



(P.J.S)

TEHRAN MOBADDEL

Designer, Consultant & Manufacturer of HVAC, Cold room
Oil/Gas & Petrochemical systems

Remote Air Cooled Condenser



www.tehranmobaddel.com



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TM

TEHRAN
MOBADDEL

AC

AIR COOLED
CONDENSER

280

NOMINAL

C

HEAT REJECTION
COPPER

Introduction and parts description

The Tehran mobaddeh air cooled condensers are designed and manufactured for air conditioning and refrigerating systems with capacity range from 5 to 120 refrigeration tons.

These condensers are suitable to work with Tehran mobaddeh TMLC-A air cooled chillers or other compressor-evaporator combination.

All units are factory assembled and wired, with easy installation and minimum maintenance requirement. The 20 to 30 ton units are single refrigerant circuit and above are dual circuit.

Casing:

The enclosure is constructed of heavy gage galvanized sheets suitable for outdoor installation. Panels are easily removed for complete accessibility.

Coil:

Coils are produced by complete fully automatic fin line equipment. Tubes are seamless copper arranged in staggered rows, mechanically expanded into aluminum or copper fins.

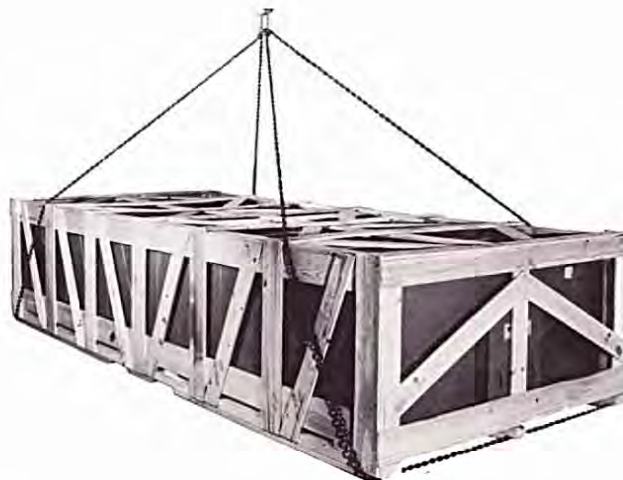
Headers made of thick wall copper tubes, brazed to coil's tubes. Coils will be leak tested, dehydrated and charged with nitrogen prior to shipment.

Fans:

Fans are propeller type, each directly driven by its own motor and positioned for vertical air discharge. Each fan is protected by a heavy gauge anodized fan guard. All fans are dynamically and statically balanced for vibration free operation. Electromotors are permanent-split-capacitor, protected with permanently lubricated ball bearings.

Packing:

All units are packed at the Factory to ensure proper crating. Fan motors are blocked to prevent damage. Legs are shipped loose resulting in 62% cubage reduction for shipment. Photograph below shows type of packing provided, plus proper method to sling and lift unit.





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Selection procedure

The total heat rejection that has been specified in tables 1 and 2 are based on nominal condition as follow:

Refrigerant: R22

Fin per inch: 10

Altitude: Sea level

For operating condition other than above please use correction factors C_1 through C_3

Example:

Given:

Refrigerant: R-22

Actual refrigeration Tons 37.8 RT

Evaporating temperature 35 °F

Condensing temperature 125 °F

Ambient air temperature 105 °F

Compressor input 38.2 KW

Fin type /FPI aluminum / 10

Altitude 2000 FT

Calculation:

1 –Heat rejection could be find as follow :

$$HR = (RT * 12000 + C.I * 3.412) * C_1 * C_2 * C_3$$

C.I : Compressor Input = 38.2 KW

RT: Refrigeration Tons = 37.8 RT

C_1 (Altitude correction factor) = 1.05 from table 3

C_2 (FPI correction) = 1 from table 4

C_3 (Refrigerant correction factor) = 1 from table 5

$$HR = (37.8 * 12000 + 38.2 * 3.412) * 1.05 * 1 * 1 = 613135 \text{ BTU/Hr} \approx 613 \text{ MBH}$$

2-Calculate Temperature Difference (TD)

TD = Condensing temperature –ambient dry air temperature

$$TD = 125 - 105 = 20 \text{ °F}$$

3-While requested fin is aluminum, from table 1 with TD = 20 select appropriate model having more than 613 MBH value .

Selected model: TMAC-740-A



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TABEL - 1 Total Heat Rejection (Aluminum Fin) (MBH)

MODEL	TD (°F)					
	10	15	20	25	30	35
TMAC - 50 - A	22	35	50	61	70	80
TMAC - 90 - A	45	70	90	114	135	155
TMAC - 140 - A	66	102	140	172	202	235
TMAC - 185 - A	90	135	185	230	270	310
TMAC - 280 - A	135	205	280	350	410	470
TMAC - 365 - A	175	270	365	455	535	618
TMAC - 460 - A	220	335	460	570	670	735
TMAC - 560 - A	274	412	560	700	825	950
TMAC - 740 - A	360	542	740	923	1085	1200
TMAC - 930 - A	450	685	930	1160	1368	1570
TMAC - 1120 - A	545	825	1120	1400	1650	1898
TMAC - 1290 - A	625	950	1290	1615	1900	2185

TABEL - 2 Total Heat Rejection (Copper Fin) (MBH)

MODEL	TD (°F)					
	10	15	20	25	30	35
TMAC - 50 - C	25	38	50	62	75	85
TMAC - 100 - C	50	72	100	122	145	170
TMAC - 150 - C	72	108	150	180	215	252
TMAC - 192 - C	95	145	192	240	290	338
TMAC - 290 - C	145	194	290	365	438	510
TMAC - 385 - C	194	292	385	484	580	675
TMAC - 475 - C	240	358	475	595	714	831
TMAC - 585 - C	290	440	585	730	878	1025
TMAC - 770 - C	385	578	770	962	1155	1348
TMAC - 970 - C	484	725	970	1208	1448	1690
TMAC - 1175 - C	585	878	1175	1460	1755	2048

TABEL - 3 ALTITUDE CORRECTION FACTOR (C_1)							
ALTITUDE (ft.)	0	1000	2000	3000	4000	5000	6000
CORRECTION FACTOR	1	1.03	1.05	1.075	1.1	1.12	1.14

TABEL - 4 FIN PER INCH CORRECTION FACTOR (C_2)				
FPI	8	10	12	14
CORRECTION FACTOR	1.08	1	0.9	0.8

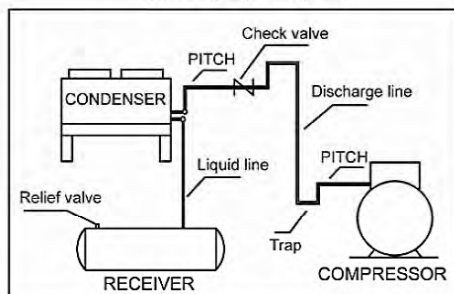
TABEL - 5 REFRIGERANT CORRECTION FACTOR (C_3)				
R- 22	R - 134 A	R - 407 C	R - 404 A	R - 502
1	1.02	0.96	0.98	1.04

Refrigerant Piping

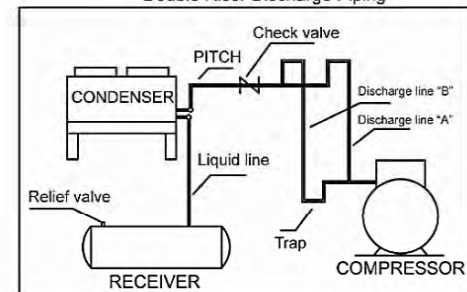
Figures below illustrates a typical piping arrangement involving a remote condenser located at a higher elevation, as commonly encountered when the condenser is on the roof and chiller is on the ground level or in a basement equipment room. In this case, the design of the discharge line is very critical. If properly sized for full load condition, the gas velocity might be too low at reduced loads to carry oil up through the discharge line and condenser coil. Reducing the discharge line size would increase the gas velocity sufficiently at reduced load conditions; however, when operating at full load, the line would be greatly undersized, and thereby create an excessive refrigerant pressure drop. This condition can be overcome in one of two following ways:

1. The discharge line may be properly sized for the desired pressure drop at full load conditions and an oil separator installed at the bottom of the trap in the discharge line from the compressor.
2. A double riser discharge line may be used as shown in Figure. Line "A" should be sized to carry the oil at minimum load conditions and the line "B" should be sized at full load condition. Both lines would have sufficient flow velocity to carry the oil to the condenser

Typical Piping Arrangement

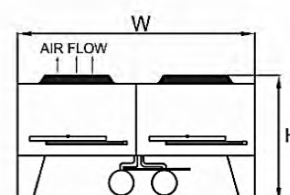
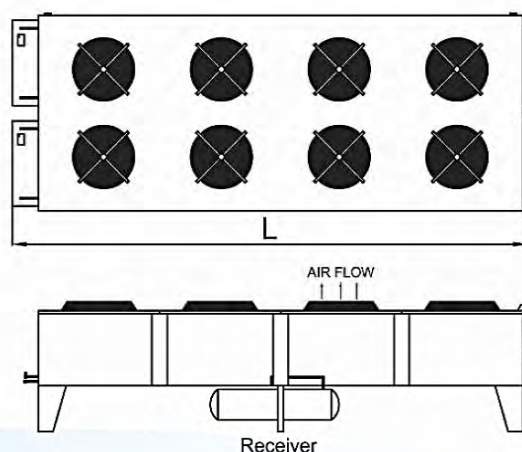


Double Riser Discharge Piping



TABEL - 6 PHYSICAL DATA											
MODEL		PROPELLER FAN PERFORMANCE				COIL			REFRIGERANT (R-22)	NO. OF CIRCUITS	WEIGHT
		CFM	No	DIAMETER (INCH)	RPM	No	ROWS DEEP	FACE AREA (ft ²)	CHARGE (kg)		KG
TMAC - 50 - A	TMAC - 50 - C	3500	1	26	950	1	3	8	3	1	160
TMAC - 90 - A	TMAC - 100 - C	7000	1	30	950	1	3	12	5	1	240
TMAC - 140 - A	TMAC - 150 - C	13500	1	36	950	1	3	18	7	1	300
TMAC - 185 - A	TMAC - 192 - C	14500	2	30	950	1	3	24	9	1	380
TMAC - 280 - A	TMAC - 290 - C	22000	3	30	950	1	3	36	13	1 & 2	550
TMAC - 365 - A	TMAC - 385 - C	29000	4	30	950	2	3	48	18	1 & 2	800
TMAC - 460 - A	TMAC - 475 - C	36000	5	30	950	2	3	59	22	1 & 2	1050
TMAC - 560 - A	TMAC - 585 - C	43000	6	30	950	2	3	74	27	1 & 2	1200
TMAC - 740 - A	TMAC - 770 - C	57500	8	30	950	4	3	96	35	1 & 2	1700
TMAC - 930 - A	TMAC - 970 - C	72000	10	30	950	4	3	122	44	1 & 2	2000
TMAC - 1120 - A	TMAC - 1175 - C	85500	12	30	950	4	3	144	53	1 & 2	2350
TMAC - 1290 - A	TMAC - 1330 - C	85500	12	30	950	4	4	146	70	1 & 2	2700

TABEL - 7 DIMENSIONS				
MODEL		L	W	H
TMAC - 50 - A	TMAC - 50 - C	1000	900	1300
TMAC - 90 - A	TMAC - 100 - C	1250	1000	1300
TMAC - 140 - A	TMAC - 150 - C	1500	1200	1300
TMAC - 185 - A	TMAC - 192 - C	2000	1200	1300
TMAC - 280 - A	TMAC - 290 - C	3000	1200	1300
TMAC - 365 - A	TMAC - 385 - C	2000	2500	1400
TMAC - 460 - A	TMAC - 475 - C	2500	2500	1400
TMAC - 560 - A	TMAC - 585 - C	3000	2500	1400
TMAC - 740 - A	TMAC - 770 - C	4300	2500	1400
TMAC - 930 - A	TMAC - 970 - C	5300	2500	1400
TMAC - 1120 - A	TMAC - 1175 - C	6300	2500	1400
TMAC - 1290 - A	TMAC - 1330 - C	6300	2500	1400





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Refrigerant Pipe sizing

Install piping according to standard accepted refrigeration practice. See Table 7 and Table 8 for discharge and liquid drain line sizes for remote condenser connections. Use only refrigeration grade copper tubing and put dry nitrogen through lines while brazing.

Discharge Lines

Design discharge lines to ensure refrigerant pressure drop is minimized (high pressure losses cause increased compressor horsepower per ton of refrigerant) and a sufficiently high gas velocity to carry oil through to the condenser coil and receiver at all loading conditions is maintained.

TABEL - 8 TONS OF REFRIGERATION								
Line Size Type L Copper OD	Discharge Line						Drain Line Velocity 100 FPM Refrigerant	
	R - 22 Sat. Suction Temp. (°F)			R - 404A, R - 507 Sat. Suction Temp. (°F)				
	-40	0	40	-40	0	40	R - 22	R - 502
1/2	0.75	0.8	0.85	0.56	0.63	0.7	2.3	1.5
5/8	1.4	1.5	1.6	1.0	1.2	1.3	3.7	2.3
7/8	3.7	4.0	4.2	2.7	3.1	3.4	7.8	4.9
1 1/8	7.5	8.0	8.5	5.5	6.3	7.0	13.2	8.3
1 3/8	13.1	14.0	14.8	9.6	10.9	12.1	20.2	12.6
1 5/8	20.7	22.0	23.4	15.2	17.2	19.1	28.5	17.9
2 1/8	42.8	45.7	48.5	31.4	35.6	39.5	49.6	31.1
2 5/8	75.4	80.4	85.4	55.3	62.8	69.5	76.5	48.0
3 1/8	120.2	128.2	136.2	87.9	99.8	110.5	109.2	68.4
3 5/8	178.4	190.3	202.1	130.5	148.1	164.0	147.8	92.6
4 1/8	251.1	267.8	284.4	183.7	208.4	230.9	192.1	120.3

Notes:

1. Source: ASHRAE Refrigeration Handbook;
2. Line sizes based on pressure drop equivalent to 1' wft per 100 equivalent feet
3. Values in Table are based on 105°F condensing temperature.
4. If subcooling is substantial or the line is short, a smaller line size may be used. Applications with very little subcooling or very long lines may require larger sizes.



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Operation Start-Up

Check for proper fan rotation. Air is drawn through the coil on all units. Be sure the fans turn freely. Rotation of the motors and blades should be in a "clock-wise" direction looking at the unit from the blade side. On three phase units, it may be necessary to reverse two of the three power leads to the unit.

Discharge Gas Pulsation

Gas pulsations in a refrigeration system are most commonly associated with the compressor and connecting discharge piping. Variations in the system piping configuration, line sizing, operating pressures and compressor and component mounting all contribute to the presence and magnitude of these pulsations. The vibration and movement of components caused by the pulsations may result in line breakage or damage to the condenser. In order to eliminate discharge pulsations and the potential for related condenser damage, install a discharge muffler in the refrigeration piping. Follow the recommendations of the compressor or muffler manufacturer when selecting these components.

Low Ambient Operation Head Pressure Control

The capacity of an air-cooled condenser varies with the difference between the entering air dry bulb temperature and the condensing temperature of the refrigerant. Since air temperature in some regions varies from summer to winter, the condensing temperature must be kept high enough to ensure proper operation of the refrigerant expansion valve during low ambient operation, and also allow enough capacity to ensure excessively high condensing temperatures do not occur air temperature, additional head pressure control will be required.

The low limit of the head pressure is dependent upon the required pressure drop across the thermostatic expansion valve. For normal air conditioning applications, maintain head pressure above a condensing temperature corresponding to 90° F. This corresponds to a normal lower limit of about 60°F ambient air. When operation is required below 60°F ambient during high ambient conditions.

Fan Cycling

A decrease in ambient air temperature results in a capacity increase in the air-cooled condenser. This capacity increase is directly proportional to the temperature difference between the condensing temperature and the temperature of the ambient air entering the condenser. Air-cooled condensers are often required to operate over a wide range of ambient air temperatures and variable loading conditions. Provisions must be made to maintain the overall system balance. Low head pressures cause poor expansion valve operation and poor system operation. The cycling of condenser fans provides an automatic means of maintaining head pressure control, within reasonable limits, at lower ambient air temperatures. A fan cycling control system allows fans to cycle in sequence by sensing condensing pressures. Short cycling is normally caused by too close a differential in the control settings or set points. If flooding valves are used with fan cycling, set valves to follow the fan cycling. Set pressure switches to at least 35 PSIG differential setting. Any fan cycle that is less than three minutes is considered short cycling, and could be detrimental to the system. Adjust controls accordingly. Wire the fan closest to the header end of the condenser to run continuously, whenever the compressor(s) is (are) operational.

Space and Location Requirements

The most important consideration which must be taken into account when deciding upon the location of air-cooled

equipment is the provision for a supply of ambient air to the condenser, and removal of heated air from the condenser area. Where this essential requirement is not adhered to, it will result in higher head pressures, which cause poor operation and possible eventual failure of equipment. Units must not be located in the vicinity of steam, hot air or fume exhausts.

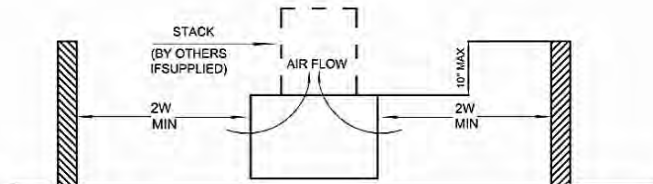
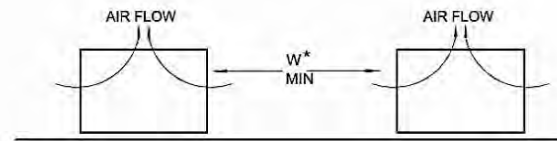
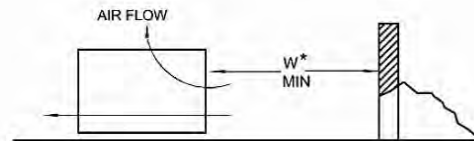
Another consideration which must be taken is that the unit should be mounted away from noise sensitive spaces and must have adequate support to avoid vibration and noise transmission into the building. Units should be mounted over corridors, utility areas, rest rooms and other auxiliary areas where high levels of sound are not an important factor. Sound and structural consultants should be retained for recommendations.

Walls or Obstructions

The unit should be located so that air may circulate freely and not be recirculated. For proper air flow and access all sides of the unit should be a minimum of "W" away from any wall or obstruction. It is preferred that this distance be increased whenever possible. Care should be taken to see that ample room is left for maintenance work through access doors and panels. Overhead obstructions are not permitted. When the unit is in an area where it is enclosed by three walls the unit must be installed as indicated for units in a pit.

Multiple Units

For units placed side by side, the minimum distance between units is the width of the largest unit. If units are placed end to end, the minimum distance between units is 4 feet.



Units in Pits

The top of the unit should be level with the top of the pit, and

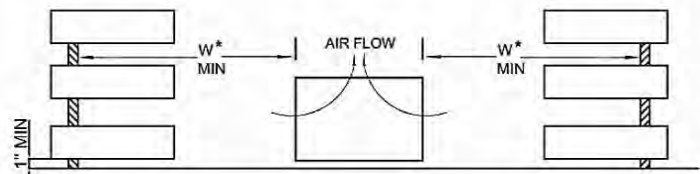
side distance increased to "2W".

If the top of the unit is not level with the top of pit, discharge cones or stacks must be used to raise discharge air to the top of the pit. This is a minimum requirement.

Decorative fences

Fences must have 50% free area with 1 foot undercut, a "W" minimum clearance and must not exceed the top of unit.

If these requirements are not met, unit must be installed as indicated for "Units in pits".



"W" = Total width of the condenser