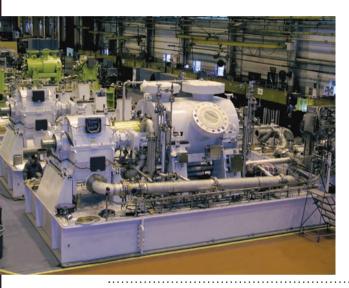


Bringing energy and the environment into harmony. $\hspace{-0.5em}^{\hspace{-0.5em} \bullet}$

DATUM®
CENTRIFUGAL COMPRESSORS

centrifugal compressors

The result of our unmatched experience.



DATUM Model D14R6B centrifugal compressor destined for export gas service in the Middle East.

BUILDING ON A HERITAGE OF FIELD-PROVEN ENGINEERING AND SUPERIOR SERVICE

For more than 100 years, Dresser-Rand has been a world leader in energy conversion technology, designing, manufacturing, and servicing a wide range of field-proven centrifugal and reciprocating compressors, gas and steam turbines, expanders, rotating separators, and control systems. Since the mid-1900s, we have built centrifugal compressors for applications as diverse and challenging as LNG, ethylene, refining, ammonia, gas production, and gas reinjection for enhanced oil production.

Our DATUM centrifugal compressors are the latest in this illustrious line. Introduced in 1995, they have gone on to demonstrate their superior efficiency, reduced emissions, and numerous other benefits in hundreds of applications worldwide.

COMMITTED TO DELIVERING VALUE

D-R provides reliable, efficient energy conversion solutions that deliver the highest value to our clients. Our engineers constantly seek improvements in design, production, and testing to make our equipment even more efficient and reliable. This R&D focus is reflected in every product and service we offer, from new equipment to upgrades that extend the life of your installed equipment.

Our emphasis on maximizing the value you receive also extends to the way we work with you. Our Corporate Product Configurator (CPC) coordinates all elements of the bidding, engineering, design, and manufacturing process. It improves communication and results by fostering closer collaboration with our clients and within D-R. Best of all, it has dramatically cut our cycle times for all project phases, so your equipment can be on-line and producing sooner.

Our leading-edge technology, the shortest cycle times in the industry, advanced business processes, and global presence help our clients reduce unit operation costs, which are 70 to 80 percent of the total cost of compression assets. That helps our clients to be more competitive.





We can reduce the time offshore to replace the rotor

bundle by about a day and a half to two days compared to conventional designs. If you equate that to availability, that's about a half percent a year improvement — just for that feature alone.

— Senior Consultant, ConocoPhillips



DATUM COMPRESSORS ARE PROVING THEMSELVES AROUND THE WORLD

The DATUM line of centrifugal compressors was designed for maximum performance in all pressure and flow applications. Their unmatched efficiency, reliability, and ease of maintenance make them the most advanced turbocompressors available for the oil, gas, and process industries. Typical applications include:

Oil and gas production—gas gathering, liquid recovery, gas lift, gas injection, pipeline boosters, gas storage, recompression, and reinjection

- Refining—wet gas, hydrogen, coker, and other hydrocarbon and utility gases
- Ethylene charge gas, ethylene, and propane/ propylene refrigeration
- **Methanol**—feed gas and syngas
- LNG—mixed refrigerant, propane, methane, nitrogen, and feed gas compression
- Ammonia —feed gas, syngas, refrigeration, and air compression
- Urea—CO₂ compression
- Air separation—nitrogen feed, recycle, and air services

DATUM

technological advantages

Innovative design and superior components give DATUM compressors that competitive edge.



WE BUILT IN ENHANCED PERFORMANCE AND CONVENIENCE RIGHT FROM THE START

From initial concept, through consultations with our clients, to design and production, our goal with the DATUM line was to produce a better centrifugal compressor with an eye toward the environment. This has led to a number of client benefits:

Improved Efficiencies

Depending on application requirements and configuration, DATUM compressors often operate at efficiencies that are two to five percent greater than competitive turbomachinery, thereby reducing fuel consumption or increasing throughput per installed horsepower. In addition, the improved aerodynamic design and larger shaft diameter enable DATUM com-

DRESSER-RAND.

pressors to handle greater flows and pressure ratios than standard designs for a given frame size. In some cases, a single DATUM compressor can deliver pressure ratios that previously required multiple bodies.

Reduced Emissions

The superior efficiency of the DATUM compressor reduces driver fuel consumption, which can result in a decrease in harmful CO₂ and NO_X emissions—more important than ever as environmental regulations tighten. D-R is committed to addressing critical environmental concerns while continuing to improve operational efficiencies. Incorporating D-R dry gas seals further reduces emissions by eliminating the need for processing sour seal oil.

Reduced Noise

The most significant development in our efforts to design quieter machines has been the introduction of D-R™ duct resonator arrays. This patented feature is internal and can be designed into new equipment and revamps, including non—Dresser-Rand equipment.

Extensive testing on D-R duct resonator arrays was performed at the company's test facility in Olean, New York. The results demonstrated that the overall noise level of a 60 PDI (axial inlet single-stage overhung pipeline booster) compressor could be reduced by 10 dB with no adverse effect on compres-

sor performance. In some instances, field noise level reductions have been measured in excess of 20 dB for PDI compressors and 10 dB and higher in multi-stage DATUM compressors. D-R duct

resonator arrays have been used in more than 150 DATUM compressors to date.

Easier, Faster Maintenance

Even a single lost day of production can translate into losses of hundreds of thousands of dollars. so we made easy maintenance a priority throughout the design process. One way we dramatically reduced maintenance time was by combining the rotor, diaphragms, and other stationary flowpath components, bearings, seals, and instruments—almost everything but the casing-into a module. This module can be completely pre-assembled outside of the casing (in the controlled environmental conditions of a shop, for example), then installed as a complete assembly. Critical dimensions, fits, and clearances can be checked much more easily. By storing a spare module on site, turnaround times can be reduced to a few hours.

The modular design of the DATUM unit also yields additional advantages:

bundle has horizontally split stationary carrier housings that enable the rotor-to-stator alignment to be verified with

■ The DATUM modular

- alignment to be verified with the rotor in its true axial position and with the thrust bearing fully assembled. This allows direct determination of correct rotor positioning in the axial direction, as well as measurement of the radial clearance between the rotor and all labyrinths at the impeller eye and shaft
- interstage locations.

 Because the bearing housings, journal bearings, and thrust bearing assemblies are horizontally split, the coupling does not have to be removed to replace a bearing assembly on the driven end of the machine, and the thrust disc does not have to be removed to replace a bearing on the free end of the machine.
- For larger frame sizes, the radial vibration probes are externally adjustable and removable, as are the axial position probes on nonthrough-drive units.

Standardization

To improve reliability and reduce cost, we standardized DATUM compressor components wherever possible, maximizing the use of proven designs. The DATUM line consists of 15 standard frame sizes that are scaled from the median size frame. The impellers, diaphragms, inlets, volutes, and shafts are all directly scaled. The bearings and seals are not directly scaled, in order to take advantage of outside vendors' standard sizes. Further standardization was achieved by using the same internal components in both the radially split and axially split versions.







DATUM centrifugal compressors are available in 15 different sizes with discharge pressures ranging up to more than 15,000 psig (1000 bar), maximum flow rates from 5,400 cfm (9,200 m³/h) to 700,000 cfm (1,200,000 m³/h), and power ratings to more than 120,000 bhp (90 MW). Cases can be split axially (900 psig max.) or radially (15,000 psig max.).

PAYING CAREFUL ATTENTION TO THE DETAILS

When we designed the DATUM compressor, we made sure its components supported our goals of higher efficiency, lower cost, and easier maintenance.

Impeller Design

To improve performance, we used the latest aerodynamic design and analysis technology to develop a new family of impellers and matched stationary flowpath components. The new impeller designs were tested in single- or multistage test rigs to simulate a complete compressor stage.

Accuracy and quality of the impeller manufacturing process were substantially improved. Impellers are two-piece, milled from solid forgings, with welded or brazed construction. The majority of our new impeller designs are five-axis milled bladed discs, providing the sophisticated aero-mechanical design required for strength and high performance. All diaphragms and other stationary flowpath components are fully machined from steel or alloy for

dynamic
The pad
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compliance with aerodynamic design requirements. For special applications, single-piece, integral-machined or single-piece powdered metal impellers are available.

EBraze Welding

Created specifically for the DATUM product family, EBraze welding combines two proven methods—electron beam welding and vacuum furnace brazing—to create a weld joint with superior strength.



To fuse the impeller cover and blades, an electron beam weld is directed through the cover and a braze alloy foil to each blade. Fusion occurs across the complete cover-to-blade interface, creating an impeller with greater reliability, longer life, and more accurate performance.

Vacuum Furnace Brazing and One-Piece Integral Machining

Depending on the application, impellers can also be fabricated using vacuum furnace brazing and one-piece integral machining or one-piece HIP powder metal super alloy impellers.

Bearings

Tilt Pad Journal Bearings— Pad length, offset factor, pad orientation, clearance, preload and other geometric parameters are selected for optimum dynamic rotor performance. The pads possess axial and radial aligning capability to uniformly distribute the load over the pad surfaces. Directed oil lubrication reduces oil consumption and power loss, lowers operating temperatures, and allows higher operating speeds.

Tilt Pad Thrust Bearings—These double-acting, self-equalizing bearings accommodate the same thrust loading in either direction. The bearing has six or more pads supported on a base ring in the thrust housing. Pads are babbitt-faced steel with high load-carrying capacity.

Seals

Shaft seals, located between the bearing chambers and the gas stream, minimize gas leakage outward and prevent lubricating oil leakage into the gas stream.

D-R offers a variety of seal assemblies to handle various compressor applications:

- Labyrinth seals
- Contact seals
- Dry gas seals
- Oil film seals
- Tilt pad seals

With more than 1000 dry gas seals produced to date, we are an experienced manufacturer of dry gas seals with a proven proprietary design that maximizes reliability under all operating conditions. Our gas seal service and test facilities in Tulsa, Oklahoma, and Le Havre, France, stand ready to provide full support.

Rotor Stability

The DATUM shaft diameter is 30 percent larger than our earlier turbocompressor models. This enables higher power density with improved rotor stability, both of which are increasingly vital as pressure ratios and gas densities increase.



Additional stability is provided by the D-R damper seal, a significant recent development that has resulted in an inherently stable centrifugal compressor. With the D-R damper seal, the rotor's dynamic stability (log-decrement) actually increases with increasing discharge pressure.



Large ebraze welding machine located at the Dresser-Rand facility in Olean, NY. DATUM Model D18R9S (destined for hydrogen service in a Spanish refinery) on test stand in Le Havre, France. The Le Havre test facility allows for full load testing of compressor trains, together with their gas turbine or electric motor drivers.

uilding in quality

Major investments have made our design and production facilities second to none.



PERFORMS FOR US

With test facilities in Olean, New York, USA, and Le Havre, France, D-R has some of the most comprehensive test capabilities in the world. That allows us to check all aspects of equipment operation, including fullload testing in Olean. ASME PTC 10 Type 1 hydrocarbon tests can be conducted up to 80 MW with gas turbine drives and 50

Twenty test stands allow maximum flexibility in meeting client requirements.

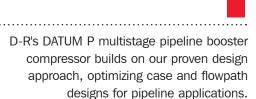
Comprehensive data acquisition

MW with electric drives.

and analysis systems assure that everything meets strict API and other standards.

In early 2009, D-R completed construction of its large compressor full load test facility in Le Havre, increasing its worldwide testing capacity with natural gas up to 150 MW (gas turbine drive) or 100 MW (electrical drive). This facility includes a high capacity quay with direct sea access, enabling compressor train delivery and shipment from and to any location around the world.

Development single- and multistage test vehicles are used to confirm the mechanical and performance characteristics of various components. This gives us the hard data to predict the performance of the completed compressors more accurately than by relying solely on theoretical calculations.



COMMITTED TO WORLD-CLASS MANUFACTURING

Proper execution of a good design is vital, so we've invested both human and financial resources at an unprecedented level to upgrade our facilities. As a result, our ISO-certified, state-of-the-art facilities are among the world's most advanced for turbocompressor design, production, and testing.

The NX CAD/CAM system further enhances our ability to design and manufacture custom engineered products. It allows our engineers to work simultaneously with each other on all aspects of design, analysis, and manufacturing. This leads to better coordination of the various stages of a project and reduced cycle times.

6

DRESSER-RAND.



and a wide variety of other rotating machinery. Decades of machinery design and manufacturing experience are built into our electronic control products for gas turbine

fuel systems, steam turbine governors, compressor surge, compressor capacity and performance, machine vibration and temperature monitoring, train sequencing,

and overall machinery

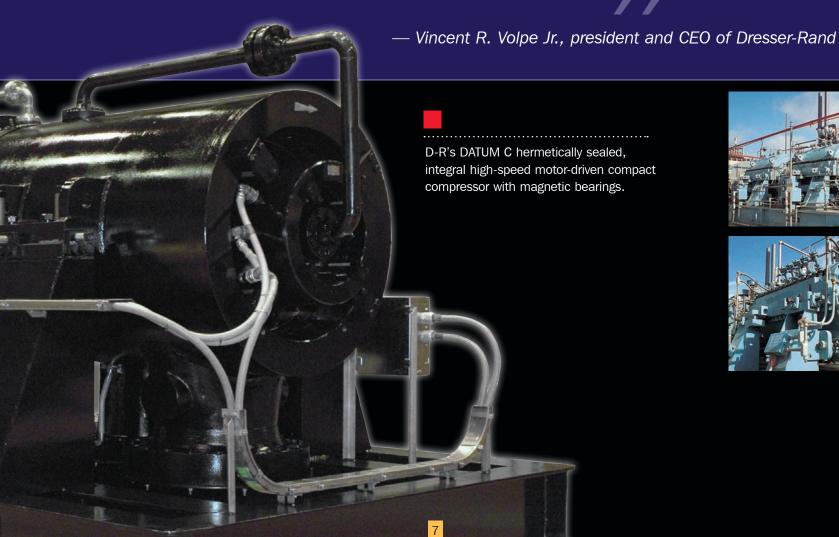
protection. We can help you maximize the performance of your DATUM compressor with our compressor performance monitor (CPM) software and vibration condition monitoring products. Userfriendly operator interfaces feature real-time and historical trending, report generation, system alarms, shutdown, and event logging capabilities.

CONTROL SYSTEMS AS ADVANCED AS OUR **COMPRESSORS**

D-R's PLC-based DI-TRONICS™ control system can be configured to control, monitor, and protect DATUM compressors

Chevron's decision to enter a worldwide preferred supplier agreement with

Dresser-Rand was based in part on the technology of DATUM compressors.







DATUM

family of products

Designed for maximum performance in all pressure and flow applications.



DATUM C multi-stage compressor.

DATUM C COMPRESSOR

Our DATUM C (compact) compressor was developed using our industry-leading DATUM compressor technology and is the fundamental building block for the integrated compression system (ICS) and subsea compression.

The DATUM C compressor is a hermetically sealed, integral high-speed motor-driven com-

pact compressor with magnetic bearings designed for natural gas pipeline and process gas applications. Its small footprint and modular compressor bundle make installation and maintenance easier than for conventional units, while minimizing the requirements for

auxiliary systems and buildings. Because of its integrated, totally enclosed configuration, the DATUM C compressor offers significant environmental benefits including the following:

- Emission-free design
- Quiet operation
- Reduced footprint
- No on-site leakage from shaft
- Magnetic bearings that eliminate need for oil lubrication

DATUM ICS INTEGRATED COMPRESSION SYSTEM (ICS)

The DATUM ICS is a complete motordriven compression system that can be applied to all markets-upstream, midstream, and downstreamwith a small footprint, reduced weight, and at the lowest total cost. It provides a compact and highly efficient means for removing liquid from a gasliquid stream while increasing the pressure of the dehydrated outlet gas.

Features of the DATUM ICS system include high-efficiency DATUM centrifugal compressor technology; Dresser-Rand's proprietary centrifugal separation technology; a high-speed, close-coupled, gas-cooled motor; magnetic bearing rotor system; dedicated unit controls; process coolers, valves, instrumentation and interconnecting piping—all packaged in a compact module design. Dresser-Rand's approach to compact compression could typically result in as much as a 45% reduced footprint and a 35% reduction in weight



DATUM ICS compressor.

when compared to traditional compression modules.

DATUM P COMPRESSOR

Dresser-Rand has offered pipeline booster equipment for the gas transmission industry for more than 50 years. The DATUM P compressor uses components-impellers, bearings, seals, stationary flow-path components, etc.-from the DATUM multi-stage compressor product line. As such, it benefits from the proven experience and flexibility of the DATUM design product line, including its many innovative features. One of those features is the modular bundle assembly that enables rapid change-out of rotating elements -together with bearings, seals, and stationary components—in one cartridge-style assembly.



DATUM P compressor.

herever and whenever you need us

A single source for all your energy conversion needs.



A WORLD OF ENERGY CONVERSION SOLUTIONS

Dresser-Rand works with you to achieve the lowest total cost of ownership for your compression facilities. We'll study your requirements and consider a variety of options before selecting the most cost-effective solution with the shortest cycle time. This flexible perspective helps us develop creative, field-proven solutions that include all aspects of a project, from initial concept to equipment retirement:

Operation and

maintenance of both D-R and other power-conversion equipment. We can take full responsibility, including appropriate performance guarantees. Dresser-Rand Availability PLUS® maintenance provides comprehensive machinery health care by bundling D-R's value-added products and services into a single, typically performance-based agreement. An on-site D-R representative serves as a single point of contact.

■ Upgrades and retrofits to adapt other brands of rotating machinery to your operating conditions and requirements. Dresser-Rand's Applied Technology capabilities allow you to enjoy the benefits of the latest DATUM compressor technology in many makes and models of your installed turbomachinery. Options include major assemblies, individual parts, upgrades, retrofits, and many other unique solutions designed to improve compressor operation and performance.

■ Engineering evaluations that show you how to optimize your equipment's

performance.

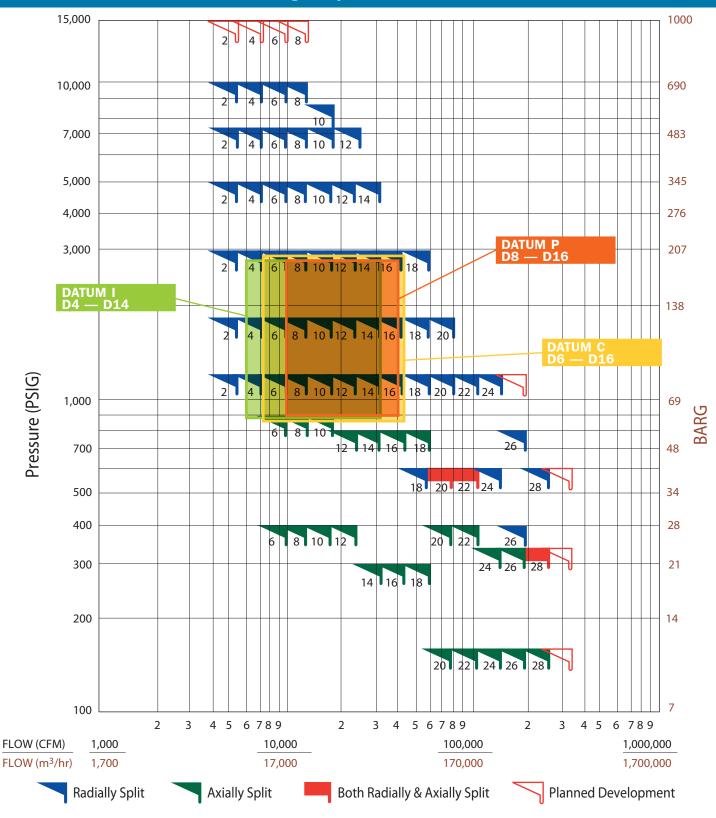
Equipment reliability and life assessment evaluations using the most advanced and consistent testing methods.

OUR GLOBAL PRESENCE ALLOWS US TO BE MORE RESPONSIVE

When you accept delivery of a DATUM centrifugal compressor (or any other D-R product), your relationship with us is just beginning. More than 6,000 employees, located in three key regions of the world, are ready to keep your equipment running with responsive, reliable technical support 24 hours a day. With 35 service centers located in 18 countries, we are there when you need us. We have 63 sales offices in 21 countries, and 12 major manufacturing facilities in The Americas Region, European Served Area, and Asia-Pacific Region.

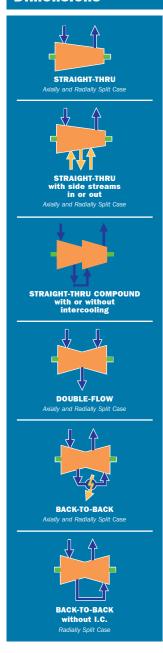
Services include remanufacturing out-of-service rotating machinery to fit your present operating conditions; expert repair service from factorytrained technicians through our worldwide network of service centers; replacement parts that include the latest design improvements; around-the-clock field service, including installation assistance or complete installation; revamps and rerates to bring your equipment up to new specs to match changes to your process or operating conditions; safe, secure rotor storage; and training, either at your location or ours.

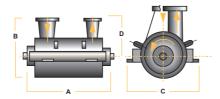
DATUM Frame Size Flow/Pressure Coverage Map



DATUM Nomenclature DXYN(Z) Example: D 1 0 R 9 B Where: D: Always a "D" for DATUM **N:** Total number of impellers, X: Frame size designation, one or two digits, one or two digits (Z): Casing configuration, if either: 2 through 28 in steps of two "B" for back-to-back Y: Case split designation as follows: "D" for double-flow "R" for radial (barrel type) "S" for straight-thru "A" for axial (horizontally split) "P" for pipeline (barrel type) "CS" for centrifugal separator "C" for compact compressor configuration "I" Integrated Compression System

Dimensions





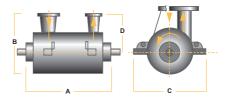
Axially split cases

Dimensions in inches (mm)

FRAME	A	В	C	D	WT IN LBS x 10 ³ (KGS x 10 ³)
6A	52-63	38.5	42	24	14.0-22.0
	(1320-1600)	(980)	(1070)	(610)	(6.3-10)
8A	58-73	45	48	28	19.0–29.5
	(1470-1850)	(1140)	(1220)	(710)	(8.6–14)
10A	65–85	51.5	56	32	24.5–40.0
	(1650–2160)	(1310)	(1420)	(810)	(11.1–18)
12A	76–98	59.5	65	37	28.0–53.5
	(1930–2490)	(1510)	(1650)	(940)	(12.5–24)
14A	88-114	70	75	44	45.0–72.0
	(2230-2890)	(1780)	(1910)	(1180)	(20.5–33)
16A	96–132	80.5	84	51	56.5–95.0
	(2440–3350)	(2050)	(2130)	(1300)	(25.5–43)
18A	97–154	92	92	59	66.5–131.5
	(2460–3910)	(2340)	(2340)	(1500)	(30–60)
20A	109–178	106.5	107	68	86.5–176.0
	(2770–4250)	(2710)	(2720)	(1730)	(39–80)
22A	132-207	124	123	79	121.5–237.5
	(3350-5260)	(3150)	(3120)	(2010)	(55–108)
24A	147-240	144	140	92	151.5–310.5
	(3730-6100)	(3660)	(3560)	(2340)	(69–141)
26A	161–279	163.5	151	106	199.5–411.5
	(4090–7090)	(4150)	(3840)	(2690)	(90–187)
28A	172-323	189	170	123	239.0–562.5
	(4360-8200)	(4800)	(4320)	(3120)	(108-255)
30A	200-375	219	197	143	375-877
	(5080-9525)	(5563)	(5004)	(3632)	(170-399)

Conventional driver arrangements include:

- Gas turbine
- Steam turbine
- Electric motor (low-speed, high-speed, variable-speed)
- Others as required



Radially split cases

Dimensions in inches (mm)

FRAME	A	В	C	D	WT IN LBS x 10 ³ (KGS x 10 ³)
2R	38–47	33.5	35	21	6.5–10.0
	(970–1200)	(850)	(890)	(530)	(3–4.5)
4R	45–54	33.5	35	21	9.0–13.8
	(1140–1370)	(850)	(890)	(530)	(4–6.3)
6R	52–63	38.5	39	24	12.0-18.5
	(1320–1600)	(980)	(990)	(610)	(5.5-8.5)
8R	58–73	45	47	28	15.5–25.0
	(1470–1850)	(1140)	(1190)	(710)	(7–11.5)
10R	65–85	51.5	53	32	20.0–34.0
	(1650–2160)	(1310)	(1350)	(810)	(9–15.5)
	76–98	59.5	58	37	27.0–45.5
14R	(1930–2490)	(1510)	(1470)	(940)	(12–21)
	88–114	70	67	44	36.5–61.5
	(2230–2890)	(1780)	(1700)	(1180)	(16.5–28)
16R	96–132	80.5	75	51	46.0-82.5
	(2440–3300)	(2050)	(1910)	(1300)	(21-37.5)
18R	97–154	92	82	59	54.0–112.0
	(2460–3900)	(2340)	(2080)	(1500)	(25–51)
20R	109–178	106.5	95	68	70.5–150.0
	(2770–4250)	(2710)	(2410)	(1730)	(32–68)
22R	132–207	124	110	79	99.5–202.5
	(3350–5260)	(3150)	(2790)	(2010)	(45–92)
24R	147–240	144	124	92	128.5–272.5
	(3730–6100)	(3660)	(3150)	(2340)	(58–124)
26R	161–279	163.5	135	106	163.0–367.5
	(4090–7090)	(4150)	(3430)	(2690)	(74–167)
28R	172-323	189	152	123	202.0-494.0
	(4360-8200)	(4800)	(3860)	(3120)	(92-224)
30A	200-375	219	176	143	315-771
	(5080-9525)	(5563)	(4479)	(3632)	(143-350)

Note: All weights and dimensions are estimated; weight variation is linked to the number of stages and design pressure of the compressor.

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