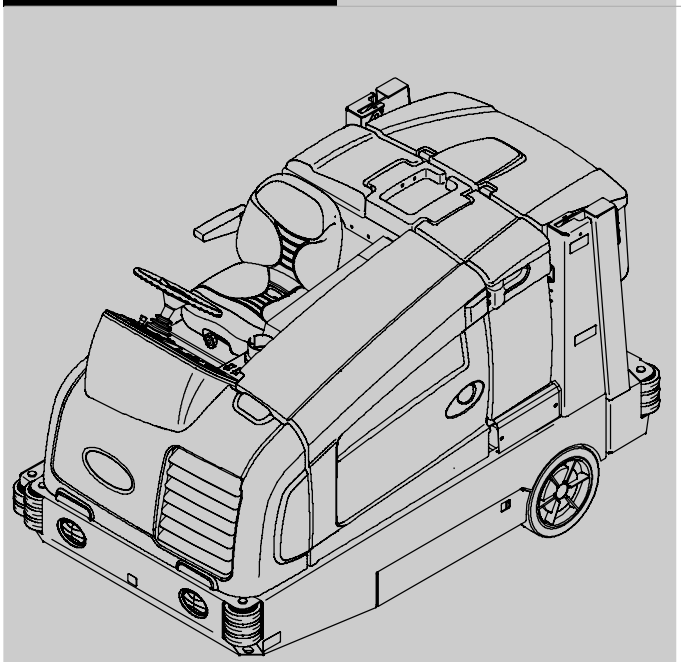
TENNANT®

M20



Service Information Manual

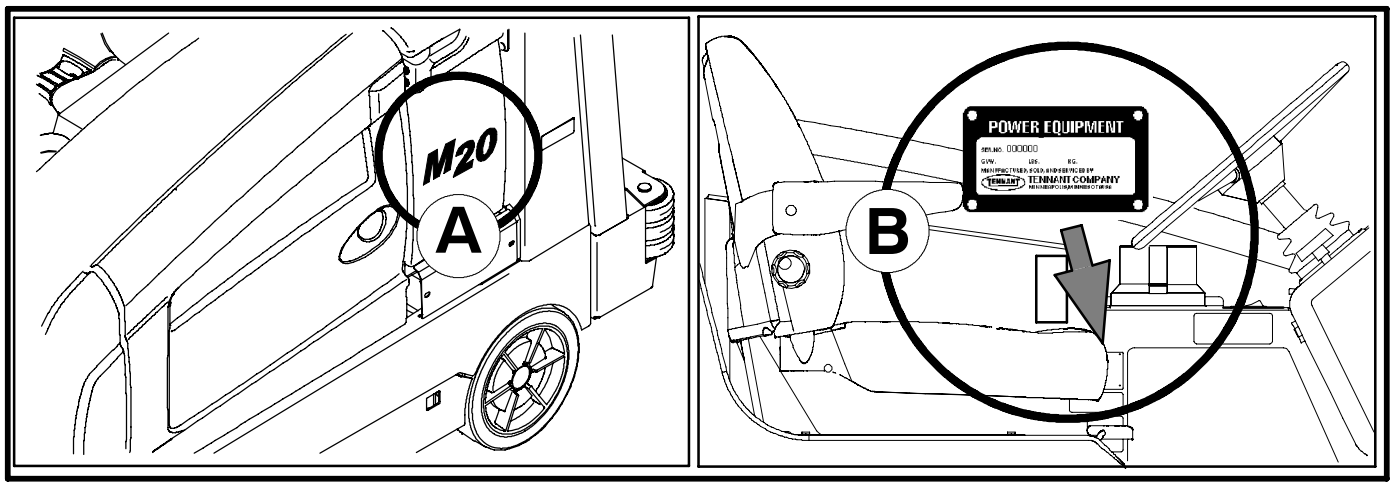
FaST®
Foam Scrubbing Technology

The Safe Scrubbing Alternative®

Hygenic® Fully Cleanable Tanks
FloorSmart ™ Integrated Cleaning System
ES® Extended Scrub System

331385
Rev.01 (02-2007)

www.tennantco.com



FOR REPLACEMENT PARTS

Identify machine model and serial number.

1. **(A)** Identify the machine model.
2. **(B)** Identify the machine serial number from the data plate.

Refer to the TENNANT Parts Manual.

NOTE: Only use TENNANT Company supplied or equivalent parts. Parts and supplies may be ordered online, by phone, by fax or by mail.

Tennant Company
PO Box 1452
Minneapolis, MN 55440
Phone: (800) 553–8033 or (763) 513–2850
www.tennantco.com

M20 Service Information Manual

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M20 Safety Precautions

The following precautions are used throughout this manual as indicated in their description:

WARNING: To warn of hazards or unsafe practices that could result in severe personal injury or death.

CAUTION: To warn of unsafe practices that could result in minor or moderate personal injury.

FOR SAFETY: To identify actions that must be followed for safe operation of equipment.

Do not use the machine other than described in this Operator Manual. The machine is not designed for use on public roads.

The following information signals potentially dangerous conditions to the operator or equipment:

WARNING: Flammable materials can cause an explosion or fire. Do not use flammable materials in tank.

WARNING: Flammable materials or reactive metals can cause an explosion or fire. Do not pickup.

WARNING: Moving belt and fan. Keep away.

WARNING: Engine emits toxic gases. Serious injury or death can result. Provide adequate ventilation.

WARNING: Raised hopper may fall. Engage hopper support pin.

WARNING: Lift arm pinch point. Stay clear of hopper lift arms.

WARNING: Burn hazard. Hot surface. Do NOT touch.

CAUTION: LPG engine will run for a few seconds after key is turned off. Apply parking brake before leaving machine.

CALIFORNIA PROPOSITION 65
WARNING: Engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

FOR SAFETY:

1. **Do not operate machine:**
   - **Unless trained and authorized.**
   - **Unless operator manual is read and understood.**
   - **If it is not in proper operating condition.**
   - **In flammable or explosive areas.**
   - **In areas with possible falling objects unless equipped with overhead guard.**

2. **Before starting machine:**
   - **Check for fuel, oil, and liquid leaks.**
   - **Keep sparks and open flame away from refueling area.**
   - **Make sure all safety devices are in place and operate properly.**
   - **Check brakes and steering for proper operation.**

3. **When starting machine:**
   - **Keep foot on brake and directional pedal in neutral.**

4. **When using machine:**
   - **Use brakes to stop machine.**
   - **Go slow on inclines and slippery surfaces.**
   - **Use care when reversing machine.**
   - **Move machine with care when hopper is raised.**
   - **Make sure adequate clearance is available before raising hopper.**
   - **Do not carry passengers on machine.**
   - **Always follow safety and traffic rules.**
   - **Report machine damage or faulty operation immediately.**
   - **Follow mixing and handling instructions on chemical containers.**

M20 Safety Precautions

5. **Before leaving or servicing machine:**
   - **Stop on level surface.**
   - **Set parking brake.**
   - **Turn off machine and remove key.**

6. **When servicing machine:**
   - **Avoid moving parts. Do not wear loose jackets, shirts, or sleeves.**
   - **Block machine tires before jacking machine up.**
   - **Jack machine up at designated locations only. Support machine with jack stands.**
   - **Use hoist or jack that will support the weight of the machine.**
   - **Wear eye and ear protection when using pressurized air or water.**
   - **Disconnect battery connections before working on machine.**
   - **Avoid contact with battery acid.**
   - **Avoid contact with hot engine coolant.**
   - **Do not remove cap from radiator when engine is hot.**
   - **Allow engine to cool.**
   - **Keep flames and sparks away from fuel system service area. Keep area well ventilated.**
   - **Use cardboard to locate leaking hydraulic fluid under pressure.**
   - **Use Tennant supplied or approved replacement parts.**

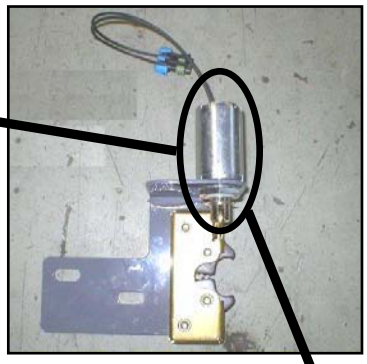
7. **When loading/unloading machine onto/off truck or trailer:**
   - **Turn off machine.**
   - **Use truck or trailer that will support the weight of the machine.**
   - **Use winch. Do not drive the machine onto/off the truck or trailer unless the load height is 380 mm (15 in) or less from the ground.**
   - **Set parking brake after machine is loaded.**
   - **Block machine tires.**
   - **Tie machine down to truck or trailer.**

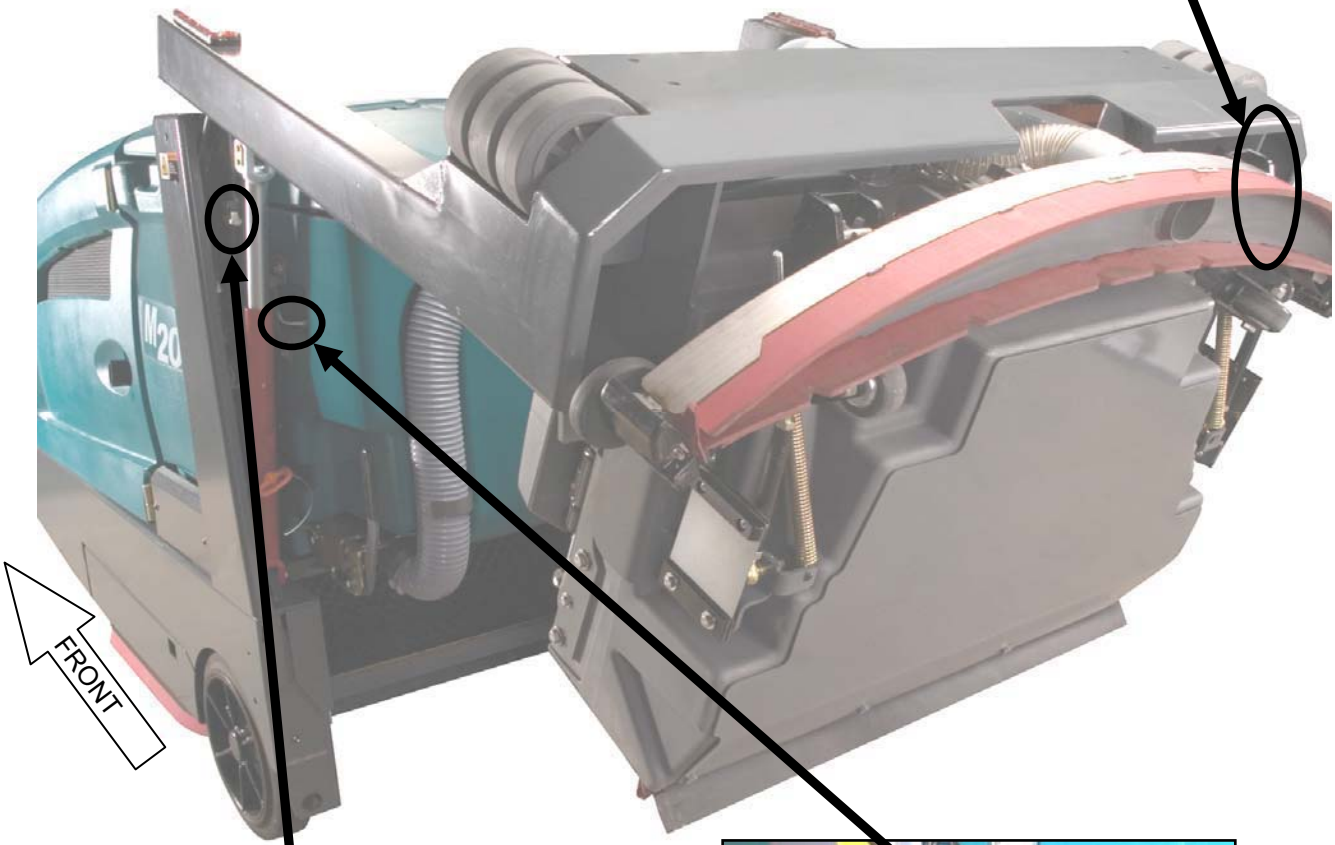
GENERAL MACHINE INFORMATION

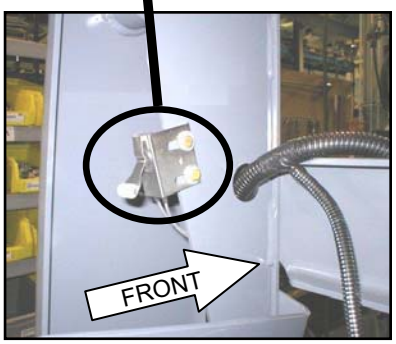
M20 Electrical Component Locator

G

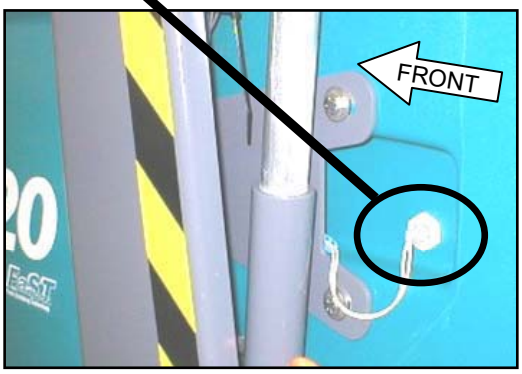
HOPPER LATCH
SOLENOID SOL-9







HOPPER DOWN SENSE SWITCH S-6



RECOVERY TANK FULL SWITCH S-15

M20 Electrical Component Locator

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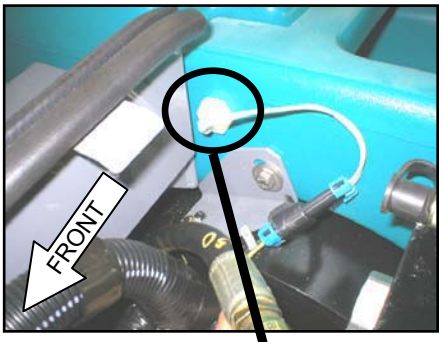
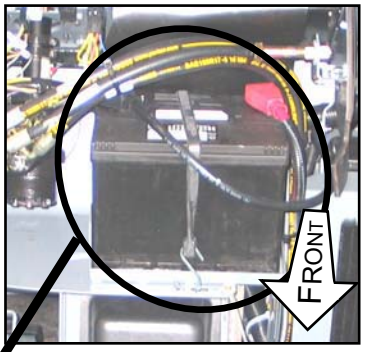
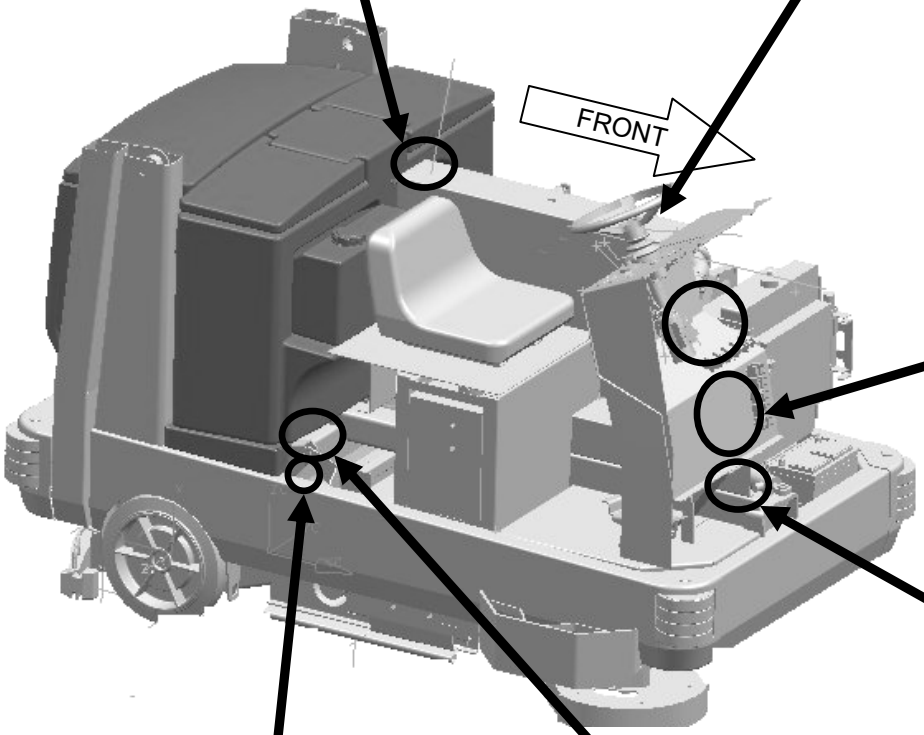
G

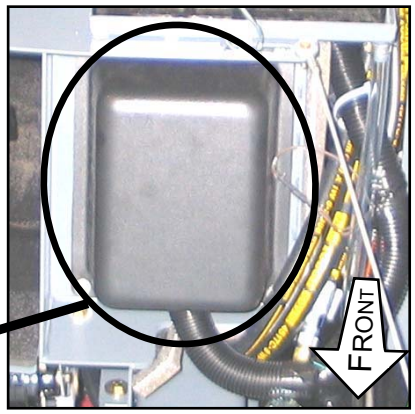
SOLUTION TANK FULL SWITCH S-14



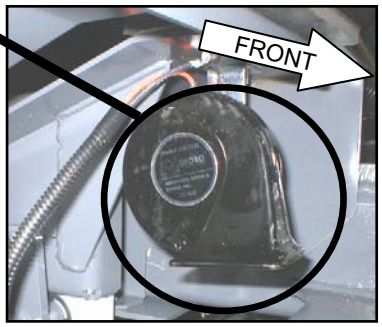
BATTERY



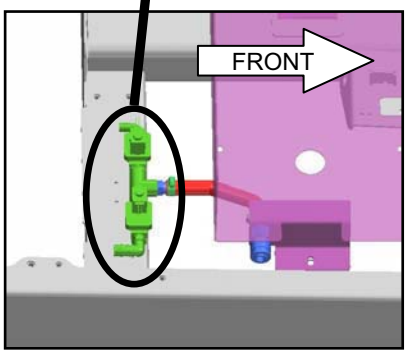




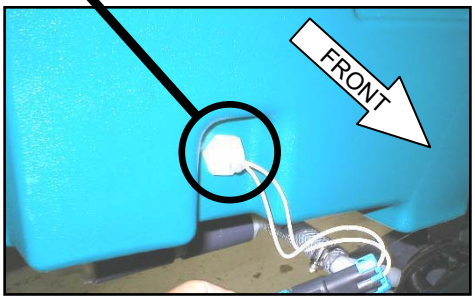
FUSE/RELAY PANEL



HORN



AUTO FILL SOLENOID VALVES
SOL-1, SOL-2

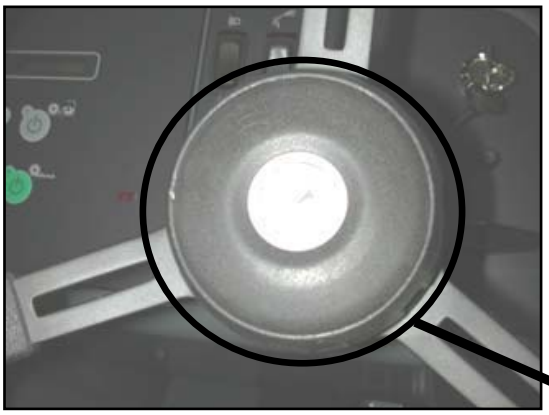


SOLUTION TANK EMPTY SWITCH S-19

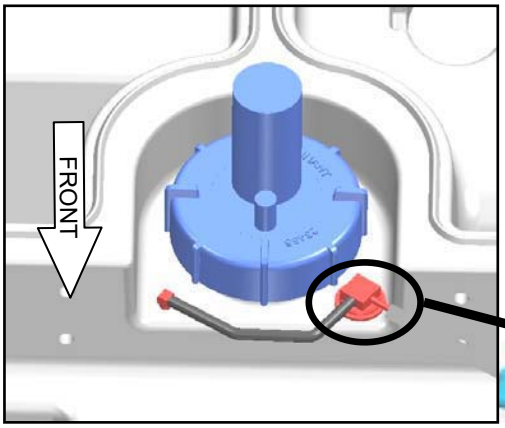
M20 Electrical Component Locator

G

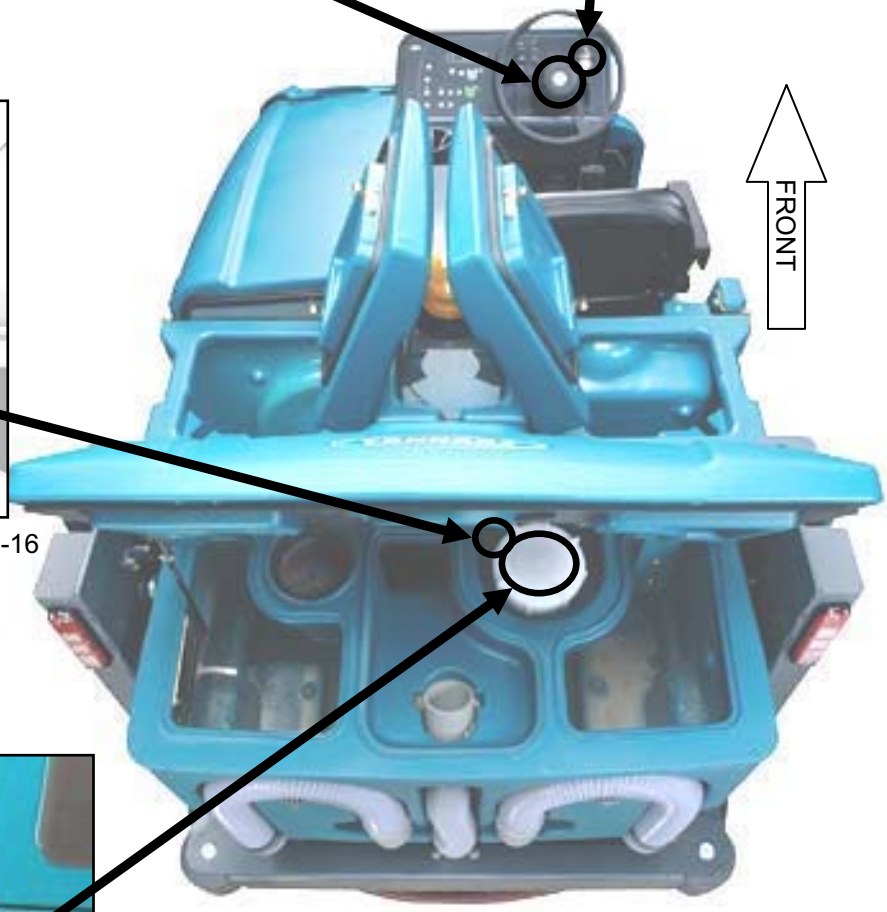
HORN SWITCH S-22



IGNITION SWITCH



RECOVERY TANK HALF FULL SWITCH S-16



ES PUMP

M20 Electrical Component Locator

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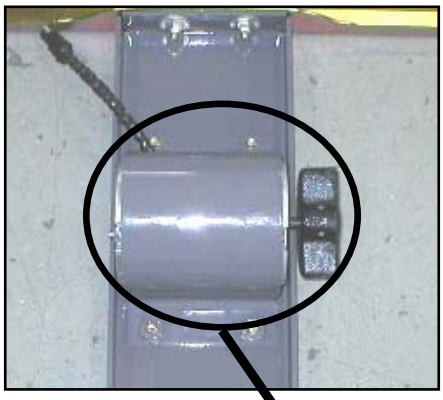
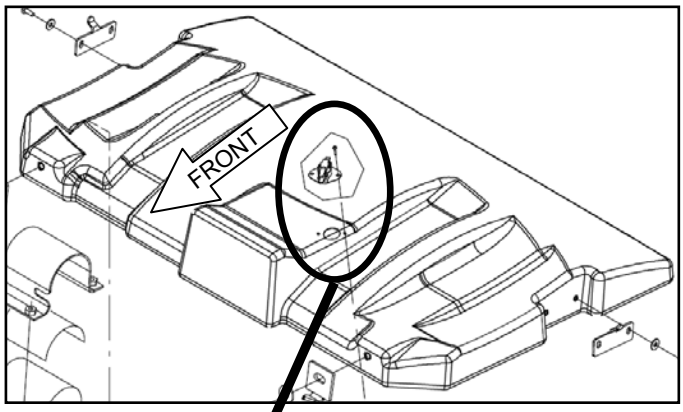
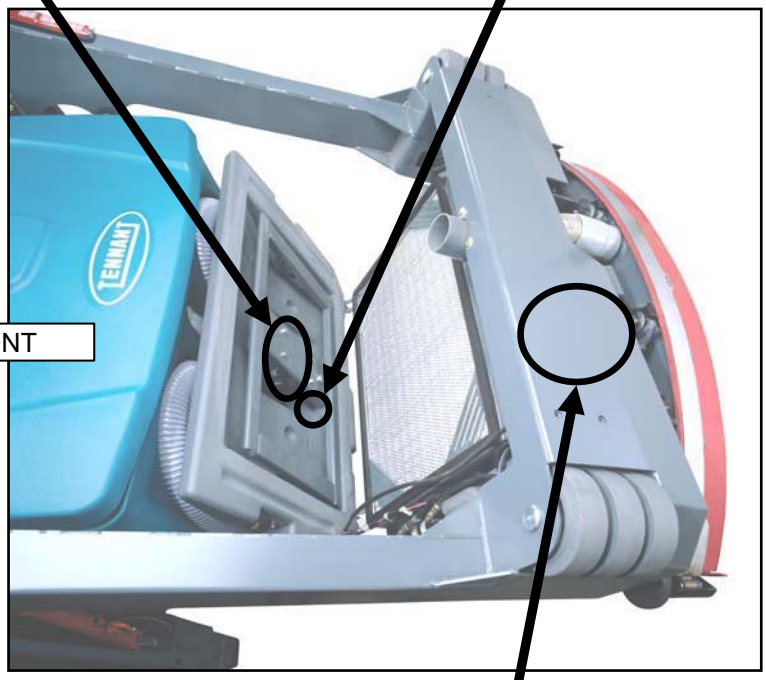
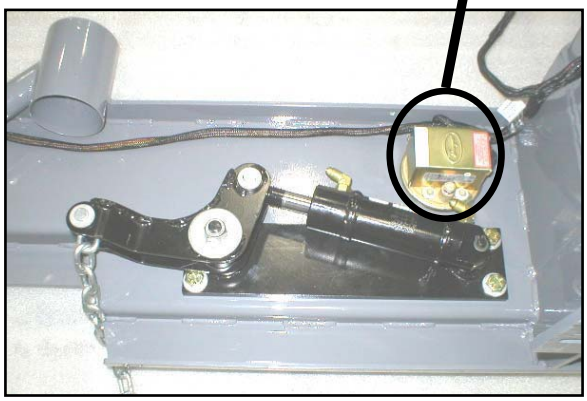
SHAKER MOTOR



HOPPER THERMAL SENTRY SWITCH S-9







SWEEP FILTER CLOGGED SWITCH S-18
(VIEWED BEHIND BUMPER)

M20 Electrical Component Locator

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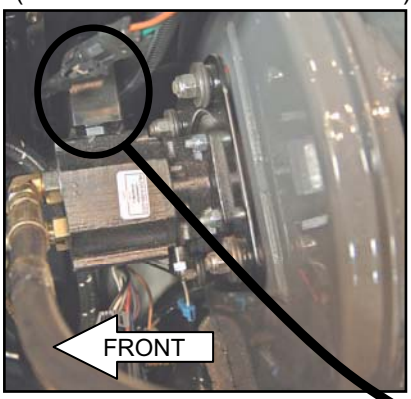
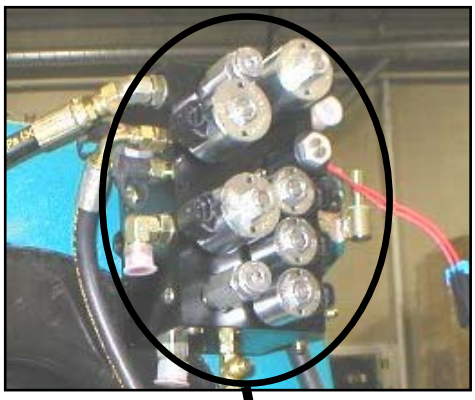
G

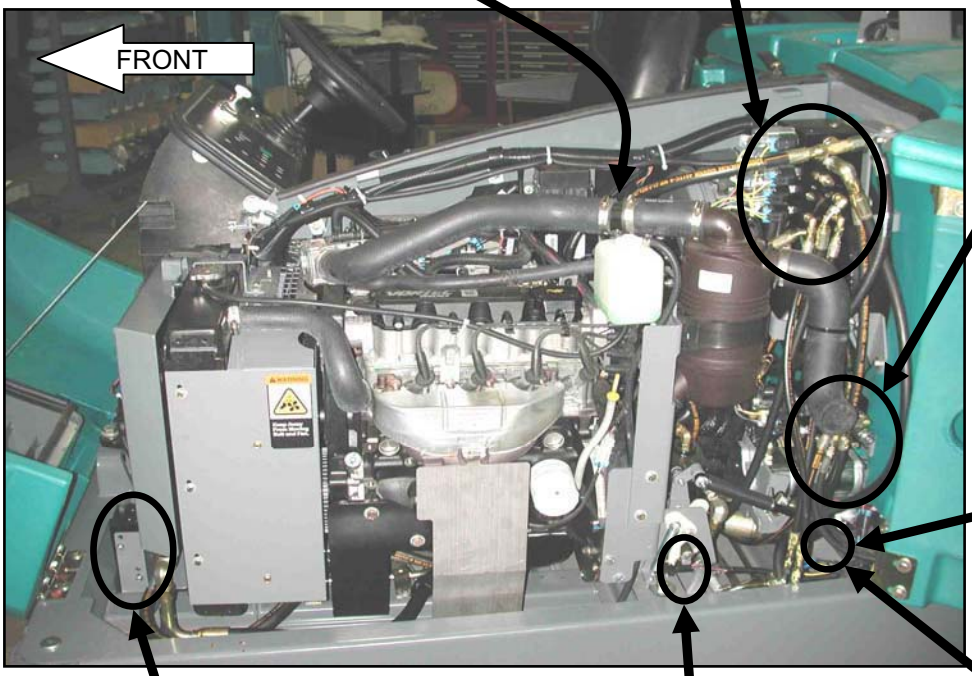
SWEEP FAN VALVE SV9
(BESIDE ENGINE FUSE PANEL)



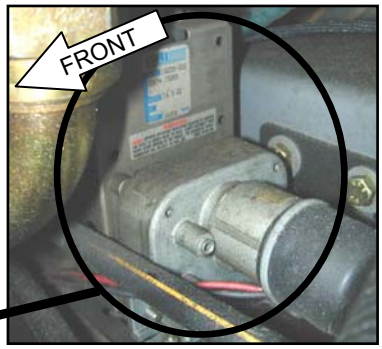
SCRUB VALVE
SV1, SV2, SV3, SV4,SV6, SV7

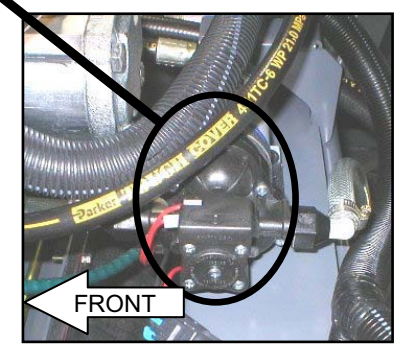


SWEEP VALVE
SV13, SV14, SV15

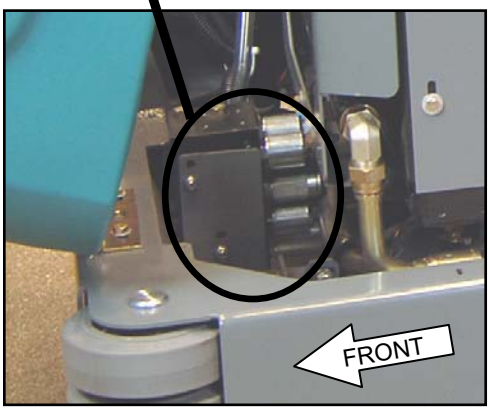


DETERGENT PUMP

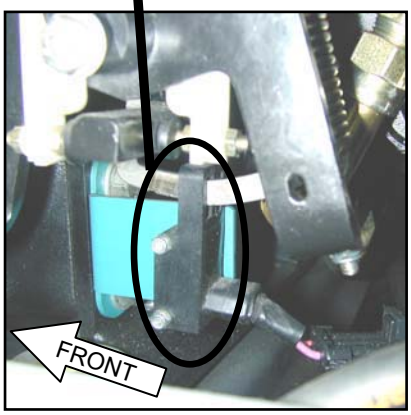




SPRAY NOZZLE PUMP



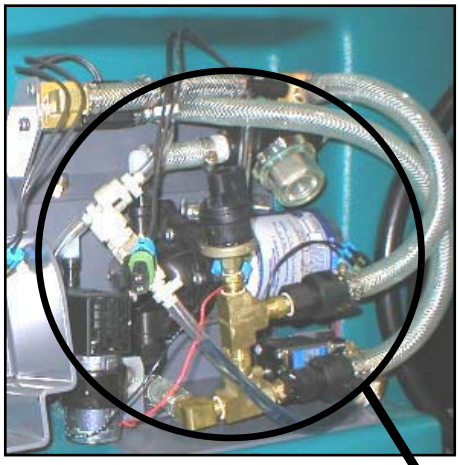
SIDE BRUSH VALVE
SV8, SV10, SV11, SV12



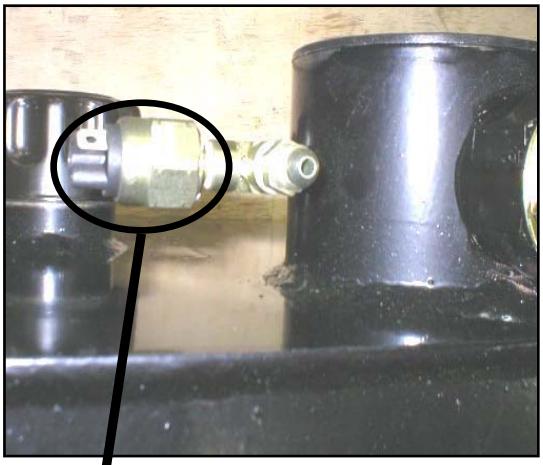
PROPEL PEDAL POSITION SENSOR

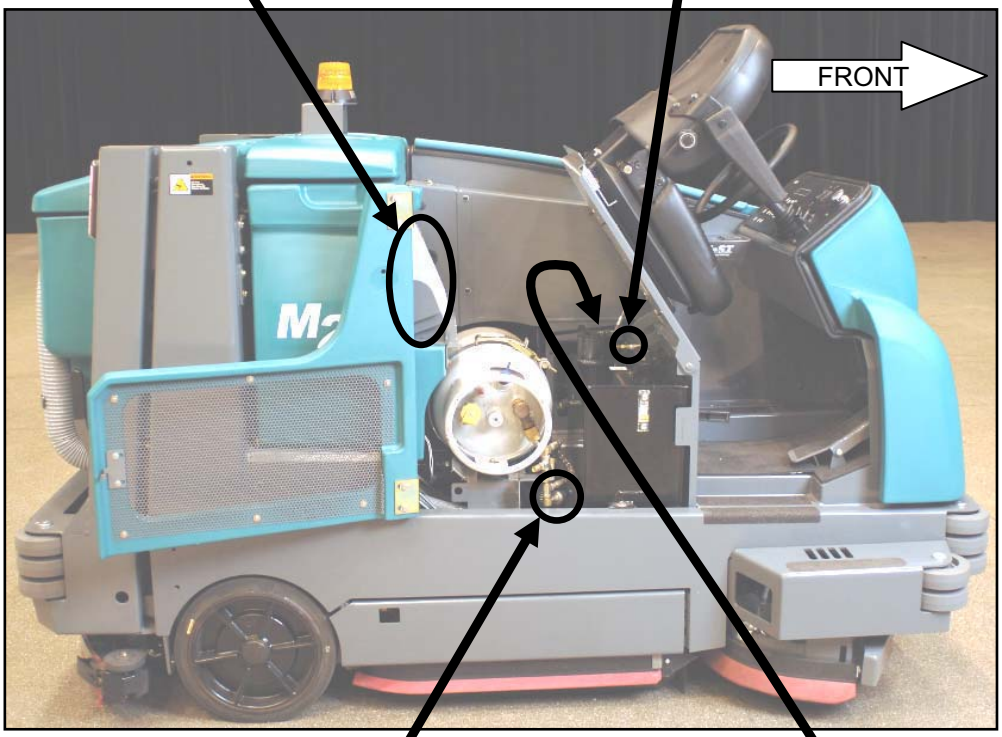
M20 Electrical Component Locator

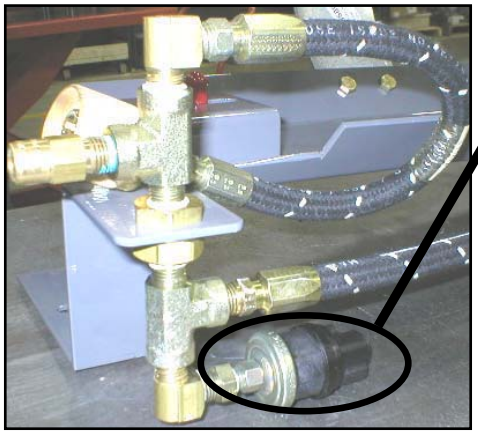
FaST COMPONENTS



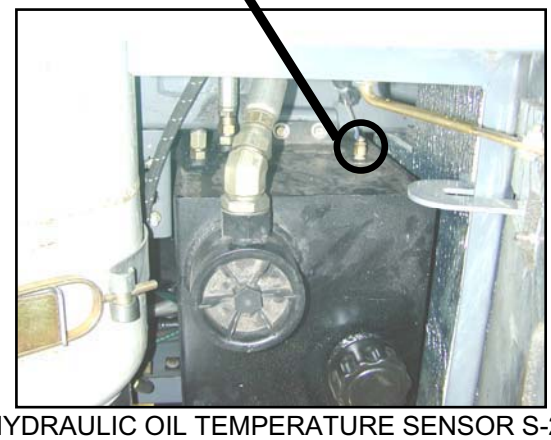
HYDRAULIC FILTER CLOGGED SWITCH S-17







LPG LOW FUEL PRESSURE SWITCH S-8

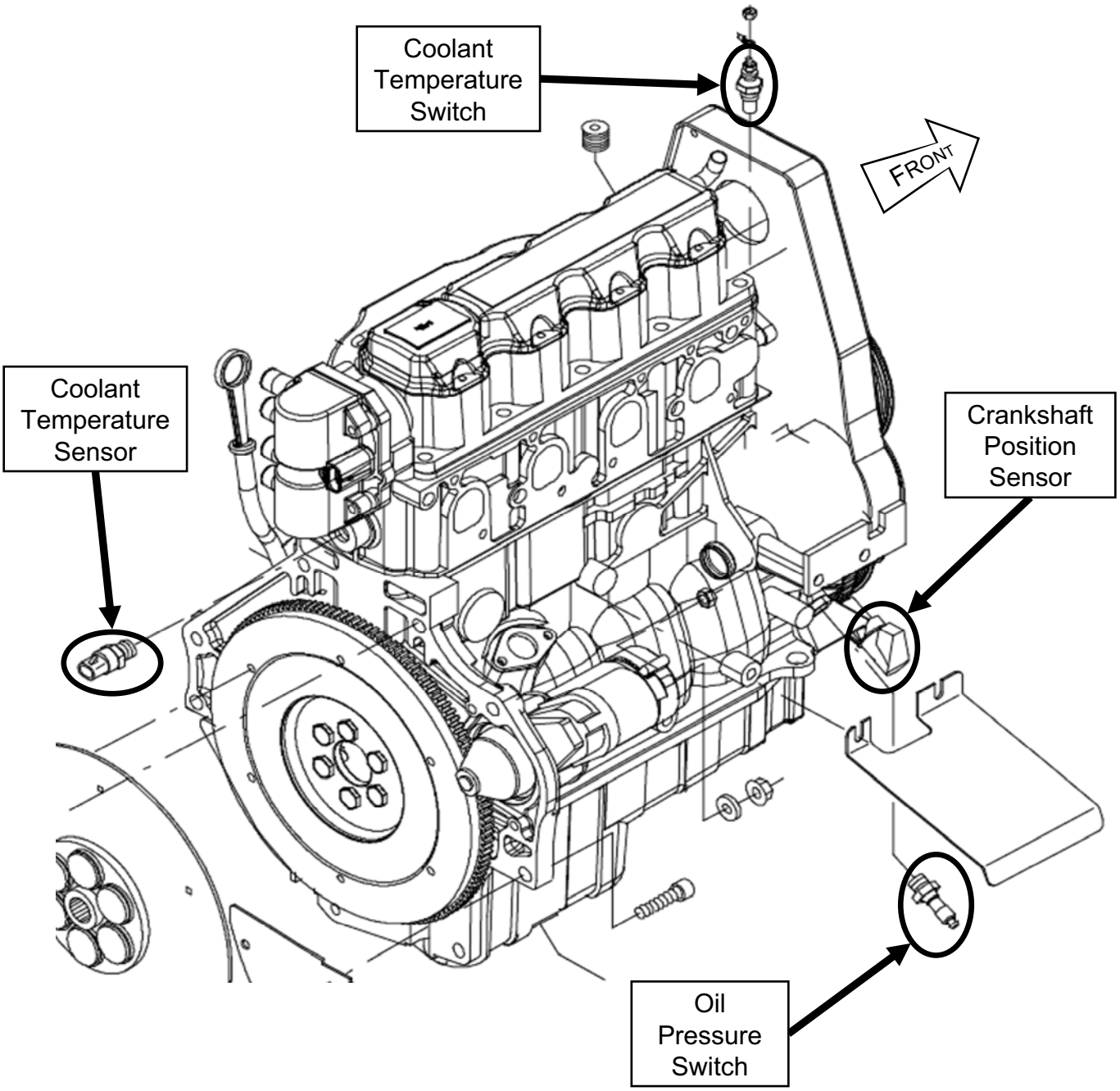


HYDRAULIC OIL TEMPERATURE SENSOR S-20
(BACK SIDE)

M20 Electrical Component Locator

G

Gas / LPG Engine



M20 Electrical Component Locator

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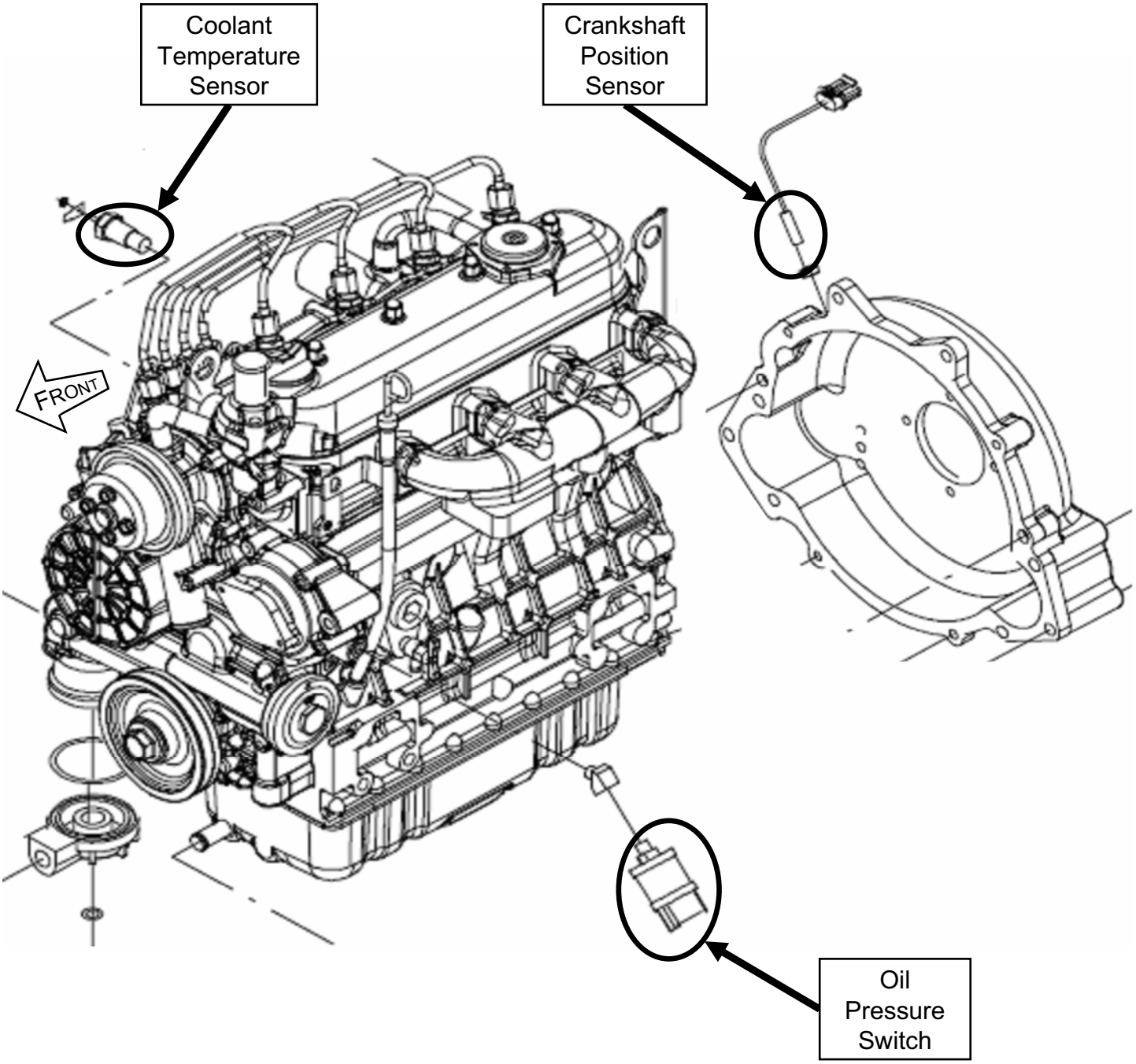
G

Diesel Engine



M20 Hydraulic Component Locator

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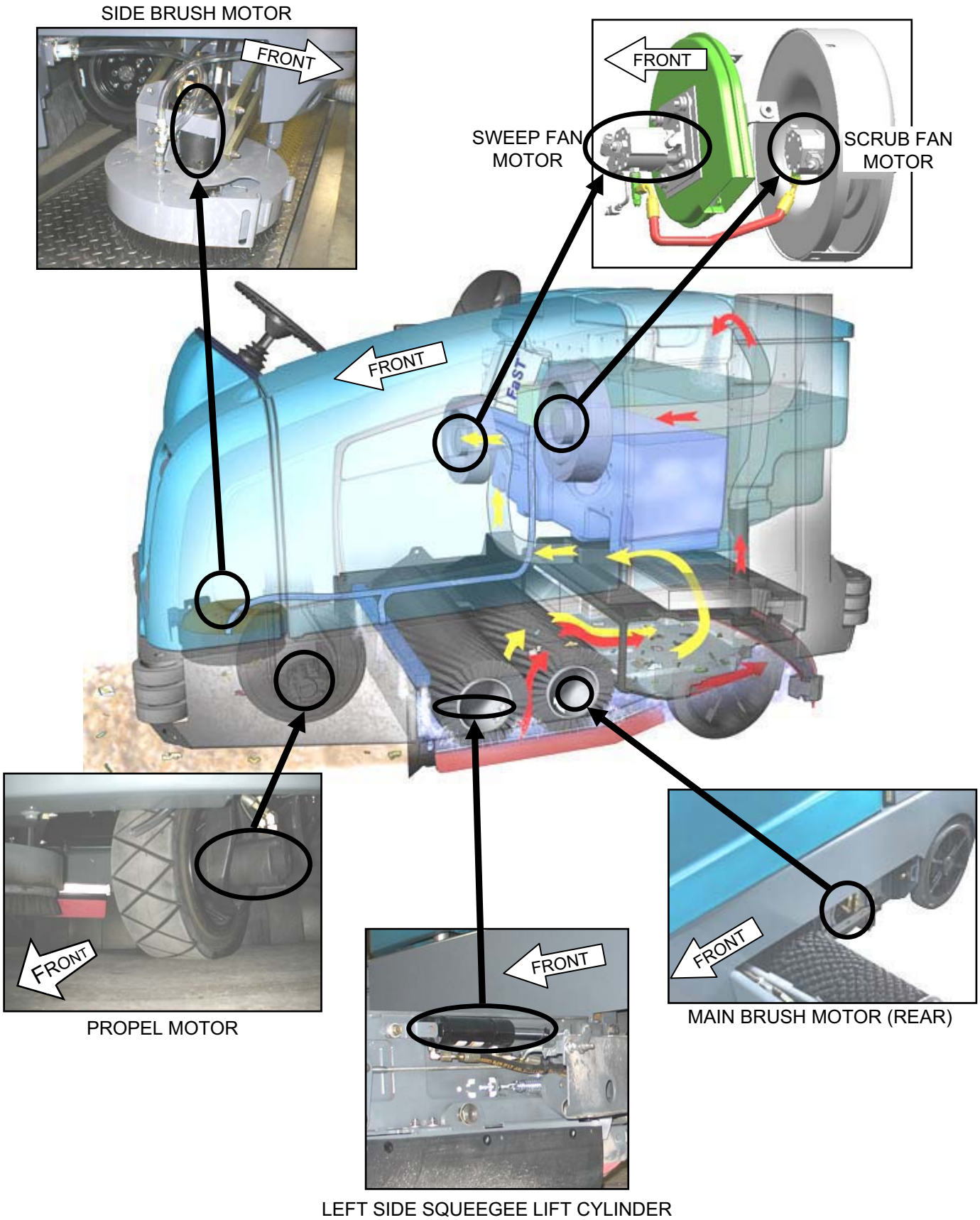

M20 Hydraulic Component Locator

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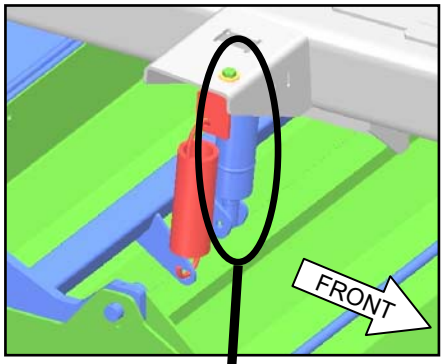
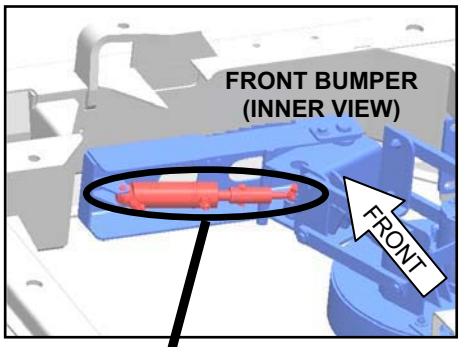
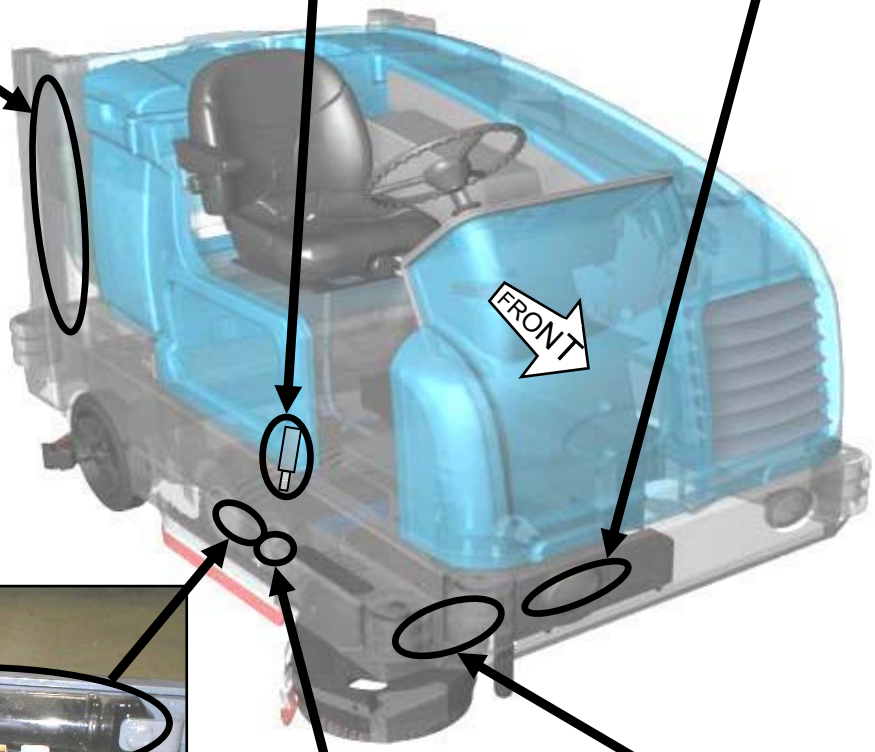
HOPPER LIFT CYLINDER

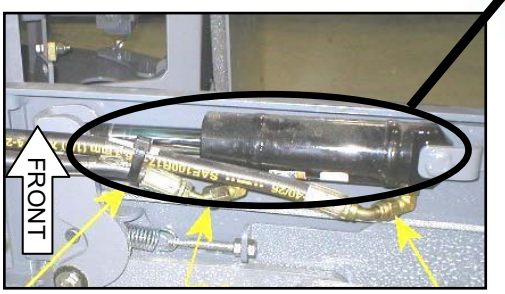
SCRUB HEAD LIFT CYLINDER



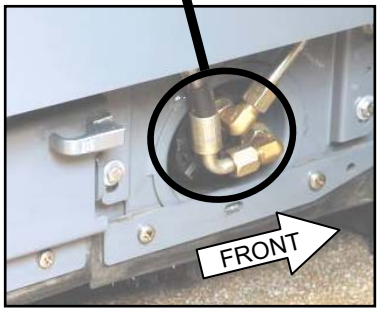
SIDE BRUSH EXTEND CYLINDER



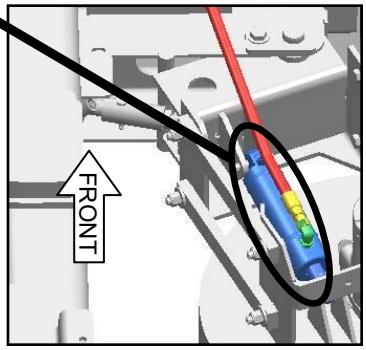




RIGHT SIDE SQUEEGEE LIFT CYLINDER



MAIN BRUSH MOTOR (FRONT)



SIDE BRUSH LIFT CYLINDER

M20 Hydraulic Component Locator

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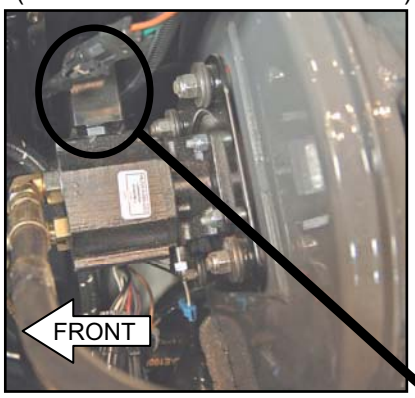
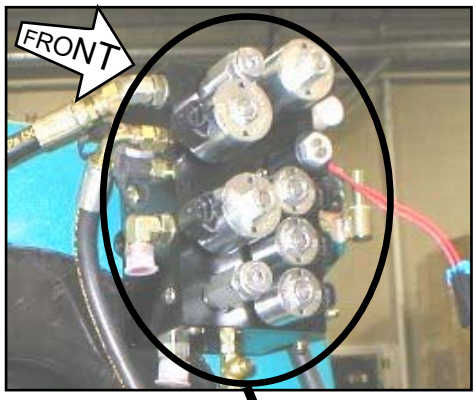
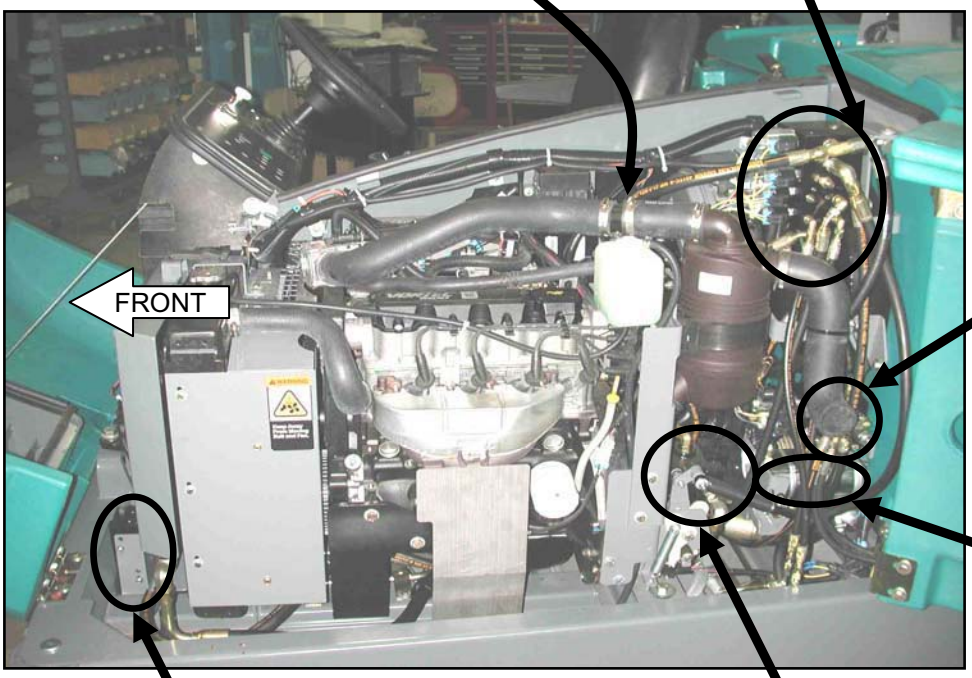
SWEEP FAN VALVE SV9
(BESIDE ENGINE FUSE PANEL)



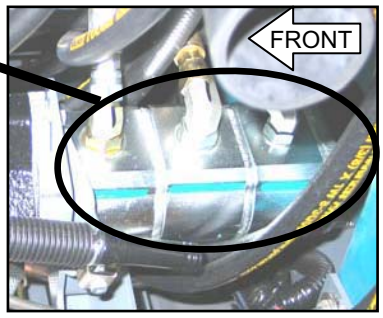
SCRUB MANIFOLD
SV1, SV2, SV3, SV4,SV6, SV7
RV1, RV2, CV1, PC1, PC2



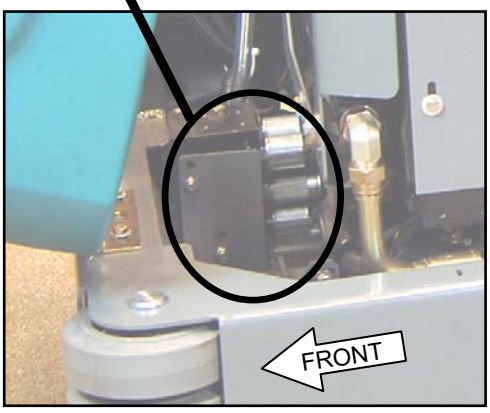
See pages 14, 15 and 16 for more information on the Scrub, Sweep, and Side Brush manifolds



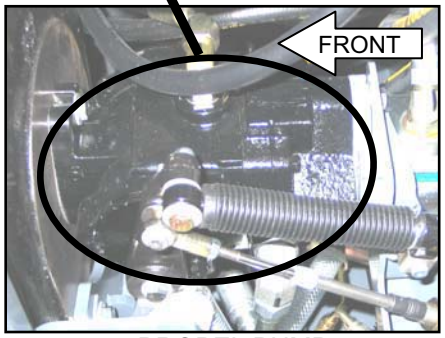
SWEEP MANIFOLD
SV13, SV14, SV15,
RV3, PC5, PC6



ACCESSORY PUMPS



SIDE BRUSH MANIFOLD
SV8, SV10, SV11, SV12, PR1, PC8



PROPEL PUMP

M20 Hydraulic Component Locator

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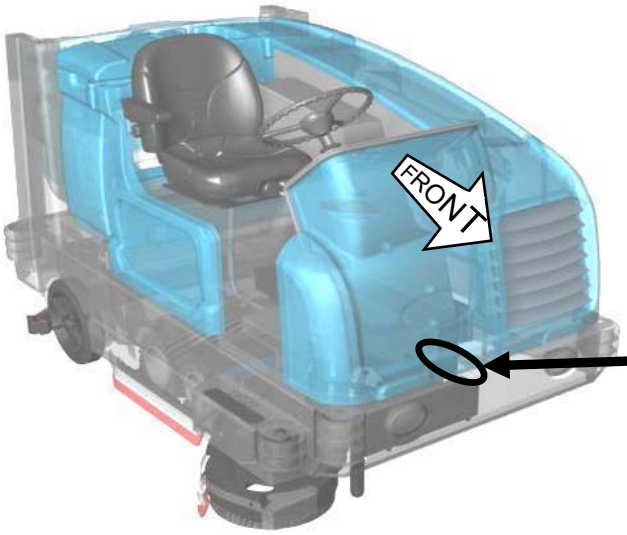
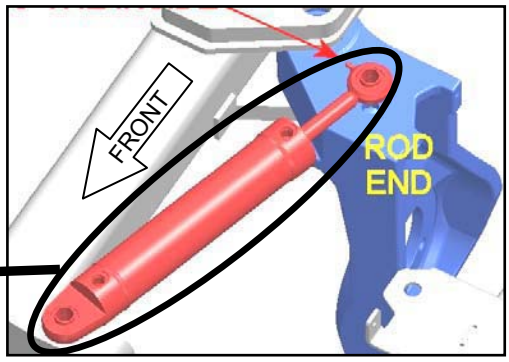
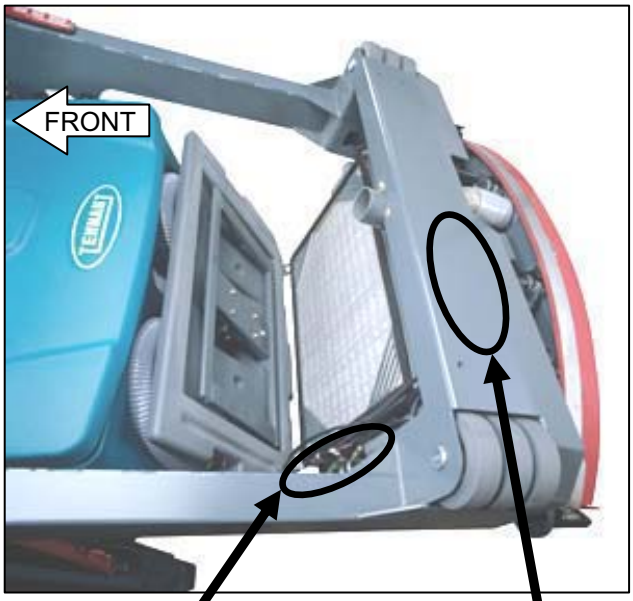
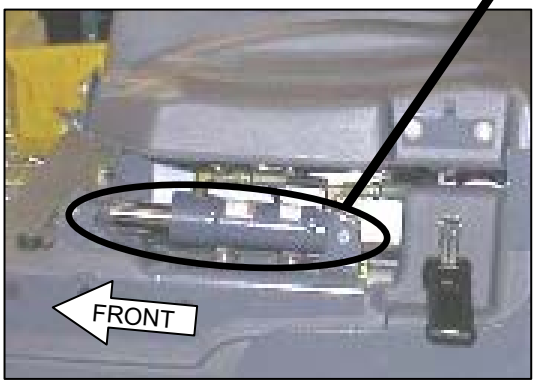


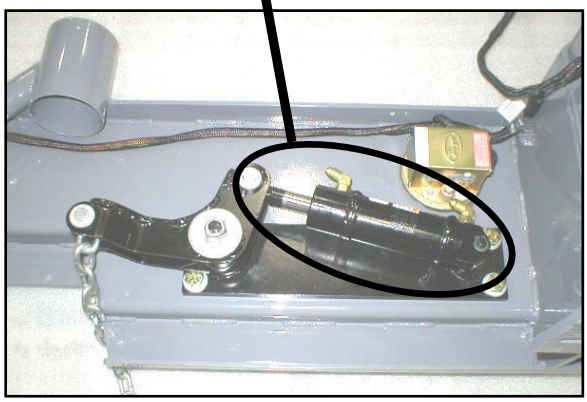
STEERING CYLINDER







HOPPER DOOR CYLINDER



REAR SQUEEGEE LIFT CYLINDER
(VIEWED BEHIND BUMPER)

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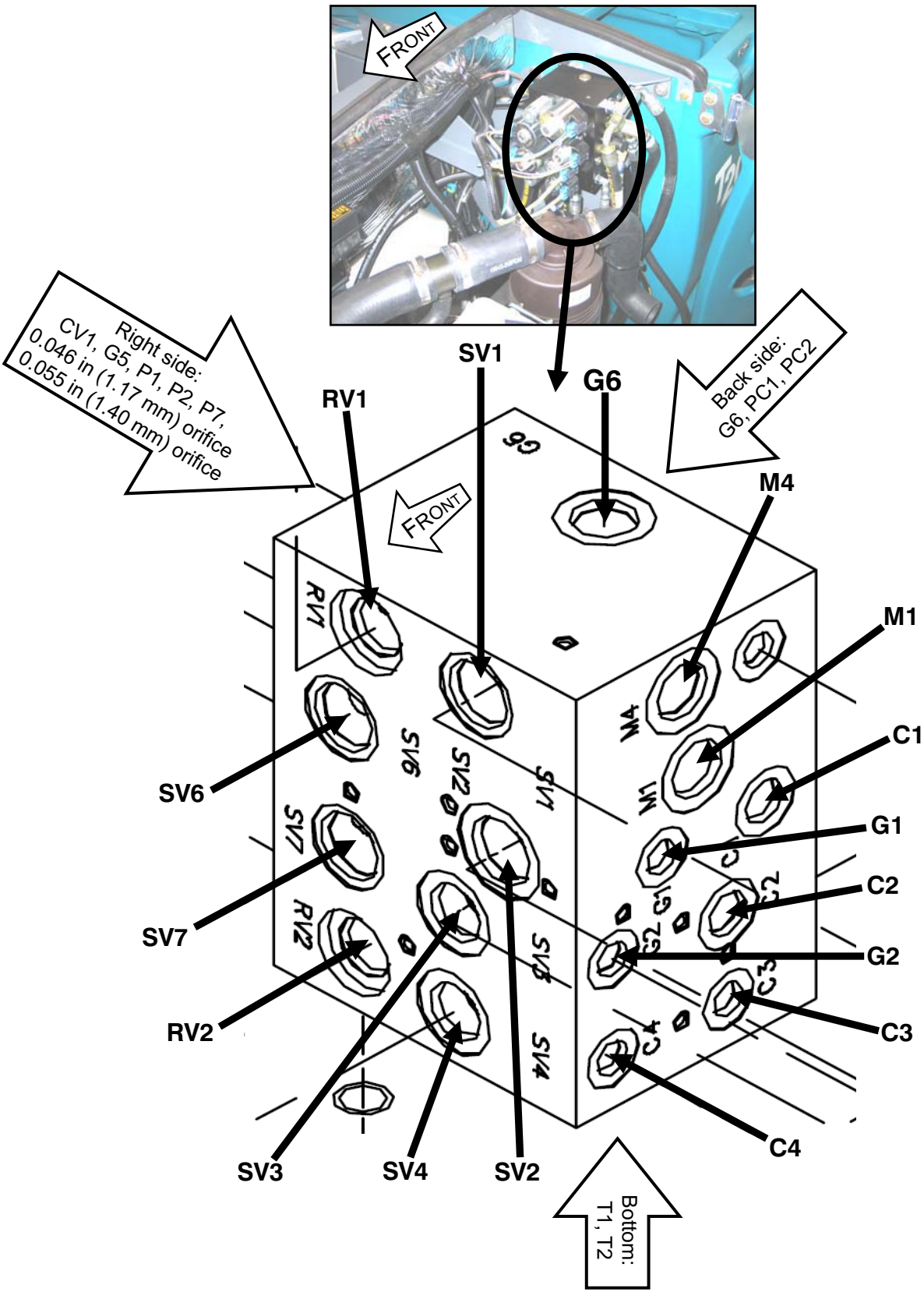
SCRUB MANIFOLD DETAILS



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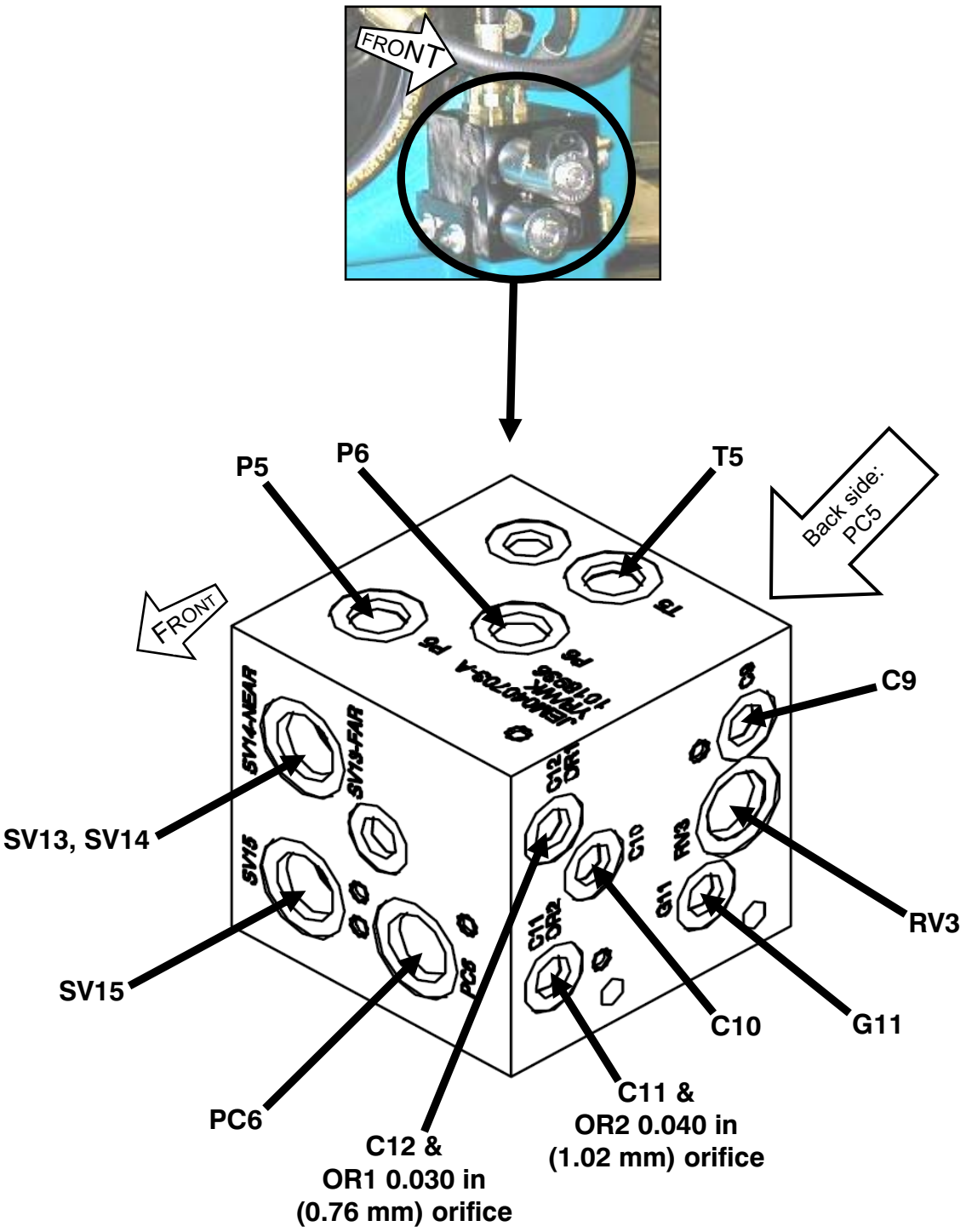
SWEEP MANIFOLD DETAILS



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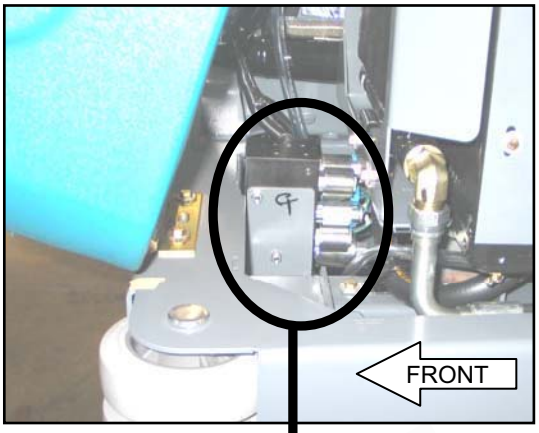
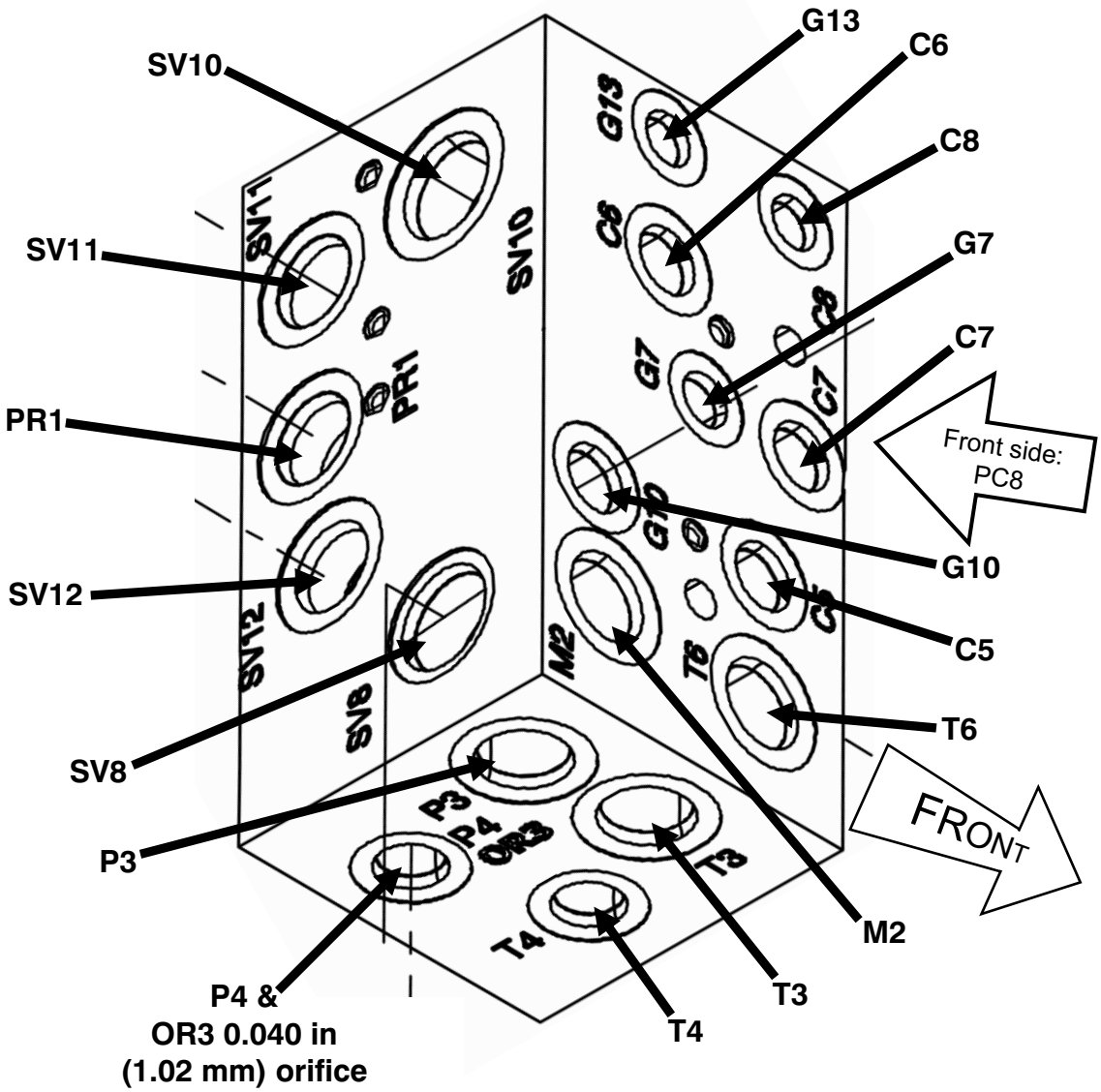
SIDE BRUSH MANIFOLD DETAILS





M20 Specifications

GENERAL MACHINE DIMENSIONS/CAPACITIES

Item	Dimension/capacity
Length	2410 mm (95 in)
Height	1470 mm (58 in)
Height (with overhead guard)	2120 mm (83.5 in)
Width/frame (roller to roller)	1270 mm (50 in)
Width (rear squeegee)	1300 mm (51 in)
Width (with side brush)	1470 mm (58 in)
Cleaning path width (Main brush length)	1020 mm (40 in)
Cleaning path width (with scrubbing side brush)	1370 mm (54 in)
Cleaning path width (with sweeping side brush)	1420 mm (56 in)
Main brush diameter (2)	300 mm (12 in)
Side brush diameter (scrubbing)	410 mm (16 in)
Side brush diameter (sweeping)	530 mm (21 in)
Solution tank capacity	212 L (56 gallons)
Recovery tank capacity	276 L (73 gallons)
Debris hopper volume capacity	110 L (3.9 ft^3)
Debris hopper weight capacity	177 kg (390 lbs)
Dump height (variable to)	1520 mm (60 in)
Minimum ceiling dump height	2500 mm (98 in)
Weight – empty	1497 Kg (3300 lbs)
GVWR	2359 Kg (5200 lbs)
Transport ground clearance	80 mm (3 in)
Operating Sound Level At Operator Ear	81 ±1.5 dBA
Vibration level at steering wheel does not exceed	0.2 m/s^2

GENERAL MACHINE PERFORMANCE

Item	Measure
Minimum aisle turn	2790 mm (110 in)
Travel speed forward (maximum)	12.9 Km/h (8 mph)
Travel speed reverse (maximum)	4.8 Km/h (3 mph)
Maximum rated climb and descent at GVWR	10°/18%
Maximum rated climb and descent angle when scrubbing	8°/14%

HYDRAULIC SYSTEM

System	Capacity	Fluid Type
Hydraulic reservoir	38 L (10 gal)	TENNANT part no. 65869 – above 7° C (45° F)
Hydraulic total	45 L (12 gal)	TENNANT part no. 65870 – below 7° C (45° F)

STEERING

Type	Power source	Emergency steering
Front wheel, hydraulic cylinder and rotary valve controlled	Hydraulic accessory pump	Manual hydraulic

M20 Specifications

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POWER TYPE

Engine	Type	Ignition	Cycle	Aspiration	Cylinders	Bore	Stroke
GM 1.6	Piston	Distributorless-type spark	4	Natural	4	79 mm (3.11 in)	81.5 mm (3.21 in)
	Displacement		Net power, governed			Net power, maximum	
	1600 cc (98 cu in)		23.2 kw (32 hp) @ 2400 rpm			39.5 kw (53 hp) @ 4000 rpm	
	Fuel		Cooling system			Electrical system	
	Gasoline, 87 octane minimum, unleaded Fuel tank: 42 L (11.2 gal)		Water/ethylene glycol antifreeze			12 V nominal	
	LPG, Fuel tank: 15 kg (33 lb)		Total: 7.5 L (2 gal)			75 A alternator	
			Radiator: 3.8 L (1 gal)				
	Idle speed, no load		(Fast) governed speed, under load			Firing order	
	950 ± 50 rpm		2400 ± 50 rpm			1–3–4–2	
	Spark plug gap		Valve clearance, cold			Engine lubricating oil with filter	
	1 mm (0.04 in)		No Adjustment OHC Engine			3.5 L (3.7 qt) 5W30 SAE–SG/SH	

Engine	Type	Ignition	Cycle	Aspiration	Cylinders	Bore	Stroke
Kubota V1505–B	Piston	Diesel	4	Natural	4	78 mm (3.07 in)	78.4 mm (3.08 in)
	Displacement		Net power, governed			Net power, maximum	
	1500 cc (91.4 cu in)		24.6 kw (34 hp) @ 2400 rpm			27.2 kw (37.5 hp) @ 3000 rpm	
	Fuel		Cooling system			Electrical system	
	Diesel Fuel tank: 42 L (11.2 gal)		Water/ethylene glycol antifreeze			12 V nominal	
			Total: 7.5 L (2 gal)			37 A alternator	
			Radiator: 3.8 L (1 gal)				
	Idle speed, no load		(Fast) governed speed, under load			Engine lubricating oil without filter	
	950 ± 50 rpm		2400 ± 50 rpm			6 L (6.35 qt) Diesel rated engine oil above CD grade only	

BRAKING SYSTEM

Type	Operation
Service brakes	Mechanical drum brakes (2), one per rear wheel, cable actuated
Parking brake	Utilize service brakes, cable actuated

M20 Specifications

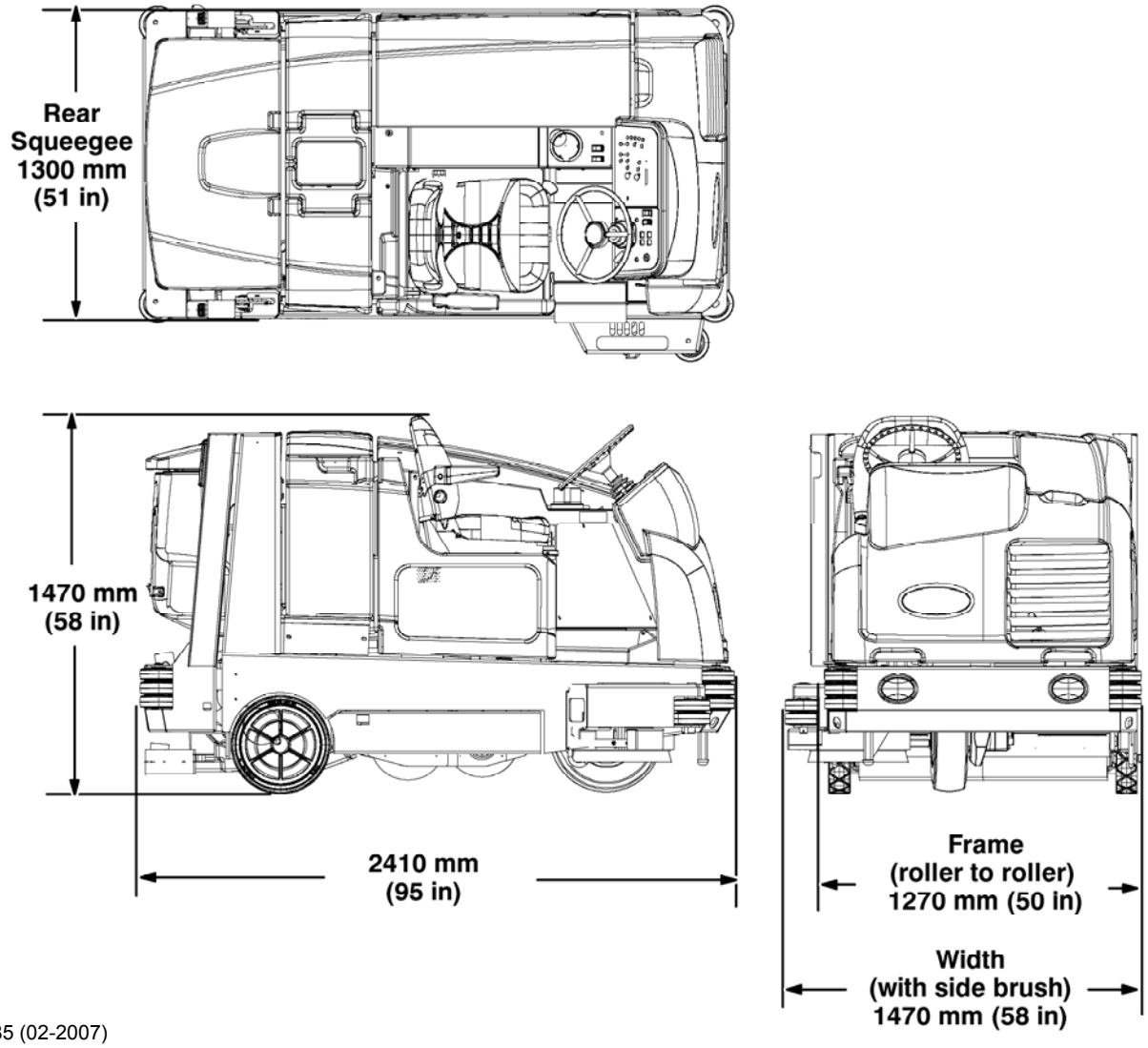
TIRES

Location	Type	Size
Front (1)	Solid	140 mm x 460 mm (5.5 in x 18 in)
Rear (2)	Solid	90 mm x 410 mm (3.5 in x 16 in)

FaST SYSTEM

Item	Measure
Solution pump	12 Volt DC, 11A, 11.6 LPM (3.0 GPM) open flow, 45 psi bypass setting
Low solution flow rate	2.7 LPM (0.7 GPM)
High solution flow rate	5.4 LPM (1.4 GPM)
Detergent pump	12 Volt DC
Low concentrate flow rate	2.6 CC/Minute (0.085 Liquid Ounces/Minute)
High concentrate flow rate	5.2 CC/Minute (0.17 Liquid Ounces/Minute)
Air pump	12 Volt DC, 0.6 Maximum Amp draw
Air pump flow rate	8.7 LPM (0.3 CFM) open flow

MACHINE DIMENSIONS



T20 Basic Troubleshooting

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MACHINE TROUBLESHOOTING

Problem	Cause	Remedy
Trailing water–poor or no water pickup	Scrub vacuum fan turned off	Turn on vacuum fan
	Worn squeegee blades	Rotate or replace squeegee blades
	Squeegee out of adjustment	Adjust squeegee
	No detergent in solution tank causing squeegee to chatter	Add detergent to solution tank
	Vacuum hose clogged	Flush vacuum hoses
	Vacuum screen dirty	Clean vacuum screen
	Scrub vacuum fan cover seals worn	Replace seals
	Debris caught in squeegee	Remove debris
	Vacuum hose to squeegee or recovery tank disconnected or damaged	Reconnect or replace vacuum hose
	Recovery tank cover not completely closed	Check for obstructions and make sure cover is closed properly
Scrub vacuum fan will not turn on	Vacuum fan / squeegee button turned off	Turn on Vacuum fan / squeegee button
	Recovery tank full	Drain recovery tank
	Foam filling recovery tank	Empty recovery tank
		Use less detergent/or use defoamer
	Recovery tank sensor dirty or stuck	Clean or replace sensor
Little or no solution flow to the floor (Conventional Scrubbing Mode)	Solution tank empty	Fill solution tank
	Solution flow turned off	Turn on solution flow
	Solution supply lines plugged	Flush solution supply lines
Excessive dusting	Brush skirts and dust seals worn, damaged, or out of adjustment	Replace or adjust brush skirts and/ or brush seals
	Hopper dust filter clogged	Shake and/or replace dust filter
	Sweep vacuum fan seal damaged	Replace vacuum fan seal
	Sweep vacuum fan failure	Call Tennant service representative
	Thermo–Sentry tripped	Allow Therm–Sentry to cool
Poor sweeping performance	Worn brush bristles	Replace brushes
	Brush pressure set too light	Increase brush pressure
	Main brushes not properly adjusted	Adjust brushes
	Debris caught in main brush drive mechanism	Remove debris from main brush drive mechanism
	Main and/or side brush drive failure	Call Tennant service representative
	Hopper is full	Empty hopper
	Hopper lip skirts worn or damaged	Replace lip skirts
	Improper main brushes	Call Tennant service representative

T20 Basic Troubleshooting

Problem	Cause	Remedy
Poor scrubbing performance	*1-STEP Scrub button* not on	Turn on *1-STEP Scrub button*
	Improper detergent or brushes	Call Tennant service representative
	Solution tank empty	Fill solution tank
	Debris caught on main brushes	Remove debris
	Worn main brushes	Replace brushes
	Brush pressure set too light	Increase brush pressure
FaST System does not operate	FaST button is turned off	Turn on the FaST button
	Clogged FaST-PAK supply hose and/or connector	Soak connector and hose in warm water and clean
	FaST-PAK carton is empty or not connected	Replace FaST-PAK carton and/or connect supply hose
	FaST system is not primed	To prime, operate the FaST solution system for a few minutes
	Clogged filter screen	Drain solution tank, remove and clean filter screen
	Blown fuse	Call Tennant service representative
	Faulty solution pump	Call Tennant service representative
ES System does not operate	*ES button* is turned off	Turn on *ES button*
	ES sensor in tank dirty	Clean sensor
	Clogged ES pump filter	Clean ES filter
	Water level in recovery tank too low	Fill recovery tank about half full
	Water level in solution tank too low	Fill solution tank
Sweeping or Scrubbing functions do not turn on	Hopper is up	Completely lower hopper
	Fire in the hopper	Shut off machine. Extinguish fire. If necessary, call emergency personnel.
	Recovery tank full	Press the *Scrub vacuum fan/squeegee button* for one minute of extended water pickup. Empty recovery tank. ES models: activate the ES system to prevent this.

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MAINTENANCE

Information

BEFORE CONDUCTING TESTS:

*** Read and Follow ALL Safety Warnings and Precautions as mentioned at the beginning of this manual**

*** Always use an ESD (Electrostatic Discharge) strap when working near the Control Board**

*** Be cautious when working near Control Board – *Battery voltage is always present, even with Key OFF***

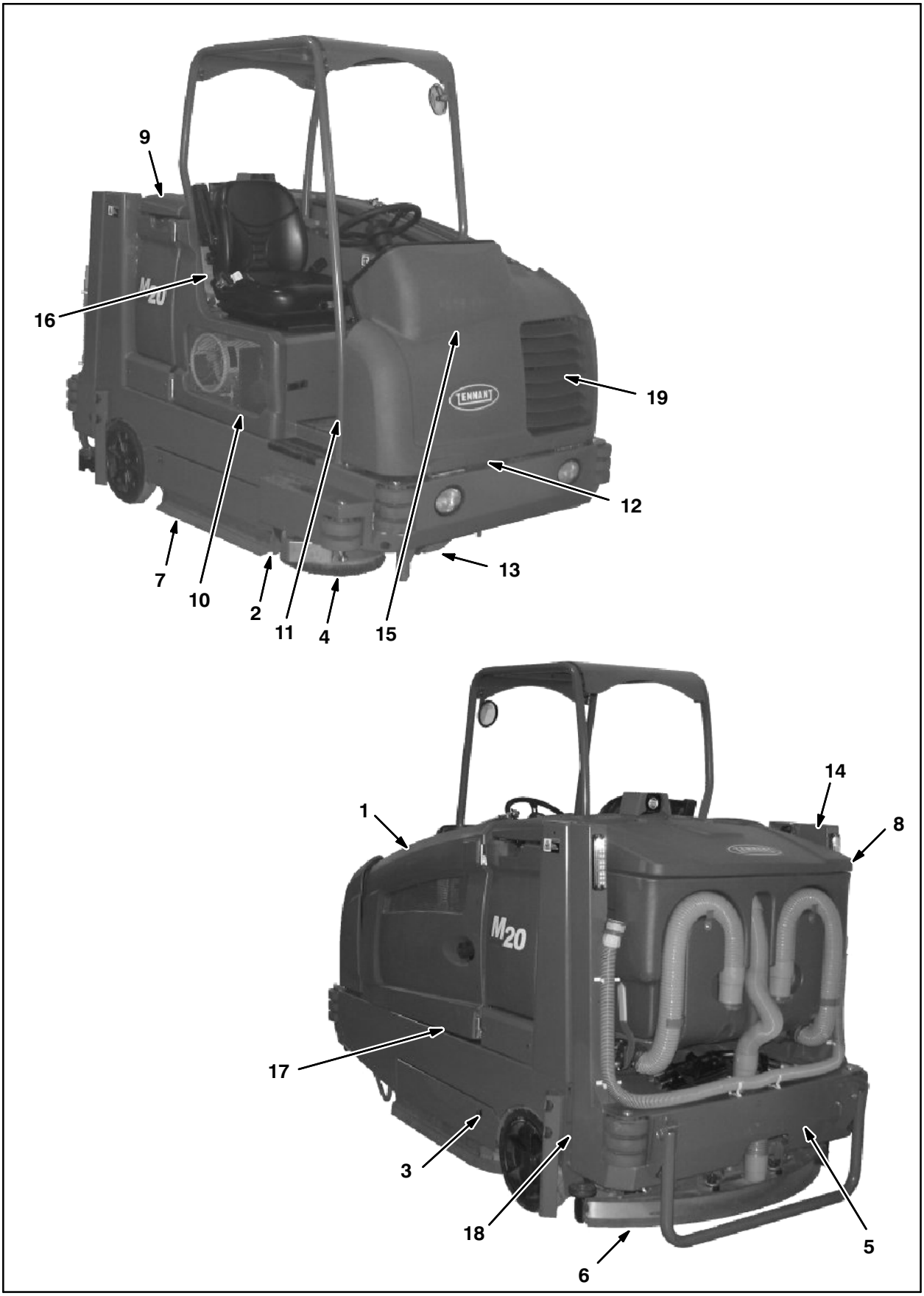
*** Always unhook Battery when removing or replacing components**

DURING TESTS:

*** Call Technical Services if Diagnostic Time Exceeds One Hour With Unknown Cause or Course of Action**

NOTE: Troubleshooting charts may be shown with optional equipment. The optional equipment may not be specified in these charts. Some machines may not be equipped with all components shown.

MAINTENANCE



MAINTENANCE

Interval	Key	Description	Procedure	Lubricant/ Fluid	No. of Service Points
Daily	1	Engine	Check oil level	EO	1
			Check coolant level in reservoir	WG	1
			Check belt tension	–	1
	10	Hydraulic fluid reservoir	Check fluid level	HYDO	1
	8, 9	Tank cover seals	Check for damage or wear	–	3
	3	Main brushes	Check for damage and wear	–	2
			Check brush pattern	–	2
	4	Side brush (option)	Check for damage and wear	–	1
			Check squeegee blade for damage and wear	–	1
	5	Hopper dust filter	Shake to clean	–	1
	6	Rear Squeegee Blade	Check for damage and wear	–	1
			Check deflection	–	1
	7	Side Squeegee Blades	Check for damage and wear	–	2
	8	Recovery tank	Clean	–	1
	8	Recovery tank, ES mode (option)	Clean ES filter	–	1
	9	Solution tank, ES mode (option)	Clean	–	1
	5	Hopper	Clean hopper, debris screen, and hose	–	1
20 Hours	5	Hopper dust filter	Check for damage, clean, replace if necessary	–	1
50 Hours	16	FaST filter screen	Clean	–	1
	3	Main brushes	Rotate front to rear	–	2
	13	Front wheel	Torque wheel nuts **(after initial 50 hours only)**	–	1
	15	Battery	Clean and tighten battery cable connections **(after initial 50 hours only)**	–	1
100 Hours	19	Radiator	Clean core exterior	–	1
			Check coolant level	WG	1
	19	Hydraulic cooler	Clean core exterior	–	1
	1	Engine	Change oil and filter	EO	1
	–	Tires	Check for damage	–	3
	6	Rear squeegee casters	Lubricate	SPL	2
	6	Rear squeegee	Check leveling	–	1
	2	Scrub head skirt	Check for damage or wear	–	1

MAINTENANCE

Interval	Key	Description	Procedure	Lubricant/ Fluid	No. of Service Points
200 Hours	12	Front wheel support bearings	Lubricate	SPL	2
	1, 17	Torque tube	Lubricate	SPL	4
	12	Steering cylinder	Lubricate	SPL	1
	1, 19	Radiator hoses and clamps	Check for tightness and wear	–	2
	11	Parking brake	Check adjustment	–	1
	11	Brake pedal	Check adjustment	–	1
	14	Hopper lift arm pivots	Lubricate	SPL	2
	5	Hopper door pivots	Lubricate	SPL	2
	18	Hopper lift arm latch	Clean and lubricate	SPL	1
	16	FaST air filter	Clean	–	1
400 Hours	1	Engine	Clean and re–gap or replace spark plugs (Gas/LPG)	–	4
			Replace air filter	–	1
			Replace fuel filter (LPG/Diesel)	–	1
800 Hours	10	Hydraulic reservoir	Change hydraulic fluid	HYDO	1
			Replace strainer outlet		1
			Replace filler cap		1
			Replace fluid filter	–	1
	1	Engine	Check timing belt (Gas,LPG)	–	1
			Replace fuel filter (Gasoline)	–	1
	–	Hydraulic hoses	Check for wear and damage	–	All
	1, 19	Cooling system	Flush	WG	2
	13	Propelling motor	Torque shaft nut	–	1
	13	Front wheel	Torque wheel nuts	–	1
	15	Battery	Clean and tighten battery cable connections	–	1
1600 Hours	1	Engine	Replace timing belt (Gas,LPG)	–	1

LUBRICANT/FLUID

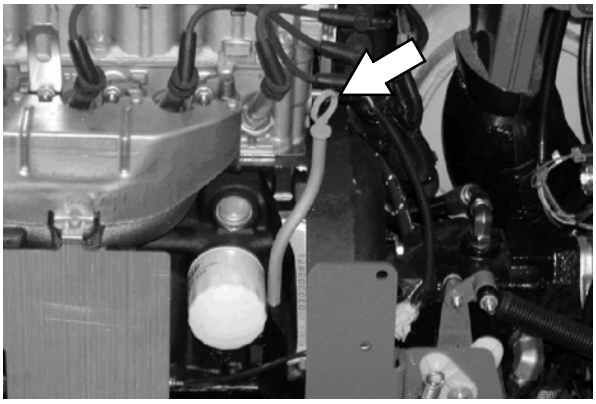
EO . . . . . Engine oil, Gas/LPG: 10W30 SAE--SG/SH only; Diesel: Rating above CD grade only
HYDO . Tennant or approved hydraulic fluid
WG . . . Water and ethylene glycol anti-freeze, –34° C (–30° F)
SPL . . . Special lubricant, Lubriplate EMB grease (Tennant part number 01433–1)

NOTE: More frequent maintenance intervals may be required in extremely dusty conditions.

LUBRICATION

GAS/LPG ENGINE OIL

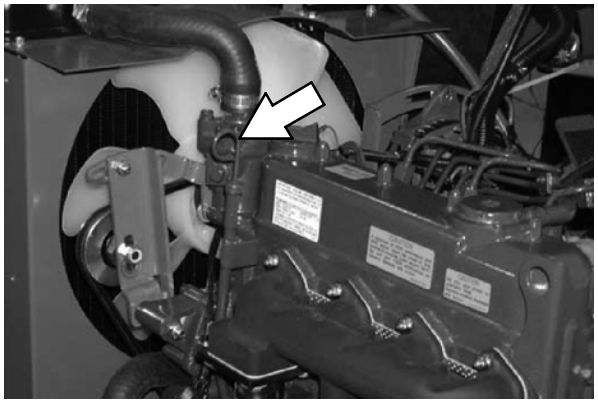
Check the engine oil level daily. Change the oil and oil filter after every 100 hours of operation.



Fill the engine with oil until the oil is between the indicator marks on the dipstick. DO NOT fill past the top indicator mark. The engine oil capacity is 3.5 L (3.7 qt) with oil filter.

DIESEL ENGINE OIL

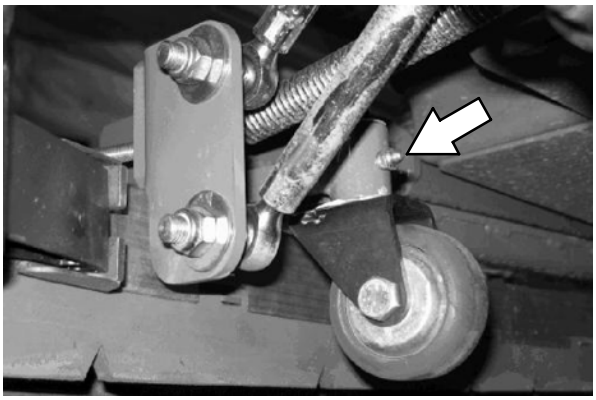
Check the engine oil level daily. Change the oil and oil filter after every 100 hours of operation. Use engine oil with a diesel rating above CD grade only.



Fill the engine with oil until the oil is between the indicator marks on the dipstick. DO NOT fill past the top indicator mark. The engine oil capacity is 6 L (6.35 qt) with oil filter.

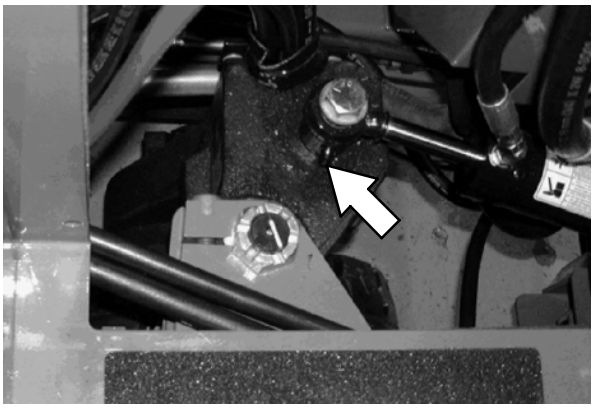
SQUEEGEE CASTER BEARINGS

Lubricate the squeegee caster bearings after every 100 hours of operation.



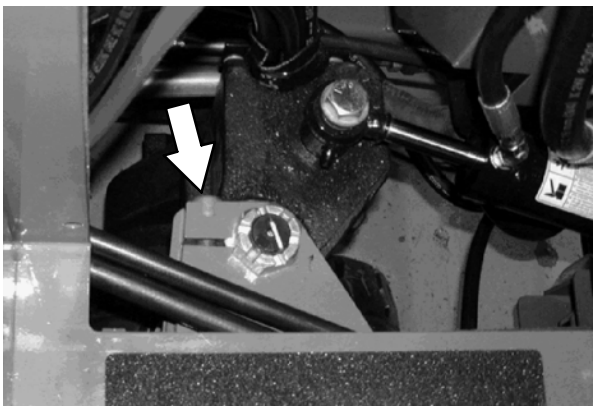
STEERING CYLINDER BEARING

Lubricate the steering cylinder after every 200 hours of operation. The steering cylinder bearing is located next to the front wheel support.



FRONT WHEEL SUPPORT BEARING

Lubricate the front wheel support bearings after every 200 hours of operation. Both front wheel support grease fittings are located underneath the frame support plate.



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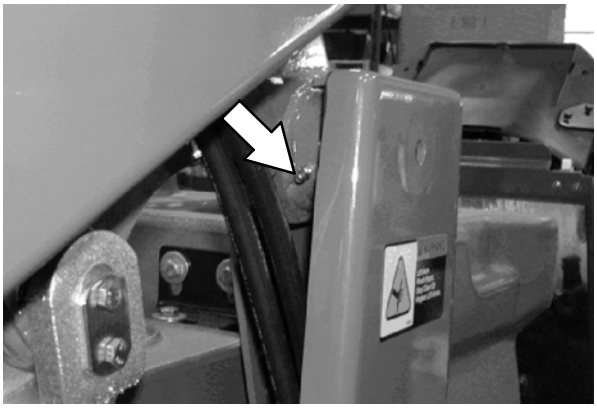
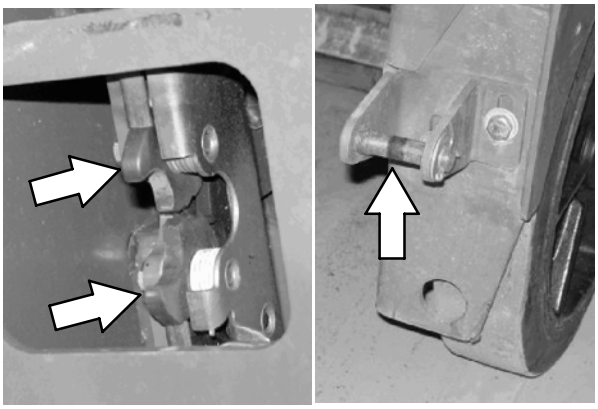
HOPPER LIFT ARM PIVOTS

Lubricate the hopper lift arm pivots after every 200 hours of operation.



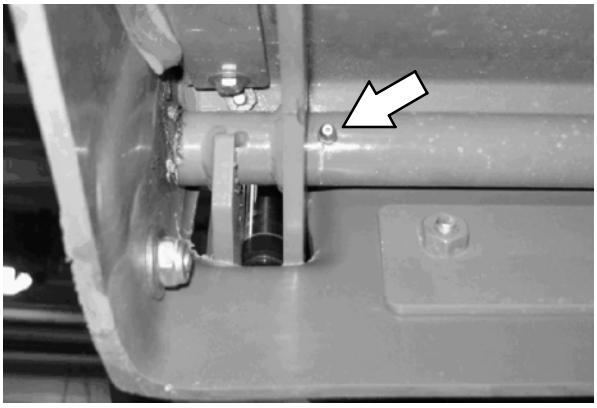
LIFT ARM LATCH

Clean and lubricate the lift arm latch and latch stop after every 200 hours of operation.



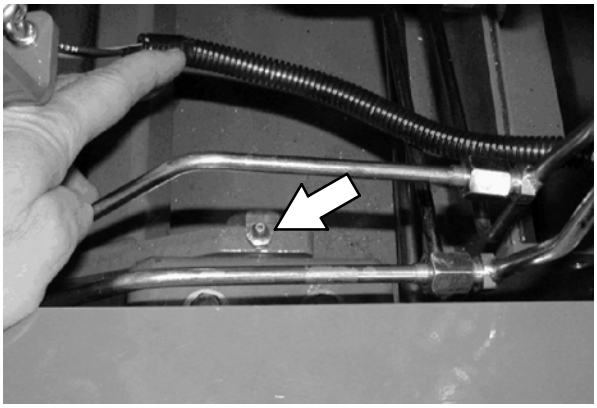
HOPPER DOOR PIVOTS

Lubricate the hopper door pivots after every 200 hours of operation.

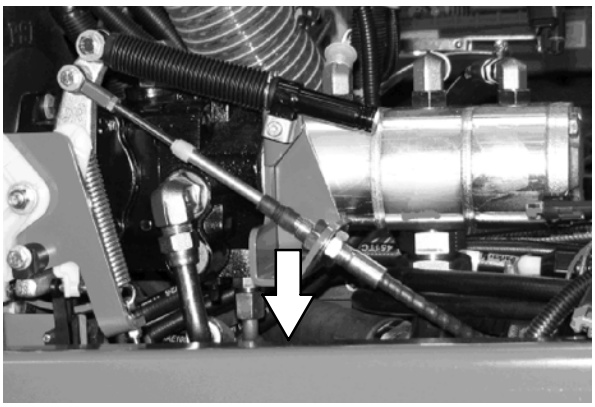


TORQUE TUBES

Lubricate the torque tubes after every 200 hours of operation. The torque tube grease fittings on the operator side of the machine are located beneath the fuel tank.

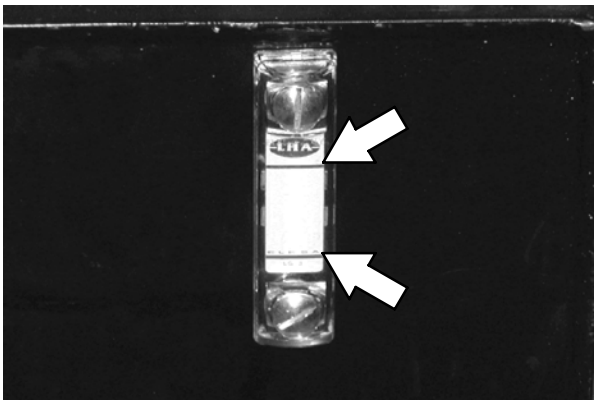


On the other side of the machine the torque tube grease fittings are located beneath the propel pump.



HYDRAULICS

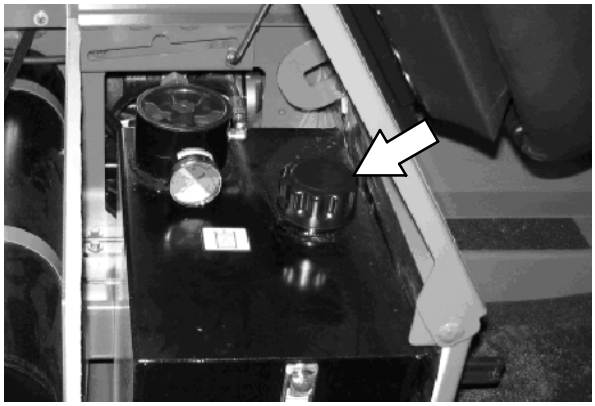
Check the hydraulic fluid level at operating temperature daily. The hydraulic fluid level should be between the two lines on the hydraulic gauge. The hopper must be down when checking hydraulic fluid level.



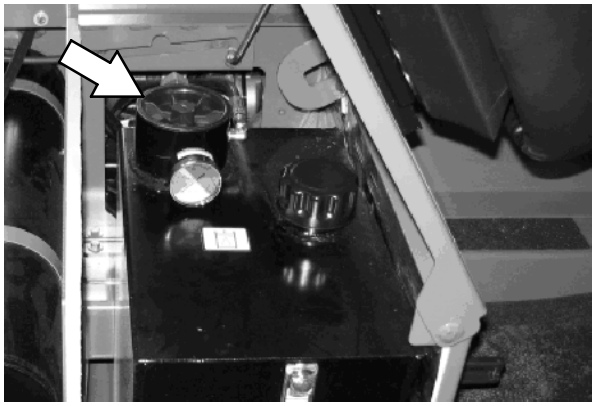
ATTENTION! Do not overfill the hydraulic fluid reservoir or operate the machine with a low level of hydraulic fluid in the reservoir. Damage to the machine hydraulic system may result.

Drain and refill the hydraulic fluid reservoir with new hydraulic fluid after every 800 hours of operation.

Replace the filler cap after every 800 hours of operation. Apply a light film of hydraulic fluid onto the filler cap gasket before installing the cap onto the reservoir.



Replace the hydraulic fluid filter after every 800 hours of operation or if the hydraulic reservoir gauge is in the yellow/red zone when the reservoir hydraulic fluid is approximately 32° C (90° F).



Replace the hydraulic strainer outlet after every 800 hours of operation.

HYDRAULIC FLUID

Tennant hydraulic fluid is specially selected to meet the needs of Tennant machines. There are two fluids available for different temperature ranges:

Tennant part no.	Ambient Temperature
65869	above 7° C (45° F)
65870	below 7° C (45° F)

High temperature fluids have a higher viscosity (thicker) and should only be used in high temperature environments. Low temperature fluids have a lower viscosity (thinner) and should only be used in cold temperature environments. Select the appropriate hydraulic fluid for the environment where the machine is operated. Using improper hydraulic fluids can cause premature failure of hydraulic components.

If using a locally-available hydraulic fluid, be sure the specifications match Tennant hydraulic fluid specifications. Substitute fluids can cause premature failure of hydraulic components.

ATTENTION! Hydraulic components depend on system hydraulic fluid for internal lubrication. Malfunctions, accelerated wear, and damage will result if dirt or other contaminants enter the hydraulic system.

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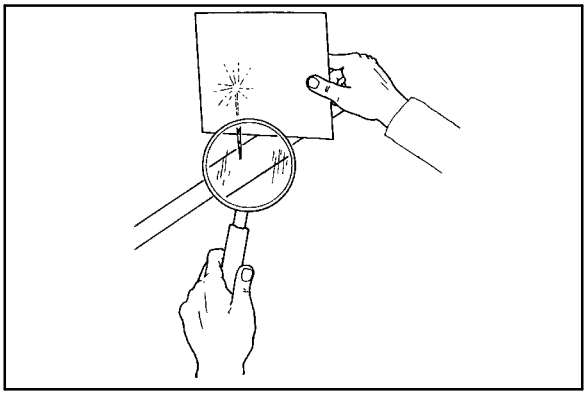
HYDRAULIC HOSES

Check the hydraulic hoses after every 800 hours of operation for wear or damage.

FOR SAFETY: When servicing machine, use cardboard to locate leaking hydraulic fluid under pressure.

High pressure fluid escaping from a very small hole can almost be invisible, and can cause serious injuries.



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Consult a physician immediately if injury results from escaping hydraulic fluid. Serious infection or reaction can occur if proper medical treatment is not given immediately.

Contact a mechanic or supervisor if a leak is discovered.

ENGINE

COOLING SYSTEM

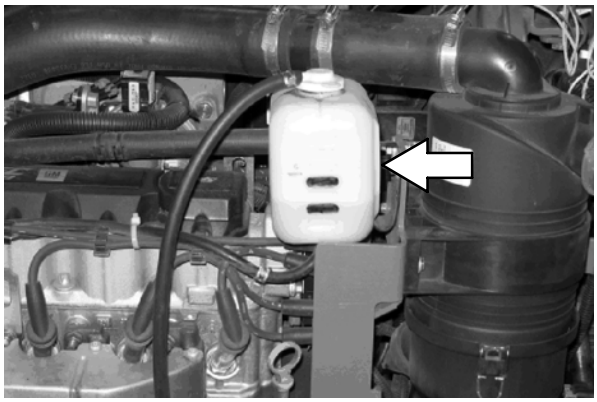
FOR SAFETY: When servicing machine, avoid contact with hot engine coolant.

Check the coolant level in the reservoir daily. The coolant level must be between the two indicator marks when the engine is cold.

FOR SAFETY: When servicing machine, do not remove cap from radiator when engine is hot. Allow engine to cool.

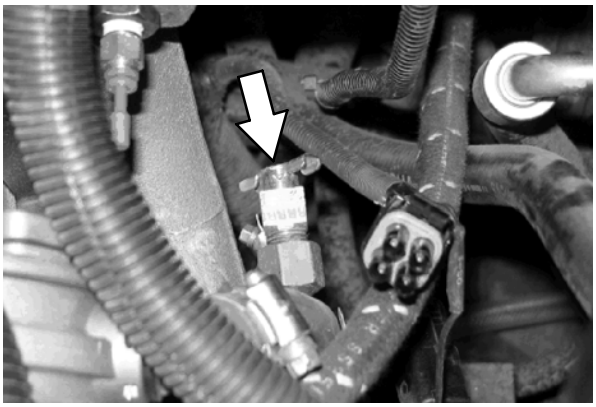
Check the coolant level in the radiator after every 100 hours of operation. Refer to the label on the coolant container for water/coolant mixing instructions.

Flush the radiator and the cooling system after every 800 hours of operation.

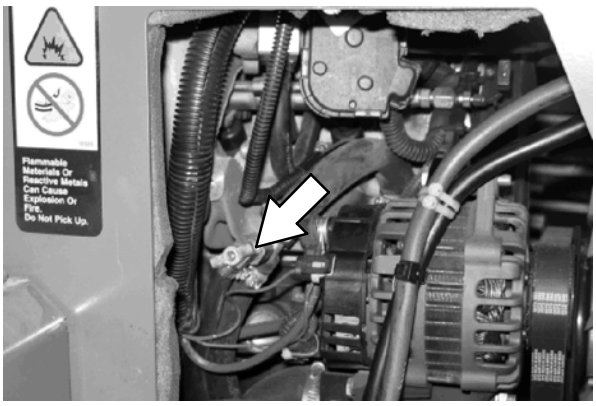


The cooling system must be completely filled with coolant to keep the engine from overheating. When filling the cooling system, open the drain cocks to bleed the air from the system.

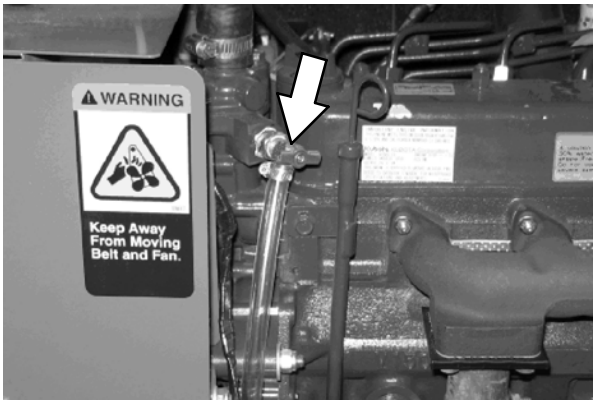
Location of drain cock on LPG machines.



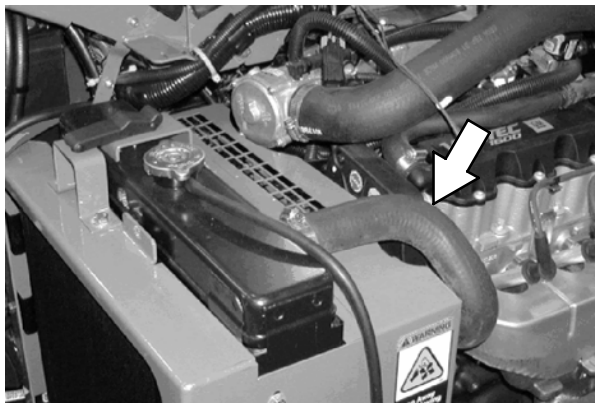
Location of drain cock on gasoline machines. Remove the panel from operators compartment to access the drain cock.



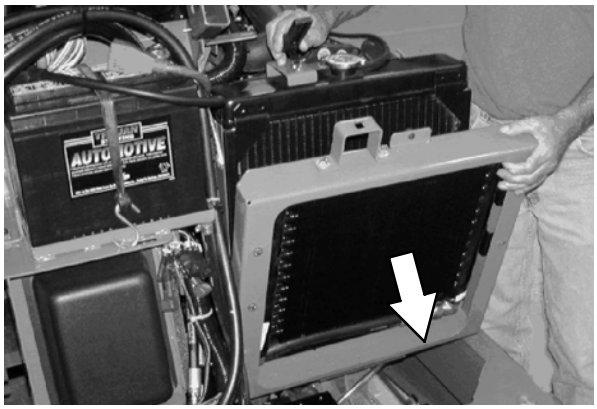
Location of drain cock on diesel machines.



Check the radiator hoses and clamps after every 200 hours of operation. Tighten loose clamps. Replace damaged hoses and clamps.



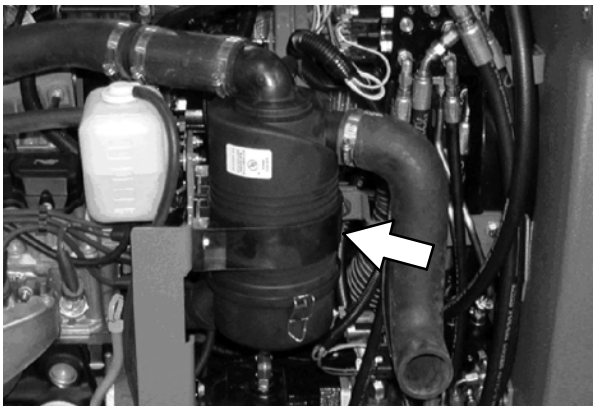
Check the radiator core exterior and hydraulic cooler fins for debris after every 100 hours of operation. Blow or rinse all dust through the grille and radiator fins, in the opposite direction of normal air flow. Be careful to not bend the cooling fins when cleaning. Clean thoroughly to prevent the fins from becoming encrusted with dust. To avoid cracking the radiator, allow the radiator and cooler fins to cool before cleaning.



FOR SAFETY: When servicing machine, wear eye and ear protection when using pressurized air or water.

AIR FILTER

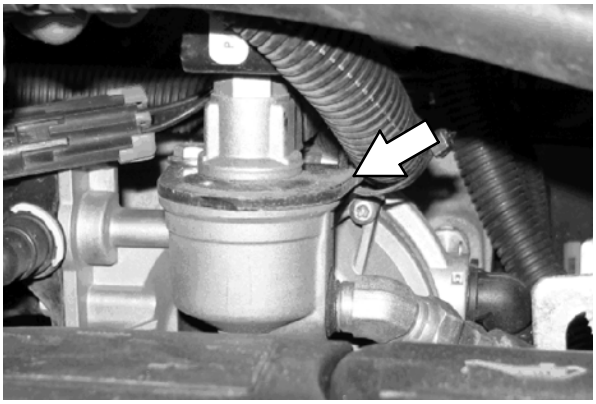
Replace the air filter after every 400 hours of operation.



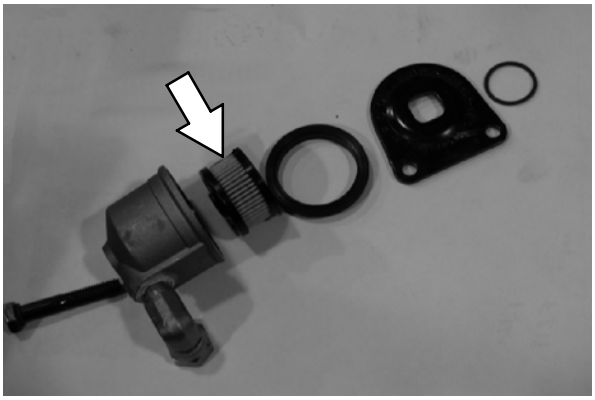
FUEL FILTER (LPG)

Replace the LPG fuel filter after every 400 hours of operation.

FOR SAFETY: When servicing machine, keep flames and sparks away from fuel system service area. Keep area well ventilated.



Disassemble the fuel lock off valve to access the LPG fuel filter.



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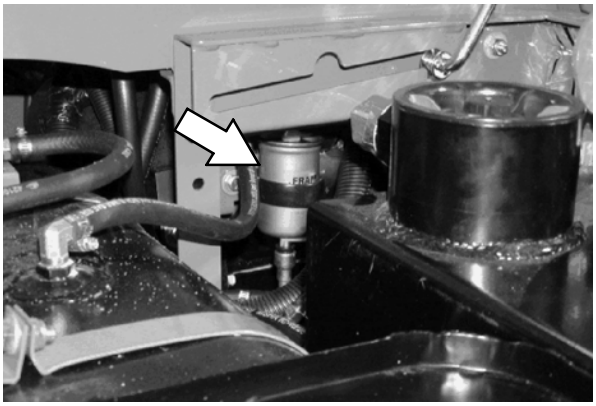
FUEL FILTER (Gasoline)

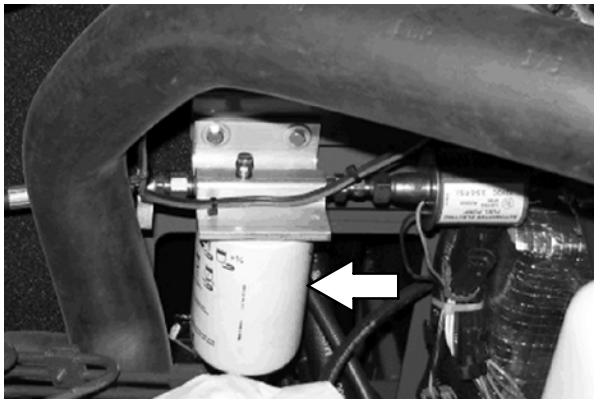
Replace the gasoline fuel filter after every 800 hours of operation.

FOR SAFETY: When servicing machine, keep flames and sparks away from fuel system service area. Keep area well ventilated.



FUEL FILTER (DIESEL)

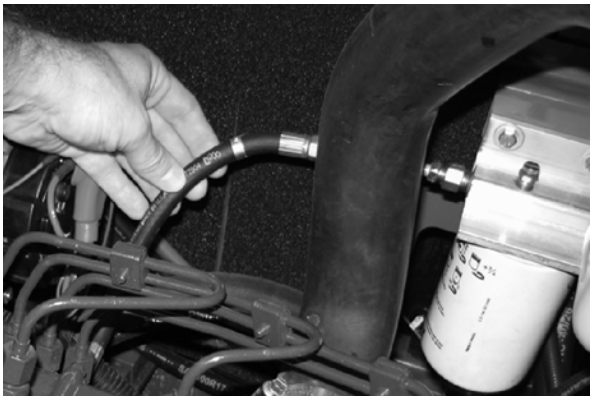
Replace the diesel fuel filter after every 400 hours of operation.



FOR SAFETY: When servicing machine, keep flames and sparks away from fuel system service area. Keep area well ventilated.

FUEL LINES (DIESEL)

Check the fuel lines every 50 hours of operation. If the clamp band is loose, apply oil to the screw of the band and securely tighten the band.



The diesel rubber fuel lines can become worn-out whether the engine has been used much or not. Replace the fuel lines and clamp bands every two years.

FOR SAFETY: When servicing machine, keep flames and sparks away from fuel system service area. Keep area well ventilated.

If the fuel lines and clamp bands are found worn or damaged before two years' time; replace or repair them at once. Bleed the fuel system after replacement of any fuel lines, see PRIMING THE FUEL SYSTEM. When the fuel lines are not installed, plug both ends with clean cloth or paper to prevent dirt from entering the lines. Dirt in the lines can cause fuel injection pump malfunction.

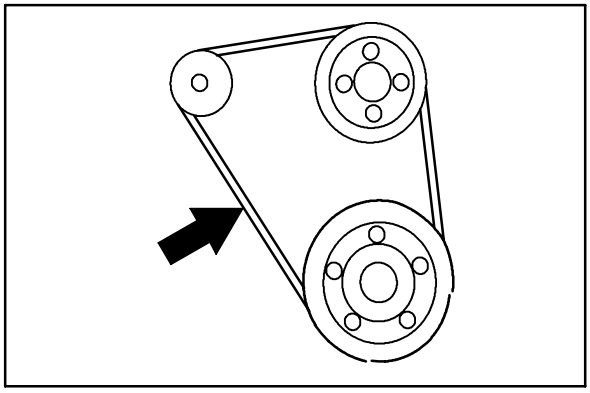
PRIMING THE DIESEL FUEL SYSTEM

Typical diesel fuel systems require priming to remove pockets of air from the fuel lines and fuel components. This is usually required after running out of fuel, changing fuel filter elements or repairing a fuel system component. Air in the fuel prevents smooth engine operation.

This fuel system however is self-priming. The return line comes from the top of the injector that allows the air to escape through the return line.

ENGINE BELT

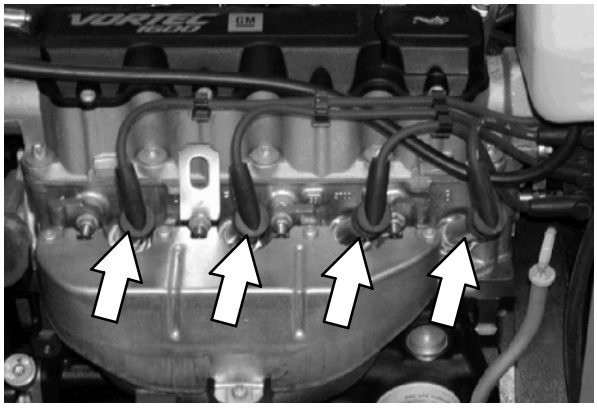
Check the belt tension daily. Adjust tension as necessary. Proper belt tension is 13 mm (0.50 in) from a force of 4 to 5 kg (8 to 10 lb) applied at the mid-point of the longest span.



WARNING: Moving belt and fan. Keep away.

SPARK PLUGS

Clean or replace, and set the gap of the spark plugs after every 400 hours of operation. The proper spark plug gap is 1 mm (0.042 in).



TIMING BELT

Check the timing belt after every 800 hours of operation.

Replace the timing belt after every 2000 hours of operation.

BATTERY

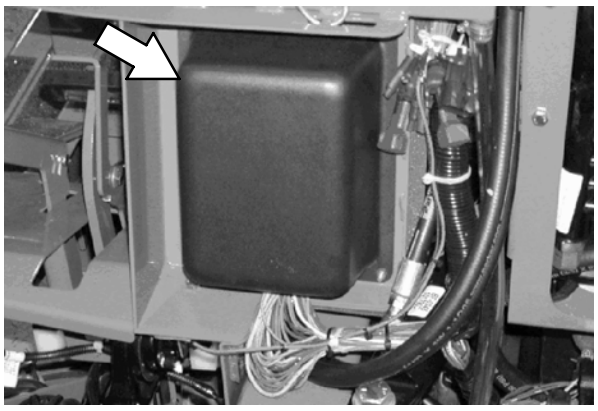
Clean and tighten the battery connections after the first 50 hours of operation and after every 800 hours after that. Do not remove the vent plugs from the battery or add water to the battery.

FOR SAFETY: When servicing machine, avoid contact with battery acid.

FUSES AND RELAYS

RELAY PANEL FUSES AND RELAYS

Fuses are one-time protection devices designed to protect the wire harness by stopping the flow of current in the event of a circuit overload. *Relays* switch the electrical power going to the machine electrical systems on/off. Remove the relay panel cover to access *fuses* and *relays*.



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Refer to the table below for the *fuses* and circuits protected.

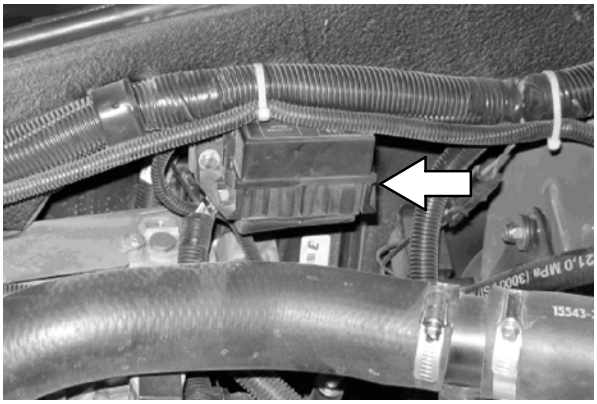
Fuse	Rating	Circuit Protected
FU1	15 A	Auxiliary Relays/Engine Controls
FU2	15 A	Shaker
FU3	15 A	Horn
FU4	15 A	Not Used
FU5	15 A	Scrub Vacuum/Main Brush/ Squeegee Down/Hopper Up
FU6	15 A	Enable/Side Brush/Sweep Vacuum
FU7	15 A	Solution/Hopper Latch and Door/ Auto Fill/Reverse/Shaker
FU8	15 A	ES/FaST/Detergent/ Hopper Down/Spray Wand
FU9	15 A	Lights
FU10	15 A	Unswitched B+ for controller board
FU11	15 A	Not Used: Options
FU12	15 A	Spray Nozzle Pump
FU13	15 A	Not Used
FU14	15 A	Not Used

Refer to the table below for the *relays* and circuits controlled.

Relay	Rating	Circuit Controlled
M1	12 VDC, 40 A	Auxiliary 1
M2	12 VDC, 40 A	Auxiliary 2
M3	12 VDC, 40 A	Shaker
M4	12 VDC, 40 A	Reverse
M5	12 VDC, 40 A	Horn
M6	12 VDC, 40 A	Shutdown
M7	12 VDC, 40 A	Starter
M8	12 VDC, 40 A	Not Used
M9	12 VDC, 40 A	Not Used
M10	12 VDC. 40 A	Spray Wand (Separate Relay)

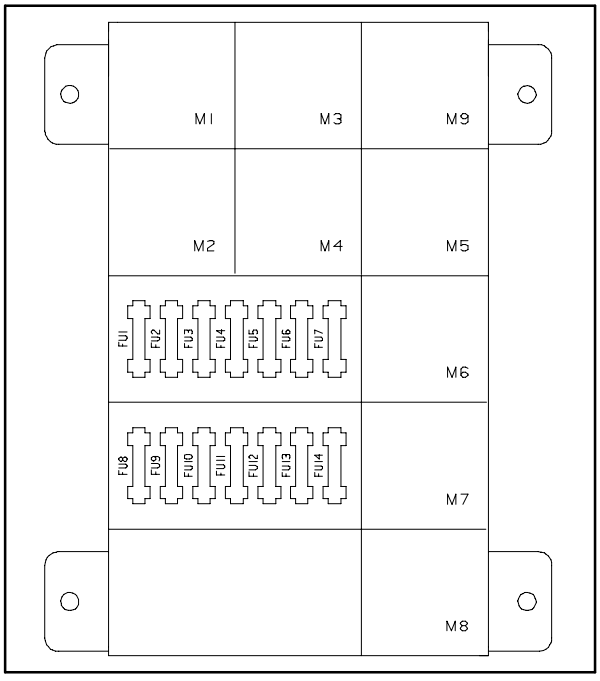
ENGINE HARNESS FUSES AND RELAYS

The *engine harness fuses* and *relays* are located in the fuse box on the side panel inside the engine compartment. Refer to the fuse box cover for locations of engine harness fuses and relays.



NOTE: Always replace a fuse with a fuse of the same amperage. Extra 15 Amp fuses are provided inside the relay panel drawer on the relay panel.

Refer to the diagram below for locations of the *fuses* and *relays* on the relay panel. The M10 relay for the optional spray nozzle is located behind the battery.



CLEANING THE HOPPER DUST FILTER

Shake the dust filter before emptying the hopper and at the end of every shift. Inspect and clean the filter after every 20 hours of operation. Replace damaged dust filters.

NOTE: The dust filter may need to be cleaned at more frequent intervals if the machine is used in extremely dusty conditions.

Use one of the following methods to clean the dust filter:

SHAKING–Press the *filter shaker button*.

TAPPING–Tap the filter, with the dirty side down, gently on a flat surface. **Do not damage the edges of the filter.** The filter will not seal properly in the filter frame if the edges of the filter are damaged.

AIR–Always wear eye protection when using compressed air. Blow air through the dust filter opposite the direction of the arrows. Never use more than 690 kPa (100 psi) of air pressure and never hold the nozzle closer than 50 mm (2 in) to the filter. This may be done with the dust filter in the machine.

FOR SAFETY: When servicing machine, wear eye and ear protection when using pressurized air or water.

WATER–Rinse the dust filter with a low pressure garden hose through the dust filter opposite the direction of the arrows.

*NOTE: If water is used to clean the dust filter, be sure the filter is completely dry before reinstalling it into the hopper. **Do** **Not** reinstall a wet dust filter.*

THERMO–SENTRY

The Thermo–Sentry, located inside the hopper, senses the temperature of the air pulled up from the hopper. If there is a fire in the hopper, the Thermo–Sentry stops the vacuum fan and cuts off the air flow. The Thermo–Sentry automatically resets after cooling down.

MAIN BRUSHES

Check the main brushes daily for tangled wire or string, wear, damage, and adjustment.

Replace the brushes if large portions of the bristles are missing or if the remaining bristles are 19 mm (0.75 in) or less in length.

For optimal cleaning performance, rotate the brushes front to rear after every 50 hours of operation.

NOTE: Replace brushes in sets of two. Otherwise one scrub brush may scrub more aggressively than the other.

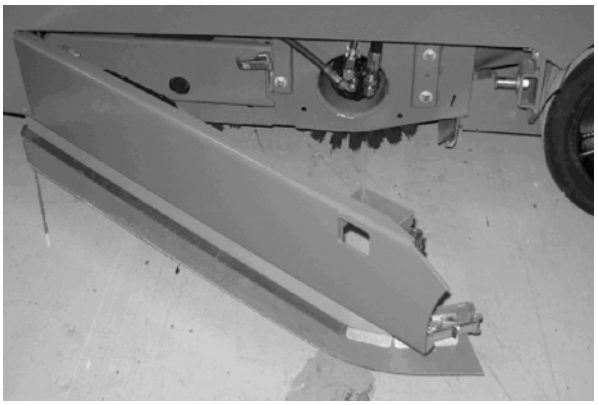
REPLACING OR ROTATING THE MAIN BRUSHES

The front brush can be accessed on the left side of the machine and rear brush can be accessed on the right side of the machine.

1. Raise the scrub head.

FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, and turn off machine.

2. Open the outer brush doors.



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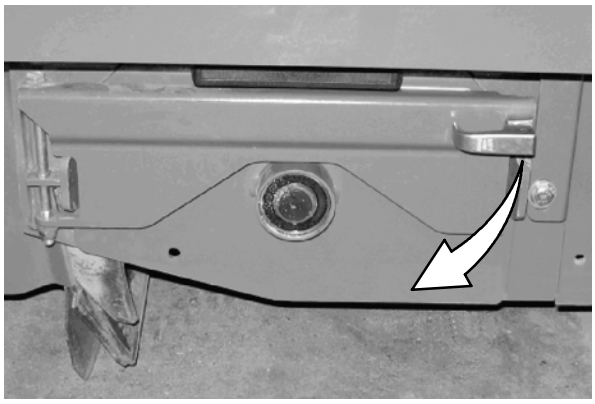
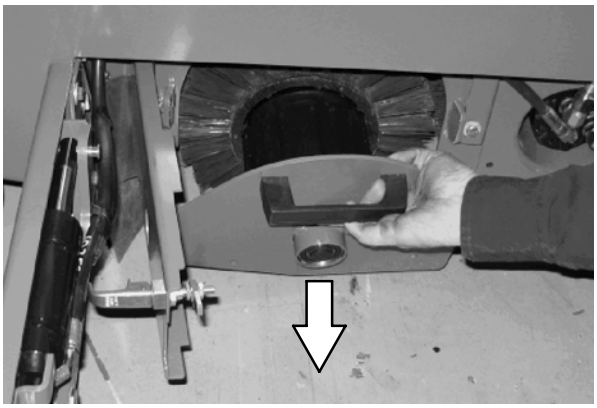
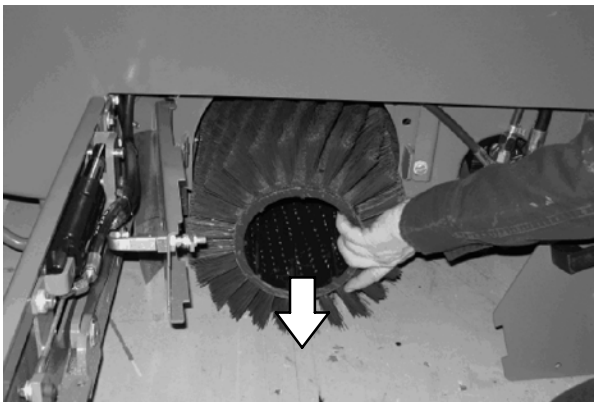
3. Open the inner brush doors.



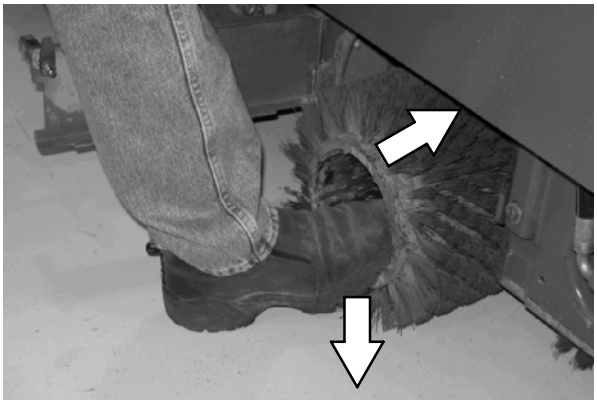
4. Remove the brush idler plates.



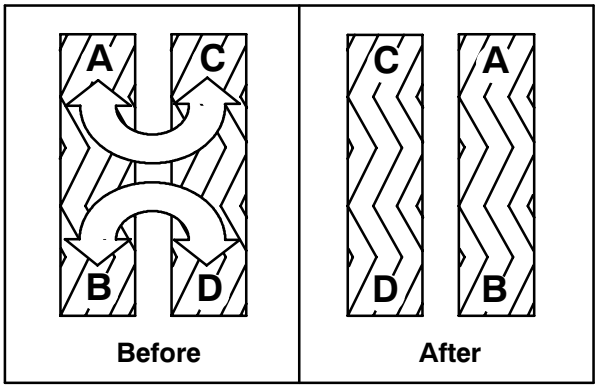
5. Pull the brushes out from the scrub head.



6. Install the new or rotated brushes by pushing down on the ends while sliding them onto the drive motor hubs.



7. If rotating the existing brushes, only rotate front to rear. Do NOT rotate end-for-end.



8. Reinstall the brush idler plates.

9. Close the inner and outer brush doors.

10. Check and adjust the brush pattern if needed. Refer to *CHECKING AND ADJUSTING THE MAIN BRUSH PATTERN*.

CHECKING THE MAIN BRUSH PATTERN

1. Apply chalk, or a similar marking material, to a smooth and level section of the floor.

NOTE: If chalk or other material is not available, allow the brush to spin on the floor for two minutes. A polish mark will remain on the floor.

2. Raise the scrub head, then position the brushes over the chalked area.

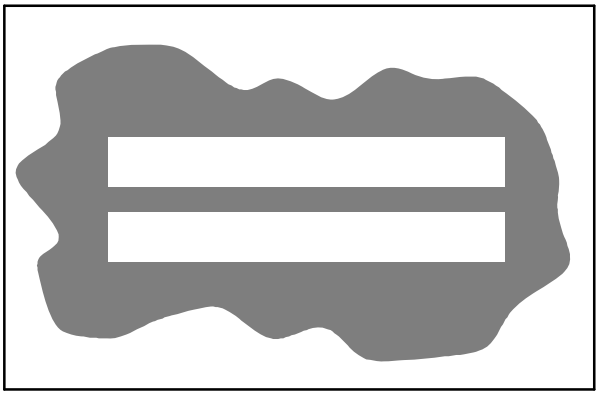
3. Set the parking brake.

4. Press the *1-STEP Sweep button* to lower the scrub head. Set the brush pressure to the lowest setting and allow the brushes to operate for 15 to 20 seconds. Keep the scrub head in one spot in the chalked area.

5. Raise the scrub head, release the parking brake, and drive the machine away from the chalked area.

FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, and turn off machine.

6. Observe the brush patterns. If the brush pattern is the same width across the entire length of each brush and both brushes are the same width, no adjustment is necessary.



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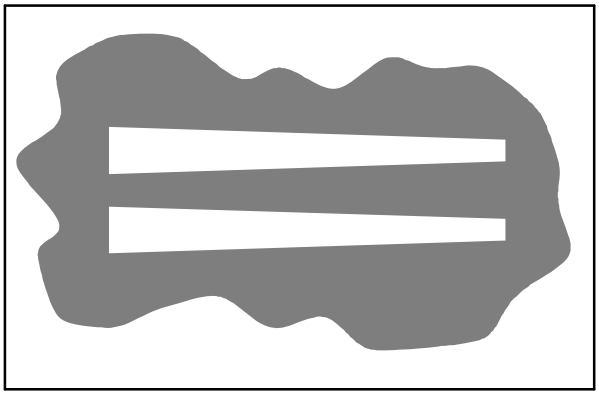
7. If the brush patterns are tapered, see *ADJUSTING THE MAIN BRUSH TAPER* section of this manual.



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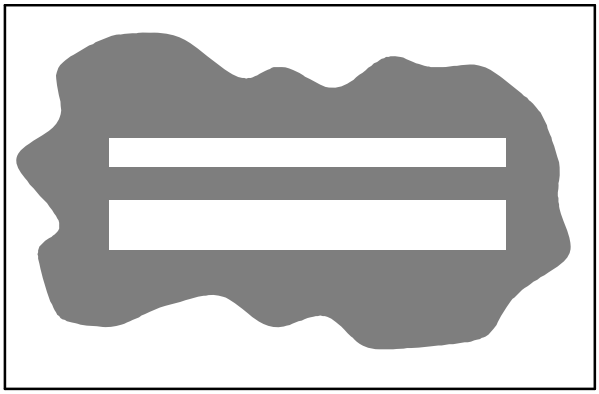
8. The brush patterns should be 75 to 130 mm (3 to 5 in) wide with the brushes in the lowered position and both patterns should be the same width. If the width of the brushes is not the same, see *ADJUSTING THE MAIN BRUSH WIDTH* section of this manual.



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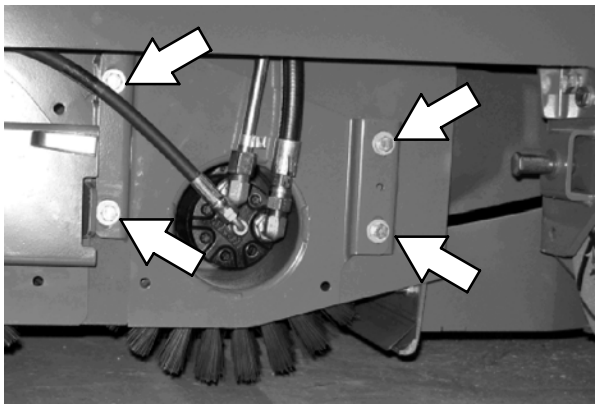
ADJUSTING THE MAIN BRUSH TAPER

1. Loosen the four mounting bolts on the brush drive housing.

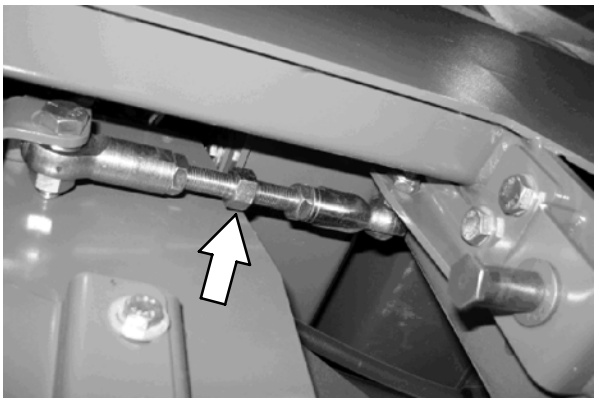


2. Move the brush drive housing up to decrease the pattern width on that side of the scrub head or down to increase the pattern width on that side of the scrub head.
3. Tighten the mounting bolts.
4. Recheck the pattern. Readjust if necessary.

ADJUSTING THE MAIN BRUSH WIDTH

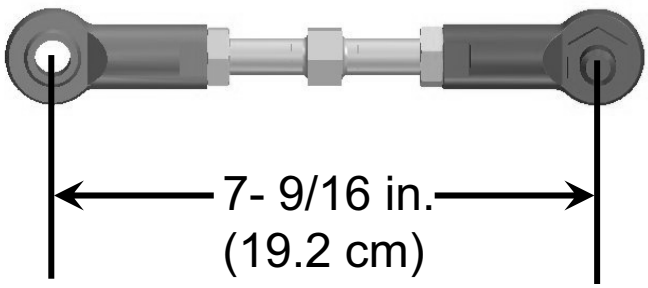
1. Adjust the length of the drag links on both sides of the scrub head. Lengthen the drag links to increase the rear brush pattern width. Shorten the drag links to increase the front brush pattern. Always adjust the nut on each drag link an equal number of turns.

NOTE: Two full turns of the drag link adjustment bolt will change the brush pattern approximately 25 mm (1 in).



2. Recheck the pattern. Readjust if necessary.

NOTE: If replacing Drag Link, refer to diagram below to set adjustment to factory specifications, then adjust as necessary to obtain equal front and rear brush pattern widths.



SIDE BRUSH (OPTION)

Check the side brush daily for wear or damage. Remove any tangled string or wire from the side brush or side brush drive hub.

REPLACING THE SIDE BRUSH

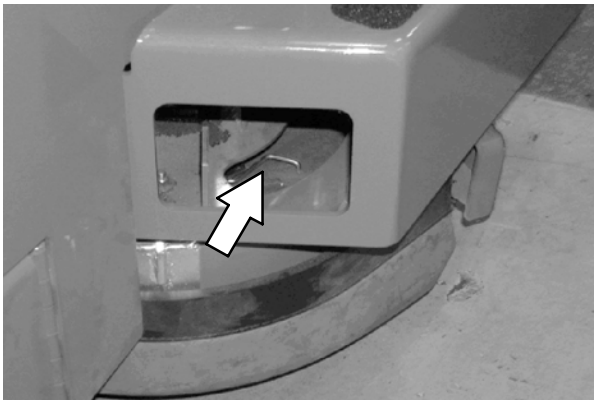
Replace the side brush when it no longer cleans effectively or when the remaining bristles are 19 mm (0.75 in) or less in length for the scrub brush or 64 mm (2.5 in) or less in length for the sweep brush. The side brush may be changed sooner if sweeping light litter. The bristles may be worn shorter if sweeping heavy debris.

1. If necessary, raise the side brush.

FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, and turn off machine.

2. Turn the brush until the spring handles are visible through the access hole in the side brush assembly.

3. Squeeze the spring handles and let the side brush drop to the floor.



4. Remove the side brush from underneath the side brush assembly.

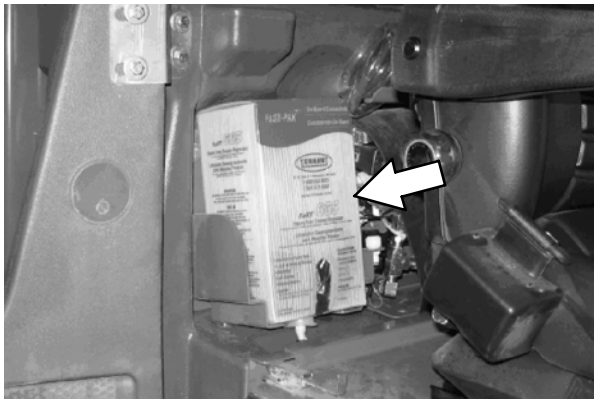
5. Place the new side brush underneath the side brush assembly and lift the side brush up onto the side brush hub until the brush locks onto the hub.

FaST SYSTEM

REPLACING THE FaST-PAK CARTON

FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, and turn off machine.

1. Open the side access door.
2. Slide the seat completely forward.
3. Squeeze the button on the FaST supply hose connector, then pull the empty FaST-PAK carton out from the compartment and discard.



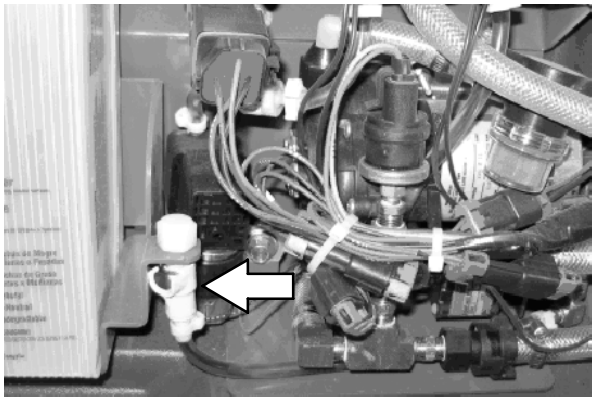
4. Remove the perforated knock outs from the new FaST-PAK carton. Do Not remove the bag from the carton. Pull out the hose connector located on the bottom of the bag and remove the hose cap from the connector.

NOTE: The FaST-PAK Floor Cleaning Concentrate is specially designed for use with the FaST system scrubbing application. NEVER use a substitute. Other cleaning solutions may cause FaST system failure.

5. Slide the FaST-PAK carton into the FaST-PAK bracket.
6. Connect the FaST supply hose to the FaST-PAK hose connector.
7. Scrub with the FaST system for a few minutes to allow the detergent to reach maximum foaming.

CLEANING THE FaST SUPPLY HOSE CONNECTOR

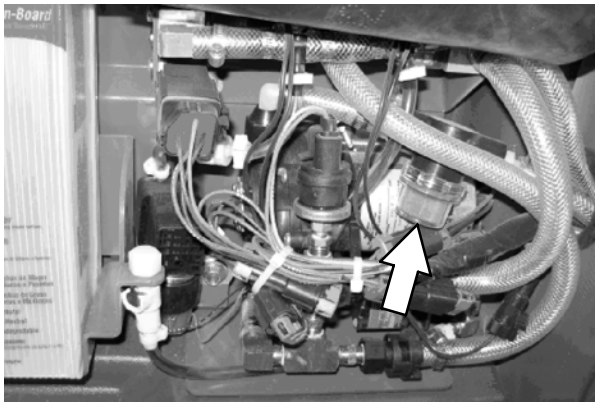
Soak the connector in warm water if detergent buildup is visible. When a FaST-PAK carton is not installed, store the supply hose connector on the storing plug to prevent the hose from clogging.



CLEANING THE FaST SYSTEM FILTER SCREEN

The FaST system filter screen filters water from the solution tank as the water flows into the FaST system.

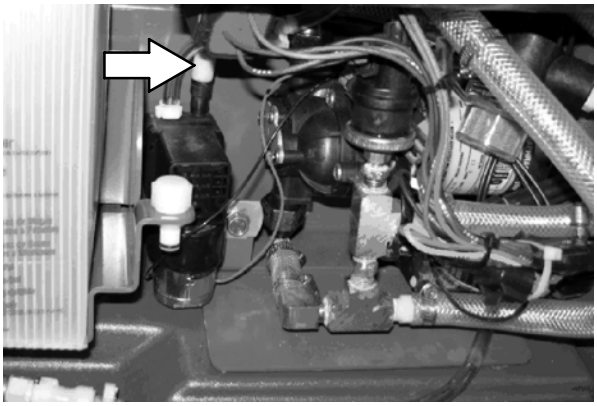
Remove the filter screen bowl and clean the filter screen after every 50 hours of operation. Empty the solution tank before removing the filter.



CLEANING THE FaST SYSTEM AIR PUMP FILTER

Remove and clean the air filter with compressed air after every 200 hours of FaST scrubbing.

FOR SAFETY: When servicing machine, wear eye protection when using pressurized air or water.



M

SQUEEGEE BLADES

Check the squeegee blades for damage and wear daily. When the blades become worn, rotate the blades end-for-end or top-to-bottom to a new wiping edge. Replace blades when all edges are worn.

Check the deflection of the squeegee blades daily or when scrubbing a different type of surface. Check the leveling of the rear squeegee every 100 hours of operation.

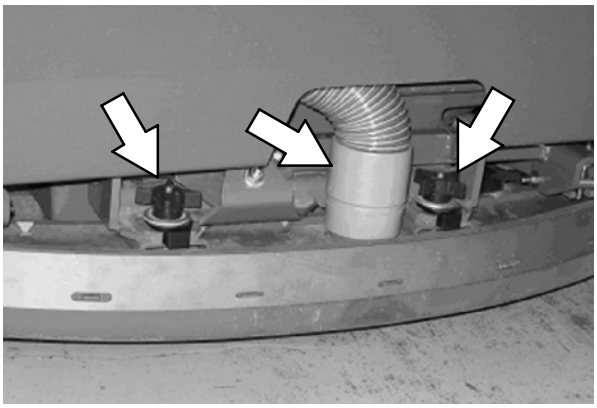
M

REPLACING (OR ROTATING) THE REAR SQUEEGEE BLADES

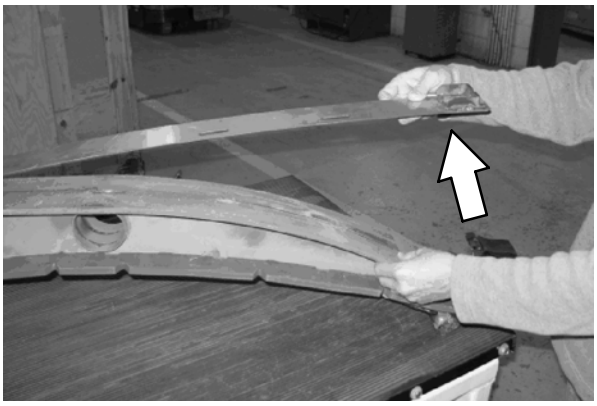
1. Lower the scrub head.

FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, and turn off machine.

2. Disconnect the vacuum hose from the rear squeegee assembly.

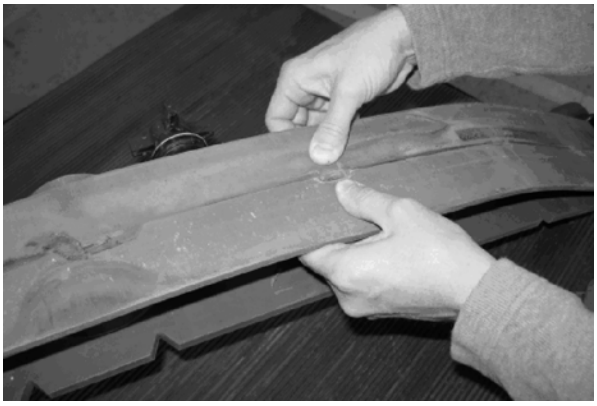


3. Remove both mounting knobs from the rear squeegee assembly.
4. Turn on the machine, raise the scrub head, and turn off the machine.
5. Remove the rear squeegee assembly from the machine.
6. Loosen the rear retaining band tension latch and open the retaining band.

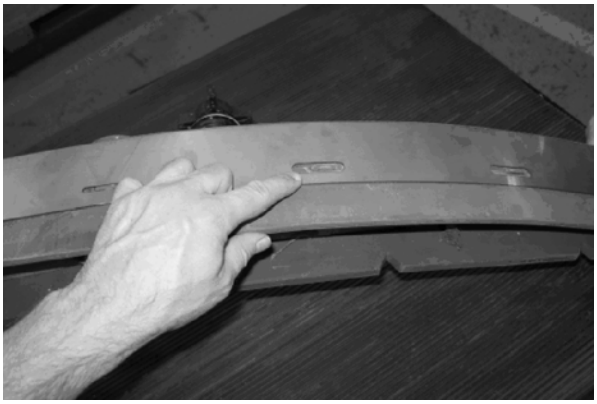


7. Remove the rear squeegee.

8. Install the new rear squeegee blade or rotate the existing blade to the new edge. Be sure all the holes in the squeegee blade are hooked onto the tabs.



9. Reinstall the rear retaining band aligning the tabs with the holes.

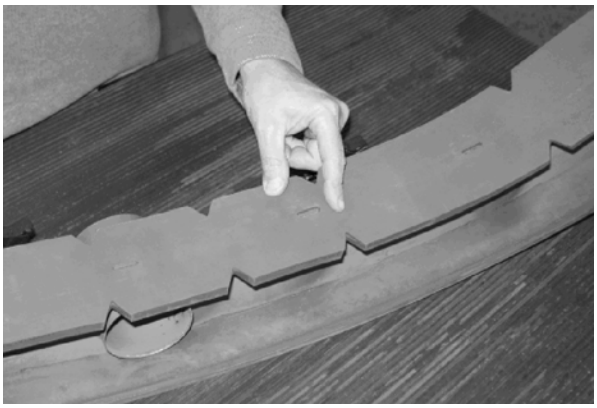


10. Tighten the rear retaining band tension latch.

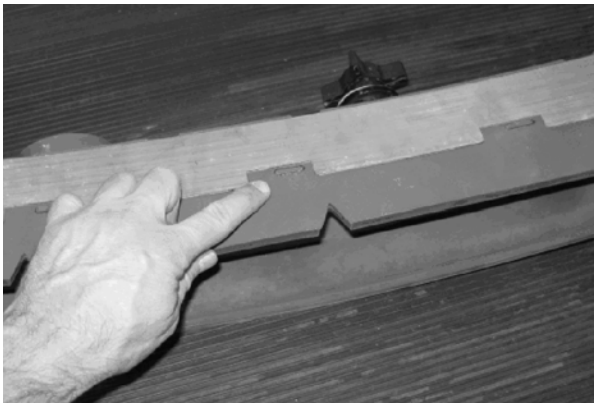
11. Loosen the front retaining band tension latch and open the retaining band.

12. Remove the front squeegee.

13. Install the new front squeegee blade or rotate the existing blade to the new edge. Be sure the holes in the squeegee blade are hooked onto the tabs.



14. Reinstall the front retaining band aligning the tabs with the notches.



15. Tighten the front retaining band tension latch.

16. Reinstall the rear squeegee assembly onto the machine.

17. Check and adjust the rear squeegee if necessary. Refer to *ADJUSTING THE REAR SQUEEGEE BLADE DEFLECTION* and *LEVELING THE REAR SQUEEGEE* sections of this manual.

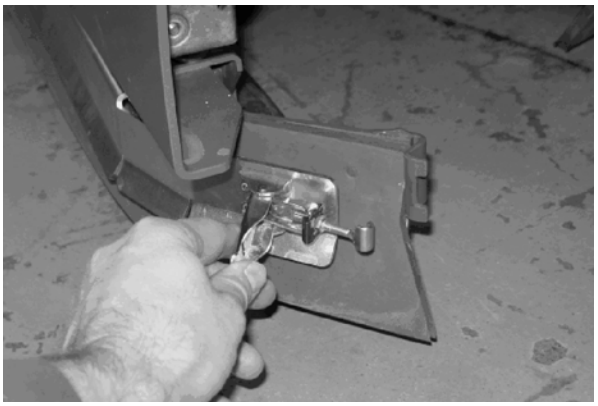
REPLACING OR ROTATING THE SIDE SQUEEGEE BLADES

1. If necessary, raise the scrub head.

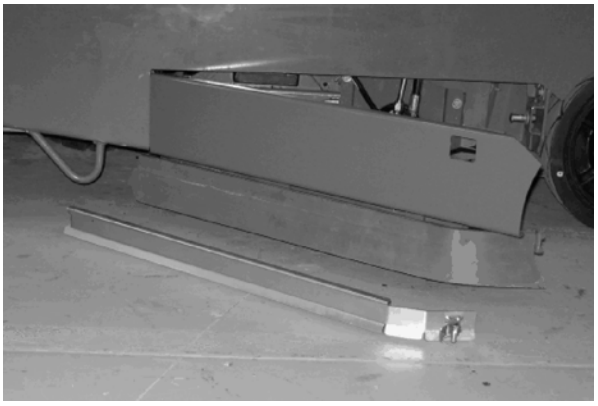
FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, and turn off machine.

2. Open the outer brush doors.

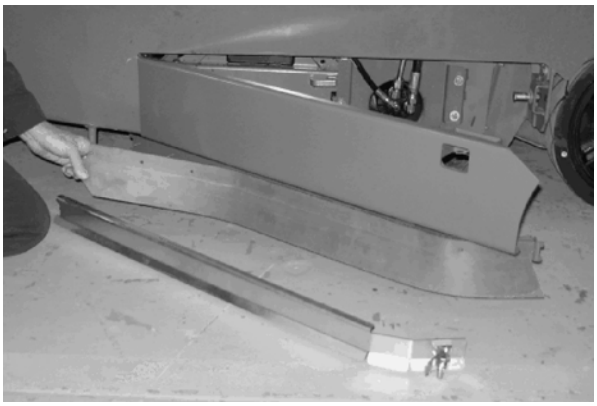
3. Unhook the latch on the side squeegee retaining band from the side squeegee assembly.



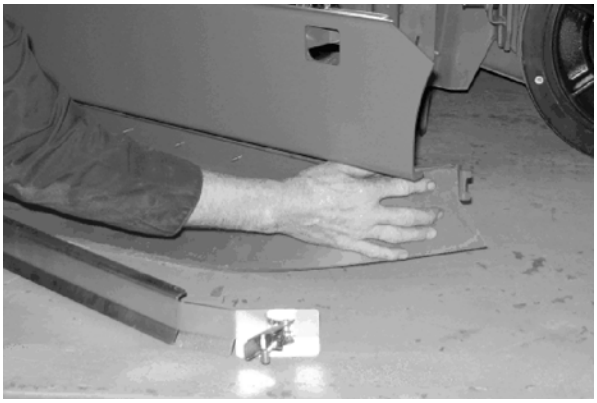
4. Remove the retaining band from the side squeegee assembly.



5. Remove the side squeegee blade. If the outer edge of the squeegee blade is not worn, rotate the squeegee blade with the blade from the other side of the machine. Discard the squeegee blade if both edges are worn.

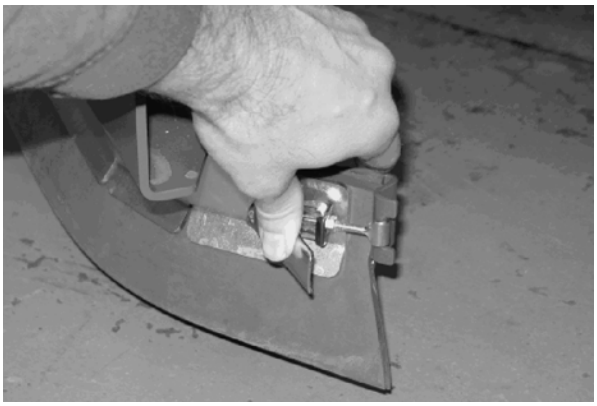


6. Install the new or rotated squeegee blades.



7. Reattach the side squeegee retaining band to the side squeegee assembly.

8. Hook the latch on the side squeegee retaining band.



9. Close the outer brush door.

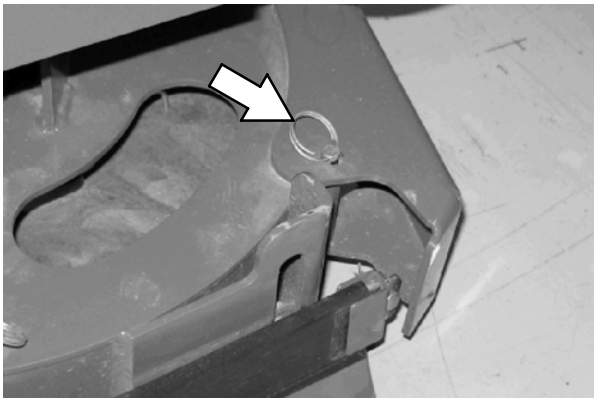
REPLACING THE SIDE BRUSH SQUEEGEE BLADE (OPTION)

Check the side brush squeegee blade for damage and wear daily. Replace the blade if the leading edge is torn or worn half-way through the thickness of the blade.

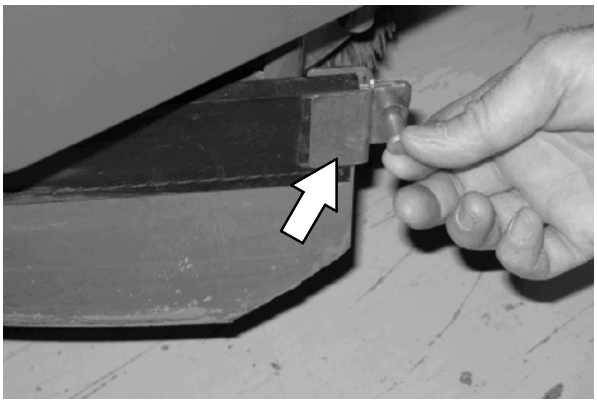
1. If necessary, raise the scrub head.

FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, and turn off machine.

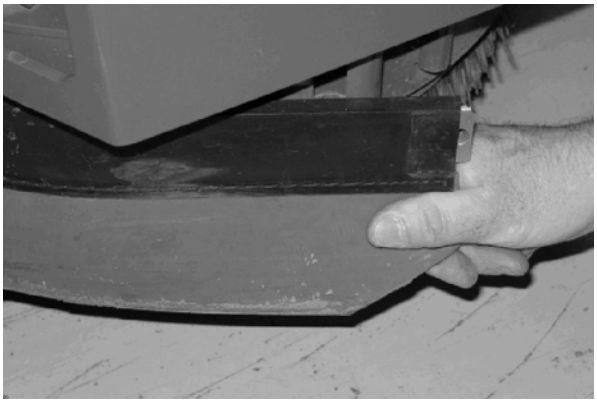
2. Pull the pin from the squeegee bumper and open the squeegee bumper.



3. Remove the clevis pin and squeegee retainer.



4. Pull the squeegee out from the side brush assembly.



5. Slide the new squeegee into the side brush assembly.

6. Reinstall the squeegee retainer and clevis pin.

7. Close the squeegee bumper and reinsert the pin.

LEVELING THE REAR SQUEEGEE

Leveling the squeegee assures the entire length of the squeegee blade is in even contact with the surface being scrubbed. Perform this adjustment on an even and level floor.

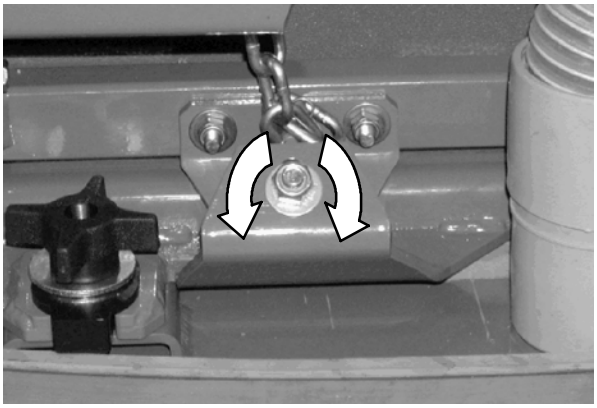
1. Lower the squeegee and drive the machine forward a few meters (feet).

FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, and turn off machine.

2. Look at the deflection of the squeegee over the full length of the squeegee blade.

3. If the deflection is not the same over the full length of the blade, turn the squeegee levelling nut to make adjustments.

   DO NOT *disconnect the suction hose from the squeegee frame when leveling squeegee.*



4. Turn the squeegee leveling nut counter-clockwise to decrease the deflection at the ends of the squeegee blade.

   Turn the squeegee leveling nut clockwise to increase the deflection at the ends of the squeegee blade.

5. Drive the machine forward with the squeegee down to recheck the squeegee blade deflection if adjustments were made.

6. Readjust the squeegee blade deflection if necessary.

ADJUSTING THE REAR SQUEEGEE BLADE DEFLECTION

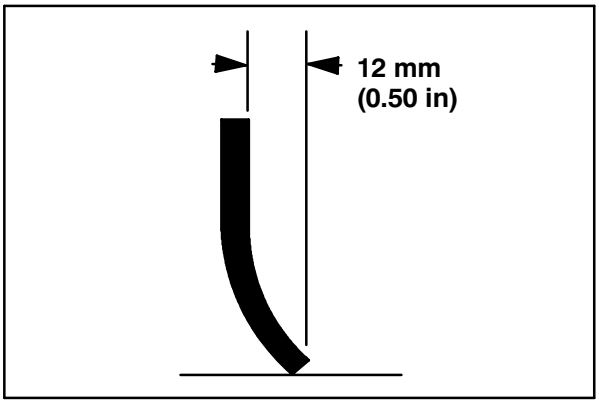
Deflection is the amount of curl the overall squeegee blade has when the machine moves forward. The best deflection is when the squeegee wipes the floor dry with a minimal amount of deflection.

NOTE: Make sure the squeegee is level before adjusting the deflection. See LEVELING THE REAR SQUEEGEE.

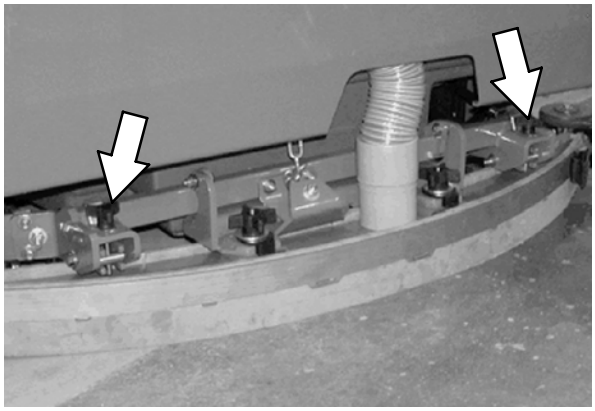
1. Lower the squeegee and drive the machine forward a few meters (feet).

FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, and turn off machine.

2. Look at the amount of deflection or “curl” of the squeegee blade. The correct amount of deflection is 12 mm (0.50 in) for scrubbing smooth floors and 15 mm (0.62 in) for rough floors.



3. To adjust the overall squeegee blade deflection, turn the adjustment knobs counterclockwise to increase deflection or clockwise to decrease deflection.



4. Drive the machine forward again to recheck the squeegee blade deflection after adjustments are made.

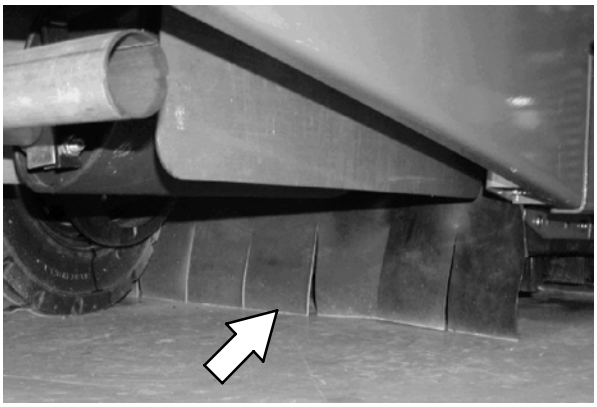
5. Readjust the squeegee blade deflection if necessary.

M

SKIRTS AND SEALS

SCRUB HEAD SKIRT

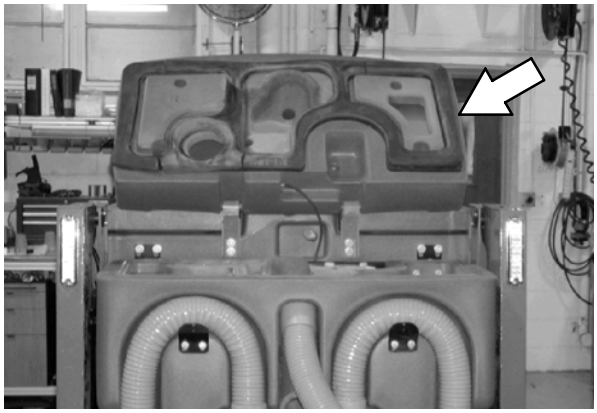
Check the skirt for damage and wear after every 100 hours of operation.



The skirts should be between 0 to 6 mm (0 to 0.25 in) from the floor when the scrub head is down.

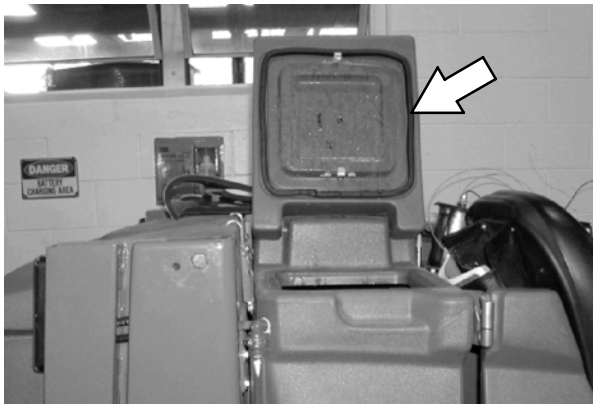
RECOVERY TANK SEAL

Check the recovery tank cover seal for damage and wear daily.



SOLUTION TANK SEALS

Check each solution tank cover seal for damage and wear daily.



BRAKES AND TIRES

BRAKES

The mechanical brakes are located on the rear wheels. The brakes are operated by the foot brake pedal and connecting cables.

Check the brake adjustment after every 200 hours of operation.

PARKING BRAKE

The parking brake is set with the parking brake pedal that activates the brakes.

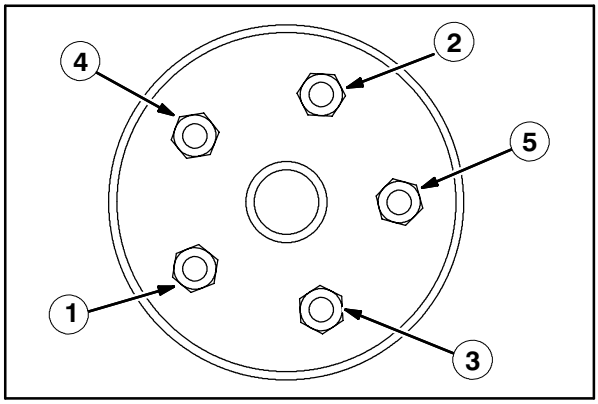
Check the parking brake adjustment after every 200 hours of operation.

TIRES

Check tires for damage and wear after every 100 hours of operation.

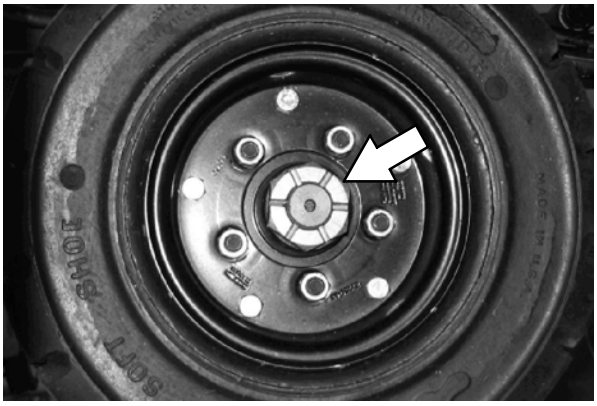
FRONT WHEEL

Torque the front wheel nuts twice in the pattern shown to 122 to 149 Nm (90 to 110 ft lb) after the first 50 hours of operation, and after every 800 hours there after.



PROPELLING MOTOR

Torque the shaft nut to 508 Nm (375 ft lb) lubricated, 644 Nm (475 ft lb) dry, after every 800 hours of operation.



M

PUSHING, TOWING, AND TRANSPORTING THE MACHINE

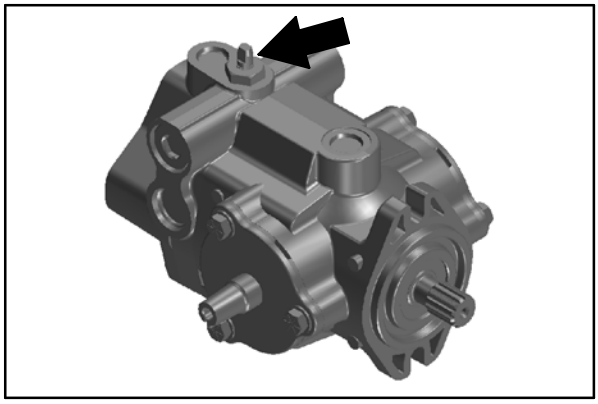
PUSHING OR TOWING THE MACHINE

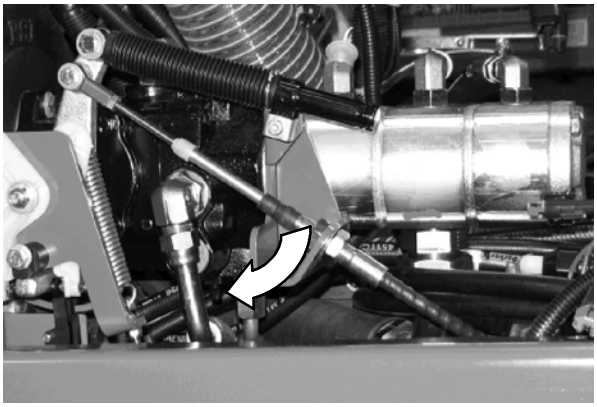
If the machine becomes disabled, it can be pushed from the front or rear, but only towed from the front.

The propelling pump has a bypass valve to prevent damage to the hydraulic system when the machine is being pushed or towed. This valve allows a disabled machine to be moved for a *very short distance* and at a speed to not exceed 1.6 kp/h (1 mph). The machine is NOT intended to be pushed or towed a long distance or at a high speed.

ATTENTION! Do not push or tow machine for a long distance or damage may occur to the propelling system.

Turn the bypass valve located on the bottom of the propelling pump 90° (either direction) from the normal position before pushing or towing the machine. Return the bypass valve back to the normal position when through pushing or towing the machine. **Do Not** use the bypass valve during normal machine operation.





TRANSPORTING THE MACHINE

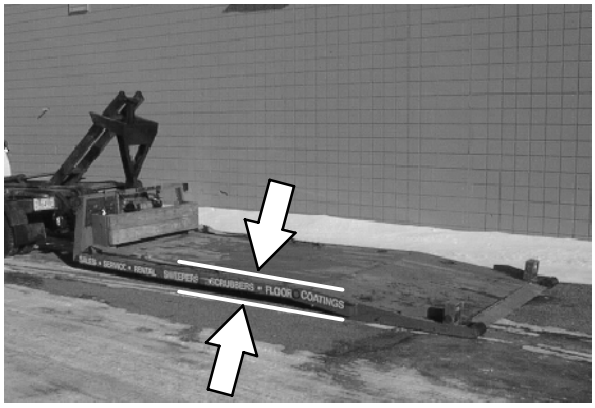
1. Raise the squeegee, scrub head, and brushes. If necessary, raise the hopper for additional ramp clearance.

NOTE: Empty the hopper, the recovery tank, and the solution tank before transporting.

2. Position the rear of the machine at the loading edge of the truck or trailer.

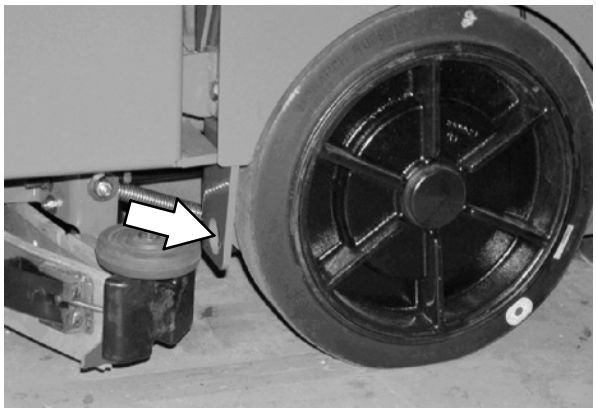
3. If the loading surface is not horizontal or is higher than 380 mm (15 in) from the ground, use a winch to load machine.

   If the loading surface is horizontal and 380 mm (15 in) or less from the ground, the machine may be driven onto the truck or trailer.



FOR SAFETY: When loading machine onto truck or trailer, use winch. Do not drive the machine onto the truck or trailer unless the loading surface is horizontal AND is 380 mm (15 in) or less from the ground.

4. To winch the machine onto the truck or trailer, attach the winching chains to the holes in the rear jacking brackets behind the rear tires.

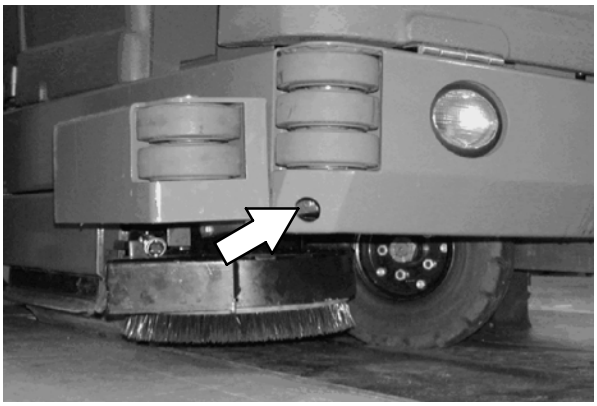


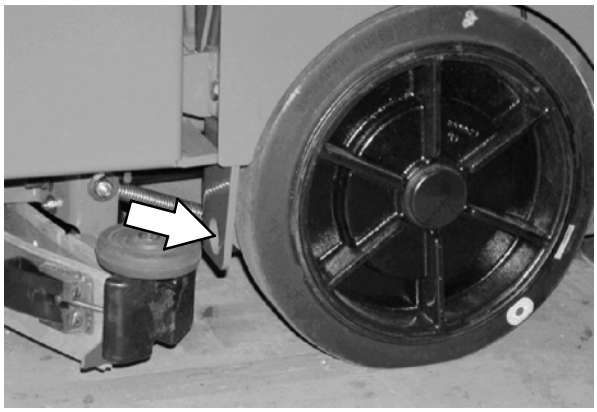
5. Position the machine as close to the front of the trailer or truck as possible.

6. Set the parking brake and place a block behind each wheel to prevent the machine from rolling.

7. Lower the scrub head.

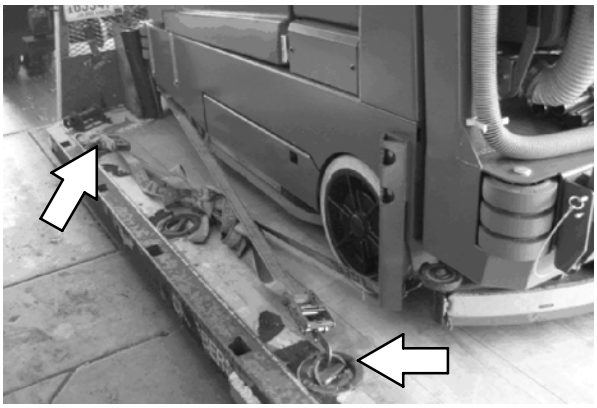
8. Connect the tie-down straps to the holes in the right and left lower corners in front of the machine and the holes in the rear jacking brackets behind the rear tires.





9. Route the tie-downs to the opposite ends of the machine and hook them to the brackets on the floor of the trailer or truck. Tighten the tie-down straps.

NOTE: It may be necessary to install tie-down brackets to the floor of the trailer or truck.



10. If the loading surface is not horizontal or is higher than 380 mm (15 in) from the ground, use a winch to unload machine.

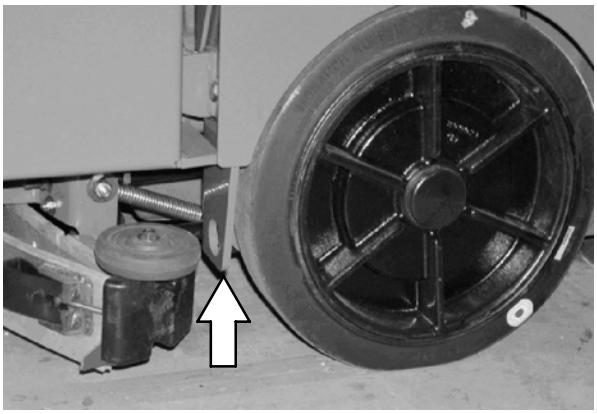
    If the loading surface is horizontal AND is 380 mm (15 in) or less from the ground, the machine may be driven off the truck or trailer.

FOR SAFETY: When unloading machine off truck or trailer, use winch. Do not drive the machine off the truck or trailer unless the loading surface is horizontal AND 380 mm (15 in) or less from the ground.

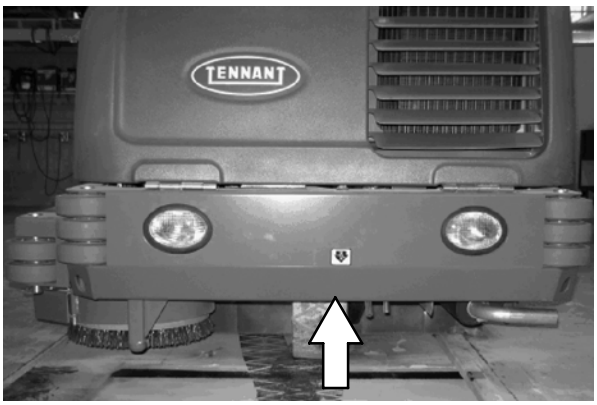
MACHINE JACKING

Empty the hopper, recovery tank, and solution tank before jacking up the machine. Jack up the machine at the designated locations. Use a hoist or jack capable of supporting the weight of the machine. Use jackstands to support the machine. Always stop the machine on a flat, level surface and block the tires before jacking up the machine.

Rear jacking locations are located directly behind the rear tires on each side of the machine.



Front jacking locations are located on the frame directly in front of the front tire.



FOR SAFETY: Before leaving or servicing machine, stop on level surface.

FOR SAFETY: When servicing machine, block machine tires before jacking machine up. Use a hoist or jack that will support the weight of the machine. Jack machine up at designated locations only. Support machine with jack stands.

STORAGE INFORMATION

The following steps should be taken prior to storing the machine for extended periods.

1. Drain and clean the solution and recovery tanks. Open the recovery tank and solution tank covers to allow the air to circulate.
2. Park the machine in a cool, dry area. Do not expose the machine to rain. Store indoors.
3. Remove the battery, or charge battery every three months.

FREEZE PROTECTION

FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, and turn off machine.

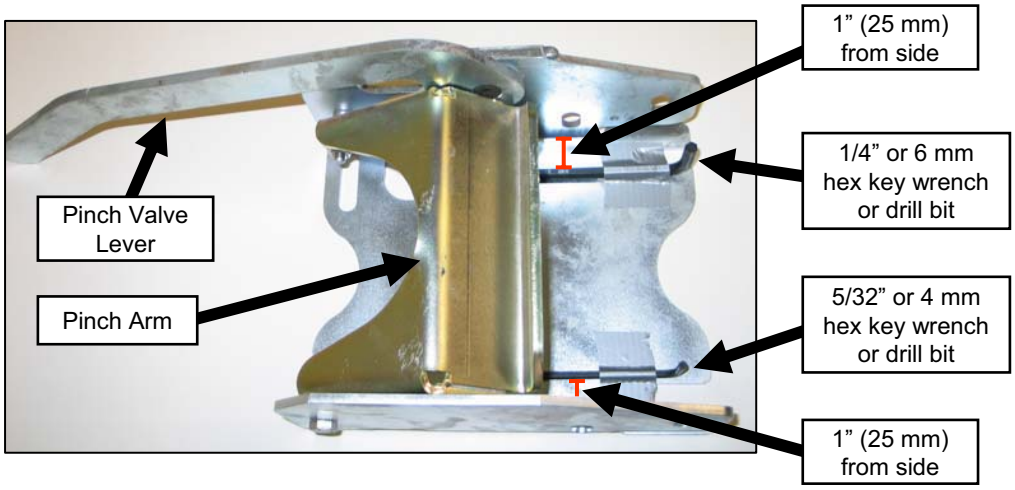
1. Be sure the solution tank and recovery tank are empty.
2. Pour 3.8 L (1 gal) of premixed automotive windshield washer solution into the solution tank.
3. Turn the key to the on position **(without starting the machine)**.
4. Press the *1-STEP Scrub button*.
5. Repeatedly press the *Solution increase button (+)* until the solution flow is at the highest setting.
6. Press the *directional pedal* to circulate the windshield washer solution completely through the system.
7. Press the *1-STEP Scrub button* again to turn off the system and turn the key to the off position.
8. The remaining washer solution does not need to be drained from the solution tank.

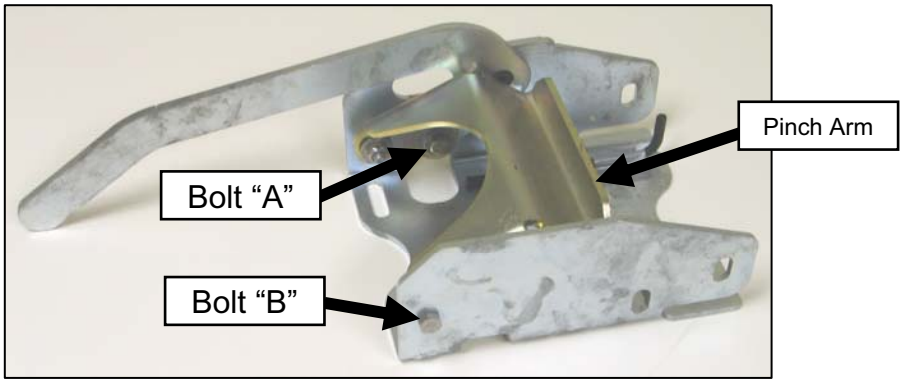
NOTE: Storing or transporting machines equipped with the ES or the FaST system in freezing temperatures requires special procedures. Consult a TENNANT representative for more information.

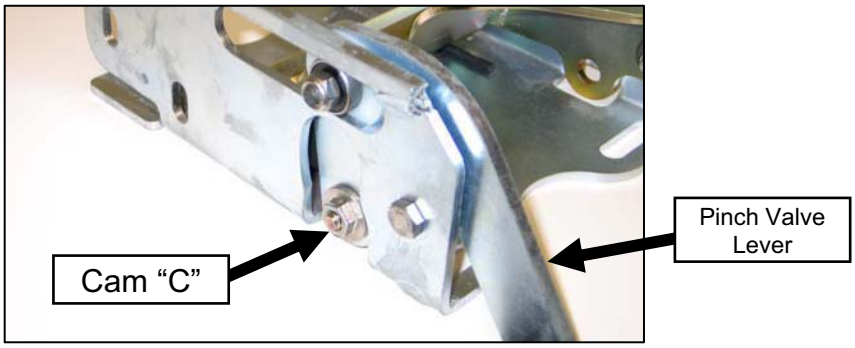
Solution & Recovery Tanks Pinch Valve Adjustments

Procedure to adjust Solution & Recovery Tank pinch valves:

1) Place a 1/4” or 6 mm hex key wrench or drill bit approximately 1” (25 mm) from the **LEVER** side of the pinch valve bracket. Secure with tape.
2) Place a 5/32” or 4 mm hex key wrench or drill bit approximately 1” (25 mm) from the **NON-LEVER** side of the pinch valve bracket. Secure with tape.
3) Loosen bolts “A” and “B”.
4) Apply downward pressure to Pinch Arm.
5) Turn cam “C” on Pinch Valve Lever until contact is made with the 1/4” or 6 mm hex key wrench or drill bit.
6) While keeping downward pressure on the Pinch Arm, ensure that contact is made with the 5/32” or 4 mm hex key wrench or drill bit on the **NON-LEVER** side.
7) Tighten bolts “A” & “B”.
8) Verify proper clearances have been attained. Repeat procedure if needed.







M

ELECTRICAL

Troubleshooting Information

BEFORE CONDUCTING TESTS:

*** Read and Follow ALL Safety Warnings and Precautions as mentioned at the beginning of this manual**

*** Always use an ESD (Electrostatic Discharge) strap when working near the Control Board**

*** Be cautious when working near Control Board – *Battery voltage is always present, even with Key OFF***

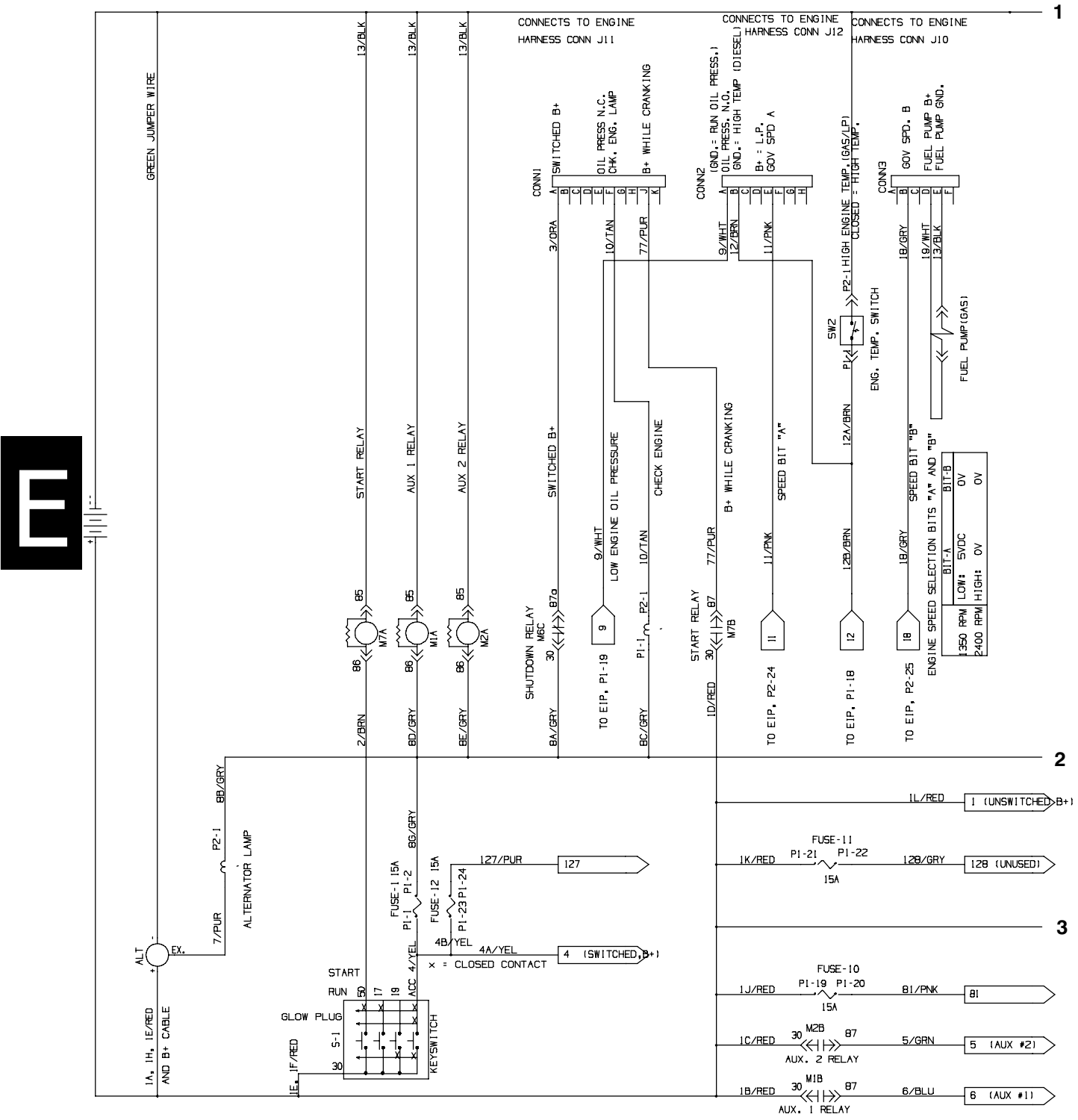
*** Always unhook Battery when removing or replacing components**

DURING TESTS:

*** Call Technical Services if Diagnostic Time Exceeds One Hour With Unknown Cause or Course of Action**

NOTE: Troubleshooting charts may be shown with optional equipment. The optional equipment may not be specified in these charts. Some machines may not be equipped with all components shown.

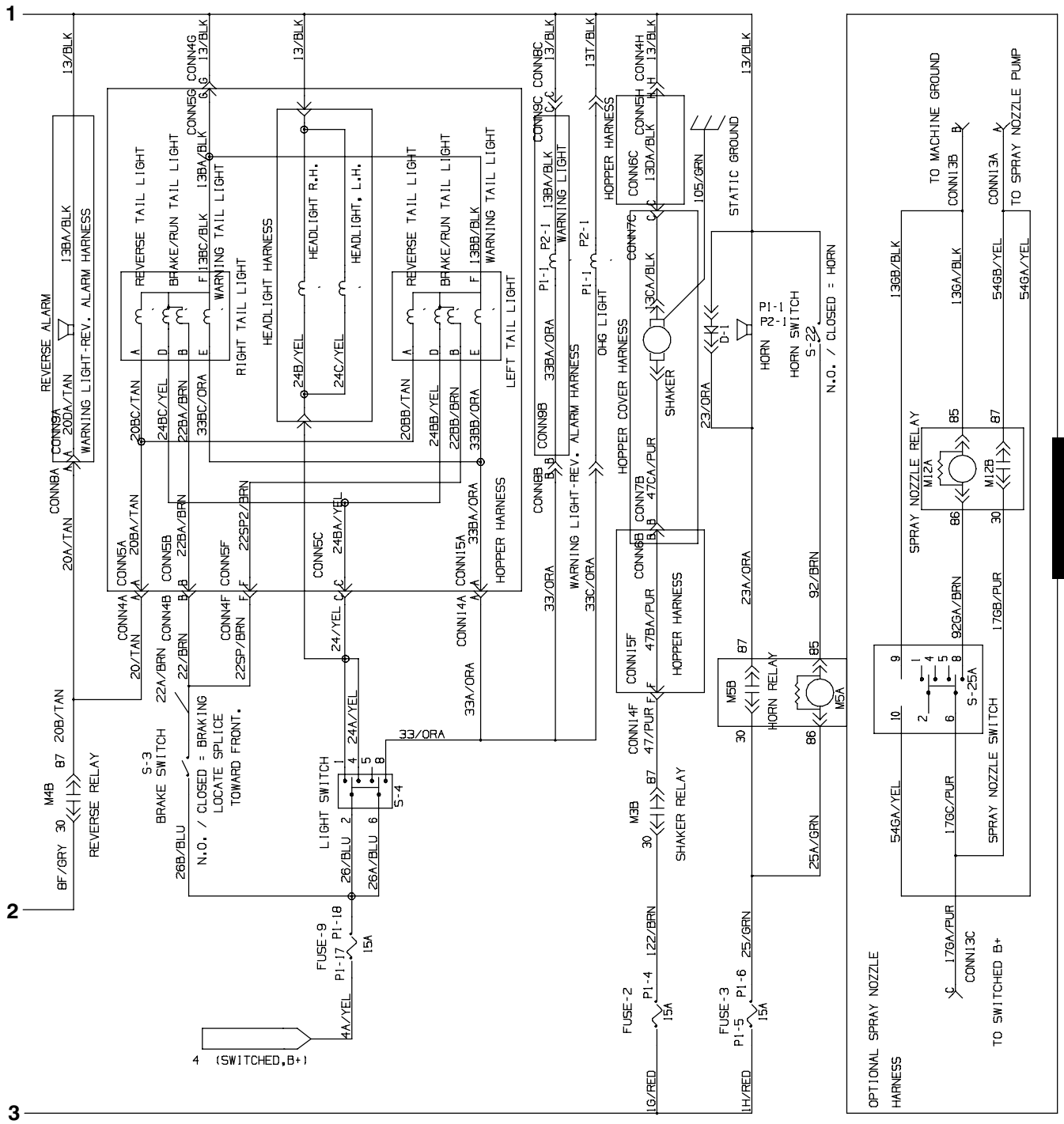
M20 Electrical Schematic



1018547

NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

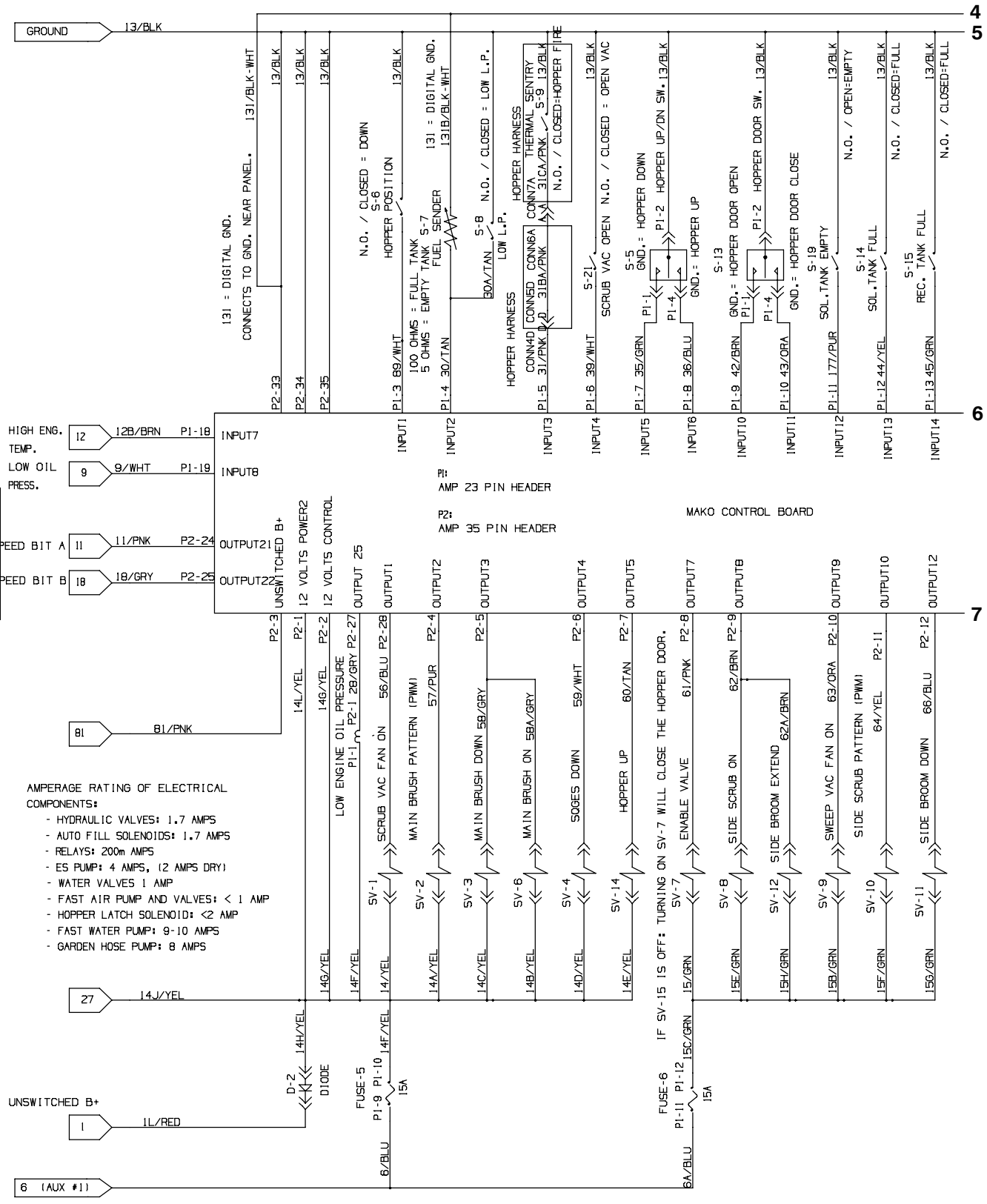
M20 Electrical Schematic



1018547

NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

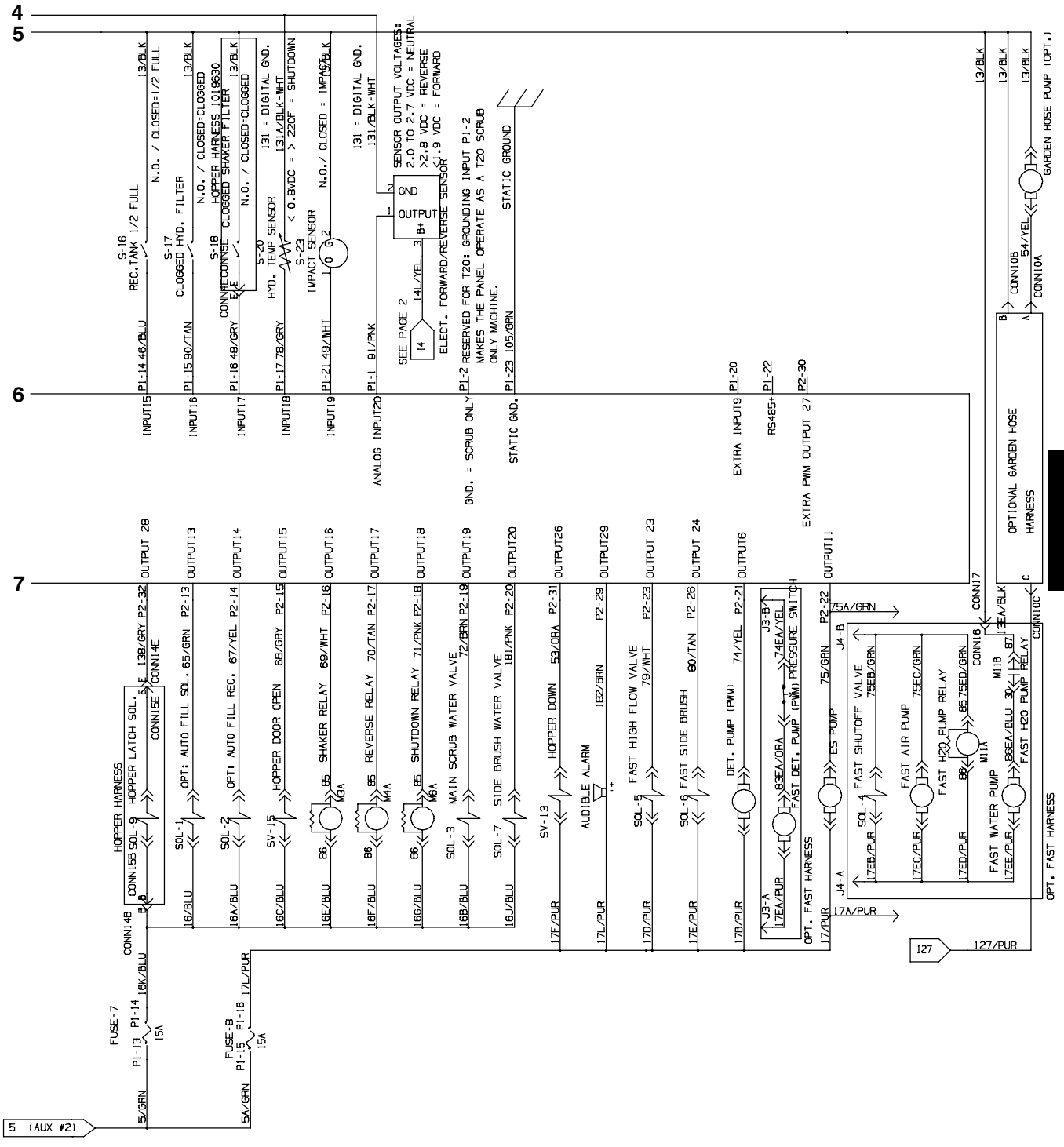
M20 Electrical Schematic



1018547

NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

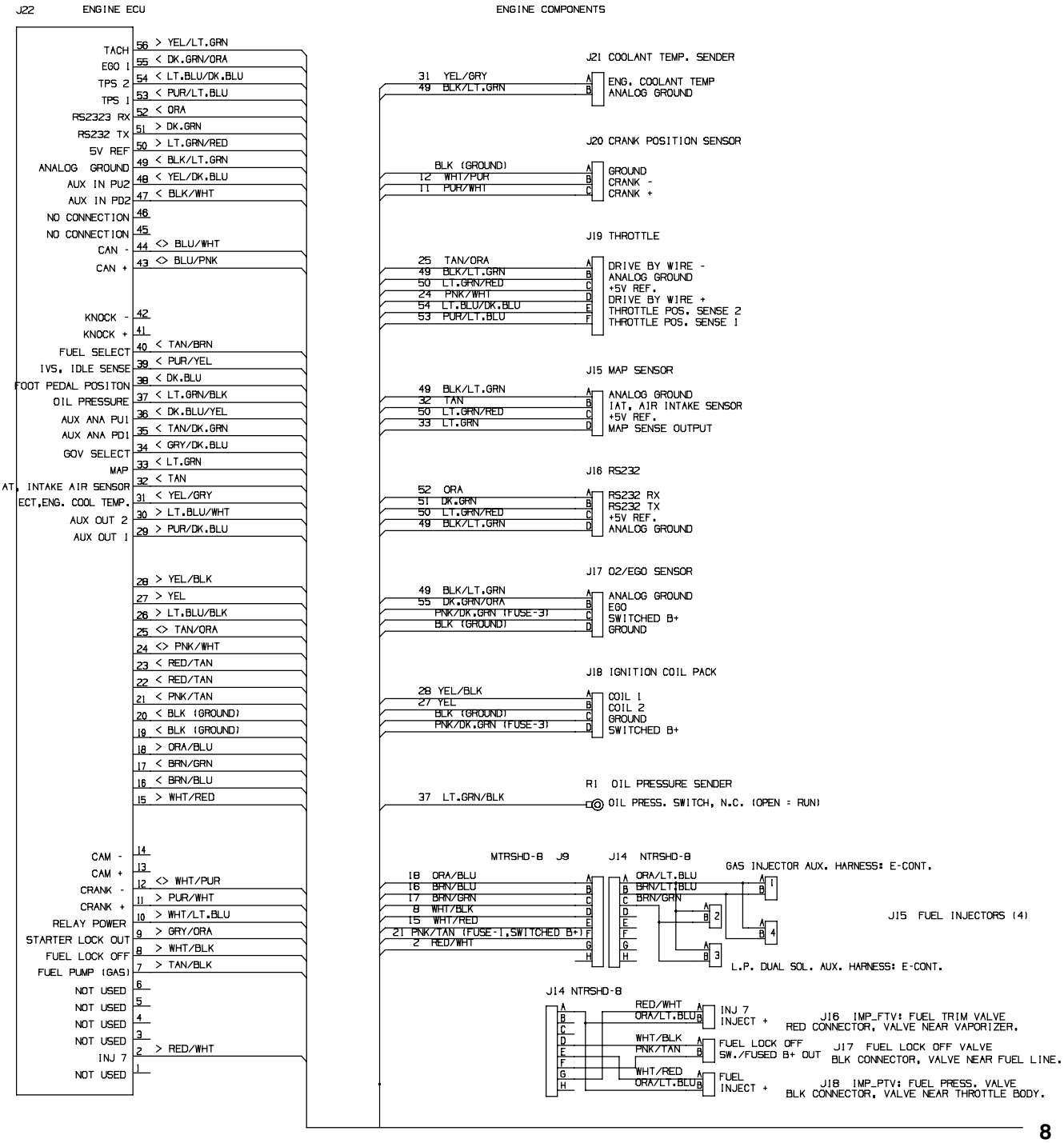
M20 Electrical Schematic



1018547

NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

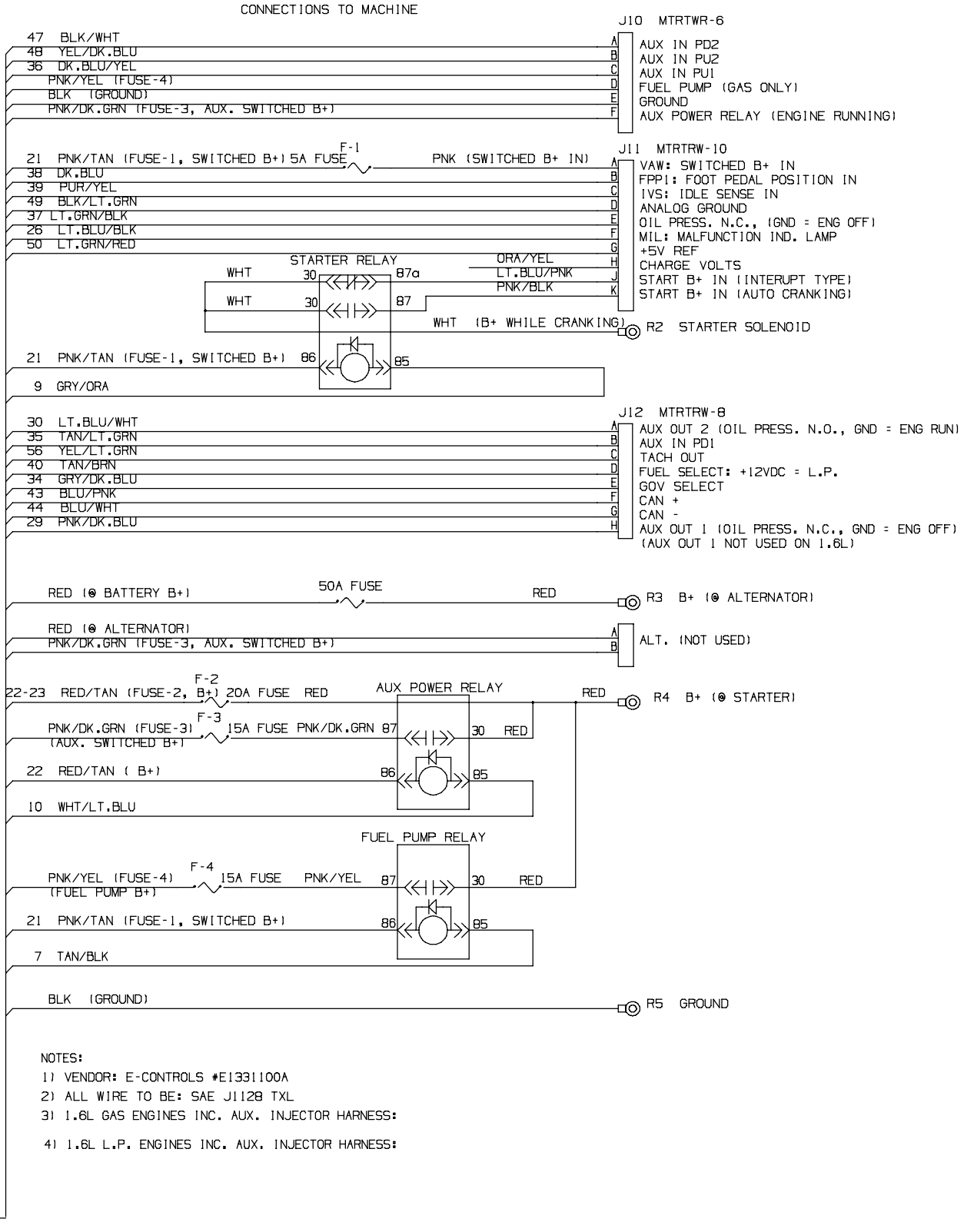
M20 Electrical Schematic (Gas/LPG only)



1018547

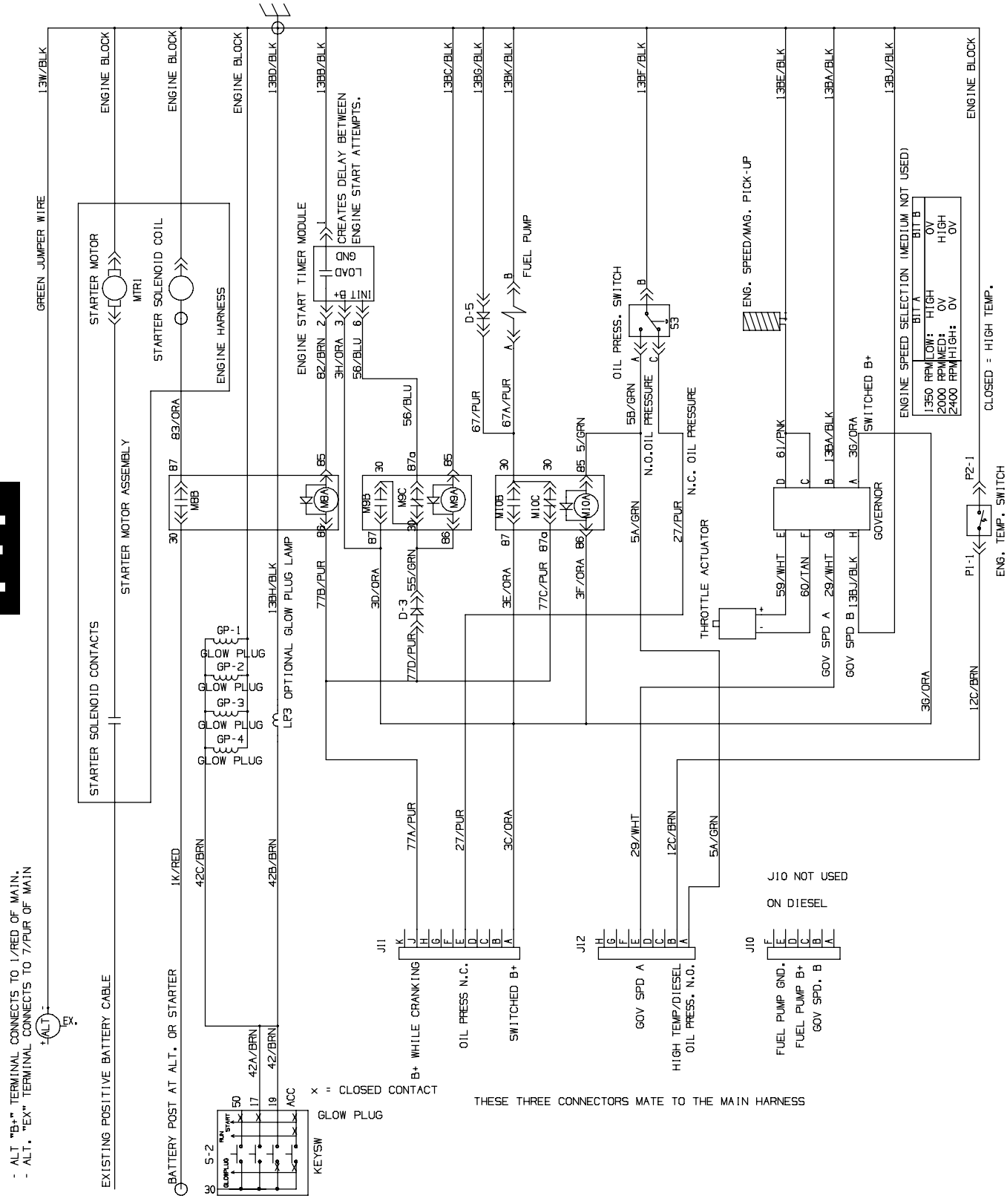
NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

M20 Electrical Schematic (Gas/LPG only)



NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

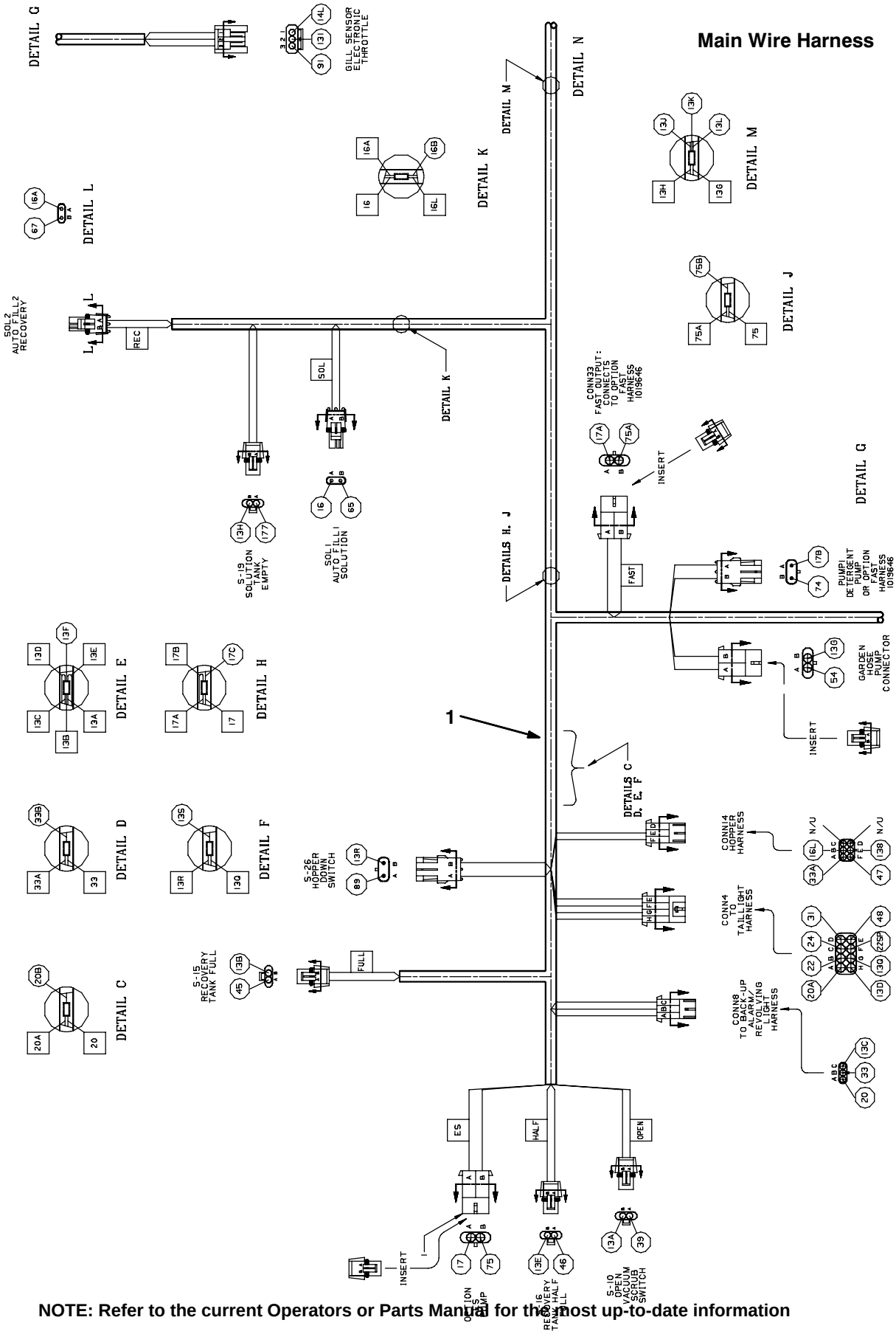
M20 Electrical Schematic (Diesel only)



1018547

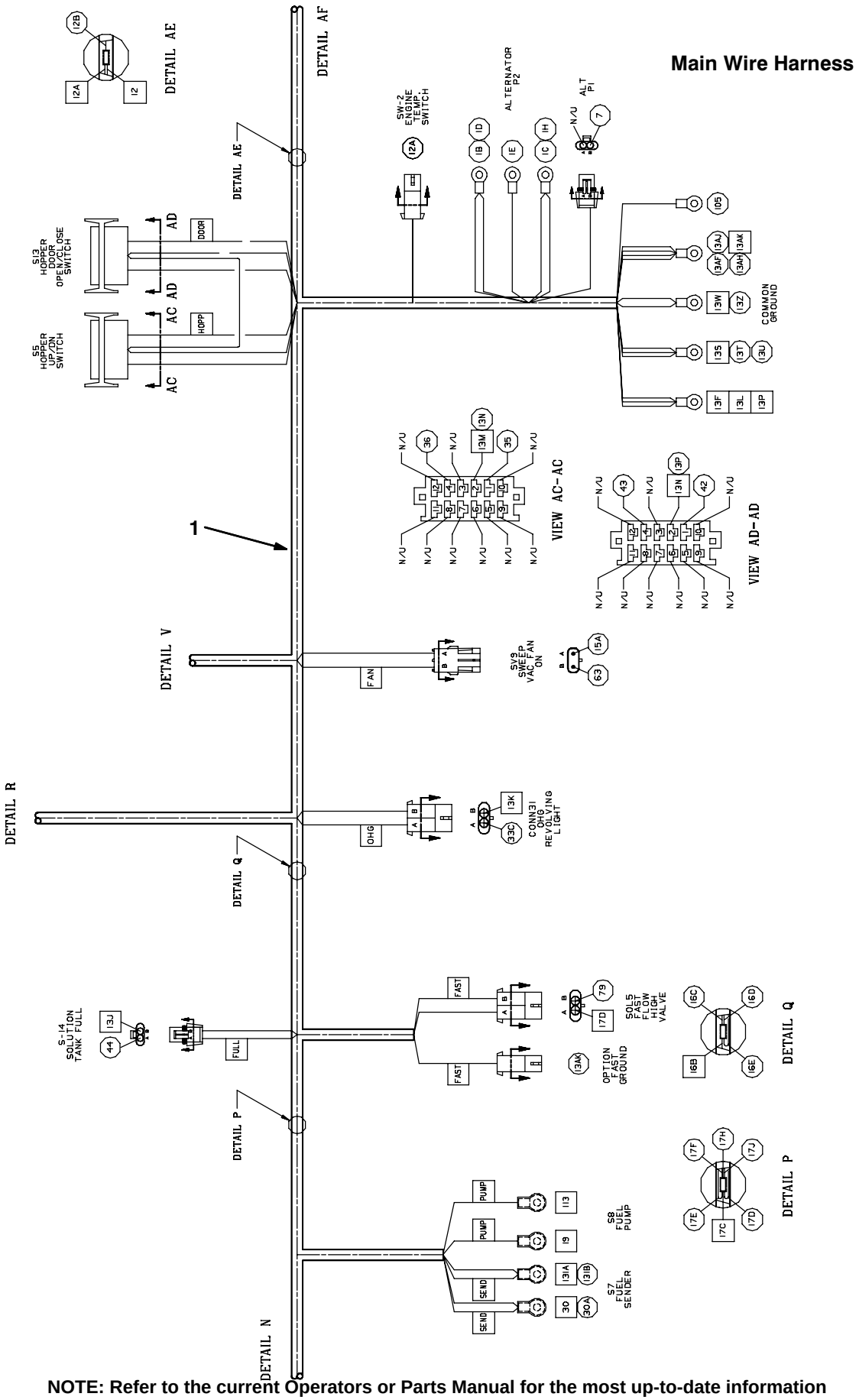
NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

M20 Electrical Wiring Harness Detail



NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

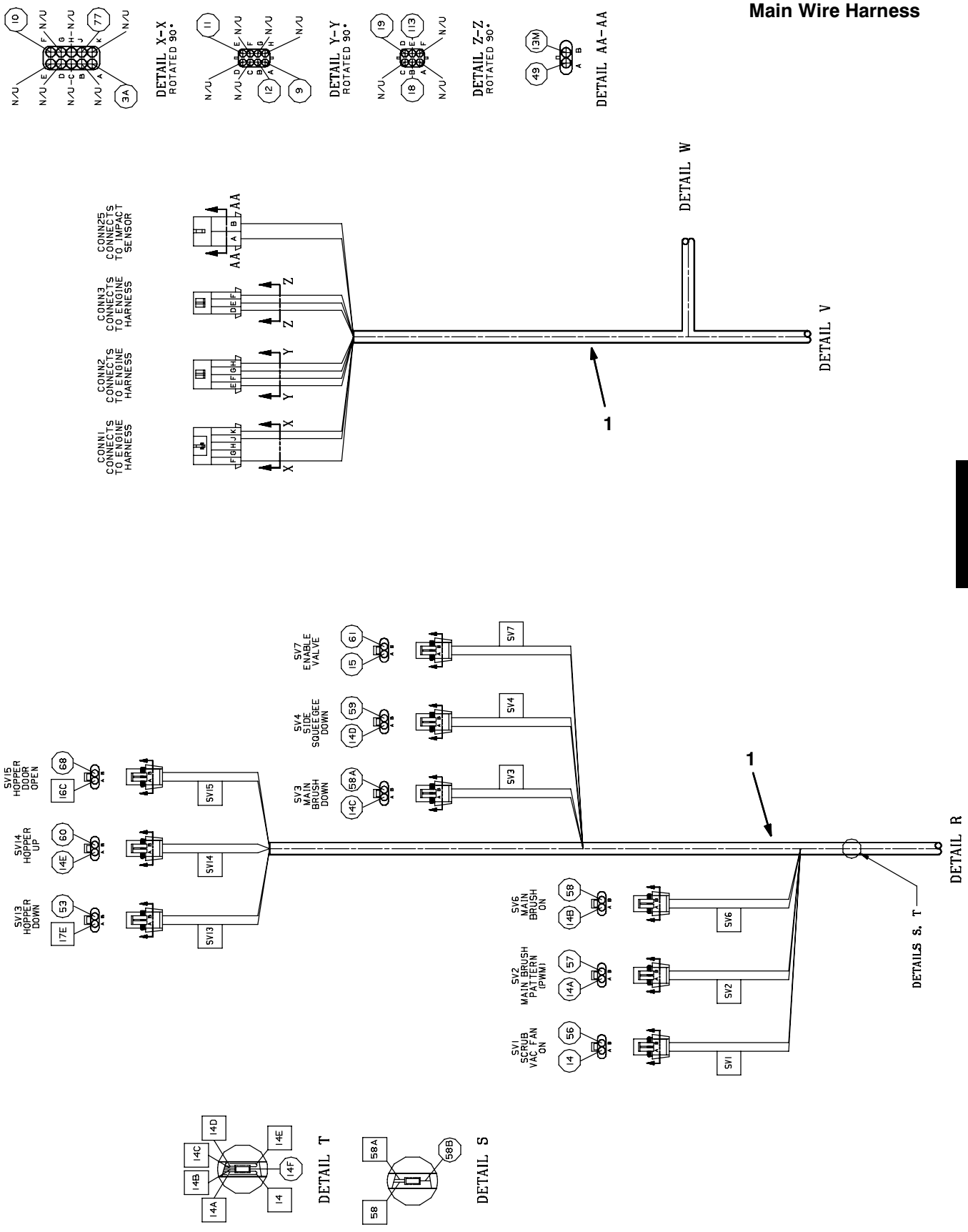
M20 Electrical Wiring Harness Detail



NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

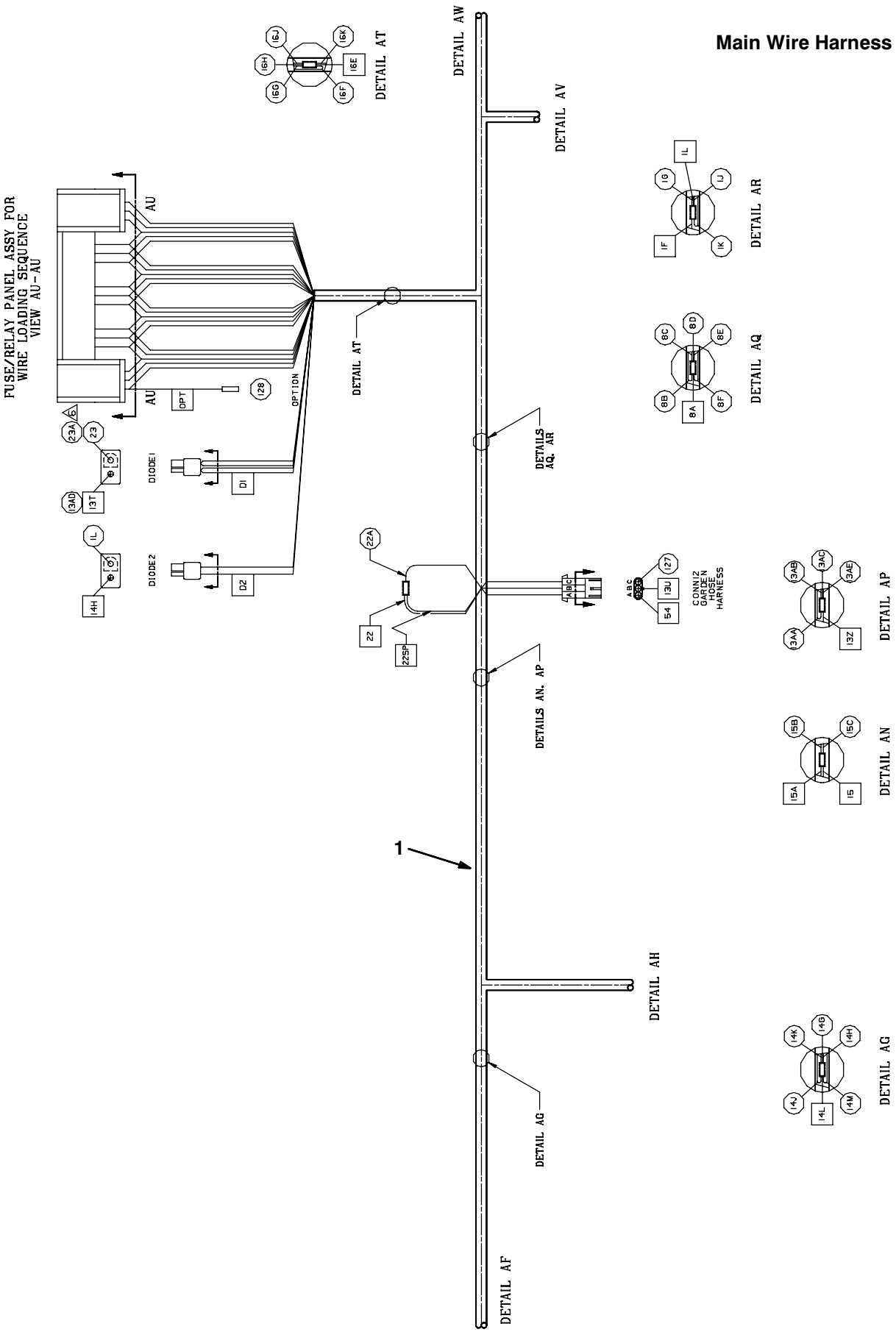
M20 Electrical Wiring Harness Detail

Main Wire Harness



NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

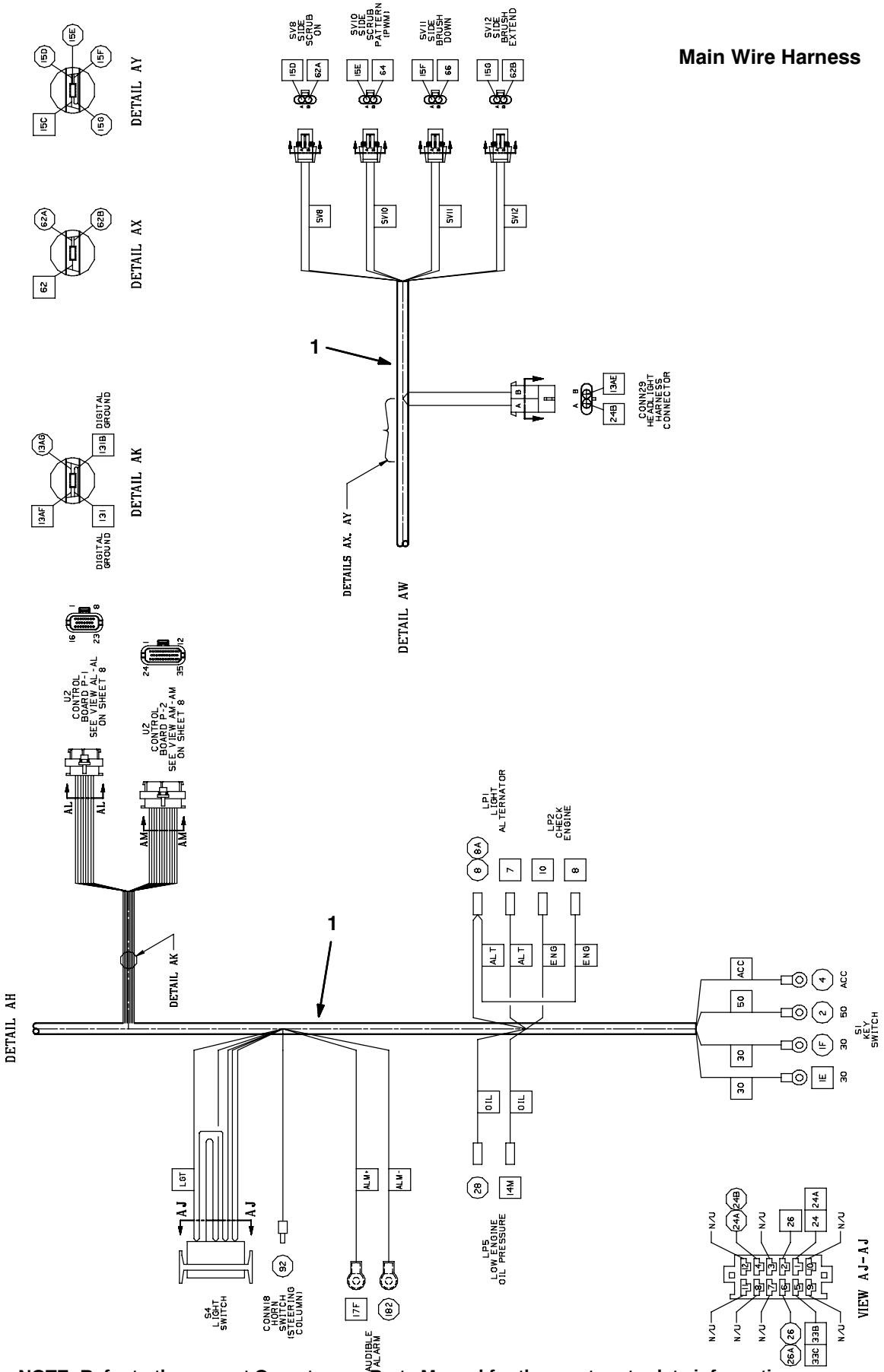
M20 Electrical Wiring Harness Detail



NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

M20 Electrical Wiring Harness Detail

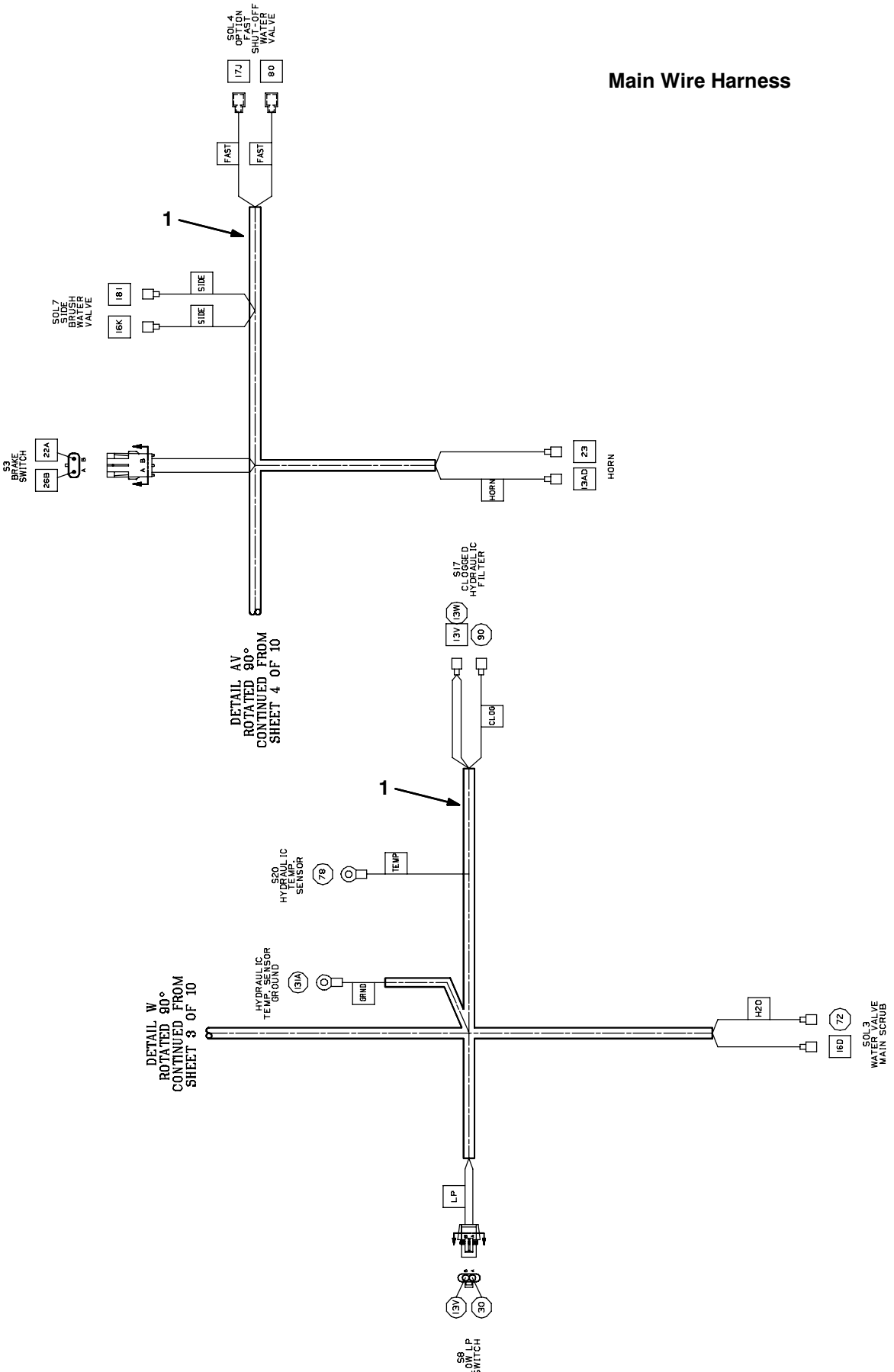
Main Wire Harness



NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

M20 Electrical Wiring Harness Detail

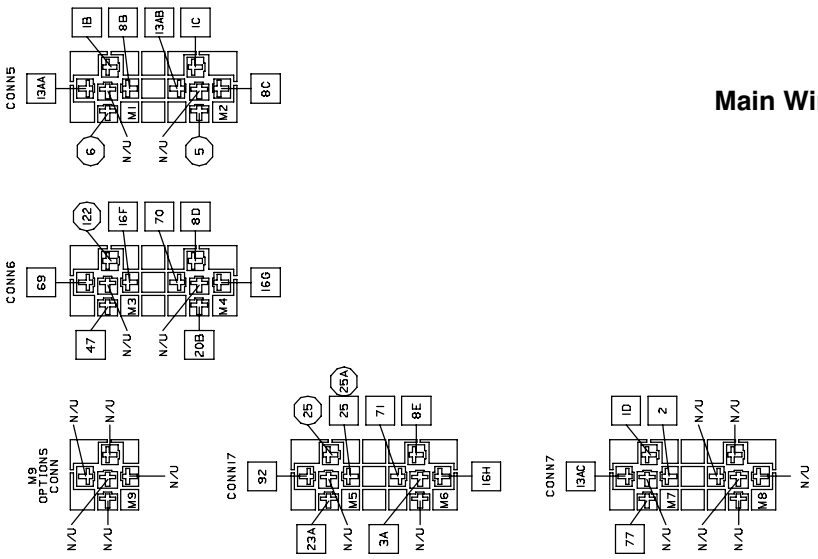
Main Wire Harness

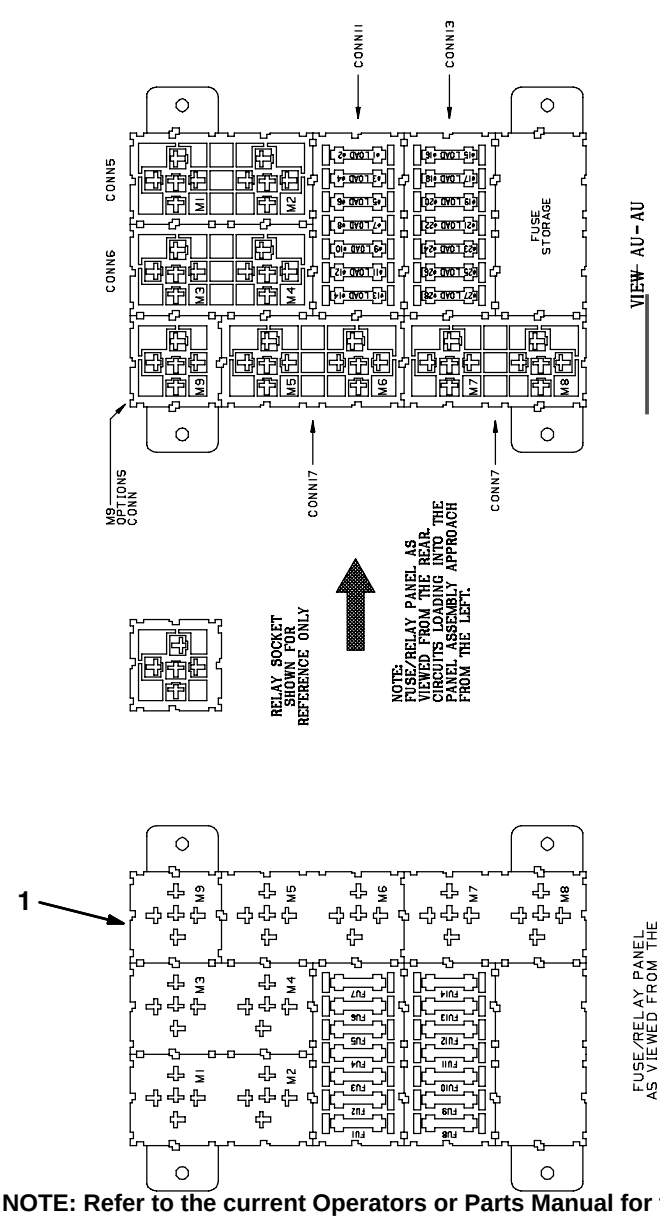


NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

M20 Electrical Wiring Harness Detail

Main Wire Harness





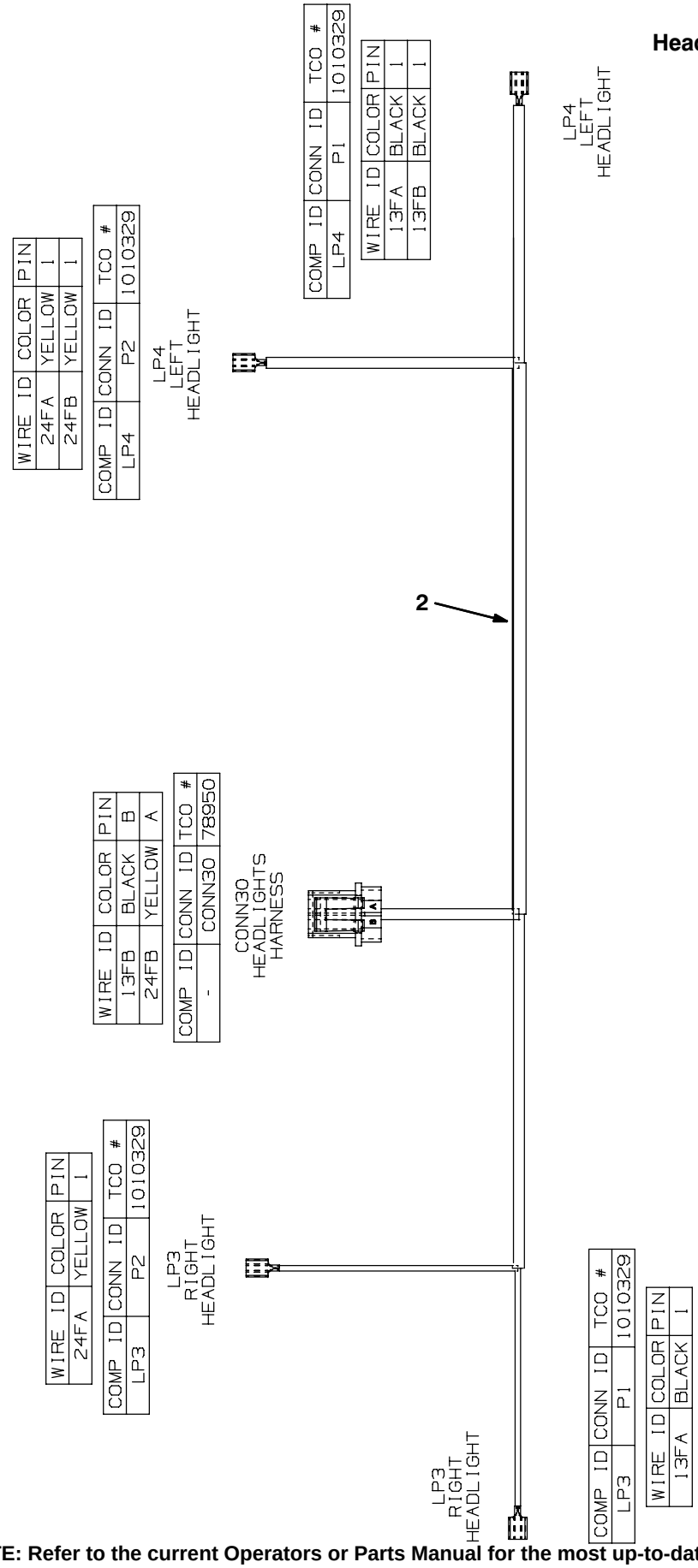
FUSE PANEL ASSEMBLY WIRING

	CONN11 PIN POSITION	CONN11 TERMINAL LOADING BOTTOM HALF	CONN11 PIN POSITION	CONN11 TERMINAL LOADING TOP HALF
FUSE 1	1	□ 4 & ○ 4A	2	□ 8F
FUSE 2	3	□ 1G	4	□ 122
FUSE 3	5	□ 1H	6	□ 25A
FUSE 4	7	✕ N/U	8	✕ N/U
FUSE 5	9	□ □ 6 & ○ 6A	10	✕ 14F & □ 14G
FUSE 6	11	□ 6A	12	□ □ 15B
FUSE 7	13	□ □ 5 & ○ 5A	14	□ □ 16J
	CONN13 PIN POSITION	CONN13 TERMINAL LOADING BOTTOM HALF	CONN13 PIN POSITION	CONN13 TERMINAL LOADING TOP HALF
FUSE 8	15	□ 5A	16	□ 17H
FUSE 9	17	□ 4A & ○ 4C	18	□ □ 26A & ○ 26B
FUSE 10	19	□ 1J	20	□ 81
FUSE 11	21	□ 1K	22	□ 128
FUSE 12	23	□ 4C	24	□ 127
FUSE 13	25	✕ N/U	26	✕ N/U
FUSE 14	27	✕ N/U	28	✕ N/U

NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

M20 Electrical Wiring Harness Detail

Headlight Wire Harness



WIRE ID	COLOR	PIN
24FA	YELLOW	1
24FB	YELLOW	1

COMP ID	CONN ID	TCO #
LP4	P2	1010329

COMP ID	CONN ID	TCO #
LP4	P1	1010329

WIRE ID	COLOR	PIN
13FA	BLACK	1
13FB	BLACK	1

WIRE ID	COLOR	PIN
13FB	BLACK	B
24FB	YELLOW	A

COMP ID	CONN ID	TCO #
-	CONN30	78950

WIRE ID	COLOR	PIN
24FA	YELLOW	1

COMP ID	CONN ID	TCO #
LP3	P2	1010329

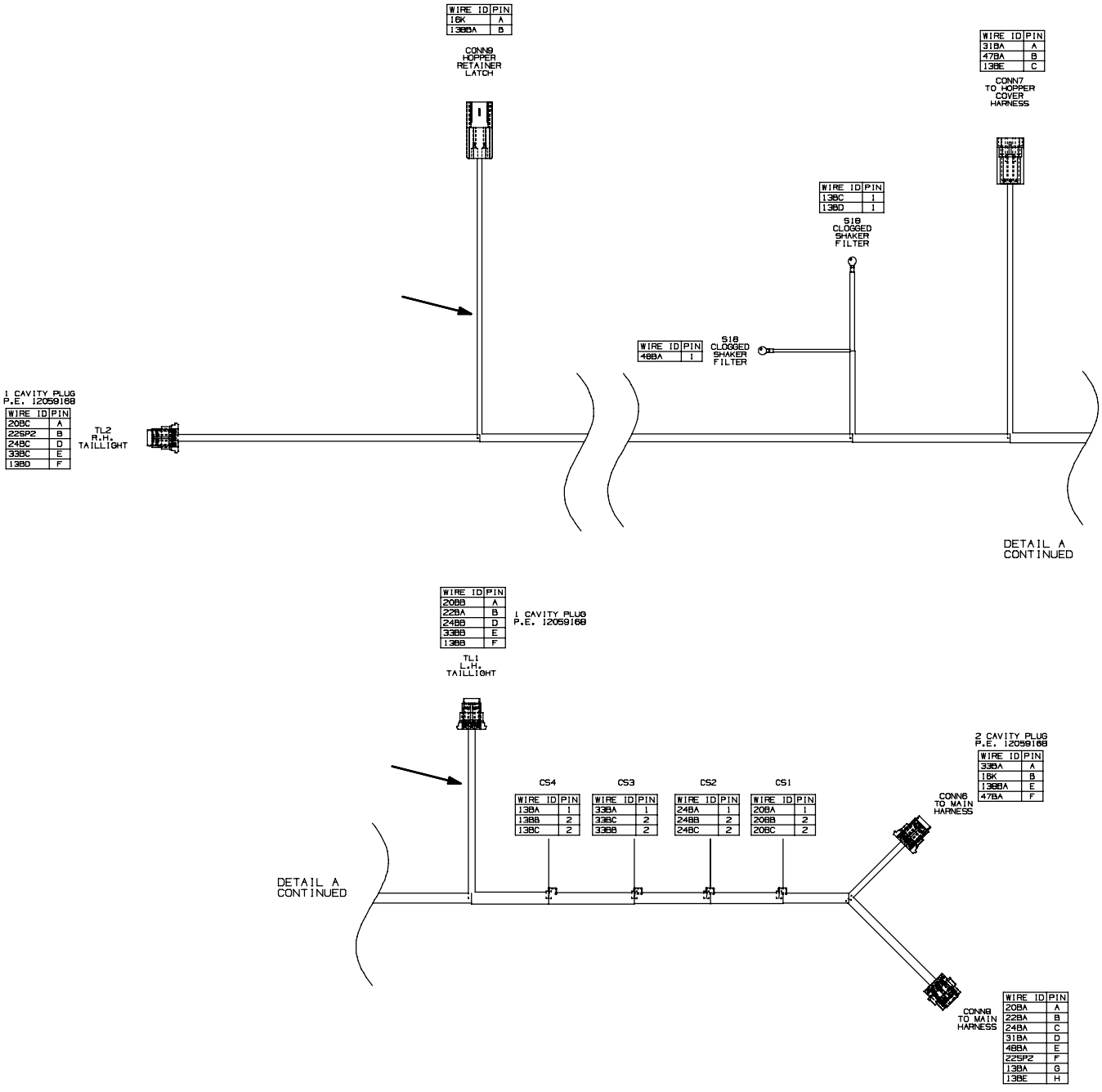
COMP ID	CONN ID	TCO #
LP3	P1	1010329

WIRE ID	COLOR	PIN
13FA	BLACK	1

NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

M20 Electrical Wiring Harness Detail

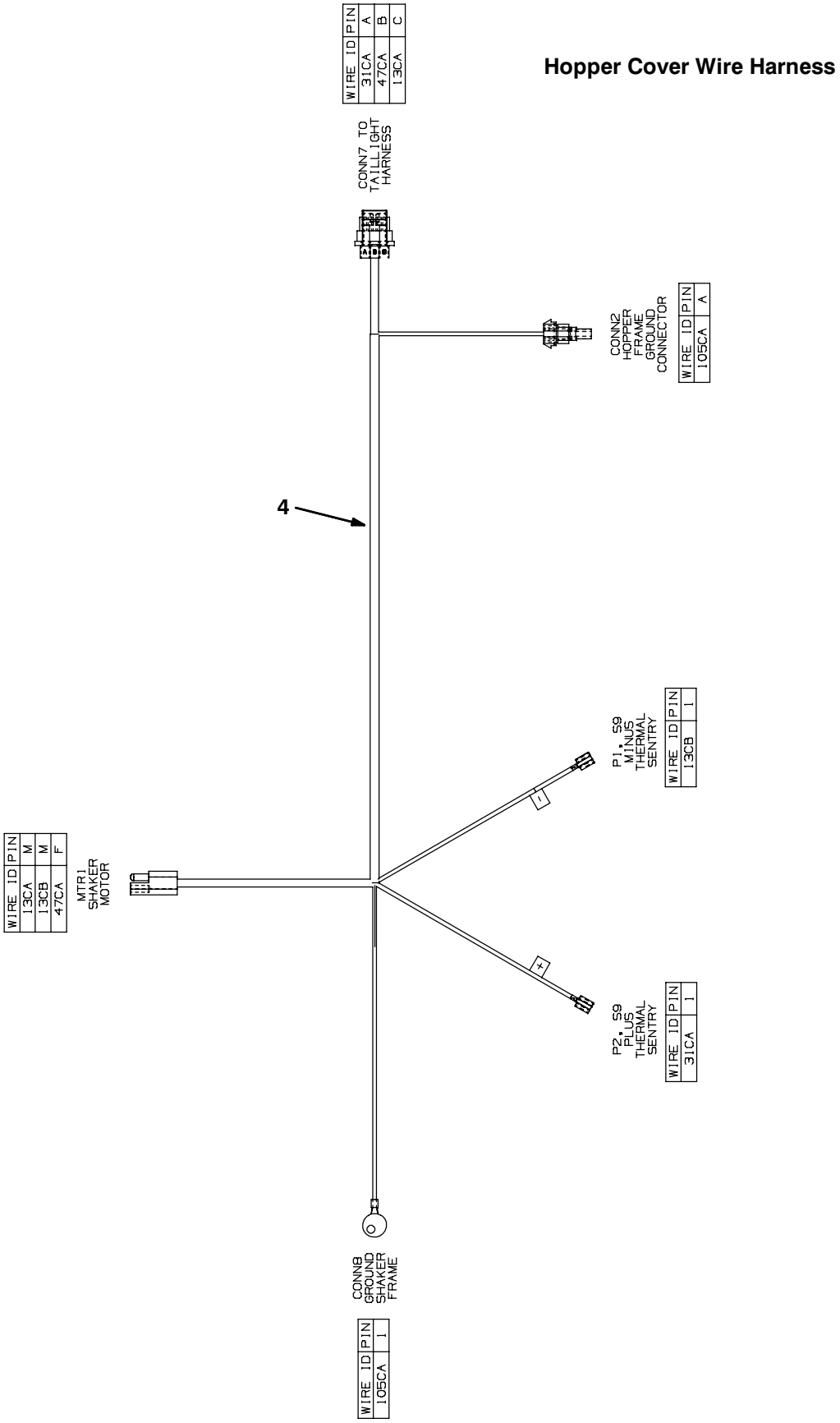
Hopper Wire Harness



NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

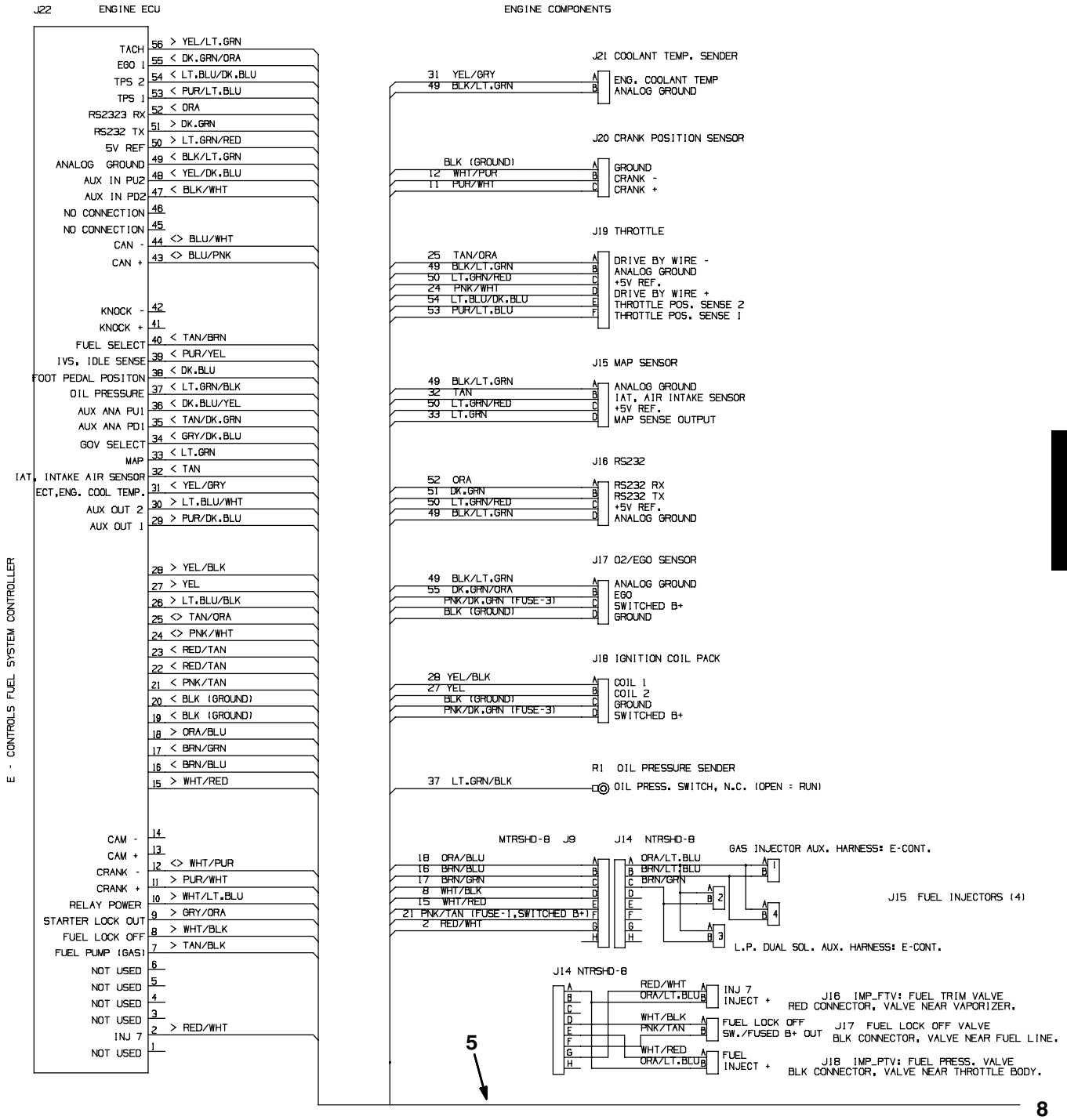
M20 Electrical Wiring Harness Detail

(Page 10 of 14)



NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

M20 Electrical Wiring Harness Detail

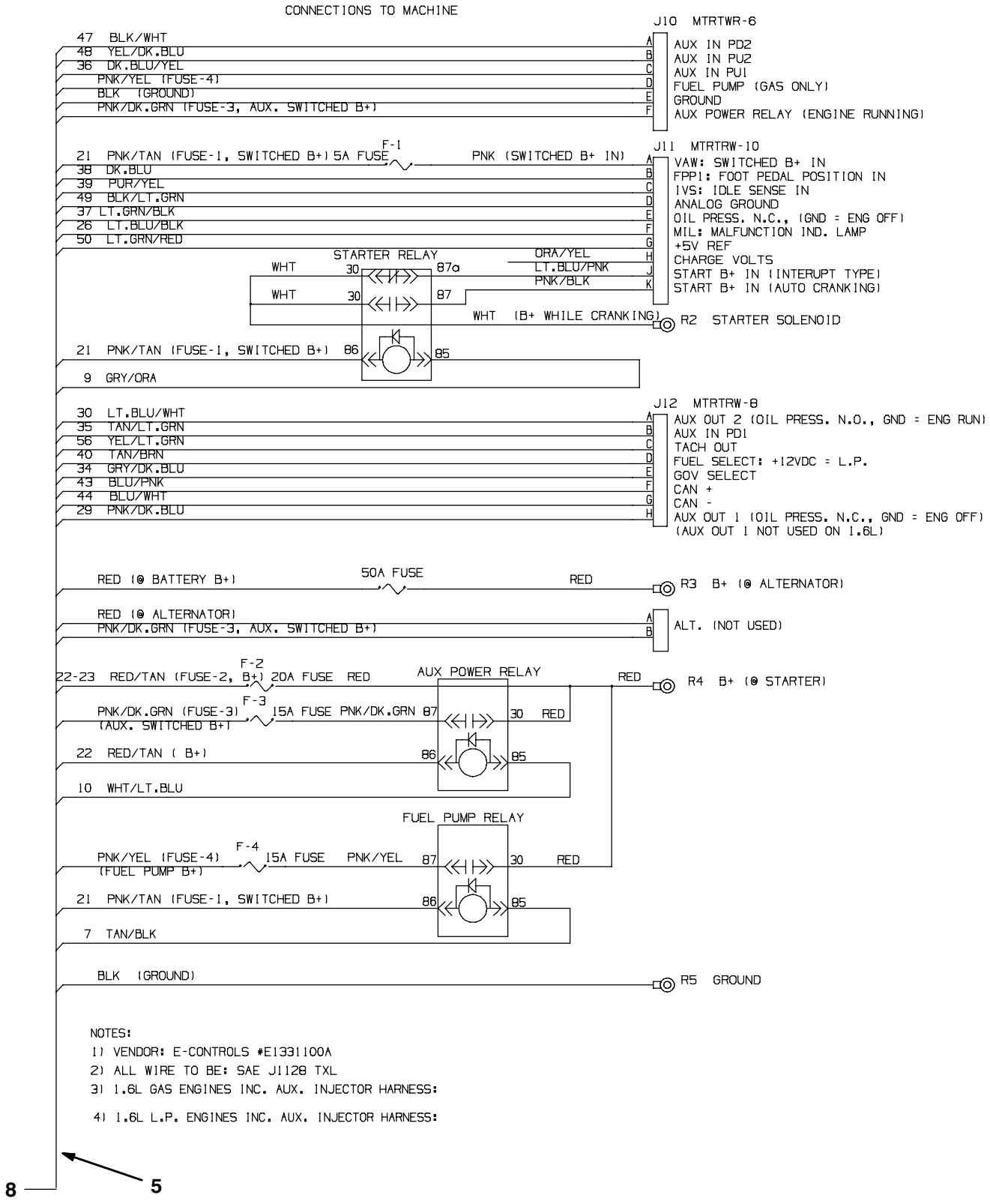


1018547

NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

M20 Electrical Wiring Harness Detail

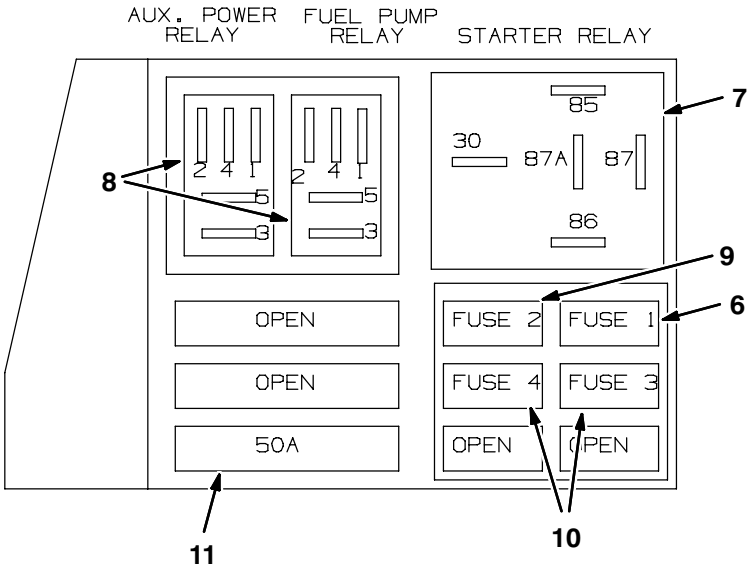
(Page 12 of 14)



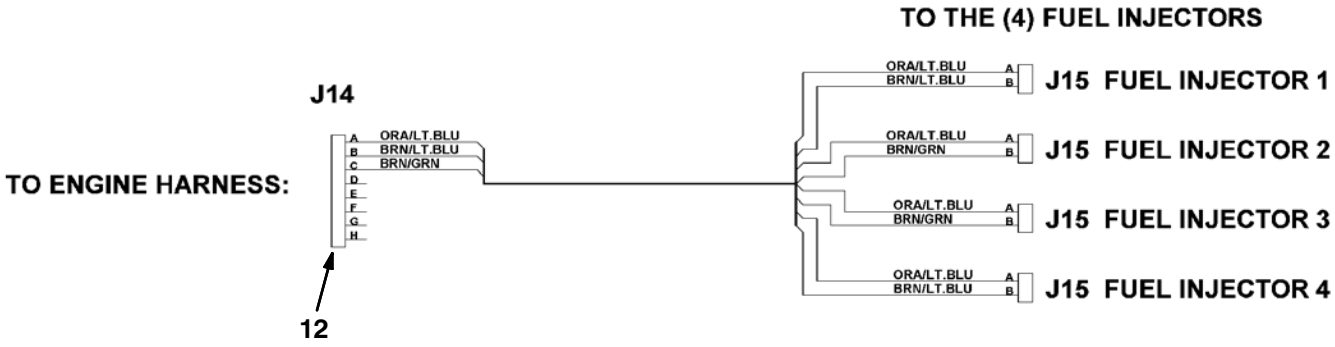
E

1018547 **NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information**

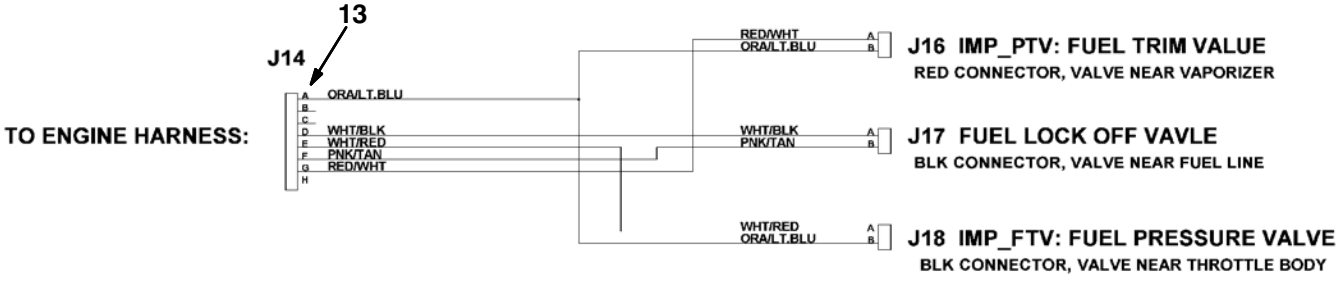
M20 Electrical Wiring Harness Detail



GAS INJECTOR AUX. HARNESS



L.P. DUAL SOL. AUX. HAENESS



NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

M20 Electrical Wiring Harness Detail

354389

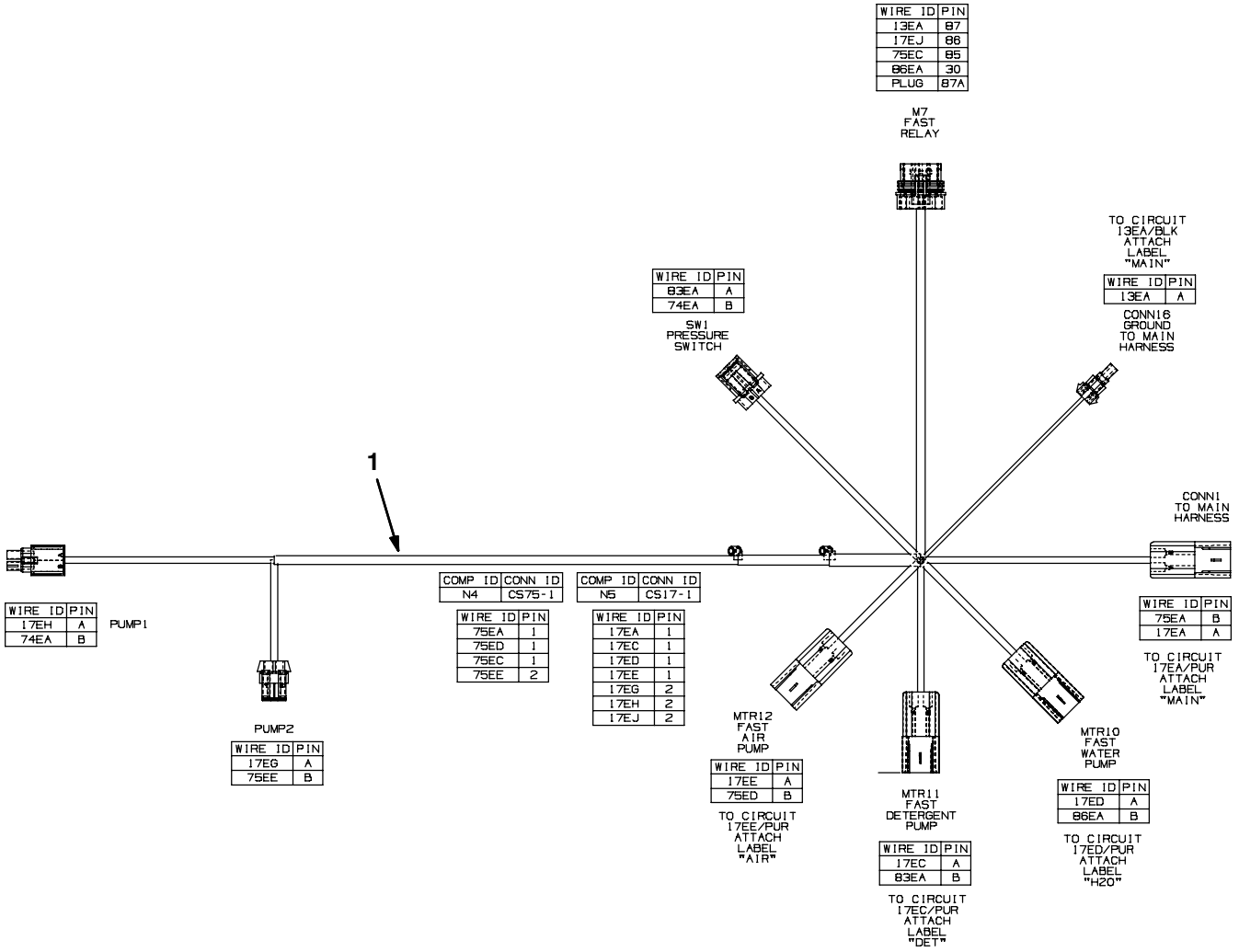
	Ref.	Serial Number	Description	Qty.
	1	(000000-)	Harness, Main [M20]	1
	2	(000000-)	Harness, Headlight [M20 And T20]	1
	3	(000000-)	Harness, Hppr [M20]	1
	4	(000000-)	Harness, Hppr, Cover [M20]	1
▽	5	(000000-)	Harness, Eng [1.6l, Gm, E-cntrl]	1
▲	6	(000000-)	Relay, 12vdc, 20a, Spdt	1
▲	7	(000000-)	Relay, 12vdc, 40a, Spdt	2
▲	8	(000000-)	Fuse, 5 Amp, [Min-5]	1
▲	9	(000000-)	Fuse, 20 Amp, [Min-20]	1
▲	10	(000000-)	Fuse, 15 Amp, [Min-15]	2
▲	11	(000000-)	Fuse, 50amp	1
	12	(000000-)	Harness, Injector, Gas [1.6l,Gm,E-cntrl]	1
	13	(000000-)	Harness, Injector, Lpg [1.6l,Gm,E-cntrl]	1

E

NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

M20 Wiring Harness Detail

Fast Wire Harness Group



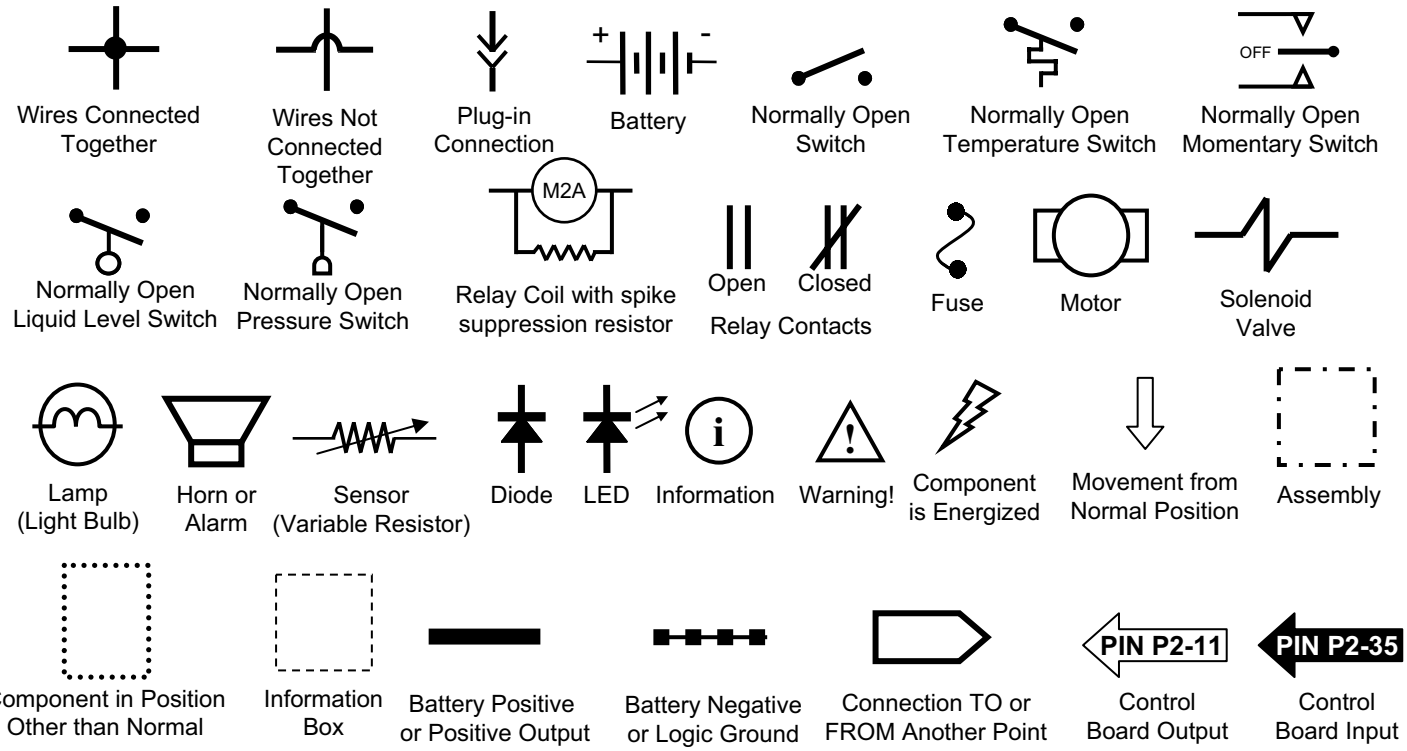
1019646

Ref.	Serial Number	Description	Qty.
1	(000000-)	Harness [Fast, M20 And T20]	1

NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

Commonly Used Electrical Symbols & Terms

NOTE: The term “NORMALLY” refers to the component’s “at rest” or “de-energized” position



E

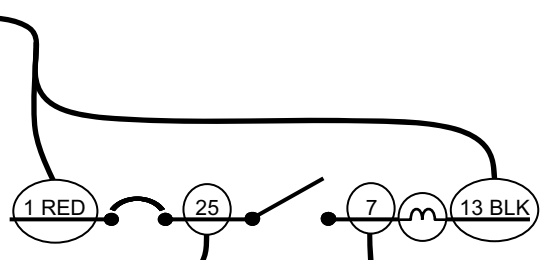
Terms & Abbreviations

ECM – Engine Control Module
LED – Light Emitting Diode
MIL – Malfunction Indicator Lamp
PWM – Pulse Width Modulation (A method of using controlled on/off times to regulate the voltage and current supplied to an electrical device)
SV – Solenoid Valve
SW – Switch

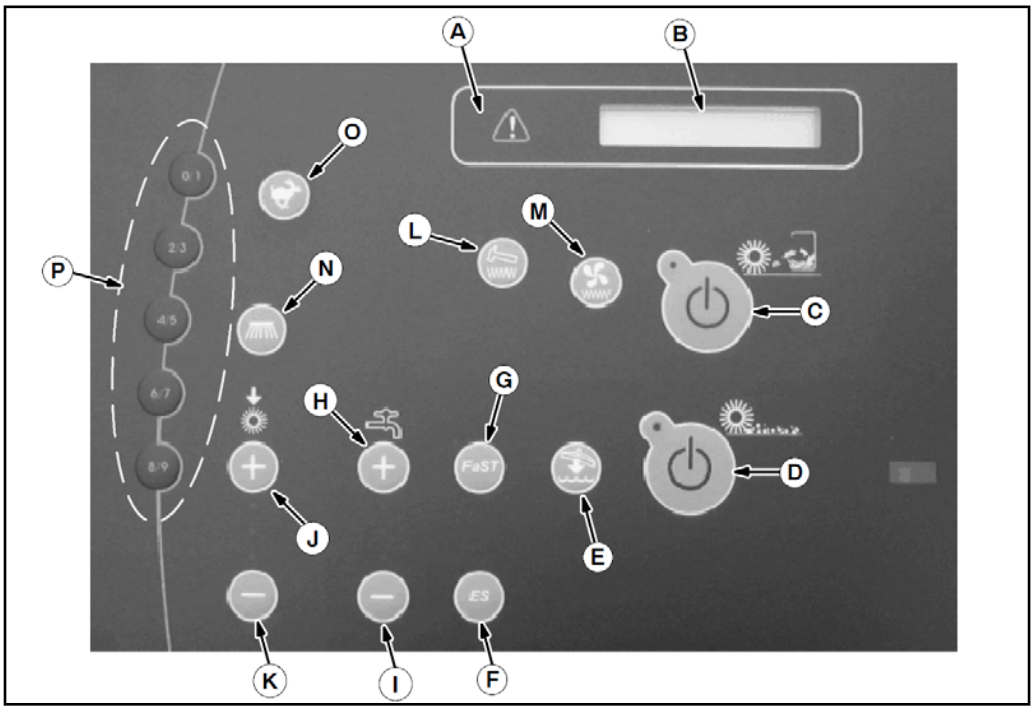
Example of Wiring Numbers & Colors:

Wiring Color Codes
(Unless otherwise marked)

Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

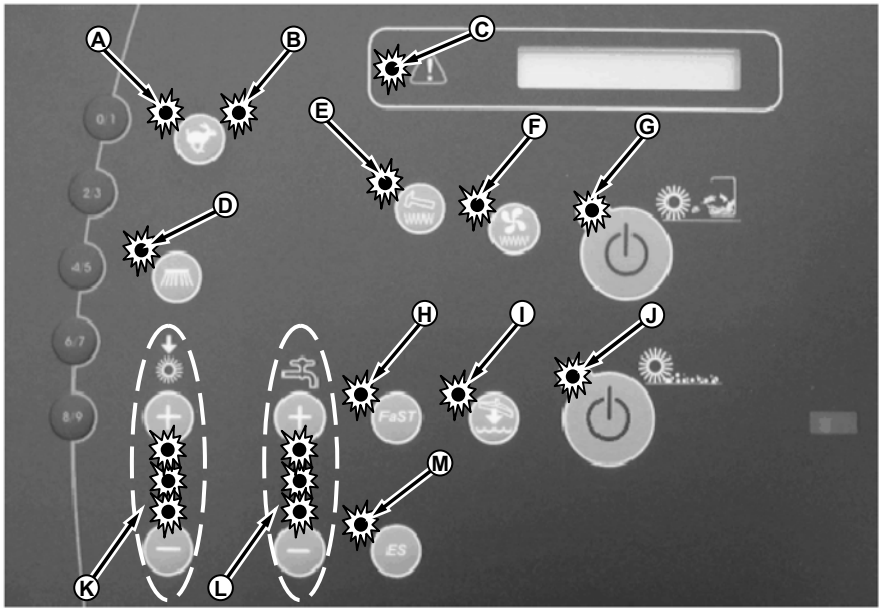


M20 Touch Panel Detail



A. **Fault indicator light**
B. **Hour meter / fuel indicator / fault code indicator**
C. **1-STEP sweep button**
D. **1-STEP scrub button**
E. **Scrub vacuum fan / squeegee button**
F. **ES (Extended Scrub) button (option)**
G. **FaST button (option)**
H. **Solution & detergent increase button (+)**
I. **Solution & detergent decrease button (-)**
J. **Brush pressure increase button (+)**
K. **Brush pressure decrease button (-)**
L. **Filter shaker button**
M. **Sweep vacuum fan button**
N. **Side brush button**
O. **Engine speed button**
P. **Supervisor control buttons**

M20 Touch Panel LED's Detail



A. **Low Engine Speed Indicator**
B. **High Engine Speed Indicator**
C. **Fault/Condition Indicator**
D. **Side Brush ON Indicator**
E. **Filter Shaker ON Indicator**
F. **Sweeping Vacuum Fan ON Indicator**
G. **1-STEP Sweep ON Indicator**
H. **FaST System ON Indicator**
I. **Scrubbing Vacuum Fan ON & Squeegee System ON Indicator**
J. **1-STEP Scrub ON Indicator**
K. **Brush Pressure Indicators** (1 LED=Low, 2 LED's=Medium, 3 LED's=High)
L. **Solution Volume Indicators** (1 LED=Low, 2 LED's=Medium, 3 LED's=High)
M. **ES (Extended Scrub) System ON Indicator**

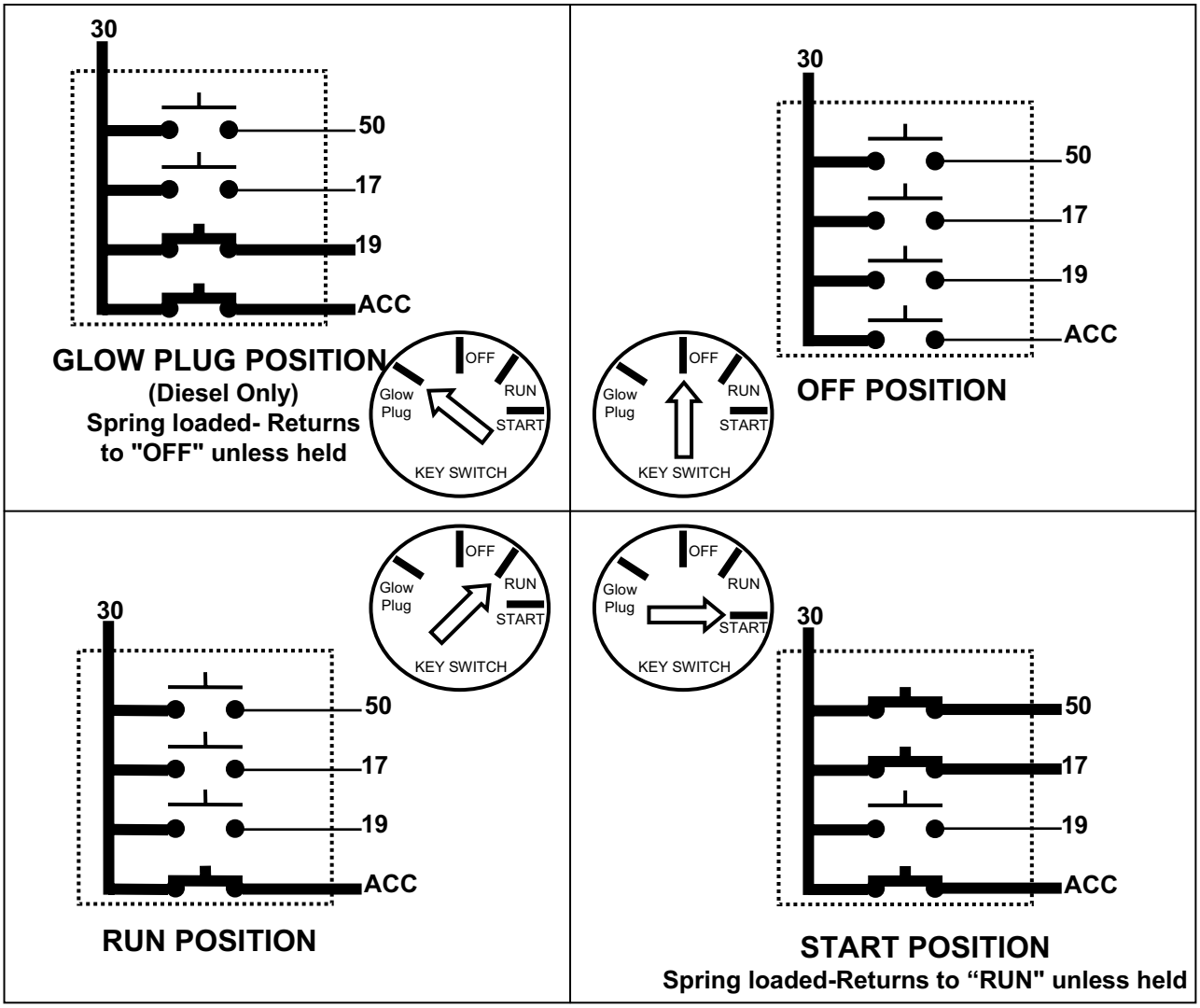
M20 Option Components

The following chart lists various options and the electrical and/or hydraulic components that are associated with the option. Refer to the “notes” section for any components that are deleted from a standard machine in order to have the installed option.

option	added components	E or H	component #	notes
Side Brush	Side Brush ON Solenoid Valve	E,H	SV-8	
	Side Brush Pressure Solenoid Valve	E,H	SV-10	
	Side Brush Down Solenoid Valve	E,H	SV-11	
	Side Brush Extend Solenoid Valve	E,H	SV-12	
	FaST Side Brush Valve	E	SOL-6	
	Side Brush Water Valve	E	SOL-7	
	Side Brush Manifold	H	x	
	Side Brush Lift Cylinder	H	x	
	Side Brush Extend Cylinder	H	x	
	Side Brush Motor	H	x	
ES (Extended Scrub)	Solution Tank Auto Fill Water Valve	E	SOL-1	If machine has ES option, the following components will ***not*** be on the machine: FaST Water Pump, FaST Water Pump Relay (M11), FaST Detergent Pump, FaST Air Pump, FaST Enable Valve (SOL-4), FaST High Flow Valve (SOL-5), FaST Side Brush Valve (SOL-6)
	Recovery Tank Auto Fill Water Valve	E	SOL-2	
	Solution Tank Full Switch	E	S-14	
	Recovery Tank Half Full Switch	E	S-16	
	Detergent Pump	E	x	
	ES Pump	E	x	
Spray Hose	Spray Hose Pump	E	x	
	Spray Hose Relay	E	M12	
	Spray Hose Switch	E	S-25	

E = Electrical Component
H = Hydraulic Component

M20 Key Switch



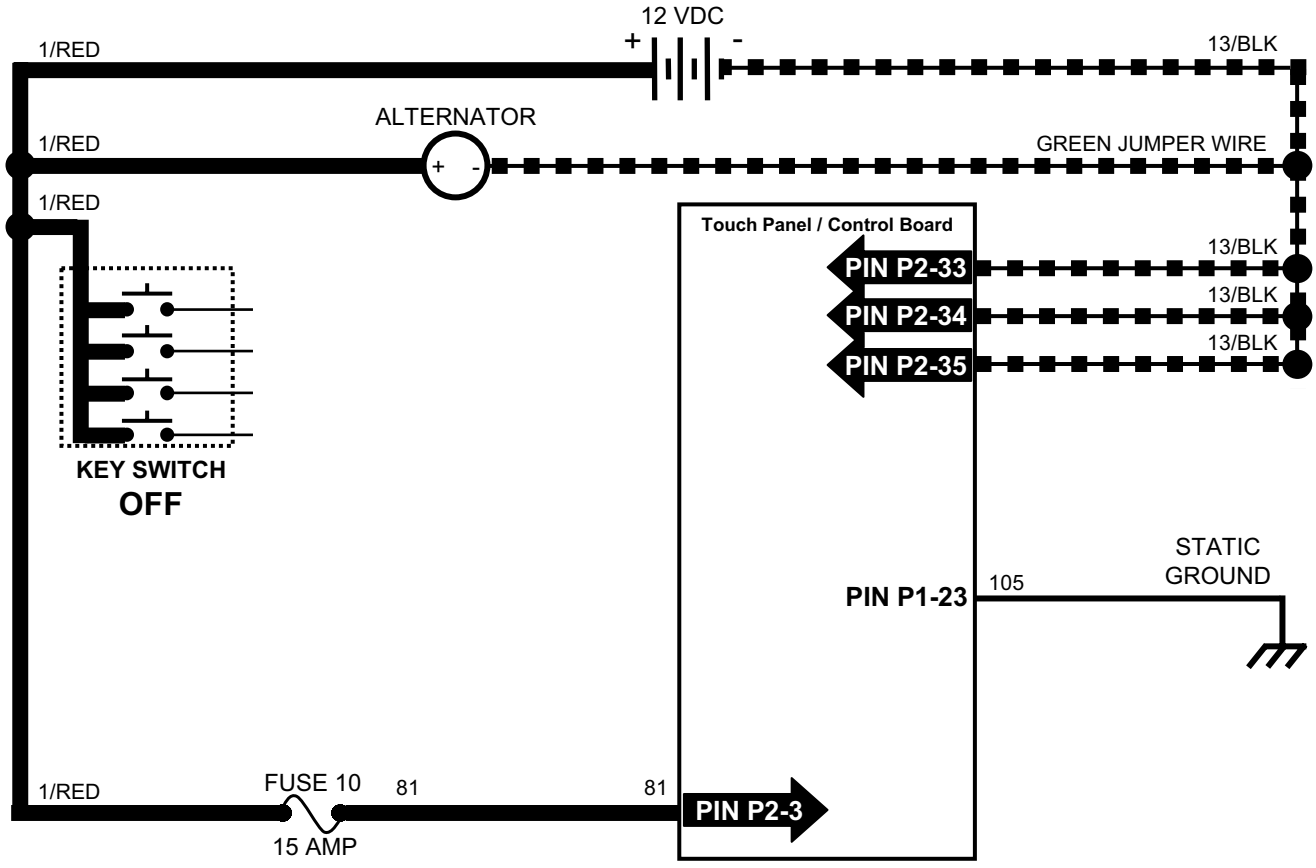
KEY SWITCH POSITION	SWITCH TERMINAL MARKING				
	30	50	17	19	ACC
GLOW PLUG	●			●	●
OFF	NO CONNECTIONS				
RUN	●				●
START	●	●	●		●

"●—●" Indicates a common connection

NOTE: Common connections in various switch positions should be less than 1Ω

M20 Key OFF Power Distribution

Conditions: Key off



E

Be cautious when working near Control Board -
Battery voltage is always present, even with Key OFF

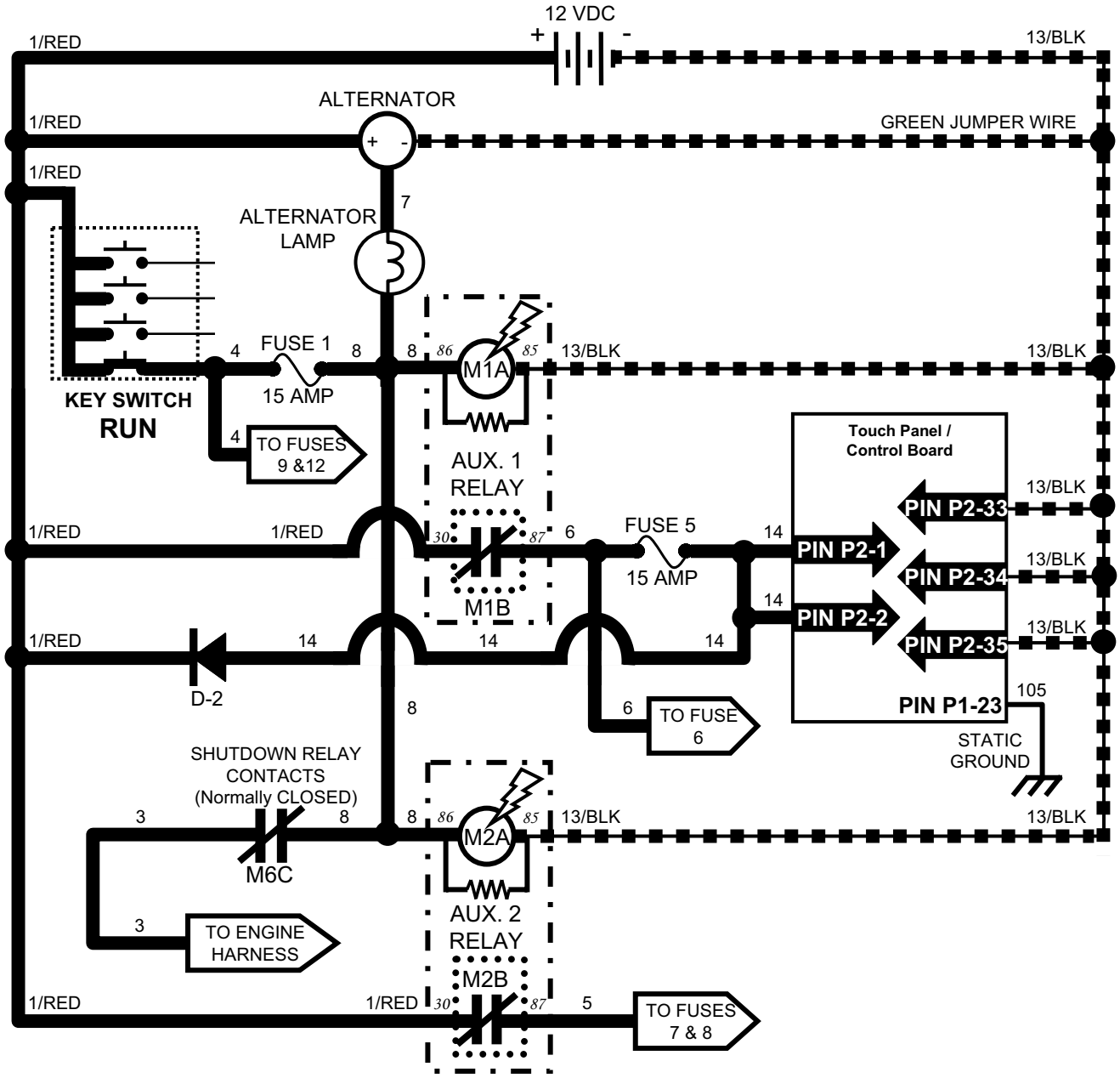
Pin P2-3 supplies power to the on-board clock only. Disconnecting battery, removing Fuse 10, or removing connector P2 from Control Board will require the clock to be reset.

Wiring Color Codes
(Unless otherwise marked)

Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

M20 Key ON Power Distribution

Conditions: Key on, engine off

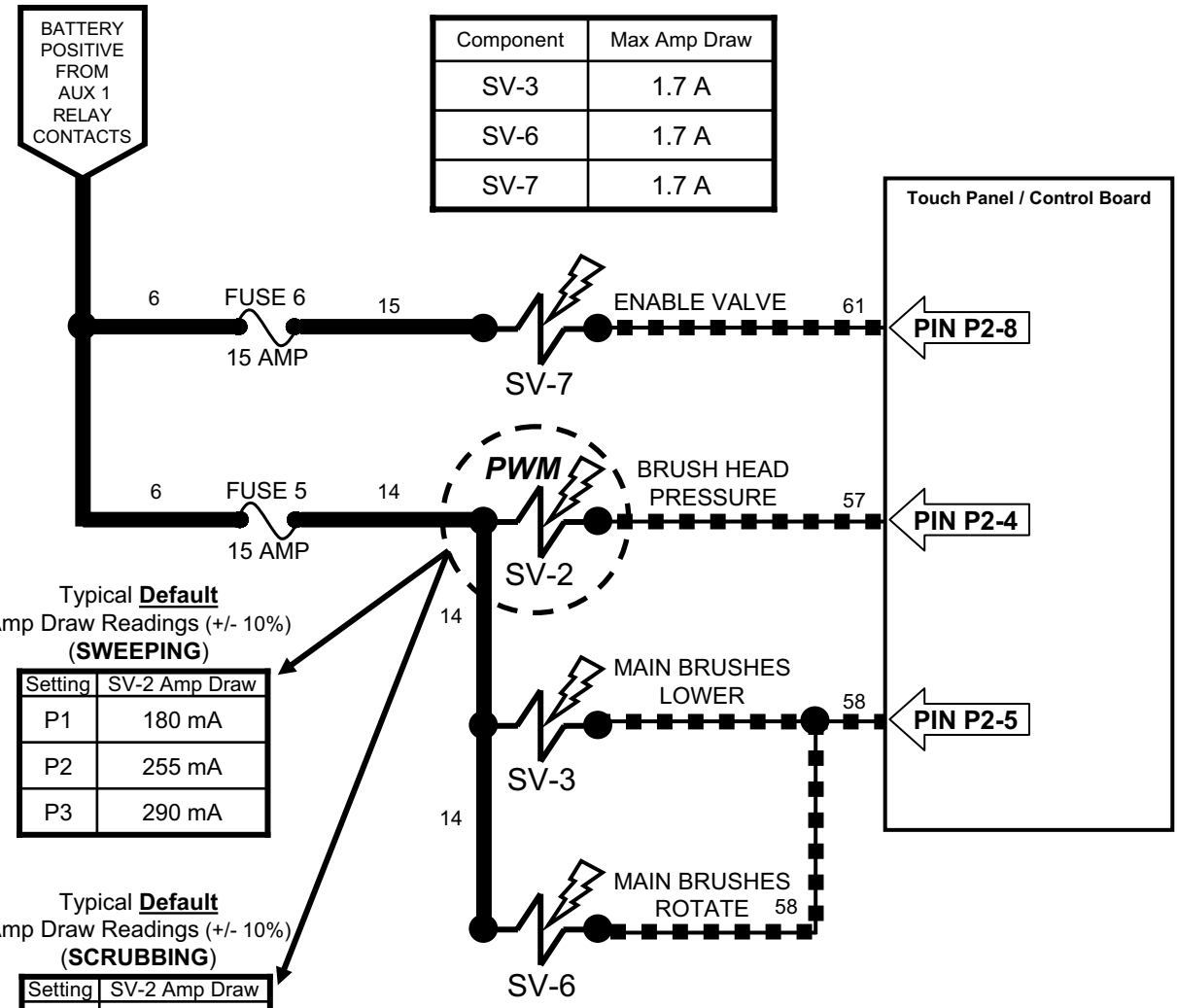


Wiring Color Codes
(Unless otherwise marked)

Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

M20 Main Brushes ON

Conditions: Key on, engine running, scrubbing or sweeping system on, propel forward or reverse



Component	Max Amp Draw
SV-3	1.7 A
SV-6	1.7 A
SV-7	1.7 A

Typical **Default**
Amp Draw Readings (+/- 10%)
(**SWEEPING**)

Setting	SV-2 Amp Draw
P1	180 mA
P2	255 mA
P3	290 mA

Typical **Default**
Amp Draw Readings (+/- 10%)
(**SCRUBBING**)

Setting	SV-2 Amp Draw
P1	285 mA
P2	395 mA
P3	490 mA

Pressure settings P1, P2, & P3 are the Touch Panel LED indicators for Brush down pressure

SV-2 is controlled by PWM; A higher duty cycle (more Brush Pressure LED's lit on Touch Panel) will result in more brush down pressure

Wiring Color Codes
(Unless otherwise marked)

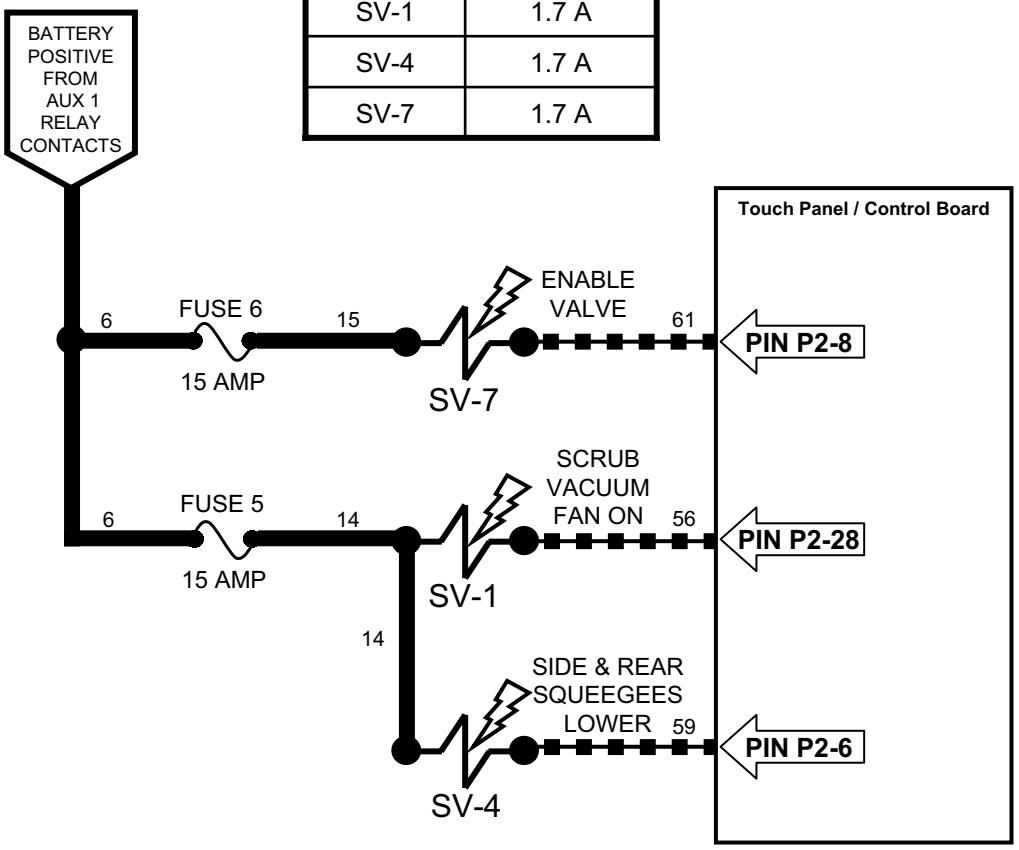
Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

E

M20 Scrub Vacuum Fan ON & Squeegees DOWN

Conditions: Key on, engine running, scrubbing system & scrub vacuum on, propel forward

Component	Max Amp Draw
SV-1	1.7 A
SV-4	1.7 A
SV-7	1.7 A



Reverse propel will turn OFF SV-4 (Pin P2-6) and raise the side and rear squeegees.

Wiring Color Codes
(Unless otherwise marked)

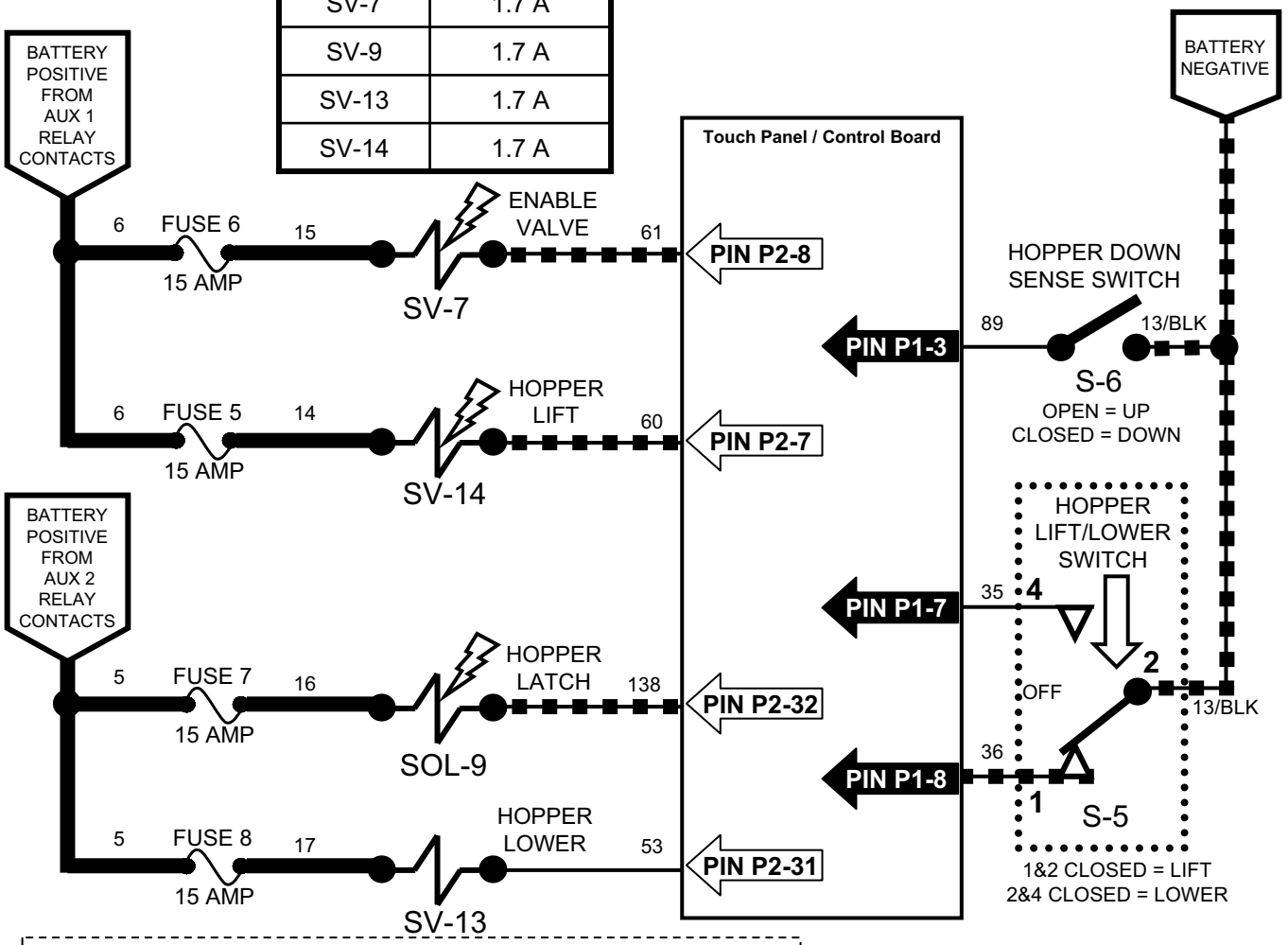
Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

Any condition that cancels the scrub functions will also turn OFF the scrub vacuum fan and raise squeegees.

M20 Hopper LIFT

Conditions: Key on, engine running, hopper lift switch activated

Component	Max Amp Draw
SV-7	1.7 A
SV-9	1.7 A
SV-13	1.7 A
SV-14	1.7 A



i **If hopper is in the fully DOWN position when activating Hopper Lift, the Hopper Lower Valve (SV-13) is momentarily turned ON to help "jog" the hopper latch**

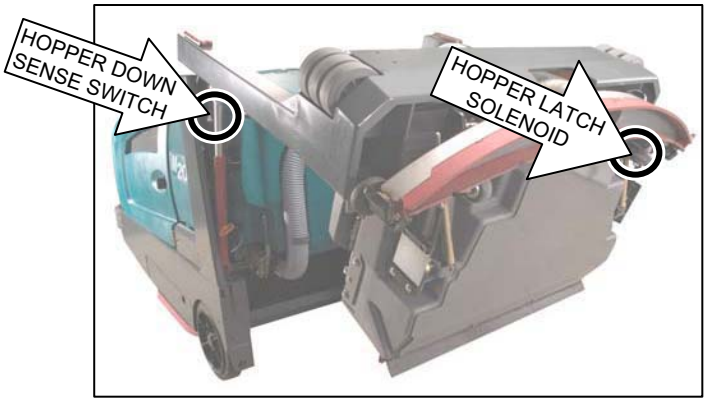
i **Hopper Latch solenoid (SOL-9) is an electro-mechanical device**

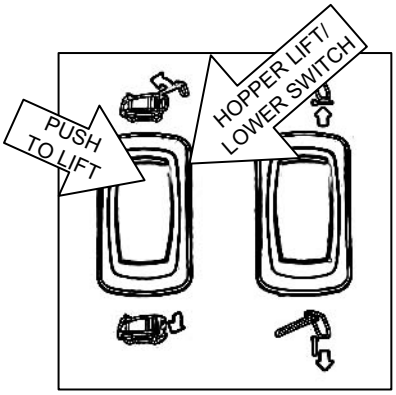
i **Activating the Hopper Lift/Lower Switch will cancel the sweep or scrub systems and automatically selects HIGH engine speed**

i **Hopper Latch solenoid (SOL-9) turns ON for 3 to 5 seconds with each activation of Hopper Lift Switch**

Wiring Color Codes
(Unless otherwise marked)

Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White



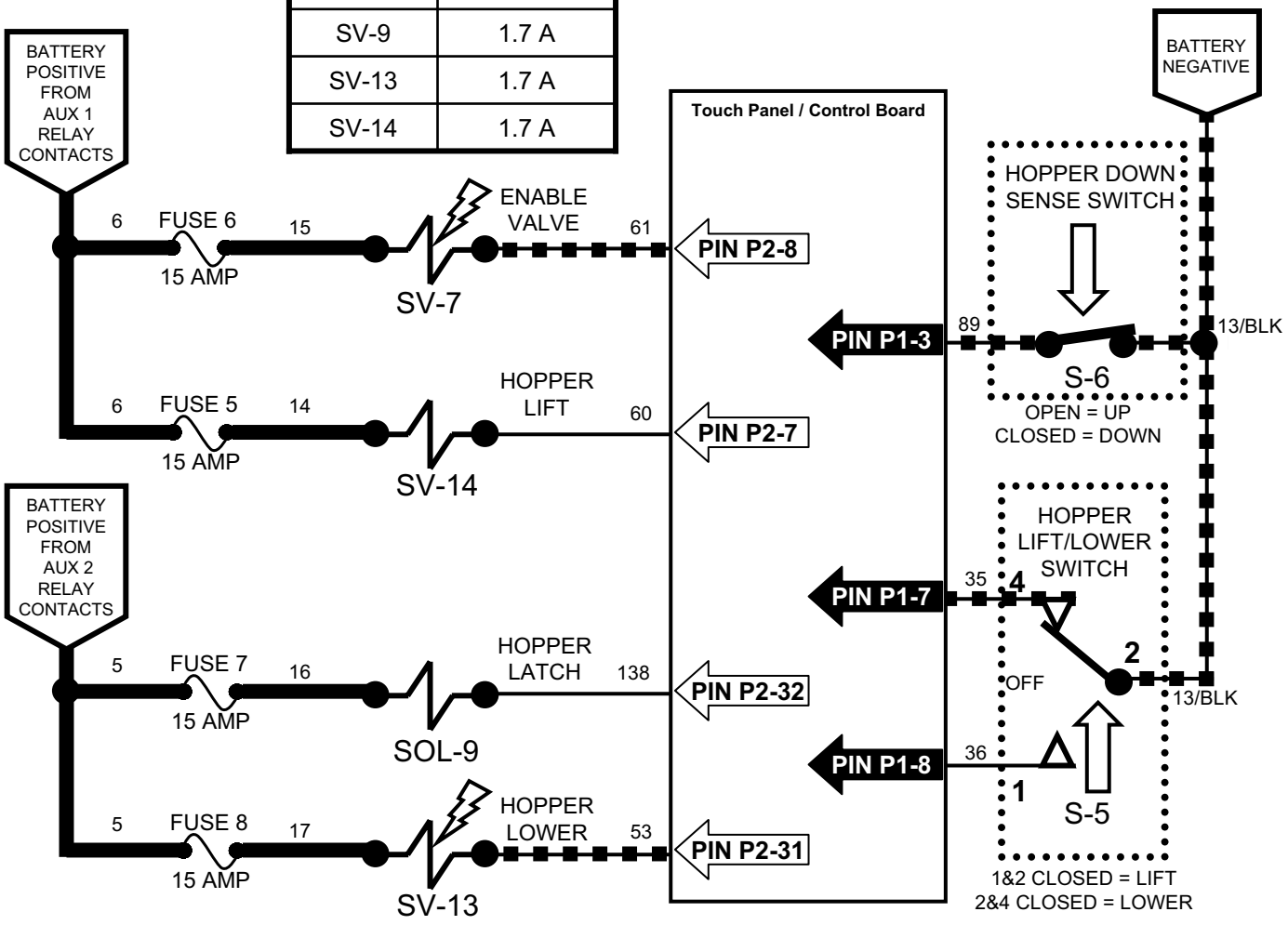


E

M20 Hopper LOWER

Conditions: Key on, engine running, hopper lower switch activated

Component	Max Amp Draw
SV-7	1.7 A
SV-9	1.7 A
SV-13	1.7 A
SV-14	1.7 A

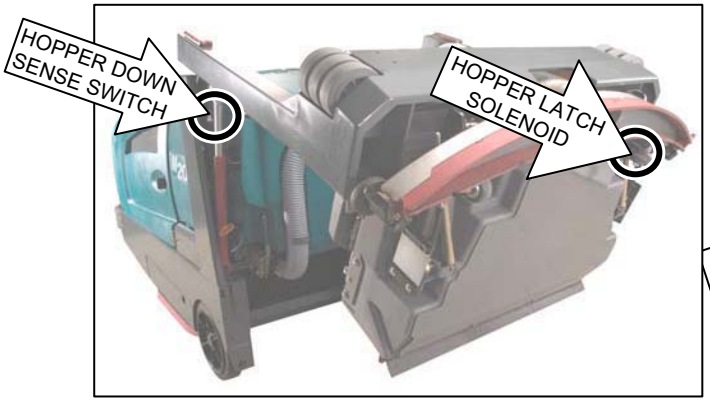


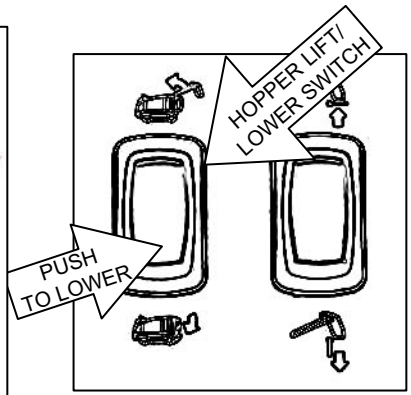
Activating the Hopper Lift/Lower Switch will cancel the sweep or scrub systems and automatically selects HIGH engine speed

Hopper Latch solenoid (SOL-9) is an electro-mechanical device

Wiring Color Codes
(Unless otherwise marked)

Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

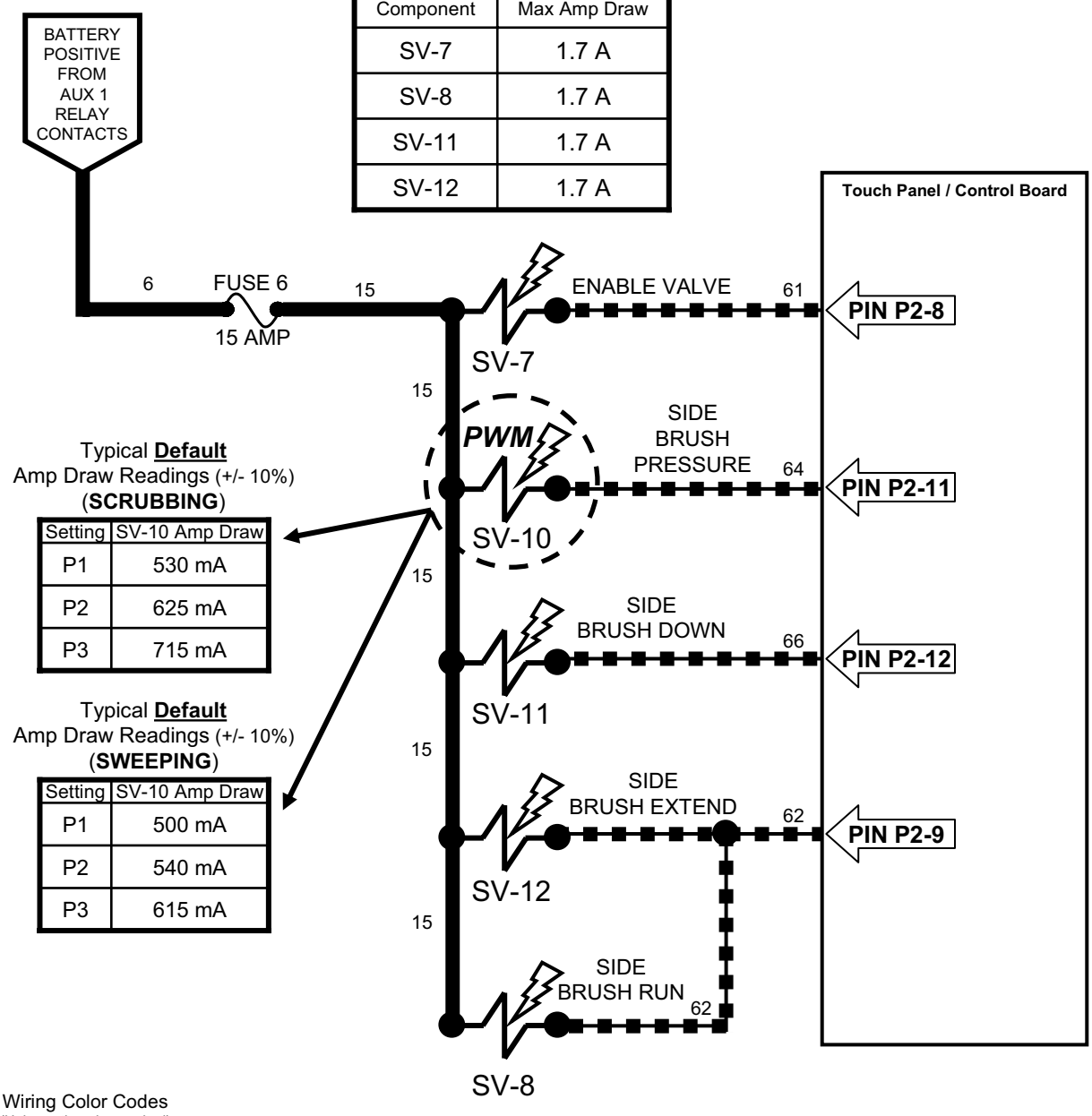




M20 Side Brush ON

Conditions: Key on, engine running, scrubbing or sweeping system on, side brush on, propel forward or reverse

Component	Max Amp Draw
SV-7	1.7 A
SV-8	1.7 A
SV-11	1.7 A
SV-12	1.7 A



Typical **Default**
Amp Draw Readings (+/- 10%)
(**SCRUBBING**)

Setting	SV-10 Amp Draw
P1	530 mA
P2	625 mA
P3	715 mA

Typical **Default**
Amp Draw Readings (+/- 10%)
(**SWEEPING**)

Setting	SV-10 Amp Draw
P1	500 mA
P2	540 mA
P3	615 mA

Wiring Color Codes
(Unless otherwise marked)

Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

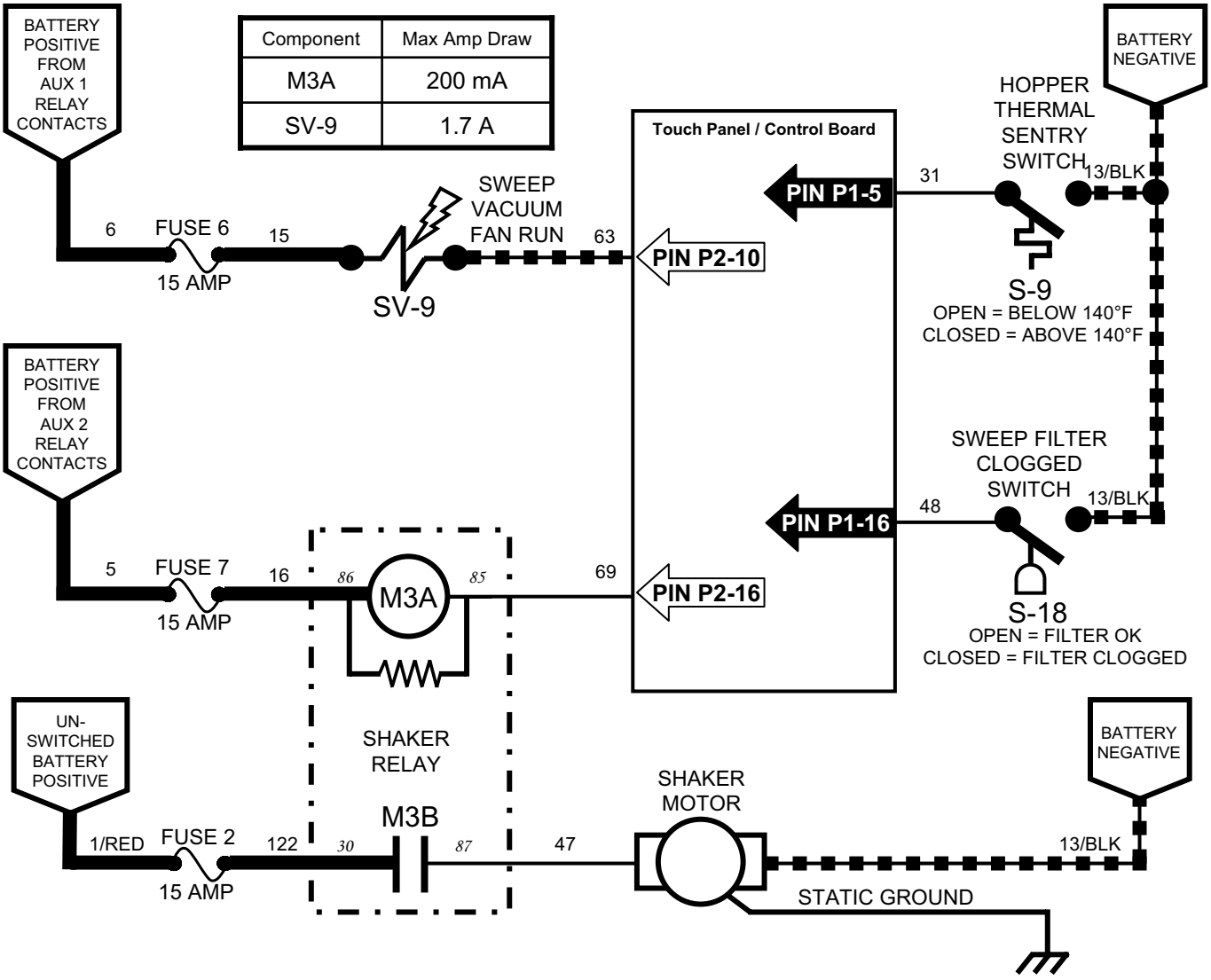
Pressure settings P1, P2, & P3 are the Touch Panel LED indicators for Brush down pressure

SV-10 is controlled by PWM; A higher duty cycle (more Brush Pressure LED's lit on Touch Panel) will result in more brush down pressure

E

M20 Sweep Vacuum Fan ON

Conditions: Key on, engine running, sweeping system and/or sweep vacuum fan on

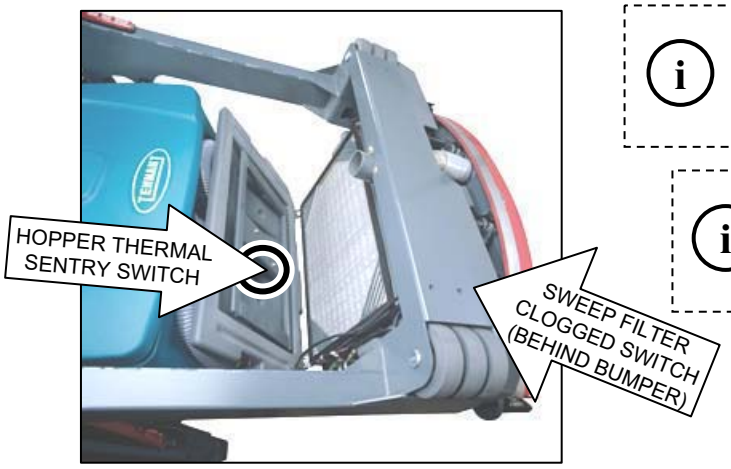


i **If the shaker system is manually selected when Sweep Vacuum Fan is ON, the fan is turned OFF during the shaker cycle, and turned back ON when shaker cycle is complete**

i **If Sweep Filter Clogged Switch closes (restriction in filter), a fault condition will be displayed, but vacuum fan will continue operating normally.**

Wiring Color Codes
(Unless otherwise marked)

Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

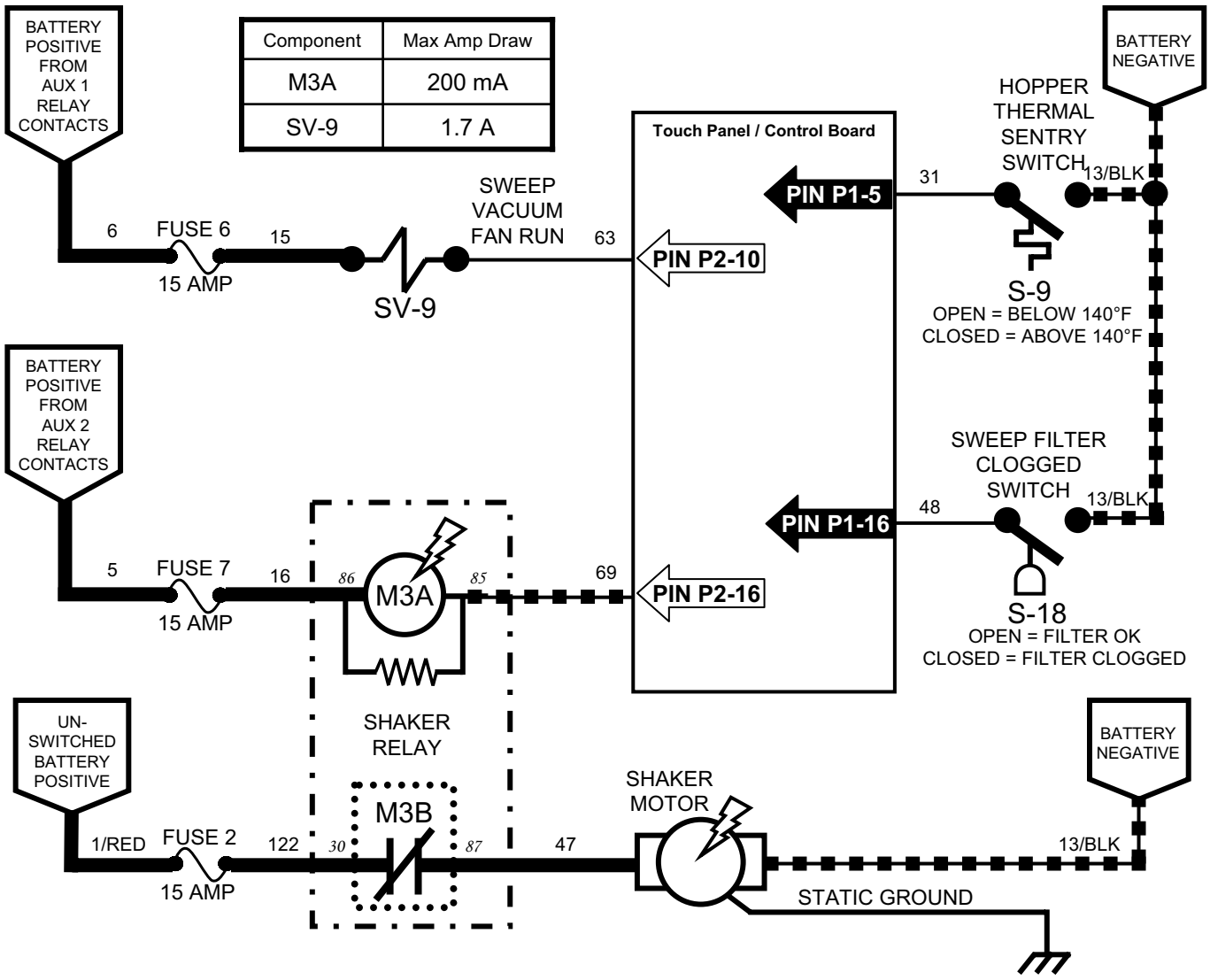


i **If the Hopper Thermal Sentry Switch closes (above 140°F in hopper), all sweep functions are cancelled.**

i **A short shaker cycle is automatically performed each time the Sweep Vacuum is turned OFF**

M20 Shaker Motor ON

Conditions: Key on, One-Step sweeping turned off or shaker system on

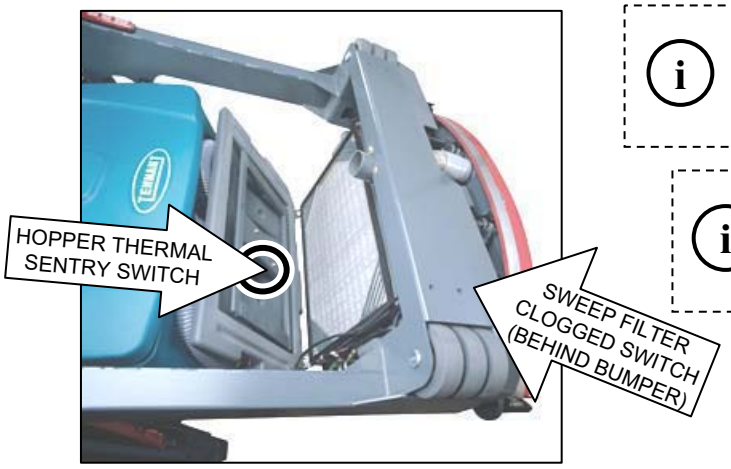


i **If the shaker system is manually selected when Sweep Vacuum Fan is ON, the fan is turned OFF during the shaker cycle, and turned back ON when shaker cycle is complete**

i **If Sweep Filter Clogged Switch closes (restriction in filter), a fault condition will be displayed, but vacuum fan will continue operating normally.**

Wiring Color Codes
(Unless otherwise marked)

Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

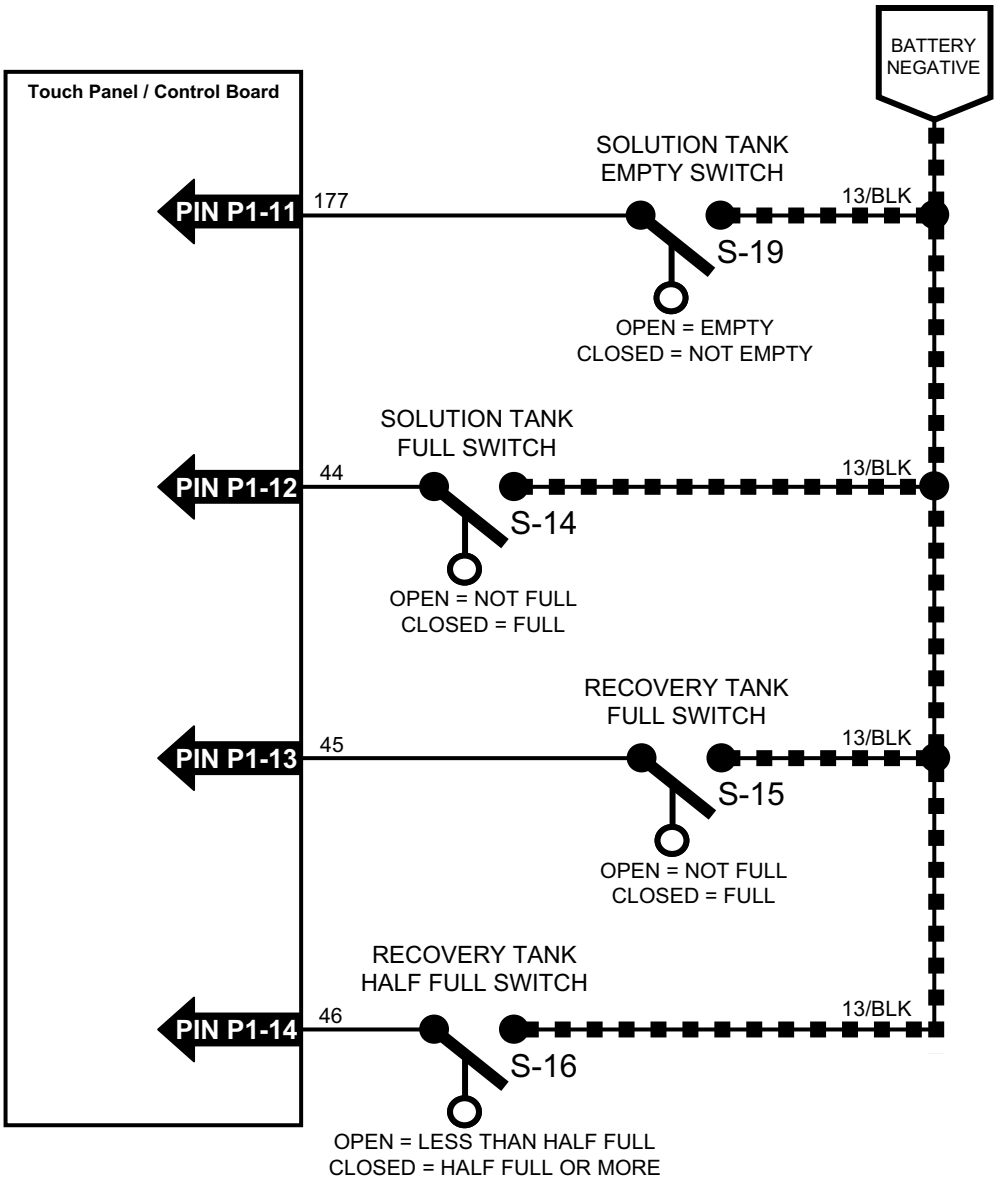


i **If the Hopper Thermal Sentry Switch closes (above 140°F in hopper), all sweep functions are cancelled.**

i **A short shaker cycle is automatically performed each time the Sweep Vacuum is turned OFF**

E

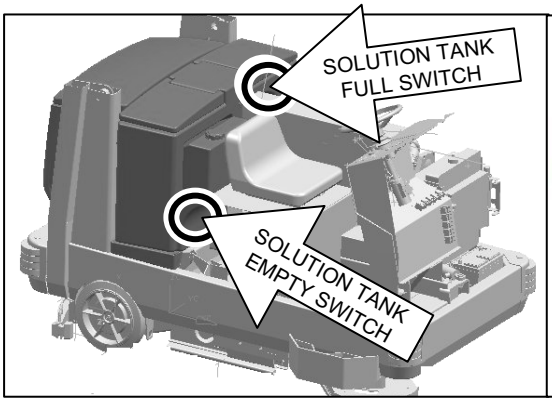
M20 Float Switches

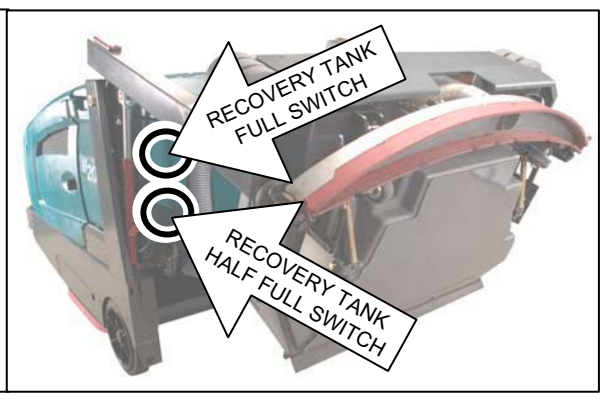


The Float Switches must be closed for 5 seconds before any output is affected

Wiring Color Codes
(Unless otherwise marked)

Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

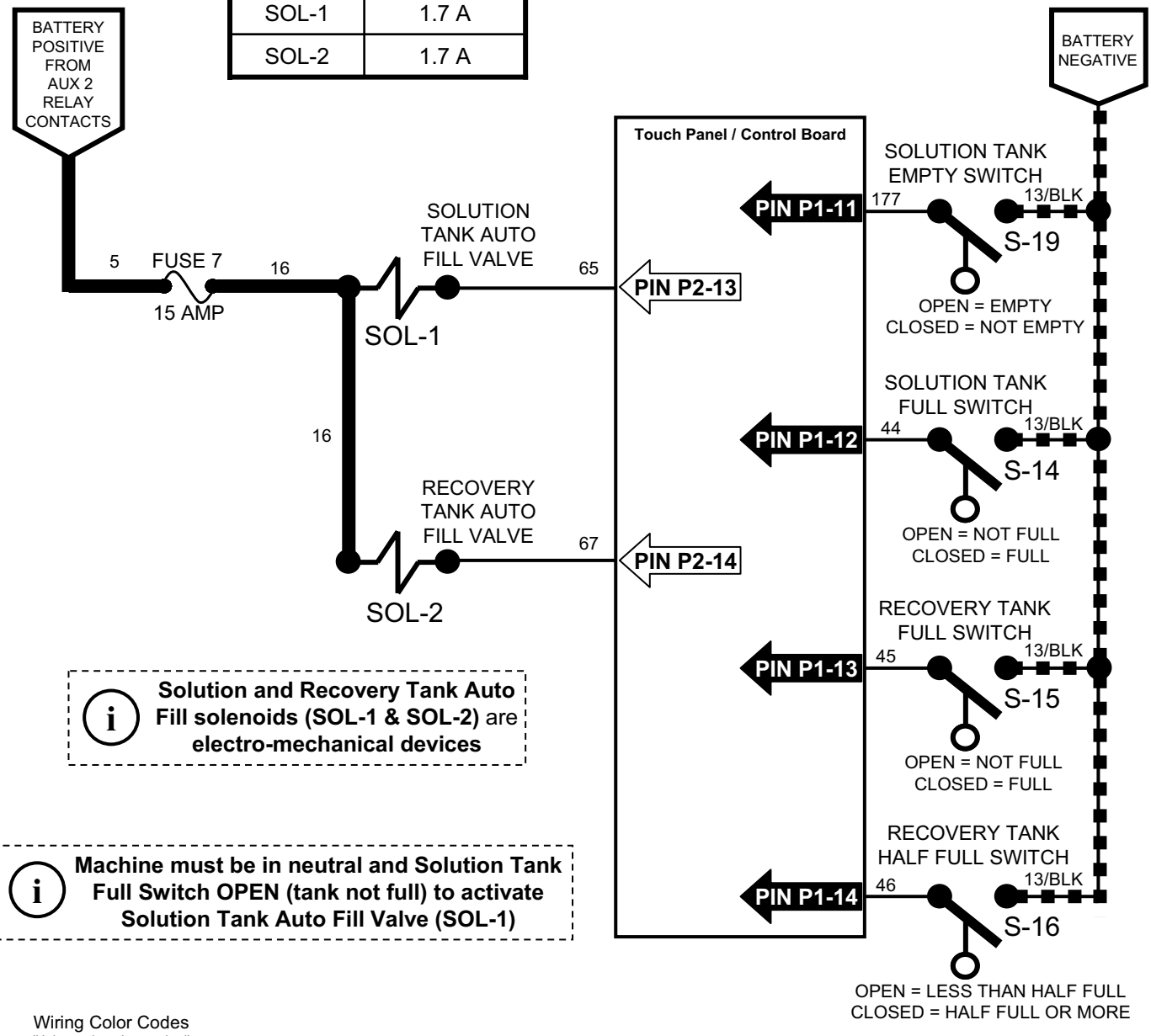




M20 Auto Fill Solenoids

Conditions: Key on

Component	Max Amp Draw
SOL-1	1.7 A
SOL-2	1.7 A



Solution and Recovery Tank Auto Fill solenoids (SOL-1 & SOL-2) are **electro-mechanical devices**

Machine must be in neutral and Solution Tank Full Switch OPEN (tank not full) to activate Solution Tank Auto Fill Valve (SOL-1)

Machine must be in neutral and Recovery Tank Half Full Switch OPEN (tank less than half full) to activate Recovery Tank Auto Fill Valve (SOL-2)

The Float Switches must be closed for 5 seconds before any output is affected

Wiring Color Codes
(Unless otherwise marked)

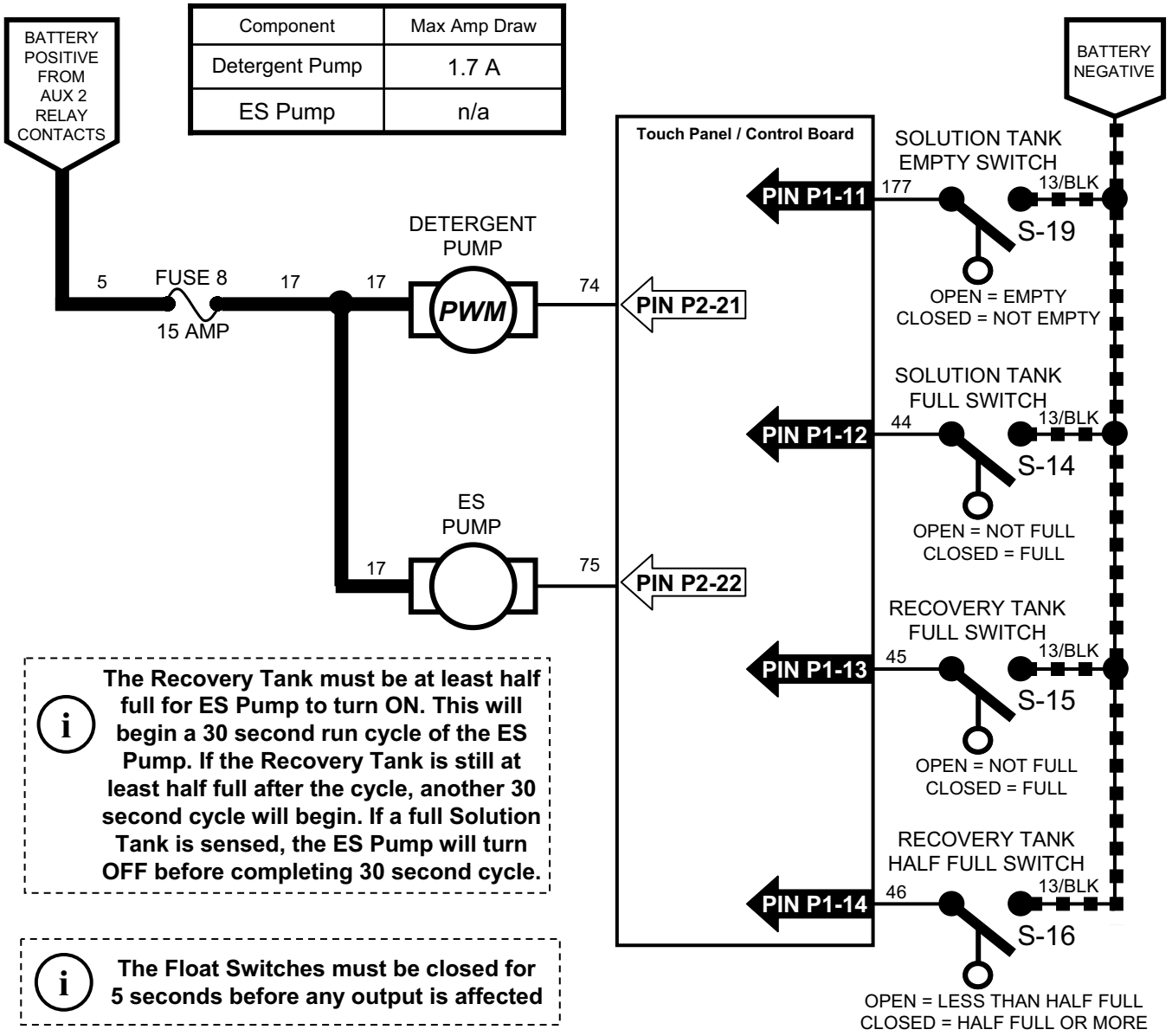
Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

E

M20 Conventional Detergent Pump & ES Pump

Conditions: Key on, engine running, scrubbing system on, ES system on, two or three solution LED's lit

Component	Max Amp Draw
Detergent Pump	1.7 A
ES Pump	n/a



i **The Recovery Tank must be at least half full for ES Pump to turn ON. This will begin a 30 second run cycle of the ES Pump. If the Recovery Tank is still at least half full after the cycle, another 30 second cycle will begin. If a full Solution Tank is sensed, the ES Pump will turn OFF before completing 30 second cycle.**

i **The Float Switches must be closed for 5 seconds before any output is affected**

Wiring Color Codes
(Unless otherwise marked)

Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

i **The Detergent Pump is controlled by PWM; A higher duty cycle (more Solution LED's lit on Touch Panel) will result in more detergent & solution applied to floor**

Low Water and Detergent Pump OFF

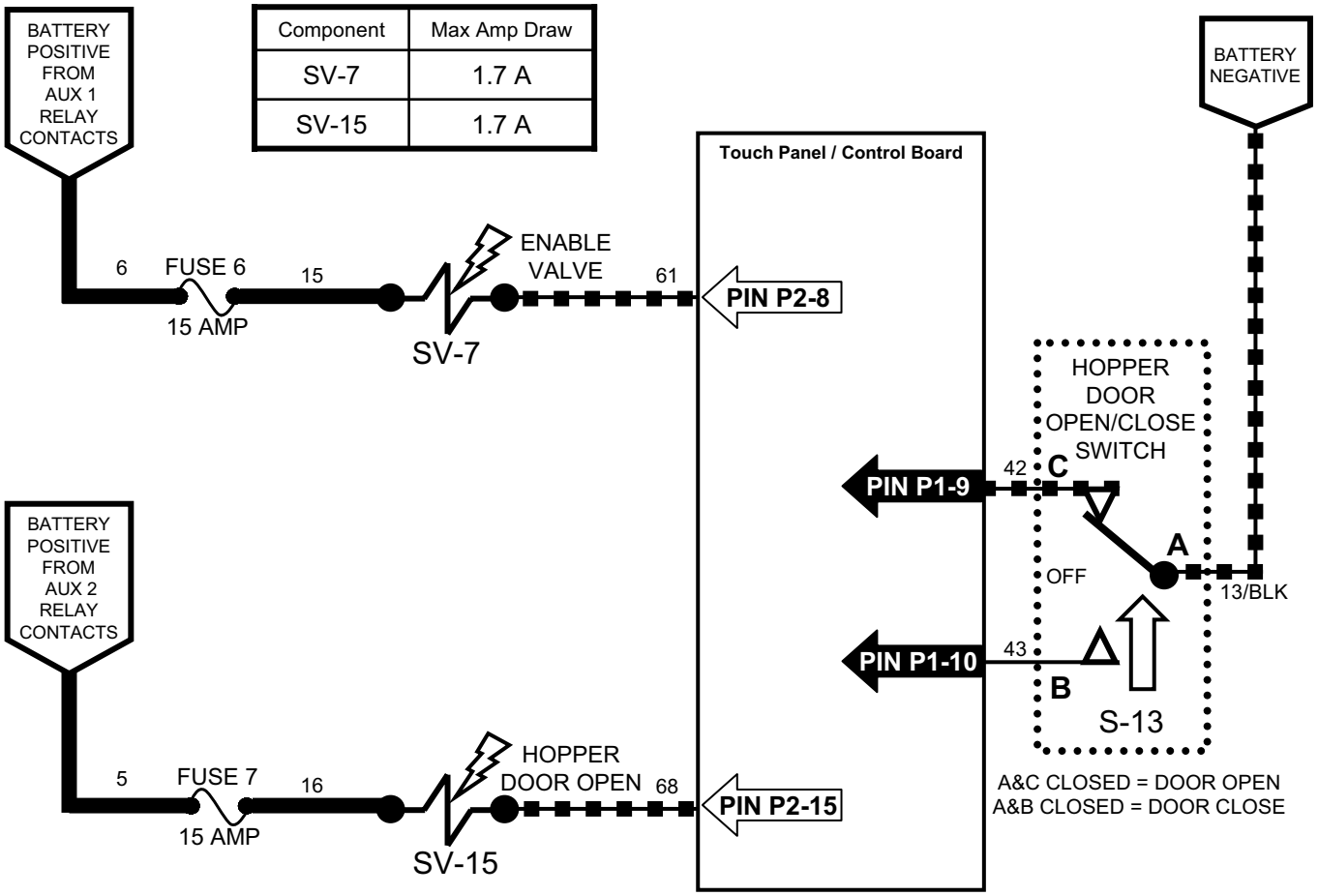
Medium Water and Detergent Pump LOW

High Water and Detergent Pump HIGH

M20 Hopper Door OPEN

Conditions: Key on, engine running, hopper door open switch activated

Component	Max Amp Draw
SV-7	1.7 A
SV-15	1.7 A

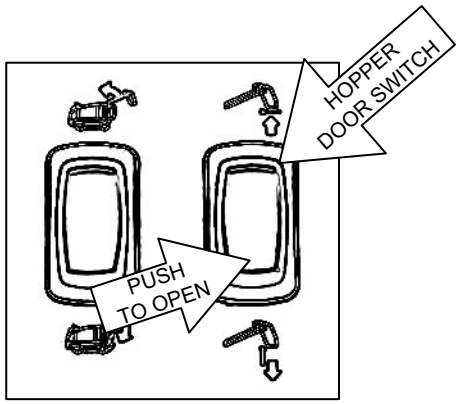


i **Anytime the Enable Valve (SV-7) is ON and the Hopper Door Open Valve (SV15) is OFF, the hopper door will close**

i **Activating the Hopper Door Switch to open or close the door will cancel the sweep or scrub systems and automatically selects HIGH engine speed**

Wiring Color Codes
(Unless otherwise marked)

Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

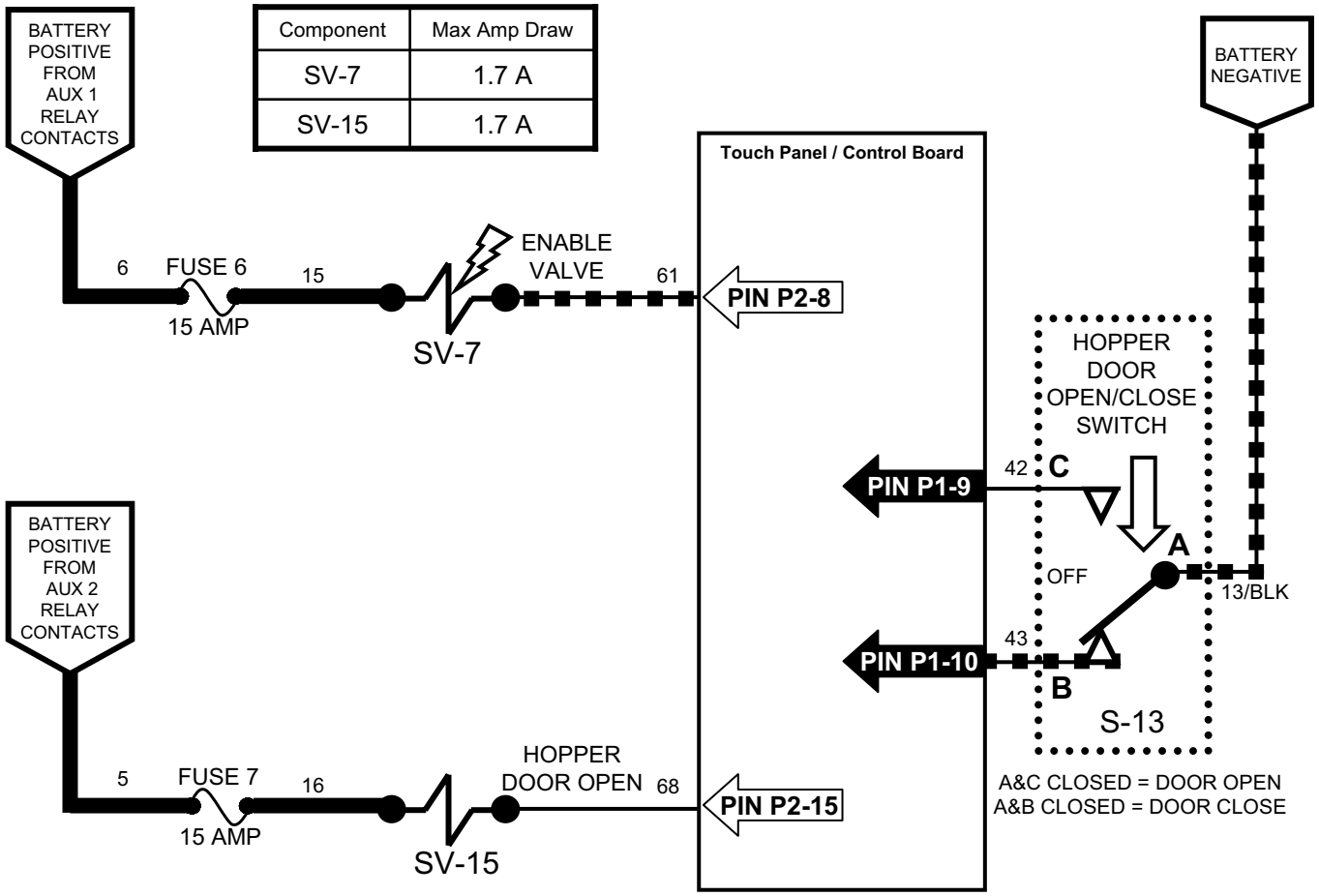


E

M20 Hopper Door CLOSE

Conditions: Key on, engine running, hopper door close switch activated

Component	Max Amp Draw
SV-7	1.7 A
SV-15	1.7 A



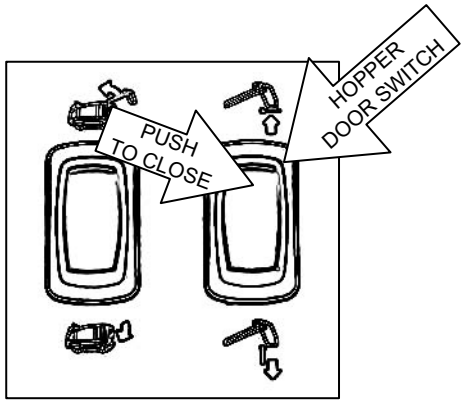
E

i **Anytime the Enable Valve (SV-7) is ON and the Hopper Door Open Valve (SV15) is OFF, the hopper door will close**

i **Activating the Hopper Door Switch to open or close the door will cancel the sweep or scrub systems and automatically selects HIGH engine speed**

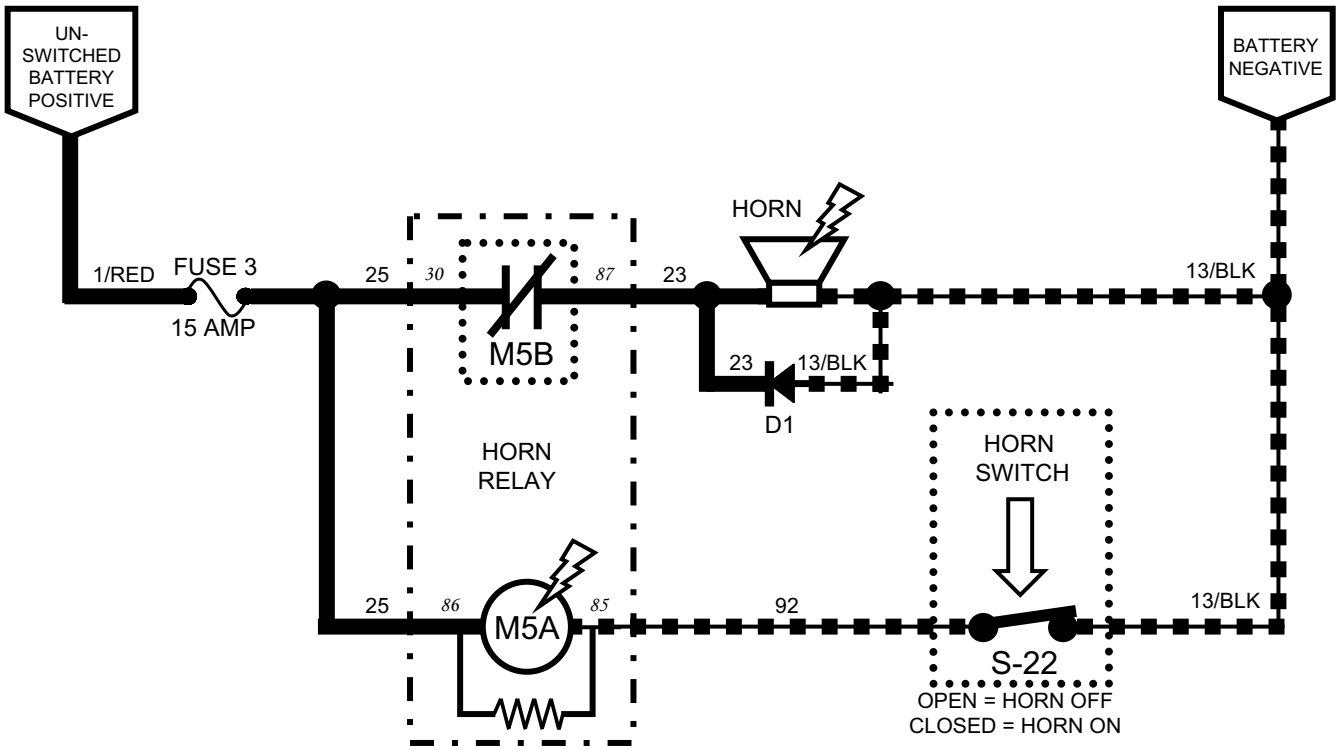
Wiring Color Codes
(Unless otherwise marked)

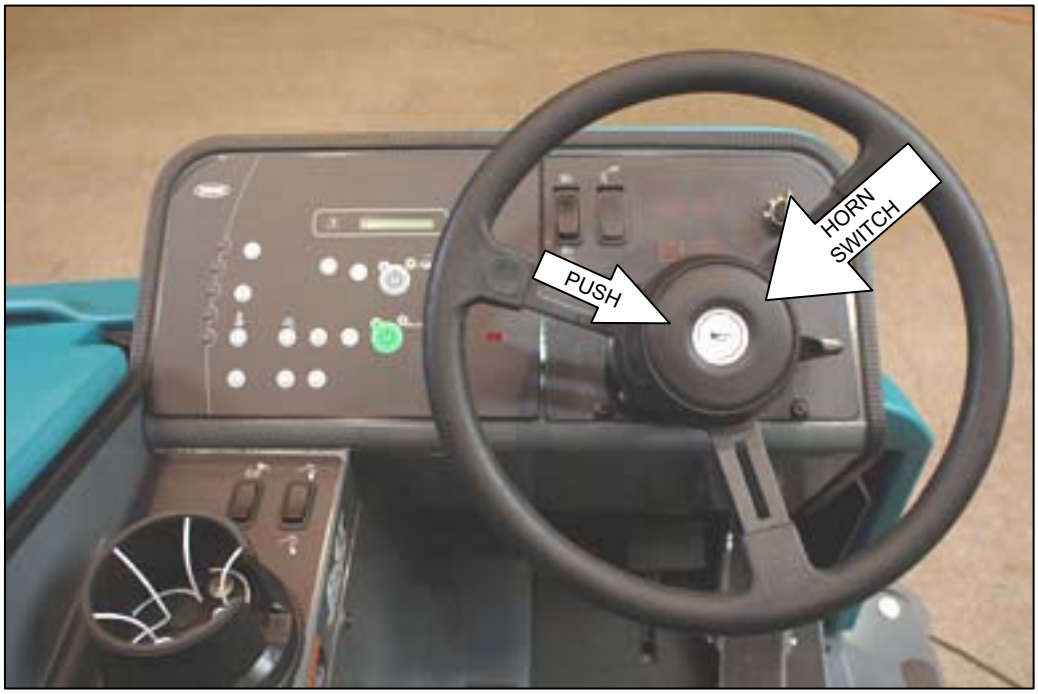
Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White



M20 Horn

Conditions: Horn switch activated





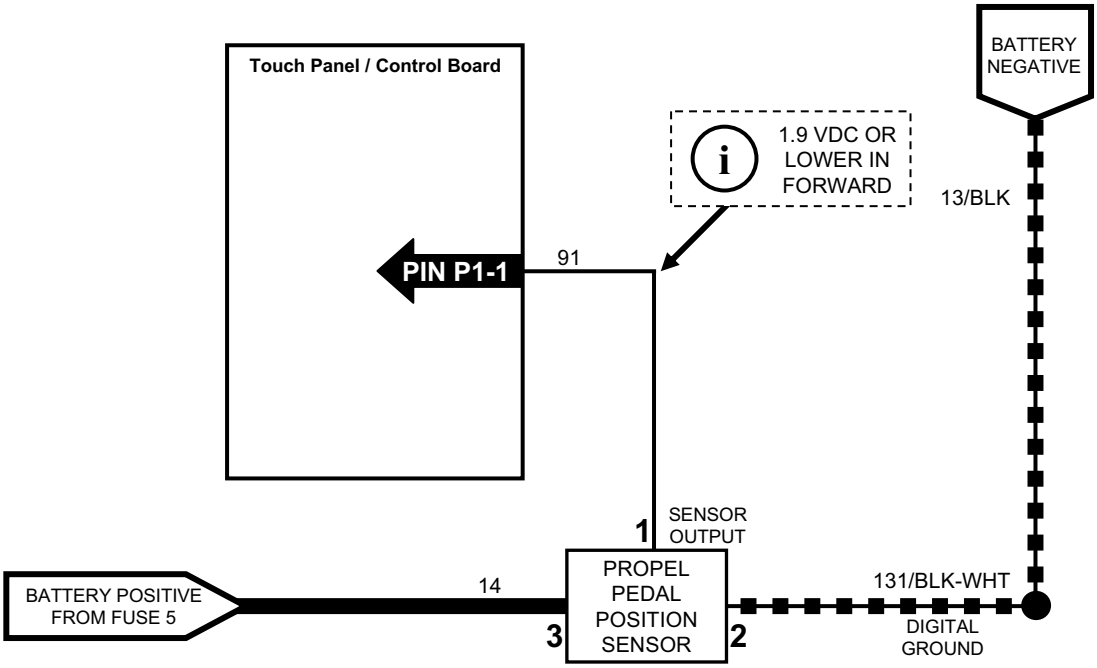
Wiring Color Codes
(Unless otherwise marked)

Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

E

M20 Forward Propel

Conditions: Key on, propel pedal pushed for forward travel



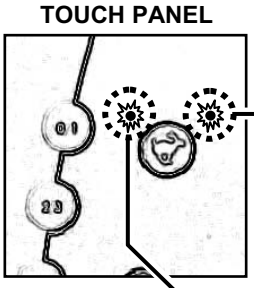
SENSOR OUTPUT VOLTAGES:
2.0 to 2.7 VDC = NEUTRAL
2.8 VDC OR HIGHER = REVERSE
1.9 VDC OR LOWER = FORWARD

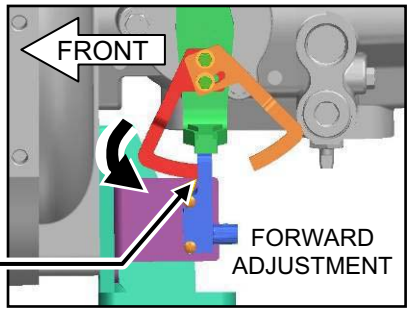
E

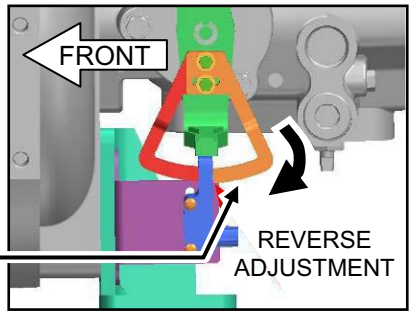
Propel Pedal Position Sensor Arms Adjustment

1) Enter Input Diagnostics Mode
2) Loosen sensor arms hardware
3) Tighten top bolt to snug
4) Slide arm until the light goes ON
5) **Back arm out until the light goes OFF**
6) Retighten all hardware

NOTE: Use the High Engine Speed LED to adjust the arm closest to the front of machine (forward adjustment), and the Low Engine Speed LED to adjust the arm closest to the rear of machine (reverse adjustment).

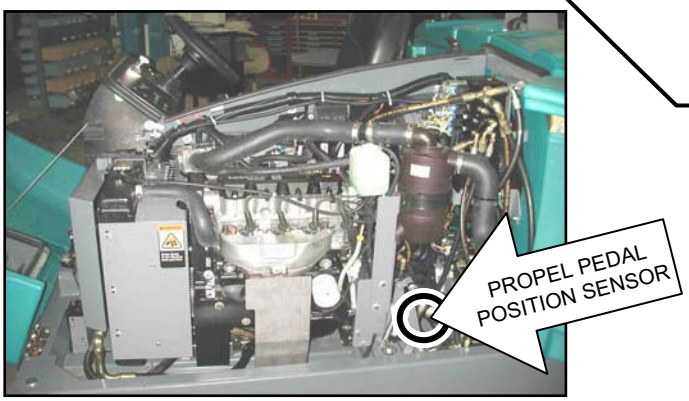






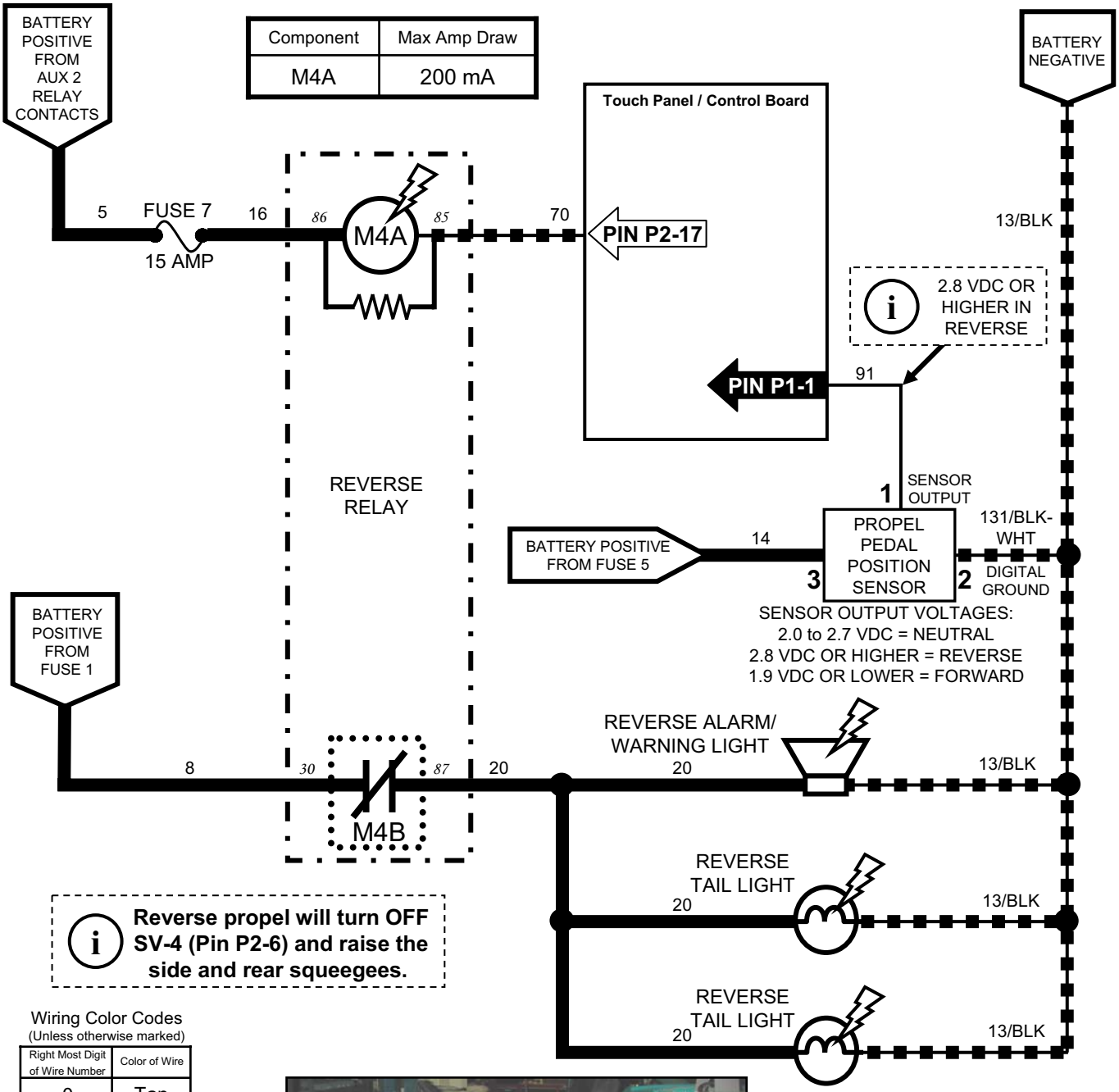
Wiring Color Codes
(Unless otherwise marked)

Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White



M20 Reverse Propel

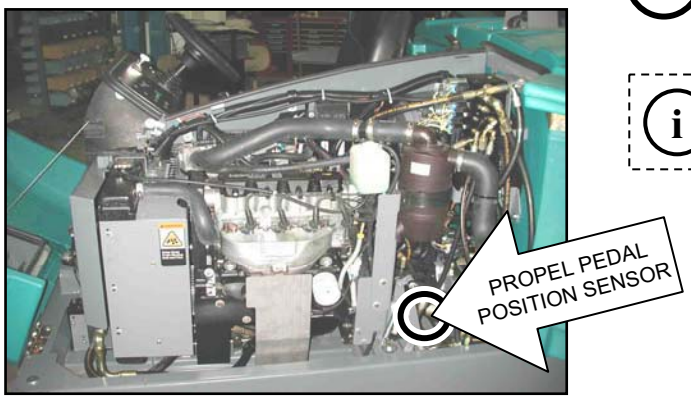
Conditions: Key on, propel pedal pushed for reverse travel



Reverse propel will turn OFF SV-4 (Pin P2-6) and raise the side and rear squeegees.

Wiring Color Codes
(Unless otherwise marked)

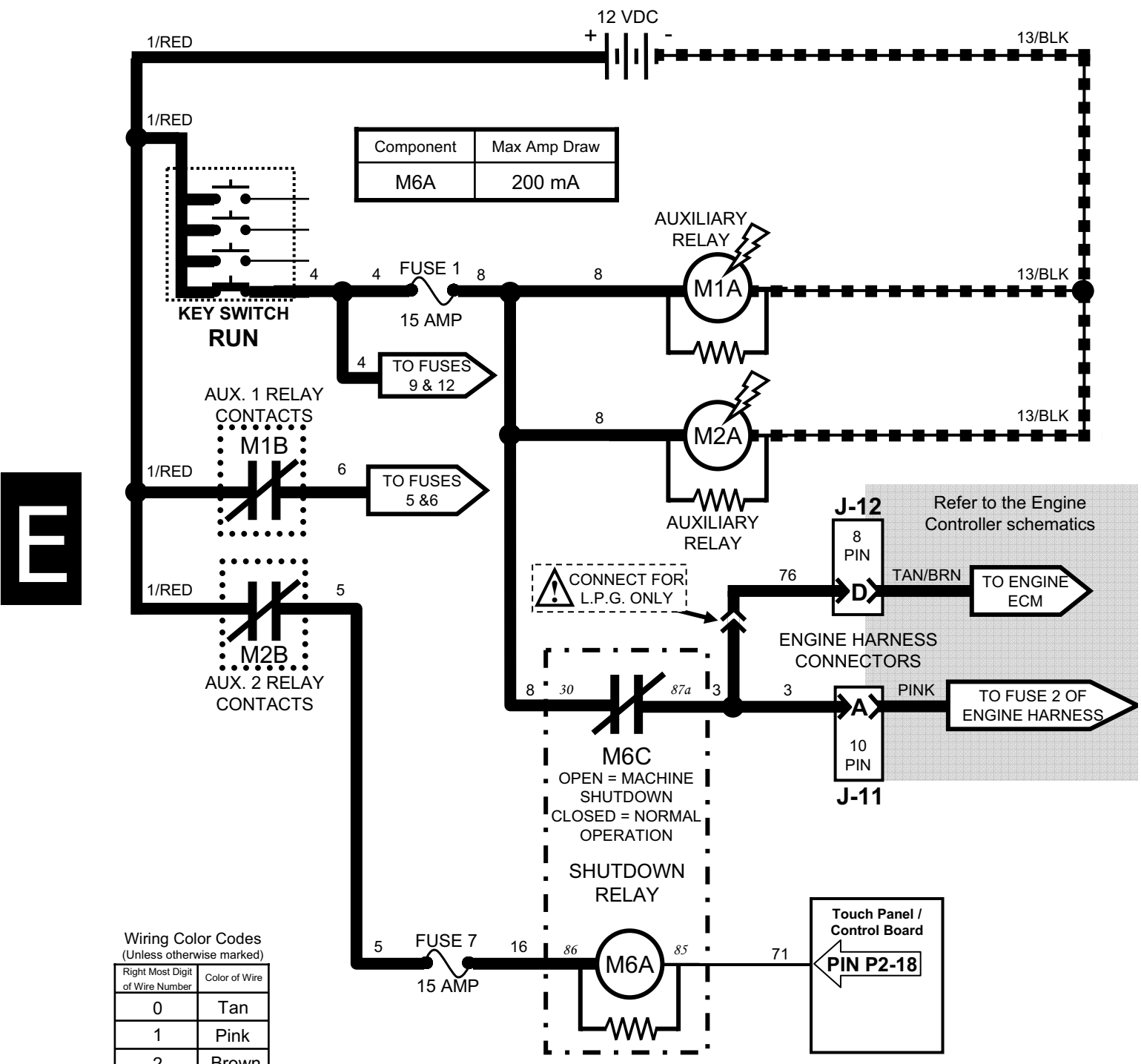
Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White



See Forward Propel page for information on adjusting Propel Pedal Position Sensor

E

M20 Shutdown Relay (Normal Machine Operation)
(Gas/LPG)



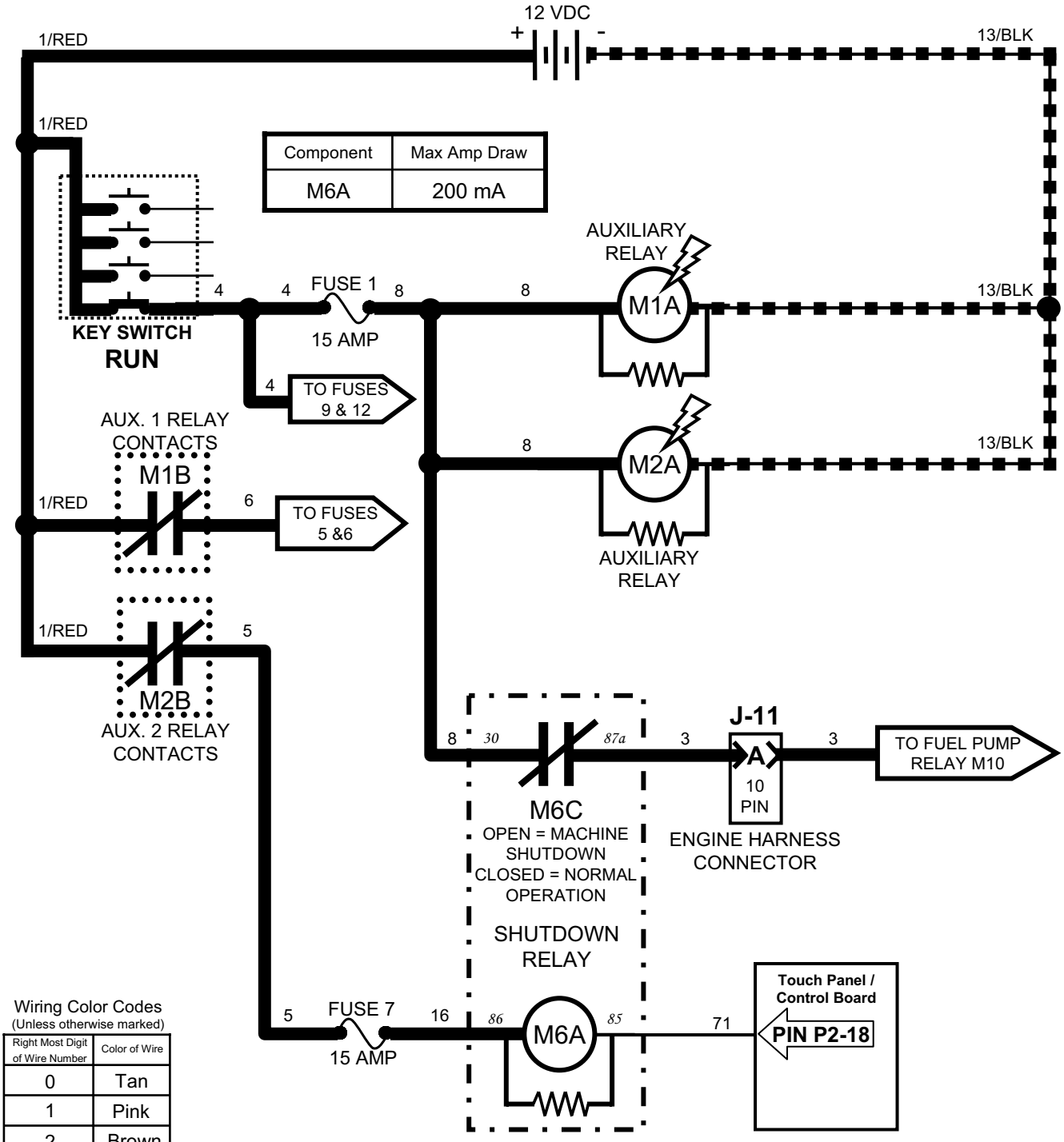
Wiring Color Codes
(Unless otherwise marked)

Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

The Shutdown system is used to turn OFF the engine under certain conditions on machines with certain optional equipment

When control board turns ON M6A, the engine ECM loses power, and engine shuts OFF

M20 Shutdown Relay (Normal Machine Operation)
(Diesel)



Wiring Color Codes
(Unless otherwise marked)

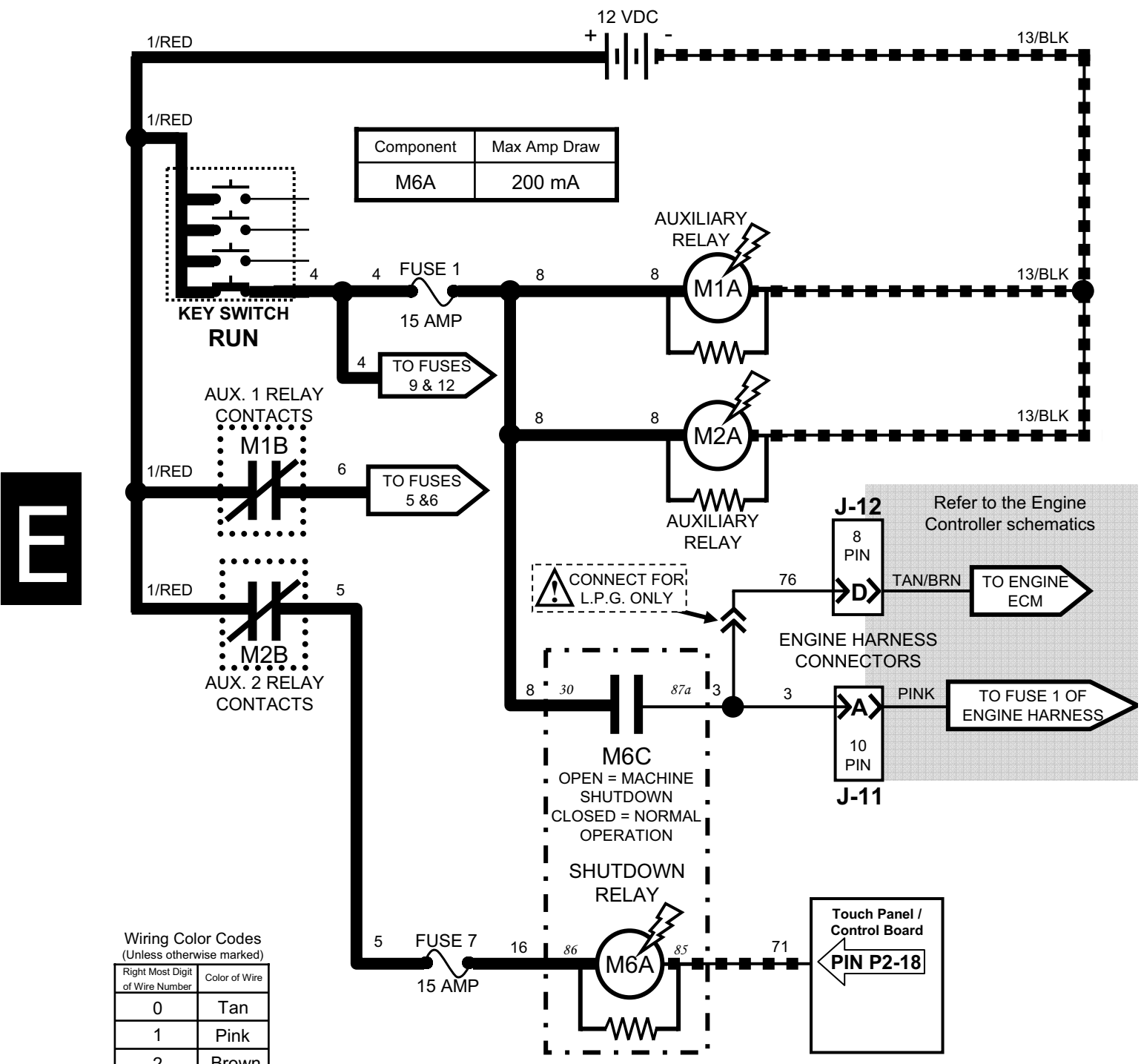
Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

The Shutdown system is used to turn OFF the engine under certain conditions on machines with certain optional equipment

When control board turns ON M6A, the engine ECM loses power, and engine shuts OFF

E

M20 Shutdown Relay (Shutdown Mode)
(Gas/LPG)



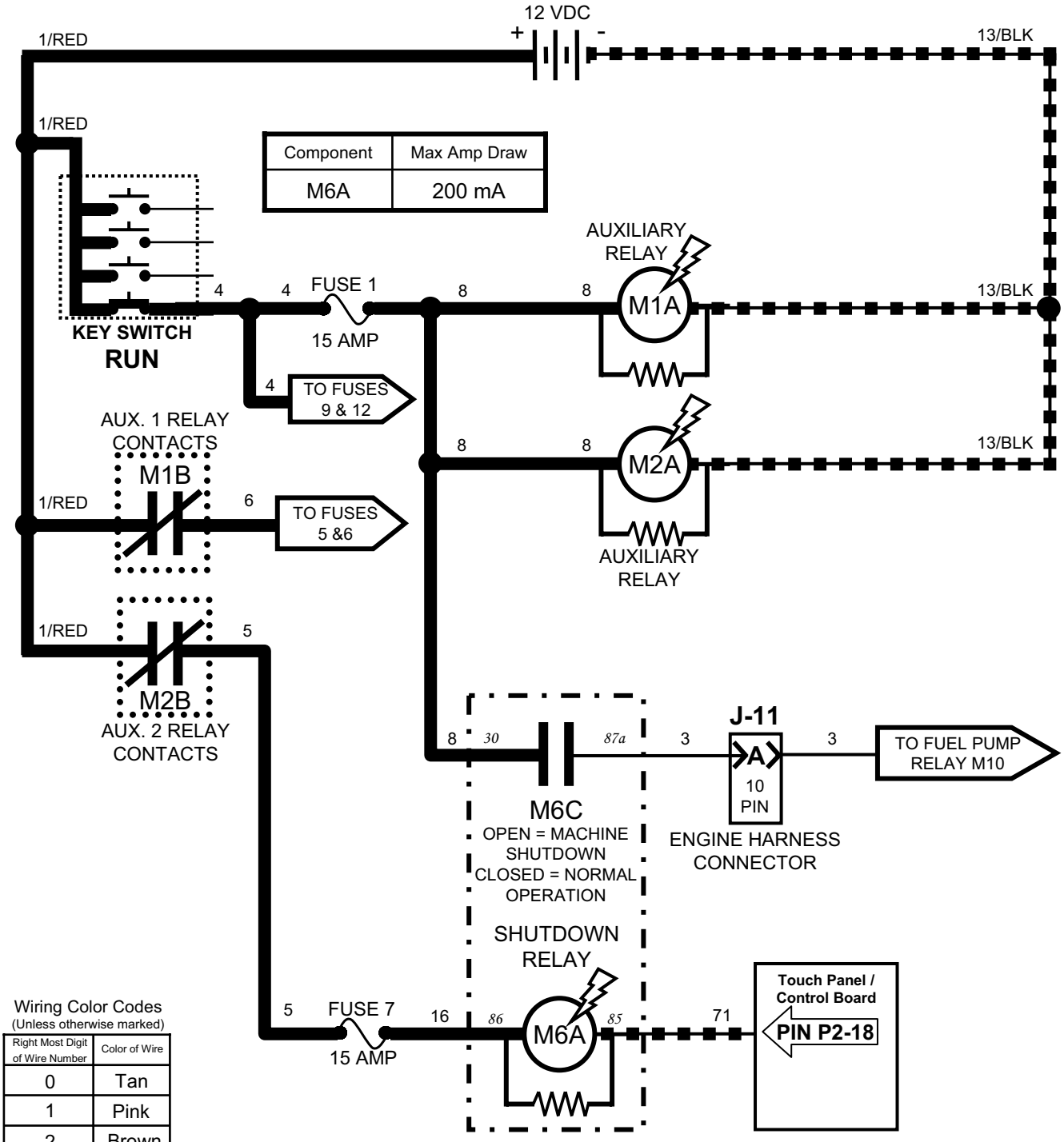
Wiring Color Codes
(Unless otherwise marked)

Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

The Shutdown system is used to turn OFF the engine under certain conditions on machines with certain optional equipment

When control board turns ON M6A, the engine ECM loses power, and engine shuts OFF

M20 Shutdown Relay (Shutdown Mode)
(Diesel)



Wiring Color Codes
(Unless otherwise marked)

Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

The Shutdown system is used to turn OFF the engine under certain conditions on machines with certain optional equipment

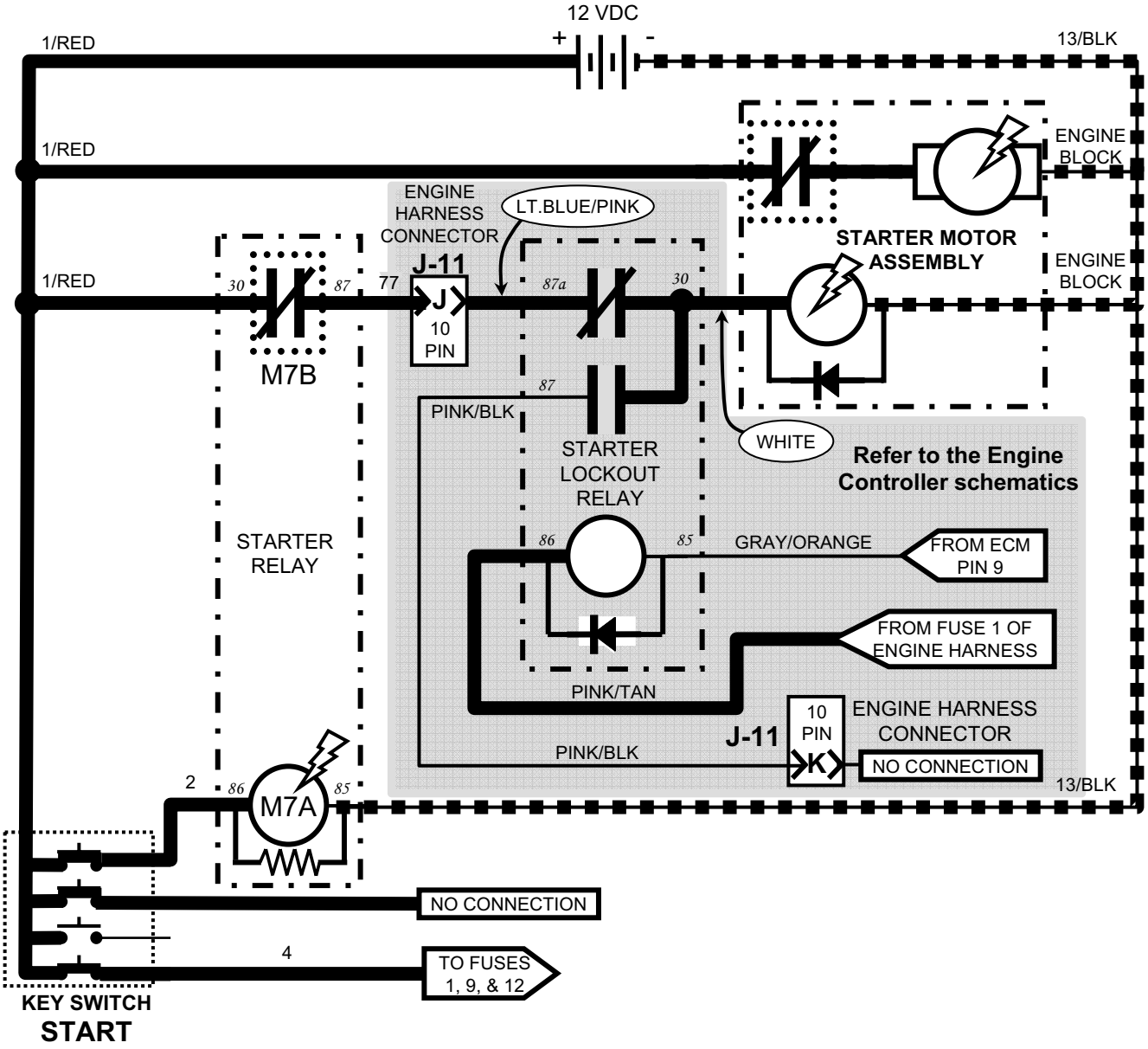
When control board turns ON M6A, the engine ECM loses power, and engine shuts OFF

E

M20 Starting System ON

Conditions: Key turned to start position

(Gas/LPG)



Wiring Color Codes
(Unless otherwise marked)

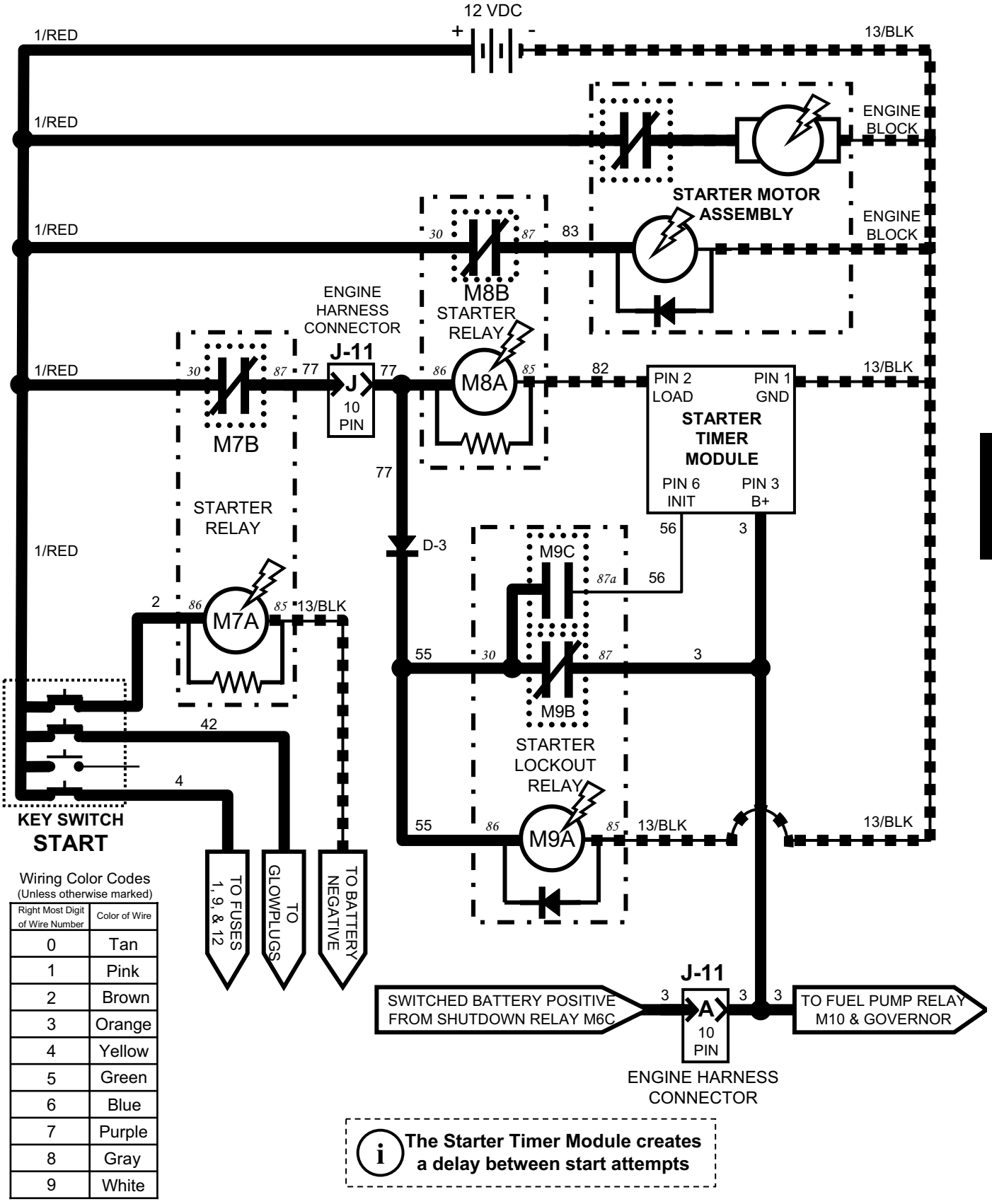
Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

E

M20 Starting System ON

Conditions: Key turned to start position

(Diesel)



Wiring Color Codes
(Unless otherwise marked)

Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

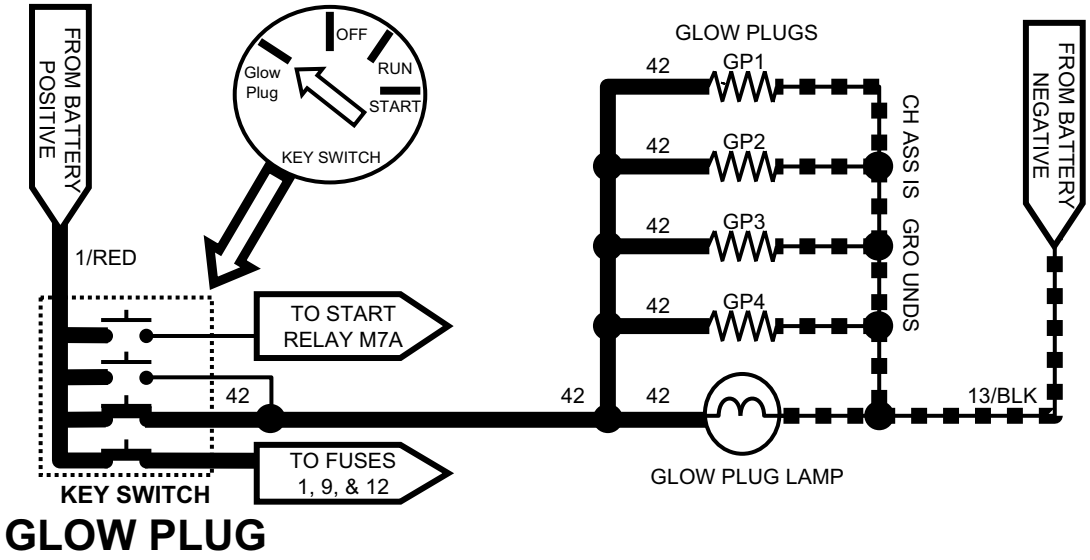
i **The Starter Timer Module creates a delay between start attempts**

E

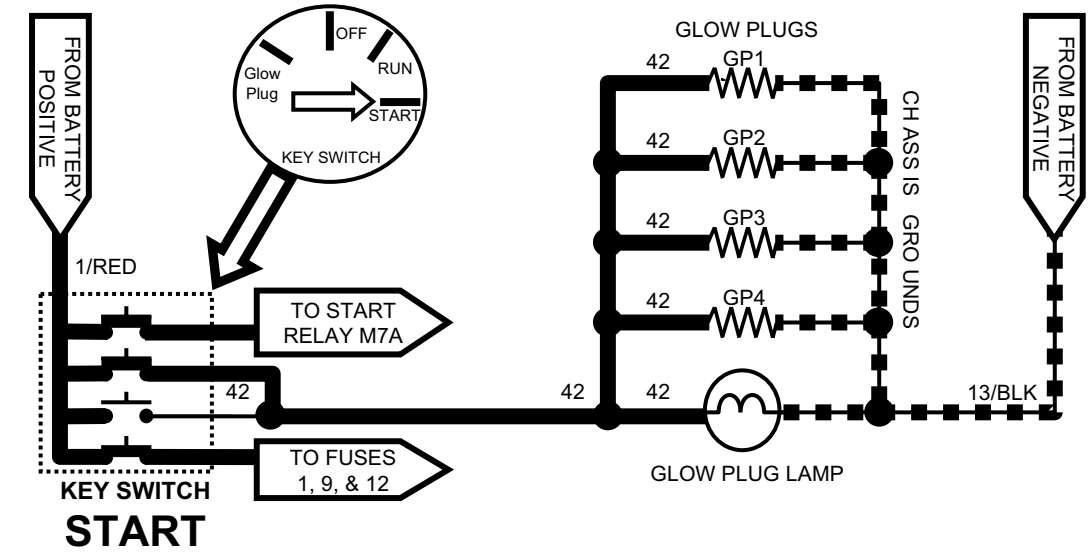
M20 Glow Plugs ON

Conditions: Key turned to start or glow plug position

(Diesel)



GLOW PLUG



START

Wiring Color Codes
(Unless otherwise marked)

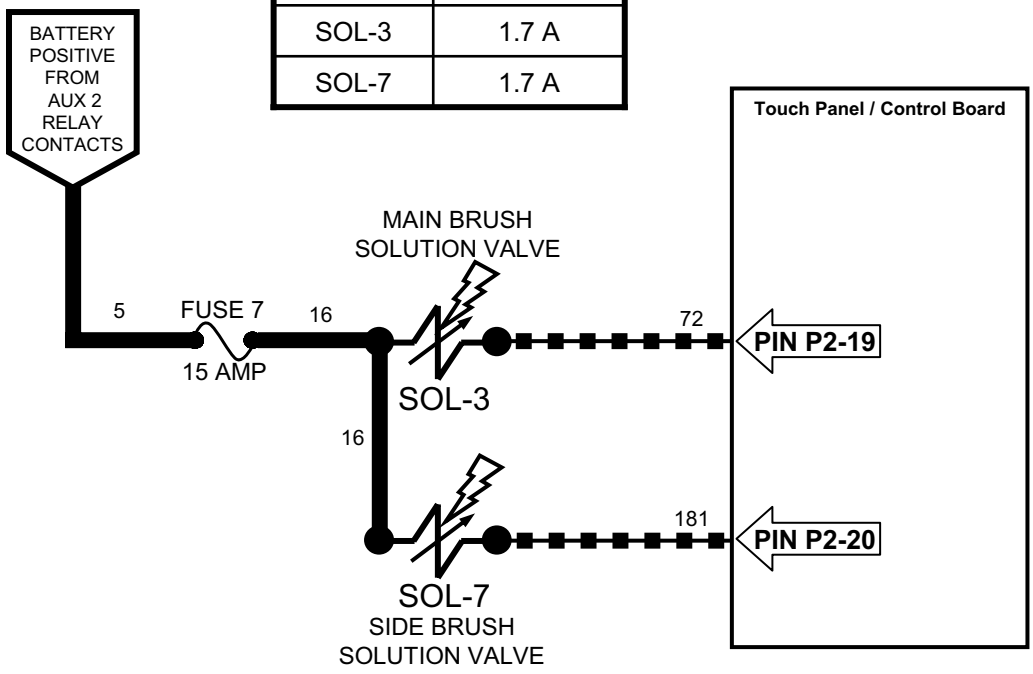
Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

The Glow Plugs are ON *only* when ignition switch is in the "Glow Plug" or "Start" position

M20 Conventional Main & Side Brush Solution Valves

Conditions: Key on, scrubbing system on, side brush on, forward or reverse propel, one or more solution LED's lit

Component	Max Amp Draw
SOL-3	1.7 A
SOL-7	1.7 A



E

i **The Solution Valves are pulsed slowly to adjust the solution volume. Less OFF time (more Solution LED's lit on Touch Panel) will result in more solution applied to floor**

i **The Solution Valves will function only while propelling forward or reverse during scrub operation**

Wiring Color Codes
(Unless otherwise marked)

Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

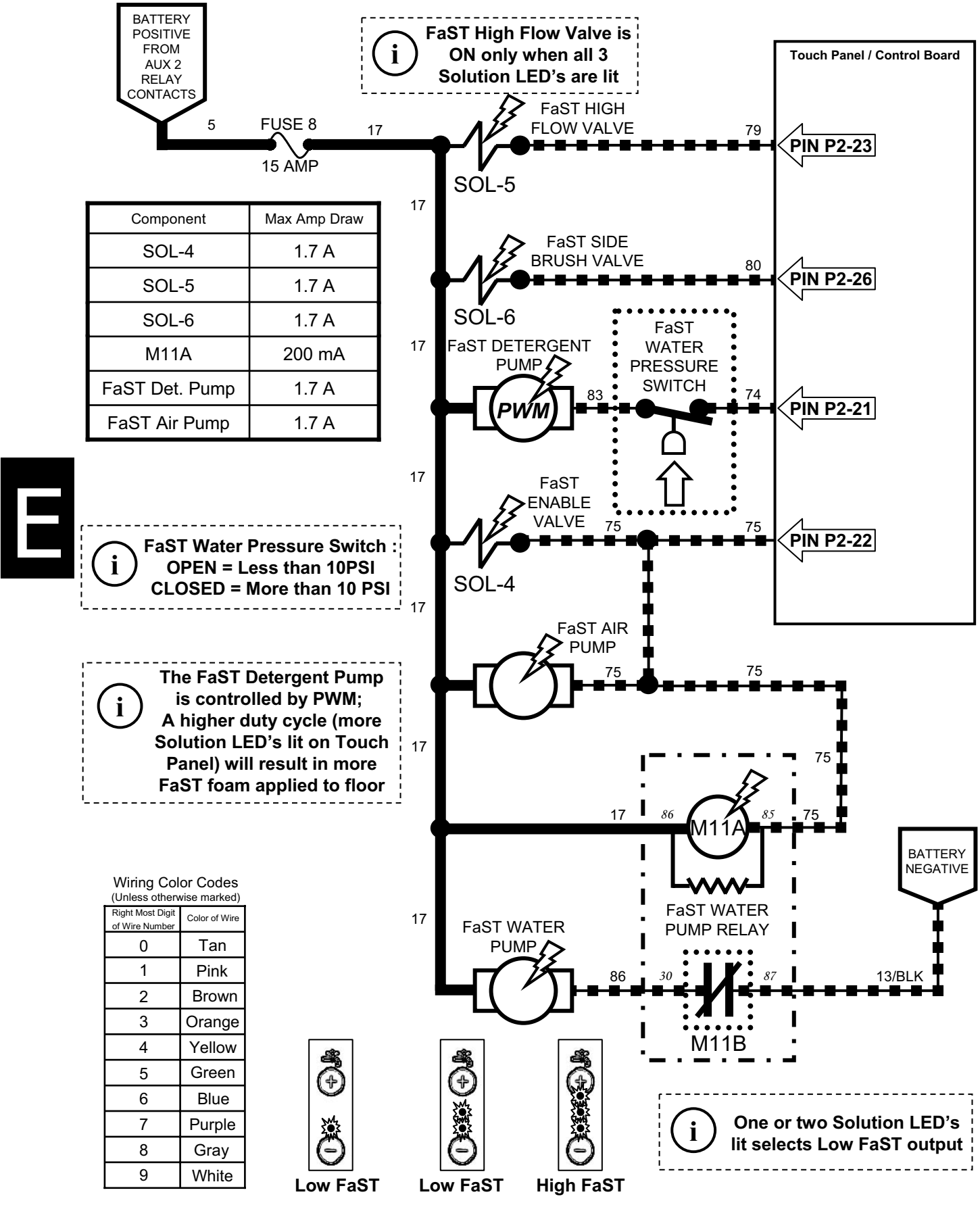
Low Solution

Medium Solution

High Solution

M20 FaST System ON

Conditions: Key on, scrubbing system on, side brush on, forward or reverse propel, one or more solution LED's lit



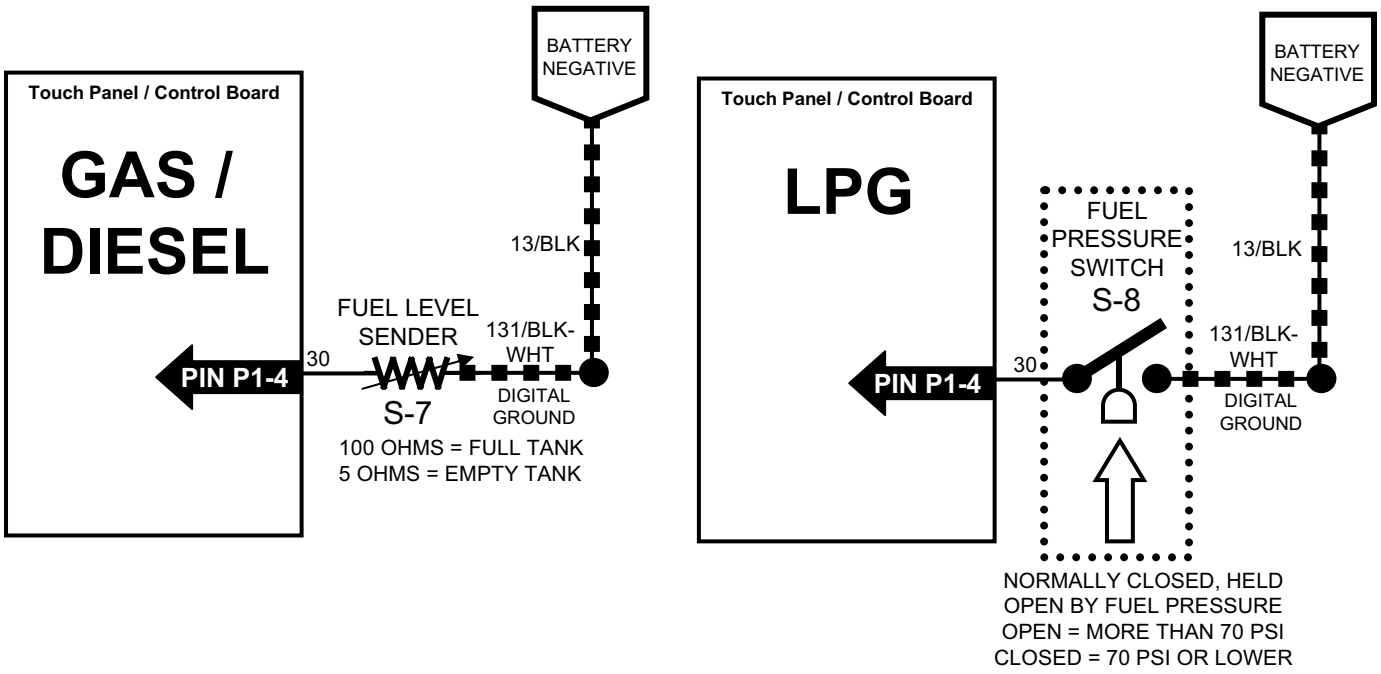
Component	Max Amp Draw
SOL-4	1.7 A
SOL-5	1.7 A
SOL-6	1.7 A
M11A	200 mA
FaST Det. Pump	1.7 A
FaST Air Pump	1.7 A

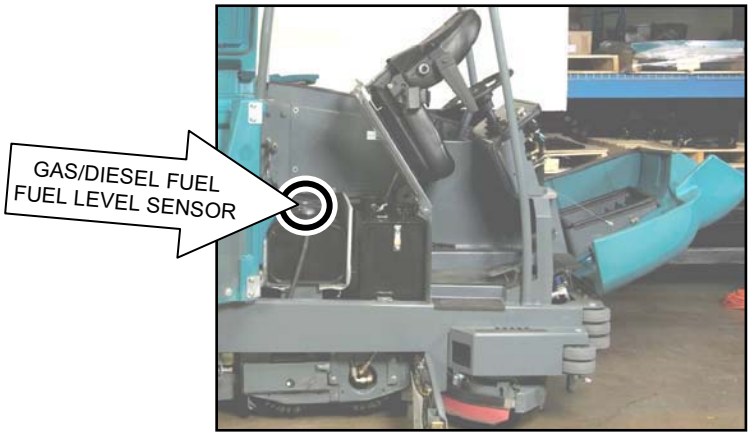
Wiring Color Codes
(Unless otherwise marked)

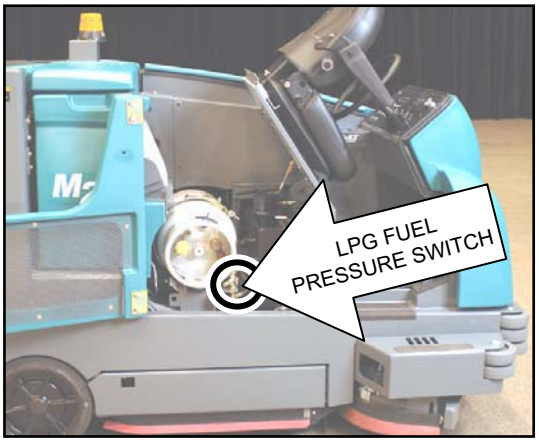
Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

M20 Fuel Level Sensors

Conditions: Key on





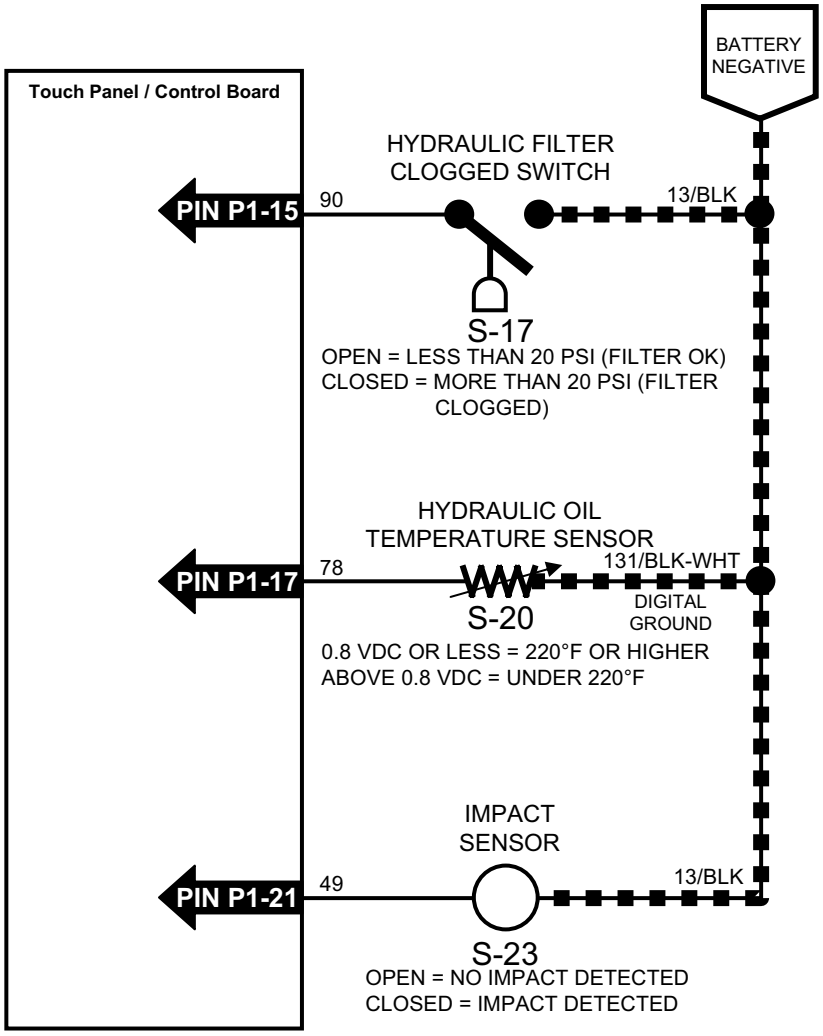


Wiring Color Codes
(Unless otherwise marked)

Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

E

M20 Impact, Hydraulic Temperature, & Hydraulic Filter Sensors

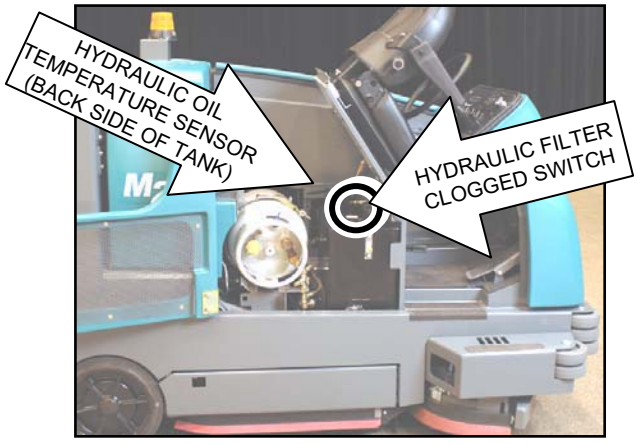


i **The Hydraulic Filter Clogged Switch will not be sensed until after the machine has run for 5 minutes to allow the hydraulic oil to warm up**

i **Impact Sensor S-23 is used only on machines with certain optional equipment**

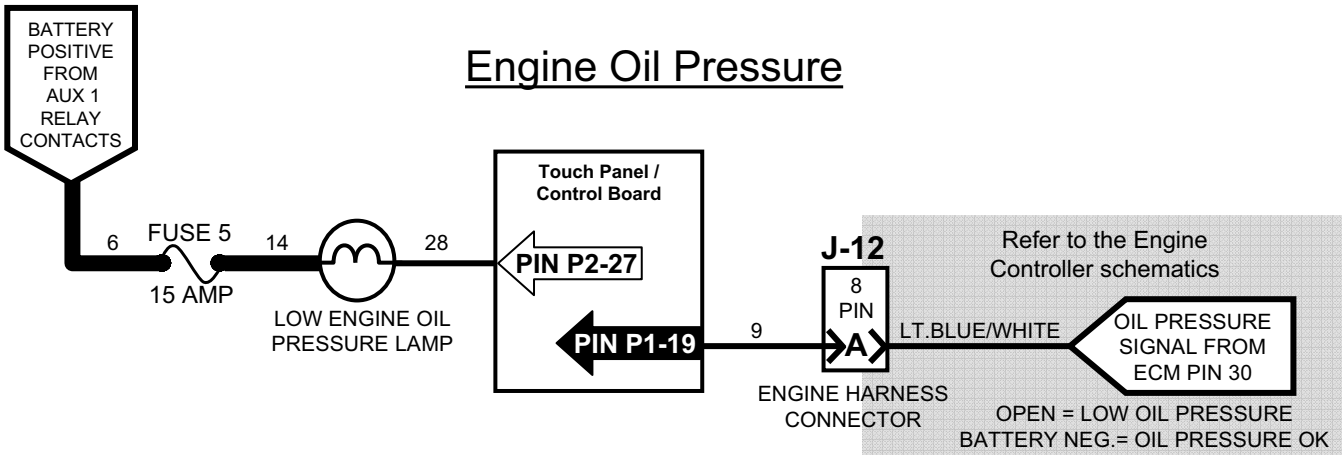
Wiring Color Codes
(Unless otherwise marked)

Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

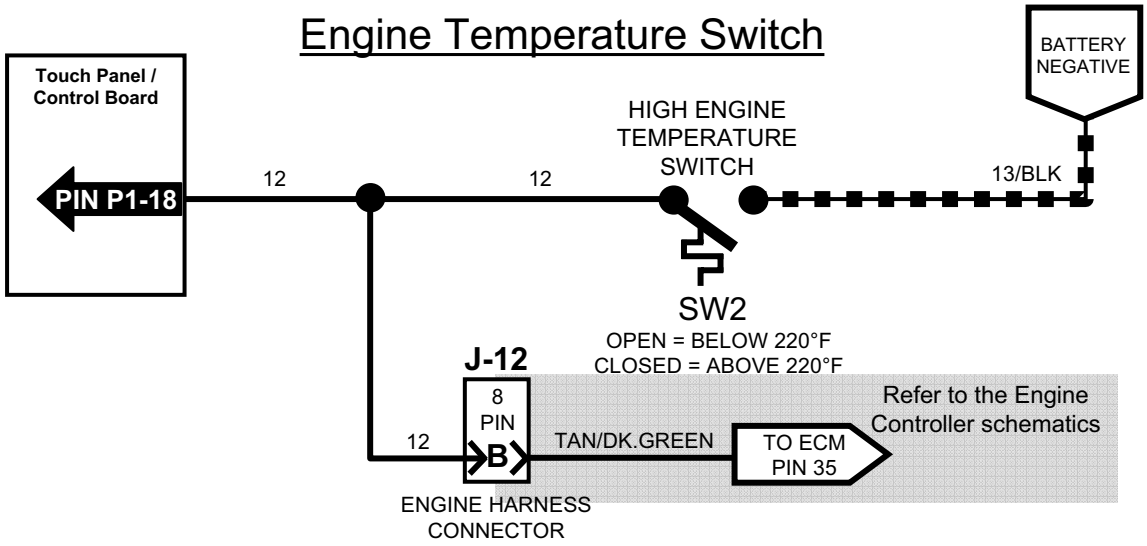


M20 Engine Oil Pressure, Temperature, & MIL Systems
(Gas/LPG)

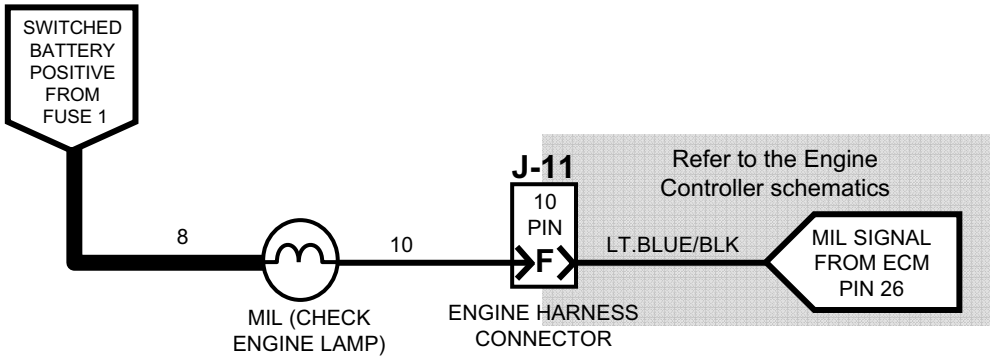
Engine Oil Pressure



Engine Temperature Switch



Malfunction Indicator Lamp



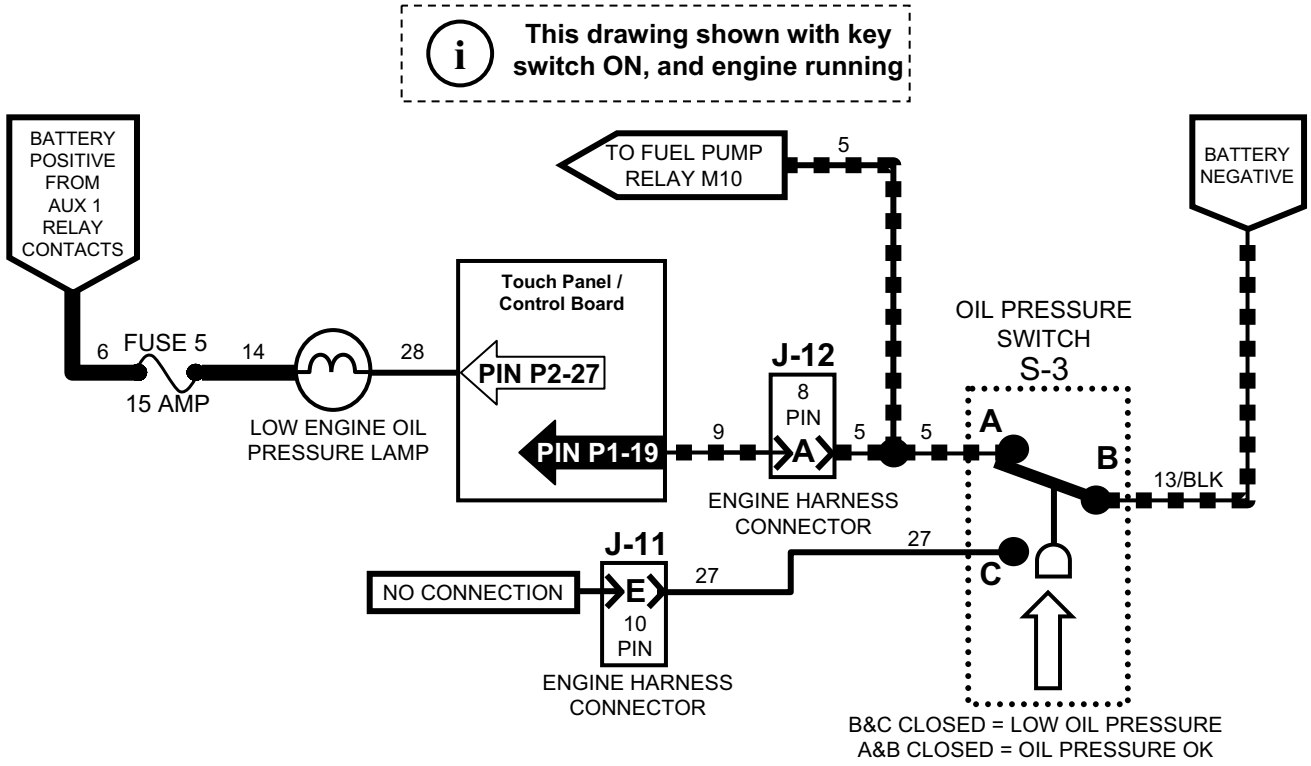
Wiring Color Codes
(Unless otherwise marked)

Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

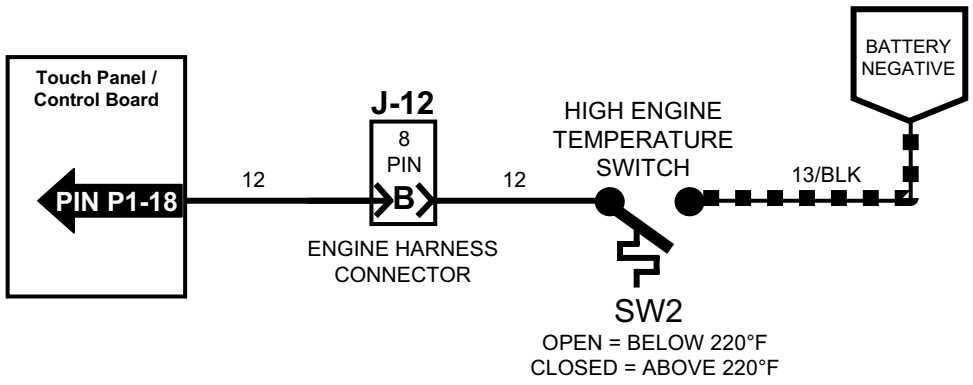
E

M20 Engine Oil Pressure & Temperature Systems
(Diesel)

Engine Oil Pressure Switch



Engine Temperature Switch



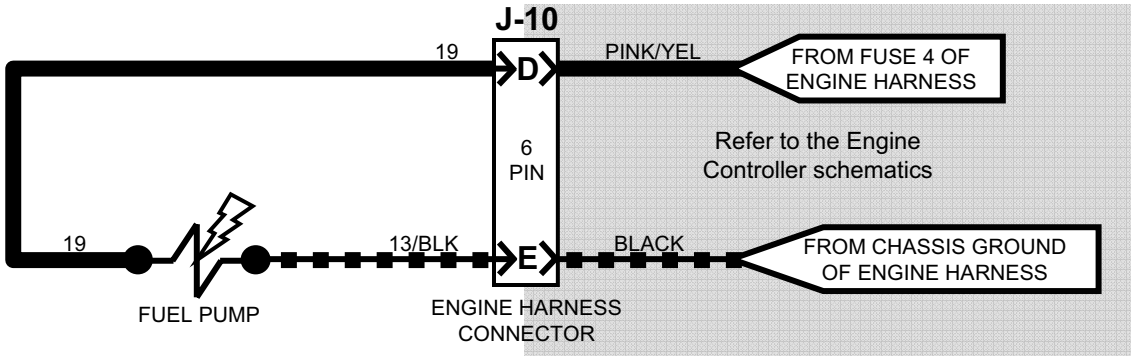
Wiring Color Codes
(Unless otherwise marked)

Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

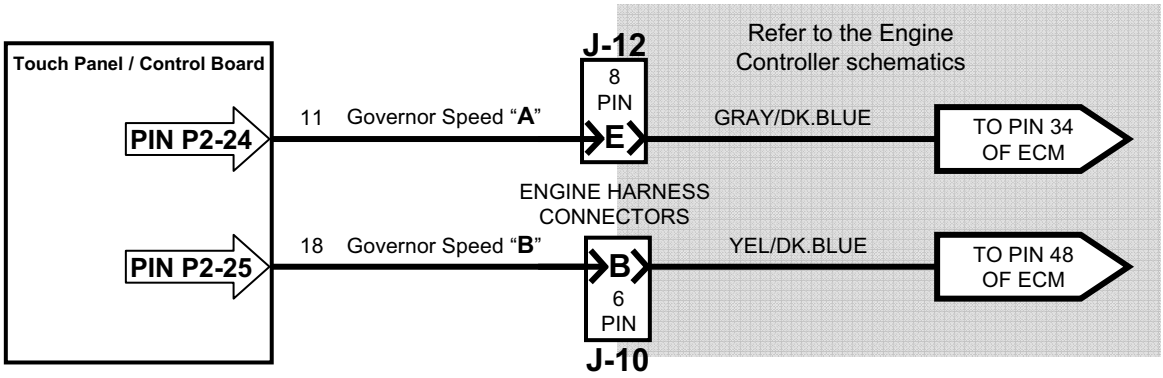
M20 Fuel Pump & Engine Speed Control
(Gas/LPG)

Fuel Pump (Gasoline Only)

This drawing shown with key switch ON, and engine running



Speed Control Output



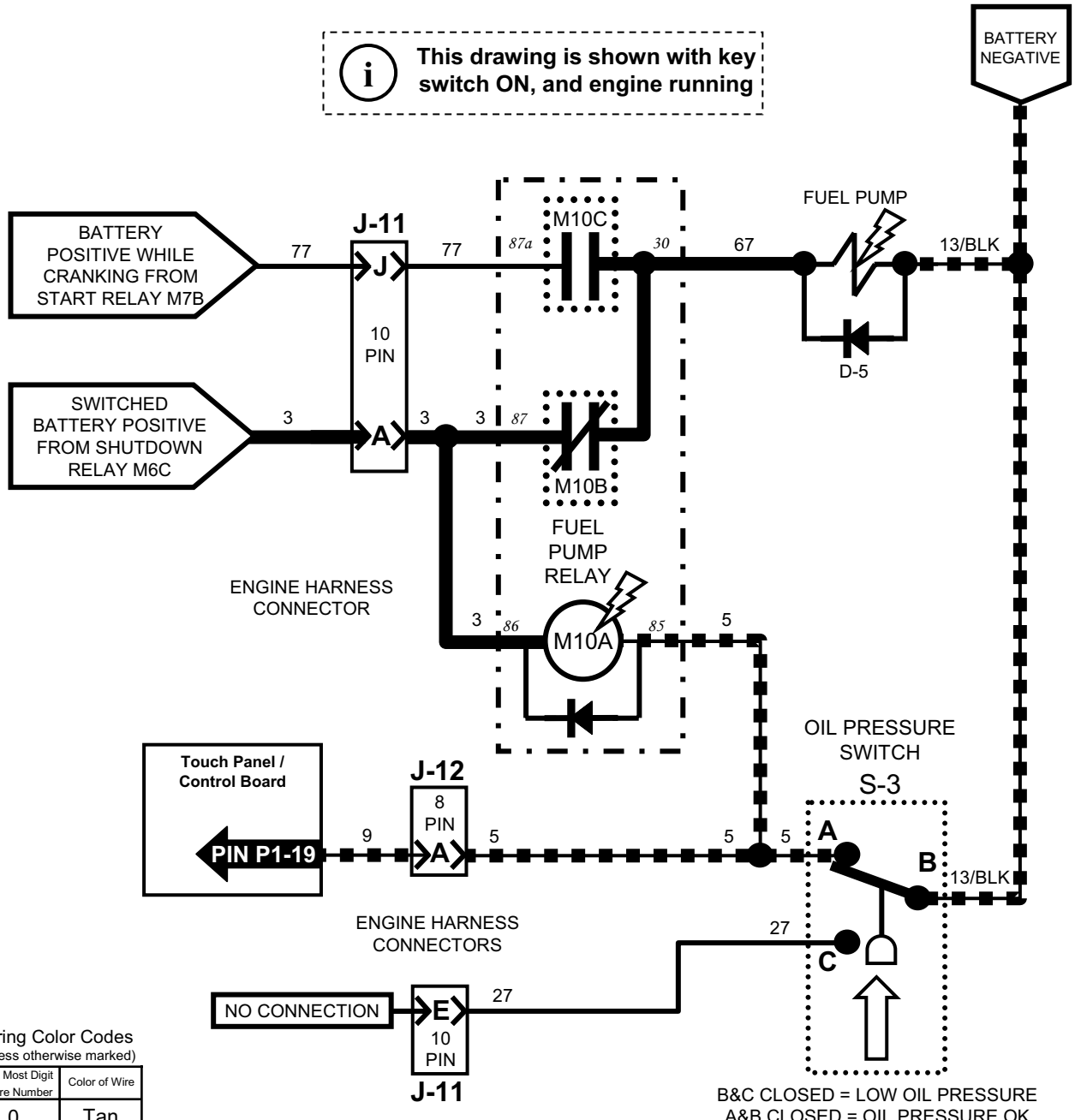
Wiring Color Codes
(Unless otherwise marked)

Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

ENGINE SPEED CHART	Low Engine Speed	High Engine Speed
Engine RPM	950 (+/- 25)	2400 (+/- 25)
Voltage Speed "A"	5 VDC	0 VDC
Voltage Speed "B"	0 VDC	0 VDC

E

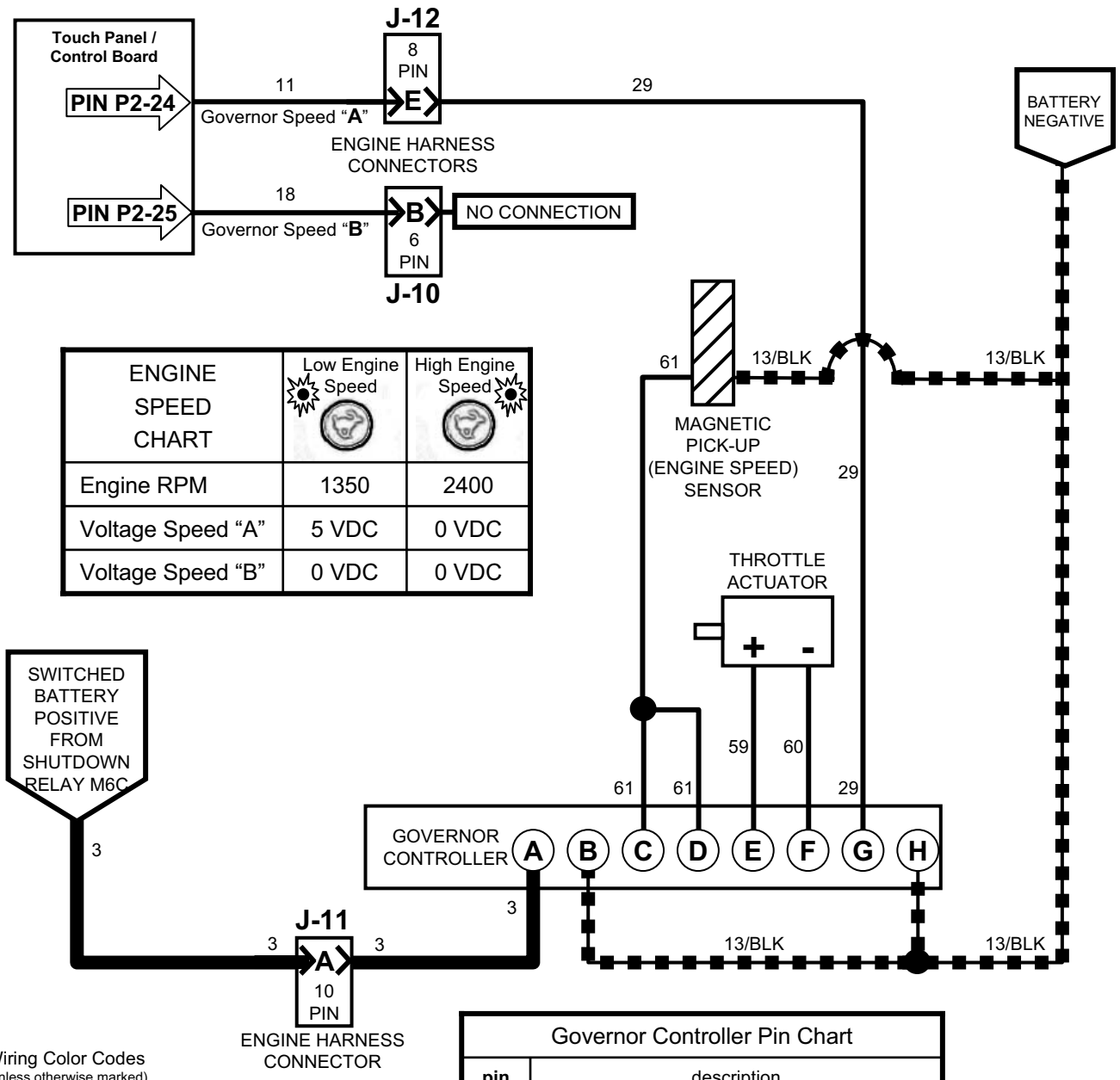
M20 Fuel Pump
(Diesel)



Wiring Color Codes
(Unless otherwise marked)

Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

M20 Engine Speed Control
(Diesel)



ENGINE SPEED CHART	Low Engine Speed	High Engine Speed
Engine RPM	1350	2400
Voltage Speed "A"	5 VDC	0 VDC
Voltage Speed "B"	0 VDC	0 VDC

Wiring Color Codes
(Unless otherwise marked)

Right Most Digit of Wire Number	Color of Wire
0	Tan
1	Pink
2	Brown
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

Governor Controller Pin Chart	
pin	description
A	INPUT – Battery Positive
B	INPUT – Battery Negative
C	INPUT – Engine Speed Sensor
D	INPUT – Engine Speed Sensor
E	OUTPUT – Throttle Actuator **(PWM)**
F	OUTPUT – Throttle Actuator
G	INPUT – Engine Speed Selection "A"
H	INPUT – Engine Speed Selection "B"

E

M20 Enable/Disable Chart

(Page 1 of 2)

M20 Control Board Inputs and the Outputs they Control	Input →		Lower Hopper Switch Closed	Raise Hopper Switch Closed	Hopper Position Switch Closed (Hopper Down)	Hopper Position Switch Open (Hopper Up)	Fuel Level Sender (Gas, Diesel)	Fuel Pressure Switch Closed (LPG)	Hopper Thermal Sentry Switch Closed	Open Hopper Door Switch Closed	Close Hopper Door Switch Closed	Solution Tank Full Switch Closed	Recovery Tank Full Switch Closed	Recovery Tank Half Full Switch Closed	Clogged Hydraulic Filter Switch Closed	Notes
Output ↓	component #		S-5	S-5	S-6	S-6	S-7	S-8	S-9	S-13	S-13	S-14	S-15	S-16	S-17	
		pin	P1-7	P1-8	P1-3	P1-3	P1-4	P1-4	P1-5	P1-9	P1-10	P1-12	P1-13	P1-14	P1-15	
Scrub Vacuum Fan Valve ON	SV-1	P2-28	**D**	**D**	**E**	**D**			**D**	**D**	**D**		**D**			
Main Brush Head Down Pressure Valve ON	SV-2	P2-4	**D**	**D**	**E**	**D**			**D**	**D**	**D**		**D** scrub only			Propel required to to get full operational down pressure
(SCRUBBING) Main Brush Head Lower Valve ON	SV-3	P2-5	**D**	**D**	**E**	**D**			**D**	**D**	**D**		**D**			Propel required to to get full operational down pressure
(SWEEPING) Main Brush Head Lower Valve ON	SV-3	P2-5	**D**	**D**	**E**	**D**			**D**	**D**	**D**					Propel required to to get full operational down pressure
Rear and Side Squeegees Lower Valve ON	SV-4	P2-6	**D**	**D**	**E**	**D**			**D**	**D**	**D**		**D**			
(SCRUBBING) Main Brushes Spin Valve ON	SV-6	P2-5	**D**	**D**	**E**	**D**			**D**	**D**	**D**		**D**			Propel required to to get full operational down pressure
(SWEEPING) Main Brushes Spin Valve ON	SV-6	P2-5	**D**	**D**	**E**	**D**			**D**	**D**	**D**					Propel required to to get full operational down pressure
Hydraulic Enable Valve ON	SV-7	P2-8	**E**	**E**						**E**	**E**					Turns OFF automatically if not required (SV-7 is required for all hydraulic functions EXCEPT sweep and scrub vacuum fans)
Side Brush Spin Valve ON	SV-8	P2-9	**D**	**D**	**E**	**D**			**D**	**D**	**D**		**D** scrub only			
Sweep Vacuum Fan Valve ON	SV-9	P2-10	**D**	**D**	**E**	**D**			**D**	**D**	**D**					
Side Brush Down Pressure Valve ON	SV-10	P2-11	**D**	**D**	**E**	**D**			**D**	**D**	**D**		**D** scrub only			
Side Brush Lower Valve ON	SV-11	P2-12	**D**	**D**	**E**	**D**			**D**	**D**	**D**		**D** scrub only			
Side Brush Extend Valve ON	SV-12	P2-9	**D**	**D**	**E**	**D**			**D**	**D**	**D**		**D** scrub only			
Hopper Lower Valve ON	SV-13	P2-31	**E**	**D**												All sweep or scrub functions are cancelled as long as switch is closed
Hopper Lift Valve ON	SV-14	P2-7	**D**	**E**												Mechanical hopper latch must release for hopper to lift from full down position; All sweep or scrub functions are cancelled as long as switch is closed
Hopper Door Open Valve ON	SV-15	P2-15			Refer to Notes	Refer to Notes				**E**						All sweep or scrub functions are cancelled as long as switch is open; Hopper door closes automatically when hopper down is sensed
Auto-Fill Solution Tank Valve ON	SOL-1	P2-13										**D**				
Auto-Fill Recovery Tank Valve ON	SOL-2	P2-14												**D**		
Main Brushes Solution Valve ON	SOL-3	P2-19	**D**	**D**	**E**	**D**			**D**	**D**	**D**		**D**			
ES Pump ON ***OR*** FaST Enable Valve, Air Pump & Water Pump Relay ON	SOL-4, M11	P2-22	**D**	**D**	**E**	**D**			**D**	**D**	**D**	**D** ES Pump only	**D**	**E** ES Pump only		
FaST High Flow Valve ON	SOL-5	P2-23	**D**	**D**	**E**	**D**			**D**	**D**	**D**		**D**			
FaST Side Brush Valve ON	SOL-6	P2-26	**D**	**D**	**E**	**D**			**D**	**D**	**D**		**D**			
Side Brush Solution Valve ON	SOL-7	P2-20	**D**	**D**	**E**	**D**			**D**	**D**	**D**		**D**			
Hopper Latch Solenoid ON	SOL-9	P2-32		**E**												
Shaker Motor ON	M3A	P2-16														
Reverse Propel	M4A	P2-17														
Shut Down Relay ON	M6A	P2-18														
Detergent Pump ON ***OR*** FaST Detergent Pump ON	n/a	P2-21	**D**	**D**	**E**	**D**			**D**	**D**	**D**		**D**			
Audible Alarm	n/a	P2-29					**E** when low	**E** when low	**E**						**E**	
Low Engine Oil Pressure Lamp	n/a	P2-27														If low oil pressure, engine ECM will shutdown the engine after a time delay
Governor Speed Bit "A"	n/a	P2-24														
Governor Speed Bit "B"	n/a	P2-25														

E = Input required to ENABLE output

D = Input required to DISABLE output

M20 Enable/Disable Chart

(Page 2 of 2)

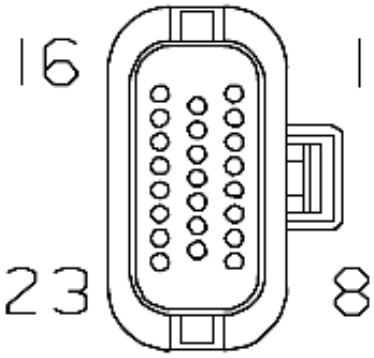
M20 Control Board Inputs and the Outputs they Control	Input →		Clogged Sweep Filter Switch Closed	Soution Tank Empty Switch Closed	Hydraulic Oil Temperature Sensor above 230F	Scrub Vacuum Open Switch Closed	Impact Sensor Closed	Propel Pedal Sensor FORWARD	Propel Pedal Sensor REVERSE	Propel Pedal Sensor NEUTRAL	Touch Panel Input Required to **ENABLE**	Touch Panel Input Required to **DISABLE**	Notes
Output ↓	component #		S-18	S-19	S-20	S-21	S-23	n/a	n/a	n/a			
		pin	P1-16	P1-11	P1-17	P1-6	P1-21	P1-1	P1-1	P1-1			
Scrub Vacuum Fan Valve ON	SV-1	P2-28									OneStep Scrub ON; Squeegee/Scrub Vacuum ON	OneStep Scrub OFF; OneStep Sweep ON; Squeegee/Scrub Vacuum OFF; Low Engine Speed Selected	
Main Brush Head Down Pressure Valve ON	SV-2	P2-4						**E** see notes	**E** see notes	Refer to Notes	OneStep Scrub ON; OneStep Sweep ON	OneStep Scrub OFF; OneStep Sweep OFF; Low Engine Speed Selected	Propel required to to get full operational down pressure
(SCRUBBING) Main Brush Head Lower Valve ON	SV-3	P2-5						**E** see notes	**E** see notes	Refer to Notes	OneStep Scrub ON	OneStep Scrub OFF; OneStep Sweep ON; Low Engine Speed Selected	Propel required to to get full operational down pressure
(SWEEPING) Main Brush Head Lower Valve ON	SV-3	P2-5						**E**	**E**	Refer to Notes	OneStep Sweep ON	OneStep Sweep OFF; OneStep Scrub ON; Low Engine Speed Selected; Squeegee/Scrub Vacuum ON	Propel required to to get full operational down pressure
Rear and Side Squeegees Lower Valve ON	SV-4	P2-6						**E**	**D**	**E**	OneStep Scrub ON; Squeegee/Scrub Vacuum ON	OneStep Scrub OFF; OneStep Sweep ON; Low Engine Speed Selected; Squeegee/Scrub Vacuum OFF	
(SCRUBBING) Main Brushes Spin Valve ON	SV-6	P2-5						**E** see notes	**E** see notes	Refer to Notes	OneStep Scrub ON	OneStep Scrub OFF; OneStep Sweep ON; Low Engine Speed Selected	Propel required to to get full operational down pressure
(SWEEPING) Main Brushes Spin Valve ON	SV-6	P2-5						**E**	**E**	Refer to Notes	OneStep Sweep ON	OneStep Sweep OFF; OneStep Scrub ON; Low Engine Speed Selected; Scrub Vacuum ON	Propel required to to get full operational down pressure
Hydraulic Enable Valve ON	SV-7	P2-8									Turning ON Any Touch Panel Function OR Selecting High Engine Speed	Refer to Notes	Turns OFF automatically if not required (SV-7 is required for all hydraulic functions EXCEPT sweep and scrub vacuum fans)
Side Brush Spin Valve ON	SV-8	P2-9						**E**	**E**		Side Brush ON (after OneStep Scrub ON ***OR*** OneStep Sweep ON)	OneStep Scrub OFF; OneStep Sweep OFF; Low Engine Speed Selected; Side Brush OFF	
Sweep Vacuum Fan Valve ON	SV-9	P2-10											
Side Brush Down Pressure Valve ON	SV-10	P2-11						**E**	**E**		Side Brush ON (after OneStep Scrub ON ***OR*** OneStep Sweep ON)	OneStep Scrub OFF; OneStep Sweep OFF; Low Engine Speed Selected; Side Brush OFF	
Side Brush Lower Valve ON	SV-11	P2-12											
Side Brush Extend Valve ON	SV-12	P2-9						**E**	**E**		Side Brush ON (after OneStep Scrub ON ***OR*** OneStep Sweep ON)	OneStep Scrub OFF; OneStep Sweep OFF; Low Engine Speed Selected; Side Brush OFF	
Hopper Lower Valve ON	SV-13	P2-31											All sweep or scrub functions are cancelled as long as switch is closed
Hopper Lift Valve ON	SV-14	P2-7											Mechanical hopper latch must release for hopper to lift from full down position; All sweep or scrub functions are cancelled as long as switch is closed
Hopper Door Open Valve ON	SV-15	P2-15											All sweep or scrub functions are cancelled as long as switch is open; Hopper door closes automatically when hopper down is sensed
Auto-Fill Solution Tank Valve ON	SOL-1	P2-13											
Auto-Fill Recovery Tank Valve ON	SOL-2	P2-14											
Main Brushes Solution Valve ON	SOL-3	P2-19											
ES Pump ON ***OR*** FaST Enable Valve, Air Pump & Water Pump Relay ON	SOL-4, M11	P2-22											
FaST High Flow Valve ON	SOL-5	P2-23											
FaST Side Brush Valve ON	SOL-6	P2-26											
Side Brush Solution Valve ON	SOL-7	P2-20											
Hopper Latch Solenoid ON	SOL-9	P2-32											
Shaker Motor ON	M3A	P2-16											
Reverse Propel	M4A	P2-17											
Shut Down Relay ON	M6A	P2-18											
Detergent Pump ON ***OR*** FaST Detergent Pump ON	n/a	P2-21											
Audible Alarm	n/a	P2-29	**E**	**E**	**E**	**E**							
Low Engine Oil Pressure Lamp	n/a	P2-27											If low oil pressure, engine ECM will shutdown the engine after a time delay
Governor Speed Bit "A"	n/a	P2-24											
Governor Speed Bit "B"	n/a	P2-25											

E = Input required to ENABLE output
D = Input required to DISABLE output

M20 Control Board Connectors

socket #	wire #	color	type	goes to	
P1-1	91	pink	input		Forward/Reverse Propel Sensor
P1-2	x	x	x		empty
P1-3	89	white	input	S-6	Hopper Position Switch
P1-4	30	tan	input	S-7 or S-8	Fuel Level Sensor or Pressure Switch
P1-5	31	pink	input	S-9	Thermal Sentry Switch
P1-6	39	white	input	S-21	Scrub Vacuum Open Switch
P1-7	35	green	input	S-5	Hopper Up/Down Switch
P1-8	36	blue	input	S-5	Hopper Up/Down Switch
P1-9	42	brown	input	S-13	Hopper Door Open/Close Switch
P1-10	43	orange	input	S-13	Hopper Door Open/Close Switch
P1-11	177	purple	input	S-19	Solution Tank Empty Switch
P1-12	44	yellow	input	S-14	Solution Tank Full Switch
P1-13	45	green	input	S-15	Recovery Tank Full Switch
P1-14	46	blue	input	S-16	Recovery Tank Half Full Switch
P1-15	90	tan	input	S-17	Clogged Hydraulic Filter Switch
P1-16	48	gray	input	S-18	Clogged Shaker Filter Switch
P1-17	78	gray	input	S-20	Hydraulic Temperature Sensor
P1-18	12	brown	input	SW2	High Engine Temperature Switch
P1-19	9	white	input		Engine Oil Pressure Signal
P1-20	x	x	x		empty
P1-21	49	white	input	S-23	Impact Sensor
P1-22	x	x	x		empty
P1-23	105	green	ground		Static Ground

Connector P1



Viewed from wire side of connector

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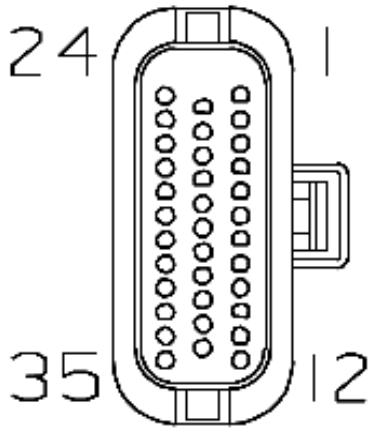
socket #	wire #	color	type	goes to	
P2-1	14	yellow	power		Switched Battery Positive
P2-2	14	yellow	power		Switched Battery Positive
P2-3	81	pink	power		Unswitched Battery Positive
P2-4	57	purple	output	SV-2	Brush Head Pressure Solenoid Valve
P2-5	58	gray	output	SV-3, SV-6	Brush Head Down & ON Solenoid Valves
P2-6	59	white	output	SV-4	Squeegees Down Solenoid Valve
P2-7	60	tan	output	SV-14	Hopper Up Solenoid Valve
P2-8	61	pink	output	SV-7	Hydraulic Enable Solenoid Valve
P2-9	62	brown	output	SV-8, SV-12	Side Brush ON & Extend Solenoid Valves
P2-10	63	orange	output	SV-9	Sweep Vacuum Fan Solenoid Valve
P2-11	64	yellow	output	SV-10	Side Brush Pressure Solenoid Valve
P2-12	66	blue	output	SV-11	Side Brush Down Solenoid Valve
P2-13	65	green	output	SOL-1	Solution Tank Auto Fill Water Valve
P2-14	67	purple	output	SOL-2	Recovery Tank Auto Fill Water Valve
P2-15	68	gray	output	SV-15	Hopper Door Open Solenoid Valve
P2-16	69	white	output	M3A	Shaker Relay
P2-17	70	tan	output	M4A	Reverse Relay
P2-18	71	pink	output	M6A	Shutdown Relay
P2-19	72	brown	output	SOL-3	Main Brush Head Water Valve
P2-20	181	pink	output	SOL-7	Side Brush Water Valve
P2-21	74	yellow	output		Detergent Pump or FaST Pressure Switch
P2-22	75	green	output	SOL-4, M11A	ES Pump or FaST Enable Valve, Air Pump, Water Pump Relay
P2-23	79	white	output	SOL-5	FaST High Flow Valve
P2-24	11	pink	output		ECM (Governor Speed Bit "A")
P2-25	18	gray	output		ECM (Governor Speed Bit "B")
P2-26	80	tan	output	SOL-6	FaST Side Brush Valve
P2-27	28	gray	output		Low Engine Oil Pressure Lamp
P2-28	56	blue	output	SV-1	Scrub Vacuum Fan Valve
P2-29	182	brown	output		Audible Alarm
P2-30	x	x	x		empty
P2-31	53	orange	output	SV-13	Hopper Down Solenoid Valve
P2-32	138	gray	output	SOL-9	Hopper Latch Solenoid
P2-33	13	black	ground		Unswitched Battery Negative
P2-34	13	black	ground		Unswitched Battery Negative
P2-35	13	black	ground		Unswitched Battery Negative

Connector P2



Viewed from wire side of connector

M20 Fault Indicators

The following table describes fault codes communicated to the operator. A fault code is indicated by blinking a Fault LED (red), sounding an alarm, and also by displaying the fault name on the LCD. Faults can be cleared when they are no longer present ***and*** one of the action buttons (i.e. One-Step) is depressed. If there is more than one fault, they are displayed for about a second, one after the other.

Fault	LCD Display	Description
Hopper Up Error	**F1: HOPPER UP**	Indicates and prevents an attempt to engage Scrub/Sweep systems without the hopper down switch engaged.
Hydraulic Filter Clogged	**F3: CLOGGED HYD.**	Indicates the hydraulic filter is clogged.
Sweep Filter Clogged	**F4: SHAKER FILTER**	Indicates the Sweep dust filter is clogged.
Hopper Fire	**F5: HOPPER FIRE**	Indicates that the hopper is too hot due to fire, etc. Turns off entire sweep system.
Solution Tank empty	**F6: SOL. TANK E**	Indicates the solution tank is empty.
Recovery Tank Full	**F7: REC. TANK FULL**	Indicates the recovery tank is full and shuts down the entire Scrub system.
High Engine Temperature	**F8: HIGH ENG TEMP**	Indicates high engine temperature.
High Hydraulic Temperature	**F9: HIGH HYD TEMP**	Indicates excessive hydraulic temperature
Low Fuel	**F10: LOW FUEL**	Low fuel indicator (blinking lowest fuel gauge block).
Squeegee Disconnected (Option)	**F11: OPEN SCB VAC**	Indicates squeegee may have broken free.

M20 Condition & Warning Indicators

The following table describes displayed conditions or warnings. If a condition is sensed, the condition or warning code will be displayed on the LCD. Conditions are typically caused by activating buttons that are unavailable. For example: the Sweep vacuum fan is unavailable when the scrub functions are active.

Condition	LCD DISPLAY	Description
Squeegee Vacuum button is activated with Sweep system active.	**C1: NO SQGE/VAC**	When Sweep system is active, the Scrub vacuum is unavailable.
Sweep Vacuum button is activated with Scrub system active.	**C2: NO SWEEP VAC**	When Scrub system is active, the Sweep vacuum is unavailable.
FaST system is selected by the operator and the machine is not configured with the FaST option.	**C3: NO FAST MODE**	Only machines with the FaST system installed (and programmed to be FaST machines) can turn ON the FaST system.
ES system is selected by the operator and the machine is not configured with the ES option.	**C4: NO ES MODE**	Only machines with the ES system installed (and programmed to be ES machines) can turn ON the ES system.
FaST or ES system is selected by the operator and the machine is not configured with the ES or FaST option.	**C5: NO ES/FAST**	Only machines with the ES or FaST system installed (and programmed to be ES or Fast machines) can turn ON the ES or FaST system.
Side Brush button is activated alone without 1-STEP Sweep/Scrub.	**C6: NO SIDE BRUSH**	The M20 machine is NOT programmed to operate with only the side brush ON.

M20 Configuration Modes

Configuration modes are designed for use by a technician for setup purposes.

To enter the Configuration modes:

1) Press "**4/5**" and **Side-Brush** buttons simultaneously.
2) While holding the "**4/5**" and **Side-Brush** buttons, turn the ignition key switch to the "RUN" position.
3) Continue holding the "**4/5**" and **Side-Brush** buttons until "**CONFIG MODE**" is displayed on the screen, then release the buttons.

While In Configuration Mode:
Each single activation of the "**2/3**" button will scroll through the various configurations available. Each configuration is displayed one at a time on the LCD. Once the desired configuration mode is displayed, push the "**0/1**" to select the displayed mode.

To enter Pressure Adjust Mode:

1) Enter Configuration Mode.
2) Press "**2/3**" button until "PRESS. ADJ MODE" is displayed.
3) Press "**0/1**" button again to select pressure adjust mode. "READY" is displayed on LCD screen.

The following table shows the different configuration modes the machine can be placed in.

Mode	Entry Sequence / Indicator	Function / Notes
Reset Default down pressures	1) Enter Configuration Mode, then put the machine into Pressure Adjust Mode. 2) Press "**4/5**" button to reset all the down pressures. "SET TO DEFAULT" is displayed on LCD screen.	Resets all the down pressure defaults to the factory default levels.
Adjusting the Main Scrub brush down pressure	1) Enter Configuration Mode, then put the machine into Pressure Adjust Mode. 2) Press 1-STEP Scrub button to select Scrub pressure adjust. The 1-STEP Scrub LED is ON. 3) Use brush pressure "**+**" or "**-**" buttons to select which pressure level to adjust (Low/Medium/High). 4) Press "**0/1**" button to increase the down pressure OR press "**8/9**" button to decrease the down pressure. 5) Press 1-STEP Scrub button again or turn key switch OFF to save new down pressure settings.	Adjusts main scrub brush down pressures. Bars on bar graph represent solenoid valve current when adjusting the down pressure. Each bar indicates approximately 125mA of valve current.
Adjusting the Main Sweep brush down pressure	1) Enter Configuration Mode, then put the machine into Pressure Adjust Mode. 2) Press 1-STEP Sweep button to select Sweep pressure adjust. The 1-STEP Sweep LED is ON. 3) Use brush pressure "**+**" or "**-**" buttons to select which pressure level to adjust (Low/Medium/High). 4) Press "**0/1**" button to increase the down pressure OR press "**8/9**" button to decrease the down pressure. 5) Press 1-STEP Sweep button again or turn key switch OFF to save new down pressure settings.	Adjusts main sweep brush down pressures. Bars on bar graph represent solenoid valve current when adjusting the down pressure. Each bar indicates approximately 125mA of valve current.

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M20 Configuration Modes

To enter the Configuration modes:

1) Press "**4/5**" and **Side-Brush** buttons simultaneously.
2) While holding the "**4/5**" and **Side-Brush** buttons, turn the ignition key switch to the "RUN" position.
3) Continue holding the "**4/5**" and **Side-Brush** buttons until "**CONFIG MODE**" is displayed on the screen, then release the buttons.

While In Configuration Mode:
Each single activation of the "**2/3**" button will scroll through the various configurations available. Each configuration is displayed one at a time on the LCD. Once the desired configuration mode is displayed, push the "**0/1**" to select the displayed mode.

To enter Pressure Adjust Mode:

1) Enter Configuration Mode.
2) Press "**2/3**" button until "PRESS. ADJ MODE" is displayed.
3) Press "**0/1**" button again to select pressure adjust mode. "READY" is displayed on LCD screen.

Mode	Entry Sequence / Indicator	Function / Notes
Adjusting the Side Scrub brush down pressure	1) Enter Configuration Mode, then put the machine into Pressure Adjust Mode. 2) Press Side Brush button to select Side Scrub Brush pressure adjust. The Side Brush LED is ON. 3) Use brush pressure "**+**" or "**-**" buttons to select which pressure level to adjust (Low/Medium/High). 4) Press "**0/1**" button to increase the down pressure OR press "**8/9**" button to decrease the down pressure. 5) Press Side Brush button again or turn key switch OFF to save new down pressure settings.	Adjusts Side Scrub brush down pressures. Bars on bar graph represent solenoid valve current when adjusting the down pressure. Each bar indicates approximately 125mA of valve current.
Adjusting the Side Sweep brush down pressures	1) Enter Configuration Mode, then put the machine into Pressure Adjust Mode. 2) Press Sweep Vacuum Fan button to select Side Sweep Brush pressure adjust. The Sweep Vacuum Fan LED is ON. 3) Use brush pressure "**+**" or "**-**" buttons to select which Side Sweep Brush pressure level is desired (Low/Medium/High). 4) Press Sweep Vacuum Fan button again or turn key switch OFF to save new down pressure settings.	Adjust sweeping side brush down pressure. **Note**: Only one of three Side Sweep down pressure settings can be selected. The Side Brush pressure does not increase when Main Brush pressure is increased during **SWEEP FUNCTION ONLY**.

M20 Configuration Modes

To enter the Configuration modes:

1) Press "**4/5**" and **Side-Brush** buttons simultaneously.
2) While holding the "**4/5**" and **Side-Brush** buttons, turn the ignition key switch to the "RUN" position.
3) Continue holding the "**4/5**" and **Side-Brush** buttons until "**CONFIG MODE**" is displayed on the screen, then release the buttons.

While In Configuration Mode:
Each single activation of the "**2/3**" button will scroll through the various configurations available. Each configuration is displayed one at a time on the LCD. Once the desired configuration mode is displayed, push the "**0/1**" to select the displayed mode.

Mode	Entry Sequence / Indicator	Function / Notes
Disable *BOTH* the ES and FaST systems	1) Enter Configuration Mode. 2) Press "**2/3**" button until "C5: NO ES/FAST" is displayed. 3) Press "**0/1**" button to disable ES and FaST systems. "DONE" is displayed on LCD screen.	This is a set-up mode that disables both ES and FaST functions.
Enable the FaST system (also disables the ES system)	1) Enter Configuration Mode. 2) Press "**2/3**" button until "FAST MODE" is displayed. 3) Press "**0/1**" button to enable the FaST system. "DONE" is displayed on LCD screen.	This is a set-up mode that enables the FaST system, and disables the ES system.
Enable the ES system (also disables the FaST system)	1) Enter Configuration Mode. 2) Press "**2/3**" button until "ES MODE" is displayed 3) Press "**0/1**" button to enable the ES system. "DONE" is displayed on LCD screen.	This is a set-up mode that enables the ES system, and disables the FaST system.
LCD Display Contrast Adjust mode	1) Enter Configuration Mode. 2) Press "**2/3**" button until "CONTRAST ADJUST" is displayed. 3) Press "**0/1**" button to select mode. "SET CONTRAST" is displayed on screen. 4) Press and hold "**0/1**" button to increase screen contrast OR press and hold "**8/9**" to decrease screen contrast.	This allows the setting of the contrast of the LCD screen display.

M20 Configuration Modes

To enter the Configuration modes:

1) Press "**4/5**" and **Side-Brush** buttons simultaneously.
2) While holding the "**4/5**" and **Side-Brush** buttons, turn the ignition key switch to the "RUN" position.
3) Continue holding the "**4/5**" and **Side-Brush** buttons until "**CONFIG MODE**" is displayed on the screen, then release the buttons.

While In Configuration Mode:
Each single activation of the "**2/3**" button will scroll through the various configurations available. Each configuration is displayed one at a time on the LCD. Once the desired configuration mode is displayed, push the "**0/1**" to select the displayed mode.

Mode	Entry Sequence / Indicator	Function / Notes
Detergent delivery level adjustment mode	1) Enter Configuration Mode. 2) Press "**2/3**" button until "SET DET LEVEL" is displayed. 3) Press "**0/1**" button to enter mode. "READY" is displayed on screen. 4) Press button shown below to select the desired detergent delivery level: "**0/1**" – HEAVY "**2/3**" – NORMAL "**4/5**" – LIGHT "**6/7**" – OFF The selected level is displayed on screen.	Allows for the adjustment of the Detergent level flow. There are four selections: HEAVY, NORMAL, LIGHT, and OFF. NOTE: "NORMAL" means factory default detergent delivery level.
Water delivery level adjustment mode	1) Enter Configuration Mode. 2) Press "**2/3**" button until "SET WATER LEVEL" is displayed. 3) Press "**0/1**" button to enter mode. "READY" is displayed on screen. 4) Press button shown below to select the desired water delivery level: "**0/1**" – HEAVY WATER "**2/3**" – NORMAL WATER "**4/5**" – ECONOMY WATER The selected level is displayed on screen.	Allows for the adjustment of the Water flow. There are three selections: HEAVY, NORMAL, and ECONOMY. NOTE: "NORMAL" means factory default water delivery level.
Side Brush Mode	1) Enter Configuration Mode. 2) Press "**2/3**" button until "SIDE_BRUSH _MODE" is displayed. 3) Press "**0/1**" button to observe "SIDE_SWEEP&SCRUB" or "SIDE_SWEEP_ONLY" 4) Press 1-STEP Scrub button to toggle between modes. 5) After desired mode is displayed, press "**2/3**" button to continue to a different mode or turn key switch OFF to save new setting.	This mode allows the machine to be set-up as a Side Sweep ONLY machine **OR** Side Sweep AND Side Scrub machine. **Note**: There will be ***NO*** solution delivery to Side Brush when in Scrub mode if "SIDE_SWEEP_ONLY" is selected.

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M20 Diagnostic Modes

To enter the Configuration modes:

1) Press "**4/5**" and **Side-Brush** buttons simultaneously.
2) While holding the "**4/5**" and **Side-Brush** buttons, turn the ignition key switch to the "RUN" position.
3) Continue holding the "**4/5**" and **Side-Brush** buttons until "**CONFIG MODE**" is displayed on the screen, then release the buttons.

While In Configuration Mode:
Each single activation of the "**2/3**" button will scroll through the various configurations available. Each configuration is displayed one at a time on the LCD. Once the desired configuration mode is displayed, push the "**0/1**" to select the displayed mode.

<table>
<tr><th>Mode</th><th>Entry Sequence / Indicator</th><th>Function / Notes</th></tr>
<tr><td rowspan="2">Self Test Mode</td><td>1) Enter Configuration Mode.
2) Press "2/3" button until "SELF TEST" is displayed.
3) Press "0/1" button to run the self test. When Self Test is finished, "DONE" & the software revision date is shown (mmddyy).</td><td>This diagnostic test determines the status of the electrical load on each output. All output pins with open or shorted electrical loads are displayed on the screen with the control board pin number, and the condition of that output. If no faults are detected an "OK" message is displayed.</td></tr>
<tr><td colspan="2">Self Test Mode Notes:
• The LCD screen will show "DONE" when the Self-Test is complete. <u>It will not show "PASS" or FAIL".</u>
• All unused outputs will show "OPEN" if the machine is not equipped with certain options.
Some examples of this may be:
– Solution Tank Auto Fill Valve (P2-13 OPEN)
– Recovery Tank Auto Fill Valve (P2-14 OPEN)
• The Detergent Pump output (P2-21) will show "OPEN" on machines equipped with the FaST system because of the FaST Water Pressure Switch (open when Water Pump is not running). To allow the Self-Test to check the FaST Detergent Pump output, place a jumper wire across the terminals of the FaST Water Pressure Switch harness connector.</td></tr>
<tr><td>Manual Mode</td><td>1) Enter Configuration Mode.
2) Press "2/3" button until "MANUAL MODE" is displayed.
3) Press "0/1" button to select Manual Mode. "MANUAL MODE OPR" is displayed on screen.</td><td>Allows the technician to turn on machine functions regardless of the status of the sensed inputs.
EX: The ES pump will turn on when ES is selected, regardless of the state of the tank float switches.</td></tr>
</table>

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M20 Diagnostic Modes

To enter the Configuration modes:

1) Press "**4/5**" and **Side-Brush** buttons simultaneously.
2) While holding the "**4/5**" and **Side-Brush** buttons, turn the ignition key switch to the "RUN" position.
3) Continue holding the "**4/5**" and **Side-Brush** buttons until "**CONFIG MODE**" is displayed on the screen, then release the buttons.

While In Configuration Mode:
Each single activation of the "**2/3**" button will scroll through the various configurations available. Each configuration is displayed one at a time on the LCD. Once the desired configuration mode is displayed, push the "**0/1**" to select the displayed mode.

Mode	Entry Sequence / Indicator	Function / Notes
Input Display Mode (This mode is used to test input sensors and circuitry)	1) Enter Configuration Mode 2) Press "**2/3**" button until "INPUT MODE" is displayed. 3) Press "**0/1**" button to select Input Mode. "READY" is displayed on screen.	Each LED on the panel represents the state of one of the control board inputs. If the input is grounded (0V), the associated LED is turned ON. If the input NOT grounded (open), the associated LED is turned off. Each input (**bold**) has an associated LED as described below:

LED	Input
One Step Scrub LED	**Clogged Hydraulic Filter**
Shaker LED	**Clogged Shaker Filter**
Squeegee/Scrub Vacuum Fan LED	**High Engine Temp**
One Step Sweep LED	**Hopper Up Select**
Sweep Vacuum Fan LED	**Hopper Down Select**
Low Engine Speed LED	**Reverse**
High Engine Speed LED	**Forward**
ES LED	**Thermal Sentry**
FaST LED	**Hopper Down Position**
Side Brush LED	**Impact Sense**
Scrub Pressure High LED	**Hopper Door Open**
Scrub Pressure Medium LED	**Hopper Door Close**
Scrub Pressure Low LED	**Solution Tank Empty**
Solution Level High LED	**Solution Tank Full**
Solution Tank Medium LED	**Recovery Tank Full**
Solution Tank Low LED	**Recovery Tank Half Full**
Red warning LED	**Open Scrub Vacuum**

HYDRAULIC

Troubleshooting Information

BEFORE CONDUCTING TESTS:

*** Read and Follow ALL Safety Warnings and Precautions as mentioned at the beginning of this manual**

*** Engine & Hydraulic Oil Must Be At Normal Operating Temperatures after Running Machine and Hydraulics a Minimum of 5 Minutes**

*** Examine Machine For Any Linkage Binding or Mechanical Problems**

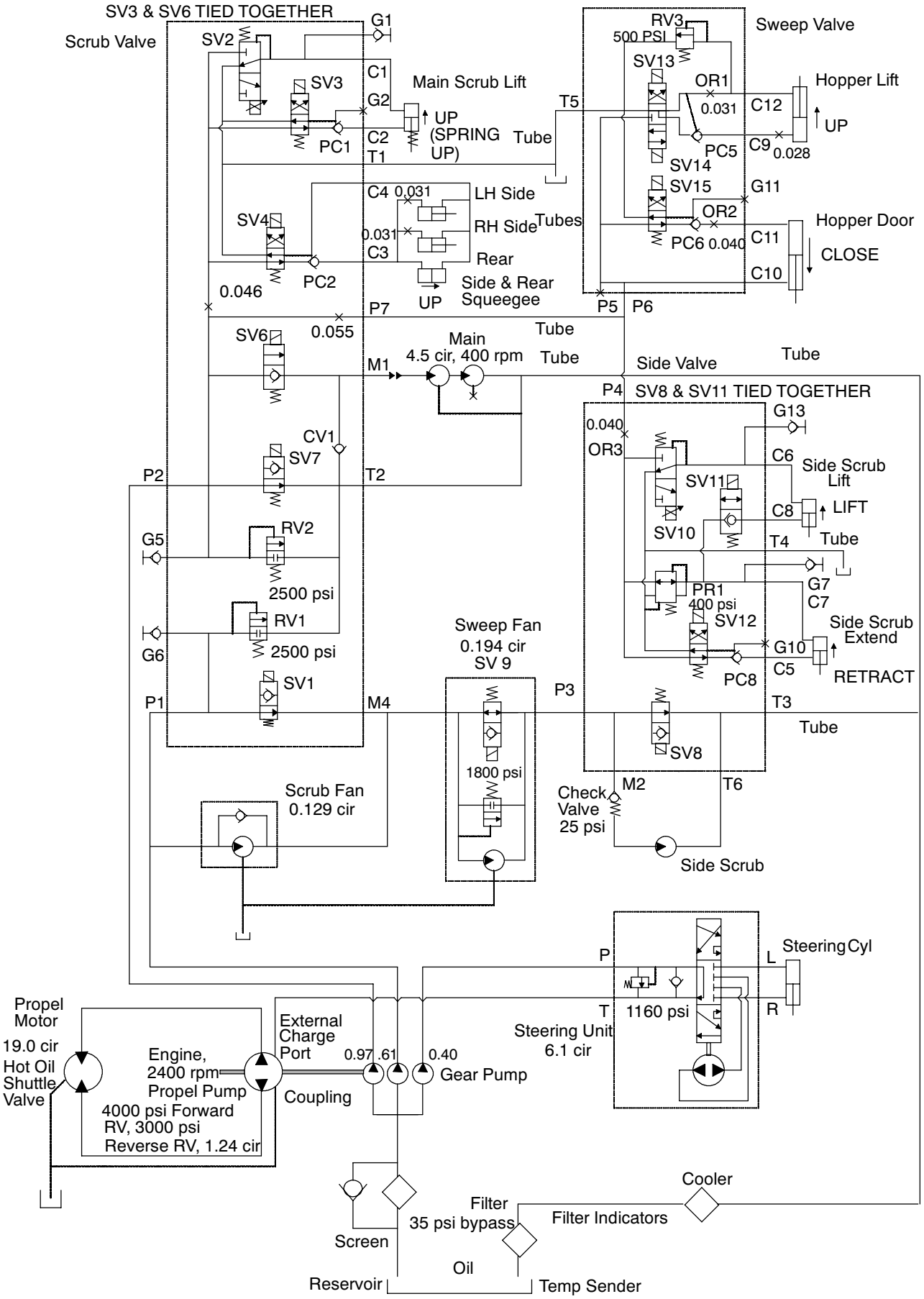
DURING TESTS:

*** Call Technical Services if Diagnostic Time Exceeds One Hour With Unknown Cause or Course of Action**

*** Maintain Normal Main Brush Pressure as Listed in Operator's Manual**

NOTE: Troubleshooting charts may be shown with optional equipment. The optional equipment is not specified in these charts. Some machines may not be equipped with all components shown.

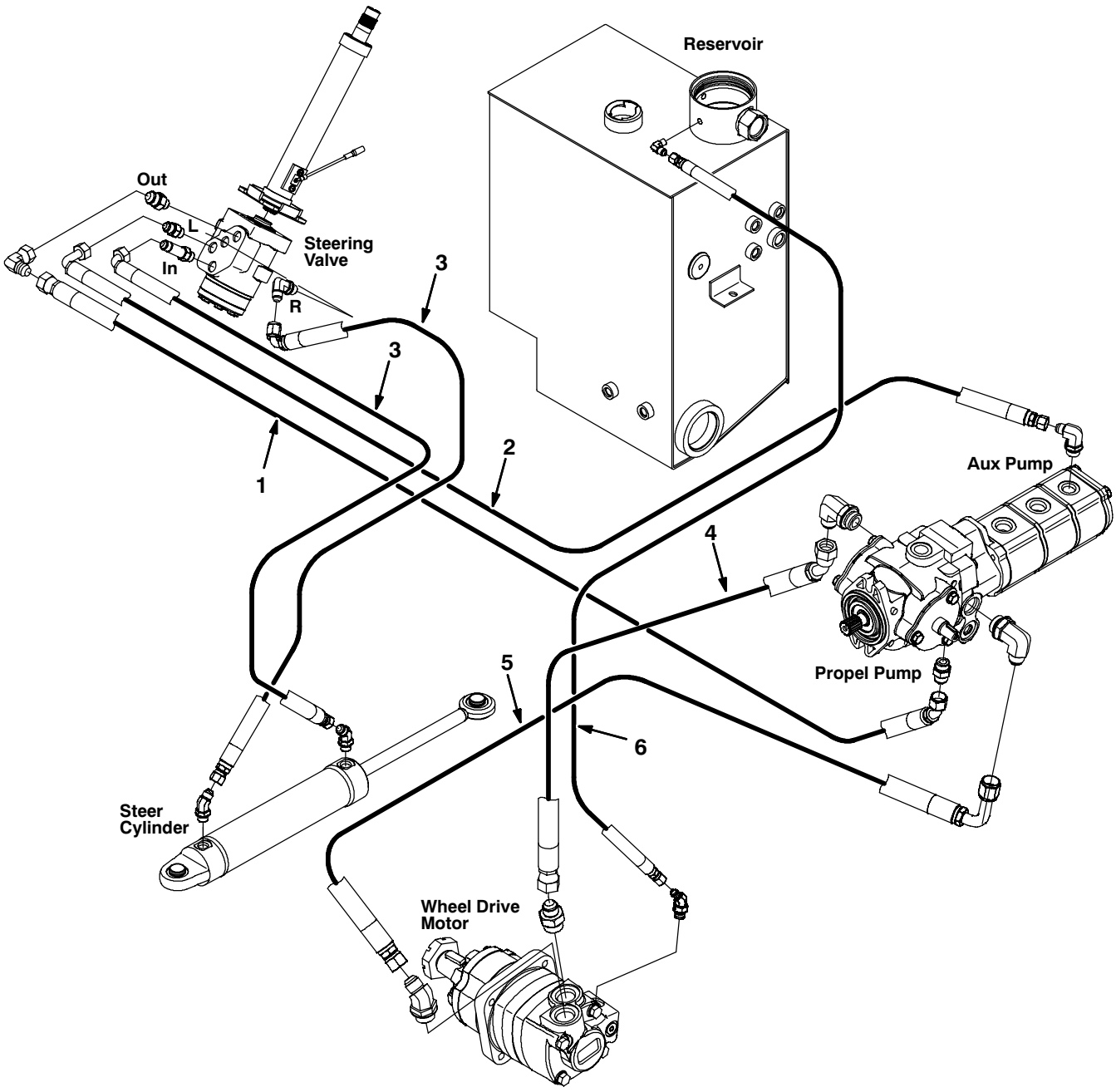
M20 Hydraulic Schematic



NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

M20 Hydraulic Hose, Pump & Valve Drawings

Hydraulic Hose Group, Steering and Propel



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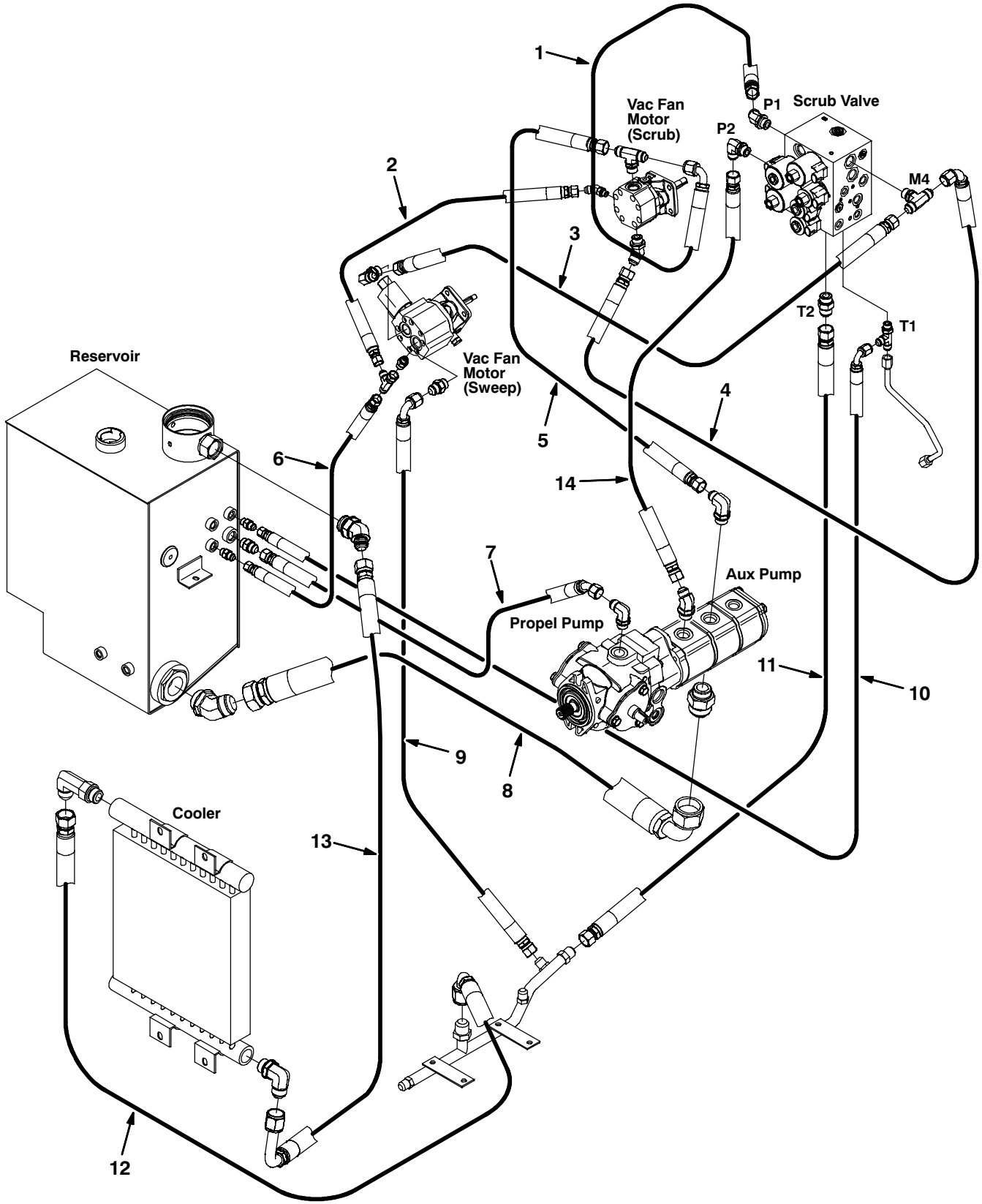
Ref.	Serial Number	Description	Qty.
1	(000000–)	Hose, Hyd, Tc08, Jf08e45/Jf08str, 96.0	1
2	(000000–)	Hose, Hyd, Tc06, Jf06e90/Jf06str, 104.0	1
3	(000000–)	Hose, Hyd, Tc06, Jf06e90/Jf06str, 040.0	2
4	(000000–)	Hose, Hyd, Spcl, Jf10e45/Jf10str, 58.0	1
5	(000000–)	Hose, Hyd, Spcl, Jf10e90/Jf10str, 63.0	1
6	(000000–)	Hose, Hyd,Med04, Jf04str/Jf04str, 066.0	1

NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

M20 Hydraulic Hose, Pump & Valve Drawings

Hydraulic Hose Group, Pump and Vacuum Fans



NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

M20 Hydraulic Hose, Pump & Valve Drawings

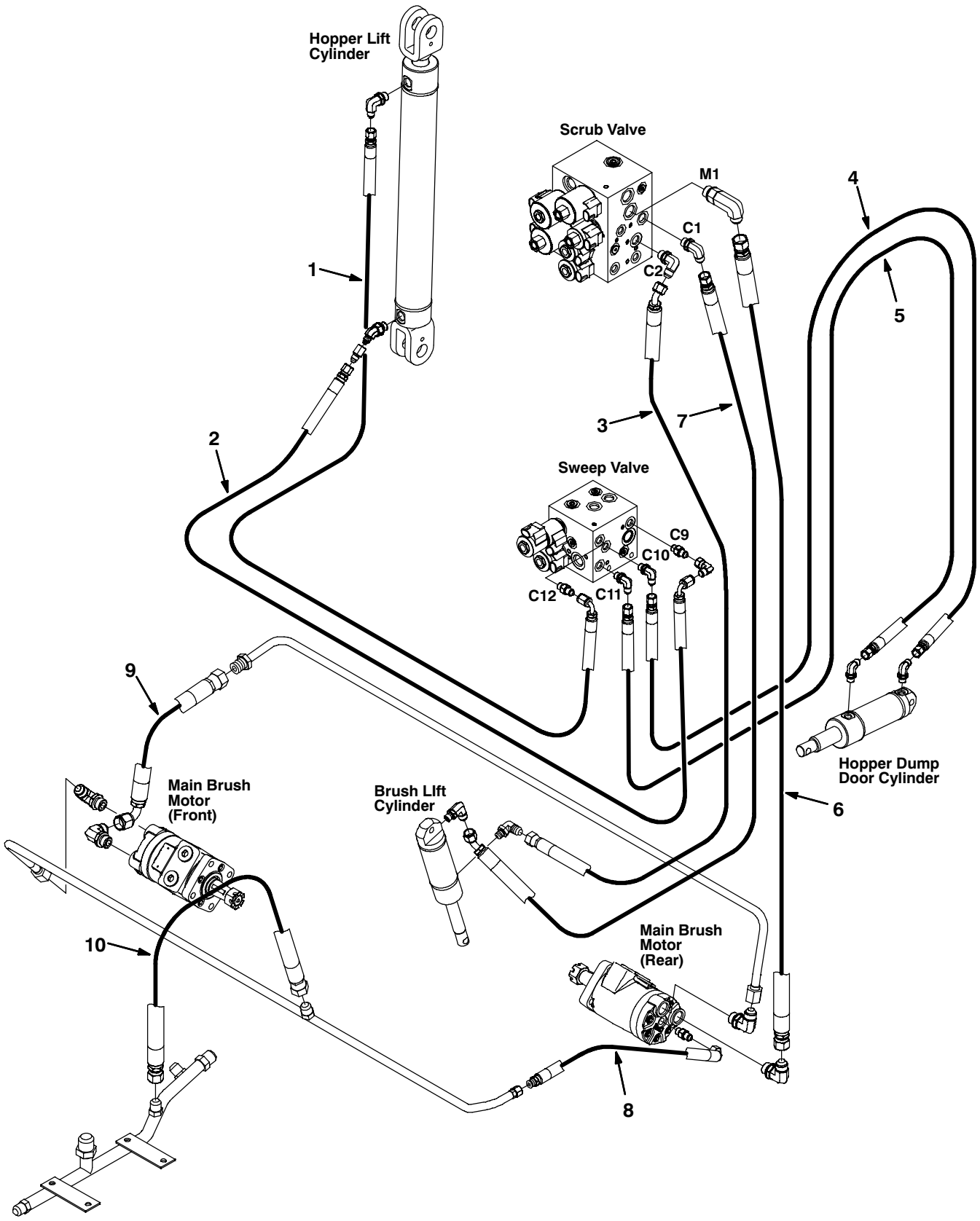
Hydraulic Hose Group, Pump and Vacuum Fans

Ref.	Serial Number	Description	Qty.
1	(000000–)	Hose, Hyd, Tc08, Jf08e90/Jf08str, 046.0	1
2	(000000–)	Hose, Hyd, Med06, Jf06str/Jf06str, 018.0	1
3	(000000–)	Hose, Hyd, Tc08, Jf08str/Jf08str, 024.0	1
4	(000000–)	Hose, Hyd, Tc08, Jf08str/Jf08e90, 031.0	1
5	(000000–)	Hose, Hyd, Tc08, Jf08e45/Jf08str, 26.0	1
6	(000000–)	Hose, Hyd, Med06, Jf06str/Jf06str, 022.0	1
7	(000000–)	Hose, Hyd, Med08, Jf08str /Jf08e45, 21.0	1
8	(000000–)	Hose, Hyd, Suc20, Jf20str /Jf20e90, 29.0	1
9	(000000–)	Hose, Hyd, Med08, Jf08e90/Jf08str, 031.0	1
10	(000000–)	Hose, Hyd, Med06, Jf06e90/Jf06str, 042.0	1
11	(000000–)	Hose, Hyd, Med10, Jf10str/Jf10str, 41.0	1
12	(000000–)	Hose, Hyd, Tc12, Jf12e90/Jf12str, 044.0	1
13	(000000–)	Hose, Hyd, Med12, Jf12e90/Jf12str, 50.0	1
14	(000000–)	Hose, Hyd, Tc08, Jf08str/Jf08str, 21.0	1

NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

M20 Hydraulic Hose, Pump & Valve Drawings

Hydraulic Hose Group, Brush and Hopper



NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

M20 Hydraulic Hose, Pump & Valve Drawings

Hydraulic Hose Group, Brush and Hopper

Ref.	Serial Number	Description	Qty.
1	(000000-)	Hose, Hyd, Tc04, Jf04str /Jf04e90, 88.0	1
2	(000000-)	Hose, Hyd, Tc04, Jf04str /Jf04e90, 70.0	1
3	(000000-)	Hose, Hyd, Tc06, Jf06str /Jf06e45, 54.0	1
4	(000000-)	Hose, Hyd, Spcl, Jf04str/Jf04str, 115.0	1
5	(000000-)	Hose, Hyd, Spcl, Jf04str/Jf04str, 121.0	1
6	(000000-)	Hose, Hyd, Tc08, Jf08str/Jf08str, 48.0	1
7	(000000-)	Hose, Hyd, Tc 06, Jf06str /Jf06e45, 56.0	1
8	(000000-)	Hose, Hyd, Med04, Jf04e90/Jf04str, 016.0	1
9	(000000-)	Hose, Hyd, Tc08, Jf08e90/Jf08str, 13.0	1
10	(000000-)	Hose, Hyd, Med08, Jf08str/Jf08str, 022.0	1

NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

M20 Hydraulic Hose, Pump & Valve Drawings

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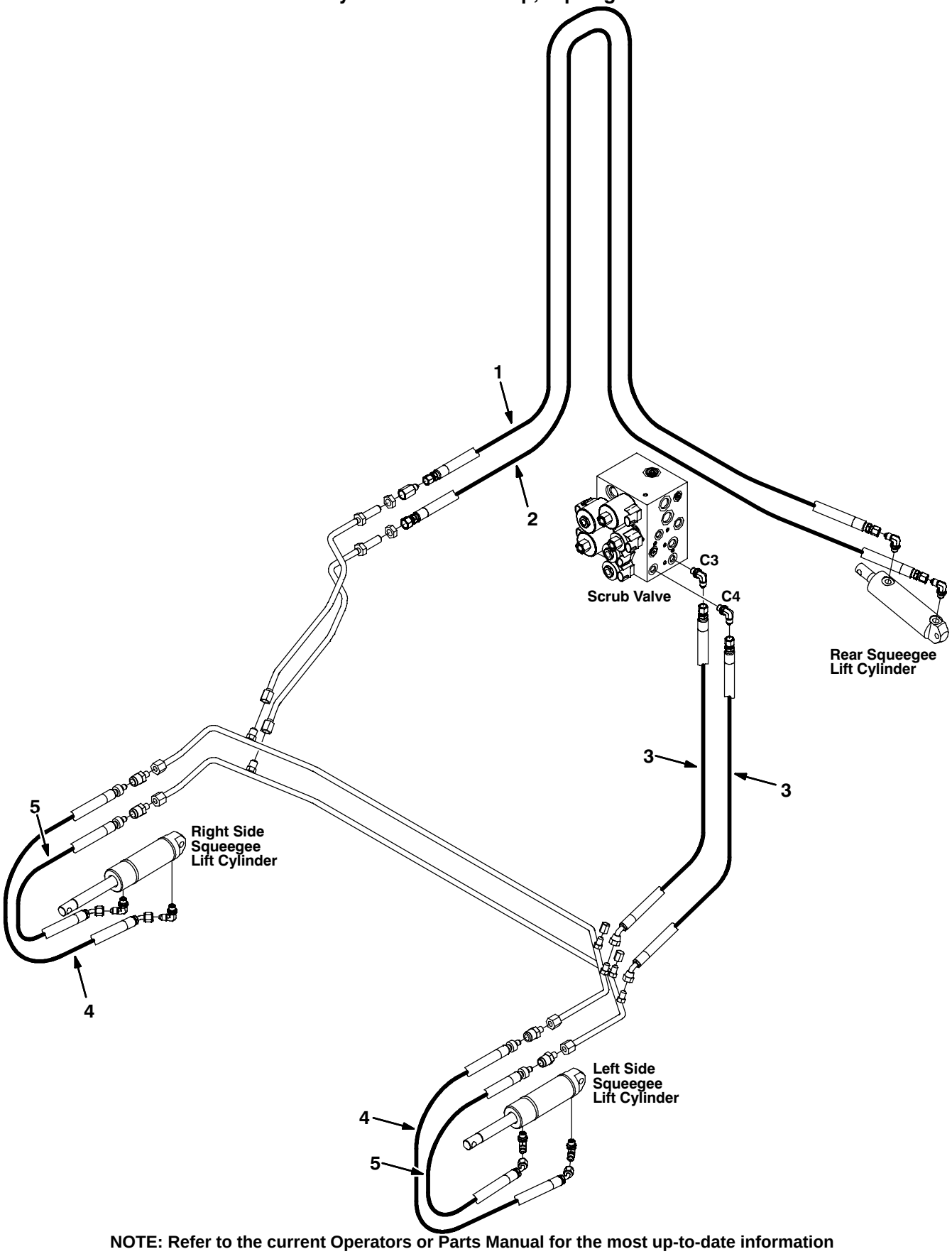
Hydraulic Hose Group, Squeegee Lift



NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

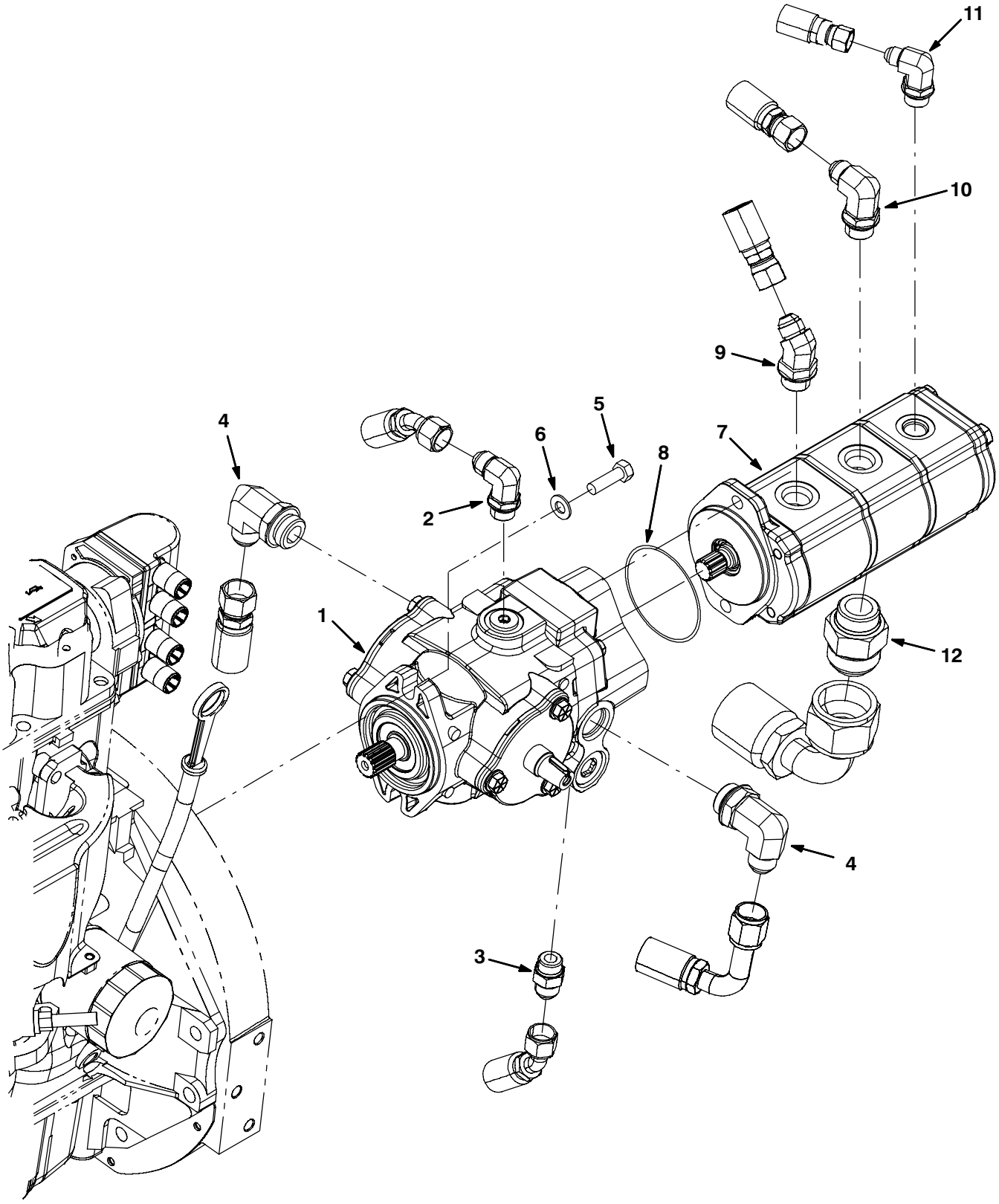
Hydraulic Hose Group, Squeegee Lift

Ref.	Serial Number	Description	Qty.
1	(000000-)	Hose, Hyd, Spcl, Jf04str/Jf04str, 121.0	1
2	(000000-)	Hose, Hyd, Spcl, Jf04str/Jf06str, 125.0	1
3	(000000-)	Hose, Hyd,Tc 04, Jf04str /Jf04e45 , 35.0	2
4	(000000-)	Hose, Hyd, Tc04, Jf04e45/Qm06, 28.0	2
5	(000000-)	Hose, Hyd, Tc04, Jf04e45/Qm06, 26.0	2

NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

M20 Hydraulic Hose, Pump & Valve Drawings

Hydraulic Pumps Group



NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

M20 Hydraulic Hose, Pump & Valve Drawings

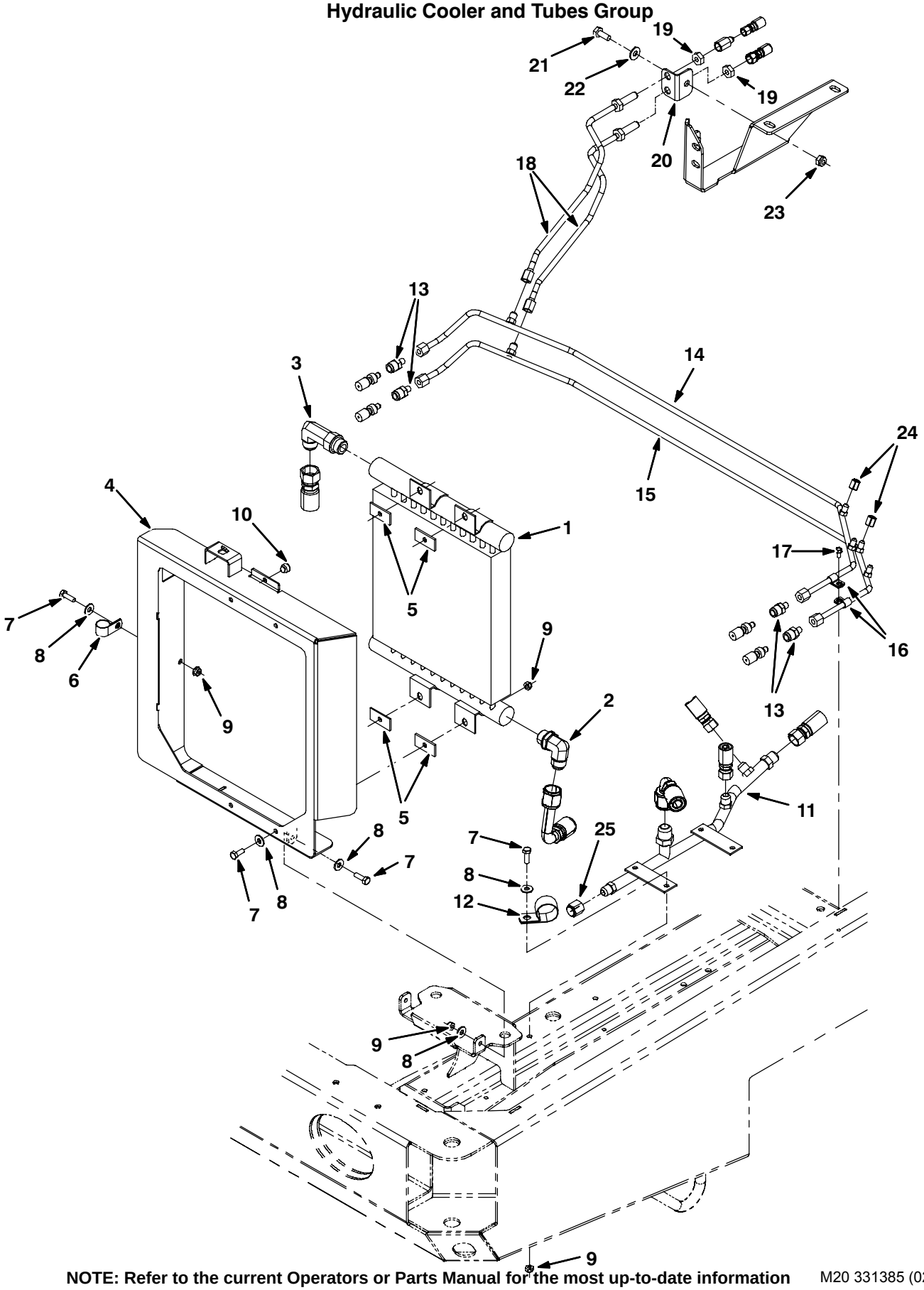
Hydraulic Pumps Group

Ref.	Serial Number	Description	Qty.
1	(000000-)	Pump, Hyd, Piston, Var, 1.24 4000, Cw (See Breakdown)	1
2	(000000-)	Fitting, Hyd, E90, Jm08/Om08	1
3	(000000-)	Fitting, Hyd, Str, Jm08/Om08	1
4	(000000-)	Fitting, Hyd, E90, Jm10/Om12	2
5	(000000-)	Screw, Hex, .38-16 X 1.25, 5	22
6	(000000-)	Washer, Flat, 0.38 Sae	2
7	(000000-)	Pump, Hyd, Gear, Ext, 3, 00.97 2500, Cw	1
8	(000000-)	Seal, Org, .069 X 3.06id	11
9	(000000-)	Fitting, Hyd, E45, Jm08/Om10	1
10	(000000-)	Fitting, Hyd, E90, Jm08/Om10	1
11	(000000-)	Fitting, Hyd, E90, Jm06/Om08	1
12	(000000-)	Fitting, Hyd, Str, Jm20/Om16	1

NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

M20 Hydraulic Hose, Pump & Valve Drawings

Hydraulic Cooler and Tubes Group



M20 Hydraulic Hose, Pump & Valve Drawings

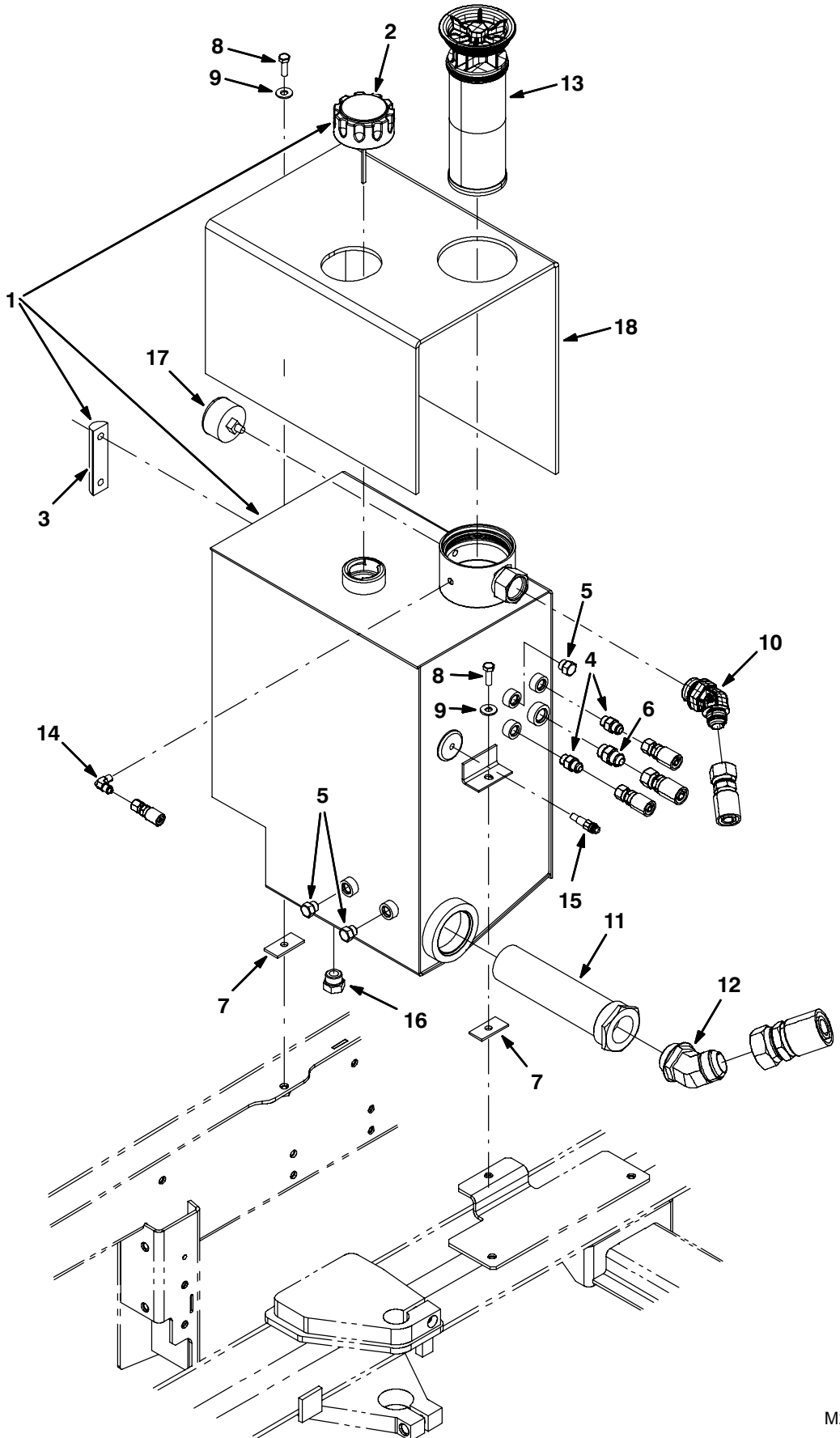
Hydraulic Cooler and Tubes Group

Ref.	Serial Number	Description	Qty.
1	(000000-)	Cooler, Hyd, 25gpm 325btu Of12 13x12x2	1
2	(000000-)	Fitting, Hyd, E90, Jm12/Om12	1
3	(000000-)	Fitting, Hyd, E90, Jm12/Om12, L	1
4	(000000-)	Bracket Wldt, Cooler, Hyd Fluid	1
5	(000000-)	Pad, Tank, Hyd	4
6	(000000-)	Clamp, Cable, Stl, 1.00d X 0.62w, 1h	1
7	(000000-)	Screw, Hex, M8 X 1.25 X 25, 8.8	9
8	(000000-)	Washer, Flat, 0.31 Std	15
9	(000000-)	Nut, Hex, Flng, M8 X 1.25	9
10	(000000-)	Bumper, Rbr, 0.6d 0.34t .3d Tip	1
11	(000000-)	Tube, Hyd, Main Return [M20]	1
12	(000000-)	Clamp, Cable, Stl, 1.50d X 1.00w, 1h	1
13	(000000-)	Fitting, Hyd, Str, Spcl	4
14	(000000-)	Tube, Hyd, Sqge	1
15	(000000-)	Tube, Hyd, Sqge	1
16	(000000-)	Clamp, Cable, Stl, 0.44d X 0.62w, 1h	2
17	(000000-)	Screw, Hex, M6 X 1.0 X 12, Fmg	1
18	(000000-)	Tube, Hyd, Rear Sqge [M20]	2
19	(000000-)	Nut, Ftg, Hyd, 0.56-18	2
20	(000000-)	Angle, Mtg, Stl, .12 1.6 1.6 02.2l	1
21	(000000-)	Screw, Hex, M10 X 1.5 X 25, 8.8	1
22	(000000-)	Washer, Flat, 0.38 Std	1
23	(000000-)	Nut, Hex, Lock, M10 X 1.5, Nl	1
24	(000000-)	Fitting, Hyd, Cap, Jf04	2
25	(000000-)	Fitting, Hyd, Cap, Jf08	1

NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

M20 Hydraulic Hose, Pump & Valve Drawings

Hydraulic Reservoir Group



NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

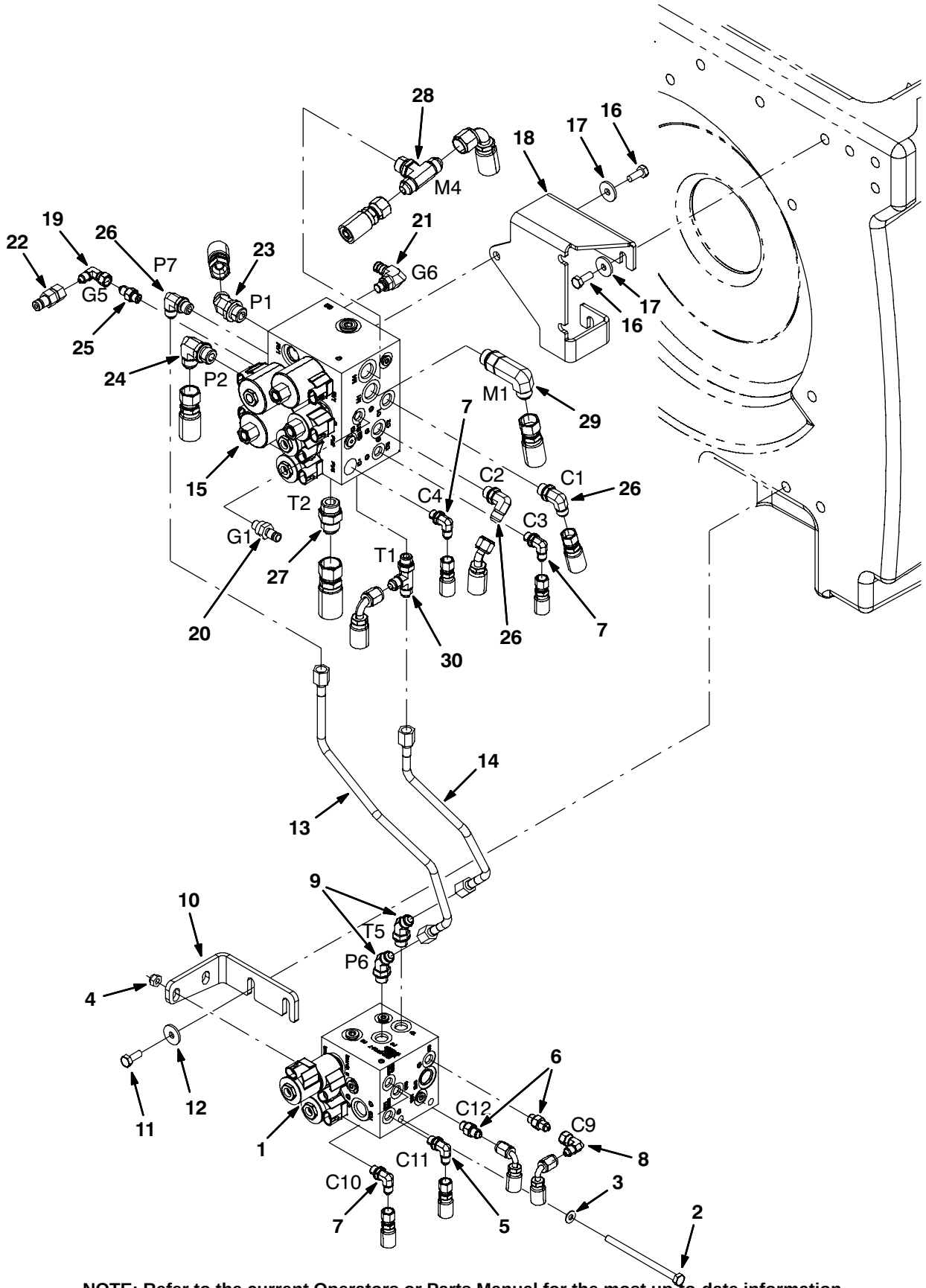
M20 Hydraulic Hose, Pump & Valve Drawings

Hydraulic Reservoir Group

	Ref.	Serial Number	Description	Qty.
▽	1	(000000-)	Reservoir, Hyd, 10.0 Gal	1
▲	2	(000000-)	Cap, Breather, Hyd, 2.4 Ds	1
▲	3	(000000-)	Gauge, Sensing, Level	1
	4	(000000-)	Fitting, Hyd, Str, Jm06/Om06	2
	5	(000000-)	Fitting, Hyd, Plug, Om06	3
	6	(000000-)	Fitting, Hyd, Str, Jm08/Om08	1
	7	(000000-)	Pad, Tank, Hyd	2
	8	(000000-)	Screw, Hex, M8 X 1.25 X 25, 8.8	2
	9	(000000-)	Washer, Flat, 0.31 Std	2
	10	(000000-)	Fitting, Hyd, E45, Jm12/Om16	1
	11	(000000-)	Strainer, Hyd, 25gpm 100mesh Psi	1
	12	(000000-)	Fitting, Hyd, E45, Jm20/Om20	1
	13	(000000-)	Filter Assy [Pt4 936498]	1
	14	(000000-)	Fitting, Hyd, E90, Jm04/Pm02	1
	15	(000000-)	Send-Unit, Water, Temp, 04npt 113oh/195d	1
	16	(000000-)	Fitting, Hyd, Plug, Om10	1
	17	(000000-)	Indicator, Press, 60psi	1
	18	(000000-)	Insulation, Thermal, Hydraulic Blanket	1

M20 Hydraulic Hose, Pump & Valve Drawings

Hydraulic Valves Group



NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

M20 Hydraulic Hose, Pump & Valve Drawings

Hydraulic Valves Group

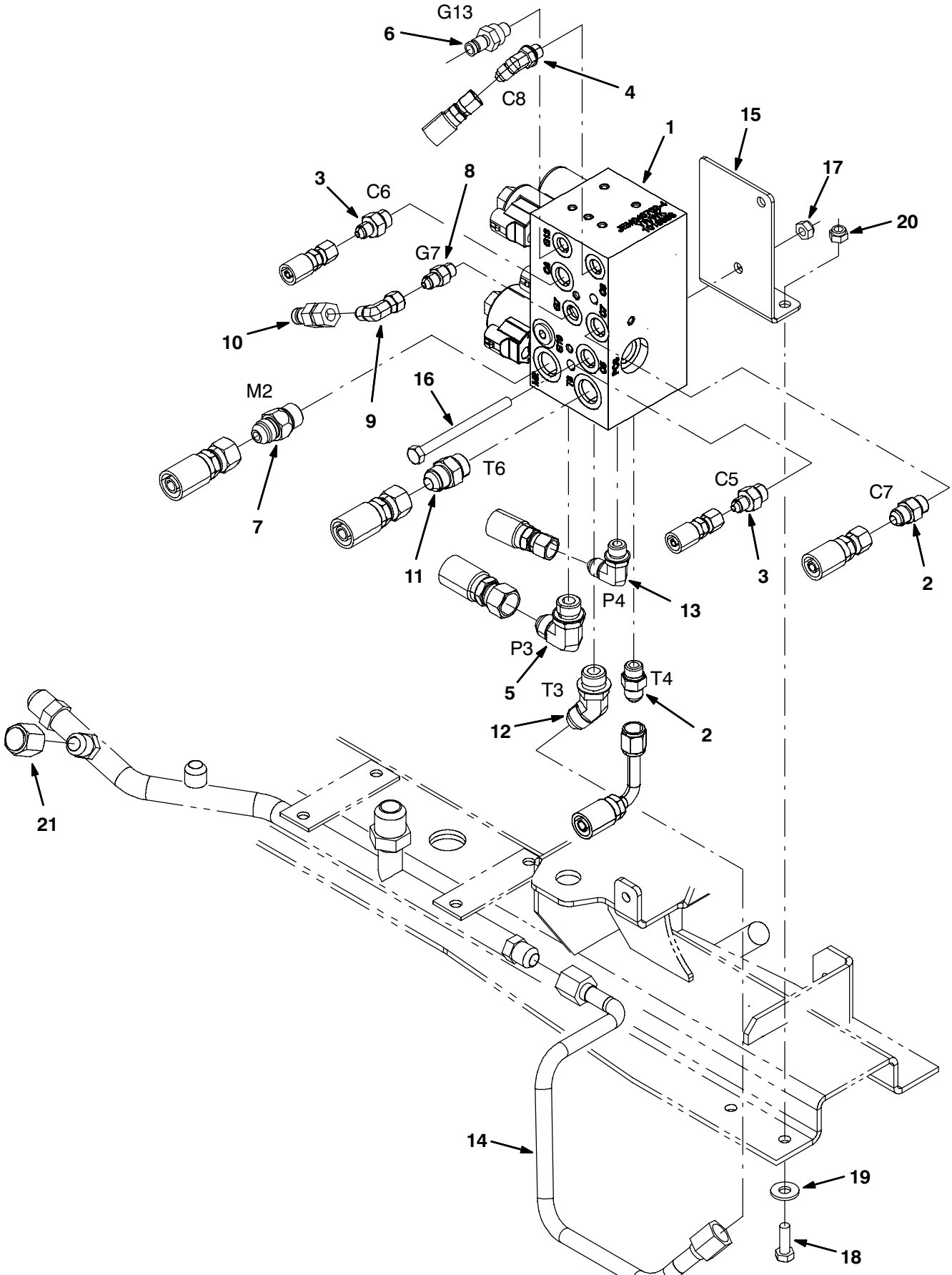
Ref.	Serial Number	Description	Qty.
1	(000000-)	Valve, Cntrl, Hyd [M20] (See Breakdowns)	1
2	(000000-)	Screw, Hex, M8 X 1.25 X 120, 8.8, Fl	2
3	(000000-)	Washer, Flat, 0.31, Std	2
4	(000000-)	Nut, Hex, Lock, M8 X 1.25, Nl	2
5	(000000-)	Fitting, Hyd, E90, Jm04/Om04	2
6	(000000-)	Fitting, Hyd, Str, Jm04/Om04	2
7	(000000-)	Fitting, Hyd, E90, Jm04/Om04	2
8	(000000-)	Fitting, Hyd, E90, Jf04/Jm04	1
9	(000000-)	Fitting, Hyd, E45, Jm06/Om06	2
10	(000000-)	Bracket, Mtg, Valve, Hyd, Swp	1
11	(000000-)	Screw, Hex, M8 X 1.25 X 20, Ss	2
12	(000000-)	Washer, Flat, 0.32b 1.00d .12, Ss	2
13	(000000-)	Tube, Hyd, Swp	1
14	(000000-)	Tube, Hyd, Swp	1
15	(000000-)	Valve, Cntrl, Hyd (See Breakdowns)	1
16	(000000-)	Screw, Hex, M8 X 1.25 X 20, Ss	6
17	(000000-)	Washer, Flat, 0.32b 1.00d .12, Ss	6
18	(000000-)	Bracket, Mtg, Valve, Hyd, Scb	1
19	(000000-)	Fitting, Hyd, E90, Jf04/Jm04	1
20	(000000-)	Fitting, Hyd, Str, Om04/Qm04	1
21	(000000-)	Fitting, Hyd, E90, Om04/Qm04	1
22	(000000-)	Fitting, Hyd, Str, Jf04/Qm04	1
23	(000000-)	Fitting, Hyd, E45, Jm08/Om08	1
24	(000000-)	Fitting, Hyd, E90, Jm08/Om08	1
25	(000000-)	Fitting, Hyd, Str, Jm04/Om04	1
26	(000000-)	Fitting, Hyd, E90, Jm06/Om06	3
27	(000000-)	Fitting, Hyd, Str, Jm10/Om10	1
28	(000000-)	Fitting, Hyd, Tee, Jm08/Jm08/Om08, Br	1
29	(000000-)	Fitting, Hyd, E90, Jm08/Om08, L	1
30	(000000-)	Fitting, Hyd, Tee, Jm06/Jm06/Om06, Run	1

NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

M20 Hydraulic Hose, Pump & Valve Drawings

(Page 16 of 19)

Side Brush Hydraulic Valve Group



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NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

M20 Hydraulic Hose, Pump & Valve Drawings

Side Brush Hydraulic Valve Group

Ref.	Serial Number	Description	Qty.
1	(000000-)	Valve, Cntrl, Hyd [M20 And T20] (See Breakdown)	1
2	(000000-)	Fitting, Hyd, Str, Jm06/Om06	2
3	(000000-)	Fitting, Hyd, Str, Jm04/Om06	2
4	(000000-)	Fitting, Hyd, E45, Jm04/Om04	1
5	(000000-)	Fitting, Hyd, E90, Jm08/Om08	1
6	(000000-)	Fitting, Hyd, Str, Om04/Qm04	1
7	(000000-)	Valve, Hyd, Check, Jm08/Om08 5000psi	1
8	(000000-)	Fitting, Hyd, Str, Jm04/Om04	1
9	(000000-)	Fitting, Hyd, E90, Jf04/Jm04	1
10	(000000-)	Fitting, Hyd, Str, Jf04/Qm04	1
11	(000000-)	Fitting, Hyd, Str, Jm08/Om08	1
12	(000000-)	Fitting, Hyd, E45, Jm08/Om08	1
13	(000000-)	Fitting, Hyd, E90, Jm06/Om06	1
14	(000000-)	Tube, Hyd, 08 Jf08/Jf08	1
15	(000000-)	Bracket, Valve, Sba [M20 And T20]	1
16	(000000-)	Screw, Hex, M8 X 1.25 X 100, 8.8	2
17	(000000-)	Nut, Hex, Lock, M8 X 1.25, Nl	2
18	(000000-)	Screw, Hex, M8 X 1.25 X 25, Ss	2
19	(000000-)	Washer, Flat, 0.31, Std	2
20	(000000-)	Nut, Hex, Lock, M8 X 1.25, Nl, Ss	2
21	(000000-)	Fitting, Hyd, Cap, Jf08	1

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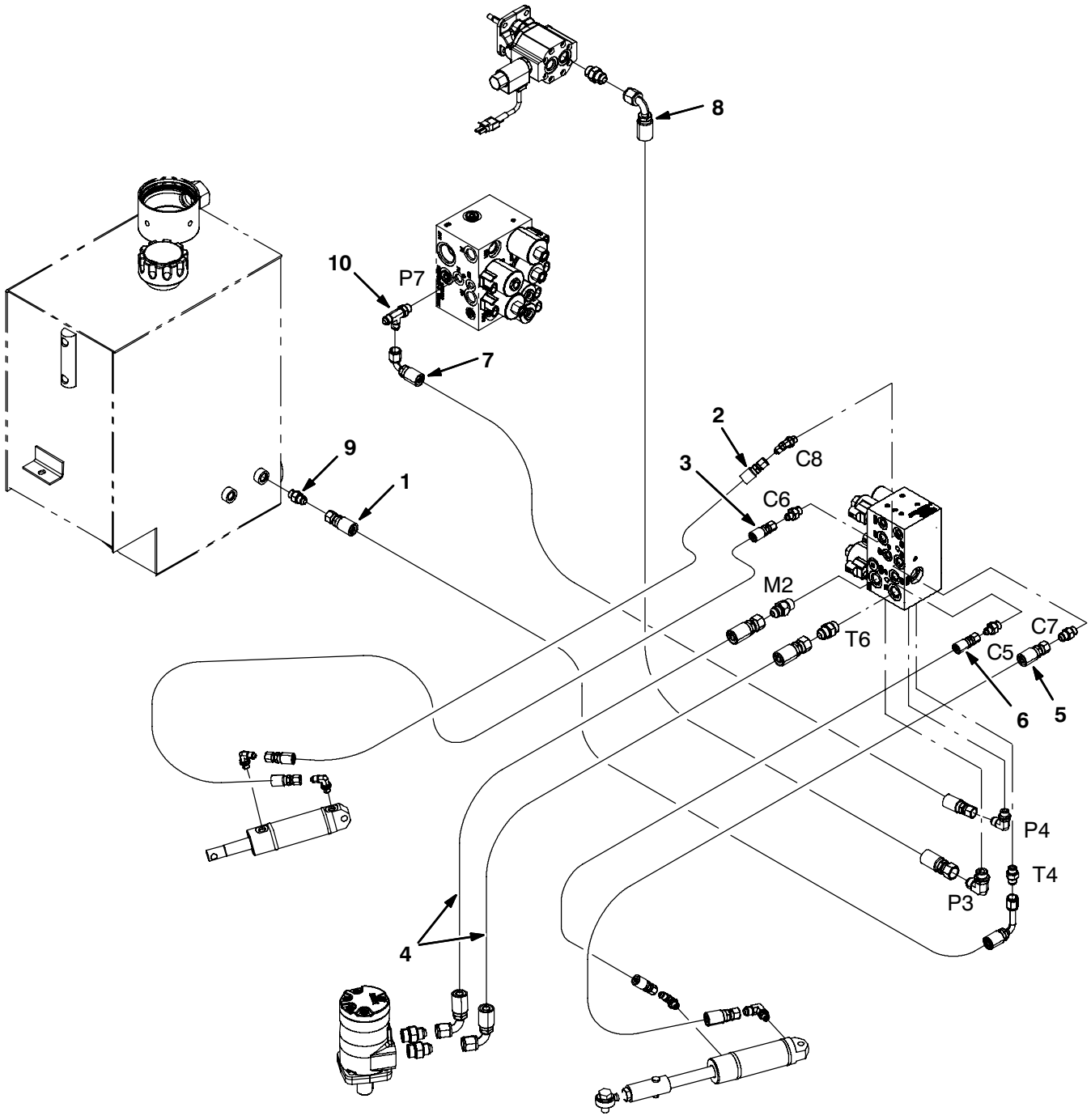
NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

M20 Hydraulic Hose, Pump & Valve Drawings

Side Brush Hydraulic Hose Group



NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

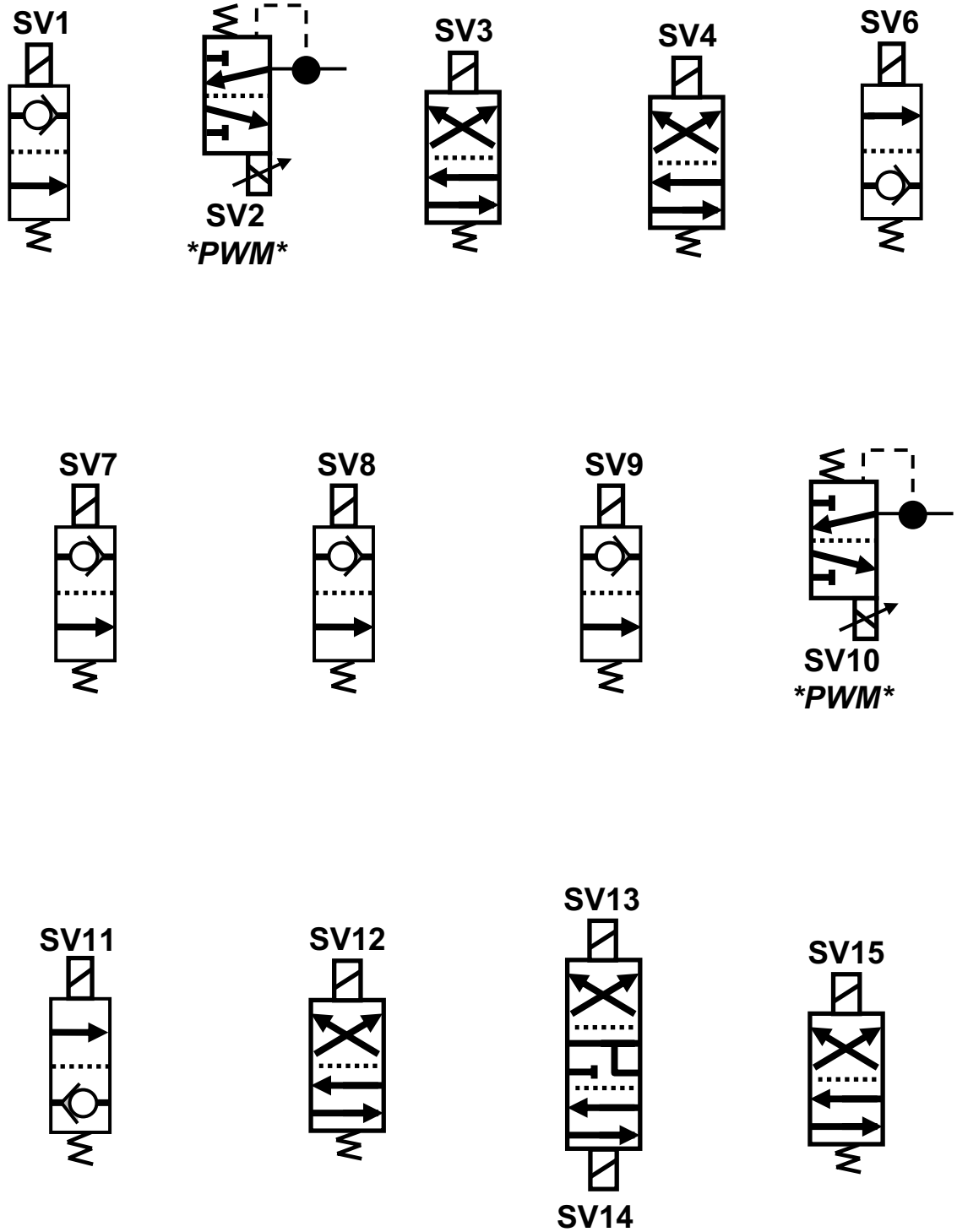
M20 Hydraulic Hose, Pump & Valve Drawings

Side Brush Hydraulic Hose Group

Ref.	Serial Number	Description	Qty.
1	(000000–)	Hose, Hyd, Med06, Jf06e90l/Jf06str,038.0	1
2	(000000–)	Hose, Hyd, Tc06, Jf06str/Jf06str, 033.0	1
3	(000000–)	Hose, Hyd, Tc04, Jf04str /Jf04str, 39.0	1
4	(000000–)	Hose, Hyd, Tc08, Jf08e90/Jf08str, 034.0	2
5	(000000–)	Hose, Hyd, Tc06, Jf06str /Jf06str, 23.0	1
6	(000000–)	Hose, Hyd, Tc04, Jf04str /Jf04str, 20.0	1
7	(000000–)	Hose, Hyd, Tc06, Jf06str /Jf06e90, 74.0	1
8	(000000–)	Hose, Hyd, Tc08, Jf08e90/Jf08str, 056.0	1
9	(000000–)	Fitting, Hyd, Str, Jm06/Om06	1
10	(000000–)	Fitting, Hyd, Tee, Jm06/Jm06/Om06, Run	1

NOTE: Refer to the current Operators or Parts Manual for the most up-to-date information

M20 Hydraulic Solenoid Valve Details



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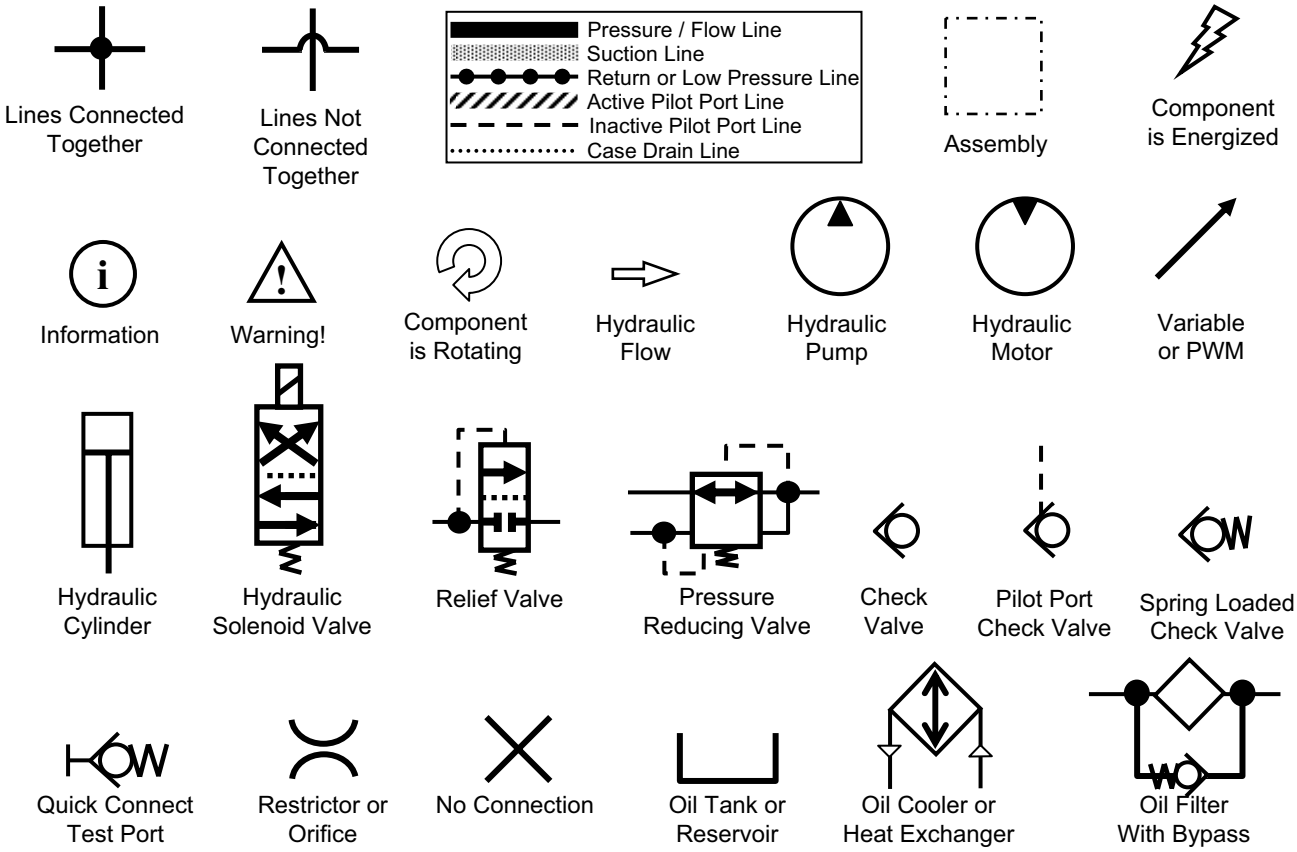
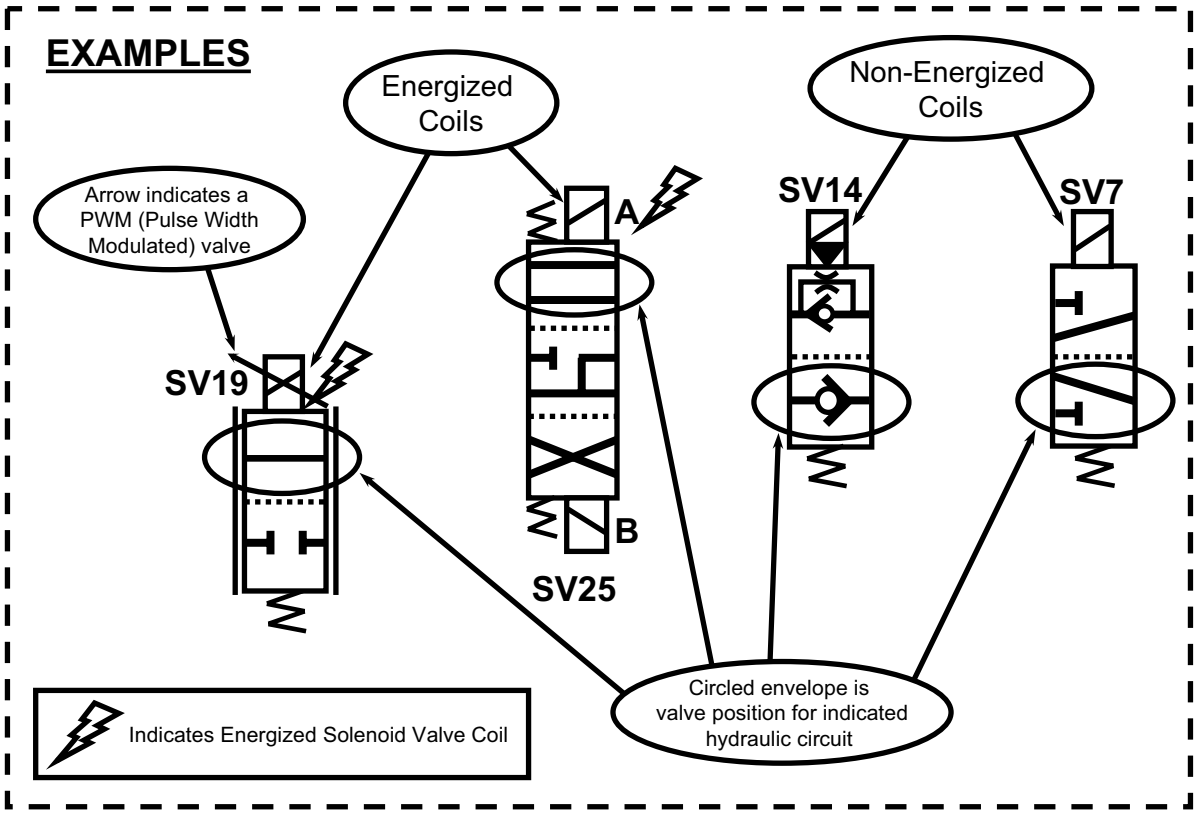
M20 General Information

Commonly Used Hydraulic Symbols





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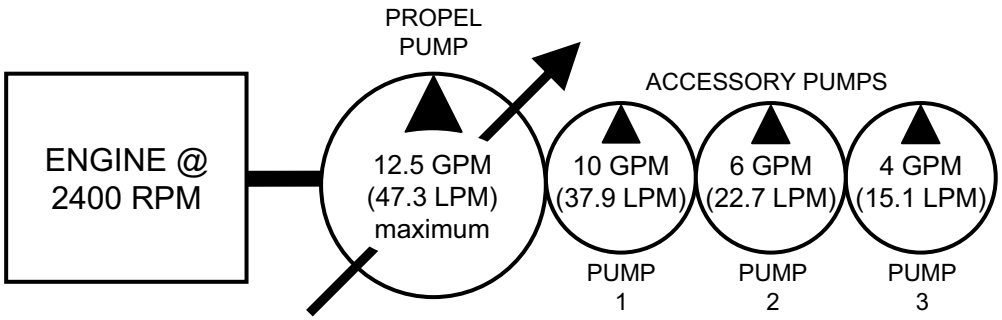
M20 General Information

M20 Hydraulic Pump Flow Rates (typical)



Commonly Used Abbreviations

AUX	Auxiliary
CIR	Cubic Inch Displacement per Revolution
CK	Check Valve
CM	Centimeters
CONV	Conveyor
CU	Cubic
CV	Control Valve
CYL	Cylinder
DC	Disconnect Coupler (Hydraulic)
DC	Direct Current (Electrical)
E	Engine (Combustion)
FLTR	Filter
GPM	Gallons Per Minute
HTX	Heat Exchanger
IN	Inches
LH	Left Hand
LPM	Liters Per Minute
LS	Load Sense
M	Motor (Combustion)

MFLD	Manifold
MTR	Motor (Hydraulic)
OR	Orifice
PC	Pilot Port Check Valve
PMP	Pump
PR	Pressure Relief Valve
PSI	Pounds Per Square Inch
PTO	Power Take Off
PWM	Pulse Width Modulation
RES	Reservoir
RH	Right Hand
RPM	Revolutions Per Minute
RV	Relief Valve
SC	Spring Loaded Check Valve
STRN	Strainer
SV	Solenoid Valve
SW	Switch
TV	Throttle Valve
V	Volts

Typical Hydraulic Manifold Port Markings

C	Hydraulic Cylinder Connection
G	Test Port
LS	Load Sense Port

M	Hydraulic Motor Connection
P	Pump Connection
R or T	Return Port (To Tank)

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M20 Operating Matrix

Component / System	Function	Test Port	Test Port Location	Enable Coil	Energized Coil(s)	Notes	Valve Block	Valve Block Number	Location	Feed Port	Exit Port	Pressure Control in Circuit	Pressure Setting (PSI)	Notes
Scrub Head	Down	G1	Scrub Valve	SV7	SV2, SV3	SV2 is PWM controlled; Down pressure varies with current to SV2; SV3 and SV6 tied together electrically	Scrub Valve	1020394	Left Side, on vacuum fan frame	C1	C2	SV2	0 to 800	Operating Flow from Pump # 1 (inner most pump)
	Up	C2			default					C2	C1	RV2	2500	
Squeegees, Side and Rear	Down	G5	Scrub Valve	SV7	SV4	Operate Squeegees "Up and Down" using Manual Mode--Monitor pressure at G5	Scrub Valve	1020394	Left Side, on vacuum fan frame	C4	C3	RV2	2500	Operating Flow from Pump # 1 (inner most pump)
	Up	C3			default					C3	C4			
Hopper Door	Closed	P5	Sweep Valve	SV7	default	Lift Hopper, Operate Hopper Door "Open and Closed" using Manual Mode -Monitor pressure at P5 and/or G11	Sweep Valve	1018936	Left Side, on vacuum fan frame	C11	C10	RV2	2500	Operating Flow from Pump # 1 (inner most pump)
	Open	G11			SV15					C10	C11			
Main Brushes	Run	G5	Scrub Valve	SV7	SV6	Operate Main Brushes "On" using Manual Mode--Monitor pressure at G5; SV3 and SV6 tied together electrically	Scrub Valve	1020394	Left Side, on vacuum fan frame	M1	Direct to Tank	RV2	2500	Operating Flow from Pump # 1 (inner most pump)
Hopper Lift	Down	P5	Sweep Valve	SV7	SV13	500 PSI RV3 keeps hopper pushed tight to frame	Sweep Valve	1018936	Left Side, on vacuum fan frame	C12	C9	RV3	500	Operating Flow from Pump # 1 (inner most pump)
	Up				SV14					C9	C12	RV2	2500	
Scrub Fan	Run	G6	Scrub Valve	-	SV1		Scrub Valve	1020394	Left Side, on vacuum fan frame	Direct from Pump	Direct to Tank	RV1	2500	Operating Flow from Pump # 2 (middle pump)
Sweep Fan	Run	G6	Scrub Valve	-	SV9		On Sweep Fan Motor	53485	On sweep fan motor	M4 (on Scrub Valve)	P3 (on Side Valve)	On Sweep Fan Motor	1800	Operating Flow from Pump # 2 (middle pump)
Side Brush (Sweep/Scrub)	Run	G6	Scrub Valve	-	SV8	Operate Side Brush "On" using Manual Mode--Monitor pressure at G6; SV8 and SV11 tied together electrically	Side Valve	1018938	Left front	M2	T6	RV1	2500	Operating Flow from Pump # 2 (middle pump)
Side Brush	Up	G7	Side Valve	SV7	default	SV10 is PWM controlled; Operate Side Brush up and down using Manual Mode; SV8 and SV11 tied together electrically; If main brush is ON, there may not be enough pump pressure to fully retract against the 400 PSI.	Side Valve	1018938	Left front	C8	C6	PR1	400	Operating Flow from Pump # 1 (inner most pump)
	Down	G13			SV10, SV11					C6	C8	SV10	0 to 800	
	Retract	C5			default					C5	C7	RV1	2500	
	Extend	G7			SV12					C7	C5	PR1	400	

M20 Option Components

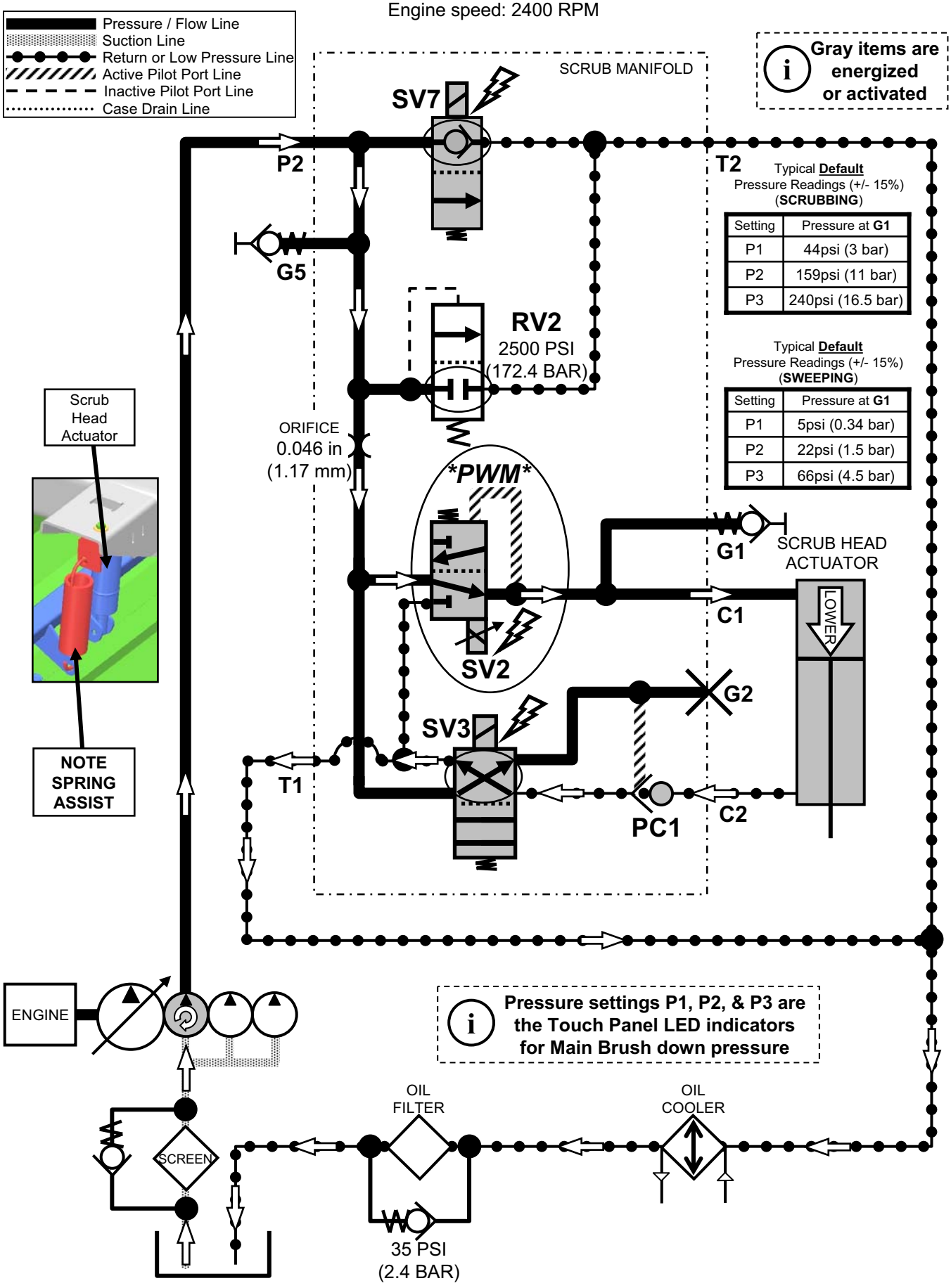
The following chart lists various options and the electrical and/or hydraulic components that are associated with the option. Refer to the “notes” section for any components that are deleted from a standard machine in order to have the installed option.

option	added components	E or H	component #	notes
Side Brush	Side Brush ON Solenoid Valve	E,H	SV-8	
	Side Brush Pressure Solenoid Valve	E,H	SV-10	
	Side Brush Down Solenoid Valve	E,H	SV-11	
	Side Brush Extend Solenoid Valve	E,H	SV-12	
	FaST Side Brush Valve	E	SOL-6	
	Side Brush Water Valve	E	SOL-7	
	Side Brush Manifold	H	x	
	Side Brush Lift Cylinder	H	x	
	Side Brush Extend Cylinder	H	x	
	Side Brush Motor	H	x	
ES (Extended Scrub)	Solution Tank Auto Fill Water Valve	E	SOL-1	If machine has ES option, the following components will ***not*** be on the machine: FaST Water Pump, FaST Water Pump Relay (M11), FaST Detergent Pump, FaST Air Pump, FaST Enable Valve (SOL-4), FaST High Flow Valve (SOL-5), FaST Side Brush Valve (SOL-6)
	Recovery Tank Auto Fill Water Valve	E	SOL-2	
	Solution Tank Full Switch	E	S-14	
	Recovery Tank Half Full Switch	E	S-16	
	Detergent Pump	E	x	
	ES Pump	E	x	
Spray Hose	Spray Hose Pump	E	x	
	Spray Hose Relay	E	M12	
	Spray Hose Switch	E	S-25	

E = Electrical Component
H = Hydraulic Component

M20 Scrub/Sweep Head Lower

Engine speed: 2400 RPM



Typical **Default** Pressure Readings (+/- 15%) (**SCRUBBING**)

Setting	Pressure at **G1**
P1	44psi (3 bar)
P2	159psi (11 bar)
P3	240psi (16.5 bar)

Typical **Default** Pressure Readings (+/- 15%) (**SWEEPING**)

Setting	Pressure at **G1**
P1	5psi (0.34 bar)
P2	22psi (1.5 bar)
P3	66psi (4.5 bar)

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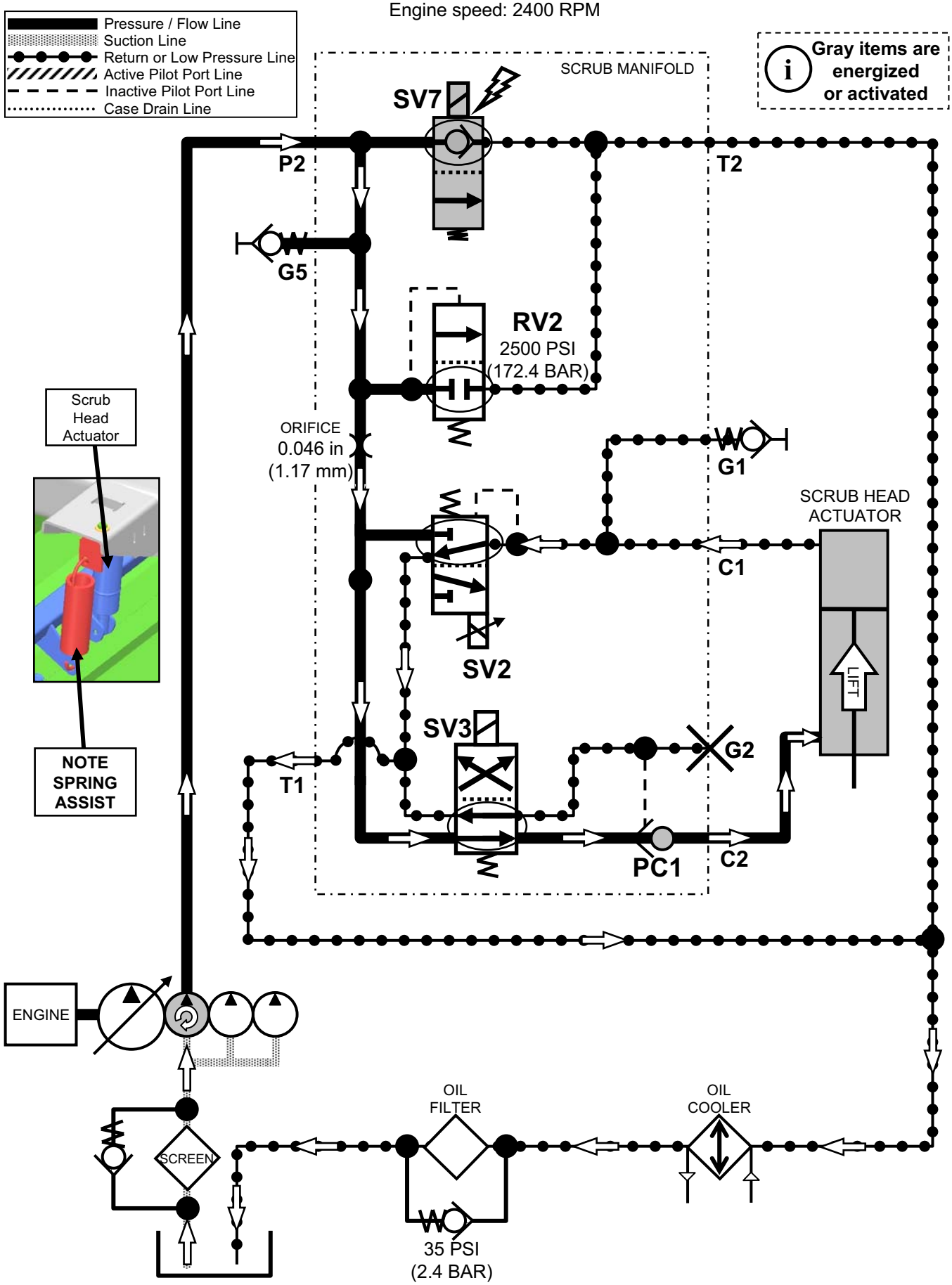
M20 Scrub/Sweep Head Lift

Engine speed: 2400 RPM



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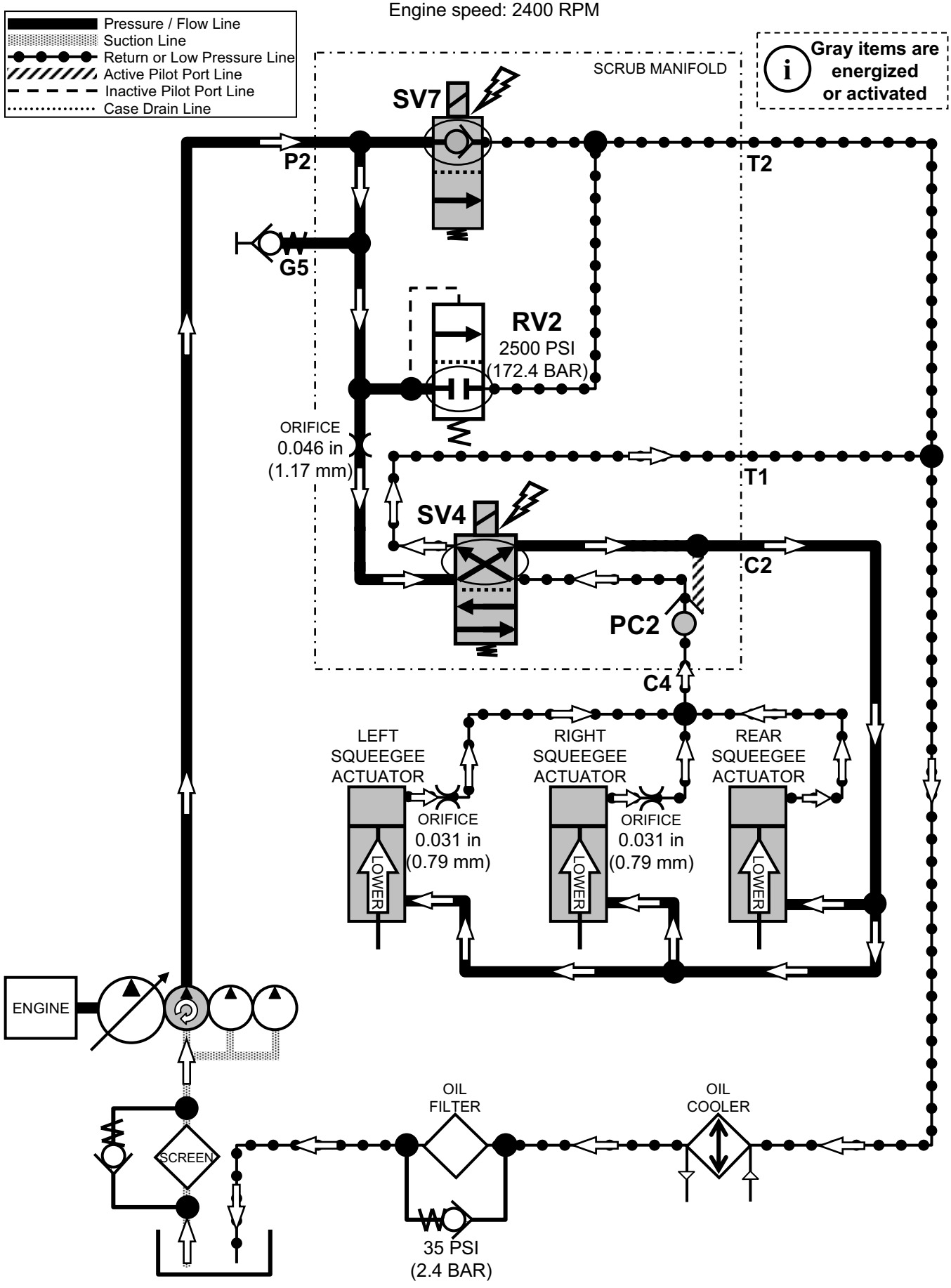
M20 Squeegees Lower

Engine speed: 2400 RPM



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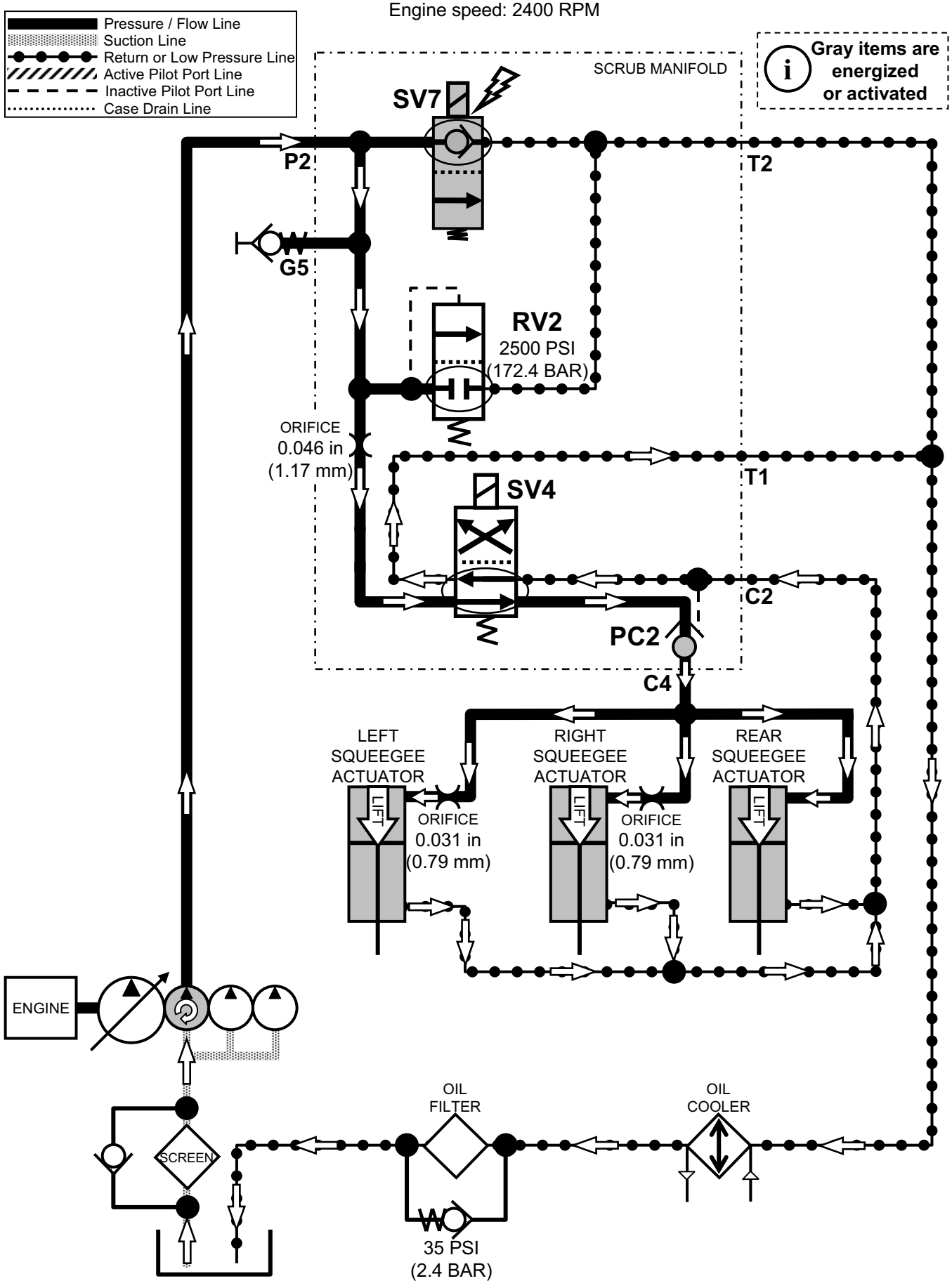
M20 Squeegees Lift

Engine speed: 2400 RPM



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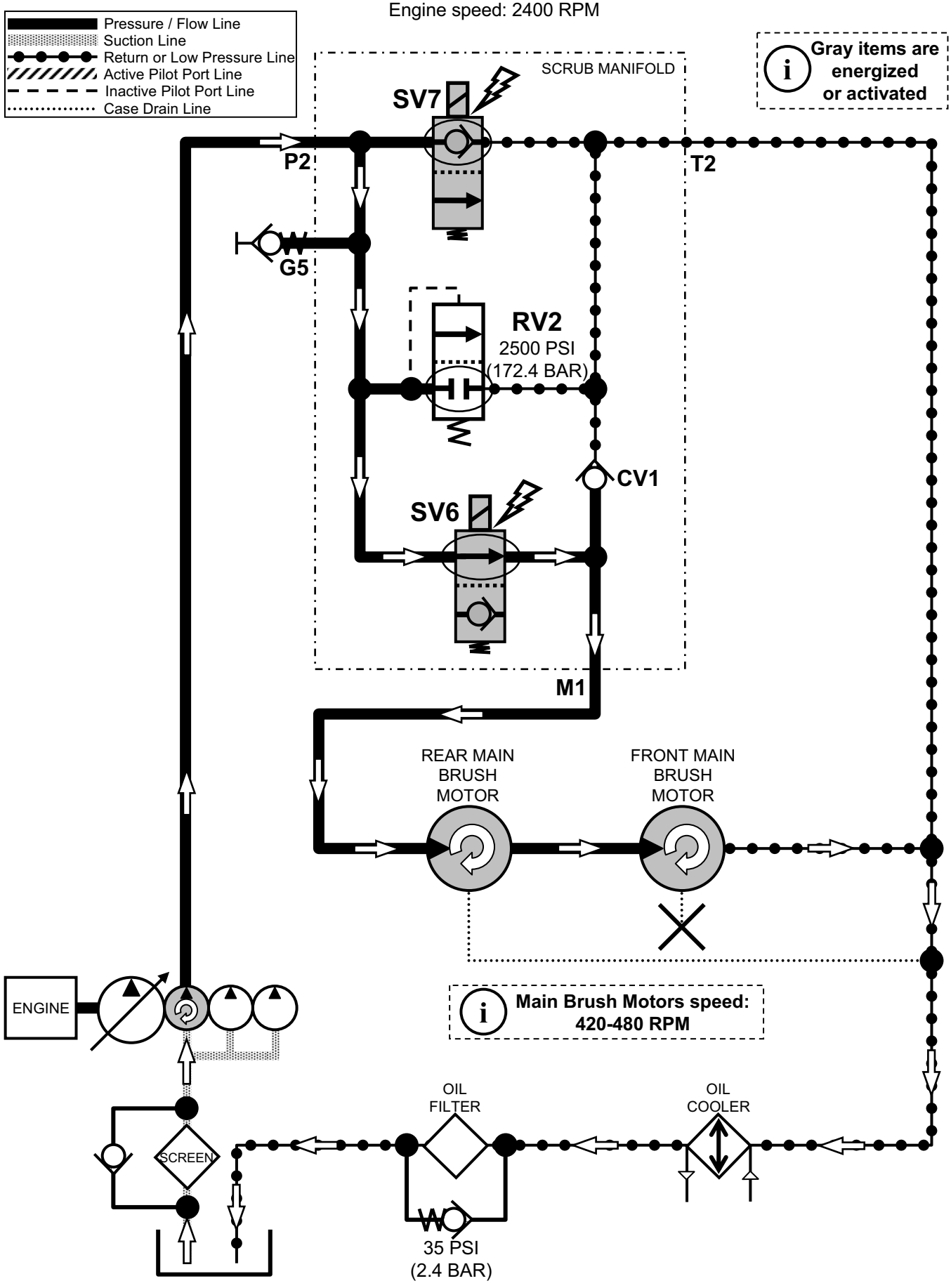
M20 Main Brushes ON

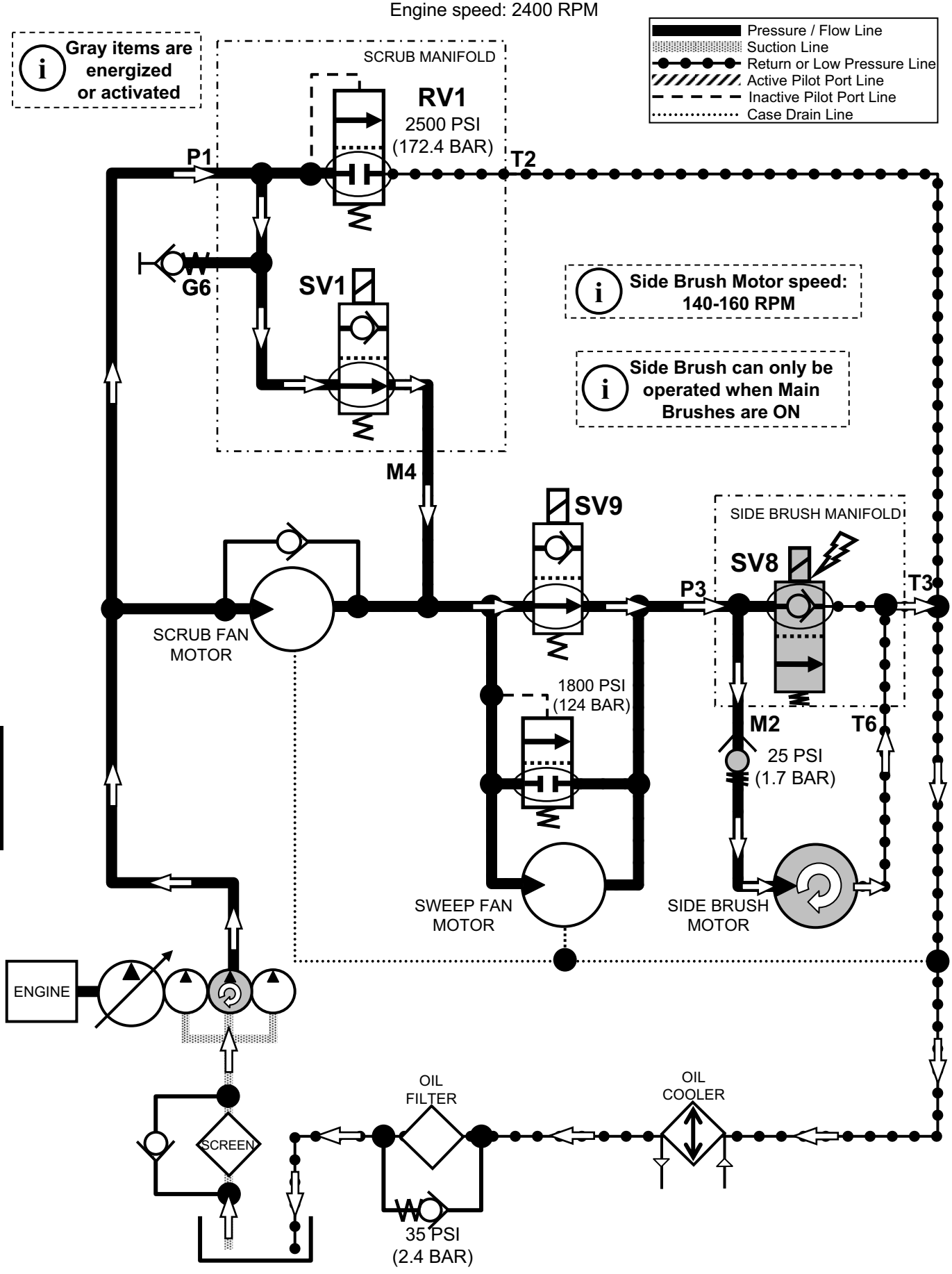
Engine speed: 2400 RPM



H

M20 Side Brush ON

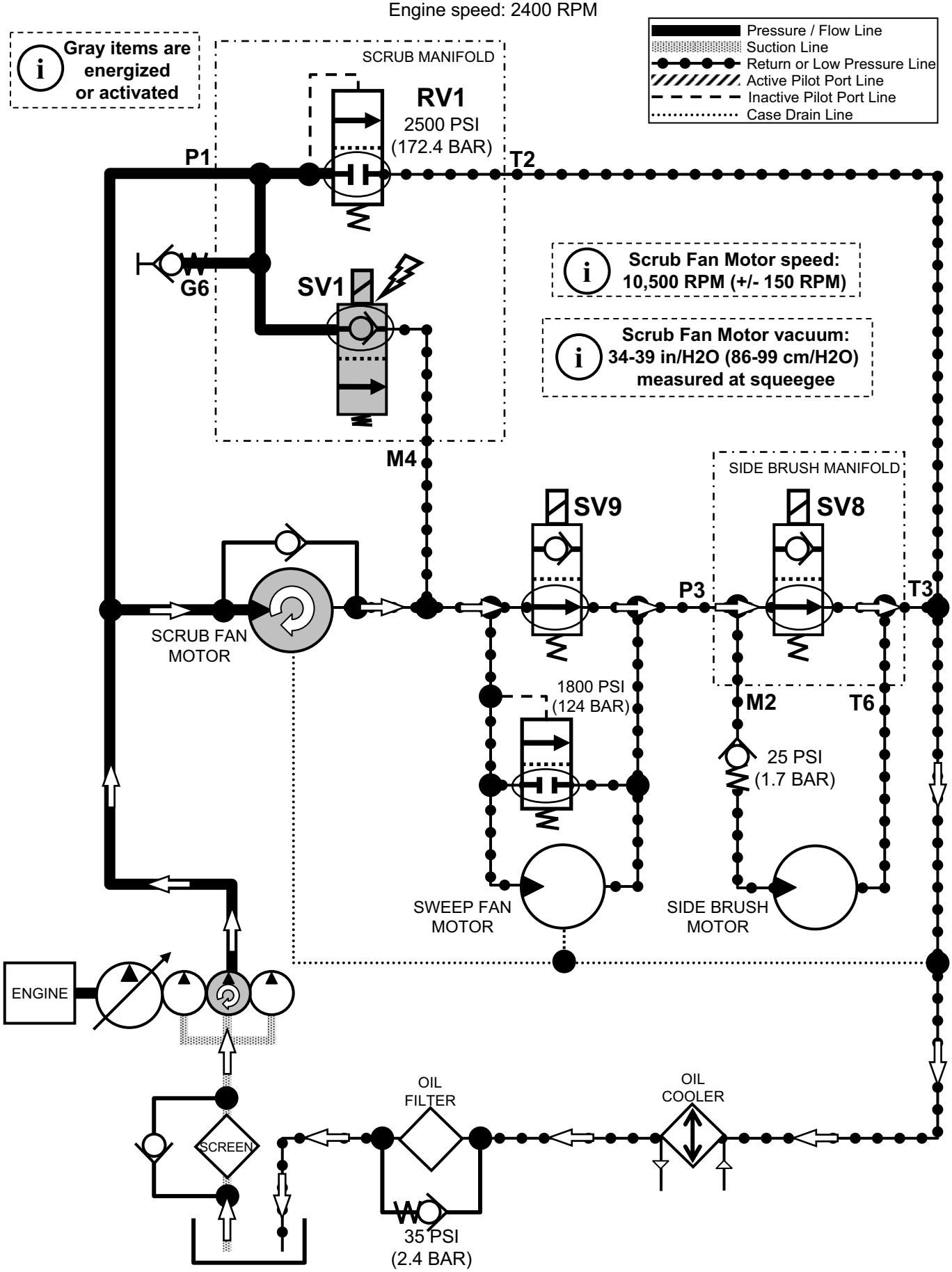
Engine speed: 2400 RPM



H

M20 Scrub Vacuum Fan ON

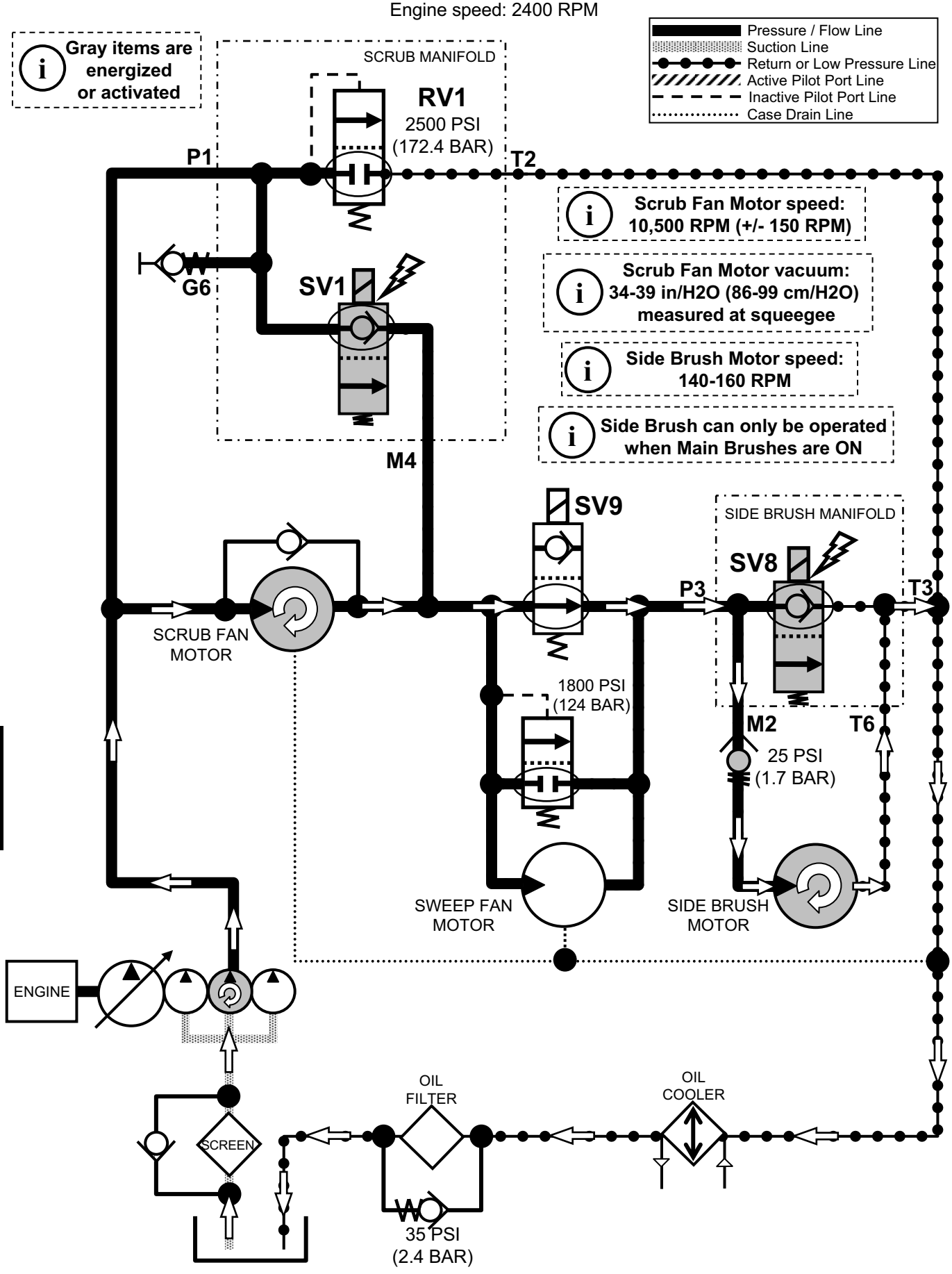
Engine speed: 2400 RPM



H

M20 Scrub Vacuum Fan & Side Brush ON

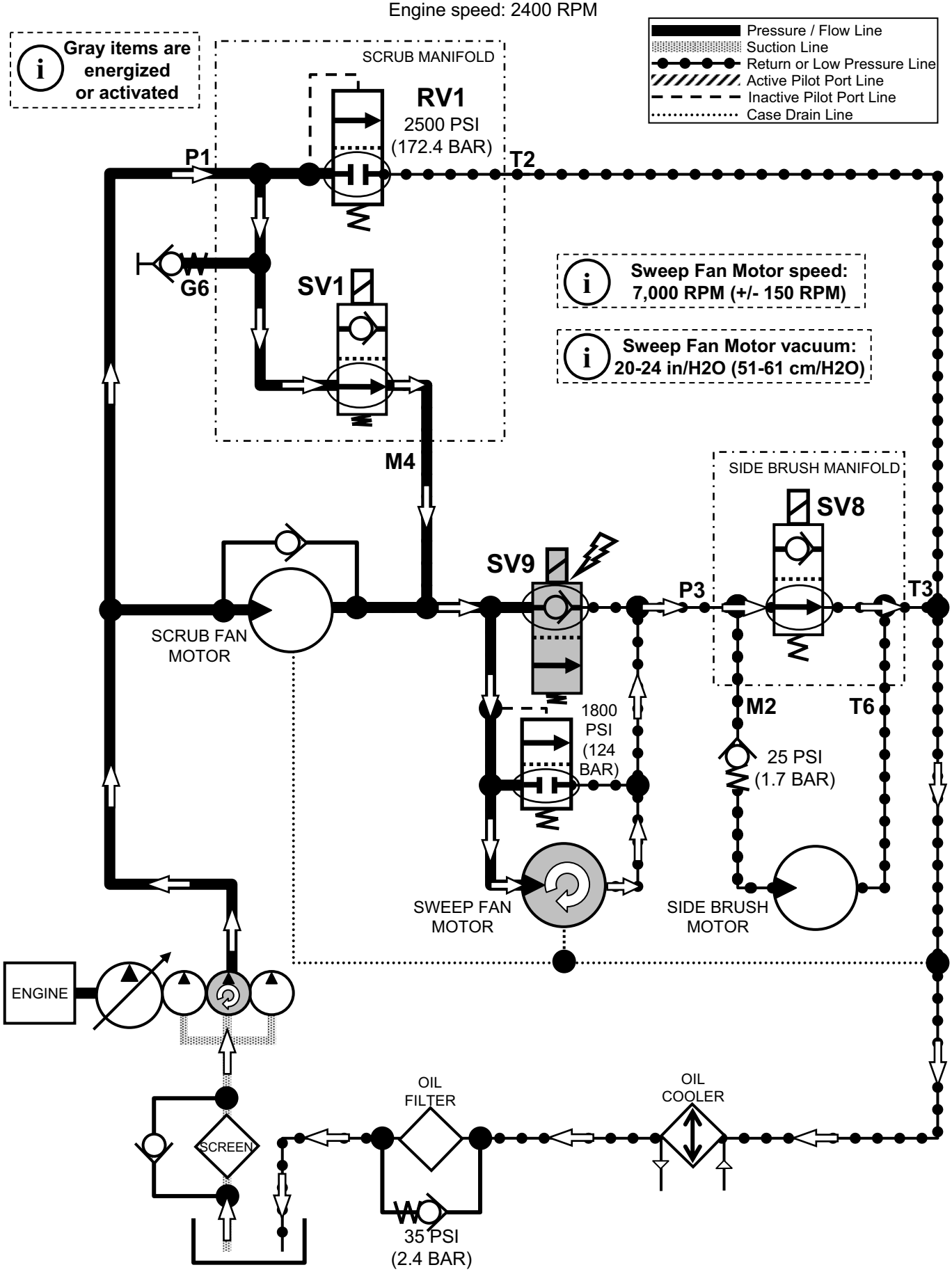
Engine speed: 2400 RPM



H

M20 Sweep Vacuum Fan ON

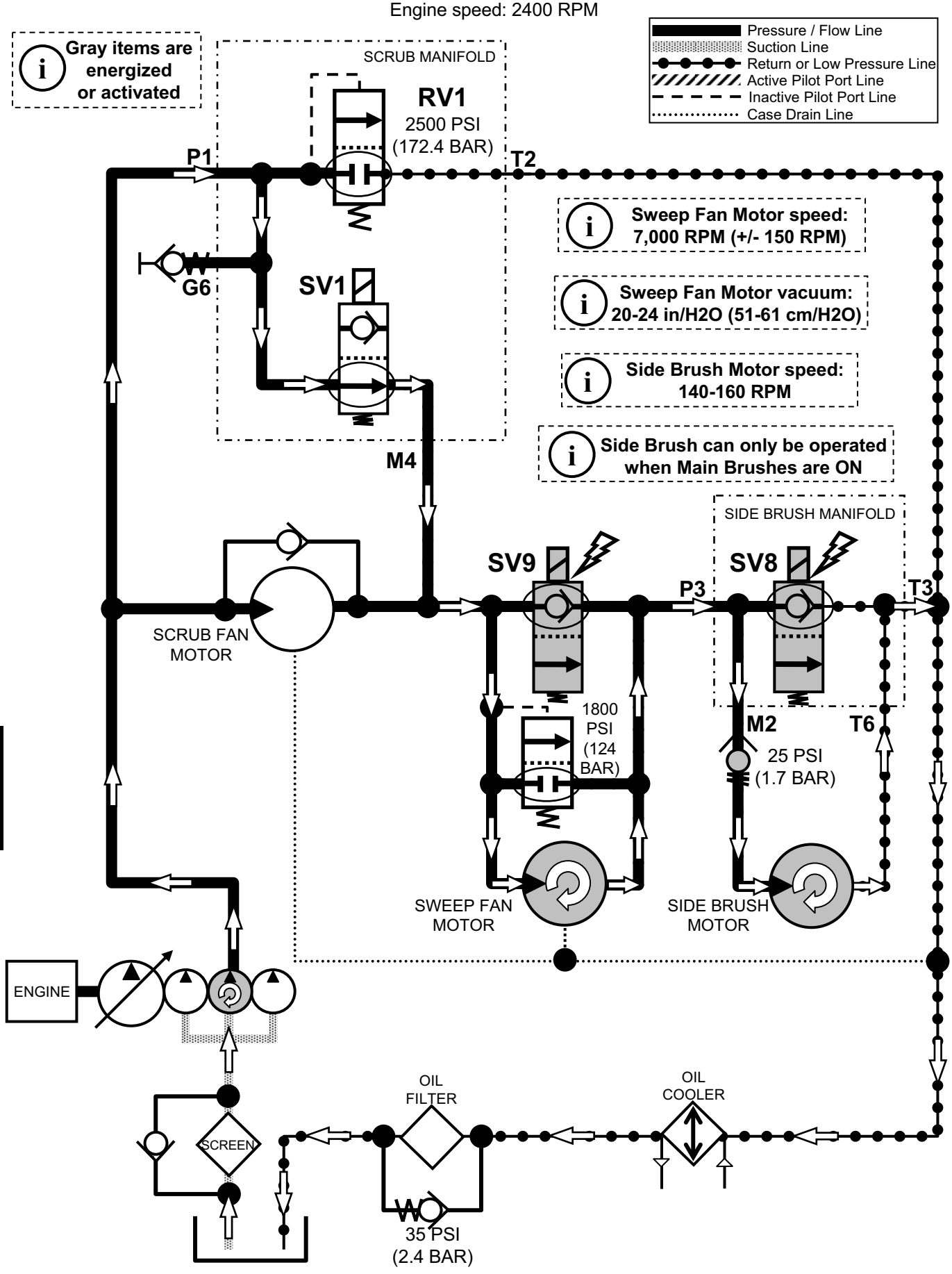
Engine speed: 2400 RPM



H

M20 Sweep Vacuum Fan & Side Brush ON

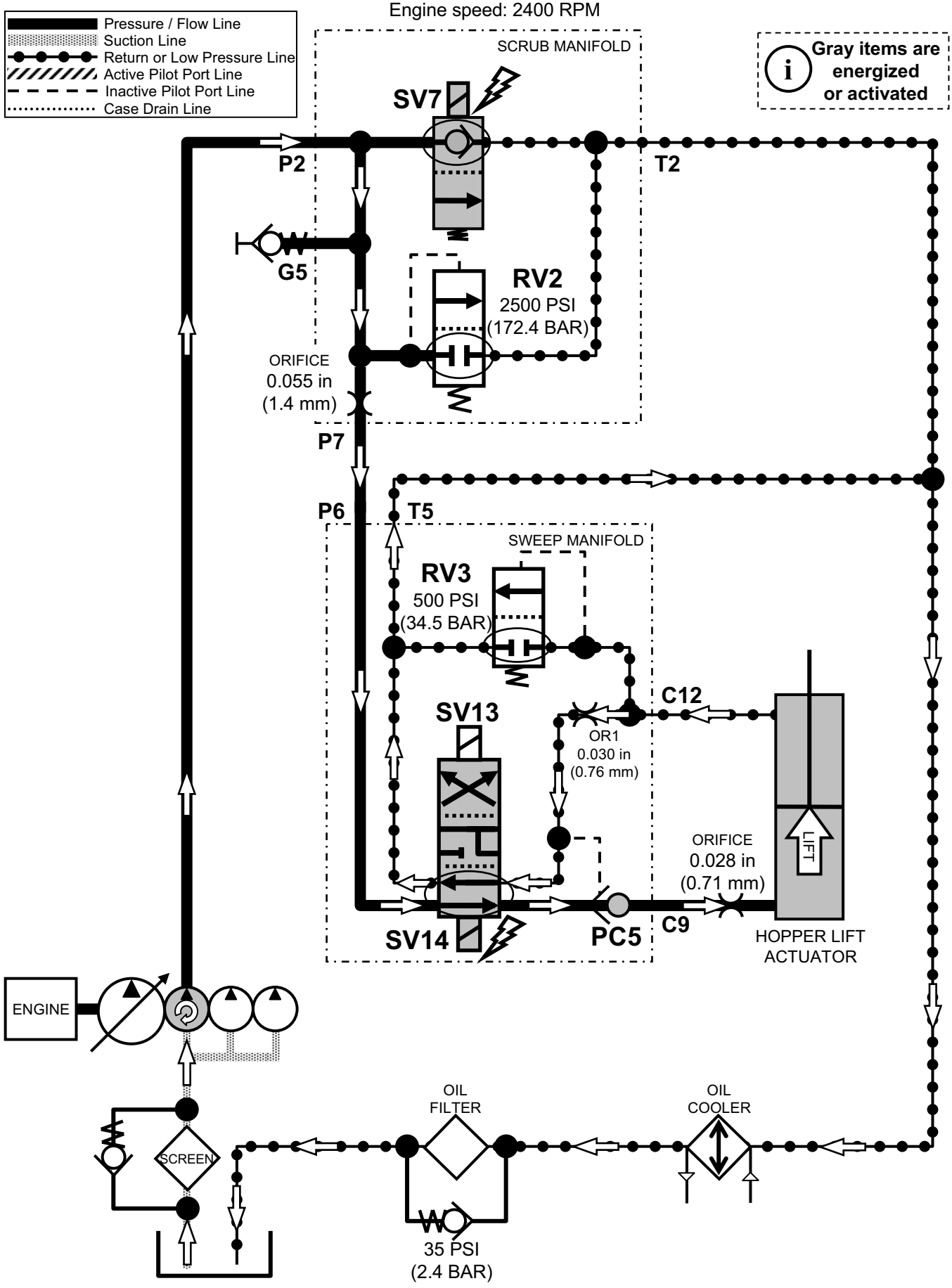
Engine speed: 2400 RPM



H

M20 Hopper Lift

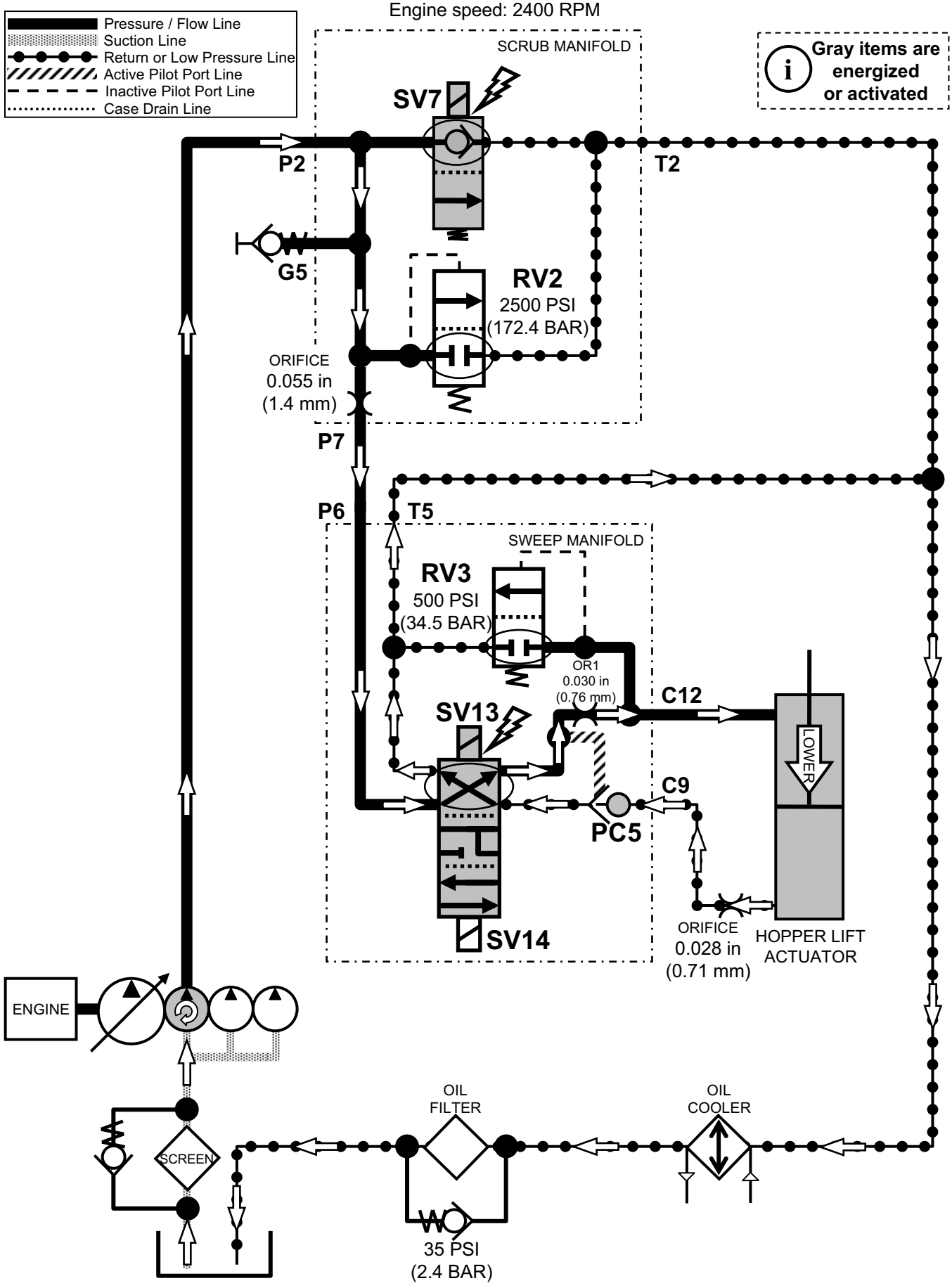
Engine speed: 2400 RPM



H

M20 Hopper Lower

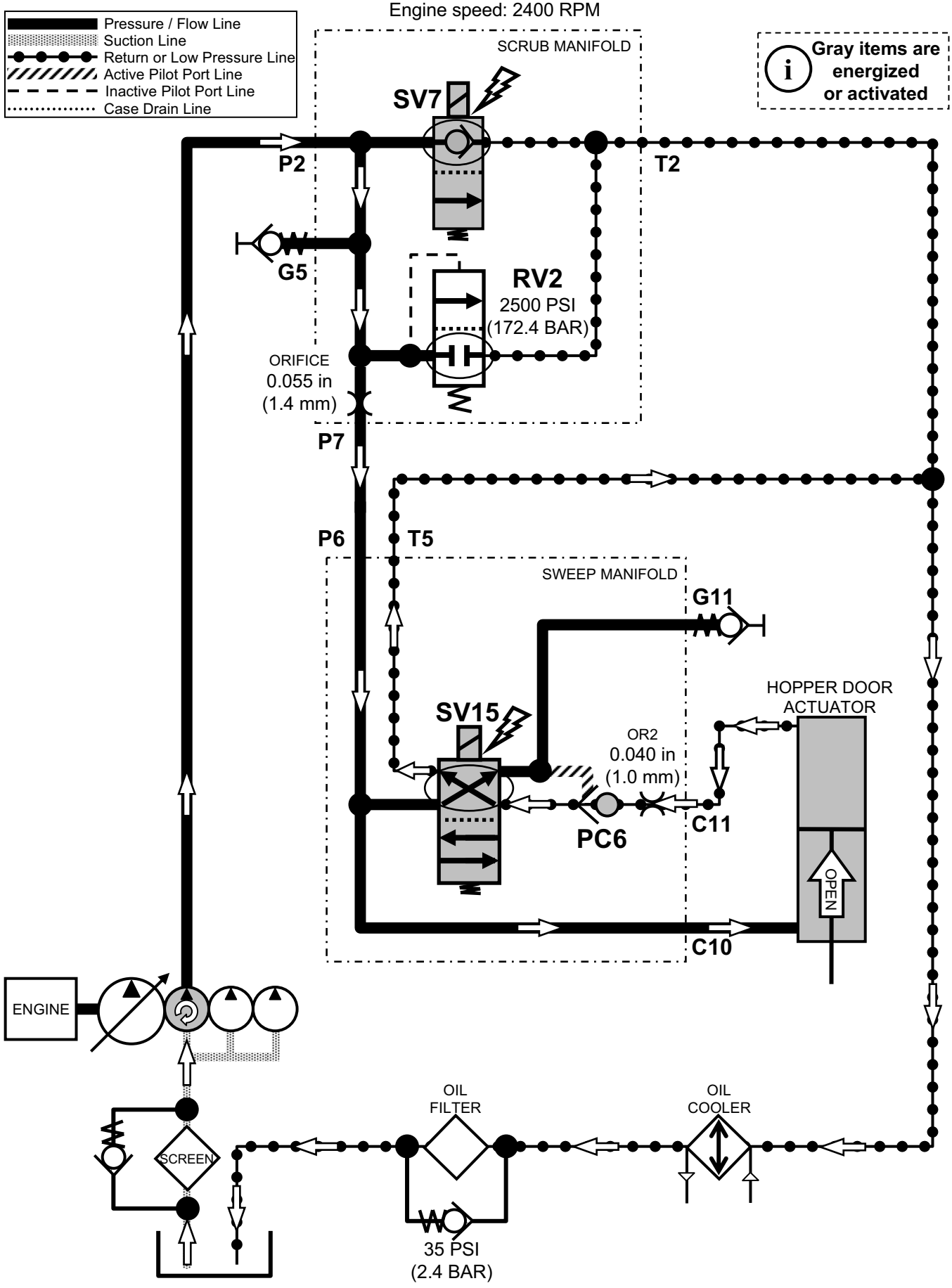
Engine speed: 2400 RPM



H

M20 Hopper Door Open

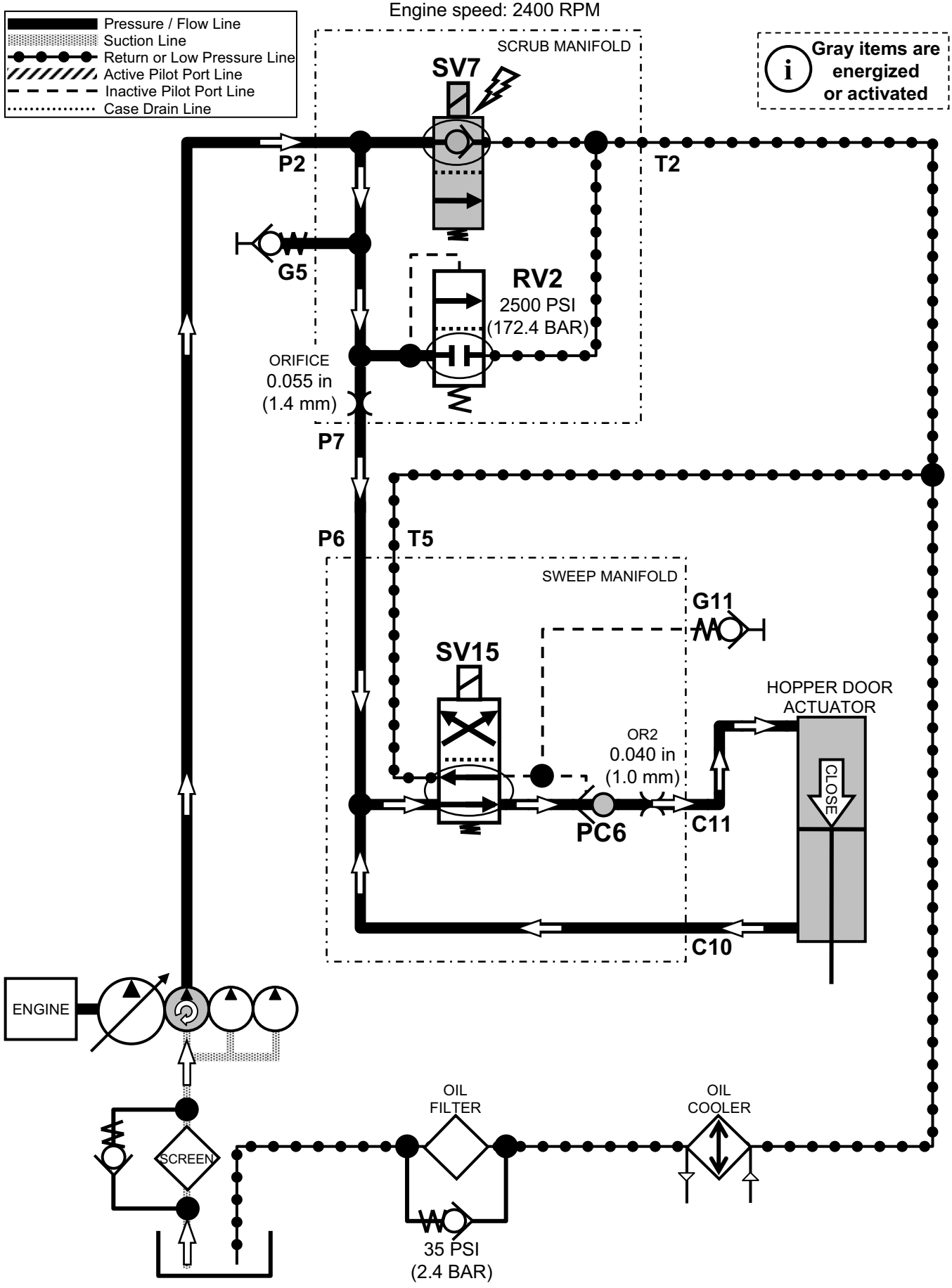
Engine speed: 2400 RPM



H

M20 Hopper Door Close

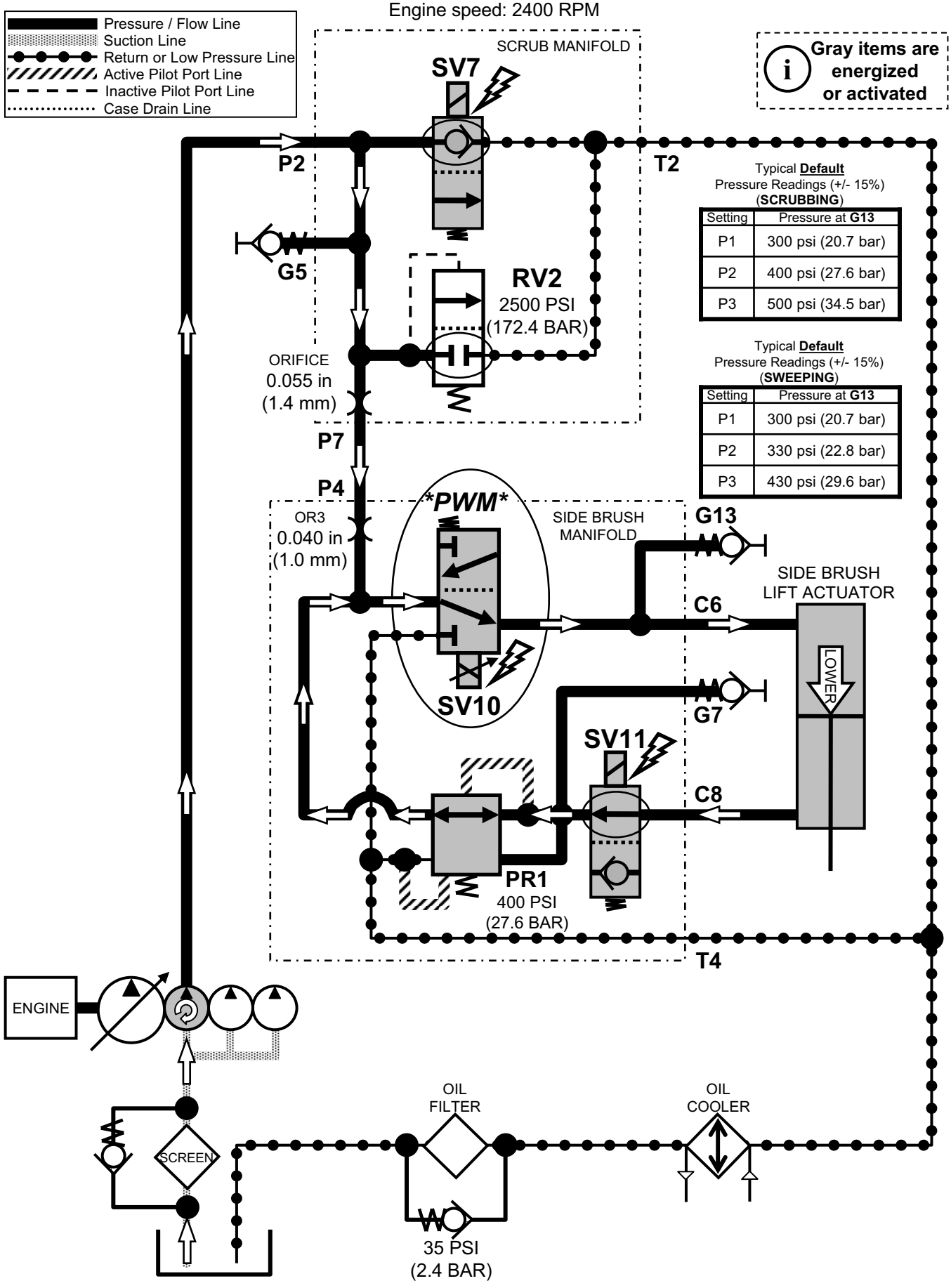
Engine speed: 2400 RPM



H

M20 Side Brush Lower

Engine speed: 2400 RPM



Gray items are energized or activated

Typical **Default** Pressure Readings (+/- 15%) (**SCRUBBING**)

Setting	Pressure at **G13**
P1	300 psi (20.7 bar)
P2	400 psi (27.6 bar)
P3	500 psi (34.5 bar)

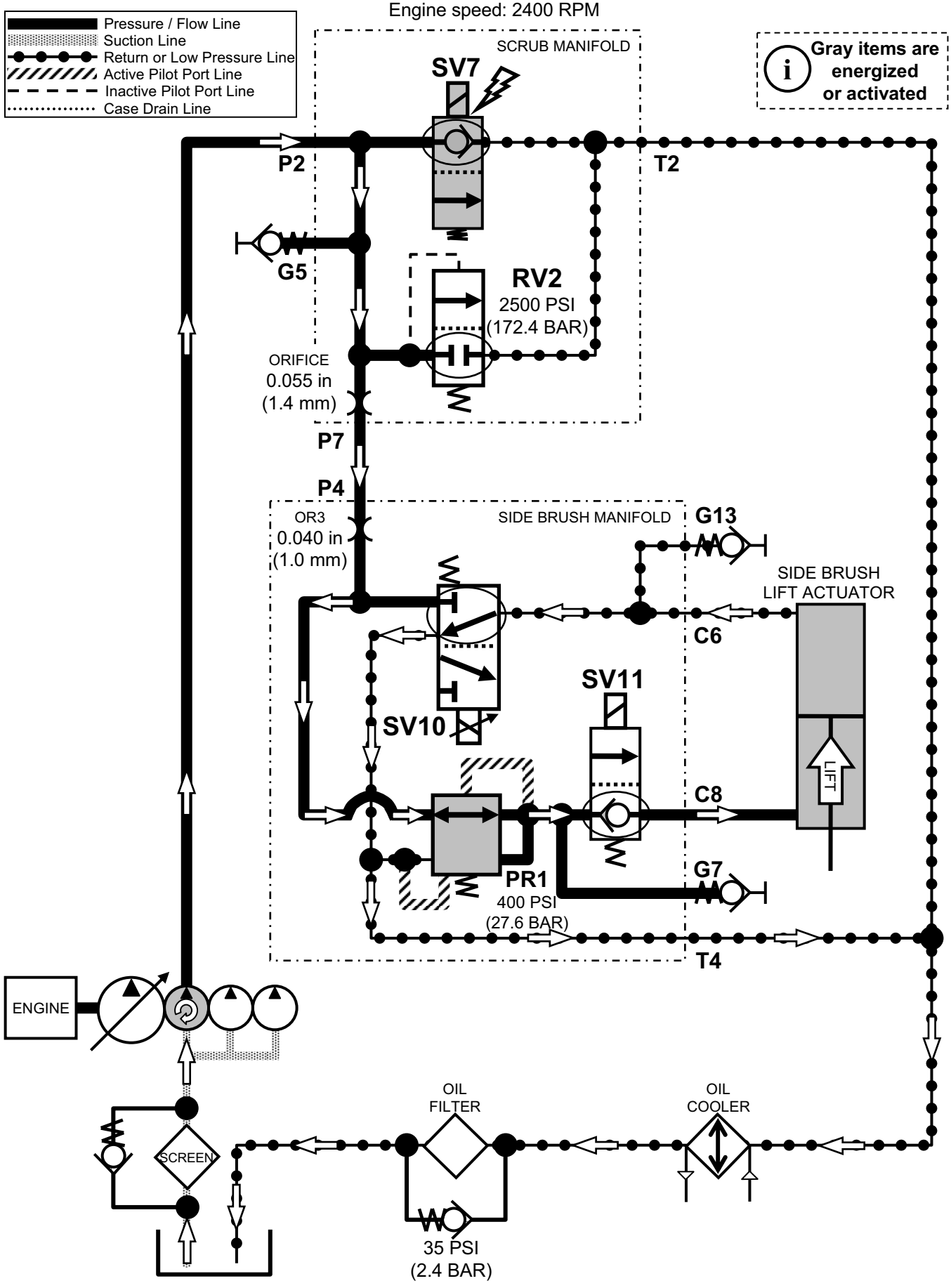
Typical **Default** Pressure Readings (+/- 15%) (**SWEEPING**)

Setting	Pressure at **G13**
P1	300 psi (20.7 bar)
P2	330 psi (22.8 bar)
P3	430 psi (29.6 bar)

H

M20 Side Brush Lift

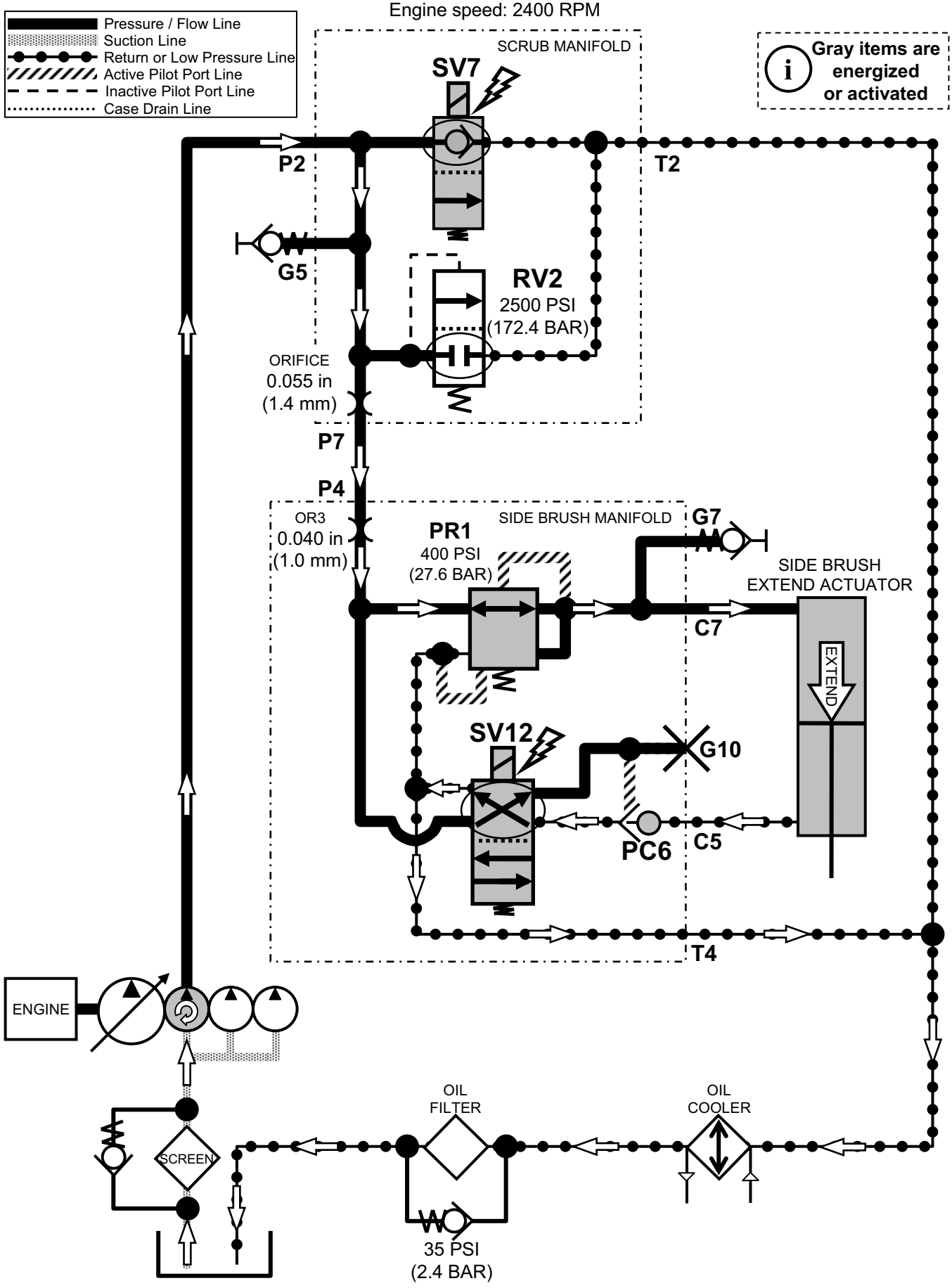
Engine speed: 2400 RPM



H

M20 Side Brush Extend

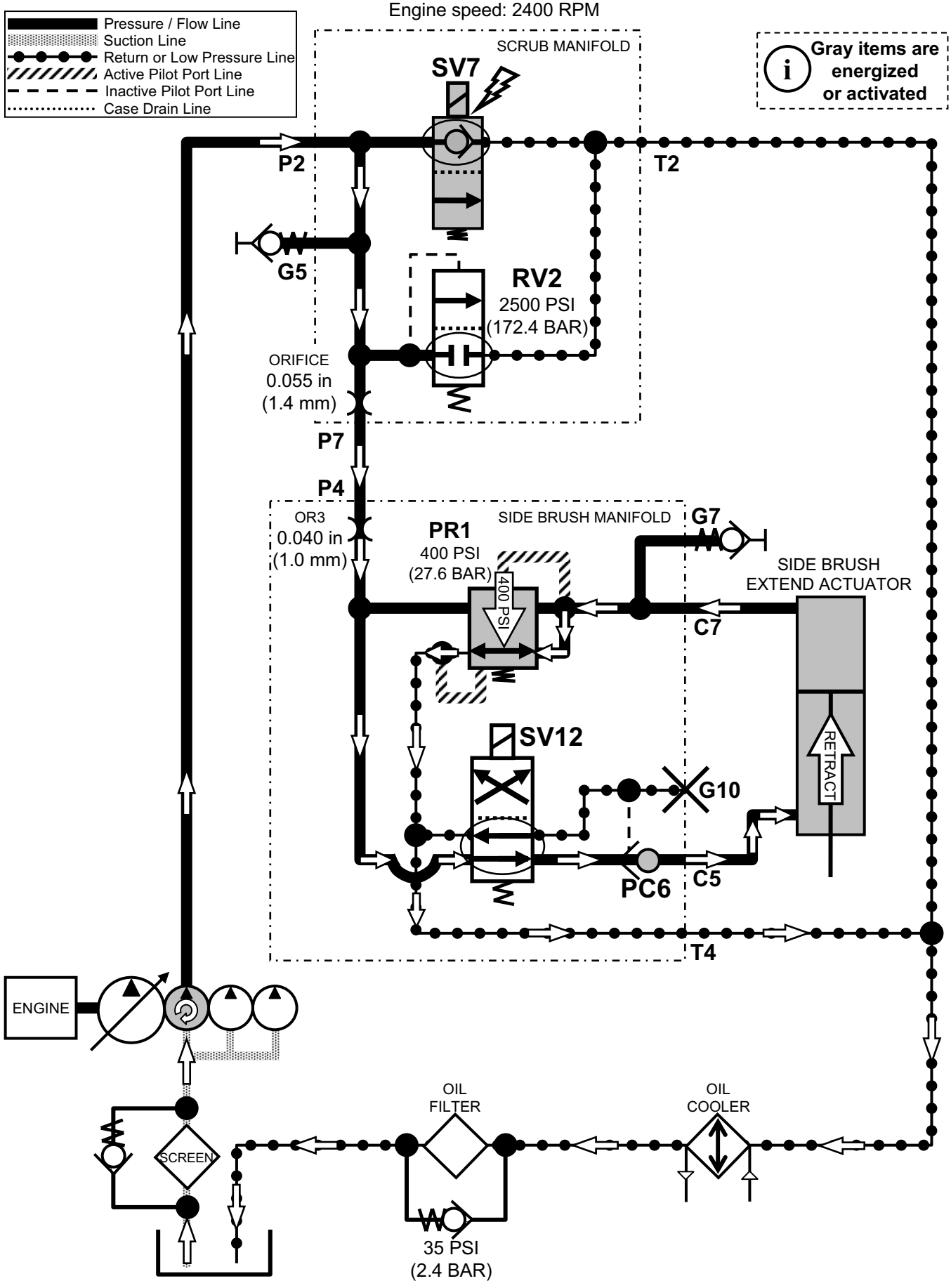
Engine speed: 2400 RPM



H

M20 Side Brush Retract

Engine speed: 2400 RPM



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