OIL SUPPLY PUMPING UNITS

WARNING

These instructions are intended for use only by experienced, qualified combustion start-up personnel. Adjustment of this equipment and its components by unqualified personnel can result in fire, explosion, severe personal injury, or even death.

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These instructions are intended to serve as guidelines covering the installation, operation, and maintenance of Hauck equipment. While every attempt has been made to ensure completeness, unforeseen or unspecified applications, details, and variations may preclude covering every possible contingency. **WARNING: TO PREVENT THE POSSIBILITY OF SERIOUS BODILY INJURY, DO NOT USE OR OPERATE ANY EQUIPMENT OR COMPONENT WITH ANY PARTS REMOVED OR ANY PARTS NOT APPROVED BY THE MANUFACTURER.** Should further information be required or desired or should particular problems arise which are not covered sufficiently for the purchaser's purpose, contact Hauck Mfg. Co.

WARNING

This equipment is potentially dangerous with the possibility of serious personal injury and property damage. Hauck Manufacturing Company recommends the use of flame supervisory equipment and fuel safety shutoff valves. Furthermore, Hauck urges rigid adherence to National Fire Protection Association (NFPA) standards and insurance underwriter's requirements. Operation and regular preventative maintenance of this equipment should be performed only by properly trained and qualified personnel. Annual review and upgrading of safety equipment is recommended.

A. GENERAL INFORMATION

Hauck SPU Supply Pumping Units are pre-assembled, skid mounted units engineered for installation in a fuel oil system at a point where oil is to be received from the storage tank and delivered, under pressure, to the supply line. Standard pumping units, commonly referred to as simplex units, utilize a single pump for operation. The standard design includes an inlet ball valve, double basket strainer, pump and motor assembly, and pressure relief valve. Three connections are provided on each unit: 1) oil inlet (suction), 2) oil outlet (discharge), and 3) oil return line to carry oil back to the supply tank or tank suction heater if applicable. Specially engineered duplex units are available which use two pumps; one pump for operation and a second pump for standby or alternating use. Both standard simplex and special duplex SPU's utilize the same basic components, therefore the SPU-9 Instructions are applicable to either unit.

The pumps utilized in Hauck SPU's are a positive displacement, gear pump. The pump assembly consists of a TEFC C-flange motor directly mounted to the gear pump to eliminate alignment issues. Two specific pump designs are available for light oil and heavy/recycled oil; wear resistant pump internals and slower pump speeds are utilized to extend service life for the commonly abrasive heavy/recycled oils. It is recommended that the oil supplied to light oil pumps not exceed a viscosity of 90 SSU ($1.8 \times 10^{-5} m^2/sec$), and to heavy/recycled oil pumps not exceed a viscosity of 2000 SSU ($4.3 \times 10^{-4} m^2/sec$). This may require the use of a tank suction heater or other suitable means to achieve the proper pumping viscosity; consult Hauck.

B. RECEIVING AND INSPECTION

Upon receipt, check each item on the bill of lading and/or invoice to determine that all equipment has been received. A careful examination of all parts should be made to ascertain if there has been any damage in shipment.

IMPORTANT

If the installation is delayed and the equipment is stored outside, provide adequate protection as dictated by climate and period of exposure. Special care should be given to all motors and bearings, if applicable, to protect them from rain or excessive moisture.

C. CAPACITIES

SPU Model No.	Viscosity			
	40 SSU		90 SSU	
	Discharge Pressure			
	50 psig	100 psig	50 psig	100 psig
	(gph)	(gph)	(gph)	(gph)
RP1-56C-1/3-1800	246	216	255	225
GP26-56C-3/4-1200	308	286	313	298
GP26-56C-1-1800	477	455	482	468
GP33-145TC-1 1/2-1200	555	521	564	542
GP33-145TC-1 1/2-1800	860	826	869	847
GP41-145TC-1 1/2-1200	1,070	1,010	1,090	1,060
GP41-182TC-3-1800	1,670	1,610	1,690	1,650

NOTES:

1. Fuel oil flow capacities based on No. 2 fuel oil at a viscosity of 40 SSU and No. 4 fuel oil at a viscosity of 90 SSU with 60Hz power.

2. To calculate maximum Btu/hr throughput, multiply No. 2 fuel oil flow in gallons per hour (gph) by higher heating value (HHV) of 141,146 Btu/gal, or No. 4 fuel oil flow in gph by HHV of 146,130 Btu/gal.

3. For applications where catalogued flow capacities do not meet specific requirements, consult Hauck for information on special design supply pumping units.

4. SPU Model No. designators are as follows: Pump Model – Motor Frame – Motor HP – Pump RPM.

Table 1. SPU Light Oil Capacities – 60 Hz Operation

C. CAPACITIES (Continued

SPU Model No.	Viscosity			
	$4.6x10^{-6}$ m^2/sec		$1.8x10^{-5}$ m^2/sec	
	Discharge Pressure			
	345 kPa	690 kPa	345 kPa	690 kPa
	(lph)	(lph)	(lph)	(lph)
RP1-56C-1/3-1800	930	820	965	850
GP26-56C-3/4-1200	1,170	1,080	1,180	1,130
GP26-56C-1-1800	1,810	1,720	1,824	1,770
GP33-145TC-1 1/2-1200	2,100	1,970	2,130	2,050
GP33-145TC-1 1/2-1800	3,260	3,130	3,290	3,210
GP41-145TC-1 1/2-1200	4,050	3,820	4,130	4,010
GP41-182TC-3-1800	6,320	6,090	6,400	6,250

NOTES:
1. Fuel oil flow capacities based on No. 2 fuel oil at a viscosity of $4.6x10^{-6}$ m^2/sec and No. 4 fuel oil at a viscosity of $1.8x10^{-5}$ m^2/sec with 60Hz power.

2. To calculate maximum kW throughput, multiply respective fuel oil flow in liters per hour (lph) by lower heating value (LHV) in MJ/liter, and by 0.2778 kW/MJ; LHV for No. 2 fuel oil is 36.99 MJ/liter, and for No. 4 fuel oil is 38.37 MJ/liter.

3. For applications where catalogued flow capacities do not meet specific requirements, consult Hauck for information on special design supply pumping units.

4. SPU Model No. designators are as follows: Pump Model – Motor Frame – Motor HP – Pump RPM.

Table 2. SPU Light Oil Metric Capacities – 60 Hz Operation

C. CAPACITIES (Continued

SPU Model No.	Viscosity			
	90 SSU		2000 SSU	
	Discharge Pressure			
	50 psig	100 psig	50 psig	100 psig
	(gph)	(gph)	(gph)	(gph)
GP26-182TC-1-900	228	214	236	231
GP26-145TC-1-1200	313	298	321	315
GP33-182TC-1-900	412	390	425	417
GP33-184TC-2-1200	565	542	578	570
GP41-184TC-2-900	795	756	829	816
GP41-213TC-3-1200	1,100	1,060	1,130	1,110
HD51-184TC-5-930	1,900	1,790	1,990	1,960

NOTES:

1. Fuel oil flow capacities based on No. 5, No.6, or recycled fuel oil heated to a viscosity of 90 SSU, and No.6 fuel oil at or heated to a viscosity of 2000 SSU with 60Hz power.

2. To calculate maximum Btu/hr throughput, multiply No. 5 fuel oil flow in gallons per hour (gph) by higher heating value HHV of 149,943 Btu/gal, or No. 6 fuel oil flow in gph by HHV of 157,174 Btu/gal or recycled oil flow in gph by HHV from fuel supplier.

3. Supply pumping units for heavy/recycled oil have special wear resistant internals not found in supply pumping units for light oil.

4. For applications where catalogued flow capacities do not meet specific requirements, consult Hauck for information on special design supply pumping units.

5. SPU Model No. designators are as follows: Pump Model – Model Frame – Motor HP – Pump RPM.

Table 3. SPU Heavy/Recycled Oil Capacities – 60 Hz Operation

C. CAPACITIES (Continued

SPU Model No.	Viscosity			
	$1.8x10^{-5}$ m^2/sec		$4.3x10^{-4}$ m^2/sec	
	Discharge Pressure			
	345 kPa	690 kPa	345 kPa	690 kPa
	(lph)	(lph)	(lph)	(lph)
GP26-182TC-1-900	863	810	893	874
GP26-145TC-1-1200	1,180	1,130	1,210	1,190
GP33-182TC-1-900	1,560	1,480	1,610	1,580
GP33-184TC-2-1200	2,140	2,050	2,190	2,160
GP41-184TC-2-900	3,010	2,860	3,140	3,090
GP41-213TC-3-1200	4,160	4,010	4,280	4,200
HD51-184TC-5-930	7,190	6,780	7,530	7,420

NOTES:

1. Fuel oil flow capacities based on No. 5, No. 6, or recycled fuel oil heated to a viscosity of $1.8x10^{-5}$ m^2/sec and No. 6 fuel oil at or heated to a viscosity of $4.3x10^{-4}$ m^2/sec with 60Hz power.

2. To calculate maximum kW throughput, multiply respective fuel oil flow in liters per hour (lph) by lower heating value (LHV) in MJ/liter, and by 0.2778 kW/MJ; LHV for No. 5 fuel oil is 39.65 MJ/liter, and for No. 6 fuel oil is 41.27 MJ/liter - consult supplier for LHV of recycled oil.

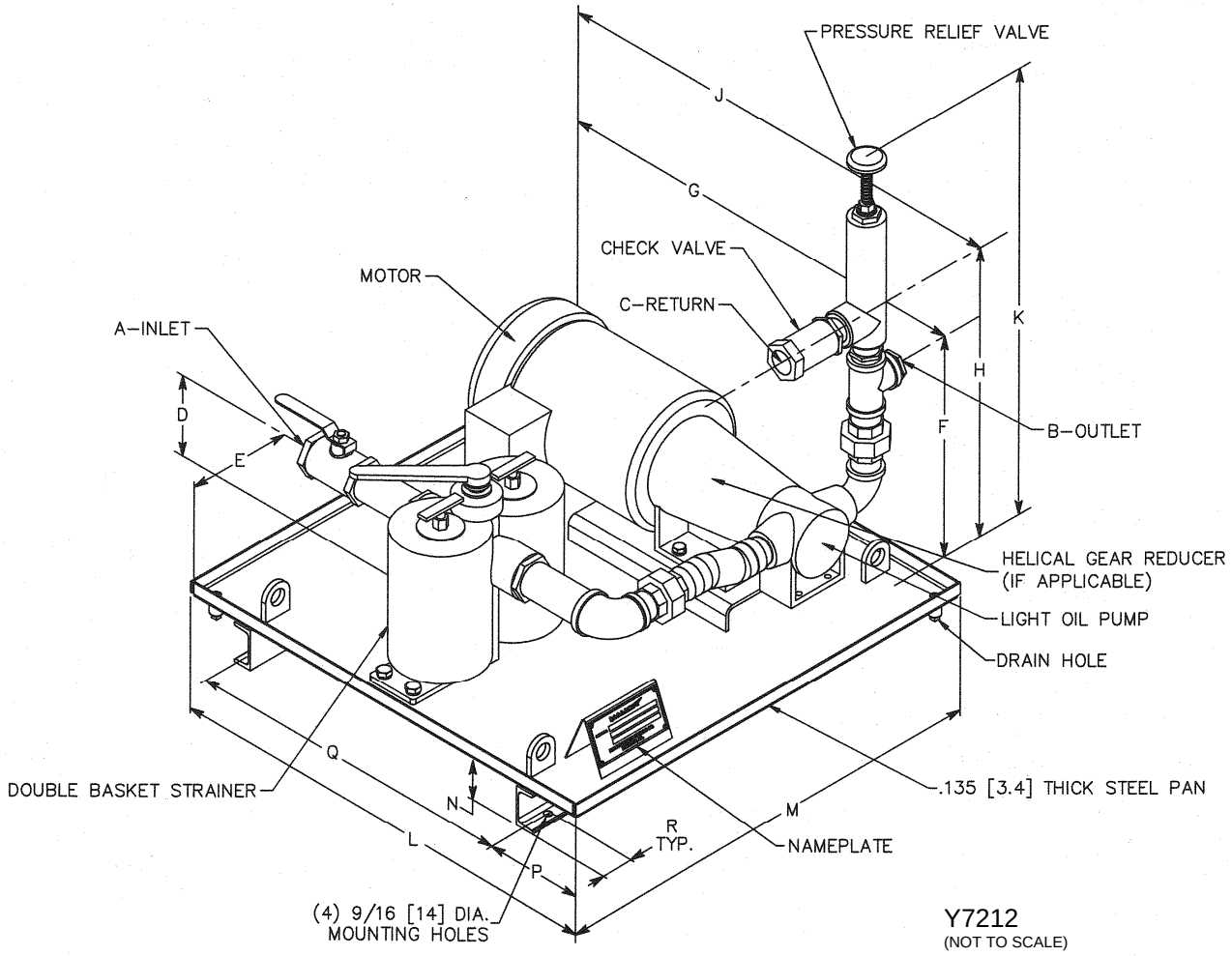
3. Supply pumping units for heavy/recycled oil have special wear resistant internals not found in supply pumping units for light oil.

4. For applications where catalogued flow capacities do not meet specific requirements, consult Hauck for information on special design supply pumping units.

5. SPU Model No. designators are as follows: Pump Model – Motor Frame – Motor HP – Pump RPM.

Table 4. SPU Heavy/Recycled Oil Metric Capacities – 60 Hz Operation

D. DIMENSIONS



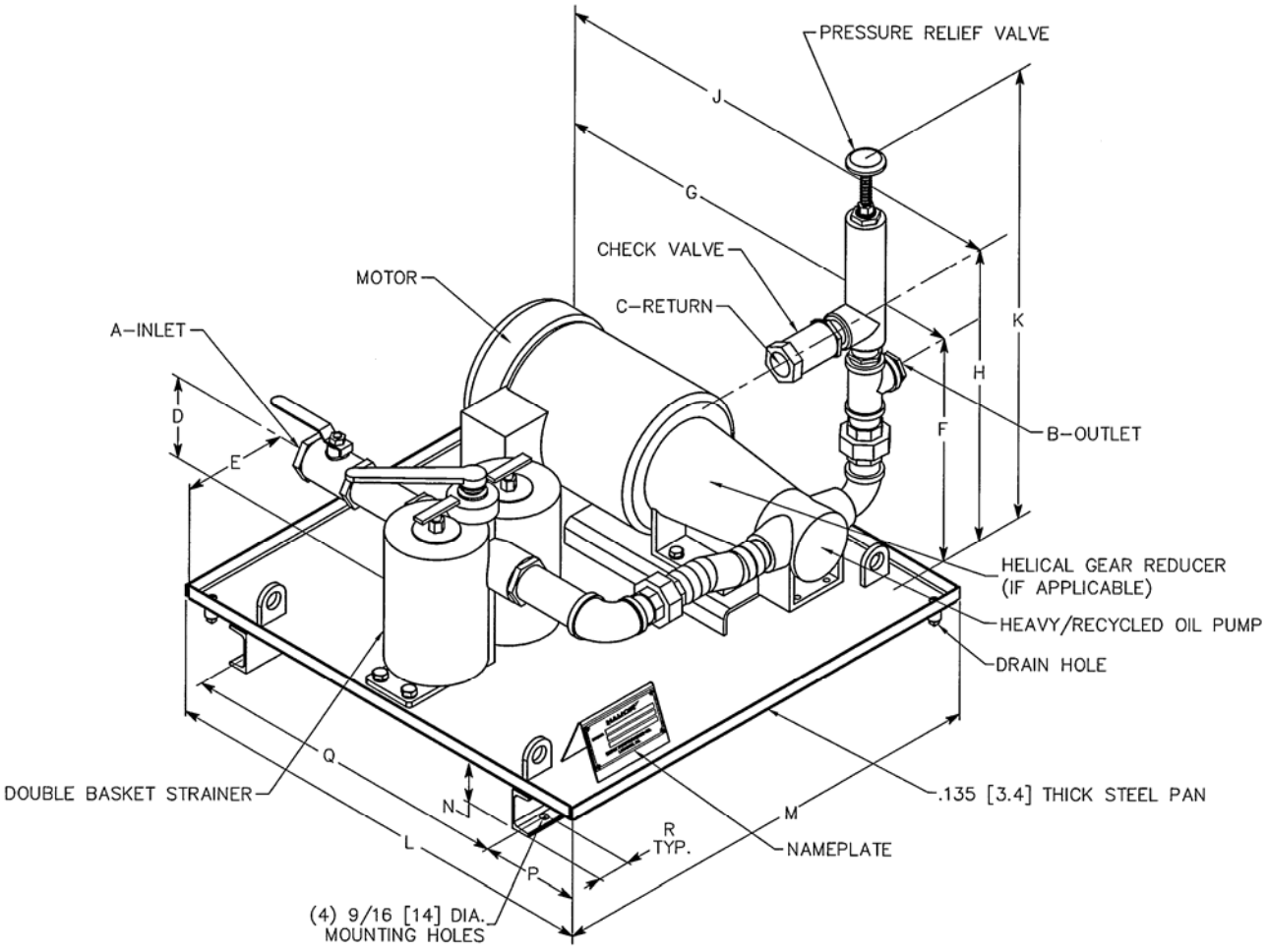
NOTE:
1. ALL DIMENSIONS ARE IN INCHES [MM]; PIPE CONNECTIONS ARE IN NPT [DN].
2. ALL VERTICAL DIMENSIONS REFERENCED FROM TOP SURFACE OF PAN;
   ALL HORIZONTAL DIMENSIONS REFERENCED FROM OUTSIDE SURFACE OF PAN.
3. DO NOT USE FOR CONSTRUCTION PURPOSES; CERTIFIED DRAWINGS AVAILABLE
   AT TIME OF SHIPMENT.

DIMENSIONS, LIGHT OIL																
MODEL NO.	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R
SPU–RP1–56C–1/3–1800	1 NPT	1 NPT	3/4 NPT	5	8 3/8	14 1/8	27 1/2	18 7/8	27 1/2	26 7/8	34	34	3	5 1/4	23 5/8	2
SPU–GP26–56C–3/4–1200	1 NPT	1 NPT	3/4 NPT	5	8 3/8	14 3/8	27 1/2	19	27 1/2	26 7/8	34	34	3	4 1/2	25	2
SPU–GP26–56C–1–1800	1 NPT	1 NPT	3/4 NPT	5	8 3/8	14 3/8	27 1/2	19	27 1/2	26 7/8	34	34	3	4 1/2	25	2
SPU–GP33–145TC–1 1/2–1200	1 1/4 NPT	1 NPT	1 NPT	6 13/16	8 3/4	15 7/8	28 1/2	20 7/8	28 1/2	28 1/8	34	34	3	5 1/4	23 5/8	2
SPU–GP33–145TC–1 1/2–1800	1 1/4 NPT	1 NPT	1 NPT	6 13/16	8 3/4	16 5/8	27 3/8	21 5/8	27 3/8	28 7/8	34	34	3	4 1/2	25	2
SPU–GP41–145TC–1 1/2–1200	2 NPT	1 1/4 NPT	1 1/4 NPT	8 1/4	10 5/8	15 1/2	29 1/8	20 3/4	29 1/8	32 3/4	34	34	3	4 1/2	25	2
SPU–GP41–182TC–3–1800	2 NPT	1 1/4 NPT	1 1/4 NPT	8 1/4	10 5/8	15 1/2	29 1/8	20 3/4	29 1/8	32 3/4	34	34	3	4 1/2	25	2

METRIC DIMENSIONS, LIGHT OIL																
MODEL NO.	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R
SPU–RP1–56C–1/3–1800	DN 25	DN 25	DN 20	127	171	359	699	479	699	683	864	864	76	133	600	51
SPU–GP26–56C–3/4–1200	DN 25	DN 25	DN 20	127	184	365	699	483	699	683	864	864	76	114	635	51
SPU–GP26–56C–1–1800	DN 25	DN 25	DN 20	127	184	365	699	483	699	683	864	864	76	114	635	51
SPU–GP33–145TC–1 1/2–1200	DN 32	DN 25	DN 25	173	216	403	724	530	724	714	864	864	76	133	600	51
SPU–GP33–145TC–1 1/2–1800	DN 32	DN 25	DN 25	173	216	422	695	549	695	733	864	864	76	114	635	51
SPU–GP41–145TC–1 1/2–1200	DN 50	DN 32	DN 32	210	203	394	740	527	740	832	864	864	76	114	635	51
SPU–GP41–182TC–3–1800	DN 50	DN 32	DN 32	210	203	394	740	527	740	832	864	864	76	114	635	51

Figure 1. SPU Light Oil Dimensions

D. DIMENSIONS (Continued)



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NOTE:
1. ALL DIMENSIONS ARE IN INCHES [MM]; PIPE CONNECTIONS ARE IN NPT [DN].
2. ALL VERTICAL DIMENSIONS REFERENCED FROM TOP SURFACE OF PAN; ALL HORIZONTAL DIMENSIONS REFERENCED FROM OUTSIDE SURFACE OF PAN.
3. DO NOT USE FOR CONSTRUCTION PURPOSES; CERTIFIED DRAWINGS AVAILABLE AT TIME OF SHIPMENT.

DIMENSIONS, RECYCLED OIL																
MODEL NO.	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R
SPU–GP26–182TC–1–900	1 NPT	1 NPT	3/4 NPT	5	8 3/8	15 3/8	27 3/8	20 1/8	27 3/8	28 1/8	34	34	3	5 1/4	23 1/2	2
SPU–GP26–145TC–1–1200	1 NPT	1 NPT	3/4 NPT	5	8 3/8	14 3/8	27 1/2	19	27 1/2	26 7/8	34	34	3	4 1/2	25	2
SPU–GP33–182TC–1–900	1 1/4 NPT	1 NPT	1 NPT	6 13/16	8 3/4	16 5/8	28 1/2	21 5/8	28 1/2	28 7/8	34	34	3	5 1/4	23 1/2	2
SPU–GP33–184TC–2–1200	1 1/4 NPT	1 NPT	1 NPT	6 13/16	8 3/4	16 5/8	27 3/8	21 5/8	27 3/8	28 7/8	34	34	3	4 1/2	25	2
SPU–GP41–184TC–2–900	1 1/2 NPT	1 NPT	1 NPT	6 7/8	8 3/4	17 3/8	29 1/8	22 5/8	29 1/8	29 7/8	34	34	3	5 1/4	23 1/2	2
SPU–GP41.1–213TC–3–1200	1 1/2 NPT	1 NPT	1 NPT	6 13/16	8 3/4	17 3/8	29 3/16	22 5/8	29 3/16	29 7/8	34	34	3	4 1/2	25	2
SPU–GP41.2–213TC–3–1200	2 NPT	1 1/4 NPT	1 1/4 NPT	8 1/4	10 5/8	15 1/2	29 1/8	20 3/4	29 1/8	32 3/4	34	34	3	4 1/2	25	2
SPU–HD51–254TC–5–930	2 NPT	1 1/2 NPT	1 1/4 NPT	8 1/4	12 1/4	16 3/4	41 1/2	21 1/4	41 1/2	33 1/4	46	44	3	2	42	8

METRIC DIMENSIONS, RECYCLED OIL																
MODEL NO.	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R
SPU–GP26–182TC–1–900	DN 25	DN 25	DN 20	127	184	390	695	511	695	714	864	864	76	133	597	51
SPU–GP26–145TC–1–1200	DN 25	DN 25	DN 20	127	184	365	699	483	699	683	864	864	76	114	635	51
SPU–GP33–182TC–1–900	DN 32	DN 25	DN 25	173	216	422	724	549	724	733	864	864	76	133	597	51
SPU–GP33–184TC–2–1200	DN 32	DN 25	DN 25	173	216	422	695	549	695	733	864	864	76	114	635	51
SPU–GP41–184TC–2–900	DN 40	DN 25	DN 25	175	216	441	740	575	740	759	864	864	76	133	597	51
SPU–GP41.1–213TC–3–1200	DN 40	DN 25	DN 25	173	216	441	741	575	741	759	864	864	76	114	635	51
SPU–GP41.2–213TC–3–1200	DN 50	DN 32	DN 32	210	203	394	740	527	740	832	864	864	76	114	635	51
SPU–HD51–254TC–5–930	DN 50	DN 40	DN 32	210	308	425	1054	540	1054	845	1168	1118	76	51	1067	203

Figure 2. SPU Heavy/Recycled Oil Dimensions

E. INSTALLATION

1. Locate the SPU skid as close to the fuel supply tank as possible to avoid unnecessary pressure losses in the suction line.

2. Bolt the skid to the floor using the holes provided for this purpose in the steel channel of the base. The unit should be mounted on a level, concrete or other suitable floor. Ensure access to at least one of the drain plugs located in the base (pan) of the skid.

Piping Connections

IMPORTANT

All piping must be accurately aligned with the connections provided on the SPU and must be properly supported to prevent strains on the equipment. If necessary, use flexible piping to relieve strain. On high pressure applications, the flexible piping must be constrained. All skid piping is properly positioned, tightened, and sealed at the factory. However, union pipe fittings may have loosened during shipment, which could cause leakage. Check and, if necessary, retighten these fittings. **Extreme care should be taken to maintain piping alignment to avoid serious problems.**

3. Pipe the oil inlet (suction) line to the appropriate connection on the SPU. **The oil suction line should be as short as possible with a minimum number of elbows.** For best operation, the following conditions should be met:
   a. Use piping one size larger, and never smaller, than the connection on the SPU. The maximum net positive suction head, or suction lift, in the typical viscosity range from 40 to 2000 ($4.6x10^{-6}$ to $4.3x10^{-4}$ m^2/sec) is 7.2 psi (50kPa) for priming, and 11.6 psi (80kPa) during operation.
   b. Position the piping with a slight upward slope toward the SPU.
   c. Avoid upward loops or high points where air might be trapped.
   d. Use clean pipe with good threaded joints.
   e. Ensure tight joints by using a high quality thread sealant with teflon; Hauck recommends Loctite 565 or equal – **do not use teflon tape.**

CAUTION

Leaky joints in the suction piping will cause the pump to become air bound and cavitate. This could result in excessive wear and serious pump damage.

   f. On installations with a negative suction head, i.e., a system where the oil level in the tank is lower than the pump, a foot or check valve should be installed near the tank or suction heater. This valve will hold oil in the piping leg to facilitate priming.
   g. Install a flow activated, normally open switch in the suction line when an electric suction heater is used with the SPU. Wire this switch in series with the heater contactor to shut off the heater if the pump should fail. Adjust the flow switch to open when the flow stops.

NOTE

It is also recommended that an oil level, flow, or pressure control device be installed to shut down the pump to preclude operation when the system has an air leak or a lack of oil.

4. Pipe the oil return line from the storage tank or suction heater to the appropriate connection on the SPU. This return line recirculates pumped oil that is not used in the system back to the storage tank or suction heater. For best operation, the following conditions should be met:
   a. Use piping the same size as the connection provided on the SPU. A larger size may be used when the lines are long to avoid excessive pressure losses.
   b. Do not use a shutoff valve in the return line.
   c. Install an air bleed vent valve at the highest point in the line.
   d. Install a drain valve at the lowest point in the line.

5. Pipe the oil outlet (discharge) line to the appropriate connection on the SPU. Use piping the same size as the connection provided on the SPU, or larger size when the lines are long to avoid excessive pressure losses. It is recommended that a manual shutoff valve be installed in the outlet (discharge) oil line as close to the SPU as possible to allow for ease of maintenance. It is also recommended that an oil pressure or flow activated, normally open switch be installed in the line. This switch should be wired to shut off the pump if the flow stops or the pressure falls 10 psig (69kPa) below the established pump discharge pressure.

IMPORTANT

All heavy fuel oil piping must be heat traced (electric or steam) and insulated. Self-regulating heat tracing is recommended to maintain the desired temperature of a given fuel oil to achieve 90 SSU ($1.8x10^{-5}$ m^2/sec) or less at the burner. Electrical heat tracing with a nominal rating 12W/ft (39 W/m covered with a nominal 2" (50mm) fiberglass type insulation is sufficient for most applications.

Electrical Connections

6. All wiring should be done by a licensed electrician in accordance with applicable national and local electrical codes.

7. Wire the pump as indicated on the unit's nameplate. Motor starters are not normally supplied as a part of the SPU. This permits the customer to choose the most convenient location for the switch. **Before the wiring is sealed, check that the motor's direction of rotation corresponds with the desired pump direction.** When the pump unit is viewed from the motor end, if the pump is to discharge to the left, the motor's rotation must be clockwise; if the pump is to discharge to the right, the motor's rotation must be counterclockwise.

8. Seal all wiring to the pump motor.

SPU Component Checkout

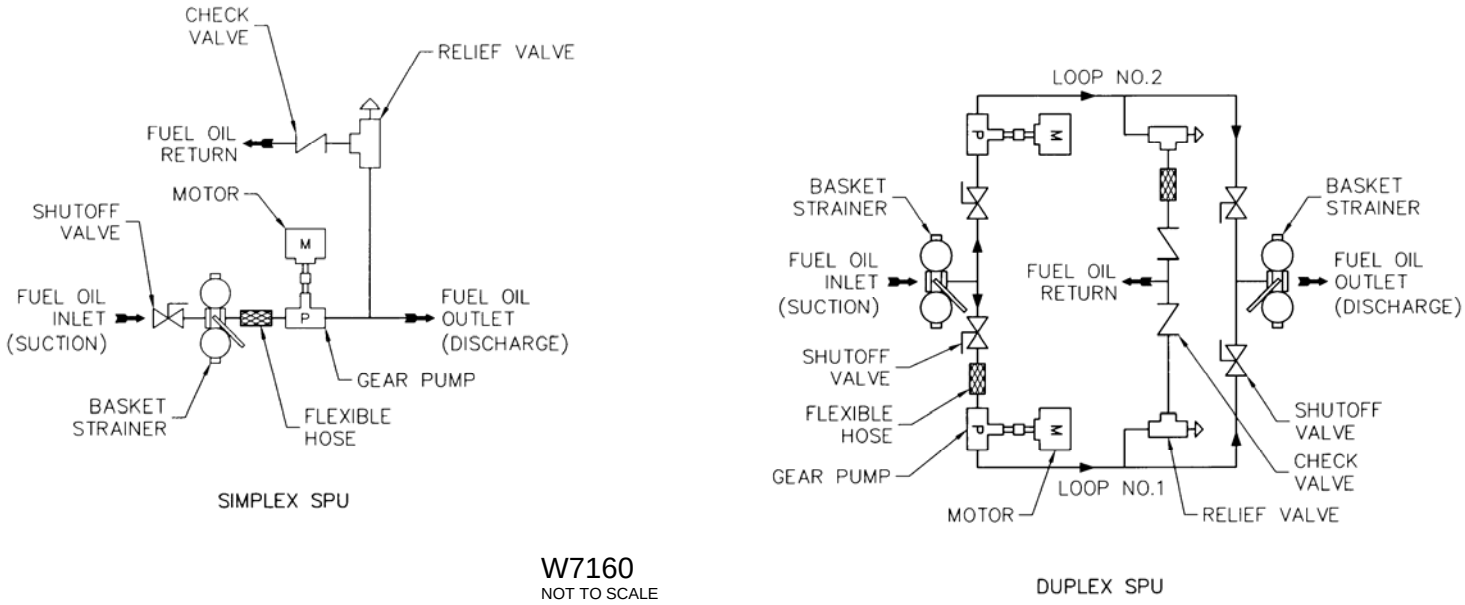
9. Rotate the ball valve handle to ensure smooth operation over the entire travel range.

10. Check the basket strainer. Ensure that:
    a. The strainer handle has been properly installed.
    b. The handle travels through a full 180°.
    c. The strainer baskets are in place.
    d. The O-ring seal on each basket cover is present and properly positioned.
    e. The seals are tight when the strainer is completely reassembled.

Complete instructions on how to accomplish each of these checks is given in the section containing the detailed component description.

> **NOTE**
> The strainer basket that is in use is the basket being covered by the handle.

11. Check that the pressure relief valve bonnet is secure.



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NOT TO SCALE

Figure 3. SPU Piping Schematics

12. If not previously completed, rotate the pump shaft by hand to ensure that there is unrestricted movement of the pump shaft.

> **IMPORTANT**
> If the installation is for heavy oil, turn on the heat tracing and allow the oil line to come up to operating temperature. **Do not turn on the suction heater until you are ready to turn on the pump.**

F. START-UP

Simplex SPU

Initial start-up of a simplex SPU must be accomplished as follows (refer to Figure 3):

1. Close the shutoff valve installed in the oil discharge line closest to the SPU. On initial start-up, the oil should flow through a closed loop formed by the inlet suction line and the oil return line (it may be necessary to reduce the setting of the pressure relief valve to initiate oil flow through the loop).

2. Open the inlet shutoff valve on the SPU.

3. Open the main oil valve at the storage tank.

4. Momentarily energize the suction heater, if present. Normally the suction heater can be energized for a few minutes prior to pump start-up by using a push-button switch.

5. **For positive suction head systems,** i.e., a system where the oil level in the storage tank is higher than the pump, crack a union fitting on the discharge side of the pump and allow the oil to fill the piping to the pump by gravity flow. **For negative suction head systems,** i.e., a system where the oil level in the storage tank is lower than the pump, typically an underground tank with a pump at ground level, difficulty may be encountered in the initial priming of the suction line. If the pump has insufficient suction to draw fuel oil through the suction piping and into the pump, an alternate line priming method must be utilized. Install a tee pipe fitting in the suction piping to the pump and a fill valve in the vertical inlet to the tee. Close the main oil valve at the storage tank. Open the fill valve on the tee and fill the suction line between the tank and pump with fuel oil. When the suction line is filled, close the fill valve on the tee. **The pump must be wetted and oil must be present on the discharge side of the pump.**

> **CAUTION**
> While the suction heater may be energized momentarily to help fill the suction line and prime the pump, never allow the suction heater to operate for more than 30 seconds without the pump in operation. Failure to comply with this requirement could result in serious damage to the suction heater.

6. Ensure that there is oil in the suction line and that the pump has been properly primed. **Do not run the pump without oil.** Rotate the pump shaft by hand to ensure that fuel oil is in the pump. The pump can now be safely started.

7. Start the pump and initiate continuous operation of the suction heater, if present. The fuel oil will circulate in a loop from the tank or suction heater, through the pump and pressure relief valve, and back through the return line to the storage tank or suction heater.

8. Use caution to remove any air in the loop by opening the bleed vent valve at the highest point of the return line.

CAUTION

Utilize proper shielding to avoid being sprayed by fuel oil when venting air from a pressurized line. In particular, **heated oil can cause severe burns.**

NOTE

Air which is pumped through the loop back into the suction heater will not vent into the tank but will continue to be repumped.

9. Check all union and pipe fittings for tightness.

Duplex SPU

Initial start-up of a duplex SPU must be accomplished as follows (refer to Figure 3):

Pump No. 1

1. Isolate pump No. 2 by closing the shutoff valve in the oil suction line and the shutoff valve in the oil discharge line of the second pump.

2. Close the shutoff valve in the oil discharge line of pump No. 1. On initial start-up, the oil should flow through a closed loop formed by the inlet suction line and the oil return line (it may be necessary to reduce the setting of the pressure relief valve to initiate oil flow through the loop).

3. Open the main oil valve at the storage tank.

4. Momentarily energize the suction heater, if present. Normally the suction heater can be energized for a few minutes prior to pump start-up by using a push-button switch.

5. **For positive suction head systems,** i.e., a system where the oil level in the storage tank is higher than the pump, crack a union fitting on the discharge side of the pump and allow the oil to fill the piping to the pump by gravity flow. **For negative suction head systems,** i.e., a system where the oil level in the storage tank is lower than the pump, typically an underground tank with a pump at ground level, difficulty may be encountered in the initial priming of the suction line. If the pump has insufficient suction to draw fuel oil through the suction piping and into the pump, an alternate line priming method must be utilized. Install a tee pipe fitting in the suction piping to the pump and a fill valve in the vertical inlet to the tee. Close the main oil valve at the storage valve at the storage tank. Open the fill valve on the tee and fill the suction line between the tank and pump with fuel oil. When the suction line is filled, close the fill valve on the tee. **The pump must be wetted and oil must be present on the discharge side of the pump.**

6. Ensure that there is oil in the suction line and that the pump has been properly primed. **Do not run the pump without oil.** Rotate the pump shaft by hand to ensure that fuel oil is in the pump. The pump can now be safely started.

7. Start the pump and initiate continuous operation of the suction heater, if present. The fuel oil will circulate in a loop from the tank or suction heater, through the pump and pressure relief valve, and back through the return line to the storage tank or suction heater.

8. Use caution to remove any air in the loop by opening the bleed vent valve at the highest point of the return line.

> **CAUTION**
> Utilize proper shielding to avoid being sprayed by fuel oil when venting air from a pressurized line. In particular, **heated oil can cause severe burns.**

> **NOTE**
> Air which is pumped through the loop back into the suction heater will not vent into the tank but will continue to be repumped.

9. Check all union and pipe fittings for tightness.

10. Ensure that the oil flowing through loop No. 1 has reached normal pumping temperatures.

11. Ensure that the shutoff valve in the oil discharge line of pump No. 2 is fully closed.

12. Open the shutoff valve to the oil suction line of pump No. 2.

13. Rotate the pump shaft by hand to ensure that oil is in the pump. **Do not run the pump without oil.**

14. Stop pump No.1. **Do not run both pumps at the same time.**

15. Close the shutoff valve in the oil suction line of pump No.1.

16. Start pump No. 2. The oil will circulate in a loop from the storage tank or suction heater, through the pump and pressure relief valve, and back through the oil return line to the storage tank or suction heater.

17. Remove any air in loop No. 2 by opening the bleed valve at the highest point of the return line.

> **CAUTION**
> Utilize proper shielding to avoid being sprayed by fuel oil when venting air from a pressurized line. In particular, **heated oil can cause severe burns.**

18. Ensure that the heat tracing for the oil discharge line has been turned on and that the line is at the operating temperature.

19. Open the shutoff valve in the oil discharge line of pump No. 2.

G. OPERATION

Prior to starting the pump of the SPU for continuous operation, ensure that steps 9 through 12 under Installation, and all steps under Start-up have been accomplished. If line heat tracing is used, ensure that it is turned on prior to initiating oil flow. If a suction heater is used, **do not allow the suction heater to run for more than 30 seconds without the pumps being in operation.**

In a duplex pump system, when switching from one pump to the other while maintaining the flow of oil, follow steps 10 through 18 under start-up. **Do not run both pumps at the same time.** In addition, keep the non-operating pump isolated by closing the shutoff valves in the oil suction and discharge lines of the pump.

IMPORTANT

It is advisable to periodically switch use of the pumps on a duplex SPU to maintain both pumps in operational condition and to accumulate comparable wear rates.

After the closed loop oil circulation, i.e., oil flowing from the storage tank to the SPU and returning to the storage tank, has been accomplished as detailed under Start-up, open the shutoff valve in the oil discharge line to supply oil flow to the downstream process. This could include an in-line oil heater and/or oil manifold supplying a single or multiple burners. (NOTE: consult individual instruction manuals for specific requirements of downstream components). Downstream oil pressure requirements will vary based on the specific piping and components used, and as a result the oil discharge pressure from the SPU may require adjustment. This can be accomplished by adjusting the pressure relief valve as required. Complete instructions on the adjustment of this valve are given in the Section H – Maintenance.

H. MAINTENANCE

General maintenance instructions for major SPU components are listed below; however, for detailed maintenance instructions it is recommended that you refer to the operating and maintenance manuals provided by the original equipment manufacturer.

1. Double Basket Strainer

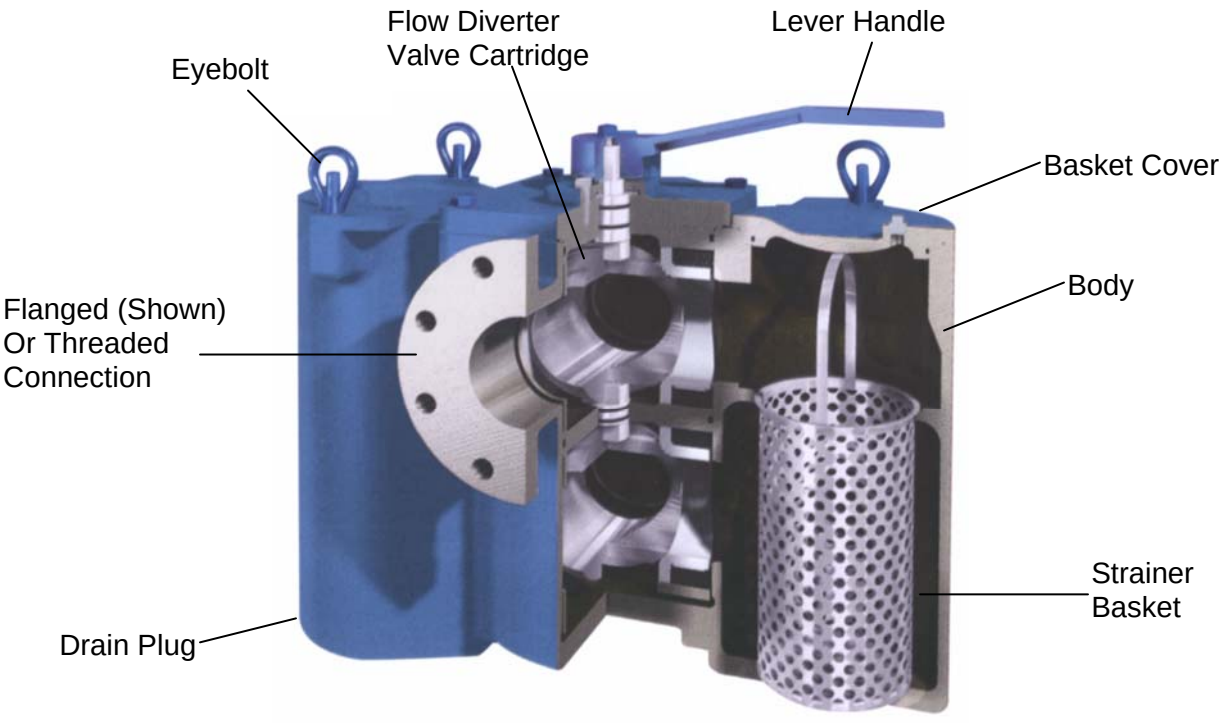

Figure 4. Cutaway View of Double Basket Strainer

Periodically clean the basket strainers to avoid an excessive pressure drop in the oil supply line. This can be accomplished without shutting down the oil supply to the downstream process, i.e., uninterrupted fuel flow during cleaning of the idle basket. Switching and cleaning of the basket strainer can be accomplished as follows:

a. Rotate the lever handle, positioned directly over the dirty strainer basket in use, by 180° to put the other clean strainer basket into service.

> **NOTE**
> The SPU does not have to be shut down while changing basket strainers.

b. Loosen, but do not remove, the eye bolts on the cover over the dirty strainer basket.

CAUTION

Utilize proper personal protective equipment to avoid being sprayed by fuel oil when removing the cover over the dirty basket strainer. **Heated fuel oil can cause severe burns.**

c. Slowly lift and swing the cover clear of the chamber opening using caution not to damage the o-rings located on the cover.
d. Remove the dirty basket strainer.
e. Clean the basket strainer. Dump, brush, or blow out all collected particles. A suitable solvent may be used if necessary.
f. Remove, if necessary, the appropriate plug located at the bottom of the housing to drain the oil and remove any sediment that may have collected at the bottom of the basket chamber.
g. Replace the drain plug.
h. Insert the clean basket strainer and ensure proper seating in the chamber.
i. Reposition the cover and secure by tightening the eyebolts.

2. Gear Pump

Periodically inspect the mechanical seals for leakage. If leakage is occurring, the seals should be replaced in accordance with the pump manufacturer's operation and maintenance manual.

Lubricate the bearings on a regular basis in accordance with the pump manufacturer's operation and maintenance manual. Recommended lubrication intervals are dependent on pump size, type, and fuel oil temperature.

CAUTION

When pumping fuel oils over 212°F (100°C), bearings must be lubricated with heat-resistant grease, and intervals between re-lubrication are significantly reduced. Failure to adhere to these recommendations may cause severe damage to the pump.

If it should become necessary to remove a pump for repair or replacement, accomplish the following:

a. Isolate the pump to be removed by closing the shutoff valves in the pump's suction and discharge lines. On duplex pump units, one pump can be removed while the system remains fully operational.
b. Label and disconnect wiring from the motor.
c. Loosen the union pipe fittings located up and downstream of the pump**. Avoid breaking piping connections other than at union fittings.**
d. Remove the pump and motor assembly from the mounting base.
e. Disassemble the pump for maintenance or repair per the pump manufacturer's operation and maintenance manual.
f. Reassemble the pump. Always use gaskets of the same size as the originals since pump operation and performance are dictated by accurate gasket clearances.
g. Replace the pump and motor assembly on its mounting base.
h. Retighten union pipe fittings to the pump.
i. Reconnect wiring to the motor.
j. Rotate the pump shaft by hand to ensure that there are no restrictions to its movement.

3. Pressure Relief Valves

Periodic adjustment of the pressure relief valve may be required as a result of changes in the oil supply system, i.e., variation in fuel oil quality, wear on pump internals, reduced efficiency of in-line fuel heaters, etc.

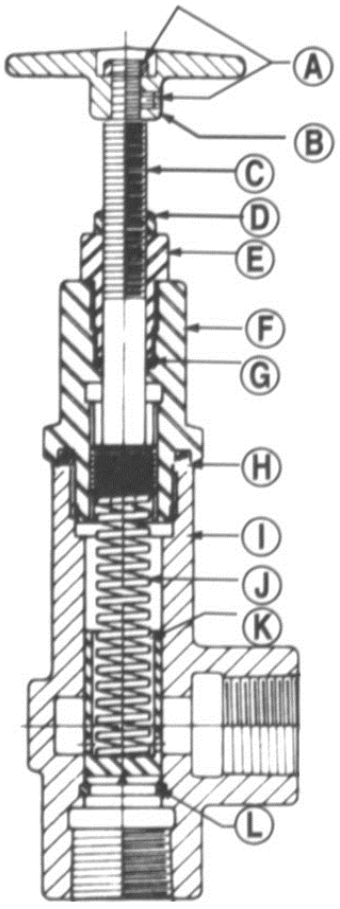

Figure 5. Cross-Sectional View of a Pressure Relief Valve

IMPORTANT
Unfiltered fuel oil and recycled oil may affect the operation and wear rates of the pressure relief valve.

To adjust the pressure relief valve to change the oil discharge pressure, accomplish the following:

a. Loosen locknut D.
b. Turn handwheel B until desired pressure is read on the gauge in the oil discharge line. Turn the handwheel clockwise to increase the pressure and counterclockwise to decrease the pressure.
c. Tighten locknut D.

Pressure relief valves are designed to be inspected and cleaned without being removed from the line.

CAUTION
If the pressure relief valve must be removed from the line for replacement or repair, always use wrenches on the heavy, threaded portion of the valve's body. Valves can be distorted if the neck of the valve is excessively torqued with a wrench which may result in damage to the valve.

To dismantle the pressure relief valve for inspection and cleaning, accomplish the following:

CAUTION
Prior to any attempt to disassemble the pressure relief valve, ensure that pressure is removed from the oil supply system.

a. Loosen lock nut D.
b. Release spring tension by backing off handwheel B as far as it will go.
c. Remove lock nut or setscrew A and take off handwheel B.
d. Remove lock nut D.
e. Unscrew and remove gland E.
f. Unscrew and remove bonnet F.
g. Remove O-ring H.
h. Remove adjusting screw C (turn clockwise and pull out from bottom of bonnet F).
i. Remove O-ring packing G.
j. Remove spring J.
k. Remove piston K.

Inspect valve bore and piston for wear or scoring. Replace broken or damaged parts. Clean all parts thoroughly and re-assemble by reversing the above procedure.

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