

Duties, Tasks, and Steps

Electrician/Technician

A.		Electrical Systems	Tools and Equipment	Calculations	Communications	Technology	Safety
	1	Demonstrate knowledge of AC theory					
	a	General concepts of phase rotation	DVOM	Measure voltage	Read technical materials	Computer literacy	Common safety practices
	b	Influence of inductance and capacitance on the sine wave	Ammprobe	Measure resistance	Verbal with vendors	Equipment knowledge	
	c	Frequency	Oscilloscope	Measure current	Verbal with engineering	Test equipment operation	
	d	AC motor theory	Megger	Decimals	Update Electrical Drawngs		
	e	Transformers	Common hand tools	Fractions			
	f	Basic components (resisters, capacitors, etc.)		Read scales (digital)			
	g	Ohm's law		Ohm's law			
	2	Demonstrate knowledge of DC theory					
	a	Ohm's Law	DVOM	Measure voltage	Read technical materials	Computer literacy	Common safety practices
	b	Polarity	Ammprobe	Measure resistance	Verbal with vendors	Equipment knowledge	
	c	DC motors	Oscilloscope	Measure current	Verbal with engineering	Test equipment operation	
	d	Generator and motor theory	Megger	Decimals	Update Electrical Drawngs		
	e	Electromagnetism	Common hand tools	Fractions			
	f	Basic components (resisters, capacitors, etc.)		Read scales (digital)			
				Ohm's law			
	3	Install cable and wire					
	a	Calculate fill; determine conduit adequacy	Common hand tools	Measure length accurately	Verbal with engineer	Basic electrical theory	Common safety practices
	b	Set up pull; label wires	Fish tape	Basic math	Verbal with co-worker	Wiring principles and sizes	PPE
	c	Set up pull rack	Wire rack	Calculate load	Interpret Electrical Drawings	NEC code	Fall hazard
	d	Lubricate wires	Cable cutters		Verbal with outside contractors	Local codes	Electrocution hazard
	e	Pull wire--manual pull; mechanical pull	Wire lubricant		Complete work orders	Plant preferences	Pinch points
	f	Terminate and label wires; close fittings	Ladders or lifting equipment			GMP	Rotating equipment
	g	Check for shorts and grounds	Pulling head				Cutting hazards
	h	Calculate box and wire size	Electric puller and ropes				Entanglement
	4	Run conduit					
	a	Select conduit layout	Common hand tools	Measure length accurately	Verbal with engineer	Basic electrical	Common safety practices
	b	Assess routing of conduit	Pipe threaders	Trig	Verbal with co-worker	Conduit principles	PPE
	c	Select appropriate fittings, boxes and hangers	Conduit benders (hydraulic, electric and manual)	Algebra	Interpret Electrical Drawings	NEC code	Fall hazard
	d	Cut, thread and bend conduit	Reciprocating saw	Geometry	Use Ugly's Manual		Electrocution hazard
	e	Anchor conduit	Portaband	Basic math	Verbal with outside contractor		Pinch points
	f	Fabricate hangers	Step ladders	Take ups	Update Plant Layout Drawings		Rotating equipment
	g	Size conduit	Pipe reamer		Complete work order		Cutting hazards
	h	Select appropriate type	Rotary hammer				Entanglement
		--IMC	Hand set				Burn hazard
		--rigid	Hydraulic knock outs				Dust hazards
		--EMT	Drill motor				
		--coated	Ruler/plumb bob				
			Level				
			Electric scissor lift				

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	5	Install/maintain/troubleshoot AC and DC Controls					
	a	Confirm voltage	Multimeter	Measure voltage	Verbal with co-workers	Basic electrical theory	Common safety practices
	b	Locate and repair opens and shorts	Common hand tools	Ohm's law	Verbal with contractors	Basic troubleshooting	PPE
	c	Update to new controller	Megger	Calculate load	Verbal with engineers	Use test equipment	Fall hazard
	d	Replace control components	Amprobes (AC and DC)	Percentages	Verbal with supervisors		Electrocution hazard
		--frequency drives	Laptop	Interpret NEC	Verbal with vendors		Pinch points
		--relays	Safety equipment	Interpret charts and graphs	Complete work order		Rotating equipment
		--motor starters			Take notes		Cutting hazards
		--motor overloads			Update Electrical Drawngs		Entanglement
		--fuses					Burn hazard
		--breakers					Dust hazards
		--various switches, such as push buttons, limit, etc.					Equipment damage
		--control circuitry					Potential hazard to others
		--transformers					
		--DC drives					
	e	Interpret documentation such as schematic					
	f	E-Stop Cirucuitry & Safety Relays					
	6	Install/maintain/troubleshoot lighting					
	a	Replace light bulbs	Common hand tools	Interpret NEC	Verbal with co-workers	Basic electrical theory	Common safety practices
	b	Replace ballast	Ladders or lifts	Calculate loads	Verbal with contractors	Basic troubleshooting	PPE
	c	Install new sockets	Multimeters	Determine wattage requirements	Verbal with engineers	Use test equipment	Fall hazard
	d	Install new fixtures	Drills and power tools		Verbal with supervisors	Types of lighting	Electrocution hazard
	e	Troubleshoot lighting problems such as			Verbal with vendors	flourescent	Pinch points
		--locate overloads			Complete work order	--incandescent	Rotating equipment
		--locate shorts			Update Electrical Drawngs	--low pressure sodium	Cutting hazards
		--locate feed			Update Plant Layout Drawings	--mercury vapor	Entanglement
		--replace switch				--HID	Burn hazard
	f	Replace motion, heat or light sensors				--quartz	Dust hazards
						--UV	Equipment damage
							Potential hazard to others

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	7	Install/maintain/troubleshoot building electrical systems					
	a	Troubleshoot problems	Common hand tools	Interpret NEC	Verbal with co-workers	Basic electrical theory	Common safety practices
		--card reader	Ladders or lifts	Calculate loads	Verbal with contractors	Basic troubleshooting	PPE
		--door locks and readers	Multimeters	Measure voltage	Verbal with engineers	Use test equipment	Fall hazard
		--camera failures	Drills and power tools	measure temperatures	Verbal with supervisors	System knowledge and operation	Electrocution hazard
		--temperature controllers	Laptop or PC	Measure pressures	Verbal with vendors	Chemical knowledge	Pinch points
		--boiler and AC controls	Control panel for system		Complete work order	--glycol	Rotating equipment
		--Flame Boiler controls					
		--HVAC controls			P + ID's	--kathabar	Cutting hazards
		--lighting generators			Reading comprehension		Entanglement
		--valves (proportional, solenoid, etc.)			Interpret vendor manuals		Burn hazard
	b	Install and replace components			Update Electrical Drawngs		Dust hazards
		--switches			Update Plant Layout Drawings		Equipment damage
		--valves					Potential hazard to others
		--sensors					Chemical safety
		--motors					MSDS
		--transformers					
		--igniters					
		--circuit breakers					
		--fuses					
		--thermostat					
		--controller units(Temperature, Pressure, Flame)					
		--circuit boards					
		--magnetic locks					
		--time clocks					
		--fire alarms and vessels					
		--elevators					
		--PA/paging systems					
		--telephone systems					
		--security and alarm systems					
	c	Install and replace heat trace and controls					
	d	Maintain / Program Building Management Systems					
	8	Fabricate/retrofit electrical panels					
	a	Size the panel	Common hand tools	Basic math	Verbal with engineer	Electrical panel technology	Common safety practices
	b	Select appropriate components (size, etc.)	Drill motor	Measure distance	Verbal with associates	NEC code	Pinch points
	c	Select layout	Drills and taps		Interpret Electrical Drawings	Mfg. specifications	Cutting hazard
	d	Drill and tap; punch holes in panel	Layout tools		Interpret mfg. manuals	Interpret parts list	PPE
	e	Mount components	Hole saws/knock out punches		Update Electrical Drawngs	Mechanical principles	Electrocution hazard
	f	Wire components (including layout, labeling, etc.)	Recipicating saw				
	g	Create/install legend plates	Grinder/polisher				
			Tie wrap gun				
			Wire labeler				
			Tape measurer				

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	9	Operate electrical test equipment					
	a	Multimeter	Multimeter	Basic math	Verbal with engineer	Electrical panel technology	Common safety practices
	b	Amprobe	Amprobe	Measure distance	Verbal with associates	NEC code	Pinch points
	c	Oscilloscope	Oscilloscope	Decimals	Interpret Electrical Drawings	Mfg. specifications	PPE
	d	Logic Probe	Logic Probe	Percentages	Interpret mfg. manuals	Interpret parts list	Electrocution hazard
	e	Voltmeter	Voltmeter	Ratios	Interpret numeric data	Mechanical principles	
	f	4-20mA	4-20mA / 0-10V Simulator	Interpret scales		Electrical knowledge	
	g	Frequency generators	Frequency generators	Use charts and graphs		Electronics	
	h	Decade boxes	Decade boxes	Interpret tolerances			
	i	Pneumatic calibrator	Pneumatic calibrator				
	j	Load cell calibrator	Load cell calibrator				
	k	Weights	Weights				
	l	Thermometer	Thermometer				
	m	Metal check chips	Metal check chips				
	n	Tachometer	Tachometer				
	o	Sound meter	Sound meter				
	p	Vibration analyzer	Vibration analyzer				
	q	Vendor-specific calibrators	Vendor-specific calibrators				
	r	Hart communicator	Hart communicator				
	s	Smart transmitter calibrator	Smart transmitter calibrator				
	t	Ethernet tester	Ethernet tester				
	u	Palm (PDA)	Palm				
	v	Laptop and software	Laptop and software				
	w	Hot Block Calibrator for RTD's & Thermocouples					
	x	Black Body Calibrator					
	10	Troubleshoot/replace/install circuit boards					
		<i>Install/replace</i>	Common hand tools	Measure voltage	Programming language	Computer literacy	Common safety practices
	a	Determine function of board or module	DVOM	Measure current	Verbal with engineering	Advanced electronics	Electrical shock
	b	Select appropriate board or module (vendor)	Simulators	Measure resistance	Verbal with vendors	Type of boards	Electrocution hazard
	c	Verify Hardware serial and version numbers					
	d	Set jumpers or dip switches as required	Calibrators	Establish ranges	Interpret Electrical Drawings	ESD practices	Confined space entry
	e	Follow vendor procedures to install board	Terminal computer	Ratios	Update Electrical Drawings	Grounding device	Vendor required safety
	f	Calibrate board or module	Static strap	Decimals		Shielding practices	PPE
	g	Replace EPROM and EEPROM					
		<i>Troubleshoot</i>		Algebra		Addressing system	
	h	Perform visual inspection of board		Numbering systems			
	i	Check blown fuse					
	j	Check inputs and outputs					
	k	Verify calibration					
	l	Program unit and/or verify PLC program for unit					
	m	Verify configuration per vendor specifications					
	n	Clean contacts					
	o	Replace board as above					
	p	Replace solder-in fuse					

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	g	Inspect for broken or bent pins					
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B		Machine Controls	Tools and Equipment	Calculations	Communications	Technology	Safety
	11	Install/maintain/troubleshoot photo eyes					
	a	Replace photoeye	Common hand tools	Basic math	Verbal with co-workers	Basic electricity	Common safety practices
	b	Determine adjustment requirements using DVOM, PLC, visual, indicator displays, audio	Drill and tapping equipment	Tolerances	Verbal with operator	Photoeye principles	PPE
	c	Change reflectors	Drill motor	Calculate distance in mm	Verbal with mechanical tech	Sensor principles	Shock hazard
	d	Inspect contacts for corrosion, high resistance, water, intermittence	Drill press	Convert mm to ft.	Interpret technical manual/ instruction sheet	Type of material being sensed Identify application within system	Pinch points Lock out/tag out
	e	Clean lens and contacts	Saws				
	f	Align beam to target	Grinders		Verbal with engineering	Types of photoeyes	Laser Hazards
	g	Tighten mounting bolts or brackets	Light emitter and receiver		Interpret Electrical Drawings	--sinking and sourcing	
	h	Fabricate/design brackets to mount	Multimeter		Update Electrical Drawngs	--retroreflective	
	i	Set distance to target	Laptop		P + ID's	--diffuse	
	j	Set sensitivity	Program (troubleshooting tool)			--color sensitive	
	k	Set up and install	Manuals				
	l	Replace light source					
	m	Replace receiver					
	n	Select correct photoeye replacement					
	o	Install new inspection device					
	p	Inspect for proper operation					
		--solid state					
		--electromechanical					
	q	Set time delay					
	r	Teach photoeye					

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B		Machine Controls	Tools and Equipment	Calculations	Communications	Technology	Safety
12		Install/maintain/troubleshoot stepper/servo motors					
		<i>Troubleshoot</i>	Common hand tools	Ohm's law	Verbal with co-workers	Physics	Common safety practices
	a	Interpret program	DVOM	Measure speed	Verbal with operator	Accelerations	PPE
	b	Check for feedback on the servo	Laptop	Measure rpm	Interpret Electrical Drawings	Programming language	Rotating parts
	c	Verify parameters; setup the drive to appropriate parameters	Cables	Interpret feet per minute	Verbal with vendor	--Basic	Pinch points
	d	Check motor for shorts with VOM	Oscilloscope	Measure distance	Interpret technical manuals	--Emerson	Shock hazard
	e	Check servo power supply for correct voltage	Vendor documentation	Ratios	Update Electrical Drawngs	--Reliance servos (C+ type)	Stored energy
	f	Check output of servo drive with VOM	Vendor software	Interpret binary code	P + ID's	--Indramat	Lock out/tag out
	g	Verify condition of fuses				--Elmo	Working in tight spaces
	h	Verify correct operation of Resolvers / Encoders					
		<i>Repair/replace</i>					
	i	Change servo drive; replace motor				--Allen Bradley	
	j	Repair/replace brushes				--Elau	
	k	Repair/replace fuses				--Mitsubishi	
	l	Replace the encoder and resolver				--Bosch	
	m	Replace the relay				--Superior	
	n	Replace the controller; upload and/or download program, if required				--Pacific Scientific	
	o	Replace power supply				Function--absolute and incremental	
	p	Set up responses, commands, current limit				Homing sequence	
	q	Identify application for servo					
13		Install/maintain VFD drives (Variable Frequency Drive)					
		<i>Install</i>	Common hand tools	Measure voltage	Verbal with engineering	Basic electrical principles	OSHA regulations
	a	Determine application; select and obtain appropriate drive, size and NEMA rating	DVOM	Measure amps	Read technical manuals	Basic mechanical	Common safety practices
	b	Determine location for drive and install drive	Tachometer	Measure resistance	Written documentation	Electromagnetic principles	Electrocution hazard
	c	Determine start, stop, remote and local control; wire if appropriate	PC	Decimals to tenths	Update Electrical Drawngs	Computer literacy	Short circuit protection
	d	Determine Line and or Load Reactors and install	Oscilloscope	Read scale	Read vendor materials	Encoders	Cutting hazards
	e	Determine and establish control interface for speed control (4-20 ma, Digital, etc)	Frequency meters	Basic math	Verbal with maintenance	Resolvers	Safety equipment/PPE
	f	Configure operating parameters; document		Substitute numbers into a formula	P + ID's	Closed and open loop systems	Lifting hazard
	g	Power up, test and operate		Use a chart/table		VFD knowledge	Hoists/crane safety
		<i>Maintain/repair</i>		Measure rpm			Shock hazard
	h	Troubleshoot and replace as required electrical components (i.e., capacitors, transistors, etc.)					Explosion hazard
	i	Replace electronic boards					
	j	Inspect HIM (human interface module)					
	k	Check parameters for modifications					
	l	Inspect termination wiring and input and output voltages and current					
	m	Check DC buss voltage					
	n	Check overloads					
	o	Check for closed interlocks					
	p	Replace faulty unit					
	q	Replace faulty Line and or Load Reactors					
	r	Update obsolete equipment					
	s	Set up communications					

Duties, Tasks, and Steps
Electrician/Technician

B		Machine Controls	Tools and Equipment	Calculations	Communications	Technology	Safety
14		Install/maintain electrically operated valve					
		<i>Installation</i>	Common hand tools	Measure voltage	Verbal with engineering	Basic electrical principles	OSHA regulations
	a	Select and obtain appropriate solenoid for application (AC or DC)	DVOM	Measure amps	Read technical manuals	Basic mechanical	Common safety practices
	b	Mechanically and electrically install solenoid	PC or laptop	Measure resistance	Written documentation	Electromagnetic principles	Electrocution hazard
	c	Power up and test operate			Read vendor materials	Computer literacy	Short circuit protection
		<i>maintain/repair</i>			Update Electrical Drawngs	Valves principles	Cutting hazards
	d	Perform visual inspection of unit			P + ID's	Types of electrical valves	Safety equipment/PPE
	e	Check for power to unit				--solenoid	Burn hazard
	f	Check for fluid pressure (air, water, etc.)				--3 - way valves	
	g	Check wiring and termination to solenoid					
	h	Replace unit					
15		Install/maintain/troubleshoot limit and proximity switches					
	a	Replace limit or proximity switch	Common hand tools	Basic math	Verbal with co-workers	Basic electricity	Common safety practices
	b	Determine adjustment requirements using DVOM, PLC, visual, indicator displays, audio	Drill and tapping equipment	Tolerances	Verbal with operator	Limit switch operation	PPE
	c	Adjust lever position mechanically	Drill motor	Calculate distance in mm	Verbal with mechanical tech	Sensor principles	Shock hazard
	d	Inspect contacts for corrosion, high resistance, water, intermittent operation	Drill press	Convert from english to Metric	Interpret technical manual/	Proximity switch operation	Pinch points
	e	Replace rollers and lever arms	Saws	Convert from Metric to english	instruction sheet	Type of material	Lock out/tag out
	f	Replace stop or cam	Grinders		Verbal with engineering	Hall effect	Confined spaces
	g	Tighten mounting bolts or brackets			Interpret Electrical Drawings	Inductive principles	Confining spaces
	h	Fabricate/design brackets to mount limit switches			Update Electrical Drawngs	Capacitive principles	
	i	Set clearance on proximity switches			P + ID's		
	j	Set sensitivity on proximity switches					
	k	Update obsolete equipment					
	l	Program programmable switches					
16		Troubleshoot/repair/replace vision systems					
	a	Adjust light source	Common hand tools	Measure optical distance	Verbal with associates	Functions of vision systems	Common safety practices
	b	Align and repair camera or cabling	DVOM	Measure pixels	Verbal with operator	--product presence	PPE
	c	Install Vision system	Software	Adjust contrast	Interpret technical manual/	--product absence	Shock hazard
	d	Adjust inspection criteria	PC or laptop	Linear distance	Verbal with engineering	--good/bad part	High pressure hazard
	e	Replace circuit board components		Basic math--%, ratios, etc.	Interpret Electrical Drawings	--defect	Stored energy
	f	Adjust or change parameters			Verbal with vendor	--bar codes	Burn hazard/steam
					Update Electrical Drawngs	--position	Lock out/tag out

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B		Machine Controls	Tools and Equipment	Calculations	Communications	Technology	Safety
	17	Install/maintain/troubleshoot bar code readers					
	a	Identify purpose and function of bar codes	Common hand tools	Measure distances	Verbal with associates	Bar code formats	Common safety practice
	b	Identify communication problems	Laptop		Verbal with operator	Interpret PLC software	Pinch points
		--loose connections	Documentation		Interpret technical manual/		Avoid dangerous lights
		--faulty cable and component	Multimeter		Verbal with engineering		Electrocution hazard
		--addressing problems			Interpret Electrical Drawings		Fall hazard
		--if bar code is in program			Verbal with vendor		Moving equipment hazard
	c	Replace component			Update Electrical Drawngs		PPE
		--scanner					
		--wires and cables					
		--add bar code with appropriate software					
	d	Visually assess legibility of bar code					
	e	Change or modify sensing distances					
	f	Teach sensing device					
	g	Update obsolete to new equipment					
	h	Troubleshoot bar code equipment					
		--clean lens					
		--adjust eye					
		--verify proper function and operation					
		--attempt scanning					
		--verify power to unit					

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C		Power Distribution	Tools and Equipment	Calculations	Communications	Technology	Safety
18		Maintain/repair switch gear (<600V)					
	a	Clean and inspect for dirt, dust, infestation, arcing, etc.	Common hand tools	Interpret analog scale	Verbal with outside contractors	Ohm's law	PPE
	b	Lubricate contacts, operating mechanism, cooling fans	Megger	Interpret ranges	Verbal with co-workers	Transformer operation	Common safety practices
	c	Inspect and tighten all connections	DVOM		Verbal with engineering	Basic electrical knowledge	Electrocution hazard
	d	Replace defective components:	High voltage gloves		Verbal with operators	Read meters	Mechanical force
		--contacts and springs	Insulated screw driver		Written check list	Interpret schematics	Stored energy
		--programmable operator	Grounding jumpers		Update Electrical Drawngs	Equipment operation	Lifting hazards
		--breakers	Signal tracers		Single Line Power Drawings	Residual energy	Hoist safety
		--fuses	High voltage tester/probe				High voltage safety
		--linkages	Safety locks				
		--instrumentation devices (current transformers and potential transformers)					
	e	Replace removable contact and breakers; send for calibration					
	f	Replace switch gear unit					
	g	Energize switch gear to restore to service					
	h	Conduct insulation test; troubleshoot insulation problems					
	i	Terminate wires to field devices					
	j	Perform safe work practices around switch gears					
	k	Charge switch gear					
	l	Test switch gear (or contract for testing)					
19		Maintain/repair emergency generating equipment					
	a	Maintain fire protection equipment on generator	Common hand tools	Ohm's law	Verbal with co workers		Common safety practices
	b	Maintain transfer switch	DVOM	Basic Algebra	Verbal with shift engineer	Generator operation	Electrocution
	c	Monitor load	Clamp-on Ammeter		Verbal with power house engineer	Basic instrumentation	High pressure steam hazard
	d	Change filters on electrical panel			Written documentation	Basic electricity	High pressure gas hazard
	e	Maintain UPS and battery backup system for switchgear			Interpret technical manuals		Explosion
	f	Verify operation for unit			Input data into terminal		Asphyxiation
					Verbal with vendors		Chemical hazards (MSDS)
					Update Electrical Drawngs		Rotating equipment hazard
					Single Line Power Drawings		Pinch points
20		Maintain ground fault detection systems					
	a	Locate grounds	Common hand tool	Ohm's law	Verbal with co workers	Basic electrical principles	Common safety practices
	b	Test ground fault system	Megger		Verbal with engineering	Transformer operation	Electrocution
	c	Replace wire	DVOM		Verbal with mechanical technologist	Semi-conductor cable principles	Explosion
	d	Replace components	Signal tracer		Verbal with shift engineer	Power distribution system	Burn hazards
		--motor			Interpret technical manuals	Interpret schematics	Confined space entry
		--terminal strip			Update Electrical Drawngs	Ground fault principles	Lock out/tag out
		--disconnect			Single Line Power Drawings		
	e	Clean / Dry wiring and connections to equipment					
	f	Remove moisture					

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C		Power Distribution	Tools and Equipment	Calculations	Communications	Technology	Safety
	21	Repair/replace overhead bus systems					
	a	Inspect connections	Common hand tools	Ohm's law	Verbal with co-workers	Buss system operation	PPE
	b	Inspect for ground	Lifting equipment		Verbal with engineer	Basic electrical principles	Common safety practices
	c	Inspect for heat and heat damage	Hoisting equipment		Verbal with mechanical technologist	Mechanical principles	Electrocution hazard
	d	Remove/replace buss system	Ladder		Interpret Electrical Drawings/power diagrams		Mechanical force
	e	Replace components:	DVOM		Verbal with vendors		Lifting hazards
		--disconnects and switches	Megger		Update Electrical Drawngs		Hoist safety
		--joints	Torque wrench		Plant Layout Drawings		High voltage safety
		--insulators	Ruler or tape measuring device				Lock out/tag out
		#NAME?					
		--housing and covers					
	f	Perform or contract for thermal imaging					
	g	Update obsolete equipment					

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C		Power Distribution	Tools and Equipment	Calculations	Communications	Technology	Safety
22		Maintain/repair capacitors					
	a	Inspect damage, swelling, leaking, and corrosion	Common hand tools	Ohm's law	Verbal with co-workers	Basic electrical principles	PPE
	b	Inspect and replace fuses	DVOM	Measure current	Verbal with engineer	Capacitor theory	Common safety practices
	c	Inspect/replace contactors	Ammeter	Measure capacitance in farads	Verbal with mechanical technologist	Capacitance	Electrocution hazard
	d	Inspect for loose mechanical connections	Capacitor tester	Algebra	Interpret Electrical Drawings/power diagrams	Power factor	Mechanical force
	f	Inspect for cleanliness	Voltage tester		Verbal with vendors	Working voltage	Lifting hazards
	g	Inspect and replace insulators			Update Electrical Drawings	Capacitor rating/adequacy	Hoist safety
	h	Inspect and replace discharge resistors					High voltage safety
							Lock out/tag out
23		Install/maintain/troubleshoot transformers					
		Install					
			Common hand tools	Measure current	Verbal with engineering	Basic electrical (AC/DC)	Common safety practices
	a	Determine circuit requirements including wire size, conduit size, etc.	Megger	Measure voltage	Verbal with vendors	Basic mechanical	PPE
	b	Size the transformer for job	DVOM	Measure resistance	Verbal with operations	Type of transformers	OSHA regulations
	c	Determine mounting requirements	Ammeter	Read scale	Interpret Electrical Drawings/power diagrams	--Delta	Lifting devices
	d	Mount the transformer	Temperature device	Decimals	Interpret vendor drawings	--Wye	Shock hazard
	e	Wire in the transformer	Forklift		Update Electrical Drawings	--auto	Electrocution hazard
	f	Verify connections for type of transformer	Hoist and cranes		Single Line Power Drawings	--step down	Grounding
	g	Power up and test system				--step up	
	h	Measure voltage and adjust taps, if necessary				--current	
	i	Reconnect load				--center tapped	
		Troubleshoot/replace/repair				--multi-tapped	
	j	Inspect transformer for physical damage (smell, visual inspection)				--constant voltage	
	k	Measure insulation with megger				--dry type and oil filled	
	l	Measure amps and voltage				--buck boost	
	m	Replace transformer if required				--isolation transformer	
						NEC codes	
						Types of fasteners	

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24		Install/maintain/troubleshoot fuses and breakers (<600 V)					
	a	Disconnect power; open box or panel	Common hand tools	Measure amps	Verbal with co-workers	Basic electrical	Common safety practices
	b	Determine power requirements and type of protection required	Fuse puller	Measure voltage	Verbal with engineering	Basic mechanical	Lock out/tag out
	c	Size fuse/breaker for job	DVOM	Measure resistance	Interpret schematic	NEC code	OSHA regulations
	d	Obtain fuse/breaker/fuse holder	Megger	Read scale	Verbal with operations	Type of fuses	Shock hazard
	e	Prepare mounting for fuse or breaker	Infrared camera		Update Electrical Drawngs	--slow blow	Electrocution hazard
	f	Mount fuse or breaker or replace fuse/breaker	Torque wrench			--fast blow	Eye protection
	g	Inspect using infrared device				#NAME?	PPE
	h	Check tightness of fasteners and connections				Difference between fuse	
	i	Locate acceptable replacements				and breaker	
	j	Update obsolete equipment					

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Electrician/Technician

D.		Electromechanical	Tools and Equipment	Calculations	Communications	Technology	Safety
25		Install/maintain/troubleshoot AC and DC motors					
		<i>Install</i>					
			Common hand tools	Measure voltage	Verbal with engineering	NEC code	OSHA regulations
	a	Determine motor type and requirements (horsepower, voltage, type of wiring, Nema Rating etc.)	Megger	Measure amps	Verbal with operations	Basic electrical principles	Common safety practices
	b	Determine appropriate brake if required for the motor	DVOM	Measure resistance	Read technical manuals	Basic mechanical	Electrocution hazard
	c	Size the motor, frame and brake, if required	Clamp-on ammeter	Decimals to tenths	Written documentation	Electromagnetic principles	Short circuit protection
	d	Mechanically prepare site (or request that it be done)	Phase rotation device	Read scale	Update Electrical Drawngs	Types of motors	Cutting hazards
		--drill and tap holes	Temperature device	Basic math	Read vendor materials	--inverter rated	Safety equipment/PPE
		--install mountings	Tachometer	Substitute numbers into a formula	Verbal with mechanical	--DC drive	Lifting hazard
	e	Bolt motor in position		Use a chart/table		--wash down rating	Hoists/crane safety
	f	Attach motor to device		Measure rpm		--NEMA ratings	Rotating Equipment
		--Attach coupling, pulleys		Hertz rating		--types of AC motors	Pinch Points
	g	Align motor to device(s)				(split phase, syncro, etc.)	
	h	Attach wiring per appropriate schematic; verify integrity of wiring				--induction	
	i	Power equipment, test, and operate				--3-phase, single phase	
	j	Verify rotation				Centrifugal switch	
		<i>Repair/replace</i>				Capacitors	
	k	Inspect wiring and insulation with megger					
	l	Inspect termination					
	m	Check and/or change rotation					
	n	Inspect coupling					
	o	Inspect bearings					
	p	Inspect shafts					
	q	Check incoming power to unit					
	r	Replace motor unit					
	s	Replace bearings					
	t	Replace rotors					
	u	Replace wiring and reterminate					
	v	Check brushes, commutator (DC motors only)					
	w	Check armature and field wiring (DC motors only)					

Duties, Tasks, and Steps

Electrician/Technician

D.		Electromechanical	Tools and Equipment	Calculations	Communications	Technology	Safety
26		Install/repair/replace Motor starters (NEMA or IEC) and Soft Starts					
	a	Determine appropriate size of contactor, overloads, breaker/fuses, and Soft Start	Common hand tools	Measure voltage	Verbal with engineering	NEC code	OSHA regulations
	b	Secure appropriate starter required for the job and NEC regulations	Megger	Measure amps	Verbal with operations	Basic electrical principles	Common safety practices
		<i>Install</i>					
	c	Determine current and voltage requirements	DVOM	Measure resistance	Read technical manuals	Basic mechanical	Electrocution hazard
	d	Size contactor, breakers or fuses, overloads, and soft start	Clamp-on ammeter	Decimals to tenths	Written documentation	Electromagnetic principles	Short circuit protection
	e	Obtain appropriate motor starter required for the job	Phase rotation device	Read scale	Update Electrical Drawngs	Starting Systems	Cutting hazards
	f	Drill and tap holes to mount starter	Vibration sensor	Basic math	Read vendor materials	--delta-wye	Safety equipment/PPE
	g	Wire in the starter; terminate as appropriate		Substitute numbers into a formula		--resistance	
	h	Set overloads and short circuits on IEC and Program Soft Start Settings		Use a chart/table		--low voltage start	
	i	Install correct size if NEMA				--soft starts	
	j	Initiate power and test system					
		<i>Troubleshoot, Repair or replace</i>					
	k	Inspect for burned contacts					
	l	Inspect for proper termination of wires; loose wires					
	m	Inspect for burned wire					
	n	Inspect overload units					
	o	Inspect integrity of load wiring					
	p	Inspect condition of breaker					
	q	Measure coil resistance using DVOM					
	r	Replace coil					
	s	Replace overload module in IEC					
	t	Replace auxiliary contacts on IEC					
	u	Replace contacts on NEMA					
	v	Replace breaker on starter					
	w	Replace overloads on NEMA					
	x	Adjust settings on soft start, if required					

Duties, Tasks, and Steps

Electrician/Technician

D.	Electromechanical	Tools and Equipment	Calculations	Communications	Technology	Safety
27	Troubleshoot/repair/replace relays					
	<i>Install</i>					
a	Determine type of relay to use for application (AC, DC, solid state)	Common hand tools	Measure voltage	Verbal with engineering	Basic electrical principles	OSHA regulations
		DVOM	Measure amps	Verbal with operations	Basic mechanical	Common safety practices
b	Determine number and type of contacts and mounting mechanism	PC or laptop	Measure resistance	Read technical manuals	Operation and Understanding of relays	Electrocution hazard
c	Determine current/voltage rating		Substitute numbers into a formula	Written documentation	AC/DC theory	Short circuit protection
d	Mount and install and wire relay		Read scale	Update Electrical Drawngs	Types of relays	Cutting hazards
e	Determine type of surge suppression required, if any		Basic math	Read vendor materials	--timers	Safety equipment/PPE
f	Program relay, if appropriate		Use a chart/table	Verbal with mechanical	--normally open	
g	Power up, test and operate				--normally closed	
					--programmable	
	<i>Maintain</i>				--safety	
h	Perform visual inspection of unit					
i	Clean or replace contacts					
j	Check wiring and termination					
k	Replace relay if faulty					
28	Maintain/troubleshoot And/Or blocks					
a	Interpret schematic	Multimeter	Binary operation	Verbal with engineering	Basic electrical principles	Common safety practices
b	Replace board	Logic probe	Boolean logic	Verbal with operations	Logic principles	Electrocution hazard
c	Check for loose wire and accurate wiring	Schematic	Measure voltage	Read technical manuals	Boolean logic	
d	Measure voltage to verify operation	Common hand tools		Written documentation		
e	Trace and test logic			Update Electrical Drawngs		
f	Replace and/or block with PLC			Read vendor materials		
				Verbal with mechanical		
29	Use operating systems					
a	Demonstrate knowledge of DOS	Computer	Basic math	Verbal with supervisor	Basic computer literacy	PPE
	--copy/move commands	Printer	Input numeric data in computer	Read computer manuals	Computer hardware knowledge	
	--format	Software DOS		Verbal with operator	Computer software knowledge	
	--directories/subdirectory	Software Windows		Verbal with Informational Services (I.S.)		
	--DOS editor	Common hand tools		Input data		
	#NAME?					
	--load software					
b	Demonstrate knowledge of MS Windows					
	--load and set up software					

Duties, Tasks, and Steps

Electrician/Technician

E.		Computer Literacy	Tools and Equipment	Calculations	Communications	Technology	Safety
30		Use computer software					
	a	Use word processing software	Computer	Basic math	Verbal with supervisor	Basic computer literacy	PPE
	b	Use database software	Printer	Input numeric data in computer	Read computer manuals	Computer hardware knowledge	
	c	Use spreadsheet software	Software DOS		Verbal with operator	Computer software knowledge	
	d	Use e-mail	Software Windows		Verbal with Informational Services (I.S.)		
	e	Use specialized vendor software	Common hand tools		Input data		
	f	Use communication software					
31		Set up communication devices and software					
	a	Install, setup and maintain modems and I/O interface	Common hand tools	Basic math	Verbal with supervisor	Basic computer literacy	PPE
	b	Install communication network/data highway, Devicenet, Controlnet	Specialized crimp tools	Estimate length	Read computer manuals	Computer hardware knowledge	Shock hazards
	c	Install Ethernet hardware and software	Soldering iron		Verbal with operator	Computer software knowledge	Soldering safety
	d	Update and troubleshoot problems	Portable floppy drive		Verbal with Informational Services (I.S.)	Communication protocol	
		--not able to communicate	Laptop/interface		Input data	Basic networking concepts	
		--upgrade hardware and reconfigure software					
		--change video and communication cards					
	e	Install, set up wireless					
32		Install/repair/configure computer components (HMI screen)					
	a	Install and set up floppy drives	Common hand tools	Basic math	Verbal with supervisor	Basic computer literacy	PPE
	b	Install and set up hard drives	Static strap	Numbering systems	Read computer manuals	Computer hardware knowledge	Shock hazards
	c	Install and set up CD-ROM	DVOM		Verbal with operator	Computer software knowledge	Pinch points
	d	Install and set up batteries	Software		Verbal with Informational Services (I.S.)	Communication protocol	Soldering safety
	e	Install and set up motherboards			Input data	Basic networking concepts	Burn hazard
	f	Install and set up EPROMs					
	g	Install memory chips					
	h	Install power supplies					
	i	Install interfaces					
	j	Perform backup					
	k	Install touchscreen and touchscreen driver					
	l	Upgrade obsolete equipment					

Duties, Tasks, and Steps

Electrician/Technician

F.		Networking	Tools and Equipment	Calculations	Communications	Technology	Safety
	33	Perform process control networking tasks					
	a	Connect PC to network; install appropriate software, if required	PC and laptop	Basic math	Verbal with vendors	Computer literacy	Common safety practices
	b	Set IP addresses	Cables	Measure length	Verbal with tech support	Networking concepts	Shock Hazards
	c	Navigate network to proper PLC	Software	Measure voltage	Interpret technical materials	Cabling systems	
	d	Troubleshoot and Identify network components	Network analyzer	Measure resistance	Reading comprehension		
		--switches	DVOM		Verbal with engineers		
		--routers	Vendor documentation		Verbal with co-workers		
		--PLC			Update Network Drawngs		
		--NIC					
		--cables (Thick & Thin Net, Cat5, Cat5E, Cat6)					
	e	Use various network protocols, such as					
		--Data Highway					
		--TCP/IP					
		--Sercos					
		--Modbus					
		--Devicenet					
		--ControlNet					
		--Honeywell (ControlNet; DeviceNet; DCMIS Peer Net)					
	f	Calibrate touchscreen on network					
	34	DeviceNet Network					
	a	Add/commission node	PC and laptop	Basic math	Verbal with vendors	Computer literacy	Common safety practices
	b	Set parameters	Cables	Measure length	Verbal with tech support	Networking concepts	Shock Hazards
	c	Identify maximum length	Software		Interpret technical materials	Devicenet Cabling systems	PPE
	d	Identify baud rate	Network analyzer		Reading comprehension	RSNetworkx Software	Short Circuit Protection
	e	Install EDS files	Multimeter		Verbal with engineers		
	f	Connect to Network	Vendor documentation		Verbal with co-workers		
	g	Upload/Download a project to the Scanner Module			Update Electrical Drawings		
	h	Upload/Download to a Device					
	i	Configure a device on a network					
	j	Understand I/O mapping for devices					
	k	Scanner Scan list and how they work					
	l	Save a project offline/online					
	m	How to use Scanner Error Codes					

Duties, Tasks, and Steps

Electrician/Technician

G.		Schematics	Tools and Equipment	Calculations	Communications	Technology	Safety
	38	Interpret electrical schematics					
	a	Identify common electrical American, European and specific symbols, such as	Print	Conversions	Translate from foreign language	Basic schematic reading	Common safety practices
		--PLC input and output	Magnifying glasses		P + ID's	Troubleshooting principles	
		--switches					
		--relays / contacts					
		--overloads					
		--breakers					
		--timers					
		--drives					
		--servos					
		--fuses or circuit breakers					
		--transformers					
		--motors					
		--input and output symbol					
	b	Interpret definition page on a schematic					
	c	Cross reference prints					
	39	Maintain schematic documentation					
	a	Manually draw modifications made to a system	Print	Conversions	Translate from foreign language	Basic schematic reading	Common safety practices
	b	Use CADD package to update	Magnifying glasses		P + ID's	Troubleshooting principles	
	c	Date and initial changes made	CADD package				
	d	Destroy old prints					
	e	Communicate changes to appropriate parties					
	f	Sketch/draw schematics					

Duties, Tasks, and Steps

Electrician/Technician

H.		Robots	Tools and Equipment	Calculations	Communications	Technology	Safety
40		Maintain robot systems					
	a	Troubleshoot mechanical related problems, such as --belts, coupling, gear boxes, bearings, etc.	Common hand tools DVOM	Basic math Tolerances	Verbal with associates Verbal with operator	Basic electricity Robotic principles	Common safety practices PPE
	b	Replace motors and drive amps	Computer and software	Calculate distance in mm	Interpret technical manual/ instruction sheet	Sensor principles Robot controller Software	Shock hazard Pinch points
	c	Adjust teach points and parameters		Use coordinate system	Verbal with engineering	Servo software	Lock out/tag out
	d	Back up program			Interpret Electrical Drawings		Rotating Equipment
	e	Adjust associated switches and sensors			Update Electrical Drawings		
	f	Troubleshoot and replace safety interlocks					
	g	Write programs for robot operation					
	h	Home robot					
		Maintenance of battery backups for Robotic Controllers					

Duties, Tasks, and Steps

Electrician/Technician

I.		Process Controls	Tools and Equipment	Calculations	Communications	Technology	Safety
	41	Calibrate/install/repair flow and density transmitters, gages and switches					
	a	Determine calibration points (ex. zero, 50, 100%, etc.)	Reference device	Compare numbers in range	Verbal with co-workers	Calibration procedures	Common safety practices
	b	Determine acceptable accuracy tolerances/range	Common hand tools	Percentages	Verbal with operator	Basic mechanical	PPE
	c	Simulate an input signal from reference device	DVOM	Scale numeric data	Verbal with mechanical tech	Basic electrical	Shock hazard
	d	Verify output with operator interface or terminal	mA mV source and reading	Basic math	Interpret technical manual/	Operating principle of device	High pressure hazard
	e	Adjust per manufacturer's guidelines	Manometer	Algebra	Verbal with engineering	Types of flow sensors:	Stored energy
	f	Revalidate readings	Differential pressure gage		Interpret Electrical Drawings	--differential temperature	Burn hazard/steam
	g	Complete documentation	Hand-held programmers		Update Electrical Drawings	--mass flow	Lock out/tag out
	h	Determine appropriate calibration procedure	Stop watch		P + ID's	--flow indicating	Chemical hazard (MSDS)
		--Rosemont, Micromotion, Foxboro, E&H, Honeywell, etc.	Weigh scale and bucket			--volumetric	
		<i>Install</i>				Physics	
	a	Set up sensor				Sensor principles	
	b	Calibrate flow sensors				Densities	
	c	Install flow sensors					
	d	Interface flow sensor to PLC					
		<i>Repair/replace</i>					
	e	Unclog flow sensor					
	f	Replace/repair circuit boards					
	g	Replace heads (flow tube)					
	h	Replace paddle					
	i	Replace transmitter					

Duties, Tasks, and Steps

Electrician/Technician

I.		Process Controls	Tools and Equipment	Calculations	Communications	Technology	Safety
	42	Calibrate/install/repair temperature transmitter, gages and switches					
	a	Determine calibration points (ex. zero, 50, 100%, etc.)	Reference device	Compare numbers in range	Verbal with co-workers	Calibration procedures	Common safety practices
	b	Determine acceptable accuracy tolerances/range	Common hand tools	Percentages	Verbal with operator	Basic mechanical	PPE
	c	Simulate an input signal from reference device	DVOM	Scale numeric data	Verbal with mechanical tech	Basic electrical	Shock hazard
	d	Verify output with operator interface or terminal	4-20ma / 0-10V Simulator	Algebra	Interpret technical manual/	Operating principle of device	High pressure hazard
	e	Adjust per manufacturer's guidelines	Resistance substitution box	Measure temperature	Verbal with engineering	Types of temperature sensors	Stored energy
	f	Revalidate readings	Calibrate temperature source	Convert temperature C to F	Interpret Electrical Drawings	--thermocouple	Burn hazard/steam
	g	Complete documentation	Thermometer	RTD tables	Update Electrical Drawings	--RTD	Lock out/tag out
	h	Determine appropriate calibration procedure	Thermocouple calibrator	Thermocouple tables	P + ID's	--infrared	Chemical hazard (MSDS)
		--RTD, Thermocouple, thermister	Pneumatic calibrator			--laser	
		<i>Install</i>	Squeeze bulb			--capillary	
	i	Check primary sensing element	Decade Box			--bi-metal strip	
	j	Calibrate temperature sensor	Hand-held programmer			Thermocouple principles	
	k	Check and verify polarity	Hot Box			Pelete	
	l	Check connections for looseness				Temperature coefficients	
	m	Verify correct type of sensor					
	n	Verify controller parameters					
		<i>Repair/replace</i>					
	o	Repair/replace primary sensor					
	p	Repair/replace circuit boards					
	q	Repair/replace extension wire					
	r	Repair/replace well					
	s	Clean the exhaust port (nozzle flapper)					
	t	Replace the thermostat					
	u						

Duties, Tasks, and Steps

Electrician/Technician

I.		Process Controls	Tools and Equipment	Calculations	Communications	Technology	Safety
	43	Calibrate/install/repair pressure transmitters, gages, switches					
	a	Determine calibration points (ex. zero, 50, 100%, etc.)	Reference device	Compare numbers in range	Read technical materials	Calibration procedures	Common safety practices
	b	Determine acceptable accuracy tolerances/range	Common hand tools	Percentages	Verbal with co-workers	Basic mechanical	PPE
	c	Simulate an input signal from reference device	DVOM	Scale numeric data	Verbal with operator	Basic electrical	Shock hazard
	d	Verify output with operator interface or terminal	4-20ma / 0-10V Simulator	Algebra	Verbal with mechanical tech	Operating principle of device	High pressure hazard
	e	Adjust per manufacturer's guidelines	Tubing benders	Measure pressure	Interpret technical manual/	Types of pressure sensors:	Stored energy
	f	Revalidate readings	Hand-held programmer	Conversions	Verbal with engineering	--peizo electric	Burn hazard/steam
	g	Complete documentation	Calibrated pressure source		Interpret Electrical Drawings	--bourdon	Lock out/tag out
	h	Determine appropriate calibration procedure for type of switches and transmitters	Pipe threader		Update Electrical Drawings	--capacitance	Chemical hazard (MSDS)
		--pressure transducer, differential pressure	Pneumatic calibrator		P + ID's	--mechanical	
		<i>Install</i>				--pneumatic	
	i	Set up pressure sensors				Types of pressures:	
	j	Calibrate pressure sensors				--vacuum	
	k	Replace pressure sensor				--absolute (psia)	
	l	Program				--differential (psi)	
	m	Tighten connections and tubing				--atmospheric (psig)	
	n	Inspect electrical connections					
	o	Substitute sources					
		<i>Repair/replace</i>					
	p	Repair/replace boards					
	q	Repair/replace transmitters					
	r	Repair/replace sensing unit					
	s	Install and "pipe in" a pressure sensor					
	44	Calibrate/install/repair level transmitter, gages, switches					
	a	Determine calibration points (ex. zero, 50, 100%, etc.)	Reference device	Compare numbers in range	Verbal with operations	Calibration procedures	Common safety practices
	b	Determine acceptable accuracy tolerances/range	Common hand tools	Percentages	Read technical materials	Basic mechanical	Burn hazard
	c	Simulate an input signal from reference device	DVOM	Scale numeric data	Update Electrical Drawings	Basic electrical	Fall hazard
	d	Verify output with operator interface or terminal	4-20ma / 0-10V Simulator		Verbal with engineering	Operating principle of device	
	e	Adjust per manufacturer's guidelines	Hart Communicator		P + ID's	Types of level sensors:	
	f	Revalidate readings	Hand held programmers			RF Admittance	
	g	Complete documentation				ultrasonic	
	h	Determine appropriate calibration procedure and software				Radar	
		--capacitance, RF, Microwave, ultrasonic				Continuous or Level	
	i	Adjust Sensitivity of instrument					

Duties, Tasks, and Steps

Electrician/Technician

I.		Process Controls	Tools and Equipment	Calculations	Communications	Technology	Safety
	45	Calibrate/install/repair speed transmitter and switches					
	a	Determine calibration points (ex. zero, 50, 100%, etc.)	Reference device	Compare numbers in range	Verbal with operations	Calibration procedures	Common safety practices
	b	Determine acceptable accuracy tolerances/range	Common hand tools	Percentages	Read technical materials	Basic mechanical	Burn hazard
	c	Simulate an input signal from reference device	DVOM	Scale numeric data	Update Electrical Drawings	Basic electrical	Fall hazard
	d	Verify output with operator interface or terminal	4-20ma / 0-10V Simulator		Verbal with engineering	Operating principle of device	
	e	Adjust per manufacturer's guidelines	Tachometer		P + ID's		
	f	Revalidate readings					
	g	Complete documentation					
	h	Determine appropriate calibration procedure					
		<i>Install</i>					
	i	Calibrate speed sensors	Common hand tools	Algebra	Verbal with operations	Types of speed sensors:	Common safety practices
	j	Replace speed sensors	DVOM	Measure speed	Read technical materials	--optical	PPE
	k	Check output	Metric Allen Wrenches	Measure motion	Update Electrical Drawings	--mechanical	Shock hazard
	l	Align speed sensor	Oscilloscope		Verbal with engineering	--proximity	Rotating equipment
	m	Perform set up	Frequency counter		P + ID's	--rotary	Stored energy
	n	Install speed sensor	Tachometer			--pulse	Burn hazard/steam
	o	Check connections and power supply	Strobe lights			--hall effect	Lock out/tag out
		Repair/replace				--electro-mechanical	Pinch points
	p	Replace unit				--encoders	
						--resolvers	
						Physics (time and rate)	
	46	Calibrate moisture/humidity transmitters					
	a	Determine calibration points (ex. zero, 50, 100%, etc.)	Reference device	Compare numbers in range	Verbal with operations	Calibration procedures	Common safety practices
	b	Determine acceptable accuracy tolerances/range	Common hand tools	Percentages	Read technical materials	Basic mechanical	Burn hazard
	c	Simulate an input signal from reference device	DVOM	Scale numeric data	Update Electrical Drawings	Basic electrical	Fall hazard
	d	Verify output with operator interface or terminal	4-20ma / 0-10V Simulator	Interpret chart	Verbal with engineering	Operating principle of device	
	e	Adjust per manufacturer's guidelines			P + ID's		
	f	Revalidate readings					
	g	Complete documentation					
	h	Determine appropriate calibration procedure					
		--chilled mirror					

Duties, Tasks, and Steps

Electrician/Technician

I.		Process Controls	Tools and Equipment	Calculations	Communications	Technology	Safety
	47	Calibrate proportional control valves					
	a	Determine calibration points (ex. zero, 50, 100%, etc.)	Reference device	Compare numbers in range	Verbal with operations	Calibration procedures	Common safety practices
	b	Determine acceptable accuracy tolerances/range	Common hand tools	Percentages	Read technical materials	Basic mechanical	Burn hazard
	c	Simulate an input signal from reference device	DVOM	Scale numeric data	Update Electrical Drawings	Basic electrical	Fall hazard
	d	Verify output with operator interface or terminal	4-20ma / 0-10V Simulator	Interpret chart	Verbal with engineering	Operating principle of device	
	e	Adjust per manufacturer's guidelines			P + ID's		
	f	Revalidate readings					
	g	Complete documentation					
	h	Determine appropriate calibration procedure					
		--detailed mfg. procedure					
	48	Calibrate process control loop (PID)					
	a	Determine acceptable accuracy tolerances/range	Chart recorders	Compare numbers in range	Verbal with operations	Calibration procedures	Common safety practices
	b	Revalidate readings	Voltmeter	Percentages	Read technical materials	Basic mechanical	Burn hazard
	c	Complete documentation	Milliamp meter	Scale numeric data	Update Electrical Drawings	Basic electrical	Fall hazard
	d	Determine appropriate calibration procedure	Calculator		Verbal with engineering	PID Control Theory	
	e	Tuning of PID loops	4-20ma / 0-10V Simulator		P + ID's	Interpret PID charts	
	f	Observe changes and trends	Common hand tools				
	g	Change set point and observe response to process; determine adjustment requirements	PC or laptop				
		--P, I, or D					
	h	U					
	49	Verify/calibrate metal detectors					
	a	Send test device through system	Oscilloscope	Measure voltage	Verbal with engineering	Basic electrical principles	OSHA regulations
	b	Verify output's operation	Test device	Measure amps	Verbal with operations	Basic mechanical	Common safety practices
	c	Adjust sensitivity per manufacturer's guidelines based on application	Common hand tools	Measure resistance	Read technical manuals	Electromagnetic principles	Electrocution hazard
	d	Revalidate readings	PC or laptop	Decimals to tenths	Written documentation	Computer literacy	Short circuit protection
	e	Complete documentation		Read scale	Update Electrical Drawings	Metal detector theory	Cutting hazards
				Basic math	Read vendor materials		
		Install		Substitute numbers into a formula	Verbal with mechanical		Safety equipment/PPE
	f	Determine metal free zone		Use a chart/table			Lifting hazard
	g	Install detector; mount and wire					Hoists/crane safety
	h	Calibrate detector					
	i	Interface detector to control system					
	j	Verify operation; test and run					
	k	Maintain/repair					
	l	Verify power and proper grounding					
	m	Verify detection and reject					
	n	Verify phasing and sensitivity					
	o	Check shaft and bearings for wear on belt					
	p	Check belt for metal contamination					
	q	Check for RF interference					
	r	Replace circuit boards					
	s	Replace or adjust search head					
	t	Check for vibration on the unit					

Duties, Tasks, and Steps

Electrician/Technician

I.		Process Controls	Tools and Equipment	Calculations	Communications	Technology	Safety
	50	Install/calibrate load cells					
	a	Troubleshoot/replace load cell	Common hand tools	Basic math	Verbal with associates	Basic electricity	Common safety practices
	b	Calibrate load cells	Dead weight or load simulator	Tolerances	Verbal with operator	Load cell principles	PPE
	c	Replace related electronic cards	4-20ma / 0-10V Simulator	Calculate distance in mm	Interpret technical manual/	Sensor principles	Shock hazard
	d	Use installed indicating equipment	Ladder and lifting equipment		instruction sheet		Pinch points
	e	Program controller for new load cells			Verbal with engineering		Lock out/tag out
	f	Determine appropriate calibration procedure			Interpret Electrical Drawings		
		--deadweight, loss of weight, electronically scales, hydraulically, check weigher			P + ID's		
	51	Troubleshoot/replace transducers					
		<i>Troubleshoot/replace</i>	Common hand tools	Measure voltage	Programming language	Computer literacy	Common safety practices
	a	Perform visual inspection of unit (broken, burned, case, wet, etc.)	DVOM	Measure current	Verbal with engineering	Advanced electronics	Electrical shock
	b	Verify signal in and out	4-20ma / 0-10V Simulator	Measure resistance	Verbal with vendors	Type of transducers	Electrocution hazard
	c	Verify power to the unit, if appropriate	Calibrators	Establish ranges	Interpret Electrical Drawings	--temperature	Ladder safety
	d	Verify and adjust calibration with test equipment	PC or laptop	Ratios	Update Electrical Drawings	--pressure	Safety harness
	e	Verify accuracy of program	Ladder and lifting equipment	Decimals	P + ID's	--current	Lifting hazard
	f	Inspect cleanliness of air equipment; plugged holes		Algebra		--pH	PPE
	g	Replace transducer, if required				--flow	Confined space
	h	Power up and test operate				--optical	
	i	Calibrate unit; program PLC if required				--ultrasonic	
						--Hall effect	
						--capacitive	

Duties, Tasks, and Steps

Electrician/Technician

J.		Programmable Logic Controllers (PLC)	Tools and Equipment	Calculations	Communications	Technology	Safety
52		Create/modify ladder logic					
	a	Modify block transfer/read writes	Common hand tools	Binary	Verbal with co-workers	Troubleshoot equipment processes	Common safety practices
	b	Modify I/O routines	DVOM	Hex	Interpret technical manuals	FIFO	ESD
	c	Configure PID module block/program	Laptop/PC	Octal	Verbal with vendor	Shift registers	
	d	Configure ASCII module block/program	Diagnostic programs	BCD	Update Electrical Drawings	Computer literacy	
	e	Set up soft switches and PLC cards	Software	Scaling	P + ID's	Binary	
	f	Configure analog input and output modules		Limits		Electronic principles	
	g	Set up sequencer		PID		Ladder logic software	
	h	Set/enable bits		Boolean algebra			
	i	Manipulate files and messages					
	j	Set mathematical limits and scaling calculations					
	k	Force logic					
	l	Check/verify module to module interlocks					
	m	Monitor data flow Data Tables					
	n	Understand the operation of timers and counters					
53		Install/troubleshoot PLC hardware (Allen-Bradley)					
	a	Install/troubleshoot chassis on panel	Common hand tools	Measure voltage	Verbal with vendor	Create/read ladder logic	Common safety practices
	b	Install/troubleshoot I/O modules	PC	Measure current	Read technical materials	PLC operation	Shock hazard
	c	Install/troubleshoot processors	DVOM	Measure resistance	Update Electrical Drawings	Equipment function	Electrocution hazard
	d	Install/troubleshoot power supplies	4-20ma / 0-10V Simulator	Binary, hex, octal numbers	Verbal with operations	Computer literate	OSHA regulations
	e	Install/maintain cabling	Calibrators		P + ID's	Addressing I/O	
	f	Connect and fabricate cabling and wiring				Loop controls	
	g	Install/troubleshoot communication module in terminal or computer				Grounding principles	
	h	Demonstrate knowledge of basic PLC systems				Shielding principles	
	i	Define the basic elements of a Control System.				Basic electronics	
	j	Identify sections of a programmable controller system.					
	k	Explain the function of the PLC program in a PLC.					
	h	Identify parameters that each PLC has.					
	m	Explain the operation of N.O. and N.C. contacts on a relay					
	n	Determine which elements in a PLC program are allowing power flow.					
54		Program PLC using software (Allen-Bradley)					
	a	Configure processor for application	Common hand tools	Binary, hex, octal numbers	Verbal with vendor	Create/read ladder logic	Common safety practices
	b	Configure processor for rack/channel	PC		Read technical materials	PLC operation	Shock hazard
	c	Configure processor for I/O module			Update Electrical Drawings	Equipment function	Electrocution hazard
	d	Update processor revisions			Verbal with operations	Computer literate	OSHA regulations
	e	Install programming upgrades			Programming languages	Addressing I/O	
	f	Use computer terminal for programming			--AB A/I	Loop controls	
	g	Create and edit PLC ladder logic code			Rslogix	Serial communications	
	h	Check/clear processor faults			P + ID's	Parallel communications	
	i	Upload and download files				Ethernet communications	
	j	Archive changes					
	k	Force contacts					
	l	Document and communicate as appropriate					
	m	Install and configure software					

Duties, Tasks, and Steps

Electrician/Technician

		n	Establish communication between processors and laptop or PC						
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Duties, Tasks, and Steps

Electrician/Technician

J.		Programmable Logic Controllers (PLC)	Tools and Equipment	Calculations	Communications	Technology	Safety
	55	Create/modify alternative Programming Languages					
	a	Use Boolean logic	Common hand tools	Measure voltage	Verbal with vendor	Create/read ladder logic	Common safety practices
	b	Use SFC (Sequential Function Chart)	PC	Measure current	Read technical materials	PLC operation	Shock hazard
	c	Use structured text	DVOM	Measure resistance	Update Electrical Drawings	Equipment function	Electrocution hazard
			4-20ma / 0-10V Simulator	Binary, hex, octal numbers	Verbal with operations	Computer literate	OSHA regulations
			Calibrators		Programming languages	Addressing I/O	
			Breakout box		Rslgix	Loop controls	
					P + ID's	Serial communications	
						Parallel communications	
						Ethernet communications	
	56	Troubleshoot Honeywell PLC hardware and software					
	a	Install/troubleshoot chassis on Honeywell panel	Common hand tools	Measure voltage	Verbal with vendor	Create/read ladder logic	Common safety practices
	b	Install/troubleshoot I/O modules	PC	Measure current	Read technical materials	PLC operation	Shock hazard
	c	Install/troubleshoot processors	DVOM	Measure resistance	Update Electrical Drawings	Equipment function	Electrocution hazard
	d	Install/troubleshoot power supplies	4-20ma / 0-10V Simulator	Binary, hex, octal numbers	Verbal with operations	Computer literate	OSHA regulations
	e	Install/maintain cabling	Calibrators		Programming languages	Addressing I/O	
	f	Connect and fabricate cabling and wiring	Breakout box		Loader Package	Loop controls	
	a	Configure Honeywell processor for application				Create/read ladder logic	
	b	Configure Honeywell processor for rack/channel			P + ID's	PLC operation	
	c	Configure Honeywell processor for I/O module				Equipment function	
	d	Use computer terminal for programming				Computer literate	
	e	Create and edit PLC ladder logic code					
	f	Check/clear processor faults					
	g	Upload and download files					
	h	Archive changes					
	i	Force contacts					
	j	Document and communicate as appropriate					
	k	Install and configure software					

Duties, Tasks, and Steps

Electrician/Technician

K.		Human Machine Interface (HMI)	Tools and Equipment	Calculations	Communications	Technology	Safety
57		Program/maintain operator interface software (Wonderware)					
	a	Create/maintain/edit graphics	Common hand tools	Basic math	Verbal with vendor	Create/read ladder logic	Common safety practices
	b	Upload and download programs	Laptop	Calculate process data	Read technical materials	PLC operation	Shock hazard
	c	Configure interface for communications (baud rate, driver, etc.)			Update Electrical Drawings	Equipment function	
	d	Integrate graphics with PLC program			Verbal with operations	Computer literate	
	e	Integrate graphics with DCS host			P + ID's	Addressing I/O	
	f	Upgrade programming software				Loop controls	
	g	Perform backups; verify integrity and changes; verify security					
	h	Maintain plant standards for graphics					
	i	Maintain database					
58		Program/maintain operator interface software (Intellution)					
	a	Create/maintain/edit graphics	Common hand tools	Basic math	Verbal with vendor	Create/read ladder logic	Common safety practices
	b	Upload and download programs	Laptop	Calculate process data	Read technical materials	PLC operation	Shock hazard
	c	Configure interface for communications (baud rate, etc.)			Update Electrical Drawings	Equipment function	
	d	Integrate graphics with PLC program			Verbal with operations	Computer literate	
	e	Integrate graphics with DCS host			P + ID's	Addressing I/O	
	f	Upgrade programming software				Loop controls	
	g	Perform backups; verify integrity and changes; verify security					
	h	Maintain plant standards for graphics					
	i	Maintain database, poll records and tag groups					
	j	Troubleshoot SQL					
59		Program/maintain operator interface software (PanelBuilder)					
	a	Create/maintain/edit graphics	Common hand tools	Basic math	Verbal with vendor	Create/read ladder logic	Common safety practices
	b	Upload and download programs	Laptop	Calculate process data	Read technical materials	PLC operation	Shock hazard
	c	Configure interface for communications (baud rate, etc.)			Update Electrical Drawings	Equipment function	
	d	Integrate graphics with PLC program			Verbal with operations	Computer literate	
	e	Integrate graphics with DCS host			P + ID's	Addressing I/O	
	f	Upgrade programming software				Loop controls	
	g	Perform backups; verify integrity and changes; verify security					
	h	Maintain plant standards for graphics					
	i	Maintain database					

Duties, Tasks, and Steps

Electrician/Technician

K.		Human Machine Interface (HMI)	Tools and Equipment	Calculations	Communications	Technology	Safety
60		Program/maintain operator interface software (Interact)					
	a	Create/maintain/edit graphics	Common hand tools	Basic math	Verbal with vendor	Create/read ladder logic	Common safety practices
	b	Upload and download programs	Laptop	Calculate process data	Read technical materials	PLC operation	Shock hazard
	c	Configure interface for communications (baud rate, etc.)			Update Electrical Drawings	Equipment function	
	d	Integrate graphics with PLC program			Verbal with operations	Computer literate	
	e	Integrate graphics with DCS host			P + ID's	Addressing I/O	
	f	Upgrade programming software				Loop controls	
	g	Perform backups; verify integrity and changes; verify security					
	h	Maintain plant standards for graphics					
	i	Maintain database					
61		Program/maintain operator interface software (RSView 32)					
	a	Create/maintain/edit graphics	Common hand tools	Basic math	Verbal with vendor	Create/read ladder logic	Common safety practices
	b	Upload and download programs	Laptop	Calculate process data	Read technical materials	PLC operation	Shock hazard
	c	Configure interface for communications (baud rate, etc.)			Update Electrical Drawings	Equipment function	
	d	Integrate graphics with PLC program			Verbal with operations	Computer literate	
	e	Integrate graphics with DCS host			P + ID's	Addressing I/O	
	f	Upgrade programming software				Loop controls	
	g	Perform backups; verify integrity and changes; verify security					
	h	Maintain plant standards for graphics					
	i	Maintain database					

Duties, Tasks, and Steps

Electrician/Technician

L.		Safety	Tools and Equipment	Calculations	Communications	Technology	Safety
62		Lock out/tag out procedures					
	a	Purpose of a lock and tag	Lock and Tags	Ease of lock out for operator	Verbal with vendor	Basic electricity	Common safety practices
	b	Demonstrate proper procedure for lock and tag		One button for different source	Read technical materials		PPE
	c	Procedures for removing your lock		E-stop design	Verbal with operations		Fall hazard
	d	Procedures for removing someone else's lock		Power down vs. lock down			Electrocution hazard
	e	Location of locks and issue procedures (plant specific)		Lock out a component while leaving system operational			Pinch points
	f	Communication for shift changes					Rotating equipment
	g	Multiple lock out procedures					Cutting hazards
	h	System lock vs. local lock					Entanglement
	i	Multiple energy sources					Burn hazard
	j	Differentiate between control vs. power					Dust hazards
63		Personal Protective Equipment					
	a	Hearing safety	Hearing protection	Measure sound in db	Interpret hazard signs	Basic electricity	Common safety practices
		--Annual hearing test is required	Safety glasses		Read safety manual	Basic chemistry	Electrical safety
		--Hearing protection required in assigned areas	Goggles		Comply with written safety instructions	Basic physical principles	Chemical safety
		--Why noise causes hearing loss?	Face shield		Comply with verbal safety instructions		Mechanical equipment safety
		--Relationship of intensity to hearing loss	Gloves		Read MSDS sheets		
		--Types of hearing protection	Steel toed shoes				
	b	Eye and face protection	Bump caps				
		--Mandatory eye protection	Hard hat				
		--When to wear goggles vs. glasses					
		--Face shield requirements--when required					
		--Face shield required with safety glasses underneath; Rx must be safety glass					
		--Must be ANSI approved					
	c	Hand protection					
		--Correct gloves for application					
		--When it is appropriate to use and not use gloves					
		--Inspection and certification of gloves (including electrical)					
		--Fit of gloves important					
		--Awareness of pinch points					
	d	Foot protection					
		--ANSI approved					
		--Steel toed					
		--Proper tread or sole selection					
		--Replace regularly					
		--Fit is important					
		--Correct type of protection for chemical and hot water					
		--Shoes vs boots vs. overshoes					
	e	Head protection					
		--Bump caps vs. hard hat (classes A, B, C)					
		--Hair net for food safety					
		--How to adjust					
		--Proper fit					

Duties, Tasks, and Steps
Electrician/Technician

		--Disposal of ones once hit					
L.		Safety	Tools and Equipment	Calculations	Communications	Technology	Safety
64		High voltage (over 50 volts but less than 600)					
	a	Respect high voltage	Common safety practices	Segregate voltages	Appropriate labeled	High voltage knowledge	Common safety practices
	b	Only trained personnel	High voltage gloves	Maintain clearances in front of door	Consistency of labels	Electrical knowledge	PPE
	c	Identify how low voltage can kill		Proper sizing of wires and conduit protection	Start and stop stations labels	Safety practices	Fall hazard
	d	Don't allow to cross heart (right hand rule)			Consistent cross-references of electrical labeling		Electrocution hazard
	e	Ohms law and Kirchoff's law			Single line Power Drawings		Pinch points
	f	Understanding grounding; stay out of ground loop			Update Electrical Drawings		Rotating equipment
	g	PPE--including gloves, face, stick, guarding					Cutting hazards
	h	Know safe way to reset breakers					Entanglement
	i	Knowledge of flash					Burn hazard
	j	Hazards of electricity					Dust hazards
	k	Distinguish exposed live electrical parts from non-exposed parts					
	l	Proper clearance distances specified in OSHA					
	m	Prohibition of work on live part except under unusual circumstances					
	n	Use and limitations of electrical PPE, including before use inspections					
	o	Color codes of wires					
	p	Adhere to required electrical PPE table					
	q	Recognize hazards of florescent lights and proper disposal					
	r	Recognize hazards of PCB transformers					
	s	Identify materials that produce electrical conductivity vs. insulation					
	t	Resistance changes with moisture and water					
	u	Electrocution response--facilities and medical; identify risks					
	v	Foreign Voltage					
65		High Voltage (over 600)					
	a	Proper PPE	Common safety practices	Segregate voltages	Appropriate labeled	High voltage knowledge	Common safety practices
		--high voltage gloves	High voltage gloves	Maintain clearances in front of door	Consistency of labels	Electrical knowledge	PPE
		--verify inspection	Hot stick	Proper sizing of wires and conduit protection	Start and stop stations labels	Safety practices	Fall hazard
		--hot stick inspection	Face Shield		Consistent cross-references of electrical labeling		Electrocution hazard
		--wear face shield			Single line Power Drawings		Pinch points
	b	Avoid looking when throwing jacks			Update Electrical Drawings		Rotating equipment
	c	Confirm by-standers safely out of range					Cutting hazards
	d	Replace Incoming Line Fuses					Entanglement
							Burn hazard
							Dust hazards