

ENHANCED GEOMETRY PUMPING UNIT

API Rear Mounted Geometry Class I Lever System with Phased Crank Counterbalance



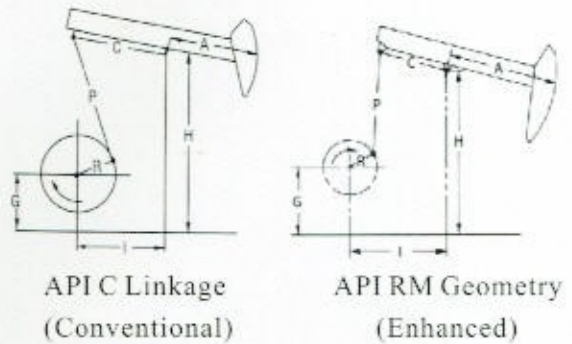
Photo: RM-640D-305-166
Operating in Neuquen, Argentina

ENHANCED GEOMETRY PUMPING UNIT

General Specifications

API GEOMETRY CONSIDERATIONS

LS PUMPJACK's RM pumping unit offers certain benefits not typically found in any other Class I Conventional (C) pumping unit. Through its unique design geometry, the LS's Enhanced Geometry (RM) pumping unit exhibits higher mechanical efficiency and allows more crank rotation during the upstroke portion of the pumping cycle. This results in reduced energy requirements and added time for more complete pump fillage.



PHASED COUNTERBALANCE

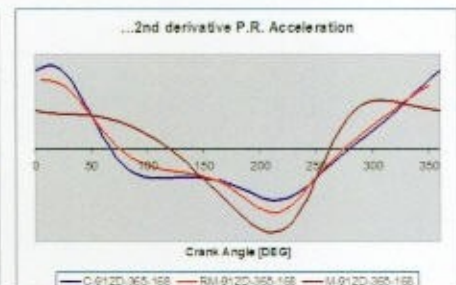
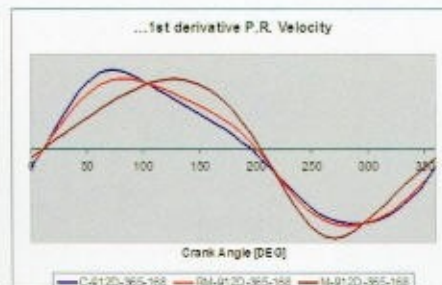
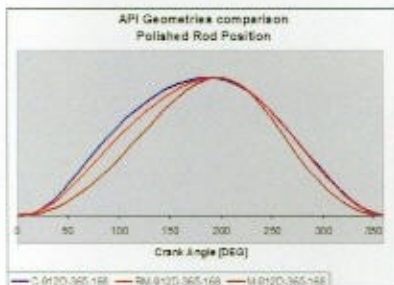
The Enhanced (RM) Pumping Unit design also allows the counterbalance moment to be phased in a way that optimizes the lifting cycle, further decreasing gear reducer net torque and prime mover energy requirements.

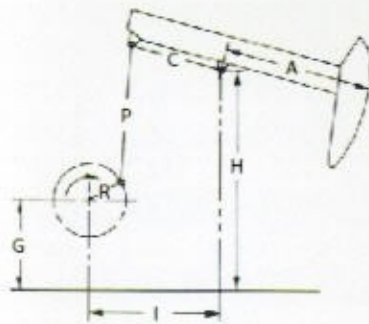


TANGIBLE BENEFITS OVER CONVENTIONAL & FRONT MOUNTED UNITS

Compared to Conventional Class I geometries (C units), RM's upstroke dedicates a greater portions of its crank 360° rotation to the upstroke (as seen on Displacement and Velocity graphs below) enabling slower upstroke velocities for a better pump fillage.

Compared to Class III geometries (M units), RM's downstroke imposes lower accelerations to sucker rod strings, therefore preventing tension/compression transitions and so extending fatigue life of the pumping system.





Enhanced Geometry
Pumping Unit API Linkage
Nomenclature

Unit Designation	Polished Rod Capacity, lbs.	Stroke Length in Inches
RM-1280D-427-192	42,700	192,158,126
RM-1280D-365-192	36,500	192,158,126
RM-1280D-427-168	42,700	168,139,112
RM-1280D-365-168	36,500	168,139,112
RM-912D-427-192	42,700	192,158,126
RM-912D-365-192	36,500	192,158,126
RM-912D-305-192	30,500	192,158,126
RM-912D-427-168	42,700	168,139,112
RM-912D-365-168	36,500	168,139,112
RM-912D-305-168	30,500	168,139,112
RM-912D-427-144	42,700	144,119,96
RM-912D-365-144	36,500	144,119,96
RM-912D-305-144	30,500	144,119,96
RM-640D-305-192	30,500	192,158,126
RM-640D-365-168	36,500	168,139,112
RM-640D-305-168	30,500	168,139,112
RM-640D-427-144	42,700	144,119,96
RM-640D-365-144	36,500	144,119,96
RM-640D-305-144	30,500	144,118,93
RM-640D-256-144	25,600	144,118,93
RM-640D-305-120	30,500	120,98,78
RM-640D-256-120	25,600	120,98,78
RM-456D-305-168	30,500	168,139,112
RM-456D-365-144	36,500	144,119,96
RM-456D-305-144	30,500	144,118,93
RM-456D-256-144	25,600	144,118,93
RM-456D-365-120	36,500	120,98,78
RM-456D-305-120	30,500	120,98,78
RM-456D-256-120	25,600	120,98,78
RM-320D-256-144	25,600	144,118,93
RM-320D-305-120	30,500	120,98,78
RM-320D-256-120	25,600	120,98,78
RM-320D-213-120	21,300	120,98,78
RM-320D-305-100	30,500	100,82,65
RM-320D-256-100	25,600	100,82,65
RM-320D-246-86	24,600	86,71,56
RM-228D-213-120	21,300	120,98,78
RM-228D-256-100	25,600	100,82,65
RM-228D-213-100	21,300	100,82,66
RM-228D-173-100	17,300	100,82,66
RM-228D-246-86	24,600	86,71,56
RM-228D-213-86	21,300	86,71,56
RM-228D-200-74	20,000	74,61,49
RM-228D-173-74	17,300	74,61,49

ENHANCED GEOMETRY PUMPING UNITS - API Linkage Table

UNIT MODEL	A	C	P	H	I	G	K	R1	R2	R3	SU [lbf]	T [Deg]	T.F. @ 90° / Max. Stroke
RM-1280D-427-192	231.89	118.11	171.26	273.23	161.42	111.81	228.28	45.08	38	30.91	-1450	-9	88.86
RM-1280D-365-192	231.89	118.11	171.26	273.23	161.42	111.81	228.28	45.08	38	30.91	-1380	-9	88.86
RM-1280D-427-168	198.03	114.17	161.42	263.39	151.58	111.81	214.36	45.08	38	30.91	-435	-9	78.78
RM-1280D-365-168	198.03	114.17	161.42	263.39	151.58	111.81	214.36	45.08	38	30.91	-360	-9	78.78
RM-912D-427-192	231.89	118.11	171.26	273.23	161.42	111.81	228.28	45.08	38	30.91	-1450	-9	88.86
RM-912D-365-192	231.89	118.11	171.26	273.23	161.42	111.81	228.28	45.08	38	30.91	-1380	-9	88.86
RM-912D-305-192	231.89	118.11	171.26	273.23	161.42	111.81	228.28	45.08	38	30.91	-1320	-9	88.86
RM-912D-427-168	198.03	114.17	161.42	263.39	151.58	111.81	214.36	45.08	38	30.91	-435	-9	78.78
RM-912D-365-168	198.03	114.17	161.42	263.39	151.58	111.81	214.36	45.08	38	30.91	-360	-9	78.78
RM-912D-305-168	198.03	114.17	161.42	263.39	151.58	111.81	214.36	45.08	38	30.91	-455	-9	78.78
RM-912D-427-144	169.49	114.17	161.42	263.39	151.58	111.81	214.36	45.08	38	30.91	75	-9	67.4
RM-912D-365-144	169.49	114.17	161.42	263.39	151.58	111.81	214.36	45.08	38	30.91	85	-9	67.4
RM-912D-305-144	169.49	114.17	161.42	263.39	151.58	111.81	214.36	45.08	38	30.91	350	-9	67.4
RM-640D-305-192	231.89	118.11	171.26	273.23	161.42	111.81	228.28	45.08	38	30.91	-1320	-9	88.86
RM-640D-365-168	198.03	114.17	161.42	263.39	151.58	111.81	214.36	45.08	38	30.91	-360	-9	78.78
RM-640D-305-168	198.03	114.17	161.42	263.39	151.58	111.81	214.36	45.08	38	30.91	-450	-9	78.78
RM-640D-427-144	169.49	114.17	161.42	263.39	151.58	111.81	214.36	45.08	38	30.91	75	-9	67.4
RM-640D-365-144	169.49	114.17	161.42	263.39	151.58	111.81	214.36	45.08	38	30.91	85	-9	67.4
RM-640D-305-144	173.23	102.36	141.73	231.5	135.04	96.46	190.97	39.37	32.87	26.38	350	-12	66.97
RM-640D-256-144	173.23	102.36	141.73	231.5	135.04	96.46	190.97	39.37	32.87	26.38	-150	-12	66.97
RM-640D-305-120	144.49	102.36	141.73	231.5	135.04	96.46	190.97	39.37	32.87	26.38	200	-12	55.87
RM-640D-256-120	144.49	102.36	141.73	231.5	135.04	96.46	190.97	39.37	32.87	26.38	126	-12	55.87
RM-456D-305-168	198.03	114.17	161.42	263.39	151.58	111.81	214.36	45.08	38	30.91	-455	-9	78.78
RM-456D-365-144	169.49	114.17	161.42	263.39	151.58	111.81	214.36	45.08	38	30.91	-85	-9	67.4
RM-456D-305-144	173.23	102.36	141.73	231.5	135.04	96.46	190.97	39.37	32.87	26.38	-245	-12	66.97
RM-456D-256-144	173.23	102.36	141.73	231.5	135.04	96.46	190.97	39.37	32.87	26.38	-230	-12	66.97
RM-456D-365-120	144.49	102.36	141.73	231.5	135.04	96.46	190.97	39.37	32.87	26.38	220	-12	55.87
RM-456D-305-120	144.49	102.36	141.73	231.5	135.04	96.46	190.97	39.37	32.87	26.38	200	-12	55.87
RM-456D-256-120	144.49	102.36	141.73	231.5	135.04	96.46	190.97	39.37	32.87	26.38	120	-12	55.87
RM-320D-256-144	173.23	102.36	141.73	231.5	135.04	96.46	190.97	39.37	32.87	26.38	-230	-12	66.97
RM-320D-305-120	144.49	102.36	141.73	231.5	135.04	96.46	190.97	39.37	32.87	26.38	200	-12	55.87
RM-320D-256-120	144.49	102.36	141.73	231.5	135.04	96.46	190.97	39.37	32.87	26.38	120	-12	55.87
RM-320D-213-120	144.49	102.36	141.73	231.5	135.04	96.46	190.97	39.37	32.87	26.38	115	-12	55.87
RM-320D-305-100	120.28	102.36	141.73	231.5	135.04	96.46	190.97	39.37	32.87	26.38	450	-12	46.5
RM-320D-256-100	120.28	102.36	141.73	231.5	135.04	96.46	190.97	39.37	32.87	26.38	220	-12	46.5
RM-320D-246-86	101.18	89.76	122.05	194.88	116.14	78.74	164.25	35.43	29.72	24.02	550	-14	40.2
RM-228D-213-120	144.49	102.36	141.73	231.5	135.04	96.46	190.97	39.37	32.87	26.38	50	-12	55.87
RM-228D-256-100	120.28	102.36	141.73	231.5	135.04	96.46	190.97	39.37	32.87	26.38	220	-12	46.5
RM-228D-213-100	117.72	89.76	122.05	194.88	116.14	78.74	164.25	35.43	29.72	24.02	210	-14	46.77
RM-228D-173-100	117.72	89.76	122.05	194.88	116.14	78.74	164.25	35.43	29.72	24.02	210	-14	46.77
RM-228D-246-86	101.18	89.76	122.05	194.88	116.14	78.74	164.25	35.43	29.72	24.02	550	-14	40.2
RM-228D-213-86	101.18	89.76	122.05	194.88	116.14	78.74	164.25	35.43	29.72	24.02	550	-14	40.2
RM-228D-200-74	87.21	89.76	122.05	194.88	116.14	78.74	164.25	35.43	29.72	24.02	750	-14	34.65
RM-228D-173-74	87.21	89.76	122.05	194.88	116.14	78.74	164.25	35.43	29.72	24.02	750	-14	34.65

ENHANCED GEOMETRY PUMPING UNITS Maximum ECB (Effective Counterbalance) Table

UNIT MODEL	Crank Name	ECB Cranks-only	ECB for LS Counterweight Sizes								
			No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9
RM-1280D-427-192	4354	4,624	23,278	19,724	17,947	16,701	14,848	13,037	11,153	9,595	8,194
RM-1280D-365-192	4354	4,624	23,278	19,724	17,947	16,701	14,848	13,037	11,153	9,595	8,194
RM-912D-365-192	4354	4,407	23,235	19,660	17,865	16,606	14,757	12,882	10,977	8,960	7,596
RM-912D-365-168	4354	6,240	27,284	23,275	21,271	19,865	17,775	15,732	13,607	11,849	10,268
RM-912D-305-168	4354	5,926	26,970	22,961	20,957	19,551	17,461	15,418	13,293	11,535	9,954
RM-912D-427-144	4045	5,907	-	24,109	22,027	20,519	18,305	16,085	13,822	11,412	9,771
RM-912D-365-144	4045	5,907	-	24,109	22,027	20,519	18,305	16,085	13,822	11,412	9,771
RM-640D-365-168	4354	5,940	26,984	22,975	20,971	19,565	17,475	15,432	13,307	11,549	9,968
RM-640D-305-168	4354	5,848	26,892	22,883	20,879	19,473	17,383	15,340	13,215	11,457	9,876
RM-640D-365-144	4045	5,907	-	24,109	22,027	20,519	18,305	16,085	13,822	11,412	9,771
RM-640D-305-144	4045	5,671	-	23,990	21,895	20,378	18,149	15,915	13,638	11,212	9,560
RM-640D-256-144	4045	5,431	-	23,702	21,613	20,099	17,876	15,648	13,376	10,957	9,311
RM-640D-305-120	3064	5,512	-	24,821	22,884	21,274	18,885	16,525	14,110	11,519	9,742
RM-456D-305-168	4354	5,560	26,821	22,784	20,758	19,336	17,248	15,131	12,980	10,702	9,161
RM-456D-305-144	3064	3,927	-	20,114	18,489	17,139	15,137	13,159	11,135	8,962	7,472
RM-456D-256-144	4045	5,431	-	23,702	21,613	20,099	17,876	15,648	13,376	10,957	9,311
RM-456D-365-120	3064	5,640	-	24,991	23,051	21,452	19,056	16,689	14,266	11,666	9,884
RM-456D-305-120	3064	5,532	-	24,892	22,951	21,352	18,955	16,585	14,162	11,560	9,777
RM-456D-256-120	3064	5,756	-	-	23,028	21,413	19,004	16,727	14,334	12,337	10,506
RM-320D-256-144	3064	3,824	-	20,019	18,393	17,042	15,040	13,060	11,036	8,862	7,371
RM-320D-256-120	3064	4,792	-	24,113	22,174	20,564	18,174	15,812	13,396	10,803	9,024
RM-320D-213-120	3064	4,801	-	23,842	21,930	20,343	17,968	15,661	13,280	10,724	8,971
RM-320D-305-100	3064	7,171	-	30,481	28,141	26,198	23,315	20,465	17,551	14,422	12,276
RM-320D-256-100	3064	7,167	-	30,463	28,125	26,183	23,301	20,453	17,540	14,414	12,270
RM-320D-246-86	1940	4,535	-	-	-	-	18,384	16,060	13,653	10,997	9,127
RM-228D-213-120	3064	4,466	-	24,260	22,080	20,433	18,013	15,622	13,176	10,551	8,750
RM-228D-256-100	3064	5,853	-	29,052	26,724	24,790	21,920	19,084	16,183	13,070	10,935
RM-228D-213-100	1940	3,646	-	-	-	-	15,512	13,520	11,457	9,182	7,582
RM-228D-173-100	1940	3,098	-	-	-	-	14,964	12,972	10,910	8,635	7,033
RM-228D-246-86	1940	4,500	-	-	-	-	18,294	15,980	13,581	10,937	9,075
RM-228D-213-86	1940	3,917	-	-	-	-	17,710	15,397	12,998	10,354	8,492
RM-228D-200-74	1940	5,178	-	-	-	-	21,189	18,503	15,719	12,649	10,488
RM-228D-173-74	1940	5,178	-	-	-	-	21,189	18,503	15,719	12,649	10,488

All Values Shown in Lbs. of Effective Counterbalance (ECB) at Polish Rod w/ Four Weights At Maximum Position on Crank, at Longest Stroke Length

*Maximum ECB achieved with Counterweight positioned not at end of crank arm. Contact LS Petrochem Equipment for counterweight maximum position on crank.

APPLICATION FORMULAS
Strokes Per Minute

$$SPM = \frac{RPM}{R} \times \frac{d}{D}$$

Example:

RPM = 1170 Revolutions per minute of prime mover
 R = 30.28 (912D Gear Reducer)
 d = 12" Pitch Diameter of Prime Mover Sheave
 D = 50" Pitch Diameter of Gear Reducer Sheave

$$SPM = \frac{1170}{30.28} \times \frac{12}{50} = 9.3$$

Prime Mover Sheave Diameter

$$d = \frac{SPM \times R \times D}{RPM}$$

SPM = 7 Strokes Per Minute
 R = 30.28 Ratio (912D Gear Reducer)
 D = 50" Pitch Diameter of Gear Reducer Sheave
 RPM = 1170 Revolutions Per Minute of Prime Mover

$$d = \frac{7 \times 30.28 \times 50}{1170} = 9 \text{ Inches}$$

Use nearest size available depending upon belt section and number of grooves in sheave.

Center Distance

$$CD = \sqrt{\left(S + \frac{I}{2}\right)^2 + (I - b)^2}$$

$$CD = \sqrt{\left(SS + \frac{TT}{2}\right)^2 + (II - b)^2}$$

Example:

Assume Hi-Prime Electric Motor
 Driven C228D-213-120 Conventional Unit
 SS = 27.5 (See General Dimensions)
 TT = 34.25 (See General Dimensions)
 II = 52.75 (See General Dimensions)
 b = 8 (Assume 25 HR Frame 324T Motor)

$$CD = \sqrt{\left(27.5 + \frac{34.25}{2}\right)^2 + (52.75 - 8)^2}$$

$$CD = 63.2 \text{ Inches}$$

Belt Length

$$PL = 2 CD + 1.57 (D + d) + \frac{(D - d)^2}{4 \times CD}$$

Example:

CD = 65.5 Inch Center Distance of Shafts
 D = 46 Inch Pitch Diameter of Gear Reducer Sheave
 d = 14 Inch Pitch Diameter of Prime Mover Sheave

$$PL = 2 \times 65.5 + 1.57 (46 + 14) + \frac{(46 - 14)^2}{4 \times 65.5}$$

PL = 229.1 Inches
 Use C225 Belts.

Horsepower of Prime Mover

For High Slip Electric Motors and Slow Speed Engines

$$HP = \frac{BPM \times \text{Depth}}{56000}$$

For Normal Slip Electric Motors and Multi-cylinder Engines

$$HP = \frac{BPM \times \text{Depth}}{45000}$$

Example:

BPD = 250 @ 100% pump efficiency
 Depth = 5000 Feet pump depth
 Assume High Slip (Nema D) Motor)

$$HP = \frac{250 \times 5000}{56000} = 22.32, \text{ use } 25 \text{ HP Motor}$$

Maximum Strokes Per Minute Based on the Free Fall Speed of the Rod

$$SPM = .7 \sqrt{\frac{60000}{L}}$$

Example:

Assume C-228-213-120 Unit

$$SPM = .7 \sqrt{\frac{60000}{L}} = 15.65 \text{ SPM Maximum}$$

SYMBOL DEFINITION

SPM = Strokes Per Minute
 RPM = Revolutions Per Minute of Prime Mover
 R = Gear Reducer Ratio
 D = Gear Reducer Sheave Pitch Diameter, Inches
 d = Prime Mover Sheave Pitch Diameter, Inches
 PL = Belt Pitch, Inches
 CD = Shaft Center Distance, Inches
 S = See General Dimensions
 T = See General Dimensions

I = See General Dimensions
 SS = See General Dimensions
 TT = See General Dimensions
 II = See General Dimensions
 b = Prime Mover Backing (Vertical Distance from Mounting Feet to Center to Shaft), Inc.
 HP = Horsepower
 BPD = Barrels Per Day at 100% Pump Efficiency
 Depth = Pump Setting, Feet
 L = Stroke Length, Inches



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