

▼ FLUOR ENGINEERS, INC.
ENGINEERING SPECIFICATIONS

CLIENT	PHILLIPS 66 COMPANY	SPECIFICATION NO.	PC-7469-117-25-4003
PLANT	HOUSTON CHEMICAL COMPLEX	BY	CAS DATE 12-18-86
	POLYPROPYLENE EXPANSION	REV.	5 APPROVED
	AFE PC-7469	PAGE	3 OF 42
LOCATION	PASADENA, TEXAS		
CONTRACT NO.	659106		

1.0 SCOPE

This specification describes the specific requirements for a Werner and Pfleiderer ZSK 300 Twin Screw Compounding Extruder to be supplied to the Houston Chemical Complex of Phillips 66 Company, Pasadena, Texas.

2.0 EQUIPMENT DESCRIPTION

Furnish equipment as follows for the compounding and pelletizing of Phillips Sixty-Six Company's particle form polypropylene fluff supplied from the owners feed hopper. Installation shall be in a Class I, Group D, Division 2 location.

2.1 ZSK 300 Twin Screw Compounding Extruder

2.1.1 General

Furnish a ZSK 300 Werner and Pfleiderer twin screw extruder for plasticizing and extruding polypropylene fluff with metered liquid and/or solid additives. Extruder shall have an L/D ratio of 22.4 to 1. Unit is to be suitable for operation with a 5000 HP AC 1200 RPM drive motor with 100 HP AC 1800 RPM auxiliary starting motor with a cam type over-running clutch. Drive motor shall be connected to the gear reducer using a Desch over-torque slip coupling. Unit shall have right hand drive when viewed from the motor end with an in-line drive arrangement. Locate local controls, instruments and indicators on operating side of unit when possible. Operating side of unit is right side when facing unit from main drive end.

2.1.2 Starting Motor

1. Starting motor shall be 100 hp, 460 volt AC induction type motor, NEMA Type C, 1800 rpm, 3 phase, and 60 Hertz. Motor starter by others.
2. See attached Specification F for motors 150 hp and below for additional starting motor requirements.
3. Starting motor shall be connected to a gear reducer to supply a screw shaft speed of 3 RPM. Coupling shall be such that spacer disc can be replaced without removal of motor or gear box.

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4. Output shaft of gear reducer shall be connected to a Flender gear box by an over-riding cam type clutch. Clutch shall engage automatically with starting of the starting motor and disengage automatically with acceleration of the main drive motor rotor. No manual engaging or disengaging shall be required.
5. OSHA approved personnel guards shall be provided for cam clutch and coupling.


2.1.3 Extruder Drive Motor - 5000 HP

1. Motor shall be rated 5000 HP, 1180 rpm, 4000 volt, 3 phase, 60 Hertz, frame P612, code letter G. The motor shall be stored outdoors in Gulf Coast Area, and shall have temporary corrosion protection on the shaft.
2. Motor and lube oil system shall be rated for a Class I, Division II, Group D area.
3. Motor shall be a squirrel cage induction motor, TEWAC, totally enclosed, tube cooled, air to water, with mica and glass Class F insulation. At rated HP, total motor winding temperature shall not exceed 95°C measured by RTD's in windings when using 96°F water to motor and ambient air temperature of 40°C. Motor shall have copper windings.
4. Bearing RTD's shall be drilled to within 0.125 inches of bearing where possible. Cast iron explosion proof heads with terminal strip are to be provided on bearing RTD's, (see 9.b).
5. Motor shall be by General Electric.
6. Bearings shall be pressure oil lubricated split sleeve with thrust or ball such that the end play is limited to 0.010 inches. Drive motor shall be supplied with a pressurized lubrication system complete with the following items: one six-gallon capacity reservoir complete with level gauge, temperature indicator, screw-on water-and-dust tight cap and shall be completely drainable and cleanable. Two 3/4 H.P. pumps shall be supplied, one to be used as inline spare. Pump

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discharge piping to include check and block valves, one-micro filter complete with bypass and block valves, low pressure switch, pressure indicator and pressure relief valve to be separate from pump housing.

7. Motor shall be furnished with internal 115 volt, 1 phase, space heaters, surface temperature not to exceed 200°C.
8. Motor shall have stainless steel breather and drain and stainless steel nameplate with bearing numbers stamped on it.
9. Temperature detectors shall be as follows:
 - a. Windings - 2 per phase 6 total. Shall be manufacturers standard 10/100 OHM Cu/Pt RTD.
 - b. Bearings - 2 total shall be manufacturer's standard  10/100 OHM Cu/Pt RTD.
10. Junction boxes required as follows:
 - a. One for winding temperature elements.
 - b. One for motor leads.
 - c. One for space heater.
 - d. All junction boxes shall be cast iron, except on water cooled motors.
11. Provide lifting eyes or equivalent means of hoisting motors.
12. Information shall be furnished with all motor quotations as follows:
 - a. Current, minimum guaranteed efficiency, power factor at no load, at 50% load, 75% load, and full load as tested using IEEE/ANSI standard 112 most recent Method F.

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- b. Rotor construction (cast or fabricated) and type material.
 - c. Winding construction (form or basket) and type insulation material.
13. Leveling jack screws (Fixator Type) shall be provided  for vertical adjustments.
14. Motor shall be balanced with half coupling attached, maximum vibration not to exceed 0.5 mil at 3600 RPM, 1.0 mil at 1800 RPM, 1.5 mil at 1200 RPM.
15. A half coupling shall be furnished by the driven equipment vendor for installation by the motor vendor.
16. Design rating:
- a. Motor horsepower rating not including service factor shall be equal to or greater than that required by the driven machine under maximum load conditions. Starting torque shall be adequate to bring driven machine up to full speed.
17. Motor starters shall be provided by others. Starting to be full voltage.
18. Motor shall have an integral water leak detector switch installed to be interlocked by others for alarm.
19. Fluor Electrical Engineer must approve motor selection after reviewing the load current, efficiency, and power factor furnished with the quotation as specified above.

2.1.4 Over-torque Desch Coupling

- 1. To prevent the machine from being overloaded, a Desch Planox PPF type slip coupling shall be provided between the drive motor and gear reducer. Design of the clutch shall be such that the entire friction section can be dismantled and replaced without moving the motor or dismantling the gear box. The clutch shall be designed to have a constant slip of approximately 2 revolutions per minute to ensure a constant friction value.

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2. The clutch shall be pneumatically operated. A pneumatic control unit complete with filter, oiler, pressure reduction valve, 3/2 way magnetic valve and quick venting valve shall be provided for controlling the torque setting. In addition to items listed above, gauges, switches and any other items required for the safe and proper operation of the clutch shall be provided.
 3. The clutch shall be furnished with an electronic control unit for sensing the difference in speeds of the two clutch halves. The speed shall be sensed using two contactless sensors, one on each half of the clutch. The electronic control unit shall be used to monitor the difference in speeds and in the case of an overload (clutch slipping more than the predetermined amount) shall disengage the clutch and shutdown the main drive motor. The electronic control unit shall include all the necessary components required for the safe and proper operation of the clutch.
 4. The overtorque slip clutch shall be provided with an OSHA-approved guard complete with a U.S. standard coupling for purge connection (See Section 5.29).
 5. An air inlet rotary union shall be furnished to supply air to the clutch. Air connection to rotary union shall be U.S. standard (See Section 5.29).
 6. Control sketches and manuals shall be furnished.
 7. Drive motor half of coupling shall be supplied to motor Vendor for mounting.
 8. Gearbox half of coupling shall be supplied to Flender for mounting.
- 2.1.5 ZSK Gear Reducer and Thrust Bearing Assembly
1. The gear reduction unit shall have a minimum durability service factor of 1.75 in accordance with AGMA Standard 420.03. All gear tolerances shall conform to Quality

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Class 12 as outlined in AGMA Standard 390.02 or equivalent DIN Class 6. Accuracy shall be achieved by hobbing, grinding, or shaving of the gear teeth.

2. The gear reducer shall be a two-speed, three-stage (2-Reduction, 1-Distribution) with overall reduction ratios 6.877 and 8.105 to 1. Final screw speeds shall be 172 and 146 rpm with a main drive motor speed of 1180 rpm. The gear reducer shall have two co-rotating output shafts which shall be equipped with a double tandem thrust bearing assembly with multiple race bearing to resist thrust generated by the screw shafts.
3. Mating gears shall have an odd number of teeth (hunting type) to give a more uniform wear pattern.
4. The pitch line velocity shall be as slow as possible (not to exceed 4,000 feet per minute) to minimize noise level from the gears.
5. The maximum noise level for the reduction gear unit shall not exceed 102 DBA. This noise level shall be determined under no-load condition performance tests in vendor's shop and under actual operating conditions of 80-100 percent full load in customer's plant. The test shall be witnessed by Fluor and/or Client representatives.
6. A permanently installed SPM type 36 shock pulse system shall be installed on the gear reducer. System shall provide continuous monitoring of bearing conditions and shall include the following:
 - a. Monitoring points on all bearings in gear reducer.
 - b. Bearing detectors for all monitoring points.
 - c. A 30-channel (maximum) type 32 panel-mounted alarm indicating unit connected for panel alarm.
 - d. A type 43A mini SPM shock pulse hand held measuring instrument.

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- e. Coaxial cables for connecting bearing detectors to monitoring points.
7. Provide a lip-type oil seal in the output shaft bearing retainers at shaft openings. These oil seals shall be dual type lip seals with provisions for grease injection. All other oil seals to be labyrinth type.
8. The gear reducer thrust bearings shall have a minimum B-10 life of 100,000 hours at 172 RPM and 2900 psi pressure. All other bearings in the gear reducer shall have a minimum B-10 life of 40,000 hours at 5000 HP rated drive motor load.
9. Leveling shoes (Fixator type) shall be provided by Werner and Pfleiderer for vertical and horizontal alignment of the gear reducer. Werner and Pfleiderer shall furnish a template for installation of Fixators.
10. Flexible coupling between gear reducer and drive motor shall be an overtorque slip type Desch Planox PPF (See Section 2.1.4). Coupling shall have personnel guard per OSHA requirements.
11. Electric motors shall be per attached electrical motor Specification F.
12. Lube Oil System:
 - a. Pressure lubrication for the gear reducer shall be supplied by a 25 HP, 460 v, 3 phase 60 HZ TEFC high efficiency, U-frame electric motor-driven gear type oil pump with oil seals. The pump oil circuit shall be completely piped with carbon steel pipe and extra heavy stainless steel tubing. Pipe fittings shall be carbon steel and tubing fittings shall be stainless steel. (See specification for Auxiliary Piping, Section 5.29). The oil circuit piping, tubing, fittings, cooler, etc., shall be properly cleaned before assembly and fully protected for shipment to customer's plant. The gearbox shall have an inspection port for cleaning and inspection prior to operation. 

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- b. The lubrication system shall include lube oil cooler with self-acting temperature control valve, a block valve in pump suction line with provisions to lock the valve in open position. The lubrication system shall contain two 30 micron leaf type filters in parallel, piped so filter switch can be made without shutdown. Filters shall include drain valves for removing sludge and provisions for eliminating air from the system. A delta P indicator and switch for high differential pressure shall be provided across each of the dual filters for panel alarm.
- c. All pipe downstream of the lube oil filters shall be stainless steel.
- d. Provide a magnet for iron pick-up in the lubrication system at a point easily accessible for cleaning or inspection without shutdown. Provide low oil pressure switch downstream of filters for panel alarm and shutdown of extruder drive motor.
- e. Provide oil pressure relief valve separate from pump housing. Provide oil pressure indicators on inlet and outlet of oil cooler, outlet of pump and downstream of filters. Provide oil temperature indicators on inlet and outlet of oil cooler and high oil temperature switch downstream of oil cooler for panel alarm and shutdown of extruder drive motor.
- f. The filler pipe for the gearbox shall be elevated for easy access and contain an oil screen strainer and screw-on water tight cap. The gearbox shall have a low level switch for panel alarm and local indicator for oil level. Filler pipe to be at opposite end from pump suction.
- g. Oil flow to each lube point in the gear reducer shall be monitored by a monitoring system supplied by Werner and Pfleiderer. The monitoring system shall include a local low-flow switch and two low-pressure switches. The low-pressure switches shall be connected for panel alarm and shutdown of extruder drive motor. There shall be sight glasses for indication of flow for each lubrication point.

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h. Electrical contacts in switches shall open in alarm condition and be rated 5 amps., 120 volts AC.

13. Vendor shall furnish alignment tolerances for cold conditions for motor and gear box.

14. Vendor shall furnish electric lubricating oil heater for startup. Heater to be capable of maintaining oil temperature of 90°F with ambient as low as 30°F. Heater to be 460 Volts 3 phase. Vendor to provide temperature control switch, on-off selector, and pilot light to operate customer's 115 VAC control circuit for customer's 460 Volt contactor. Heater to be sized so it does not carbonize the oil.

2.1.6 Converging Feed Chute

Shall be supplied by others.

2.1.7 Barrel Sections

1. General

- a. The barrel assembly shall be made up of 8 barrel sections for an L/D of 22.4 to 1 and one 8/0 transition section with provisions for connection of a diverter valve. All barrel sections to have an internal design pressure of 5,000 psi at 300°C. The barrel section bores shall be nitrided for increased wear resistance. Barrel section shall be supported by three pedestals with guide plates and base plates complete with leveling shoes for alignment. All barrel support sections shall have cylindrical alignment holes. Vendor shall furnish tolerances for bore scope alignment.
- b. All barrel sections including the 8/0 transition piece shall be forged steel construction, cored design for heating and/or cooling and shall be hydrostatically tested at 1024 psig (72Kg/cm²). ANSI 600# class, flanged inlet and outlet connections shall be supplied on barrel sections for heating and cooling. Nine pairs of connection pipes for cooling/heating supply shall be furnished. All

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barrel sections shall be furnished with metal temperature thermocouple wells. Thermocouples shall be furnished with cast iron weather-proof heads with terminal strip for connection of thermocouple to field wiring.

2. Arrangement

The barrel sections shall be arranged in the following order:

- a. Section number 1 shall be equipped with a top entry feed port. This section shall be complete with cooling bores. Manually controlled water cooling will be provided by others. This section shall be mounted directly to the gear reducer.
- b. Section numbers 2, 3, 4 shall be closed sections for plasticizing, complete with heating bores. These three sections shall be drilled and tapped for Type J thermocouples for monitoring metal temperature. This zone shall be furnished with one thermocouple to be located in Section 3. This zone shall be heated with 300 psi steam at all times and shall be manually controlled.
- c. Section number 5 shall be a vent section complete with cooling and heating bores. This section shall be temperature zone #2 and shall be furnished complete with thermocouple (Type J). This section shall be heated with 300 psi steam or cooled with water, and, in either case, shall be manually controlled. The vent port shall be furnished with a rotatable vent deflector type A. A contoured vent plug shall be furnished to be used when the vent is not used.
- d. Section numbers 6, 7 and 8 shall be closed sections for pressurizing the melt, complete with cooling and heating bores. These sections shall be temperature zones #3, #4 and #5 respectively. These zones shall be complete with thermocouples (Type J). These

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sections shall be heated with 300 psi steam or cooled with water, and, in either case, shall be manually controlled.

- e. The last barrel section shall be the 8/0 transition piece and shall be temperature zone #6. This section shall be complete with heating bores and will be heated with 300 psi steam. The 8/0 section shall be furnished with one Dynisco melt pressure transducer and one thermocouple (Type J) for melt temperature (Hakensonde type). △

2.1.8 Plasticizing Screws

1. Two identical 300 mm diameter intermeshing and co-rotating nitrided steel screws shall be furnished. The screws shall consist of a pair of screw shafts with removable screw elements for a processing length of eight barrel sections. The one piece screw shafts shall connect to the gear reducer output shafts with splined couplings, have Werner and Pfleiderer's standard heated viscous seals at the entrance to feed barrel section No. 1 and contain longitudinal keyways for connection of removable screw elements. The downstream end of each screw shaft shall terminate with a removable nitrided steel locking screw tip for compressing and locking screw elements to the shafts. A hydraulic screw compressor cylinder is to be furnished by the vendor. The screw elements, consisting of screw bushings and kneading blocks, shall be nitrided steel. The screw elements on each shaft shall be of a configuration reviewed by a client representative. Drawings are to be sent to purchaser for review before manufacturing the screws.
2. All special tools such as screw tip wrenches, hydraulic piston press for screw assembly, clamps, spanner for screw couplings, Allen Head wrenches, alignment gauges, etc. shall be furnished by Werner and Pfleiderer.

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2.1.9 Diverter Valve

1. A Werner and Pfleiderer type AV-120 hydraulically operated diverter valve shall be provided for diverting polymer melt from the die plate to the floor during periods of upset and at start-up. This shall be mounted between 8/0 section and screen pack changer.
2. The hydraulically actuated valve stem shall have an angle of traverse of 110 degrees with a maximum operating cycle of three seconds.
3. Valve housing shall be bored for oil heating (125 psig/600°F) furnished by others. Unit shall be hydrostatically tested at 60 Kg/cm². Oil piping flanges shall be ANSI 600# class furnished by others.
4. Bore of diverter contacting polymer shall be 120 mm diameter and shall have a finish of between 8 and 32 RMS.
5. Valve body and plug shall be constructed of nitrided steel. Seals shall be wedge type constructed of brass complete with followers.
6. Hydraulic power unit shall be furnished with the diverter valve. See section 2.1.11 for details.
7. Diverter valve shall be temperature zone #7 and shall be furnished complete with a type J thermocouple.
8. Provide push button controls on panel board for operating diverter valve with process and dump position lights.
9. Two SPDT limit switches shall be provided for indicating position of valve. This valve is to operate automatically on shutdown and automatic startup.
10. Mechanical stops shall be provided to limit valve travel.
11. Solenoid valve for operation of Diverter Valve shall be provided and installed on the hydraulic unit.

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2.1.10 Screen Pack Changer

1. A Werner and Pfleiderer SWZ-1900 screen pack changer shall be furnished to mount between the (AV-120) diverter valve and pellet die housing. The screen pack changer shall be a basket type with 19 stainless steel screen elements containing 1900 cm² of total screen area.
2. The screen changer housing and slide plate shall be designed for oil heating (125 psig/600°F) furnished by others and shall be hydrostatically tested at 60 Kg/cm². Inlet and outlet flanges shall be ANSI class 600 supplied by others. Hot oil hose for the slide plate shall be provided (8 feet) complete with U.S. standard flanges.
3. Screen changer shall be capable of switching to clean screen element in one second or less without shutting down the process.
4. Hydraulic power unit shall be furnished with the screen pack changer. See section 2.1.11 for details.
5. Screen pack changer shall have water-cooled seals.
6. Provide push-button controls on panel board for operating screen changer. Furnish electrically operated valve on screen pack changer, valve to be mounted as close to screen pack changer as possible. Solenoid valve to be installed on unit by manufacturer.
7. Screen pack changer shall be supplied with OSHA approved guards complete with limit switches.
8. Screen pack changer shall be mounted on a rigid support complete with provisions for vertical and horizontal adjustment.
9. Hydraulic hoses (15' ft) U.S. standard shall be furnished.
10. Screen pack changer shall be temperature zone #8 and will be furnished with two duplex type J thermocouples.

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11. Screen pack changer shall be furnished with two complete breaker plate assemblies. Assemblies to include breaker plate support, 19 support baskets and 19 filter elements for screening 3MF product.

2.1.11 Hydraulic Power Unit

1. This section lists the minimum requirements for two hydraulic units to be furnished by Werner and Pfleiderer, one to operate the AV-120 diverter valve and the other to operate the SWZ-1900 screen pack changer. Unless otherwise noted items listed are common to both units.
2. Units to be located within 75 feet of powered units.
3. Hydraulic unit shall be complete with but not limited to the following:
 - a. Gear pump with 5 hp TEFC high efficiency, U-frame electric motor, operating pressure of 2700 psig, design pressure of 3000 psig at 1.5 GPM for the SWZ-1900 and design pressure of 2700 psig at 2.8 GPM for the AV-120 (motor per attached specification F).
 - b. 40 gal. oil reservoir for SWZ-1900 and 10 gal. oil reservoir for AV-120, complete with level gauge, temperature indicator, screw-on water-and-dust tight cap, and shall be completely drainable and cleanable.
 - c. 2-Accumulators complete with U.S. standard coupling for N₂ charge, owner to supply N₂ bottle for charging accumulators, Charge gauge and valves to be supplied as part of hydraulic unit. SWZ-1900 unit only.
 - d. Solenoid to relieve pressure in accumulators for maintenance when pump control circuit motor switch is in the off position. SWZ-1900 unit only.
 - e. High-low pressure switches with Form "C" contacts.

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f. One cartridge type oil filter to remove 10 micron and larger particles with local delta P indicator switches for high delta P.

g. Pressure relief valves separate from pump housings.

h. Local Pressure Indicator in psig.

4. Any tubing or tubing fittings used in hydraulic unit shall be minimum of extra heavy stainless steel. Pipe and pipe fittings shall be carbon steel. (See specifications for auxiliary piping, Section 5.29). Stainless steel (18-8) tubing to be used down stream of the filter.

5. SWZ-1900 hydraulic system shall be capable of shifting to clean screen elements within one second, or less.

6. Valves shall be Parker Hannifin or equal.

7. Stainless fittings shall be Swagelock or equal.

8. Controls and instrumentation required to operate the AV-120 diverter valve and SWZ-1900 screen pack changer in a safe and proper fashion shall be provided.

9. Maximum hydraulic operating pressure of the system shall be 2700 psig.


2.1.12 Pelletizer Assembly

1. An underwater pelletizer, Werner and Pfleiderer Type UG 500, shall be furnished to adapt to screen pack changer mounted on extruder. Essential components of the pelletizer are die housing, die plate, pelletizer hood, knife rotor assembly and drive motor. The pelletizer hood, knife rotor assembly and drive constitute the cutter assembly and shall be mounted on a carriage which shall be supported on trolley rails 18 ft. long.

2. The pelletizer drive shall be a 100 HP AC TEFC variable frequency drive motor, 1.15 S.F., 900 rpm, T-frame. Motor shall be in accordance with attached motor specification F (Section 1.b shall be deleted for this

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motor only). Speed control with overload protection will be supplied by others. For pelletizer motor controls see section 2.2.4. Pelletizer drive motor is to have 2 winding temperature RTD's, 10/100 OHM Cu/Pt.  A speed indicator, calibrated in RPM, shall be provided in the extruder local control panel. Drive motor shall be designed for 460 Volts AC. Pelletizer drive shall have dynamic braking on shutdown. A Pepperl & Fuchs tachometer with 4-20 ma DC output isolated from ground shall be installed on the motor side of the coupling. This tachometer signal shall be used for motor speed control.

3. The flexible coupling (Type Taake) between drive motor and cutter shaft shall have a personnel guard per OSHA requirements.
4. The pelletizing die shall be Werner and Pfleiderer's insulation gap die plate design. The die plate (500 mm nominal diameter) shall be nitrided steel, with Ferrotic inserts, with approximately 1226 step bored holes in a grid pattern and 2.4 mm diameter at discharge end. The land length shall be 0.375 inches. Werner and Pfleiderer to furnish and install plugs in die to limit die hole number to approximately 986 holes.
5. The die plate and die housing shall be heated with oil.
6. The die housing shall be equipped with a melt pressure transmitter. The pressure transmitter shall have local panel indication with 4-20 ma current signal output to the programmable controller for high pressure alarm, extruder motor shutdown and switch diverter valve to dump. Housing shall also be provided with a drilled hole complete with plug for a future rheometer connection. Rheometer to be furnished by others at a later date.
7. The die housing (heat zone No. 9) and die plate (heat zone No. 10) shall each be equipped with a metal thermocouple. In addition a Hackensonde Type J melt thermocouple shall be provided in the die housing for melt temperature. These will be connected to the programmable controller for temperature indication.

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8. Pelletizer hood shall be fabricated of 304 stainless steel. The inlet and outlet water connections shall be made using flanges supplied by Werner and Pfleiderer. Provide limit switch and interlock with pelletizer drive to assure pelletizer hood is placed in position against die housing before pelletizer drive can be started. Hood shall have a minimum design pressure of 90 psig at 100°C.
9. All water-wetted parts of the knife rotor assembly shall be stainless steel. Chrome plated carbon steel bolts are acceptable. The cutter head shall be one piece and designed to carry 12, 16, or 24 Ferrotic knives. An air-over-oil automatic adjustment and startup of cutter head to die plate will be provided by Werner and Pfleiderer.
10. An Air Pax speed switch or equivalent shall be provided and connected for alarm and extruder shutdown in the event of cutter head slowdown or stoppage.
11. Water inlet and outlet to be piped directly to the pelletizer with 2500 mm of flex hose supplied by Werner and Pfleiderer. Flex hose shall be furnished with flanged connection on both ends complete with mating flanges. Flex hose shall permit 3 ft. withdrawal of unit without disconnecting water lines. Piping to be sized for a water rate of 1100 to 1300 gpm at 40-80°C, 1/4 turn drain valve shall be provided on unit on the operating side of machine.
12. Pelletizer carriage to be equipped with a rack and pinion drive for movement along the 18 ft. of trolley rail for access to the die plate and knife rotor. Hand wheel for chain drive of pinion shall be located on operating side of machine.
13. Two (2) extra die rings and one (1) extra die plate will be supplied and priced separately. The die rings must match the die plate. Die to be furnished with plugs installed as noted in Section 2.1.12.4 of this specification.

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14. The pelletizer shall be designed for auto-startup. A solenoid for automatic cutter head forward is to be provided for auto-start.

2.2 Extruder Local Control Panel

2.2.1 Extent of Supply

- a. The fabricator's extent of supply shall be the design, supply of materials, fabrication, testing, painting, delivery, and all necessary subcontract coordination required to provide the equipment as specified.
- b. The panel shall be provided as one complete unit, completely pre-wired and ready for operation.

2.2.2 General

- a. The extruder local control panel shall be complete and ready for field installation, including all internal connections.
- b. All equipment necessary for the construction of the panel shall be supplied by the fabricator.
- c. Prior to construction, the fabricator shall submit approval drawings showing the following:
 1. Details of the terminals and the terminal strip arrangement.
 2. Structural and physical arrangement.
 3. Panel physical data including weight, size, material thickness, paint and finish specifications, and field wiring entries.
 4. Wiring diagram, type of wiring, and schematics.
 5. Sub-panel equipment layout.
- d. All drawings are to be on standard drawing forms.

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2.2.3 Details

a. Construction

1. The control panel shall be self-supporting rigid metal framework of boxlike construction with the top and sides enclosed with double doors on the back, NEMA-4. Panel is to be suitable for purging.
2. The face and the top of the panel shall be 12 ga. hot rolled steel. The sides shall be 12 gauge rolled steel. The outside edges of the panel shall be ground or formed so that no sharp edges are present.
3. The panel shall include two full height rear doors of 12 gauge steel. The doors shall be complete with three-point latches and handles.
4. The panel shall include three internal sub-panels of 12 gauge steel: one full height on the left side, one full height on the right side and one part height on the lower front.
5. Unistrut (or equal) shall be included for supporting sub-panels, wireways, and shelf-mounted instruments, and as panel stiffeners where required.
6. Removable eyebolts shall be provided in the top of the panel to enable lifting.

b. Finish

1. All exposed metal shall be cleaned of mill scale, oils and other contaminates before painting. All sharp edges and burrs shall be removed.
2. One primer coat and two coats of the final color shall be applied to all exposed metal surfaces. Interior color shall be fabricator's standard white enamel. Exterior shall be Dulex Metal Protective and Machinery Enamel No. 96-Y-67642, Meadow Green.

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c. Material

1. All material used in the fabrication of this control panel shall be new.
2. All unpainted hardware shall be cadmium-plated or stainless steel.

d. Purge Requirements

The panel is to have an air purge system to be designed by the fabricator such that the panel will meet Class I, Division II, Group D classification.

2.2.4 Instruments

a. Lube Oil Pump

Stop pushbutton - red (Square D, KR-1RH13)
Start pushbutton - black (Square D, KR-1BH13)
Run light - green (Square D, KT-38G6)

b. Screen Pack Changer

Slide plate selector switch-black "Left-off-Right"
spring return to center (Square D, KS-53BH13)



c. Screen Changer Hydraulic Unit



Pump run light-green (Square D, KT-38G6)
Accumulator charged light-green (Square D, KT-38G6)
System on light-green (Square D, KT-38G6)

d. Diverter Valve Hydraulic Unit

Stop push button - red (Square D, KR-1RH13)
Start push button - black (Square D, KR-1BH13)
Run light - green (Square D, KT-38G6)



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e. Pellet Water Diverter Valve

Process pushbutton - black (Square D, KR-1BH13)
 Tank pushbutton - black (Square D, KR-1BH13)
 Run light - green (Square D, KT-38G6)
 Bypass light - amber (Square D, KT-38G6)


f. Pellet Water Pump

Stop pushbutton - red (Square D, KR-9P38RH1) 
 Start pushbutton - black (Square D, KR-1BH13)
 Run light - green (Square D, KT-38G6)


g. De-watering Dryer

Stop pushbutton - red (Square D, KR-9P38RH1) 
 Start pushbutton - black (Square D, KR-1BH13)
 Run light - green (Square D, KT-38G6)
 Oversize Pellet Dump Valve Open-Close Selector Switch - 
 black (Square D, KS-11BH13)


h. Scalping Screen

Stop pushbutton - red (Square D, KR-9P38RH1) 
 Start pushbutton - black (Square D, KR-1BH13)
 Run light - green (Square D, KT-38G6)

i. De-watering Dryer Blower

Stop pushbutton - red (Square D, KR-9P38RH1) 
 Start pushbutton - black (Square D, KR-1BH13)
 Run light - green (Square D, KT-38G6)

j. Starting Motor

Stop pushbutton - red (Square D, KR-9P38RH1) 
 Start pushbutton - black (Square D, KR-1BH13)
 Run light - green (Square D, KT-38G6)
 Ammeter - scale in actual amps, 4-20 ma input signal
 Ready light - amber (Square D, KT-38A6)

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k. Main Drive Motor

Stop pushbutton - red (Square D, KR-9P38RH1) △
Start pushbutton - black (Square D, KR-1BH13)
Run light - green (Square D, KT-38G6)
KW indicating meter, scale in actual KW, 4-20 ma signal
Ready light - amber (Square D, KT-38A6)

l. Desch Coupling

Disengaged pushbutton - red (Square D, KR-1RH13)
Engaged pushbutton - black (Square D, KR-1BH13)
Engaged light - green (Square D, KT-38G6)

m. Pelletizer AC Drive

Stop pushbutton - red (Square D, KR-1RH13)
Start pushbutton - black (Square D, KR-1BH13)
Run light - green (Square D, KT-38G6) △
Auto/Manual select switch-black (Square D, KS-11BH4)
Speed control potentiometer-scale 0-100% (1-turn)
Auto/Manual transfer indicating meter, zero center
indication (to be specified by Fluor at a later date)
RPM meter - scaled in actual rpm, signal 4-20 ma input
KW indicating meter - scaled in actual KW, signal 4-20
ma input
Ready light - amber (Square D, KT-38A6)

n. Alarm Acknowledge

Acknowledge pushbutton - black (Square D, KR-1BH13)

o. Pressure Indicators

Pressure indicators are to be provided as follows:

- (1) 8-0 section
- (1) Die section

Indicators are to be Dynisco DR 680 series with a 4-20 ma output signal to be input into the P.C. To be scaled in PSIG.

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p. Polymer Diverter Valve △

Dump pushbutton - black (Square D, KR-1BH13)
Process pushbutton - black (Square D, KR-1BH13)
Dump light - red (Square D, KT-38R6)
Process light - green (Square D, KT-38G6)

q. Auto-Start

Auto-Manual Select Switch - black (Square D, KS-11BH13) △
Auto-Start Ready light - green (Square D, KT-38G6)
Auto-Start- pushbutton - black (Square D, KR-1BH13)

r. Bypass Timer

Bypass Timer start pushbutton - black (Square D, KR-1BH13)
Bypass Timer reset pushbutton - black (Square D, KR-1BH13)
Bypass Timer running light - red (Square D, KT-38R6)

s. Desch Coupling Slip Monitor

The monitor will be supplied by the vendor as part of this specification. Monitor will be installed by purchaser in purchaser's control panel.
Slip monitor reset pushbutton - black (Square D, KR-1BH13)

t. Heat-Up Switch

"Bypass - Start-Up" selector switch - key-operated △
(Square D, KS-11K1H13)
Temperature Ready light - green (Square D, KT-38G6)
Heat-up saturation not complete - amber (Square D, KT-38A6)


u. Pelletizer

Forward pushbutton - black (Square D, KR-1BH13)
Backward pushbutton - black (Square D, KR-1BH13)
Knives Forward position light-green (Square D, KT-38G6)


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v. Rotary Feeder

Stop pushbutton - red (Square D, KR-9P38RH1) 
Start pushbutton - black (Square D, KR-1BH13)
Run light - green (Square D, KT-38G6)

w. High Speed Blender

Stop pushbutton - red (Square D, KR-9P38RH1) 
Start pushbutton - black (Square D, KR-1BH13)
Run light - green (Square D, KT-38G6)

x. Production to Off Spec Tank No. 404

Light - amber (Square D, KT-38A6)

y. Production to Start-Up Tank No. 405

Light - amber (Square D, KT-38A6)

z. Production to Blender #1

Light - amber (Square D, KT-38A6)

aa. Production to Blender #2

Light - amber (Square D, KT-38A6)


bb. Production to Off Spec Tank No. 406

Light - amber (Square D, KT-38A6)

cc. Emergency Stop - red (Square D, KR-9P38RH2) 

dd. Gearbox Oil Temperature 

Off-On Selector Switch - black (Square D, KS-11BH13)
Light - green (Square D, KT-38G6)

ee. Master Feeder 

Start-Stop Selector Switch - black (Square D, KS-11BH13)
Light - green (Square D, KT-38G6)

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ff. Main Drive Motor Lube Oil System



Hand-Off-Auto Selector Switch (two required) - black
(Square D, KS-43BH13)
Light (two required) - green (two required) (Square D,
KT-38A6)

2.2.5 Electrical

The fabricator shall supply the following:

a. Power Terminals, Light and Convenience Outlet

1. A separate terminal strip and a ground bar shall be installed for incoming 110 volt power wiring. The terminal strip and ground bar shall be sized by manufacturer as required for stranded wire. Fabricator shall properly fuse all power to the panel from this incoming terminal strip. Fuse holders are to be a neon indicating type to indicate a blown fuse. One of the fused circuits shall be used exclusively for the interior lighting and a convenience outlet. Each instrument located in the panel and each field device shall be separately fused as required. Fuse holder shall be Weidmuller terminal strip type lighted fuse holders, Type SAKS3, Cat. 2489.3.
2. Each instrument and/or field device shall be separately fused as required. Fabricator is to provide two (2) spare 5 amp fuses pre-wired to the incoming power terminal strip.
3. All wiring shall be in accordance with the latest edition of the National Electrical Code.
4. All indicating lights shall be push-to-test type, 120 VAC, 60 Hz. Fabricator to dedicate one 5 amp fuse and circuit for a lamp test circuit. Push-to-test circuit to be provided and installed by panel fabricator.
5. Interior fluorescent lighting operated by door switch shall be provided inside the enclosure.

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6. A three-pin, 120 volt, 60 Hertz, 15 Ampere, duplex convenience outlet shall be provided for each panel section. The outlet shall be mounted on the lower section of the left sub-panel. No panel-mounted instruments shall use this outlet.

7. All conduit entry into and out of panel shall be thru the top of the panel.

2.2.6 Power Wiring

- a. 110 VAC power wiring shall be minimum #14 AWG stranded copper with 600 volt THHN insulation.
- b. All wiring shall be routed in Panduit or approved equal wireways.

2.2.7 Instrument and PC Wiring

- a. Terminals shall be provided to terminate all field instrument and PC wiring. The terminal strips shall be mounted on the sub-panels. Terminal strips shall be Weidmuller SAKS3 or approved equal.
- b. Instrument signal wiring shall be shielded twisted pairs minimum #20 AWG stranded copper with 300 volt insulation. Wires shall be terminated with self-insulated spade lugs where required. Terminals shall be provided for terminating incoming wire shield with panel wire shields. All shields shall be terminated at main control console. Do not ground shields in this panel.
- c. All signal wiring shall be complete with Raychem or equal heat shrink wire tags attached to each end of the wire. The wire tag information will be supplied by WPC.
- d. Instrument wiring shall be routed in Panduit or approved wireways. AC power wiring and signal wiring shall not be routed in the same wireway.

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2.2.8 Control Wiring

- a. Control wiring shall be minimum #14 AWG stranded copper with 600 volt THHN/THWN insulation. Wires shall be terminated with self-insulated spade lugs where required.
- b. Wires shall be tagged as described in 2.2.7c above.
- c. Control wiring shall be routed in Panduit or approved equal wireways. Power wiring and instrument signal wiring shall not be routed in the same wireway as control wiring.
- d. Terminal strips are to be installed on sub-panels for field wiring to connect to all panel-mounted push buttons, indicating lights, PC, etc. Fabricator shall wire all devices called for in this specification to these terminal strips and label as required. All terminal strips are to be labeled TB-1, TB-2, etc. as required.

2.2.9 Component Installation

- a. The panel fabricator shall mount and wire all instruments, switches, pilot lights, relays, etc. All field wiring to and from the control panel shall be terminated at the terminal strips provided by the panel fabricator.

2.2.10 Name Tags


- a. Two name tags shall be used to identify each front panel mounted instrument, switch, or light; one each on the front and the rear of the front panel.
- b. One name tag shall be used to identify each sub-panel mounted instrument or relay. The text on the name tag shall be supplied by Fluor at a later time.
- c. The name tags shall be engraved laminated phenolic plastic with black characters on a white background. The characters shall be 1/8 inch high. Name tags shall be attached to the control panel with stainless steel screws.

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2.2.11 Equipment

- a. The panel fabricator shall supply and install in the panel all instruments, switches, lights, pushbuttons, relays, hardware, etc. All pushbuttons and indicating lights are to be Square D. Fabricator is to supply wiring sketches showing wire numbers, wire color, and to what terminals that these pushbuttons, indicating lights and relays are to be wired by panel fabricator. 

2.2.12 Testing

All equipment and instruments shall be installed and the completed panel functionally tested by the panel fabricator as follows:

- a. All panel mounted equipment checked against stock lists and instrument schedules.
- b. A point-to-point check of all wiring shall be made simultaneously checking cable sizes and label details against the relevant drawings, schedules, and specifications.
- c. Simulate operation of electronic control and receiving instruments and circuits by injecting or measuring signals at the field terminations.
- d. Check all power and signal wiring for continuity, insulation and stray grounds.
- e. The panel shall be shop tested and all instruments given a simulated signal prior to shipment, with the Buyer's representative in attendance. The panel fabricator shall insure that the panel is operational prior to this test. The fabricator shall make available all necessary equipment, services, etc., that may be needed for testing. The electrical system shall be tested by applying power to the panel by the same method as in the field and checking each terminal point for operation. Testing will not include any calibration of the instruments.

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2.2.13 Inspection

- a. Purchaser reserves the right to inspect the control panel at any stage of completion. The fabricator shall notify purchaser when:
 - 1. The panel is ready for painting.
 - 2. The panel is painted.
 - 3. The panel is completed and tested.

2.2.14 Shipping

- a. The panel shall be prepared and packed in accordance with purchaser's standard requirements. In addition, the following requirements shall be met:
 - 1. All instruments shall have shipping packings replaced for shipment after panel functional tests. Plug-in type instruments shall be removed from panel cases and packed and shipped separately.
 - 2. All conduit ends and enclosure entries are to be securely plugged or capped.
 - 3. The panel shall be supported in the crate in such a manner that neither instrument cases, doors, nor panel facings can make contact with the crate.
 - 4. The panel shall be enclosed in sealed polyethylene sheet to prevent ingress of dust and moisture.
 - 5. The panel shall be mounted on shock absorbent rubber pads to reduce vibration and shock during transit.
 - 6. The panel shall be shipped on an air-cushion van designed for electronic equipment transfer.

2.2.15 Miscellaneous

- a. Vendor shall assume complete system responsibility for all components listed in this specification.

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- b. Equipment shall be suitable for operation 24 hrs./day, 7 days/week with proper preventive maintenance.
- c. (This statement deleted.)
- d. All interlocks, temperature controllers, KW monitoring, RTD monitoring, alarms, and start-up interlocks are to be incorporated into a programmable controller provided by purchaser. The machine manufacturer is to provide an interlocking drawing to purchaser detailing interlocks required. Programmable controller will be a Modicon 584 to be supplied and programmed by purchaser.
- e. A main control console is to be provided by purchaser complete with CRT monitors for machine control.
- f. The local extruder control panel is to interface with the programmable controller. Properly designed terminal strips and layouts are to be provided by machine manufacturer to allow for proper interfacing of all local panel controls, lights and meters to P.C.

3.0 PROCESS WARRANTY

- 1. Werner and Pfleiderer shall guarantee the finishing equipment to deliver rate and quality as stated in paragraph 2 of this section.
- 2. The process warranty shall be based upon the following specification of rate and conditions.
 - a. Feed to Extruder
 - 1) Specific gravity (grams/cu cm) 0.900 to 0.910
 - 2) Volatiles content wt % less than 0.03 to 0.10
 - 3) Melt flow index 1.0 to 25.0
 - 4) Feed Temperature 190°F
 - 5) Bulk density (#/cu ft) 26 to 31
 - b. Discharge from Hot Melt Extruder
 - 1) Melt temperature at the extruder gate downstream of the screen pack shall not exceed 250°C for 2.1 MF material.


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- 2) Melt pressures are estimated as follows, these pressures do not necessarily apply to the warranty stated in this section.

Melt Flow	Total Pressure Upstream of Screen Pack PSIG	ΔP Across Die
2.1	2526	1466
13.1	1965	724
35.0	1200	500

- c. The screen packs and normally applied polymers are described as follows:

<u>Melt Flow</u>	<u>Major Production Pack (Mesh Size)</u>	<u>W. & P. Equivalent</u>	<u>Minor Production Pack (Mesh Size)</u>	<u>W. & P. Equivalent</u>
1.0	20, 20	20		
2	20, 20	20	20, 50, 20	50, 20
3 to 4	20, 50, 20	50, 20	20, 100, 80, 20	100, 20
	20, 80, 20	80, 20	20, 80, 50, 20	80, 20
5	20, 50, 20	50, 20		
8	20, 100, 80, 20	100, 20	20, 50, 20	50, 20
12	20, 50, 20	50, 20		
	20, 100, 80, 20	100, 20		
14-15	20, 100, 80, 20	100, 20		
	20	20, 80, 20	80, 20	
	35	20, 80, 20	80, 20	
	<u>Screen Mesh</u>	<u>Wire Size</u>		
	20	0.02		
	50	0.0090		
	80	0.0055		
	100	0.0045		

- d. Melt flow index of the pelletized product shall not differ by more than $\pm 10\%$ from the melt flow index of the control. The control is to be extruded with the same additive package with a small ($< 1\frac{1}{2}$) extruder at a maximum melt temperature of 216°C (420°F) measured by a calibrated pyrometer.

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- e. The b color value as determined by a compression mold disk shall not be greater than 0.5 units higher than disk made from control. The control is described in section d above.
- f. Rate at 172 RPM with 5000 HP extruder drive with 190°F feed temperature. Warranty rate in the table below is based on the vent being opened and the expected rate based on the vent being closed. △

Melt Flow	Screen Pack	WPC Equivalent Screen Pack	Warranty Rate	Expected Melt Temp.	Expected Rate
1.0	20, 20	20	30,000#/hr.	260°C	30,500#/hr.
3	20, 80, 20	80, 20	31,000#/hr.	250°C	35,500#/hr.
12	20, 100, 80, 20	100, 20	31,000#/hr.	250°C	37,500#/hr.
35.0	20, 80, 20	80, 20	28,000#/hr.	230°C	39,000#/hr.

Minimum guaranteed rate of 17,000 lb/hr. for each melt flow and melt temperature.

Nominal rate 30,000#/hr.

Approximate screen analysis:

Screen Size	Homopolymer Weight % on U. S. Std. Screen	Retain
12MF-	+10	0.04
	+20	0.19
	+35	41.7
	+60	53.4
	+100	3.2
	+200	1.0
	Pan	0.4
2MF-	+10	0.06
	+20	0.39
	+35	46.2
	+60	44.9
	+100	4.3
	+200	2.5
	Pan	1.6

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- g. Specification pellets are defined as being cylindrical in shape, 35 to 65 pellets per gram with no more than 0.2% by weight on a U.S. Standard 4 screen and no more than 15% by weight on a U.S. Standard 5 screen. Melt flow of pellets shall range from 1 to 35+.
- h. Warranty rates and expected rates stated in paragraph f. of this section were derived from Test #6484, performed in Stuttgart, Germany from June 5 to 12, 1984. Performance tests shall be run at the Houston Chemical Complex within six months of machine being available for start-up. A Werner and Pfleiderer representative shall be present to witness the tests. Performance tests shall be run for each of the melt flows (1, 3, 12, 35) listed in paragraph f. Each test shall be run for a duration of 24 hours. Test conditions shall be typical of those for test #6484 (N₂ purge, additive package, water/steam injection). If the performance tests indicate that the process warranty is met or if owner does not make the equipment available within the six months stated above then the Werner and Pfleiderer Corporation shall have no further financial responsibility in this regard. In the event the test does not pass on the first attempt, Werner and Pfleiderer Corporation will have the right to repair or replace parts and take whatever steps necessary with owner's approval to insure the equipment will pass the warranty tests. Owner reserves the right to waive any or all performance tests.

4.0 EQUIPMENT WARRANTY

All material furnished shall be free of defects in material and workmanship under normal use and the service for which it is designed for a period of one year after installation, but not to exceed eighteen months after transfer of risk. This obligation shall be limited to repair at the plant where reasonable or replacement at the original F.O.B. point of the defective item with necessary dismantling and assembly by owner. Vendor shall supply supervision at no charge under terms of this warranty. All pass-thru warranties shall be identified by the manufacturer and become part of this specification. Warranty of all other items shall be the responsibility of Werner and Pfleiderer Corporation. This warranty shall inure only to the benefit of the owner and shall not be transferred to any other person.

5.0 UTILITY SERVICES

1. Power to extruder drive motor shall be 4160 Volts AC, 3 phase, 60 Hz. Motor must meet Class I, Division II, Group D requirements.

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2. All other motors less than 150 hp shall be 460 Volts, 3 phase 60 Hz TEFC and must meet Class I, Division II, Group D requirements.
3. Pelletizer shall be driven by variable frequency controlled AC motor which must meet Class I, Division II, Group D requirements.
4. All controls and lighting shall be 110 volts, single phase, 60 Hz.
5. Instrument air at 90 psig is available.
6. Saturated steam at 300 psig is available.
7. Closed system cooling tower water at 87°F is available.
8. Plant air at 100 psig is available.
9. Hot oil at 600°F, 100 psig and 225 GPM is available.


6.0 MISCELLANEOUS ITEMS

1. Important - All nuts, bolts, screws, gauges, and other threaded items supplied in the U.S. shall be US standard. Equipment supplied from Germany can be metric.
2. Lifting eyebolts or lugs shall be furnished by vendor on all heavy pieces of equipment to facilitate handling and installation.
3. All gaskets contacting polymer shall be white asbestos or white Neoprene depending on operating temperature.
4. Vendor shall supply all the special tools required for the extruder operation, maintenance and service.
5. Minimum B10 bearing life shall be 30,000 hours except where noted otherwise.
6. All pumps, motors, gear boxes shall be marked with rotational arrows after painting.
7. Junction boxes, heaters, motors, etc. shall be readily accessible.
8. All equipment requiring alignment shall have either leveling shoes or jack screws for vertical alignment.



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9. All interlocks shall operate fail safe, that is, for normal operating conditions, contacts are closed.
10. Vendor shall tag all extruder, pelletizer and auxiliary equipment inlet and outlet piping connections with proper identification corresponding to Service connection drawings. Stainless steel tags shall be used.
11. Pneumatic instrument tubing shall be $\frac{1}{4}$ " copper with brass swagelock fittings terminating in a bulk head.
12. Stainless steel fittings shall be used with stainless steel tubing.
13. Temperature RTD units will be wired directly by others and not through terminal strips.
14. Pressure and temperature switches shall be removable, where possible, without requiring a shutdown. Also, where possible, pressure switches shall have isolating block valves and temperature switches shall have temperature wells.
15. Oil low flow switches for the gear reducer shall be wired in series to a common alarm. Individual switches shall have flow indication.
16. All electrical equipment supplied shall be in enclosures rated for NEMA 4 construction. Panels shall be NEMA 4.
17. All drives and SCR controls shall be in accordance with attached motor specifications.
18. 440 VAC motor starters will be supplied by others. Also 4160 volt motor starter will be supplied by others.
19. Wiring from local mounted terminal boxes to main control panel will be provided by others. Tagged circuit terminals will be provided for these connections by manufacturer. Terminals are to be tagged on all terminal strips both local and control panel.
20. The electrical design shall be in accordance with the latest published edition of the National Electric Code.
21. Electrical power available: 460 volt, 3 phase, 60 Hz for motors and heaters; 110 volt, 1 phase 60 Hz for controls; 4160 volt, 3 phase, 60 HZ for main drive motor. 

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22. All electrical local terminal boxes shall be (cast iron) NEMA 4. All local controls, switches and indicating lights shall be in cast aluminum housings. Wiring shall be run in rigid galvanized conduit, except liquid-tight flexible conduit shall be type "UA" for $\frac{1}{2}$ " through $1\frac{1}{4}$ " sizes and type "EF" for sizes larger than $1\frac{1}{2}$ ".
23. Electrical contacts in switches will open in alarm condition and be rated for 5 amps minimum, 120 volts. Fail safe design is to be used throughout design.
24. Pelletizer motor control shall be a variable frequency AC drive controller to be provided by others.
25. In all cases, alarm and shutdown conditions shall be indicated by open switch contacts and in normal operation these contacts shall be closed. Relays, where used, shall be energized in normal condition and deenergized on abnormal conditions.
26. All junction boxes mounted on vendor supplied equipment shall be accessible. Conduit must not be run alongside equipment having high temperatures. Power and signal wiring shall be kept separate. Junction boxes shall be equipped with rigid molded terminals strips that will accept (1) hole lug for #6 screws minimum.
27. All equipment sections shall be permanently match-marked (including barrel sections, etc.) including unit number. Vendor shall advise purchaser of the location of these match marks. Match marks to be made after factory assembly and testing and before shipping.
28. Root pass of all butt welds shall be with the gas tungsten-arc method (GTAW) with an internal inert gas purge.
29. Specifications for auxiliary piping.
 1. General. Auxiliary piping for the unit shall be in accordance with Para. 2.7 of API.617 and Para. 2.11, 4.1.5, 4.2.4, 5.1 and 5.2 of API 614 and in accordance with the following additional purchaser requirements.
 2. Bolting for pipe flanges (Para. 2.11.4 API 614) shall be ASTM A-193, Grade B-7, full threaded alloy steel bolts studs with two ASTM A-194, Grade 2H heavy hexagon nuts.

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3. The ½ inch Pipe or Tubing in (Para. 2.11.5 API 614) may also be used to connect to regulating valve actuator heads, and for atmospheric oil bleed lines returning to reservoir from instruments and actuator heads.
4. Pipe and fittings instead of (Para. 2.11.9 API 614) the following shall apply:
 - a) All pipe shall be traceable through mill test reports.
 - b) All flanges and fittings shall be marked per MSS SP-25.
 - c) Piping and fittings shall be seamless carbon steel manufactured in accordance with ASTM A-106 GRB, A-53 GRB SMLS or API 5L GRB SMLS. Schedule 80 shall be used as a minimum for 1½" and smaller, Schedule 40 as a minimum for 2" and larger. Fittings shall be A234 GR WPB.
 - d) Threaded nipples shall not be used unless absolutely necessary such as to connect gauges and instruments to piping. When used, threaded nipples shall be a minimum of ½" NPT size, schedule 160 for sizes ½", ¾" and 1" and schedule 80 for larger than 1" size. Minimum nipple length is 3 inches with no all-thread or close nipples allowed.
 - e) The ¾" and 1" tubing permitted by Para. 2.11.9 API 614 is acceptable, but is to be avoided if at all possible.
5. Pipe fabrication shall be in accordance with Para. 2.11.10 API 614 with the requirements that:
 - a) All joints shall be butt welded; socket weld fittings and slip-on flanges are not acceptable.
 - b) The root pass of the butt welds shall be with the gas tungsten - arc method (GTAW) with an internal inert gas purge.
 - c) Branch connections are to be made with tees, weldolets or seal welded threadolets.
 - d) Examination and inspection of the piping system shall be in accordance with paragraph 336 of ANSI B31.3. Examination of the butt welds shall be as covered by Paragraph 336.5 of

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B31.3 by "random radiology" rather than "ultrasonic" or "in-process examination".

- e) Flange gaskets shall be Flexitallic CG or equal, spiral wound, asbestos filled, ANSI Type 304, with carbon steel gauge ring.
6. Threaded Joints (Para. 2.11.12 API 614) that are not to be seal welded shall be made up with a high temperature thread compound. Teflon tape is not acceptable.
 7. All tubing other than instrument tubing (Para. 2.11.13 API 614) shall be seamless 18-8 stainless steel. Tubing fittings shall be 18-8 stainless steel Imperial Hy-Seal, or other approved compression type fittings. Copper tubing with jacketing may be used for instrument tubing, otherwise is not acceptable.
 8. Valves (Para. 2.11.14 API 614) shall be carbon steel body with 11-13% chrome trim in hand valves, 18-8 trim in relief valves. All control valves shall be flanged, and control valve manifolds shall be provided with bypass valves and a 3/4 inch bleed valve. Shut-off valve shall be supplied on each side of control valve. All valves shall be easily accessible.
 9. All piping removed and shipped separately shall have metal tag attached to identify it, with the manufacturer's piping drawings and schematics.
 10. Dual oil pumps and coolers are not required as called for in API 614.
 30. Painting of equipment shall be in accordance with manufacturer's standards using gray color except for heated surfaces which shall be heat resistant Aluminum color.
 31. The extruder shall be fully assembled except for gearbox with pelletizer in place and rotated following bore scope alignment before disassembly for shipment. In addition the gear box shall be fully assembled (including the feed barrel template to assure proper alignment) and rotated to assure proper tooth contact. Phillips Petroleum Company shall be advised in sufficient time to have a representative present to witness the final assembly test.

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32. Proper packing, crating and protection of equipment for shipment shall include proper coating and/or protection of bearings, seals, shafts, screws and other parts of the equipment during the shipping and erection period at the plant site. Screws shall be removed from extruders, coated with cosmoline or equal and shipped disassembled. All machine parts disassembled for shipment shall be permanently match-marked for proper reassembly.

7.0 EXCLUSIONS

1. All motor starters.
2. Cooling water, steam and oil heating supply and return.
3. Run tank weigh totalizers.
4. Feeders and feeder panel components.
5. Pellet water system.
6. Isolation transformers.
7. Compounder inlet hopper.

8.0 SPARE PARTS

1. The vendor shall supply a list of recommended spare parts, including full descriptions and prices. Vendor shall advise purchaser ordering schedule for spare parts to assure delivery can be made prior to start-up.
2. Other than those rotating (in and out of service) spare parts listed in Section 7.0.4 this purchase specification is not intended to cover spare parts and the spare parts list mentioned in Section 7.0.1 shall reflect the minimum requirements the Vendor's experience indicates should be available for start-up and the first year of operation.
3. Spare parts, other than rotating spares in Section 7.0.4, will be ordered by purchaser's operating group on a separate purchase order in time for spare parts to be delivered prior to start-up. If spare parts are shipped with equipment, they must be packaged separately and identified as spare parts with appropriate purchase order number marked on package.

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4. The following rotating spare parts are a part of these purchase specifications and shall be quoted separately for the equipment for accounting purposes and are in addition to those furnished as standard with the machine.
 1. a) One extrusion die plate complete with die ring.
(See Section 1.1.12.4)
 - b) Two die rings to match die plate.
 2. One pelletizer knife holder complete with knives.
 3. Screen changer parts as follows:
 - a) (2) support plates
 - b) (3 sets) basket supports
 - c) (4 sets) filter screens for 3 MF
(2 sets) filter screens for 35 MF

9.0 ATTACHMENTS

The following Phillips Petroleum Company specifications and Engineering Standards shall be considered as part of these specifications:

1. General Design Specification
Section F - Motors 150 HP (112 kw) and below.

10.0 SPECIAL ITEMS

- 10.1 Cancellation Schedule - Vendor to provide a schedule of cancellation charges by months for a period covering the first 11 months.
- 10.2 This statement deleted.
- 10.3 This statement deleted.
 - 10.3.1 Deleted.
- 10.4 Deleted.