LUFKIN

MARK II
Unitorque Pumping Units

The MARK II Unitorque Operating and Maintena

The LUFKIN Mark II pumping unit is made up of the traditional pumping unit components, but post, equalizer, cranks and pitmans are arranged in a *reverse type geometry* which normally produces improved performance characteristics.

With its patented uniform torque (UNITORQUE) system, the Mark II generally (1) smooths out and reduces peak torque by a substantial amount, in many cases enough to lower gear reducer and prime mover requirements by one API size; (2) reduces rod and structural loads significantly; (3) often increases bottomhole plunger travel; and (4) frequently lowers prime mover size requirements and energy costs.

Possibly the best proof of the effectiveness and reliability of the LUFKIN MARK II is the fact that over 500 different oil companies operate more than 15,000 LUFKIN MARK IIs around the world. Above, a M-640D-305-168 MARK II, a 168-inch stroke unit with a 640,000 in./lb. gear box and a structure rated for 30,500 lbs., is at work in Alberta, Canada.

(Cover) LUFKIN M-114-143-86 MARK II Unitorque units operating side-by-side in a crowded field near Fellows, California.

The Mark II's Unique Geometry Reduces Peak Torque Requirements

The Mark II's special geometry produces a lower maximum upstroke torque factor, thereby reducing upstroke torque, and a higher downstroke torque factor, which tends to decrease maximum downstroke torque. When combined with the phased crank system, the Mark II produces a smoother net torque profile (Fig. A) at the crankshaft, often permitting the use of a smaller prime mover and speed reducer to handle a given polished rod load.

Additionally, the massive "propeller type" cranks provide a significantly higher rotary inertial torque (downstream) which further reduces torque peaks and smooths out torsional demand on unit and prime mover.

The curves in Fig. A show crankshaft torques of a conventional pumping unit and a Mark II under the same well conditions. The peak torque demand of 110,000 in./lbs. would require a API-114 gear reducer on conventional geometry. The Mark II peak torque demand of only 65,000 in./lbs. would require an API-80 reducer for the same application.

A 40% Lower Off Bottom Acceleration Cuts Rod Stress And Increases Life

Due to the unique push-up geometry and low pitman-to-crank ratio and uni-directional crank rotation, the acceleration at the bottom polished rod reversal is decreased as much as 40 percent.

Fig. B shows comparative accelerations at the bottom polish rod reversal for a conventional unit and the Mark II turning in synchronism. Note the Mark II's lower maximum acceleration and smoother profile.

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System Cuts Installation, nce Costs for Producers

Lifting the maximum mass of rods and fluid with a reduced acceleration tends to decrease structural loads and reduce peak rod load, sometimes by as much as 15 percent. As a result, producers using Mark IIs report longer rod life, reduced servicing costs and less production loss from rod break shutdowns.

Lower Rod Stress—An Added Benefit For Producers With Special Applications

Where small diameter tubing limits the size of sucker rods, the lower rod stress obtained with the Mark II allows the use of longer rod strings or larger pumps.

The Mark II extends the range of sucker rod pumping to depths previously unattainable with conventional pumping systems.

Lower peak loads permits a greater portion of the polished rod capacity to handle additional fluid in high volume applications.

A pair of gas engine-drive M-320D-305-100 MARK IIs in Ventura, California. These units are capable of producing over 4,000 bf/d from shallow depths.

(Right) A M-640D-305-168 operating on a platform in Louisiana's Black Lake produces over 550 bf/d from a depth of 9,000 feet. This is the largest beam type pumping unit ever installed on a platform.

FIGURE A

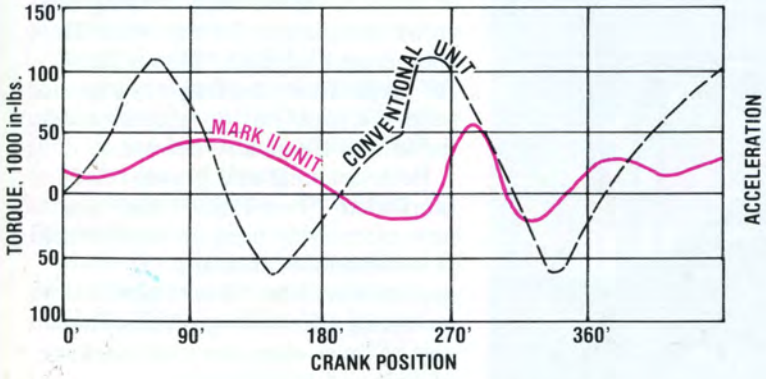
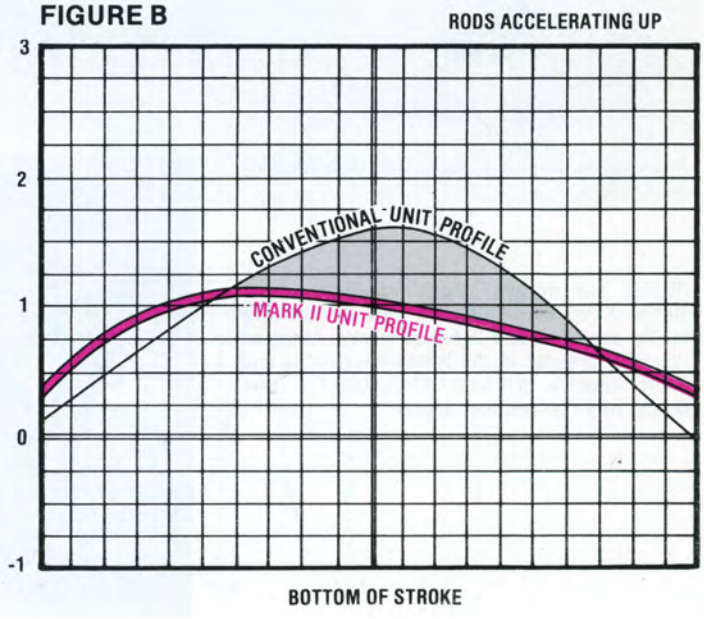


FIGURE B



Cost Saving Features Reliable Service in Oil

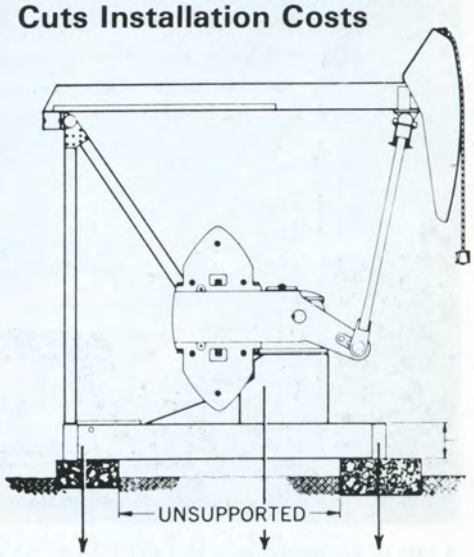
A typical Mark II installation using portable concrete blocks.

(Right) The world's largest pumping unit, a 50-ton LUFKIN MARK II with a 1,280,000 in./lb. gear box and 216-inch stroke. Units of this size, popular in the Rocky Mountains and South America, efficiently lift 1,000 bf/d from depths of 9,000 feet and deeper.

Increased Bottom Dwell Time Improves Efficiency

Because of its faster downstroke and increased bottom reversal dwell time, greater net plunger travel often results. This Mark II feature, along with the greater pump barrel fill time, tends to maximize productivity.

The Two Point Suspension Cuts Installation Costs



All resultant forces are downward, therefore, eliminating the need for massive concrete blocks to avoid lift up. "Two point suspension" bases can reduce concrete requirements by as much as 80 percent.

Small portable foundation piers or timbers can be used, making the entire installation for the Mark II 100 percent salvable. This is ideal for areas where drifting snow or sand is a problem, or relocation of the unit is frequently necessary.

Both concrete and gravel-filled, fabricated "Two-Point" piers are now extensively used on most Mark II installations. In many applications, the "Two-Point" mounting offers a significant first cost savings when the total package of unit and foundation is considered.

Proven By 25 Years of Fields Around the World

Uniform Torque Design Provides A Substantial Savings In Prime Mover Costs

The LUFKIN Mark II, due to its more uniform torque demand, generally permits the use of a smaller prime mover to pump any given application. In the case of a gas engine drive, first cost savings are substantial.

With an electric motor drive, additional savings are obtained when electric power charges are based on demand or connected horsepower. Illustrated by the power curves in Fig. C, watt meter studies are shown on a head-to-head comparative test between a conventional pumping unit and the Mark II pumping the same well under identical conditions.

Where electric motors are used, the continual day-to-day savings in electrical consumption and demand charges may, in the long run, amount to as much or more than first cost savings.

The Mark II Design Proven By 25 Years Of Service

Today, nearly 15,000 LUFKIN Mark II pumping units are in operation in practically all the major oil producing areas of the free world. Operated by more than 500 different oil companies, Mark IIs are providing dependable, economical service.

Mark IIs, like LUFKIN conventional units, perform reliably under extreme operating conditions, such as the blowing sand and high temperatures of desert terrain or artic temperatures to -30 degrees Fahrenheit.

Mark II units are particularly desirable in remote areas where machine shop facilities are limited.

What others say about the Mark II

The Petroleum Section Of A Respected Tulsa Newspaper

Several years ago, a Tulsa, Oklahoma newspaper whose Petroleum Section is highly regarded throughout the oil industry, named the MARK II UNITORQUE pumping unit "the second major advance in beam pumping systems in the past century."

A Major Oil Company's Findings

A six-week study by a major oil company resulted in this opinion: "The motion, torque characteristics, and other features of the Mark II unit combine to make a significant advance in beam type pumping unit design . . . Our evaluation indicates that a major advance in pumping unit design has been made by the manufacturers of the Mark II pumping unit."

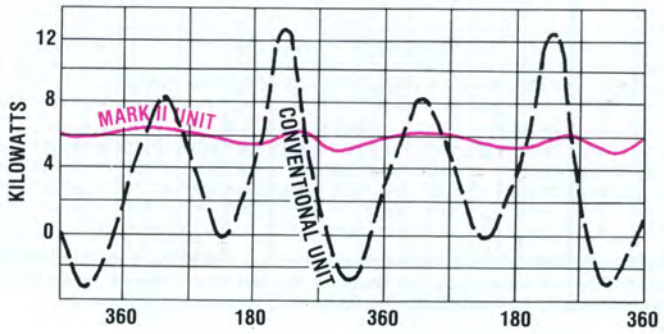
A Major Oil Company Production Manual

Recently, another major oil company's production manual stated in the section on artificial lift: "The push-up geometry and phased counterbalance of the LUFKIN MARK II give it the best pumping characteristics of any unit now being manufactured. The unit geometry tends to decrease both the maximum polished rod load and the minimum polished rod load, thus creating a better operating range with sucker rods.

"This type of geometry tends to maximize overtravel at the pump, increasing the amount of production per stroke. The negative torque on the gear reducer is kept to a minimum—thereby reducing operating costs. In many cases, it is possible to use a smaller size MARK II where a larger size conventional unit would be needed. The choice of MARK II also allows the use of a smaller prime mover which will reduce operating costs even further. Occasionally, a less expensive sucker rod string can be used due to the lessening of the well loads."

To symbolize America's dependence upon petroleum energy, a LUFKIN MARK II, beam type oil field pumping unit was included in the Smithsonian's Bicentennial Exhibit "OUR CHANGING LAND". This particular Mark II pump was in field service 14 years and produced five million barrels of fluid (oil and water) from the Wall Creek Formation in central Wyoming. This was the first, full-size oil field pumping unit ever exhibited by the Smithsonian Institution.

FIGURE C



MARK II Units Are Backed We've Given Continuously

Only one company in the world, LUFKIN INDUSTRIES, INC. has manufactured more than 164,000 oil field pumping units—continuously—for nearly six decades. During bad, as well as good times, our units and parts have always been available.

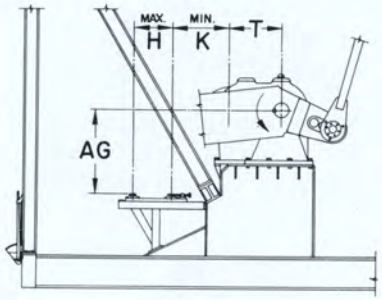
Since we began building pumping units in 1923, LUFKIN has pioneered most of the significant breakthroughs in the pumping unit industry.

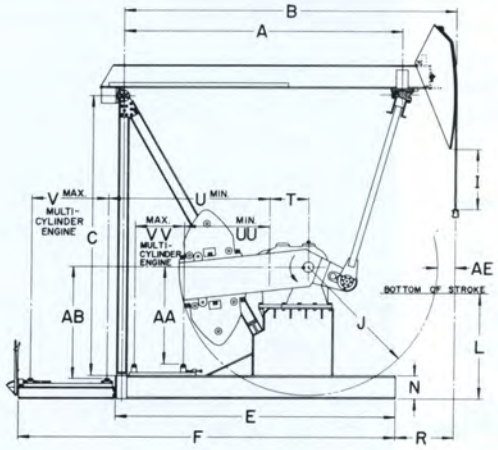
A 60-Year History of Continuous Service

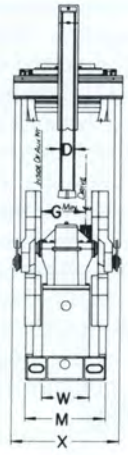
LUFKIN introduced the Trout Adjustable Counterbalanced Crank in July, 1925 and in 1931, the first twin crank pumping unit. Both are still standards of pumping unit design today.

We were the first to propose nodular iron as an improved material for pumping unit reducer gears in the early 1950's. As a result of our testing, nodular iron gears became an accepted API standard.

Today, LUFKIN pumping units have provided the industry over 2,800,000 field-service-years under the severest field conditions. And, as FORTUNE Magazine stated, "A good many of these units manufactured nearly 50 years ago are still bobbing up and down."







UNIT	A	B	C	D	E	F	G	H	I	J	K	L	M	N	R	T	U	V	W	X	AA	AB	AE	AG	UU	VV
M-320D-256-144	21'-6"	26'-0"	21'-0⅞"	9"	21'-3½"	29'-2"	44½"	33¼"	44¼"	108"	35⅛"	79⅜"	69¾"	24"	60"	34"	9'-4⅜"	68⅛"	43½"	7'-4⅛"	7'-2"	9'-0⅛"	18"	46⅛"	7'-4"	51½"
M-320D-305-120	"	"	"	12"	"	*	"	"	64¾"	"	"	83⅛"	"	"	"	"	*	*	"	"	"	*	"	"	"	"
M-320D-256-120	"	"	"	9"	"	*	"	"	69"	"	"	79⅜"	"	"	"	"	*	*	"	"	"	*	"	"	"	"
M-320D-213-120	"	"	"	"	"	*	"	"	"	"	"	"	"	"	"	"	*	*	"	"	"	*	"	"	"	"
M-320D-305-100	"	"	"	12"	"	*	"	"	7'-1"	"	"	82⅝"	"	"	"	"	*	*	"	"	"	*	"	"	"	"
M-320D-256-100	"	"	"	9"	"	*	"	"	7'-5"	"	"	79⅜"	"	"	"	"	*	*	"	"	"	*	"	"	"	"
M-228D-256-120	"	"	"	"	"	*	38⅞"	29¾"	69"	"	41⅛"	"	"	"	"	30"	*	*	37"	6'-9⅜"	"	*	"	47⅞"	7'-8"	"
M-228D-213-120	"	"	"	"	"	*	"	"	"	"	"	"	"	"	"	"	*	*	"	"	"	*	"	"	"	"
M-228D-256-100	"	"	"	"	"	*	"	"	7'-5"	"	"	"	"	"	"	"	*	*	"	"	"	*	"	"	"	"
M-228D-173-100	"	"	"	"	"	*	"	"	"	"	"	"	"	"	"	"	*	*	"	"	"	*	"	"	"	"
M-228D-246-86	15'-6"	18'-6"	15'-8⅜"	"	15'-6½"	21'-0"	"	30¼"	40¾"	86⅝"	22¼"	75⅜"	57"	"	39"	"	8'-7¾"	51½"	"	6'-8⅜"	**	6'-3"	11⅜"	40½"	**	**
M-228D-213-86	"	"	"	"	"	"	"	"	"	"	"	73¼"	"	21"	"	"	"	"	"	"	**	"	"	"	**	**
M-228D-200-74	"	"	"	"	"	"	"	"	52½"	"	"	"	"	"	"	"	"	"	"	"	**	"	"	"	**	**
M-228D-173-74	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	**	"	"	"	**	**
M-160D-213-86	"	"	"	"	"	"	32⅞"	33¼"	40¾"	"	24½"	72⅝"	54"	"	"	26"	8'-11¾"	"	32"	6'-0⅜"	**	"	"	38¼"	**	**
M-160D-173-86	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	**	"	"	"	**	**
M-160D-200-74	"	"	"	"	"	"	"	"	52½"	"	"	73¼"	"	"	"	"	"	"	"	"	**	"	"	"	**	**
M-160D-173-74	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	**	"	"	"	**	**
M-114D-143-86	13'-6"	15'-9"	12'-3½"	"	13'-0¼"	18'-6¼"	29⅜"	30"	14¼"	62"	20⅛"	55⅝"	42¾"	16"	32"	24"	8'-0½"	"	25"	67⅜"	**	50"	16"	31⅛"	**	**
M-114D-173-74	15'-6"	18'-6"	15'-8⅜"	"	15'-6½"	21'-0"	"	30¼"	52½"	86⅝"	28"	73¼"	54"	21"	39"	"	9'-1¾"	"	"	69"	**	6'-3"	11⅜"	43¼"	**	**
M-114D-143-74	13'-6"	15'-9"	12'-3½"	"	13'-0¾"	18'-6¼"	"	30"	26⅛"	62"	20⅛"	55¾"	42¾"	16"	32"	"	8'-0½"	"	"	67⅛"	**	50"	16"	31⅛"	**	**
M-114D-173-64	"	"	"	"	"	"	"	"	20½"	"	"	70⅝"	"	"	"	"	"	"	"	"	**	"	"	"	**	**
M-114D-143-64	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	**	"	"	"	**	**

* On 100", 120" and 144" Stroke Units, on This Page Multi-Cylinder Engines are Mounted on Main Base Beams Forward of Samson Post. See Dimensions UU, VV, and AA.

** On 64", 74" and 86" Stroke Units, Multi-Cylinder Engines are Mounted Behind the Samson Post. See Dimensions U, V and AB.

By the Same Service For Six Decades

Lufkin Offers 125 Pumping Units Sizes in Three Proven Configurations

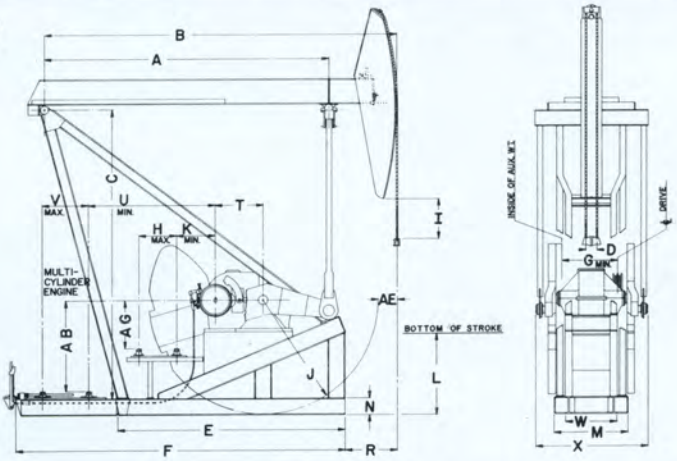
We manufacture 125 different API sizes to meet every pumping application efficiently.

The Mark II Unitorque Pumping Unit is now available in API sizes 114 thru 1824. The M-1824D-427-216, now offered by LUFKIN, is the largest crank-balanced pumping unit manufactured anywhere in the world today. This Mark II features a gear box rated for 1,824,000 inch pounds maximum torque, a 216 inch stroke and a structure rated for a maximum polished rod load of 42,700 pounds.

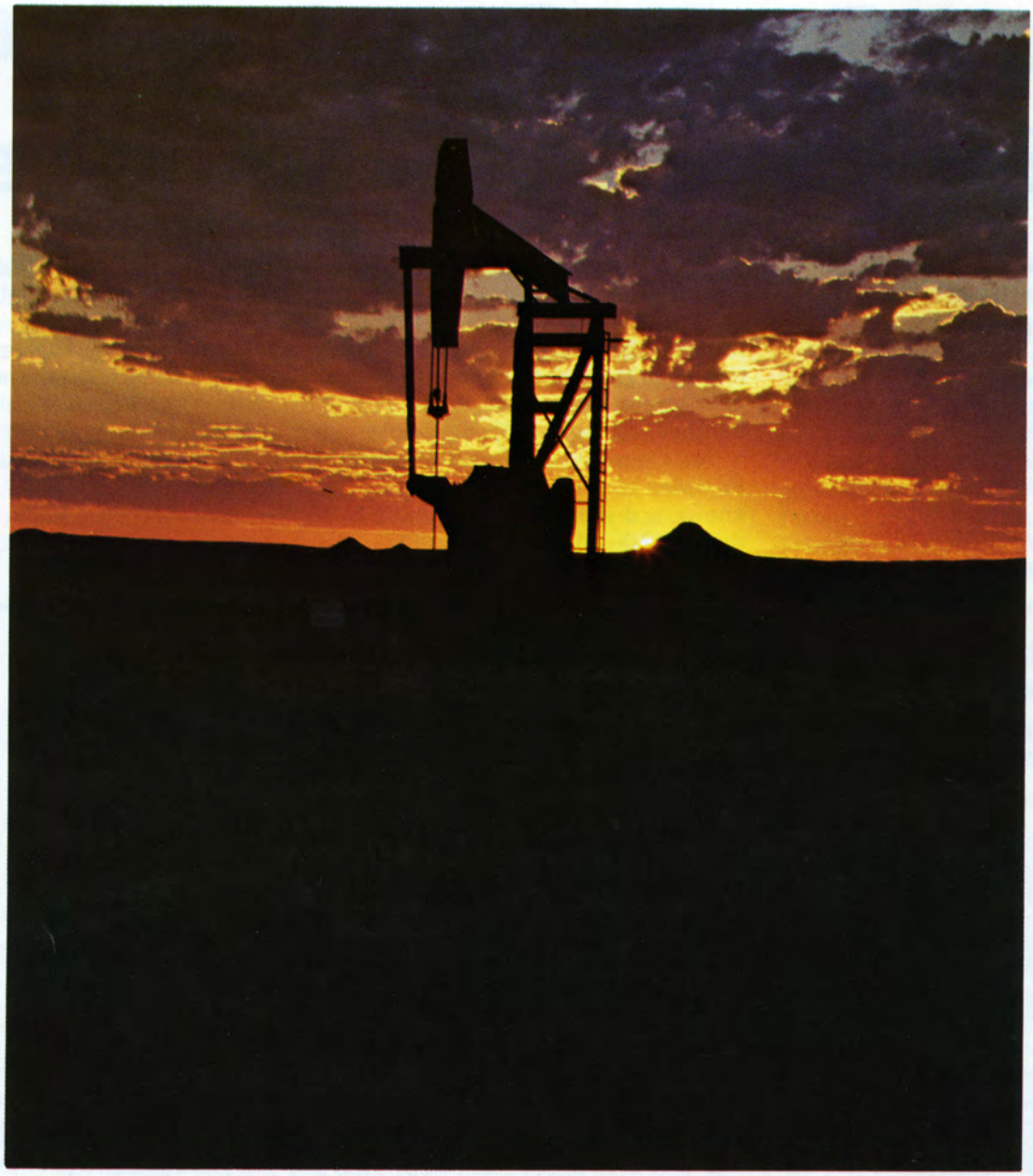
The Conventional Crank Balanced Pumping Unit is the most widely known and is available in sizes up to the C-912D-365-168, a 168 inch stroke unit with a polished rod capacity of 36,500 pounds and a 912,000 inch pound double reduction gear box.

The Air Balanced Pumping Unit which utilizes compress air instead of cast iron counterweights allowing stroke lengths up to 240 inches and peak torques to 2,560,000 inch pounds.

MARK II PUMPING UNIT GENERAL DIMENSIONS



UNIT	A	B	C	D	E	F	G	H	I	J	K	L	M	N	R	T	U	V	W	X	AB	AE	AG
M-1824D-427-216	25′-6″	32′-0″	27′-5⅞″	16″	18′-7″	25′-2½″	57⅜″	55″	47¼″	130″	31¾″	68⅜″	8′-0″	18″	45″	50⅞″	10′-8⅞″	48½″	48½″	9′-6″	9′-6″	26″	51″
M-1280D-427-216	25′-6″	32′-0″	27′-5⅞″	16″	18′-7″	25′-2½″	57⅜″	55″	47¼″	130″	31¾″	68⅜″	8′-0″	18″	45″	52½″	11′-3¼″	48½″	48½″	9′-6″	9′-6″	26″	51″
M-1280D-427-192	“	“	“	“	“	“	“	“	72½″	“	“	71¼″	“	“	“	“	“	“	“	“	“	“	“
M-912D-305-216	“	“	“	“	“	“	54″	51¾″	47¼″	“	23″	68⅜″	“	“	“	48½″	“	“	“	9′-1″	“	“	59⅛″
M-912D-305-192	“	“	“	“	“	“	“	“	72½″	“	“	71¼″	“	“	“	“	“	“	“	“	“	“	“
M-912D-365-168	22′-6″	27′-10″	23′-0⅞″	12″	18′-2¾″	24′-10¼″	“	46¾″	42¾″	108″	25½″	71½″	6′-9½″	16″	48″	“	9′-2″	“	50″	8′-9″	7′-8″	19″	46⅛″
M-912D-305-168	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	23⅜″	“
M-912D-365-144	21′-6″	26′-0″	21′-0⅞″	“	“	“	“	“	40″	“	“	75⅛″	“	“	42½″	“	“	“	“	“	“	“	13½″	“
M-912D-305-144	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	8′-7⅛″	“	“	“
M-640D-305-192	25′-6″	32′-0″	27′-5⅞″	16″	18′-7″	25′-2½″	50¼″	51¾″	72½″	130″	26⅝″	71¼″	8′-0″	18″	45″	41½″	11′-3¼″	“	48½″	8′-9″	9′-6″	26″	60⅛″
M-640D-305-168	22′6″	27′-10″	23′0⅞″	12″	18′-2¾″	24′-10¼″	“	46¾″	42¾″	108″	27⅞″	71½″	6′-9½″	16″	48″	“	9′-2″	“	50″	8′-5″	7′-8″	23⅜″	46⅛″
M-640D-365-144	21′-6″	26′-0″	21′-0⅞″	“	“	“	“	“	40″	“	“	75⅛″	“	“	42½″	“	“	“	“	“	“	18″	“
M-640D-305-144	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	8′-3⅛″	“	“	“
M-640D-256-144	“	“	“	9″	“	“	“	“	44¼″	“	“	71⅜″	“	“	“	“	“	“	“	“	“	“	“
M-640D-305-120	“	“	“	12″	“	“	“	“	64¾″	“	“	75⅛″	“	“	“	“	“	“	“	“	“	“	“
M-456D-305-192	25′-6″	32′-0″	27′-5⅞″	16″	18′-7″	25′-2½″	“	51¾″	72½″	130″	29¾″	71¼″	8′-0″	18″	45″	38⅜″	11′-3¼″	“	48½″	8′-9″	9′-6″	26″	60⅛″
M-456D-305-168	22′-6″	27′-10″	23′-0⅞″	12″	18′-2¾″	24′-10¼″	“	46¾″	42¾″	108″	31″	71½″	6′-9½″	16″	48″	“	9′-2″	“	50″	8′-5″	7′-8″	23⅜″	46⅛″
M-456D-365-144	21′-6″	26′-0″	21′-0⅞″	“	“	“	“	“	40″	“	“	75⅛″	“	“	42½″	“	“	“	“	“	“	18″	“
M-456D-305-144	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	8′-3⅛″	“	“	“
M-456D-256-144	“	“	“	9″	“	“	“	“	44¼″	“	“	71⅜″	“	“	“	“	“	“	“	“	“	“	“
M-456D-365-120	“	“	“	12″	“	“	“	“	64¾″	“	“	75⅛″	“	“	“	“	“	“	“	8′-5″	“	“	“
M-456D-305-120	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	8′-3½″	“	“	“
M-456D-256-120	“	“	“	9″	“	“	“	“	69″	“	“	71⅛″	“	“	“	“	“	“	“	“	“	“	“



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