

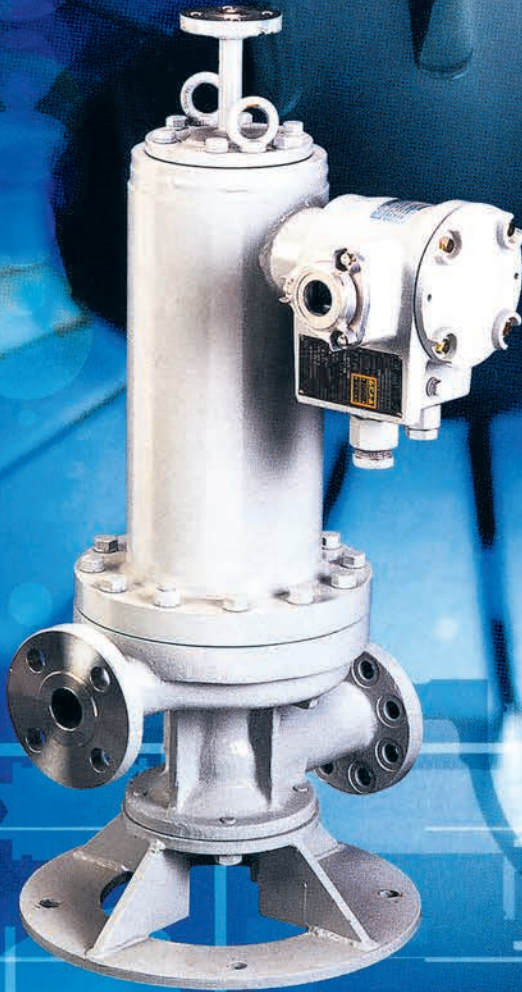


TEIKOKU

CANNED MOTOR PUMPS

World's Largest Manufacturer of Canned Motor Pumps

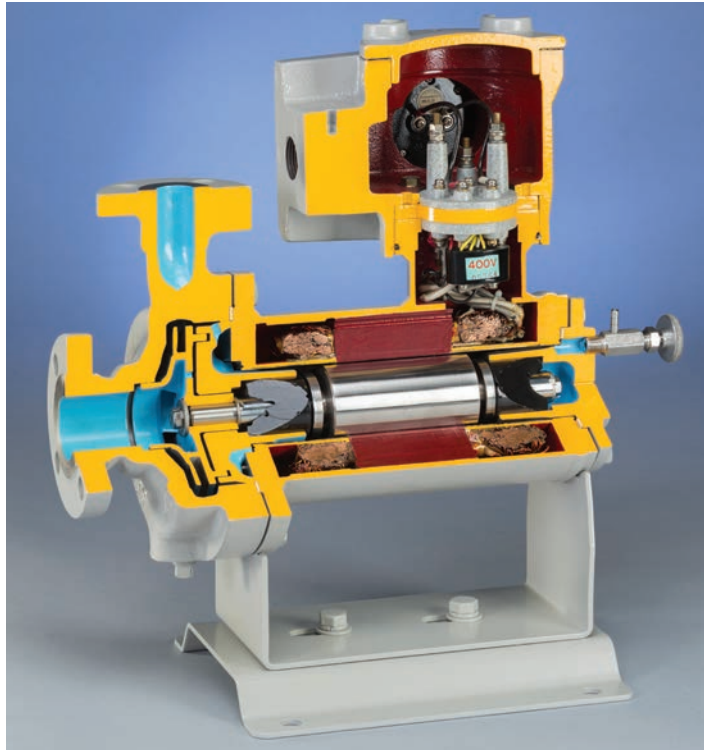
ISO 9001 CERTIFIED



TEIKOKU ELECTRIC MFG. CO., LTD.



To Meet Today's Standards



Teikoku Canned Motor Pumps

NO LEAKAGE OR EMISSIONS

Handles toxic, explosive, expensive, hazardous, carcinogenic and corrosive fluids without leaking during operation, shutdown or process upset conditions.

AIRTIGHT

Ideal for vacuum services or for fluids with high reactivity to atmosphere.

NO SHAFT SEAL

No dynamic mechanical seal. No gland packing.

NO EXTERNAL LUBRICATION

Pumped fluid provides cooling and thin film lubrication of motor and bearings. No lubrication levels to check or maintain.

VACUUM TO HIGH SYSTEM PRESSURE

Designs can be rated like pressure vessels to handle conditions from full vacuum to 5,000 psi / 35 MPa.

COMPACT DESIGN

Motor and pump are a combined, single unit. No alignment is necessary. Grouting and/or elaborate foundation design is eliminated.

QUIET OPERATION

Low noise levels are achieved since the motor is cooled without a fan. All rotating parts operate within the thick motor shell.

EXPLOSION PROOF

Certified by several underwriting agencies around the globe for use in electrical hazardous area locations.

API 610 / 685 NOZZLE LOADS

FIELD REPAIRABLE

Minimal number and simplicity of wear parts makes field service quick and safe.

ELECTRONIC BEARING MONITORS

All TEIKOKU Canned Motor Pumps are supplied with bearing wear monitors.

ANSI B73.3 & ISO2858 SIZES AVAILABLE

ALL PUMPS PERFORMANCE TESTED

Every component of a TEIKOKU Canned Motor Pump, including the motor and hydraulics parts, are manufactured by TEIKOKU to the strict statistical quality control tolerances important to canned motor pump performance, where hermetic motor and hydraulic performance are linked by design. Every pump manufactured by TEIKOKU is tested and documented for performance and Net Positive Suction Head Required (NPSH_r) before shipment.

Safety Meets Economy

Increase safety, while minimizing risk to the environment, plant personnel and neighbors, by specifying TEIKOKU Canned Motor Pumps. TEIKOKU's unique pumping solutions operate emission-free and are 100% leakproof by design, with secondary containment offered as standard to enhance corporate goals for safety and long term sustainability.

TEIKOKU Canned Motor Pumps offer unique solutions to the demands of Process Industries to utilize equipment that, while operating leak-free, performs with a high degree of reliability and efficiency. TEIKOKU's Canned Motor Pumps more than meet this challenge.

Besides providing for safe, redundant control for total fluid containment, TEIKOKU pumps offer some remarkable performance advantages. Designed for long periods of time between maintenance (MTBM) intervals, pre-planned maintenance during scheduled downtime is achievable. TEIKOKU Canned Motor Pumps feature a minimal number of components that need to be monitored and serviced. Costly, time consuming alignment procedures and external lubrication are completely eliminated. And, because TEIKOKU Canned Motor Pumps are sealless, complicated seal support systems and seal maintenance are eliminated.

TEIKOKU Canned Motor Pumps: true secondary containment safety, highly reliable operation, cost-economy...and ZERO environmental impact.

CENTRIFUGAL PUMPS with double mechanical seals

MECHANICAL SEALS

Seal failure usually results in total shutdown and pumps offer no secondary containment.

SEPARATE MOTOR AND PUMP

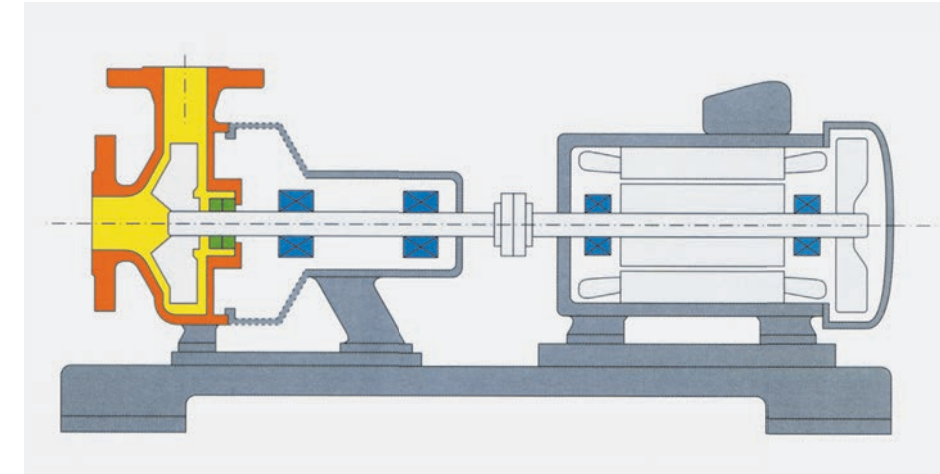
Requires scheduled and proper alignment to maximize unit reliability and the life of bearings and couplings. Motors are exposed and require fan cooling. Foundation pads must be poured and are necessary to support the increased weight and reduce the danger of misalignment. More than 60% longer than similar sized canned motor pumps.

COMPLEX MAINTENANCE

Motor and bearing lubrication and vibration levels must be continually monitored to extend operating life.

ELEVATED NOISE LEVEL

Separate motor cooling fan and other rotating parts greatly increase operating noise levels.



MAGNETIC DRIVE PUMPS

THIN CONTAINMENT SHELL

Required for efficiency and subject to damage by driven magnet sets and subsequent leakage to atmosphere. No secondary containment.

MULTIPLE BEARING TECHNOLOGY EMPLOYED

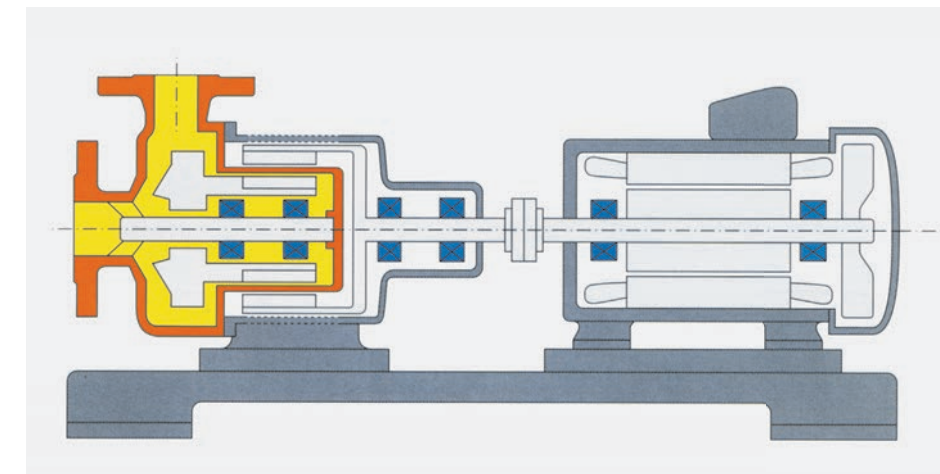
Combination of oil and grease lubricated ball bearings and fluid lubricated sleeve bearings requires frequent monitoring for proper lubrication. Rotating sleeve bearings cannot be externally monitored.

DECOUPLING DUE TO PROCESS UPSET

Decoupling may lead to sudden catastrophic failure and rapid heat rise.

SEPARATE MOTOR AND PUMP

Requires scheduled and proper alignment to maximize unit reliability and the life of bearings and couplings. Motors are exposed and require fan cooling. Foundation pads must be poured and are necessary to support the increased weight and reduce the danger of misalignment. More than 60% longer than similar sized canned motor pumps.



NOISY FAN

Separate motor cooling fan and other rotating parts greatly increase operating noise levels.

TEIKOKU CANNED MOTOR PUMPS



Designed For Zero-Leakage Services In The CPI & HPI

TEIKOKU, the world's largest supplier of canned motor pumps, offers a state-of-the-art, sealless pump.

No newcomer to the field, TEIKOKU has provided customers with proven Canned Motor Pump solutions for more than 50 years. Over 500,000 units have been installed worldwide, covering every possible application.

TEIKOKU is unique in that it designs and manufactures both pumps and motors, thus, ensuring users total quality control and matched hydraulic/driver performance.

The TEIKOKU Canned Motor Pump replaces conventional sealed pumps providing safer, more economical operation through reduced long term cost of ownership. This is especially advantageous when pumping

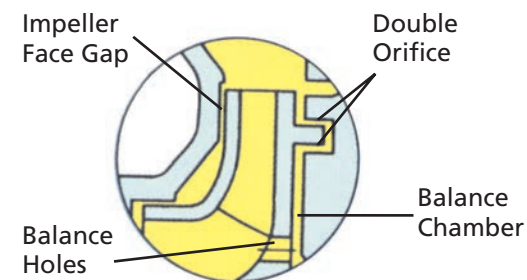
hazardous, volatile, toxic and hard to handle fluids.

TEIKOKU provides expertise in selecting the pump best suited to a user's specific needs. TEIKOKU's experience encompasses horizontal standard pumps, vertical designs with either pump up or motor up configurations, pumps and motors jacketed for cooling or heating, self-priming volutes, submerged units, slurry design, non-cooled, high heat resistant motor pumps and more.

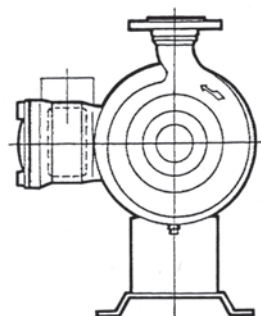
Vacuum dried, N₂ purged stator with Class C or F insulation

No couplings or ball bearings are required.
No mechanical shaft seal is required.

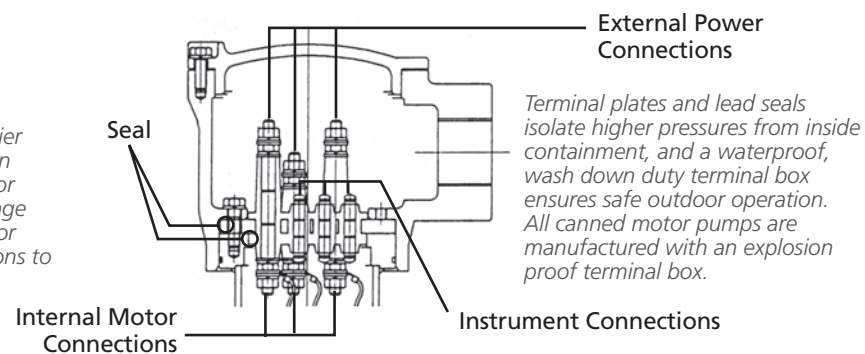
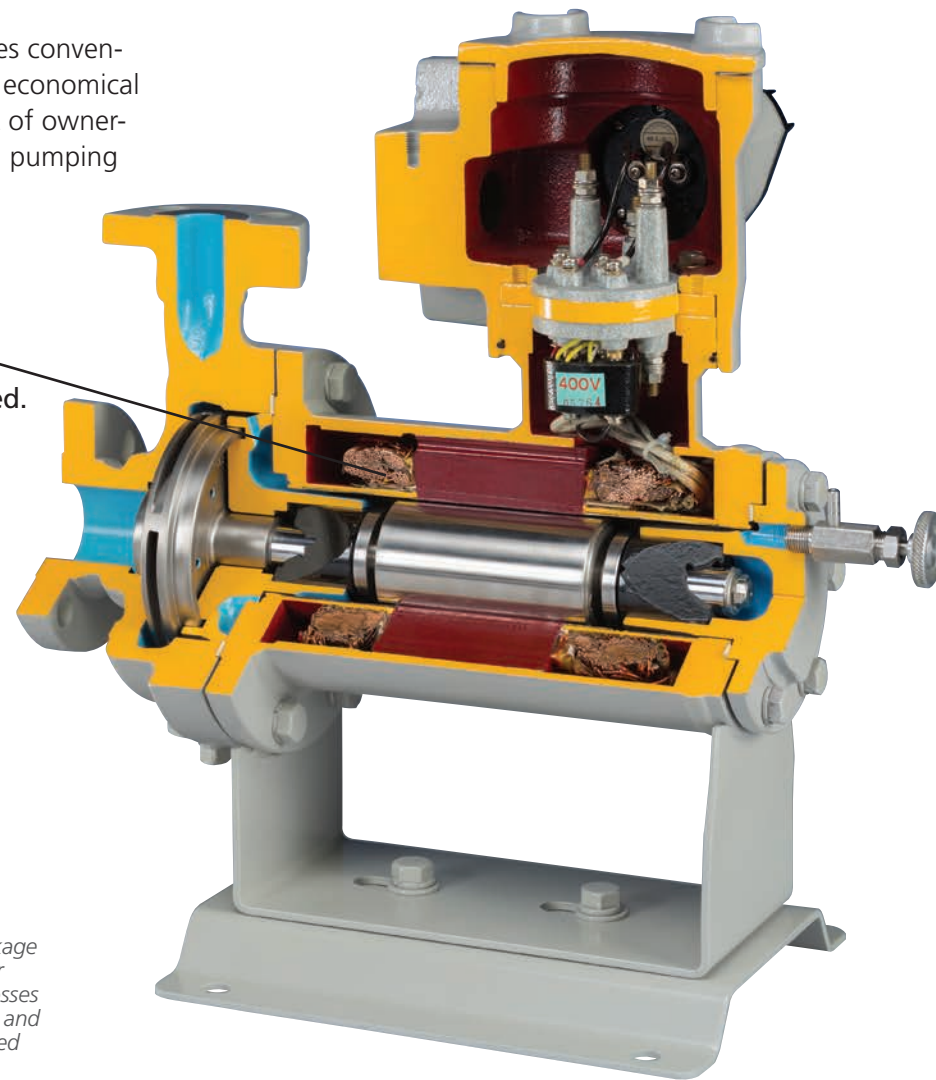
TEIKOKU THRUST BALANCE SYSTEM



Non-contacting double orifice permits minimum leakage and improves volumetric efficiency. Enclosed impeller with optimized face gap tolerance keeps hydraulic losses to a minimum for increased hydraulic efficiency. Size and number of balance holes set balance pressure for fixed axial operating position.



Centered End Suction and Centerline Discharge for easier piping design and installation consistent with either ANSI or ISO standards. Standard flange connections are raised face or available in a variety of options to meet user piping standards.



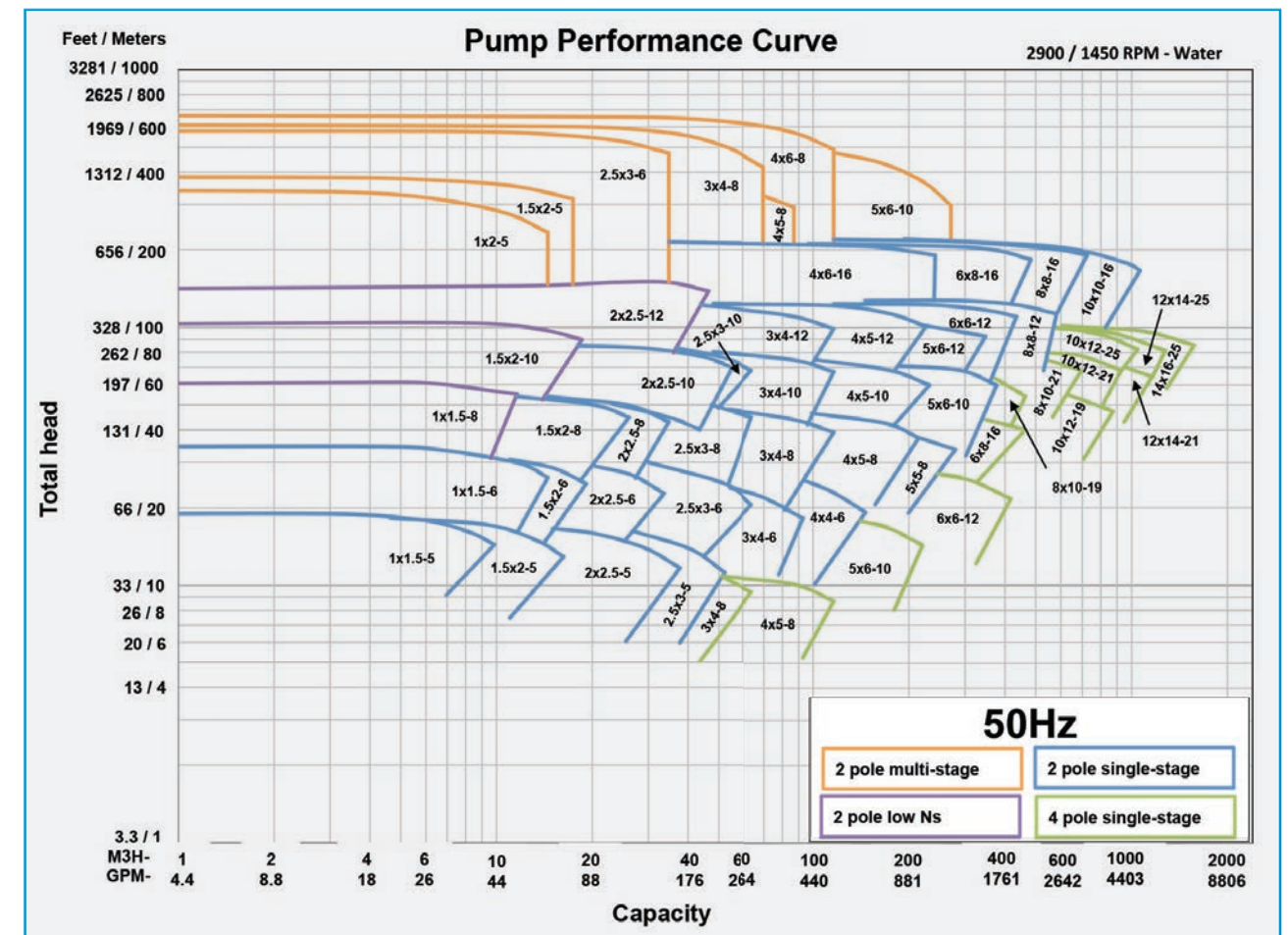
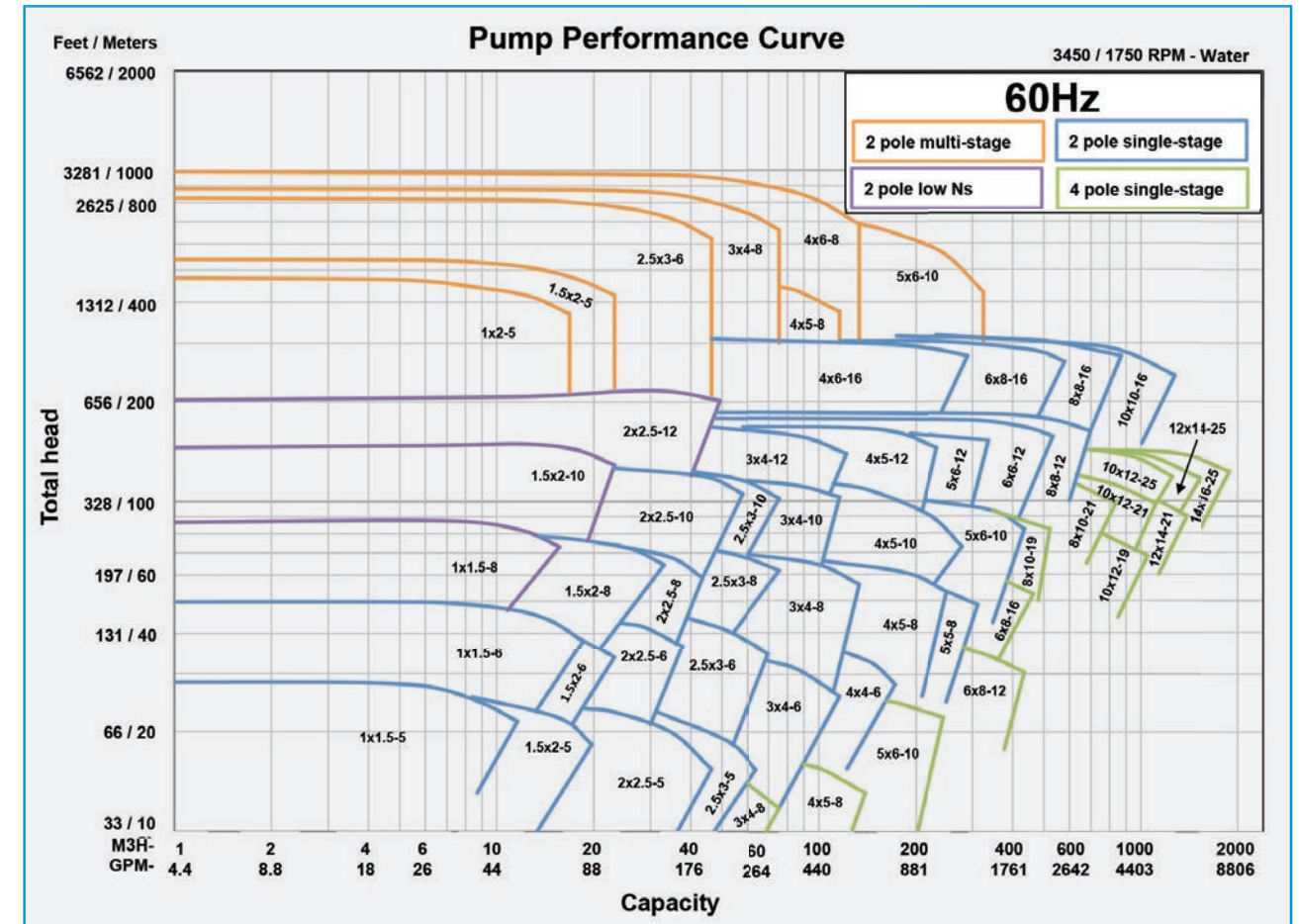
External Power Connections

Terminal plates and lead seals isolate higher pressures from inside containment, and a waterproof, wash down duty terminal box ensures safe outdoor operation. All canned motor pumps are manufactured with an explosion proof terminal box.

Internal Motor Connections

Instrument Connections

PUMP PERFORMANCE CURVES



TYPE BA WITH ON-BOARD COOLER AND MOTOR COOLING JACKET PER API 685 ANNEX D PLAN 23-S



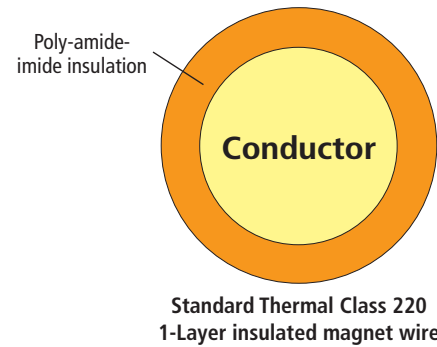
CUSTOM MADE TEIKOKU CANNED MOTOR PUMPS

- Highest tolerance sealless pump design available for temperature changes and thermal upsets
- Broadest range of sealless solutions on the market
- No mechanical seal, no ball bearings, no coupling and NO LEAKAGE
- Water & Air Cooled versions are available
- Wide variety of heat exchangers to meet plant requirements

Thermal Class 220 Standard Externally Cooled Motors	Motor Speed (RPM)	Minimum		Maximum			
		Pump Size	Motor		Pump Size	Motor	
			KW	HP		KW	HP
	3600	1.5 x 1 - 5	1.1	1.5	10 x 10 -16	300	402
	1800		2.2	3	14 x 16 - 25	600	805

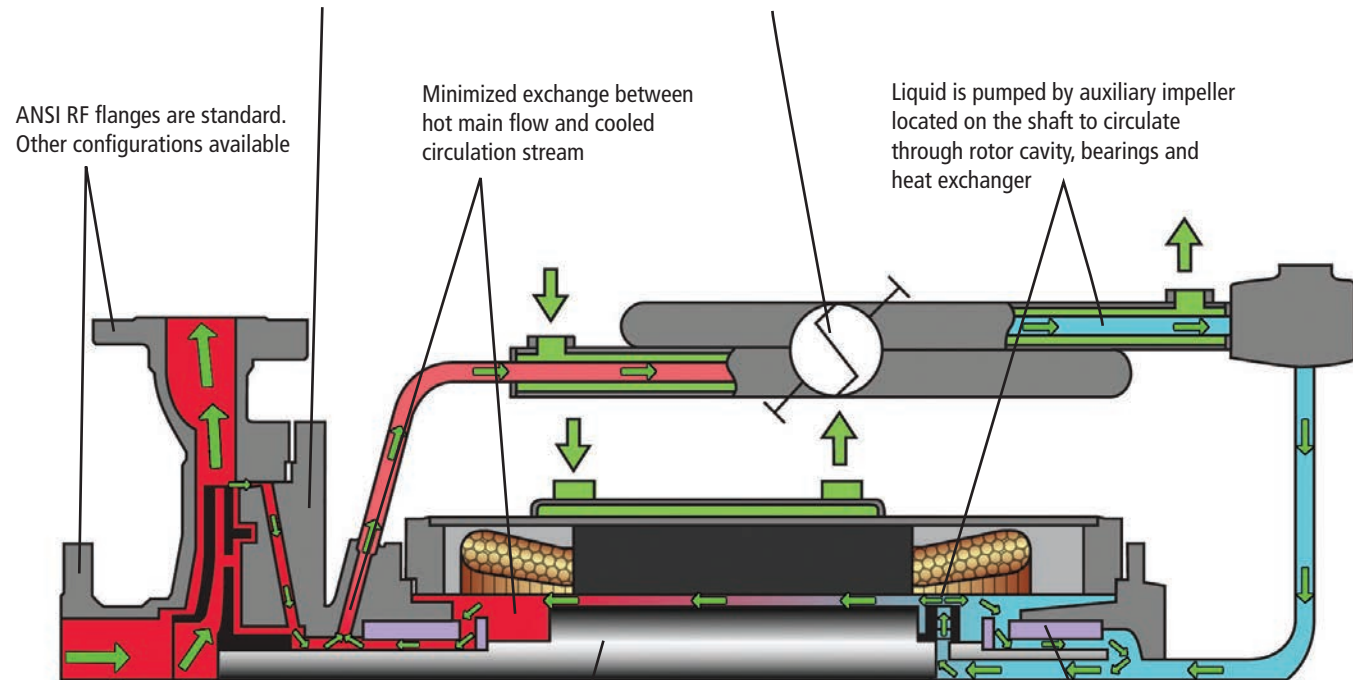
Maximum Liquid Temperature: 850°F / 455°C
Maximum Allowable Working Pressures to 5000 PSIG available

TEIKOKU Standard Class C Insulated Motor

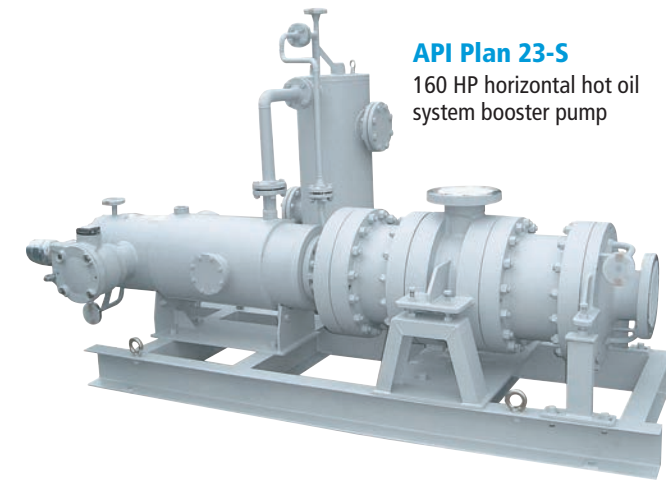


Process liquids as high as 850°F / 455°C are pumped. Heat conduction to motor is minimized by adaptor which thermally isolates pump casing from motor, while maintaining hydraulic connectivity

Heat exchanger maintains circulating liquid temperature well below the maximum temperature capacity of the motor insulation system while main flow is as high as 850°F / 455°C

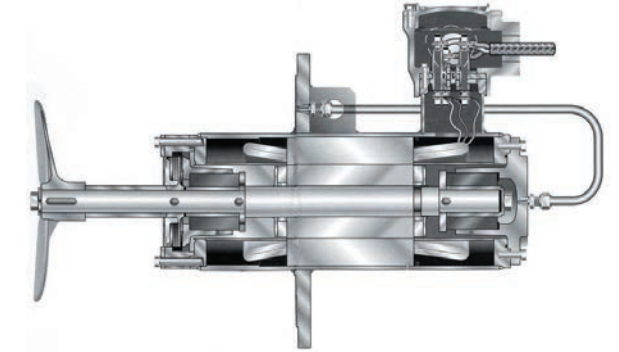


For Diversified Customer Needs

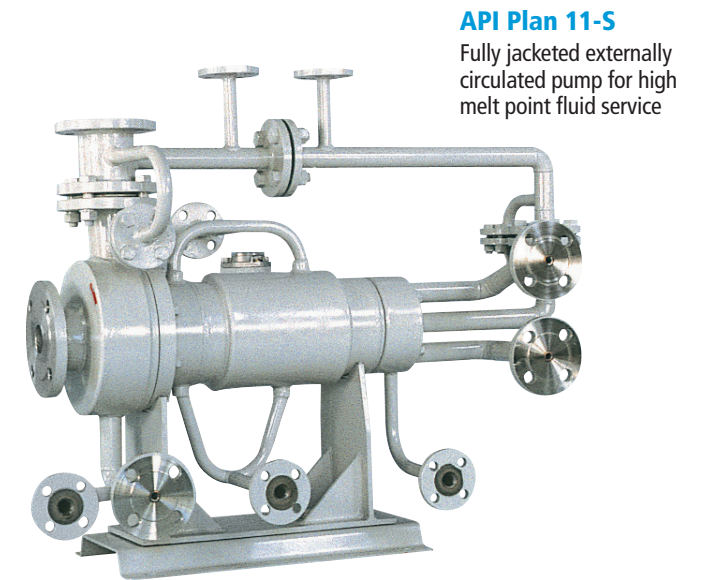


API Plan 23-S
160 HP horizontal hot oil system booster pump

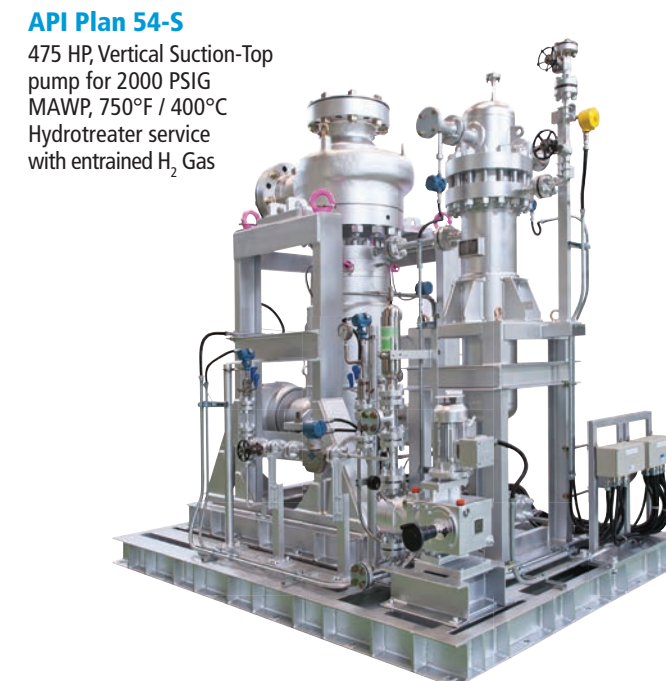
API Plan 11-S
Canned Motor Sealless Agitator provides leak-free, zero maintenance operation under full vacuum or high internal tank pressures.



API Plan 1-S
5000 PSIG MAWP Vertical In-Line Loop Circulation Pump



API Plan 11-S
Fully jacketed externally circulated pump for high melt point fluid service



API Plan 54-S
475 HP, Vertical Suction-Top pump for 2000 PSIG MAWP, 750°F / 400°C Hydrotreater service with entrained H₂ Gas



API Plan 23-S
Air cooled high temperature pump



Dual Function Rotor Position Monitor for TEIKOKU Canned Motor Pumps

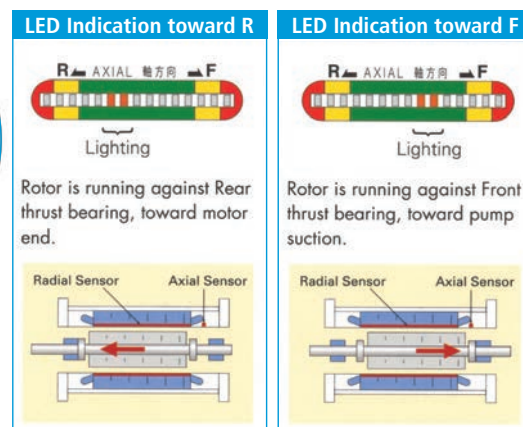
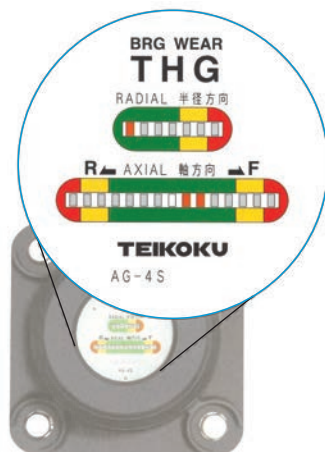


Principle of Operation

Sensors embedded in the stator cavity of a leakproof TEIKOKU Canned Motor Pump produce signals that enable the on-board THG monitor to both display and provide instrument outputs indicating the real-time axial and radial positions of the entire pump rotating assembly. Position signals are converted into low voltage outputs that power the THG monitor display band featuring LED indication of actual rotor position. Rotor position changes over time are indicative of bearing wear in both axial and radial directions and the process conditions causing the changes.

LED Display

THG Hybrid monitor provides accurate, real-time monitoring of both the direction and range of hydraulic axial thrust. This display information indicates both the direction and amount of axial bearing wear, while simultaneously displaying the amount of radial bearing wear.



Features:

- Real-time indication of the rotor position in both axial and radial directions during operation.
- Detection accuracy is as high as 0.2mm (0.0078 inches) in the axial direction.
- Axial display indicates the direction of pump hydraulic thrust: either forward or toward the rear of the pump.
- After normal replacement of worn parts, the THG is easily recalibrated to the null position in the field utilizing Teikoku's Industry First Zero Aid remote hand held instrument.
- THG features two 4-20mA analog instrument output signal capabilities: one each for axial and radial position indication. Connections are provided on the THG to wire signals directly from the monitor.
- If full functionality is required with a Variable Frequency Drive, ask TEIKOKU about the THG II, patented in Japan, pending in USA

ZERO-AID Initial Calibration & Field Re-Calibration Device for THG

- Battery powered portable instrument that enables field zero (null point) adjustment of TEIKOKU's THG after field or pump shop preventative maintenance.
- The industry's first-ever recalibration device suitable for operator use.
- SAFE! All field re-calibrations are made before plant power is applied to the pump.



Light	Condition	User Reponse
Green	Good	Continued Operation - regularly check wear rate
Yellow	Caution	Plan Routine Maintenance - more frequent wear rate checks
Red	Alert	Shutdown & Replace Worn Parts

The industry standard for sealless pump monitoring and reliability for over 40 years

- Monitor current conditions
- Develop data-based preventative maintenance schedules



*US Patent No. 4211973 & 4334189

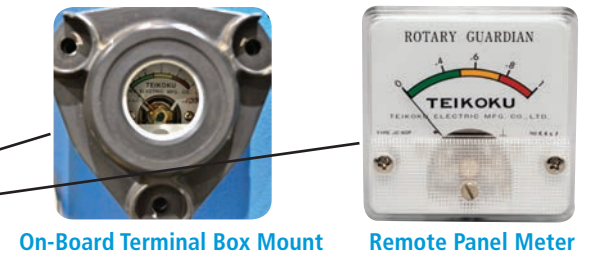
Principle of Operation

1. The TRG meter operates on the principle of induced voltage. A magnetic field is created in the TRG coils by the current flowing through the stator winding. In addition, a magnetic field is created by induced currents in the rotor.
2. When the rotor is perfectly centered in the stator, the two magnetic fields are essentially concentric or balanced.
3. When bearing wear occurs and the gap "B" between the rotor and stator decreases, a magnetic flux created by the imbalance in the magnetic fields causes an induced voltage in the TRG coils.
4. This voltage is indicated on the TRG voltmeter. The meter is mounted on the pump terminal box as standard but is available as remote panel-mount.

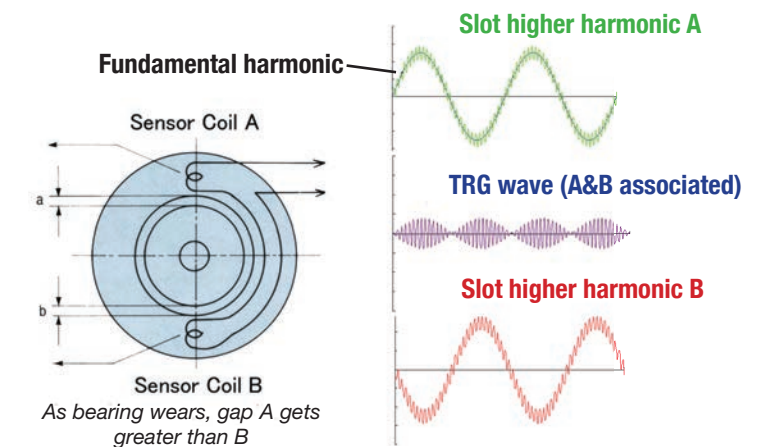
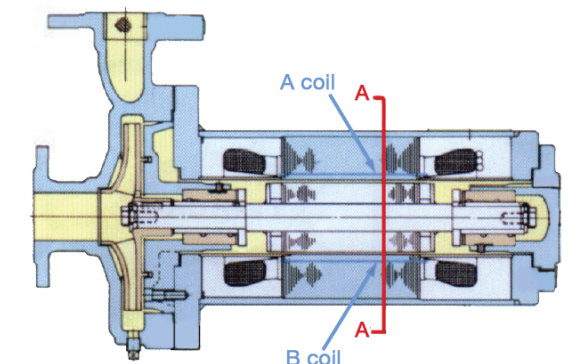
TRG with Phase Sequence Sensor in Operation

TRG initial indication varies from pump to pump. Users can record the initial value to establish a baseline. This determines a point from which to monitor the wear rate of the bearings and establishes preventative maintenance schedules.

TRG Indication Zone	Diagnosis	User Action
Green	Good	No Action
Yellow > 0.3v over baseline	Bearings Worn Caution Level	Plan Routine Maintenance
Red > 0.5v over baseline	Maintenance Required	Immediate Shutdown Replace Worn Parts



- Monitors and indicates rate of radial bearing wear
- Detects lost phase
- Shows reverse rotation
- The only bearing wear monitor on the market that operates with Variable Frequency Drives



Optional TRG Converter

Converts signal into either analog 4-20mA or 1-5 VDC for various I&E control



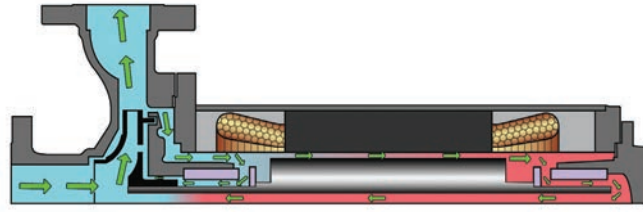


BASIC CANNED MOTOR PUMP APPLICATION SOLUTIONS

with API 685 Annex D Circulation Plan References

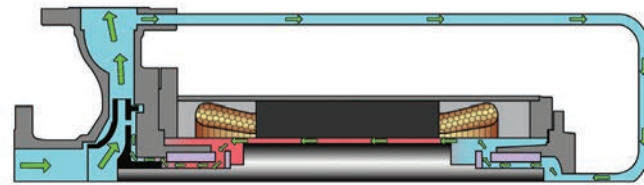
F-V Type – Plan 1-S (Internal Circulation)

Most basic and commonly used design of TEIKOKU Canned Motor Pumps with a hollow shaft for a wide variety of applications.



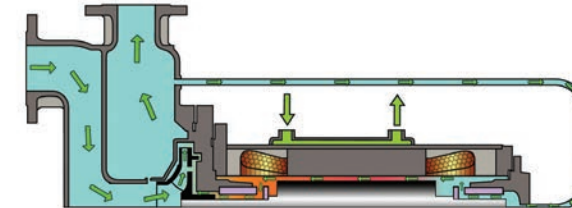
F Type – Plan 11-S (External Circulation)

Basic design of TEIKOKU Canned Motor Pumps with a solid shaft for a wide variety of applications and the ability to condition circulated fluid.



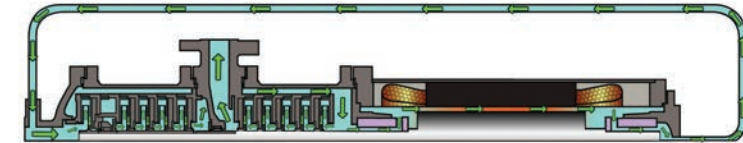
G Type – Plan 11-S (Self Priming)

Adaptation of basic design with self-priming pump casing suitable for external circulation. Application suitability for pumping fluids from underground tank or rail/tank car unloading.



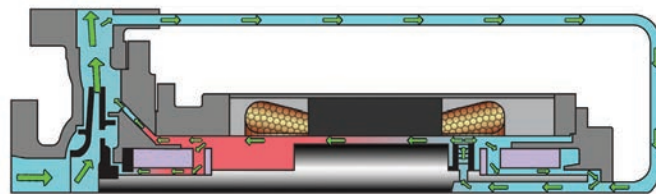
F-M or R-M or B-M Types – Plan 11-S (Multi-Stage)

High head, high hydraulic efficiency pumps with reverse circulation to pump suction or suction vessel. Externally cooled, high temperature designs are also available.



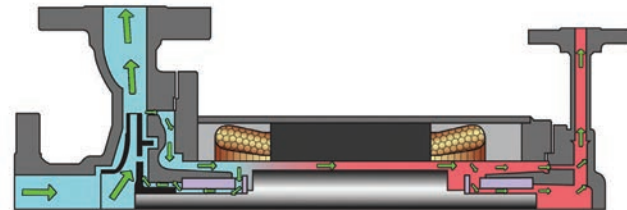
F-R Type – Plan 1-SD (Pressurized Circulation)

Suitability for handling volatile fluids with a high degree of safety for expensive and/or toxic volatiles and low boilers with a minimum of accessory system components and control.



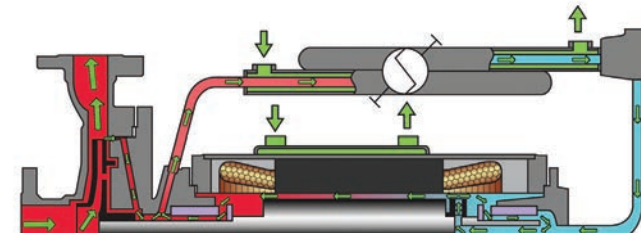
R Type – Plan 13-SE (Reverse Circulation)

Suitability for economically handling volatile fluids, such as refrigerants, liquefied gasses and other low boilers, and low NPSH margins.



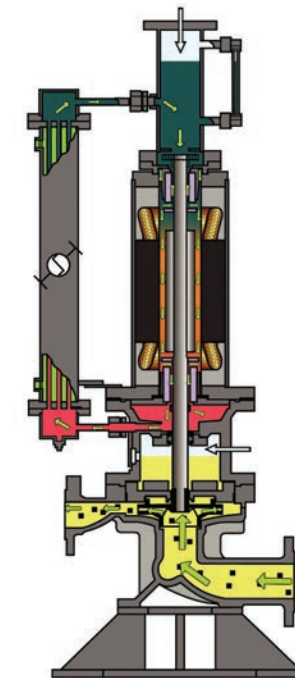
B Type – Plan 23-S (Externally Cooled Motor)

Suitability for economically handling high temperature fluids, such as heat transfer oils with air or liquid heat exchangers.



XG and SG Type – 53-S Variant (Gas Sealed Slurry Handling)

Suitability for handling fluids with various slurry concentrations by isolating the motor from the pump to allow for a barrier fluid that is cooled for the motor. Balanced N₂ charge eliminates migration of slurry into motor section. Available in both XG design with onboard, gas charged reservoir and heat exchanger and SG design for external motor flush with cool liquid.

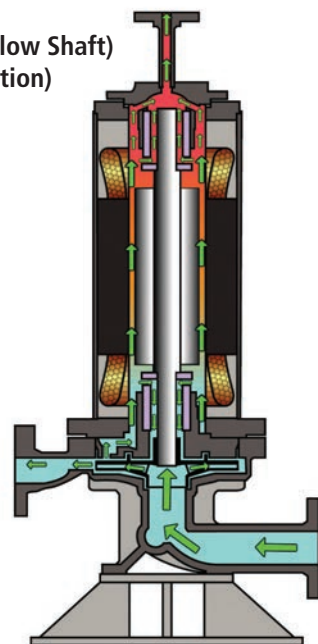


RW or RV – Plan 13-SE (Reverse Circulation)

- Improved venting
- Lower bearing loads
- Recommended for fluids with low viscosity and/or steep vapor pressure vs. temperature profiles
- Minimizes floor space

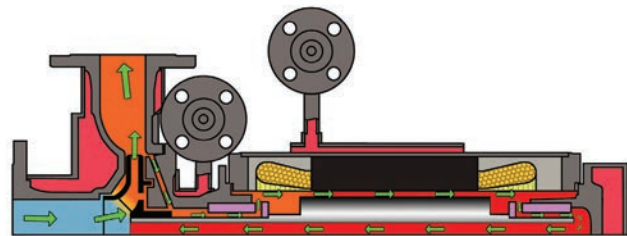
FW or FV – Plan 1-S (Internal Circulation with Hollow Shaft) or Plan 11-S (External Circulation)

- Minimizes floor space



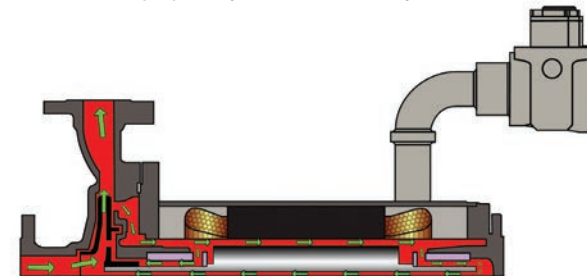
K Type – Plan 1-S (Internal Circulation) with Fully Jacketed Components

Suitability for handling fluids with high melting points.



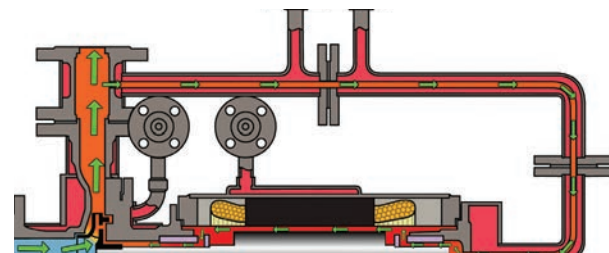
X and U Type – Plan 1-S (High Temperature Insulated Motor)

Suitability for handling high temperature fluids such as heat transfer oils with no need for external coolers through the use of Class 300 and Class 400 proprietary motor insulation systems.



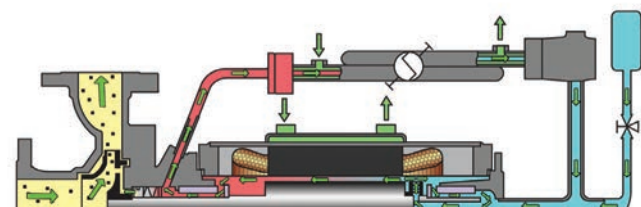
K-S Type – Plan 11-S (External Circulation) with Fully Jacketed Components

Suitability for handling fluids with high melting points.



D Type – Plan 53-S and 54-S (Sealed Slurry Type)

Suitability for handling fluids containing small amounts of fine solids or fluids with entrained gas. Motor isolation is provided by a mechanical seal or throttle bushing and requires flush provided by a seal pot (Plan 53-S) or external flush (Plan 54-S).



Other API 685 Annex D Circulation Plan variants available for custom, leak-free solutions.



	Standard Range		Extended Range	
CAPACITY (max)	4,403 GPM	1000 m ³ /hr	10,500 GPM	2385 m ³ /hr
TDH (max)	2,000 ft.	609 m	3,281 ft.	1,000 m
TEMPERATURE*	-112 to 716°F	-80 to 380°C	-328 to 842°F	-200 to 450°C
VISCOSITY (max)	100 cst		350 cst	
DESIGN PRESSURE (max)	430 psi	3 MPa	7,900 psi	55 MPa
MOTOR HORSEPOWER (max)	267 HP	200 KW	805 HP	600 KW
MAJOR MATERIALS OF WETTED PART	304SS, 316SS		304L & 316L SS, Alloy 20, Alloy B & C, Titanium	

*temperature of pumped liquid

Quality Assurance

All motors and pumps are designed and manufactured by TEIKOKU under its full quality control program. Every canned unit is inspected and tested before shipment. The QC program consists of the following tests and inspections.

- Applied to all pumps, data furnished to customer if required.
- Applied to all pumps, no data available to customer.
- △ Applied to all pumps, data submitted by customer.
- △ Test done only upon customer request, data submitted to customer.

I. MOTOR

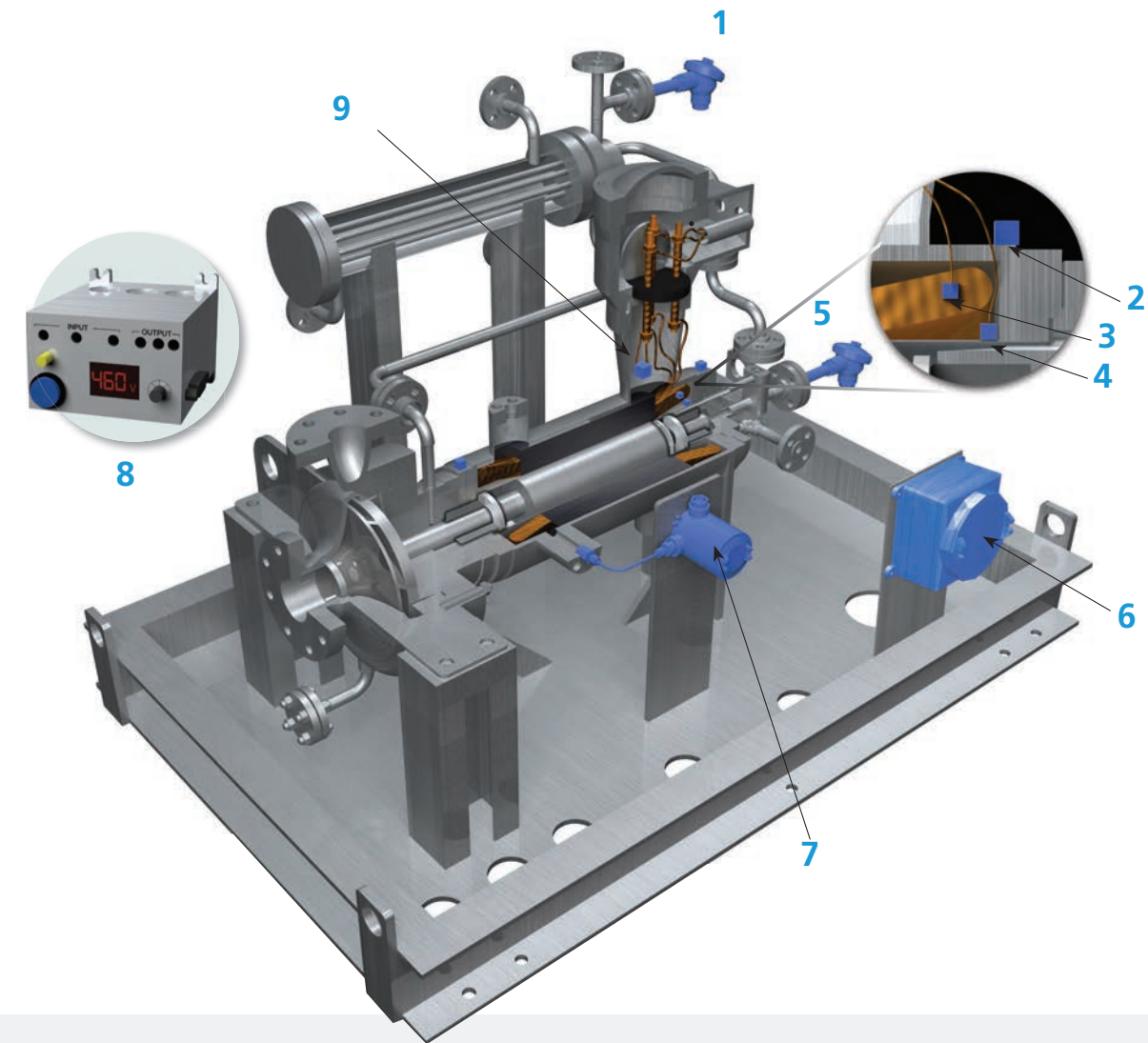
- 1-1 Measurement of resistance between terminals (main power coils) ●
- 1-2 No load test ●
- 1-3 Locked rotor test ●
- 1-4 Surge test ○
- 1-5 Insulation test △
- 1-6 Dielectric strength test △
- 1-7 Temperature rise test △
- 1-8 Measurement of resistance between terminals (TRG coils) ○

II. PUMP PERFORMANCE

- 2-1 Capacity vs. head, current, input △
- 2-2 NPSH test △
- 2-3 Capacity vs. TRG output measurement ○
- 2-4 Thrust force and circulation flow measurement ○
- 2-5 TRG output check for reverse rotation ○

III. OTHERS

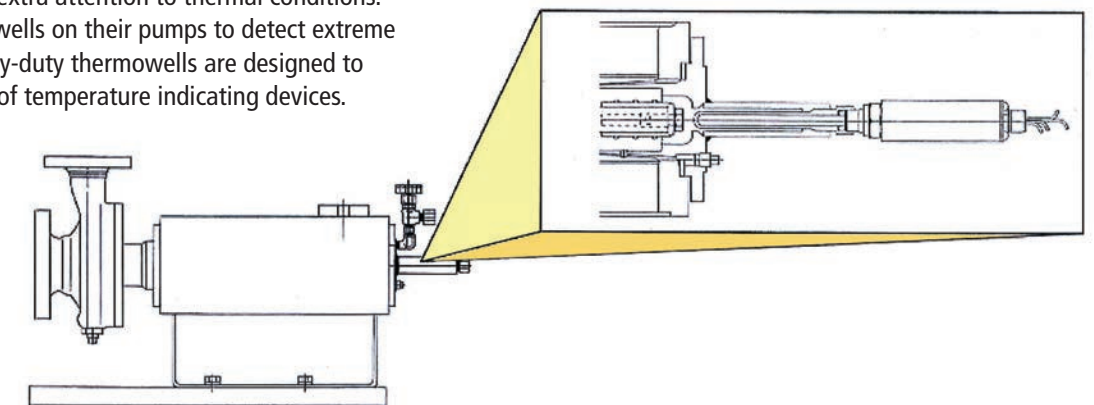
- 3-1 Vibration test △
- 3-2 Noise test △
- 3-3 Dimensional check △
- 3-4 Hydrostatic test △
- 3-5 Pneumatic test △
- 3-6 Vacuum test ○
- 3-7 Halogen leak test △
- 3-8 Mechanical seal leak test (slurry design) ○
- 3-9 Priming test (for type G only) ●
- 3-10 Mill certificate on metallic materials △
- 3-11 ND tests on metals and welding △



- 1 Heat Exchanger Level Sensor
- 2 Vibration Pads
- 3 Stator Winding RTD
- 4 Stator Liner Temperature Sensor
- 5 Rotor Cavity Temperature Probe
- 6 Instrument Junction Box
- 7 Secondary Containment Pressure Transmitter
- 8 Power Monitor
- 9 Secondary Containment Pressure Sensor (TPS)

THERMOWELL

Certain applications demand extra attention to thermal conditions. TEIKOKU can provide thermowells on their pumps to detect extreme temperature operations. Heavy-duty thermowells are designed to accommodate a wide variety of temperature indicating devices.



Contact TEIKOKU for other available options.

TEIKOKU Group Global Network

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