White Paper

IEER vs ISMRE2$_{70}$

Commercial Ducted Systems Efficiency Rating Metrics

IEER
Commercial Rooftop Units

The majority of commercial unit efficiencies are based upon ASHRAE Standard 90.1 minimum values (table 6.8.1) and AHRI-340/360 standard testing conditions. The intent of the standards is to provide an efficiency measurement for package and split systems air conditioning equipment used for space temperature conditioning applications.

Energy Efficiency Ratio (EER)

Example:

$$EER = \frac{\text{Net Capacity}}{\text{Power Input}} = \frac{\text{Btu/h}}{\text{Watts}}$$

$$EER = \frac{\text{Airside Delivered Capacity}}{\text{Fans (Supply \& Condenser) + Compressors + Other}}$$

$$EER = \frac{556{,}000 \text{ Btu}}{5{,}400 + 45{,}000 + 1{,}900 \text{ Watts}} = 10.6$$

Integrated Energy Efficiency Ratio (IEER)

The EER rating is measured at 100% capacity. However, package units do NOT run at 100% capacity for the majority of the time. Therefore, AHRI standards 340/360 measures efficiency at different capacities and condenser ambient conditions. The IEER value is a weighted average of the different EER values. Calculating EER at various outdoor air condenser temperature reflects the affect of weather on the units. The weight average thereby reflects a more seasonal efficiency.

IEER = 2% x A* + 61.7% x B* + 23.8% x C* + 12.5% x D*

***Note:** EER

Typical IEER Calculation
Entering Air Conditions for DX and Performance

	Unit Capacity	Evaporator Coil EAT (°F)	Condenser Air Temp (°F)	EER	MBH	Wgt (%)
A	100%	80.0 dB 67.0 wB	95.0	10.6	55.6	2.0
B	75%		81.5	14.9	42.4	61.7
C	50%		68.0	18.6	28.3	23.8
D	25%		65.0	19.4	14.1	12.5
IEER = 16.3						

***Note:** Unit at 400 CFM/ton and 0.75 inch-WC ESP

ISMRE2$_{70}$
Dedicated Outside Air Systems

The industry created a new DOAS efficiency standard, AHIR 920, that better represents the product application which is dehumidification. ASHRAE 90.1 has adopted the standard and provides a minimum efficiency for the units.

Moisture Removal Efficiency (MRE$_{70}$)

MRE$_{70}$ is a ratio of the moisture removed from an entering air volume (EA) to the total power input at the given set of rating conditions expressed in pounds of moisture per kWh. In addition, the leaving air volume must be reheated to a sensible LAT of 70.0°F. If the DX system can not achieve 70.0°F, a penalty of electric heat energy is added to the system to reach 70.0°F.

$$MRE_{70} = \frac{\text{Water Removed}}{\text{Power Input}} = \frac{\text{lbs}}{\text{kWh}}$$

Example: The water content of the air entering and leaving air conditions at 3,000 CFM. The standard limits the maximum leaving air dewpoint to 55.0°F.

Water Removed = EA 211.3 lbs/hr – LA 125.4 lbs/hr (54.3F dp)

$$MRE_{70} = \frac{85.9 \text{ lbs/hr}}{\text{Fans + Compressors + Reheat Penalty (LAT = 70.0°F)}}$$

$$MRE_{70} = \frac{85.9 \text{ lbs}}{18 \text{ kWh}} = 4.8$$

Integrated Seasonal Moisture Removal Efficiency

Like IEER, the ISMRE270 value is a season weighted value for various high humidity periods.

$ISMRE2_{70}$ = 12% x A* + 28% x B* + 36% x C* + 24% x D*

***Note:** MRE

Typical ISMRE Calculation
Entering Air Conditions for DX and Performance

	EAT dB/wB/dB (°F)	Coil LAT dB/wB (°F)	EER	MRE	lbs/hr (MRC)	Wgt (%)
A	95.0/78.0/95.0	54.5/54.4	12.6	4.8	90.0	12
B	80.0/73.0/80.0	53.1/53.0	16.2	8.2	94.9	28
C	70.0/66.0/70.0	53.0/52.9	17.3	9.4	87.0	36
D	63.0/59.0/63.0	51.2/51.2	17.3	7.8	28.2	24
$ISMRE2_{70}$ = 8.1						

***Note:** Unit at 3,000 CFM

September 2020

White Paper

IEER vs ISMRE2$_{70}$

Commercial Ducted Systems Efficiency Rating Metrics

When do I use IEER or ISMRE2$_{70}$?

Even though package units look similar, the efficiency metrics drive different optimized outcomes. Therefore the product application dictates which metric should be used. Furthermore, most equipment will NOT have both ratings. 100% DOAS product should be rated using ISMRE2$_{70}$ and Standard Package units handling less than 25% outside air should use IEER. If an energy recovery device is added to the product use the base product application's efficiency metric.

Is there a conversion between IEER to ISMRE2$_{70}$?

The simple answer is NO. Products using AHRI 920 can use a wide variety of CFMs and leaving air dewpoints. Therefore a conversion between IEER and ISMRE2$_{70}$ could be very misleading.

Does a unit have to meet both a minimum EER value as well as IEER value?

ASHRAE Standard 90.-2016 & 2019 shows a unit must meet both a minimum EER value at max condition and a seasonal IEER value until 2023. After 2023, the unit only needs to meet an IEER value.

What is ISMRE, ISMER2 and ISMRE2$_{70}$?

Integrated Seasonal Moisture Removal Efficiency (ISMRE) is the weight average of the four (4) dehumidification Moisture Removal Efficiency (MRE) ratings (shown in table) for DX-DOAS units expressed in lb of moisture/kWh.

Moisture Removal Efficiency (MRE) ratio expressed in pounds of water removed/hour to the total power input in kW at a rating conditions.

ISMRE2 was created to differentiate between AHRI 920 standard 2015 and 2020. ISMRE2 requires the unit to dehumidify the air to less than 55°F dewpoint and reheat the air. Its does NOT carry a reheat penalty requiring the unit to reach a 70°F leaving air temperature condition.

Integrated Seasonal Moisture Removal Efficiency 70 (ISMRE2$_{70}$) is the same as ISMRE2 except it requires the leaving air temperature to reach 70°F or carry an energy penalty in additional electric heat to achieve the require leaving air condition.

When do you use ISMRE2 vs ISMRE2$_{70}$?

ISMRE2 should be used when reheat is NOT important. Currently, ASHRAE Std 90.1-2019 refers to "ISMRE", thus a reasonable interpretation would be to use ISMRE2. When comparing units, ISMRE2$_{70}$ provides the necessary penalty so that an equitable comparison can be made when a 70F leaving air condition is required for the application.

The power behind **your mission**

Johnson Controls