|  |
| --- |
| **طرح نگهداشت و افزایش تولید 27 مخزن** |
| **HVAC CALCULATION NOTE FOR SWITCHGEAR BUILDING – BK05** **نگهداشت و افزایش تولید میدان نفتی بینک** |
|  |  |  |  |  |  |  |
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|  |  |  |  |  |  |  |
| D00 | SEP. 2023 | IFC | K.Ahmadi | M.Fakharian | S.Faramarzpour |  |
| **Rev.** | **Date** | **Purpose of Issue/Status** | **Prepared by:** | **Checked by:** | **Approved by:** | **CLIENT Approval** |
| **Class: 2** | **CLIENT Doc. Number:** **F0Z-708440** |
| **Status:** | **IDC: Inter-Discipline Check****IFC: Issued For Comment** **IFA: Issued For Approval** **AFD: Approved For Design** **AFC: Approved For Construction** **AFP: Approved For Purchase****AFQ:** Approved For Quotation **IFI: Issued For Information****AB-R: As-Built for CLIENT Review** **AB-A: As-Built –Approved** |

**REVISION RECORD SHEET**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PAGE** | **D00** | **D01** | **D02** | **D03** | **D04** |  | **PAGE** | **D00** | **D01** | **D02** | **D03** | **D04** |
| **1** | **X** |  |  |  |  | **58** |  |  |  |  |  |
| **2** | **X** |  |  |  |  | **59** |  |  |  |  |  |
| **3** | **X** |  |  |  |  | **60** |  |  |  |  |  |
| **4** | **X** |  |  |  |  | **61** |  |  |  |  |  |
| **5** | **X** |  |  |  |  | **62** |  |  |  |  |  |
| **6** | **X** |  |  |  |  | **63** |  |  |  |  |  |
| **7** | **X** |  |  |  |  | **64** |  |  |  |  |  |
| **8** | **X** |  |  |  |  | **65** |  |  |  |  |  |
| **9** | **X** |  |  |  |  | **66** |  |  |  |  |  |
| **10** | **X** |  |  |  |  | **67** |  |  |  |  |  |
| **11** | **X** |  |  |  |  | **68** |  |  |  |  |  |
| **12** | **X** |  |  |  |  | **69** |  |  |  |  |  |
| **13** | **X** |  |  |  |  | **70** |  |  |  |  |  |
| **14** | **X** |  |  |  |  | **71** |  |  |  |  |  |
| **15** | **X** |  |  |  |  | **72** |  |  |  |  |  |
| **16** | **X** |  |  |  |  | **73** |  |  |  |  |  |
| **17** | **X** |  |  |  |  | **74** |  |  |  |  |  |
| **18** | **X** |  |  |  |  | **75** |  |  |  |  |  |
| **19** | **X** |  |  |  |  | **76** |  |  |  |  |  |
| **20** | **X** |  |  |  |  | **77** |  |  |  |  |  |
| **21** | **X** |  |  |  |  | **78** |  |  |  |  |  |
| **22** |  |  |  |  |  | **79** |  |  |  |  |  |
| **23** |  |  |  |  |  | **80** |  |  |  |  |  |
| **24** | X |  |  |  |  | **81** |  |  |  |  |  |
| **25** | X |  |  |  |  | **82** |  |  |  |  |  |
| **26** | X |  |  |  |  | **83** |  |  |  |  |  |
| **27** | X |  |  |  |  | **84** |  |  |  |  |  |
| **28** | X |  |  |  |  | **85** |  |  |  |  |  |
| **29** | X |  |  |  |  | **86** |  |  |  |  |  |
| **30** |  X |  |  |  |  | **87** |  |  |  |  |  |
| **31** | X |  |  |  |  | **88** |  |  |  |  |  |
| **32** |  X |  |  |  |  | **89** |  |  |  |  |  |
| **33** |  |  |  |  |  | **90** |  |  |  |  |  |
| **34** |  |  |  |  |  | **91** |  |  |  |  |  |
| **35** |  |  |  |  |  | **92** |  |  |  |  |  |
| **36** |  |  |  |  |  | **93** |  |  |  |  |  |
| **37** |  |  |  |  |  | **94** |  |  |  |  |  |
| **38** |  |  |  |  |  | **95** |  |  |  |  |  |
| **39** |  |  |  |  |  | **96** |  |  |  |  |  |
| **40** |  |  |  |  |  | **97** |  |  |  |  |  |
| **41** |  |  |  |  |  | **98** |  |  |  |  |  |
| **42** |  |  |  |  |  | **99** |  |  |  |  |  |
| **43** |  |  |  |  |  | **100** |  |  |  |  |  |
| **44** |  |  |  |  |  | **101** |  |  |  |  |  |
| **45** |  |  |  |  |  | **102** |  |  |  |  |  |
| **46** |  |  |  |  |  | **103** |  |  |  |  |  |
| **47** |  |  |  |  |  | **104** |  |  |  |  |  |
| **48** |  |  |  |  |  | **105** |  |  |  |  |  |
| **49** |  |  |  |  |  | **106** |  |  |  |  |  |
| **50** |  |  |  |  |  | **107** |  |  |  |  |  |
| **51** |  |  |  |  |  | **108** |  |  |  |  |  |
| **52** |  |  |  |  |  | **109** |  |  |  |  |  |
| **53** |  |  |  |  |  | **110** |  |  |  |  |  |
| **54** |  |  |  |  |  | **111** |  |  |  |  |  |
| **55** |  |  |  |  |  | **112** |  |  |  |  |  |
| **56** |  |  |  |  |  | **113** |  |  |  |  |  |
| **57** |  |  |  |  |  | **114** |  |  |  |  |  |

**CONTENTS**

[1.0 INTRODUCTION 4](#_Toc146623136)

[2.0 Scope 4](#_Toc146623137)

[3.0 NORMATIVE REFERENCES 5](#_Toc146623138)

[3.1 Local Codes and Standards 5](#_Toc146623139)

[3.2 International Codes and Standards 5](#_Toc146623140)

[3.3 ENVIRONMENTAL DATA 5](#_Toc146623141)

[4.0 HVAC CALCULATION 6](#_Toc146623142)

[4.1 Design weather Parameters: 6](#_Toc146623143)

[4.2 CONSTRUCTIONS U-VALUE: 8](#_Toc146623144)

[4.3 SPACE INPUT DATA: 10](#_Toc146623145)

[4.4 SYSTEM INPUT DATA: 12](#_Toc146623146)

[4.5 AIR SYSTEM SIZING SUMMARY 13](#_Toc146623147)

[4.6 ventilation sizing summary 14](#_Toc146623148)

[4.7 air system design load summary: 15](#_Toc146623149)

[4.8 ZONE DESIGN LOAD SUMMARY: 16](#_Toc146623150)

[4.9 SPACE DESIGN LOAD SUMMARY: 17](#_Toc146623151)

[5.0 Equipment Selection 19](#_Toc146623152)

[5.1 Air Conditioning Unit 19](#_Toc146623153)

[5.2 Exhaust fan selection 20](#_Toc146623154)

[5.3 SAND TRAP LOUVER SELECTION 21](#_Toc146623155)

1. **INTRODUCTION**

Binak oilfield in Bushehr province is a part of the southern oilfields of Iran, is located 20 km northwest of Genaveh city.

With the aim of increasing production of oil from Binak oilfield, an EPC/EPD Project has been defined by NIOC/NISOC and awarded to Petro Iran Development Company (PEDCO).Also PEDCO (as General Contractor) has assigned the EPC-packages of the Project to "Hirgan Energy - Design and Inspection" JV.

**GENERAL DEFINITION**

The following terms shall be used in this document.

|  |  |
| --- | --- |
| CLIENT:  | National Iranian South Oilfields Company (NISOC)  |
| PROJECT: | Binak Oilfield Development – General Facilities |
| GENERAL CONTRACTOR (GC):  | Petro Iran Development Company (PEDCO) |
| EPC CONTRACTOR: | Joint Venture of :Hirgan Energy – Design & Inspection(D&I) Companies |
| VENDOR: | The firm or person who will fabricate the equipment or material. |
| EXECUTOR:  | Executor is the party which carries out all or part of construction and/or commissioning for the project. |
| THIRD PARTY INSPECTOR (TPI): | The firm appointed by EPD/EPC CONTRACTOR (GC) and approved by CLIENT (in writing) for the inspection of goods. |
| SHALL: | Is used where a provision is mandatory. |
| SHOULD: | Is used where a provision is advisory only. |
| WILL:  | Is normally used in connection with the action by CLIENT rather than by an EPC/EPD CONTRACTOR, supplier or VENDOR |
| MAY:  | Is used where a provision is completely discretionary. |

1. **Scope**

This document covers minimum necessary requirements for basis of design and main equipment’s to be used for the Heating, Ventilating, Air-Conditioning and pressurizing and plumbing system for buildings for project

1. **NORMATIVE REFERENCES**

## Local Codes and Standards

* IPS Iranian petroleum standards
* INBC Iranian National Building Code

## International Codes and Standards

* ASTM American Society for Testing Materials Relevant Parts
* API 610 Centrifugal Pumps for General Refinery Service, 10th Edition
* ISO 15156 Petroleum and Natural Gas Industries. Materials for use in H2S Containing Environments in Oil and Gas

Production

* AMCA Air Movement and Control Association
* ANSI American National Standards Institute.
* ASHRAE American Society of Heating, Refrigeration and Air-conditioning Engineer
* ASTM American Society for Testing and Material
* BOCA Building Officials and Code Administrators international
* BS British Standards
* CIBSE Chartered Institute of Building Services Engineers.
* NFPA National fire protection association
* SBCCI Southern Building Code Congress International
* SMACNA Sheet Metal and Air Conditioning Contractors’ National Association
* AWWA [American Water Works Association](http://www.awwa.org/)
* ASME [The American Society of Mechanical Engineers](https://www.asme.org/)

Note: The latest issued or revised edition of all above mentioned codes and standards shall be considered as reference.

## ENVIRONMENTAL DATA

Refer to "Process Basis of Design; Doc. No BK-GNRAL-PEDCO-000-PR-DB-0001.

1. **HVAC CALCULATION**

## Design weather Parameters:

**Design Parameters:**

    City Name   **Binak**

    Location   **IRAN**

    Latitude   **29.7** Deg.

    Longitude   **-50.4** Deg.

    Elevation   **26.2** m

    Summer Design Dry-Bulb   **41.0** °C

    Summer Coincident Wet-Bulb   **32.0** °C

    Summer Daily Range   **16.7** °K

    Winter Design Dry-Bulb   **6.0** °C

    Winter Design Wet-Bulb   **6.0** °C

    Atmospheric Clearness Number   **1.00**

    Average Ground Reflectance   **0.20**

    Soil Conductivity   **1.385** W/ (m-°K)

    Local Time Zone (GMT +/- N hours)   **-3.5** hours

    Consider Daylight Savings Time   **No**

    Simulation Weather Data   **noneN/A**

    Current Data is   **User Modified**

    Design Cooling Months  **January to December**

**Design Day Maximum Solar Heat Gains**

    (The MSHG values are expressed in W/m² )

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Month** | **N** | **NNE** | **NE** | **ENE** | **E** | **ESE** | **SE** | **SSE** | **S** |
| January | 77.5 | 77.5 | 95.1 | 360.4 | 561.2 | 730.9 | 794.1 | 786.3 | 762.3 |
| February | 89.1 | 89.1 | 206.7 | 484.1 | 668.9 | 760.8 | 782.0 | 718.9 | 671.9 |
| March | 101.4 | 120.5 | 367.4 | 576.2 | 723.5 | 759.6 | 702.5 | 590.8 | 520.1 |
| April | 113.0 | 252.7 | 487.2 | 636.6 | 705.1 | 688.3 | 568.6 | 408.7 | 322.0 |
| May | 124.3 | 351.1 | 551.9 | 666.3 | 679.9 | 619.4 | 469.6 | 279.8 | 199.5 |
| June | 161.0 | 389.1 | 570.0 | 664.8 | 662.8 | 586.8 | 421.4 | 228.9 | 165.7 |
| July | 128.9 | 355.9 | 541.6 | 644.7 | 671.3 | 606.9 | 452.1 | 270.2 | 196.1 |
| August | 118.3 | 256.1 | 470.7 | 606.2 | 686.0 | 663.8 | 546.8 | 395.4 | 311.9 |
| September | 104.3 | 109.2 | 354.3 | 538.8 | 681.8 | 728.9 | 670.0 | 569.4 | 503.5 |
| October | 91.2 | 91.2 | 226.5 | 441.2 | 642.7 | 746.9 | 748.8 | 692.4 | 650.8 |
| November | 78.1 | 78.1 | 103.7 | 341.8 | 572.3 | 707.9 | 785.7 | 774.1 | 747.8 |
| December | 71.9 | 71.9 | 71.9 | 306.4 | 524.4 | 699.0 | 788.1 | 799.2 | 780.7 |
| **Month** | **SSW** | **SW** | **WSW** | **W** | **WNW** | **NW** | **NNW** | **HOR** | **Mult** |
| January | 779.8 | 791.7 | 733.2 | 577.4 | 337.4 | 108.2 | 77.5 | 591.4 | 1.00 |
| February | 716.3 | 777.2 | 772.2 | 650.4 | 482.8 | 225.6 | 89.1 | 714.5 | 1.00 |
| March | 590.5 | 703.8 | 755.6 | 713.7 | 589.1 | 369.6 | 114.3 | 816.8 | 1.00 |
| April | 413.5 | 574.6 | 682.6 | 707.6 | 645.8 | 485.9 | 241.4 | 863.3 | 1.00 |
| May | 282.1 | 471.6 | 614.4 | 688.4 | 669.7 | 550.4 | 343.5 | 875.1 | 1.00 |
| June | 233.1 | 424.2 | 577.0 | 674.2 | 670.6 | 567.0 | 376.4 | 872.9 | 1.00 |
| July | 274.2 | 458.7 | 596.0 | 677.5 | 657.5 | 539.9 | 345.0 | 865.3 | 1.00 |
| August | 398.9 | 554.0 | 657.3 | 682.8 | 624.7 | 473.1 | 240.3 | 846.4 | 1.00 |
| September | 569.0 | 669.3 | 728.9 | 681.0 | 540.4 | 354.6 | 108.6 | 783.8 | 1.00 |
| October | 697.0 | 755.4 | 737.2 | 647.9 | 457.7 | 216.5 | 91.2 | 696.8 | 1.00 |
| November | 775.6 | 786.0 | 708.0 | 568.2 | 351.0 | 91.0 | 78.1 | 582.8 | 1.00 |
| December | 798.2 | 790.7 | 685.6 | 536.9 | 295.2 | 71.9 | 71.9 | 533.5 | 1.00 |

    Mult. = User-defined solar multiplier factor.

**Design Temperature Profile**



## CONSTRUCTIONS U-VALUE:

**Wall (Anti acid ceramic tile)**

**Wall Details**

    Outside Surface Color   **Medium**

    Absorptivity   **0.675**

    Overall U-Value   **0.217** W/ (m²-°K)

**Wall Layers Details (Inside to Outside)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Thickness** | **Density** | **Specific Ht.** | **R-Value** | **Weight** |
| **Layers** | **mm** | **kg/m³** | **kJ / (kg - °K)** | **(m²-°K)/W** | **kg/m²** |
| Inside surface resistance | 0.000 | 0.0 | 0.00 | 0.12064 | 0.0 |
| Anti acid ceramic tile | 12.500 | 1000.0 | 0.34 | 0.03676 | 12.5 |
| Cement plaster | 25.000 | 1600.0 | 0.80 | 0.03125 | 40.0 |
| Wall brick | 200.000 | 2000.0 | 0.20 | 1.00000 | 400.0 |
| Rock wool | 50.000 | 25.0 | 0.05 | 1.00000 | 1.3 |
| Cement plaster | 30.000 | 1600.0 | 0.80 | 0.03750 | 48.0 |
| Face brick | 70.000 | 2000.0 | 0.03 | 2.33000 | 140.0 |
| Outside surface resistance | 0.000 | 0.0 | 0.00 | 0.05864 | 0.0 |
| **Totals** | **387.500** | **-** |  | **4.61479** | **641.8** |

**Wall (Cement plaster)**

**Wall Details**

    Outside Surface Color   **Medium**

    Absorptivity   **0.675**

    Overall U-Value   **0.218** W/ (m²-°K)

**Wall Layers Details (Inside to Outside)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Thickness** | **Density** | **Specific Ht.** | **R-Value** | **Weight** |
| **Layers** | **mm** | **kg/m³** | **kJ / (kg - °K)** | **(m²-°K)/W** | **kg/m²** |
| Inside surface resistance | 0.000 | 0.0 | 0.00 | 0.12064 | 0.0 |
| Cement plaster | 25.000 | 1600.0 | 0.80 | 0.03125 | 40.0 |
| Wall brick | 200.000 | 2000.0 | 0.20 | 1.00000 | 400.0 |
| Rock wool | 50.000 | 25.0 | 0.05 | 1.00000 | 1.3 |
| Cement plaster | 30.000 | 1600.0 | 0.80 | 0.03750 | 48.0 |
| Face brick | 70.000 | 2000.0 | 0.03 | 2.33000 | 140.0 |
| Outside surface resistance | 0.000 | 0.0 | 0.00 | 0.05864 | 0.0 |
| **Totals** | **375.000** | **-** |  | **4.57803** | **629.3** |

**Roof**

**Roof Details**

    Outside Surface Color   **Medium**

    Absorptivity   **0.675**

    Overall U-Value   **0.479** W/ (m²-°K)

**Roof Layers Details (Inside to Outside)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Thickness** | **Density** | **Specific Ht.** | **R-Value** | **Weight** |
| **Layers** | **mm** | **kg/m³** | **kJ / (kg - °K)** | **(m²-°K)/W** | **kg/m²** |
| Inside surface resistance | 0.000 | 0.0 | 0.00 | 0.12064 | 0.0 |
| HW concrete | 200.000 | 2242.6 | 0.84 | 0.11556 | 448.5 |
| Rock wool | 50.000 | 25.0 | 0.84 | 1.00000 | 1.3 |
| LW concrete | 100.000 | 640.7 | 0.84 | 0.57779 | 64.1 |
| Waterproofing/isogume or similar | 4.000 | 1000.0 | 1.67 | 0.17390 | 4.0 |
| Cement plaster | 25.000 | 1600.0 | 0.80 | 0.03750 | 40.0 |
| Terrazzo tile | 25.000 | 2000.0 | 0.84 | 0.00185 | 50.0 |
| Outside surface resistance | 0.000 | 0.0 | 0.00 | 0.05864 | 0.0 |
| **Totals** | **404.000** | **-** |  | **2.08588** | **607.8** |

**M.D.-1**

**Door Details:**

    Gross Area   **2.6** m²

    Door U-Value   **5.800** W/ (m²-°K)

**Glass Details:**

    Glass Area   **0.0** m²

    Glass U-Value   **3.293** W/ (m²-°K)

    Glass Shade Coefficient   **0.880**

    Glass Shaded All Day?   **No**

**M.D.-2**

**Door Details:**

    Gross Area   **5.0** m²

    Door U-Value   **5.800** W/ (m²-°K)

**Glass Details:**

    Glass Area   **0.0** m²

    Glass U-Value   **3.293** W/ (m²-°K)

    Glass Shade Coefficient   **0.880**

    Glass Shaded All Day?   **No**

## SPACE INPUT DATA:

**00-Swithchgear Room**

**1. General Details:**

    Floor Area   **59.5** m²

    Avg. Ceiling Height   **4.5** m

    Building Weight   **341.8** kg/m²

**1.1. OA Ventilation Requirements:**

    Space Usage   **User-Defined**

    OA Requirement 1   **0.0** L/s/person

    OA Requirement 2   **0.00** L/ (s-m²)

    Space Usage Defaults   **ASHRAE Standard 62.1-2010**

**2. Internals:**

**2.1. Overhead Lighting:**

    Fixture Type   **Recessed (Unvented)**

    Wattage   **14.00** W/m²

    Ballast Multiplier   **1.25**

    Schedule   **Lighting**

**2.2. Task Lighting:**

    Wattage   **0.00** W/m²

    Schedule   **None**

**2.3. Electrical Equipment:**

    Wattage   **6500.0** Watts

    Schedule   **Electrical Eq.**

**2.4. People:**

    Occupancy   **0.0** Person

    Activity Level   **Office Work**

    Sensible   **71.8** W/person

    Latent   **60.1**W/person

    Schedule   **None**

**2.5. Miscellaneous Loads:**

    Sensible   **0** W

    Schedule   **None**

    Latent   **0** W

    Schedule   **None**

**3. Walls, Windows, Doors:**

| **Exp.** | **Wall Gross Area (m²)** | **Window 1 Qty.** | **Window 2 Qty.** | **Door 1 Qty.** |
| --- | --- | --- | --- | --- |
| NE | 26.5 | 0 | 0 | 1 |
| NW | 45.6 | 0 | 0 | 0 |
| SW | 26.7 | 0 | 0 | 1 |
| SE | 31.3 | 0 | 0 | 0 |

**3.1. Construction Types for Exposure NE**

    Wall Type   **Wall (Cement plaster)**

    Door Type   **M.D.-2**

**3.2. Construction Types for Exposure NW**

    Wall Type   **Wall (Cement plaster)**

**3.3. Construction Types for Exposure SW**

    Wall Type   **Wall (Cement plaster)**

    Door Type   **M.D.-1**

**3.4. Construction Types for Exposure SE**

    Wall Type   **Wall (Cement plaster)**

**4. Roofs, Skylights:**

| **Exp.** | **Roof Gross Area (m²)** | **Roof Slope (deg.)** | **Skylight Qty.** |
| --- | --- | --- | --- |
| H | 59.5 | 0 | 0 |

**4.1. Construction Types for Exposure H**

    Roof Type   **Roof**

**5. Infiltration:**

    Design Cooling   **1.00** ACH

    Design Heating   **1.00** ACH

    Energy Analysis   **1.00** ACH

    Infiltration occurs at all hours

**6. Floors:**

    Type   **Slab Floor On Grade**

    Floor Area   **59.5** m²

    Total Floor U-Value   **0.568** W/ (m²-°K)

    Exposed Perimeter   **28.9** m

    Edge Insulation R-Value   **0.00** (m²-°K)/W

**7. Partitions:**

    **(No partition data).**

**01-Battery Room**

**1. General Details:**

    Floor Area   **9.9** m²

    Avg. Ceiling Height   **5.3** m

    Building Weight   **341.8** kg/m²

**1.1. OA Ventilation Requirements:**

    Space Usage   **User-Defined**

    OA Requirement 1   **0.0** L/s/person

    OA Requirement 2   **0.00** L/ (s-m²)

    Space Usage Defaults   **ASHRAE Standard 62.1-2010**

**2. Internals:**

**2.1. Overhead Lighting:**

    Fixture Type   **Recessed (Unvented)**

    Wattage   **14.00** W/m²

    Ballast Multiplier   **1.25**

    Schedule   **Lighting**

**2.2. Task Lighting:**

    Wattage   **0.00** W/m²

    Schedule   **None**

**2.3. Electrical Equipment:**

    Wattage   **200.0** Watts

    Schedule   **Electrical Eq.**

**2.4. People:**

    Occupancy   **0.0** Person

    Activity Level   **Office Work**

    Sensible   **71.8**W/person

    Latent   **60.1**W/person

    Schedule   **None**

**2.5. Miscellaneous Loads:**

    Sensible   **0** W

    Schedule   **None**

    Latent   **0** W

    Schedule   **None**

**3. Walls, Windows, Doors:**

| **Exp.** | **Wall Gross Area (m²)** | **Window 1 Qty.** | **Window 2 Qty.** | **Door 1 Qty.** |
| --- | --- | --- | --- | --- |
| NE | 16.6 | 0 | 0 | 0 |
| SE | 16.9 | 0 | 0 | 1 |
| SW | 16.6 | 0 | 0 | 0 |

**3.1. Construction Types for Exposure NE**

    Wall Type   **Wall (Anti acid ceramic tile)**

**3.2. Construction Types for Exposure SE**

    Wall Type   **Wall (Anti acid ceramic tile)**

    Door Type   **M.D.-1**

**3.3. Construction Types for Exposure SW**

    Wall Type   **Wall (Anti acid ceramic tile)**

**4. Roofs, Skylights:**

| **Exp.** | **Roof Gross Area (m²)** | **Roof Slope (deg.)** | **Skylight Qty.** |
| --- | --- | --- | --- |
| H | 59.5 | 0 | 0 |

**4.1. Construction Types for Exposure H**

    Roof Type   **Roof**

**5. Infiltration:**

    Design Cooling   **6.00** ACH

    Design Heating   **6.00** ACH

    Energy Analysis   **6.00** ACH

    Infiltration occurs at all hours.

**6. Floors:**

    Type   **Slab Floor On Grade**

    Floor Area   **9.9** m²

    Total Floor U-Value   **0.568** W/ (m²-°K)

    Exposed Perimeter   **9.5** m

    Edge Insulation R-Value   **0.00** (m²-°K)/W

**7. Partitions:**

    **(No partition data).**

## SYSTEM INPUT DATA:

**1. General Details:**

    Air System Name   **Default System**

    Equipment Type   **Terminal Units**

    Air System Type   **Split DX Fan Coil**

    Number of zones   **2**

    Ventilation   **Direct Ventilation**

**2. Ventilation System Components:**

(Common Ventilation System not used: no inputs)

**3. Zone Components:**

**Space Assignments:**

|  |  |
| --- | --- |
| **Zone 1: Switchgear Room** |   |
| 00-Swithchgear Room | x1 |
| **Zone 2: Battery Room** |   |
| 01-Battery Room | x1 |

**Thermostats and Zone Data:**

| **Zone** | **Cooling T-Stat Occ.** | **Cooling T-Stat Unocc.** | **Heating T-Stat Occ.** | **Heating T-Stat Unocc.** | **T-Stat Throttling Range** |
| --- | --- | --- | --- | --- | --- |
|  | **(°C)** | **(°C)** | **(°C)** | **(°C)** | **(°C)** |
| **1** | 30.0 | 30.0 | 10.0 | 10.0 | 0.83 |
| **2** | 27.0 | 27.0 | 21.0 | 21.0 | 0.83 |

    Thermostat Schedule   **Fan**

    Unoccupied Cooling is   **Available**

**Common Terminal Unit Data:**

    **Cooling Coil:**

    Design Supply Temperature   **22.0** °C

    Coil Bypass Factor   **0.100**

    Cooling Source   **Air-Cooled DX**

    Schedule   **JFMAMJJASOND**

    **Heating Coil:**

    Design Supply Temperature   **35.0** °C

    Heating Source   **Air Source Heat Pump**

    Schedule   **JFMAMJJASOND**

    Fan Control   **Fan On**

    Ventilation Sizing Method   **ASHRAE Std 62.1-2010**

**Terminal Units Data:**

    Zone   **All**

    Terminal Type   **Fan Coil**

    Minimum Airflow   **0.00** L/s/person

    Fan Performance   **0** Pa

    Fan Overall Efficiency   **50** %

**4. Sizing Data (Computer-Generated):**

**System Sizing Data:**

    **Sizing Data:**

    Cooling Supply Temperature   **22.0** °C

    Heating Supply Temperature   **35.0** °C

    **Hydronic Sizing Specifications:**

    Chilled Water Delta-T   **5.6** °K

    Hot Water Delta-T   **11.1** °K

    **Safety Factors:**

    Cooling Sensible   **10** %

    Cooling Latent   **10** %

    Heating   **10** %

**Zone Sizing Data:**

    Zone Airflow Sizing Method   **Peak zone sensible load**

    Space Airflow Sizing Method   **Individual peak space loads**

| **Zone** | **Supply Airflow** | **Zone Htg Unit** | **Reheat Coil** | **Ventilation** |
| --- | --- | --- | --- | --- |
|  | **(L/s)** | **(kW)** | **(kW)** | **(L/s)** |
| **1** | 946.0 | - | - | 0.0 |
| **2** | 365.0 | - | - | 0.0 |

## AIR SYSTEM SIZING SUMMARY

**Air System Information**

   Air System Name   **Default System**

    Equipment Class   **TERM**

    Air System Type   **SPLT-FC**

Number of zones   **2**

Floor Area   **69.4** m²

Location   **Binak, IRAN**

**Sizing Calculation Information**

Calculation Months   **Jan to Dec**

Sizing Data   **Calculated**

Zone L/s Sizing   **Peak zone sensible load**

Space L/s Sizing   **Individual peak space loads**

**Air System Information**

    Air System Name   **Default System**

    Equipment Class   **TERM**

    Air System Type   **SPLT-FC**

Number of zones   **2**

Floor Area   **69.4** m²

Location   **Binak, IRAN**

**Sizing Calculation Information**

Calculation Months   **Jan to Dec**

Sizing Data   **Calculated**

**Zone Sizing Data**

|  | **Maximum** |  |  |  | **Maximum** | **Zone** |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Cooling** | **Design** | **Minimum** |  | **Heating** | **Floor** |  |
|  | **Sensible** | **Airflow** | **Airflow** | **Time of** | **Load** | **Area** | **Zone** |
| **Zone Name** | **(kW)** | **(L/s)** | **(L/s)** | **Peak Load** | **(kW)** | **(m²)** | **L/ (s-m²)** |
| Switchgear Room | 9.1 | 946 | 946 | Jul 1500 | 0.9 | 59.5 | 15.90 |
| Battery Room | 2.2 | 365 | 365 | Jul 1500 | 2.3 | 9.9 | 36.87 |

**Terminal Unit Sizing Data – Cooling**

|  | **Total** | **Sens** | **Coil** | **Coil** | **Water** | **Time** |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Coil** | **Coil** | **Entering** | **Leaving** | **Flow** | **of** |
|  | **Load** | **Load** | **DB / WB** | **DB / WB** | **@ 5.6 °K** | **Peak** |
| **Zone Name** | **(kW)** | **(kW)** | **(°C)** | **(°C)** | **(L/s)** | **Load** |
| Switchgear Room | 13.1 | 9.0 | 30.5 / 25.1 | 22.5 / 22.0 | - | Jul 1500 |
| Battery Room | 2.8 | 2.1 | 27.5 / 24.1 | 22.7 / 22.4 | - | Jul 1500 |

**Terminal Unit Sizing Data - Heating, Fan, Ventilation**

|  |  | **Heating** | **Htg Coil** |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Heating** | **Coil** | **Water** | **Fan** |  |  | **OA Vent** |
|  | **Coil** | **Ent/Lvg** | **Flow** | **Design** | **Fan** | **Fan** | **Design** |
|  | **Load** | **DB** | **@11.1 °K** | **Airflow** | **Motor** | **Motor** | **Airflow** |
| **Zone Name** | **(kW)** | **(°C)** | **(L/s)** | **(L/s)** | **(BHP)** | **(kW)** | **(L/s)** |
| Switchgear Room | 3.1 | 21.8 / 24.5 | - | 946 | 0.000 | 0.000 | 0 |
| Battery Room | 2.3 | 209 / 26.1 | - | 365 | 0.000 | 0.000 | 0 |

**Space Loads and Airflows**

|  |  | **Cooling** | **Time** | **Air** | **Heating** | **Floor** |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Zone Name /** |  | **Sensible** | **of** | **Flow** | **Load** | **Area** | **Space** |
|  **Space Name** | **Mult.** | **(kW)** | **Load** | **(L/s)** | **(kW)** | **(m²)** | **L/ (s-m²)** |
| ***Switchgear Room*** |  |  |  |  |  |  |  |
|  00-Swithchgear Room  | 1 | 9.1 | Jul 1500 | 946 | 0.9 | 59.5 | 15.90 |
| ***Battery Room*** |  |  |  |  |  |  |  |
|  01-Battery Room  | 1 | 2.2 | Jul 1500 | 365 | 2.3 | 9.9 | 36.87 |

## ventilation sizing summary

**1. Summary**

    Ventilation Sizing Method   **ASHRAE Std 62.1-2010**

    Design Condition   **Cooling operation**

**2. Space Ventilation Analysis Table**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | **Space** | **Area** | **Time** | **People** |  |  | **Breathing** |  |
|  |  |  | **Floor** | **Outdoor** | **Averaged** | **Outdoor** | **Air** | **Space** | **Zone** | **Space** |
|  |  | **Supply Air** | **Area** | **Air Rate** | **Occupancy** | **Air Rate** | **Distribution** | **Outdoor Air** | **Outdoor Air** | **Ventilation** |
|  |  | **(L/s)** | **(m²)** | **(L/ (s-m²))** | **(Occupants)** | **(L/s/person)** | **Effectiveness** | **(L/s)** | **(L/s)** | **Efficiency** |
| **Zone Name / Space Name** | **Mult.** | **(Vpz)** | **(Az)** | **(Ra)** | **(Pz)** | **(Rp)** | **(Ez)** | **(Voz)** | **(Vbz)** | **(Evz)** |
| **Switchgear Room** |  |  |  |  |  |  |  |  |  |  |
|  00-Swithchgear Room | 1 | 946 | 59.5 | 0.00 | 0.0 | 0.00 | 1.00 | **0** | *0* | 1.000 |
| **Battery Room** |  |  |  |  |  |  |  |  |  |  |
|  01-Battery Room | 1 | 365 | 9.9 | 0.00 | 0.0 | 0.00 | 1.00 | **0** | *0* | 1.000 |
| **Totals (incl. Space Multipliers)** |  | **1311** |  |  |  |  |  |  | **0** | **1.000** |

##  air system design load summary:

|  |  |  |
| --- | --- | --- |
|  | **DESIGN COOLING** | **DESIGN HEATING** |
|  | **COOLING DATA AT Jul 1500** | **HEATING DATA AT DES HTG** |
|  | **COOLING OA DB / WB 41.0 °C / 32.0 °C** | **HEATING OA DB / WB 6.0 °C / 6.0 °C** |
|  |  | **Sensible** | **Latent** |  | **Sensible** | **Latent** |
| **ZONE LOADS** | **Details** | **(W)** | **(W)** | **Details** | **(W)** | **(W)** |
| Window & Skylight Solar Loads | 0 m² | 0 | - | 0 m² | - | - |
| Wall Transmission | 170 m² | 266 | - | 170 m² | 261 | - |
| Roof Transmission | 69 m² | 304 | - | 69 m² | 185 | - |
| Window Transmission | 0 m² | 0 | - | 0 m² | 0 | - |
| Skylight Transmission | 0 m² | 0 | - | 0 m² | 0 | - |
| Door Loads | 10 m² | 519 | - | 10 m² | 403 | - |
| Floor Transmission | 69 m² | 0 | - | 69 m² | 108 | - |
| Partitions | 0 m² | 0 | - | 0 m² | 0 | - |
| Ceiling | 0 m² | 0 | - | 0 m² | 0 | - |
| Overhead Lighting | 0 W | 30 | - | 0 | 0 | - |
| Task Lighting | 0 W | 0 | - | 0 | 0 | - |
| Electric Equipment | 6700 W | 6700 | - | 0 | 0 | - |
| People | 0 | 0 | 0 | 0 | 0 | 0 |
| Infiltration | - | 2458 | 4313 | - | 1937 | 0 |
| Miscellaneous | - | 0 | 0 | - | 0 | 0 |
| Safety Factor | 10% / 10% | 1028 | 431 | 10% | 289 | 0 |
| **>> Total Zone Loads** | **-** | **11304** | **4744** | **-** | **3183** | **0** |
| Zone Conditioning | - | 11163 | 4744 | - | 5416 | 0 |
| Plenum Wall Load | 0% | 0 | - | 0 | 0 | - |
| Plenum Roof Load | 0% | 0 | - | 0 | 0 | - |
| Plenum Lighting Load | 0% | 0 | - | 0 | 0 | - |
| Exhaust Fan Load | 0 L/s | 0 | - | 0 L/s | 0 | - |
| Ventilation Load | 0 L/s | 0 | 0 | 0 L/s | 0 | 0 |
| Ventilation Fan Load | 0 L/s | 0 | - | 0 L/s | 0 | - |
| Space Fan Coil Fans | - | 0 | - | - | 0 | - |
| Duct Heat Gain / Loss | 0% | 0 | - | 0% | 0 | - |
| **>> Total System Loads** | **-** | **11163** | **4744** | **-** | **5416** | **0** |
| Terminal Unit Cooling | - | 11163 | 4717 | - | 0 | 0 |
| Terminal Unit Heating | - | 0 | - | - | 5416 | - |
| **>> Total Conditioning** | **-** | **11163** | **4717** | **-** | **5416** | **0** |
| **Key:** | **Positive values are clg loads** | **Positive values are htg loads** |
|  | **Negative values are htg loads** | **Negative values are clg loads** |

## ZONE DESIGN LOAD SUMMARY:

|  |  |  |
| --- | --- | --- |
| **Switchgear Room** | **DESIGN COOLING** | **DESIGN HEATING** |
|  | **COOLING DATA AT Jul 1500** | **HEATING DATA AT DES HTG** |
|  | **COOLING OA DB / WB 41.0 °C / 32.0 °C** | **HEATING OA DB / WB 6.0 °C / 6.0 °C** |
|  | **OCCUPIED T-STAT 30.0 °C** | **OCCUPIED T-STAT 10.0 °C** |
|  |  | **Sensible** | **Latent** |  | **Sensible** | **Latent** |
| **ZONE LOADS** | **Details** | **(W)** | **(W)** | **Details** | **(W)** | **(W)** |
| Window & Skylight Solar Loads | 0 m² | 0 | - | 0 m² | - | - |
| Wall Transmission | 123 m² | 169 | - | 123 m² | 107 | - |
| Roof Transmission | 60 m² | 248 | - | 60 m² | 114 | - |
| Window Transmission | 0 m² | 0 | - | 0 m² | 0 | - |
| Skylight Transmission | 0 m² | 0 | - | 0 m² | 0 | - |
| Door Loads | 8 m² | 353 | - | 8 m² | 176 | - |
| Floor Transmission | 60 m² | 0 | - | 60 m² | 60 | - |
| Partitions | 0 m² | 0 | - | 0 m² | 0 | - |
| Ceiling | 0 m² | 0 | - | 0 m² | 0 | - |
| Overhead Lighting | 0 W | 25 | - | 0 | 0 | - |
| Task Lighting | 0 W | 0 | - | 0 | 0 | - |
| Electric Equipment | 6500 W | 6500 | - | 0 | 0 | - |
| People | 0 | 0 | 0 | 0 | 0 | 0 |
| Infiltration | - | 985 | 1942 | - | 358 | 0 |
| Miscellaneous | - | 0 | 0 | - | 0 | 0 |
| Safety Factor | 10% / 10% | 828 | 194 | 10% | 82 | 0 |
| **>> Total Zone Loads** | **-** | **9108** | **2136** | **-** | **897** | **0** |

|  |  |  |
| --- | --- | --- |
| **Battery Room** | **DESIGN COOLING** | **DESIGN HEATING** |
|  | **COOLING DATA AT Jul 1500** | **HEATING DATA AT DES HTG** |
|  | **COOLING OA DB / WB 41.0 °C / 32.0 °C** | **HEATING OA DB / WB 6.0 °C / 6.0 °C** |
|  | **OCCUPIED T-STAT 27.0 °C** | **OCCUPIED T-STAT 21.0 °C** |
|  |  | **Sensible** | **Latent** |  | **Sensible** | **Latent** |
| **ZONE LOADS** | **Details** | **(W)** | **(W)** | **Details** | **(W)** | **(W)** |
| Window & Skylight Solar Loads | 0 m² | 0 | - | 0 m² | - | - |
| Wall Transmission | 48 m² | 98 | - | 48 m² | 154 | - |
| Roof Transmission | 10 m² | 56 | - | 10 m² | 71 | - |
| Window Transmission | 0 m² | 0 | - | 0 m² | 0 | - |
| Skylight Transmission | 0 m² | 0 | - | 0 m² | 0 | - |
| Door Loads | 3 m² | 166 | - | 3 m² | 226 | - |
| Floor Transmission | 10 m² | 0 | - | 10 m² | 48 | - |
| Partitions | 0 m² | 0 | - | 0 m² | 0 | - |
| Ceiling | 0 m² | 0 | - | 0 m² | 0 | - |
| Overhead Lighting | 0 W | 4 | - | 0 | 0 | - |
| Task Lighting | 0 W | 0 | - | 0 | 0 | - |
| Electric Equipment | 200 W | 200 | - | 0 | 0 | - |
| People | 0 | 0 | 0 | 0 | 0 | 0 |
| Infiltration | - | 1473 | 2371 | - | 1579 | 0 |
| Miscellaneous | - | 0 | 0 | - | 0 | 0 |
| Safety Factor | 10% / 10% | 200 | 237 | 10% | 208 | 0 |
| **>> Total Zone Loads** | **-** | **2197** | **2608** | **-** | **2286** | **0** |

## SPACE DESIGN LOAD SUMMARY:

|  |
| --- |
| **TABLE 1.1.A. COMPONENT LOADS FOR SPACE '' 00-Swithchgear Room '' IN ZONE '' Switchgear Room ''** |
|  | **DESIGN COOLING** | **DESIGN HEATING** |
|  | **COOLING DATA AT Jul 1500** | **HEATING DATA AT DES HTG** |
|  | **COOLING OA DB / WB 41.0 °C / 32.0 °C** | **HEATING OA DB / WB 6.0 °C / 6.0 °C** |
|  | **OCCUPIED T-STAT 30.0 °C** | **OCCUPIED T-STAT 10.0 °C** |
|  |  | **Sensible** | **Latent** |  | **Sensible** | **Latent** |
| **SPACE LOADS** | **Details** | **(W)** | **(W)** | **Details** | **(W)** | **(W)** |
| Window & Skylight Solar Loads | 0 m² | 0 | - | 0 m² | - | - |
| Wall Transmission | 123 m² | 169 | - | 123 m² | 107 | - |
| Roof Transmission | 60 m² | 248 | - | 60 m² | 114 | - |
| Window Transmission | 0 m² | 0 | - | 0 m² | 0 | - |
| Skylight Transmission | 0 m² | 0 | - | 0 m² | 0 | - |
| Door Loads | 8 m² | 353 | - | 8 m² | 176 | - |
| Floor Transmission | 60 m² | 0 | - | 60 m² | 60 | - |
| Partitions | 0 m² | 0 | - | 0 m² | 0 | - |
| Ceiling | 0 m² | 0 | - | 0 m² | 0 | - |
| Overhead Lighting | 0 W | 25 | - | 0 | 0 | - |
| Task Lighting | 0 W | 0 | - | 0 | 0 | - |
| Electric Equipment | 6500 W | 6500 | - | 0 | 0 | - |
| People | 0 | 0 | 0 | 0 | 0 | 0 |
| Infiltration | - | 985 | 1942 | - | 358 | 0 |
| Miscellaneous | - | 0 | 0 | - | 0 | 0 |
| Safety Factor | 10% / 10% | 828 | 194 | 10% | 82 | 0 |
| **>> Total Zone Loads** | **-** | **9108** | **2136** | **-** | **897** | **0** |

|  |
| --- |
| **TABLE 1.1.B. ENVELOPE LOADS FOR SPACE '' 00-Swithchgear Room '' IN ZONE '' Switchgear Room ''** |
|  |  |  |  | **COOLING** | **COOLING** | **HEATING** |
|  | **Area** | **U-Value** | **Shade** | **TRANS** | **SOLAR** | **TRANS** |
|  | **(m²)** | **(W/(m²-°K))** | **Coeff.** | **(W)** | **(W)** | **(W)** |
| **NE EXPOSURE** |   |   |   |   |   |   |
|  WALL | 22 | 0.218 | - | 31 | - | 19 |
|  DOOR | 5 | 5.800 | - | 232 | - | 116 |
| **NW EXPOSURE** |   |   |   |   |   |   |
|  WALL | 46 | 0.218 | - | 61 | - | 40 |
| **SW EXPOSURE** |   |   |   |   |   |   |
|  WALL | 24 | 0.218 | - | 32 | - | 21 |
|  DOOR | 3 | 5.800 | - | 121 | - | 60 |
| **SE EXPOSURE** |   |   |   |   |   |   |
|  WALL | 31 | 0.218 | - | 45 | - | 27 |
| **H EXPOSURE** |   |   |   |   |   |   |
|  ROOF | 60 | 0.479 | - | 248 | - | 114 |

|  |
| --- |
| **TABLE 2.1.A. COMPONENT LOADS FOR SPACE '' 01-Battery Room '' IN ZONE '' Battery Room ''** |
|  | **DESIGN COOLING** | **DESIGN HEATING** |
|  | **COOLING DATA AT Jul 1500** | **HEATING DATA AT DES HTG** |
|  | **COOLING OA DB / WB 41.0 °C / 32.0 °C** | **HEATING OA DB / WB 6.0 °C / 6.0 °C** |
|  | **OCCUPIED T-STAT 27.0 °C** | **OCCUPIED T-STAT 21.0 °C** |
|  |  | **Sensible** | **Latent** |  | **Sensible** | **Latent** |
| **SPACE LOADS** | **Details** | **(W)** | **(W)** | **Details** | **(W)** | **(W)** |
| Window & Skylight Solar Loads | 0 m² | 0 | - | 0 m² | - | - |
| Wall Transmission | 48 m² | 98 | - | 48 m² | 154 | - |
| Roof Transmission | 10 m² | 56 | - | 10 m² | 71 | - |
| Window Transmission | 0 m² | 0 | - | 0 m² | 0 | - |
| Skylight Transmission | 0 m² | 0 | - | 0 m² | 0 | - |
| Door Loads | 3 m² | 166 | - | 3 m² | 226 | - |
| Floor Transmission | 10 m² | 0 | - | 10 m² | 48 | - |
| Partitions | 0 m² | 0 | - | 0 m² | 0 | - |
| Ceiling | 0 m² | 0 | - | 0 m² | 0 | - |
| Overhead Lighting | 0 W | 4 | - | 0 | 0 | - |
| Task Lighting | 0 W | 0 | - | 0 | 0 | - |
| Electric Equipment | 200 W | 200 | - | 0 | 0 | - |
| People | 0 | 0 | 0 | 0 | 0 | 0 |
| Infiltration | - | 1473 | 2371 | - | 1579 | 0 |
| Miscellaneous | - | 0 | 0 | - | 0 | 0 |
| Safety Factor | 10% / 10% | 200 | 237 | 10% | 208 | 0 |
| **>> Total Zone Loads** | **-** | **2197** | **2608** | **-** | **2286** | **0** |

|  |
| --- |
| **TABLE 2.1.B. ENVELOPE LOADS FOR SPACE '' 01-Battery Room '' IN ZONE '' Battery Room ''** |
|  |  |  |  | **COOLING** | **COOLING** | **HEATING** |
|  | **Area** | **U-Value** | **Shade** | **TRANS** | **SOLAR** | **TRANS** |
|  | **(m²)** | **(W/(m²-°K))** | **Coeff.** | **(W)** | **(W)** | **(W)** |
| **NE EXPOSURE** |   |   |   |   |   |   |
|  WALL | 17 | 0.217 | - | 35 | - | 54 |
| **SE EXPOSURE** |   |   |   |   |   |   |
|  WALL | 14 | 0.217 | - | 30 | - | 46 |
|  DOOR | 3 | 5.800 | - | 166 | - | 226 |
| **SW EXPOSURE** |   |   |   |   |   |   |
|  WALL | 17 | 0.217 | - | 33 | - | 54 |
| **H EXPOSURE** |   |   |   |   |   |   |
|  ROOF | 10 | 0.479 | - | 56 | - | 71 |

1. **Equipment Selection**

## Air Conditioning Unit

|  |  |
| --- | --- |
| Item | Service Area |
| Switchgear Room | Battery Room |
| Sensible Cooling Load(w) | 9108 | 2197 |
| Latent Cooling Load(w) | 2136 | 2608 |
| Total Cooling Load(w) | 11244 | 4805 |
| Total Cooling Load (btu/hr) | 38400 | 16410 |
| Sensible Heating Load(w) | 897 | 2286 |
| Sensible Heating Load (btu/hr) | 3063 | 7807 |
| Split Unit ID Indoor Unit ID | 1201-SUI-BK05-01 | 1201-SUO-BK05-01 |
| Split Unit Outdoor Unit ID | 1201-SUI-BK05-02 | 1201-SUO-BK05-02 |
| Equipment QTY. | 2 | 1 |
| Equipment Type | Wall Mounted Split Unit | Wall Mounted Split Unit |
| Cooling Load+ 10% Over Cap. (btu/hr) Each | 21120 | 18051 |
| Selected Eq. Nominal Cooling Cap. (btu/hr) Each | 24000 | 18000 |
| Selected Eq. Actual Cooling Cap. (btu/hr) Each | 24500 | 18300 |
| Selected Eq. Actual Heating Cap. (btu/hr) Each | 24500 | 20800 |
| Power Supply (V/PH/Hz) | 230/1/50 | 230/1/50 |
| Max. Power Consumption (w) Each Eq. (Cooling/Heating)\* | 2420/2500 | 1710/1800 |
| REMARKE  | Outdoor and Indoor Unit (With Thermostat & All Standard Accessory)-T3 | Outdoor and Indoor Unit (With Thermostat & All Standard Accessory)-T3 |

\* Max. Power Consumption Should Be Finalized By Vendor.

## Exhaust fan selection

Air Flow = 9.9 (area, m²) × 5.3 (height, m) × 6 ACH ÷ 60 min

=5.247 m³/min

=87.45 L/S

=185.3 cfm

Battery Room (Nickel–Cadmium (Ni-Ca) Battery) Air-Change per Hour (ACH) rate is based on:

* NFPA 76 (Standard for the Fire Protection of Telecommunications Facilities 2009 Edition) - Fan capacity should be 1 CFM per square feet of floor space.
* NFPA 111 (Standard on Stored Electrical Energy Emergency and Standby Power Systems 2005 Edition) - Recommends a minimum of 2 air-changes per hour to remove gasses generated by vented batteries.
* ASHRAE Guideline 21 (Guide for Ventilation and Thermal Management of Batteries for Stationary Applications) - 1 CFM per charging amp, no less than 6 air-changes per hour.
* IMC (International Mechanical Code) - Fan capacity should be 1 CFM per square feet of floor space.
* IEEE 1635 (Institute of Electrical and Electronics Engineers Standard) - 1 CFM per charging amp, no less than 6 air-changes per hour.

|  |  |
| --- | --- |
| Item | Service Area |
| Battery Room  |
| Equipment QTY. | 1 |
| Air Flow(L/S) | 87.45 |
| Air Flow(CFM) | 185.30 |
| Component Pressure Drop | 0.00 | 0.00 |
| 0.31 | 0.31 |
| 0.00 | 0.00 |
| 0.00 | 0.00 |
| Total Pressure Drop \* | 0.31 | 0.31 |
| 77.14 | 77.14 |
| Exhaust Fan ID | 1201-EF-BK05-01 |
| Exhaust Fan type |  Wall Mounted/Axial |
| Power Supply (V/PH/Hz) | 230/1/50 |
| Power Consumption (w) Each Eq.\*\* | 180 |
| REMARKE  | Equipped With Exhaust Air Louver - Explosion Proof - Eexd-IIC-T3 |

\*Total Pressure Drop Include Louver and etc. Should Be Specified By Vendor.

\*\* Power Consumption Should Be Finalized By Vendor.

## SAND TRAP LOUVER SELECTION

Air Flow=87.45 $^{L}/\_{S}$ = 185.30 CFM

$V\_{k}$= 400 fpm = 2 $^{m}/\_{s}$ (Face velocity)

Required $A\_{k}$= Air Flow ÷ $V\_{k}$ = 185.30 ÷ 400 fpm = 0.46 ft² = 0.043 m²

Selected product information:

Model = SH.SAL.L- 18 × 12 (Shahrokhi Manufacturing CO.)

$A\_{k}$= 0.046 m², W=0.45 m, H=0.3 m, P.D. = 0.310 in.wg = 77.14 pa