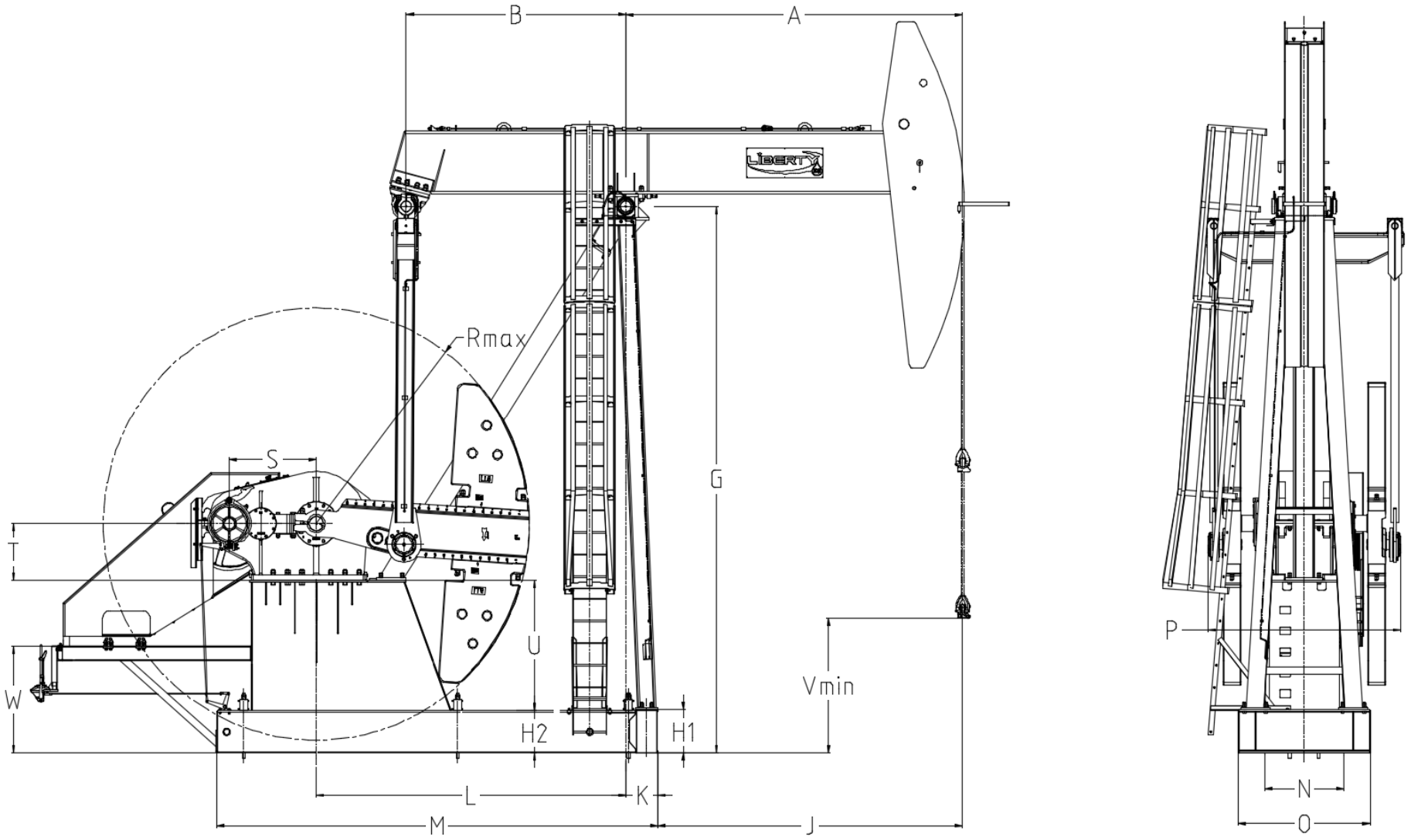
LIBERTY LIFT EG PUMPING UNIT HP



UNIT	A	B	G	H1	H2	J	K	L	M	N	O	P	R	S	T	U	V	W
456-365-144	13'-2 3/8"	10'-0 5/8"	24'-7 7/8"	23 3/8"	22 7/8"	11'-8 7/8"	1'-5 1/2"	14'-2"	20'-2 3/8"	3'-7 1/4"	6'-0 1/4"	7'-8 1/8"	117"	39.914"	25.591"	5'-10 1/2"	7'-5 3/4"	4'-9 7/8"

LIBERTY LIFT SOLUTIONS

TORQUE FACTOR TABLE

UNIT DESIGNATION 456-365-144 Enhanced Geometry

Cranks : CR051

Position of Crank degrees	Polished Rod Position Length of Stroke, inches			Torque Factor Length of Stroke, inches		
	144.017	118.973	96.008	144.017	118.973	96.008
0	0.0193	0.0184	0.0177	-20.977	-16.929	-13.315
15	0.0000	0.0000	0.0000	0.093	0.412	0.493
30	0.0201	0.0205	0.0204	21.888	18.046	14.359
45	0.0782	0.0780	0.0770	41.359	33.796	26.777
60	0.1673	0.1663	0.1639	55.615	45.686	36.418
75	0.2764	0.2755	0.2724	63.349	52.724	42.544
90	0.3940	0.3950	0.3927	65.212	55.143	45.148
105	0.5110	0.5156	0.5159	62.950	53.962	44.750
120	0.6214	0.6307	0.6347	58.301	50.331	42.040
135	0.7222	0.7359	0.7436	52.421	45.086	37.584
150	0.8115	0.8282	0.8383	45.754	38.590	31.683
165	0.8879	0.9047	0.9151	38.063	30.715	24.351
180	0.9487	0.9619	0.9697	28.366	20.903	15.406
195	0.9888	0.9947	0.9975	14.855	8.383	4.680
210	0.9992	0.9966	0.9938	-4.424	-7.158	-7.609
225	0.9697	0.9619	0.9554	-28.466	-24.469	-20.493
240	0.8967	0.8898	0.8829	-50.918	-40.565	-32.361
255	0.7891	0.7864	0.7813	-66.015	-52.607	-41.641
270	0.6614	0.6620	0.6590	-73.340	-59.547	-47.447
285	0.5261	0.5278	0.5259	-74.732	-61.701	-49.591
300	0.3924	0.3935	0.3917	-71.616	-59.699	-48.246
315	0.2680	0.2678	0.2657	-64.622	-53.990	-43.660
330	0.1598	0.1585	0.1563	-53.859	-44.801	-36.077
345	0.0746	0.0731	0.0714	-39.259	-32.313	-25.793

1.) The position of the crank is the angular displacement measured clockwise from the 12 o'clock position View with the well head to the right.

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

3.) Torque factor = T/P_R, where T = torque on pumping unit reducer due to polished rod load P_R.

Strctural Unbalance = 100

A =	158.386
C =	120.630
G =	118.976
H =	295.898
K =	245.359
I =	170.000
P =	186.997
R1 =	49.500
R2 =	42.000
R3 =	34.500

LIBERTY LIFT SOLUTIONS

EFFECTIVE COUNTERBALANCE TABLE

Unit Designation 456-365-144 Enhanced Geometry

CRANK : CR051

Stroke Length, inches	144.017		118.973		96.008	
Cranks Only, pounds	9160		10814		13186	
Description	Max	Min	Max	Min	Max	Min
Cranks and 4 each LLH	16885	11505	19949	13587	24344	16574
Cranks w/2-LLH & 2-LLJ	17703	11339	20917	13391	25526	16334
Cranks and 4 each LLJ	18521	11172	21885	13194	26708	16093
Cranks w/2-LLJ & 2-LL2	19526	11329	23073	13380	28159	16320
Cranks and 4 each LL2	20530	11486	24260	13565	29609	16546
Cranks w/2-LL2 & 2-LL3	23935	12495	28287	14759	34528	18004
Cranks and 4 each LL3	27340	13504	32314	15952	39447	19462
*Cranks w/2-LL3 & 2-LL4	29790	14388	35211	16997	42985	20738
*Cranks and 4 each LL4	32239	15271	38108	18041	46523	22013

* Not Recommended

** Maximum recommended ECB for this unit is 29200 in maximum stroke position.

LIBERTY LIFT SOLUTIONS,LLC GEAR REDUCER DATA SHEET

MANFACTURED BY: Dwang Jinai DATE SUBMITTED : August 8, 2014

NOMINAL API REDUCER SIZE : 456

CALCULATED VALUES

PITTING RESISTANCE TORQUE

First reduction 650,406 in-lb

Second reduction 649,379 in-lb

STATIC TORQUE

First reduction :

Gear 660,640 in-lb Pinion 857,487 in-lb

Second reduction :

Gear 648,107 in-lb Pinion 827,361 in-lb

BENDING STRENGTH TORQUE

First reduction :

Gear 816,155 in-lb Pinion 957,642 in-lb

Second reduction :

Gear 790,063 in-lb Pinion 911,754 in-lb

Notes:

1. First reduction is high-speed reduction.
2. Seond reduction is the slow-speed reduction.

CONSTRUCTION FEATURES

TYPE OF REDUCER : Double Reduction, Double Helical, Involute gearing

TEETH

Number of teeth and normal diametral pitch or transverse diametral pitch:

First reduction, Np = 19 Ng = 104 Pnd = 4.6182 Pd = 3.9995

Second reduction, Np = 19 Ng = 103 Pnd = 2.8222 Pd = 2.4861

Center distance ans net face width :

First reduction, CD = 15.3771 in F = 5.1181 in

Second reduction, CD = 24.5367 in F = 11.0236 in

Helix angle and normal pressure angle or transverse pressure angle.

First reduction, HA = 30.00 deg NPA = 20 deg

Second reduction, HA = 28.25 deg NPA = 20 deg

Geometry factors I and J for the pinion and gear.

First reduction, I = .2519 Jp = .5199 Jg = .4911

Second reduction, I = .2504 Jp = .5292 Jg = .5082

Manufacturing methods

Teeth generated by hobbing process. Teeth finished by hobbing process.

Tooth hardening method through hardened.

Gear and pinion materials and hardness

First reduction,

Gear material Normalized Ductile Iron Hardness BHN 245 - 275

Pinion material Q and T AISI4145 Hardness BHN 285 - 315

Second reduction,

Gear material Normalized Ductile Iron Hardness BHN 245 - 275

Pinion material Q and T AISI4145 Hardness BHN 285 - 315

Other components

Crankshaft material Q and T AISI4140 Hardness BHN 285 - 315

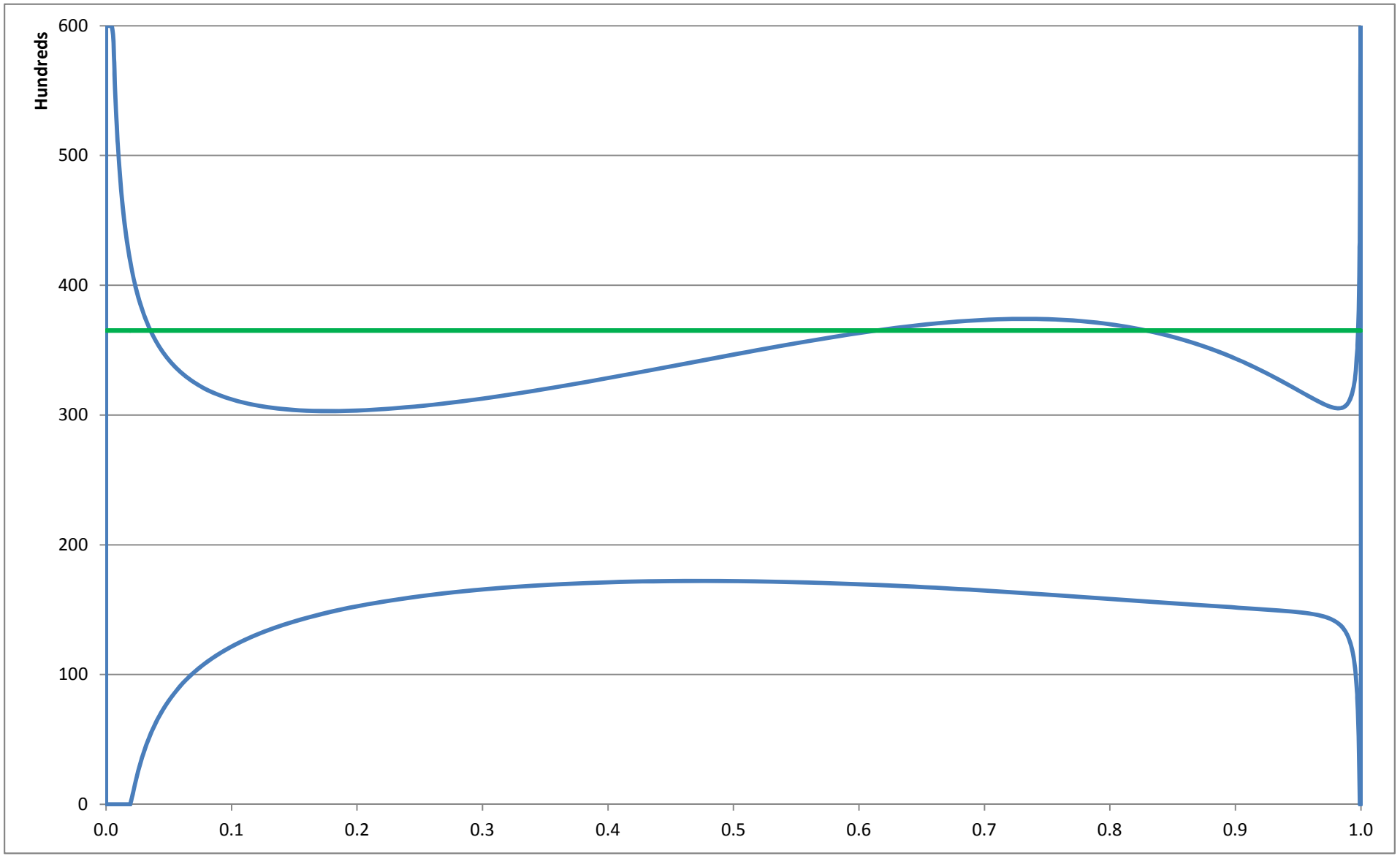
Housing material Cast Iron

Housing type Split Type

Bearing Sizes

High speed pinion	NU2322
Intermediate speed pinion	NU2326
Low speed shaft	NJ2240

Bearing Life, L10

High speed pinion	>135,000 hours
Intermediate speed pinion	>135,000 hours
Low speed shaft	>135,000 hours

456-365-144 Enhanced Geometry
Calculated Permissible Load with 1731593 in-lb Moment