Bay Square Residences

Cambridge Multifamily Retrofit Advisor

Opportunity Assessment Memo

NEW ECOLOGY

Community-Based Sustainable Development

March 2, 2023

Overview

New Ecology completed an opportunity assessment of the Bay Square Residences on February 7th, 2023. The intent of the assessment was to inspect and evaluate retrofit opportunities for the buildings mechanical, electrical, and plumbing systems. An outline of the assessments findings are presented below:

- There is sufficient amperage to electrify the HVAC and hot water systems.
- Additional electrical infrastructure within the building will be needed.
- Commercial air-to-water heat pump systems do exist, options are limited at this time.
- Heat pump hot water system requires a storage tank.
- Recommend solar pool heater.
- Existing dwelling fan coil units can be retrofitted with new heat pump chassis. Little difference in performance between competing brands.
- Ductless mini-split heat pumps are recommend for common areas.

Building Summary

Address	950 Massachusetts Avenue
Year Built	1982
# Units	114
Heating	Natural gas, HiE boiler, hydronic, fan coil
Cooling	Chiller, hydronic, fan coil
Domestic Hot Water	Natural gas, HiE, on-demand
Building envelope	Brick masonry, 2x4 wall cavity, flat roof, insulation levels unknown
Pool, jacuzzi	Gas fired heaters,

Findings

Electrical Service

There is a 4000 amp service running to the building currently. According to the energy engineer who conducted the assessment, this should be sufficient supply to power the proposed upgrades explored later in this document.

Electric vehicle charging stations will require a dedicated circuit either on an existing panel or on a separate sub-panel. Depending upon location of EV parking spaces, electric raceways my need to be installed. Spaces near electrical or pool room offer easy access to existing electrical infrastructure. The City of Boston has created a guide for decision makers interested in adding EV charging and is a good reference for neighboring communities. The guide will be included with this memo.

Regarding power to the boiler room supporting electrification? For planning purposes, we recommend anticipating to run addition service and a new panel to the space. An electrician can make the final decision on if this is necessary.

Heating, Cooling, and Domestic Hot Water

- Boiler use throughout the building falls into three different use categories: 1. Space heating 2. Domestic Hot Water Supply 3. Pool/jacuzzi heating.
- The space heating boilers are relatively new and have a median equipment life expectancy of 25 years. Both boilers are plumbed in series, with duty cycling, and provide up to 2,853 MBH of peak heating capacity to the building. It is assumed these are oversized and a replacement air-to-water heat pump would be sized at 1.4 times the building heating load. Using an estimated monthly gas use of 2,500 therms, a replacement heat pump unit would need to supply 600-650 MBH of heating. Few systems of this size exist in the market currently, but one option is the model WRK system from Aermec which can provide not only heating, but cooling and domestic hot water as well (Figure 1). The product datasheet can found in Appendix 1.

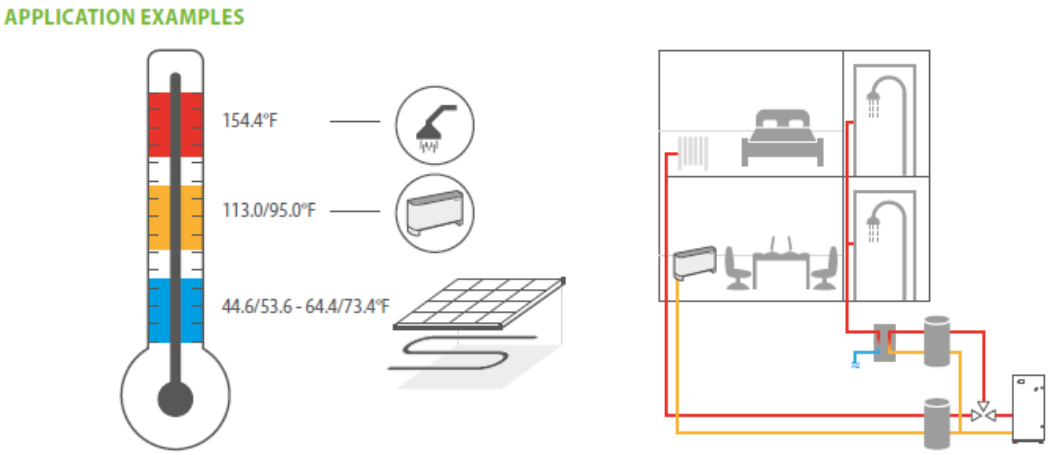


FIGURE 1: AERMEC WRK SYSTEM CONFIGURATION

- Unit space heating and cooling is provided by Whalen fan coil units (FCUs) with heat exchangers connected to central hydronic loops. The hot water loop is supplied by the boilers mentioned, and the cold water loop is supplied by a chiller and cooling tower. Replacing the fan coil units is only recommended if sourcing parts becomes an issues for older model units. There is little difference in terms of energy performance between Whalen and the competing brands. Other manufacturers do offer units with similar dimensions that could be retroffited to the existing mechanical closet.
- Common area fan coil units be replaced with ductless mini-split heat pumps. Consideration will need to given to the design and layout of the refrigeration linesets between the indoor and outdoor units. Mini-split heat pumps are a mature market in the US with many reputable manufacturers with an array of design configurations to best suit the need.
- Regarding the questions of if there are on-demand electric solutions for domestic hot water; and if a storage tank will be needed? Yes, there are electric on-demand hot water heaters, but these are typically used at point of use. An example would be for a sink in a public restroom. Units large enough to serve an apartment would have large power draw and over 100 units across the building would not be feasible. If heat pump water heating is installed, a storage tank will be needed to optmize performance as heat pumps work best with constant and consistent loads.
- The two options for heating the pool/jacuzzi are: solar thermal and heat pumps. Solar thermal is most suitable if there is unused roof space adjacent to the pool where the collectors can be located. An added benefit of solar thermal is to potentially integrate the system into the

domestic hot water supply to pre-heat the water coming from the mains. Solar thermal is also a relatively low tech, with minimal upkeep of the collectors (Figure 2). Heat pumps are also an option, though additional electric supply would be needed.

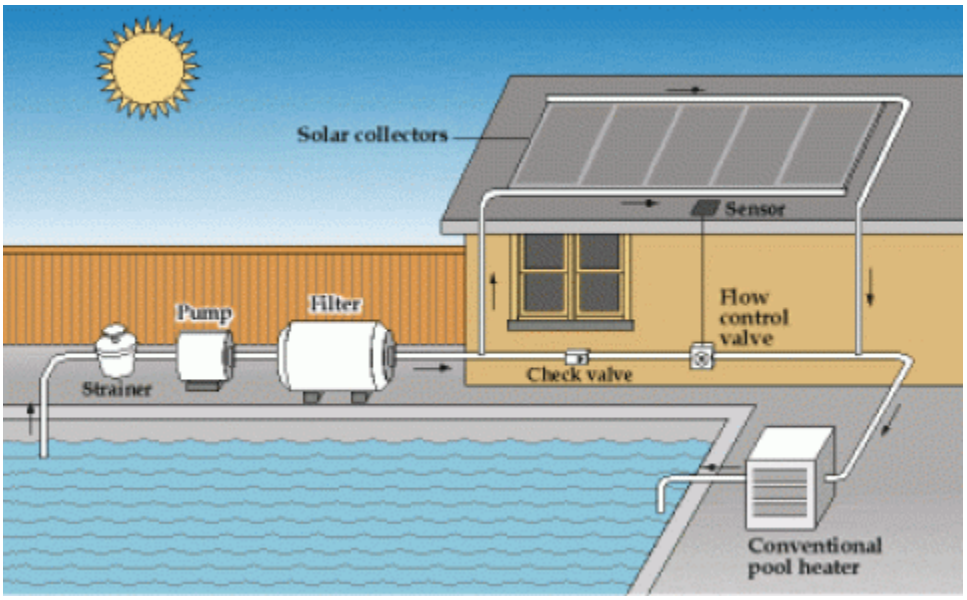


FIGURE 2: SOLAR THERMAL POOL HEATER

Appendix 1

WRK

Reversible water-cooled heat pump, gas side

Cooling capacity 19.2 ÷ 49.3 ton
Heating capacity 281,781 ÷ 742,025 BTU/h

- **Optimised for heating in centralised systems.**
- **Production of hot water at high temperature up to 154.4 °F.**
- **Independent from the gas network.**
- **DHW production.**

DESCRIPTION
Water source heat pump with reverse cycle valve. The unit can produce chilled and hot water but it is optimized for high temperature hot water production, making it a perfect solution for DHW applications. It can also work with low source temperatures which make it possible to work with geothermal applications.

VERSIONS
L Standard silenced

FEATURES

Extended operating range
Particular attention has been given to winter operation, ensuring the production of hot water up to 154.4 °F.

Plug and play
All units are equipped with scroll compressors with steam injection and brazed plate heat exchangers. The base and panels are made of steel treated with polyester paints RAL 9003.
The heat pump can be supplied with all the components required for its installation in new systems and in retrofit applications. It can be combined with low temperature emission systems such as in floor radiant heating or fan coils, but also with conventional radiators.

Integrated hydronic kit
Integrated hydronic kit containing the main hydraulic components; available with various configurations with one or two pumps, high or low head, to obtain a solution that allows you to save money and to facilitate installation.

CONTROL PCO_5
Microprocessor adjustment, with keyboard and LCD display,for easy access on the unit is a menu available in several languages.
— Possibility to control two units in a Master-Slave configuration
— The presence of a programmable timer allows functioning time periods and a possible second set-point to be set.
— The temperature control takes place with the integral proportional logic, based on the water output temperature.

ACCESSORIES
AER485P1: RS-485 interface for supervision systems with MODBUS protocol.
AERBACP: Ethernet communication Interface for protocols Bacnet/IP, Modbus TCP/IP, SNMP
AERNET: The device allows the control, the management and the remote monitoring of a Chiller with a PC, smartphone or tablet using Cloud connection. AERNET works as Master while every unit connected is configured as Slave (max. 6 unit); also, with a simple click is possible to save a log file with all the connected unit datas in the personal terminal for post analysis.
FL-UL: Flow switch.
MULTICHILLER_EVO: Control, switch-on and switch-off system of the single chillers where multiple units are installed in parallel, always ensuring constant flow rate to the evaporators.
AVX: Spring anti-vibration supports.
VT: Antivibration supports

FACTORY FITTED ACCESSORIES
T6: Double safety valve with exchange cock, both on the high and low pressure branches.

ACCESSORIES COMPATIBILITY

Model	Ver	0300	0330	0350	0500	0550	0600	0650	0700
AER485P1	L	•	•	•	•	•	•	•	•
AERBACP	L	•	•	•	•	•	•	•	•
AERNET	L	•	•	•	•	•	•	•	•
FL-UL (1)	L	•	•	•	•	•	•	•	•
MULTICHILLER_EVO	L	•	•	•	•	•	•	•	•

(1) Compliant with UL regulation

Antivibration

Version	Integrated hydronic kit, user side	Integrated hydronic kit, source side	0300	0330	0350	0500	0550	0600	0650	0700
L	°	°	-	-	-	AVX345	AVX343	AVX342	AVX342	AVX342
L	°,M	U	-	-	-	AVX343	AVX343	AVX343	AVX343	AVX343
L	N	°	-	-	-	AVX343	AVX343	AVX343	AVX343	AVX343
L	°	V	-	-	-	AVX313	AVX343	AVX343	AVX343	AVX343
L	M	°	-	-	-	AVX313	AVX343	AVX343	AVX343	AVX343
L	°,M	W	-	-	-	AVX343	AVX343	AVX343	-	-
L	N	Z	-	-	-	AVX343	AVX343	AVX343	-	-
L	O	U,W	-	-	-	AVX343	AVX343	AVX343	-	-
L	P	°,V,Z	-	-	-	AVX343	AVX343	AVX343	-	-
L	°	Z	-	-	-	AVX313	AVX343	AVX343	-	-
L	O	°	-	-	-	AVX313	AVX343	AVX343	-	-
L	M	V,Z	-	-	-	AVX343	AVX343	AVX343	AVX344	AVX344
L	N	U,V,W	-	-	-	AVX343	AVX343	AVX343	AVX344	AVX344
L	O	V,Z	-	-	-	AVX343	AVX343	AVX343	AVX344	AVX344
L	P	U,W	-	-	-	AVX343	AVX343	AVX343	AVX344	AVX344

- not available

Version	Integrated hydronic kit, user side	Integrated hydronic kit, source side	0300	0330	0350	0500	0550	0600	0650	0700
L	°	°	VT9	VT9	VT9	-	-	-	-	-
L	°	U,V,W,Z	VT15	VT15	VT15	-	-	-	-	-
L	M,N,O,P	°,U,V,W,Z	VT15	VT15	VT15	-	-	-	-	-

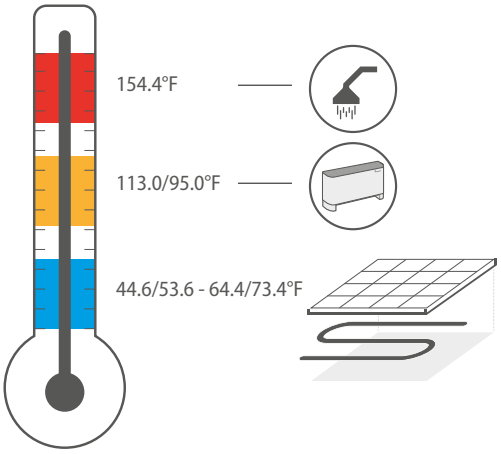
- not available

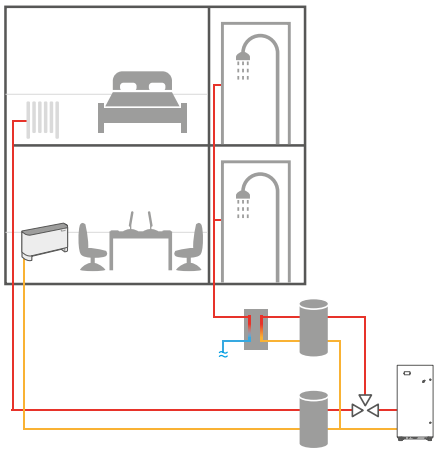
Double safety valve.

Ver	0300	0330	0350	0500	0550	0600	0650	0700
L	T6WRK1	T6WRK1	T6WRK1	T6WRK2	T6WRK2	T6WRK2	T6WRK2	T6WRK2

A grey background indicates the accessory must be assembled in the factory

APPLICATION EXAMPLES





WRK units are used in building renovations, where centralised boilers need replacing, while maintaining the existing distribution system and terminals (e.g. radiators) at the same time, to ensure the production of domestic hot water. This situation is typical when operating in contexts such as public buildings, but also in the case of centralised residential systems such as condominiums, where costs must be limited without changing the distribution system, while also offering a renewable energy source, represented precisely by heat pumps. Being able to upgrade a building without involving the distribution system also eliminates the inconveniences associated with the renovation of the premises, ensuring the continuity of the property's use, saving time and money.

CONFIGURATOR

Field		Description
1,2,3		**WRK**
4,5,6,7		**Size** 0300, 0330, 0350, 0500, 0550, 0600, 0650, 0700
8		**Operating field**
	°	Standard mechanic thermostatic valve
9		**Model**
	H	Reversible heat pump, gas side
10		**Version**
	L	Standard silenced
11		**Evaporator**
	°	Standard
12		**Heat recovery**
	°	Without heat recovery
	D	With desuperheater
13		**Power supply**
	7	460V~3 60Hz with magnet circuit breakers
14		**Integrated hydronic kit, user side**
	°	Without hydronic kit
	M	Single pump low head
	N	Pump low head + stand-by pump
	O	Single pump high head (1)
	P	Pump high head + stand-by pump (1)
15		**Integrated hydronic kit, source side**
	°	Without hydronic kit
	U	Single pump low head
	V	Pump low head + stand-by pump
	W	Pump high head (1)
	Z	Pump high head + stand-by pump (1)
16		**Field for future development**

(1) Option not available only for sizes 0650-0700.

PERFORMANCE SPECIFICATIONS

WRK - HL

Size			0300	0330	0350	0500	0550	0600	0650	0700
Cooling performances 54.0 °F / 44.0 °F (1)										
Cooling capacity	L	ton	19.2	22.8	26.0	28.7	33.6	38.3	45.1	49.3
Input power	L	kW	14.2	16.7	19.4	21.4	24.8	28.4	33.8	39.9
Cooling total input current	L	A	25	31	41	41	46	50	62	82
EER	L	BTU/W	16.14	16.38	16.02	16.10	16.24	16.17	16.04	14.84
Water flow rate system side	L	gpm	45.9	54.7	62.2	68.9	80.4	91.9	108.2	118.1
Pressure drop system side	L	ft H_2O	4.99	3.44	3.25	4.07	4.14	5.30	4.52	5.30
Water flow rate source side	L	gpm	59.7	70.9	81.0	89.5	104.4	119.3	140.7	155.7
Pressure drop source side	L	ft H_2O	8.42	5.78	5.50	6.89	6.97	8.95	7.64	9.20
Heating performance 104.0 °F / 113.0 °F (2)										
Heating capacity	L	BTU/h	281,781	336,417	376,103	420,308	493,822	563,041	665,583	742,025
Input power	L	kW	16.8	20.0	23.2	25.1	29.2	33.6	40.1	47.0
Heating total input current	L	A	29	34	44	45	51	57	68	88
COP	L	kW/kW	4.91	4.94	4.75	4.91	4.95	4.91	4.86	4.62
Water flow rate system side	L	gpm	63.2	75.4	84.3	94.3	110.7	126.3	149.3	166.4
Pressure drop system side	L	ft H_2O	9.72	6.61	6.29	7.86	7.93	10.31	8.85	8.02
Water flow rate source side	L	gpm	83.9	100.4	111.1	125.2	147.4	167.7	197.8	217.8
Pressure drop source side	L	ft H_2O	17.14	11.70	10.92	13.87	14.05	18.19	15.54	13.74

(1) Water user side 54.0 °F / 44.0 °F; Water source side 85.0 °F / 94.3 °F
(2) Water user side 104.0 °F /113.0 °F; Water source side 50.0 °F / 44.6 °F

ELECTRIC DATA

	Version	Integrated hydronic kit, user side	Integrated hydronic kit, source side		0300	0330	0350	0500	0550	0600	0650	0700
Peak current (LRA)	L	°	°	A	148	178	213	214	223	190	230	278
	L	°	U/V	A	150	182	217	218	228	195	236	285
	L	M/N	°	A	150	182	217	218	228	195	236	285
	L	°	W/Z	A	152	183	219	220	229	196	-	-
	L	O/P	°	A	152	183	219	220	229	196	-	-
	L	M/N	U/V	A	152	186	221	222	233	200	243	291
	L	M/N	W/Z	A	154	187	223	224	235	202	-	-
	L	O/P	U/V	A	154	187	223	224	235	202	-	-
	L	O/P	W/Z	A	156	189	224	227	236	203	-	-
Minimum circuit amperage (MCA)	L	°	°	A	50	60	70	75	90	100	110	150
	L	°	U/V	A	60	70	75	75	90	100	125	150
	L	M/N	°	A	60	70	75	75	90	100	125	150
	L	°	W/Z	A	60	70	75	80	90	100	-	-
	L	O/P	°	A	60	70	75	80	90	100	-	-
	L	M/N	U/V	A	60	70	80	80	100	110	125	150
	L	M/N	W/Z	A	60	70	80	90	100	110	-	-
	L	O/P	U/V/W/Z	A	60	70	80	90	100	110	-	-
Maximum overcurrent permitted by the protection device (MOP)	L	°	°/U/V	A	70	80	100	100	110	110	125	150
	L	M/N	°	A	70	80	100	100	110	110	125	150
	L	°	W/Z	A	70	80	100	100	110	110	-	-
	L	O/P	°	A	70	80	100	100	110	110	-	-
	L	M/N	U/V	A	70	90	100	110	110	110	125	150
	L	M/N	W/Z	A	75	90	100	110	125	110	-	-
	L	O/P	U/V	A	75	90	100	110	125	110	-	-
	L	O/P	W/Z	A	75	90	110	110	125	125	-	-

- not available

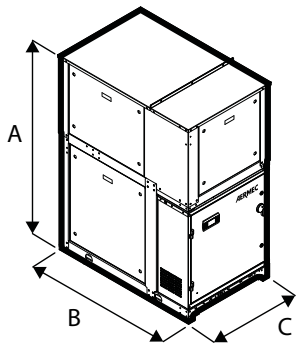
GENERAL TECHNICAL DATA

Size			0300	0330	0350	0500	0550	0600	0650	0700
Compressor										
Type	L	type					Scroll			
Number	L	no.	2	2	2	2	3	4	4	4
Circuits	L	no.	2	2	2	2	2	2	2	2
Refrigerant	L	type					R410A			
Refrigerant charge	L	lbs	21.2	31.5	34.2	34.2	41.9	41.9	55.1	55.1
System side heat exchanger										
Type	L	type					Brazed plate			
Number	L	no.	1	1	1	1	1	1	1	1
Connections (in/out)	L	Type					Grooved joints			
Sizes (in/out)	L	Ø					2 1/2"			
Source side heat exchanger										
Type	L	type					Brazed plate			
Number	L	no.	1	1	1	1	1	1	1	1
Connections (in/out)	L	Type					Grooved joints			
Sizes (in/out)	L	Ø					2 1/2"			
Sound data calculated in cooling mode (1)										
Sound power level	L	dB(A)	78.3	76.4	79.5	75.9	77.7	81.8	79.8	81.3
Sound pressure level (10 m / 33 ft)	L	dB(A)	46.8	44.9	48.0	44.2	46.0	50.1	48.1	49.6

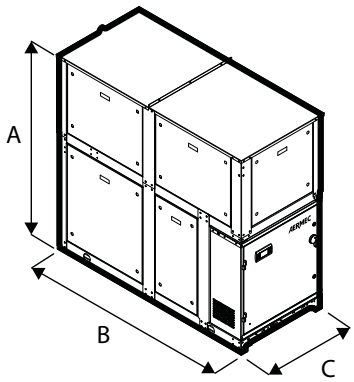
(1) Sound power calculated on the basis of measurements made in accordance with UNI EN ISO 9614-2. Sound pressure (cold functioning) measured in free field, 10 m / 33 ft away from the unit external surface (in compliance with UNI EN ISO 3744).

DIMENSIONS

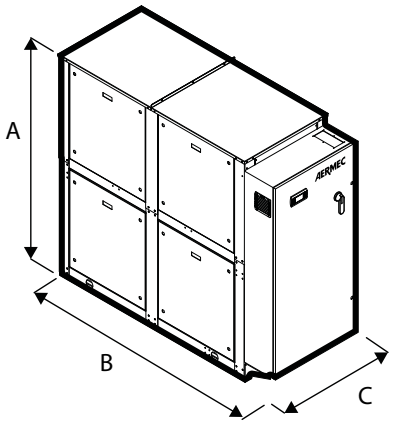
WRK 0350 °



WRK 0350 U-V-W-Z



WRK 0700 °



Size			0300	0330	0350	0500	0550	0600	0650	0700
Dimensions and weights without hydronic kit										
A	L	in	66.0	66.0	66.0	74.3	74.3	74.3	74.3	74.3
B	L	in	49.8	49.8	49.8	84.9	84.9	84.9	84.9	84.9
C	L	in	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5
Dimensions and weights with pump/s										
A	L	in	66.0	66.0	66.0	74.3	74.3	74.3	74.3	74.3
B	L	in	74.5	74.5	74.5	121.7	121.7	121.7	121.7	121.7
C	L	in	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5

	Version	Integrated hydronic kit, user side	Integrated hydronic kit, source side		0300	0330	0350	0500	0550	0600	0650	0700
Weight empty + packaging	L	°	°	lb	1,246	1,257	1,279	2,050	2,238	2,293	2,348	2,414
	L	°	U	lb	1,620	1,631	1,653	2,546	2,734	2,789	2,877	2,943
	L	°	V	lb	1,676	1,687	1,709	2,701	2,888	2,943	3,064	3,131
	L	°	W	lb	1,620	1,631	1,653	2,546	2,734	2,789	-	-
	L	°	Z	lb	1,676	1,687	1,709	2,701	2,888	2,943	-	-
	L	M	°	lb	1,609	1,631	1,653	2,469	2,657	2,712	2,789	2,855
	L	M	U	lb	1,687	1,709	1,731	2,668	2,855	2,910	3,020	3,086
	L	M	V/Z	lb	-	-	-	-	-	-	-	-
	L	N	U/W	lb	-	-	-	-	-	-	-	-
	L	O	V/Z	lb	-	-	-	-	-	-	-	-
	L	P	U/W	lb	-	-	-	-	-	-	-	-
	L	M	W	lb	1,687	1,709	1,731	2,668	2,855	2,910	-	-
	L	O	U/W	lb	1,687	1,709	1,731	2,668	2,855	2,910	-	-
	L	N	°	lb	1,676	1,687	1,709	2,624	2,811	2,866	2,965	3,031
	L	N	V	lb	1,808	1,819	1,841	2,976	3,164	3,219	3,384	3,439
	L	N	Z	lb	1,808	1,819	1,841	2,976	3,164	3,219	-	-
	L	P	V/Z	lb	1,808	1,819	1,841	2,976	3,164	3,219	-	-
	L	O	°	lb	1,609	1,631	1,653	2,469	2,657	2,712	-	-
	L	P	°	lb	1,676	1,687	1,709	2,624	2,811	2,866	-	-
Weight functioning	L	°	°	lb	1,224	1,235	1,268	2,039	2,227	2,304	2,370	2,447
	L	°	U	lb	1,642	1,664	1,698	2,590	2,789	2,855	2,965	3,042
	L	°	V	lb	1,720	1,742	1,764	2,756	2,954	3,020	3,164	3,241
	L	°	W	lb	1,642	1,664	1,698	2,590	2,789	2,855	-	-
	L	°	Z	lb	1,720	1,742	1,764	2,756	2,954	3,020	-	-
	L	M	°	lb	1,642	1,664	1,698	2,513	2,712	2,778	2,877	2,954
	L	M	U	lb	1,720	1,742	1,775	2,723	2,921	2,987	3,120	3,197
	L	M	V/Z	lb	-	-	-	-	-	-	-	-
	L	N	U/W	lb	-	-	-	-	-	-	-	-
	L	O	V/Z	lb	-	-	-	-	-	-	-	-
	L	P	U/W	lb	-	-	-	-	-	-	-	-
	L	M	W	lb	1,720	1,742	1,775	2,723	2,921	2,987	-	-
	L	O	U/W	lb	1,720	1,742	1,775	2,723	2,921	2,987	-	-
	L	N	°	lb	1,720	1,731	1,764	2,679	2,877	2,943	3,064	3,142
	L	N	V	lb	1,863	1,874	1,907	3,053	3,252	3,318	3,505	3,571
	L	N	Z	lb	1,863	1,874	1,907	3,053	3,252	3,318	-	-
	L	P	V/Z	lb	1,863	1,874	1,907	3,053	3,252	3,318	-	-
	L	O	°	lb	1,642	1,664	1,698	2,513	2,712	2,778	-	-
	L	P	°	lb	1,720	1,731	1,764	2,679	2,877	2,943	-	-

- not available

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