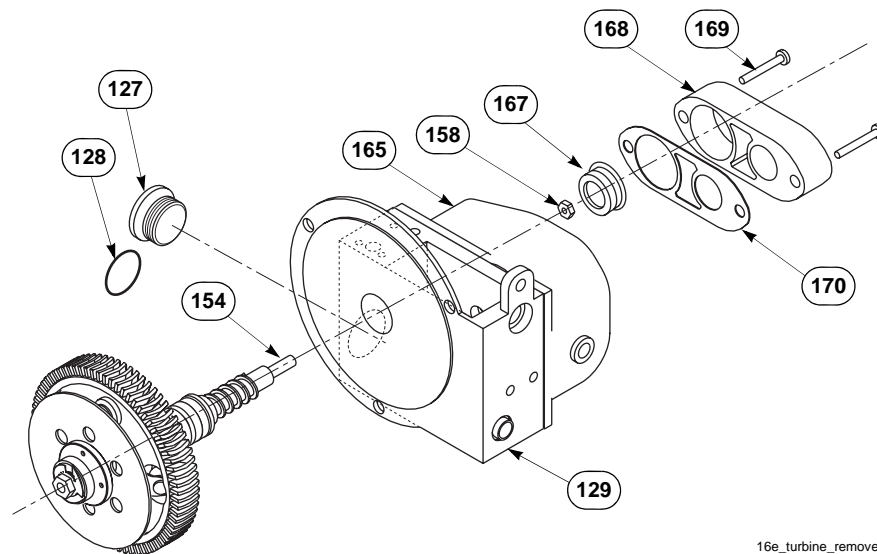
1. Install two o-rings (94 and 153) on turbine seal (152).



16e_turbine_assy

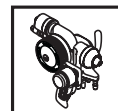
2. Slide turbine seal (152) onto turbine shaft (154) with smaller end of turbine seal near turbine shaft bushing.
3. Install turbine rotor (151) onto turbine shaft (154) and secure with set screw (9). Make sure set screw enters countersink on shaft.
4. Install disc brake (150) onto turbine shaft (154) so that spring clips engage button weights of governor spring on rotor (151).
5. Install spring (150) and washer (148) with cupped side of washer facing spring.
6. Install bearing (147) and finger spring (146) so that fingers of spring face bearing.
7. Install shaft bearing retainer nut (145) on turbine shaft (154). Shank of nut fits in inner diameter of finger spring.

8. Install turbine assembly (145-154) through central housing (129) and bearing in gear cover (165).



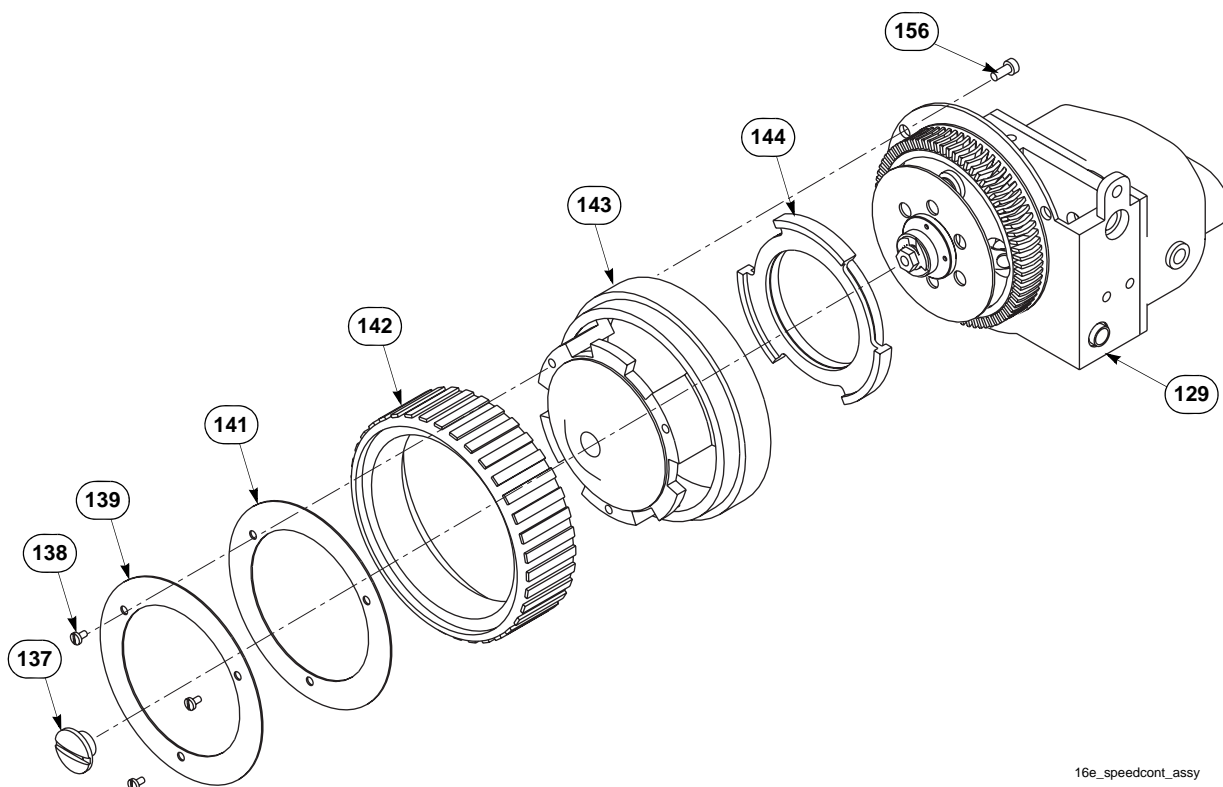
16e_turbine_remove

9. Install nut (158) on turbine shaft (154).
10. Apply gasket sealant (Loctite 587 Blue, or equivalent) to both sides of gasket (170).
11. Install bearing follower (167), gasket (170) and bearing cover (168) and secure with two screws (169).
12. Fill central housing (129) with exactly 30 ml (1 fluid ounce) of Gearlube. (See "Countershaft / Bearing Lubrication" on page 42.)
13. Install oil plug (127) with o-ring (128) in back of central housing (129).



Speed Control

1. Apply a light coating of Krytox® to inner threads of control ring (142) and outer threads of spider assembly (144).

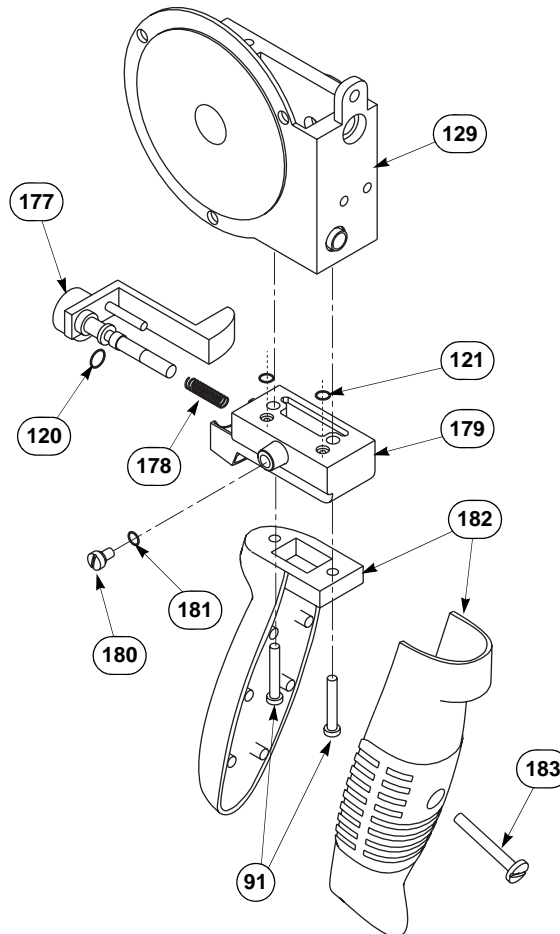


16e_speedcont_assy

2. Assemble control ring (142), turbine cover (143) and spider assembly (144) with plastic brake shoe of spider assembly facing open side of turbine cover. Rotate control ring clockwise to thread onto spider assembly. Be careful not to cross threads.
3. Apply a light coating of Krytox® to detent spring (141). Install detent spring and nameplate (139) with detents engaging notches in control ring. Align holes and secure detent spring and nameplate with three screws (138). Test control ring operation after tightening screws.
4. Install speed control assembly (137-144) onto central housing (129) and secure with three screws (156).
5. Install handle and wire feed valve or wire feed valve shaft. (See "Handle and Wire Feed Valve" on page 64.)

6.10.3 Handle and Wire Feed Valve

1. Install o-ring (120) on valve shaft (177).



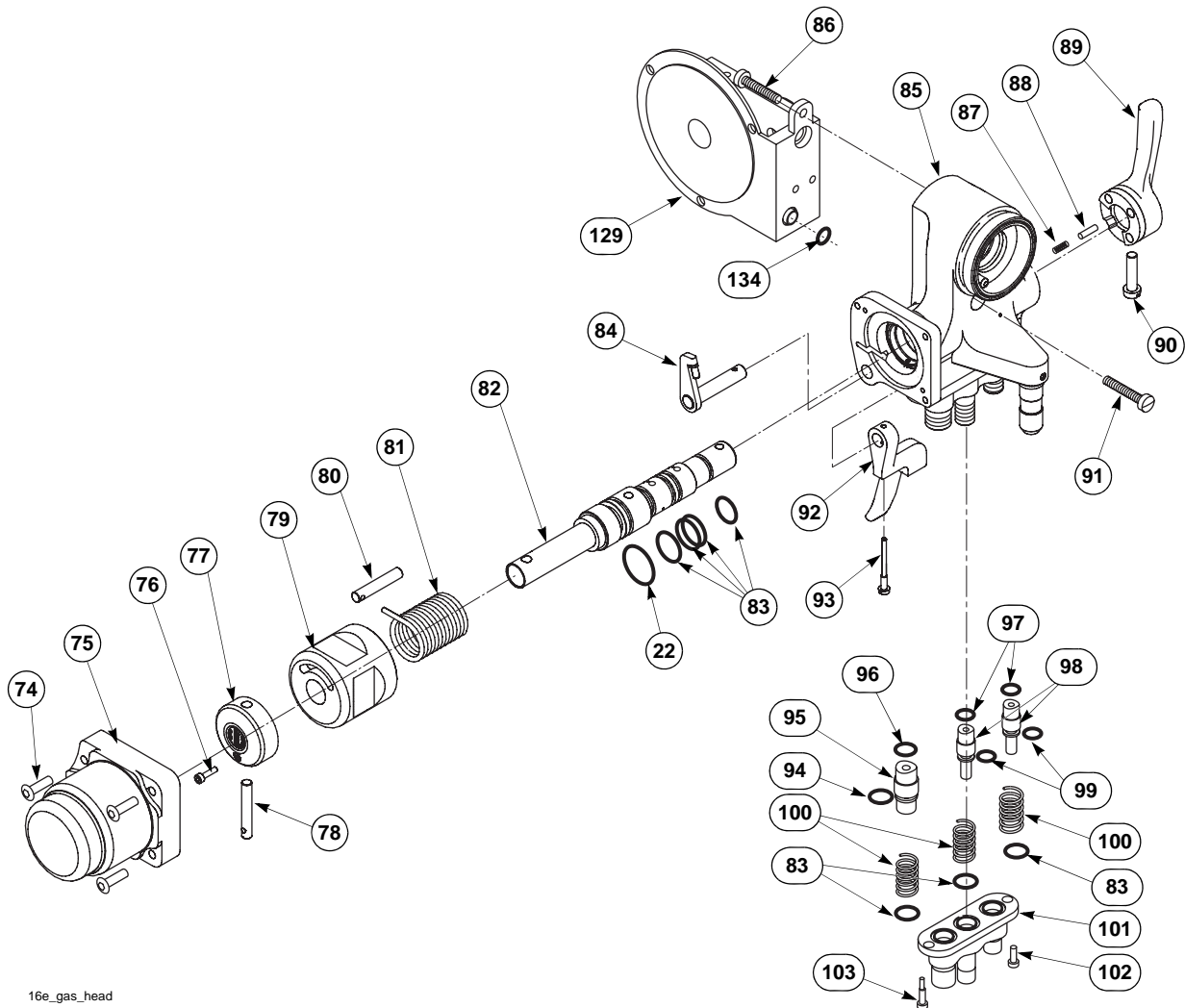
16e_handle

2. Apply a light coating of Krytox® to valve shaft (177) and install valve shaft and valve spring (178) in valve block (179).
3. Install o-ring (180) on cam follower (181).
4. Install cam follower (181) in valve block (179). While actuating the valve shaft (177), tighten the cam follower until it engages the cam and can be made flush with the valve block. After tightening all the way, back off ¼ – ½ turn and test valve operation.
5. Install two o-rings (121) on valve block (179).
6. Install rear handle (182) and wire feed valve assembly on central housing (129) and secure with two screws (91).
7. Install front handle on rear handle (182) and secure with screw (183).



6.10.4 Gas Head Assembly

The gas head assembly may be assembled on or off the spray gun. To install the gas head assembly, install o-ring (134) on central housing (129) and secure gas head assembly to central housing with one screw (86) and two screws (91).



16e_gas_head

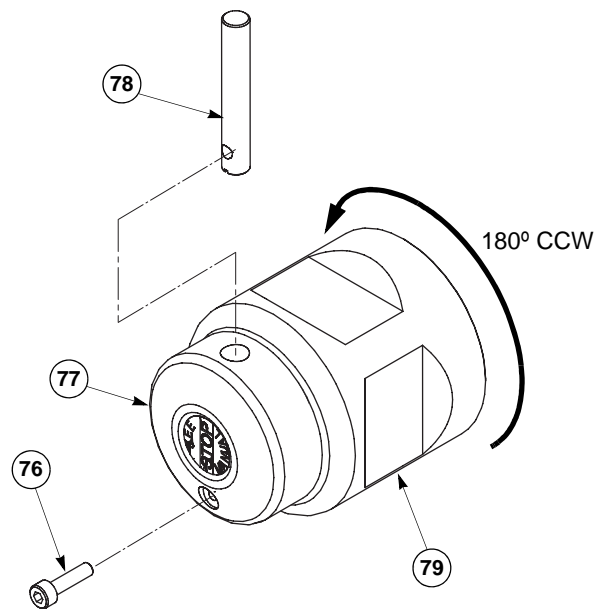
1. Install (dry; no Krytox®) four o-rings (83) and one o-ring (22) on valve core (82).
2. Apply Krytox®, to o-rings and entire surface of valve core (82).
3. Carefully install valve core (82) through right side of gas head sub-assembly (85).
1. Install compression spring (87), detent pin (88) and valve handle (89) on valve core (82) and secure with screw (90).
2. Install pawl and shaft assembly (84) through gas head subassembly (85) and safety handle (92). Secure safety handle to pawl and shaft assembly with screw (93).



INFO

See “Gas Head Valve” on page 42 for important information on servicing the gas head assembly.

3. Install torsion spring (81) in flange of gas head subassembly (85). The spring's longer free end fits in the slot of the flange and the shorter free end points downward.
4. Install spring bushing (80) on torsion spring (81).
5. Slide torsion ring (79) over spring bushing (80) and torsion spring (81). Torsion ring is cut to fit precisely over spring and bushing. Slide torsion ring all the way to the flange (clears pawl).
6. Slide end cap (77) onto valve core (82) so that pin in end cap mates with slot in torsion ring (79).
7. Make sure gas valve is in closed position (handle forward).
8. Grasp torsion ring (79) firmly and apply tension to spring by rotating counterclockwise 1/2 turn.



CAUTION

The valve plungers are radiused and keyed for orientation to mate with the valve core. The o-rings between the plungers and valve core (96, 97) are special. Do not substitute o-rings with non-Sulzer Metco parts. Do not clean o-rings with solvent. Use only Krytox® on all o-rings.

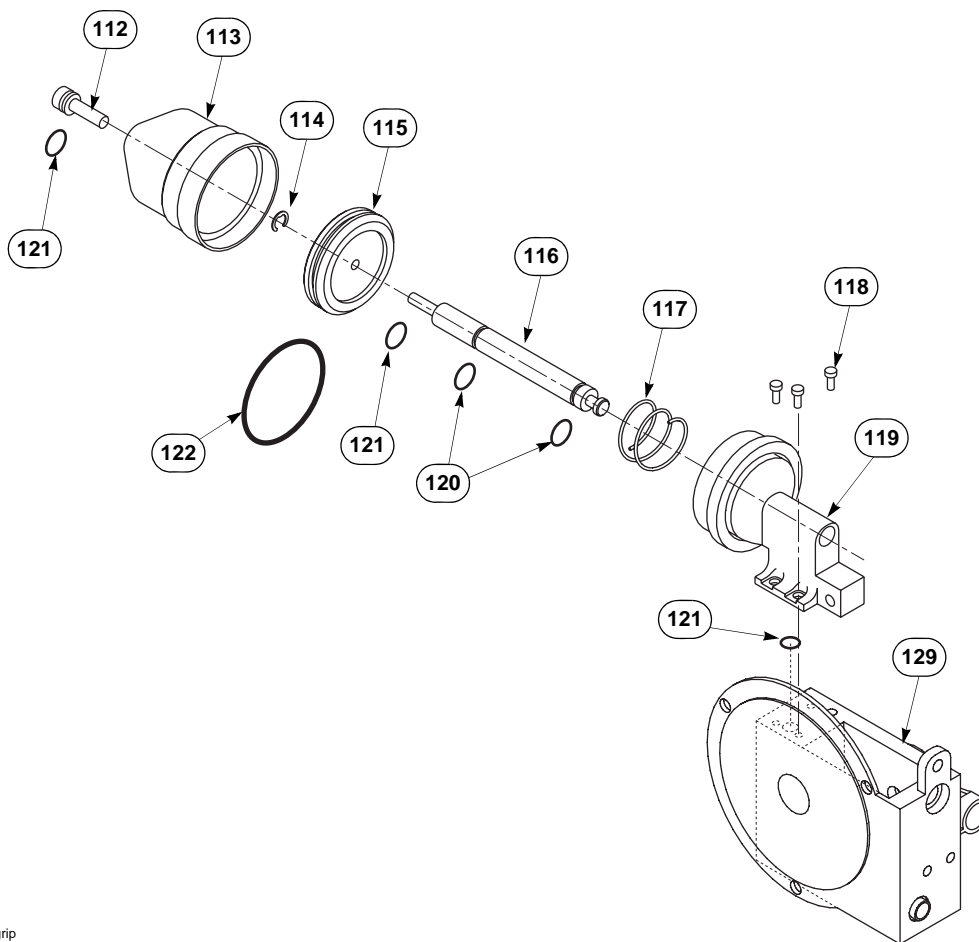
9. Insert end cap pin (78) into end cap (77). Make sure the end cap pin is oriented so that the hole in end cap pin will line up with the hole in end cap. Once the end cap pin is all the way through the valve core shaft, release the torsion ring.
10. Using a small screwdriver, align holes in end cap pin (78) and end cap (77) and install screw (76).
11. Install torsion ring cover (75) and secure with three screws (74).
12. With spray gun inverted, install o-ring (96) in (larger) air valve port of gas head subassembly (85).
13. Install two o-rings (97) in fuel and oxygen ports of gas head subassembly (85).
14. Install o-ring (94) on air plunger (95).

15. Install air plunger (95) in gas head subassembly (85).
16. Install one o-ring (99) each on two fuel gas and oxygen plungers (98).
17. Install fuel gas and oxygen plungers (98) in gas head subassembly (85).
18. Install three compression springs (100) over plungers (95, 98) in gas head subassembly (85).
19. Install three o-rings (85) in valve block (101).
20. Install valve block (101) on bottom of gas head subassembly (85) and secure with two screws (102 and 103).



6.10.5 Wire Grip Mechanism

1. Install one o-ring (121) and two o-rings (120) on piston rod (116).



16e_wire_grip

2. Install o-ring (122) on piston (115).
3. Assemble piston (115) and piston rod (116) and secure with retaining ring (114).
4. Install piston assembly (114-116) and spring (117) into support block (119).
5. Install Unscrew and remove cylinder (113) with screw (112) and o-ring (121).
6. Install wire grip mechanism on central housing (129) and secure with three screws (118).
7. Install drive roll carrier. (See "Drive Rolls and Gears" on page 47.)



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