

SPECIFICATION SELF-ASSESSMENT GRADE: "B" (SHARED).

THIS 43 23 57 – PROGRESSIVE CAVITY PUMPS SPEC HAS BEEN COORDINATED WITH THE FOLLOWING SPECIFICATIONS: DIV 01, SECTION 46 00 00 – EQUIPMENT GENERAL, 43 20 00 – PUMPS - GENERAL.

SECTION 43 23 57 PROGRESSIVE CAVITY PUMPS

THIS INDIVIDUAL SPECIFICATION MUST BE ACCOMPANIED BY PUMPS - GENERAL, EQUIPMENT – GENERAL SECTION, DIVISION 00 AND DIVISION 01, EACH OF WHICH CONTAINS ESSENTIAL REQUIREMENTS THAT SUPPLEMENT THIS INDIVIDUAL SPECIFICATION SECTION.

SPECIFIER SHOULD VERIFY THAT EACH INDIVIDUAL PUMP SPECIFICATIONS HAS BEEN CROSS CHECKED AGAINST THESE SECTIONS TO AVOID CONFLICTING REQUIREMENTS AND/OR REDUNDANT REQUIREMENTS. IF UPDATES TO INDIVIDUAL SPEC SECTIONS AND/OR PUMPS - GENERAL ARE NECESSARY, PLEASE SEND PROPOSED TRACKED CHANGES TO INDIVIDUAL SPEC SECTION TO THAT SECTION'S SPEC LEAD FOR INCORPORATION INTO THE MASTER.

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, and place into satisfactory operation progressive cavity pumps at the locations shown on the Drawings and as specified herein. All pumps specified herein shall be supplied by the same manufacturer.
- B. Equipment shall be provided in accordance with the requirements of **Section 43 20 00 – Pumps General**.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Comply with Section 43 20 00 – Pumps General

1.03 ACTION/INFORMATIONAL SUBMITTALS

- A. Product Data: Comply with Section 01 33 00 – Submittal Procedures.
- B. Provide submittals identified in Section 46 00 00 – Equipment General Provisions in addition to the submittals identified herein and in addition to the submittals identified in the individual pumping specification sections.
- C. Provide submittals identified in Section 43 20 00 – Pumps General.

- D. [Add Requirements specific to this pump type]

1.04 CLOSEOUT SUBMITTALS

- A. Submit warranty documentation in compliance with:
 - 1. Section 01 33 00 – Submittal Procedures
 - 2. Section 01 61 00 - Product Requirements and Options
- B. Operation and Maintenance (O&M) manuals shall be submitted in accordance with Section 01 33 00 – Submittal Procedures and Section 01 78 23 – Operation and Maintenance Data.
- C. Comply with Section 43 20 00 – Pumps General.

1.05 MAINTENANCE MATERIALS SUBMITTALS

- A. Operation and Maintenance (O&M) manuals shall be submitted in accordance with:
 - 1. Section 01 33 00 – Submittal Procedures
 - 2. Section 01 78 23 Operation and Maintenance Data
- B. Comply with Section 01 78 43 – Spare Parts and Extra Materials.
- C. Comply with Section 01 79 00 – Instructions to Owner’s Personnel.
- D. Comply with Section 46 00 00 – Equipment General.
- E. Comply with Section 43 20 00 – Pumps General.

1.06 QUALITY ASSURANCE SUBMITTALS

- A. Comply with Section 43 20 00 – Pumps General.
- B. Comply with Section 01 75 00 – Check Out and Start Up Procedures.

ADD DATA TABLES/SCHEDULES AT THE END OF THE SECTION TO PRESCRIBE THE PRELIMINARY AND FINAL FIELD DATA AND FREQUENCY OF COLLECTION THAT SHALL BE COLLECTED AND SUBMITTED TO SUBSTANTIATE A FUNCTIONALITY OF A PUMP PERFORMING AS INTENDED. COORDINATE WITH INSTRUMENTATION AND CONTROL – TO THE EXTENT PRACTICAL, ALIGN DATA REQUIRED WITH AVAILABLE INSTRUMENTATION AND A PLC DATA LOG/HISTORIAN.

1.07 GENERAL INFORMATION AND DESCRIPTION

- A. Comply with Section 46 00 00 – Equipment – General Provisions.

1.08 DYNAMIC ANALYSIS – NOT USED

1.09 WARRANTY

- A. Warranty requirements shall be as specified in Section 01 61 00 – Product Requirements and Options. Warranty requirements are supplementary to the individual equipment specifications.
- B. Comply with the Equipment Warranties requirements specified in Section 46 00 00 – Equipment General Provisions.

STANDARD WARRANTY PER THE GENERAL CONDITIONS AND SECTION 46 00 00 EQUIPMENT GENERAL PROVISIONS IS ONE YEAR. IF OWNER WANTS EXTENDED WARRANTY ON THE EQUIPMENT, INCLUDE IN THIS PARAGRAPH

- C. [Warranty shall be as specified in Section 46 00 00 – Equipment General Provisions with the exception that the warranty period shall be for two (2) years.]

1.10 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

Pump Performance Criteria Schedule: 43 23 57 - 02

	DS Transfe r Pumps	TWAS Transfe r Pumps	DCEN Feed Pumps	Polyme r Feed Pumps	Polyme r Recirc Pumps	WAS Transfe r Pumps	DS Transfe r Pumps
Number of Units	4	3	3	3			1
Pump Identification Numbers	X	X	X	X			
Rated Condition Point							
Flow (gpm)	300	285	300	50			175
Design Differential Pressure (psig)	40	40	60	40			80
Minimum Flow Operating Point (at Reduced Speed)							
Flow (gpm)	Xx	Xx	XX	XX			50
Differential Pressure (psig)	Xx	Xx	XX	XX			80
Maximum Brake Horsepower for all operating points	x	x					
[Maximum] Pump Operating Speed (rpm)	200	200	200	200	200		300
Fluid Pumped	DS	TWAS	DS/TWAS Blend	Polymer	Polymer	WAS	DS
Solids Concentration (%)	2%-3.5%	3.0%	2.0%	N/A	N/A		0-6%
Fluid Temperature (degrees F)	Ambient	Ambient	Ambient	Ambient	Ambient		

	DS Transfe r Pumps	TWAS Transfe r Pumps	DCEN Feed Pumps	Polyme r Feed Pumps	Polyme r Recirc Pumps	WAS Transfe r Pumps	DS Transfe r Pumps
Fluid Specific Gravity	1	1	1	1	1		
Fluid pH range	5-9	5-9	5-9	5-9			
Fluid Viscosity (absolute centipoise at 60-deg F.)	xx cP	[500 to 2,000] cP	cP	cP	2000 cP		
Suction Diameter (in)	x	x					8
Discharge Diameter (in)	x	x					8
Drive Configuration	In-line	In-line	In-line	In-line	In-line		
Direction of rotation when viewed from driven end	clockwise	clockwise	clockwise	clockwise	clockwise		
Minimum ABMA L-10 Bearing life [along the full length of the published operating curve] (hours)	100,000	100,000	100,000	100,000	100,000		
Factory Acceptance Test Type	Type IV	Type IV	Type IV	Type IV	Type IV		
Factory Acceptance Level	Level A	Level A	Level A	Level A	Level A		
Area Classification	Unclassified	Unclassified	Unclassified	Unclassified	Unclassified		
Control Panel Rating	See Division 40	See Division 40	See Division 40	See Division 40	See Division 40		
Suction Condition	Flooded	Flooded	Flooded	Flooded	Flooded		
Number of Pump Stages	2	2	2	2	2		4
Variable Speed Drive Speed Range (%)	25-100%	25-100%	25-100%	25-100%	25-100%		25-100%
Universal Joint Life, Minimum (hours)	10,000	10,000	10,000	10,000	10,000		
Maintain in Place	Yes	Yes	Yes	Yes	Yes		No

REGARDING OPERATING CONDITIONS:

THE RATED CONDITION POINT IS THE OPERATING POINT THAT MUST BE MET IN ORDER TO ENSURE THAT THE PUMPS CAN MEET PROCESS DESIGN REQUIREMENTS. FACTORY TESTING IS REQUIRED TO MEET THE HI ACCEPTANCE GRADE AT THIS POINT ONLY.

THE REMAINDER OF THE OPERATING POINTS SHALL BE COMPLETED UPON SELECTION OF SPECIFIC PUMPS FROM MULTIPLE MANUFACTURERS. PUMP CURVES WILL VARY BETWEEN MANUFACTURERS WITH REGARD TO STEEPNESS OF CURVE AND THE LOCATION OF OPERATING POINTS ON THE CURVE RELATIVE TO BEP, POR, AND AOR. TO ACCOMMODATE THESE DIFFERENCES, THE SCHEDULE ALLOWS FOR SPECIFYING "RANGES" AND "NOT TO EXCEED" VALUES.

THE “MINIMUM FLOW OPERATING POINT (AT REDUCED SPEED)” IS THE OPERATING POINT ASSOCIATED WITH REDUCED SPEED OPERATION TO MEET MINIMUM PROCESS FLOW CONDITION. FOR CONSTANT SPEED PUMP APPLICATIONS, THIS POINT SHOULD BE ELIMINATED FROM THE SCHEDULE. THIS CONDITION TYPICALLY OCCURS WHEN A SINGLE PUMP IS OPERATING TO MEET MINIMUM PROCESS CONDITION, BUT MINIMUM FLOW PER PUMP CAN BE LESS THAN THE MINIMUM PROCESS FLOW.

IT IS RECOMMENDED TO IDENTIFY ALL BASIS OF DESIGN PUMPS AT THE SAME SPEED IN ORDER FOR MAXIMUM LEVEL COMPETITION. THERE WILL BE INSTANCES, WHERE THIS MAY NOT BE POSSIBLE IN WHICH CASE, INCLUDING OF THE TERM “MAXIMUM” ALLOWS FOR SLOWER SPEED PUMPS TO BE ALLOWED (THOUGH SIGNIFICANTLY LESS LIKELY TO BE PROCURED PERHAPS WITH THE EXCEPTION OF PACKAGING). IT IS THE SPECIFIER AND SHOP DRAWING REVIEWER’S DUTY TO PROHIBIT FASTER THAN BASIS OF DESIGN SPEED PUMPS IF/WHEN PROPOSED DURING CONSTRUCTION.

PART 2 – PRODUCTS

MODELS LISTED AND PRODUCT REQUIREMENTS BELOW ARE BASED ON CONVENTIONAL PROGRESSIVE CAVITY PUMPS THAT ARE NOT AMENABLE TO MAINTAIN-IN-PLACE.

SPECIFIER TO COORDINATE WITH OWNER TO DETERMINE IF MAINTAIN-IN-PLACE IS PREFERRED / RECOMMENDED. IF SO, COORDINATE WITH MANUFACTURERS AND CONTACT SPEC LEAD.

2.01 GENERAL

- A. Comply with Section 43 20 00 – Pumps General, except where superseded in this specification section.
- B. Pump Type: Positive displacement, progressive cavity (a.k.a., progressing cavity) pump.

2.02 ACCEPTABLE MANUFACTURERS

- A. Pump Manufacturer:
 - 1. Moyno [EZ Strip Series]
 - 2. Netzsch, [NEMO Series]
 - 3. Seepex [BN Series]

DO NOT SPECIFY MODEL NUMBERS

- A. The electric motor shall be provided by the pump manufacturer and shall be one of the named manufacturers specified in Section 26 05 60 – Low-Voltage Electric Motors.
- B. All equipment for the pumps, including motors and bases, shall be provided as a complete unit by the pump manufacturer.
- C. All pumps for same pumping application shall be provided by one manufacturer.

2.03 ANCHORS AND SUPPORTS

- A. Comply with the following Specification Sections:
 - 1. Section 05 05 23 – Metal Fastening
 - 2. Section 46 00 00 – Equipment General Provisions
 - 3. Comply with individual pump specifications.
- B. Comply with Section 43 20 00 – Pumps General

2.04 MATERIALS OF CONSTRUCTION

Materials of Construction Schedule: 43 23 57 – 03

Component	Materials of Construction						
	DS Transfer Pumps	TWAS Transfer Pumps	DCEN Feed Pumps	Polymer Feed Pumps	Polymer Recirc Pumps	WAS Transfer Pumps	DS Transfer Pumps
Casing	ASTM A48, close grained cast iron	ASTM A48, close grained cast iron	ASTM A48, close grained cast iron	ASTM A48, close grained cast iron			ASTM A48, close grained cast iron
Stuffing Box Cover	[]						Not specified
Bearing Housing	Cast iron	Cast iron	Cast iron	Stainless steel			Cast iron
Shaft	Chrome plated steel	Chrome plated steel	Chrome plated steel	Chrome plated steel			Chrome plated steel
Quill	Chrome plated steel	Chrome plated steel	Chrome plated steel	Chrome plated steel			Chrome plated steel
Rotor	Machine polished, 0.010" nominally thick chrome plated, tool steel	Machine polished, 0.010" nominally thick chrome plated, tool steel	Machine polished, 0.010" nominally thick chrome plated, tool steel	Machine polished, 0.010" nominally thick chrome plated, tool steel			Machine polished, 0.010" nominally thick chrome plated, tool steel
Stator	Molded elastomeri c BUNA-N	Molded elastomeri c BUNA-N	Molded elastomeri c BUNA-N	Molded elastomeri c BUNA-N			Molded elastomeri c BUNA-N

Component	Materials of Construction						DS Transfer Pumps
	DS Transfer Pumps	TWAS Transfer Pumps	DCEN Feed Pumps	Polymer Feed Pumps	Polymer Recirc Pumps	WAS Transfer Pumps	
Stator Tube	Steel	Steel	Steel	Steel			Steel
Pump, Gear Box & Motor Base	[Cast iron] [Fabricated Steel]						Cast iron or Fabricated Steel
Motor Mount	Cast iron	Cast iron	Cast iron	Cast iron			Cast iron
Speed reducer case	Cast iron	Cast iron	Cast iron	Cast iron			Cast iron
Speed reducer motor mount	Cast iron	Cast iron	Cast iron	Cast iron			Cast iron
Gears	A.G.M.A. Class I , Minimum Rockwell Hardness of 60	A.G.M.A. Class I Minimum Rockwell Hardness of 60	A.G.M.A. Class I Minimum Rockwell Hardness of 60	A.G.M.A. Class I Minimum Rockwell Hardness of 60			A.G.M.A. Class I, Minimum Rockwell Hardness of 60
Fasteners	Stainless Steel 316L	Stainless Steel 316L	Stainless Steel 316L	Stainless Steel 316L			Not specified

2.05 COMPONENTS

A. Suction Housing:

1. Inspection Ports:

- a. Shape: Rectangular.
- b. Quantity: two (2)
- c. Inspection ports shall be 180° apart.
- d. Inspection ports shall provide access to the universal joints within the suction housing.

B. Pump Ends: Suction and discharge connections, where flanged, shall be 125 pound NSI Standard flat face flanges.

COORDINATE PRESSURE RATING OF ENDS WITH PUMP DIFFERENTIAL PRESSURE AND NUMBER OF STAGES.

C. Rotor Design: Single helix.

D. Stator:

1. Stator Design: Double helix.
2. Stator shall be chemically bonded to stator tube.
3. Stator Clamp Rings:
 - a. Stator shall use 720° clamp rings to fasten the normal horizontal flange and suction housing, with sealed ends or thru-bolts.
 - b. The clamp rings shall facilitate stator removal.
 - c. The stator seals shall be designed to prevent the material being pumped from contracting the stator bonding and tube.

E. Universal Joints:

1. Type: Grease lubricated, totally enclosed sealed and shielded, crowned gear.
2. Maximum operating Angle: 1-1/2° off center. The low angularity shall maximize universal joint life.
3. Universal joint life: Mechanical components of the gear joints shall be designed to operate for 10,000 hours at the maximum speeds and pressures specified.
4. Function: Transmit the required thrust and torque while allowing the rotor to move in its eccentric path. DS
5. chaint seal shall prevent any liquid from contaminating the gear
6. Shield shall prevent any foreign objects from rupturing the seal.

F. Connecting Rod:

1. Design: Splined.
2. Function: Connect the gear joints of the eccentrically moving rotor and the drive shaft.
3. The connecting rod shall pass through the suction housing/shaft seal area within the hollow drive shaft quill so that no eccentric loads are imparted on the packed seal.
4. The connecting rod shall be rigid and not susceptible to chipping.

G. Shafting:

1. Shaft design shall be two-part hollow quill removable for repair.
2. Shaft quill shall be:

- a. Replaceable.
- b. Removable without removing the bearings from the bearing housing or disconnecting the driver.

H. Bearings:

1. Type: Grease lubricated, tapered roller, with diverging pressure angles for maximum shaft stability.
2. The scheduled minimum L-10 life of the bearing shall be based on maximum operating conditions.
3. Bearing cover plate:
 - a. The bearings shall be protected from contamination by means of a bearing cover plate.
 - b. Bearing cover plate shall be bolted to the bearing housing.

I. Shaft seal shall be as scheduled herein.

J. Base:

1. Equipment Support: Common pump, speed reducer and motor base shall be suitably constructed to support the full weight of pump drive unit and motor.
2. Base shall be especially fabricated for, the pump, motor and gearbox, etc. string components and sufficiently sized to ensure rigid support.
3. Materials of construction shall be heavy welded steel construction, fabricated steel, steel open channel design, or cast iron as scheduled in herein.
4. Shall be provided with bolt holes, grout holes/openings and drain connections with a drip lip.

K. Speed reducer:

1. Type: Double reduction parallel shaft helical gear drive.
2. Speed reducer shall be provided by the pump manufacturer.
3. Speed reducer construction:
 - a. The case shall be cast with integral mounting feet.
 - b. The gears shall be A.G.M.A. Class I.
 - c. Minimum hardness: Rockwell "C" hardness of 60.

- d. Lubrication: Splash type with oil maintained in the housing.
- e. Speed reducer bearings:
 - 1) Anti-friction bearings shall be used throughout
 - 2) Shafts shall be sealed with shielded spring-loaded lip type seals.
- f. Speed reducer motor mount:
 - 1) Motor mount shall be rabbeted, doweled or sleeved so that automatic alignment is maintained when bolted to the gearbox.
 - 2) It shall be designed to accept a standard frame NEMA motor.

2.06 STRUCTURAL STEEL

- A. Comply with Section 43 20 00 – Pumps General.

2.07 DISSIMILAR METALS

- A. Comply with Section 43 20 00 – Pumps General.

2.08 GALVANIZING

- A. Where applicable, galvanizing shall be performed in accordance with Section 05 05 13 – Galvanizing.

2.09 STANDARDIZATION OF GREASE FITTINGS

- A. Grease Fittings: Comply with Section 46 00 00 – Equipment General Provisions.

2.10 APPURTENANCES

- A. Shaft Seals
 - 1. Acceptable Manufacturer:
 - a. AESSEAL Converter II
 - b. or equal.
 - 2. Shaft sealing shall be accomplished by one of the following methods as identified in the schedule below.

Shaft Seal Schedule: 43 23 57-04

	DS Transfer Pump	TWAS Transfer Pumps	DCEN Feed Pumps	Polymer Feed Pumps	Polymer Recirc Pumps	WAS Transfer Pumps	DS Transfer Pumps
Shaft Sealing Arrangement	Single Mechanical Cartridge Seal	Single Mechanical Cartridge Seal	Single Mechanical Cartridge Seal	Single Mechanical Cartridge Seal			Single Mechanical Cartridge Seal
Throat Bushing	[None]	[None]	[None]	[None]			[None]
Seal Flush Source / API Flush Plan	None / Plan 02	None / Plan 02	None / Plan 02	None / Plan 02			None / Plan 02
Seal Face Material	Silicon Carbide vs. Silicon Carbide	Silicon Carbide vs. Silicon Carbide	Silicon Carbide vs. Silicon Carbide	Silicon Carbide vs. Silicon Carbide			Silicon Carbide vs. Silicon Carbide
Metallic Components	316 SST	316 SST	316 SST	316 SST			316 SST
O-rings	Viton	Viton	Viton	Viton			Viton

SHAFT SEALING AND FLUSHWATER ARRANGEMENT SHOULD BE DISCUSSED WITH PM AND OWNER. FOR APPLICATIONS WITH SOLIDS IN FLOW STREAM (MOST APPLICATIONS FOR SOLIDS-HANDLING PUMPS), AN EXTERNAL FLUSH WATER SOURCE IS RECOMMENDED. FOR RAS/WAS PUMPING, IT IS POSSIBLE TO ELIMINATE EXTERNAL FLUSH AND PROVIDE A THROAT BUSHING WITH SPIRAL GROOVES BUT THIS ARRANGEMENT WILL REDUCE SEAL LIFE AS COMPARED WITH AN EXTERNALLY FLUSHED ARRANGEMENT. PRODUCT FLUSHING (PLAN 11) SHOULD BE USED ONLY WITH CLEAN WATER APPLICATIONS WHICH ARE UNCOMMON FOR SOLIDS HANDLING PUMPS.

B. Pressure Gages: Provide pressure gages as indicated on the drawings and as specified under Section 43 20 00 – Pumps General.

C. Shaft Couplings:

1. Comply with Section 43 20 00 – Pumps General.
2. Pump shaft connections to drives and/or speed reducers shall be through flexible couplings.
3. Coupling shall be provided with coupling guard.
4. Manufacturer:
 - a. Falk
 - b. Dodge
 - c. Or equal.

2.11 ELECTRICAL AND CONTROL REQUIREMENTS

A. Comply with Specification Section 43 20 00 – Pumps General.

**INCLUDE THIS PARAGRAPH B ONLY FOR EQUIPMENT IN CLASSIFIED AREAS –
CHANGE AREA CLASSIFICATION LISTED BELOW AS REQUIRED**

B.

Electrical and Instrumentation Requirements: Schedule 43 23 57-05

Motors	DS Transfer Pump	TWAS Transfer Pumps	DCEN Feed Pumps	Polymer Feed Pumps	Polymer Recirc Pumps	WAS Transfer Pumps	DS Transfer Pumps
Rating	460V, 3 ph, 60 Hz	460V, 3 ph, 60 Hz	460V, 3 ph, 60 Hz	460V, 3 ph, 60 Hz	460V, 3 ph, 60 Hz		460V, 3 ph, 60 Hz
Horsepower							25
Speed, rpm	1800	1800	1800	1800			1800
Enclosure	TEFC	TEFC	TEFC	TEFC			TEFC
Insulation	[Class F] [Class H]	[Class F] [Class H]	[Class F] [Class H]	[Class F] [Class H]			Class H
Inverter Duty	Yes	Yes	Yes	Yes			Yes
Service Factor	1.0	1.0	1.0				1.0
Space Heater	Yes	Yes	Yes	Yes			Yes
Motor Winding Temperature Switches	[Temperature Switches] [RTDs] [None]	[Temperature Switches] [RTDs] [None]	[Temperature Switches] [RTDs] [None]	[Temperature Switches] [RTDs] [None]			Yes
Separate Cooling Fan	[[No]	[Yes] [No]	[Yes] [No]	[Yes] [No]			Yes
Pump Instrumentation							
Pump Bearing RTDs	[No]	[[No]	[[No]	[[No]			
Pump Bearing Vibration	[No]	[[No]	[No]	[No]			
Low Suction Pressure Switch	No	[No]	No	No			Yes
High Discharge Pressure Switch	Yes	Yes	Yes	Yes			Yes
Flow Switch	No	No	No	No			
Pump Stator Temperature Switch	Yes	[Yes]	[Yes]	Yes			
[Full line-size isolating ring seals]	Yes	Yes	Yes	Yes			
[]	[Yes] [No]	[Yes] [No]	[Yes] [No]	[Yes] [No]			

SEE PROCESS MECHANICAL DESIGN GUIDELINE FOR PUMP/MOTOR MONITORING & PROTECTION REQUIREMENTS. COORDINATE WITH PUMP MFR AND I&C GROUP.

INCLUDE ANY OTHER MOTOR CONTROL DEVICES THAT NEED TO BE FURNISHED BY THE EQUIPMENT SUPPLIER, E.G. CURRENT MONITORS, ZERO SPEED SWITCHES, LIMIT SWITCHES, ETC. COORDINATE W/ ELECTRICAL GROUP. IF A LOCAL CONTROL PANEL MUST BE PROVIDED BY THE MANUFACTURER, INCLUDE A SEPARATE PARAGRAPH 2.XX ENTITLED "INSERT EQUIPMENT NAME CONTROL PANEL"

CONSIDER INCLUDING INSTRUMENTATION TO FACILITATE FIELD TESTING:

- **FLOW MEASUREMENT**
- **INLET/OUTLET PRESSURE (4-20mA PIT)**
- **SPEED (FROM VFD)**
- **POWER (FROM VFD)**

- C. The motor provided shall be capable of running across the full range of operations continuously and shall be self-cooling under all conditions.
- D. High discharge and low suction pressure switches and associated full line size isolated ring seals shall be furnished and installed on the suction and discharge piping for each pump. Where specified, pressure switches and isolated ring seals shall be furnished under Division 40.
- E. Run Dry Protection System
1. A thermal run dry protection system shall be provided on each pump where specified. The system shall be designed to protect pumps from damage caused by an absence of liquid in the pump. Each thermal run dry protection system shall include an RTD temperature sensor, a remote 120 VAC 60 Hz powered digital temperature controller, and interconnecting cable.
 2. Each pump shall be furnished with a stainless steel thermal run dry protection probe. The probe shall be installed between front cover and front protection plate of each pump. The probe shall not come in contact with the pumped fluid.
 3. The temperature controller shall be mounted in a type 316 stainless steel NEMA 4X panel with viewing window. Refer to Division 40 for additional requirements for the panel and associated components. The controller shall be furnished with a fail-safe relay which shall be de-energized to alarm in the event of a malfunction or power loss. Ambient temperature limits of the electronic controller shall be -40 to 140 deg F. Outputs shall be DPDT contacts rated 10A at 120 VAC.

4. The cable connecting the temperature sensor and the electronic unit shall be teflon-insulated 2-conductor driven shield type and shall be used to connect the sensing element to the electronic unit. The manufacturer and Contractor shall examine the Drawings to determine the required cable length.
5. The thermal run dry system shall be calibrated and adjusted in the field by the pump supplier.
6. The thermal run-dry protection system shall be **WIKA Model CS4S - 3AR/M HBB** temperature controller or equal with Pt 100 RTD sensing element.

INCLUDE ANY OTHER MOTOR CONTROL DEVICES THAT NEED TO BE FURNISHED BY THE EQUIPMENT SUPPLIER. COORDINATE W/ ELECTRICAL GROUP. IF A LOCAL CONTROL PANEL MUST BE PROVIDED BY THE MANUFACTURER, INCLUDE A SEPARATE PARAGRAPH 2.XX ENTITLED "INSERT EQUIPMENT NAME CONTROL PANEL".

2.12 SPARE PARTS AND SPECIAL TOOLS

- A. Comply with Section 43 20 00 – Pumps General.
- B. Spare parts shall be provided in accordance with Section 46 00 00 – Equipment General Provisions and shall include the following for each series of pumps.

Spare Parts Schedule: 43 23 57 – 06

Component	Quantity						
	DS Transfer Pumps	TWAS Transfer Pumps	DCEN Feed Pumps	Polymer Feed Pumps	Polymer Recirc Pumps	WAS Transfer Pumps	DS Transfer Pumps
Set of motor and pump bearings	1	1	1	1	1	1	1
Set of gaskets and O-ring seals	2	2	2	2	2	2	2
Spare Stator	1	1	1	1	1	1	1
Spare Rotor	1	1	1	1	1	1	1
Set of retaining rings							1

2.13 EQUIPMENT IDENTIFICATION

- A. Comply with Section 43 20 00 – Pumps General.

PART 3 – EXECUTION

3.01 SHOP TESTING

- A. Factory testing shall be in accordance with Section 43 20 00 – Pumps General and ANSI/HI 3.6 Rotary Pump Tests, and shall include:

WITNESSED SHOP TESTS ARE TYPICALLY REQUIRED ONLY FOR LARGER PUMPS BUT MAY BE OWNER DRIVEN. SEE HAZEN DESIGN GUIDELINE FOR SPECIFYING AND WITNESSING SHOP TESTS.

Shop Testing Schedule 43 23 18 – 07

	Service 1	Service 2
Hydraulic Performance Testing	[Yes]	[Yes] [No]
Witnessed Performance Testing	[No]	[Yes] [No]
Certified Performance Curves	[Yes]	[Yes] [No]
Vibration Testing	[Yes] [No]	[Yes] [No]
Mechanical Test	[Yes] [No]	[Yes] [No]
String Test	[Yes] [No]	[Yes] [No]
Net Positive Inlet Pressure (NPIP) Test	[Single Point] [Full Curve] [No]	[Single Point] [Full Curve] [No]
Hydrostatic Test	[Yes] [No]	[Yes] [No]
Casing Hardness Test	[Yes] [No]	[Yes] [No]
Job Gearboxes	[Yes] [No]	[Yes] [No]
Job Drives	[Yes] [No]	[Yes] [No]
Job Motors	[Yes] [No]	[Yes] [No]
Outlet Pressure Corrections Allowable	No	No
Speed Corrections Allowable	No	No
[]	[Yes] [No]	[Yes] [No]

- B. Factory Acceptance Testing Process Fluid: [water]
- C. Factory acceptance test type and level shall comply with Pump Performance Criteria Schedule indicated in Part 1 of this specification.

3.02 SHIPMENT, DELIVERY, HANDLING AND STORAGE

- A. Shipment, delivery and handling of equipment and materials shall be in accordance with Section 01 65 00 – Product Delivery Requirements.
- B. Storage of equipment shall be in accordance with Section 01 66 00 – Product Storage and Protection Requirements.

3.03 MANUFACTURER'S FIELD SERVICES

- A. The services of a qualified manufacturer's technical representative shall be provided in accordance with **Section 43 20 00 – Pumps General**. For each series of pumps, field services shall include the following site visits:

Schedule 43 23 57 – 08 – Site Visits Schedule

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	1
Startup and Training	1	1
Services after Startup	1	1

3.04 INSTALLATION

- A. Install pump in strict accordance with manufacturer's recommendations and Section 43 20 00 – Pumps General.

3.05 ALIGNMENT

- A. Comply with Section 43 20 00 – Pumps General.

3.06 FIELD TESTING

- A. Field testing shall be in accordance with Section 43 20 00 – Pumps General, and shall include:

Field Testing Schedule: 43 23 57 - 09

	Service 1	Service 2
Field Performance Testing	[Yes]	[Yes] [No]
Vibration Testing	[Yes]	[Yes] [No]

NATURAL FREQUENCY TESTS ARE VERY UNCOMMON FOR PROGRESSIVE CAVITY PUMP APPLICATIONS.

Natural Frequency Tests should typically be included if Level 2/3 dynamic analysis was completed.

3.07 FAILURE OF EQUIPMENT TO PERFORM

- A. Comply with Section 46 00 00 – Equipment General Provisions.

3.08 PAINTING

- A. Comply with Section 46 00 00 – Equipment General Provisions.

B. Comply with Section 09 90 00 – Painting.

3.09 ADDITIONAL REQUIREMENTS

ADD ANY ADDITIONAL REQUIREMENTS HERE.

END OF SECTION