INSTRUCTION MANUAL

FOR PUMPING UNIT

* *

CYJ6-1.6-13B

C 114-143-64

BAOJI PETROLEUM MACHINERY MANUFACTURING PLANT

BAOJI SHAANXI CHINA

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Model CYJ6-1.6-13B (Corresponding to API114-143-64)

Pumping unit is a conventional pumping unit (Rear Mounted Geometry Class I Lever Systems with Crank Counterbalance) in accordance with API-11E Standard. It is the mechanical production equipment for pumping crude oil from non-natural flow well in the oil field, and used together with sucker rod pump and sucker rods.

SPECIFICATION

Horsehead	Polished Rod Capacity	63.7 Kn(14300 lbs)
Gear Reducer	Peak Torque Capacity	12.9 Kn.m (114000In. lbs)
	Transmission Ratio 29.55	$\frac{122}{23}$ =5.304 for high speed stage $\frac{117}{21}$ =5.571 for low speed stage
	Shaft Center Distance 850mm	250 mm for high speed stage 400 mm for low speed stage
	Pulley	700 mm
Polished Rod Stroke Length	I II III	1626 mm (64") 1321 mm (52") 1016 mm (40")
Number of Strokes Per Minute		20 16 12

Motor	Power Revolutions	18.5 KW 970 rpm Prepared by customer
V-Belt	Type	C-4 pieces
Overall Dimensions.	Length X Width X Height	6555x1598x4710
Total Weight	Excluding Belt Guard and Motor	7592 Kg (16702lbs)

INSTRUCTION MANUAL

1. SPECIFICATIONS:

For the detail specifications of pumping unit see the table listed above in this manual.

2. BRIEF DESCRIPTION OF CONSTRUCTION

2.1 Wireline and Carrier Bar Assembly

The wireline is a wire rope 25.5mm (1") in diameter, of which the upper end is attached to the horsehead and the lower end to the carrier bar.

The carrier bar equipped with the different sizes of polished rod slips is the clamping device for holding the polished rod 25mm (1"), to 30mm 1" - 1-1/4" in diameter when operation.

2.2 Walking Beam and Horsehead Assembly

The walking beam body is made of heavy duty welded H-section steel, the material is similar to W18"x71 / A36, which designed and calculated corresponding to API-11E specification, section 2 Pumping-Unit Structures. It is mounted on the upper end of the samson post by means of the center bearing assembly.

The horsehead welded from steel plate and section steel is mounted in the front end of the walking beam. It may be adjusted in position with two adjustable bolts and disconnected during workover service.

2.3 Samson Post, Ladder, Base and Prime Mover Base Assemblies

The samson post consists of front leg and back leg, and both the leg tops are jointed together with gussets and bolts.

The samson post and the ladder are seated on the base. The center bearing assembly is mounted on the samson post top and the ladder near one side of the samson post.

The center bearing assembly is furnished with two needle bearings to support the total load exerted by the walking beam. Both the bearings have been filled with lubricant before delivery.

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The prime mover base consists of section frame, slide rail and adjustable bolts. It is suitable for the various types of motor or internal combustion engine to be mounted.

2.4 Equalizer Assembly

The equalizer and its bearing housing are mounted under the rear end of the walking beam. Self-Aligning bearing connection to walking beam is utilized. Both ends of the equalizer are bolted to twe pitman tops respectively. Bearings are mounted in the bore of the bearing housing. They have been filled with lubricant before delivery.

2.5 Pitmans

The pitmans are the important components for delivering energy. Where the upper and lower joints of the pitmans are welded to steel pipes, all the welded seams have been inspected by means of magnaflux to assure the weld quality and the long-term service.

2.6 Wrist Pin Bearing Assembly

The wrist pin bearing assembly is attached to the lower end of the pitman and the crank assembly with wrist pin and

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bolts One self-adjustable roller bearing is mounted in the bore of the bearing cage for self aligning in rotation.

2.7 Crank Assembly

The crank assembly consists two crank and some counterweights. Each crank assembly is furnished with two counterweights. The position of the counterweights may be adjusted by moving the pinion forward or backward on the rack with handle. After the counterweights are adjusted at the appropriate position, either sides of the crank are tightened securely with safety dog as well as bolts.

2.8 Gear Reducer

A double reduction helical and herringbone gears reducer is available. it consists of housing, cover, driving shaft, intermediate shaft, driven shaft, pulley and brake assembly, etc. The variation in number of strokes per minute may be made by the replacement of the pulley of the driving shaft or the prime mover. The specifications of the bearings for the gear reducer conform to SKF standard.

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Easy to split housing for on-site repair.

Output shafts are forged from a high grade alloy steel 4140 and through hardened to 240 - 276 Brinell.

Gears are casted from a high grade alloy steel E4140 and through hardened to 300-330 Brinell. They are precision cut herringbone and double helical.

The pinions are forged from a high grade alloy steel E4140 and through hardened to 350-380Brinell.

The gear box housing uses a No. 35 grey cast iron type design that provides an additional safety factor and rigid structure for the gears.

The design and calculation for the gear reducers correspond with API-11E Specification, Section 3 Pumping-Unit Reducer.

The gear reducer is lubricated by lubricant. The gears and the pinions are lubricated by engine oil in oil bath, the bearings on the driven shaft and the intermediate shaft by oil wipers, the bearings on the driving shaft by splashing oil from gear. On the reducer housing, there are two

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holes with thread plugs for inspecting the highest and lowest oil levels respectively.

2.9 Brake Assembly

The brake assembly mounted on the prime mover base is the braking mechanism including brake lever, long and short pull rods, rocker arm, etc.. One end of the long pull rod is connected to the brake lever while one end of the short pull rod to the rocker arm on the driving shaft end of the reducer. For the purpose of braking, the brake shoes are forced to expand the inside of a drum by operating brake lever and pull rods.

2.10 Lubricating System

The lubricating system consists of two sets of lube line assemblies made of metal pipe, hose, etc.. One of them to the center bearing assembly under the walking beam is fixed on to the front leg of the samson post and the other of them to the bearings of the equalizer is fixed on to the pitmans. Operator on the ground can fill lubricant

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to the abovementioned bearings through the two sets of lube line assemblies.

3. INSTALLATION AND ADJUSTMENT

3.1 Construct the concrete foundation in accordance with the drawing for pumping unit foundation.

3.2 After the foundation has hardened, using a chalk line, strike a centerline from the center of the well tubing across the top of the foundation on centerline.

3.3 Set base on foundation, using wedges to support the base about 1 in. Above the foundation. Line up center marks on the base with the chalked line on foundation.

3.4 Move base to or from well according to value shown on foundation print for dimension from base member to center-line of well.

3.5 Use wedges to level top of base. Check level both leng-thwise and crosswise of base at several points along its length.

3.6 After mounting samson post on base, drop plumb line from center of samson post top to center line drawn on top

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of foundation. If plumb bob does not fall on centerline, readjust wedges or make other corrctions.

3.7 After mounting walking beam on samson post and connecting pitmans to cranks, drop a plumb line at the center of the horsehead (out from the arc plate of the horsehead a distance equal to one half of the diameter of the wire line of the hanger) down to the center of the well tubing. Adjust walking beam longitudinally or laterally so that the plumb bob will be within 1/8 in. of the center of the well tubing. Check for proper tracking of wire line on horsehead.

3.8 Grout under the base and allow grout to harden before removing wedges.

3.9 Check tightness of all structural bolts. After running unit for two weeks, recheck tightness of all bolts.

3.10 Tighten securely bolts connecting the rear end of the walking beam and the equalizer assembly and bolts connecting the pitmans and the wrist pin bearing assemblies. No over torque should be allowed to prevent these bolts from crack.

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4. MAINTENANCE

4.1 The variation in stroke length of the polished rod depends on the variation in position of the wrist pin moving along the crank, When mounted, the wrist pin is not allowed to be lubricated to assure the close fit between the wrist pin and the bore of the bearing cage.

4.2 The number of strokes may be varied with the replacement of the pulley on the driving shaft of the reducer. When mounted, the pulley is not allowed to be lubricated.

4.3 Old grease in all bearings should be replaced with new one every six months. The oil grade should be determined by the working environment and customer's requirement.

4.4 The temperature of the air in the vicinity of the reducer is of considerable importance in selecting oil of the proper viscosity. The viscosity of oil decreases with increasing temperature, making it desirable, for a given application, to use an oil with a higher viscosity

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for high air temperature than for low air temperatures. For low temperature operation, the oil should have sufficient fluidity to permit a free flow of oil through the lubricating channels.

4.5 The operating temperature of oil in pumping unit reducer normally will be from air temperature to 25°F above the air temperature. The temperature rise of oil will be negligible in slow-operating, lightly loaded reducers and will reach the upper limit in heavily loaded reducers operating at the higher speeds. The temperature of the oil in a reducer will become equal to the air temperature when the pumping unit is stopped for any appreciable time, Because most pumping units will be stopped at times, the lowest temperature of oil in a reducer usually will be the lowest air temperature reached in the locality where the pumping unit is operating. This is an important consideration when selecting a lubricant with the proper viscosity and pour point.

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4.6 For gear reducers straight mineral gear lubricants or EP gear lubricants are preferable to motor oils in that they separate quickly from water. Motor oils of equivaleut vicosity may be used in an emergency, but practically all of them contain dispersants and detergents which may cause an emulsion to form if water is present.

4.7 The temperature ranges are wide to permit year-around operation with one viscosity grade of oil in localities where seasonal air temperature range will allow. The operator should select the grade best meeting his temperature range. If the summer to winter range is too great for a single viscosity grade, a summer and a winter grade are necessary.

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VISCOSITY RECOMMENDATIONS FOR GEAR REDUCERS

1 Application+	2 SAE* Gear or Transmission Oil	3 AGMA** Oil
0°F to 140°F	90EP	5EP (ISO VG220)
-30°F to 110°F	80EP	4EP (ISO VG150)

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+ Operating temperature of oil in a gear reducer on a pumping unit normally will be from air temperature to 25°F above air temperature. The temperatures shown in the table are the limiting values between which satisfactory lubrication can be expected.

* Society of Automotive Engineers, Inc., 2 pennsylvania plaza, New York, NY10001.

** American Gear Manufacturer's Association, 1330 Massachusetts Ave., N.W., Washington, D.C. 20005.

4.8 In order to obtain long life from a pumping unit reducer it is necessary at all times that the oil should be of suitable viscosity and free from foreign material, sludge. and water.

4.9 To maintain proper viscosity, oil should be changed in the spring and fall if the seasonal air temperature range results in the temperature of the oil exceeding a range shown in table as specified above.

4.10 The method used to determine how often oil should be changed to maintain the desired condition is a matter of

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policy. It is advisable that operators periodically inspect reducer and take samples of oil for laboratory analysis to determine the percentages of water and solid material in the oil. Checks may also be made on viscosity and other properties such as acidity. Oil is then changed whenever the analysis shows that the limit set for any one of the various factors has been exceeded.

4.11 A small amount of water can accumulate in the bottom of the reducer. Such water should be drawn off to prevent accumulation to the point where it will be carried with the oil and cause emulsification or sludging.

4.12 The time interval between inspections to determine the condition of the oil depends upon operating conditions . Adverse conditions that may require inspection and change of oil as often as every three or four months include one or more of the following:

a, intermittent operation; b, excessive dust; c, sulfur fumes; d, a combination of high humidity with high varia-

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tion in daily air temperature. Under the most favorable conditions of minimum daily and seasonal temperature changes, low humidity, and freedom of atmospheric dust, a reducer may operate through one or more years before the oil is contaminated or deteriorated to the point that an oil change is required.

4.13 After petroleum solvent is used for flushing, all of the flushing agent should be removed and the reducer immediately refilled with a suitable oil. If the reducer is not immediately returned to operation, the unit should be operated for at least 10 minutes, or longer if necessary, to insure that all surfaces are covered with a protective film of oil.

4.14 The oil level in the reducer case should be inspected regularly. The plug at the lowest oil level is removed for inspecting oil volume, oil should be added in time if it does not flow out of the reducer case.

4.15 The lubrication difficulties should be recognized and

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corrected in accordance with the following maintenance regulations:

a. Difficulty: Little or no oil being carried up by gear and diverted into the bearing oil channels.

CAUSE	REMEDY
Under high temperature conditions, oil may be too thin.	Either modify with a heavier oil of the same quality, or drain and refill with an oil of proper viscosity.
Under low-temperature conditions, oil may be too viscous.	Either modify with a lighter oil of the same quality, or drain and refill with an oil of proper viscosity.
Oil level may be too low.	Fill to proper level.

b. Difficulty: Unit starts hard in cold weather.

CAUSE	REMEDY
Oil too heavy and too viscous.	Either modify with a lighter oil of the same quality, or drain and

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CAUSE	REMEDY
	refill with a lighter oil. Dilution of heavy oil with kerosene is considered hazardous and should be done only upon the advise of the lubricant supplier.

c. Difficulty: Continuing and severe pitting on scuffing of gears in the presence of sufficient lubrication. (Some slight initial corrective pitting which soon stops is not abnormal.)

CAUSE	REMEDY
Gear may be overloaded, particularly at the load peaks, (This may be caused from improper application of the pumping unit, too large a subsurface pump, or incorrect counterbalancing.)	Reduce loading.

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Oil may be of incorrect specification, or oil may have lost its lubricity through use, emulsification with water, or contamination with foreign material.	Drain, flush, and refill with proper lubricant.

d. Difficulty: Gears or bearings are wearing or abrading (as distinguished from pitting or scuffing.)

CAUSE	REMEDY
Dirty oil.	Drain, flush, and refill with proper lubricant.

e. Difficulty: Foam rises in box and, in some cases, leaks from shaft seals.

CAUSE	REMEDY
Incorrect lubricant, or lubricant contaminated with kerosene from flushing operation.	Drain, flush, and refill with proper lubricant.

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Oil level may be high, Particularly if unit is operating at high speed.	Lower oil to proper level.

f. Difficulty: Oil milky in appearance as opposed to normal bright characteristics.

CAUSE	REMEDY
Oil may be emulsified with water sometimes in combination with incorrect lubricant specification.	Drain, flush, and refill with proper lubricant.
Breather may be plugged.	Make sure that breather is open.

g. Difficulty: Heavy soapy sludge in case.

CAUSE	REMEDY
Incorrect lubricant.	Drain, flush, and refill with proper lubricant.

h. Difficulty: Excessive rusting and general corrosion of gears or bearings.

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CAUSE	REMEDY
Intermittent operation under humid conditions, water in case, improper lubricant, or deteriorat-ion of lubricant.	Drain, flush, and refill with proper lubricant. Some lubri-cants are available with rust-inhibiting agents.
Lack of ventilation.	Make sure that breather is open.

i. Difficulty: sticky and insoluble deposits on gears and bearings.

CAUSE	REMEDY
Oil operated too long	Drain, flush, and refill with proper lubricant.
Improper lubricant.	Drain, flush, and refill with proper lubricant.

5. SAFETY REGULATIONS

5.1 No moving parts are allowed to be lubricated while the pumping unit is running.

5.2 No V-belts are allowed to be adjusted while the pumping

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unit is running.

5.3 Make sure that the moving parts of the pumping unit run flexibly.

5.4 The brake shoes should be inspected before the motor is started.

5.5 All the electric equipment and elements should be protected in order to avoid exposing to all kinds of weather.

6. DESCRIPTION OF DELIVERY

6.1 The Following tools and accessories will be supplied with the pumping unit:

QTY	Description
1	Special purpose Tool Box
1	Grease Gun
1	Crank Handle Adjusting Counterweights
12	Foundation Bolt Set Including Bolt, Nut and Washer

Note:

Electric motor and Belt guard is no availavle unless otherwise noted.

6.2 The following spare parts will be supplied with the pumping unit

QTY	DESCRIPTION
2	Seal Ring for Driving Shaft Ø60xØ75x10 mm
2	Seal Ring for Driven Shaft Ø130xØ150x14 mm
2	Seal Ring for Wrist Pin Bearing Ø80xØ105x12 mm
2	Seal Ring for Center Bearing Ø135xØ165x16 mm
2	Seal Ring for Equalizer Bearing Ø90xØ115x12 mm
2	Brade Shoe for Reducer
2	Crank Key

6.3 The following technical documents will be supplied with the pumping unit;

1 Instruction Manual (Including Concrete Foundation Plan)

1 Parts List of Pumping Unit

1 Parts List of Gear Reducer

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1 Certificate

1 Packing List

1 Manufacturer's Gear Reducer Data Sheet

1 API Rating Form for Crank Counterbalance

1 Pumping-Unit Stroke and Torque Factor Sheet

1 Net Reducer Torque Calculation Sheet

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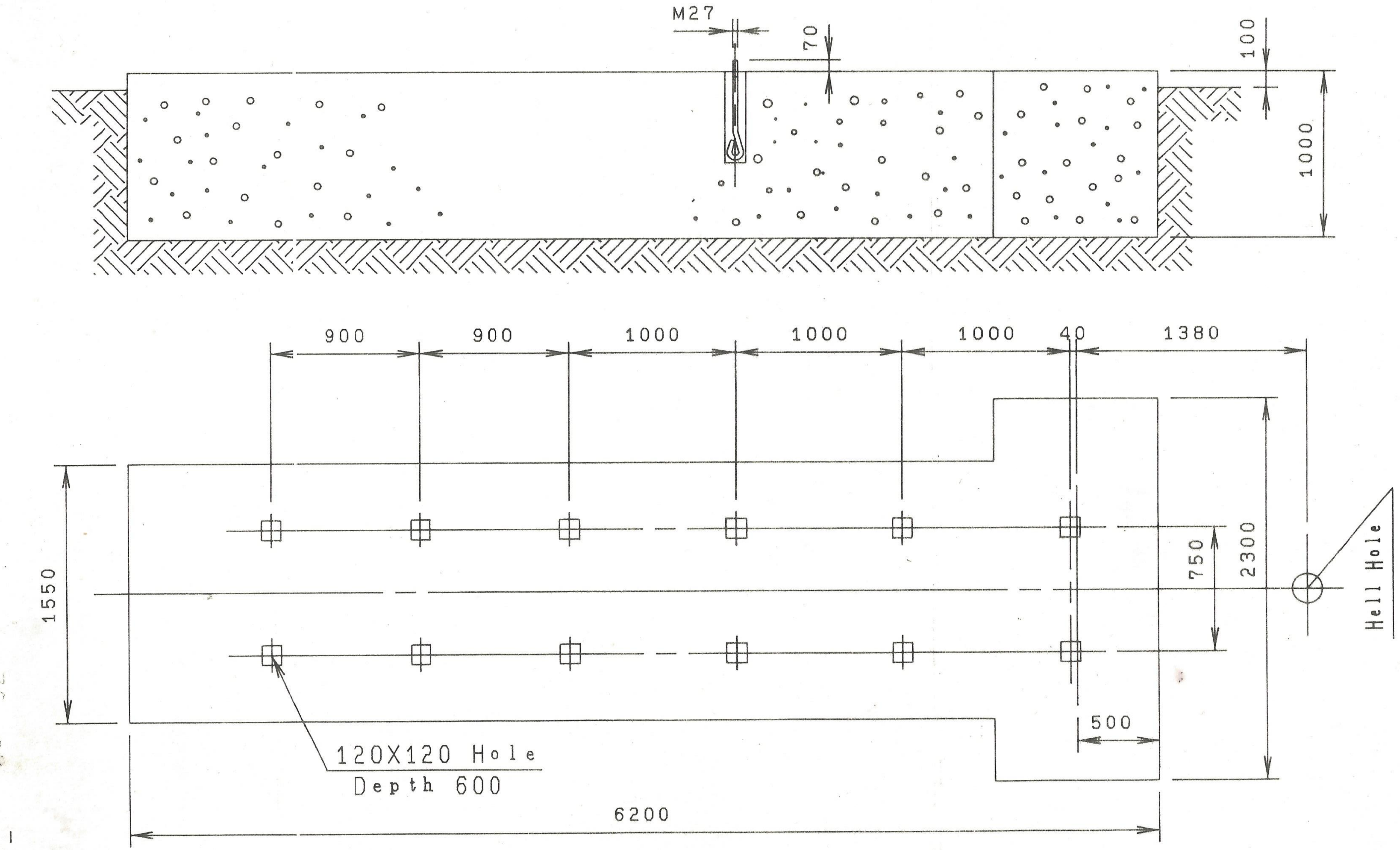

All dimensions shown in this drawing are in mm

Fig. 2 CONCRETE FOUNDATION FOR MODEL CYJ6-1.6-13B C114-143-64

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TABLE 3.9

MANUFACTURER'S GEAR REDUCER DATA SHEET

(AS PER API 11E, PAPE 26 AND 27)

MANUFACTURED BY: BPMMP CN . DATE SUBMITTED ________________

NOMINAL API REDUCER SIZE 114

CALCULATED VALUES

PITTING RESISTANCE TORQUE

First Reduction 184000 lb.in.

Second Reduction 139000 lb.in.

Third Reduction — lb.in.

BENDING STRENGTH TORQUE

First Reduction:

Gear 266000 lb.in.,

Pinion 252000 lb.in.

Second Reduction:

Gear 203000 lb.in.,

Pinion 195000 lb.in.

Third Reduction:

Gear — Lb.in. Pinion — lb.in.

STATIC TORQUE

First Reduction:

Gear 216000 lb.in.,

Pinion 43100 lb.in.

Second Reduction:

Gear 894000 lb.in.,

Pinion 171000 lb.in.

Third Reduction:

Gear — lb.in., Pinion — lb.in.

NOTE: (1) First Reduction is high speed reduction.

(2) Second reduction is slow speed reduction on double reduction gear reducers and the intermediate reduction on triple reduction gear reducers.

(3) Third reduction is the slow speed reduction on triple reduction reducers and is not applicable on double reduction reducers.

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CONSTRUCTION FEATURES

TYPE OF REDUCER: (Cross out if not applicable)

(Single) (Double) (Triple) Reduction

(Single) (Double) Helical Gearing

TEETH

Number of Teeth and Normal Diametral Pitch or Transverse Diametral Pitch

First Reduction N_P 23 . N_G 122 . P_{nd} 8.467 . P_d 7.369 .

Second Reduction N_P 21 . N_G 117 . P_{nd} 5.08 . P_d 4.38 .

Third Reduction N_P ___ . N_G ___ . P_{nd} ___ . P_d ___ .

Center Distance and Net Face Width

First Reduction 9.8425 C.D., ______ F.W.

Second Reduction. 15.748 C.D. ______ F.W.

Third Reduction ______ C.D. ______ F.W.

Helix Angle and Normal Pressure Angle or Transverse Pressure Angle(Degrees

First Reduction 29° 30' H.A., 20° NPA 22.694° TPA

Second Reduction 30° 20' H.A., 20° NPA. 22.865° TPA

Third Reduction. ______ H.A., ______ NPA. ______ TPA

TABLE (Continued 1.2.3.....)

GEOMETRY FACTORS. I&J (FOR PINION AND GEAR)

First Reduction Geometry Factor I 0.189 . J_P 0.428 . J_G 0.492

Second Reduction Geometry Factor I 0.191 . J_P 0.425 . J_G 0.484

Third Reduction Geometry Factor I ____ . J_P ____ . J_G ____

MANUFACTURING METHODS

Teeth Generated by Gear Hobbing Machine Process Teeth Finished by Gear Hobbing Machine Process Tooth Hardening Method Gear Quenching and Tempering.

GEAR & PINION MATERIALS & HARDNESS

First Reduction:

Gear Material 4135 . Surface BHN/Rc HB300-330 , Core BHN

Pinion Mtl. 4140 . Surface BHN/Rc HB350-380 Core BHN

Second Reduction:

Gear Material 4135 . Surface BHN/Rc HB300-330 . Core BHN

Pinion Mtl. 4140 . Surface BHN/Rc HB350-380 . Core BHN

Third Reduction:

Gear Material ____ , Surface BHN/Rc ____ . Core BHN ____

Pinion Mtl. ____ . Surface BHN/Rc ____ . Core BHN ____

Core hardness required for surface hardened gears and pinions only.

OTHER COMPONENTS

Crankshaft Material 4135 . Hardness HB240-276

Housing Material CAST IRON ASTM No.35

Housing Type (Check): Split ✓. One Piece ___

BEARING SIZES*

High Speed Pinion No 2612 60 x 130 x 46 (mm)

**Intermediate Speed Pinion

Low Speed Pinion No2618 90 x 190 x 64 (mm)

Low Speed Gear No3526 130 x 230 x 64 (mm)

BEARING LOADING***

High Speed Pinion 3230 lbs

**Intermediate Speed Pinion

Low Speed Pinion 5825 lbs

Low Speed Gear 7700 lbs

*For journal bearings indicate projected area: For roller bearings indicate AFBMA (or equivalent) size. List all bearings on each shaft. (State if bearings are mounted in carriers or directly in gear housing.)

**Not applicable on double reduction reducers.

***For journal bearings list psi loading on each bearing. For roller bearings. List L-10 life as calculated in 3.8 .

**Not applicable on double reduction reduceds.

API RATING FORM FOR CRANK COUNTERBALANCE

CYJ6-1.6-13B

Name of Manufacturer BPMMP Designation of Unit (C114-143-64)

1 Description	2 Total Weight Kg (lb)	3 Maximum Moment about Crankshaft Kg-cm (in -lb)
Without counterweight, 2 Cranks and 2 Wrist Pin Asm. Only.	960 Kg (2112 lbs)	58632 Kg-cm 50784 in-lb)
2 Cranks, 2 Wrist Pin Asm. and 2 Counterweights.	2376 Kg (5227 lbs)	187630 Kg-cm (162514 in-lb)

PUMPING-UNIT STROKE AND TORQUE FACTOR SHEET

****

Nane of Manufacturer: BPMMP Designation of Unit: CYJ6-1.6-138 (C-114-143-64) Pumping Unit Structural Unbalance: +178Kg(+392Pounds)

Position of Crank deg.[1]	Position of Rods[2]			Torque Factor[3]		
	Length of Stroke, in.			Length of Stroke, in.		
	64	52	40	64	52	40
0	0.00051	0.00022	0.00008	-1.66501	-0.87208	-0.38292
15	0.01689	0.01781	0.01832	9.72204	7.83665	5.91191
30	0.07913	0.07827	0.07667	20.42268	15.89504	11.68725
45	0.18024	0.17511	0.16926	28.41576	22.06088	16.22108
60	0.30611	0.29649	0.28616	32.43353	25.54334	19.03768
75	0.44035	0.42848	0.41559	32.64604	26.32555	20.04578
90	0.56961	0.55877	0.54629	30.23156	24.99906	19.48652
105	0.68586	0.67867	0.66924	26.46503	22.32705	17.75320
120	0.78546	0.78300	0.77797	22.18992	18.91074	15.21765
135	0.86721	0.86896	0.86815	17.76558	15.08220	12.14043
150	0.93062	0.93479	0.93673	13.20062	10.94004	8.66115
165	0.97474	0.97882	0.98128	8.28799	6.43386	4.83599
180	0.99753	0.99897	0.99963	2.72008	1.46308	0.69742
195	0.99575	0.99275	0.98992	-3.74861	-4.00308	-3.67809
210	0.96573	0.95799	0.95113	-11.03197	-9.79311	-8.11237
225	0.90526	0.89405	0.88377	-18.47622	-15.46607	-12.30974
240	0.81580	0.80304	0.79060	-25.02034	-20.40752	-15.90342
255	0.70305	0.69016	0.67676	-29.75781	-24.05383	-18.54382
270	0.57538	0.56292	0.54944	-32.28761	-26.05432	-19.97093
285	0.44195	0.43007	0.41717	-32.58365	-26.26510	-20.03353
300	0.31175	0.30076	0.28916	-30.71729	-24.65151	-18.66897
315	0.19357	0.18421	0.17482	-26.70043	-21.21180	-15.88177
330	0.09632	0.08959	0.08329	-20.47642	-15.97294	-11.74922
345	0.02908	0.02573	0.02287	-12.03607	-9.06654	-6.46160

1-For crank counterbalanced units with class I Geometry, the posion of the crank is the angular displacement measured olockwise from the 12 o'clock position, viewed with the wellhead to the right.

2-position is expressed as a fraction of stroke above lowermost position.

3. Torque factor=T/W where T=torque on pumping-unit reducer due to polished-rod load W.

A=2135mm, (84") C=1830mm, (72") I=1830mm, (72") P=2100mm, (82.7")

H=3650mm, (143.7") G=1490mm, (58.7") R_1=686mm, (27") R_2=559mm, (22")

R_3=432mm, (17") K=2831mm, (111.5")

NET REDUCER TORQUE CALCULATION SHEET

(Conventional Crank Balanced Unit Only-CLOCK WISE ROTATION)

Company : BPMMP CO.

Location: Baoji, Shaanxi, China

Well No,:

Unit Size: CYJ6-1.6-13B (C114-143-64)

Tn = $\overline{TF}$(W-B) - MSIN θ

STROKE LENGTH: 64"

θ	SINE θ	W	B	W-B	$\overline{TF}$	$\overline{TF}$(W-B)	-M(SINEθ)	Tn
0	0				-1.66501		0	
15	.259				9.72204		-	
30	.500				20.42268		-	
45	.707				28.41576		-	
60	.866				32.43353		-	
75	.966				32.64604		-	
90	1.000				30.23156		-	
105	.966				26.46503		-	
120	.866				22.18992		-	
135	.707				17.76558		-	
150	.500		+178Kg		13.20062		-	
165	.259				8.28799		-	
180	0				2.72008		0	
195	-.259				-3.74861		+	
210	-.500				-11.03197		+	
225	-.707				-18.47622		+	
240	-.866				-25.02034		+	
255	-.966				-29.75781		+	
270	-1.000				-32.28761		+	
285	-.966				-32.58365		+	
300	-.866				-30.71729		+	
315	-.707				-26.70043		+	
330	-.500				-20.47642		+	
345	-.259				-12.03607		+	

Tn= Net Reducer Torque, in.-lbs

θ = Position of Crank

M = Maximum Moment of Counter Blance, in. -lbs

W = Measured Polished Rod Load at θ, lbs

B = Unit Structural Unbalance, lbs

$\overline{TF}$= Torque Factor at θ, in.

CBat 90°= ______

M = (CBat90°-B) ($\overline{TF}$at90°)= ______

NET REDUCER TORQUE CALCULATION SHEET

(Conventional Crank Balanced Unit Only-CLOCK WISE ROTATION)

Company : BPMMP CO.

Location: Baoji, Shaanxi, China

Tn = $\overline{TF}$(W-B) - MSIN θ

Well No,:

STROKE LENGTH: 52"

Unit Size: CYJ6-1.6-13B (C114-143-64)

θ	SINE θ	W	B	W-B	$\overline{TF}$	$\overline{TF}$(W-B)	-M(SINEθ)	Tn
0	0				-0.87208		0	
15	.259				7.83665		-	
30	.500				15.89504		-	
45	.707				22.06088		-	
60	.866				25.54334		-	
75	.966				26.32555		-	
90	1.000				24.99906		-	
105	.966				22.32705		-	
120	.866				18.91074		-	
135	.707				15.08220		-	
150	.500		+178Kg		10.94004		-	
165	.259				6.43386		-	
180	0				1.46308		0	
195	-.259				-4.00308		+	
210	-.500				-9.79311		+	
225	-.707				-15.46607		+	
240	-.866				-20.40752		+	
255	-.966				-24.05383		+	
270	-1.000				-26.05432		+	
285	-.966				-26.26510		+	
300	-.866				-24.65151		+	
315	-.707				-21.21180		+	
330	-.500				-15.97294		+	
345	-.259				-9.06654		+	

Tn= Net Reducer Torque, in.-lbs

θ = Position of Crank

M = Maximum Moment of Counter Blance, in. -lbs

W = Measured Polished Rod Load at θ, lbs

B = Unit Structural Unbalance, lbs

$\overline{TF}$= Torque Factor at θ , in.

CBat 90°=

M = (CBat90°-B) ($\overline{TF}$at90°)=

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NET REDUCER TORQUE CALCULATION SHEET

(Conventional Crank Balanced Unit Only-CLOCK WISE ROTATION)

Company : BPMMP CO.

Location: Baoji, Shaanxi, China

Well No,:

Unit Size: CYJ6-1.6-13B (114-143-40)

$Tn = \overline{TF}(W-B) - MSIN\theta$

STROKE LENGTH: 40"

θ	SINE θ	W	B	W-B	$\overline{TF}$	$\overline{TF}(W-B)$	-M(SINEθ)	Tn
0	0				-0.38292		0	
15	.259				5.91191		-	
30	.500				11.68725		-	
45	.707				16.22108		-	
60	.866				19.03768		-	
75	.966				20.04578		-	
90	1.000				19.48652		-	
105	.966				17.75320		-	
120	.866				15.21765		-	
135	.707				12.14043		-	
150	.500		+178Kg		8.66115		-	
165	.259				4.83599		-	
180	0				0.69742		0	
195	-.259				-3.67809		+	
210	-.500				-8.11237		+	
225	-.707				-12.30974		+	
240	-.866				-15.90342		+	
255	-.966				-18.54382		+	
270	-1.000				-19.97093		+	
285	-.966				-20.03353		+	
300	-.866				-18.66897		+	
315	-.707				-15.88177		+	
330	-.500				-11.74922		+	
345	-.259				-6.46160		+	

Tn= Net Reducer Torque, in.-lbs

θ = Position of Crank

M = Maximum Moment of Counter Blance, in. -lbs

W = Measured Polished Rod Load at θ, lbs

B = Unit Structural Unbalance, lbs

$\overline{TF}$= Torque Factor at θ , in.

CBat 90°=________

M = (CBat90°-B) ($\overline{TF}$at90°)= ______

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