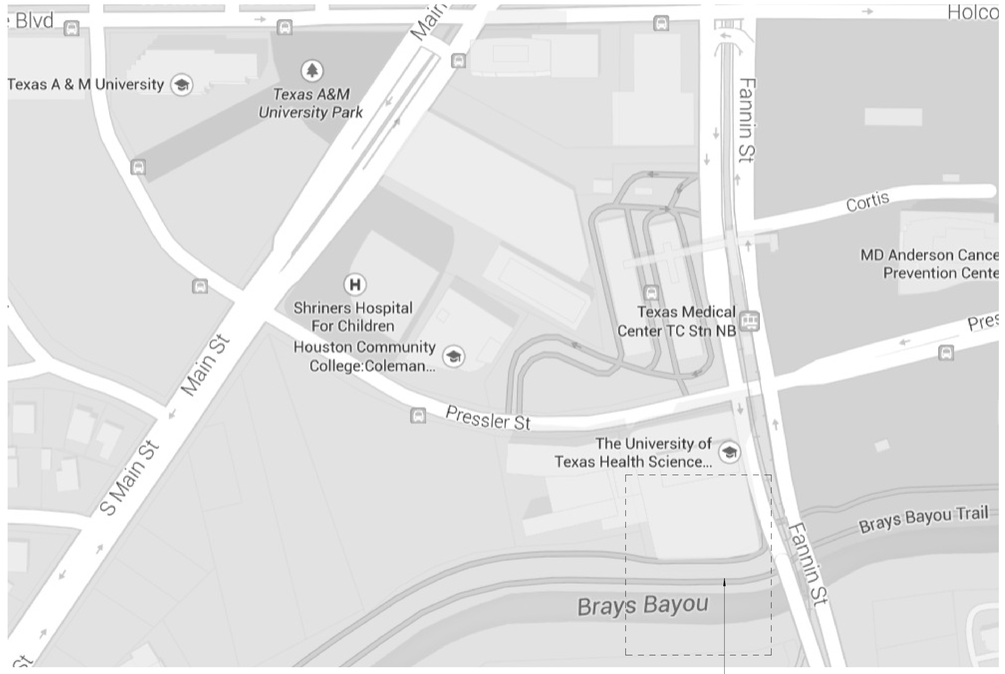
APPENDIX FIVE:
CONSTRUCTION PROJECT MANUAL AND DRAWINGS A

THE UNIVERSITY of TEXAS
HEALTH SCIENCE CENTER AT HOUSTON

# UCT AHU REPLACEMENT

Houston, Texas

ISSUE FOR CONSTRUCTION





SHAH SMITH & ASSOCIATES, INC.
2825 WILCREST, SUITE 350
HOUSTON, TEXAS 77042
Phone: 713-780-7563 Fax: 713-780-9209
Tx. Registration #F-2113


## DRAWING LIST - ARCHITECTURAL & MEP

| | | | |
|---|---|---|---|
| CS | COVER SHEET | 1 - COVER | |
| A-101 | LEVEL 1 REFERENCE FLOOR PLAN | 2 - ARCH | |
| A-102 | LEVEL 6 AND 7 REFERENCE FLOOR PLANS | 2 - ARCH | |
| A-103 | LEVEL 8 AND 9 REFERENCE FLOOR PLANS | 2 - ARCH | |
| A-104 | LEVEL 11 AND 12 REFERENCE FLOOR PLANS | 2 - ARCH | |
| A-105 | LEVEL 15 AND 16 REFERENCE FLOOR PLANS | 2 - ARCH | |
| A-106 | LEVEL 17 AND 18 REFERENCE FLOOR PLANS | 2 - ARCH | |
| A-107 | LEVEL 19 AND 20 REFERENCE FLOOR PLANS | 2 - ARCH | |
| A-108 | LEVEL 21 AND 22 REFERENCE FLOOR PLANS | 2 - ARCH | |
| A-109 | LEVEL M REFERENCE FLOOR PLAN | 2 - ARCH | |
| A-110 | PENTHOUSE REFERENCE FLOOR PLAN | 2 - ARCH | |
| M-001 | MECHANICAL LEGENDS, GENERAL NOTES AND SCHEDULES | 3 - MECH | |
| M-002 | MECHANICAL SCHEDULES | 3 - MECH | |
| M-100-1E | LEVEL 1 EAST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-1ME | LEVEL M EAST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-1MW | LEVEL M WEST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-6E | LEVEL 6 EAST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-6W | LEVEL 6 WEST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-7E | LEVEL 7 EAST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-7W | LEVEL 7 WEST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-8E | LEVEL 8 EAST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-8W | LEVEL 8 WEST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-9E | LEVEL 9 EAST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-9W | LEVEL 9 WEST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-11E | LEVEL 11 EAST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-11W | LEVEL 11 WEST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-12E | LEVEL 12 EAST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-12W | LEVEL 12 WEST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-15E | LEVEL 15 EAST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-15W | LEVEL 15 WEST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-16E | LEVEL 16 EAST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-16W | LEVEL 16 WEST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-17E | LEVEL 17 EAST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-17W | LEVEL 17 WEST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-18E | LEVEL 18 EAST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-18W | LEVEL 18 WEST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-19E-1 | LEVEL 19 EAST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-19E-2 | LEVEL 19 EAST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-19W | LEVEL 19 WEST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-20E | LEVEL 20 EAST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-20W | LEVEL 20 WEST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-21E | LEVEL 21 EAST ENLARGED MECHANICAL PLAN | 3 - MECH | |

## DRAWING LIST - ARCHITECTURAL & MEP

| | | | |
|---|---|---|---|
| M-100-21W | LEVEL 21 WEST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-22E | LEVEL 22 EAST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-22W | LEVEL 22 WEST ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-100-P | PENTHOUSE LEVEL ENLARGED MECHANICAL PLAN | 3 - MECH | |
| M-501 | COMPONENT DIAGRAMS | 3 - MECH | |
| M-502 | COMPONENT DIAGRAMS | 3 - MECH | |
| M-503 | COMPONENT DIAGRAMS | 3 - MECH | |
| M-504 | COMPONENT DIAGRAMS | 3 - MECH | |
| M-505 | AHU-19-2 COMPONENT DIAGRAM | 3 - MECH | |
| M-600 | CONTROL DIAGRAMS | 3 - MECH | |
| M-601 | CONTROL DIAGRAMS | 3 - MECH | |
| M-602 | CONTROL DIAGRAMS | 3 - MECH | |
| M-603 | CONTROL DIAGRAMS | 3 - MECH | |
| M-900 | MECHANICAL DETAILS | 3 - MECH | |
| M-901 | MECHANICAL DETAILS | 3 - MECH | |
| E-001 | ELECTRICAL LEGEND SYMBOLS AND ABBREVIATIONS | 4 - ELEC | |
| E-100-1E | LEVEL 1 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-1ME | LEVEL M EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-1MW | LEVEL M WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-6E | LEVEL 6 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-6W | LEVEL 6 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-7E | LEVEL 7 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-7W | LEVEL 7 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-8E | LEVEL 8 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-8W | LEVEL 8 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-9E | LEVEL 9 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-9W | LEVEL 9 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-11E | LEVEL 11 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-11W | LEVEL 11 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-12E | LEVEL 12 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-12W | LEVEL 12 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-15E | LEVEL 15 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-15W | LEVEL 15 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-16E | LEVEL 16 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-16W | LEVEL 16 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-17E | LEVEL 17 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-17W | LEVEL 17 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-18E | LEVEL 18 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-18W | LEVEL 18 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-19E | LEVEL 19 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-19W | LEVEL 19 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-20E | LEVEL 20 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |

## DRAWING LIST - ARCHITECTURAL & MEP

| | | | |
|---|---|---|---|
| E-100-20W | LEVEL 20 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-21E | LEVEL 21 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-21W | LEVEL 21 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-22E | LEVEL 22 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-22W | LEVEL 22 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| E-100-P | PENTHOUSE ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | |
| P-001 | PLUMBING LEGENDS, GENERAL NOTES AND SCHEDULES | 5 - PLBG | |
| P-100-6W | LEVEL 6 WEST ENLARGED PLUMBING PLAN | 5 - PLBG | |
| P-100-7E | LEVEL 7 EAST ENLARGED PLUMBING PLAN | 5 - PLBG | |
| P-100-7W | LEVEL 7 WEST ENLARGED PLUMBING PLAN | 5 - PLBG | |
| P-100-8E | LEVEL 8 EAST ENLARGED PLUMBING PLAN | 5 - PLBG | |
| P-100-8W | LEVEL 8 WEST ENLARGED PLUMBING PLAN | 5 - PLBG | |
| P-100-9E | LEVEL 9 EAST ENLARGED PLUMBING PLAN | 5 - PLBG | |
| P-100-9W | LEVEL 9 WEST ENLARGED PLUMBING PLAN | 5 - PLBG | |
| P-100-11E | LEVEL 11 EAST ENLARGED PLUMBING PLAN | 5 - PLBG | |
| P-100-11W | LEVEL 11 WEST ENLARGED PLUMBING PLAN | 5 - PLBG | |
| P-100-12E | LEVEL 12 EAST ENLARGED PLUMBING PLAN | 5 - PLBG | |
| P-100-12W | LEVEL 12 WEST ENLARGED PLUMBING PLAN | 5 - PLBG | |
| P-100-15E | LEVEL 15 EAST ENLARGED PLUMBING PLAN | 5 - PLBG | |
| P-100-15W | LEVEL 15 WEST ENLARGED PLUMBING PLAN | 5 - PLBG | |
| P-100-16E | LEVEL 16 EAST ENLARGED PLUMBING PLAN | 5 - PLBG | |
| P-100-16W | LEVEL 16 WEST ENLARGED PLUMBING PLAN | 5 - PLBG | |
| P-100-17E | LEVEL 17 EAST ENLARGED PLUMBING PLAN | 5 - PLBG | |
| P-100-17W | LEVEL 17 WEST ENLARGED PLUMBING PLAN | 5 - PLBG | |
| P-100-18E | LEVEL 18 EAST ENLARGED PLUMBING PLAN | 5 - PLBG | |
| P-100-18W | LEVEL 18 WEST ENLARGED PLUMBING PLAN | 5 - PLBG | |
| P-100-19W | LEVEL 19 WEST ENLARGED PLUMBING PLAN | 5 - PLBG | |
| P-100-20W | LEVEL 20 WEST ENLARGED PLUMBING PLAN | 5 - PLBG | |
| P-100-21W | LEVEL 21 WEST ENLARGED PLUMBING PLAN | 5 - PLBG | |
| P-100-22E | LEVEL 22 EAST ENLARGED PLUMBING PLAN | 5 - PLBG | |
| P-100-22W | LEVEL 22 WEST ENLARGED PLUMBING PLAN | 5 - PLBG | |
| P-100-ME | LEVEL M EAST ENLARGED PLUMBING PLAN | 5 - PLBG | |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Texas Registered Engineering Firm F-2113

Philo Wilke Partnership

THE UNIVERSITY of TEXAS
HEALTH SCIENCE CENTER AT HOUSTON


| No. | Description | Date |
|---|---|---|
| | Issue for Construction | 10/11/17 |

Keyplan

Tx. Registration # F-2113
STATE OF TEXAS
DAVID S. HALL
REGISTERED
PROFESSIONAL ENGINEER
10-11-2017

The University of Texas Health Science Center at Houston

UCT AHU REPLACEMENT

COVER SHEET

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | Designer |
| Checked By | Checker |
| Drawing No. | CS |
| Scale | 1/8" = 1'-0" |


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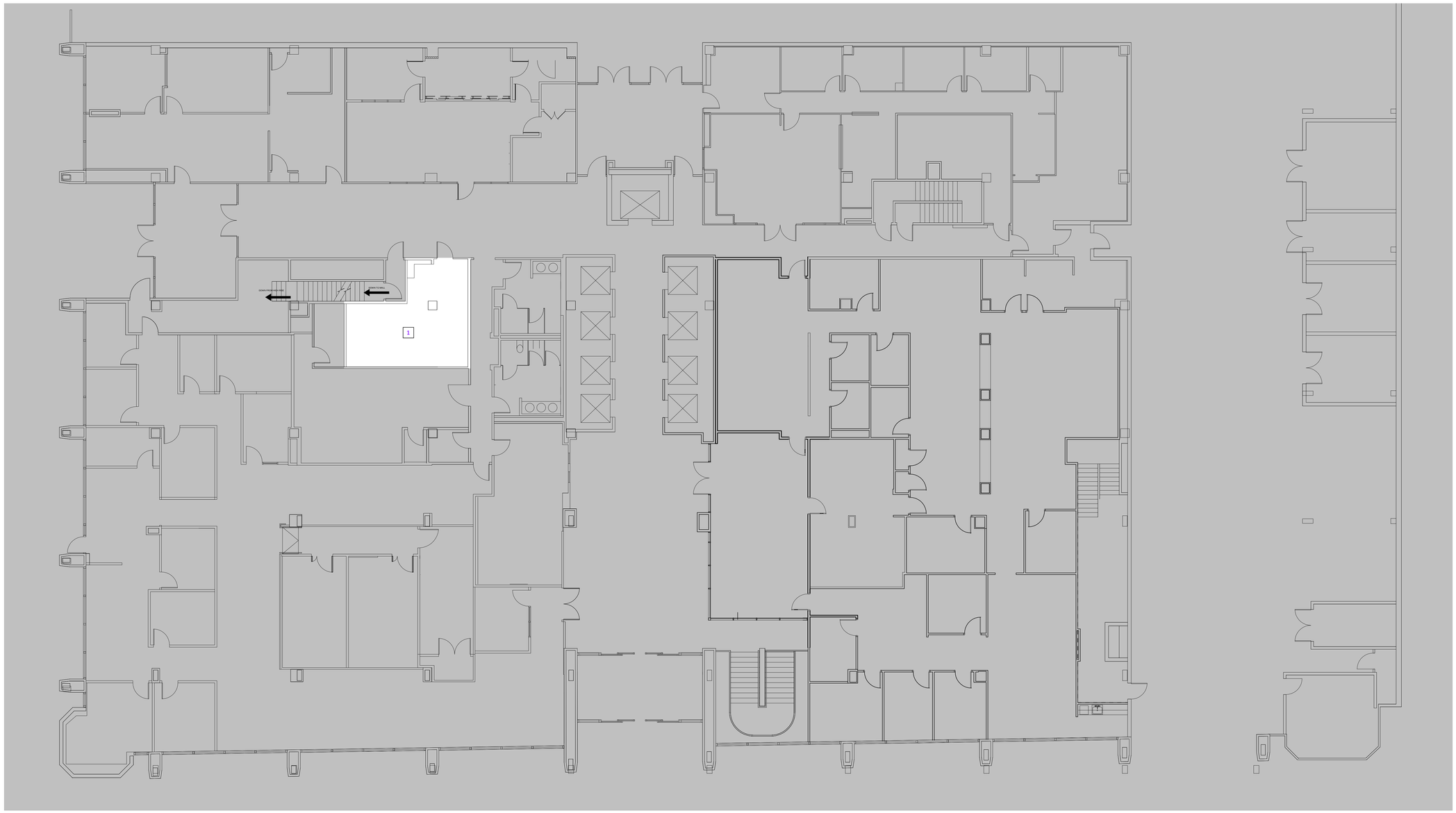


General Notes - Floor Plan

1. See Mechanical Plans for additional scope.
2. Protect existing conditions to remain.
3. If any damage occurs to existing finishes or fixtures resulting from construction activities, repair to like new condition.

Key Notes - Floor Plan

1 As an add alternate to base bid. Provide new concrete floor sealer in existing Mechanical Room. Prepare existing concrete to receive sealer per manufacturer's directions.

Legend - Floor/Demo Plan

- Existing to be removed
- Existing to remain
- Area not in scope of project

PN

**First Floor - Architectural Plan** 1/8" = 1'-0" 1


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THE UNIVERSITY of TEXAS
HEALTH SCIENCE CENTER AT HOUSTON

| No. | Description | Date |
|---|---|---|
| | Issue for Construction | 10/11/2017 |

Keyplan

REGISTERED ARCHITECT
CHRISTINA E. NAVA
18288
STATE OF TEXAS
10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU Replacement

Level 1 Reference Floor Plan

SSA Project Number

Date 10/11/2017

Designed By

Checked By

Drawing No. A-101

Scale 1/8" = 1'-0"

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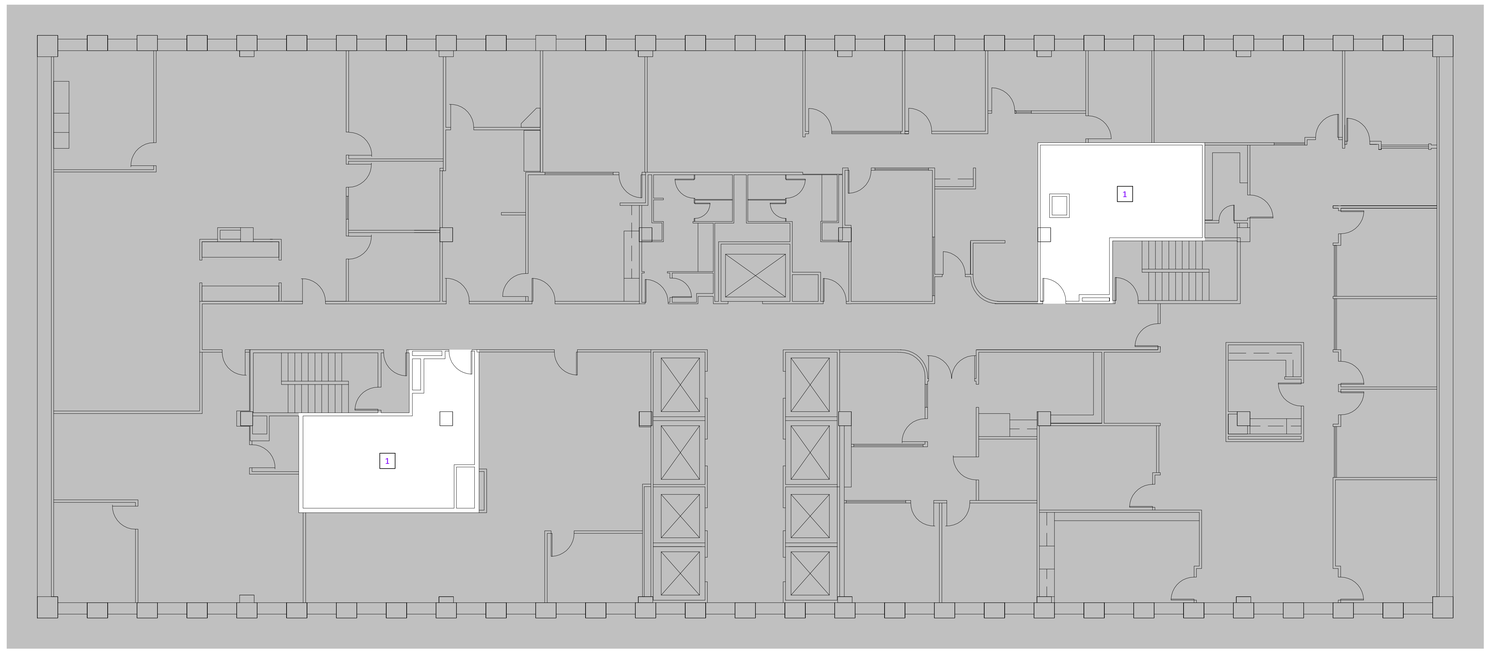



**General Notes - Floor Plan**

1. See Mechanical Plans for additional scope.
2. Protect existing conditions to remain.
3. If any damage occurs to existing finishes or fixtures resulting from construction activities, repair to like new condition.

**Key Notes - Floor Plan**

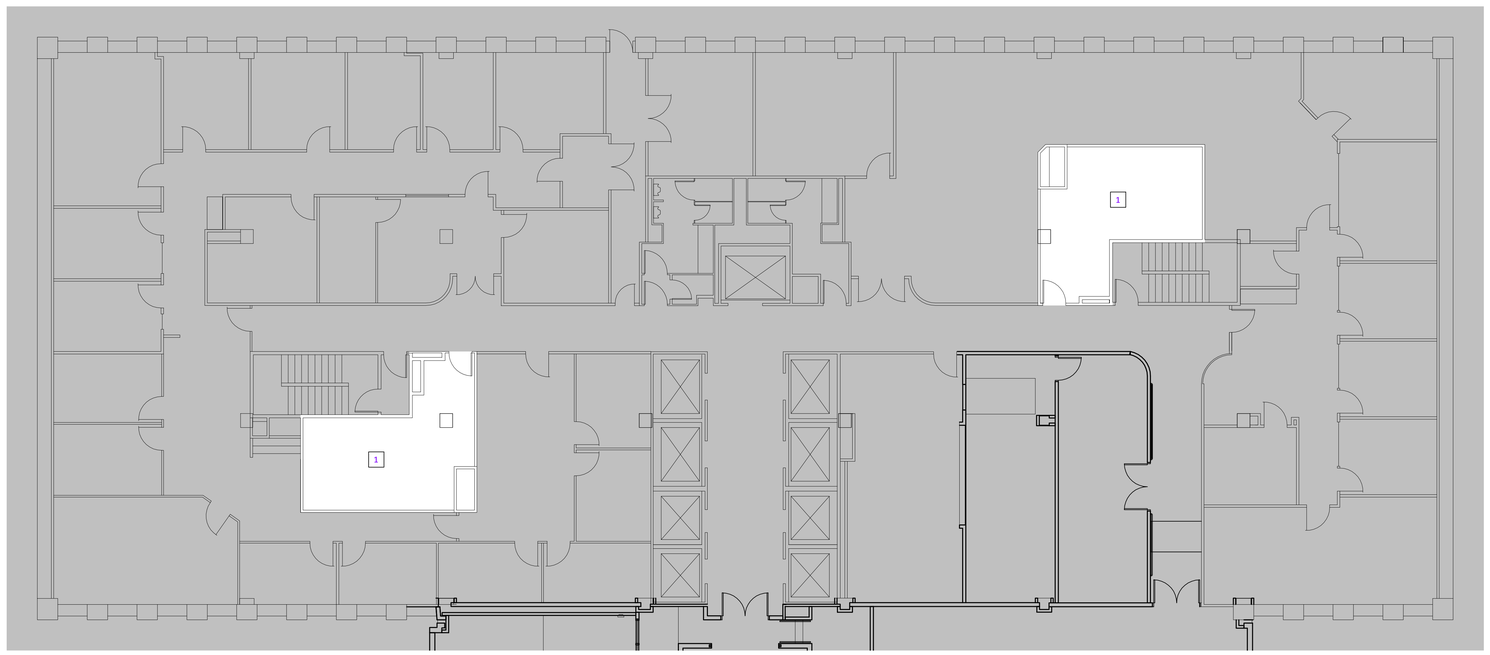
1 As an add alternate to base bid. Provide new concrete floor sealer in existing Mechanical Room. Prepare existing concrete to receive sealer per manufacturer's directions.

**Legend - Floor/Demo Plan**

- Existing to be removed
- Existing to remain
- Area not in scope of project

PN

**Level 7 Reference Floor Plan** | 1/8" = 1'-0" | 3




**General Notes - Floor Plan**

1. See Mechanical Plans for additional scope.
2. Protect existing conditions to remain.
3. If any damage occurs to existing finishes or fixtures resulting from construction activities, repair to like new condition.

**Key Notes - Floor Plan**

1 As an add alternate to base bid. Provide new concrete floor sealer in existing Mechanical Room. Prepare existing concrete to receive sealer per manufacturer's directions.

**Legend - Floor/Demo Plan**

- Existing to be removed
- Existing to remain
- Area not in scope of project

PN

**Level 6 Reference Floor Plan** | 1/8" = 1'-0" | 1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Philo Wilke Partnership

THE UNIVERSITY of TEXAS HEALTH SCIENCE CENTER AT HOUSTON

| No. | Description | Date |
|---|---|---|
| | Issue for Construction | 10/11/2017 |

Keyplan

REGISTERED ARCHITECT — STATE OF TEXAS — 18288

10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU Replacement

## Level 6 and 7 Reference Floor Plans

| | |
|---|---|
| SSA Project Number | |
| Date | 10/11/2017 |
| Designed By | |
| Checked By | |
| Drawing No. | A-102 |
| Scale | 1/8" = 1'-0" |

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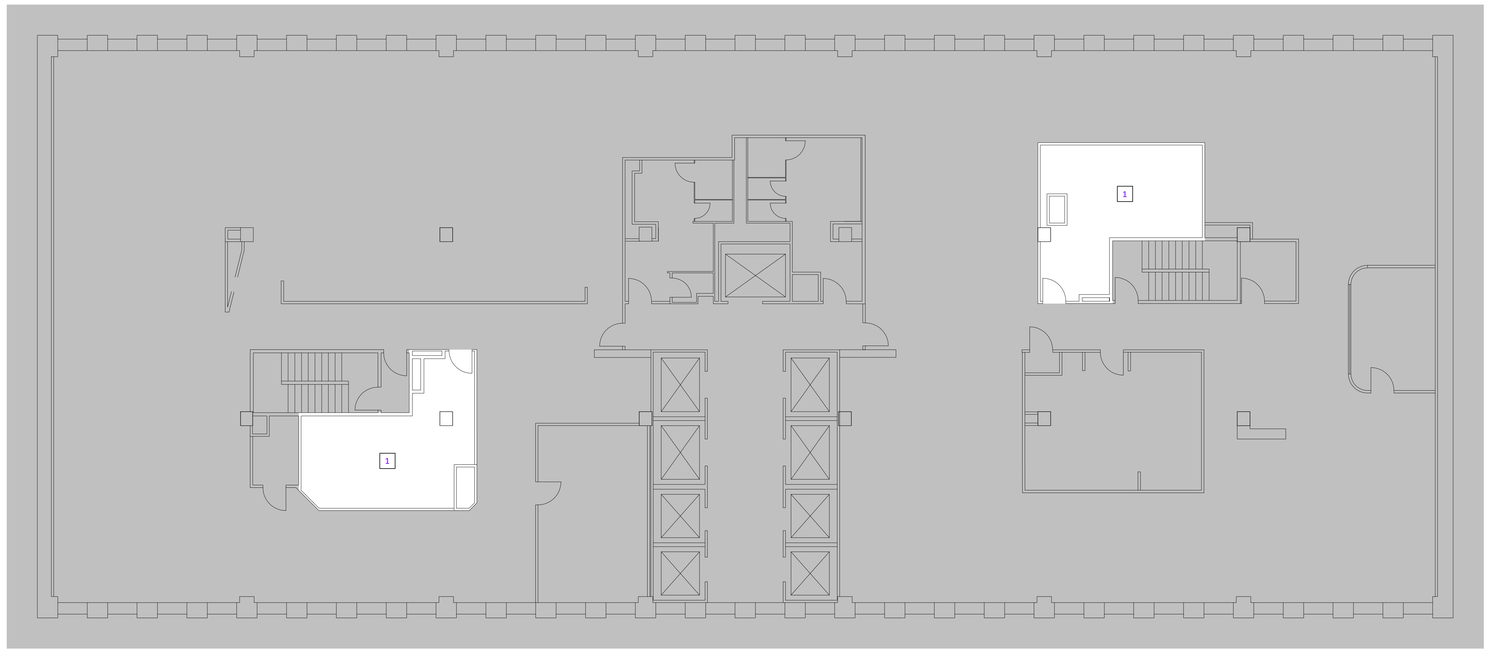



General Notes - Floor Plan

1. See Mechanical Plans for additional scope.
2. Protect existing conditions to remain.
3. If any damage occurs to existing finishes or fixtures resulting from construction activities, repair to like new condition.

Key Notes - Floor Plan

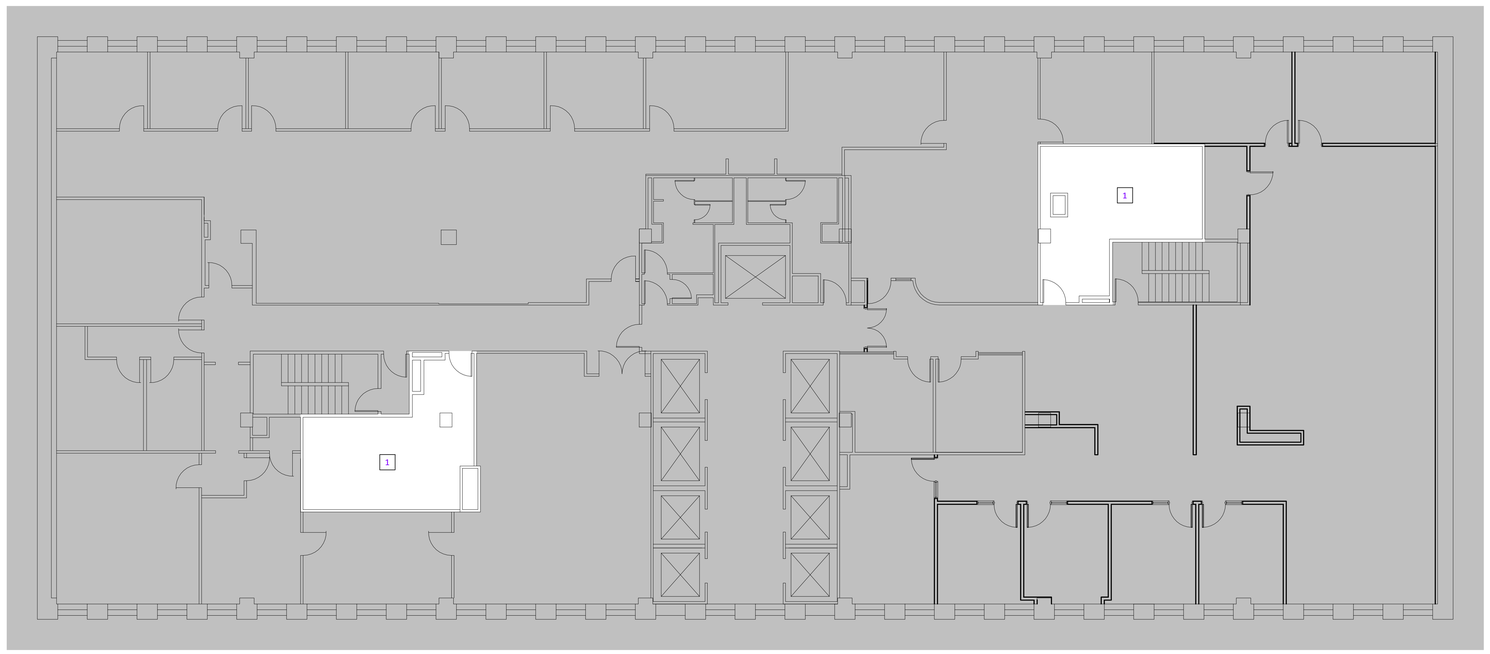
1 As an add alternate to base bid. Provide new concrete floor sealer in existing Mechanical Room. Prepare existing concrete to receive sealer per manufacturer's directions.

Legend - Floor/Demo Plan

- Existing to be removed
- Existing to remain
- Area not in scope of project

PN

**Level 9 Reference Floor Plan** | 1/8" = 1'-0" | 3




General Notes - Floor Plan

1. See Mechanical Plans for additional scope.
2. Protect existing conditions to remain.
3. If any damage occurs to existing finishes or fixtures resulting from construction activities, repair to like new condition.

Key Notes - Floor Plan

1 As an add alternate to base bid. Provide new concrete floor sealer in existing Mechanical Room. Prepare existing concrete to receive sealer per manufacturer's directions.

Legend - Floor/Demo Plan

- Existing to be removed
- Existing to remain
- Area not in scope of project

PN

**Level 8 Reference Floor Plan** | 1/8" = 1'-0" | 1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| No. | Description | Date |
|---|---|---|
| | Issue for Construction | 10/11/2017 |

Keyplan

REGISTERED ARCHITECT — DAVID SERNA — 18258 — STATE OF TEXAS

10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU Replacement

## Level 8 and 9 Reference Floor Plans

| | |
|---|---|
| SSA Project Number | |
| Date | 10/11/2017 |
| Designed By | |
| Checked By | |
| Drawing No. | A-103 |
| Scale | 1/8" = 1'-0" |


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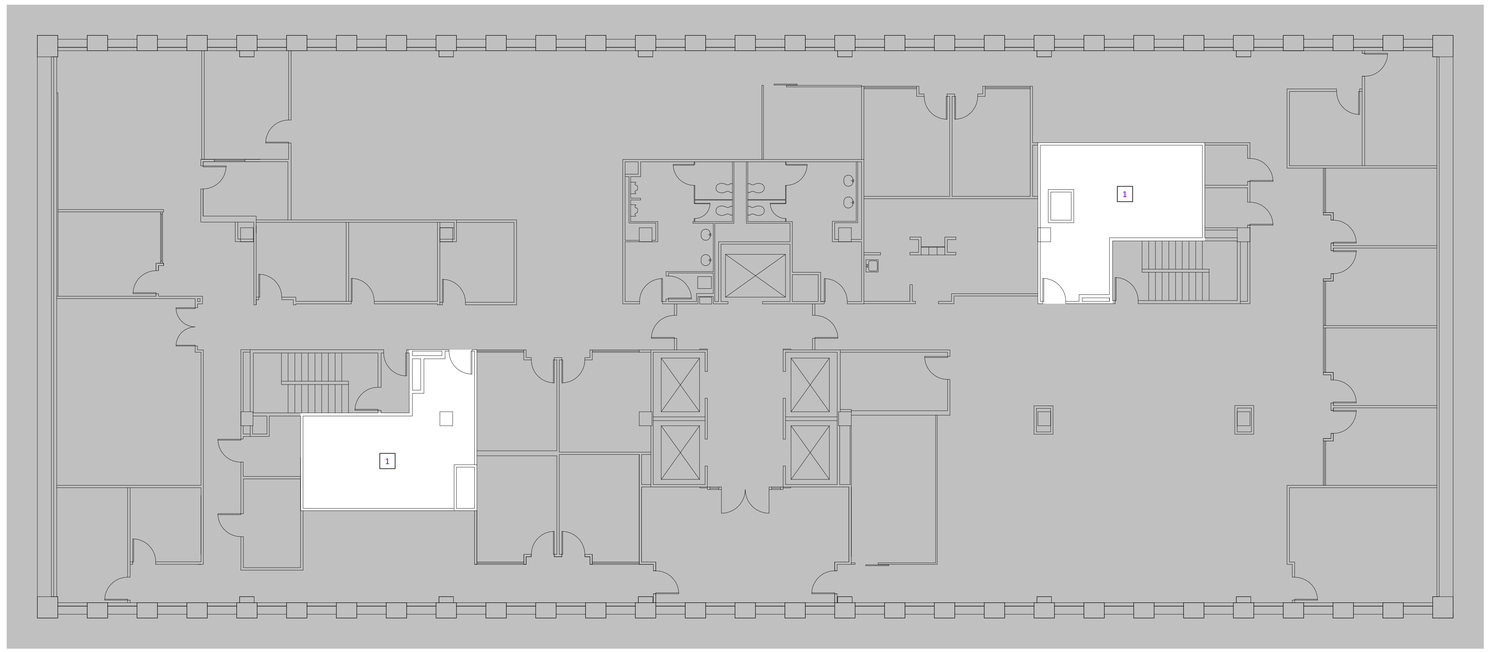



**General Notes - Floor Plan**

1. See Mechanical Plans for additional scope.
2. Protect existing conditions to remain.
3. If any damage occurs to existing finishes or fixtures resulting from construction activities, repair to like new condition.

**Key Notes - Floor Plan**

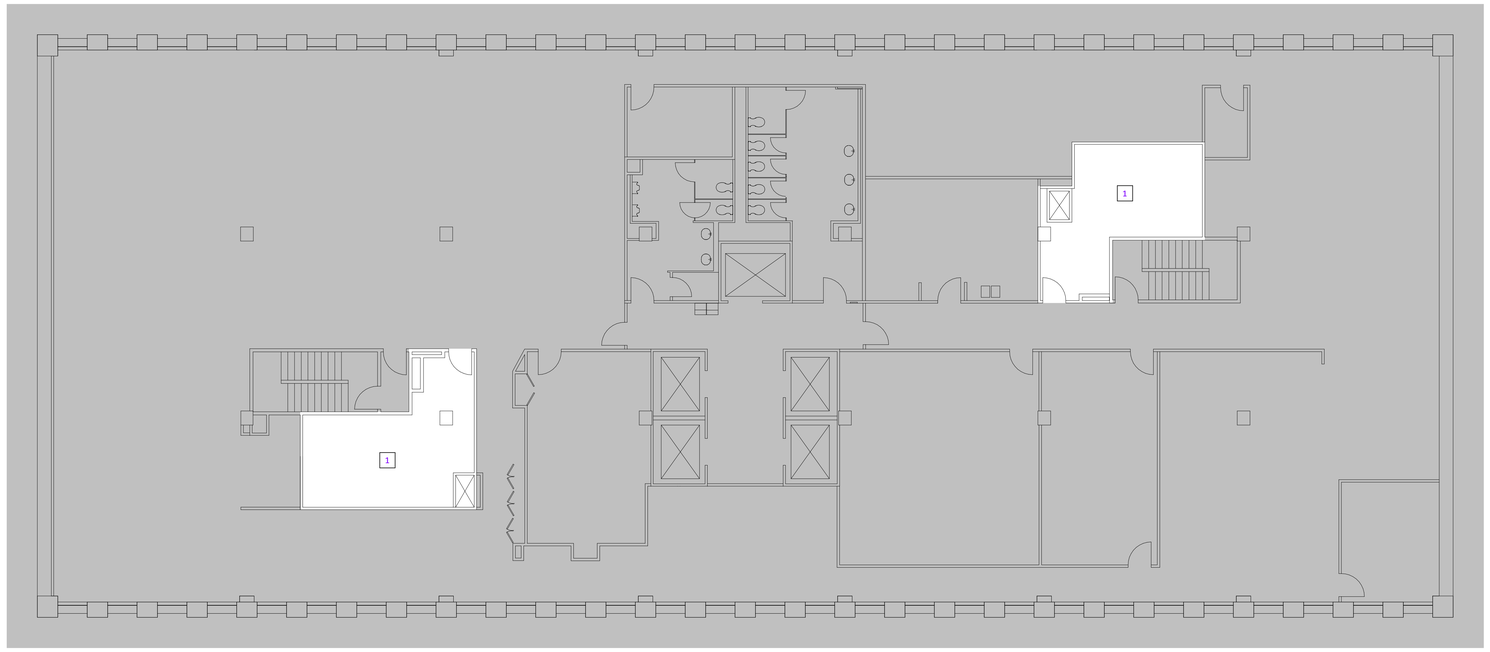
1 As an add alternate to base bid. Provide new concrete floor sealer in existing Mechanical Room. Prepare existing concrete to receive sealer per manufacturer's directions.

**Legend - Floor/Demo Plan**

- Existing to be removed
- Existing to remain
- Area not in scope of project

PN

**Level 12 Reference Floor Plan** | 1/8" = 1'-0" | 3




**General Notes - Floor Plan**

1. See Mechanical Plans for additional scope.
2. Protect existing conditions to remain.
3. If any damage occurs to existing finishes or fixtures resulting from construction activities, repair to like new condition.

**Key Notes - Floor Plan**

1 As an add alternate to base bid. Provide new concrete floor sealer in existing Mechanical Room. Prepare existing concrete to receive sealer per manufacturer's directions.

**Legend - Floor/Demo Plan**

- Existing to be removed
- Existing to remain
- Area not in scope of project

PN

**Level 11 Reference Floor Plan** | 1/8" = 1'-0" | 1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THE UNIVERSITY of TEXAS
HEALTH SCIENCE CENTER AT HOUSTON

| No. | Description | Date |
|---|---|---|
| | Issue for Construction | 10/11/2017 |

Keyplan

REGISTERED ARCHITECT
CHRISTOPHER E. HOFFMAN
18288
STATE OF TEXAS

10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU Replacement

## Level 10 and 11 Reference Floor Plans

| | |
|---|---|
| SSA Project Number | |
| Date | 10/11/2017 |
| Designed By | |
| Checked By | |
| Drawing No. | A-104 |
| Scale | 1/8" = 1'-0" |


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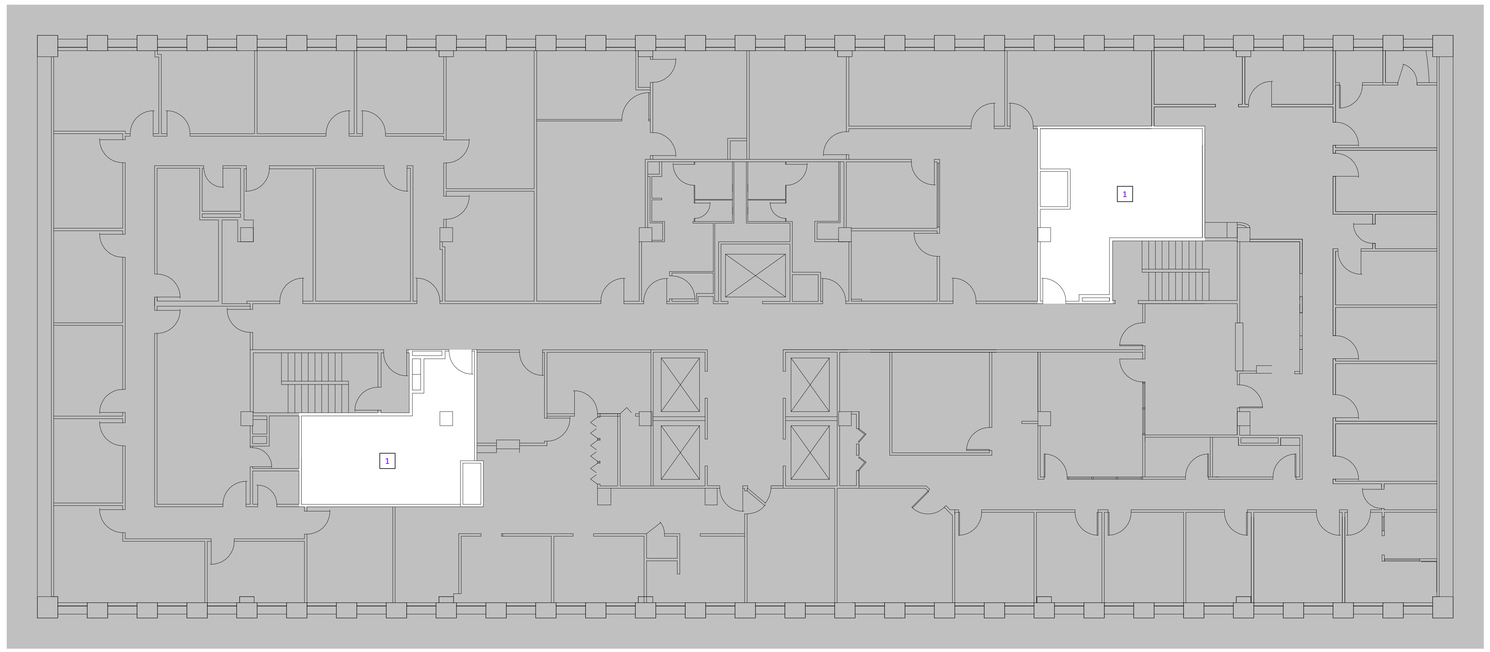



**General Notes - Floor Plan**

1. See Mechanical Plans for additional scope.
2. Protect existing conditions to remain.
3. If any damage occurs to existing finishes or fixtures resulting from construction activities, repair to like new condition.

**Key Notes - Floor Plan**

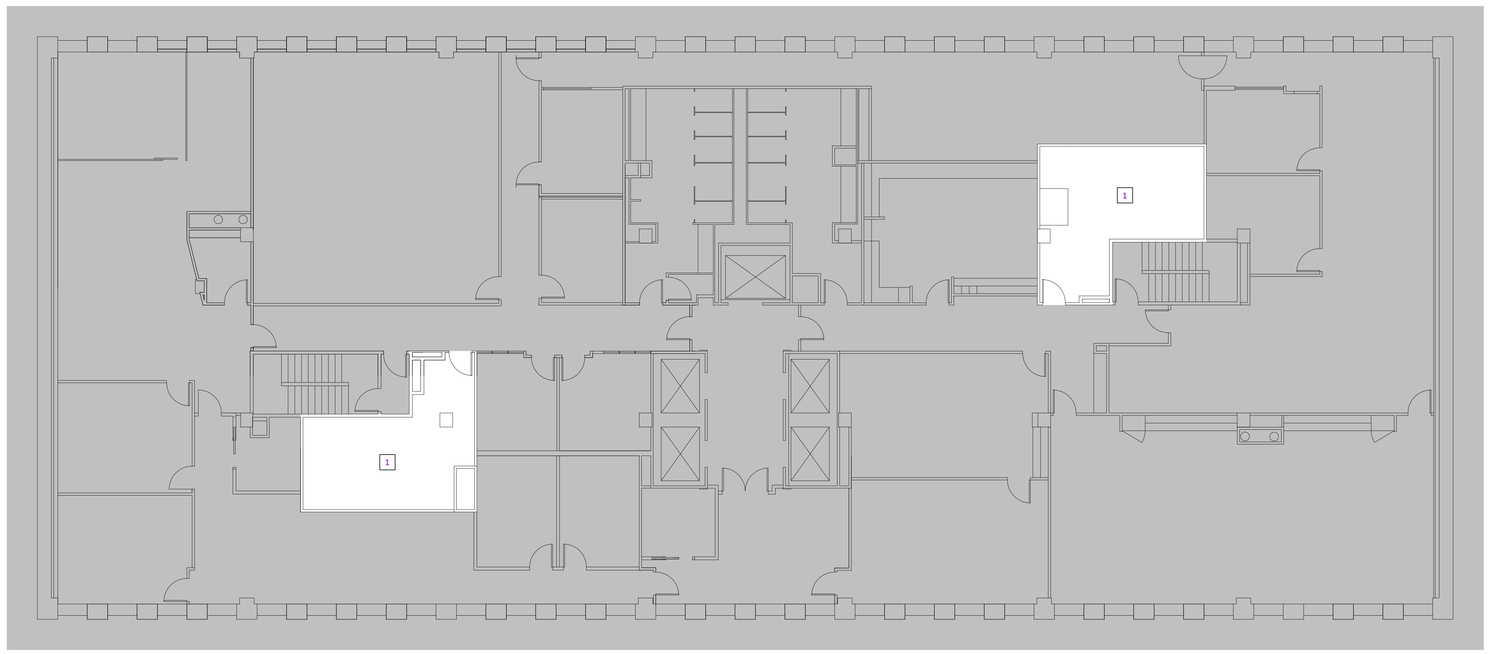
1 As an add alternate to base bid. Provide new concrete floor sealer in existing Mechanical Room. Prepare existing concrete to receive sealer per manufacturer's directions.

**Legend - Floor/Demo Plan**

- Existing to be removed
- Existing to remain
- Area not in scope of project

PN

**Level 16 Reference Floor Plan** | 1/8" = 1'-0" | 3




**General Notes - Floor Plan**

1. See Mechanical Plans for additional scope.
2. Protect existing conditions to remain.
3. If any damage occurs to existing finishes or fixtures resulting from construction activities, repair to like new condition.

**Key Notes - Floor Plan**

1 As an add alternate to base bid. Provide new concrete floor sealer in existing Mechanical Room. Prepare existing concrete to receive sealer per manufacturer's directions.

**Legend - Floor/Demo Plan**

- Existing to be removed
- Existing to remain
- Area not in scope of project

PN

**Level 15 Reference Floor Plan** | 1/8" = 1'-0" | 1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Texas Registered Engineering Firm F-2113


Philo Wilke Partnership

The University of Texas Health Science Center at Houston

| No. | Description | Date |
|---|---|---|
| | Issue for Construction | 10/11/2017 |

Keyplan

REGISTERED ARCHITECT ... 18288 ... STATE OF TEXAS

10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU Replacement

Level 15 and 16 Reference Floor Plans

| | |
|---|---|
| SSA Project Number | |
| Date | 10/11/2017 |
| Designed By | |
| Checked By | |
| Drawing No. | A-105 |
| Scale | 1/8" = 1'-0" |


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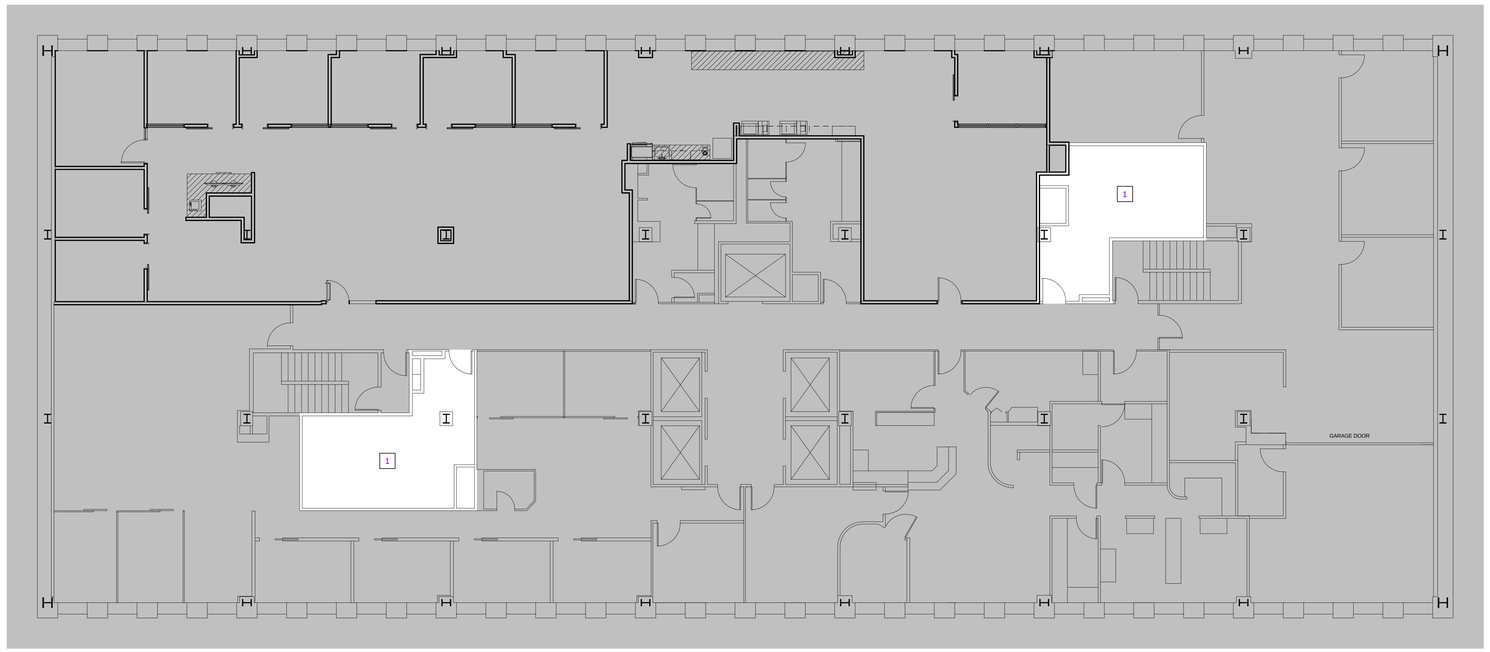



General Notes - Floor Plan

1. See Mechanical Plans for additional scope.
2. Protect existing conditions to remain.
3. If any damage occurs to existing finishes or fixtures resulting from construction activities, repair to like new condition.

Key Notes - Floor Plan

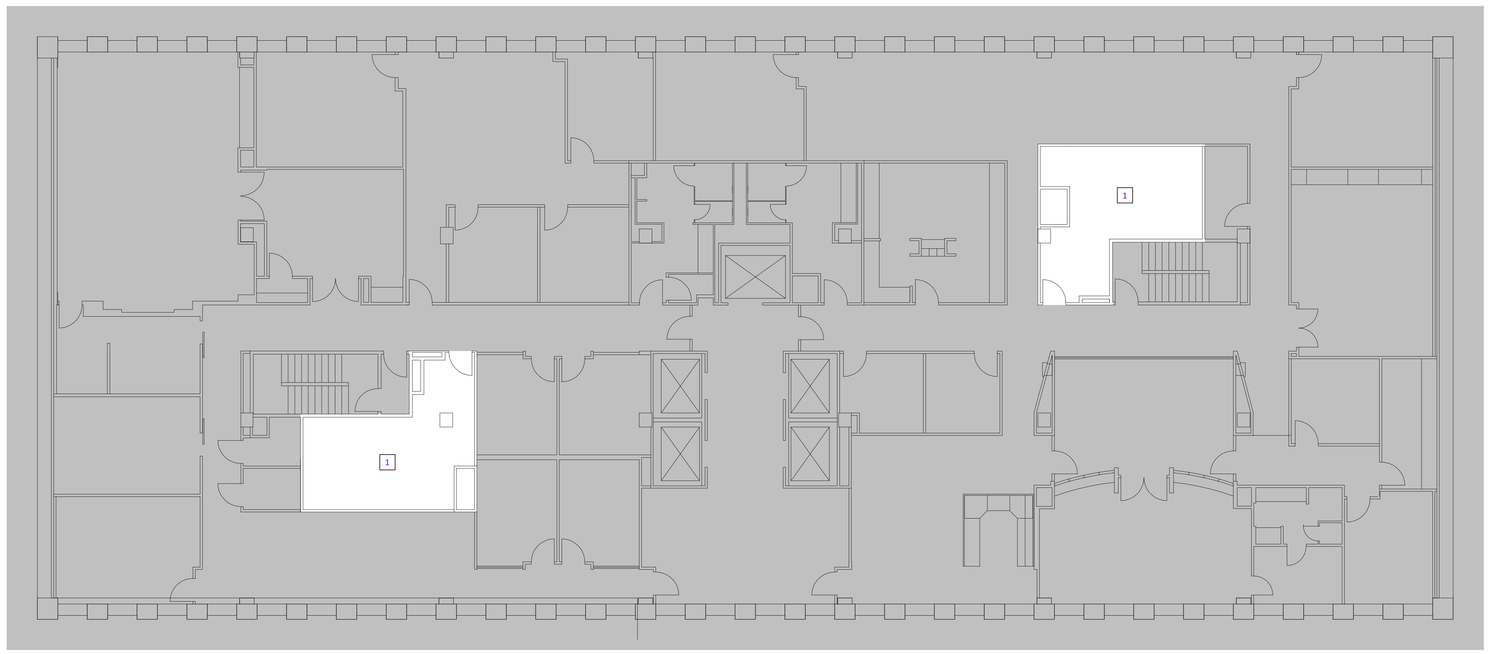
1 As an add alternate to base bid. Provide new concrete floor sealer in existing Mechanical Room. Prepare existing concrete to receive sealer per manufacturer's directions.

Legend - Floor/Demo Plan

- Existing to be removed
- Existing to remain
- Area not in scope of project

PN

**Level 18 Reference Floor Plan** 1/8" = 1'-0" **3**




General Notes - Floor Plan

1. See Mechanical Plans for additional scope.
2. Protect existing conditions to remain.
3. If any damage occurs to existing finishes or fixtures resulting from construction activities, repair to like new condition.

Key Notes - Floor Plan

1 As an add alternate to base bid. Provide new concrete floor sealer in existing Mechanical Room. Prepare existing concrete to receive sealer per manufacturer's directions.

Legend - Floor/Demo Plan

- Existing to be removed
- Existing to remain
- Area not in scope of project

PN

**Level 17 Reference Floor Plan** 1/8" = 1'-0" **1**

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THE UNIVERSITY of TEXAS HEALTH SCIENCE CENTER AT HOUSTON

| No. | Description | Date |
|---|---|---|
| | Issue for Construction | 10/11/2017 |

Keyplan

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10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU Replacement

Level 17 and 18 Reference Floor Plans

| | |
|---|---|
| SSA Project Number | |
| Date | 10/11/2017 |
| Designed By | |
| Checked By | |
| Drawing No. | A-106 |
| Scale | 1/8" = 1'-0" |

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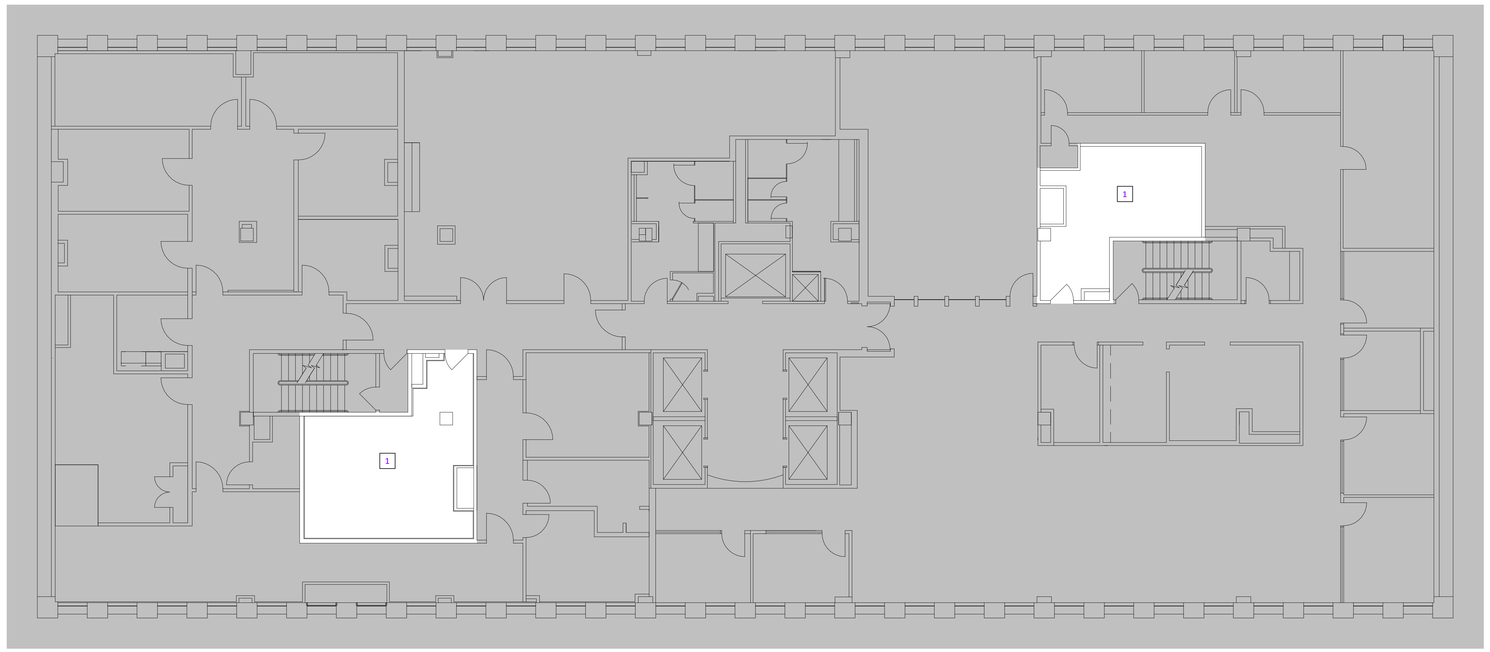



General Notes - Floor Plan

1. See Mechanical Plans for additional scope.
2. Protect existing conditions to remain.
3. If any damage occurs to existing finishes or fixtures resulting from construction activities, repair to like new condition.

Key Notes - Floor Plan

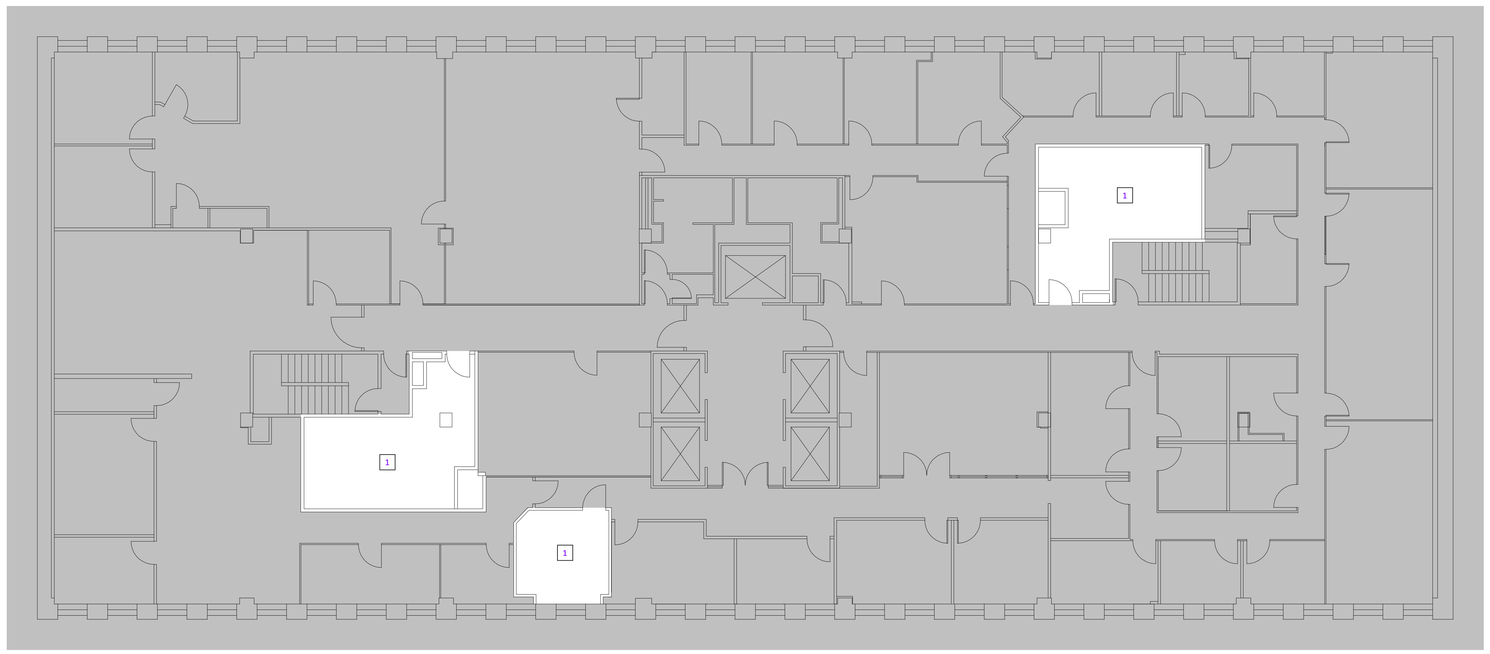
1 As an add alternate to base bid. Provide new concrete floor sealer in existing Mechanical Room. Prepare existing concrete to receive sealer per manufacturer's directions.

Legend - Floor/Demo Plan

- Existing to be removed
- Existing to remain
- Area not in scope of project

PN

**Level 20 Reference Floor Plan** 1/8" = 1'-0" **3**




General Notes - Floor Plan

1. See Mechanical Plans for additional scope.
2. Protect existing conditions to remain.
3. If any damage occurs to existing finishes or fixtures resulting from construction activities, repair to like new condition.

Key Notes - Floor Plan

1 As an add alternate to base bid. Provide new concrete floor sealer in existing Mechanical Room. Prepare existing concrete to receive sealer per manufacturer's directions.

Legend - Floor/Demo Plan

- Existing to be removed
- Existing to remain
- Area not in scope of project

PN

**Level 19 Reference Floor Plan** 1/8" = 1'-0" **1**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|---|---|---|
| | Issue for Construction | 10/11/2017 |

Keyplan

REGISTERED ARCHITECT DAVID E. NOVAK 18288 STATE OF TEXAS

10/11/2017

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# UCT AHU Replacement

Level 19 and 20 Reference Floor Plans

| | |
|---|---|
| SSA Project Number | |
| Date | 10/11/2017 |
| Designed By | |
| Checked By | |
| Drawing No. | A-107 |
| Scale | 1/8" = 1'-0" |

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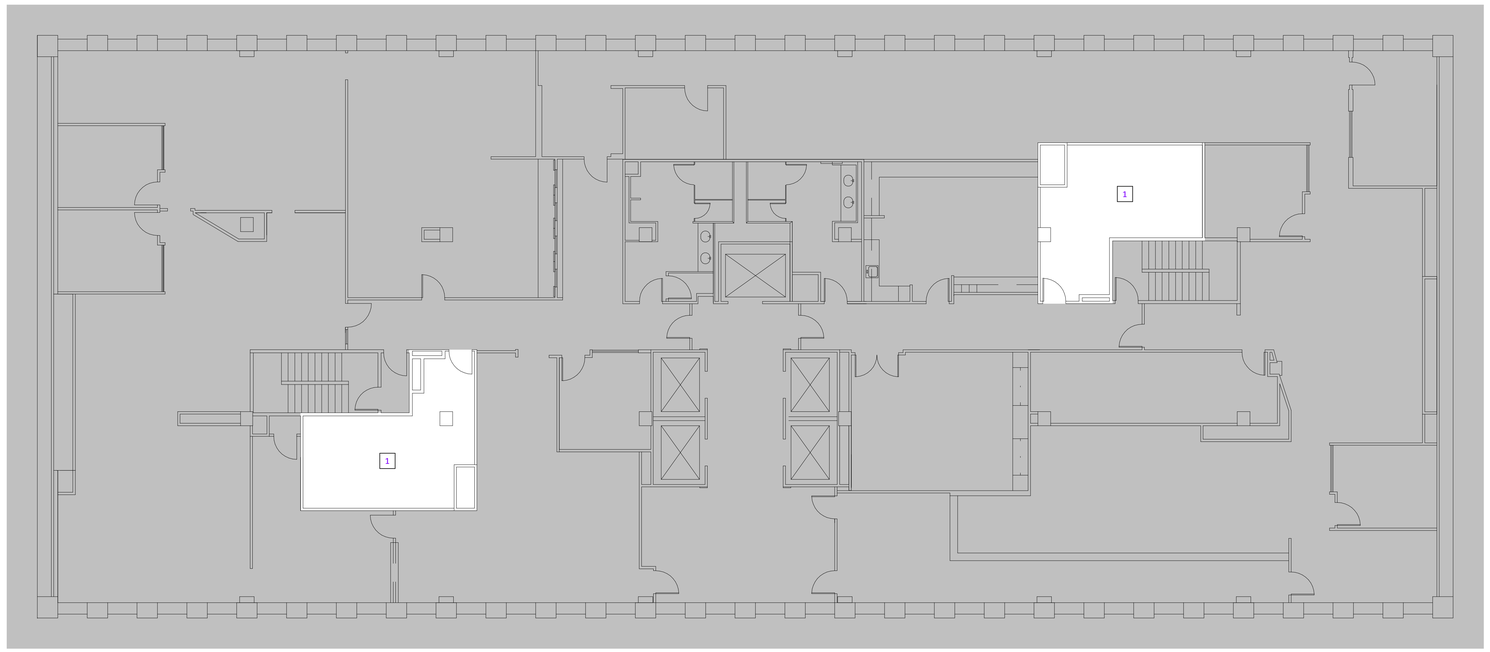



**General Notes - Floor Plan**

1. See Mechanical Plans for additional scope.
2. Protect existing conditions to remain.
3. If any damage occurs to existing finishes or fixtures resulting from construction activities, repair to like new condition.

**Key Notes - Floor Plan**

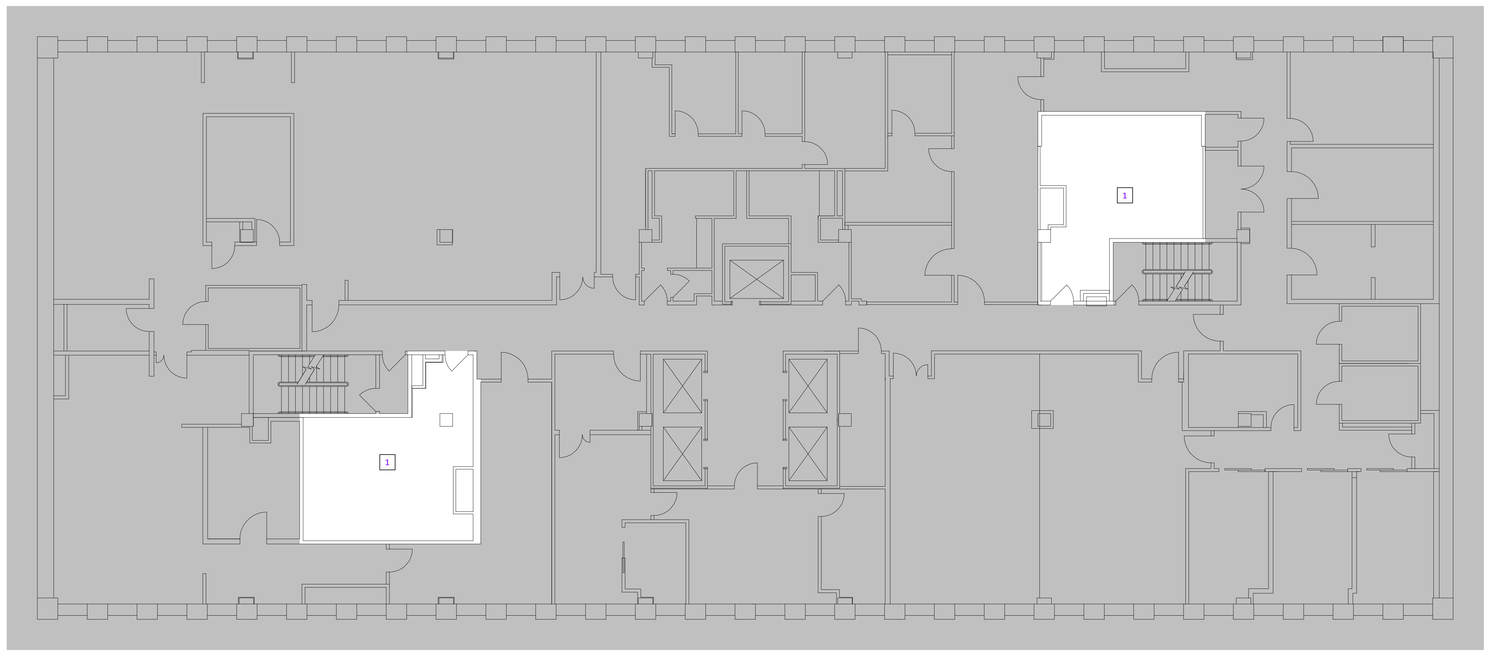
1 As an add alternate to base bid. Provide new concrete floor sealer in existing Mechanical Room. Prepare existing concrete to receive sealer per manufacturer's directions.

**Legend - Floor/Demo Plan**

- Existing to be removed
- Existing to remain
- Area not in scope of project

PN

**Level 22 Reference Floor Plan** | 1/8" = 1'-0" | 3




**General Notes - Floor Plan**

1. See Mechanical Plans for additional scope.
2. Protect existing conditions to remain.
3. If any damage occurs to existing finishes or fixtures resulting from construction activities, repair to like new condition.

**Key Notes - Floor Plan**

1 As an add alternate to base bid. Provide new concrete floor sealer in existing Mechanical Room. Prepare existing concrete to receive sealer per manufacturer's directions.

**Legend - Floor/Demo Plan**

- Existing to be removed
- Existing to remain
- Area not in scope of project

PN

**Level 21 Reference Floor Plan** | 1/8" = 1'-0" | 1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THE UNIVERSITY of TEXAS
HEALTH SCIENCE CENTER AT HOUSTON

| No. | Description | Date |
|---|---|---|
| | Issue for Construction | 10/11/2017 |

Keyplan

REGISTERED ARCHITECT
DOMINIC E. NAPOLITANO
18288
STATE OF TEXAS
10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU Replacement

Level 21 and 22 Reference Floor Plans

SSA Project Number

Date 10/11/2017

Designed By

Checked By

Drawing No. A-108

Scale 1/8" = 1'-0"

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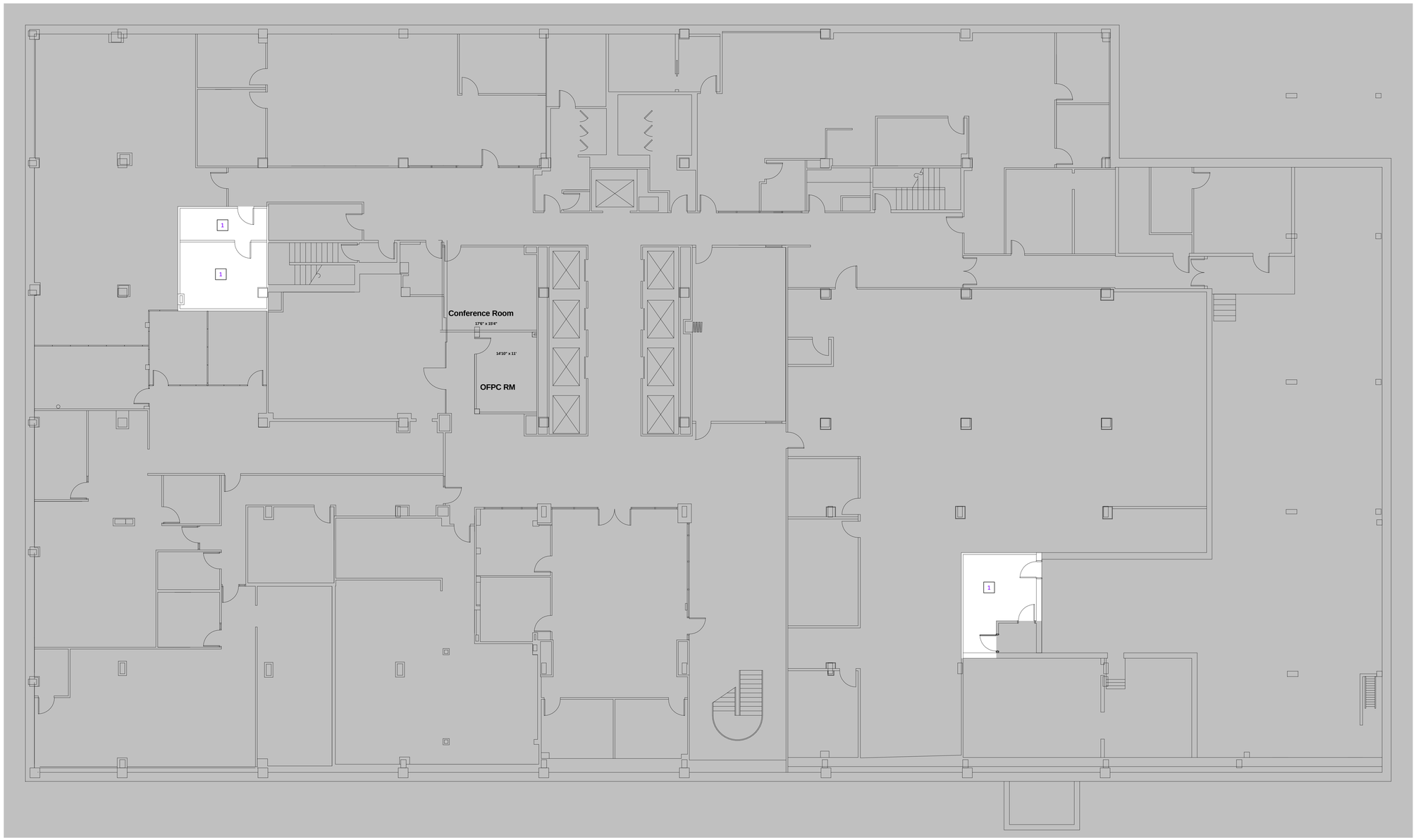


General Notes - Floor Plan

1. See Mechanical Plans for additional scope.
2. Protect existing conditions to remain.
3. If any damage occurs to existing finishes or fixtures resulting from construction activities, repair to like new condition.

Key Notes - Floor Plan

1 As an add alternate to base bid. Provide new concrete floor sealer in existing Mechanical Room. Prepare existing concrete to receive sealer per manufacturer's directions.

Legend - Floor/Demo Plan

- Existing to be removed
- Existing to remain
- Area not in scope of project

PN

**Level M Reference Floor Plan** | 1/8" = 1'-0" | 1


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THE UNIVERSITY of TEXAS
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| No. | Description | Date |
|---|---|---|
| | Issue for Construction | 10/11/2017 |

Keyplan

REGISTERED ARCHITECT
CHRISTOPHER E. HOLT
18288
STATE OF TEXAS
10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU Replacement

## Level M Reference Floor Plan

| | |
|---|---|
| SSA Project Number | |
| Date | 10/11/2017 |
| Designed By | |
| Checked By | |
| Drawing No. | A-109 |
| Scale | 1/8" = 1'-0" |

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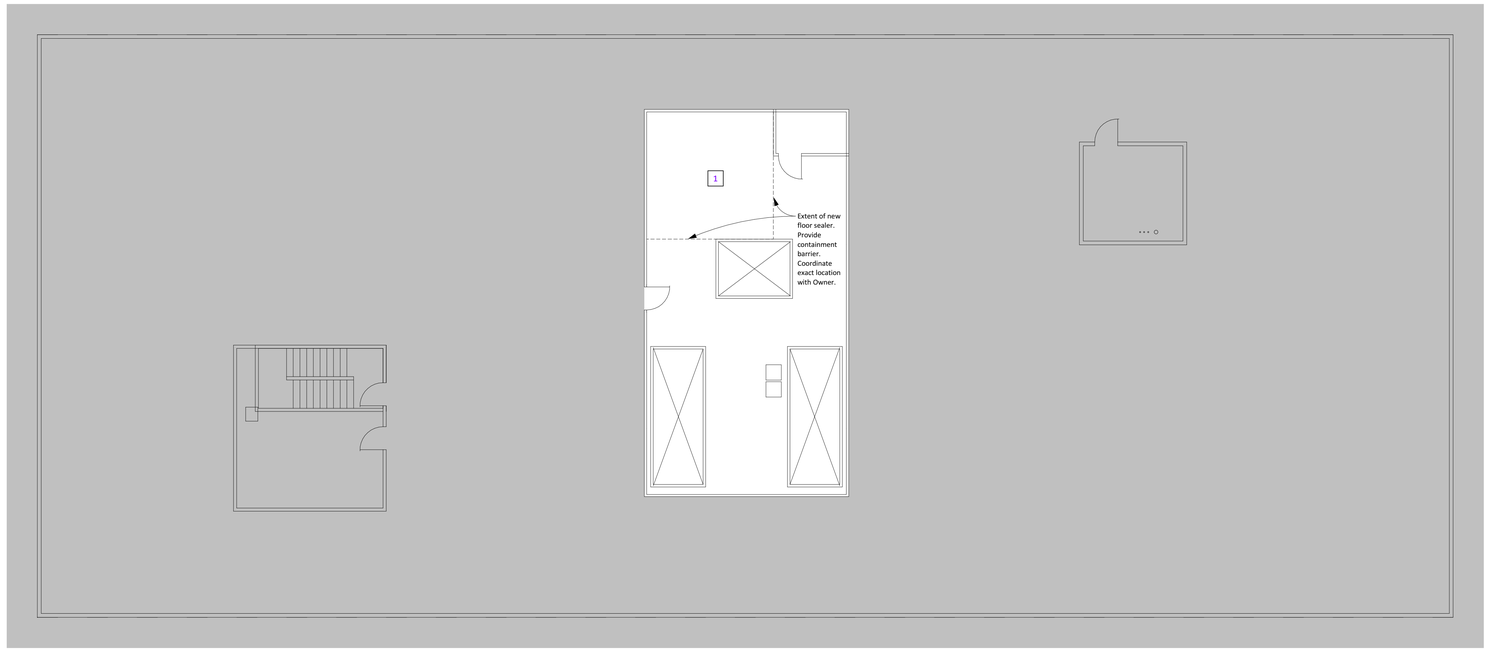


**General Notes - Floor Plan**

1. See Mechanical Plans for additional scope.
2. Protect existing conditions to remain.
3. If any damage occurs to existing finishes or fixtures resulting from construction activities, repair to like new condition.

**Key Notes - Floor Plan**

1 As an add alternate to base bid. Provide new concrete floor sealer in existing Mechanical Room. Prepare existing concrete to receive sealer per manufacturer's directions.

**Legend - Floor/Demo Plan**

- Existing to be removed
- Existing to remain
- Area not in scope of project

PN

**Penthouse Reference Floor Plan** 1/8" = 1'-0" 1

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The University of Texas Health Science Center at Houston

| No. | Description | Date |
|---|---|---|
| | Issue for Construction | 10/11/2017 |

Keyplan

REGISTERED ARCHITECT CHRISTINA E. HOLT 18288 STATE OF TEXAS
10/11/2017

# The University of Texas Health Science Center at Houston

# UCT AHU Replacement

## Penthouse Reference Floor Plan

SSA Project Number

Date 10/11/2017

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Drawing No. A-110

Scale 1/8" = 1'-0"

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## LEGEND

DISREGARD LEGEND ITEMS NOT INDICATED ON DRAWINGS

| SYMBOL | ABBREV. | DESCRIPTION | SYMBOL | ABBREV. | DESCRIPTION |
|---|---|---|---|---|---|
| | SA/OA | SUPPLY/OUTSIDE AIR DUCT | | | VALVE BOX |
| | RA | RETURN AIR DUCT | | | GAGE COCK |
| | EA/REA | EXHAUST/RELIEF AIR DUCT | | | BUTTERFLY VALVE |
| | FD/FSD | FIRE/FIRE SMOKE DAMPER | | | PLUG VALVE |
| | | NEW WORK | | | TWO-WAY CONTROL VALVE |
| | | EXISTING WORK | | | THREE-WAY CONTROL VALVE |
| | | TEMPORARY WORK | | | THERMOMETER WELL |
| | | SUPPLY AIR DIRECTION | | 12" | DENOTES ROUND DUCTWORK/PIPING |
| | | OFFSET AIR QUANTITY (CFM)/ EXHAUST/RETURN DIRECTION | | 70/22 O. | DENOTES OVAL DUCTWORK |
| | VD | VOLUME DAMPER | | 70/22 | DENOTES RECTANGULAR DUCTWORK |
| | MVD | MOTORIZED VOLUME DAMPER | | AFF | ABOVE FINISHED FLOOR |
| 10 | | KEYED NOTE | | AFMS | AIR FLOW MEASURING STATION |
| 1 | | REVISION TRIANGLE | | AHU | AIR HANDLING UNIT |
| | | ACCESS DOOR | | BOD | BOTTOM OF DUCT |
| S | | SMOKE DETECTOR | | BOP | BOTTOM OF PIPE |
| TS | | TEMPERATURE SENSOR | | CAV | CONSTANT AIR VOLUME |
| T | | THERMOSTAT | | C/C | COOLING COIL |
| DD | | SMOKE DUCT DETECTOR | | CFM | CUBIC FEET PER MINUTE |
| H OR HS | | HUMIDISTAT | | DDC | DIRECT DIGITAL CONTROL |
| SP | | STATIC PRESSURE SENSOR | | EF | EXHAUST FAN |
| CHS | CHS | CHILLED WATER SUPPLY | | EXH | EXHAUST |
| CHR | CHR | CHILLED WATER RETURN | | (E)/EXIST. | EXISTING |
| CWS | CWS | CONDENSING WATER SUPPLY | | FCU | FAN COIL UNIT |
| CWR | CWR | CONDENSING WATER RETURN | | FO | FLAT OVAL |
| HWS | HWS | HOT WATER SUPPLY | | GPM | GALLONS PER MINUTE |
| HWR | HWR | HOT WATER RETURN | | H/C | HEATING COIL |
| #S | #S | # OF STEAM SUPPLY | | NTS | NOT TO SCALE |
| #R | #R | # OF STEAM RETURN | | SAD | SOUND ATTENUATING DEVICE |
| A | A | COMPRESSED AIR | | VAV | VARIABLE AIR VOLUME |
| PCR | PCR | PUMP CONDENSATE RETURN | | VFD | VARIABLE FREQUENCY DRIVE |
| CR | CR | CONDENSATE RETURN | | VTR | VENT THRU ROOF |
| | RV | PRESSURE RELIEF VALVE | | CO2 | CARBON DIOXIDE SENSOR |
| | PRV | PRESSURE REDUCING VALVE | | HS | HUMIDITY SENSOR |
| | | THERMOMETER | | ES | MOTOR STARTER |
| | | UNION | | N.C. | NORMALLY CLOSED |
| | | STRAINER | | N.O. | NORMALLY OPEN |
| | | REDUCER | | DP | DIFFERENTIAL PRESSURE SENSOR |
| | | GAGE | | VFD | VARIABLE FREQUENCY DRIVE |
| | | FLEXIBLE JOINT | | FS | FREEZE STAT |
| | | ANCHOR | | G | FILTER GAUGE |
| | | VENTURI FLOW TUBE | | DPS | DIFFERENTIAL PRESSURE SWITCH |
| | | SOLENOID VALVE | | HP | HIGH PRESSURE SHUT OFF SWITCH |
| | | BALL VALVE | | AFMS | AIRFLOW MEASURING STATION |
| | | GATE VALVE | | ------ | ELECTRICAL SIGNAL |
| | | GLOBE VALVE | | | DAMPER OR VALVE ACTUATOR |
| | | CHECK VALVE | | | |

## GENERAL NOTES

THESE GENERAL NOTES APPLY TO ALL MECHANICAL DRAWINGS.

IN ANY CASE WHERE A PIPE OR DUCT SHOWN ON A PLAN SHEET DIFFERS FROM THAT SHOWN IN A SCHEMATIC OR DETAIL. USE THE LARGER OF THE TWO SIZES SHOWN.

ALL ELEVATIONS INDICATED IN THIS WAY (8'-0") ARE THE ELEVATIONS FROM THE FINISHED FLOOR DIRECTLY BELOW TO THE BOTTOM OF THE BARE PIPE OR DUCT.

DUCT SIZE SHOWN ARE NET FREE AIR PASSAGE DIMENSIONS. DUCTS ARE NOT LINED, BUT ARE EXTERNALLY INSULATED.

PROVIDE AIR VENTS AT HIGH POINT OF ALL WATER SYSTEM.

COORDINATE INSTALLATION OF EQUIPMENT AND PIPING WITH ELECTRICAL CONTRACTOR TO INSURE NEC CLEARANCE IN FRONT OF ALL ELECTRICAL PANELS.

ARRANGE PIPING CONNECTIONS TO ALL EQUIPMENT TO ALLOW EASY REMOVAL OF EQUIPMENT, COILS, FANS, MOTORS, FILTERS, ACCESS PANELS, ETC. PROVIDE UNIONS, FLANGES AND VALVES AT CONNECTIONS.

## DETAIL LIST - MECHANICAL


| | |
|---|---|
| 2-WAY CONTROL VALVE COIL CONNECTION DETAIL | M-900 |
| AIR RELIEF VALVE DETAIL | M-900 |
| BEAM CLAMP TYPE SUPPORT DETAIL | M-901 |
| CONCRETE SUPPORT DETAIL | M-901 |
| CONDENSATE DRAIN DETAIL | M-900 |
| DRAIN AND VENT DETAIL | M-901 |
| HANGER CONNECTION TO STRUCTURE DETAIL | M-901 |
| PRESSURE GAUGE DETAIL | M-900 |
| RECTANGULAR DUCT SUPPORTED BY UNISTRUT DETAIL | M-901 |
| STACKED COIL 2-WAY VALVE PIPING DETAIL | M-900 |
| THERMOMETER WELL LOCATED IN HORIZONTAL PIPE DETAIL | M-900 |
| TYPICAL PIPE SUPPORT DETAIL | M-901 |


## DRAWING LIST - ARCHITECTURAL & MEP


| | | | | | |
|---|---|---|---|---|---|
| CS | COVER SHEET | 1 - COVER | M-100-8E | LEVEL 8 EAST ENLARGED MECHANICAL PLAN | 3 - MECH |
| | | | M-100-8W | LEVEL 8 WEST ENLARGED MECHANICAL PLAN | 3 - MECH |
| A-101 | LEVEL 1 REFERENCE FLOOR PLAN | 2 - ARCH | M-100-9E | LEVEL 9 EAST ENLARGED MECHANICAL PLAN | 3 - MECH |
| A-102 | LEVEL 6 AND 7 REFERENCE FLOOR PLANS | 2 - ARCH | M-100-9W | LEVEL 9 WEST ENLARGED MECHANICAL PLAN | 3 - MECH |
| A-103 | LEVEL 8 AND 9 REFERENCE FLOOR PLANS | 2 - ARCH | M-100-11E | LEVEL 11 EAST ENLARGED MECHANICAL PLAN | 3 - MECH |
| A-104 | LEVEL 11 AND 12 REFERENCE FLOOR PLANS | 2 - ARCH | M-100-11W | LEVEL 11 WEST ENLARGED MECHANICAL PLAN | 3 - MECH |
| A-105 | LEVEL 15 AND 16 REFERENCE FLOOR PLANS | 2 - ARCH | M-100-12E | LEVEL 12 EAST ENLARGED MECHANICAL PLAN | 3 - MECH |
| A-106 | LEVEL 17 AND 18 REFERENCE FLOOR PLANS | 2 - ARCH | M-100-12W | LEVEL 12 WEST ENLARGED MECHANICAL PLAN | 3 - MECH |
| A-107 | LEVEL 19 AND 20 REFERENCE FLOOR PLANS | 2 - ARCH | M-100-15E | LEVEL 15 EAST ENLARGED MECHANICAL PLAN | 3 - MECH |
| A-108 | LEVEL 21 AND 22 REFERENCE FLOOR PLANS | 2 - ARCH | M-100-15W | LEVEL 15 WEST ENLARGED MECHANICAL PLAN | 3 - MECH |
| A-109 | LEVEL M REFERENCE FLOOR PLAN | 2 - ARCH | M-100-16E | LEVEL 16 EAST ENLARGED MECHANICAL PLAN | 3 - MECH |
| A-110 | PENTHOUSE REFERENCE FLOOR PLAN | 2 - ARCH | M-100-16W | LEVEL 16 WEST ENLARGED MECHANICAL PLAN | 3 - MECH |
| | | | M-100-17E | LEVEL 17 EAST ENLARGED MECHANICAL PLAN | 3 - MECH |
| M-001 | MECHANICAL LEGENDS, GENERAL NOTES AND SCHEDULES | 3 - MECH | M-100-17W | LEVEL 17 WEST ENLARGED MECHANICAL PLAN | 3 - MECH |
| M-002 | MECHANICAL SCHEDULES | 3 - MECH | M-100-18E | LEVEL 18 EAST ENLARGED MECHANICAL PLAN | 3 - MECH |
| M-100-1E | LEVEL 1 EAST ENLARGED MECHANICAL PLAN | 3 - MECH | M-100-18W | LEVEL 18 WEST ENLARGED MECHANICAL PLAN | 3 - MECH |
| M-100-1ME | LEVEL M EAST ENLARGED MECHANICAL PLAN | 3 - MECH | M-100-19E-1 | LEVEL 19 EAST ENLARGED MECHANICAL PLAN | 3 - MECH |
| M-100-1MW | LEVEL M WEST ENLARGED MECHANICAL PLAN | 3 - MECH | M-100-19E-2 | LEVEL 19 EAST ENLARGED MECHANICAL PLAN | 3 - MECH |
| M-100-6E | LEVEL 6 EAST ENLARGED MECHANICAL PLAN | 3 - MECH | M-100-19W | LEVEL 19 WEST ENLARGED MECHANICAL PLAN | 3 - MECH |
| M-100-6W | LEVEL 6 WEST ENLARGED MECHANICAL PLAN | 3 - MECH | M-100-20E | LEVEL 20 EAST ENLARGED MECHANICAL PLAN | 3 - MECH |
| M-100-7E | LEVEL 7 EAST ENLARGED MECHANICAL PLAN | 3 - MECH | M-100-20W | LEVEL 20 WEST ENLARGED MECHANICAL PLAN | 3 - MECH |
| M-100-7W | LEVEL 7 WEST ENLARGED MECHANICAL PLAN | 3 - MECH | M-100-21E | LEVEL 21 EAST ENLARGED MECHANICAL PLAN | 3 - MECH |


## DRAWING LIST - ARCHITECTURAL & MEP


| | | | | | |
|---|---|---|---|---|---|
| M-100-21W | LEVEL 21 WEST ENLARGED MECHANICAL PLAN | 3 - MECH | E-100-20W | LEVEL 20 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC |
| M-100-22E | LEVEL 22 EAST ENLARGED MECHANICAL PLAN | 3 - MECH | E-100-21E | LEVEL 21 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC |
| M-100-22W | LEVEL 22 WEST ENLARGED MECHANICAL PLAN | 3 - MECH | E-100-21W | LEVEL 21 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC |
| M-100-P | PENTHOUSE LEVEL ENLARGED MECHANICAL PLAN | 3 - MECH | E-100-22E | LEVEL 22 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC |
| M-501 | COMPONENT DIAGRAMS | 3 - MECH | E-100-22W | LEVEL 22 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC |
| M-502 | COMPONENT DIAGRAMS | 3 - MECH | E-100-P | PENTHOUSE ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC |
| M-503 | COMPONENT DIAGRAMS | 3 - MECH | | | |
| M-504 | COMPONENT DIAGRAMS | 3 - MECH | P-001 | PLUMBING LEGENDS, GENERAL NOTES AND SCHEDULES | 5 - PLBG |
| M-505 | AHU-19-2 COMPONENT DIAGRAM | 3 - MECH | P-100-6W | LEVEL 6 WEST ENLARGED PLUMBING PLAN | 5 - PLBG |
| M-600 | CONTROL DIAGRAMS | 3 - MECH | P-100-7E | LEVEL 7 EAST ENLARGED PLUMBING PLAN | 5 - PLBG |
| M-601 | CONTROL DIAGRAMS | 3 - MECH | P-100-7W | LEVEL 7 WEST ENLARGED PLUMBING PLAN | 5 - PLBG |
| M-602 | CONTROL DIAGRAMS | 3 - MECH | P-100-8E | LEVEL 8 EAST ENLARGED PLUMBING PLAN | 5 - PLBG |
| M-603 | CONTROL DIAGRAMS | 3 - MECH | P-100-8W | LEVEL 8 WEST ENLARGED PLUMBING PLAN | 5 - PLBG |
| M-900 | MECHANICAL DETAILS | 3 - MECH | P-100-9E | LEVEL 9 EAST ENLARGED PLUMBING PLAN | 5 - PLBG |
| M-901 | MECHANICAL DETAILS | 3 - MECH | P-100-9W | LEVEL 9 WEST ENLARGED PLUMBING PLAN | 5 - PLBG |
| | | | P-100-11E | LEVEL 11 EAST ENLARGED PLUMBING PLAN | 5 - PLBG |
| E-001 | ELECTRICAL LEGEND SYMBOLS AND ABBREVIATIONS | 4 - ELEC | P-100-11W | LEVEL 11 WEST ENLARGED PLUMBING PLAN | 5 - PLBG |
| E-100-1E | LEVEL 1 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | P-100-12E | LEVEL 12 EAST ENLARGED PLUMBING PLAN | 5 - PLBG |
| E-100-1ME | LEVEL M EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | P-100-12W | LEVEL 12 WEST ENLARGED PLUMBING PLAN | 5 - PLBG |
| E-100-1MW | LEVEL M WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | P-100-15E | LEVEL 15 EAST ENLARGED PLUMBING PLAN | 5 - PLBG |
| E-100-6E | LEVEL 6 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | P-100-15W | LEVEL 15 WEST ENLARGED PLUMBING PLAN | 5 - PLBG |
| E-100-6W | LEVEL 6 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | P-100-16E | LEVEL 16 EAST ENLARGED PLUMBING PLAN | 5 - PLBG |
| E-100-7E | LEVEL 7 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | P-100-16W | LEVEL 16 WEST ENLARGED PLUMBING PLAN | 5 - PLBG |
| E-100-7W | LEVEL 7 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | P-100-17E | LEVEL 17 EAST ENLARGED PLUMBING PLAN | 5 - PLBG |
| E-100-8E | LEVEL 8 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | P-100-17W | LEVEL 17 WEST ENLARGED PLUMBING PLAN | 5 - PLBG |
| E-100-8W | LEVEL 8 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | P-100-18E | LEVEL 18 EAST ENLARGED PLUMBING PLAN | 5 - PLBG |
| E-100-9E | LEVEL 9 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | P-100-18W | LEVEL 18 WEST ENLARGED PLUMBING PLAN | 5 - PLBG |
| E-100-9W | LEVEL 9 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | P-100-19W | LEVEL 19 WEST ENLARGED PLUMBING PLAN | 5 - PLBG |
| E-100-11E | LEVEL 11 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | P-100-20W | LEVEL 20 WEST ENLARGED PLUMBING PLAN | 5 - PLBG |
| E-100-11W | LEVEL 11 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | P-100-21W | LEVEL 21 WEST ENLARGED PLUMBING PLAN | 5 - PLBG |
| E-100-12E | LEVEL 12 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | P-100-22E | LEVEL 22 EAST ENLARGED PLUMBING PLAN | 5 - PLBG |
| E-100-12W | LEVEL 12 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | P-100-22W | LEVEL 22 WEST ENLARGED PLUMBING PLAN | 5 - PLBG |
| E-100-15E | LEVEL 15 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | P-100-ME | LEVEL M EAST ENLARGED PLUMBING PLAN | 5 - PLBG |
| E-100-15W | LEVEL 15 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | | | |
| E-100-16E | LEVEL 16 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | | | |
| E-100-16W | LEVEL 16 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | | | |
| E-100-17E | LEVEL 17 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | | | |
| E-100-17W | LEVEL 17 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | | | |
| E-100-18E | LEVEL 18 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | | | |
| E-100-18W | LEVEL 18 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | | | |
| E-100-19E | LEVEL 19 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | | | |
| E-100-19W | LEVEL 19 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | | | |
| E-100-20E | LEVEL 20 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL | 4 - ELEC | | | |



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Philo Wilke Partnership


THE UNIVERSITY of TEXAS HEALTH SCIENCE CENTER AT HOUSTON

| No. | Description | Date |
|---|---|---|
| | Issue for Construction | 10/11/17 |

Keyplan

Tx. Registration # F-2113
STATE OF TEXAS
DAVID S. HALL
86468
LICENSED
PROFESSIONAL
ENGINEER
10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

MECHANICAL LEGENDS, GENERAL NOTES AND SCHEDULES

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-001 |
| Scale | No Scale |


10/10/2017 1:28:01 PM C:\Users\rgarrison\Documents\1095-034-01_Mech_R16_rgarrison9MVKJ.rvt

## AHU SCHEDULE

| MARK | LEVEL | TYPE | HEIGHT | WIDTH | LENGTH | OUTSIDE AIR CFM | SUPPLY AIR | | | | | | | | | COOLING COIL | | | | | | | | | | | | HEATING COIL | | | | | | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | TOTAL SUPPLY CFM | QTY. FANS | OUTSIDE AIR FLOW | EXT. S.P. IN. W.G. | TOTAL S.P. IN. W.G. | MOTOR BHP (EA) | MOTOR HP (EA) | VOLTS | PH | HZ | COIL CFM | MIN. SENS. BTUH | TOTAL BTUH | MAX ROW | ENT. WTR. GPM | EWT °F | LWT °F | MAX FACE VEL. FPM | EAT DB °F | EAT WB °F | LAT DB °F | LAT WB °F | COIL CFM | MAX ROW | ENT. WTR. GPM | MAX FACE VEL. FPM | EWT °F | LWT °F | EAT °F | LAT °F | HEATING BTUH | |
| AHU-M-1 | BASEMENT | MULTI-ZONE | 5' - 11" | 7' - 9" | 6' - 7" | 800 CFM | 13000 | 2 | 800 | 1.75 | 3.05 | 4.88 | 7.5 | 460 | 3 | 60 | 13000 | 305,000 | 408,000 | 6 | 68 | 42 | 54 | 555 | 76.6 | 64.5 | 55.0 | 54.5 | 10400 | 4 | 9 | 880 | 190 | 160 | 70 | 82 | 135000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-M-2 | BASEMENT | MULTI-ZONE | 5' - 11" | 7' - 9" | 6' - 7" | 800 CFM | 10200 | 2 | 800 | 1.50 | 2.35 | 2.86 | 5.0 | 460 | 3 | 60 | 10200 | 235,000 | 315,000 | 6 | 52 | 42 | 54 | 435 | 76.2 | 64.3 | 55.0 | 54.5 | 8200 | 4 | 8 | 695 | 190 | 160 | 70 | 84 | 125000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-1-1 | LEVEL 1 | MULTI-ZONE | 6' - 10" | 10' - 1" | 7' - 6" | 1300 CFM | 19900 | 2 | 1300 | 1.75 | 3.15 | 6.88 | 7.5 | 460 | 3 | 60 | 19900 | 464,000 | 624,000 | 6 | 104 | 42 | 54 | 480 | 76.5 | 64.4 | 55.0 | 54.5 | 15900 | 4 | 21 | 1000 | 190 | 160 | 70 | 88 | 310000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-6-1 | LEVEL 6 | DOUBLE DUCT | 5' - 7" | 7' - 9" | 6' - 1" | 800 CFM | 10400 | 2 | 800 | 2.50 | 3.80 | 4.47 | 5.0 | 460 | 3 | 60 | 10400 | 239,000 | 322,000 | 6 | 54 | 42 | 54 | 445 | 76.2 | 64.3 | 55.0 | 54.5 | 8300 | 4 | 8 | 700 | 190 | 160 | 70 | 84 | 126000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-6-2 | LEVEL 6 | DOUBLE DUCT | 5' - 11" | 8' - 0" | 6' - 3" | 800 CFM | 11600 | 2 | 800 | 2.50 | 4.00 | 5.36 | 7.5 | 460 | 3 | 60 | 11600 | 269,000 | 362,000 | 6 | 60 | 42 | 54 | 480 | 76.4 | 64.4 | 55.0 | 54.5 | 9300 | 4 | 9 | 760 | 190 | 160 | 70 | 84 | 141000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-7-1 | LEVEL 7 | DOUBLE DUCT | 5' - 5" | 7' - 0" | 7' - 0" | 800 CFM | 8200 | 2 | 800 | 2.25 | 3.15 | 2.90 | 5.0 | 460 | 3 | 60 | 8200 | 185,000 | 250,000 | 6 | 42 | 42 | 54 | 460 | 75.8 | 64.1 | 55.0 | 54.5 | 6600 | 4 | 4 | 730 | 190 | 160 | 70 | 78 | 57000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-7-2 | LEVEL 7 | DOUBLE DUCT | 5' - 5" | 7' - 0" | 7' - 0" | 800 CFM | 9300 | 2 | 800 | 2.50 | 3.65 | 3.84 | 5.0 | 460 | 3 | 60 | 9300 | 212,000 | 285,000 | 6 | 48 | 42 | 54 | 520 | 76.0 | 64.2 | 55.0 | 54.5 | 7400 | 4 | 4 | 820 | 190 | 160 | 70 | 78 | 64000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-8-1 | LEVEL 8 | DOUBLE DUCT | 5' - 5" | 7' - 0" | 7' - 0" | 800 CFM | 8200 | 2 | 800 | 2.25 | 3.15 | 2.90 | 5.0 | 460 | 3 | 60 | 8200 | 185,000 | 250,000 | 6 | 42 | 42 | 54 | 460 | 75.8 | 64.1 | 55.0 | 54.5 | 6600 | 4 | 4 | 730 | 190 | 160 | 70 | 78 | 57000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-8-2 | LEVEL 8 | DOUBLE DUCT | 5' - 5" | 7' - 0" | 7' - 0" | 800 CFM | 9300 | 2 | 800 | 2.50 | 3.65 | 3.84 | 5.0 | 460 | 3 | 60 | 9300 | 212,000 | 285,000 | 6 | 48 | 42 | 54 | 520 | 76.0 | 64.2 | 55.0 | 54.5 | 7400 | 4 | 4 | 820 | 190 | 160 | 70 | 78 | 64000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-9-1 | LEVEL 9 | DOUBLE DUCT | 5' - 5" | 7' - 0" | 7' - 0" | 800 CFM | 8200 | 2 | 800 | 2.25 | 3.15 | 2.90 | 5.0 | 460 | 3 | 60 | 8200 | 185,000 | 250,000 | 6 | 42 | 42 | 54 | 460 | 75.8 | 64.1 | 55.0 | 54.5 | 6600 | 4 | 4 | 730 | 190 | 160 | 70 | 78 | 57000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-9-2 | LEVEL 9 | DOUBLE DUCT | 5' - 5" | 7' - 0" | 7' - 0" | 800 CFM | 9300 | 2 | 800 | 2.50 | 3.65 | 3.84 | 5.0 | 460 | 3 | 60 | 9300 | 212,000 | 285,000 | 6 | 48 | 42 | 54 | 520 | 76.0 | 64.2 | 55.0 | 54.5 | 7400 | 4 | 4 | 820 | 190 | 160 | 70 | 78 | 64000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-11-1 | LEVEL 11 | DOUBLE DUCT | 5' - 5" | 7' - 0" | 7' - 0" | 800 CFM | 8200 | 2 | 800 | 2.25 | 3.15 | 2.90 | 5.0 | 460 | 3 | 60 | 8200 | 185,000 | 250,000 | 6 | 42 | 42 | 54 | 460 | 75.8 | 64.1 | 55.0 | 54.5 | 6600 | 4 | 4 | 730 | 190 | 160 | 70 | 78 | 57000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-11-2 | LEVEL 11 | DOUBLE DUCT | 5' - 5" | 7' - 0" | 7' - 0" | 800 CFM | 9300 | 2 | 800 | 2.50 | 3.65 | 3.84 | 5.0 | 460 | 3 | 60 | 9300 | 212,000 | 285,000 | 6 | 48 | 42 | 54 | 520 | 76.0 | 64.2 | 55.0 | 54.5 | 7400 | 4 | 4 | 820 | 190 | 160 | 70 | 78 | 64000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-12-1 | LEVEL 12 | DOUBLE DUCT | 5' - 5" | 7' - 0" | 7' - 0" | 800 CFM | 8200 | 2 | 800 | 2.25 | 3.15 | 2.90 | 5.0 | 460 | 3 | 60 | 8200 | 185,000 | 250,000 | 6 | 42 | 42 | 54 | 460 | 75.8 | 64.1 | 55.0 | 54.5 | 6600 | 4 | 4 | 730 | 190 | 160 | 70 | 78 | 57000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-12-2 | LEVEL 12 | DOUBLE DUCT | 5' - 5" | 7' - 0" | 7' - 0" | 800 CFM | 9300 | 2 | 800 | 2.50 | 3.65 | 3.84 | 5.0 | 460 | 3 | 60 | 9300 | 212,000 | 285,000 | 6 | 48 | 42 | 54 | 520 | 76.0 | 64.2 | 55.0 | 54.5 | 7400 | 4 | 4 | 820 | 190 | 160 | 70 | 78 | 64000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-15-1 | LEVEL 15 | DOUBLE DUCT | 5' - 5" | 7' - 0" | 7' - 0" | 800 CFM | 8200 | 2 | 800 | 2.25 | 3.15 | 2.90 | 5.0 | 460 | 3 | 60 | 8200 | 185,000 | 250,000 | 6 | 42 | 42 | 54 | 460 | 75.8 | 64.1 | 55.0 | 54.5 | 6600 | 4 | 4 | 730 | 190 | 160 | 70 | 78 | 57000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-15-2 | LEVEL 15 | DOUBLE DUCT | 5' - 5" | 7' - 0" | 7' - 0" | 800 CFM | 9300 | 2 | 800 | 2.50 | 3.65 | 3.84 | 5.0 | 460 | 3 | 60 | 9300 | 212,000 | 285,000 | 6 | 48 | 42 | 54 | 520 | 76.0 | 64.2 | 55.0 | 54.5 | 7400 | 4 | 4 | 820 | 190 | 160 | 70 | 78 | 64000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-16-1 | LEVEL 16 | DOUBLE DUCT | 5' - 5" | 7' - 0" | 7' - 0" | 800 CFM | 8200 | 2 | 800 | 2.25 | 3.15 | 2.90 | 5.0 | 460 | 3 | 60 | 8200 | 185,000 | 250,000 | 6 | 42 | 42 | 54 | 460 | 75.8 | 64.1 | 55.0 | 54.5 | 6600 | 4 | 4 | 730 | 190 | 160 | 70 | 78 | 57000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-16-2 | LEVEL 16 | DOUBLE DUCT | 5' - 5" | 7' - 0" | 7' - 0" | 800 CFM | 9300 | 2 | 800 | 2.50 | 3.65 | 3.84 | 5.0 | 460 | 3 | 60 | 9300 | 212,000 | 285,000 | 6 | 48 | 42 | 54 | 520 | 76.0 | 64.2 | 55.0 | 54.5 | 7400 | 4 | 4 | 820 | 190 | 160 | 70 | 78 | 64000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-17-1 | LEVEL 17 | DOUBLE DUCT | 5' - 5" | 7' - 0" | 7' - 0" | 800 CFM | 8200 | 2 | 800 | 2.25 | 3.15 | 2.90 | 5.0 | 460 | 3 | 60 | 8200 | 185,000 | 250,000 | 6 | 42 | 42 | 54 | 460 | 75.8 | 64.1 | 55.0 | 54.5 | 6600 | 4 | 4 | 730 | 190 | 160 | 70 | 78 | 57000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-17-2 | LEVEL 17 | DOUBLE DUCT | 5' - 5" | 7' - 0" | 7' - 0" | 800 CFM | 9300 | 2 | 800 | 2.50 | 3.65 | 3.84 | 5.0 | 460 | 3 | 60 | 9300 | 212,000 | 285,000 | 6 | 48 | 42 | 54 | 520 | 76.0 | 64.2 | 55.0 | 54.5 | 7400 | 4 | 4 | 820 | 190 | 160 | 70 | 78 | 64000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-18-1 | LEVEL 18 | DOUBLE DUCT | 5' - 5" | 7' - 0" | 7' - 0" | 800 CFM | 8200 | 2 | 800 | 2.25 | 3.15 | 2.90 | 5.0 | 460 | 3 | 60 | 8200 | 185,000 | 250,000 | 6 | 42 | 42 | 54 | 460 | 75.8 | 64.1 | 55.0 | 54.5 | 6600 | 4 | 4 | 730 | 190 | 160 | 70 | 78 | 57000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-18-2 | LEVEL 18 | DOUBLE DUCT | 5' - 5" | 7' - 0" | 7' - 0" | 800 CFM | 9300 | 2 | 800 | 2.50 | 3.65 | 3.84 | 5.0 | 460 | 3 | 60 | 9300 | 212,000 | 285,000 | 6 | 48 | 42 | 54 | 520 | 76.0 | 64.2 | 55.0 | 54.5 | 7400 | 4 | 4 | 820 | 190 | 160 | 70 | 78 | 64000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-19-1 | LEVEL 19 | DOUBLE DUCT | 5' - 5" | 7' - 0" | 7' - 0" | 800 CFM | 8200 | 2 | 800 | 2.25 | 3.15 | 2.90 | 5.0 | 460 | 3 | 60 | 8200 | 185,000 | 250,000 | 6 | 42 | 42 | 54 | 460 | 75.8 | 64.1 | 55.0 | 54.5 | 6600 | 4 | 4 | 730 | 190 | 160 | 70 | 78 | 57000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-19-2 | LEVEL 19 | SINGLE ZONE VAV | 3' - 6" | 6' - 2" | 9' - 6" | 5300 CFM | 5300 | 2 | 5300 | 1.25 | 2.65 | 1.51 | 2.0 | 460 | 3 | 60 | 5300 | 224,000 | 440,000 | 6 | 73 | 42 | 54 | 460 | 94.0 | 78.0 | 55.0 | 54.5 | 0 | 0 | 0 | 460 | 0 | 0 | 0 | 0 | 0 | BASIS OF DESIGN JCI CUSTOM. NOTE 2 |
| AHU-19-3 | LEVEL 19 | DOUBLE DUCT | 5' - 5" | 7' - 0" | 5' - 10" | 800 CFM | 9300 | 2 | 800 | 2.50 | 4.00 | 4.20 | 5.0 | 460 | 3 | 60 | 9300 | 212,000 | 285,000 | 6 | 48 | 42 | 54 | 520 | 76.0 | 64.2 | 55.0 | 54.5 | 7400 | 4 | 4 | 820 | 190 | 160 | 70 | 78 | 64000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-20-1 | LEVEL 20 | SINGLE ZONE VAV | 5' - 0" | 8' - 0" | 12' - 0" | 8800 CFM | 11000 | 2 | 8800 | 2.50 | 4.00 | 4.65 | 7.5 | 460 | 3 | 60 | 11000 | 422,000 | 788,000 | 6 | 131 | 42 | 54 | 430 | 90.4 | 75.4 | 55.0 | 54.5 | 0 | 0 | 0 | 430 | 0 | 0 | 0 | 0 | 0 | BASIS OF DESIGN JCI CUSTOM. NOTE 2 |
| AHU-20-2 | LEVEL 20 | DOUBLE DUCT | 5' - 5" | 7' - 0" | 7' - 0" | 800 CFM | 9300 | 2 | 800 | 2.50 | 3.65 | 3.84 | 5.0 | 460 | 3 | 60 | 9300 | 212,000 | 285,000 | 6 | 48 | 42 | 54 | 520 | 76.0 | 64.2 | 55.0 | 54.5 | 7400 | 4 | 4 | 820 | 190 | 160 | 70 | 78 | 64000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-21-1 | LEVEL 21 | SINGLE ZONE VAV | 5' - 0" | 8' - 0" | 12' - 0" | 9500 CFM | 10600 | 2 | 9500 | 2.50 | 4.00 | 4.88 | 7.5 | 460 | 3 | 60 | 10600 | 426,000 | 818,000 | 6 | 136 | 42 | 54 | 410 | 92.1 | 76.7 | 55.0 | 54.5 | 0 | 0 | 0 | 415 | 0 | 0 | 0 | 0 | 0 | BASIS OF DESIGN JCI CUSTOM. NOTE 2 |
| AHU-21-2 | LEVEL 21 | SINGLE ZONE VAV | 5' - 0" | 8' - 0" | 12' - 0" | 10100 CFM | 12500 | 2 | 10100 | 2.50 | 4.40 | 6.41 | 7.5 | 460 | 3 | 60 | 12500 | 482,000 | 902,000 | 6 | 150 | 42 | 54 | 495 | 90.6 | 75.5 | 55.0 | 54.5 | 0 | 0 | 0 | 490 | 0 | 0 | 0 | 0 | 0 | BASIS OF DESIGN JCI CUSTOM. NOTE 2 |
| AHU-22-1 | LEVEL 22 | DOUBLE DUCT | 5' - 5" | 7' - 0" | 7' - 0" | 800 CFM | 8200 | 2 | 800 | 2.25 | 3.15 | 2.90 | 5.0 | 460 | 3 | 60 | 8200 | 185,000 | 250,000 | 6 | 42 | 42 | 54 | 460 | 76.0 | 64.2 | 55.0 | 54.5 | 6600 | 4 | 4 | 730 | 190 | 160 | 70 | 78 | 57000 | BASIS OF DESIGN JCI CUSTOM |
| AHU-22-2 | LEVEL 22 | DOUBLE DUCT | 5' - 5" | 7' - 0" | 7' - 0" | 800 CFM | 9300 | 2 | 800 | 2.50 | 3.65 | 3.84 | 5.0 | 460 | 3 | 60 | 9300 | 212,000 | 285,000 | 6 | 48 | 42 | 54 | 520 | 75.8 | 64.1 | 55.0 | 54.5 | 7400 | 4 | 4 | 820 | 190 | 160 | 70 | 78 | 64000 | BASIS OF DESIGN JCI CUSTOM |
| OAHU-1 | PENTHOUSE | SINGLE ZONE VAV | 8' - 8" | 10' - 10" | 15' - 0" | 36600 CFM | 36600 | 4 | 36600 | 2.00 | 4.16 | 8.54 | 10.0 | 460 | 3 | 60 | 40000 | 1,693,000 | 3,327,000 | 8 | 555 | 42 | 54 | 525 | 94.0 | 78.0 | 55.0 | 54.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | BASIS OF DESIGN JCI CUSTOM. NOTE 1 |

### AHU SCHEDULE GENERAL NOTES (THESE NOTES APPLY TO ALL AIR HANDLING UNITS):

A. ALL SUPPLY FANS SHALL OPERATE ON VFD'S WITH INTEGRAL BYPASSES. SUPPLY FANS SHALL BE DIRECT DRIVE PLENUM TYPE.
B. ALL AHU FANS AND MOTORS SHALL BE INTERNALLY ISOLATED.
C. AHU EXTERNAL STATIC PRESSURE INCLUDES LOSSES DUE TO SUPPLY AND RETURN DUCTWORK, DIFUSER AND GRILLES, VAV BOXES, DUCT MOUNTED COILS, SOUND ATTENUATORS AND FILTERS (0.5" W.G. FOR MERV-7A)
D. PROVIDE WITHOUT EXCEPTION MINIMUM MOTOR HORSEPOWER (SIZE) AS SCHEDULED.
E. (AHU-1-1 ONLY) THIS UNIT SHALL BE PROVIDE WITH UV LIGHTING IN THE COOLING COIL SECTION.

### AHU SCHEDULE NOTES:

1. PROVIDE UNIT WITH TWO FULL FACE COOLING COILS EACH MEETING THE REQUIREMENTS LISTED IN THE SCHEDULE.
2. PROVIDE UNIT WITH STEAM HEATING COIL. REFER TO AHU STEAM COIL FOR REQUIREMENTS.

## SCHEDULE - AHU STEAM COIL

| MARK | STEAM | | | | | |
|---|---|---|---|---|---|---|
| | COIL CFM | EAT °F | LAT °F | CAPACITY (MBH) | INLET PRESSURE (PSIG) | MAX FACE VELOCITY (FPM) |
| AHU-19-2 | 5300 | 20 | 50 | 172500 | 15 | 500 |
| AHU-20-1 | 11000 | 20 | 50 | 358000 | 15 | 500 |
| AHU-21-1 | 10600 | 20 | 50 | 345000 | 15 | 500 |
| AHU-21-2 | 12500 | 20 | 50 | 406000 | 15 | 500 |

## SCHEDULE - SINGLE DUCT TERMINAL BOX

| MARK | BOX TYPE | SERVED BY AHU/FAN | PRIMARY AIR | | BOX INLET | | | MAX S.P. IN. WG | POWER | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | MAX (CFM) | MIN (CFM) | HEIGHT | WIDTH | DIAMETER | | VOLTS | PH | HZ | |
| VV-1-1 | VAV RETROFIT | AHU-1-1 | 3515 | 0 | 30" | 12" | | 0.15 | 120 | 1 | 60 | NAILOR MODEL 36VRS |
| VV-1-2 | VAV RETROFIT | AHU-1-1 | 1550 | 0 | 18" | 10" | | 0.15 | 120 | 1 | 60 | NAILOR MODEL 36VRS |
| VV-1-3 | VAV RETROFIT | AHU-1-1 | 1550 | 0 | 18" | 10" | | 0.15 | 120 | 1 | 60 | NAILOR MODEL 36VRS |
| VV-1-4 | VAV RETROFIT | AHU-1-1 | 1550 | 0 | 18" | 10" | | 0.15 | 120 | 1 | 60 | NAILOR MODEL 36VRS |
| VV-1-5 | VAV RETROFIT | AHU-1-1 | 4400 | 0 | 18" | 24" | | 0.15 | 120 | 1 | 60 | NAILOR MODEL 36VRS |
| VV-1-6 | VAV RETROFIT | AHU-1-1 | 3515 | 0 | 22" | 16" | | 0.15 | 120 | 1 | 60 | NAILOR MODEL 36VRS |
| VV-1-7 | VAV RETROFIT | AHU-1-1 | 1550 | 0 | 12" | 18" | | 0.15 | 120 | 1 | 60 | NAILOR MODEL 36VRS |
| VV-1-8 | VAV RETROFIT | AHU-1-1 | 2325 | 0 | 30" | 12" | | 0.15 | 120 | 1 | 60 | NAILOR MODEL 36VRS |
| VV-1-9 | VAV | OAHU-1 | 1300 | 0 | | | 12" | 0.15 | 120 | 1 | 60 | NAILOR MODEL D3101 |
| VV-M-1 | VAV RETROFIT | AHU-M-1 | 1190 | 0 | 18" | 10" | | 0.15 | 120 | 1 | 60 | NAILOR MODEL 36VRS |
| VV-M-2 | VAV RETROFIT | AHU-M-1 | 1190 | 0 | 18" | 10" | | 0.15 | 120 | 1 | 60 | NAILOR MODEL 36VRS |
| VV-M-3 | VAV RETROFIT | AHU-M-1 | 1190 | 0 | 18" | 10" | | 0.15 | 120 | 1 | 60 | NAILOR MODEL 36VRS |
| VV-M-4 | VAV RETROFIT | AHU-M-1 | 1190 | 0 | 18" | 10" | | 0.15 | 120 | 1 | 60 | NAILOR MODEL 36VRS |
| VV-M-5 | VAV RETROFIT | AHU-M-1 | 2370 | 0 | 12" | 18" | | 0.15 | 120 | 1 | 60 | NAILOR MODEL 36VRS |
| VV-M-6 | VAV RETROFIT | AHU-M-1 | 3550 | 0 | 12" | 30" | | 0.15 | 120 | 1 | 60 | NAILOR MODEL 36VRS |
| VV-M-7 | VAV RETROFIT | AHU-M-1 | 1190 | 0 | 10" | 18" | | 0.15 | 120 | 1 | 60 | NAILOR MODEL 36VRS |
| VV-M-8 | VAV RETROFIT | AHU-M-1 | 1190 | 0 | 10" | 18" | | 0.15 | 120 | 1 | 60 | NAILOR MODEL 36VRS |
| VV-M-9 | VAV RETROFIT | AHU-M-2 | 680 | 0 | 14" | 8" | | 0.15 | 120 | 1 | 60 | NAILOR MODEL 36VRS |
| VV-M-10 | VAV RETROFIT | AHU-M-2 | 1360 | 0 | 18" | 10" | | 0.15 | 120 | 1 | 60 | NAILOR MODEL 36VRS |
| VV-M-11 | VAV RETROFIT | AHU-M-2 | 1360 | 0 | 18" | 10" | | 0.15 | 120 | 1 | 60 | NAILOR MODEL 36VRS |
| VV-M-12 | VAV RETROFIT | AHU-M-2 | 1360 | 0 | 18" | 10" | | 0.15 | 120 | 1 | 60 | NAILOR MODEL 36VRS |
| VV-M-13 | VAV RETROFIT | AHU-M-2 | 1360 | 0 | 10" | 18" | | 0.15 | 120 | 1 | 60 | NAILOR MODEL 36VRS |
| VV-M-14 | VAV RETROFIT | AHU-M-2 | 1360 | 0 | 18" | 10" | | 0.15 | 120 | 1 | 60 | NAILOR MODEL 36VRS |
| VV-M-15 | VAV RETROFIT | AHU-M-2 | 1360 | 0 | 10" | 18" | | 0.15 | 120 | 1 | 60 | NAILOR MODEL 36VRS |
| VV-M-16 | VAV RETROFIT | AHU-M-1 | 800 | 0 | 10" | 12" | | 0.15 | 120 | 1 | 60 | NAILOR MODEL 36VRS |
| VV-M-17 | VAV | AHU-M-2 | 800 | 0 | | | 8" | 0.15 | 120 | 1 | 60 | NAILOR MODEL D3101 |


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STATE OF TEXAS
DAVID S. HALL
94481
LICENSED PROFESSIONAL ENGINEER

10-11-2017

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# UCT AHU REPLACEMENT

MECHANICAL SCHEDULES

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-002 |
| Scale | No Scale |


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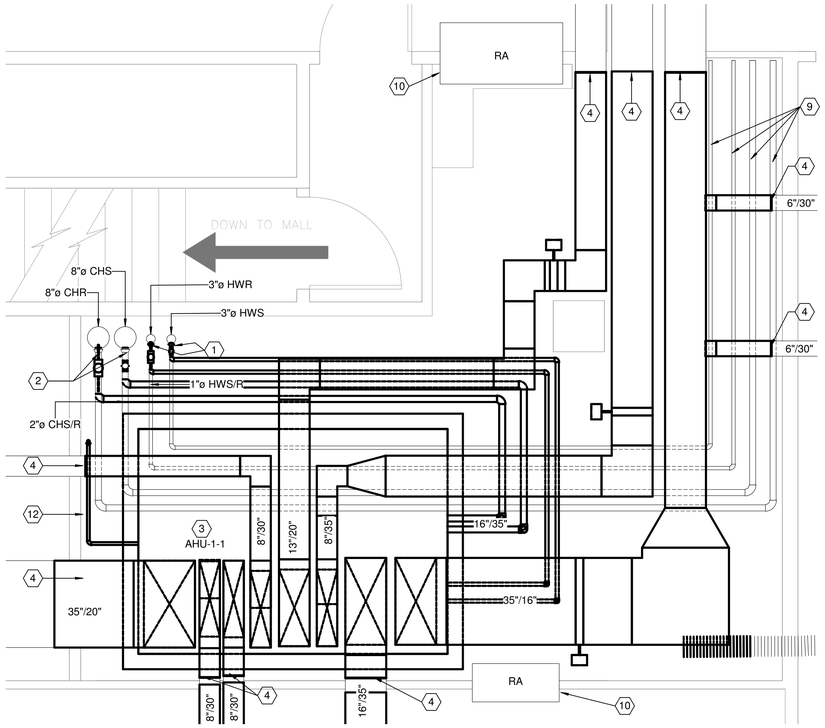
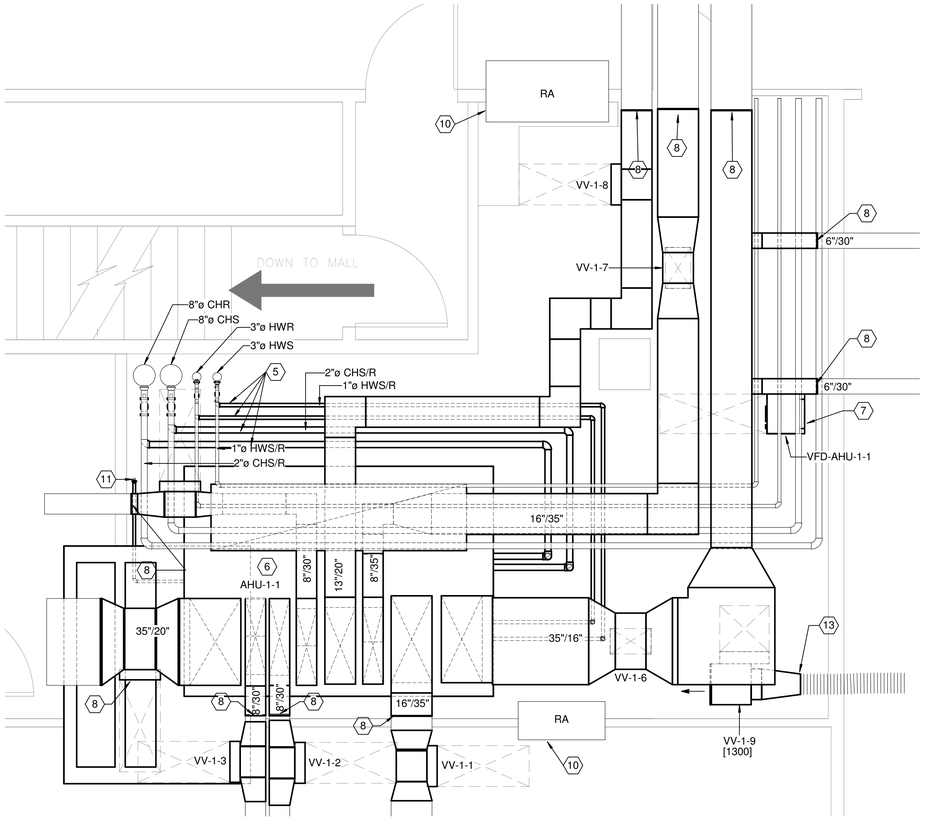



1 LEVEL 1 - DEMOLITION - MECHANICAL ROOM EAST
1/2" = 1'-0"




2 LEVEL 1 - RENOVATION - MECHANICAL ROOM EAST
1/2" = 1'-0"

## GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

## LEGEND

EXISTING TO REMAIN

TO BE DEMOLISHED

## LEGEND

CONNECT TO EXISTING

EXISTING

NEW CONSTRUCTION

## KEYED NOTES - M-100-1E

1 DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE WELDOLET AT THE RISER.

2 DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE WELDOLET AT THE RISER.

3 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.

4 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.

5 PROVIDE NEW CHILLED AND HEATING HOT WATER PIPING BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

6 PROVIDE NEW AIR HANDLING UNIT AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.

7 INSTALL VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

8 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

9 REPLACE THE INSULATION ON THE HWS/R AND CHS/R WITHIN THE MECHANICAL ROOM PERIMETER. REFER TO MECHANICAL SPECIFICATION FOR INSULATION REQUIREMENTS.

10 RETURN AIR OPENINGS EXISTING TO REMAIN.

11 AHU CONDENSATE DRAIN. PIPING TO BE ROUTED BETWEEN THE UNIT AND THE DRAIN. REFER TO CONDENSATE DRAIN DETAIL FOR MORE INFORMATION.

12 DEMOLISH EXISTING PVC CONDENSATE DRAIN BETWEEN THE AIR HANDLING UNIT AND THE FLOOR DRAIN.

13 CONNECT NEW OUTSIDE AIR TERMINAL UNIT TO EXISTING OUTSIDE AIR DUCTWORK AT THE LOCATION SHOWN.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'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LICENSED PROFESSIONAL ENGINEER
10-11-2017

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# UCT AHU REPLACEMENT

LEVEL 1 EAST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-1E |
| Scale | As indicated |

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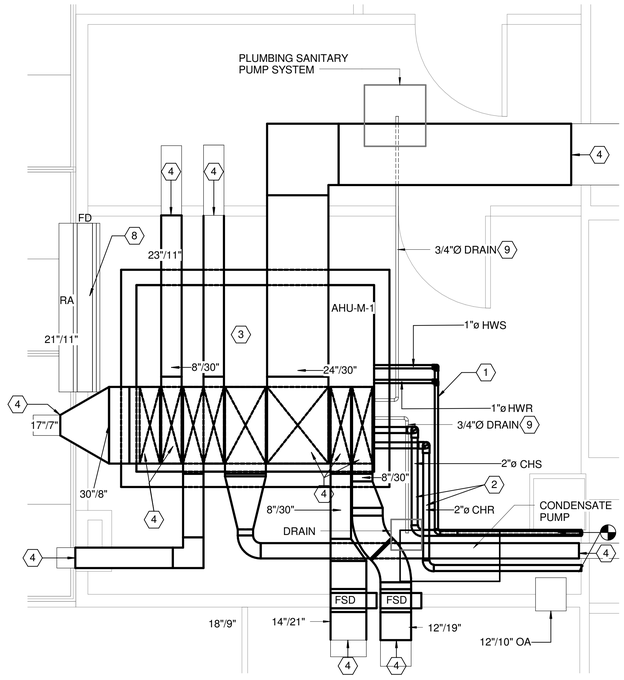
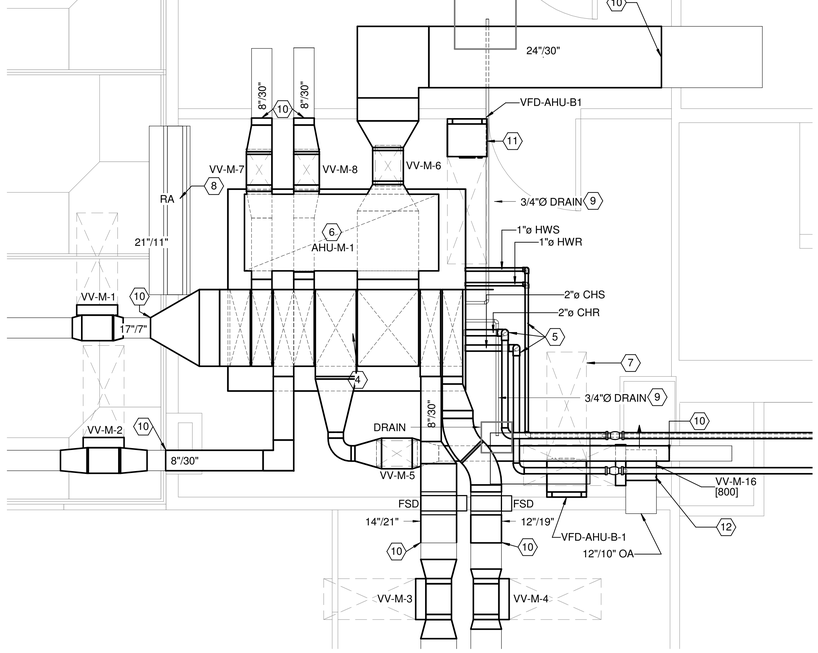



## LEVEL M - DEMOLITION - MECHANICAL ROOM EAST

1 1/2" = 1'-0"




## LEVEL M - RENOVATION - MECHANICAL ROOM EAST

2 1/2" = 1'-0"

### LEGEND

- EXISTING TO REMAIN
- TO BE DEMOLISHED

### LEGEND

- CONNECT TO EXISTING
- EXISTING
- NEW CONSTRUCTION

### GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

### KEYED NOTES - M-100-ME

1 DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE LOCATION SHOWN.

2 DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE LOCATION SHOWN.

3 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.

4 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT. UP TO THE MECHANICAL ROOM WALLS AS SHOWN.

5 PROVIDE NEW CHILLED AND HEATING HOT WATER PIPING BETWEEN THE EXTENT OF THE DEMOLITION AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE WITHIN MECHANICAL ROOM SPACE. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

6 PROVIDE NEW AIR HANDLING UNIT AND CONTROLS AT THE LOCATION SHOWN AND RECONNECT/PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS.

7 INSTALL VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

8 RETURN AIR OPENINGS EXISTING TO REMAIN.

9 AHU CONDENSATE DRAIN. EXISTING CONDENSATE DRAIN PIPING TO BE RECONNECTED TO NEW AIR HANDLING UNIT.

10 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

11 PROVIDE NEW VFD AT THE LOCATION SHOWN.

12 PROVIDE AND CONNECT NEW OUTSIDE AIR TERMINAL UNIT TO THE EXISTING OUTSIDE AIR DUCT AT THE LOCATION SHOWN.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'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PROFESSIONAL
ENGINEER
10-11-2017

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# UCT AHU REPLACEMENT

## LEVEL M EAST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-1ME |
| Scale | As indicated |

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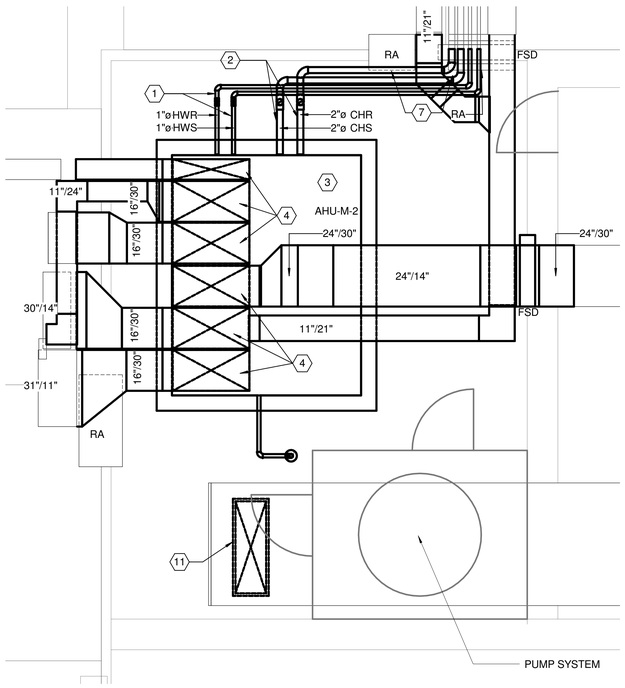
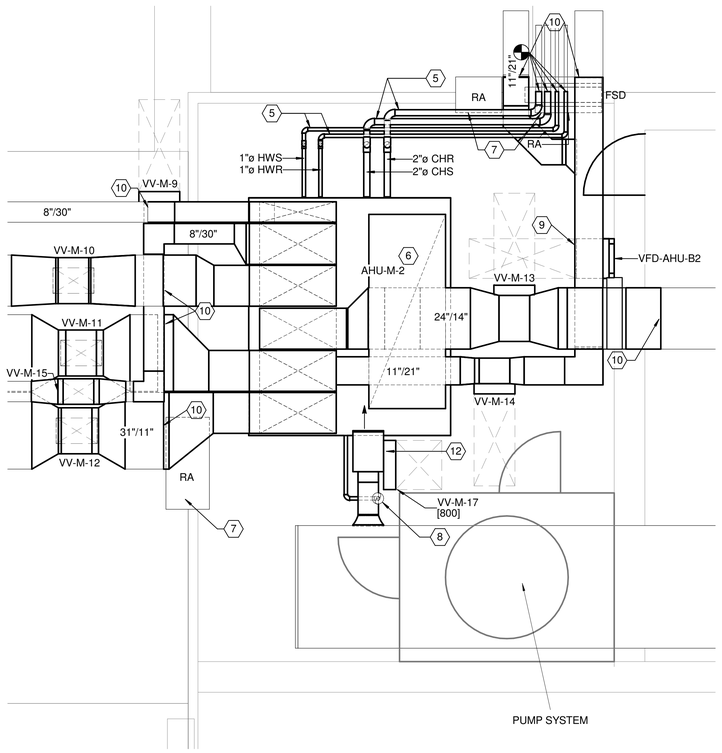



1 LEVEL M - DEMOLITION - MECHANICAL ROOM WEST
1/2" = 1'-0"




2 LEVEL M - RENOVATION - MECHANICAL ROOM WEST
1/2" = 1'-0"

## LEGEND

EXISTING TO REMAIN

TO BE DEMOLISHED

## LEGEND

CONNECT TO EXISTING

EXISTING

NEW CONSTRUCTION

## GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

F. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 3-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

G. INSULATE ALL HOT WATER PIPING, INCLUDING RISERS AND EXISTING PIPINGTO REMAIN.

H. ZONE 1, 4 AND 6 TERMINAL BOX LOCATED OUTSIDE THE MECHANICAL ROOM.

I. ZONE 2, 3 AND 5 TERMINAL BOX LOCATED WITHIN THE MECHANICAL ROOM.

## KEYED NOTES - M-100-MW

1 DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE LOCATION SHOWN.

2 DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE LOCATION SHOWN.

3 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.

4 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.

5 PROVIDE NEW CHILLED AND HEATING HOT WATER PIPING BETWEEN THE EXTENT OF THE DEMOLITION AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE WITHIN MECHANICAL ROOM SPACE REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

6 PROVIDE NEW AIR HANDLING UNIT AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.

7 RETURN AIR OPENING EXISTING TO REMAIN.

8 AHU CONDENSATE DRAIN. REFER TO THE CONDENSATE DRAIN DETAIL FOR MORE INFORMATION.

9 INSTALL VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

10 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

11 EXISTING OUTSIDE AIR TAP AND DAMPER TO BE DEMOLISHED AT THE LOCATION SHOWN.

12 PROVIDE AND CONNECT NEW OUTSIDE AIR TERMINAL UNIT AT THE LOCATION SHOWN.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'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ENGINEER
10-11-2017

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# UCT AHU REPLACEMENT

LEVEL M WEST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-1MW |
| Scale | As indicated |

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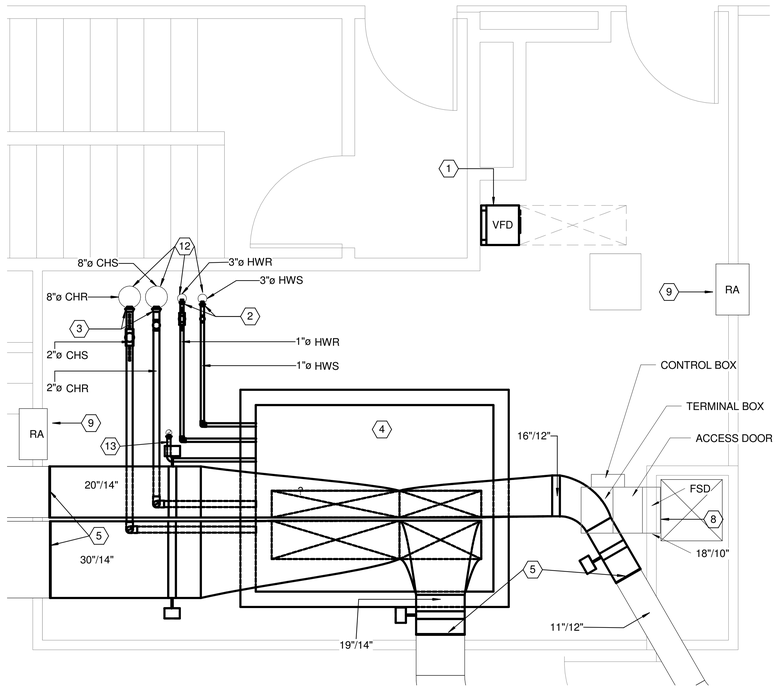
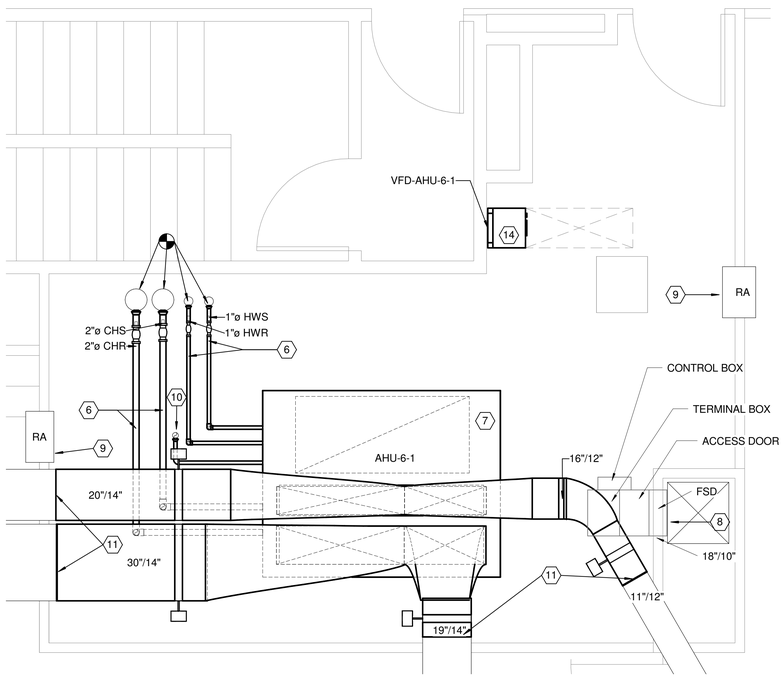



LEVEL 6 - DEMOLITION - MECHANICAL ROOM EAST

1 1/2" = 1'-0"




LEVEL 6 - RENOVATION - MECHANICAL ROOM EAST

2 1/2" = 1'-0"

## LEGEND

EXISTING TO REMAIN

TO BE DEMOLISHED

## LEGEND

CONNECT TO EXISTING

EXISTING

NEW CONSTRUCTION

## GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

## KEYED NOTES - M-100-6E

1 DEMOLISH EXISTING VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

2 DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

3 DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

4 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.

5 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.

6 PROVIDE NEW CHILLED AND HEATING HOT WATER PIPING BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

7 PROVIDE NEW AIR HANDLING UNIT AS SCHEDULED AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.

8 OUTSIDE AIR TERMINAL UNIT EXISTING TO REMAIN.

9 RETURN AIR OPENING EXISTING TO REMAIN.

10 AHU CONDENSATE DRAIN. PIPING TO BE ROUTED BETWEEN THE UNIT AND THE DRAIN. REFER TO THE CONDENSATE DRAIN DETAIL FOR MORE INFORMATION.

11 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

12 REPLACE THE HOT AND CHILLED WATER RISER INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

13 DEMOLISH EXISTING PVC CONDENSATE DRAIN BETWEEN THE AIR HANDLING UNIT AND THE FLOOR DRAIN.

14 PROVIDE NEW VFD AT THE LOCATION SHOWN.

True NORTH Plan NORTH

0' 2' 4'
1/2" = 1'-0"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10-11-2017

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# UCT AHU REPLACEMENT

## LEVEL 6 EAST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-6E |
| Scale | As indicated |


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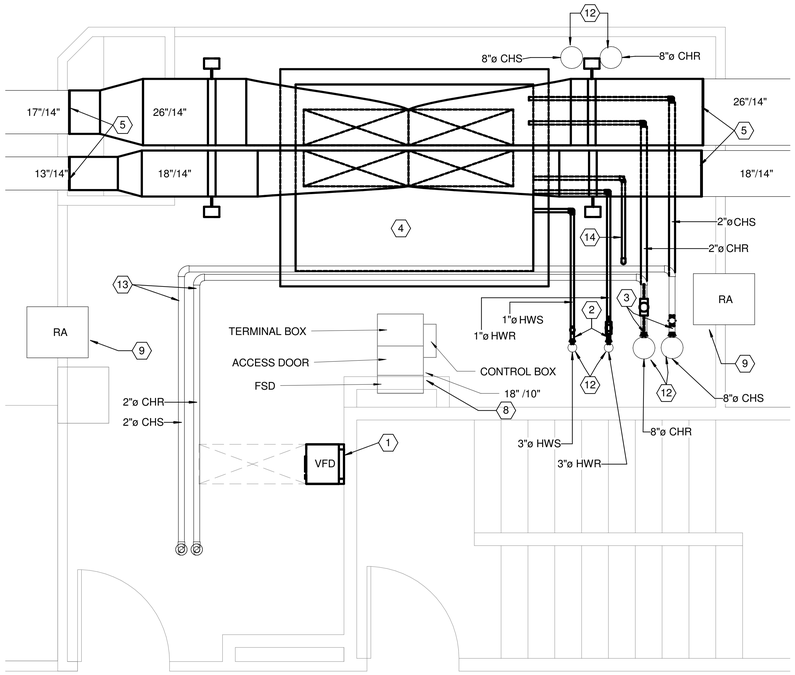
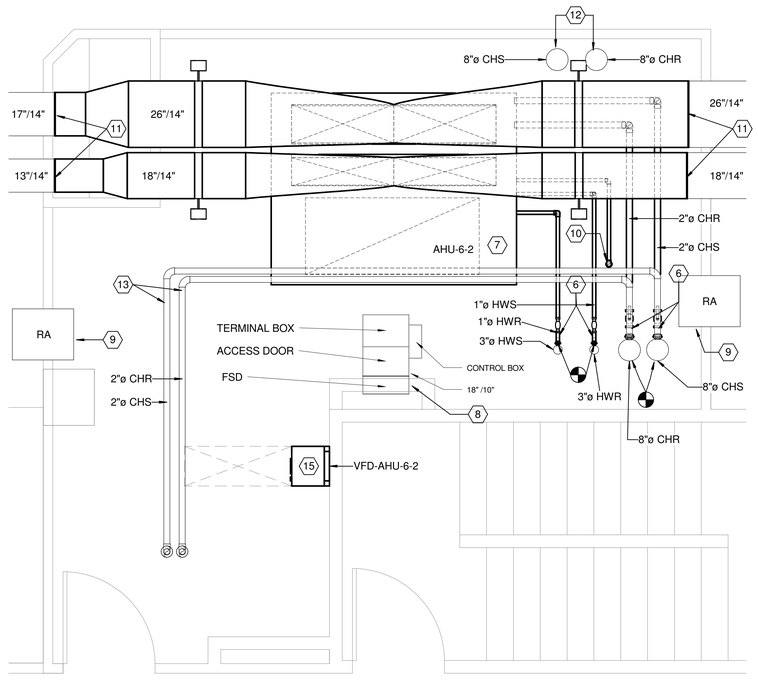



1 LEVEL 6 - DEMOLITION - MECHANICAL ROOM WEST
1/2" = 1'-0"




2 LEVEL 6 - RENOVATION - MECHANICAL ROOM WEST
1/2" = 1'-0"

## GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

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E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

## LEGEND

EXISTING TO REMAIN

TO BE DEMOLISHED

## LEGEND

CONNECT TO EXISTING

EXISTING

NEW CONSTRUCTION

## KEYED NOTES - M-100-6W

1 DEMOLISH EXISTING VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

2 DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

3 DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

4 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.

5 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.

6 PROVIDE NEW CHILLED AND HEATING HOT WATER PIPING BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

7 PROVIDE NEW AIR HANDLING UNIT AS SCHEDULED AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.

8 OUTSIDE AIR TERMINAL UNIT EXISTING TO REMAIN.

9 RETURN AIR OPENING EXISTING TO REMAIN.

10 AHU CONDENSATE DRAIN. PIPING TO BE ROUTED BETWEEN THE UNIT AND THE DRAIN. REFER TO THE CONDENSATE DRAIN DETAIL FOR MORE INFORMATION.

11 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

12 REPLACE THE HOT AND CHILLED WATER RISER INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

13 REPLACE CHILLED WATER BRANCH INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

14 DEMOLISH EXISTING PVC CONDENSATE DRAIN BETWEEN THE AIR HANDLING UNIT AND THE FLOOR DRAIN.

15 PROVIDE NEW VFD AT THE LOCATION SHOWN.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'


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Texas Registered Engineering Firm F-2113


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THE UNIVERSITY of TEXAS HEALTH SCIENCE CENTER AT HOUSTON

| No. | Description | Date |
|---|---|---|
| | Issue for Construction | 10/11/17 |

Keyplan

Tx. Registration # F-2113
STATE OF TEXAS
DAVID S. HALL
95466
REGISTERED
PROFESSIONAL
ENGINEER
10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 6 WEST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-6W |
| Scale | As indicated |

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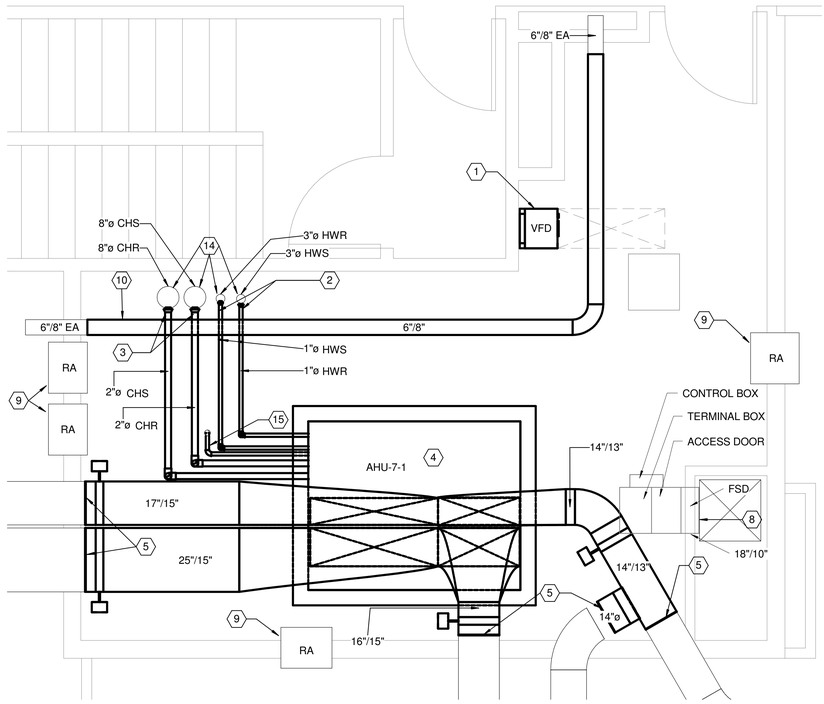
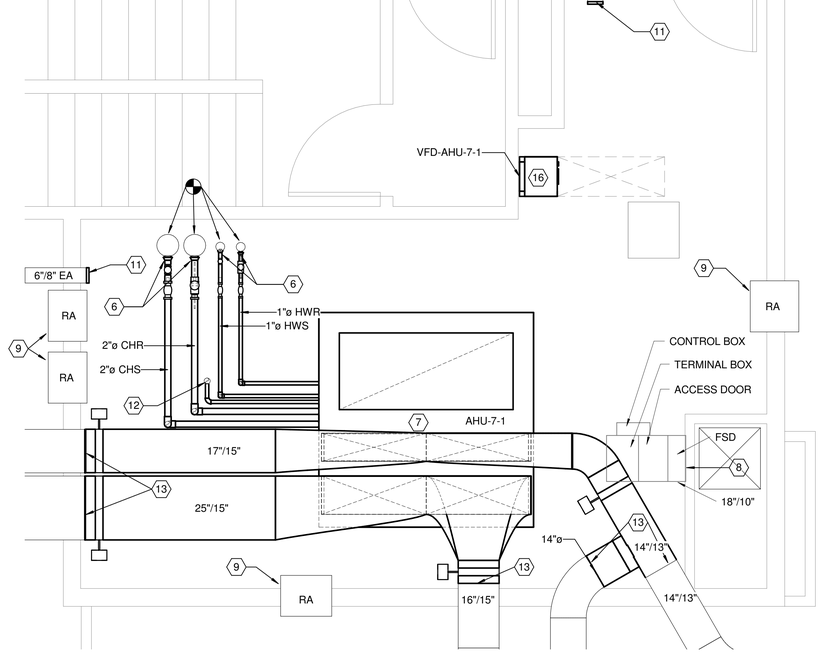



## LEVEL 7 - DEMOLITION - MECHANICAL ROOM EAST

1 1/2" = 1'-0"




## LEVEL 7 - RENOVATION - MECHANICAL ROOM EAST

2 1/2" = 1'-0"

## GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

## LEGEND

- EXISTING TO REMAIN
- TO BE DEMOLISHED

## LEGEND

- CONNECT TO EXISTING
- EXISTING
- NEW CONSTRUCTION

## KEYED NOTES - M-100-7E

1 DEMOLISH EXISTING VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

2 DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

3 DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

4 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.

5 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.

6 PROVIDE NEW CHILLED AND HEATING HOT WATER PIPING BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

7 PROVIDE NEW AIR HANDLING UNIT AS SCHEDULED AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.

8 OUTSIDE AIR TERMINAL UNIT EXISTING TO REMAIN.

9 RETURN AIR OPENING EXISTING TO REMAIN.

10 DEMOLISH EXISTING EXHAUST DUCTWORK.

11 CAP AND SEAL EXHAUST DUCT OPENINGS AIR TIGHT.

12 AHU CONDENSATE DRAIN. PIPING TO BE ROUTED BETWEEN THE UNIT AND THE DRAIN. REFER TO THE CONDENSATE DRAIN DETAIL FOR MORE INFORMATION.

13 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

14 REPLACE THE HOT AND CHILLED WATER RISER INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

15 DEMOLISH EXISTING PVC CONDENSATE DRAIN BETWEEN THE AIR HANDLING UNIT AND THE FLOOR DRAIN.

16 PROVIDE NEW VFD AT THE LOCATION SHOWN.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2" 4'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Ph. 713.780.7563 Fax.713.780.9209
Texas Registered Engineering Firm F-2113


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| | Issue for Construction | 10/11/17 |

Keyplan

Tx. Registration # F-2113

STATE OF TEXAS DAVID S. HALL 96468 LICENSED PROFESSIONAL ENGINEER

10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

## LEVEL 7 EAST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-7E |
| Scale | As indicated |

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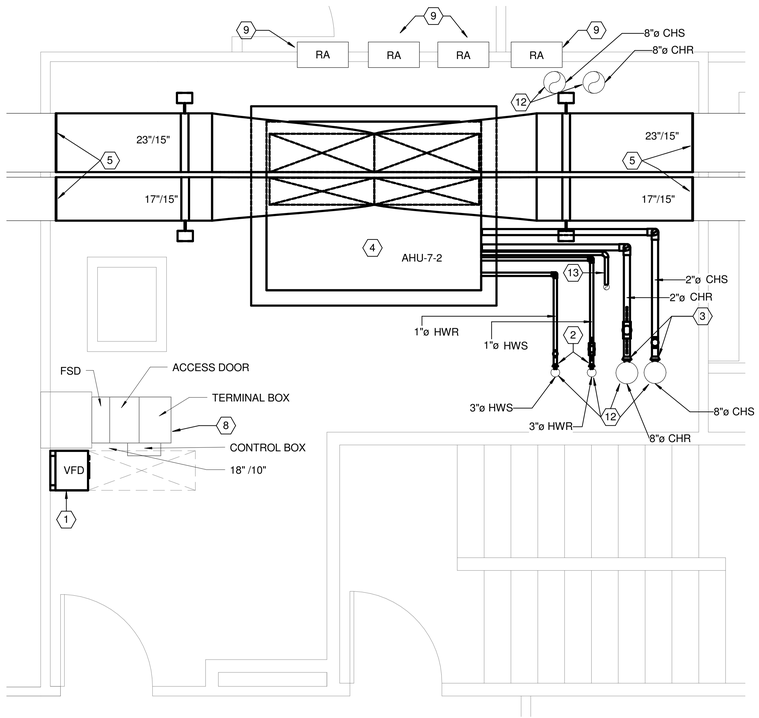
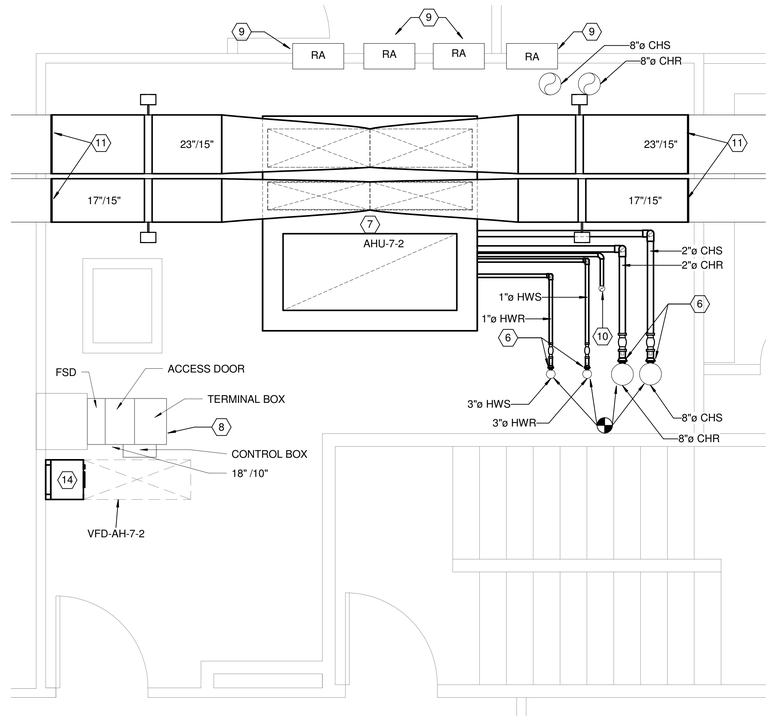



## LEVEL 7 - DEMOLITION - MECHANICAL ROOM WEST

1 1/2" = 1'-0"




## LEVEL 7 - RENOVATION - MECHANICAL ROOM WEST

2 1/2" = 1'-0"

### LEGEND

- EXISTING TO REMAIN
- TO BE DEMOLISHED

### GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

### LEGEND

- CONNECT TO EXISTING
- EXISTING
- NEW CONSTRUCTION

### KEYED NOTES - M-100-7W

1 DEMOLISH EXISTING VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

2 DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

3 DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

4 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.

5 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.

6 PROVIDE NEW CHILLED AND HEATING HOT WATER PIPING BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

7 PROVIDE NEW AIR HANDLING UNIT AS SCHEDULED AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.

8 OUTSIDE AIR TERMINAL UNIT EXISTING TO REMAIN.

9 RETURN AIR OPENING EXISTING TO REMAIN.

10 AHU CONDENSATE DRAIN. PIPING TO BE ROUTED BETWEEN THE UNIT AND THE DRAIN. REFER TO THE CONDENSATE DRAIN DETAIL FOR MORE INFORMATION.

11 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

12 REPLACE THE HOT AND CHILLED WATER RISER INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

13 DEMOLISH EXISTING PVC CONDENSATE DRAIN BETWEEN THE AIR HANDLING UNIT AND THE FLOOR DRAIN.

14 PROVIDE NEW VFD AT THE LOCATION SHOWN.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'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| | Issue for Construction | 10/11/17 |

Keyplan

Tx. Registration # F-2113

STATE OF TEXAS DAVID S. HALL 95498 LICENSED PROFESSIONAL ENGINEER

10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

## LEVEL 7 WEST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-7W |
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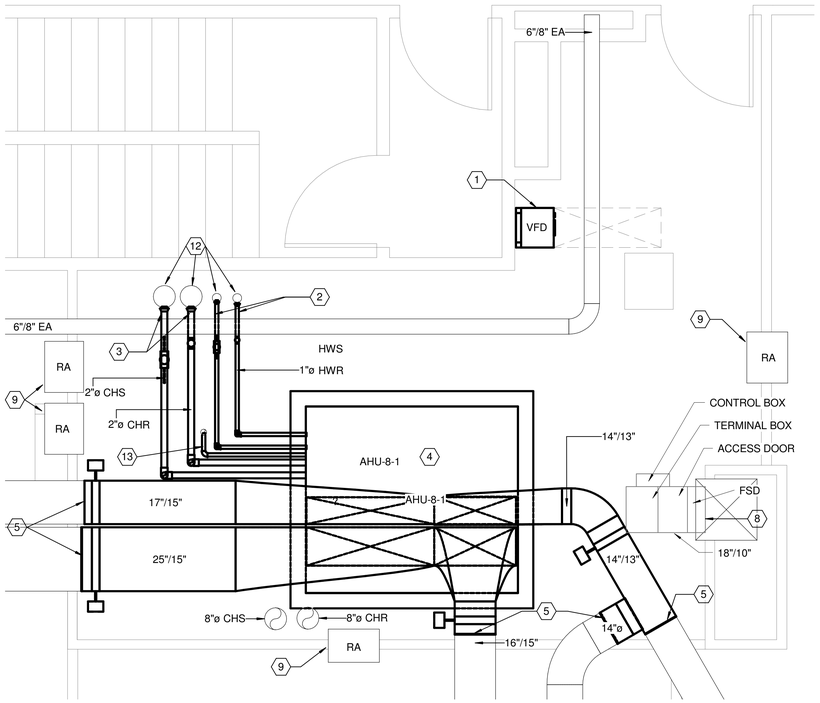



## LEVEL 8 - DEMOLITION - MECHANICAL ROOM EAST

1 1/2" = 1'-0"

### LEGEND

- EXISTING TO REMAIN
- TO BE DEMOLISHED

### GENERAL NOTES

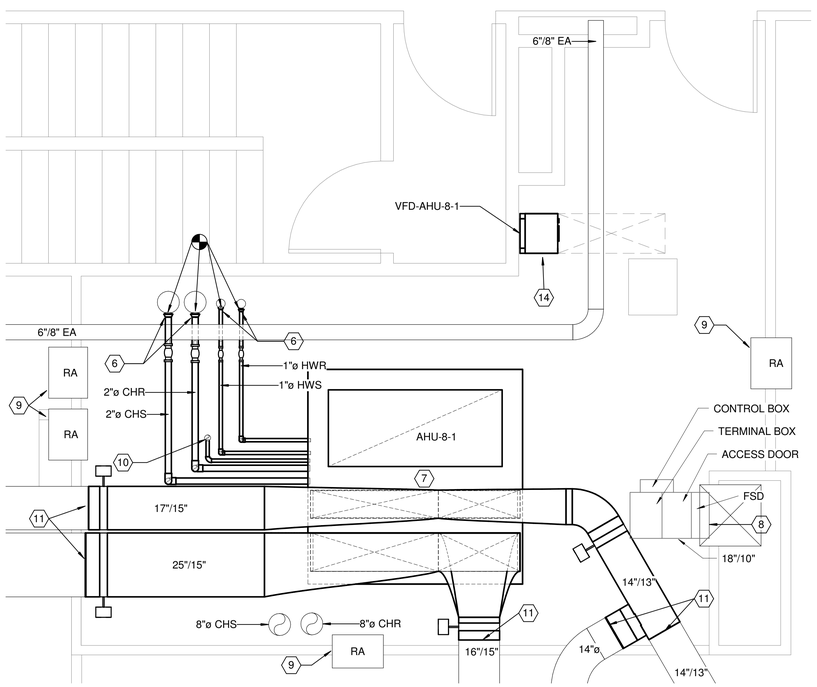
A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.




## LEVEL 8 - RENOVATION - MECHANICAL ROOM EAST

2 1/2" = 1'-0"

### LEGEND

- CONNECT TO EXISTING
- EXISTING
- NEW CONSTRUCTION

### KEYED NOTES - M-100-8E

1. DEMOLISH EXISTING VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.
2. DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.
3. DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.
4. DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.
5. DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.
6. PROVIDE NEW CHILLED AND HEATING PIPING HOT WATER BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.
7. PROVIDE NEW AIR HANDLING UNIT SCHEDULED AS SELECTED AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.
8. OUTSIDE AIR TERMINAL UNIT EXISTING TO REMAIN.
9. RETURN AIR OPENING EXISTING TO REMAIN.
10. AHU CONDENSATE DRAIN. PIPING TO BE ROUTED BETWEEN THE UNIT AND THE DRAIN. REFER TO THE CONDENSATE DRAIN DETAIL FOR MORE INFORMATION.
11. CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.
12. REPLACE THE HOT AND CHILLED WATER RISER INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.
13. DEMOLISH EXISTING PVC CONDENSATE DRAIN BETWEEN THE AIR HANDLING UNIT AND THE FLOOR DRAIN.
14. PROVIDE NEW VFD AT THE LOCATION SHOWN.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'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STATE OF TEXAS DAVID S. HALL LICENSED PROFESSIONAL ENGINEER
10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

## LEVEL 8 EAST ENLARGED MECHANICAL PLAN

| | |
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| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
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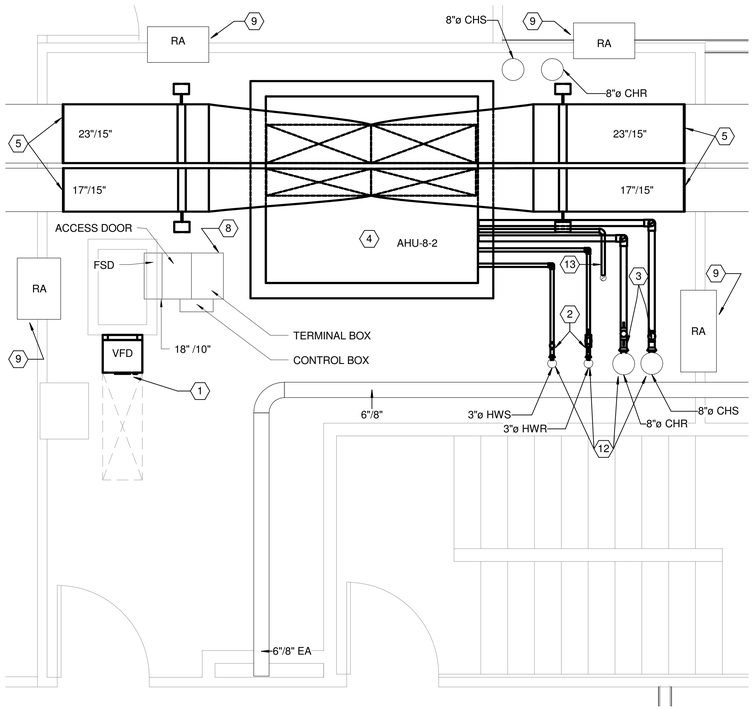
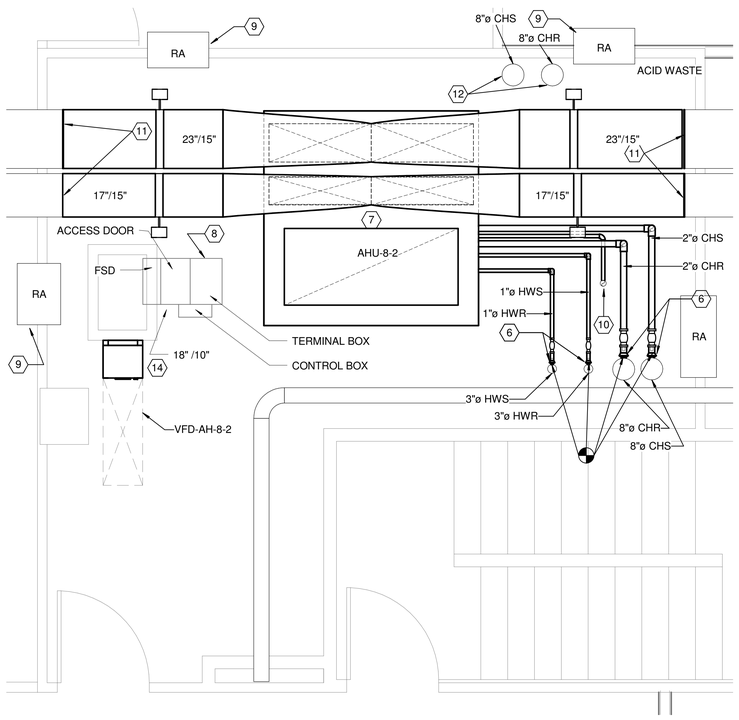



1 LEVEL 8 - DEMOLITION - MECHANICAL ROOM WEST
1/2" = 1'-0"




2 LEVEL 8 - RENOVATION - MECHANICAL ROOM WEST
1/2" = 1'-0"

## GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

## LEGEND

EXISTING TO REMAIN

TO BE DEMOLISHED

## LEGEND

CONNECT TO EXISTING

EXISTING

NEW CONSTRUCTION

## KEYED NOTES - M-100-8W

1 DEMOLISH EXISTING VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

2 DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

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4 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.

5 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.

6 PROVIDE NEW CHILLED AND HEATING HOT WATER PIPING BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

8 OUTSIDE AIR TERMINAL UNIT EXISTING TO REMAIN.

9 RETURN AIR OPENING EXISTING TO REMAIN.

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11 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

12 REPLACE THE HOT AND CHILLED WATER RISER INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

13 DEMOLISH EXISTING PVC CONDENSATE DRAIN BETWEEN THE AIR HANDLING UNIT AND THE FLOOR DRAIN.

14 PROVIDE NEW VFD AT THE LOCATION SHOWN.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'


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STATE OF TEXAS
DAVID S. HALL
90468
LICENSED
PROFESSIONAL ENGINEER
10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 8 WEST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
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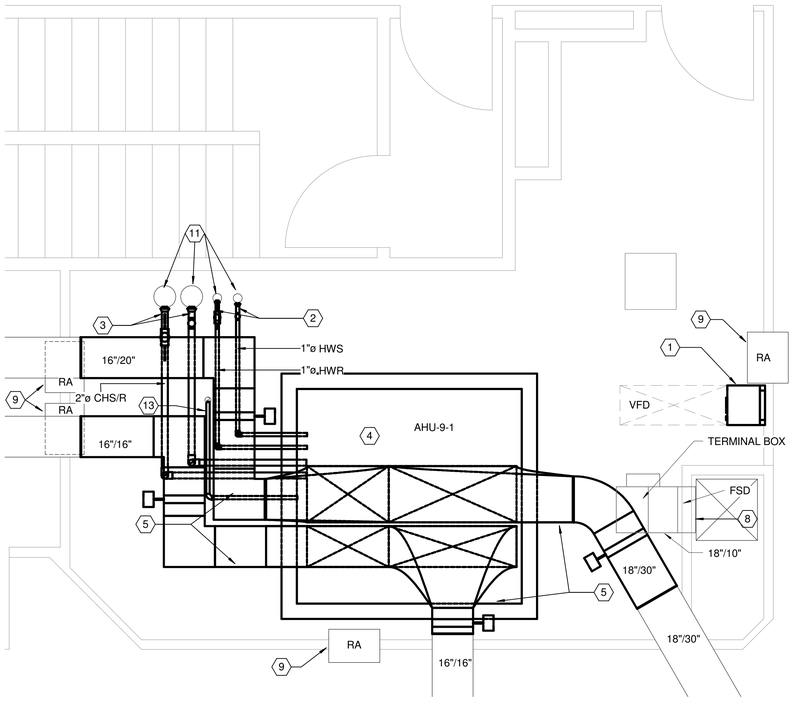
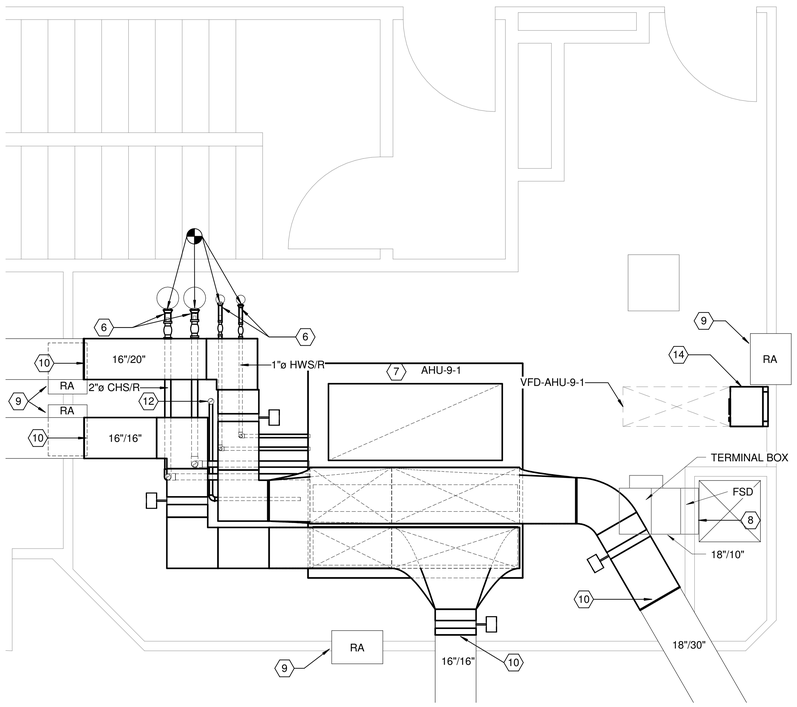



1 LEVEL 9 - DEMOLITION - MECHANICAL ROOM EAST
1/2" = 1'-0"




2 LEVEL 9 - RENOVATION - MECHANICAL ROOM EAST
1/2" = 1'-0"

## LEGEND

EXISTING TO REMAIN

TO BE DEMOLISHED

## LEGEND

CONNECT TO EXISTING

EXISTING

NEW CONSTRUCTION

## GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

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E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

## KEYED NOTES - M-100-9E

1 DEMOLISH EXISTING VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

2 DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

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7 PROVIDE NEW AIR HANDLING UNIT AS SCHEDULED AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.

8 OUTSIDE AIR TERMINAL UNIT EXISTING TO REMAIN.

9 RETURN AIR OPENING EXISTING TO REMAIN.

10 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

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13 DEMOLISH EXISTING PVC CONDENSATE DRAIN BETWEEN THE AIR HANDLING UNIT AND THE FLOOR DRAIN.

14 PROVIDE NEW VFD AT THE LOCATION SHOWN.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'


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Tx. Registration # F-2113

STATE OF TEXAS DAVID S. HALL 90568 LICENSED MECHANICAL ENGINEER

10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

## LEVEL 9 EAST ENLARGED MECHANICAL PLAN

| | |
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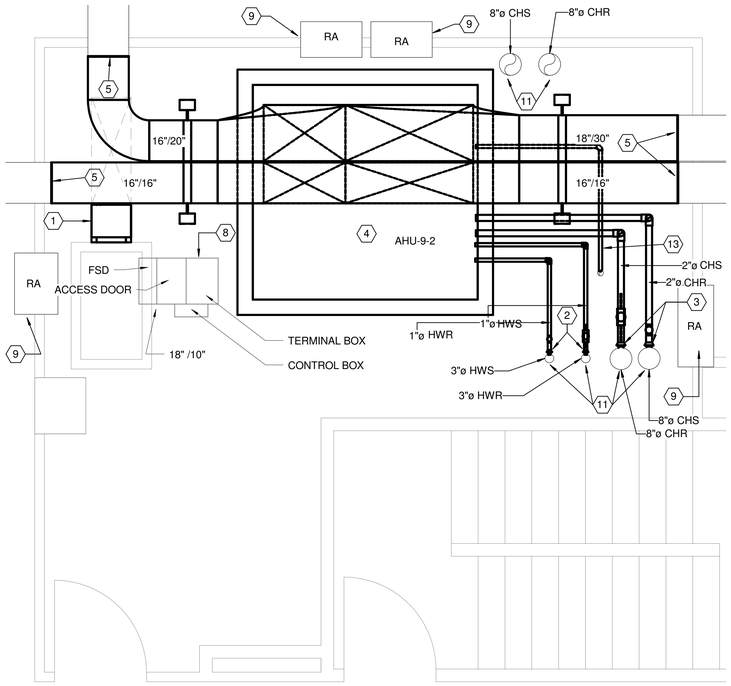
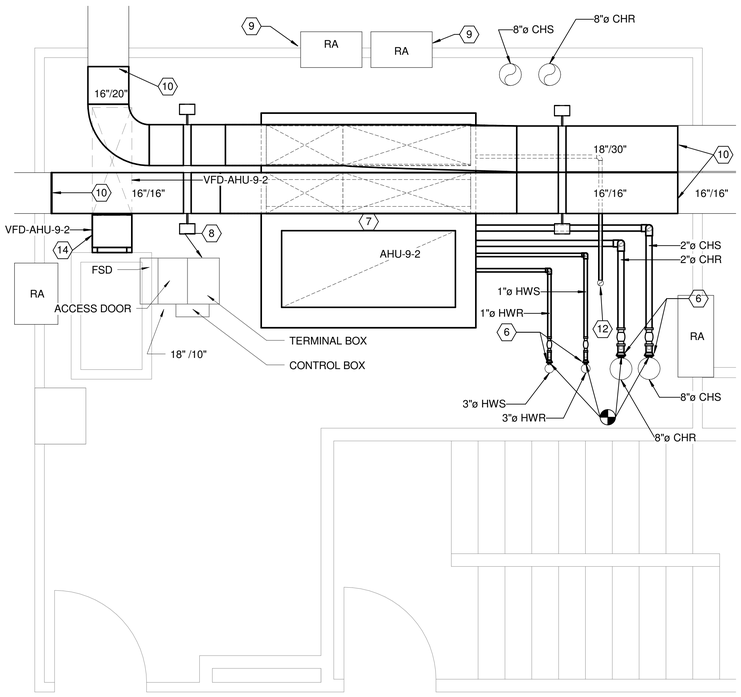



## 1 LEVEL 9 - DEMOLITION - MECHANICAL ROOM WEST

1/2" = 1'-0"




## 2 LEVEL 9 - RENOVATION - MECHANICAL ROOM WEST

1/2" = 1'-0"

### GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

### LEGEND

EXISTING TO REMAIN

TO BE DEMOLISHED

### LEGEND

CONNECT TO EXISTING

EXISTING

NEW CONSTRUCTION

### KEYED NOTES - M-100-9W

1 DEMOLISH EXISTING VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

2 DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

3 DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

4 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.

5 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.

6 PROVIDE NEW CHILLED AND HEATING HOT WATER PIPING BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

7 PROVIDE NEW AIR HANDLING UNIT AS SCHEDULED AT THE LOCATION SHOWN AND RECONNECT/PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS.

8 OUTSIDE AIR TERMINAL UNIT EXISTING TO REMAIN.

9 RETURN AIR OPENING EXISTING TO REMAIN.

10 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

11 REPLACE THE HOT AND CHILLED WATER RISER INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

12 AHU CONDENSATE DRAIN. PIPING TO BE ROUTED BETWEEN THE UNIT AND THE DRAIN. REFER TO THE CONDENSATE DRAIN DETAIL FOR MORE INFORMATION.

13 DEMOLISH EXISTING PVC CONDENSATE DRAIN BETWEEN THE AIR HANDLING UNIT AND THE FLOOR DRAIN.

14 PROVIDE NEW VFD AT THE LOCATION SHOWN.

True NORTH Plan NORTH

0' 2' 4'

1/2" = 1'-0"


SHAH SMITH & ASSOCIATES, INC.

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Ph. 713.780.7563 Fax.713.780.9209

Texas Registered Engineering Firm F-2113


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THE UNIVERSITY of TEXAS HEALTH SCIENCE CENTER AT HOUSTON

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|---|---|---|
| | Issue for Construction | 10/11/17 |

Keyplan

Tx. Registration # F-2113

STATE OF TEXAS DAVID S. HALL 94481 LICENSED PROFESSIONAL ENGINEER

10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

## LEVEL 9 WEST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-9W |
| Scale | As indicated |


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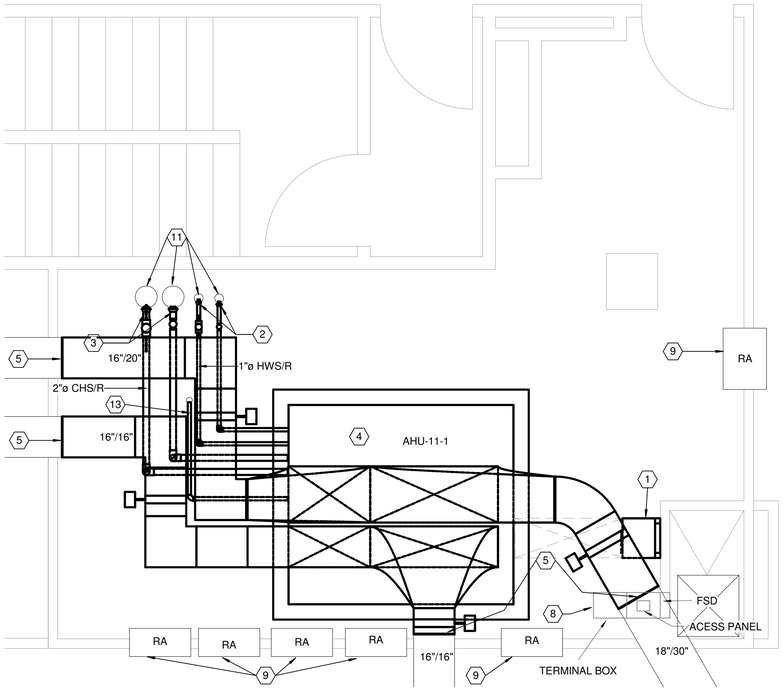
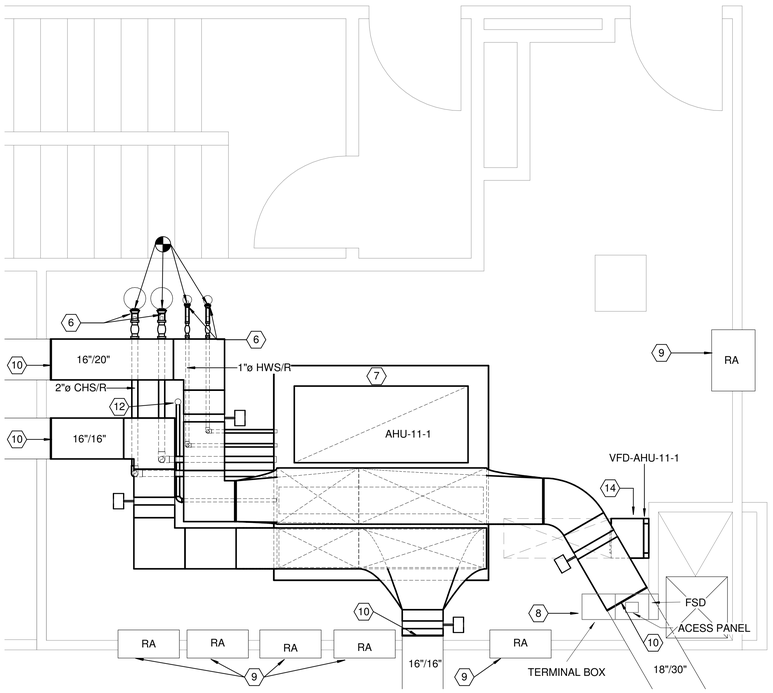



1 LEVEL 11 - DEMOLITION - MECHANICAL ROOM EAST
1/2" = 1'-0"




2 LEVEL 11 - RENOVATION - MECHANICAL ROOM EAST
1/2" = 1'-0"

## GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

## LEGEND

EXISTING TO REMAIN

TO BE DEMOLISHED

## LEGEND

CONNECT TO EXISTING

EXISTING

NEW CONSTRUCTION

## KEYED NOTES - M-100-11E

1 DEMOLISH EXISTING VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

2 DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

3 DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

4 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.

5 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.

6 PROVIDE NEW CHILLED AND HEATING HOT WATER PIPING BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

7 PROVIDE NEW AIR HANDLING UNIT AS SCHEDULED AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.

8 OUTSIDE AIR TERMINAL UNIT EXISTING TO REMAIN.

9 RETURN AIR OPENINGS EXISTING TO REMAIN.

10 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

11 REPLACE THE HOT AND CHILLED WATER RISER INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

12 AHU CONDENSATE DRAIN. PIPING TO BE ROUTED BETWEEN THE UNIT AND THE DRAIN. REFER TO THE CONDENSATE DRAIN DETAIL FOR MORE INFORMATION.

13 DEMOLISH EXISTING PVC CONDENSATE DRAIN BETWEEN THE AIR HANDLING UNIT AND THE FLOOR DRAIN.

14 PROVIDE NEW VFD AT THE LOCATION SHOWN.

True NORTH Plan NORTH

0' 2' 4'
1/2" = 1'-0"

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Ph. 713.780.7563 Fax.713.780.9209
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Keyplan

Tx. Registration # F-2113
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10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 11 EAST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-11E |
| Scale | As indicated |

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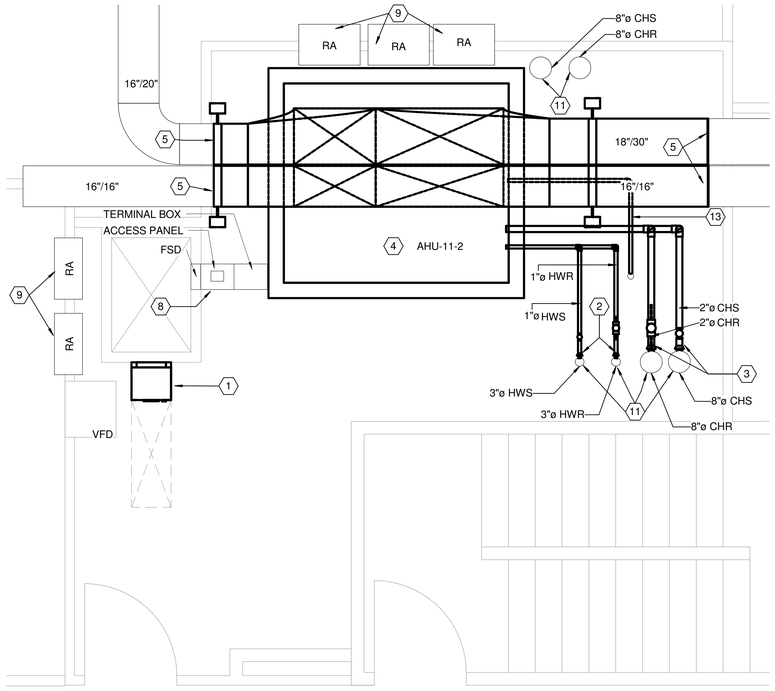
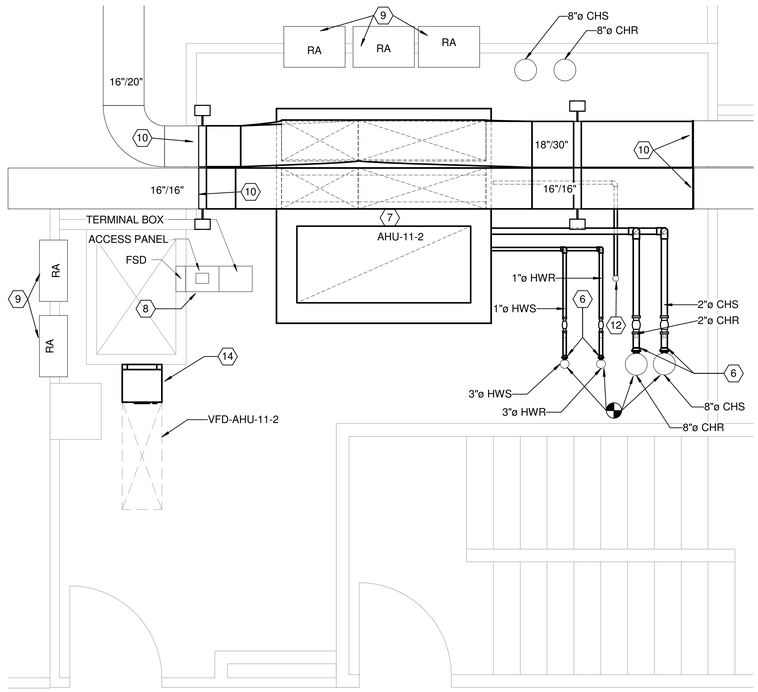



## LEVEL 11 - DEMOLITION - MECHANICAL ROOM WEST

1 1/2" = 1'-0"




## LEVEL 11 - RENOVATION - MECHANICAL ROOM WEST

2 1/2" = 1'-0"

## GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

## LEGEND

- EXISTING TO REMAIN
- TO BE DEMOLISHED

## LEGEND

- CONNECT TO EXISTING
- EXISTING
- NEW CONSTRUCTION

## KEYED NOTES - M-100-11W

1 DEMOLISH EXISTING VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

2 DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

3 DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

4 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.

5 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.

6 PROVIDE NEW CHILLED AND HEATING HOT WATER PIPING BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

7 PROVIDE NEW AIR HANDLING UNIT AS SCHEDULED AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.

8 OUTSIDE AIR TERMINAL UNIT EXISTING TO REMAIN.

9 RETURN AIR OPENING EXISTING TO REMAIN.

10 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

11 REPLACE THE HOT AND CHILLED WATER RISER INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

12 AHU CONDENSATE DRAIN. PIPING TO BE ROUTED BETWEEN THE UNIT AND THE DRAIN. REFER TO THE CONDENSATE DRAIN DETAIL FOR MORE INFORMATION.

13 DEMOLISH EXISTING PVC CONDENSATE DRAIN BETWEEN THE AIR HANDLING UNIT AND THE FLOOR DRAIN.

14 PROVIDE NEW VFD AT THE LOCATION SHOWN.

True NORTH / Plan NORTH

1/2" = 1'-0" 0' 2' 4'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10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 11 WEST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-11W |
| Scale | As indicated |

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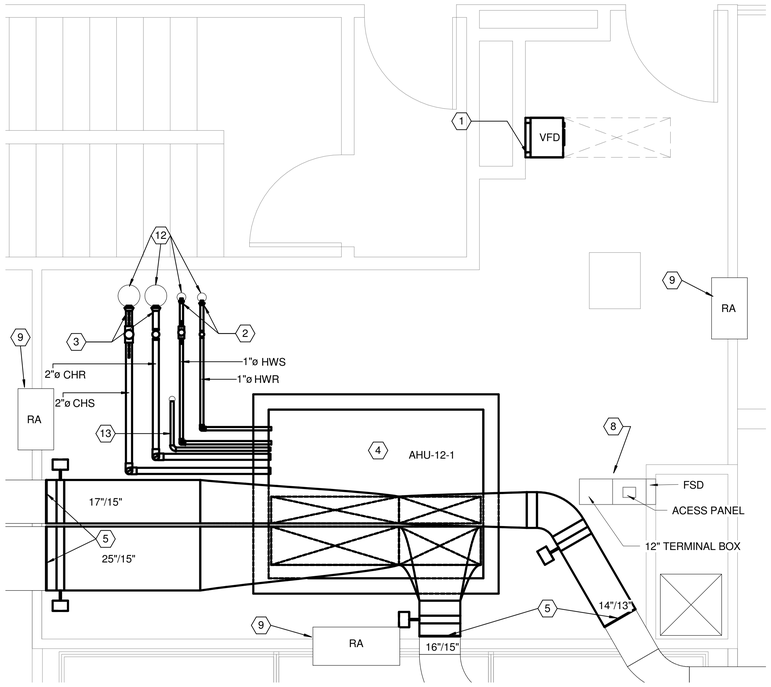
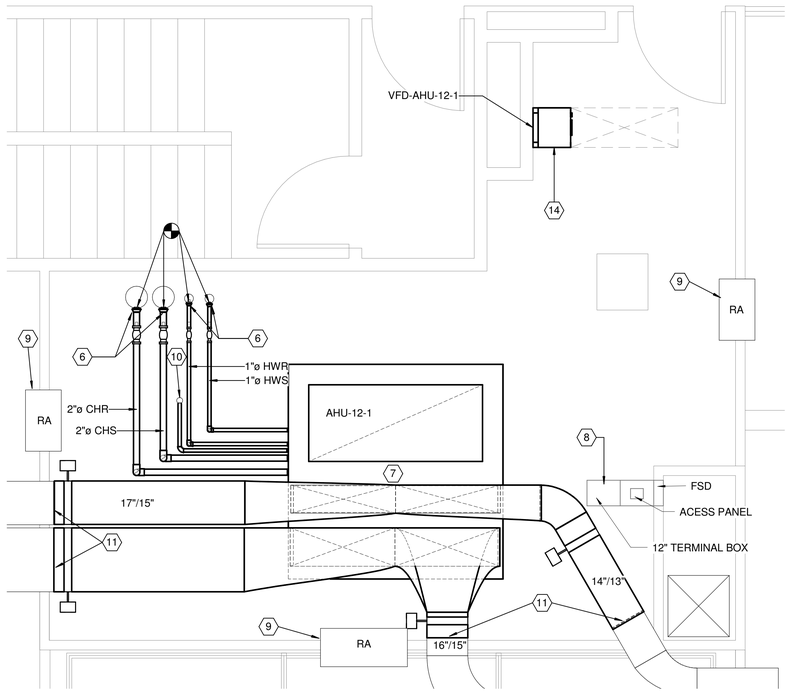



1 LEVEL 12 - DEMOLITION - MECHANICAL ROOM EAST
1/2" = 1'-0"




2 LEVEL 12 - RENOVATION - MECHANICAL ROOM EAST
1/2" = 1'-0"

## GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

## LEGEND

EXISTING TO REMAIN

TO BE DEMOLISHED

## KEYED NOTES - M-100-12E

1 DEMOLISH EXISTING VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

2 DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

3 DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

4 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.

5 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.

6 PROVIDE NEW CHILLED AND HEATING HOT WATER PIPING BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

7 PROVIDE NEW AIR HANDLING UNIT AS SCHEDULED AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.

8 OUTSIDE AIR TERMINAL UNIT EXISTING TO REMAIN.

9 RETURN AIR OPENING EXISTING TO REMAIN.

10 AHU CONDENSATE DRAIN. PIPING TO BE ROUTED BETWEEN THE UNIT AND THE DRAIN. REFER TO THE CONDENSATE DRAIN DETAIL FOR MORE INFORMATION.

11 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

12 REPLACE THE HOT AND CHILLED WATER RISER INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

13 DEMOLISH EXISTING PVC CONDENSATE DRAIN BETWEEN THE AIR HANDLING UNIT AND THE FLOOR DRAIN.

14 PROVIDE NEW VFD AT THE LOCATION SHOWN.

## LEGEND

CONNECT TO EXISTING

EXISTING

NEW CONSTRUCTION

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'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Texas Registered Engineering Firm F-2113


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Keyplan

Tx. Registration # F-2113
STATE OF TEXAS DAVID S. HALL 103 LICENSED PROFESSIONAL ENGINEER
10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 12 EAST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-12E |
| Scale | As indicated |


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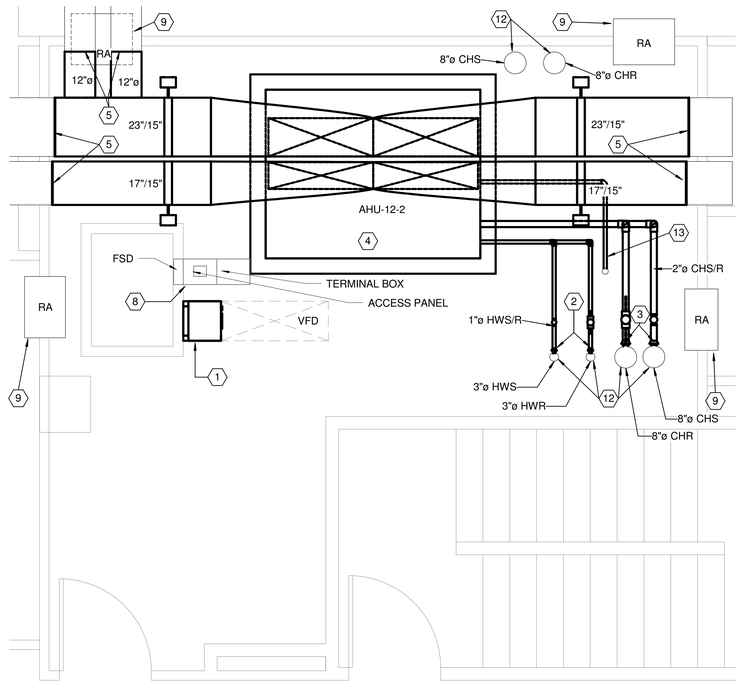
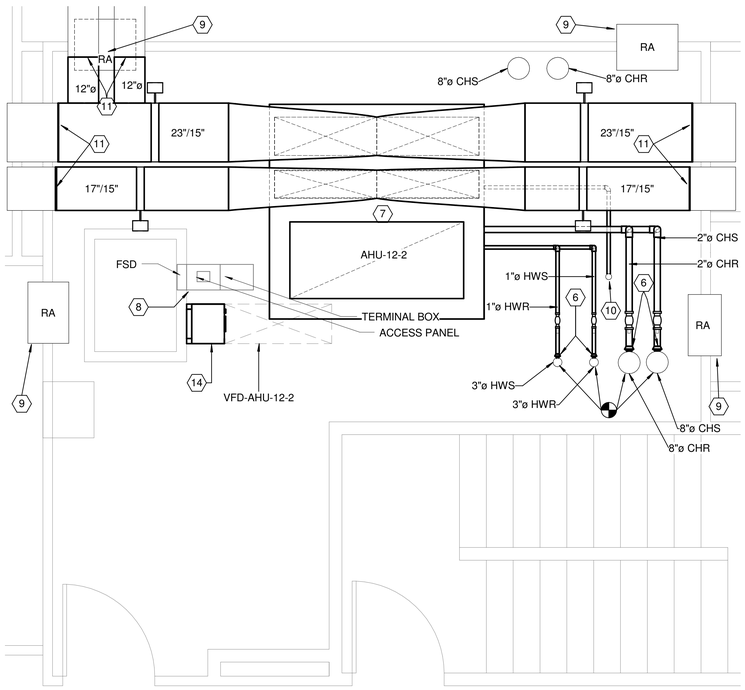



LEVEL 12 - DEMOLITION - MECHANICAL ROOM WEST

1 1/2" = 1'-0"




LEVEL 12 - RENOVATION - MECHANICAL ROOM WEST

2 1/2" = 1'-0"

## LEGEND

EXISTING TO REMAIN

TO BE DEMOLISHED

## LEGEND

CONNECT TO EXISTING

EXISTING

NEW CONSTRUCTION

## GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

## KEYED NOTES - M-100-12W

1 DEMOLISH EXISTING VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

2 DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

3 DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

4 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.

5 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.

6 PROVIDE NEW CHILLED AND HEATING HOT WATER PIPING BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

7 PROVIDE NEW AIR HANDLING UNIT AS SCHEDULED AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.

8 OUTSIDE AIR TERMINAL UNIT EXISTING TO REMAIN.

9 RETURN AIR OPENING EXISTING TO REMAIN.

10 AHU CONDENSATE DRAIN. PIPING TO BE ROUTED BETWEEN THE UNIT AND THE DRAIN. REFER TO THE CONDENSATE DRAIN DETAIL FOR MORE INFORMATION.

11 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

12 REPLACE THE HOT AND CHILLED WATER RISER INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

13 DEMOLISH EXISTING PVC CONDENSATE DRAIN BETWEEN THE AIR HANDLING UNIT AND THE FLOOR DRAIN.

14 PROVIDE NEW VFD AT THE LOCATION SHOWN.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'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|---|---|---|
| | Issue for Construction | 10/11/17 |

Keyplan

Tx. Registration # F-2113

STATE OF TEXAS DAVID S. HALL 96988 LICENSED PROFESSIONAL ENGINEER

10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 12 WEST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-12W |
| Scale | As indicated |


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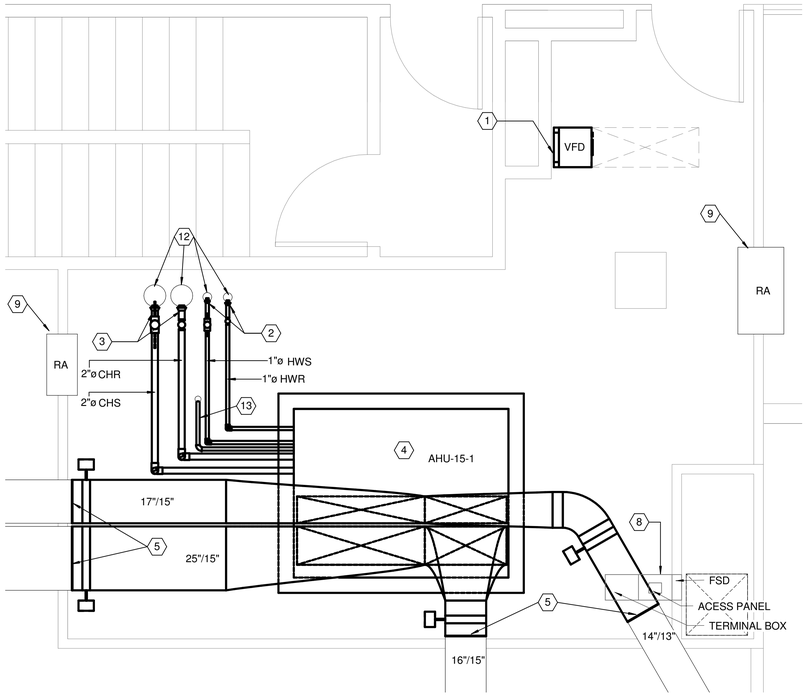



LEVEL 15 - DEMOLITION - MECHANICAL ROOM EAST

1 1/2" = 1'-0"

## GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

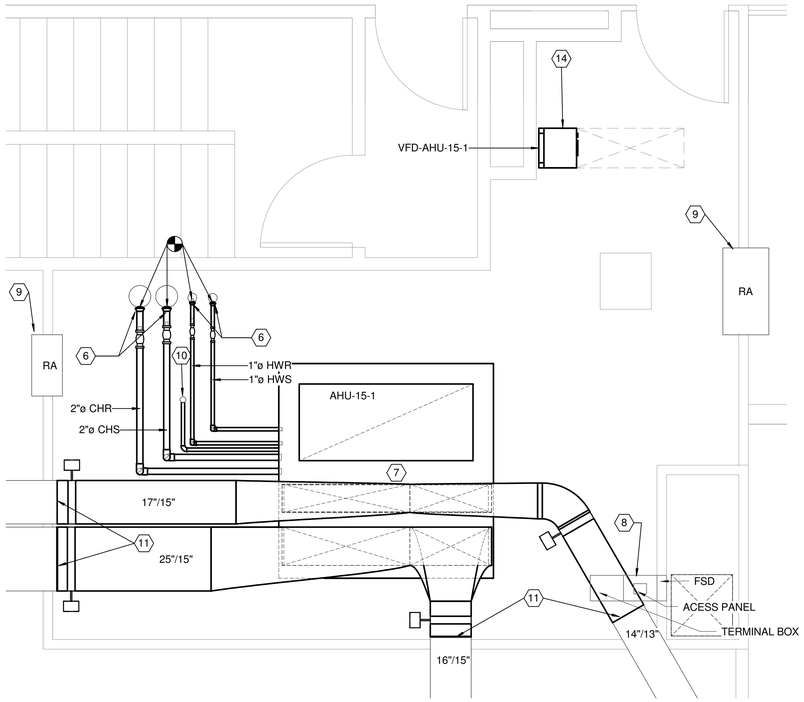
D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

## LEGEND

EXISTING TO REMAIN

TO BE DEMOLISHED




LEVEL 15 - RENOVATION - MECHANICAL ROOM EAST

2 1/2" = 1'-0"

## LEGEND

CONNECT TO EXISTING

EXISTING

NEW CONSTRUCTION

## KEYED NOTES - M-100-15E

1 DEMOLISH EXISTING VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

2 DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

3 DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

4 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.

5 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.

6 PROVIDE NEW CHILLED AND HEATING HOT WATER PIPING BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

7 PROVIDE NEW AIR HANDLING UNIT AS SCHEDULED AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.

8 OUTSIDE AIR TERMINAL UNIT EXISTING TO REMAIN.

9 RETURN AIR OPENING EXISTING TO REMAIN.

10 AHU CONDENSATE DRAIN. PIPING TO BE ROUTED BETWEEN THE UNIT AND THE DRAIN. REFER TO THE CONDENSATE DRAIN DETAIL FOR MORE INFORMATION.

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12 REPLACE THE HOT AND CHILLED WATER RISER INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

13 DEMOLISH EXISTING PVC CONDENSATE DRAIN BETWEEN THE AIR HANDLING UNIT AND THE FLOOR DRAIN.

14 PROVIDE NEW VFD AT THE LOCATION SHOWN.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'


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2825 Wilcrest, Suite #350 Houston, Texas 77042
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|---|---|---|
| | Issue for Construction | 10/11/17 |

Keyplan

Tx. Registration # F-2113

STATE OF TEXAS DAVID S. HALL 91078 LICENSED PROFESSIONAL ENGINEER

10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 15 EAST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-15E |
| Scale | As indicated |


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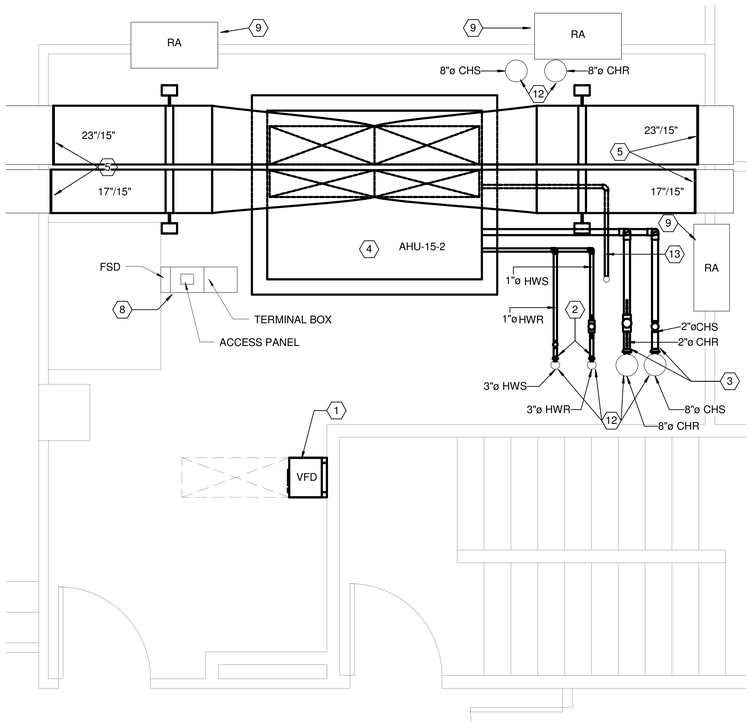
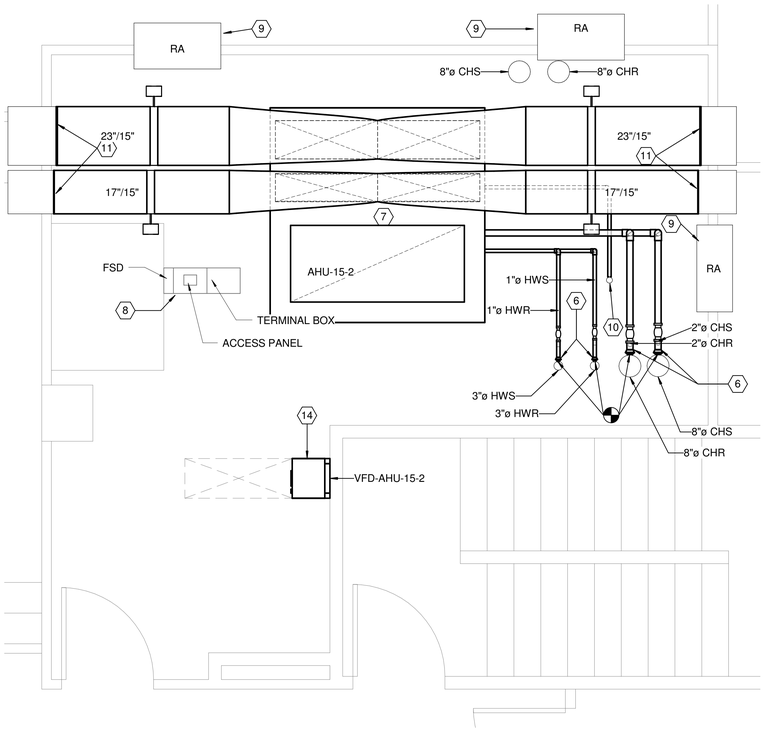



## LEVEL 15 - DEMOLITION - MECHANICAL ROOM WEST

1 1/2" = 1'-0"




## LEVEL 15 - RENOVATION - MECHANICAL ROOM WEST

2 1/2" = 1'-0"

### LEGEND

- EXISTING TO REMAIN
- TO BE DEMOLISHED

### LEGEND

- CONNECT TO EXISTING
- EXISTING
- NEW CONSTRUCTION

### GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

### KEYED NOTES - M-100-15W

1 DEMOLISH EXISTING VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

2 DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

3 DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

4 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.

5 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.

6 PROVIDE NEW CHILLED AND HEATING HOT WATER PIPING BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

7 PROVIDE NEW AIR HANDLING UNIT AS SCHEDULED AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.

8 OUTSIDE AIR TERMINAL UNIT EXISTING TO REMAIN.

9 RETURN AIR OPENING EXISTING TO REMAIN.

10 AHU CONDENSATE DRAIN. PIPING TO BE ROUTED BETWEEN THE UNIT AND THE DRAIN. REFER TO THE CONDENSATE DRAIN DETAIL FOR MORE INFORMATION.

11 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

12 REPLACE THE HOT AND CHILLED WATER RISER INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

13 DEMOLISH EXISTING PVC CONDENSATE DRAIN BETWEEN THE AIR HANDLING UNIT AND THE FLOOR DRAIN.

14 PROVIDE NEW VFD AT THE LOCATION SHOWN.

True NORTH Plan NORTH

0' 2' 4'
1/2" = 1'-0"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Tx. Registration # F-2113
STATE OF TEXAS
DAVID S. HALL
94481
LICENSED
PROFESSIONAL
ENGINEER
10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 15 WEST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-15W |
| Scale | As indicated |

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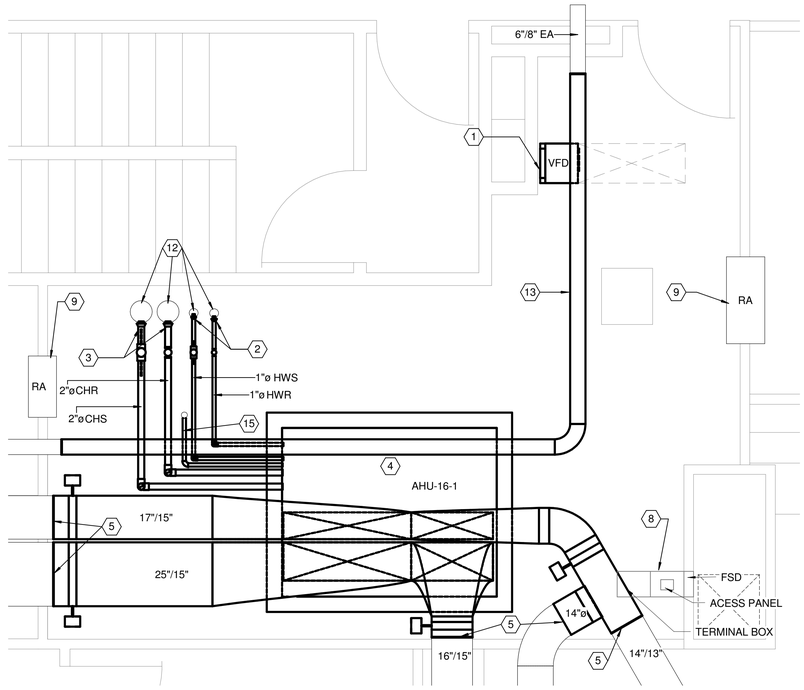



1 LEVEL 16 - DEMOLITION - MECHANICAL ROOM EAST
1/2" = 1'-0"

**LEGEND**

- EXISTING TO REMAIN
- TO BE DEMOLISHED

**GENERAL NOTES**

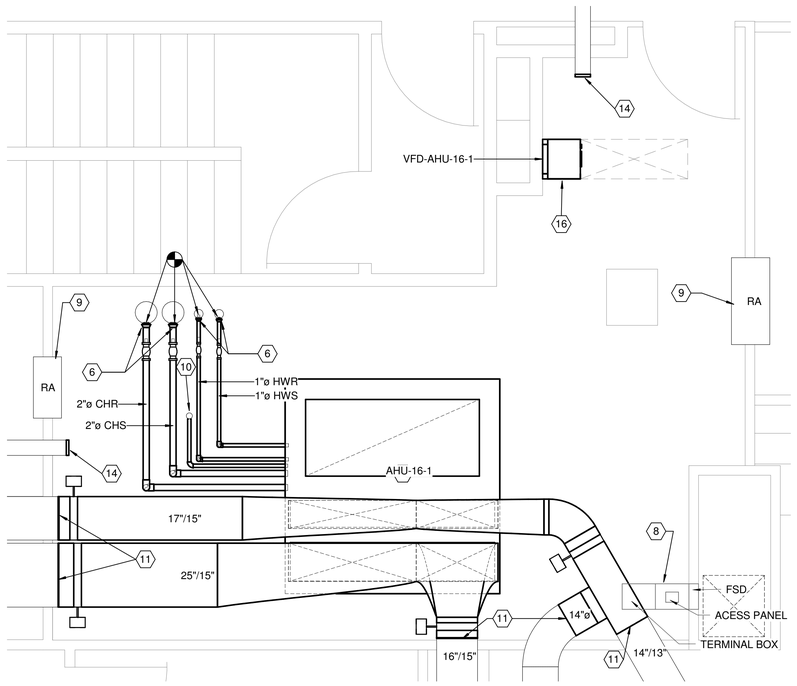
A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.




2 LEVEL 16 - RENOVATION - MECHANICAL ROOM EAST
1/2" = 1'-0"

**LEGEND**

- CONNECT TO EXISTING
- EXISTING
- NEW CONSTRUCTION

**KEYED NOTES - M-100-16E**

1. DEMOLISH EXISTING VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.
2. DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.
3. DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.
4. DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.
5. DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.
6. PROVIDE NEW CHILLED AND HEATING HOT WATER PIPING BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.
7. PROVIDE NEW AIR HANDLING UNIT AS SCHEDULED AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.
8. OUTSIDE AIR TERMINAL UNIT EXISTING TO REMAIN.
9. RETURN AIR OPENING EXISTING TO REMAIN.
10. AHU CONDENSATE DRAIN. PIPING TO BE ROUTED BETWEEN THE UNIT AND THE DRAIN. REFER TO THE CONDENSATE DRAIN DETAIL FOR MORE INFORMATION.
11. CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.
12. REPLACE THE HOT AND CHILLED WATER RISER INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.
13. DEMOLISH EXISTING EXHAUST DUCTWORK.
14. CAP AND SEAL EXHAUST DUCT OPENING AIRTIGHT.
15. DEMOLISH EXISTING PVC CONDENSATE DRAIN BETWEEN THE AIR HANDLING UNIT AND THE FLOOR DRAIN.
16. PROVIDE NEW VFD AT THE LOCATION SHOWN.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'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10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 16 EAST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-16E |
| Scale | As indicated |

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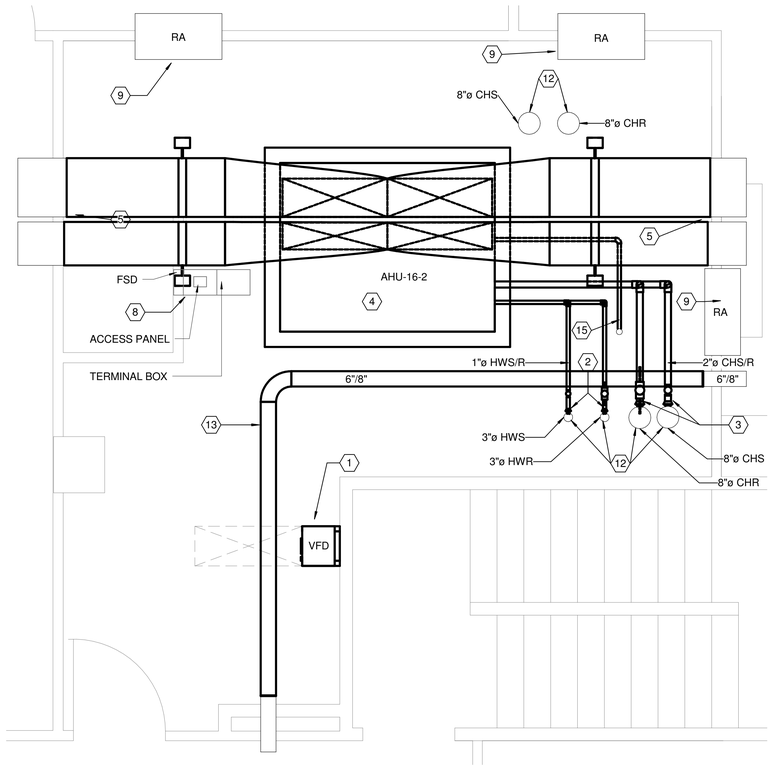
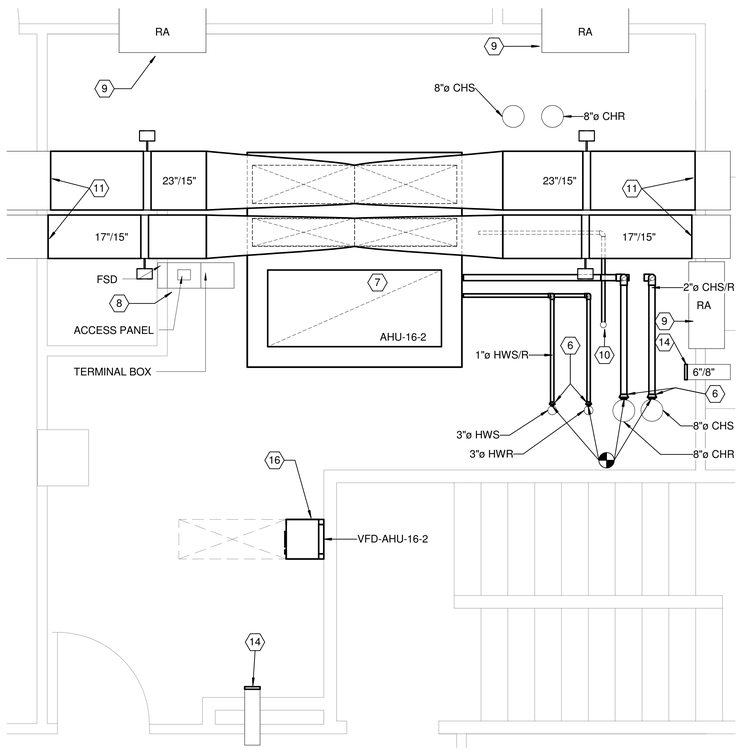



LEVEL 16 - DEMOLITION - MECHANICAL ROOM WEST

1 1/2" = 1'-0"




LEVEL 16 - RENOVATION - MECHANICAL ROOM WEST

2 1/2" = 1'-0"

## LEGEND

EXISTING TO REMAIN

TO BE DEMOLISHED

## LEGEND

CONNECT TO EXISTING

EXISTING

NEW CONSTRUCTION

## GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

## KEYED NOTES - M-100-16W

1 DEMOLISH EXISTING VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

2 DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

3 DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

4 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.

5 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.

6 PROVIDE NEW CHILLED AND HEATING HOT WATER PIPING BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

7 PROVIDE NEW AIR HANDLING UNIT AS SELECTED AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.

8 OUTSIDE AIR TERMINAL UNIT EXISTING TO REMAIN.

9 RETURN AIR OPENING EXISTING TO REMAIN.

10 AHU CONDENSATE DRAIN. PIPING TO BE ROUTED BETWEEN THE UNIT AND THE DRAIN. REFER TO THE CONDENSATE DRAIN DETAIL FOR MORE INFORMATION.

11 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

12 REPLACE THE HOT AND CHILLED WATER RISER INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

13 DEMOLISH EXISTING EXHAUST DUCTWORK.

14 CAP AND SEAL EXHAUST DUCT OPENINGS AIR TIGHT.

15 DEMOLISH EXISTING PVC CONDENSATE DRAIN BETWEEN THE AIR HANDLING UNIT AND THE FLOOR DRAIN.

16 PROVIDE NEW VFD AT THE LOCATION SHOWN.

True NORTH Plan NORTH

1/8" = 1'-0" 0' 8' 16'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| | Issue for Construction | 10/11/17 |

Keyplan

Tx. Registration # F-2113

STATE OF TEXAS DAVID S. HALL 95081 LICENSED PROFESSIONAL ENGINEER

10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 16 WEST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-16W |
| Scale | As indicated |

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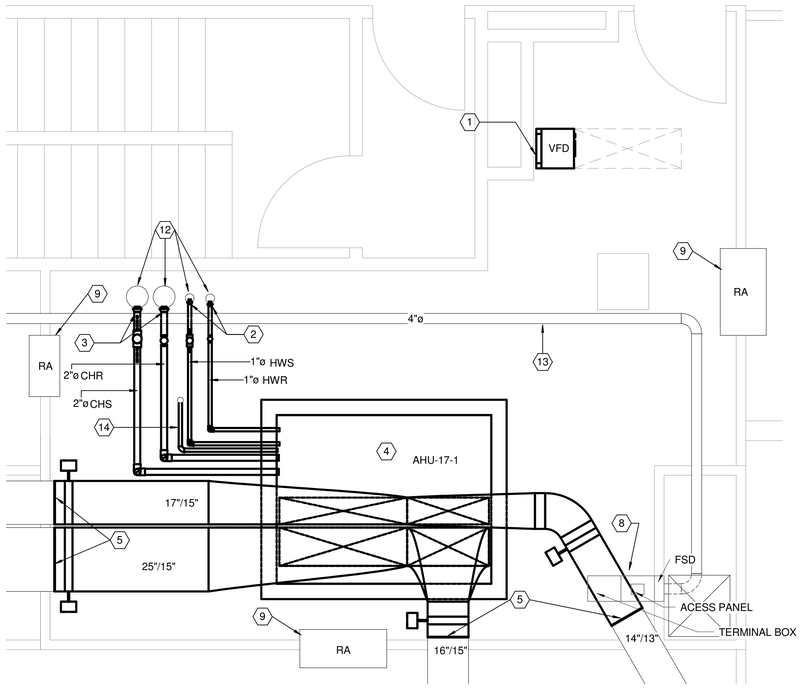
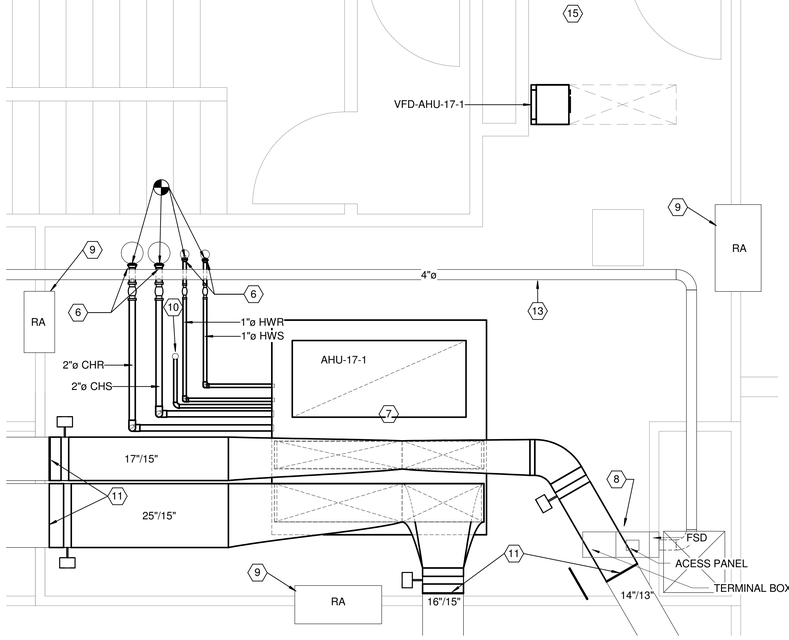



1 LEVEL 17 - DEMOLITION - MECHANICAL ROOM EAST
1/2" = 1'-0"

**LEGEND**

- EXISTING TO REMAIN
- TO BE DEMOLISHED




2 LEVEL 17 - RENOVATION - MECHANICAL ROOM EAST
1/2" = 1'-0"

**LEGEND**

- CONNECT TO EXISTING
- EXISTING
- NEW CONSTRUCTION

## GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

## KEYED NOTES - M-100-17E

1 DEMOLISH EXISTING VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

2 DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

3 DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

4 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.

5 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.

6 PROVIDE NEW CHILLED AND HEATING HOT WATER PIPING BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

7 PROVIDE NEW AIR HANDLING UNIT AS SCHEDULED AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.

8 OUTSIDE AIR TERMINAL UNIT EXISTING TO REMAIN.

9 RETURN AIR OPENINGS EXISTING TO REMAIN.

10 AHU CONDENSATE DRAIN. PIPING TO BE ROUTED BETWEEN THE UNIT AND THE DRAIN. REFER TO THE CONDENSATE DRAIN DETAIL FOR MORE INFORMATION.

11 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

12 REPLACE THE HOT AND CHILLED WATER RISER INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

13 OUTSIDE AIR SUPPLY DUCT EXISTING TO REMAIN.

14 DEMOLISH EXISTING PVC CONDENSATE DRAIN BETWEEN THE AIR HANDLING UNIT AND THE FLOOR DRAIN.

15 PROVIDE NEW VFD AT THE LOCATION SHOWN.

True NORTH / Plan NORTH

1/2" = 1'-0" 0' 2' 4'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| | Issue for Construction | 10/11/17 |

Keyplan

Tx. Registration # F-2113
STATE OF TEXAS DAVID S. HALL 96338 LICENSED MECHANICAL ENGINEER
10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 17 EAST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-17E |
| Scale | As indicated |

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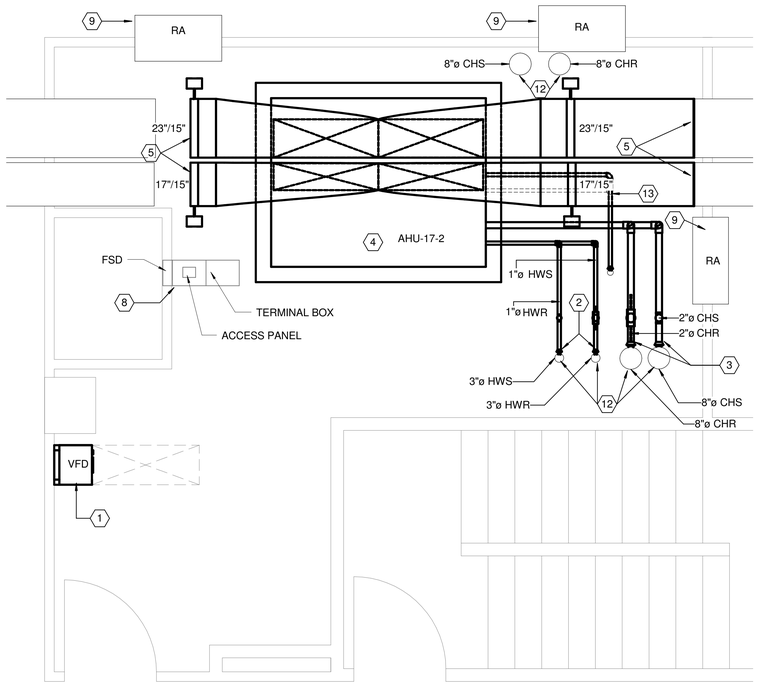



## LEVEL 17 - DEMOLITION - MECHANICAL ROOM WEST

1/2" = 1'-0"

### LEGEND

- EXISTING TO REMAIN
- TO BE DEMOLISHED

### GENERAL NOTES

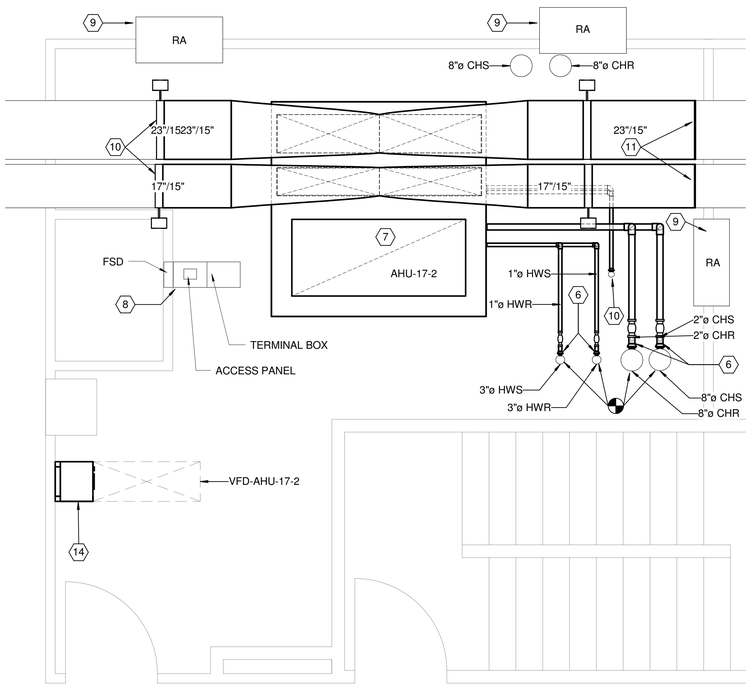
A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.




## LEVEL 17 - RENOVATION - MECHANICAL ROOM WEST

1/2" = 1'-0"

### LEGEND

- CONNECT TO EXISTING
- EXISTING
- NEW CONSTRUCTION

### KEYED NOTES - M-100-17W

1 DEMOLISH EXISTING VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

2 DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

3 DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE LOCATION SHOWN. EXISTING PIPING RISERS TO REMAIN.

4 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.

5 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.

6 PROVIDE NEW CHILLED AND HEATING HOT WATER PIPING BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

7 PROVIDE NEW AIR HANDLING UNIT AS SCHEDUED AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.

8 OUTSIDE AIR TERMINAL UNIT EXISTING TO REMAIN.

9 RETURN AIR OPENING EXISTING TO REMAIN.

10 AHU CONDENSATE DRAIN. PIPING TO BE ROUTED BETWEEN THE UNIT AND THE DRAIN. REFER TO THE CONDENSATE DRAIN DETAIL FOR MORE INFORMATION.

11 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

12 REPLACE THE HOT AND CHILLED WATER RISER INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

13 DEMOLISH EXISTING PVC CONDENSATE DRAIN BETWEEN THE AIR HANDLING UNIT AND THE FLOOR DRAIN.

14 PROVIDE NEW VFD AT THE LOCATION SHOWN.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'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Keyplan

Tx. Registration # F-2113

STATE OF TEXAS DAVID S. HALL 93481 LICENSED PROFESSIONAL ENGINEER

10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

## LEVEL 17 WEST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
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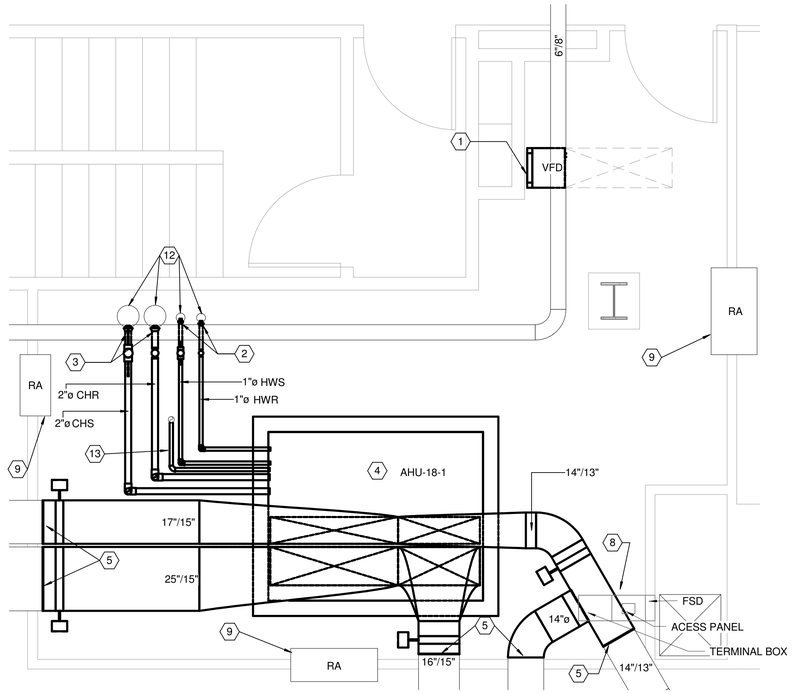



LEVEL 18 - DEMOLITION - MECHANICAL ROOM EAST

1 1/2" = 1'-0"

**LEGEND**

- EXISTING TO REMAIN
- TO BE DEMOLISHED

## GENERAL NOTES

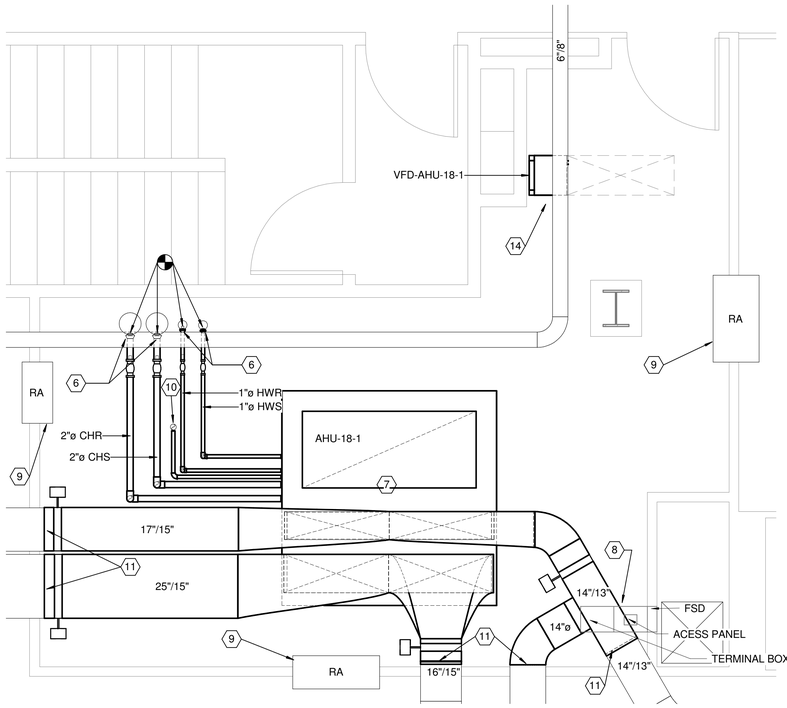
A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.




LEVEL 18 - RENOVATION - MECHANICAL ROOM EAST

2 1/2" = 1'-0"

**LEGEND**

- CONNECT TO EXISTING
- EXISTING
- NEW CONSTRUCTION

## KEYED NOTES - M-100-18E

1 DEMOLISH EXISTING VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

2 DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

3 DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

4 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.

5 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.

6 PROVIDE NEW CHILLED AND HEATING HOT WATER PIPING BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

7 PROVIDE NEW AIR HANDLING UNIT AS SCHEDULED AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.

8 OUTSIDE AIR TERMINAL UNIT EXISTING TO REMAIN.

9 RETURN AIR OPENING EXISTING TO REMAIN.

10 AHU CONDENSATE DRAIN. PIPING TO BE ROUTED BETWEEN THE UNIT AND THE DRAIN. REFER TO THE CONDENSATE DRAIN DETAIL FOR MORE INFORMATION.

11 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

12 REPLACE THE HOT AND CHILLED WATER RISER INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

13 DEMOLISH EXISTING PVC CONDENSATE DRAIN BETWEEN THE AIR HANDLING UNIT AND THE FLOOR DRAIN.

14 PROVIDE NEW VFD AT THE LOCATION SHOWN.

True NORTH Plan NORTH

0' 2' 4'
1/2" = 1'-0"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|---|---|---|
| | Issue for Construction | 10/11/17 |

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STATE OF TEXAS
DAVID S. HALL
95468
REGISTERED
PROFESSIONAL
ENGINEER
10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 18 EAST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-18E |
| Scale | As indicated |

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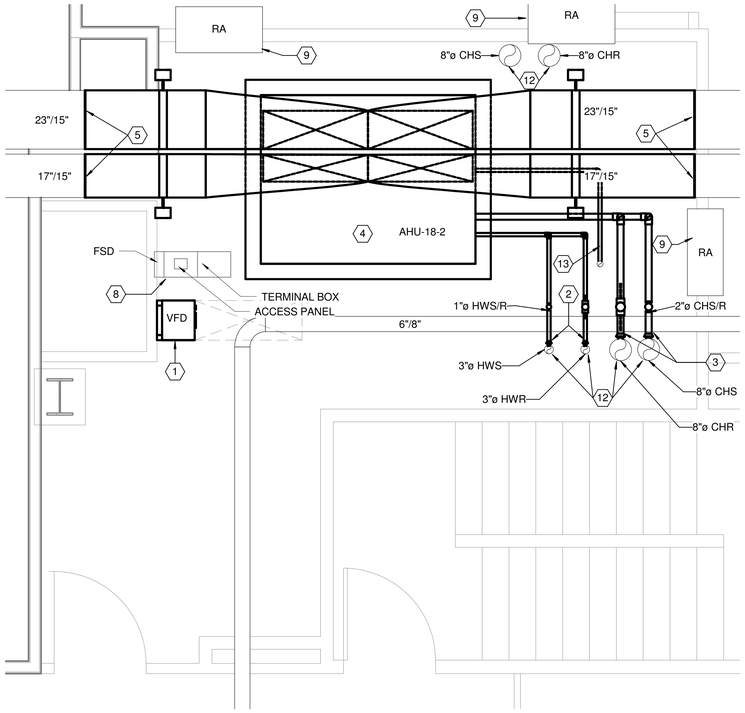
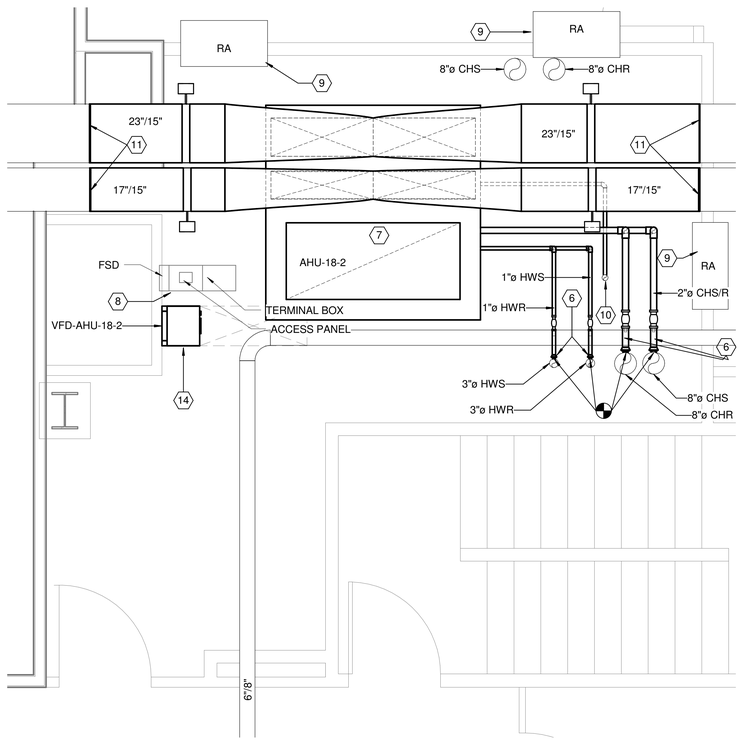



## LEVEL 18 - DEMOLITION - MECHANICAL ROOM WEST

1 1/2" = 1'-0"




## LEVEL 18 - RENOVATION - MECHANICAL ROOM WEST

2 1/2" = 1'-0"

### GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

### LEGEND

- EXISTING TO REMAIN
- TO BE DEMOLISHED

### LEGEND

- CONNECT TO EXISTING
- EXISTING
- NEW CONSTRUCTION

### KEYED NOTES - M-100-18W

1 DEMOLISH EXISTING VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

2 DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

3 DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

4 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.

5 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.

6 PROVIDE NEW CHILLED AND HEATING HOT WATER BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

7 PROVIDE NEW AIR HANDLING UNIT AS SELECTED AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.

8 OUTSIDE AIR TERMINAL UNIT EXISTING TO REMAIN.

9 RETURN AIR OPENING EXISTING TO REMAIN.

10 AHU CONDENSATE DRAIN. PIPING TO BE ROUTED BETWEEN THE UNIT AND THE DRAIN.

11 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

12 REPLACE THE HOT AND CHILLED WATER RISER INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

13 DEMOLISH EXISTING PVC CONDENSATE DRAIN BETWEEN THE AIR HANDLING UNIT AND THE FLOOR DRAIN.

14 PROVIDE NEW VFD AT THE LOCATION SHOWN.

True NORTH Plan NORTH

0' 2' 4'
1/2" = 1'-0"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90568
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PROFESSIONAL ENGINEER
10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

## LEVEL 18 WEST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-18W |
| Scale | As indicated |

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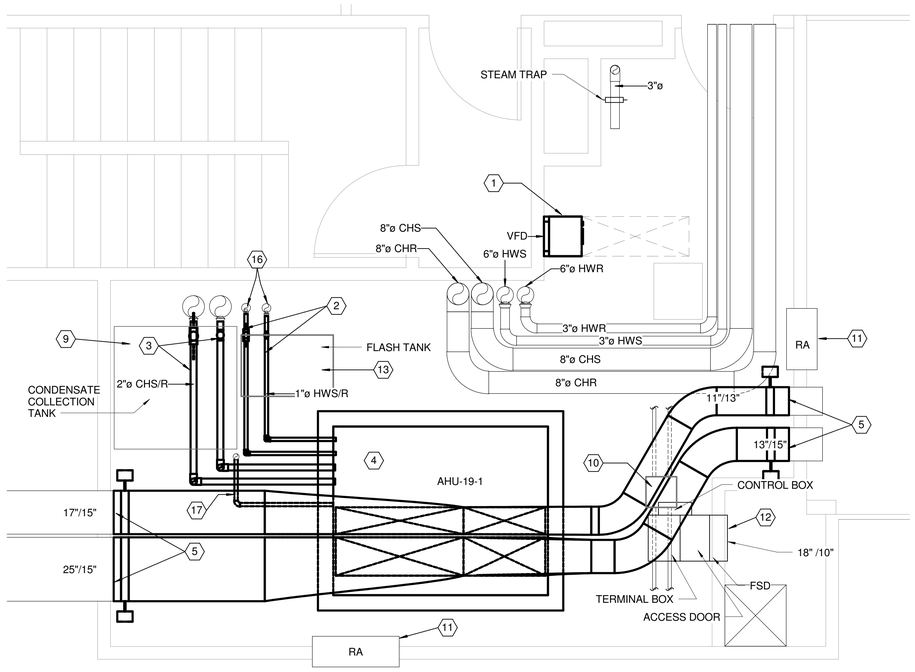
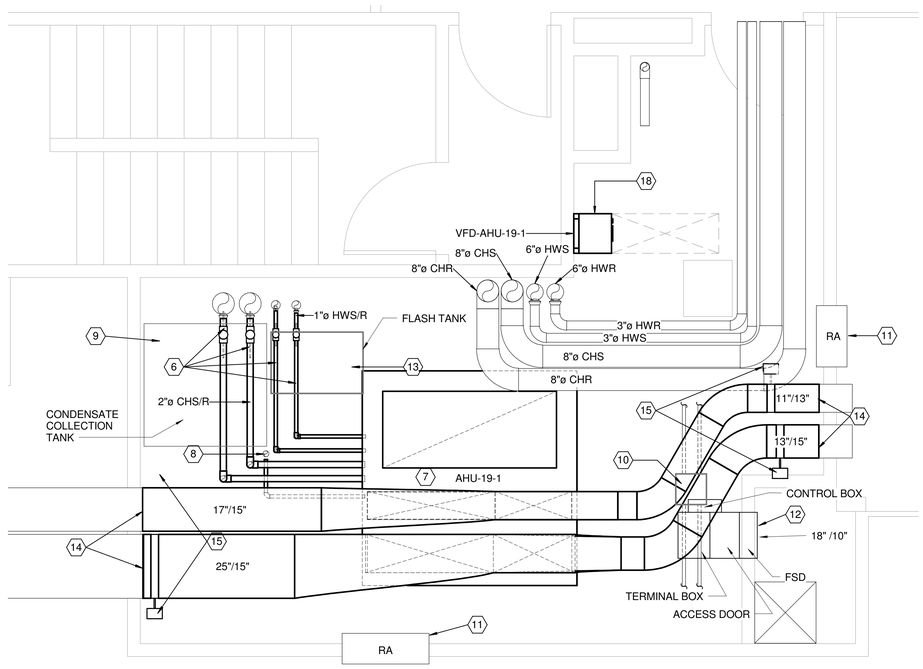



1 LEVEL 19 - DEMOLITION - MECHANICAL ROOM EAST-1
1/2" = 1'-0"




2 LEVEL 19 - RENOVATION - MECHANICAL ROOM EAST-1
1/2" = 1'-0"

## GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

## KEYED NOTES - M-100-19E-1

1 DEMOLISH EXISTING VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.
2 DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE LOCATION SHOWN. EXISTING PIPING RISERS TO REMAIN.
3 DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE LOCATION SHOWN. EXISTING PIPING RISERS TO REMAIN.
4 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.
5 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.
6 PROVIDE NEW CHILLED AND HEATING HOT WATER BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.
7 PROVIDE NEW AIR HANDLING UNIT AS SCHEDULED AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.
8 AHU CONDENSATE DRAIN. PIPING TO BE ROUTED BETWEEN THE UNIT AND THE DRAIN. REFER TO THE CONDENSATE DRAIN DETAIL FOR MORE INFORMATION.
9 CONDENSATE RETURN COLLECTION TANK EXISTING TO REMAIN.
10 BOOSTER HOT WATER PUMP SYSTEM EXISTING TO REMAIN.
11 RETURN AIR OPENINGS EXISTING TO REMAIN.
12 OUTSIDE AIR TERMINAL UNIT EXISTING TO REMAIN.
13 FLASH TANK EXISTING TO REMAIN.
14 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.
15 PROVIDE MOTORIZED VOLUME DAMPER AT THE LOCATION SHOWN.
16 REPLACE THE HOT WATER RISER INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.
17 DEMOLISH EXISTING PVC CONDENSATE DRAIN BETWEEN THE AIR HANDLING UNIT AND THE FLOOR DRAIN.
18 PROVIDE NEW VFD AT THE LOCATION SHOWN.

## LEGEND

EXISTING TO REMAIN
TO BE DEMOLISHED

## LEGEND

CONNECT TO EXISTING
EXISTING
NEW CONSTRUCTION

True NORTH  Plan NORTH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90568
REGISTERED
ENGINEER
10-11-2017

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# UCT AHU REPLACEMENT

LEVEL 19 EAST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-19E-1 |
| Scale | As indicated |

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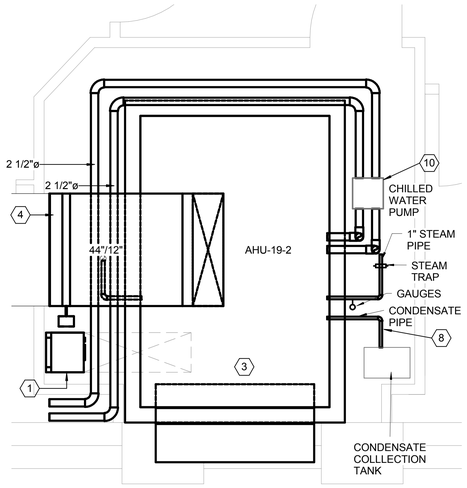



LEVEL 19 - DEMOLITION - MECHANICAL ROOM EAST-2

1 1/2" = 1'-0"

**LEGEND**

- EXISTING TO REMAIN
- TO BE DEMOLISHED

## GENERAL NOTES

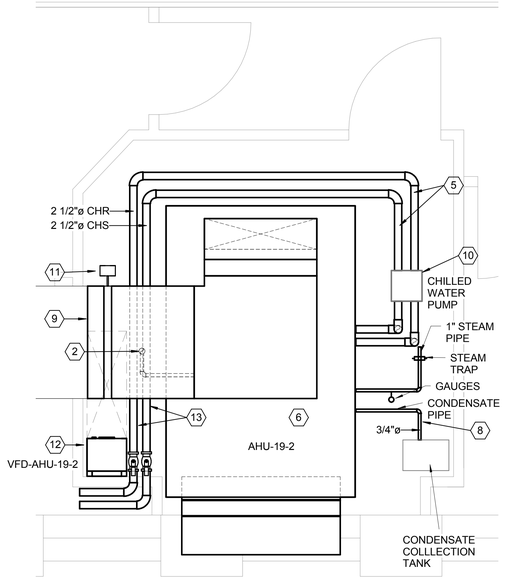
A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.




LEVEL 19 - RENOVATION - MECHANICAL ROOM EAST-2

2 1/2" = 1'-0"

**LEGEND**

- CONNECT TO EXISTING
- EXISTING
- NEW CONSTRUCTION

## KEYED NOTES - M-100-19E-2

1 DEMOLISH EXISTING VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

2 AHU CONDENSATE DRAIN. PIPING TO BE ROUTED BETWEEN THE UNIT AND THE DRAIN.

3 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.

4 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.

5 PROVIDE NEW CHILLED WATER PIPING BETWEEN THE EXTENT OF THE DEMOLITION AND THE NEW AIR HANDLING UNIT. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

6 PROVIDE NEW AIR HANDLING UNIT AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.

8 REPLACE THE STEAM AND CONDENSATES SYSTEM FROM THE CONTROL VALVE INTO THE UNIT. ALSO, THE STRAINER, GAUGES, STEAM TRAPS AND ASSOCIATED COMPONENTS WITH THE STEAM AND CONDENSATES SYSTEM. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

9 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

10 CHILLED WATER PUMP EXISTING TO REMAIN.

11 PROVIDE MOTORIZED VOLUME DAMPER AT THE LOCATION SHOWN.

12 PROVIDE NEW VFD AT THE LOCATION SHOWN.

13 PROVIDE ISOLATION VALVES AT THE LOCATION SHOWN.

True NORTH

Plan NORTH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The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 19 EAST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-19E-2 |
| Scale | As indicated |


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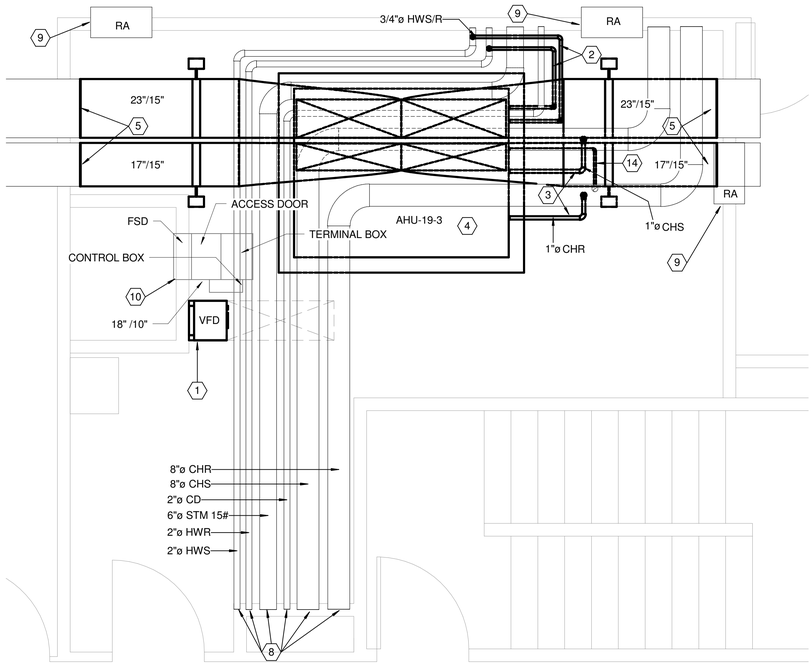
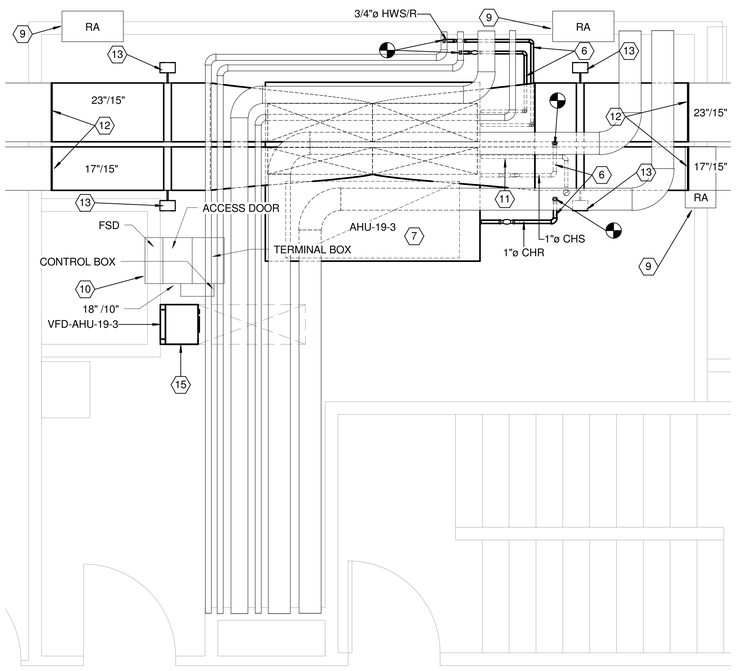



## LEVEL 19 - DEMOLITION - MECHANICAL ROOM WEST

1 1/2" = 1'-0"




## LEVEL 19 - RENOVATION - MECHANICAL ROOM WEST

2 1/2" = 1'-0"

### GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

### LEGEND

EXISTING TO REMAIN

TO BE DEMOLISHED

### KEYED NOTES - M-100-19W

1 DEMOLISH EXISTING VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.
2 DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.
3 DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE LOCATION SHOWN. EXISTING PIPING RISERS TO REMAIN.
4 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.
5 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.
6 PROVIDE NEW CHILLED AND HEATING HOT WATER BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.
7 PROVIDE NEW AIR HANDLING UNIT AS SCHEDULED AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.
8 HOT WATER RETURN, HOT WATER SUPPLY, CHILLED WATER RETURN, CHILLED WATER SUPPLY, STEAM AND CONDENSATE RETURN PIPING EXISTING TO REMAIN.
9 RETURN AIR OPENING EXISTING TO REMAIN.
10 OUTSIDE AIR TERMINAL UNIT EXISTING TO REMAIN.
11 AHU CONDENSATE DRAIN. PIPING TO BE ROUTED BETWEEN THE UNIT AND THE DRAIN. REFER TO THE CONDENSATE DRAIN DETAIL FOR MORE INFORMATION.
12 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.
13 PROVIDE MOTORIZED VOLUME DAMPER AT THE LOCATION SHOWN.
14 DEMOLISH EXISTING PVC CONDENSATE DRAIN BETWEEN THE AIR HANDLING UNIT AND THE FLOOR DRAIN.
15 PROVIDE NEW VFD AT THE LOCATION SHOWN.

### LEGEND

CONNECT TO EXISTING

EXISTING

NEW CONSTRUCTION

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'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STATE OF TEXAS DAVID S. HALL 98468 LICENSED PROFESSIONAL ENGINEER

10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 19 WEST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-19W |
| Scale | As indicated |


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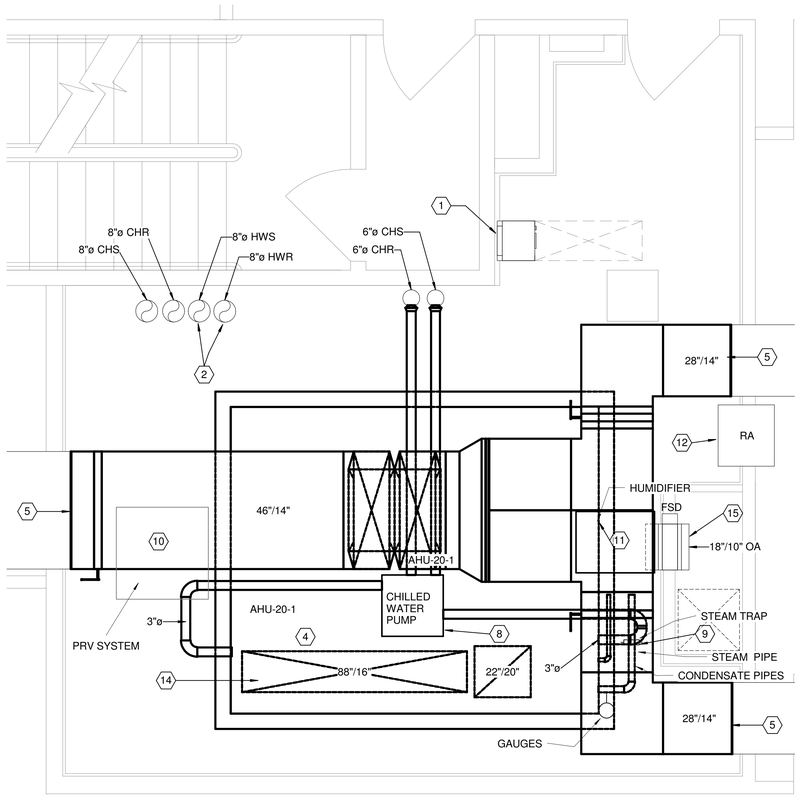
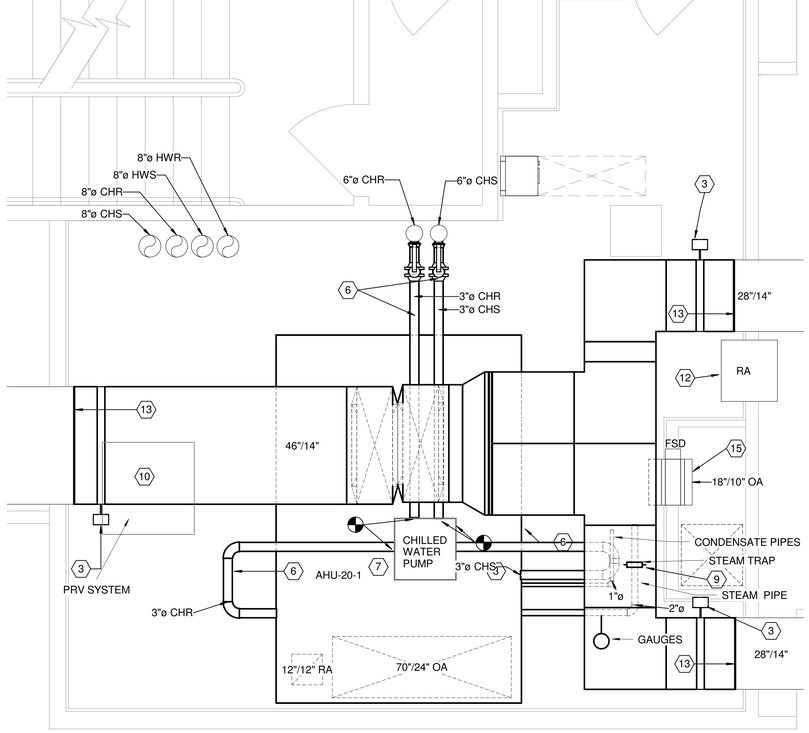



## LEVEL 20 - DEMOLITION - MECHANICAL ROOM EAST

1/2" = 1'-0"




## LEVEL 20 - RENOVATION - MECHANICAL ROOM EAST

1/2" = 1'-0"

### GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

### LEGEND

EXISTING TO REMAIN

TO BE DEMOLISHED

### LEGEND

CONNECT TO EXISTING

EXISTING

NEW CONSTRUCTION

### KEYED NOTES - M-100-20E

1 CONTRACTOR TO VERIFY VFD HORSEPOWER RATING COMPATIBILITY WITH NEW AIR HANDLING UNIT. IF VFD IS REPLACED, THE EXISTING VFD SHALL BE HANDED OVER TO OWNER AS SPARE.

2 REPLACE THE HOT WATER RISER INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

3 PROVIDE MOTORIZED VOLUME DAMPER AT THE LOCATION SHOWN.

4 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISTING DIGITAL CONTROLLERS TO OWNER.

5 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.

6 PROVIDE NEW CHILLED WATER PIPING BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

7 PROVIDE NEW AIR HANDLING UNIT AS SELECTED AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.

8 CHILLED WATER PUMP EXISTING TO REMAIN.

9 REPLACE THE STEAM AND CONDENSATE SYSTEM FROM THE CONTROL VALVE INTO THE UNIT. ALSO, THE STRAINER, GAUGES, STEAM TRAPS AND ASSOCIATED COMPONENTS WITH THE STEAM AND CONDENSATES SYSTEM. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

10 PRV SYSTEM EXISTING TO REMAIN.

11 DEMOLISH ABANDONED HUMIDIFIER AND CAP OFF.

12 RETURN AIR OPENING EXISTING TO REMAIN.

13 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

14 REPLACE THE OA DUCT FROM THE MECHANICAL ROOM CEILING DOWN TO AHU-20-1 AND THE ASSOCIATED MOTORIZED AND MANUAL VOLUME DAMPERS.

15 OA OPENING EXISTING TO REMAIN.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'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THE UNIVERSITY of TEXAS HEALTH SCIENCE CENTER AT HOUSTON


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|---|---|---|
| | Issue for Construction | 10/11/17 |

Keyplan

Tx. Registration # F-2113

STATE OF TEXAS DAVID S. HALL 103 LICENSED PROFESSIONAL ENGINEER

10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 20 EAST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-20E |
| Scale | As indicated |

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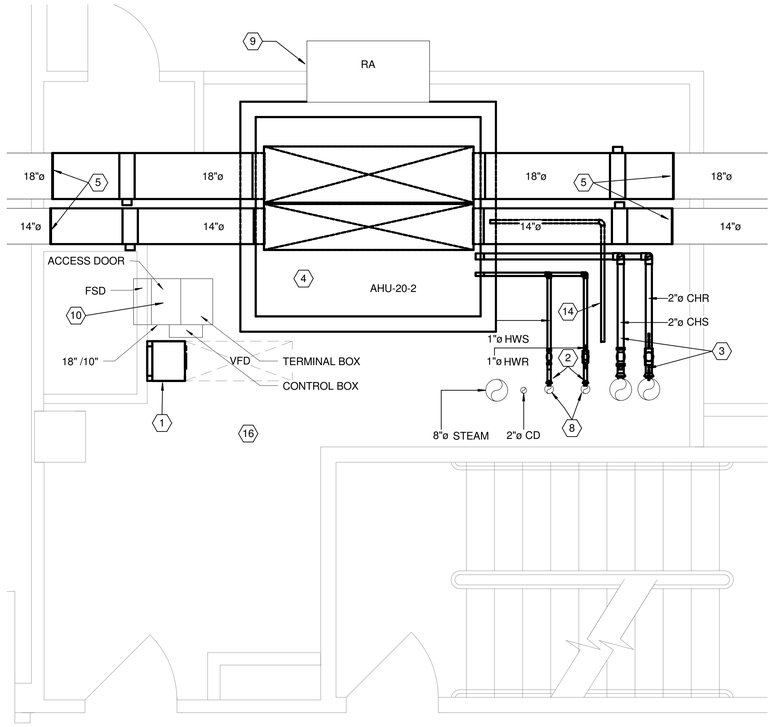
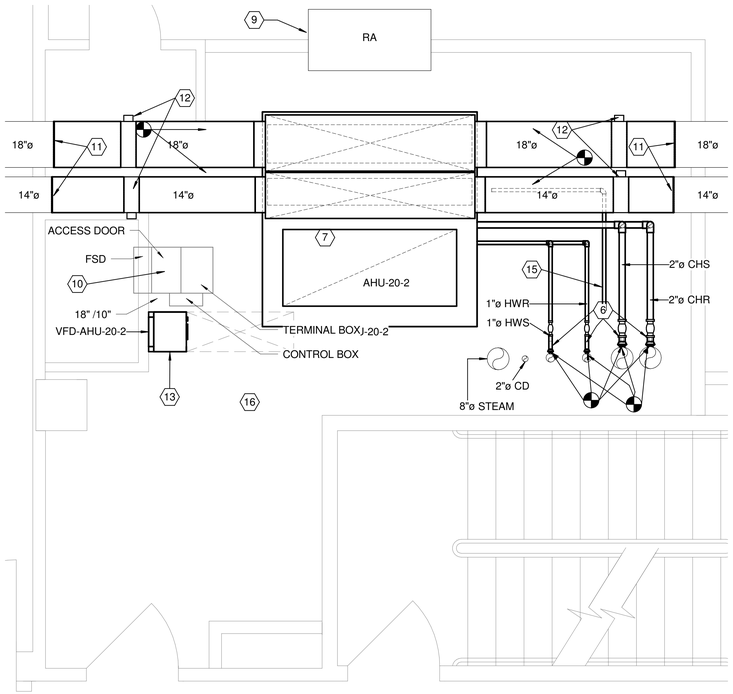



LEVEL 20 - DEMOLITION - MECHANICAL ROOM WEST

1 1/2" = 1'-0"




LEVEL 20 - RENOVATION - MECHANICAL ROOM WEST

2 1/2" = 1'-0"

## GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

## LEGEND

EXISTING TO REMAIN

TO BE DEMOLISHED

## LEGEND

CONNECT TO EXISTING

EXISTING

NEW CONSTRUCTION

## KEYED NOTES - M-100-20W

1 DEMOLISH EXISTING VFD AT THE WELDOLET AT THE RISER. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

2 DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.

3 DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE LOCATION SHOWN. EXISTING PIPING RISERS TO REMAIN.

4 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.

5 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.

6 PROVIDE NEW CHILLED AND HEATING HOT WATER BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

7 PROVIDE NEW AIR HANDLING UNIT AS SCHEDULED AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.

8 REPLACE THE HOT WATER RISER INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

9 RETURN AIR OPENING EXISTING TO REMAIN.

10 OUTSIDE AIR TERMINAL UNIT EXISTING TO REMAIN.

11 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

12 PROVIDE MOTORIZED VOLUME DAMPER AT THE LOCATION SHOWN.

13 PROVIDE NEW VFD AT THE LOCATION SHOWN.

14 DEMOLISH EXISTING PVC CONDENSATE DRAIN BETWEEN THE AIR HANDLING UNIT AND THE FLOOR DRAIN.

15 AHU CONDENSATE DRAIN. PIPING TO BE ROUTED BETWEEN THE UNIT AND THE DRAIN.

16 CONTRACTOR SHALL REMOVE, STORE, AND RE-INSTALL EXISTING WATER DETECTORS ON THE MECHANICAL ROOM FLOOR AND AHU CONDENSATE PAN.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'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10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 20 WEST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-20W |
| Scale | As indicated |


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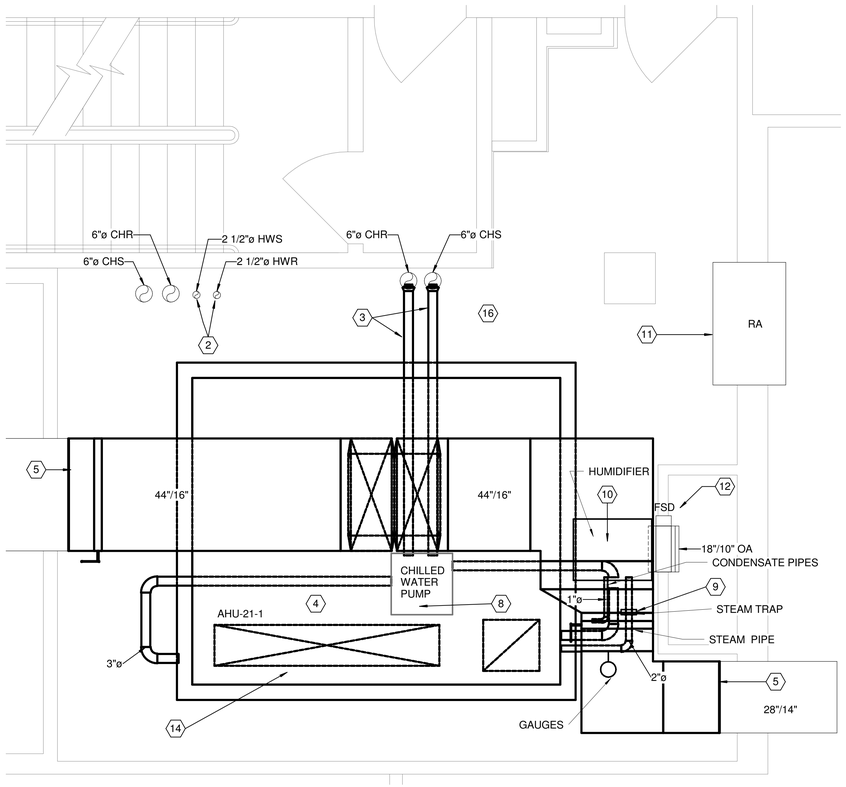
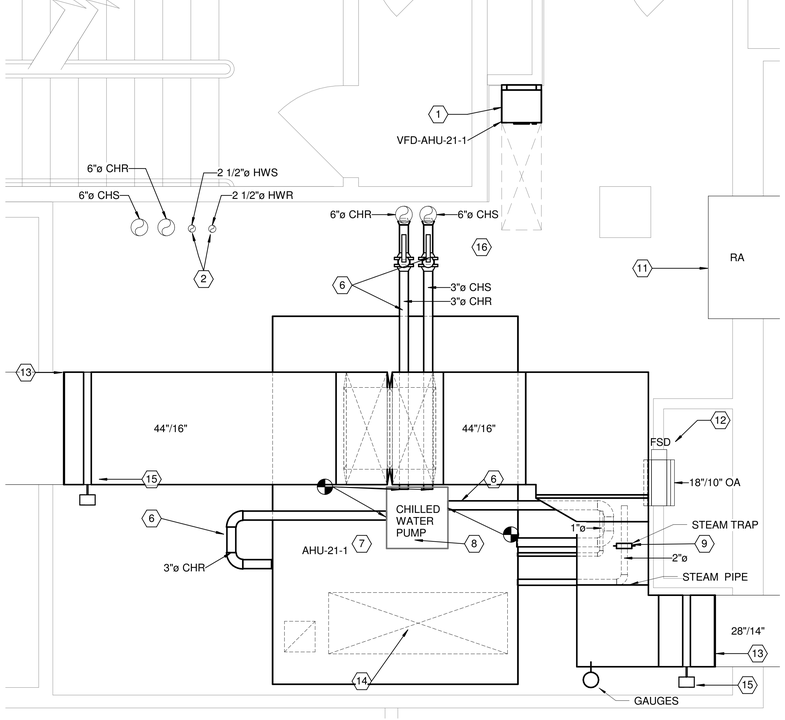



## LEVEL 21 - DEMOLITION - MECHANICAL ROOM EAST

1 1/2" = 1'-0"

**LEGEND**

- EXISTING TO REMAIN
- TO BE DEMOLISHED




## LEVEL 21 - RENOVATION - MECHANICAL ROOM EAST

2 1/2" = 1'-0"

**LEGEND**

- CONNECT TO EXISTING
- EXISTING
- NEW CONSTRUCTION

## GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

## KEYED NOTES - M-100-21E

1 PROVIDE NEW VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

2 REPLACE THE HOT WATER RISER INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

3 DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE LOCATION SHOWN. EXISTING PIPING RISERS TO REMAIN.

4 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.

5 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.

6 PROVIDE NEW CHILLED WATER PIPING BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

7 PROVIDE NEW AIR HANDLING UNIT AS SCHEDULED AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.

8 CHILLED WATER PUMP EXISTING TO REMAIN.

9 REPLACE THE STEAM AND CONDENSATE SYSTEM FROM THE CONTROL VALVE INTO THE UNIT. ALSO, THE STRAINER, GAUGES, STEAM TRAPS AND ASSOCIATED COMPONENTS WITH THE STEAM AND CONDENSATE SYSTEM. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

10 DEMOLISH ABANDONED HUMIDIFIER AND CAP OFF.

11 48" X 24" RETURN AIR OPENING.

12 OA OPENING EXISTING TO REMAIN.

13 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

14 REPLACE THE OA DUCT FROM THE MECHANICAL ROOM CEILING DOWN TO AHU-21-1 AND THE ASSOCIATED MOTORIZED AND MANUAL VOLUME DAMPERS.

15 PROVIDE MOTORIZED VOLUME DAMPER AT THE LOCATION SHOWN.

16 CONTRACTOR SHALL REMOVE, STORE, AND RE-INSTALL EXISTING WATER DETECTORS ON THE MECHANICAL ROOM FLOOR AND AHU CONDENSATE PAN.

True NORTH Plan NORTH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10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 21 EAST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-21E |
| Scale | As indicated |

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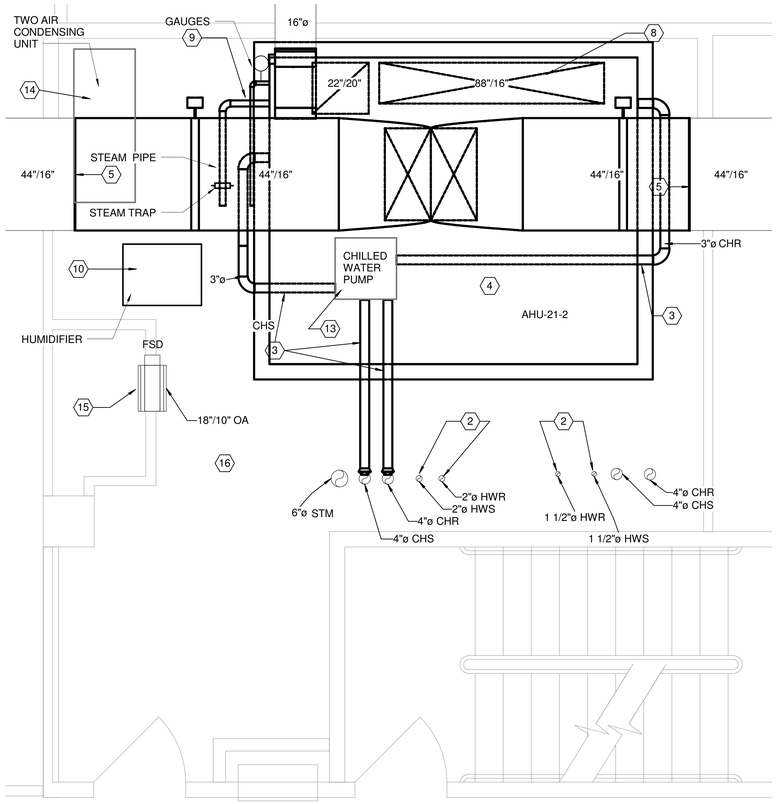
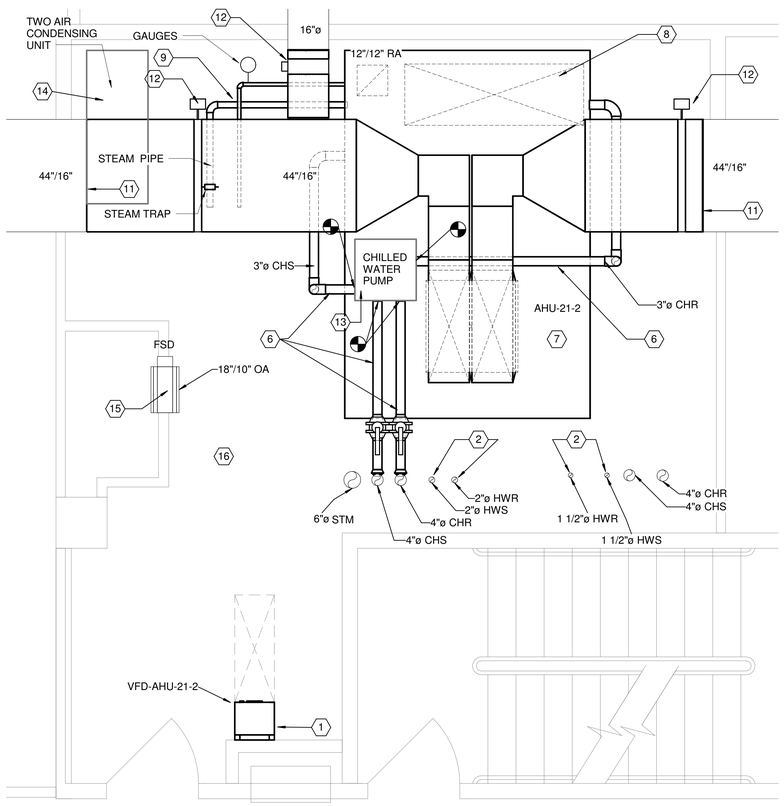



## LEVEL 21 - DEMOLITION - MECHANICAL ROOM WEST

1/2" = 1'-0"




## LEVEL 21 - RENOVATION - MECHANICAL ROOM WEST

1/2" = 1'-0"

### LEGEND

- EXISTING TO REMAIN
- TO BE DEMOLISHED

### LEGEND

- CONNECT TO EXISTING
- EXISTING
- NEW CONSTRUCTION

### GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

### KEYED NOTES - M-100-21W

1 PROVIDE NEW VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

2 REPLACE THE HOT WATER RISER INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENT.

3 DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE LOCATION SHOWN. EXISTING PIPING RISERS TO REMAIN.

4 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.

5 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.

6 PROVIDE NEW CHILLED WATER PIPING BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

7 PROVIDE NEW AIR HANDLING UNIT AS SCHEDULED AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.

8 REPLACE THE OA DUCT FROM THE MECHANICAL ROOM CEILING DOWN TO AHU-21-2 AND THE ASSOCIATED MOTORIZED AND MANUAL VOLUME DAMPERS.

9 REPLACE THE STEAM AND CONDENSATE SYSTEM FROM THE CONTROL VALVE INTO THE UNIT. ALSO, THE STRAINER, GAUGES, STEAM TRAPS AND ASSOCIATED COMPONENTS WITH THE STEAM AND CONDENSATES SYSTEM. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

10 DEMOLISH ABANDONED HUMIDIFIER AND CAP OFF.

11 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

12 PROVIDE MOTORIZED VOLUME DAMPER AT THE LOCATION SHOWN.

13 CHILLED WATER PUMP EXISTING TO REMAIN.

14 TWO AIR COOLED CONDENSING UNITS EXISTING TO REMAIN.

15 OA OPENING EXISTING TO REMAIN.

16 CONTRACTOR SHALL REMOVE, STORE, AND RE-INSTALL EXISTING WATER DETECTORS ON THE MECHANICAL ROOM FLOOR AND AHU CONDENSATE PAN.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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| | Issue for Construction | 10/11/17 |

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Tx. Registration # F-2113

STATE OF TEXAS — DAVID S. HALL — 94468 — LICENSED PROFESSIONAL ENGINEER

10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 21 WEST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-21W |
| Scale | As indicated |

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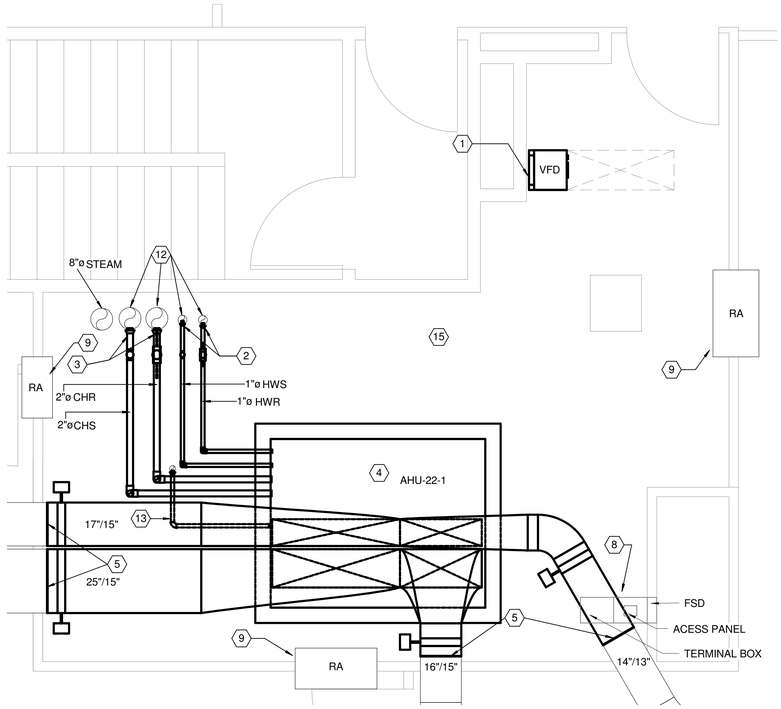
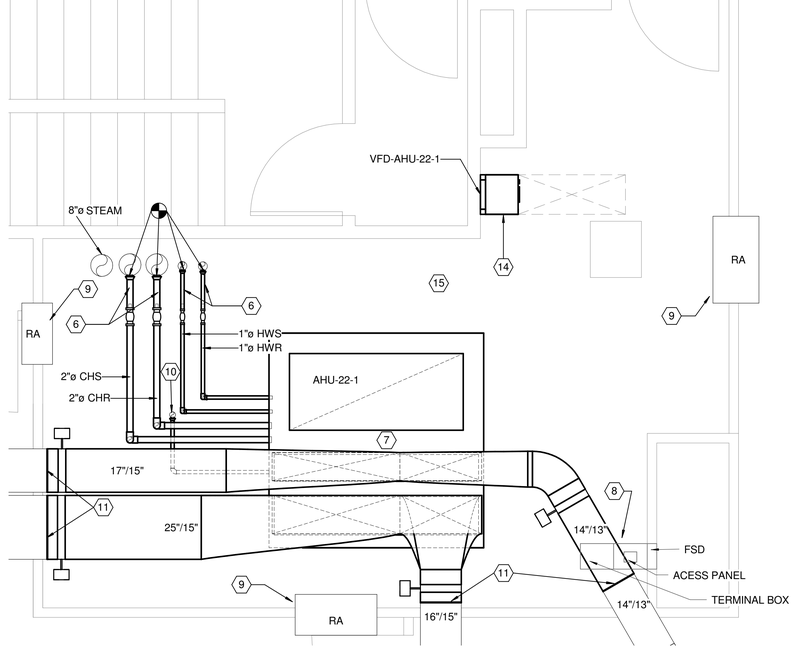



1 LEVEL 22 - DEMOLITION - MECHANICAL ROOM EAST
1/2" = 1'-0"




2 LEVEL 22 - RENOVATION - MECHANICAL ROOM EAST
1/2" = 1'-0"

## LEGEND

EXISTING TO REMAIN

TO BE DEMOLISHED

## LEGEND

CONNECT TO EXISTING

EXISTING

NEW CONSTRUCTION

## GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

## KEYED NOTES - M-100-22E

1 DEMOLISH EXISTING VFD AT THE WELDOLET AT THE RISER REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

2 DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE LOCATION SHOWN. EXISTING PIPING RISERS TO REMAIN.

3 DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE LOCATION SHOWN. EXISTING PIPING RISERS TO REMAIN.

4 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.

5 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.

6 PROVIDE NEW CHILLED AND HEATING HOT WATER PIPING BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

7 PROVIDE NEW AIR HANDLING UNIT AS SCHEDULED AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.

8 OUTSIDE AIR TERMINAL UNIT EXISTING TO REMAIN.

9 RETURN AIR OPENINGS EXISTING TO REMAIN.

10 AHU CONDENSATE DRAIN. PIPING TO BE ROUTED BETWEEN THE UNIT AND THE DRAIN. REFER TO THE CONDENSATE DRAIN DETAIL FOR MORE INFORMATION.

11 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

12 REPLACE THE HOT AND CHILLED WATER RISER INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

13 DEMOLISH EXISTING PVC CONDENSATE DRAIN BETWEEN THE AIR HANDLING UNIT AND THE FLOOR DRAIN.

14 PROVIDE NEW VFD AT THE LOCATION SHOWN.

15 CONTRACTOR SHALL REMOVE, STORE, AND RE-INSTALL EXISTING WATER DETECTORS ON THE MECHANICAL ROOM FLOOR AND AHU CONDENSATE PAN.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'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Texas Registered Engineering Firm F-2113

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STATE OF TEXAS DAVID S. HALL 90718 LICENSED PROFESSIONAL ENGINEER
10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 22 EAST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-22E |
| Scale | As indicated |

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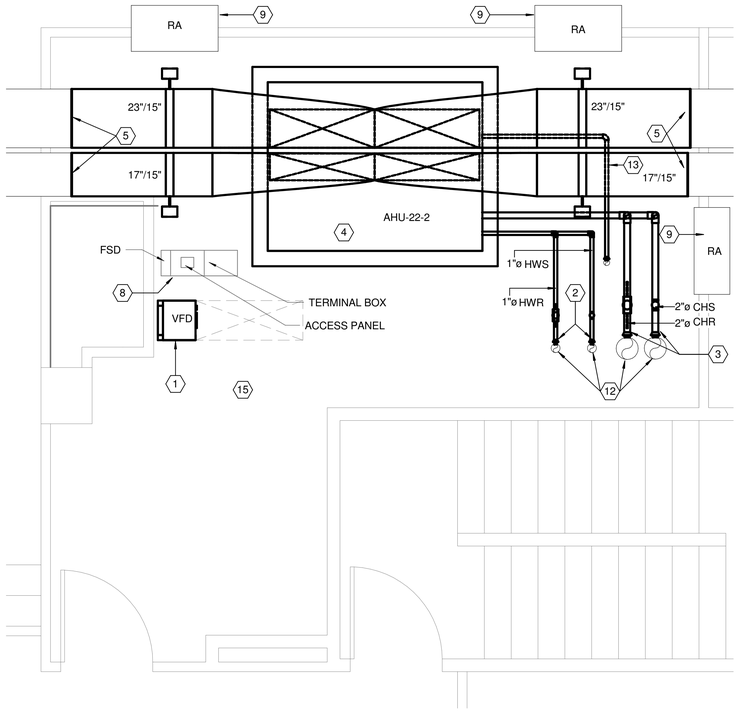



1 LEVEL 22 - DEMOLITION - MECHANICAL ROOM WEST
1/2" = 1'-0"

## LEGEND

- EXISTING TO REMAIN
- TO BE DEMOLISHED

## GENERAL NOTES

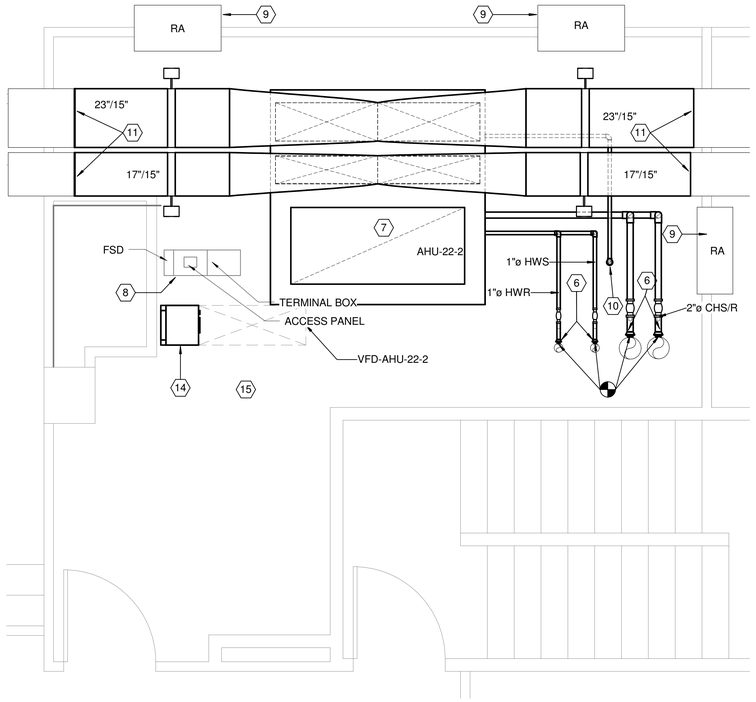
A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.




2 LEVEL 22 - RENOVATION - MECHANICAL ROOM WEST
1/2" = 1'-0"

## LEGEND

- CONNECT TO EXISTING
- EXISTING
- NEW CONSTRUCTION

## KEYED NOTES - M-100-22W

1. DEMOLISH EXISTING VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.
2. DEMOLISH EXISTING HEATING HOT WATER PIPING BACK TO THE WELDOLET AT THE RISER. EXISTING PIPING RISERS TO REMAIN.
3. DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE LOCATION SHOWN. EXISTING PIPING RISERS TO REMAIN.
4. DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN AND RETURN EXISITNG DIGITAL CONTROLLERS TO OWNER.
5. DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE MECHANICAL ROOM WALLS AS SHOWN.
6. PROVIDE NEW CHILLED AND HEATING HOT WATER PIPING BETWEEN THE RISER AND THE NEW AIR HANDLING UNIT. PROVIDE ISOLATION VALVE AT CONNECTION TO RISER. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.
7. PROVIDE NEW AIR HANDLING UNIT AS SCHEDULED AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.
8. OUTSIDE AIR TERMINAL UNIT EXISTING TO REMAIN.
9. RETURN AIR OPENINGS EXISTING TO REMAIN.
10. AHU CONDENSATE DRAIN. PIPING TO BE ROUTED BETWEEN THE UNIT AND THE DRAIN. REFER TO THE CONDENSATE DRAIN DETAIL FOR MORE INFORMATION.
11. CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.
12. REPLACE THE HOT AND CHILLED WATER RISER INSULATION. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.
13. DEMOLISH EXISTING PVC CONDENSATE DRAIN BETWEEN THE AIR HANDLING UNIT AND THE FLOOR DRAIN.
14. PROVIDE NEW VFD AT THE LOCATION SHOWN.
15. CONTRACTOR SHALL REMOVE, STORE, AND RE-INSTALL EXISTING WATER DETECTORS ON THE MECHANICAL ROOM FLOOR AND AHU CONDENSATE PAN.

True NORTH Plan NORTH

0' 2' 4'
1/2" = 1'-0"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Philo Wilke Partnership

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HEALTH SCIENCE CENTER AT HOUSTON

| No. | Description | Date |
|---|---|---|
| | Issue for Construction | 10/11/17 |

Keyplan

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STATE OF TEXAS
DAVID S. HALL
94484
LICENSED PROFESSIONAL ENGINEER
10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

## LEVEL 22 WEST ENLARGED MECHANICAL PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-100-22W |
| Scale | As indicated |

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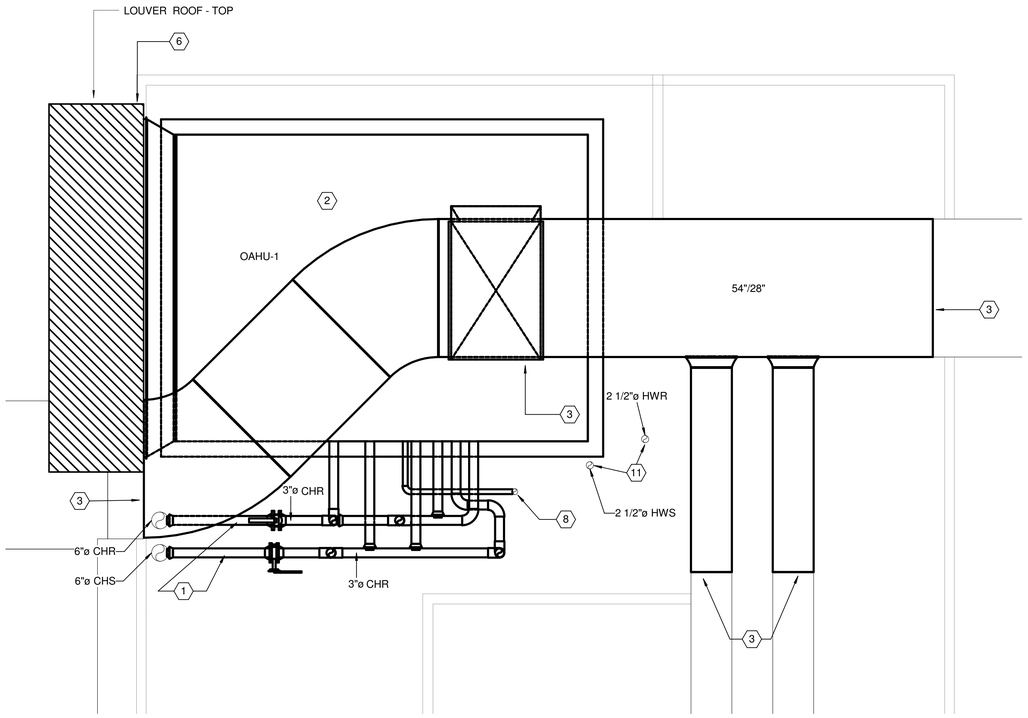



1 PENTHOUSE LEVEL - DEMOLITION - MECHANICAL ROOM

1/2" = 1'-0"

## GENERAL NOTES

A. CONTRACTOR SHALL PROVIDE CLEARANCE IN FRONT AND AT SIDES OF VFD ENCLOSURES AS REQUIRED BY N.E.C. (36 INCHES).

B. PROVIDE TURNING VANES IN ALL RECTANGULAR DUCT ELBOWS.

C. INSULATE EXTERIOR OF ALL SUPPLY AIR DUCTWORK.

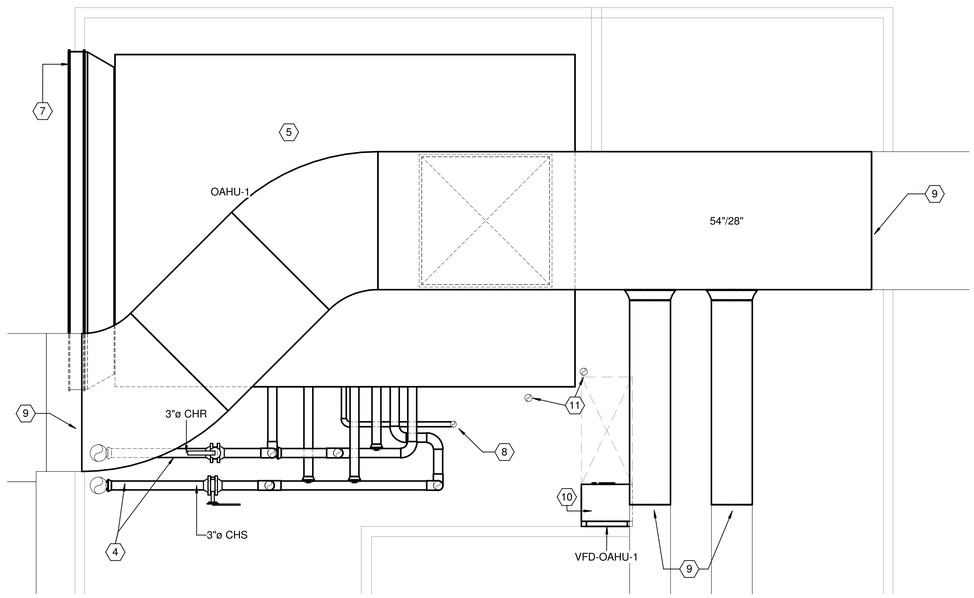
D. PIPING AND DUCTWORK ARE NOT PERMITTED IN ELECTRICAL ROOMS, ELEVATOR MACHINE ROOMS AND COMMUNICATION ROOMS.

E. REFER TO MECHANICAL DETAIL SCHEDULE FOR LOCATION FOR 2-WAY CONTROL VALVE CONNECTION PIPING DETAIL.

## LEGEND

EXISTING TO REMAIN

TO BE DEMOLISHED




2 PENTHOUSE LEVEL - RENOVATION - MECHANICAL ROOM

1/2" = 1'-0"

## LEGEND

CONNECT TO EXISTING

EXISTING

NEW CONSTRUCTION

## KEYED NOTES - M-100-P

1 DEMOLISH EXISTING CHILLED WATER PIPING BACK TO THE LOCATION SHOWN.

2 DEMOLISH EXISTING AIR HANDLING UNIT AND ASSOCIATED CONTROLS AT THE LOCATION SHOWN.

3 DEMOLISH EXISTING DUCTWORK CONNECTED TO EXISTING AIR HANDLING UNIT UP TO THE LOCATION SHOWN.

4 PROVIDE NEW CHILLED WATER PIPING BETWEEN THE RISER ISOLATION VALVES AND THE NEW AIR HANDLING UNIT. REFER TO SPECIFICATION FOR INSULATION REQUIREMENTS.

5 PROVIDE NEW AIR HANDLING UNIT AT THE LOCATION SHOWN AND PROVIDE NEW DUCTWORK AS NECESSARY TO CONNECT TO THE EXISTING DUCTWORK MAINS AT THE MECHANICAL ROOM WALLS AS SHOWN.

6 DEMOLISH EXISTING LOUVER AND ASSOCIATED DUCTWORK AT THE LOCATION SHOWN.

7 PROVIDE NEW LOUVER AND CONNECT TO THE OAHU INLET AT THE LOCATION SHOWN.

8 AHU CONDENSATE DRAIN. PIPING TO BE ROUTED BETWEEN THE UNIT AND THE DRAIN.REFER TO CONDENSATE DRAIN DETAIL FOR ADDITIONAL REQUIREMENTS. REFER TO CONDENSATE DRAIN DETAIL FOR ADDITIONAL REQUIREMENTS.

9 CONNECT TO EXISTING DUCT. FIELD VERIFY DUCT SIZE AND DUCT LOCATION AND TRANSITION AS REQUIRED TO CONNECT TO EXISTING DUCT.

10 PROVIDE NEW VFD AT THE LOCATION SHOWN. REFER TO ELECTRICAL PLANS FOR INFORMATION REGARDING THE ELECTRICAL SCOPE OF WORK.

11 HWS/R EXISTING TO REMAIN.

True NORTH Plan NORTH

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Philo Wilke Partnership

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| | Issue for Construction | 10/11/17 |

Keyplan

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MECHANICAL ENGINEER
10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

PENTHOUSE LEVEL ENLARGED MECHANICAL PLAN

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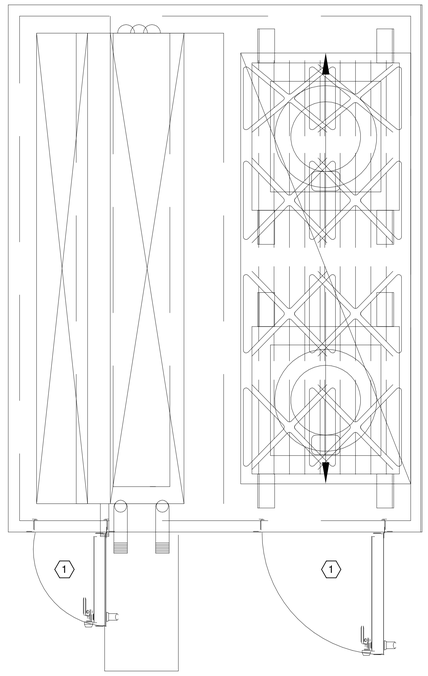
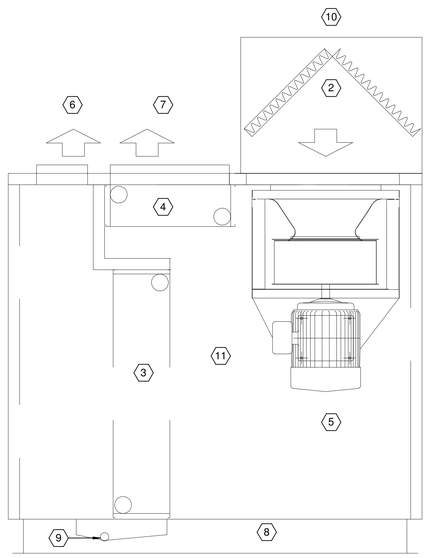



PLAN VIEW




ELEVATION VIEW

1 Double Duct AHU Component Diagram
NO SCALE

## KEYED NOTES - M-501

1. ACCESS DOOR WITH WINDOW. COORDINATE LOCATION WITH MECHANICAL ROOM LAYOUTS.
2. 4" PLEATED MERV-7 FILTER SECTION. PROVIDE INDEPENDENT UNIT MOUNTED FILTER GAUGE.
3. COOLING COIL SECTION.
4. HEATING COIL LOCATED IN HOT DECK DISCHARGE.
5. SUPPLY FAN SECTION. REFER TO AHU SCHEDULE FOR QUANTITY OF FANS. EACH FAN SHALL HAVE VIBRATION ISOLATION SPRINGS.
6. COLD DECK SUPPLY AIR OPENING.
7. HOT DECK SUPPLY AIR OPENING.
8. MINIMUM 6" BASE RAIL. HEIGHT TO BE INCREASE AS REQUIRED TO MEET CONDENSATE DRAIN TRAP REQUIREMENTS.
9. CONDENSATE DRAIN. REFER TO SPECIFICATIONS AND DETAILS FOR REQUIREMENTS. COORDINATE DRAIN LOCATION WITH FLOOR DRAINS.
10. RETURN AIR OPENING.
11. AHU MANUFACTURER TO PROVIDE LIGHT IN THIS SECTION. AHU MANUFACTURER TO FACTORY WIRE LIGHTS TO A UNIT MOUNTED SWITCH OUTSIDE THE UNIT.

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# UCT AHU REPLACEMENT

COMPONENT DIAGRAMS

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-501 |
| Scale | NO SCALE |

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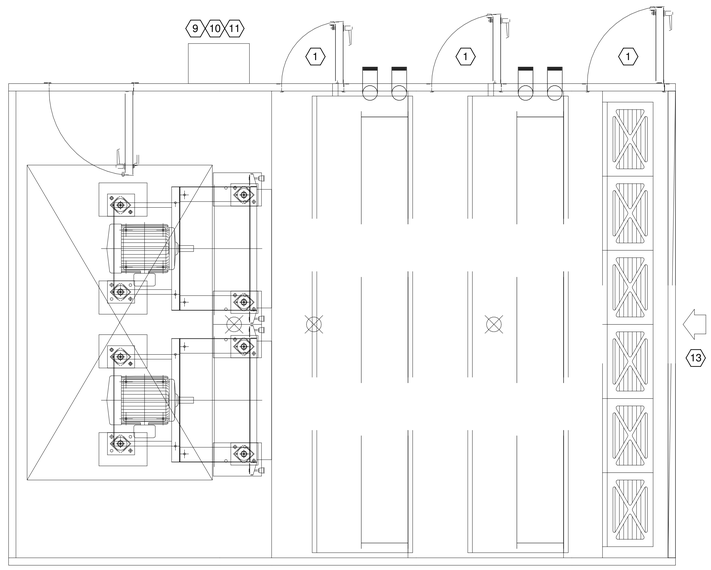
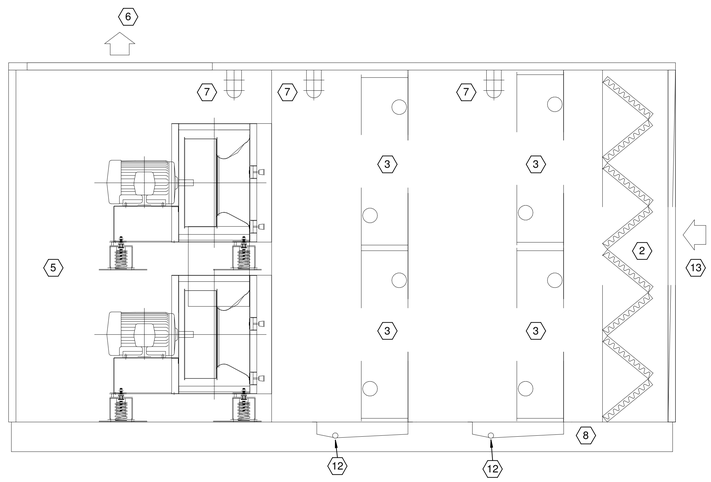



PLAN VIEW




ELEVATION VIEW

## KEYED NOTES - M-502

1 ACCESS DOOR WITH WINDOW. COORDINATE LOCATION WITH MECHANICAL ROOM LAYOUTS.
2 2" MERV-7 PRE-FILTER WITH 12" MERV-14 FILTER. PROVIDE INDEPENDENT UNIT MOUNTED FILTER GAUGES FOR EACH FILTER SECTION.
3 COOLING COIL SECTION.
5 SUPPLY FAN SECTION. REFER TO AHU SCHEDULE FOR QUANTITY OF FANS. EACH FAN SHALL HAVE VIBRATION ISOLATION SPRINGS.
6 SUPPLY AIR OPENING.
7 AHU MANUFACTURER TO PROVIDE LIGHT IN THIS SECTION. AHU MANUFACTURER TO FACTORY WIRE LIGHTS TO A UNIT MOUNTED SWITCH OUTSIDE THE UNIT.
8 MINIMUM 6" BASE RAIL. HEIGHT TO BE INCREASE AS REQUIRED TO MEET CONDENSATE DRAIN TRAP REQUIREMENTS.
9 LIGHT SWITCH ADJACENT TO FAN ACCESS DOOR. LIGHT SWITCH SHALL OPERATE ALL LIGHTS IN THE AHU. AHU MANUFACTURER TO FACTORY WIRE ALL LIGHTS TO SINGLE POINT CONNECTION.
10 FACTORY MOUNTED JUNCTION BOX FOR ELECTRICAL CONNECTION TO AHU. EXACT LOCATION TO BE DETERMINED BY AHU MANUFACTURER.
11 GFCI 120V CONVENIENCE OUTLET TO JUNCTION BOX FOR CONNECTION BY DIVISION 26.
12 CONDENSATE DRAIN. REFER TO SPECIFICATIONS AND DETAILS FOR REQUIREMENTS. COORDINATE DRAIN LOCATION WITH FLOOR DRAINS.
13 OUTSIDE AIR OPENING WITH ISOLATION DAMPER PROVIDED BY AHU MANUFACTURER.

1 Outside Air Handling Unit Component Diagram
NO SCALE

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10-11-2017

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# UCT AHU REPLACEMENT

COMPONENT DIAGRAMS

| | |
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| Drawing No. | M-502 |
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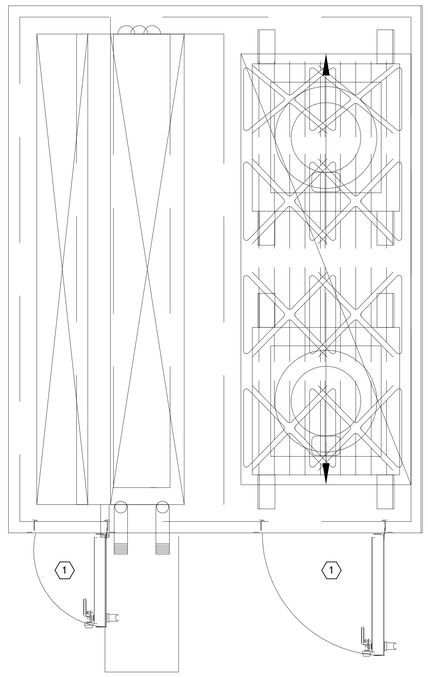


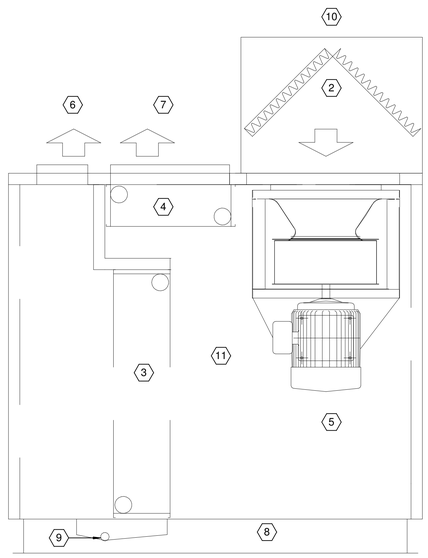

PLAN VIEW

| DUCT SIZE SCHEDULE AHU-M-1 | | |
|---|---|---|
| ZONE | WIDTH | HEIGHT |
| A | 8" | 30" |
| B | 16" | 30" |
| C | 16" | 30" |
| D | 16" | 30" |
| E | 16" | 30" |
| F | 16" | 30" |

| DUCT SIZE SCHEDULE AHU-M-2 | | |
|---|---|---|
| ZONE | WIDTH | HEIGHT |
| A | 8" | 30" |
| B | 8" | 30" |
| C | 24" | 30" |
| D | 16" | 30" |
| E | 8" | 30" |
| F | 8" | 30" |
| G | 8" | 30" |
| H | 8" | 30" |

## KEYED NOTES - M-503

1 ACCESS DOOR WITH WINDOW. COORDINATE LOCATION WITH MECHANICAL ROOM LAYOUTS.
2 4" PLEATED MERV-7 FILTER SECTION. PROVIDE INDEPENDENT UNIT MOUNTED FILTER GAUGE.
3 COOLING COIL SECTION.
4 HEATING COIL LOCATED IN HOT DECK DISCHARGE.
5 SUPPLY FAN SECTION. REFER TO AHU SCHEDULE FOR QUANTITY OF FANS. EACH FAN SHALL HAVE VIBRATION ISOLATION SPRINGS.
6 COLD DECK SUPPLY AIR OPENING.
7 HOT DECK SUPPLY AIR OPENING.
8 MINIMUM 6" BASE RAIL. HEIGHT TO BE INCREASE AS REQUIRED TO MEET CONDENSATE DRAIN TRAP REQUIREMENTS.
9 CONDENSATE DRAIN. REFER TO SPECIFICATIONS AND DETAILS FOR REQUIREMENTS. COORDINATE DRAIN LOCATION WITH FLOOR DRAINS.
10 RETURN AIR OPENING.
11 AHU MANUFACTURER TO PROVIDE LIGHT IN THIS SECTION. AHU MANUFACTURER TO FACTORY WIRE LIGHTS TO A UNIT MOUNTED SWITCH OUTSIDE THE UNIT.




ELEVATION VIEW

| DUCT SIZE SCHEDULE AHU-1-1 | | |
|---|---|---|
| ZONE | WIDTH | HEIGHT |
| A | 20" | 35" |
| B | 8" | 30" |
| C | 8" | 30" |
| D | 13" | 20" |
| E | 8" | 35" |
| F | 16" | 35" |
| G | 16" | 35" |

1 Multi-Zone AHU Component Diagram
NO SCALE

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COMPONENT DIAGRAMS

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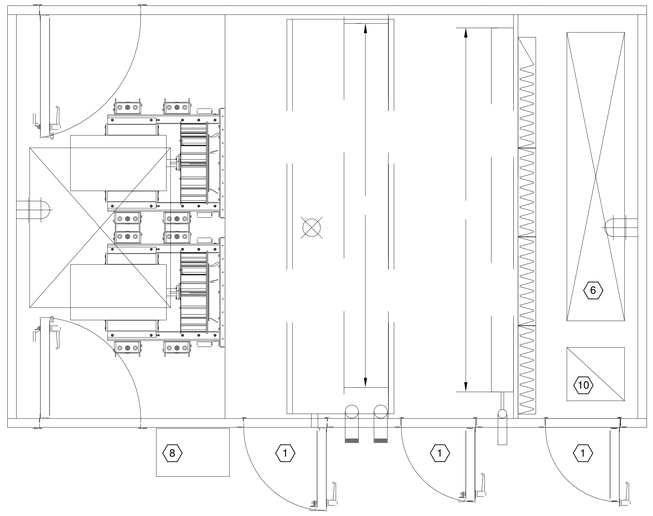
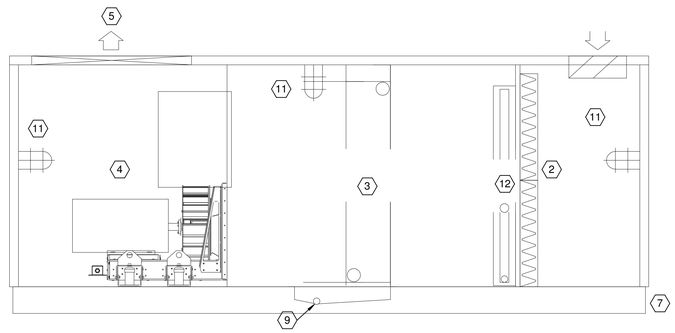



PLAN VIEW




ELEVATION VIEW

1 Single Zone VAV AHU Component Diagram
NO SCALE

## KEYED NOTES - M-504

1. ACCESS DOOR WITH WINDOW. COORDINATE LOCATION WITH MECHANICAL ROOM LAYOUTS.
2. 4" PLEATED MERV-7 FILTER SECTION. PROVIDE INDEPENDENT UNIT MOUNTED FILTER GAUGE.
3. COOLING COIL SECTION. REFER TO SCHEDULE AND SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.
4. SUPPLY FAN SECTION. REFER TO AHU SCHEDULE FOR QUANTITY OF FANS.
5. SUPPLY AIR OPENING.
6. OUTSIDE AIR OPENING.
7. 6" BASE RAIL.
8. FACTORY MOUNTED JUNCTION BOX FOR ELECTRICAL CONNECTION TO AHU. EXACT LOCATION TO BE DETERMINED BY AHU MANUFACTURER.
9. CONDENSATE DRAIN. REFER TO SPECIFICATIONS AND DETAILS FOR REQUIREMENTS. COORDINATE DRAIN LOCATION WITH FLOOR DRAINS.
10. RETURN AIR OPENING.
11. AHU MANUFACTURER TO PROVIDE LIGHT IN THIS SECTION. AHU MANUFACTURER TO FACTORY WIRE LIGHTS TO A UNIT MOUNTED SWITCH OUTSIDE THE UNIT.
12. STEAM HEATING COIL. REFER TO SCHEDULE AND SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.

True NORTH Plan NORTH

1/8" = 1'-0" 0' 8' 16'

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STATE OF TEXAS DAVID S. HALL 104615 LICENSED PROFESSIONAL ENGINEER
10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

COMPONENT DIAGRAMS

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
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| Drawing No. | M-504 |
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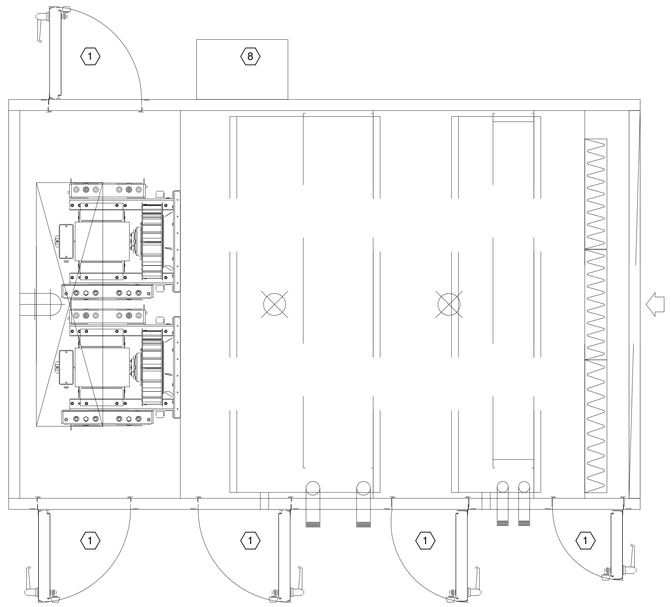
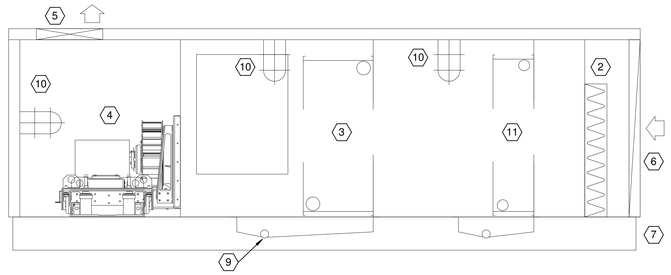



PLAN VIEW




ELEVATION VIEW

## KEYED NOTES - M-505

1 ACCESS DOOR WITH WINDOW. COORDINATE LOCATION WITH MECHANICAL ROOM LAYOUTS.
2 4" PLEATED MERV-7 FILTER SECTION. PROVIDE INDEPENDENT UNIT MOUNTED FILTER GAUGE.
3 COOLING COIL SECTION. REFER TO SCHEDULE AND SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.
4 SUPPLY FAN SECTION. REFER TO AHU SCHEDULE FOR QUANTITY OF FANS.
5 SUPPLY AIR OPENING.
6 OUTSIDE AIR OPENING.
7 6" BASE RAIL.
8 FACTORY MOUNTED JUNCTION BOX FOR ELECTRICAL CONNECTION TO AHU. EXACT LOCATION TO BE DETERMINED BY AHU MANUFACTURER.
9 CONDENSATE DRAIN. REFER TO SPECIFICATIONS AND DETAILS FOR REQUIREMENTS. COORDINATE DRAIN LOCATION WITH FLOOR DRAINS.
10 AHU MANUFACTURER TO PROVIDE LIGHT IN THIS SECTION. AHU MANUFACTURER TO FACTORY WIRE LIGHTS TO A UNIT MOUNTED SWITCH OUTSIDE THE UNIT.
11 HOT WATER HEATING COIL. REFER TO SCHEDULE AND SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.

1 AHU-19-2 Component Diagram
NO SCALE

True NORTH Plan NORTH

1/8" = 1'-0" 0" 8" 16"

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10-11-2017

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# UCT AHU REPLACEMENT

## AHU-19-2 COMPONENT DIAGRAM

| | |
|---|---|
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| Checked By | RGG |
| Drawing No. | M-505 |
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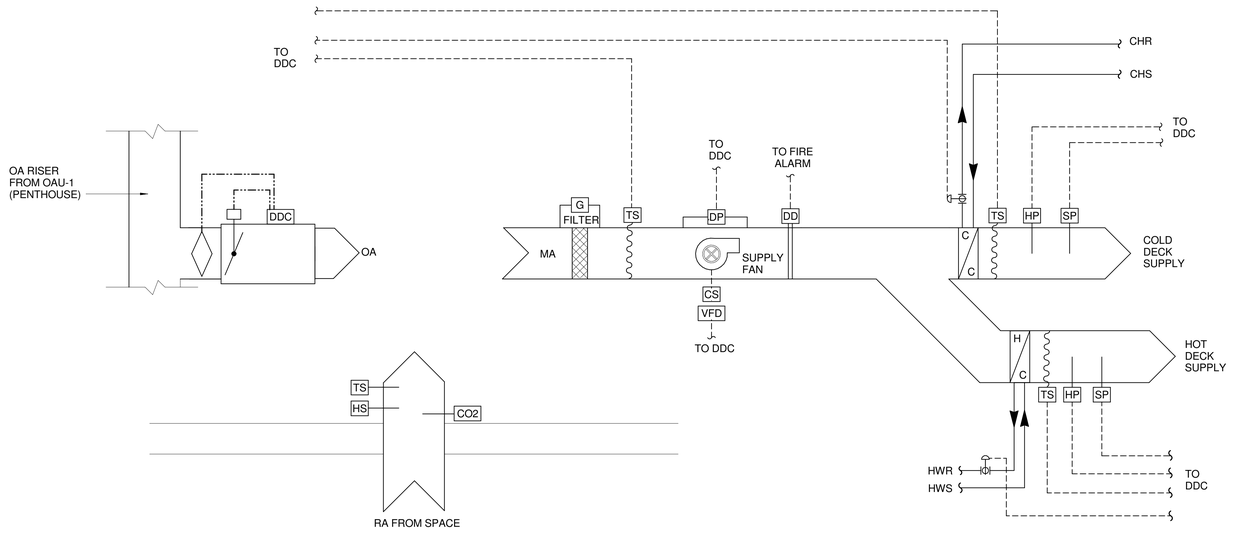


## 1 DUAL - DUCT AHU CONTROL SCHEMATIC
NO SCALE

| DUAL - DUCT AHU | | | | | | | |
|---|---|---|---|---|---|---|---|
| POINT NAME | AI | AO | DI | DO | SP | SENSOR TYPE | COMMENT |
| SUPPLY FAN SS | | | | X | | CONTACT CLOSURE ON VFD | |
| SUPPLY FAN STATUS | | | X | | | PRESSURE SWITCH | |
| SUPPLY FAN SPEED | | X | | | | VFD FREQUENCY | |
| SUPPLY FAN HIGH STATIC | | | X | | | PRESSURE SWITCH | |
| SUPPLY DUCT STATIC PRESSURE | X | | | | | STATIC PRESSURE SENSOR | |
| DUCT SMOKE DETECTOR | | | X | | | CONNECT TO AUXILIARY CONTACT ON DIV 26 FIRE ALARM DEVICE | |
| COOLING COIL DISCHARGE AIR TEMPERATURE | X | | | | | AVERAGING DUCT TEMPERATURE SENSOR | |
| COOLING COIL VALVE | | X | | | | ELECTRIC ACTUATOR | 1 |
| HOT DECK COIL DISCHARGE AIR TEMP | X | | | | | AVERAGING DUCT TEMPERATURE SENSOR | |
| HOT DECK COIL VALVE | | X | | | | ELECTRIC ACTUATOR | 1 |
| CO2 | X | | | | | CO2 SENSOR | |
| OUTSIDE AIR DAMPER | | | | X | | ELECTRIC ACTUATOR - MODULATING | |
| OA AIRFLOW | X | | | | | TERMINAL BOX FLOW CROSS | |
| FILTER GAUGE | X | | | | | DIFFERENTIAL PRESSURE SENSOR | |

NOTES:
1. TO BE CONTROLLED BY OCCUPIED OR UNOCCUPIED SETPOINT. REFER TO SEQUENCE BELOW.

NOTES:

DUAL - DUCT AHU

1. SYSTEM OFF - WHEN THE SYSTEM IS OFF:
   A. THE UNIT OUTSIDE AIR DAMPER SHALL BE CLOSED. THE SUPPLY AIR FAN SHALL BE OFF. THE COOLING AND HEATING COIL VALVES SHALL BE CLOSED.
2. INITIATION OF SYSTEM START-UP - SYSTEM START-UP SHALL BE INITIATED:
   A. BY AN OPERATOR MANUALLY ENTERED COMMAND AT THE OWS, AUTOMATICALLY BY THE SYSTEM BASED ON TIME SCHEDULE OR BY AN AFTER HOURS OCCUPANCY BUTTON LOCATED IN THE SPACE.
3. SYSTEM OPERATION - WHEN SYSTEM START-UP HAS BEEN INITIATED, THE FOLLOWING SEQUENCES SHALL BE IMPLEMENTED:
   A. THE SUPPLY AIR FAN SHALL START AND THE SPEED SHALL BE MODULATED TO MAINTAIN THE DUCT STATIC PRESSURE SETPOINT (ADJUSTABLE, INITIAL SETPOINT TO BE DETERMINED BY TAB).
   B. THE CHILLED WATER CONTROL VALVE SHALL BE MODULATED TO MAINTAIN THE OCCUPIED SUPPLY AIR TEMPERATURE SETPOINT (ADJUSTABLE) OR UNOCCUPIED SUPPLY AIR TEMPERATURE SETPOINT (ADJUSTABLE).
   C. THE HEATING WATER CONTROL VALVE SHALL BE MODULATED TO MAINTAIN THE HOT DECK DISCHARGE AIR TEMPERATURE SETPOINT (ADJUSTABLE) OR UNOCCUPIED SUPPLY AIR TEMPERATURE SETPOINT (ADJUSTABLE).
4. INITIATION OF SYSTEM SHUTDOWN - SYSTEM SHUTDOWN SHALL BE INITIATED:
   A. BY OPERATOR ENTERED MANUAL COMMAND, HIGH STATIC PRESSURE SHUT DOWN, INPUT FROM SMOKE DETECTOR
5. ALARMS - THE SYSTEM SHALL GENERATE AN ALARM:
   A. IF THE DUCT STATIC PRESSURE IS OUTSIDE THE OPERATOR ESTABLISHED LOW AND HIGHT ALARM LIMITS, THE SUPPLY AIR TEMPERATURE IS OUTSIDE THE OPERATOR ESTABLISHED LOW AND HIGHT LIMITS, WHICH SHALL BE SET AT + OR - 4 DEG F. AROUND THE CURRENT SETPOINT. THE SYSTEM IS SHUT DOWN PER ANYTHING OTHER THAN MANUAL OPERATOR COMMAND IN PARAGRAPH 4.
6. FAILURE POSITIONS - WHEN SYSTEM CONTROL OR POWER FAILURE OCCURS:
   A. SUPPLY FAN SHALL REMAIN IN THE LAST COMMANDED STATE. THE COOLING AND HEATING COIL VALVES SHALL REMAIN IN THE LAST COMMANDED POSITION, THE OUTSIDE AIR DAMPER/RETURN AIR SHALL REMAIN IN THE LAST COMMANDED POSITION.
7. DEMAND - CONTROL VENTILATION

**LEGEND**

| SYMBOL | DESCRIPTION | SYMBOL | DESCRIPTION |
|---|---|---|---|
| CO2 | CARBON DIOXIDE SENSOR | HP | HIGH PRESSURE SHUT OFF SWITCH |
| TS | TEMPERATURE SENSOR | ------ | ELECTRICAL SIGNAL |
| N.C. | NORMALLY CLOSED | | DAMPER OR VALVE ACTUATOR |
| N.O. | NORMALLY OPEN | DDC | DISTRIBUTED DIGITAL CONTROL SYSTEM |
| DP | DIFFERENTIAL PRESSURE SENSOR | HWS/HWR | HOT WATER SUPPLY & RETURN |
| SP | SPACE STATIC PRESSURE SENSOR | CHS/CHR | CHILLED WATER SUPPLY & RETURN |
| VFD | VARIABLE FREQUENCY DRIVE | (E)/EXIST. | EXISTING |
| FS | FREEZE STAT | SA | SUPPLY AIR DUCT |
| G | FILTER GAUGE | RA | RETURN AIR DUCT |
| DD | DUCT SMOKE DETECTOR | EA/REA | EXHAUST/RELIEF AIR DUCT |
| AFMS | AIRFLOW MEASURING STATION | FD/FSD | FIRE/FIRE SMOKE DAMPER |
| M | TWO POSITION MOTORIZED DAMPER | OA | OUTSIDE AIR DUCT |
| MVD | MODULATING VOLUME DAMPER | PTOA | PRETREATED OUTSIDE AIR |
| CS | CURRENT SENSOR | MERV-X | ASHRAE 52 FILTER RATING |
| HS | HUMIDITY SENSOR | | |

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Keyplan

Tx. Registration # F-2113
STATE OF TEXAS DAVID S. HALL 97405 LICENSED PROFESSIONAL ENGINEER
10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

CONTROL DIAGRAMS

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-600 |
| Scale | No Scale |

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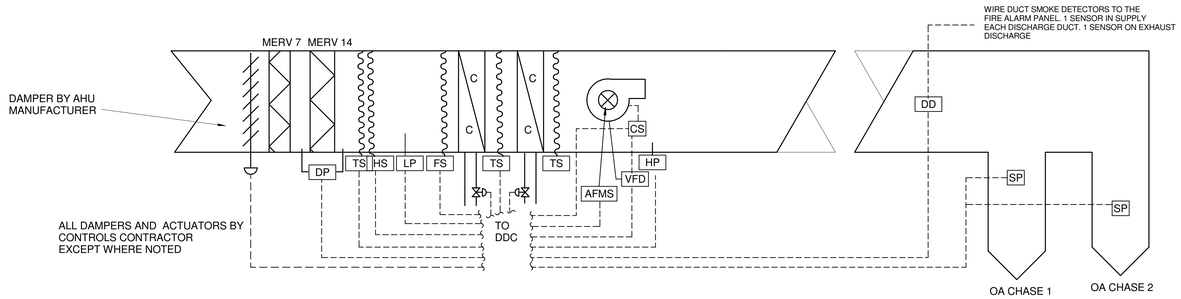


PTOA-1:

| POINT SUMMARY | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OUTPUT | | | | | | | | INPUT | | | | | | | | | | | | I/O | SOFTWARE | | | |
| | DIGITAL | | | ANALOG | | | | | DIGITAL | | | | | | ANALOG | | | | | | | | | | | |
| PTOA-1 | START/STOP | OPEN/CLOSE | ON/OFF | 4-20MA | 0-10 VDC | 1-18 PSI | OTHER | AUX. CONTACT | PRESSURE SWITCH | LOW TEMP SWITCH | END SWITCH | SMOKE DET. AUX. | CUR. MON. RELAY | TEMPERATURE | PRESSURE | FLOW (CFM, GPM) | HUMIDITY | OTHER | CO2 | COMMUNICATIONS LINK | GRAPHIC | OTHER | ALARM | COMMENT |
| (Draw-Thru AHU) | | | | | | | | | | | | | | | | | | | | | X | | | |
| SUPPLY FAN (ON VFD) | X | | | X | | | | | | | | | X | | | | | | | | | | | CURRENT SENSOR AT EACH FAN |
| SUPPLY FAN AIR MONITORING STATION | | | | | | | | | | | | | | | | X | | | | | | | | |
| SUPPLY DUCT STATIC PRESSURE (EACH) | | | | | | | | | | | | | | | X | | | | | | | | | |
| LOW-STATIC PRESSURE SWITCH | | | | | | | | | X | | | | | | | | | | | | | | X | |
| HIGH-STATIC PRESSURE SWITCH | | | | | | | | | X | | | | | | | | | | | | | | X | |
| OUTSIDE AIR DAMPER | | | | X | | | | | | | X | | | | | | | X | | | | | X | |
| HEATING COIL CONTROL VALVE | | | | | X | | | | | | | | | X | | | | | | | | | | |
| COOLING COIL CONTROL VALVE | | | | | X | | | | | | | | | | | | | | | | | | | |
| ENTERING AIR TEMPERATURE | | | | | | | | | | | | | | X | | | | | | | | | | |
| SUPPLY AIR TEMPERATURE | | | | | | | | | | | | | | X | | | | | | | | | | |
| FREEZE STAT | | | | | | | | | | X | | | | | | | | | | | | | | |
| VARIABLE FREQUENCY DRIVE FAILURE (EACH) | | | | | | | | X | | | | | | | | | | | | | | | X | |
| FILTER DIFFERENTIAL PRESSURE | | | | | | | | | X | | | | | | | | | | | | | | | |
| OUTSIDE AIR ENTHALPY | | | | | | | | | | | | | | X | | | X | | | | | | | |
| DISCHARGE AIR TEMPERATURE | | | | | | | | | | | | | | X | | | | | | | | | | |
| HEATING COIL DISCHARGE AIR TEMPERATURE | | | | | | | | | | | | | | X | | | | | | | | | | |

## PTOA-1 CONTROLS AND SEQUENCE OF OPERATION

1 NO SCALE

**SEQUENCE OF OPERATION (PTOA-1)**

GENERAL

1. THIS OUTSIDE AIR PRETREATMENT UNIT PROVIDES OUTSIDE AIR TO BUILDING AIR HANDLING UNITS.

2. THIS AIR HANDLING UNIT SYSTEM SHALL CONSIST OF A SUPPLY FAN WITH VARIABLE FREQUENCY DRIVE, RELIEF AIR FAN WITH VARIABLE FREQUENCY DRIVE, PREHEAT COIL, COOLING COILS, SUPPLY FAN AIRFLOW MEASURING STATION, OUTSIDE AIRFLOW MEASURING STATION, OUTSIDE AIR DAMPERS.

3. THE UNIT SHALL BE STARTED AND STOPPED THROUGH THE BAS. WHEN THE UNIT IS ENERGIZED, THE ELECTRONICALLY ACTUATED OA DAMPER SHALL OPEN, THE SUPPLY AND EXHAUST FANS SHALL BE STARTED UP TO A PRESET LEVEL, AND THE SUPPLY AND EXHAUST DAMPERS SHALL OPEN. THE ELECTRONICALLY ACTUATED CHW AND PREHEAT (PH) VALVES SHALL BE ALLOWED TO MODULATE. WHEN THE UNIT IS STOPPED, FANS SHALL BE SHUT DOWN, AND THE SUPPLY DAMPER, EXHAUST DAMPER, OA DAMPER AND CHW AND PH VALVES SHALL BE CLOSED. THE OA DAMPER SHALL BE INTERLOCKED WITH THE SUPPLY FAN SO THAT THE FAN WILL NOT BE ALLOWED TO OPERATE UNTIL THE DAMPER IS FULLY OPEN.

4. THE AHU DDC PANEL SHALL BE CONNECTED TO GENERATOR STAND BY POWER CONTRACTOR SHALL PROVIDE A UPS AS INDICATED IN SPECIFICATIONS.

FANS

1. SUPPLY DUCT STATIC PRESSURE SENSOR(S) SHALL BE LOCATED AS SHOWN ON THE PLANS. THE DDC SHALL MODULATE THE SUPPLY FAN (THROUGH THE VFD) TO MAINTAIN DUCT STATIC PRESSURE SETPOINT (1" W.C., MINIMUM, ADJUSTABLE).

2. THE SUPPLY SHALL HAVE INTEGRAL AIRFLOW MEASURING STATION TO BE USED FOR MONITORING. DDC SHALL READ FAN'S AIRFLOW AND DISPLAY ON UNIT BAS GRAPHIC. USE FOR INFORMATION ONLY.

3. DDC SHALL RESET SUPPLY AIR STATIC PRESSURE SETPOINT IN SMALL INCREMENTS AT 15 MINUTES INTERVALS. RESET SETPOINT ONE INCREMENT UP OR DOWN TO MAINTAIN ALL AIR INLET DAMPER 90% OR LESS OF FULL OPEN.

CHILLED WATER COILS

1. A DUCT AVERAGING TEMPERATURE SENSORS LOCATED DOWNSTREAM OF THE COOLING COIL SHALL, THROUGH THE DDC, MODULATE THE NORMALLY OPEN CHW VALVE IN SEQUENCE TO MAINTAIN DISCHARGE TEMPERATURE SETPOINT (53°F, ADJUSTABLE). WHEN THE OUTSIDE AIR TEMPERATURE IS AT OR BELOW 50°F, THE CHILLED WATER VALVE SHALL BE COMMANDED CLOSED.

FILTERS

1. FILTER BANK WILL HAVE A DIFFERENTIAL PRESSURE SWITCH TO INDICATE HIGH DIFFERENTIAL PRESSURE ACROSS THE FILTERS (FIELD ADJUSTABLE). THE SWITCH SHALL BE AN ALARM INPUT TO THE DDC SYSTEM.

SAFETIES

1. A HIGH STATIC PRESSURE CUTOUT SWITCH LOCATED AT FAN DISCHARGE SHALL BE HARD - WIRED TO DE-ENERGIZE THE SUPPLY FAN WHENEVER STATIC PRESSURE EXCEEDS 4.5" (ADJUSTABLE) W.C., AND AN ALARM SHALL BE SENT TO THE DDC.

2. A LOW STATIC PRESSURE CUTOUT SWITCH LOCATED WHERE SHOWN ON THE DIAGRAM SHALL BE HARD-WIRED TO DE-ENERGIZE THE SUPPLY FAN WHENEVER STATIC PRESSURE EXCEEDS NEGATIVE 2" (ADJUSTABLE) W.C., AND AN ALARM SHALL BE SENT TO THE DDC.

3. SMOKE DETECTORS LOCATED IN THE FAN DISCHARGE SHALL, THROUGH THE FIRE ALARM SYSTEM, DE-ENERGIZE THE SUPPLY FANS WHENEVER PRODUCTS OF COMBUSTION ARE SENSED. THIS SHALL BE A HARD-WIRED INTERLOCK. SMOKE DETECTORS SHALL PROVIDE STATUS TO THE DDC SYSTEM.

4. UPON SENSING A DROP IN PREHEAT TEMPERATURE TO 35°F (ADJUSTABLE), A MANUAL-RESET LOW TEMPERATURE THERMOSTAT LOCATED ON THE UPSTREAM SIDE OF THE COOLING COIL SHALL, THROUGH HARD-WIRE INTERLOCK, DE-ENERGIZE THE AHU SUPPLY FANS, CLOSE THE OA, SUPPLY AND DAMPERS; OPEN THE CHW AND PH VALVES FULLY, AND SEND AN ALARM TO THE DDC.

5. A SOFTWARE INTERLOCK SHALL BE PROGRAMMED FOR SUPPLY AIR FAN. WHILE IN NORMAL OPERATION, IF THE FANS FAILS AN ALARM SHALL BE SEND THROUGH THE BUILDING AUTOMATION SYSTEM.

6. WHEN ALL SAFETY ALARMS HAVE BEEN CLEARED, THE BAS SHALL ALLOW THE AHU TO RESUME NORMAL OPERATION.

7. EACH FAN SHALL BE EQUIPPED WITH CURRENT SENSORS UPON A DROP OF CURRENT DRAW, AN ALARM SHALL BE BROADCAST THROUGH THE DDC SYSTEM AND POWER FROM THE VFD SHALL BE DE-ENERGIZED.


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# UCT AHU REPLACEMENT

CONTROL DIAGRAMS

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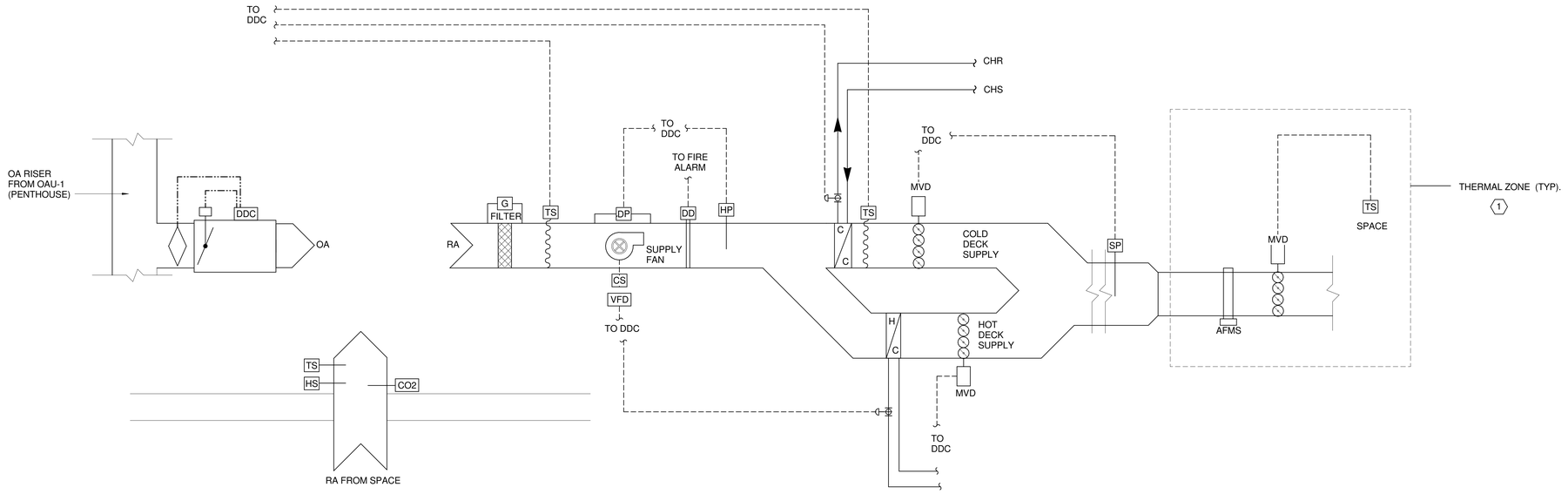


## 1 MULTI-ZONE VAV AHU CONTROL SCHEMATIC

NO SCALE

| MULTI - ZONE AHU | | | | | | | |
|---|---|---|---|---|---|---|---|
| POINT NAME | AI | AO | DI | DO | SP | SENSOR TYPE | COMMENT |
| SUPPLY FAN SS | | | | X | | CONTACT CLOSURE ON VFD | |
| SUPPLY FAN STATUS | | | X | | | PRESSURE SWITCH | |
| SUPPLY FAN SPEED | | X | | | | AFMS | |
| SUPPLY FAN HIGH STATIC | | | X | | | PRESSURE SWITCH | |
| ZONE DUCT STATIC PRESSURE | X | | | | | STATIC PRESSURE SENSOR | EA. |
| DUCT SMOKE DETECTOR | | | X | | | CONNECT TO AUXILIARY CONTACT ON DIV 26 FIRE ALARM DEVICE | |
| COOLING COIL DISCHARGE AIR TEMPERATURE | X | | | | | AVERAGING DUCT TEMPERATURE SENSOR | |
| COOLING COIL VALVE | | X | | | | ELECTRIC ACTUATOR | 1 |
| SUPPLY FAN INLET LOW STATIC | | | X | | | PRESSURE SWITCH | |
| OUTSIDE AIR DAMPER | | | | X | | ELECTRIC ACTUATOR - MODULATING | |
| RETURN AIR CO2 | X | | | | | CO2 SENSOR | |
| FILTER GAUGE DP | X | | | | | DIFFERENTIAL PRESSURE SENSOR | |
| COLD DECK ZONE DAMPER | | | | X | | OPEN/CLOSE, DAMPER ACTUATOR | |
| HOT DECK ZONE DAMPER | | | | X | | OPEN/CLOSE, DAMPER ACTUATOR | |
| ZONE DAMPER | | | | X | | ELECTRIC ACTUATOR | EA. |
| ZONE AIRFLOW MEASURING STATION | | X | | | | ELECTRIC ACTUATOR | EA. |
| HOT DECK COIL DISCHARGE AIR TEMP | X | | | | | AVERAGING DUCT TEMPERATURE SENSOR | |
| HOT DECK COIL VALVE | | X | | | | CELECTRIC ACTUATORT | 1 |
| OA AIRFLOW | X | | | | | EBTRON AIR FLOW MEASURING STATION | |

NOTES:
1. TO BE CONTROLLED BY OCCUPIED OR UNOCCUPIED SETPOINT. REFER TO SEQUENCE BELOW.

SEQUENCE OF OPERATION – MULTI-ZONE AIR HANDLING UNIT

1. SYSTEM OFF – WHEN THE SYSTEM IS OFF:
   A. THE UNIT OUTSIDE AIR DAMPER SHALL BE CLOSED. THE SUPPLY AIR FAN SHALL BE OFF. THE COOLING AND HEATING COIL VALVES SHALL BE CLOSED.
2. INITIATION OF SYSTEM START-UP – SYSTEM START-UP SHALL BE INITIATED:
   A. BY AN OPERATOR MANUALLY ENTERED COMMAND AT THE OWS, OR AUTOMATICALLY BY THE SYSTEM BASED ON TIME SCHEDULE OR BY AN AFTER HOURS OCCUPANCY BUTTON LOCATED IN THE SPACE.
3. SYSTEM OPERATION – WHEN SYSTEM START-UP HAS BEEN INITIATED, THE FOLLOWING SEQUENCES SHALL BE IMPLEMENTED:
   A. THE SUPPLY AIR FAN SHALL START AND THE SPEED SHALL BE MODULATED TO MAINTAIN THE DUCT STATIC PRESSURE SETPOINT (ADJUSTABLE, INITIAL SETPOINT TO BE DETERMINED BY TAB).
   B. THE CHILLED WATER CONTROL VALVE SHALL BE MODULATED TO MAINTAIN THE OCCUPIED SUPPLY AIR TEMPERATURE SETPOINT (ADJUSTABLE) OR UNOCCUPIED SUPPLY AIR TEMPERATURE SETPOINT (ADJUSTABLE).
   C. THE HEATING WATER CONTROL VALVE SHALL BE MODULATED TO MAINTAIN THE HOT DECK DISCHARGE AIR TEMPERATURE SETPOINT (ADJUSTABLE) OR UNOCCUPIED SUPPLY AIR TEMPERATURE SETPOINT (ADJUSTABLE).
4. INITIATION OF SYSTEM SHUTDOWN – SYSTEM SHUT DOWN SHALL BE INITIATED:
   A. BY OPERATOR ENTERED MANUAL COMMAND, HIGH STATIC PRESSURE SHUTDOWN, INPUT FROM SMOKE DETECTOR, OR BY SYSTEM BASED TIME SCHEDULE.
5. ALARMS – THE SYSTEM SHALL GENERATE AN ALARM:
   A. IF THE DUCT STATIC PRESSURE IS OUTSIDE THE OPERATOR ESTABLISHED LOW AND HIGH ALARM LIMITS, THE SUPPLY TEMPERATURE IS OUTSIDE THE OPERATOR ESTABLISHED LOW AND HIGH LIMIT (+ OR - 4 DEG. F THE CURRENT SETPOINT), THE SYSTEM IS SHUTDOWN FOR ANYTHING OTHER THAN THE ITEMS INCLUDED IN PARAGRAPH 4.
6. FAILURE POSITIONS – WHEN SYSTEM CONTROL OR POWER FAILURE OCCURS:
   A. THE SUPPLY FAN SHALL REMAIN IN THE LAST COMMANDED STATE. THE COOLING AND HEATING COIL VALVES SHALL REMAIN IN THE LAST COMMANDED POSITION. THE OUTSIDE AIR DAMPER SHALL REMAIN IN THE LAST COMMANDED POSITION.
7. STATIC PRESSURE SETPOINT RESET:
   A. THE SYSTEM WILL RESET THE DISCHARGE AIR STATIC PRESSURE SETPOINT IN INCREMENT OF 0.1" WC (ADJUSTABLE) EVERY 5 MINUTES (ADJUSTABLE) TO MAINTAIN THE MOST OPEN TERMINAL UNIT AIR DAMPER POSITION AT 90% (ADJUSTABLE) OPEN.
8. ZONE DAMPER CONTROL – THE COLD AND HOT DECK DAMPERS SHALL BE OPERATED AS FOLLOWS:
   A. THE COLD AND HOT DECK DAMPERS SHALL BE OPERATED IN OPPOSITION TO OPEN/CLOSE BASED ON SPACE TEMPERATURE. IF THE ZONE TEMPERATURE SENSOR CALLS FOR COOLING, THE COLD DECK SHALL BE FULLY OPEN AND THE HOT DECK SHALL BE FULLY CLOSED. IF THE ZONE TEMPERATURE SENSOR CALLS FOR HEATING, THE COLD DECK SHALL BE FULLY CLOSED AND THE NEUTRAL DECK SHALL BE FULLY OPEN.
9. ZONE TERMINAL BOX CONTROL – THE ZONE DAMPER SHALL BE CONTROLLED AS FOLLOWS:
   A. THE ZONE DAMPER SHALL BE CONTROLLED BY A TERMINAL EQUIPMENT CONTROLLER (TEC).
   B. THE TEC SHALL MONITOR THE SPACE TEMPERATURE AND MODULATE THE AIRFLOW TO MAINTAIN SPACE TEMPERATURE SETPOINT (ADJUSTABLE).
   C. THE TERMINAL UNIT IS CONTROLLED WITHIN USER DEFINED MAXIMUM AND MINIMUM SUPPLY AIR VOLUME SETTINGS. THE CONTROLLER MONITORS THE ROOM TEMPERATURE SENSOR AND AIR VELOCITY SENSOR AND MODULATES THE SUPPLY AIR DAMPER TO MAINTAIN THE ROOM TEMPERATURE AT SETPOINT.
   D. THE TEC SHALL MONITOR THE INLET AIRFLOW VIA THE AIRFLOW MEASURING STATION AND MODULATE THE DAMPER TO MAINTAIN PRESSURE INDEPENDENT CONTROL AT DESIGN AIR FLOW (ADJUSTABLE).

**LEGEND**

| SYMBOL | DESCRIPTION | SYMBOL | DESCRIPTION |
|---|---|---|---|
| CO2 | CARBON DIOXIDE SENSOR | DPS | DIFFERENTIAL PRESSURE SWITCH |
| TS | TEMPERATURE SENSOR | HP | HIGH PRESSURE SHUT OFF SWITCH |
| N.C. | NORMALLY CLOSED | - - - - - - | ELECTRICAL SIGNAL |
| N.O. | NORMALLY OPEN | | DAMPER OR VALVE ACTUATOR |
| DP | DIFFERENTIAL PRESSURE SENSOR | DDC | DISTRIBUTED DIGITAL CONTROL SYSTEM |
| SP | STATIC PRESSURE SENSOR | HWS/HWR | HOT WATER SUPPLY & RETURN |
| VFD | VARIABLE FREQUENCY DRIVE | CHS/CHR | CHILLED WATER SUPPLY & RETURN |
| FS | FREEZE STAT | (E)/EXIST. | EXISTING |
| G | FILTER GAUGE | SA | SUPPLY AIR DUCT |
| DD | DUCT SMOKE DETECTOR | RA | RETURN AIR DUCT |
| AFMS | AIRFLOW MEASURING STATION | EA/REA | EXHAUST/RELIEF AIR DUCT |
| M | TWO POSITION MOTORIZED DAMPER | FD/FSD | FIRE/FIRE SMOKE DAMPER |
| MVD | MODULATING VOLUME DAMPER | OA | OUTSIDE AIR DUCT |
| CS | CURRENT SENSOR | PTOA | PRETREATED OUTSIDE AIR |
| MERV-X | ASHRAE 52 FILTER RATING | | |
| HS | HUMIDITY SENSOR | | |

**KEYED NOTES - M-602**

1 REFER TO SHEET M-503 FOR NUMBER OF ZONES FOR EACH MZ UNIT, SIZES OF EACH ZONE


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# UCT AHU REPLACEMENT

CONTROL DIAGRAMS

| | |
|---|---|
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| Scale | No Scale |

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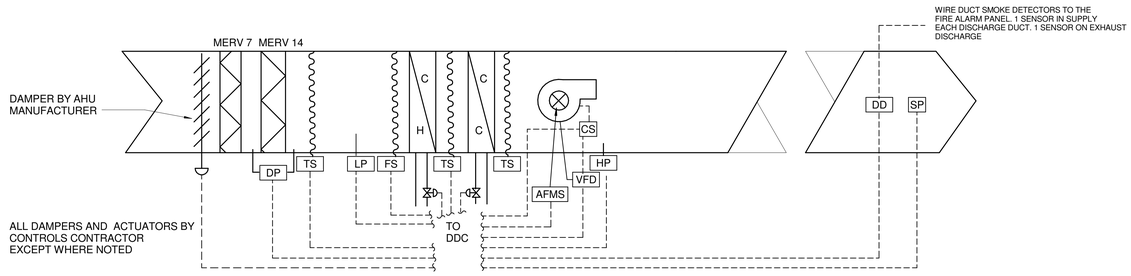


| SINGLE ZONE OUTSIDE AIR HANDLING UNIT | | | | | | | |
|---|---|---|---|---|---|---|---|
| POINT NAME | AI | AO | DI | DO | SP | SENSOR TYPE | COMMENT |
| SUPPLY FAN SS | | | | X | | CONTACT CLOSURE ON VFD | |
| SUPPLY FAN STATUS | | | X | | | PRESSURE SWITCH | |
| SUPPLY FAN SPEED | | X | | | | VFD FREQUENCY | |
| SUPPLY FAN HIGH STATIC | | | X | | | PRESSURE SWITCH | |
| SUPPLY DUCT STATIC PRESSURE | X | | | | | STATIC PRESSURE SENSOR | |
| DUCT SMOKE DETECTOR | | | X | | | CONNECT TO AUXILIARY CONTACT ON DIV 26 FIRE ALARM DEVICE | |
| COOLING COIL DISCHARGE AIR TEMPERATURE | X | | | | | AVERAGING DUCT TEMPERATURE SENSOR | |
| COOLING COIL VALVE | | X | | | | ELECTRIC ACTUATOR | 1 |
| HEATING COIL DISCHARGE AIR TEMP | X | | | | | AVERAGING DUCT TEMPERATURE SENSOR | |
| HEATING COIL VALVE | | X | | | | ELECTRIC ACTUATOR | 1 |
| CO2 | X | | | | | CO2 SENSOR | |
| OUTSIDE AIR DAMPER | | | | X | | ELECTRIC ACTUATOR - MODULATING | |
| OA TEMPERATURE SENSOR | X | | | | | AVERAGING DUCT TEMPERATURE SENSOR | |
| FILTER GAUGE | X | | | | | DIFFERENTIAL PRESSURE SENSOR | |
| FREEZESTAT | X | | | | | LOW TEMPERATURE SWITCH | |

NOTES:
1. TO BE CONTROLLED BY OCCUPIED OR UNOCCUPIED SETPOINT. REFER TO SEQUENCE.

## 1 SINGLE ZONE VAV AHU CONTROLS
NO SCALE

NOTES:

SINGLE ZONE VAV AHU

1. SYSTEM OFF - WHEN THE SYSTEM IS OFF:
   A. THE UNIT OUTSIDE AIR DAMPER SHALL BE CLOSED. THE SUPPLY AIR FAN SHALL BE OFF. THE COOLING AND HEATING COIL VALVES SHALL BE CLOSED.
2. INITIATION OF SYSTEM START-UP - SYSTEM START-UP SHALL BE INITIATED:
   A. BY AN OPERATOR MANUALLY ENTERED COMMAND AT THE OWS, AUTOMATICALLY BY THE SYSTEM BASED ON TIME SCHEDULE OR BY AN AFTER HOURS OCCUPANCY BUTTON LOCATED IN THE SPACE.
3. SYSTEM OPERATION - WHEN SYSTEM START-UP HAS BEEN INITIATED, THE FOLLOWING SEQUENCES SHALL BE IMPLEMENTED:
   A. THE SUPPLY AIR FAN SHALL START AND THE SPEED SHALL BE MODULATED TO MAINTAIN THE DUCT STATIC PRESSURE SETPOINT (ADJUSTABLE, INITIAL SETPOINT TO BE DETERMINED BY TAB).
   B. THE CHILLED WATER CONTROL VALVE SHALL BE MODULATED TO MAINTAIN THE OCCUPIED SUPPLY AIR TEMPERATURE SETPOINT (ADJUSTABLE) OR UNOCCUPIED SUPPLY AIR TEMPERATURE SETPOINT (ADJUSTABLE).
   C. THE HEATING CONTROL VALVE SHALL BE MODULATED TO MAINTAIN A 55 DEG. F. (INITIAL, ADJUSTABLE)
4. INITIATION OF SYSTEM SHUTDOWN – SYSTEM SHUT DOWN SHALL BE INITIATED:
   A. BY OPERATOR ENTERED MANUAL COMMAND, HIGH STATIC PRESSURE SHUTDOWN, INPUT FROM SMOKE DETECTOR, OR BY SYSTEM BASED TIME SCHEDULE.
5. ALARMS – THE SYSTEM SHALL GENERATE AN ALARM:
   A. IF THE DUCT STATIC PRESSURE IS OUTSIDE THE OPERATOR ESTABLISHED LOW AND HIGH ALARM LIMITS, THE SUPPLY TEMPERATURE IS OUTSIDE THE OPERATOR ESTABLISHED LOW AND HIGH LIMIT (+ OR - 4 DEG. F THE CURRENT SETPOINT), THE SYSTEM IS SHUTDOWN FOR ANYTHING OTHER THAN THE ITEMS INCLUDED IN PARAGRAPH 4.
6. FAILURE POSITIONS – WHEN SYSTEM CONTROL OR POWER FAILURE OCCURS:
   A. THE SUPPLY FAN SHALL REMAIN IN THE LAST COMMANDED STATE. THE COOLING AND HEATING COIL VALVES SHALL REMAIN IN THE LAST COMMANDED POSITION, THE OUTSIDE AIR DAMPER SHALL REMAIN IN THE LAST COMMANDED POSITION.

True NORTH Plan NORTH

1/8" = 1'-0" 0' 8" 16'

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STATE OF TEXAS
DAVID S. HALL
90626
LICENSED PROFESSIONAL ENGINEER
10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

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| Scale | NO SCALE |

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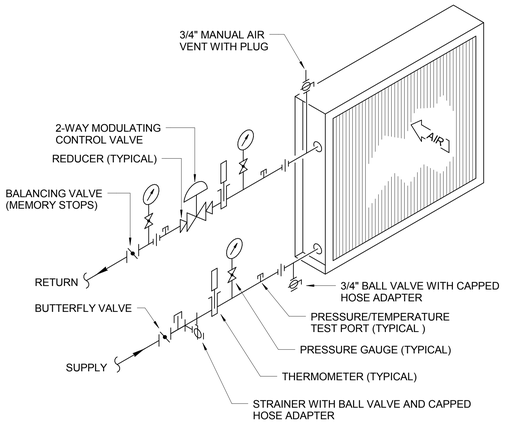
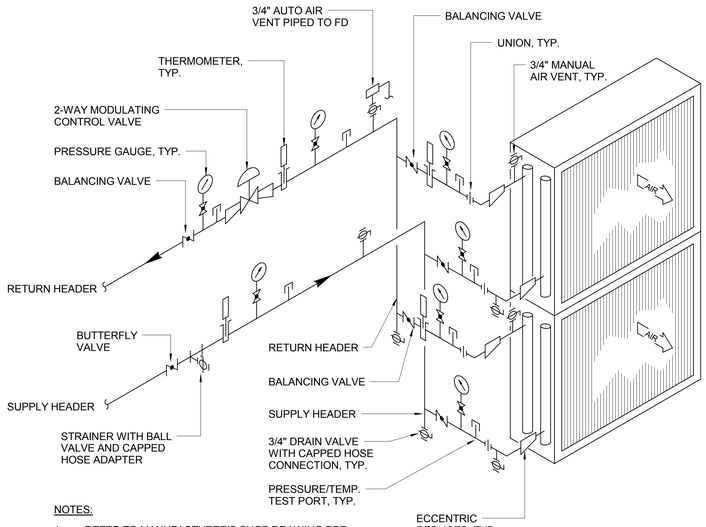



NOTES:

1. WHERE PIPE SIZE IS 2" OR SMALLER, PROVIDE BALL VALVE IN LIEU OF BUTTERFLY ISOLATION VALVE.
2. INSTALL UNIONS OR FLANGES IN PIPE LOCATIONS OUT OF WAY TO PERMIT COIL REMOVAL.
3. FOR TERMINAL AND FAN COIL UNITS PIPING PROVIDE PRESSURE/TEMPERATURE TEST PLUGS ONLY. PRESSURE GAUGES AND THERMOMETERS NOT REQUIRED.
4. PROVIDE MANUAL AIR VENT AT TERMINAL UNITS.
5. PROVIDE REDUCERS AT TERMINAL UNIT COIL CONN. AS REQUIRED.
6. CONNECT COILS IN COUNTER FLOW ARRANGEMENT.
7. PROVIDE UNIONS OR FLANGES IMMEDIATELY UPSTREAM AND DOWNSTREAM OF CONTROL VALVE.
8. 3/4" BALL VALVE WITH CAPPED HOSE ADAPTOR CAN BE OMITTED IF STRAINER IS AT LOW PART OF PIPING.

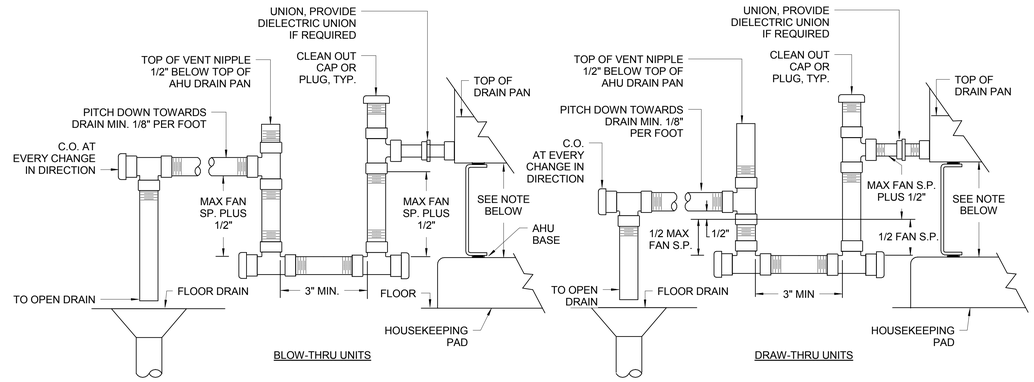
## 1 2-WAY CONTROL VALVE COIL CONNECTION DETAIL
NO SCALE




NOTES:

1. REFER TO MANUFACTURER'S SHOP DRAWING FOR QUANTITY OF STACKED COILS.
2. WHERE PIPE SIZE IS 2" OR SMALLER, PROVIDE BALL VALVE IN LIEU OF BUTTERFLY ISOLATION VALVE.
3. INSTALL UNIONS OR FLANGES IN PIPE LOCATIONS OUT OF WAY TO PERMIT COIL REMOVAL.

## 2 STACKED COIL 2-WAY VALVE PIPING DETAIL
NO SCALE

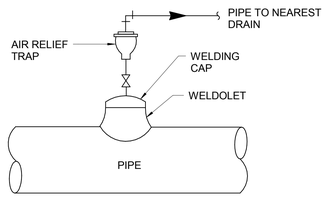



NOTES (APPLIES TO BOTH BLOW-THRU AND DRAW-THRU UNITS):

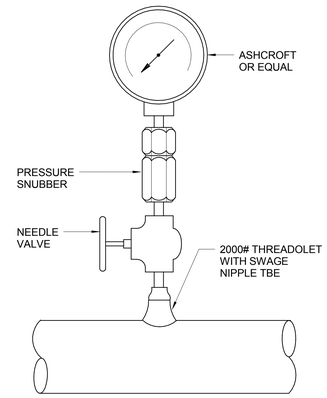
1. MAX S.P. REFERS TO THE MAXIMUM STATIC PRESSURE PRODUCED BY THE FAN AS INDICATED IN AHU SCHEDULE.
2. HEIGHT OF THE AHU BASE TO BE NO LESS THAN THE CALCULATED HEIGHT OF THE P-TRAP PLUS ONE INCH FOR CLEANING, PLUS AN ADDITIONAL 1/8" PER FOOT AS REQUIRED FOR ROUTING THE CONDENSATE TO THE FLOOR DRAIN.
3. INSULATE CONDENSATE PIPING; RE: SPECIFICATIONS.
4. CONDENSATE DRAIN SIZING CHART: PROVIDE DRAIN PIPING AS SHOWN BELOW OR SIZE SAME DRAIN PORT, WHICHEVER IS GREATER.

| TOTAL COOLING COIL BTU | DRAIN SIZE (MIN.) |
|---|---|
| 0-24,000 | 3/4" |
| 24,001-60,000 | 1" |
| 60,001-360,000 | 1-1/4" |
| 360,001-600,000 | 1-1/2" |
| 600,001-2,040,000 | 2" |
| 2,040,001-3,600,000 | 3" |

## 3 CONDENSATE DRAIN DETAIL
NO SCALE




## 6 AIR RELIEF VALVE DETAIL
NO SCALE

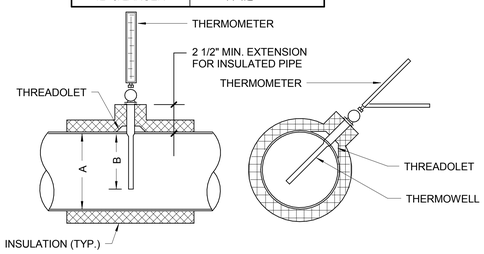



NOTES:

1. GAUGE RANGE TO BE FROM OPSIG TO 125% OF DESIGN OPERATING PRESSURE.

## 4 PRESSURE GAUGE DETAIL
NO SCALE

| INSERTION LENGTH | |
|---|---|
| A | B |
| 3" | 2" |
| 4" | 3" |
| 5" | 4" |
| 6" | 5" |
| 8" AND 10" | 7 1/2" |
| 12" & LARGER | 11 1/2" |




## 5 THERMOMETER WELL LOCATED IN HORIZONTAL PIPE DETAIL
NO SCALE

SHAH SMITH & ASSOCIATES, INC.
2825 Wilcrest, Suite #350 Houston, Texas 77042
Ph. 713.780.7563 Fax.713.780.9209
Texas Registered Engineering Firm F-2113

Philo Wilke Partnership

THE UNIVERSITY of TEXAS HEALTH SCIENCE CENTER AT HOUSTON

| No. | Description | Date |
|---|---|---|
| | Issue for Construction | 10/11/17 |

Keyplan

Tx. Registration # F-2113
STATE OF TEXAS
DAVID S. HALL
90568
ENGINEER
10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

MECHANICAL DETAILS

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-900 |
| Scale | NO SCALE |

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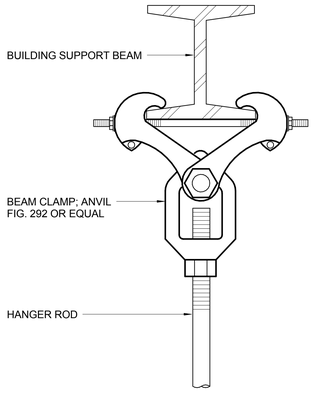
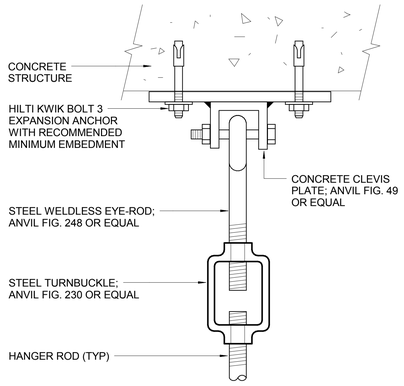
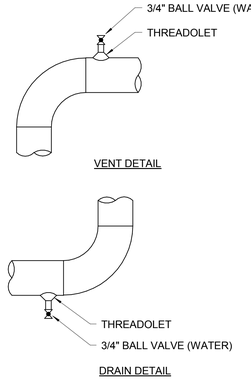



## 1 BEAM CLAMP TYPE SUPPORT DETAIL
NO SCALE

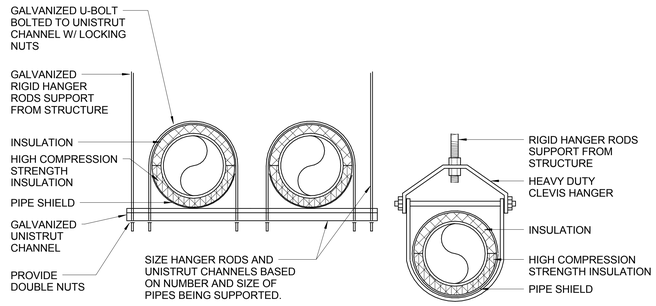



## 2 CONCRETE SUPPORT DETAIL
NO SCALE

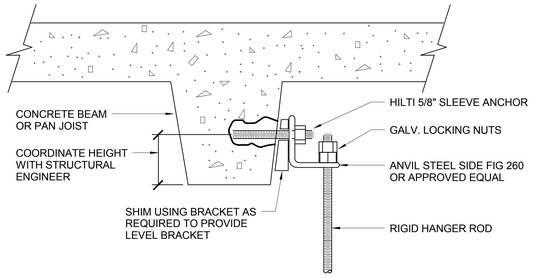



## 3 DRAIN AND VENT DETAIL
NO SCALE

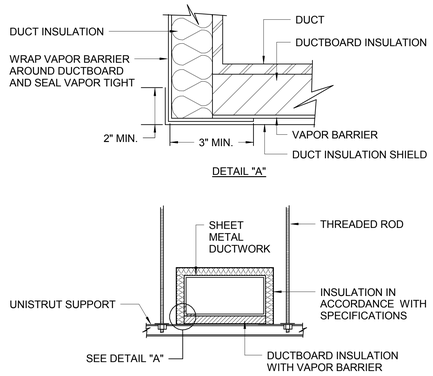
| HANGER ROD SCHEDULE ( CLEVIS ) | | | |
|---|---|---|---|
| PIPE SIZE | ROD SIZE | PIPE SIZE | ROD SIZE |
| UP TO 2" | 3/8" DIA. | 4" thru 5" | 5/8" |
| 2 1/2" thru 3" | 1/2" DIA. | 6" thru 14" | 7/8" |
| | | | |




## 4 TYPICAL PIPE SUPPORT DETAIL
NO SCALE




## 5 HANGER CONNECTION TO STRUCTURE DETAIL
NO SCALE




## 6 RECTANGULAR DUCT SUPPORTED BY UNISTRUT DETAIL
NO SCALE


SHAH SMITH & ASSOCIATES, INC.
2825 Wilcrest, Suite #350 Houston, Texas 77042
Ph. 713.780.7563 Fax.713.780.9209
Texas Registered Engineering Firm F-2113


Philo Wilke Partnership

THE UNIVERSITY of TEXAS HEALTH SCIENCE CENTER AT HOUSTON

| No. | Description | Date |
|---|---|---|
| | Issue for Construction | 10/11/17 |

Keyplan

Tx. Registration # F-2113
STATE OF TEXAS
DAVID S. HALL
96808
MECHANICAL
10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

MECHANICAL DETAILS

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | DL |
| Checked By | RGG |
| Drawing No. | M-901 |
| Scale | NO SCALE |

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## ELECTRICAL ONE-LINE AND CONTROL SYMBOLS

- SURGE SUPRESSOR, METAL OXIDE VARISTOR (MOV) MAXIMUM CONTINUOUS OPERATING VOLTAGE (MCOV) AS NOTED
- POWER TRANSFORMER
- MOLDED OR INSULATED CASE CIRCUIT BREAKER
- CIRCUIT BREAKER WITH SHUNT TRIP COIL (ST)
- DISCONNECT SWITCH, NON-FUSIBLE
- DISCONNECT SWITCH, FUSIBLE
- FUSE
- TRANSFER SWITCH
- CURRENT TRANSFORMER
- CURRENT TRANSFORMER, ZERO SEQUENCE
- VOLTAGE OR POWER TRANSFORMER
- DELTA CONNECTED
- OPEN DELTA CONNECTED
- WYE CONNECTED
- GROUND
- GROUNDED WYE
- PROTECTIVE RELAY FUNCTION, ANSI DESIGNATION AS NOTED
- K — KEY INTERLOCK
- SPD — SURGE PROTECTIVE DEVICE
- SPACE HEATER
- DM — DIGITAL MULTI-METER
- M — METER
- GENERATOR THREE PHASE SIZE AS NOTED
- MOTOR, THREE-PHASE, HP AS NOTED
- TWO SPEED MOTOR - HP AS NOTED
- M 1/4 — MOTOR, SINGLE PHASE, HP AS NOTED
- VFD — VARIABLE FREQUENCY DRIVE
- MAGNETIC MOTOR STARTER
- OVERLOAD
- CONTACTOR COIL
- CONTROL RELAY
- CONTACT, NORMALLY OPEN
- CONTACT, NORMALLY CLOSED
- R — INDICATING LAMP, COLOR AS NOTED, R RED, G GREEN, A AMBER, W WHITE
- SELECTOR SWITCH
- OFF / HAND / AUTO — SELECTOR SWITCH, HAND-OFF-AUTOMATIC
- ON / OFF — SELECTOR SWITCH, ON-OFF
- NORMALLY OPEN PUSHBUTTON, MOMENTARY CONTACT
- NORMALLY CLOSED PUSHBUTTON, MAINTAINED CONTACT
- PUSHBUTTON, MAINTAINED CONTACT
- PANELBOARD
- CP — CONTROL PANEL
- CONNECTION POINT
- EQUIPMENT ENCLOSURE
- VS — VIBRATION SWITCH

## FIRE ALARM SYMBOLS

- MFAP — MAIN FIRE DETECTION & ALARM PANEL
- FAAP — FIRE ALARM ANNUNCIATOR PANEL
- F — MANUAL FIRE ALARM PULL STATION
- FSD — FIRE/SMOKE DAMPER
- FS — FIRE ALARM FLOW SWITCH
- TS — FIRE ALARM TAMPER SWITCH
- S — SMOKE DETECTOR
- H — HEAT DETECTOR
- D — DUCT MOUNTED SMOKE DETECTOR
- RM — FIRE ALARM RELAY MODULE
- F — FIRE ALARM SPEAKER STROBE
- V — FIRE ALARM VISUAL NOTIFICATION DEVICE
- F — FIRE ALARM SPEAKER STROBE - CEILING MOUNTED

## KEYED NOTES SYMBOL (#)

## ELECTRICAL PLAN SYMBOLS

- X — LUMINAIRE
- X — LUMINAIRE
- X — LUMINAIRE - EMERGENCY POWER
- X — LUMINAIRE - WALL WASH
- X — TRACK LIGHTING SYSTEM
- X — 2'X4' LUMINAIRE
- X — 2'X4' LUMINAIRE - EMERGENCY POWER
- X — 1'X4' LUMINAIRE
- X — 1'X4' LUMINAIRE - EMERGENCY POWER
- X — LUMINAIRE WALL MOUNTED
- X — LUMINAIRE WALL MOUNTED - EMERGENCY POWER
- X — STRIP LUMINAIRE
- X — STRIP LUMINAIRE - EMERGENCY POWER
- X — 2'X2' LUMINAIRE
- X — 2'X2' LUMINAIRE - EMERGENCY POWER
- X — TWIN HEAD WALL MOUNTED EMERGENCY LUMINAIRE - BATTERY OPERATED
- X — POLE MOUNTED LUMINAIRE
- X — LUMINAIRE FLUSH MOUNTED
- X — LUMINAIRE FLUSH MOUNTED - EMERGENCY POWER
- X — EXIT SIGN WITH DIRECTIONAL ARROWS AS INDICATED SHADING INDICATES NUMBER OF FACES & CONFIGURATION
- X — EXIT SIGN WALL MOUNTED

SUBSCRIPT DENOTES
X LETTER DENOTES TYPE

- → — DIRECTION ARROW FOR EXIT SIGN
- ↔ — DIRECTION ARROW FOR EXIT SIGN
- S — SINGLE POLE SNAP SWITCH
- $S_3$ — THREE WAY SNAP SWITCH
- $S_4$ — FOUR WAY SNAP SWITCH
- $S_K$ — KEY OPERATED SNAP SWITCH
- $S_D$ — MANUAL DIMMER SWITCH
- $S_M$ — SINGLE POLE HP RATED MOTOR DISCONNECT SWITCH
- $S_{RL}$ — RAISE/LOWER SWITCH
- $S_{LC}$ — LOCAL ROOM CONTROL FOR DIMMING AND/OR LIGHTING CONTROL SYSTEM.
- $S_T$ — MANUAL TIMER SWITCH - 0 - 2 HOUR
- $S_{WP}$ — SINGLE POLE SNAP SWITCH WITH WEATHERPROOF COVER

- $a$ — SINGLE RECEPTACLE, SUBSCRIPT IS DEFINED AS FOLLOWS:
  a = NEMA 6-30R
  b = 480V, 3-PHASE PLUS GND, 50A, HUBBELL #CS8165C, OAS
  c = NEMA 15-30R
- $Y$ — DUPLEX RECEPTACLE
- $Y$ — SWITCHED RECEPTACLE
- $Y$ — QUADRUPLEX RECEPTACLE
- $Y$ — SINGLE RECEPTACLE MOUNTED FLUSH IN FLOOR BOX
- $Y$ — SINGLE RECEPTACLE, SPECIAL PURPOSE MOUNTED FLUSH IN FLOOR BOX
- $Y$ — DUPLEX RECEPTACLE MOUNTED FLUSH IN FLOOR BOX
- $Y$ — QUADRUPLEX RECEPTACLE MOUNTED FLUSH IN FLOOR BOX

Y SUBSCRIPT DENOTES

| | |
|---|---|
| WP | WEATHERPROOF |
| GFCI | GROUND FAULT CIRCUIT INTERRUPTER |
| IG | ISOLATED GROUND |
| E | EMERGENCY |
| CM | MOUNTED FLUSH IN CEILING OR SURFACE OF STRUCTURE ABOVE |

- OS — OCCUPANCY SENSOR WALL MOUNTED - DUAL TECHNOLOGY
- OS — OCCUPANCY SENSOR CEILING MOUNTED -360° COVERAGE - DUAL TECHNOLOGY
- LC — LIGHTING CONTACTOR
- LCP — LIGHTING CONTROL PANEL
- J — JUNCTION OR PULLBOX, WALL MOUNTED
- J — JUNCTION OR PULLBOX, CEILING MOUNTED
- J — JUNCTION OR PULLBOX, FLUSH MOUNTED IN FLOOR OR FLOORBOX AS NOTED ON PLANS
- DISCONNECT SWITCH, NON FUSIBLE, 30A, 3P UON
- DISCONNECT SWITCH, FUSIBLE, 30A, 3P UON
- STARTER, NEMA SIZE '1' UON
- COMBINATION SWITCH STARTER, NEMA SIZE '1' UON
- CB — ENCLOSED CIRCUIT BREAKER TYPE AND SIZE AS NOTED
- R — RELAY
- PUSH BUTTON
- K — KIRK KEY INTERLOCK
- BUZZER
- BELL
- T — TRANSFORMER

- EXISTING PANELBOARD SURFACE MOUNTED
- EXISTING PANELBOARD FLUSH MOUNTED
- LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARD - SURFACE MOUNTED
- LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARD - FLUSH MOUNTED
- POWER/DISTRIBUTION PANELBOARD - SURFACE MOUNTED
- POWER/DISTRIBUTION PANELBOARD - FLUSH MOUNTED
- EMERGENCY PANELBOARD-SURFACE MOUNTED
- EMERGENCY PANELBOARD-FLUSH MOUNTED
- GROUND ROD
- GROUNDING SYSTEM TEST WELL
- LIGHTNING PROTECTION AIR TERMINAL
- DM — DIGITAL MULTI-METER
- CONTINUATION
- CONDUIT EXPOSED
- EMERGENCY PANELBOARD-SURFACE MOUNTED
- CONDUIT CAPPED
- CONDUIT TURNED DOWN
- CONDUIT TURNED UP
- HOMERUN - ONE PHASE - ONE NEUTRAL, ONE GROUNDING CONDUCTOR
- HOMERUN - TWO PHASE, ZERO, ONE OR TWO NEUTRAL AS SCHEDULED BY TICK MARKS, ONE GROUNDING CONDUCTOR
- HOMERUN - THREE PHASE, ZERO, ONE OR THREE NEUTRAL AS SCHEDULED BY TICK MARKS, ONE GROUNDING CONDUCTOR
- M 1/6 — MOTOR SINGLE PHASE - HP AS NOTED
- 20 — MOTOR THREE PHASE - HP AS NOTED
- TWO SPEED MOTOR - HP AS NOTED
- GENERATOR THREE PHASE SIZE AS NOTED
- LP — LIGHTNING PROTECTION CONDUCTOR
- G — GROUNDING CONDUCTOR

## ABBREVIATIONS

| | |
|---|---|
| A,AMP | AMPERES |
| AC | ALTERNATING CURRENT, AIR COMPRESSOR |
| ACC | AIR COOLED CHILLER |
| AD | AIR DRYER |
| AF | AMPERE FRAME |
| AFF | ABOVE FINISHED FLOOR |
| AFG | ABOVE FINISHED GRADE |
| AHU | AIR HANDLING UNIT |
| AIC | AMPERES INTERRUPTING CAPACITY |
| AL | ALUMINUM |
| ARCH | ARCHITECT, ARCHITECTURAL |
| AT | AMPERE TRIP |
| ATS | AUTOMATIC TRANSFER SWITCH |
| AUX | AUXILIARY |
| AV | AUDIO VISUAL |
| AWG | AMERICAN WIRE GAUGE |
| B | BOILER |
| BF | BALLAST FACTOR |
| BAS | BUILDING AUTOMATION SYSTEM |
| BCP | BOILER CONTROL PANEL |
| BFP | BOILER FEEDWATER PUMP |
| BKR | BREAKER |
| BLDG | BUILDING |
| BFDF | BOILER FORCED DRAFT FAN |
| BIDF | BOILER INDUCED DRAFT FAN |
| CL | CENTERLINE |
| C | CONDUIT |
| CAFSS | CLEAN AGENT FIRE SUPPRESSION SYSTEM |
| CAOP | CHILLER AUXILIARY OIL PUMP |
| CATV | CABLE TELEVISION SYSTEM |
| CB | CIRCUIT BREAKER |
| CCP | CHILLER CONTROL PANEL |
| CCTV | CLOSED CIRCUIT TELEVISION SYSTEM |
| CDP | CONDENSATE PUMP |
| CH | CHILLER |
| CHP | CHILLED WATER PUMP |
| CKT | CIRCUIT |
| CLG | CEILING |
| CMH | COMMUNICATIONS MANHOLE |
| COAX | COAXIAL CABLE |
| CONT | CONTINUATION |
| COORD | COORDINATION, COORDINATE |
| CP | CONTROL PANEL |
| CPT | CONTROL POWER TRANSFORMER |
| CSU | COLLEGE STATION UTILITIES |
| CT | CURRENT TRANSFORMER, COOLING TOWER |
| CTF | COOLING TOWER FAN |
| CTR | CONTROLLER, CENTER |
| CU | COPPER, CONDENSING UNIT |
| CV | CONSTANT VOLUME TERMINAL UNIT |
| CWP | CONDENSER WATER PUMP |
| DA | DEAERATOR |
| DATACOM | DATA AND/OR COMMUNICATION |
| DB | DUCT BANK |
| DC | DIRECT CURRENT |
| DCS | DISTRIBUTED CONTROL SYSTEM |
| DDC | DIRECT DIGITAL CONTROL |
| DEMO | DEMOLITION |
| DIP | DEIONIZED WATER PUMP |
| DIV | DIVISION |
| DPDT | DOUBLE POLE, DOUBLE THROW |
| DPST | DOUBLE POLE, SINGLE THROW |
| DWG | DRAWING |
| DWP | DOMESTIC WATER PUMP |
| E, EM | EMERGENCY |
| EA | EACH |
| EC | EMPTY CONDUIT |
| EDF | ELECTRIC DRINKING FOUNTAIN |
| EF | EXHAUST FAN |
| EG | EQUIPMENT GROUND |
| EGP | ELECTRONIC GRADE PANEL |
| ELS | EMERGENCY LIFE SAFETY |
| EMS | ENERGY MANAGEMENT SYSTEM |
| EMT | ELECTRIC METALLIC TUBING |
| EPR | ETHYLENE-PROPYLENE RUBBER |
| EIWH | ELECTRIC INSTANT WATER HEATER |
| EXIST | EXISTING |
| FA | FIRE DETECTION AND ALARM SYSTEM |
| FCU | FAN COIL UNIT |
| FCV | FAN-CONSTANT VOLUME TERMINAL UNIT |
| FLA | FULL LOAD AMPS |
| FO | FIBER OPTIC(S) |
| FP | FIRE PUMP |
| FSD | FIRE SMOKE DAMPER |
| FUT | FUTURE |
| FVNR | FULL VOLTAGE NON-REVERSING |
| FVV | FAN-VARIABLE VOLUME TERMINAL UNIT |
| GAOP | GEAR AUXILIARY OIL PUMP |
| GEN | GENERATOR |
| GFCI | GROUND FAULT CIRCUIT INTERRUPTER |
| GFEP | GROUND FAULT EQUIPMENT PROTECTION |
| G, GND | GROUND |
| GRAP | GENERATOR REMOTE ANNUNCIATOR PANEL |
| GWH | GAS-FIRED WATER HEATER |
| H | HOT |
| HID | HIGH INTENSITY DISCHARGE |
| HMT | HARMONIC MITIGATING TRANSFORMER |
| HOA | HAND OFF AUTOMATIC |
| HP | HORSEPOWER |
| HPS | HIGH PRESSURE SODIUM |
| HRG | HIGH RESISTANCE GROUND |
| HVAC | HEATING, VENTILATING, AND AIR CONDITIONING |
| HWC | HOT WATER CIRCULATING PUMP |
| HWP | HEATING WATER PUMP |
| I/O | INPUT/OUTPUT |
| IG | ISOLATED GROUND |
| IR | INFRARED |
| IRR | IRRIGATION |
| IS | INSTANT START |
| J, JB | JUNCTION BOX |
| JP | JOCKEY PUMP |
| K | KILO, THOUSAND |
| KA | KILOAMPERES |
| KAIC | THOUSAND AMPERES INTERRUPTING CAPACITY |
| KCMIL | THOUSAND CIRCULAR MILS |
| KV | KILOVOLT |
| KVA | KILOVOLT AMPERES |
| KW | KILOWATT |
| KWH | KILOWATT-HOUR |
| LTG | LIGHTING |
| LC | LIGHTING CONTACTOR |
| LCP | LIGHTING CONTROL PANEL |
| LED | LIGHT EMITTING DIODE |
| LP | LIGHTNING PROTECTION |
| LR | LOCAL-REMOTE |
| LRA | LOCKED ROTOR AMPERES |
| LS | LONG TIME, SHORT TIME |
| LSI | LONG TIME, SHORT TIME, INSTANTANEOUS |
| LSG | LONG TIME, SHORT TIME, GROUND |
| LSIG | LONG TIME, SHORT TIME, INSTANTANEOUS, GROUND |
| LI | LONG TIME, INSTANTANEOUS |
| LIG | LONG TIME, INSTANTANEOUS, GROUND |
| mA | MILLIAMPS |
| MAX | MAXIMUM |
| MCB | MAIN CIRCUIT BREAKER |
| MCC | MOTOR CONTROL CENTER |
| MCP | MOTOR CIRCUIT PROTECTOR |
| MECH | MECHANICAL |
| MFAP | MAIN FIRE DETECTION & ALARM PANEL |
| MFR | MANUFACTURER |
| MH | METAL HALIDE |
| MLO | MAIN LUGS ONLY |
| MOV | METAL OXIDE VARISTOR |
| MTD | MOUNTED |
| MV-90, 105 | MEDIUM VOLTAGE CABLE 90C, 105C |
| MVA | MEGA VOLT AMPERES |
| MW | MEGA WATTS |
| N, NEU | NEUTRAL |
| NC | NORMALLY CLOSED |
| NEC | NATIONAL ELECTRICAL CODE |
| NEMA | NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION |
| NIC | NOT IN CONTRACT |
| NO | NORMALLY OPEN |
| # | NUMBER |
| NTS | NOT TO SCALE |
| OAS | OR APPROVED SUBSTITUTION |
| OCPD | OVERCURRENT PROTECTIVE DEVICE |
| OC | ON CENTER |
| OFCI | OWNER FURNISHED, CONTRACTOR INSTALLED |
| OFOI | OWNER FURNISHED, OWNER INSTALLED |
| OH | OVERHEAD |
| OL | OVERLOAD |
| P | POLE |
| PA | PUBLIC ADDRESS |
| PB | PULL BOX |
| PCHP | PRIMARY CHILLED WATER PUMP |
| PDU | POWER DISTRIBUTION UNIT |
| PF | POWER FACTOR |
| PFCC | POWER FACTOR CORRECTION CAPACITOR |
| PH | PHASE |
| PIR | PASSIVE INFRARED |
| PLC | PROGRAMMABLE LOGIC CONTROLLER |
| PMH | POWER MANHOLE |
| PMT | PAD MOUNT |
| PNL | PANELBOARD |
| PS | PROGRAMMED START |
| PVC | POLYVINYL CHLORIDE |
| PVC-RGS | PVC COATED RIGID GALVANIZED STEEL CONDUIT |
| RAC | RIGID ALUMINUM CONDUIT |
| RCPT | RECEPTACLE |
| RE | REFER TO, REGARDING, REFERENCE |
| RFAP | REMOTE FIRE DETECTION & ALARM PANEL |
| RGS | RIGID GALVANIZED STEEL CONDUIT |
| RL | RAISE-LOWER |
| RMS | ROOT MEAN SQUARE |
| ROP | REVERSE OSMOSIS PUMP |
| RS | RAPID START |
| RTD | RESISTANCE TEMPERATURE DETECTOR |
| RVAT | REDUCED-VOLTAGE AUTO TRANSFORMER |
| SCADA | SUPERVISORY CONTROL & DATA ACQUISITION |
| SCH | SCHEDULE |
| SCHP | SECONDARY CHILLED WATER PUMP |
| SEP | SEWAGE EJECTOR PUMP |
| SF | SUPPLY FAN |
| SHLD | SHIELDED |
| SP | SUMP PUMP |
| SPD | SURGE PROTECTION DEVICE |
| SPDT | SINGLE POLE, DOUBLE THROW |
| SPST | SINGLE POLE, SINGLE THROW |
| SPF | STAIRWELL PRESSURIZATION FAN |
| SS | STAINLESS STEEL |
| SSOL | SOLID STATE OVER LOAD |
| STD | STANDARD |
| STP | SHIELDED TWISTED PAIR |
| SW | SWITCH |
| SWBD | SWITCHBOARD |
| SWGR | SWITCHGEAR |
| SYML | SYMMETRICAL |
| SYNCH | SYNCHRONOUS |
| TELECOM | TELECOMMUNICATIONS |
| TOP | TURBINE OIL PUMP |
| TSP | TWISTED SHIELDED PAIR |
| TVSS | TRANSIENT VOLTAGE SURGE SUPPRESSOR |
| TYP | TYPICAL |
| UG | UNDERGROUND |
| UH | UNIT HEATER |
| UL | UNDERWRITER'S LABORATORY |
| UON | UNLESS OTHERWISE NOTED |
| UPS | UNINTERRUPTIBLE POWER SUPPLY |
| UTP | UNSHIELDED TWISTED PAIR |
| V | VOLTS |
| VA | VOLT AMPERES |
| VAC | VOLTS ALTERNATING CURRECT |
| VAR | VOLT AMPERES REACTIVE |
| VDC | VOLTS DIRECT CURRENT |
| VFD | VARIABLE FREQUENCY DRIVE |
| VP | VACUUM PUMP |
| VT | VOLTAGE TRANSFORMER |
| VV | VARIABLE VOLUME TERMINAL UNIT |
| W | WIRE |
| W/ | WITH |
| WG | WIRE GUARD |
| WH | WATER HEATER |
| WP | WEATHERPROOF |
| XFMR | TRANSFORMER |
| Y | WYE |
| Z | IMPEDANCE |

## DRAWING LIST - ELECTRICAL



| | |
|---|---|
| E-001 | ELECTRICAL LEGEND SYMBOLS AND ABBREVIATIONS |
| E-100-1E | LEVEL 1 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-1ME | LEVEL M EAST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-1MW | LEVEL M WEST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-6E | LEVEL 6 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-6W | LEVEL 6 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-7E | LEVEL 7 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-7W | LEVEL 7 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-8E | LEVEL 8 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-8W | LEVEL 8 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-9E | LEVEL 9 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-9W | LEVEL 9 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-11E | LEVEL 11 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-11W | LEVEL 11 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-12E | LEVEL 12 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-12W | LEVEL 12 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-15E | LEVEL 15 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-15W | LEVEL 15 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-16E | LEVEL 16 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-16W | LEVEL 16 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-17E | LEVEL 17 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-17W | LEVEL 17 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-18E | LEVEL 18 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-18W | LEVEL 18 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-19E | LEVEL 19 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-19W | LEVEL 19 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-20E | LEVEL 20 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-20W | LEVEL 20 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-21E | LEVEL 21 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-21W | LEVEL 21 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-22E | LEVEL 22 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-22W | LEVEL 22 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL |
| E-100-P | PENTHOUSE ENLARGED MECHANICAL PLAN - ELECTRICAL |




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THE UNIVERSITY of TEXAS HEALTH SCIENCE CENTER AT HOUSTON

| No. | Description | Date |
|---|---|---|
| | Issue for Construction | 10/11/17 |

Keyplan

Tx. Registration # F-2113
STATE OF TEXAS — DOUGLAS B. BELISLE — 80083 — LICENSED PROFESSIONAL ENGINEER — 10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

ELECTRICAL LEGEND SYMBOLS AND ABBREVIATIONS

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-001 |
| Scale | NO SCALE |

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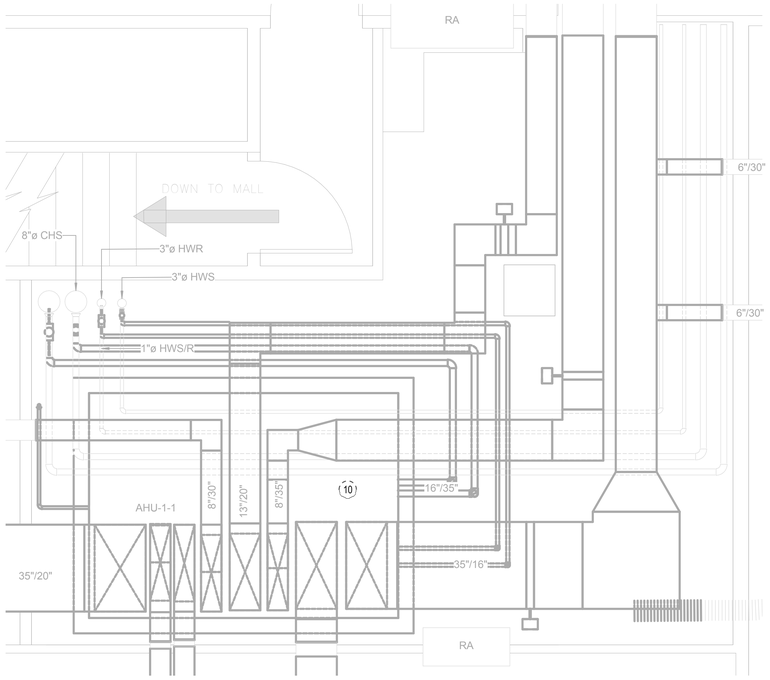
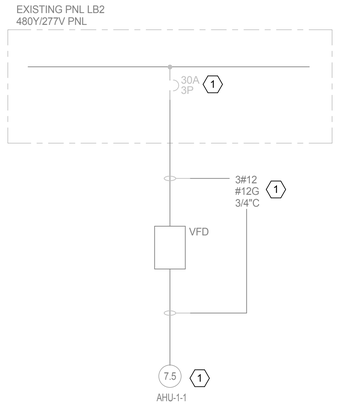
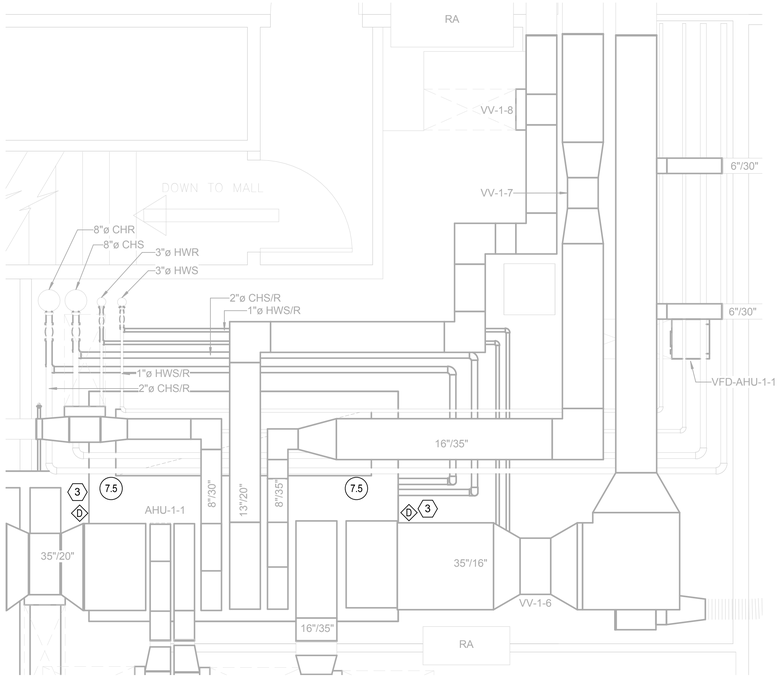


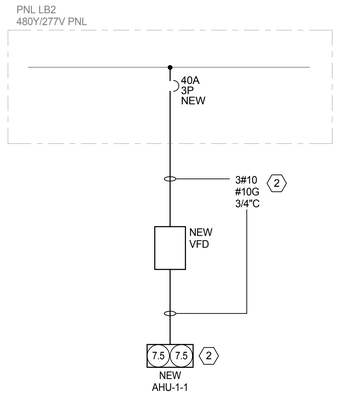

## 1 LEVEL 1 - DEMOLITION - MECHANICAL ROOM EAST
1/2" = 1'-0"




## 1A ONE LINE DIAGRAM DEMO - AHU-1-1
NO SCALE




## 2 LEVEL 1 - RENOVATION - MECHANICAL ROOM EAST
1/2" = 1'-0"




## 2A ONE LINE DIAGRAM RENO - AHU-1-1
NO SCALE

### GENERAL NOTES - GE-100

A NEW WORK SHOWN BOLD.

### KEYED NOTES - E-100-1E

1 REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.
2 NEW CONDUCTORS AND CONDUIT.
3 EXISTING DUCT DETECTORS TO BE REMOVED AND REPLACED WITH NEW DUCT DETECTORS. COORDINATE EXACT LOCATION WITH MECHANICAL EQUIPMENT INSTALLER.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|---|---|---|
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PROFESSIONAL ENGINEER
10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 1 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-1E |
| Scale | As indicated |

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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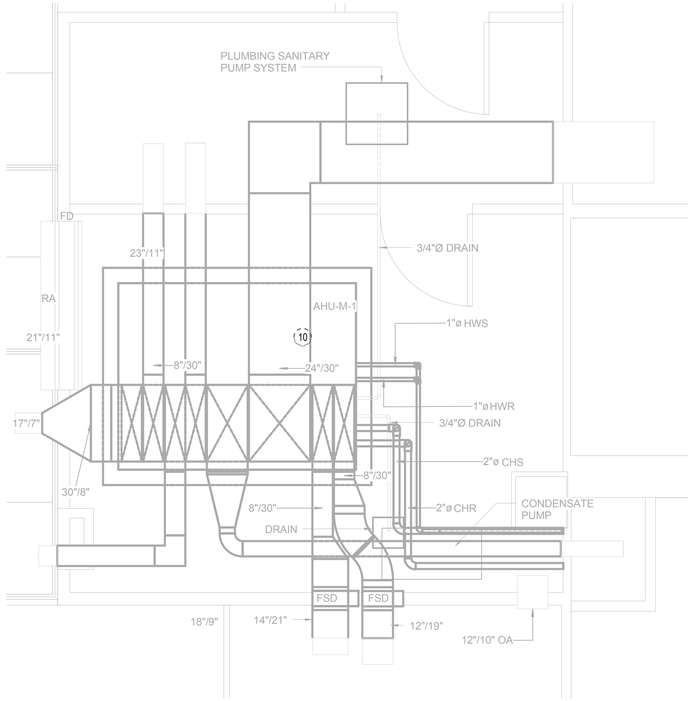


## 1 LEVEL M - DEMOLITION - MECHANICAL ROOM EAST
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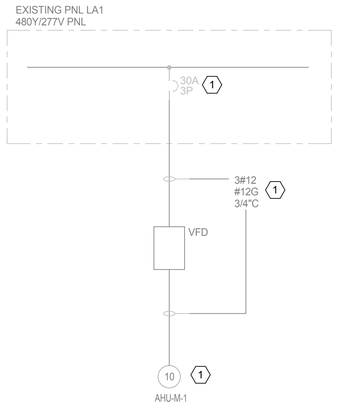
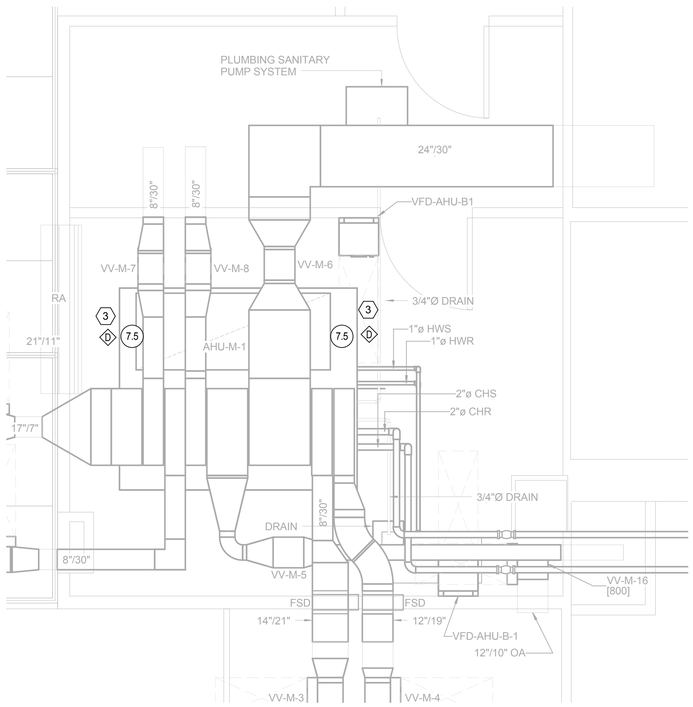
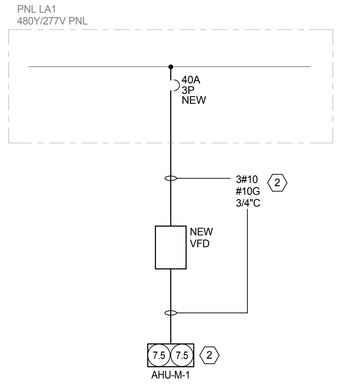



## 1A ONE LINE DIAGRAM DEMO - AHU-M-1
NO SCALE




## 2 LEVEL M - RENOVATION - MECHANICAL ROOM EAST
1/2" = 1'-0"




## 2A ONE LINE DIAGRAM RENO - AHU-M-1
NO SCALE

### GENERAL NOTES - GE-100

**A NEW WORK SHOWN BOLD.**

### KEYED NOTES - E-100-ME

**1 REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.**

**2 NEW CONDUCTORS AND CONDUIT.**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# UCT AHU REPLACEMENT

LEVEL M EAST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-1ME |
| Scale | As indicated |

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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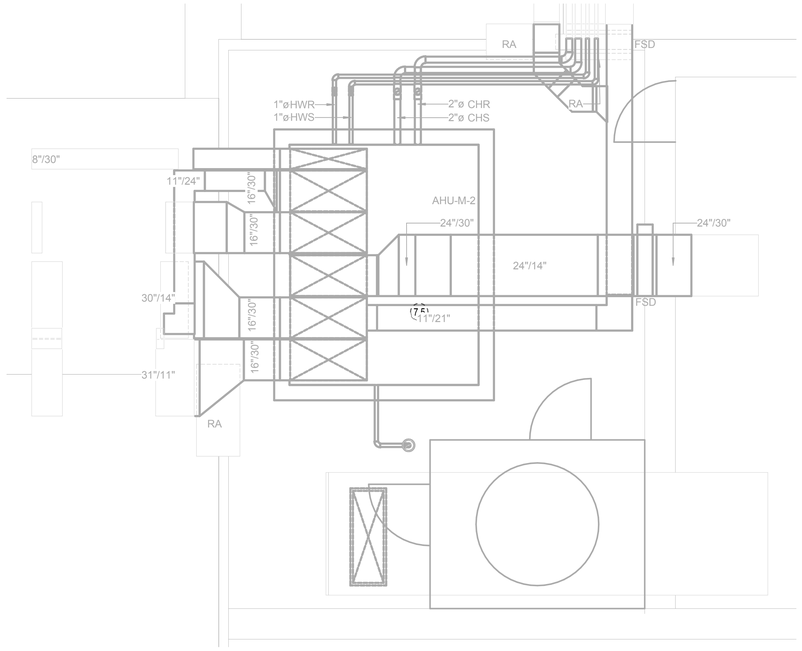
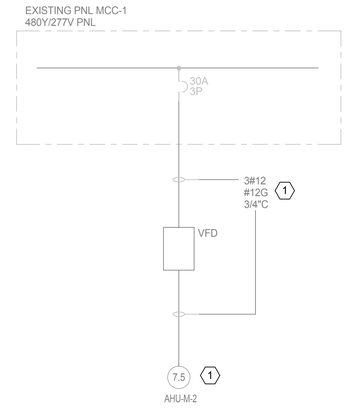
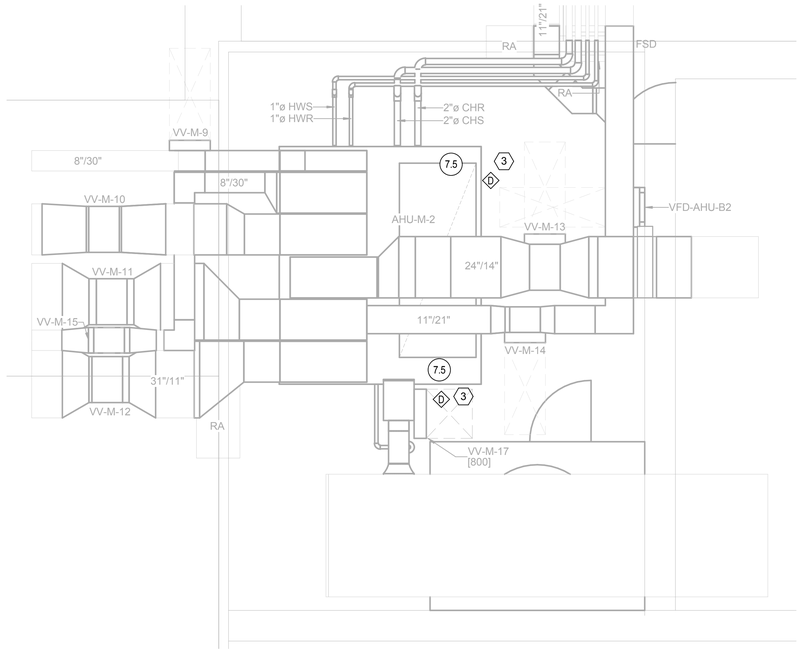


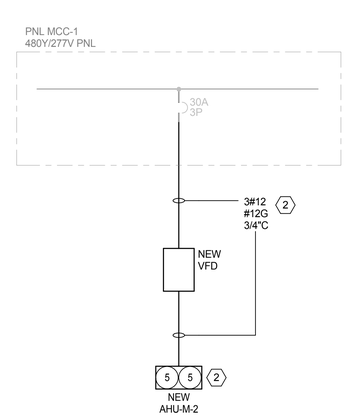

1 LEVEL M - DEMOLITION - MECHANICAL ROOM WEST
1/2" = 1'-0"




3 ONE LINE DIAGRAM DEMO - AHU-M-2
NO SCALE




2 LEVEL M - RENOVATION - MECHANICAL ROOM WEST
1/2" = 1'-0"




4 ONE LINE DIAGRAM RENO - AHU-M-2
NO SCALE

## GENERAL NOTES - GE-100

**A** NEW WORK SHOWN BOLD.

## KEYED NOTES - E-100-MW

**1** REMOVE CONDUCTORS AND CONDUIT.
**2** NEW CONDUCTORS AND CONDUIT.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# UCT AHU REPLACEMENT

LEVEL M WEST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-1MW |
| Scale | As indicated |

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'


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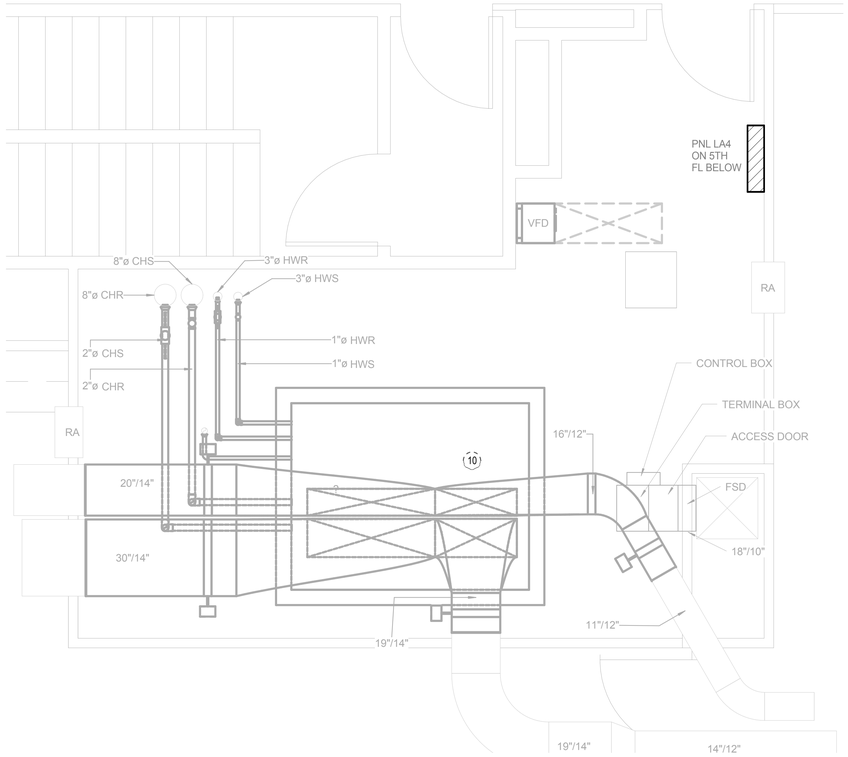
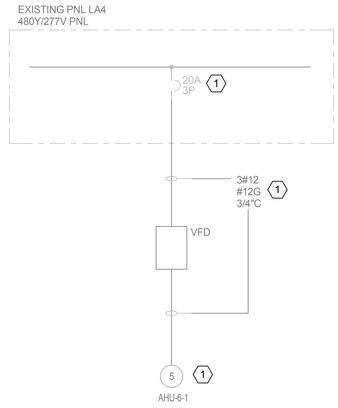



## LEVEL 6 - DEMOLITION - MECHANICAL ROOM EAST

1 1/2" = 1'-0"




## 1A ONE LINE DIAGRAM DEMO - AHU-6-1

NO SCALE

### GENERAL NOTES - GE-100

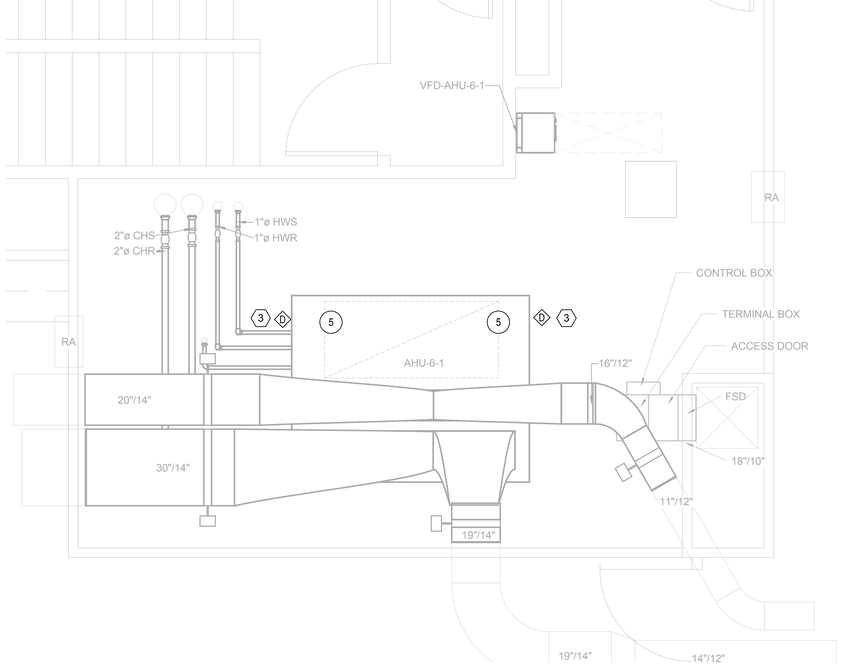
A NEW WORK SHOWN BOLD.

### KEYED NOTES - E-100-6E

1 REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.

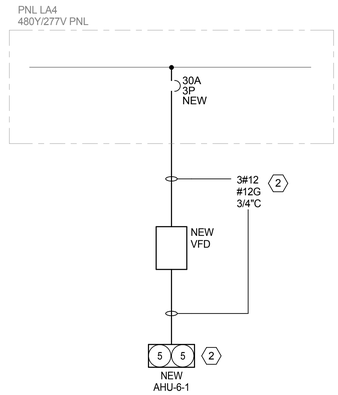
2 NEW CONDUCTORS AND CONDUIT.

3 EXISTING DUCT DETECTORS TO BE REMOVED AND REPLACED WITH NEW DUCT DETECTORS. COORDINATE EXACT LOCATION WITH MECHANICAL EQUIPMENT INSTALLER.




## LEVEL 6 - RENOVATION - MECHANICAL ROOM EAST

2 1/2" = 1'-0"




## 2A ONE LINE DIAGRAM RENO - AHU-6-1

NO SCALE

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'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Keyplan

Tx. Registration # F-2113

STATE OF TEXAS DOUGLAS B. BELISLE 80083 LICENSED PROFESSIONAL ENGINEER 10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 6 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-6E |
| Scale | As indicated |


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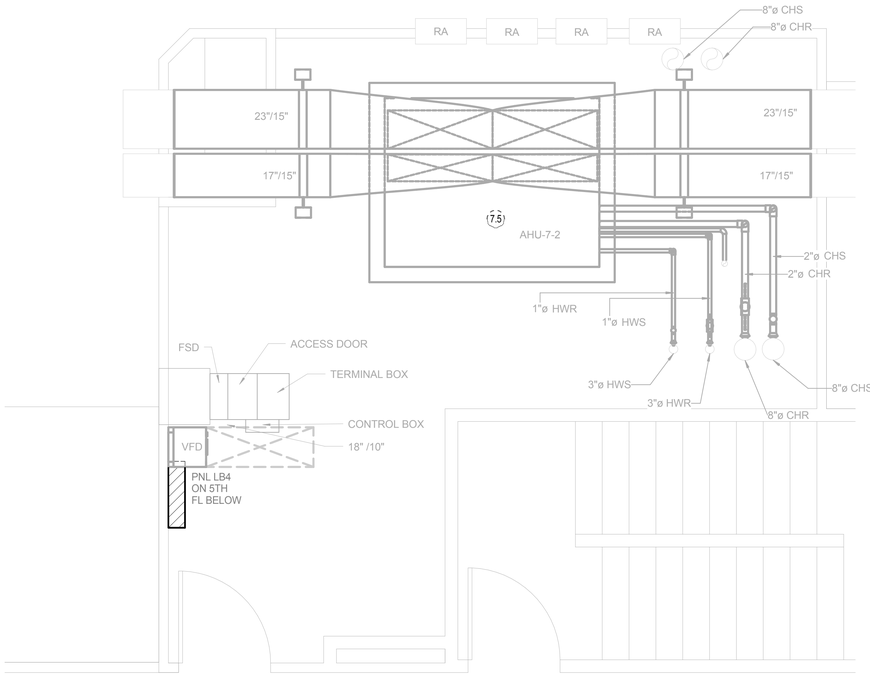
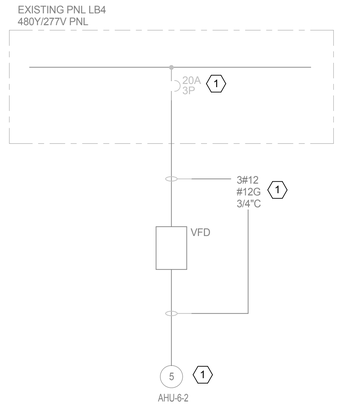


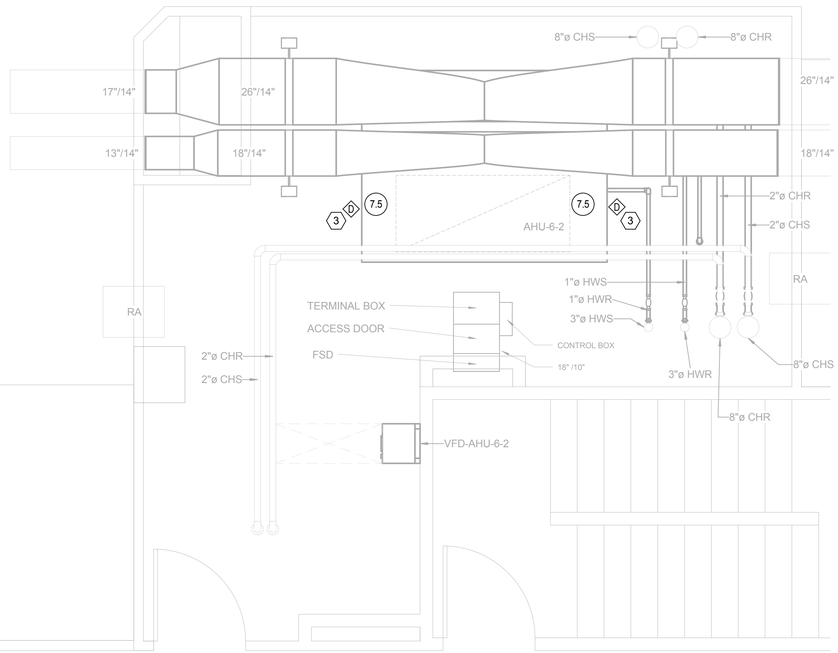

## 1 LEVEL 6 - DEMOLITION - MECHANICAL ROOM WEST

1/2" = 1'-0"



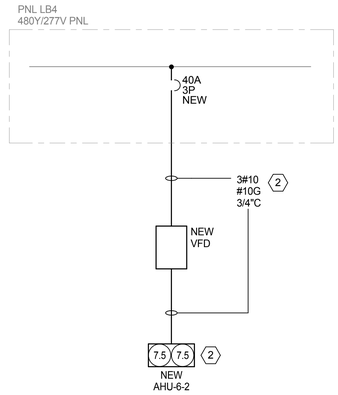

## 1A ONE LINE DIAGRAM DEMO - AHU-6-2

NO SCALE




## 2 LEVEL 6 - RENOVATION - MECHANICAL ROOM WEST

1/2" = 1'-0"




## 2A ONE LINE DIAGRAM RENO - AHU-6-2

NO SCALE

### GENERAL NOTES - GE-100

**A** NEW WORK SHOWN BOLD.

### KEYED NOTES - E-100-6W

**1** REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.

**2** NEW CONDUCTORS AND CONDUIT.

**3** EXISTING DUCT DETECTORS TO BE REMOVED AND REPLACED WITH NEW DUCT DETECTORS. COORDINATE EXACT LOCATION WITH MECHANICAL EQUIPMENT INSTALLER.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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Keyplan

Tx. Registration # F-2113

STATE OF TEXAS · DOUGLAS B. BELISLE · 80083 · LICENSED PROFESSIONAL ENGINEER · 10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 6 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-6W |
| Scale | As indicated |

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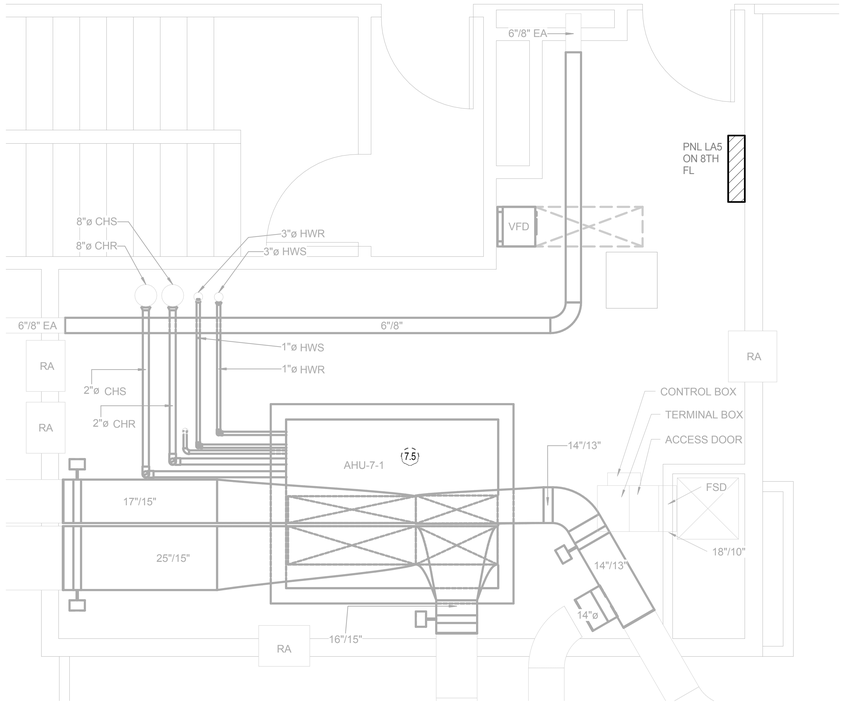
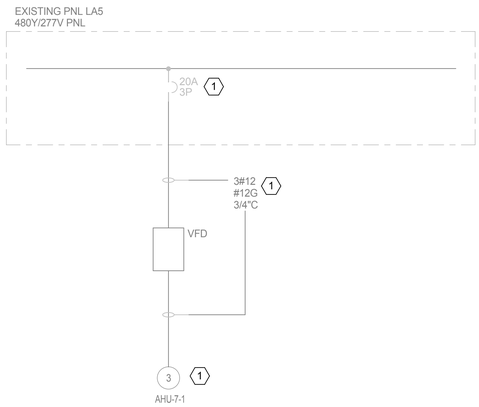
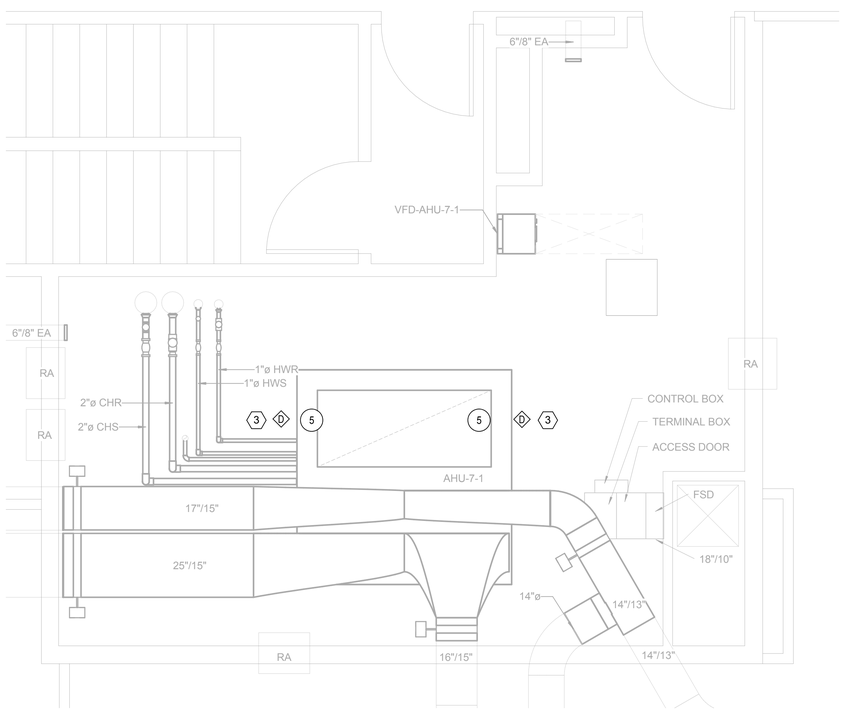


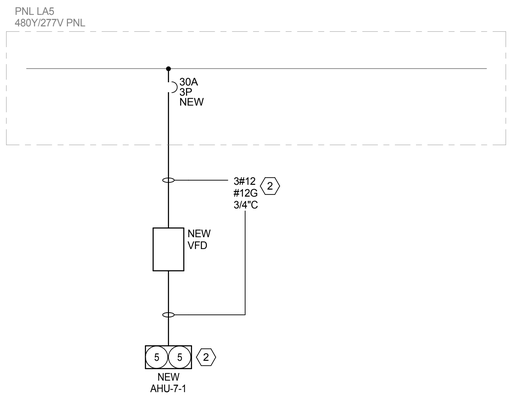

1 LEVEL 7 - DEMOLITION - MECHANICAL ROOM EAST
1/2" = 1'-0"




1A ONE LINE DIAGRAM DEMO - AHU-7-1
NO SCALE




2 LEVEL 7 - RENOVATION - MECHANICAL ROOM EAST
1/2" = 1'-0"




2A ONE LINE DIAGRAM RENO - AHU-7-1
NO SCALE

## GENERAL NOTES - GE-100

A NEW WORK SHOWN BOLD.

## KEYED NOTES - E-100-7E

1 REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.
2 NEW CONDUCTORS AND CONDUIT.
3 EXISTING DUCT DETECTORS TO BE REMOVED AND REPLACED WITH NEW DUCT DETECTORS. COORDINATE EXACT LOCATION WITH MECHANICAL EQUIPMENT INSTALLER.

SHAH SMITH & ASSOCIATES, INC.
2825 Wilcrest, Suite #350 Houston, Texas 77042
Ph. 713.780.7563 Fax.713.780.9209
Texas Registered Engineering Firm F-2113

Philo Wilke Partnership

THE UNIVERSITY of TEXAS HEALTH SCIENCE CENTER AT HOUSTON

| No. | Description | Date |
|---|---|---|
| | Issue for Construction | 10/11/17 |

Keyplan

Tx. Registration # F-2113
STATE OF TEXAS
DOUGLAS B. BELISLE
80083
LICENSED PROFESSIONAL ENGINEER
10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 7 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-7E |
| Scale | As indicated |

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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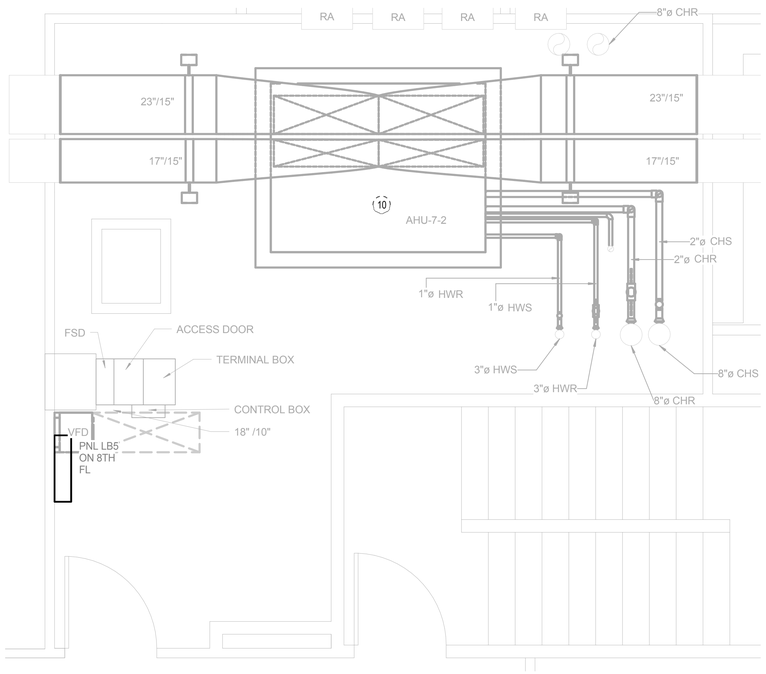
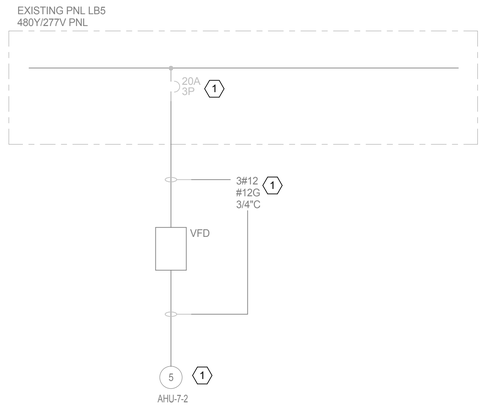
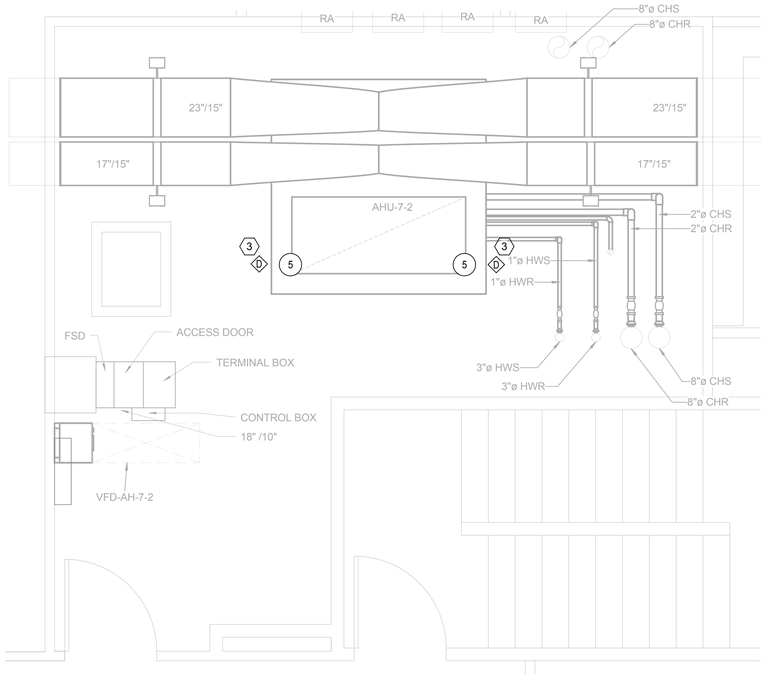


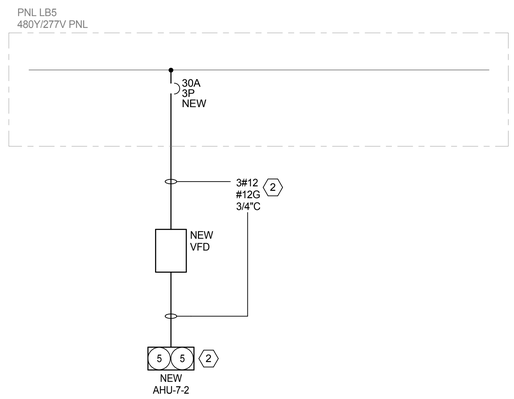

## 1 LEVEL 7 - DEMOLITION - MECHANICAL ROOM WEST
1/2" = 1'-0"




## 1A ONE LINE DIAGRAM DEMO - AHU-7-2
NO SCALE




## 2 LEVEL 7 - RENOVATION - MECHANICAL ROOM WEST
1/2" = 1'-0"




## 2A ONE LINE DIAGRAM RENO - AHU-7-2
NO SCALE

### GENERAL NOTES - GE-100

A NEW WORK SHOWN BOLD.

### KEYED NOTES - E-100-7W

1 REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.
2 NEW CONDUCTORS AND CONDUIT.
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10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 7 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-7W |
| Scale | As indicated |

True NORTH Plan NORTH

0' 2' 4'
1/2" = 1'-0"

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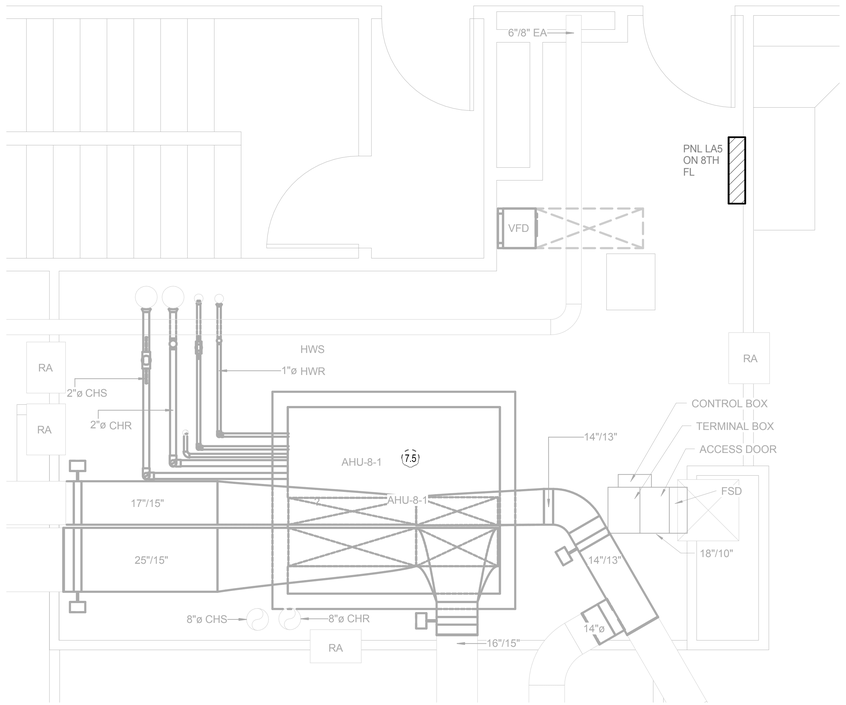
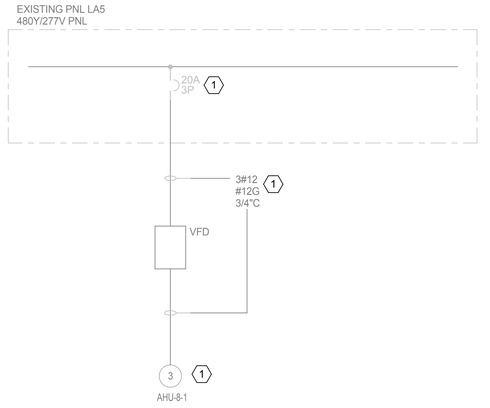
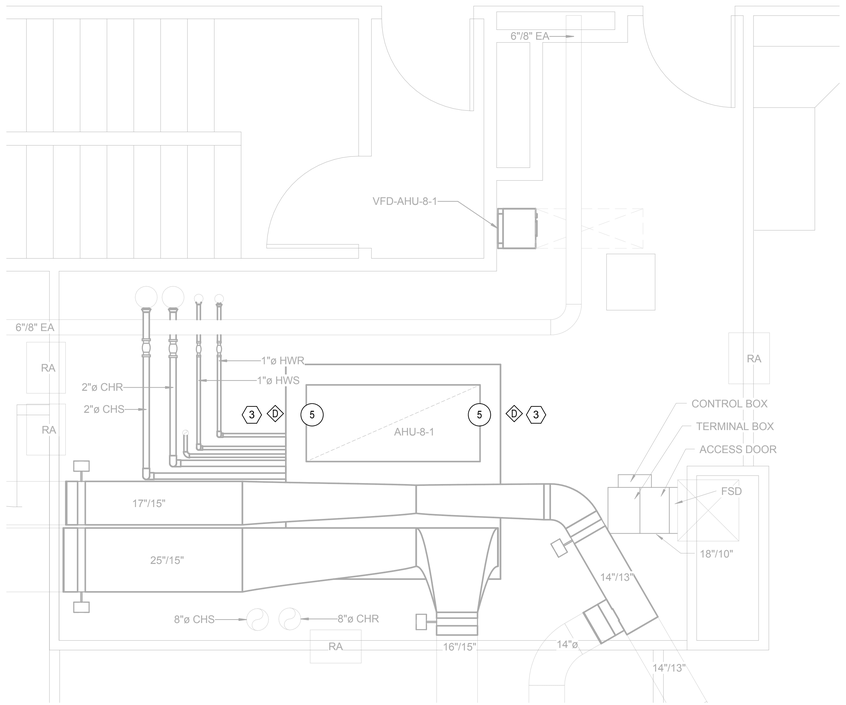


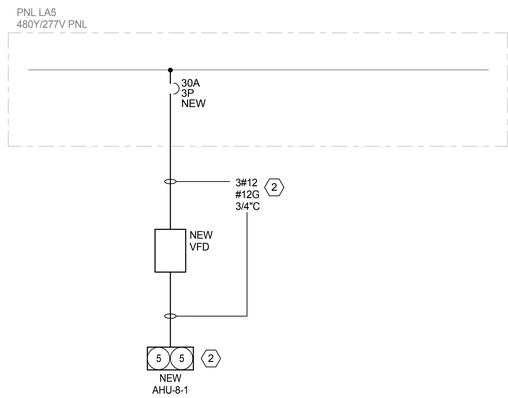

1 LEVEL 8 - DEMOLITION - MECHANICAL ROOM EAST
1/2" = 1'-0"




1A ONE LINE DIAGRAM DEMO - AHU-8-1
NO SCALE




2 LEVEL 8 - RENOVATION - MECHANICAL ROOM EAST
1/2" = 1'-0"




2A ONE LINE DIAGRAM RENO - AHU-8-1
NO SCALE

## GENERAL NOTES - GE-100

A NEW WORK SHOWN BOLD.

## KEYED NOTES - E-100-8E

1 REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.
2 NEW CONDUCTORS AND CONDUIT.
3 EXISTING DUCT DETECTORS TO BE REMOVED AND REPLACED WITH NEW DUCT DETECTORS. COORDINATE EXACT LOCATION WITH MECHANICAL EQUIPMENT INSTALLER.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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STATE OF TEXAS
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80083
LICENSED
PROFESSIONAL ENGINEER
10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 8 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-8E |
| Scale | As indicated |

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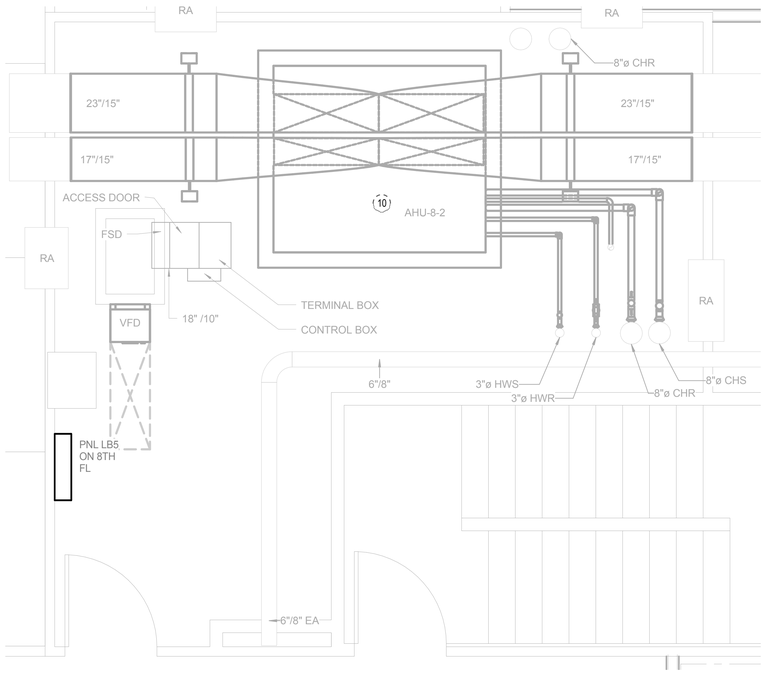
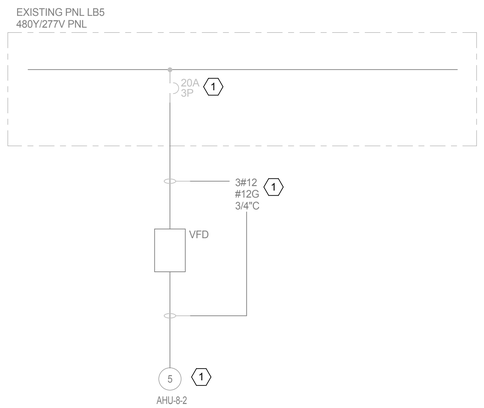
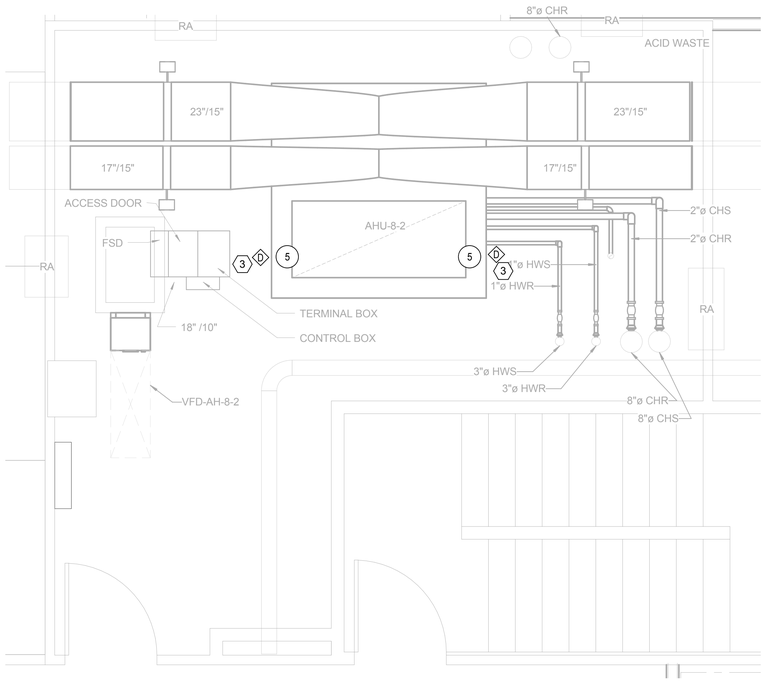


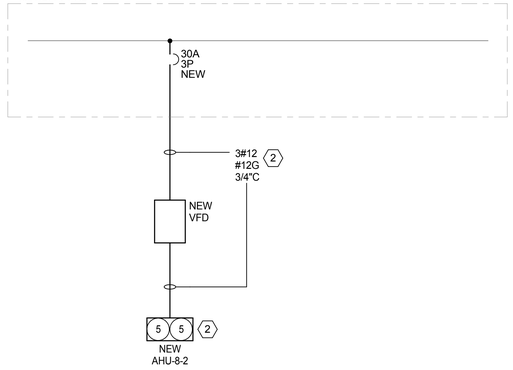

1 LEVEL 8 - DEMOLITION - MECHANICAL ROOM WEST
1/2" = 1'-0"




1A ONE LINE DIAGRAM DEMO - AHU-8-2
NO SCALE




2 LEVEL 8 - RENOVATION - MECHANICAL ROOM WEST
1/2" = 1'-0"




2A ONE LINE DIAGRAM RENO - AHU-8-2
NO SCALE

## GENERAL NOTES - GE-100

**A** NEW WORK SHOWN BOLD.

## KEYED NOTES - E-100-8W

1. REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.
2. NEW CONDUCTORS AND CONDUIT.
3. EXISTING DUCT DETECTORS TO BE REMOVED AND REPLACED WITH NEW DUCT DETECTORS. COORDINATE EXACT LOCATION WITH MECHANICAL EQUIPMENT INSTALLER.

True NORTH  Plan NORTH

1/2" = 1'-0" (0', 2', 4')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10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 8 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-8W |
| Scale | As indicated |


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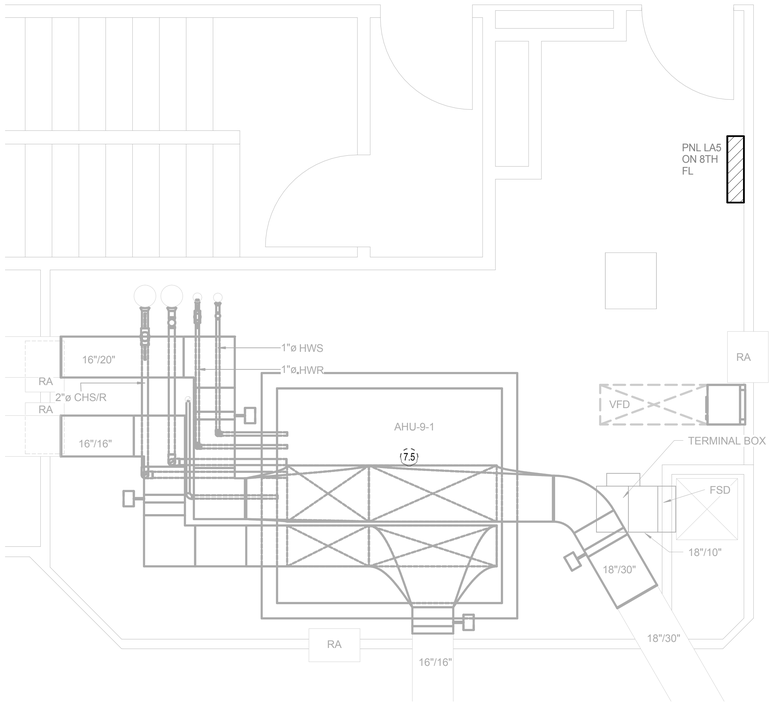
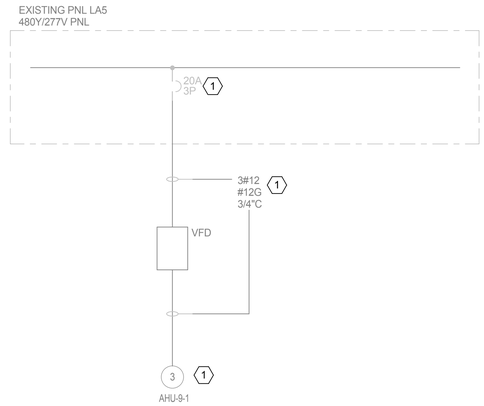
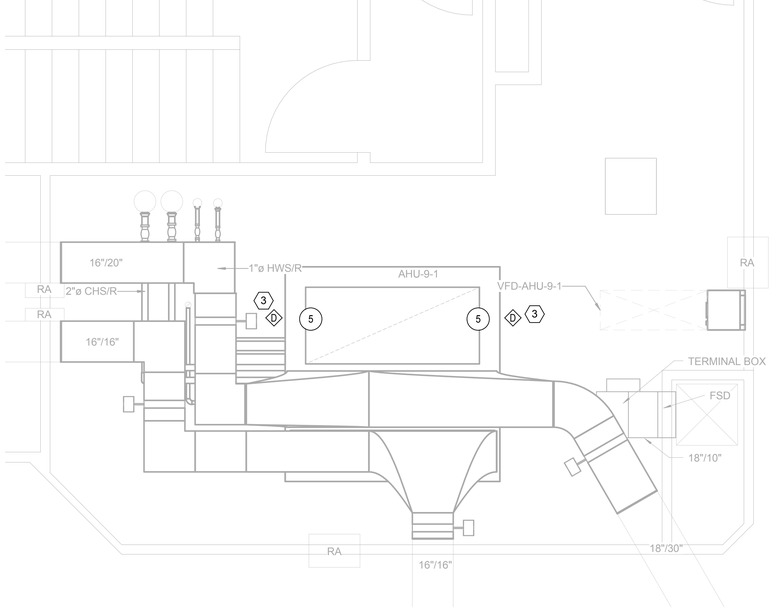


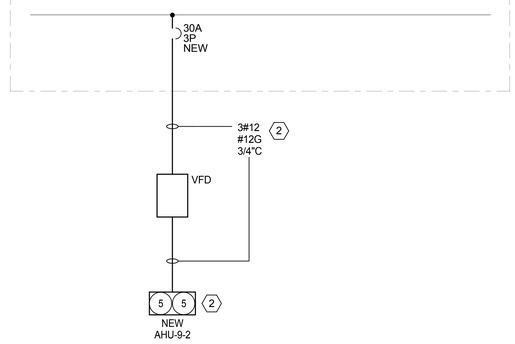

1 LEVEL 9 - DEMOLITION - MECHANICAL ROOM EAST
1/2" = 1'-0"




1A ONE LINE DIAGRAM DEMO - AHU-9-1
NO SCALE




2 LEVEL 9 - RENOVATION - MECHANICAL ROOM EAST
1/2" = 1'-0"




2A ONE LINE DIAGRAM RENO - AHU-9-1
NO SCALE

## GENERAL NOTES - GE-100

**A** NEW WORK SHOWN BOLD.

## KEYED NOTES - E-100-9E

1. REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.
2. NEW CONDUCTORS AND CONDUIT.
3. EXISTING DUCT DETECTORS TO BE REMOVED AND REPLACED WITH NEW DUCT DETECTORS. COORDINATE EXACT LOCATION WITH MECHANICAL EQUIPMENT INSTALLER.

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| | Issue for Construction | 10/11/17 |

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10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 9 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-9E |
| Scale | As indicated |

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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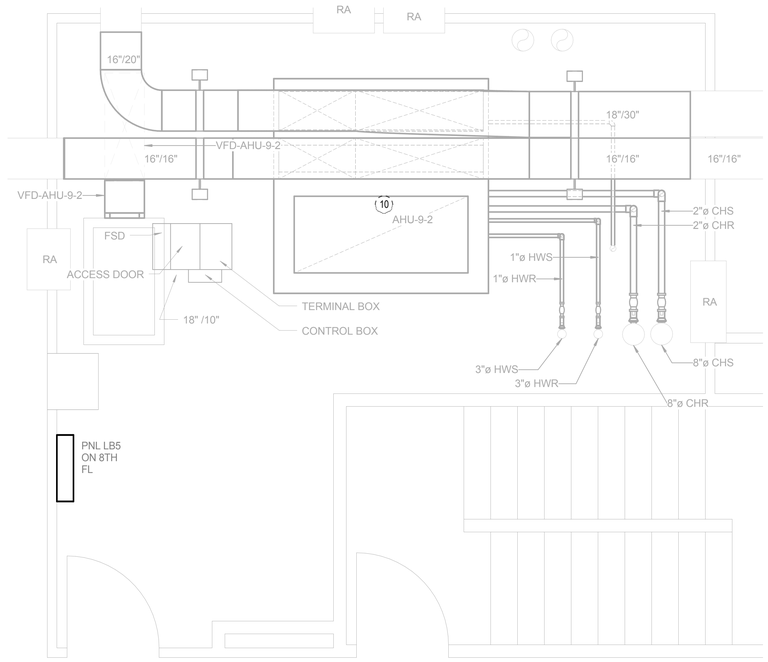
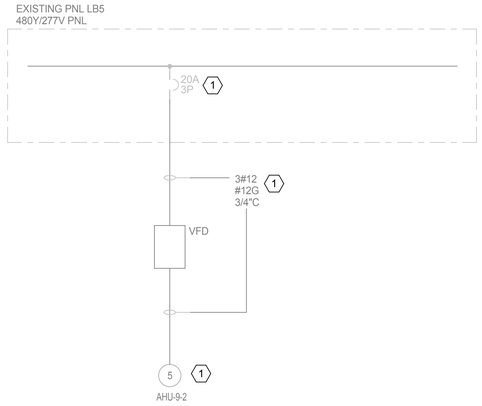


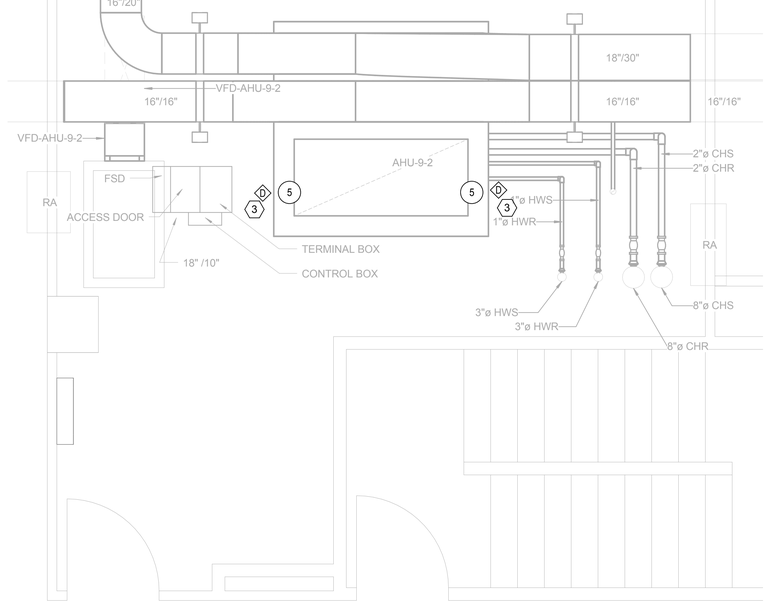

## 1 LEVEL 9 - DEMOLITION - MECHANICAL ROOM WEST

1/2" = 1'-0"



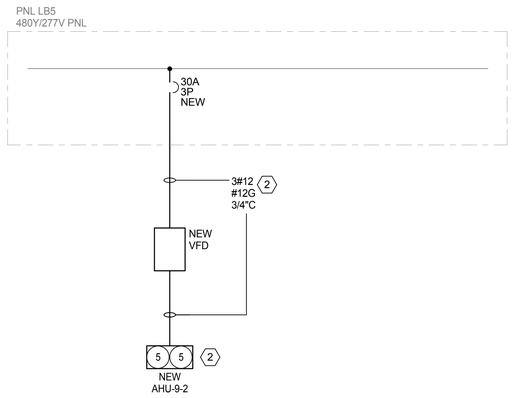

## 1A ONE LINE DIAGRAM DEMO - AHU-9-2

NO SCALE




## 2 LEVEL 9 - RENOVATION - MECHANICAL ROOM WEST

1/2" = 1'-0"




## 2A ONE LINE DIAGRAM RENO - AHU-9-2

NO SCALE

### GENERAL NOTES - GE-100

**A** NEW WORK SHOWN BOLD.

### KEYED NOTES - E-100-9W

**1** REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.

**2** NEW CONDUCTORS AND CONDUIT.

**3** EXISTING DUCT DETECTORS TO BE REMOVED AND REPLACED WITH NEW DUCT DETECTORS. COORDINATE EXACT LOCATION WITH MECHANICAL EQUIPMENT INSTALLER.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THE UNIVERSITY of TEXAS
HEALTH SCIENCE CENTER AT HOUSTON

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| | Issue for Construction | 10/11/17 |

Keyplan

Tx. Registration # F-2113
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80083
LICENSED PROFESSIONAL ENGINEER
10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 9 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-9W |
| Scale | As indicated |

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'


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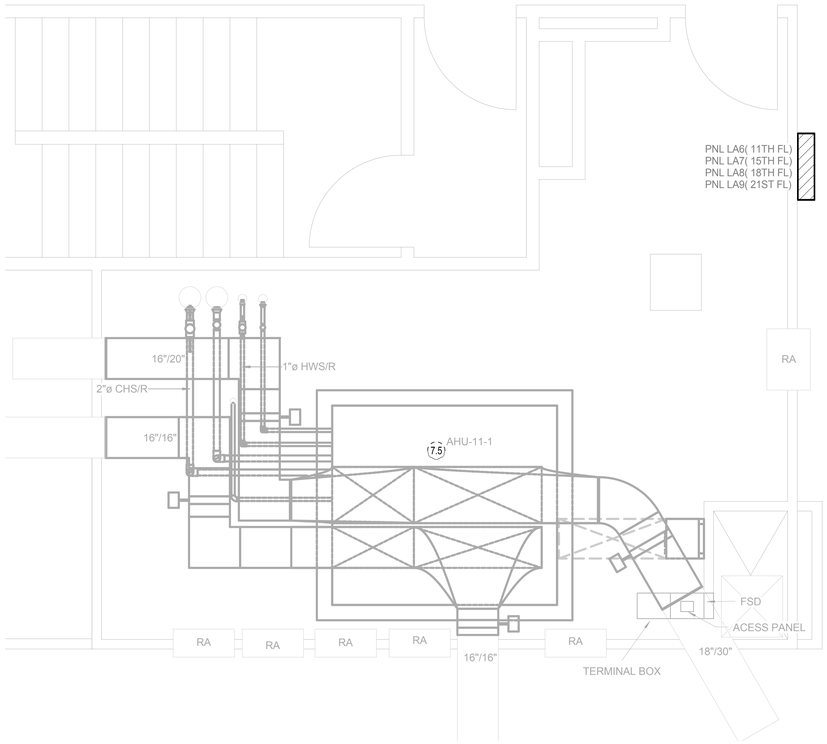
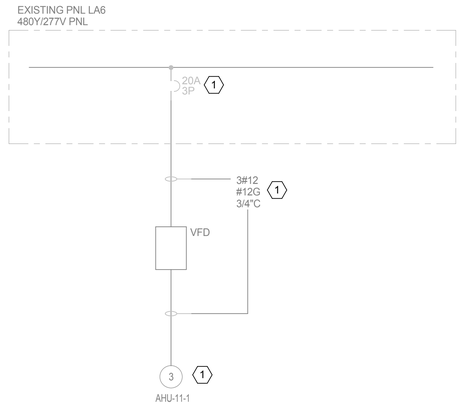
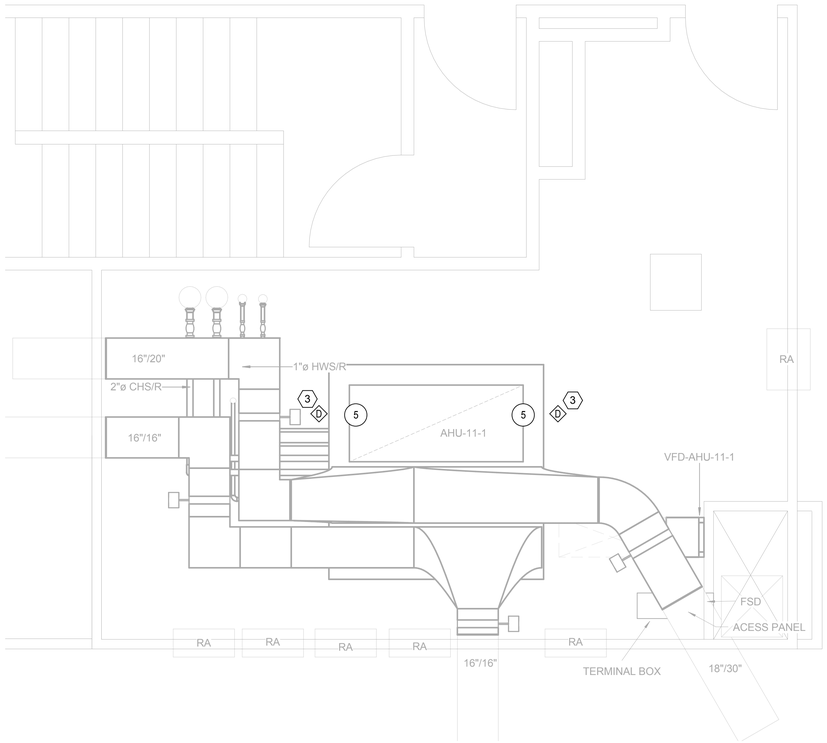


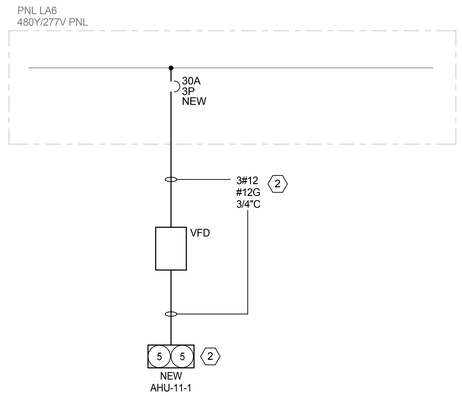

1 LEVEL 11 - DEMOLITION - MECHANICAL ROOM EAST
1/2" = 1'-0"




1A ONE LINE DIAGRAM DEMO - AHU-11-1
NO SCALE




2 LEVEL 11 - RENOVATION - MECHANICAL ROOM EAST
1/2" = 1'-0"




2A ONE LINE DIAGRAM RENO - AHU-11-1
NO SCALE

## GENERAL NOTES - GE-100

A NEW WORK SHOWN BOLD.

## KEYED NOTES - E-100-11E

1 REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.
2 NEW CONDUCTORS AND CONDUIT.
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Keyplan

Tx. Registration # F-2113
DOUGLAS B. BELISLE 80083 LICENSED PROFESSIONAL ENGINEER
10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 11 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-11E |
| Scale | As indicated |

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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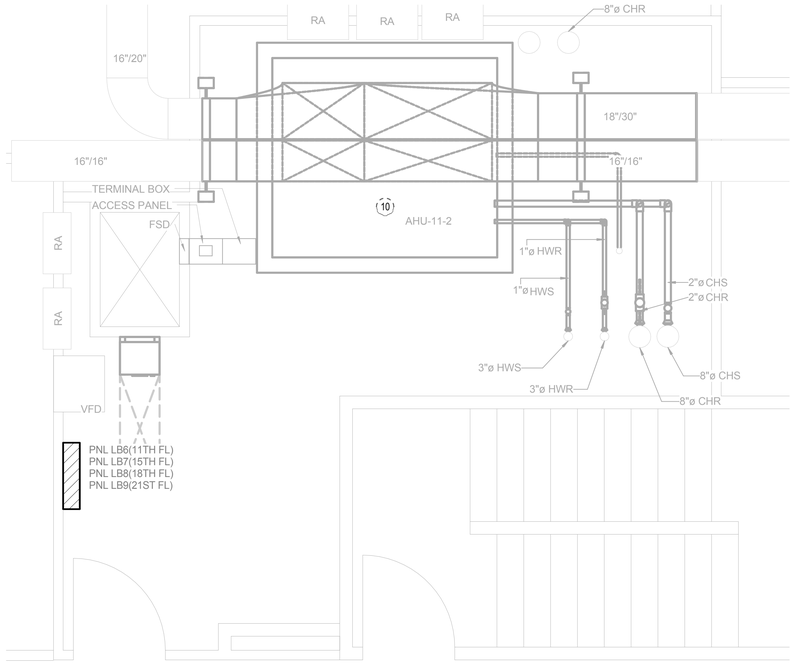
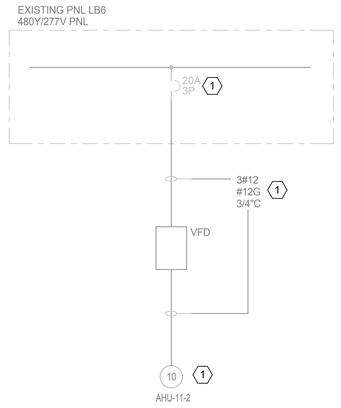
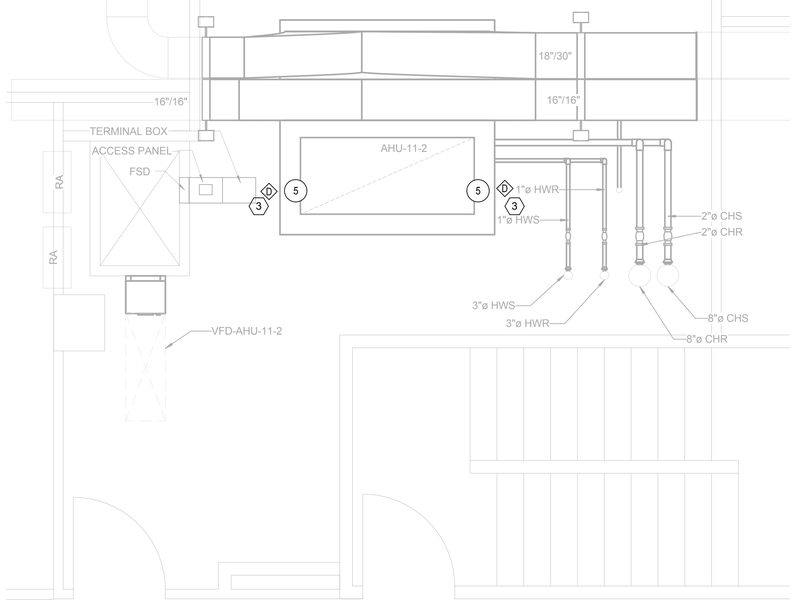


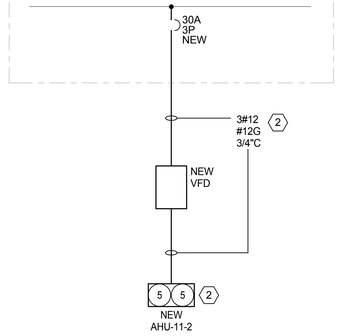

## 1 LEVEL 11 - DEMOLITION - MECHANICAL ROOM WEST
1/2" = 1'-0"




## 1A ONE LINE DIAGRAM DEMO - AHU-11-2
NO SCALE




## 2 LEVEL 11 - RENOVATION - MECHANICAL ROOM WEST
1/2" = 1'-0"




## 2A ONE LINE DIAGRAM RENO - AHU-11-2
NO SCALE

### GENERAL NOTES - GE-100

**A** NEW WORK SHOWN BOLD.

### KEYED NOTES - E-100-11W

1 REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.
2 NEW CONDUCTORS AND CONDUIT.
3 EXISTING DUCT DETECTORS TO BE REMOVED AND REPLACED WITH NEW DUCT DETECTORS. COORDINATE EXACT LOCATION WITH MECHANICAL EQUIPMENT INSTALLER.

SHAH SMITH & ASSOCIATES, INC.
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Texas Registered Engineering Firm F-2113

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THE UNIVERSITY of TEXAS
HEALTH SCIENCE CENTER AT HOUSTON

| No. | Description | Date |
|---|---|---|
| | Issue for Construction | 10/11/17 |

Keyplan

Tx. Registration # F-2113
STATE OF TEXAS
DOUGLAS B. BELISLE
80083
LICENSED
PROFESSIONAL ENGINEER
10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 11 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-11W |
| Scale | As indicated |

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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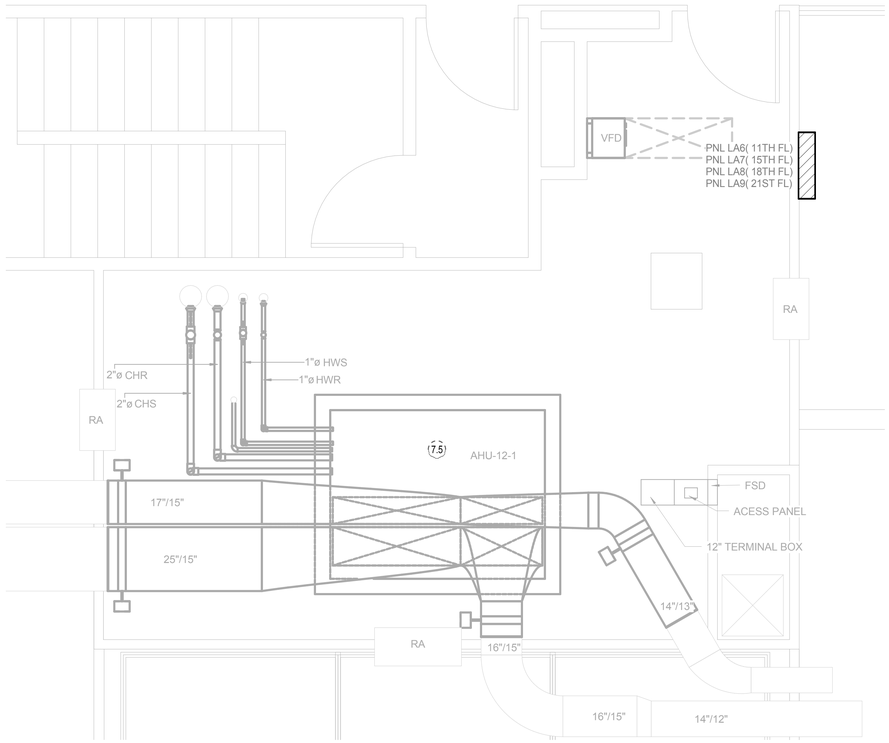
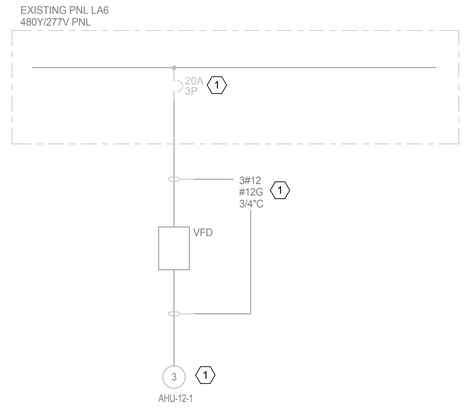
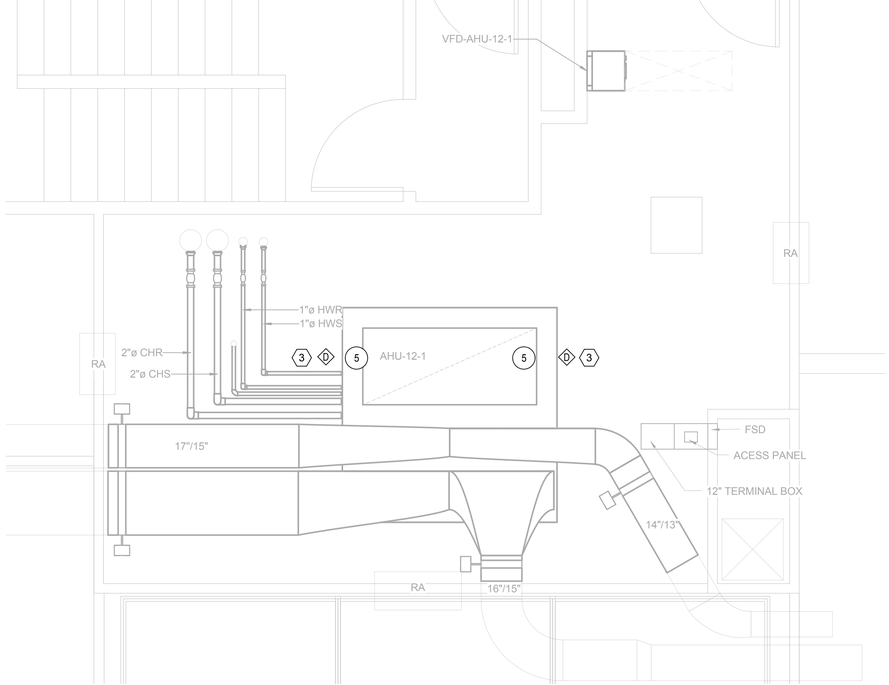


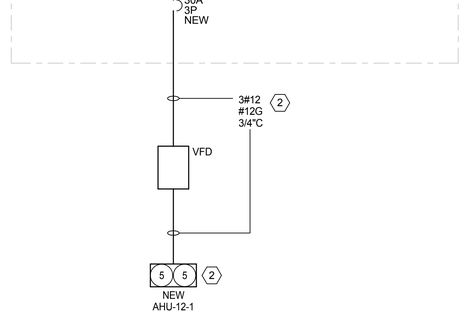

## 1 LEVEL 12 - DEMOLITION - MECHANICAL ROOM EAST
1/2" = 1'-0"




## 1A ONE LINE DIAGRAM DEMO - AHU-12-1
NO SCALE




## 2 LEVEL 12 - RENOVATION - MECHANICAL ROOM EAST
1/2" = 1'-0"




## 2A ONE LINE DIAGRAM RENO - AHU-12-1
NO SCALE

### GENERAL NOTES - GE-100

A NEW WORK SHOWN BOLD.

### KEYED NOTES - E-100-12E

1 REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.
2 NEW CONDUCTORS AND CONDUIT.
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The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 12 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-12E |
| Scale | As indicated |

True NORTH Plan NORTH

0' 2' 4'
1/2" = 1'-0"

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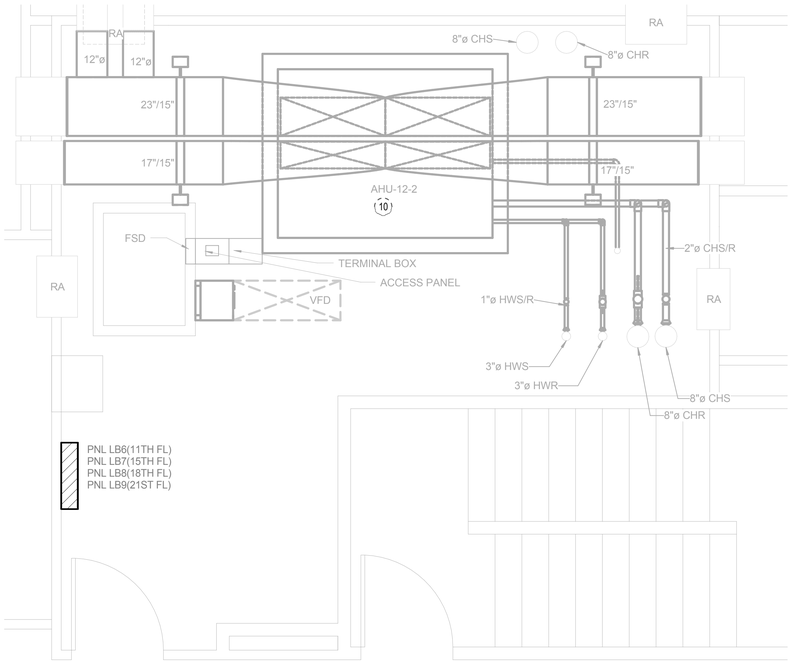
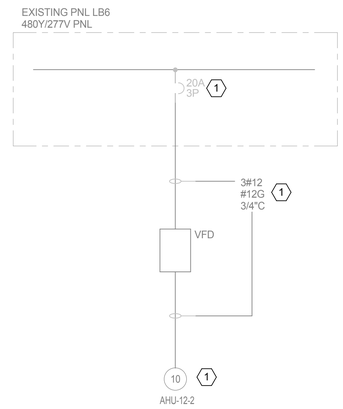
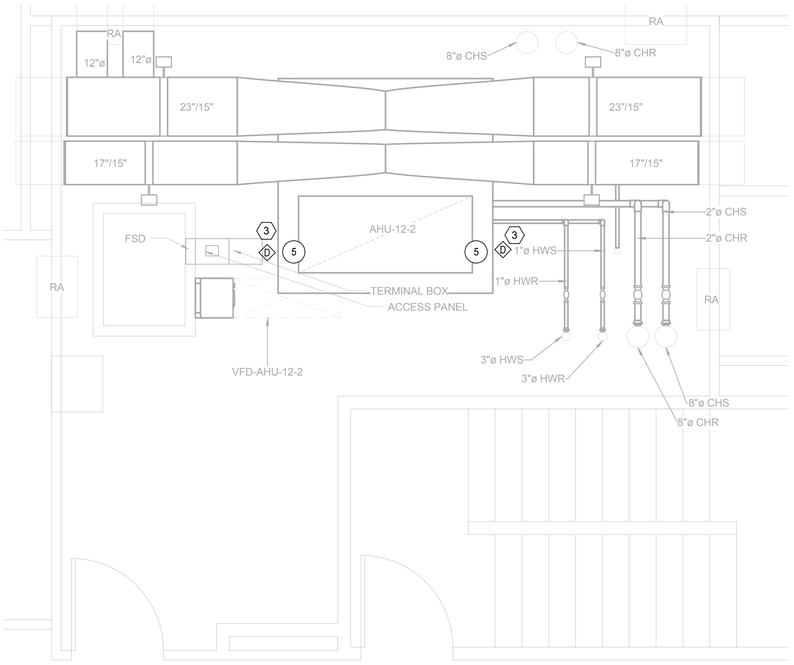


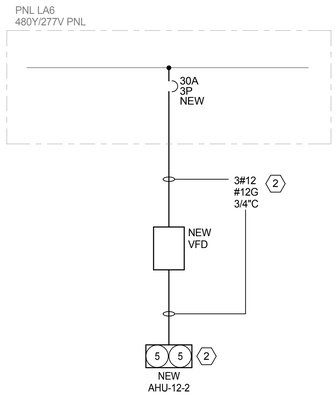

## 1 LEVEL 12 - DEMOLITION - MECHANICAL ROOM WEST
1/2" = 1'-0"




## 1A ONE LINE DIAGRAM DEMO - AHU-12-2
NO SCALE




## 2 LEVEL 12 - RENOVATION - MECHANICAL ROOM WEST
1/2" = 1'-0"




## 2A ONE LINE DIAGRAM RENO - AHU-12-2
NO SCALE

### GENERAL NOTES - GE-100

**A** NEW WORK SHOWN BOLD.

### KEYED NOTES - E-100-12W

1 REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.
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STATE OF TEXAS
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80063
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10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 12 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-12W |
| Scale | As indicated |

True NORTH Plan NORTH

1/2" = 1'-0" (0' 2' 4')


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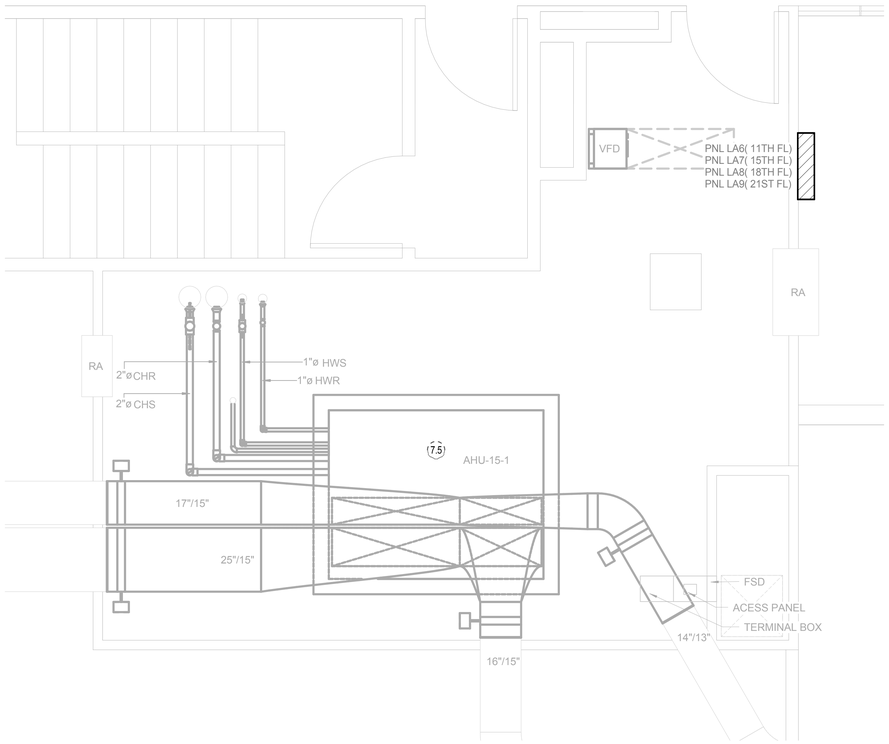
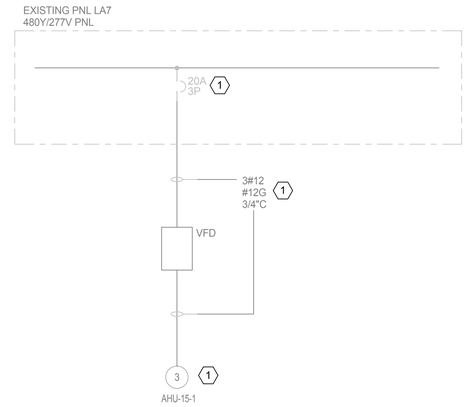


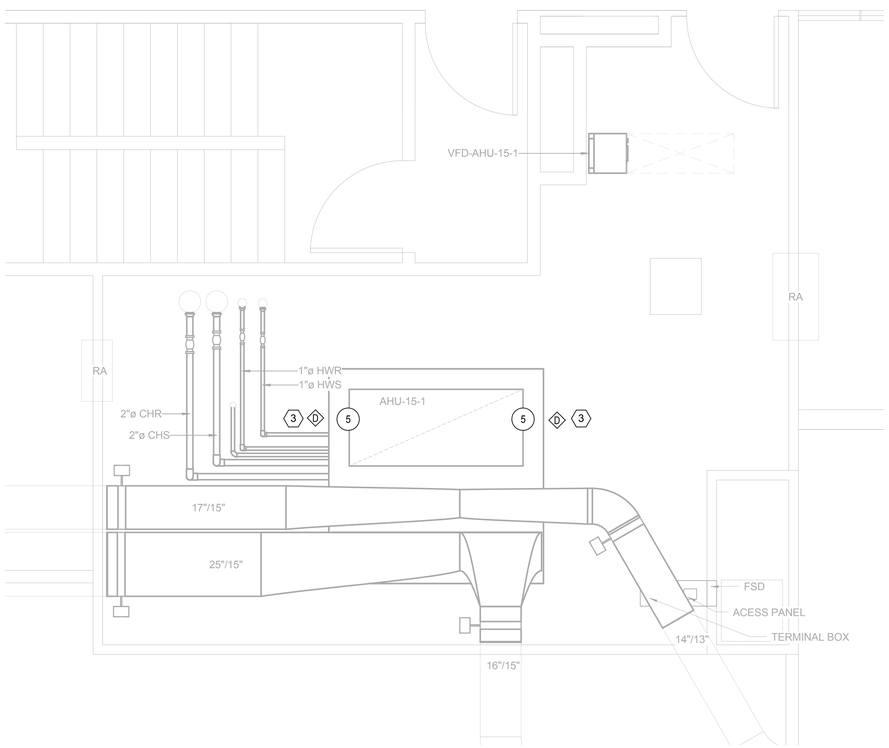

## 1 LEVEL 15 - DEMOLITION - MECHANICAL ROOM EAST

1/2" = 1'-0"



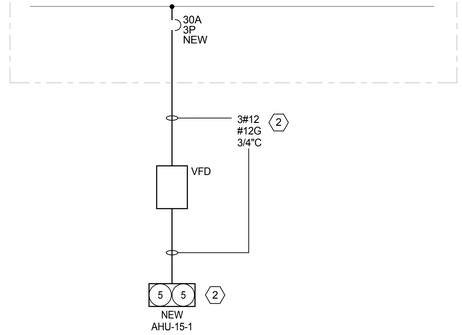

## 1A ONE LINE DIAGRAM DEMO - AHU-15-1

NO SCALE




## 2 LEVEL 15 - RENOVATION - MECHANICAL ROOM EAST

1/2" = 1'-0"




## 2A ONE LINE DIAGRAM RENO - AHU-15-1

NO SCALE

### GENERAL NOTES - GE-100

**A NEW WORK SHOWN BOLD.**

### KEYED NOTES - E-100-15E

1 REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.
2 NEW CONDUCTORS AND CONDUIT.
3 EXISTING DUCT DETECTORS TO BE REMOVED AND REPLACED WITH NEW DUCT DETECTORS. COORDINATE EXACT LOCATION WITH MECHANICAL EQUIPMENT INSTALLER.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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10/11/2017

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# UCT AHU REPLACEMENT

LEVEL 15 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-15E |
| Scale | As indicated |

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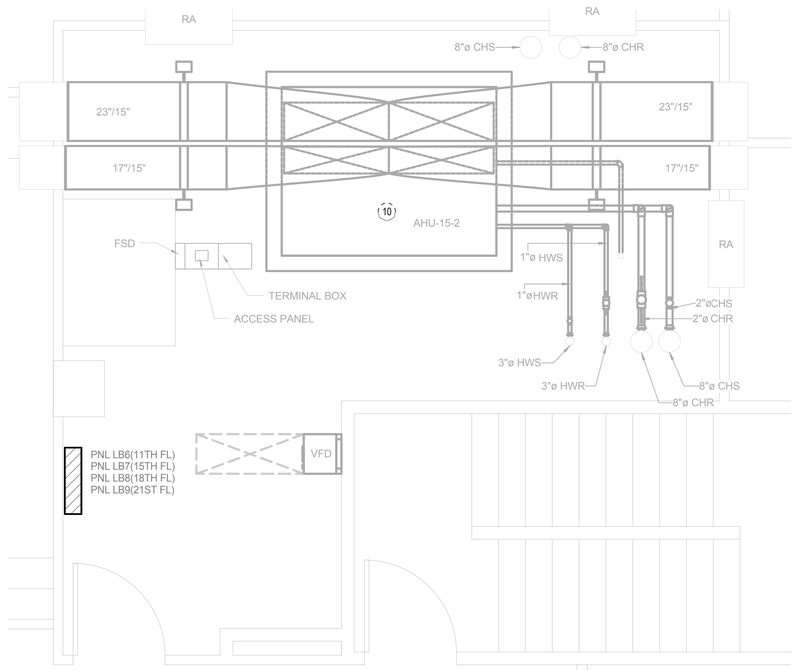
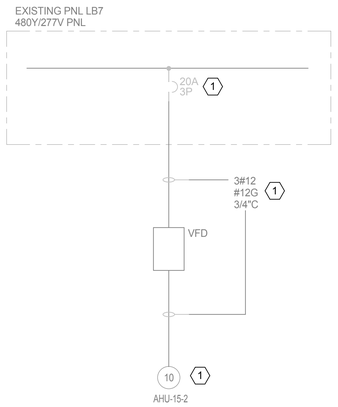
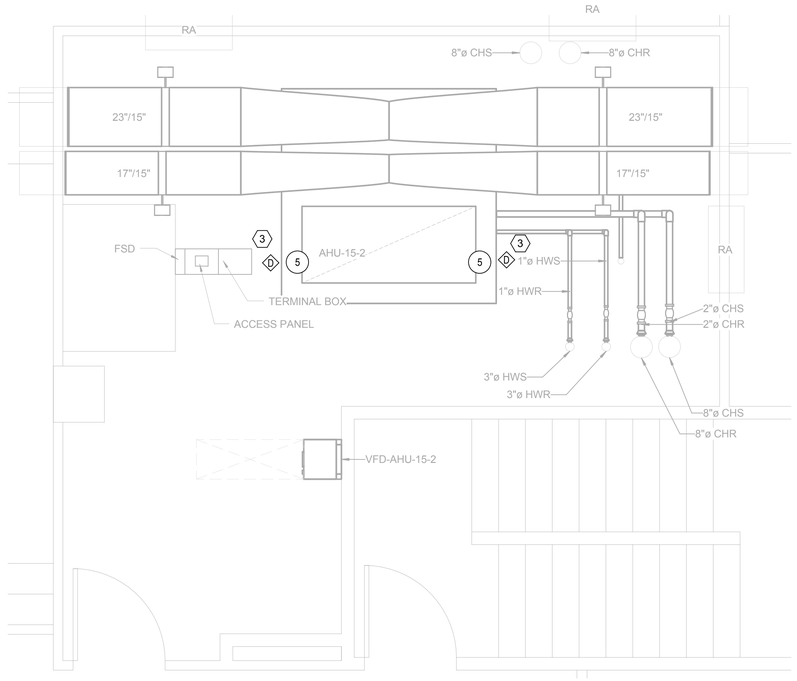


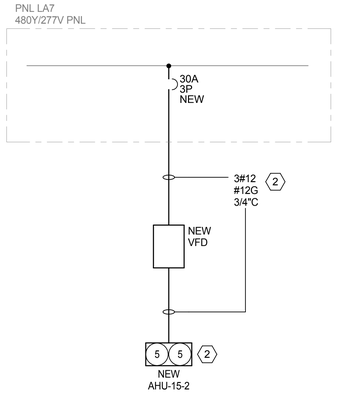

## 1 LEVEL 15 - DEMOLITION - MECHANICAL ROOM WEST
1/2" = 1'-0"




## 1A ONE LINE DIAGRAM DEMO - AHU-15-2
NO SCALE




## 2 LEVEL 15 - RENOVATION - MECHANICAL ROOM WEST
1/2" = 1'-0"




## 2A ONE LINE DIAGRAM RENO - AHU-15-2
NO SCALE

### GENERAL NOTES - GE-100

A NEW WORK SHOWN BOLD.

### KEYED NOTES - E-100-15W

1 REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.
2 NEW CONDUCTORS AND CONDUIT.
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| | Issue for Construction | 10/11/17 |

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STATE OF TEXAS
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80083
LICENSED
PROFESSIONAL ENGINEER
10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 15 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-15W |
| Scale | As indicated |

True NORTH Plan NORTH

0' 2' 4'
1/2" = 1'-0"

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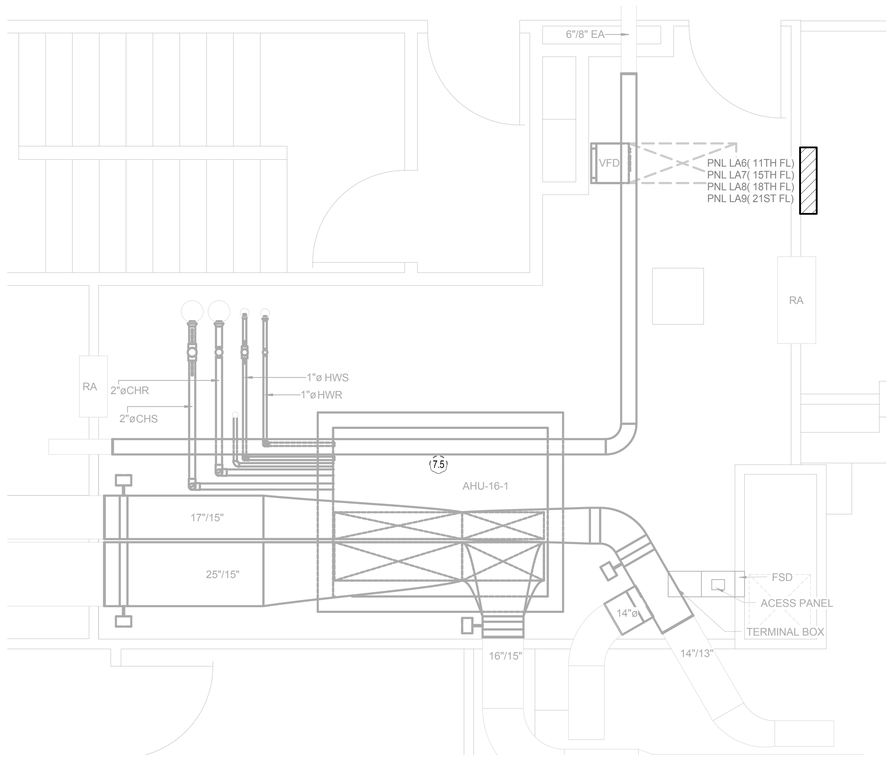
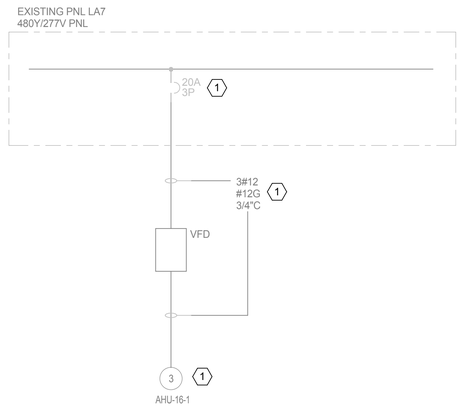
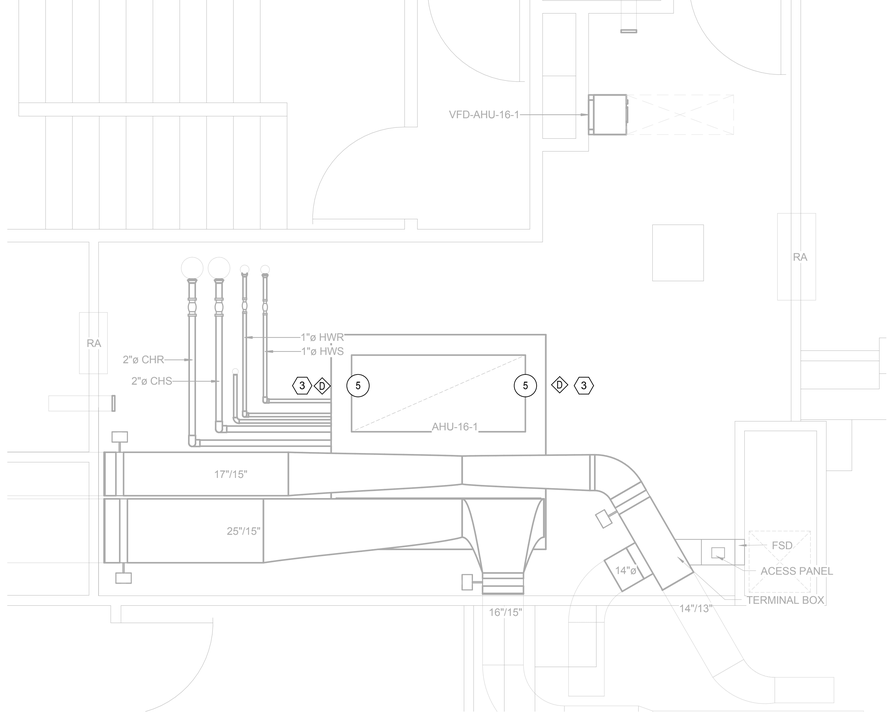


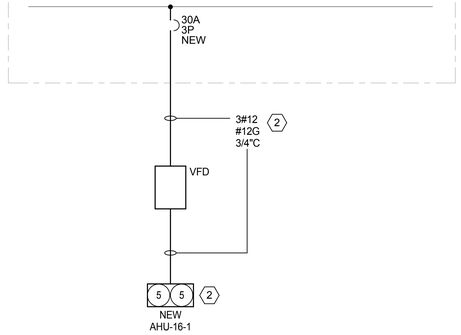

1 LEVEL 16 - DEMOLITION - MECHANICAL ROOM EAST
1/2" = 1'-0"




1A ONE LINE DIAGRAM DEMO - AHU-16-1
NO SCALE




2 LEVEL 16 - RENOVATION - MECHANICAL ROOM EAST
1/2" = 1'-0"




2A ONE LINE DIAGRAM RENO - AHU-16-1
NO SCALE

## GENERAL NOTES - GE-100

**A** NEW WORK SHOWN BOLD.

## KEYED NOTES - E-100-16E

1 REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.
2 NEW CONDUCTORS AND CONDUIT.
3 EXISTING DUCT DETECTORS TO BE REMOVED AND REPLACED WITH NEW DUCT DETECTORS. COORDINATE EXACT LOCATION WITH MECHANICAL EQUIPMENT INSTALLER.

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THE UNIVERSITY of TEXAS HEALTH SCIENCE CENTER AT HOUSTON

| No. | Description | Date |
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| | Issue for Construction | 10/11/17 |

Keyplan

Tx. Registration # F-2113
DOUGLAS B. BELISLE 80083 LICENSED PROFESSIONAL ENGINEER
10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

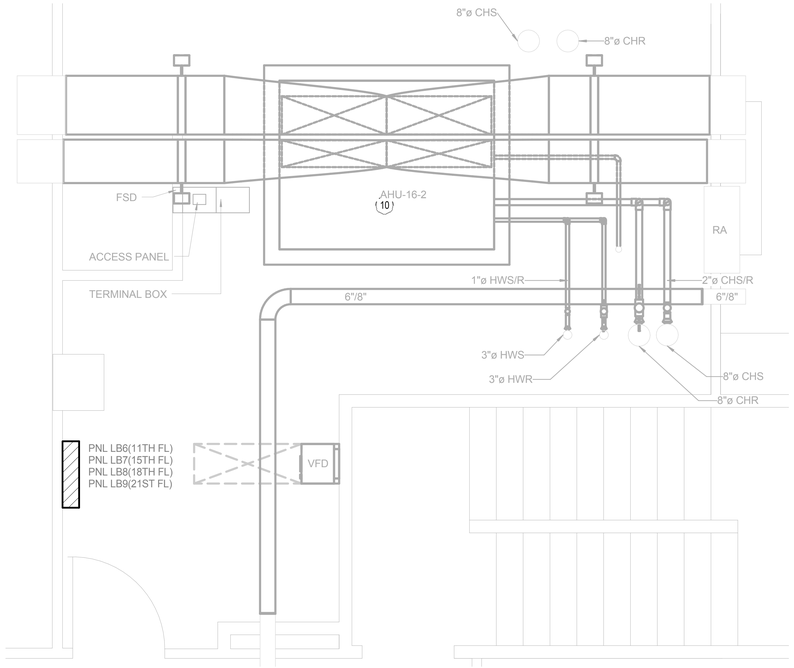
LEVEL 16 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-16E |
| Scale | As indicated |

True NORTH Plan NORTH

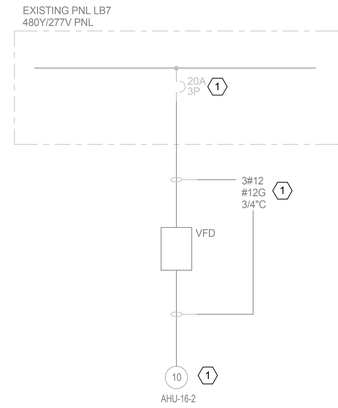
1/2" = 1'-0" 0' 2' 4'

10/10/2017 8:30:01 AM C:\Users\kmozer\Documents\1095-034-01_Elec_R16_kmozer_SSA.rvt



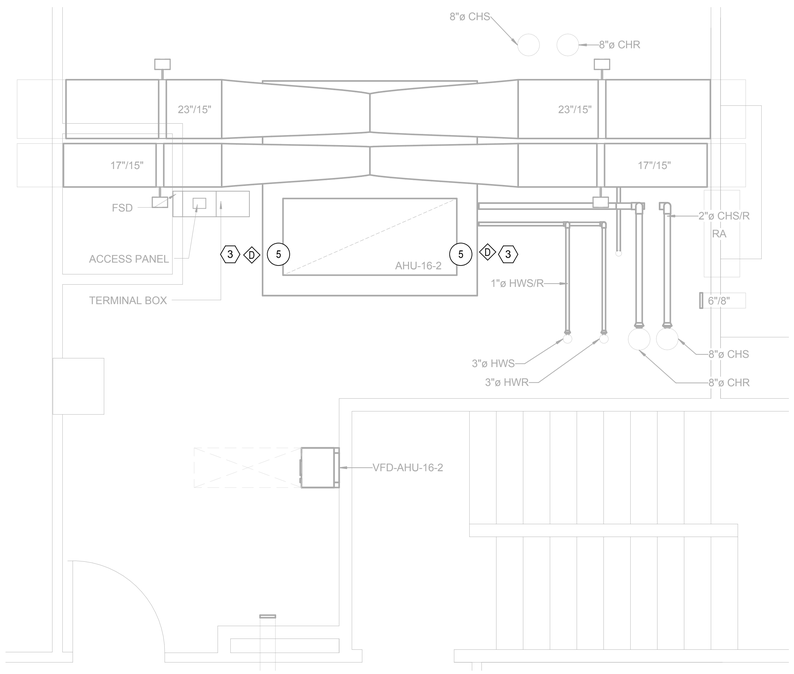

LEVEL 16 - DEMOLITION - MECHANICAL ROOM WEST

1 1/2" = 1'-0"



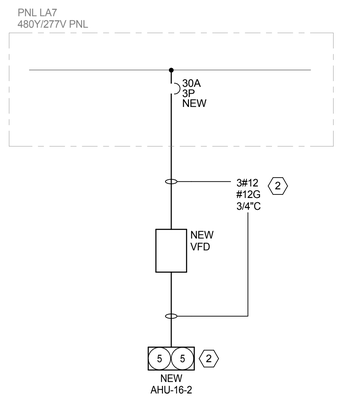

1A ONE LINE DIAGRAM DEMO - AHU-16-2

NO SCALE




LEVEL 16 - RENOVATION - MECHANICAL ROOM WEST

2 1/2" = 1'-0"




2A ONE LINE DIAGRAM RENO - AHU-16-2

NO SCALE

## GENERAL NOTES - GE-100

A NEW WORK SHOWN BOLD.

## KEYED NOTES - E-100-16W

1 REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.

2 NEW CONDUCTORS AND CONDUIT.

3 EXISTING DUCT DETECTORS TO BE REMOVED AND REPLACED WITH NEW DUCT DETECTORS. COORDINATE EXACT LOCATION WITH MECHANICAL EQUIPMENT INSTALLER.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'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DOUGLAS B. BELISLE
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PROFESSIONAL ENGINEER
10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 16 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-16W |
| Scale | As indicated |

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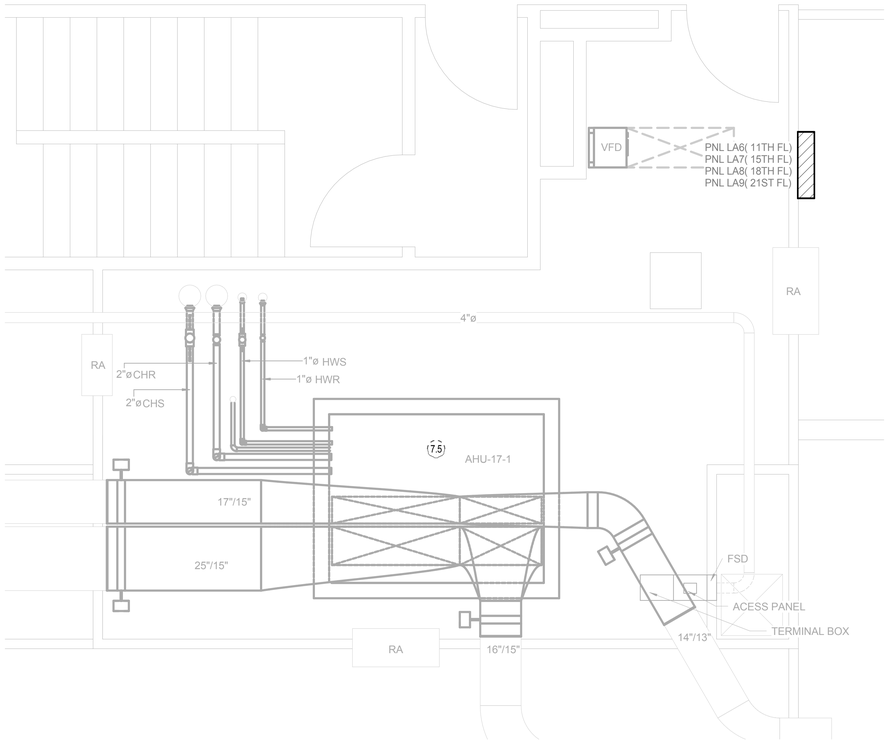
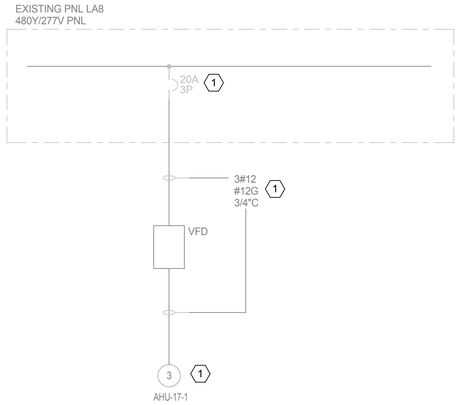
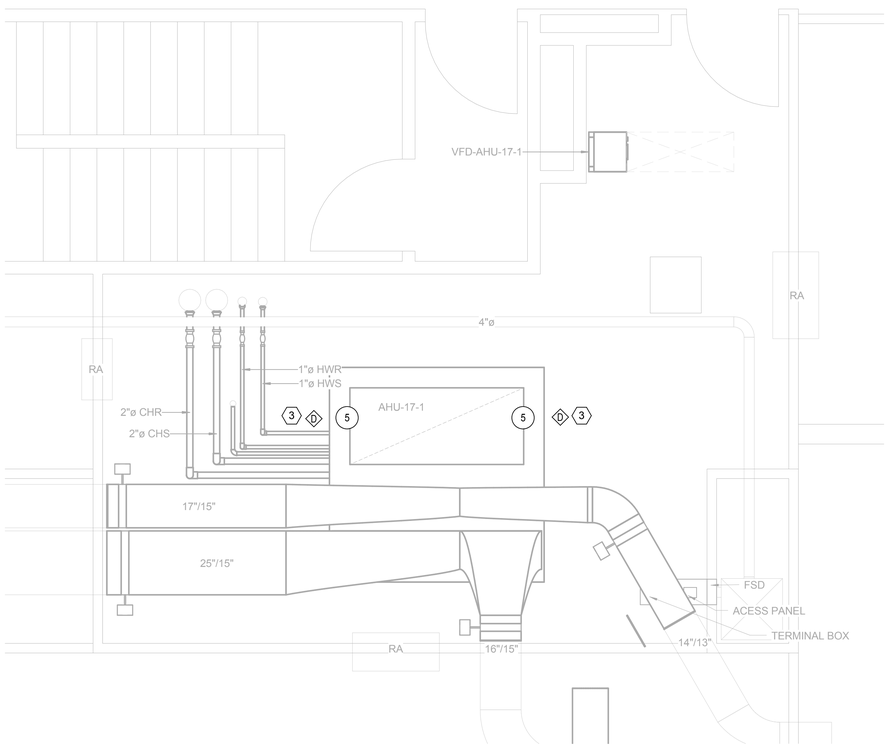


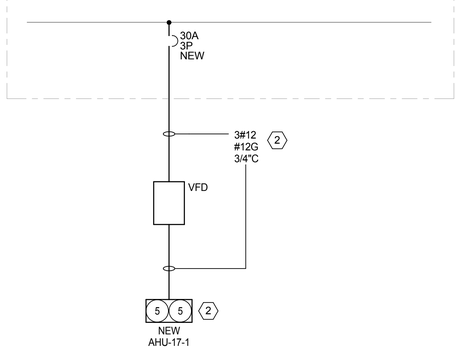

## 1 LEVEL 17 - DEMOLITION - MECHANICAL ROOM EAST
1/2" = 1'-0"




## 1A ONE LINE DIAGRAM DEMO - AHU-17-1
NO SCALE




## 2 LEVEL 17 - RENOVATION - MECHANICAL ROOM EAST
1/2" = 1'-0"




## 2A ONE LINE DIAGRAM RENO - AHU-17-1
NO SCALE

### GENERAL NOTES - GE-100

A NEW WORK SHOWN BOLD.

### KEYED NOTES - E-100-17E

1 REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.
2 NEW CONDUCTORS AND CONDUIT.
3 EXISTING DUCT DETECTORS TO BE REMOVED AND REPLACED WITH NEW DUCT DETECTORS. COORDINATE EXACT LOCATION WITH MECHANICAL EQUIPMENT INSTALLER.

SHAH SMITH & ASSOCIATES, INC.
2825 Wilcrest, Suite #350 Houston, Texas 77042
Ph. 713.780.7563 Fax.713.780.9209
Texas Registered Engineering Firm F-2113

Philo Wilke Partnership

THE UNIVERSITY of TEXAS HEALTH SCIENCE CENTER AT HOUSTON

| No. | Description | Date |
|---|---|---|
| | Issue for Construction | 10/11/17 |

Keyplan

Tx. Registration # F-2113
DOUGLAS B. BELISLE 80083 LICENSED PROFESSIONAL ENGINEER
10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 17 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-17E |
| Scale | As indicated |

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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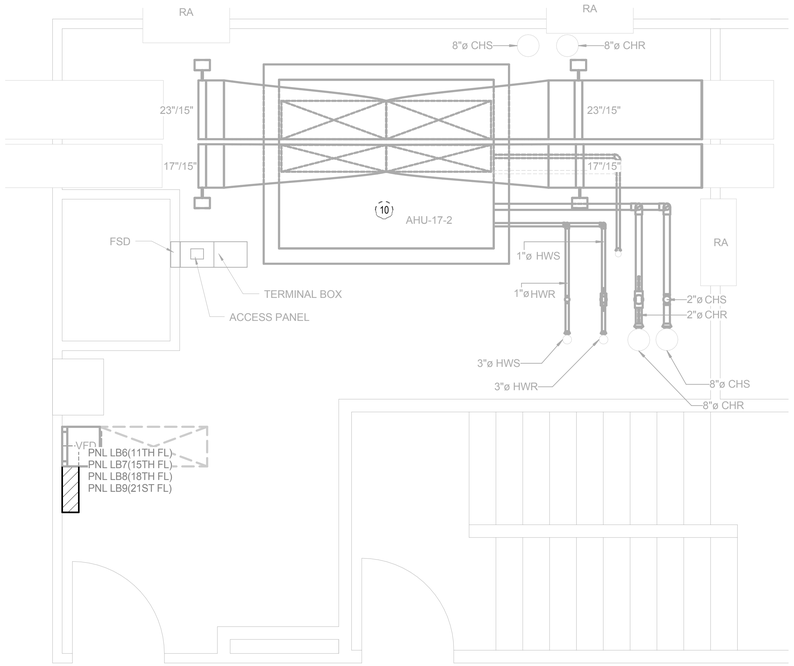
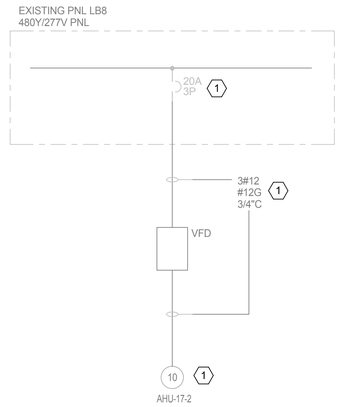
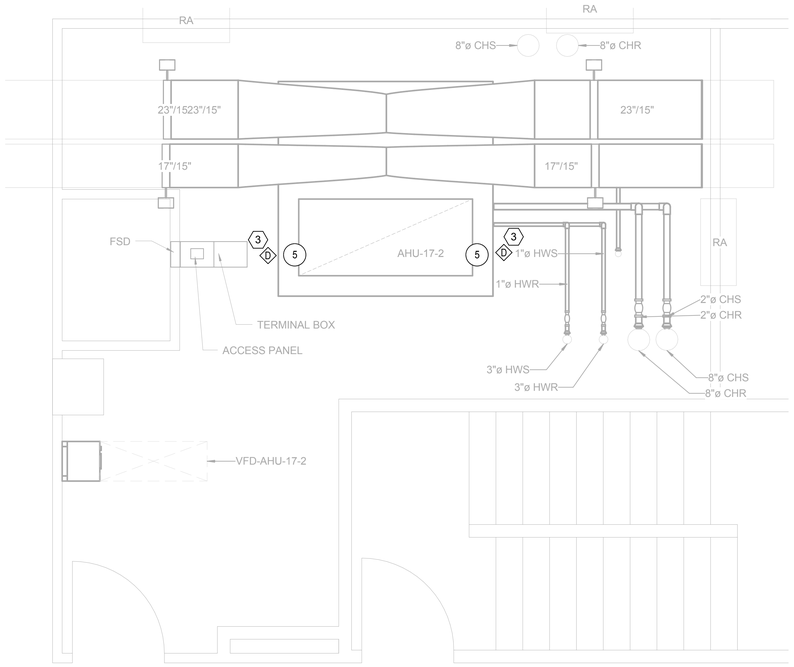


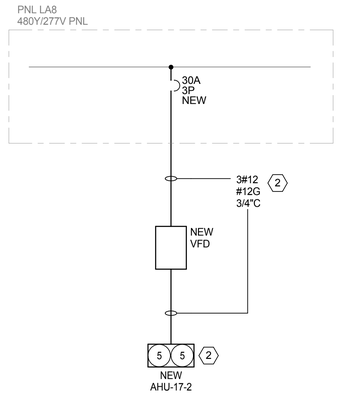

1 LEVEL 17 - DEMOLITION - MECHANICAL ROOM WEST
1/2" = 1'-0"




1A ONE LINE DIAGRAM DEMO - AHU-17-2
NO SCALE




2 LEVEL 17 - RENOVATION - MECHANICAL ROOM WEST
1/2" = 1'-0"




2A ONE LINE DIAGRAM RENO - AHU-17-2
NO SCALE

## GENERAL NOTES - GE-100

**A** NEW WORK SHOWN BOLD.

## KEYED NOTES - E-100-17W

1 REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.
2 NEW CONDUCTORS AND CONDUIT.
3 EXISTING DUCT DETECTORS TO BE REMOVED AND REPLACED WITH NEW DUCT DETECTORS. COORDINATE EXACT LOCATION WITH MECHANICAL EQUIPMENT INSTALLER.

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THE UNIVERSITY of TEXAS HEALTH SCIENCE CENTER AT HOUSTON

| No. | Description | Date |
|---|---|---|
| | Issue for Construction | 10/11/17 |

Keyplan

Tx. Registration # F-2113
STATE OF TEXAS
DOUGLAS B. BEILSLE
90083
LICENSED
PROFESSIONAL ENGINEER
10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 17 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-17W |
| Scale | As indicated |

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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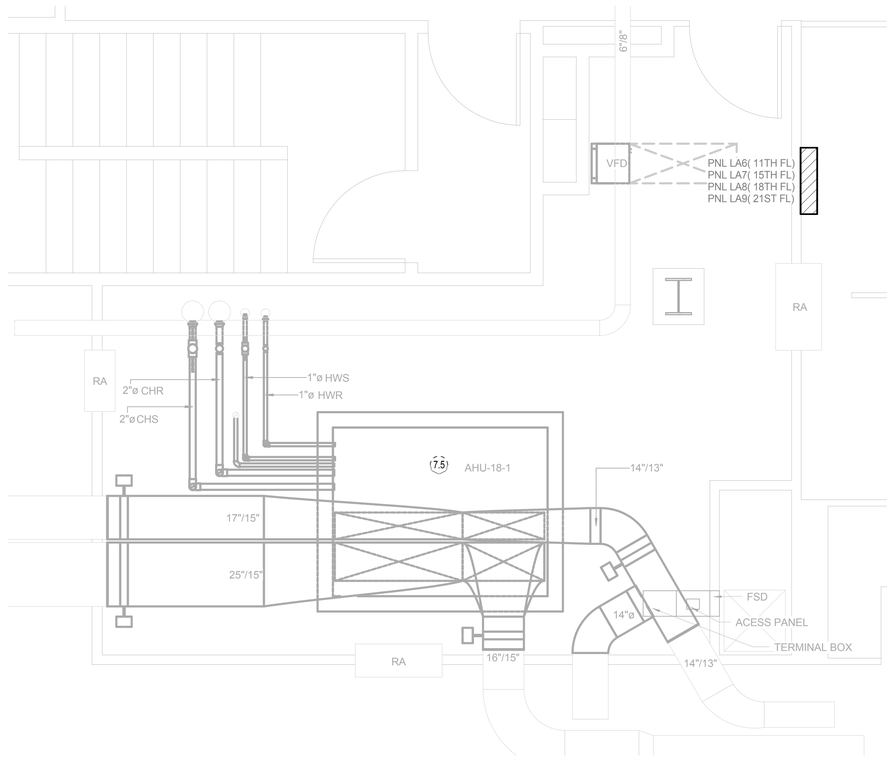
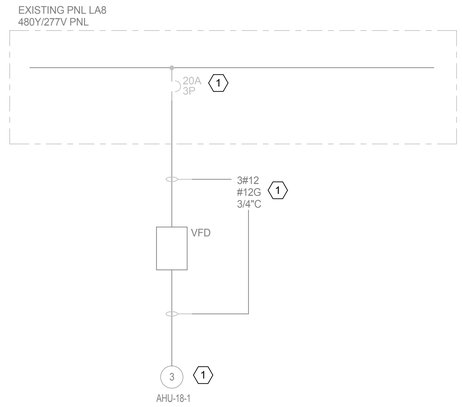



## 1 LEVEL 18 - DEMOLITION - MECHANICAL ROOM EAST

1/2" = 1'-0"




## 1A ONE LINE DIAGRAM DEMO - AHU-18-1

NO SCALE

### GENERAL NOTES - GE-100

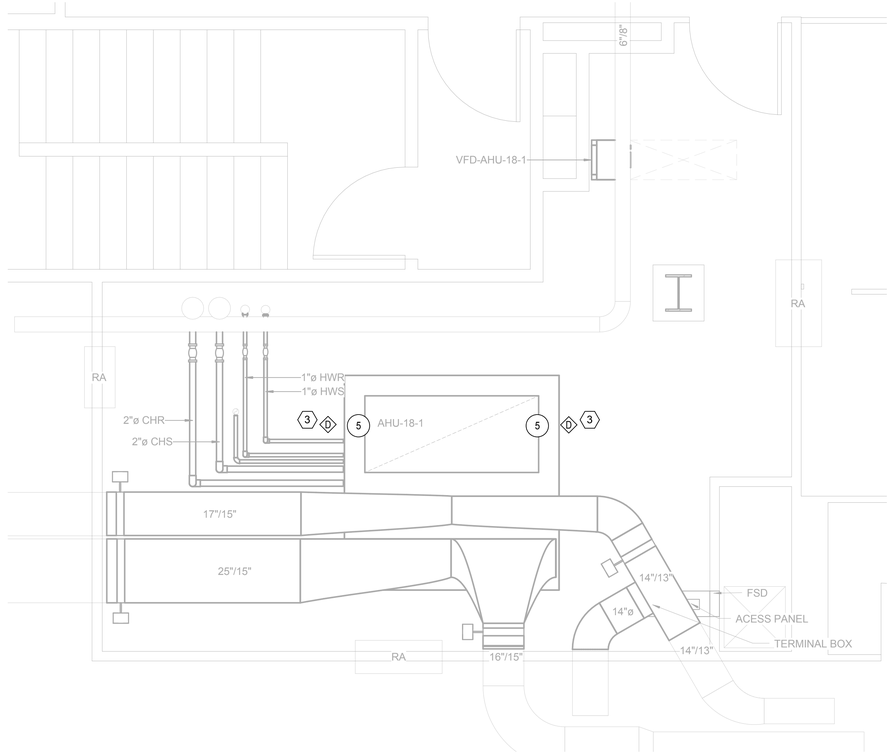
**A NEW WORK SHOWN BOLD.**

### KEYED NOTES - E-100-18E

**1 REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.**

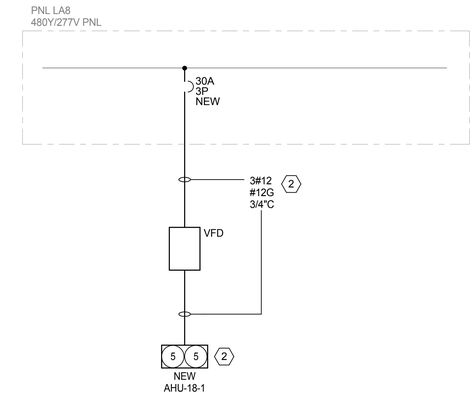
**2 NEW CONDUCTORS AND CONDUIT.**

**3 EXISTING DUCT DETECTORS TO BE REMOVED AND REPLACED WITH NEW DUCT DETECTORS. COORDINATE EXACT LOCATION WITH MECHANICAL EQUIPMENT INSTALLER.**




## 2 LEVEL 18 - RENOVATION - MECHANICAL ROOM EAST

1/2" = 1'-0"




## 2A ONE LINE DIAGRAM RENO - AHU-18-1

NO SCALE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Tx. Registration # F-2113

DOUGLAS B. BELISLE 80083 LICENSED PROFESSIONAL ENGINEER 10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 18 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-18E |
| Scale | As indicated |

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'


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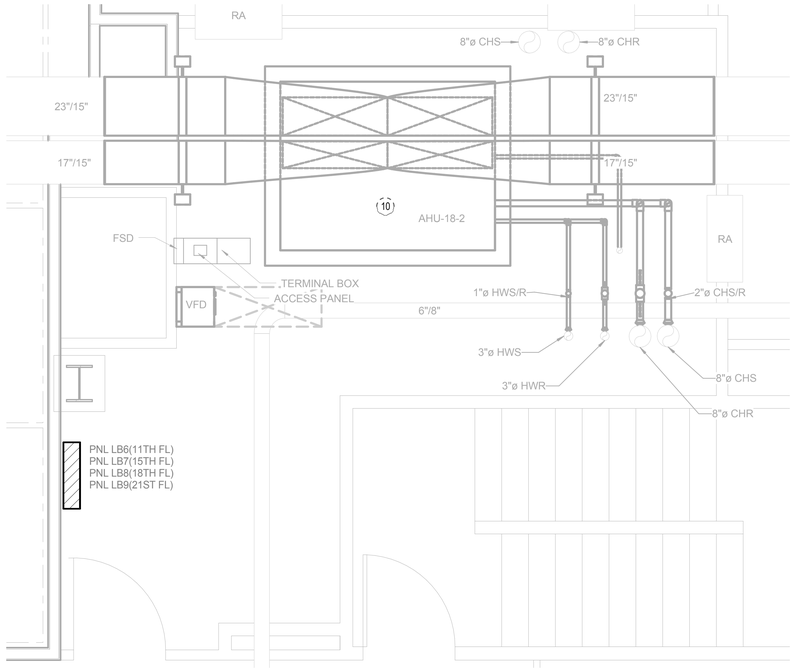
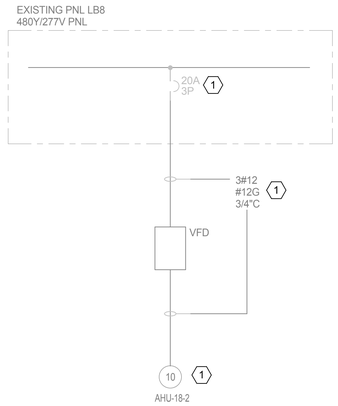


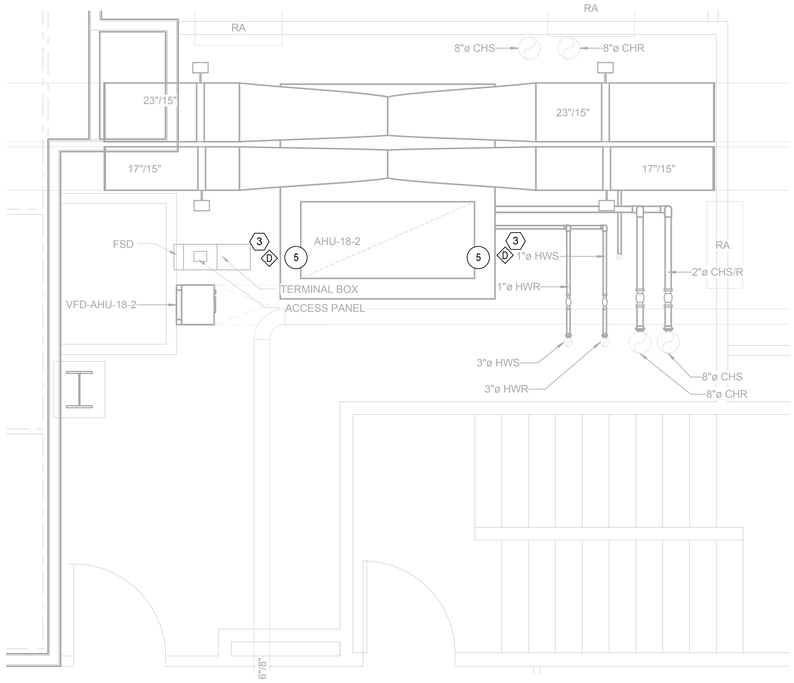

## 1 LEVEL 18 - DEMOLITION - MECHANICAL ROOM WEST

1/2" = 1'-0"



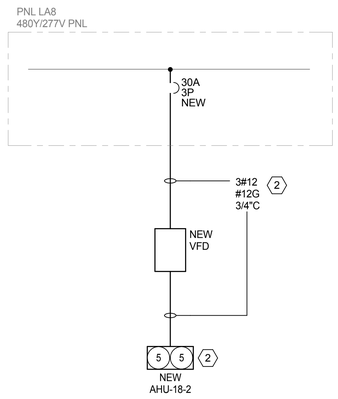

## 1A ONE LINE DIAGRAM DEMO - AHU-18-2

NO SCALE




## 2 LEVEL 18 - RENOVATION - MECHANICAL ROOM WEST

1/2" = 1'-0"




## 2A ONE LINE DIAGRAM RENO - AHU-18-2

NO SCALE

### GENERAL NOTES - GE-100

**A NEW WORK SHOWN BOLD.**

### KEYED NOTES - E-100-18W

**1 REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.**

**2 NEW CONDUCTORS AND CONDUIT.**

**3 EXISTING DUCT DETECTORS TO BE REMOVED AND REPLACED WITH NEW DUCT DETECTORS. COORDINATE EXACT LOCATION WITH MECHANICAL EQUIPMENT INSTALLER.**

True NORTH  Plan NORTH

1/2" = 1'-0"  0'  2'  4'

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10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 18 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-18W |
| Scale | As indicated |

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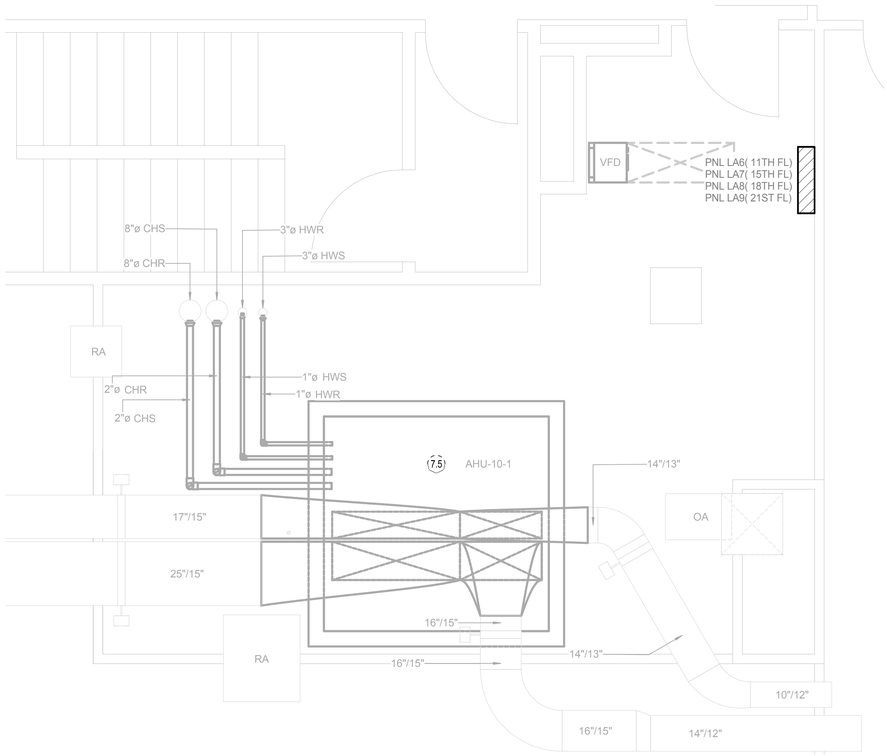
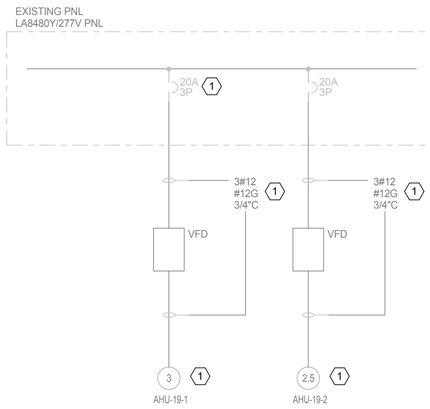


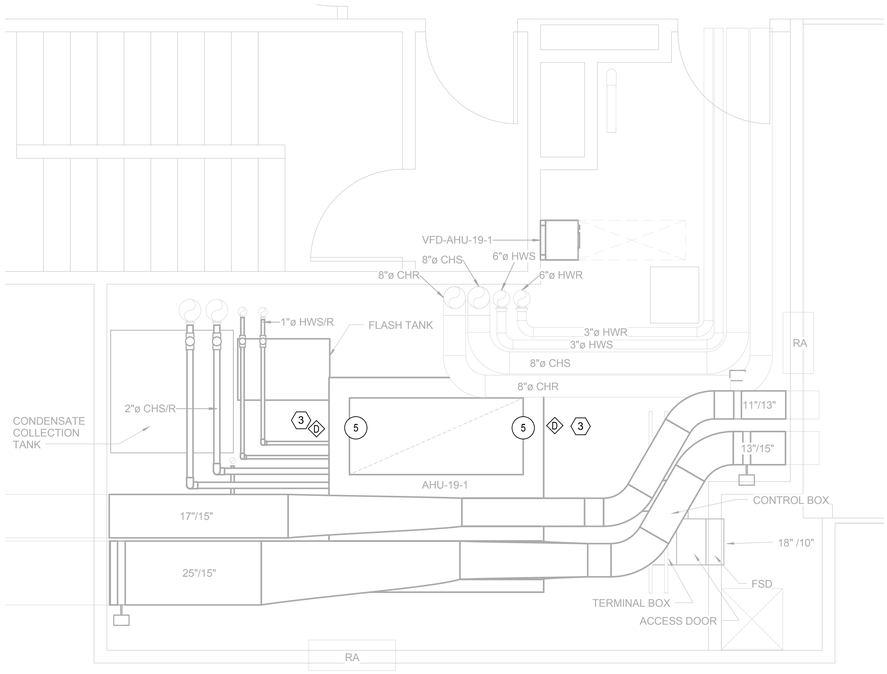

## LEVEL 19 - DEMOLITION - MECHANICAL ROOM EAST

1 1/2" = 1'-0"



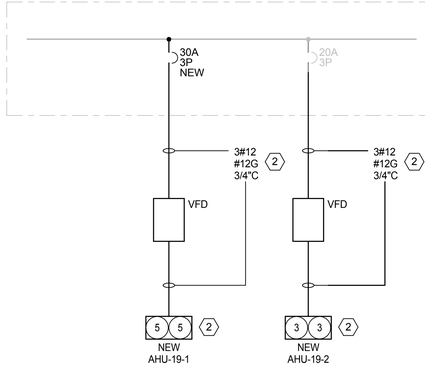

## ONE LINE DIAGRAM DEMO - AHU-19-1, AHU-19-2

1A NO SCALE




## LEVEL 19 - RENOVATION - MECHANICAL ROOM EAST

2 1/2" = 1'-0"




## ONE LINE DIAGRAM RENO - AHU-19-1, AHU-19-2

2A NO SCALE

### GENERAL NOTES - GE-100

A NEW WORK SHOWN BOLD.

### KEYED NOTES - E-100-19E

1 REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.
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10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

## LEVEL 19 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-19E |
| Scale | As indicated |

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'


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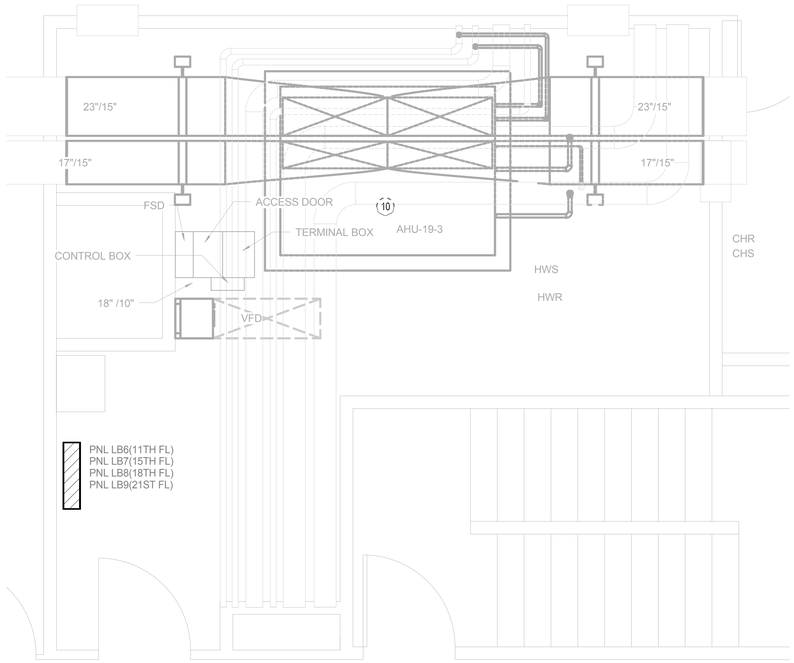
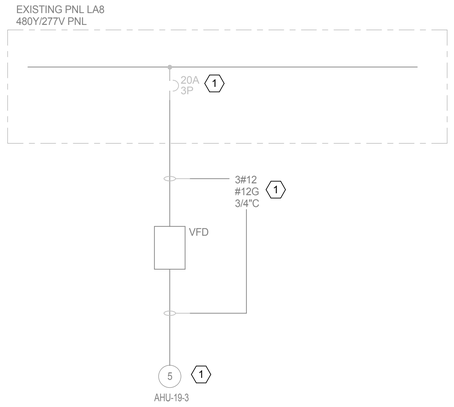


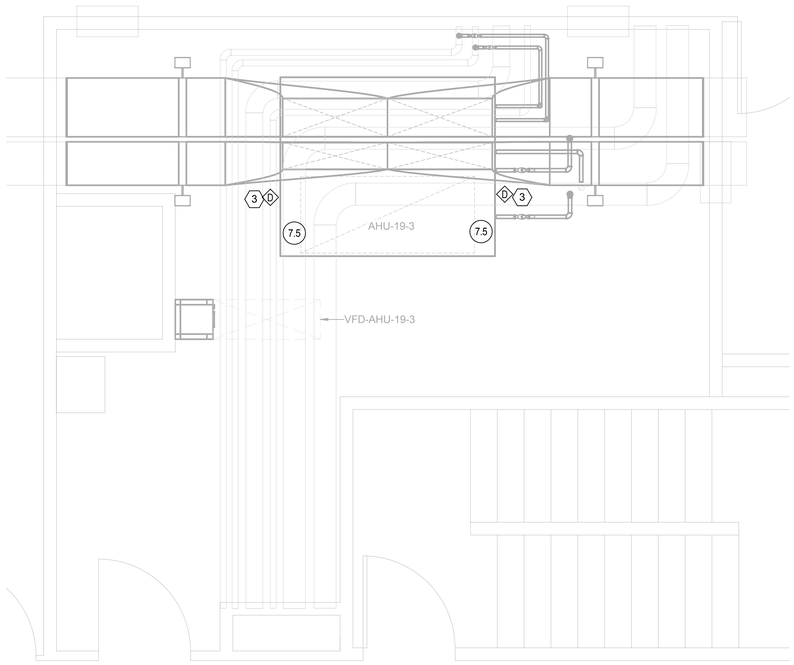

LEVEL 19 - DEMOLITION - MECHANICAL ROOM WEST

1 1/2" = 1'-0"



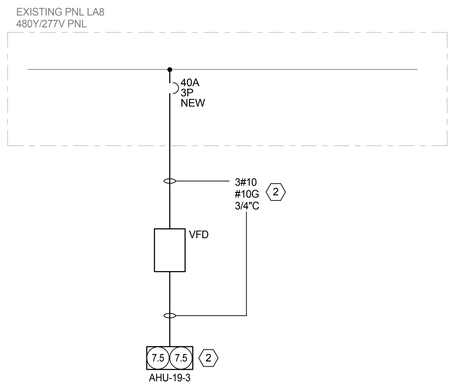

1A ONE LINE DIAGRAM DEMO - AHU-19-3

NO SCALE




LEVEL 19 - RENOVATION - MECHANICAL ROOM WEST

2 1/2" = 1'-0"




2A ONE LINE DIAGRAM RENO - AHU-19-3

NO SCALE

## GENERAL NOTES - GE-100

A NEW WORK SHOWN BOLD.

## KEYED NOTES - E-100-19W

1 REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.

2 NEW CONDUCTORS AND CONDUIT.

3 EXISTING DUCT DETECTORS TO BE REMOVED AND REPLACED WITH NEW DUCT DETECTORS. COORDINATE EXACT LOCATION WITH MECHANICAL EQUIPMENT INSTALLER.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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THE UNIVERSITY of TEXAS HEALTH SCIENCE CENTER AT HOUSTON

| No. | Description | Date |
|---|---|---|
| | Issue for Construction | 10/11/17 |

Keyplan

Tx. Registration # F-2113

DOUGLAS B. BELISLE 80083 LICENSED PROFESSIONAL ENGINEER STATE OF TEXAS

10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 19 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-19W |
| Scale | As indicated |

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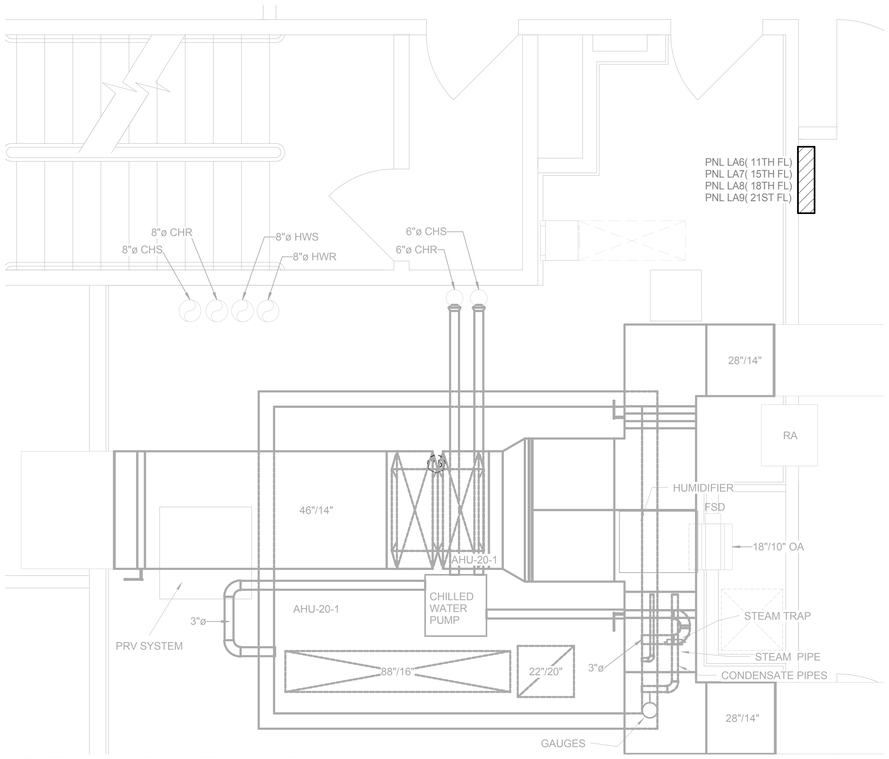
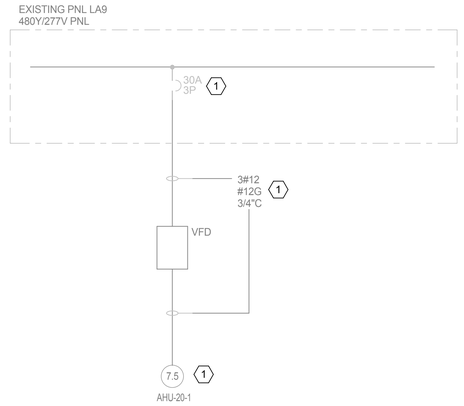
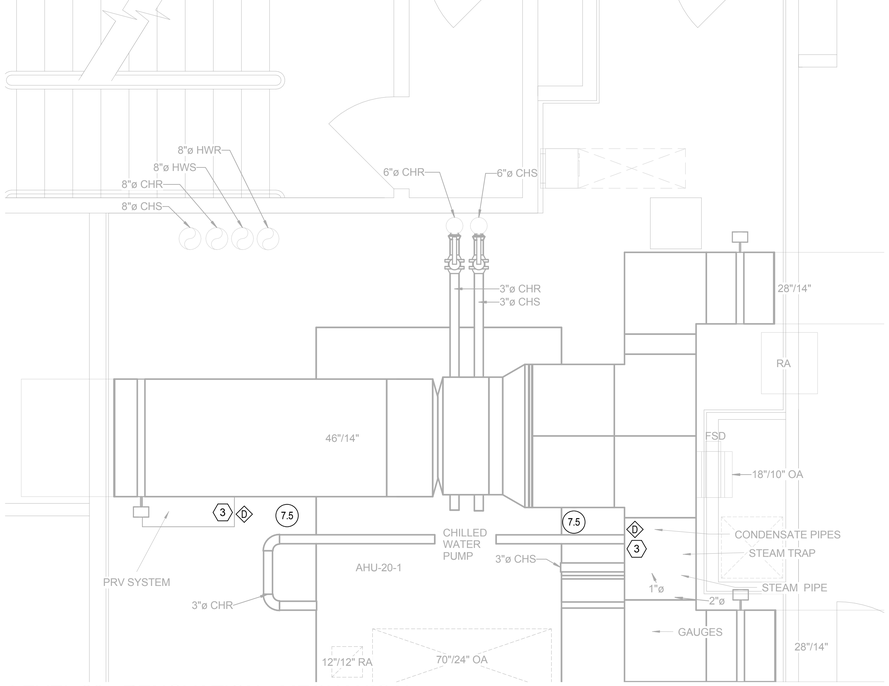


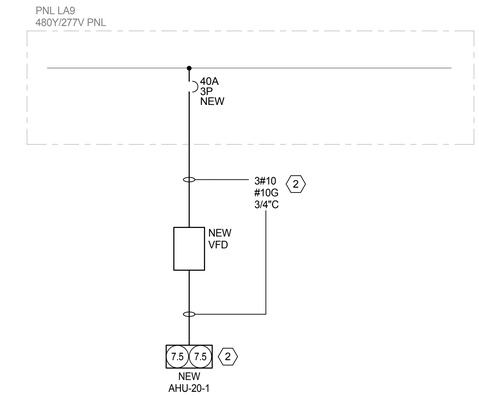

## 1 LEVEL 20 - DEMOLITION - MECHANICAL ROOM EAST
1/2" = 1'-0"




## 1A ONE LINE DIAGRAM DEMO - AHU-20-1
NO SCALE




## 2 LEVEL 20 - RENOVATION - MECHANICAL ROOM EAST
1/2" = 1'-0"




## 2A ONE LINE DIAGRAM RENO - AHU-20-1
NO SCALE

## GENERAL NOTES - GE-100

**A** NEW WORK SHOWN BOLD.

## KEYED NOTES - E-100-20E

1. REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.
2. NEW CONDUCTORS AND CONDUIT.
3. EXISTING DUCT DETECTORS TO BE REMOVED AND REPLACED WITH NEW DUCT DETECTORS. COORDINATE EXACT LOCATION WITH MECHANICAL EQUIPMENT INSTALLER.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THE UNIVERSITY of TEXAS
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| | Issue for Construction | 10/11/17 |

Keyplan

Tx. Registration # F-2113
DOUGLAS B. BELISLE 80083 LICENSED PROFESSIONAL ENGINEER
10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

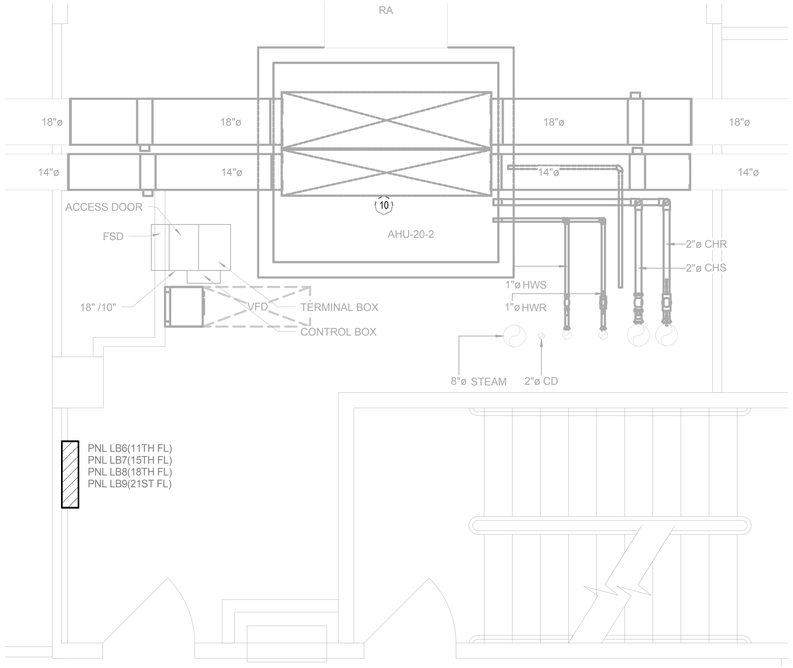
LEVEL 20 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-20E |
| Scale | As indicated |

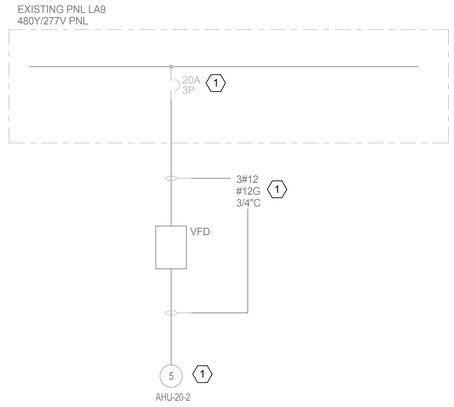
True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

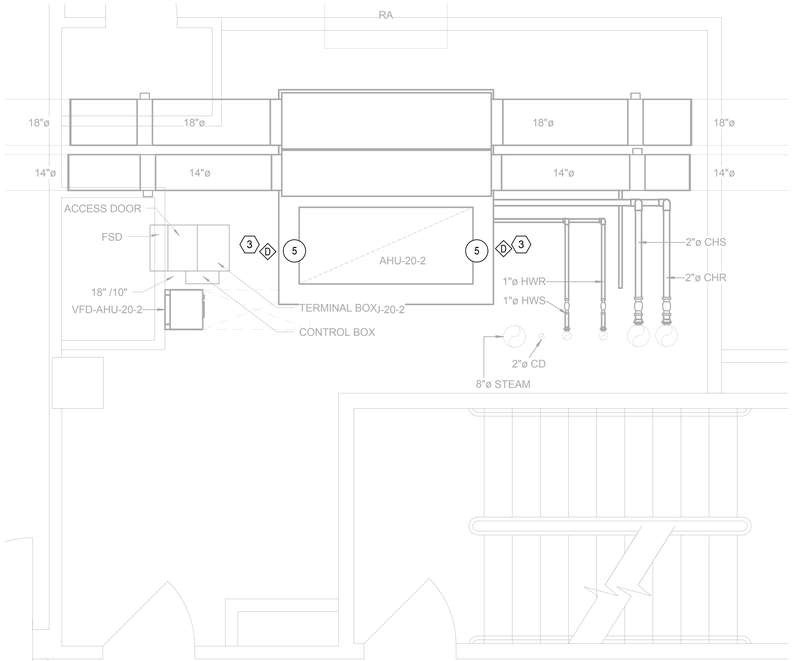
10/10/2017 8:30:12 AM C:\Users\kmozer\Documents\1095-034-01_Elec_R16_kmozer_SSA.rvt



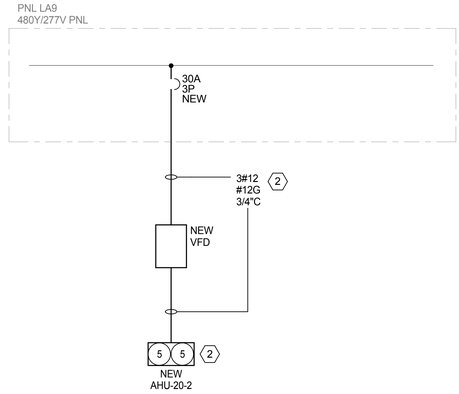

1 LEVEL 20 - DEMOLITION - MECHANICAL ROOM WEST
1/2" = 1'-0"




1A ONE LINE DIAGRAM DEMO - AHU-20-2
NO SCALE




2 LEVEL 20 - RENOVATION - MECHANICAL ROOM WEST
1/2" = 1'-0"




2A ONE LINE DIAGRAM RENO - AHU-20-2
NO SCALE

## GENERAL NOTES - GE-100

**A** NEW WORK SHOWN BOLD.

## KEYED NOTES - E-100-20W

1. REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.
2. NEW CONDUCTORS AND CONDUIT.
3. EXISTING DUCT DETECTORS TO BE REMOVED AND REPLACED WITH NEW DUCT DETECTORS. COORDINATE EXACT LOCATION WITH MECHANICAL EQUIPMENT INSTALLER.

SHAH SMITH & ASSOCIATES, INC.
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Ph. 713.780.7563 Fax.713.780.9209
Texas Registered Engineering Firm F-2113

Philo Wilke Partnership

THE UNIVERSITY of TEXAS
HEALTH SCIENCE CENTER AT HOUSTON

| No. | Description | Date |
|---|---|---|
| | Issue for Construction | 10/11/17 |

Keyplan

Tx. Registration # F-2113
DOUGLAS B. BELISLE 80083 LICENSED PROFESSIONAL ENGINEER
10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

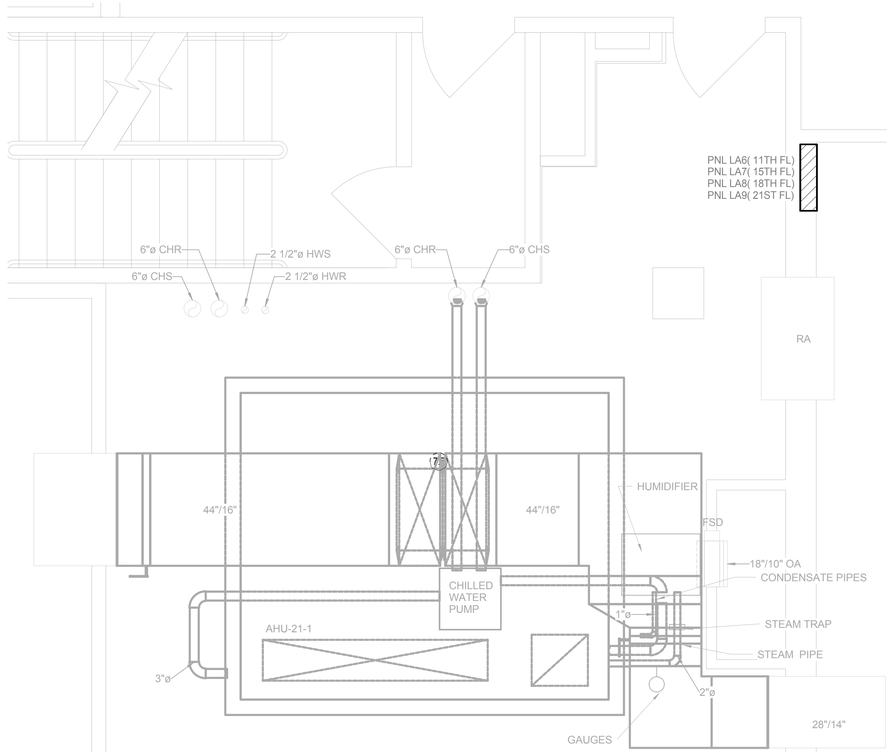
LEVEL 20 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-20W |
| Scale | As indicated |

True NORTH Plan NORTH

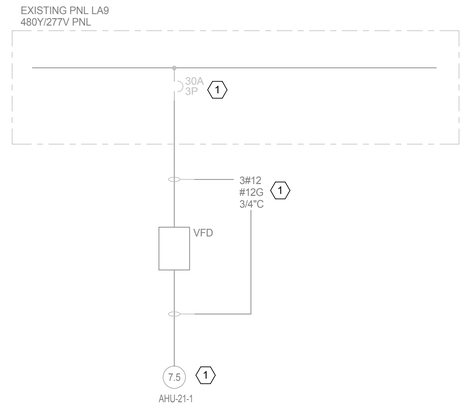
0' 2' 4'
1/2" = 1'-0"

10/10/2017 8:30:14 AM C:\Users\kmozer\Documents\1095-034-01_Elec_R16_kmozer_SSA.rvt



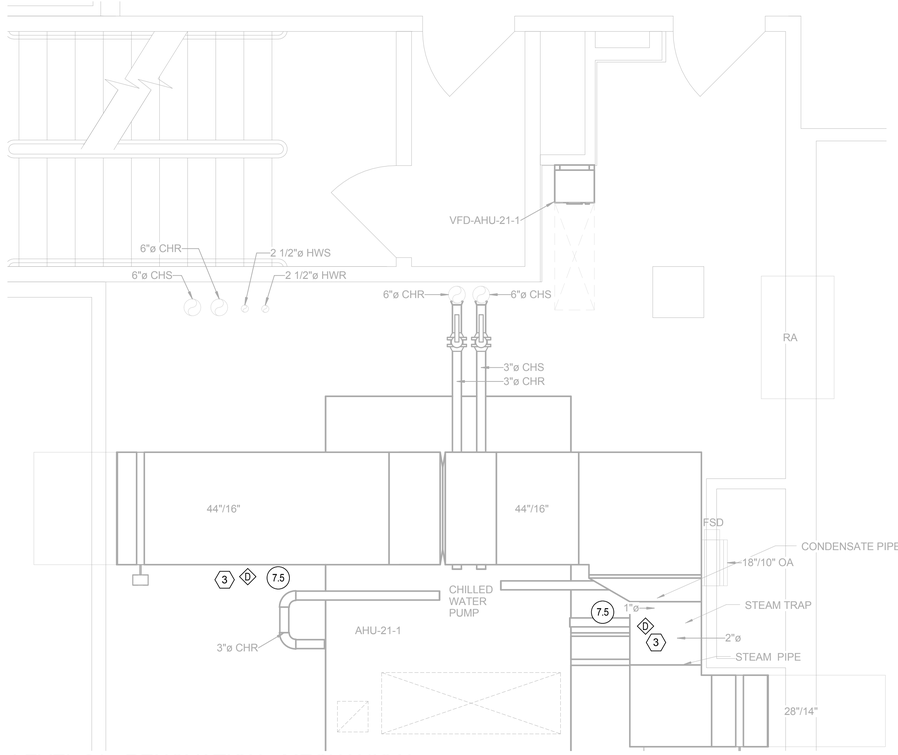

## LEVEL 21 - DEMOLITION - MECHANICAL ROOM EAST

1 1/2" = 1'-0"



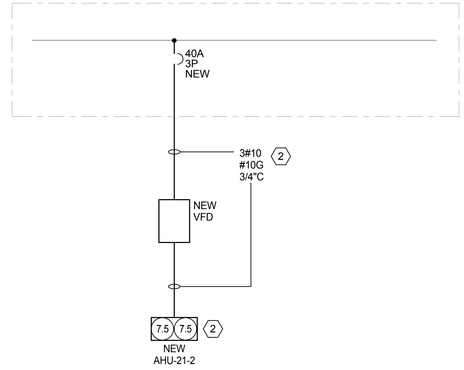

## 1A ONE LINE DIAGRAM DEMO - AHU-21-1

NO SCALE




## LEVEL 21 - RENOVATION - MECHANICAL ROOM EAST

2 1/2" = 1'-0"




## 2A ONE LINE DIAGRAM RENO - AHU-21-1

NO SCALE

### GENERAL NOTES - GE-100

A NEW WORK SHOWN BOLD.

### KEYED NOTES - E-100-21E

1 REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.
2 NEW CONDUCTORS AND CONDUIT.
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# UCT AHU REPLACEMENT

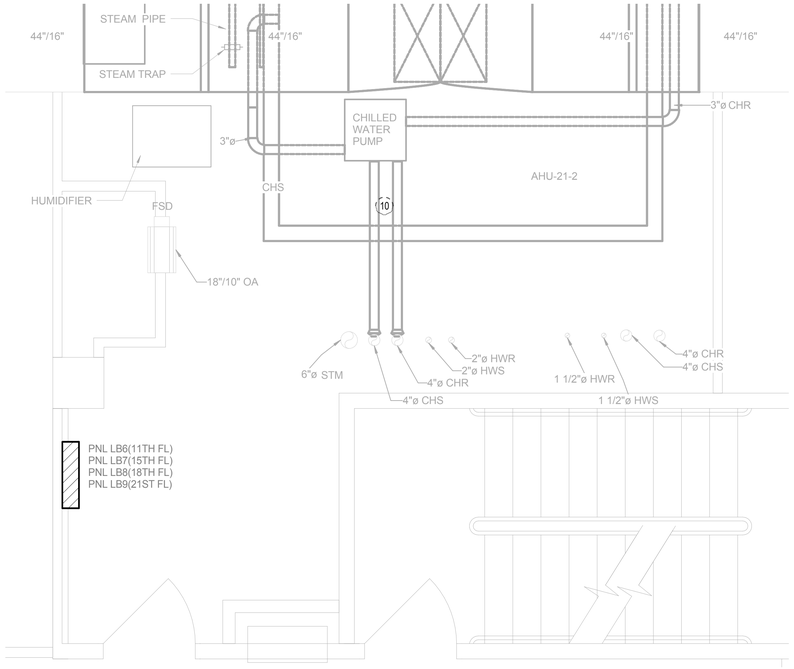
## LEVEL 21 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-21E |
| Scale | As indicated |

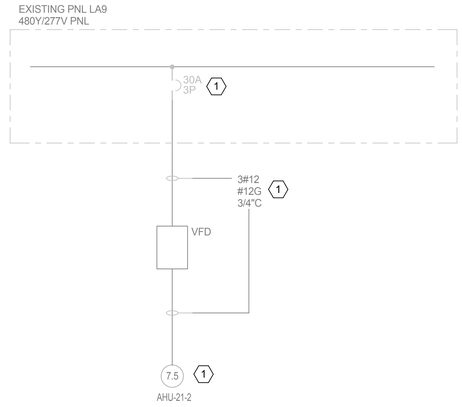
True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

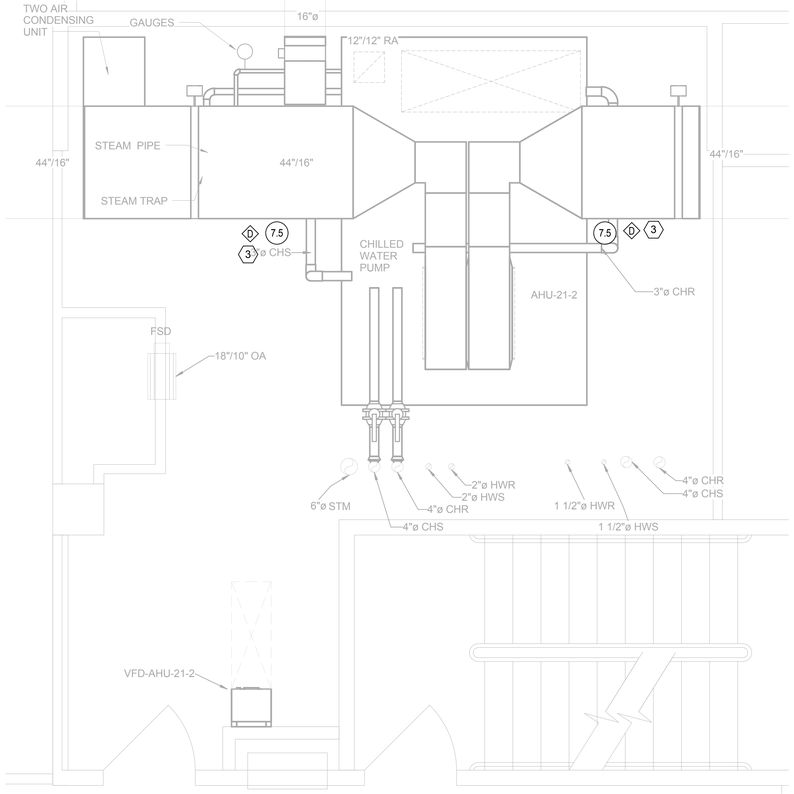
10/10/2017 8:30:15 AM C:\Users\kmozer\Documents\1095-034-01_Elec_R16_kmozer_SSA.rvt



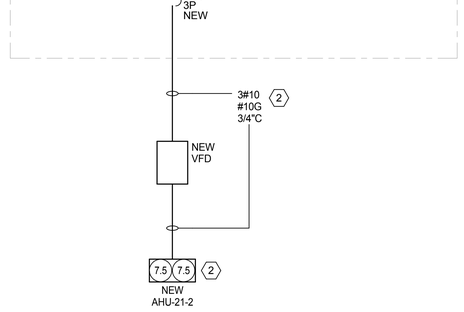

## 1 LEVEL 21 - DEMOLITION - MECHANICAL ROOM WEST
1/2" = 1'-0"




## 1A ONE LINE DIAGRAM DEMO - AHU-21-2
NO SCALE




## 2 LEVEL 21 - RENOVATION - MECHANICAL ROOM WEST
1/2" = 1'-0"




## 2A ONE LINE DIAGRAM RENO - AHU-21-2
NO SCALE

### GENERAL NOTES - GE-100

**A** NEW WORK SHOWN BOLD.

### KEYED NOTES - E-100-21W

1. REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.
2. NEW CONDUCTORS AND CONDUIT.
3. EXISTING DUCT DETECTORS TO BE REMOVED AND REPLACED WITH NEW DUCT DETECTORS. COORDINATE EXACT LOCATION WITH MECHANICAL EQUIPMENT INSTALLER.

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10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

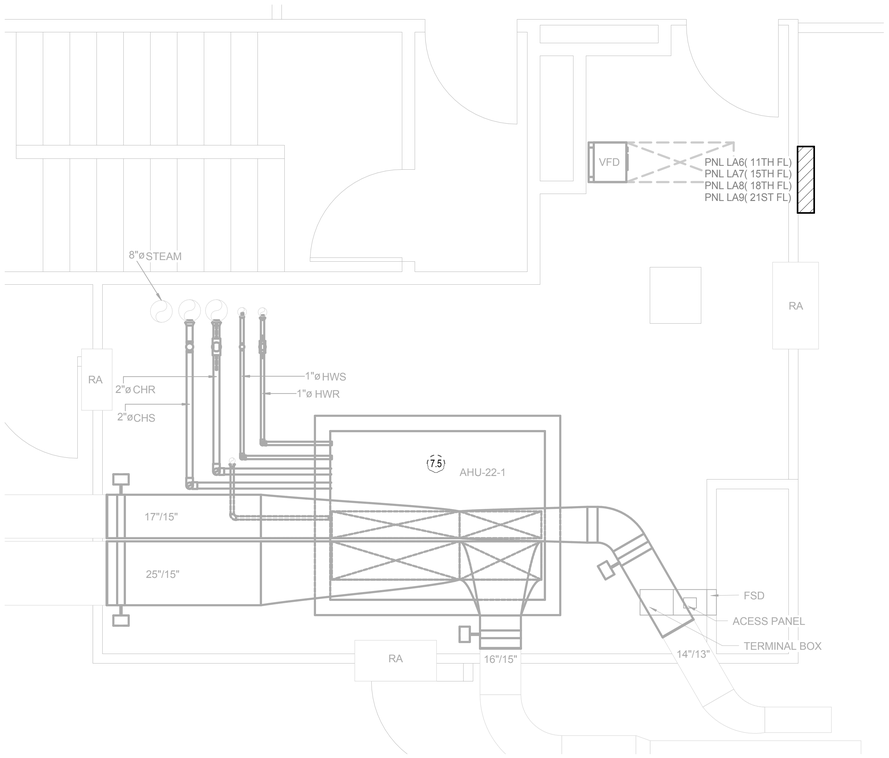
LEVEL 21 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-21W |
| Scale | As indicated |

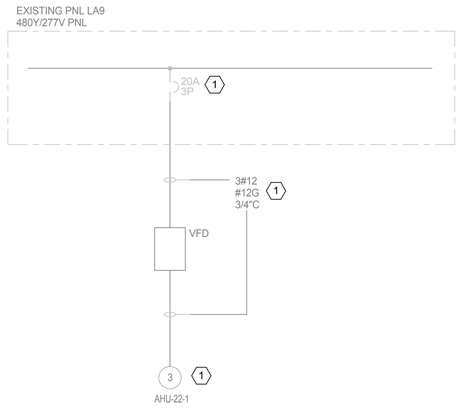
True NORTH Plan NORTH

0' 2' 4'
1/2" = 1'-0"

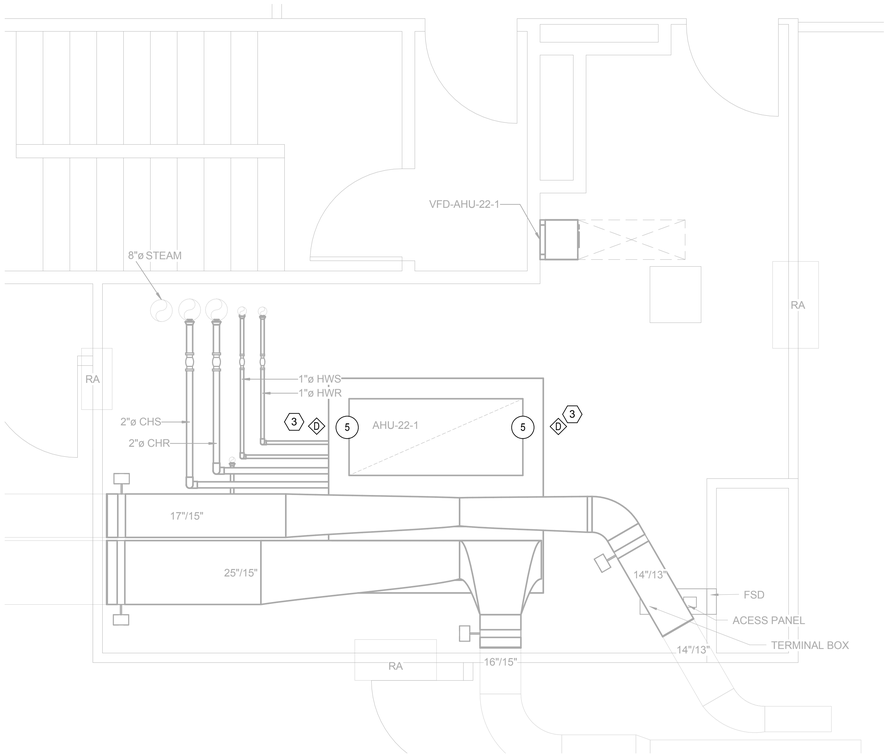
10/10/2017 8:30:16 AM C:\Users\kmozer\Documents\1095-034-01_Elec_R16_kmozer_SSA.rvt



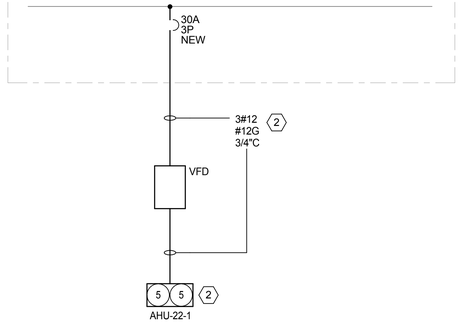

1 LEVEL 22 - DEMOLITION - MECHANICAL ROOM EAST
1/2" = 1'-0"




1A ONE LINE DIAGRAM DEMO - AHU-22-1
NO SCALE




2 LEVEL 22 - RENOVATION - MECHANICAL ROOM EAST
1/2" = 1'-0"




2A ONE LINE DIAGRAM RENO - AHU-22-1
NO SCALE

## GENERAL NOTES - GE-100

**A NEW WORK SHOWN BOLD.**

## KEYED NOTES - E-100-22E

**1 REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.**

**2 NEW CONDUCTORS AND CONDUIT.**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10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 22 EAST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-22E |
| Scale | As indicated |

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'


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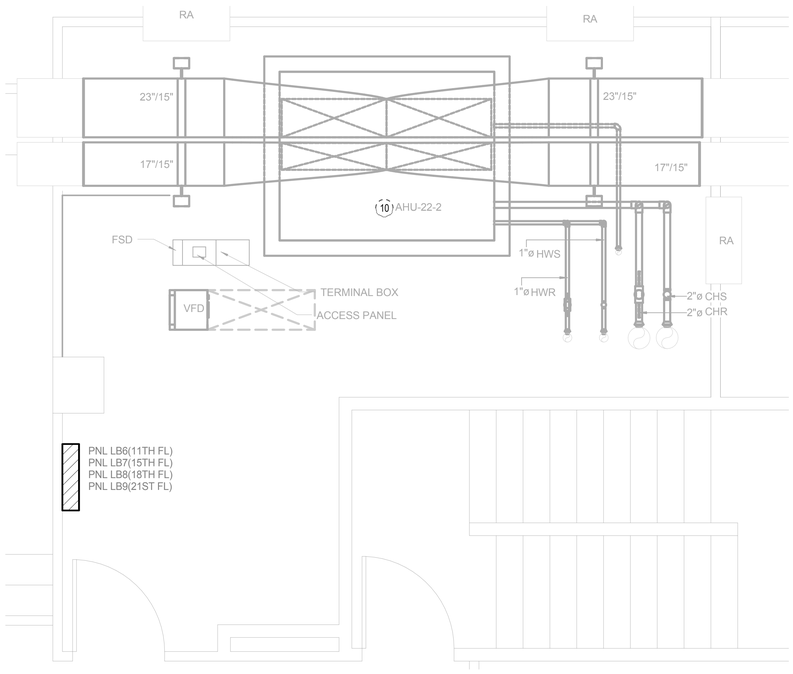
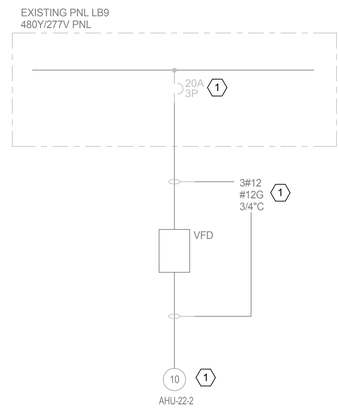
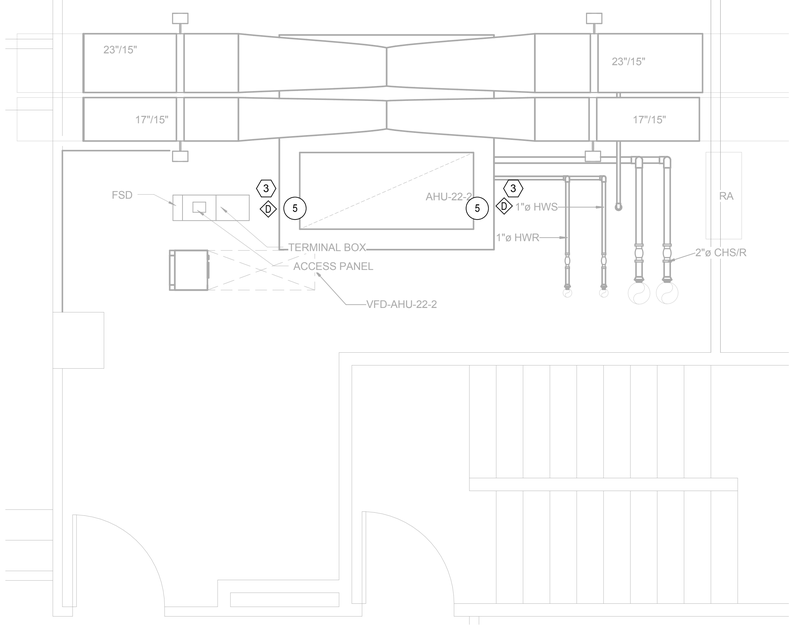


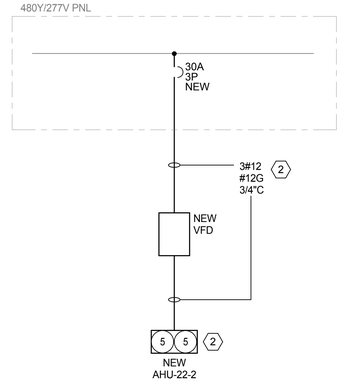

## 1 LEVEL 22 - DEMOLITION - MECHANICAL ROOM WEST
1/2" = 1'-0"




## 1A ONE LINE DIAGRAM DEMO - AHU-22-2
NO SCALE




## 2 LEVEL 22 - RENOVATION - MECHANICAL ROOM WEST
1/2" = 1'-0"




## 2A ONE LINE DIAGRAM RENO - AHU-22-2
NO SCALE

### GENERAL NOTES - GE-100

**A** NEW WORK SHOWN BOLD.

### KEYED NOTES - E-100-22W

1. REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.
2. NEW CONDUCTORS AND CONDUIT.
3. EXISTING DUCT DETECTORS TO BE REMOVED AND REPLACED WITH NEW DUCT DETECTORS. COORDINATE EXACT LOCATION WITH MECHANICAL EQUIPMENT INSTALLER.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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Philo Wilke Partnership

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|---|---|---|
| | Issue for Construction | 10/11/17 |

Keyplan

Tx. Registration # F-2113
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10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

LEVEL 22 WEST ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-22W |
| Scale | As indicated |

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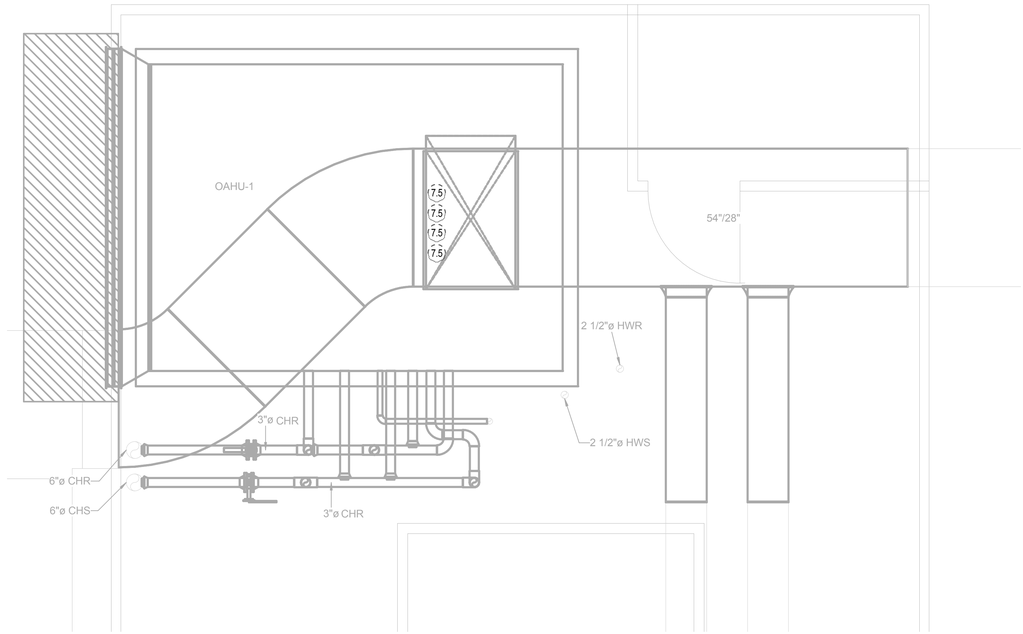
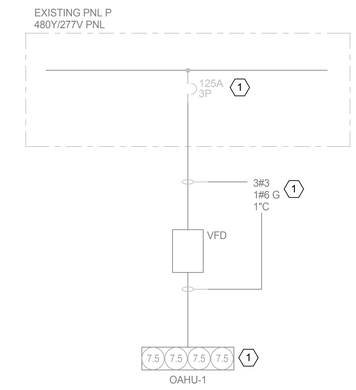
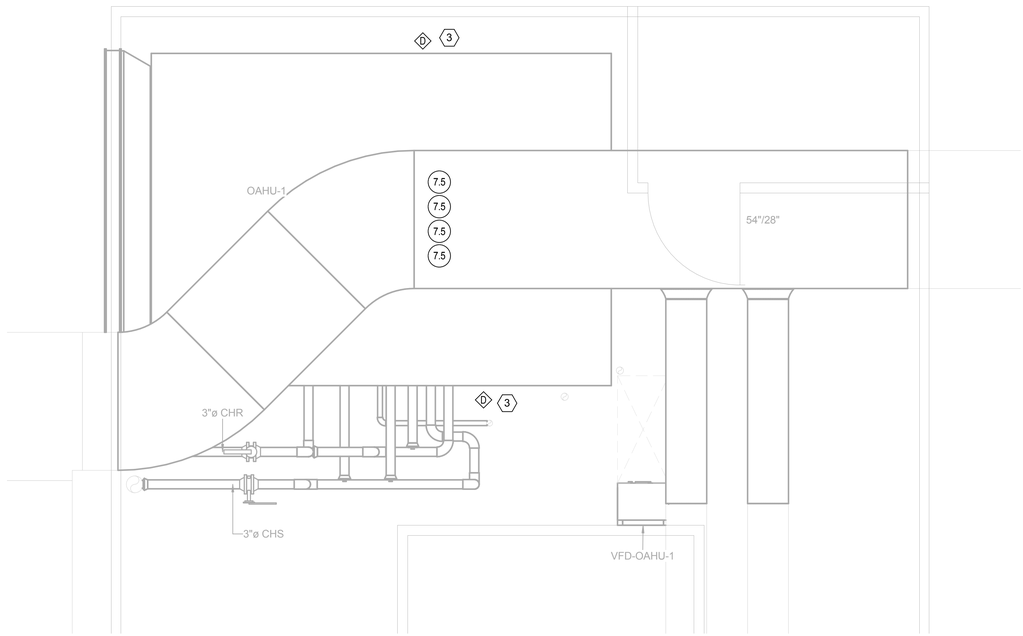


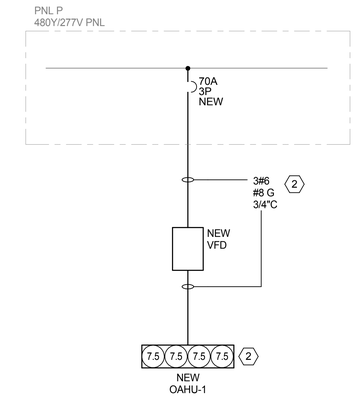

1 PENTHOUSE - DEMOLITION - MECHANICAL ROOM
1/2" = 1'-0"




3 ONE LINE DIAGRAM DEMO - OAHU-1
NO SCALE




2 PENTHOUSE - RENOVATION - MECHANICAL ROOM
1/2" = 1'-0"




4 ONE LINE DIAGRAM RENO - OAHU-1
NO SCALE

## GENERAL NOTES - GE-100

A NEW WORK SHOWN BOLD.

## KEYED NOTES - E-100-P

1 REMOVE CONDUCTORS AND CONDUIT. REPLACE BREAKER WITH NEW BREAKER.
2 NEW CONDUCTORS AND CONDUIT.
3 EXISTING DUCT DETECTORS TO BE REMOVED AND REPLACED WITH NEW DUCT DETECTORS. COORDINATE EXACT LOCATION WITH MECHANICAL EQUIPMENT INSTALLER.

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Philo Wilke Partnership

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| No. | Description | Date |
|---|---|---|
| | Issue for Construction | 10/11/17 |

Keyplan

Tx. Registration # F-2113
DOUGLAS B. BELISLE 80083 LICENSED PROFESSIONAL ENGINEER
10/11/2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

PENTHOUSE ENLARGED MECHANICAL PLAN - ELECTRICAL

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | KTM |
| Checked By | DBB |
| Drawing No. | E-100-P |
| Scale | As indicated |

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

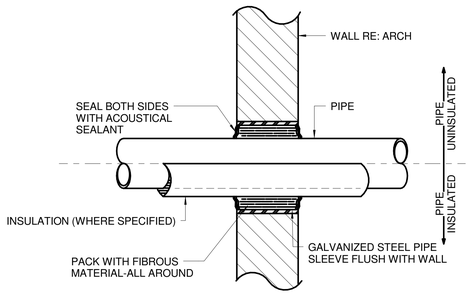
10/10/2017 8:30:20 AM C:\Users\kmozer\Documents\1095-034-01_Elec_R16_kmozer_SSA.rvt

## PLUMBING LEGEND

| SYMBOL | ABBREV. | DESCRIPTION | SYMBOL | ABBREV. | DESCRIPTION |
|---|---|---|---|---|---|
| SAN-1 / 4" | | SANITARY STACK & NUMBER | ——SAN—— | SAN | SANITARY |
| | | STACK SIZE | – – – – – – | V | VENT |
| V-1 / 4" | | VENT STACK & NUMBER | | WCO | WALL CLEANOUT |
| | | STACK SIZE | | AP | ACCESS PANEL |
| ⊣I | CO | CLEANOUT | | FL | FLOW LINE |
| | POC | POINT OF CONNECTION | | BFF | BELOW FINISHED FLOOR |
| | AFF | ABOVE FINISHED FLOOR | | | |

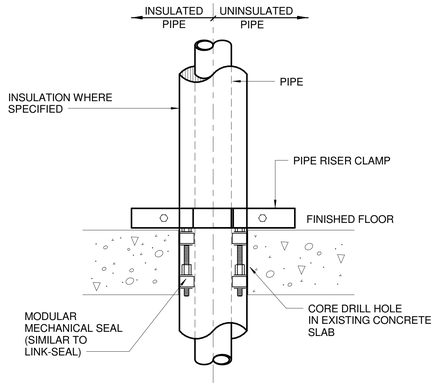
## GENERAL NOTES

1. PRIOR TO WORK CONTRACTOR SHALL COORDINATE PLUMBING WORK WITH OTHER TRADES.
2. MAKE ROUGH-IN AND FINAL CONNECTION TO ALL PLUMBING FIXTURES.
3. ALL NEW WORK SHALL CONFORM TO THE 2012 EDITION OF THE UNIFORM PLUMBING CODE UNLESS OTHERWISE NOTED OR SHOWN.
4. DRAWINGS ARE DIAGRAMMATIC IN NATURE, NOT ALL REQUIRED PIPE ELBOWS, TEES, AND ASSOCIATED FITTINGS ARE SHOWN. CONTRACTOR SHALL PROVIDE A COMPLETE WORKING PLUMBING SYSTEM PER THE SPECIFICATIONS AND PLUMBING CODE.
5. FIRE PROTECTION PIPING SHALL BE COORDINATED AROUND OTHER TRADES, SUCH AS PLUMBING, HVAC AND ELECTRICAL.
6. VERIFY LOCATION OF ALL FLOOR DRAINS WITH THE EQUIPMENT ROUGH-IN LOCATION.
7. CONTRACTOR SHALL COORDINATE DOWNTIME OF EXISTING SYSTEMS WITH OWNER PRIOR TO WORK.

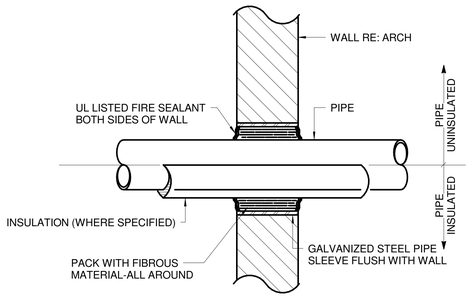



NOTES:
1. WHERE PIPING IS EXPOSED TO VIEW PROVIDE WITH ESCUTCHEON.

### 1 PIPE PENETRATION THRU NON-RATED WALL
NO SCALE




### 2 PIPE PENETRATION THRU EXISTING ELEVATED SLAB DETAIL
NO SCALE




NOTES:
1. WHERE PIPING IS EXPOSED TO VIEW PROVIDE WITH ESCUTCHEON.

### 3 PIPE PENETRATION THRU FIRE-RATED WALL
NO SCALE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Philo Wilke Partnership

THE UNIVERSITY of TEXAS HEALTH SCIENCE CENTER AT HOUSTON

| No. | Description | Date |
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| | Issue for Construction | 10/11/17 |

Keyplan

Tx. Registration # F-2113
STATE OF TEXAS
DAVID S. HALL
96908
LICENSED
PROFESSIONAL ENGINEER
10-11-2017

The University of Texas Health Science Center at Houston

# UCT AHU REPLACEMENT

PLUMBING LEGENDS, GENERAL NOTES AND SCHEDULES

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | Designer |
| Checked By | Checker |
| Drawing No. | P-001 |
| Scale | NO SCALE |

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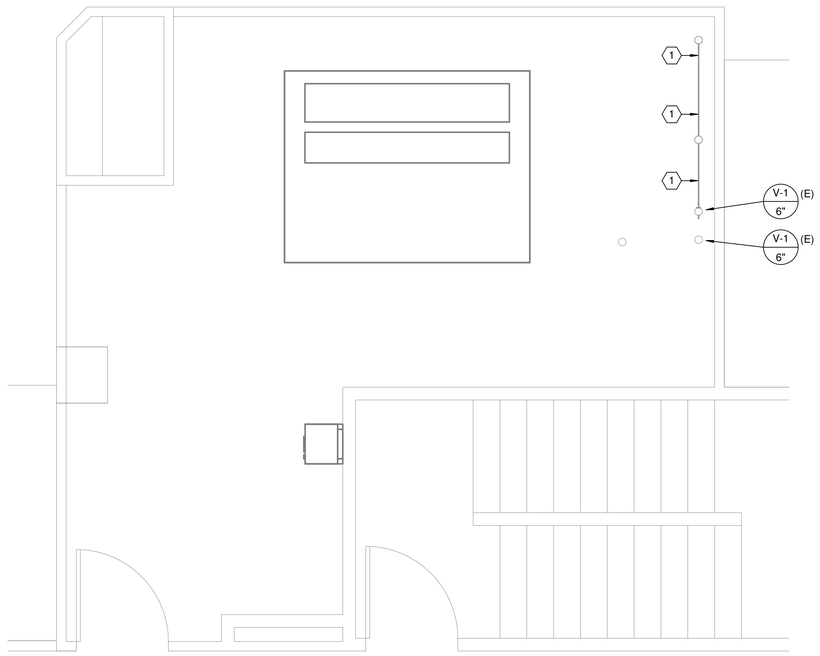


1 LEVEL 6 - PLUMBING RENOVATION - MECHANICAL ROOM WEST
1/2" = 1'-0"

## KEYED NOTES - P-100-6W

1 INSULATE PVC PIPING TO MEET NFPA RETURN AIR PLENUM REQUIREMENTS.

True NORTH  Plan NORTH

1/2" = 1'-0"  0'  2'  4'


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# UCT AHU REPLACEMENT

## LEVEL 6 WEST ENLARGED PLUMBING PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | BB |
| Checked By | RN |
| Drawing No. | P-100-6W |
| Scale | 1/2" = 1'-0" |

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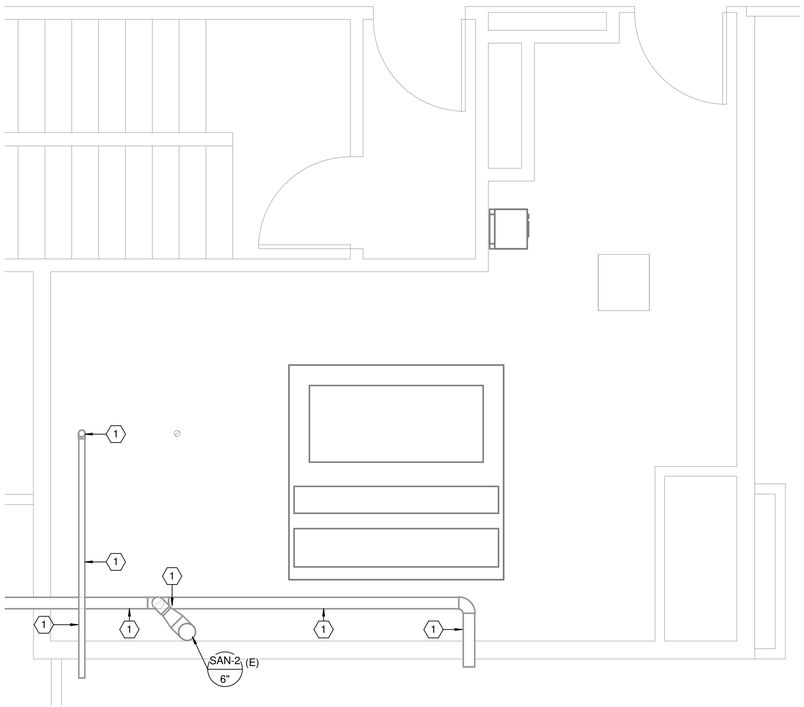
## KEYED NOTES - P-100-7E

1 INSULATE 2" PVC PIPING TO MEET NFPA RETURN AIR PLENUM REQUIREMENTS.




1 LEVEL 7 - PLUMBING RENOVATION - MECHANICAL ROOM EAST
1/2" = 1'-0"

True NORTH Plan NORTH

1/2" = 1'-0" 0" 2" 4"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# UCT AHU REPLACEMENT

LEVEL 7 EAST ENLARGED PLUMBING PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | BB |
| Checked By | RN |
| Drawing No. | P-100-7E |
| Scale | 1/2" = 1'-0" |

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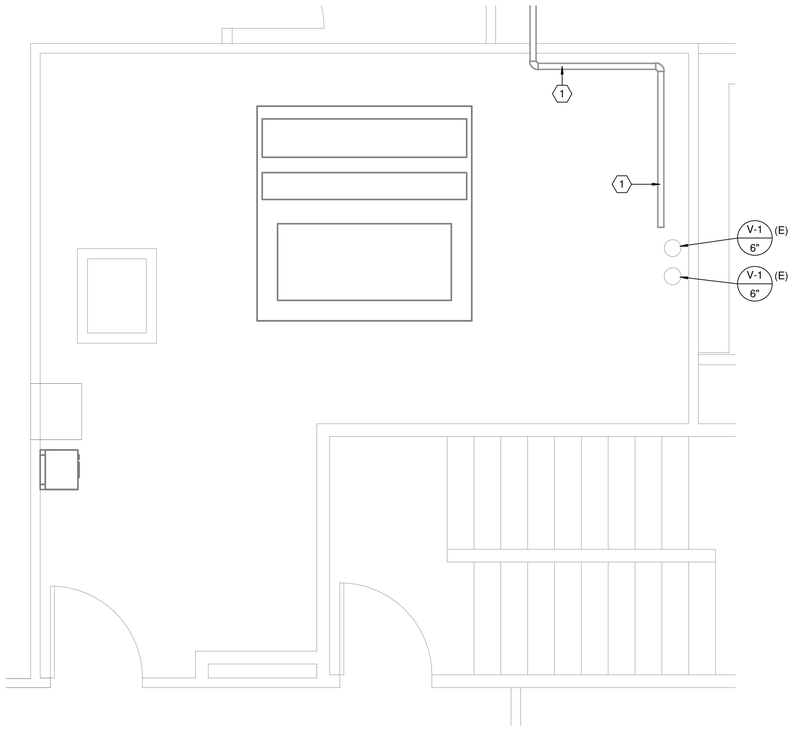
## KEYED NOTES - P-100-7W

1 INSULATE 2" PVC PIPING TO MEET NFPA RETURN AIR PLENUM REQUIREMENTS.




1 LEVEL 7 - PLUMBING RENOVATION - MECHANICAL ROOM WEST
1/2" = 1'-0"

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'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# UCT AHU REPLACEMENT

## LEVEL 7 WEST ENLARGED PLUMBING PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | BB |
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| Drawing No. | P-100-7W |
| Scale | 1/2" = 1'-0" |

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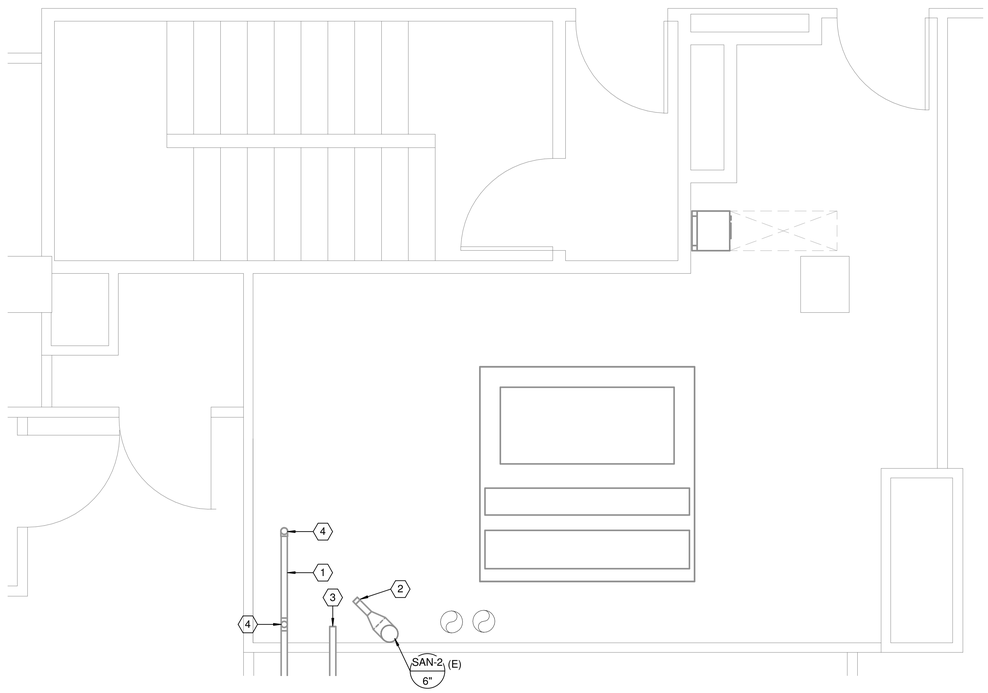
## KEYED NOTES - P-100-8E1

1 REMOVE EXISTING, REMOVE ABANDONDED PVC PIPING SERVING FLOOR ABOVE.

2 CAP EXISTING CAST IRON SANITARY RISER WITH NEW CAST IRON SANITARY PIPE CAP.

3 REMOVE EXISTING OPEN PVC PIPING AND REPAIR WALL TO MAINTAIN CURRENT FIRE RATING.

4 REMOVE PVC THRU FLOOR ABOVE. PATCH FLOOR TO MATCH FINISH AND STRENGTH.




LEVEL 8 - PLUMBING RENOVATION - MECHANICAL ROOM EAST

1 1/2" = 1'-0"

True NORTH

Plan NORTH

1/2" = 1'-0" 0' 2' 4'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# UCT AHU REPLACEMENT

## LEVEL 8 EAST ENLARGED PLUMBING PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
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| Drawing No. | P-100-8E |
| Scale | 1/2" = 1'-0" |

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LEVEL 8 - PLUMBING PLAN - MECHANICAL ROOM WEST
1 1/2" = 1'-0"

**KEYED NOTES - P-100-8W**

1 REMOVE EXISTING, ABANDONDED PVC PIPING.
2 REMOVE PVC THRU FLOOR. PATCH FLOOR TO MATCH FINISH AND STRENGTH.
3 CAP EXISTING CAST IRON SANITARY RISER WITH NEW SANITARY PIPE CAP.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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# UCT AHU REPLACEMENT

LEVEL 8 WEST ENLARGED PLUMBING PLAN

| | |
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| Date | 10/11/2017 |
| Designed By | BB |
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| Drawing No. | P-100-8W |
| Scale | 1/2" = 1'-0" |

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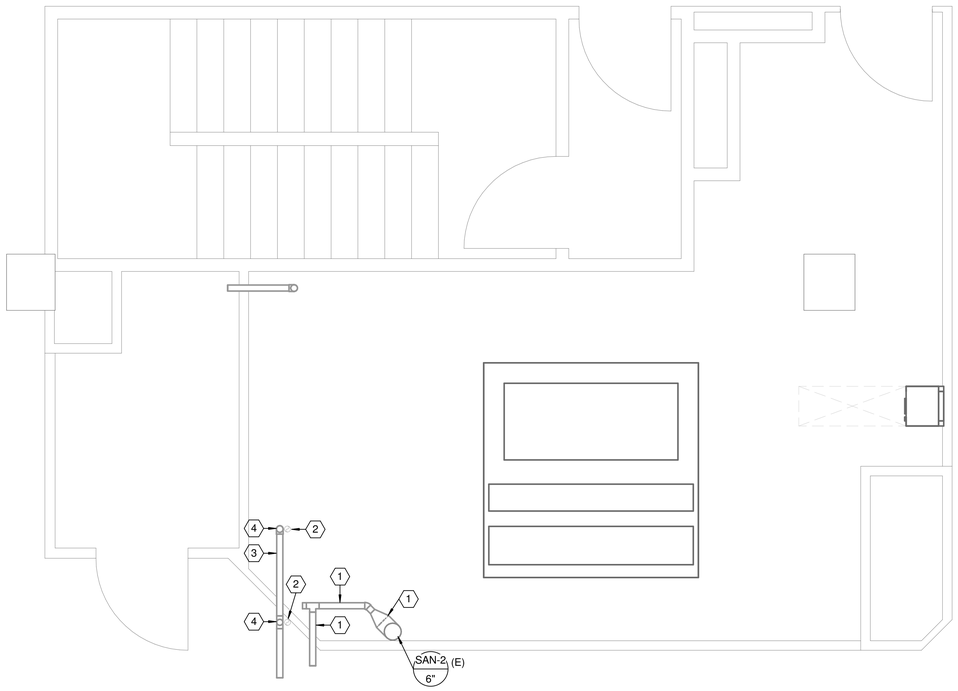


## KEYED NOTES - P-100-9E

1 INSULATE PVC PIPING TO MEET NFPA RETURN AIR PLENUM REQUIREMENTS.

2 REMOVE EXISTING PVC THRU FLOOR. PATCH FLOOR TO MATCH FINISH AND STRENGTH.

3 REMOVE EXISTING ABANDONDED PVC PIPING SERVING FLOOR ABOVE.

4 REMOVE PVC THRU FLOOR ABOVE. PATCH FLOOR TO MATCH FINISH AND STRENGTH.

## 1 LEVEL 9 - PLUMBING RENOVATION - MECHANICAL ROOM EAST

1/2" = 1'-0"

True NORTH Plan NORTH

0' 2' 4'
1/2" = 1'-0"

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LEVEL 9 EAST ENLARGED PLUMBING PLAN

| | |
|---|---|
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| Drawing No. | P-100-9E |
| Scale | 1/2" = 1'-0" |

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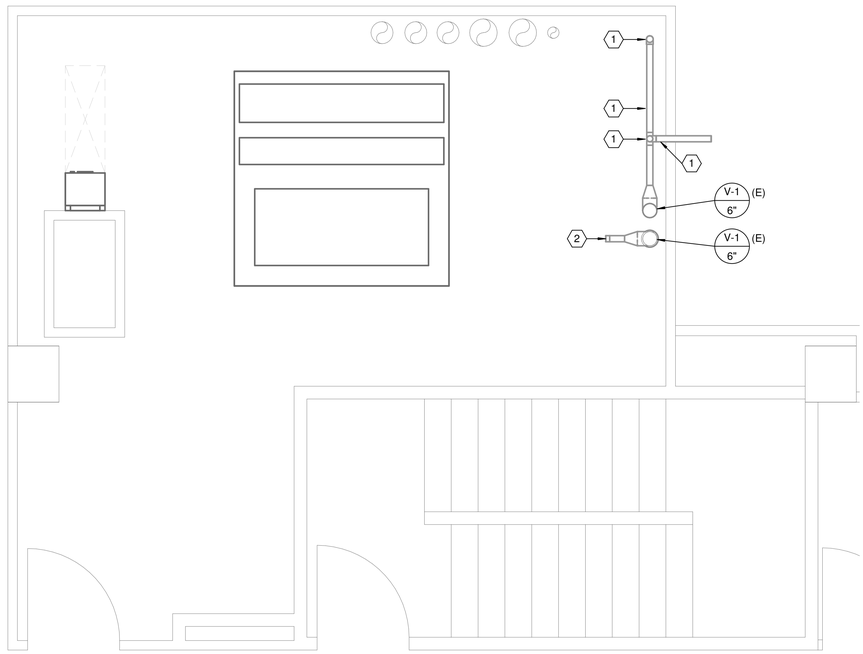


LEVEL 9 - PLUMBING RENOVATION
1 - MECHANICAL ROOM WEST
1/2" = 1'-0"

**KEYED NOTES - P-100-9W**

1 INSULATE PVC PIPING TO MEET NFPA RETURN AIR PLENUM REQUIREMENTS.
2 CAP EXISTING CAST IRON SANITARY RISER WITH NEW CAST IRON SANITARY PIPE CAP.

True NORTH
Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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# UCT AHU REPLACEMENT

LEVEL 9 WEST ENLARGED PLUMBING PLAN

| | |
|---|---|
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| Date | 10/11/2017 |
| Designed By | BB |
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| Drawing No. | P-100-9W |
| Scale | 1/2" = 1'-0" |

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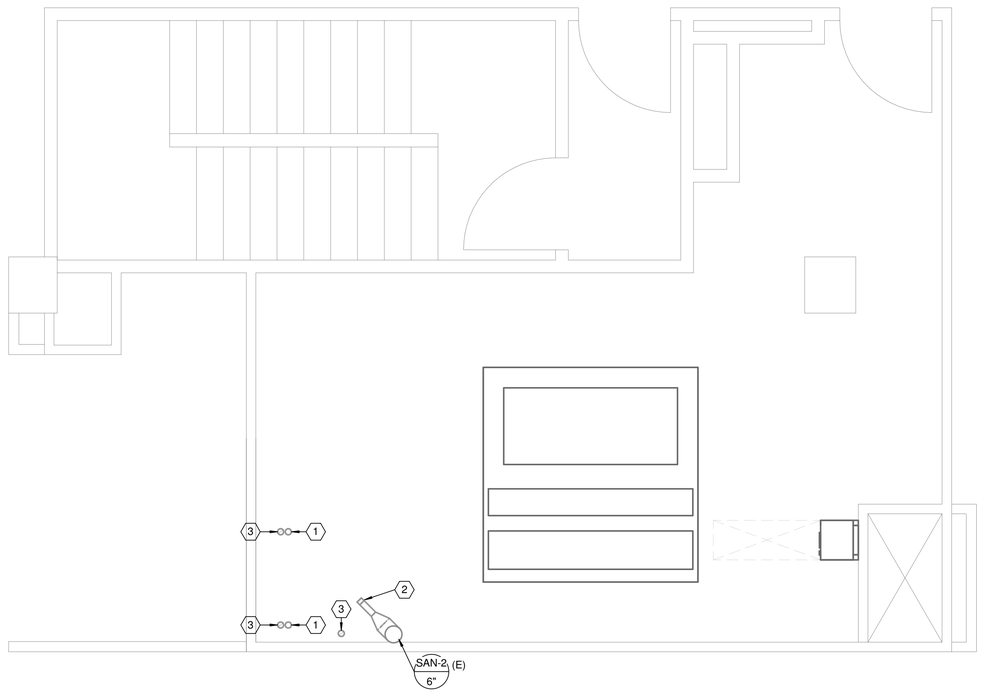


1 LEVEL 11 - PLUMBING RENOVATION - MECHANICAL ROOM EAST
1/2" = 1'-0"

**KEYED NOTES - P-100-11E**

1 REMOVE PVC THRU FLOOR ABOVE. PATCH FLOOR TO MATCH FINISH AND STRENGTH.
2 CAP EXISTING CAST IRON SANITARY RISER WITH NEW CAST IRON SANITARY PIPE CAP.
3 REMOVE PVC THRU FLOOR. PATCH FLOOR TO MATCH FINISH AND STRENGTH.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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# UCT AHU REPLACEMENT

LEVEL 11 EAST ENLARGED PLUMBING PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | BB |
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| Drawing No. | P-100-11E |
| Scale | 1/2" = 1'-0" |

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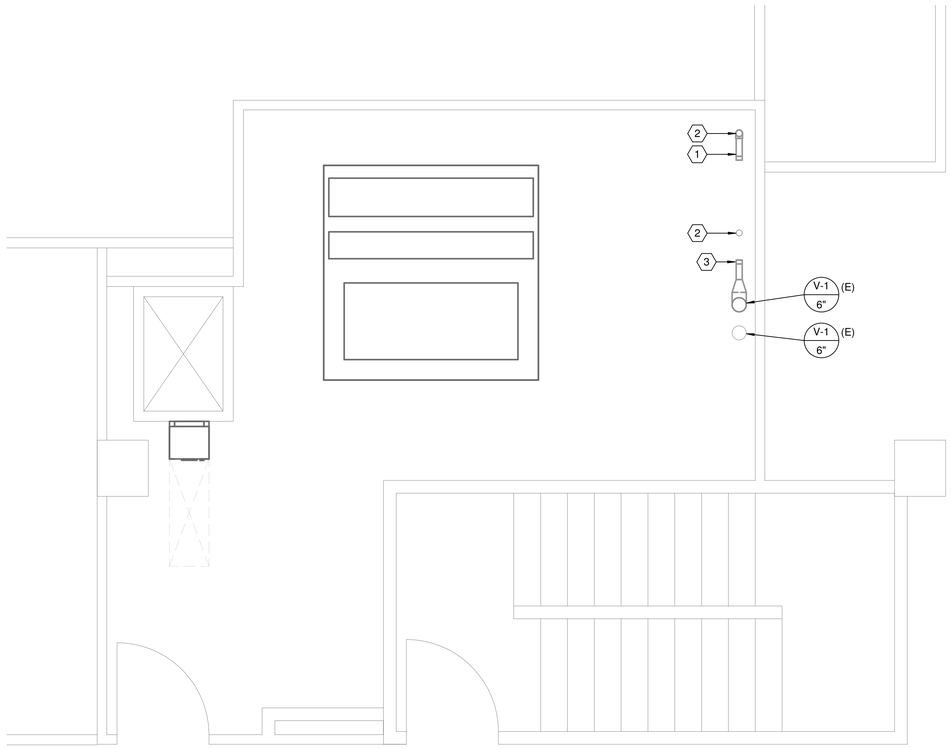


## KEYED NOTES - P-100-11W

1 REMOVE EXISTING ABANDONDED PVC PIPING.
2 REMOVE PVC THRU FLOOR. PATCH FLOOR TO MATCH FINISH AND STRENGTH.
3 CAP EXISTING CAST IRON SANITARY RISER WITH NEW SANITARY PIPE CAP.

## 1 LEVEL 11 - PLUMBING RENOVATION - MECHANICAL ROOM WEST

1/2" = 1'-0"

True NORTH Plan NORTH

1/2" = 1'-0" 0" 2" 4"


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# UCT AHU REPLACEMENT

LEVEL 11 WEST ENLARGED PLUMBING PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | BB |
| Checked By | RN |
| Drawing No. | P-100-11W |
| Scale | 1/2" = 1'-0" |

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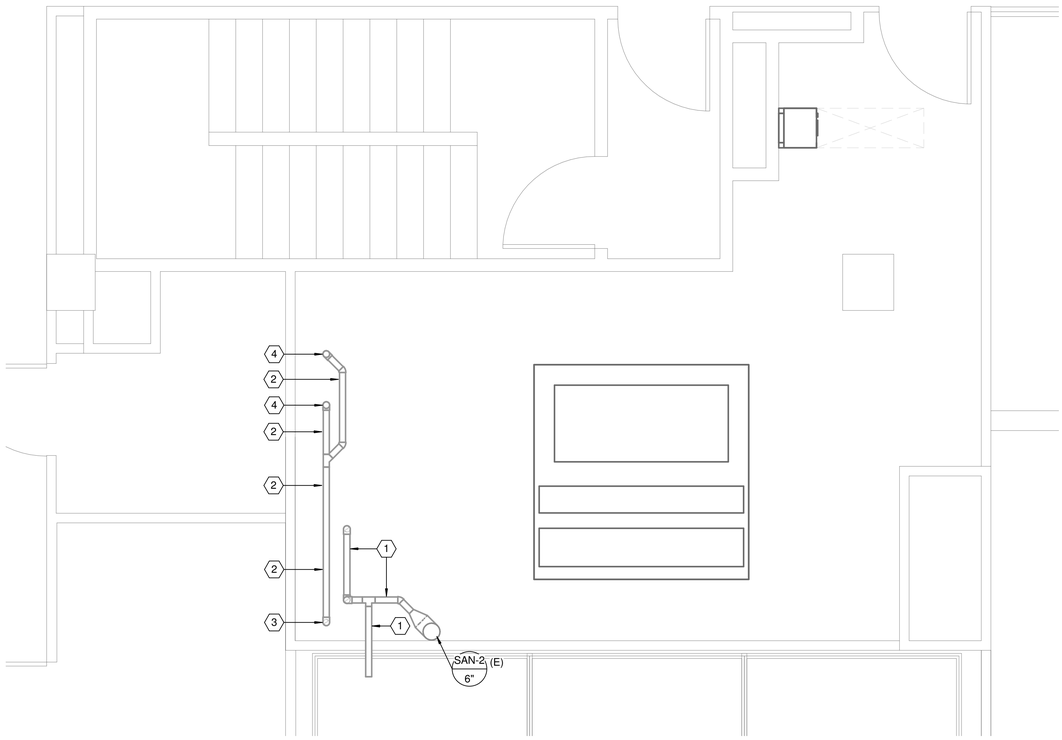


1 LEVEL 12 - PLUMBING RENOVATION - MECHANICAL ROOM EAST
1/2" = 1'-0"

**KEYED NOTES - P-100-12E**

1 INSULATE PVC PIPING TO MEET NFPA RETURN AIR PLENUM REQUIREMENTS.
2 REMOVE EXISTING ABANDONDED PVC PIPING SERVING FLOOR BELOW.
3 REMOVE PVC THRU FLOOR. PATCH FLOOR TO MATCH FINISH AND STRENGTH.
4 REMOVE PVC THRU FLOOR ABOVE. PATCH FLOOR TO MATCH FINISH AND STRENGTH.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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# UCT AHU REPLACEMENT

## LEVEL 12 EAST ENLARGED PLUMBING PLAN

| | |
|---|---|
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| Date | 10/11/2017 |
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| Drawing No. | P-100-12E |
| Scale | 1/2" = 1'-0" |

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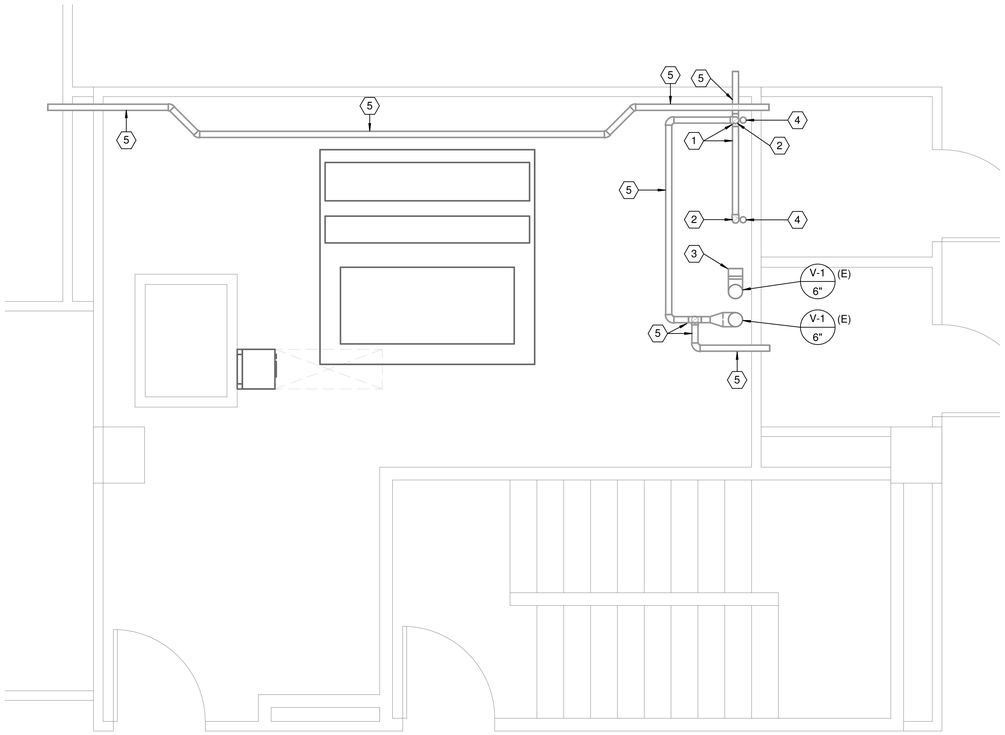


1 LEVEL 12 - PLUMBING RENOVATION - MECHANICAL ROOM WEST
1/2" = 1'-0"

## KEYED NOTES - P-100-12W

1 REMOVE EXISTING ABANDONDED PVC PIPING COMING FROM FLOOR BELOW.
2 REMOVE PVC THRU FLOOR. PATCH FLOOR TO MATCH FINISH AND STRENGTH.
3 CAP EXISTING CAST IRON SANITARY RISER WITH NEW SANITARY PIPE CAP.
4 REMOVE PVC THRU FLOOR ABOVE. PATCH FLOOR TO MATCH FINISH AND STRENGTH.
5 INSULATE PVC PIPING TO MEET NFPA RETURN AIR PLENUM REQUIREMENTS.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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# UCT AHU REPLACEMENT

LEVEL 12 WEST ENLARGED PLUMBING PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | BB |
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| Drawing No. | P-100-12W |
| Scale | 1/2" = 1'-0" |

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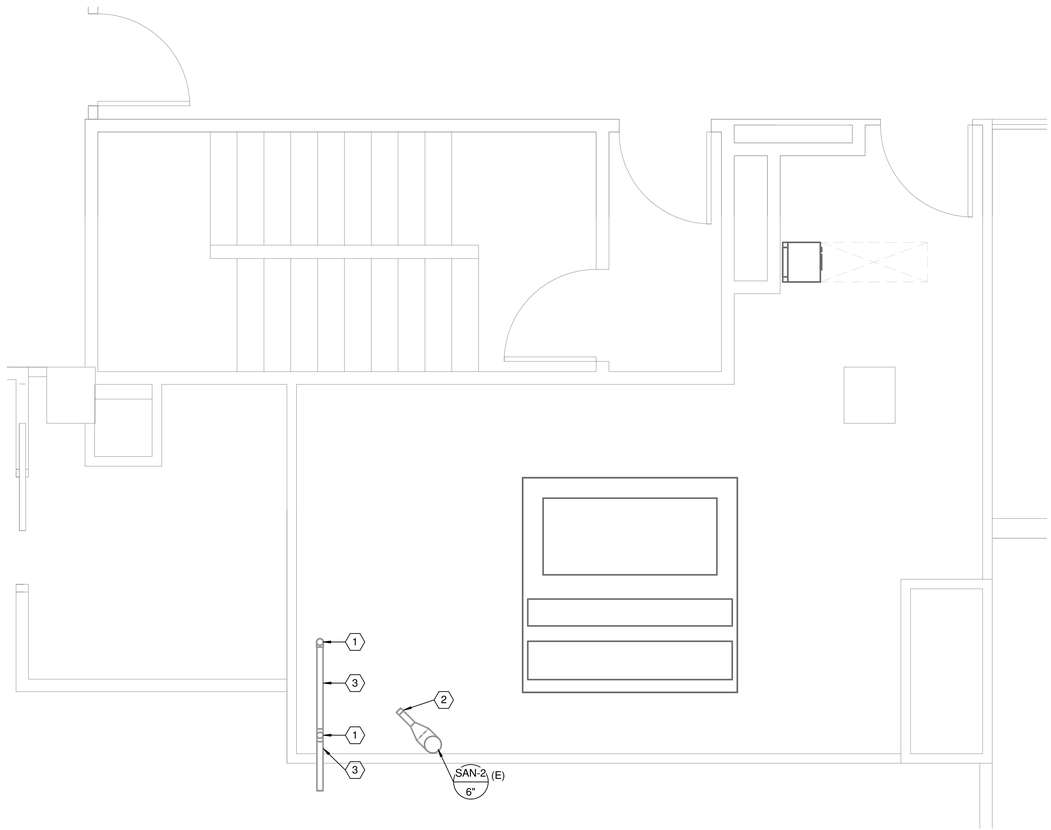


1 LEVEL 15 - PLUMBING RENOVATION - MECHANICAL ROOM EAST
1/2" = 1'-0"

## KEYED NOTES - P-100-15E

1 REMOVE PVC THRU FLOOR ABOVE. PATCH FLOOR TO MATCH FINISH AND STRENGTH.
2 CAP EXISTING CAST IRON SANITARY RISER WITH NEW CAST IRON SANITARY PIPE CAP.
3 REMOVE EXISTING ABANDONDED PVC PIPING SERVING FLOOR ABOVE.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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# UCT AHU REPLACEMENT

## LEVEL 15 EAST ENLARGED PLUMBING PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | BB |
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| Drawing No. | P-100-15E |
| Scale | 1/2" = 1'-0" |

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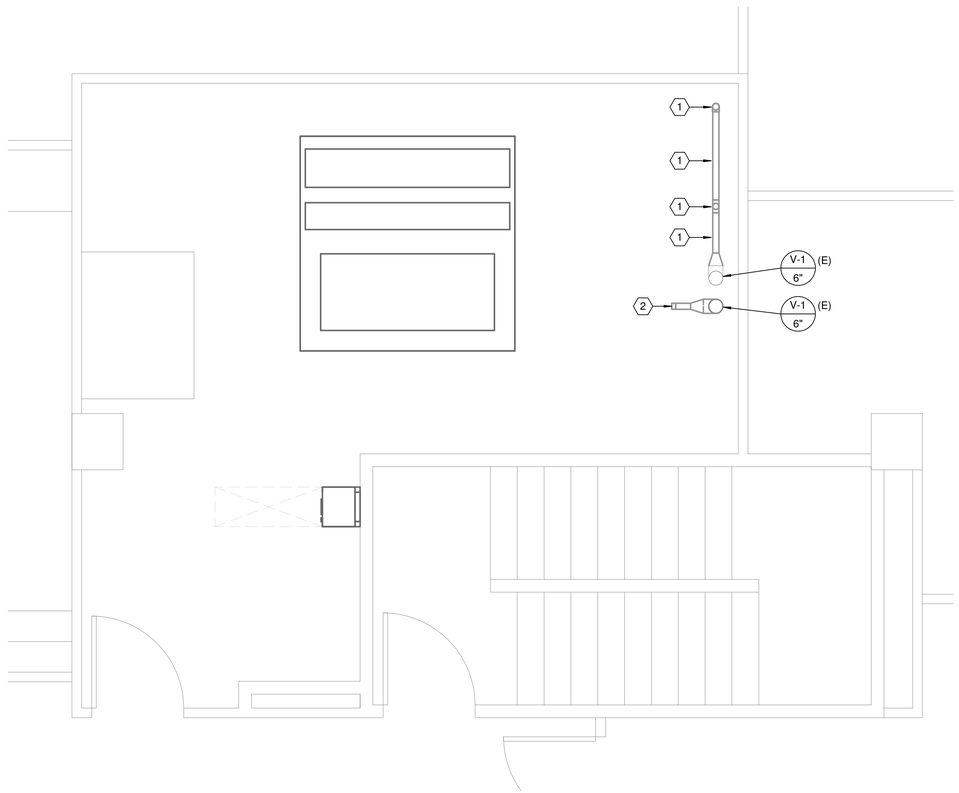


1 LEVEL 15 - PLUMBING RENOVATION - MECHANICAL ROOM WEST
1/2" = 1'-0"

**KEYED NOTES - P-100-15W**

1 INSULATE PVC PIPING TO MEET NFPA RETURN AIR PLENUM REQUIREMENTS.
2 CAP EXISTING CAST IRON SANITARY RISER WITH NEW CAST IRON SANITARY PIPE CAP.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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# UCT AHU REPLACEMENT

LEVEL 15 WEST ENLARGED PLUMBING PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | BB |
| Checked By | RN |
| Drawing No. | P-100-15W |
| Scale | 1/2" = 1'-0" |

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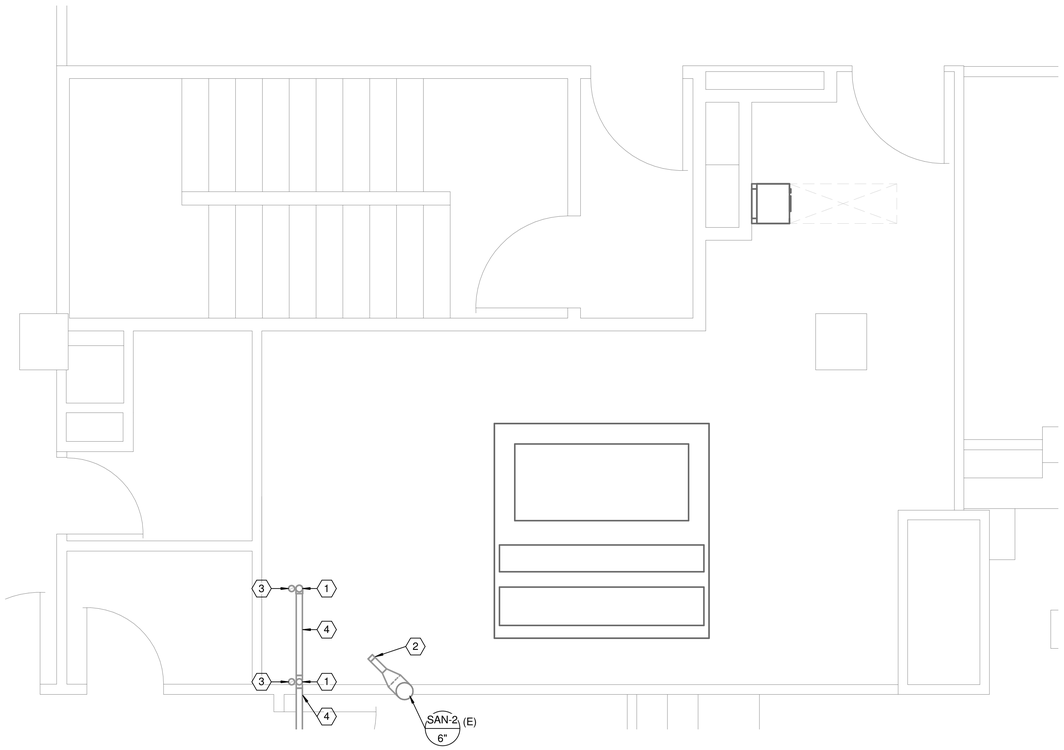


1 LEVEL 16 - PLUMBING RENOVATION - MECHANICAL ROOM EAST
1/2" = 1'-0"

**KEYED NOTES - P-100-16E**

1 REMOVE PVC THRU FLOOR ABOVE. PATCH FLOOR TO MATCH FINISH AND STRENGTH.
2 CAP EXISTING CAST IRON SANITARY RISER WITH NEW CAST IRON SANITARY PIPE CAP.
3 REMOVE PVC THRU FLOOR. PATCH FLOOR TO MATCH FINISH AND STRENGTH.
4 REMOVE EXISTING ABANDONDED PVC PIPING SERVING FLOOR ABOVE.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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ORIGINAL
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# UCT AHU REPLACEMENT

## LEVEL 16 EAST ENLARGED PLUMBING PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | BB |
| Checked By | RN |
| Drawing No. | P-100-16E |
| Scale | 1/2" = 1'-0" |

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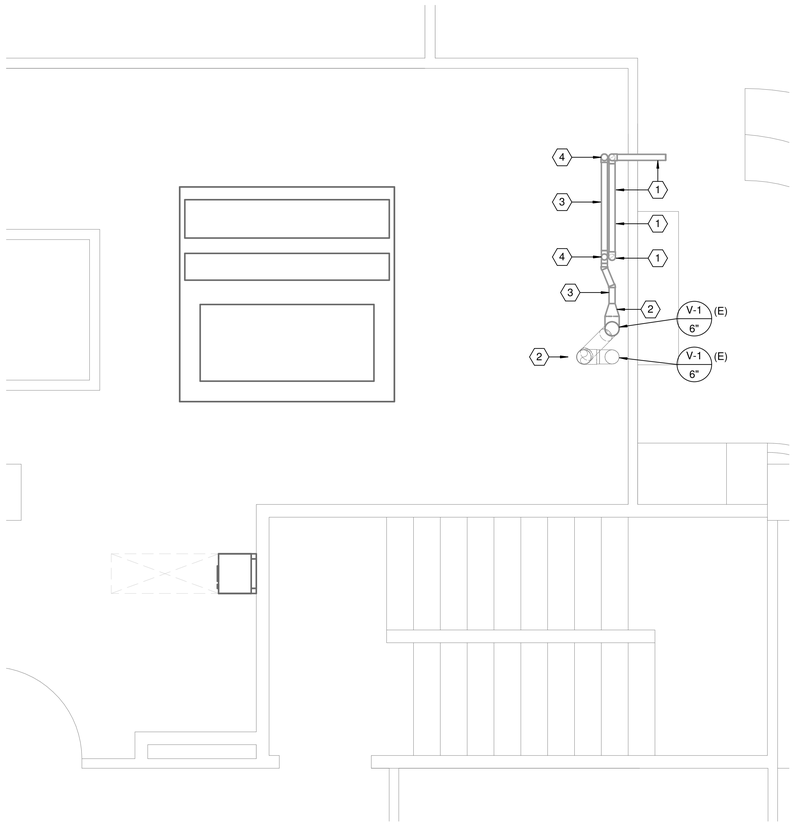


1 LEVEL 16 - PLUMBING RENOVATION - MECHANICAL ROOM WEST
1/2" = 1'-0"

## KEYED NOTES - P-100-16W

1 INSULATE PVC PIPING TO MEET NFPA RETURN AIR PLENUM REQUIREMENTS.
2 CAP EXISTING CAST IRON SANITARY RISER WITH NEW CAST IRON SANITARY PIPE CAP.
3 REMOVE EXISTING ABANDONDED PVC PIPING COMING FROM FLOOR BELOW.
4 REMOVE PVC THRU FLOOR ABOVE. PATCH FLOOR TO MATCH FINISH AND STRENGTH.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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# UCT AHU REPLACEMENT

LEVEL 16 WEST ENLARGED PLUMBING PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | BB |
| Checked By | RN |
| Drawing No. | P-100-16W |
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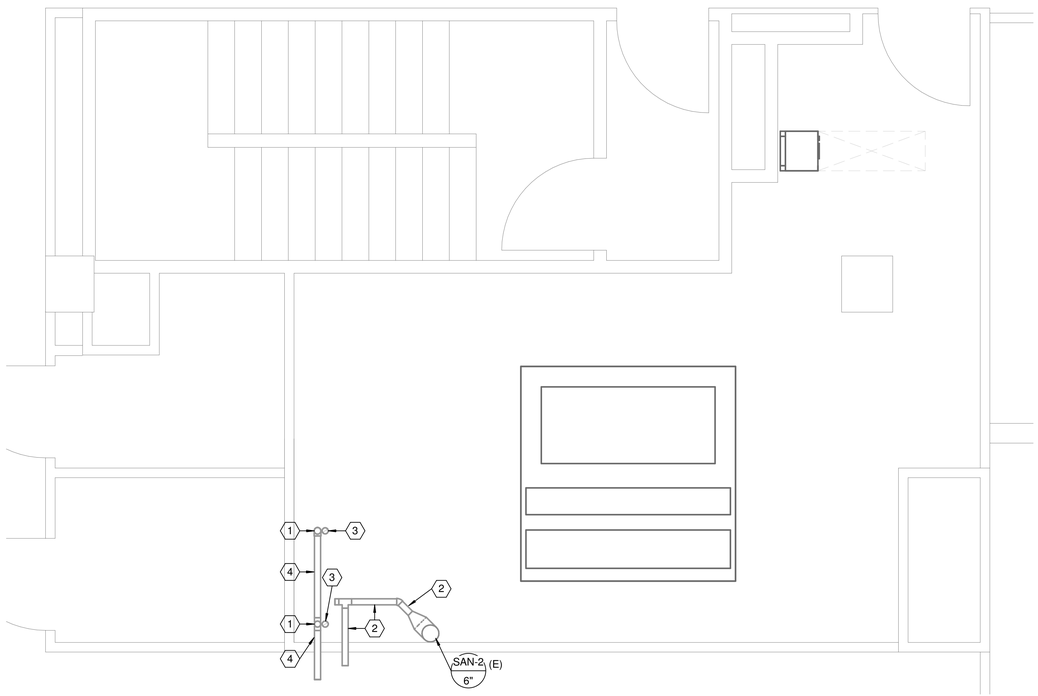


1 LEVEL 17 - PLUMBING RENOVATION - MECHANICAL ROOM EAST
1/2" = 1'-0"

**KEYED NOTES - P-100-17E**

1 REMOVE PVC THRU FLOOR ABOVE. PATCH FLOOR TO MATCH FINISH AND STRENGTH.
2 INSULATE PVC PIPING TO MEET NFPA RETURN AIR PLENUM REQUIREMENTS.
3 REMOVE PVC THRU FLOOR. PATCH FLOOR TO MATCH FINISH AND STRENGTH.
4 REMOVE EXISTING ABANDONDED PVC PIPING SERVING FLOOR ABOVE.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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## LEVEL 17 EAST ENLARGED PLUMBING PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | BB |
| Checked By | RN |
| Drawing No. | P-100-17E |
| Scale | 1/2" = 1'-0" |

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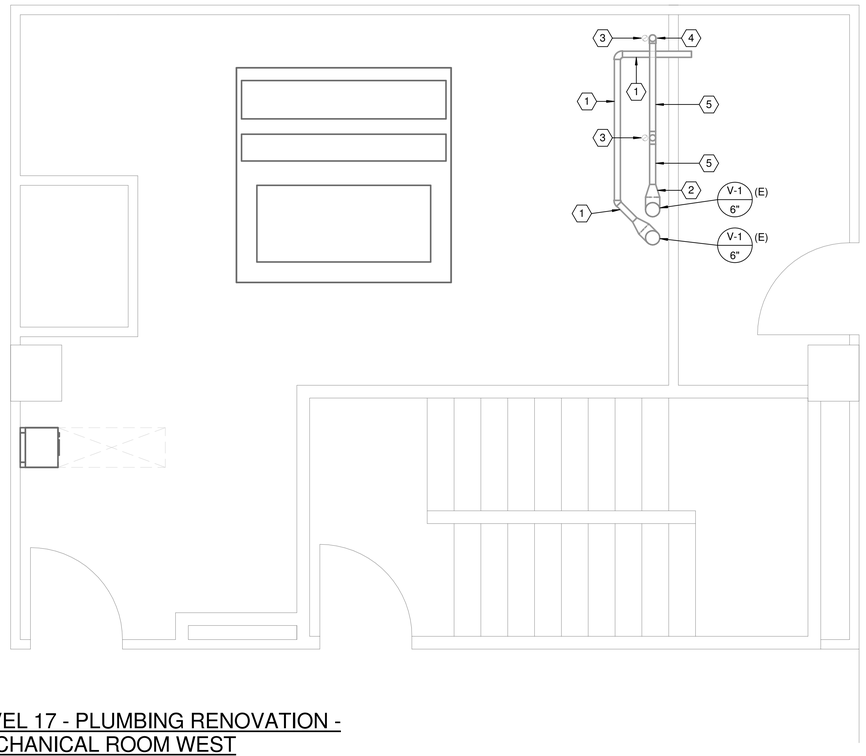


1 LEVEL 17 - PLUMBING RENOVATION - MECHANICAL ROOM WEST
1/2" = 1'-0"

## KEYED NOTES - P-100-17W

1 INSULATE PVC PIPING TO MEET NFPA RETURN AIR PLENUM REQUIREMENTS.
2 CAP EXISTING CAST IRON SANITARY RISER WITH NEW CAST IRON SANITARY PIPE CAP.
3 REMOVE EXISTING, ABANDONDED PVC PIPING COMING FROM FLOOR BELOW.
4 REMOVE PVC THRU FLOOR ABOVE. PATCH FLOOR TO MATCH FINISH AND STRENGTH.
5 REMOVE EXISTING ABANDONDED PVC PIPING SERVING FLOOR ABOVE.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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LEVEL 17 WEST ENLARGED PLUMBING PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | BB |
| Checked By | RN |
| Drawing No. | P-100-17W |
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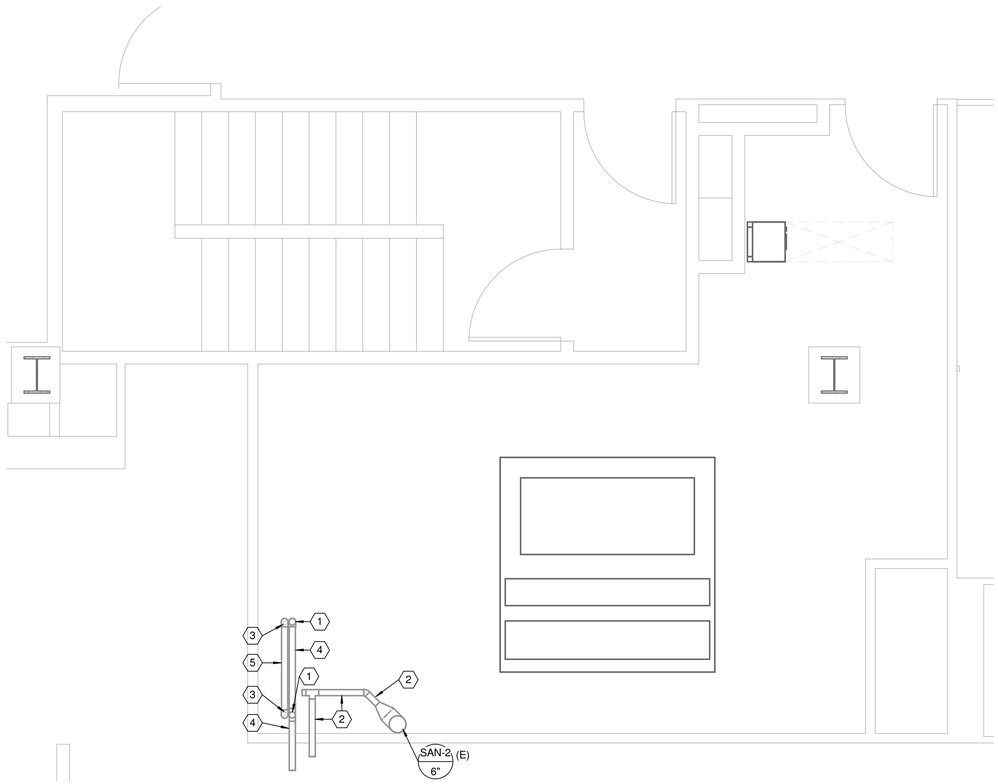


1 LEVEL 18 - PLUMBING RENOVATION - MECHANICAL ROOM EAST
1/2" = 1'-0"

## KEYED NOTES - P-100-18E

1 REMOVE PVC THRU FLOOR ABOVE. PATCH FLOOR TO MATCH FINISH AND STRENGTH.
2 INSULATE PVC PIPING TO MEET NFPA RETURN AIR PLENUM REQUIREMENTS.
3 REMOVE PVC THRU FLOOR. PATCH FLOOR TO MATCH FINISH AND STRENGTH.
4 REMOVE EXISTING ABANDONDED PVC PIPING SERVING FLOOR ABOVE.
5 REMOVE EXISTING ABANDONDED PVC PIPING SERVING THIS FLOOR.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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## LEVEL 18 EAST ENLARGED PLUMBING PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | BB |
| Checked By | RN |
| Drawing No. | P-100-18E |
| Scale | 1/2" = 1'-0" |

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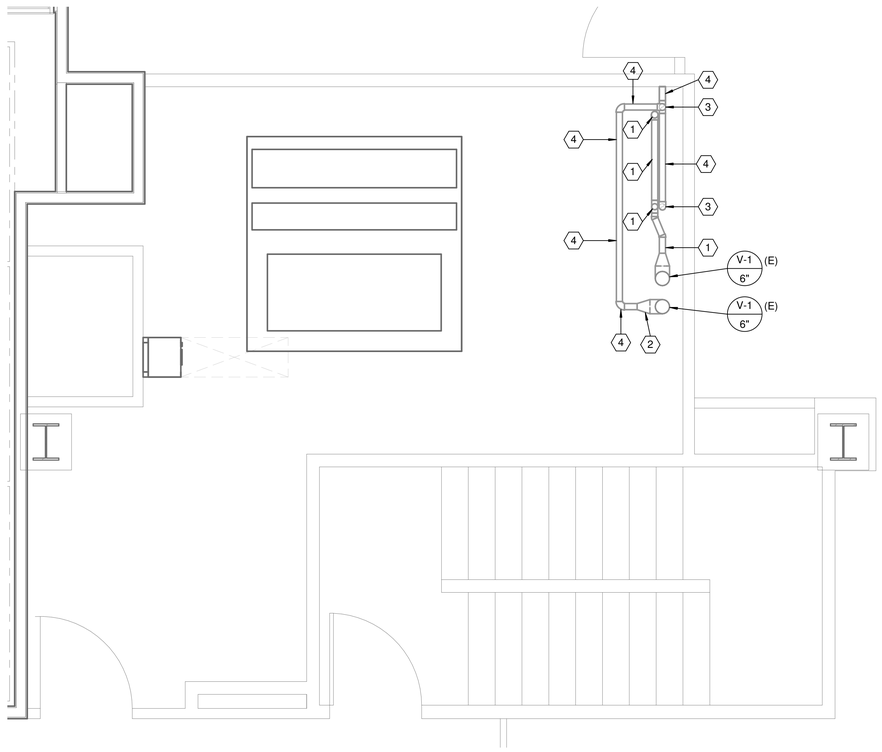


## KEYED NOTES - P-100-18W

1 INSULATE PVC PIPING TO MEET NFPA RETURN AIR PLENUM REQUIREMENTS.

2 CAP EXISTING CAST IRON SANITARY RISER WITH NEW CAST IRON SANITARY PIPE CAP.

3 REMOVE PVC THRU FLOOR. PATCH FLOOR TO MATCH FINISH AND STRENGTH.

4 REMOVE EXISTING ABANDONDED PVC PIPING SERVING FLOOR BELOW.

1 LEVEL 18 - PLUMBING RENOVATION - MECHANICAL ROOM WEST
1/2" = 1'-0"

True NORTH Plan NORTH

0' 2' 4'
1/2" = 1'-0"


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# UCT AHU REPLACEMENT

## LEVEL 18 WEST ENLARGED PLUMBING PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | BB |
| Checked By | RN |
| Drawing No. | P-100-18W |
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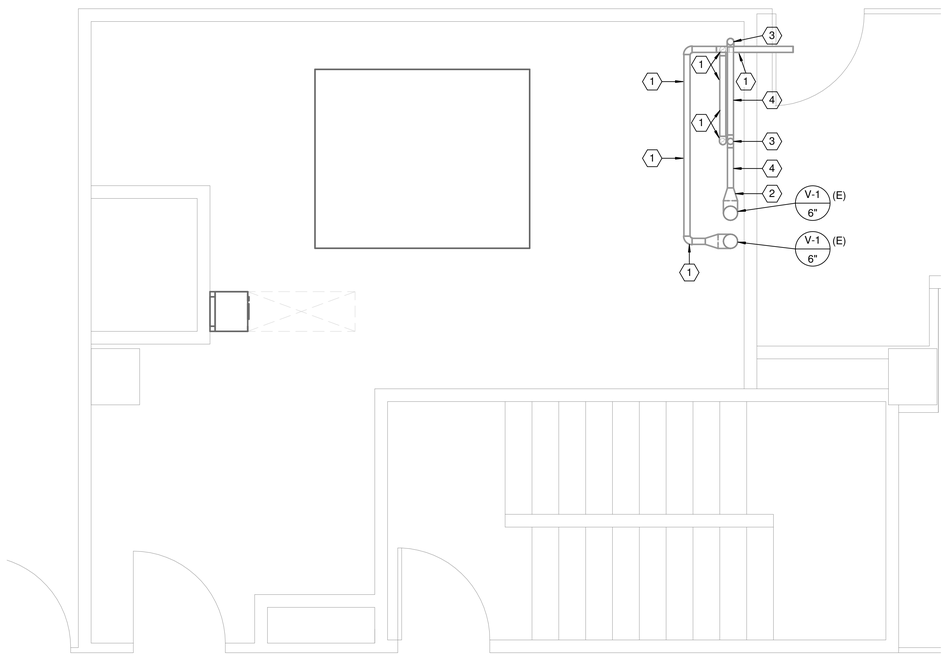


1 LEVEL 19 - PLUMBING RENOVATION - MECHANICAL ROOM WEST
1/2" = 1'-0"

**KEYED NOTES - P-100-19W**

1 INSULATE PVC PIPING TO MEET NFPA RETURN AIR PLENUM REQUIREMENTS.
2 CAP EXISTING CAST IRON SANITARY RISER WITH NEW CAST IRON SANITARY PIPE CAP.
3 REMOVE PVC THRU FLOOR ABOVE. PATCH FLOOR TO MATCH FINISH AND STRENGTH.
4 REMOVE EXISTING ABANDONDED PVC PIPING SERVING FLOOR ABOVE.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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# UCT AHU REPLACEMENT

## LEVEL 19 WEST ENLARGED PLUMBING PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | BB |
| Checked By | RN |
| Drawing No. | P-100-19W |
| Scale | 1/2" = 1'-0" |

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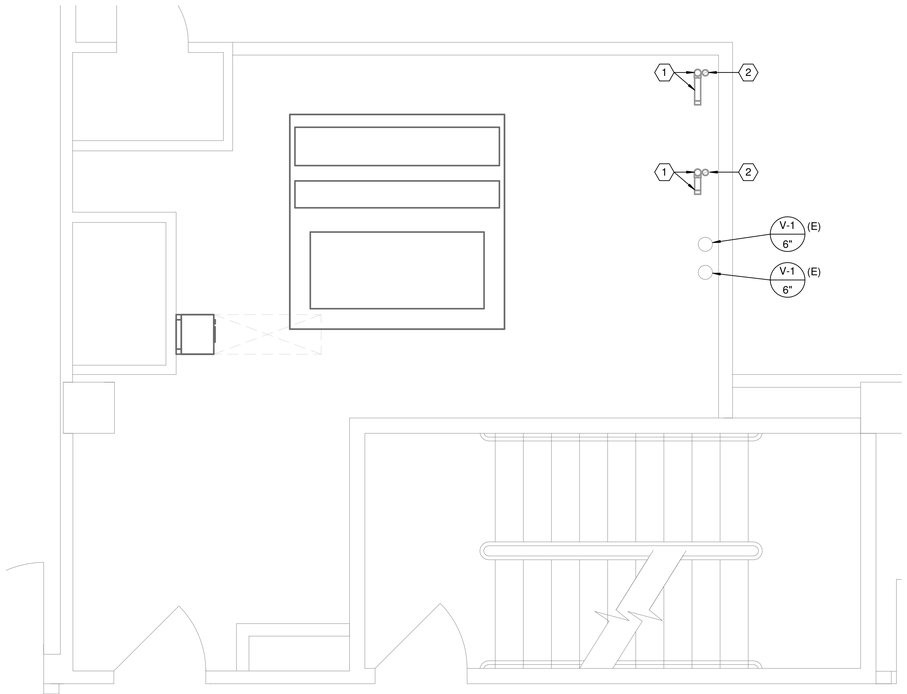


1 LEVEL 20 - PLUMBING RENOVATION - MECHANICAL ROOM WEST
1/2" = 1'-0"

**KEYED NOTES - P-100-20W**

1 REMOVE PVC THRU FLOOR ABOVE. PATCH FLOOR TO MATCH FINISH AND STRENGTH.

2 REMOVE EXISTING ABANDONDED PVC PIPING SERVING FLOOR BELOW.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'


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# UCT AHU REPLACEMENT

## LEVEL 20 WEST ENLARGED PLUMBING PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | BB |
| Checked By | RN |
| Drawing No. | P-100-20W |
| Scale | 1/2" = 1'-0" |

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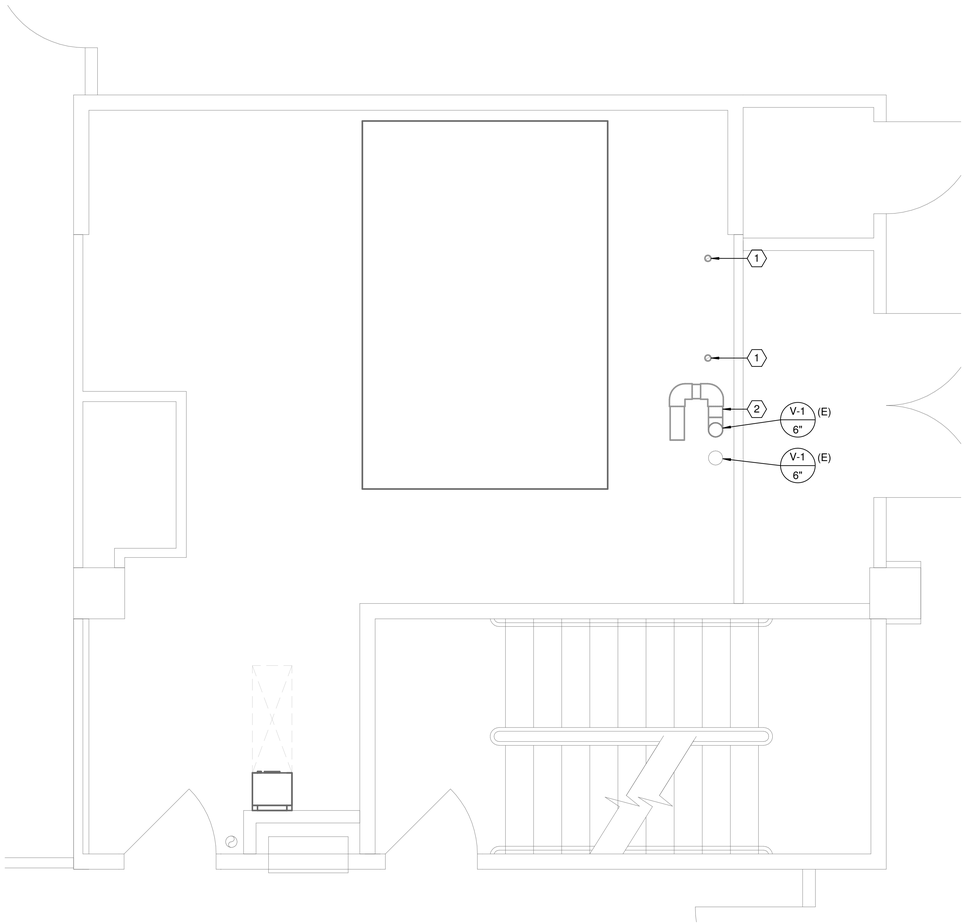


LEVEL 21 - PLUMBING RENOVATION - MECHANICAL ROOM WEST

1 1/2" = 1'-0"

## KEYED NOTES - P-100-21W

1 REMOVE PVC THRU FLOOR. PATCH FLOOR TO MATCH FINISH AND STRENGTH.

2 INSULATE PVC COUPLING TO MEET NFPA RETURN AIR PLENUM REQUIREMENTS.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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# UCT AHU REPLACEMENT

## LEVEL 21 WEST ENLARGED PLUMBING PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | BB |
| Checked By | RN |
| Drawing No. | P-100-21W |
| Scale | 1/2" = 1'-0" |

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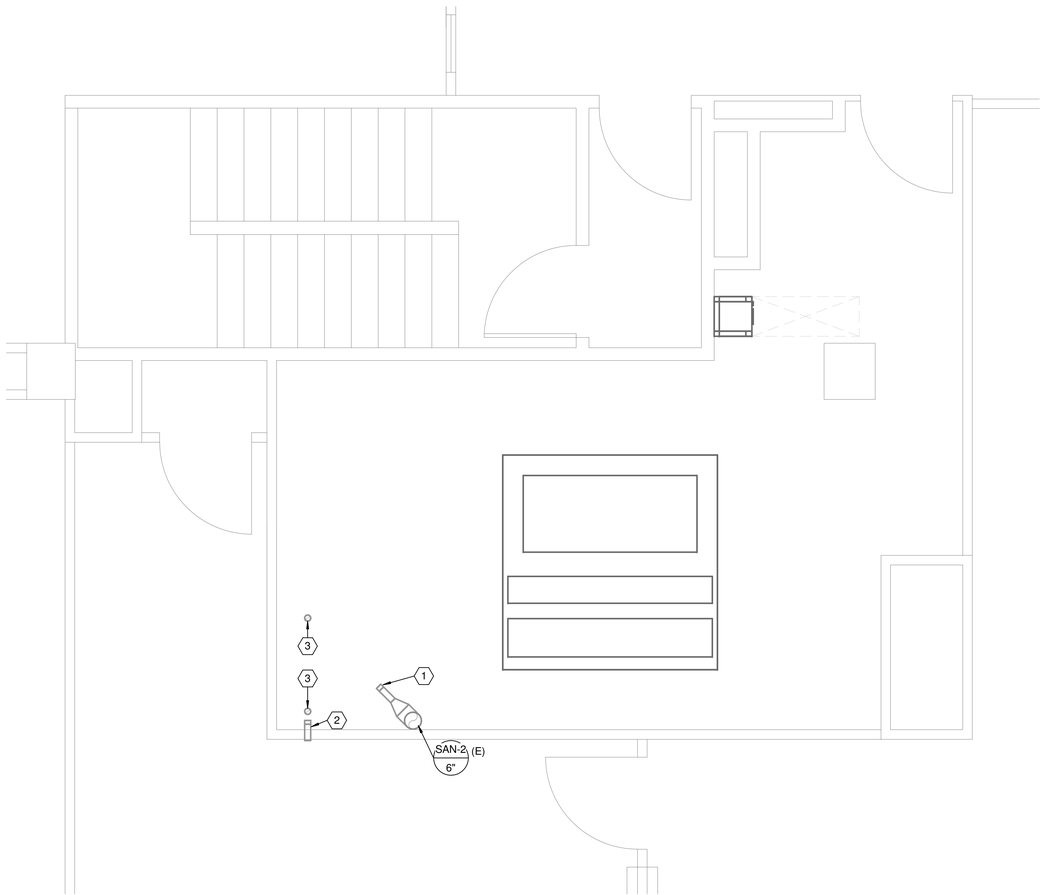


1 LEVEL 22 - PLUMBING RENOVATION - MECHANICAL ROOM EAST
1/2" = 1'-0"

## KEYED NOTES - P-100-22E

1 CAP EXISTING CAST IRON SANITARY RISER WITH NEW CAST IRON SANITARY PIPE CAP.
2 REMOVE EXISTING ABANDONDED PVC PIPING SERVING THIS FLOOR.
3 REMOVE PVC THRU FLOOR. PATCH FLOOR TO MATCH FINISH AND STRENGTH.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'

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# UCT AHU REPLACEMENT

LEVEL 22 EAST ENLARGED PLUMBING PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | BB |
| Checked By | RN |
| Drawing No. | P-100-22E |
| Scale | 1/2" = 1'-0" |

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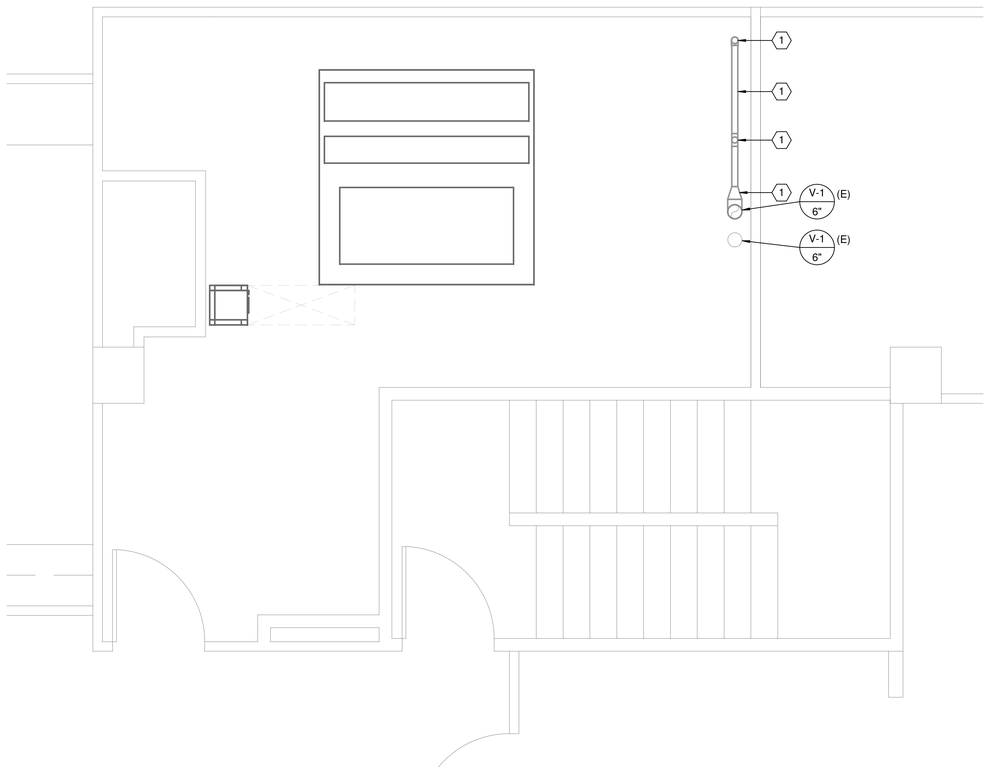


1 LEVEL 22 - PLUMBING RENOVATION - MECHANICAL ROOM WEST
1/2" = 1'-0"

**KEYED NOTES - P-100-22W**

1 INSULATE PVC PIPING TO MEET NFPA RETURN AIR PLENUM REQUIREMENTS.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'


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# UCT AHU REPLACEMENT

## LEVEL 22 WEST ENLARGED PLUMBING PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | BB |
| Checked By | RN |
| Drawing No. | P-100-22W |
| Scale | 1/2" = 1'-0" |

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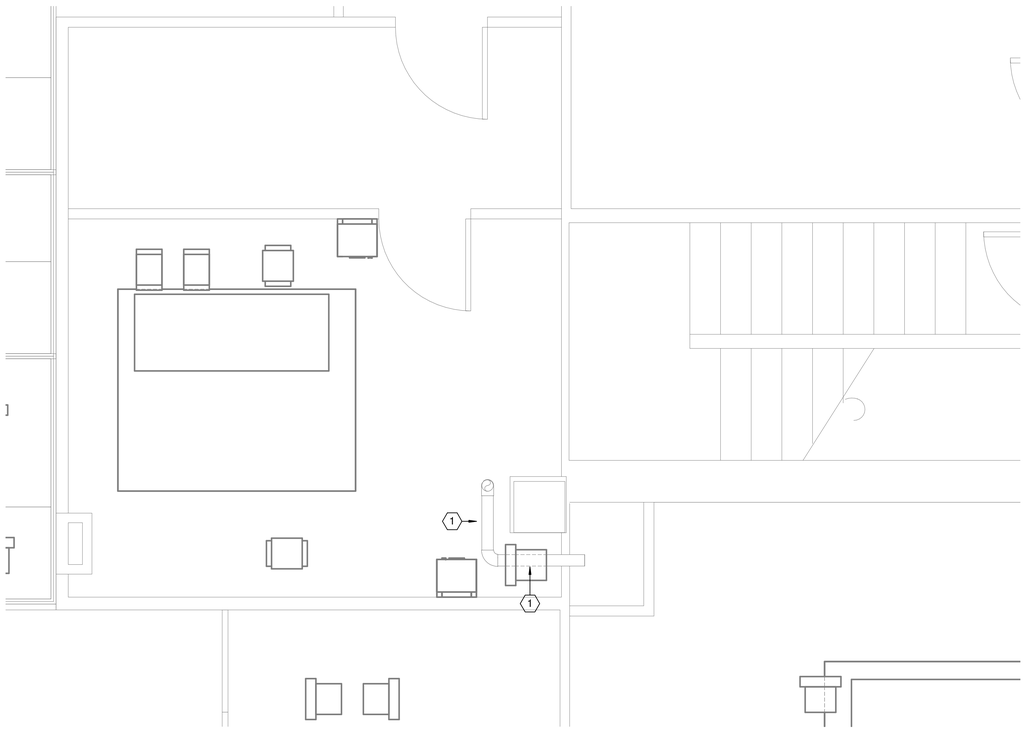


LEVEL M - PLUMBING RENOVATION - MECHANICAL ROOM EAST

1 1/2" = 1'-0"

**KEYED NOTES - P-100-ME**

1 INSULATE PVC PIPING LOCATED ALONG FLOOR TO MEET NFPA RETURN AIR PLENUM REQUIREMENTS.

True NORTH Plan NORTH

1/2" = 1'-0" 0' 2' 4'


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# UCT AHU REPLACEMENT

## LEVEL M EAST ENLARGED PLUMBING PLAN

| | |
|---|---|
| SSA Project Number | 1095-034-01 |
| Date | 10/11/2017 |
| Designed By | BB |
| Checked By | RN |
| Drawing No. | P-100-ME |
| Scale | 1/2" = 1'-0" |

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Tx. Registration # F-2113

10/11/2017

# SECTION 03 35 11
# CONCRETE FLOOR FINISHES

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Sealer for concrete floors scheduled as "Sealed Concrete."

### 1.02 SUBMITTALS

A. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.

B. Maintenance Data: Provide data on maintenance and renewal of applied finishes.

### 1.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's sealed packaging, including application instructions.

### 1.04 FIELD CONDITIONS

A. Maintain light level equivalent to a minimum 200 W light source at 8 feet above the floor surface over each 20 foot square area of floor being finished.

B. Maintain ambient temperature of 50 degrees F minimum.

## PART 2 PRODUCTS

### 2.01 CONCRETE FLOOR FINISH APPLICATIONS

A. High Gloss Clear Sealer:
   1. Use at following locations: Floors indicated to be "Sealed Concrete" on the Drawings.

### 2.02 COATINGS

A. High Gloss Clear Sealer: Transparent, non-yellowing, water-based coating.
   1. Composition: Acrylic polymer-based.
   2. Nonvolatile Content: 30 percent, minimum, when measured by volume.
   3. Products:
      a. Dayton Superior Corporation; Ultra Seal EF: www.daytonsuperior.com.
      b. Basis of Design: L&M Construction Chemicals, Inc; Dress & Seal WB30: www.lmcc.com.
      c. W.R. Meadows, Inc; Decra-Seal W/B: www.wrmeadows.com.
      d. Substitutions: Not permitted.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that floor surfaces are acceptable to receive the work of this section.

B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

### 3.02 GENERAL

A. Apply materials in accordance with manufacturer's instructions.

### 3.03 COATING APPLICATION

A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.

B. Verify that water vapor emission from concrete and relative humidity in concrete are within limits established by coating manufacturer.

C. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.

D. Apply coatings in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

**END OF SECTION**

# SECTION 23 00 10- MECHANICAL GENERAL PROVISIONS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Except as modified in this Section, General Conditions, Special Conditions, applicable provisions of Division 01, General Requirements, and other provisions and requirements of the contract documents apply to work of Division 23.

B. Applicable provisions of this Section apply to all Sections of Division 23 HVAC.

C. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements, and provide coordination drawings.

D. All work in these Sections shall be installed by craftsmen skilled in their trade.

### 1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. Furnish: The term "furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. Install: The term "install" is used to describe operations at project site including the actual unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. Provide: The term "provide" means to furnish and install, complete and ready for the intended use.

### 1.3 CODE REQUIREMENTS AND PERMITS

A. Perform work in accordance with applicable statutes, ordinances, codes, and regulations of governmental authorities having jurisdiction.

B. Resolve any code violation discovered in contract documents with the Engineer prior to award of the contract. After award of the contract, make any correction or addition necessary for compliance with applicable codes at no additional cost to Owner.

C. Obtain and pay for all permits and inspections.

1.4 REFERENCES

A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, AWWA Specifications, Federal Standards or other standard specifications must comply with latest editions except where specified otherwise in individual Sections, revisions, amendments, or supplements in effect on date bids are received.

B. Requirements in reference specifications and standards are minimums for all equipment, materials and work. In instances where capacities, size or other features of equipment, devices, or materials exceed these minimums, meet listed or shown capacities.

1.5 SUBMITTALS

A. Equipment and Materials submittals must show sufficient data to indicate complete compliance with contract documents as follows:
   1. Proper sizes and capacities.
   2. That the item will fit in the available space in a manner that will allow proper service.
   3. Construction methods, materials, and finishes.

B. Material and Equipment Shop Drawings: Submit all detailed shop drawings, descriptive literature, physical data, and performance data for review for items of equipment and for principal materials proposed for installation. HVAC controls may be submitted separately provided the controls submittal is complete and coordinated with all other applicable trades. Include identifying symbols and equipment numbers used in plans and specifications, with reference to specification paragraphs, and drawing numbers of all equipment and material submitted.

C. Final Submittal: In addition to number of copies of shop drawings and other data required for review submittals, maintain a separate file of final approved copies of such material. Deliver approved copies in a hard-back binder for the Owner's use. Incorporate changes and revisions made throughout construction period. Delivery of approved copies is a condition of final acceptance for the project.

D. Contractor's Check: Shop drawings will be submitted only by the Contractor. Indicate by signed stamp that the drawings have been checked, that the work shown on the drawings is in accordance with contract requirements and that dimensions and relationship with work of other trades have been checked. If drawings are submitted for approval that have not been checked and signed by the Contractor, they will be returned for checking before being considered by the Architect/Engineer.

E. Refer to Section 01 33 00 for additional submittal requirements

1.6 COORDINATION DRAWINGS

A. Prior to starting work, the Contractor shall provide coordination drawings for all areas of the building. The Contractor shall submit the coordination drawing for confirmation of the coordination process. The Contractor is responsible for all trade confirmation.

B. CAD. Provide 1/4 inch scale 3D coordination drawings.
   1. Drawings shall show all equipment, ductwork, fire protection system, coil pull spaces, chilled water, heating water and condensate piping and trap, electrical conduit, electrical and control panels, etc. installed in mechanical room to verify space allocation and coordination of trades.
   2. Provide plan and elevation views detailing installation.
   3. Drawings shall include 1/4 inch scale drawing of each mechanical room. Drawing shall show coil pull spaces and coordination of all ductwork, all chilled water, heating water and condensate piping and trap, electrical conduit, electrical and control panels, etc. installed in mechanical room. Provide plan and elevation views detailing installation

4. Contractor may not proceed with construction of MEP systems until trade coordination process has been demonstrated to be completed by the Contractor to the Architect, Engineer and Owner.

1.7 INTERFERENCE DRAWINGS

A. Interference drawings are drawings that indicate conflict between the various systems and other components of the building such as beams, columns, walls, etc. They shall be drawn to scale and shall include plans, elevations, sections and other details as required to clearly define the interference and to indicate the contractor's proposed solution.

B. They shall be submitted for approval whenever job measurements and an analysis of the drawings and specifications by the contractor indicate that the various systems cannot be installed without significant deviation from the intent of the contract. When such interference is encountered, work shall cease in the general area of the conflict until a resolution to the question has been approved.

1.8 GUARANTEE

A. Guarantee work for one year from the date of final acceptance of the project. During that period make good any faults or imperfections that may have arisen due to defects or omissions in materials or workmanship.

1.9 SERVICE

A. Perform service work required during the guarantee period. Perform manufacturer's recommended monthly service and provide Owner with written report. Cleaning of air filters and pipe strainers is not included.

1.10 RESOLUTION OF CONFLICTS

A. Where conflicts may exist between and/or within the drawings and/or specifications, the higher quality, greater quantity, more restrictive, and/or more expensive requirement shall be required and shall be the basis of Contractor pricing. The Contractor shall notify the A/E for resolution of the issue prior to executing the work in question.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Furnish new and unused materials, pipes, pipe fittings, and equipment of domestic manufacture, where available. Where two or more units of same type or class of equipment are required, provide units of a single manufacturer.

2.2 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers are listed in individual Sections of Division 23. Where two or more units of same type or class of equipment are required, provide units of a single manufacturer. Manufacturer must have local representation.

B. Substitutions:
1. If the Contractor desires to substitute a material or method as an equal to the specified item, he shall request permission from the Architect/ Engineer, in writing, and shall include such literature, samples, etc., deemed necessary to establish the equal quality of his proposal.
2. The Architect/Engineer will not give approval to material salesmen or subcontractors, and only in writing to the successful Contractor after the project has been awarded.

3. For each proposed substitution product, clearly show how the proposed product meets the requirements of the specifications, including performance.
4. No substitution will be considered unless it is presented in writing within that number of days after Notice to Proceed equal to 15 percent of the contract time.
5. Proposers of substitute products shall present samples, literature, test and performance data, record of other installations, names of Owners, architects, engineers, contractors and subcontractors as references, statement of current financial condition, and other technical information applicable to their products, to aid in determining the worth of the substitute product offered in relation to the material and work specified from the standpoint of the Owner's best interest. Substitute materials and products shall be used only if approved in writing by the Architect/Engineer in advance.
6. Approval of substitute materials offered shall not be a basis for contingent extra charges because of changes in other work or related work, such as roughing-in, electrical, structural or architectural, which may result from the substitution.
7. For any Contractor initiated substitutions or changes, Contractor shall be responsible for achieving results equal to or better than the product or design originally specified.

2.3 NOISE AND VIBRATION

A. Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions without cost to the Owner. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate (without cost to the Owner) that equipment performs within designated vibration limits indicated in the specifications, or as specified by manufacturer.

B. Seal all wall and partition penetrations (the penetration opening shall be one inch larger than penetrating member) by ducts and piping by stuffing the annular void with fiberglass insulation and then caulking over fully with a non hardening acoustical caulking applied to both sides of wall or partition.

2.4 AIR FILTERS AND PIPE STRAINERS

A. Immediately prior to final acceptance of project, inspect, clean and service hydronic system strainers and replace disposable type air filters.

B. Turn over to Owner additional sets of spare filters and other spare parts as specified.

2.5 ACCESS DOORS

A. Provide access doors for all walls or ceiling locations as required for access to valves, controls, regulating devices, water arresters, fire dampers, air distribution boxes, and other concealed equipment requiring maintenance adjustment or operation. Coordinate location with General Contractor.

B. Basis-of-Design Product: Design of access doors is based on model numbers manufactured by Milcor unless otherwise indicated. Subject to compliance with requirements, provide named product or approved equal.
1. Non-Fire Rated Doors:
   a. Furnish Milcor non-fire rated doors with 16-gage frames and 14 gage door panels.
   b. Provide continuous concealed hinges and flush screwdriver cam lock.
   c. Use Style M for prime painted steel, and MS for stainless steel.
   d. Use Style DW access door for drywall or gypboard construction.
   e. Use Style CF for suspended drywall ceilings.
   f. Use Style K for plastered walls and ceilings.
   g. Use Style AP for acoustical plastered ceilings with all galvanized construction.
2. Fire-Rated Access Doors:

a. Furnish Milcor, UL listed, 1-1/2 hour, “B” label for service access in walls of stairwell, corridors and all other areas where fire-rated construction occurs.
b. Access doors shall have a 16 gage steel frame and 20 gage insulated sandwich type insulated panel.
c. Use ATR for fire-rated suspended drywall ceilings.

3. Provide spring-loaded door for automatic closure and exterior key lock for security.

2.6 FLAME SPREAD PROPERTIES OF MATERIALS

A. Materials and adhesives incorporated in this project shall conform to NFPA Standard 255, "Method of Test of Surface Burning Characteristics of Building Materials" and NFPA 90. The classification shall not exceed a flame spread rating of 25 for all materials, adhesives, finishes, etc., specified for each system, and shall not exceed a smoke developed rating of 50.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Cooperation with Other Trades: Cooperation with trades of adjacent, related, or affected materials or operations and of trades performing continuations of work under subsequent contract is considered a part of this work in order to effect timely and accurate placement of work and to bring together in proper and correct sequence the work of such trades.

B. Workmanship: Work must be performed by workmen skilled in their trade.

C. Installation of all equipment and materials must be complete. Installation shall meet requirements of specifications and manufacturer’s recommendations.

D. Electrical Wiring of Motors and Equipment. The Contractor shall note that the electrical system was based upon the mechanical equipment indicated on the mechanical construction documents and specifications. If Contractor proposes any mechanical equipment that requires changes to the electrical design, the required electrical changes shall be made at no cost to the Owner.

3.2 SPACE REQUIREMENTS

A. Consider space limitations imposed by contiguous work, including clearances required for service, in selection and location of equipment and material. Do not provide equipment or material which is not suitable in this respect.

B. The following space allocation and coordination shall be followed, unless otherwise indicated on the construction drawings:
1. Gravity-fed plumbing and roof drain line shall take priority over all other systems.
2. Light fixtures and cable tray arrangements shall take priority in spatial layout. In areas with ceilings, other systems shall be routed above the light fixtures, and offset from above cable tray allowing for access and maintenance clearance.
3. Install HVAC ductwork as close to the bottom of structural framing as possible while allowing clearance for installation of insulation wrap. Install ductwork to be accessible from the ceiling plane.
4. Install HVAC chilled/hot water piping in the plane directly below HVAC ductwork unless indicated otherwise on drawings.
5. Install fire sprinkler piping in the plane directly beneath the HVAC chilled/hot water piping. Do not install sprinkler piping directly below equipment requiring maintenance.
6. Install domestic hot and cold water in the plane directly above the light fixtures.
7. Refer to Division 26 for electrical and control wiring requirements.
8. Install piping to permit removal of coils at air handling units and to permit access to all terminal unit components.
9. Do not block access to any serviceable section of equipment.

3.3 OBSTRUCTIONS

A. The drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.

B. Before any cutting or trenching operations are begun, verify with Owner's Representative, utility companies and other interested parties that all available information has been provided. Verify locations given.

C. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.

D. Assume total responsibility for and repair any damage to existing utilities or construction.

3.4 OPENINGS

A. Framed, cast or masonry openings for ductwork, equipment and piping are specified under other divisions. However, drawings and layout work for exact size and location of all such openings are included under this division.

3.5 ACCESS DOORS

A. Coordinate location of access doors for ease of operation and maintenance of concealed equipment.

3.6 DELIVERY, STORAGE AND HANDLING

A. Adequately protect work, equipment, fixtures and materials from damage during storing, installation, start-up and testing.

B. Cover all equipment stored exposed to elements with waterproof tarps, provide adequate ventilation.

C. At work completion, all work must be clean and in like new condition.

D. Storage of all mechanical equipment, piping materials and ductwork shall be in strict accordance with manufacturers written installation instructions.

E. Rotate air handler fans and pump shafts on routine basis.

F. Provide factory installed pipe caps for all pipes to be installed on the project.

G. Provide covers over all openings in ductwork stored or installed on the project.

H. Energize motor heaters with temporary power as soon as the motor is received on site.

I. Air Handling Units shall not be used as storage containers

3.7 LUBRICATION AND OIL

A. Provide a complete charge of correct lubricant and/or oil for each item of equipment requiring lubrication.

3.8 PAINTING

A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.9 CUTTING AND PATCHING

A. General: Cut and patch walls, floors, etc., resulting from work or by failure to provide proper openings or recesses in new construction.

B. Methods of cutting: Openings cut through concrete and masonry shall be made with masonry saws and/or core drills and at such locations acceptable to the Architect/Engineer.
   1. Do not use impact-type equipment except where specifically acceptable to the Architect/Engineer.
   2. Core drill openings in precast concrete slabs for pipes, conduits, outlet boxes, etc., to exact size.

C. Restoration: Restore all openings to "as-new" condition under the appropriate Specification Section for the materials involved

D. Match remaining surrounding materials and finishes.

E. Masonry: Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry.

F. Provide adequate support during cutting operation to prevent any damage to the masonry occasioned by the operation. All structural members, supports, etc., shall be of the proper size and shape, and shall be installed in a manner acceptable to the Architect/Engineer.

G. Special Note: No cutting, boring, or excavating which will weaken the structure shall be undertaken.

3.10 OPERATING TESTS

A. After all mechanical systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequence and operation throughout the range of operation witnessed by Owner's Representative.

B. Prove operations of control systems and all safeties, freezestats and alarms.

C. Make adjustments as required to ensure proper functioning of all systems.

D. Special tests on individual systems are specified under individual Sections.

3.11 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Furnish copies of commercially available standard operation and maintenance data, including operating instructions, maintenance instructions and parts listings in accordance with Division 01 Specifications. Detailed requirements for these items are as follows:
   1. Information required for the preparation of O&M manuals may be furnished in the form of manufacturers' standard brochures, schematics, and other printed instructions. Clearly distinguish between information which applies to the equipment and information which does not apply. Data shall include as a minimum the following items:
      a. Recommended procedures and frequencies for preventive maintenance; inspection, adjustment, lubrication, cleaning, etc.
      b. Special tools and equipment required for testing and maintenance.
      c. Parts lists reflecting the true manufacturer's name, part number and nomenclature.
      d. Recommended spares by part number and nomenclature and spare stocking levels.
      e. Integrated mechanical and electrical system schematics and diagrams to permit operation and troubleshooting after acceptance of the system.
      f. Troubleshooting, checkout, repair and replacement procurement procedures.
      g. Operating instructions including start up and shutdown procedures.
      h. Safety considerations including load limits, speed, temperature and pressure.
   2. Provide O&M manuals for all HVAC equipment.

3.12 PROJECT RECORD DOCUMENTS

A. Maintain at the job site a separate set of white prints of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is significantly at variance with the contract drawings.

B. Mark the drawings with a colored pencil.

C. Prepare, as the work progresses and upon completion of work, drawings clearly indicating locations of various lines, valves, ductwork, traps, equipment, and other pertinent items, as installed.

D. At conclusion of project, obtain without cost to Owner, reproducibles of original mechanical drawings and transfer as-built changes to these.

E. Delivery of as-built prints and reproducibles is a condition of final acceptance.

3.13 TRAINING

A. Upon completion of work, and at time designated by the Owner's Representative, provide services of a competent representative of the manufacturer/Contractor to instruct the Owner's Representative and up to 8 members of the Owner’s staff in the operation and maintenance of the entire system. Record training sessions on DVDs for instructing future technicians.

B. Provide training for the following pieces of equipment:

| Items: | HRs of Training Pre-Substantial Completion | HRs of Training at 6 months from Substantial Completion | HRs of Training at 11 months from Substantial Completion | Video Taping Required |
|---|---|---|---|---|
| DDC Controls | 8 | 8 | | X |
| VFDs | 4 | 4 | | X |
| Air Handling Units | 8 | | | X |

C. All training sessions shall be scheduled in coordination with the Owner’s Representative 14 days in advance, attendance taken, and sign-in sheet and training materials included in the O&M manuals.

END OF SECTION 23 00 10

# SECTION 23 05 13- COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes general requirements for 1-phase and 3-phase electric motors with NEMA frame machines sized through 200 horsepower and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation. Unless otherwise specified, provide motors meeting the basic requirements for general purpose alternating current motors, as defined in ANSI/NEMA MG 1-1.05.

### 1.2 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

### 1.3 REFERENCES

A. ANSI/IEEE 117 - Standard Test Procedure for Evaluation of Systems of Insulating Materials for Random Wound AC Electric Machinery.

B. ANSI/NEMA MG 1 - Motors and Generators.

C. ANSI/NEMA MG 2 - Safety Standard for Construction and Guide for Selection, Installation, and Use of Electric Motors.

D. ANSI/UL 674 - Electric Motors and Generators for Use in Hazardous (Classified) Locations.

E. ANSI/UL 1004 - Electric Motors.

F. Energy Conservation Design Standard for New State Buildings.

### 1.4 SUBMITTALS

A. Provide the following information for each motor:
   1. Manufacturer.
   2. Rated full load horsepower.
   3. Rated volts.
   4. Number of phases.
   5. Frequency in hertz.
   6. Full load amperes (FLA).
   7. Locked rotor amperes (LRA) at rated voltage or NEMA code letter.
   8. Nominal speed at full load (rpm).
   9. Service factor.
   10. NEMA design letter.
   11. NEMA machine type (ODP, WP-I, TEFC, etc).
   12. Motor space heater voltage, wattage and number of wires (where applicable)

B. For motors 3/4 horsepower and larger, include the following additional information:

1. NEMA frame size.
2. NEMA insulation system classification. For motors required to be installed outdoors, include information showing compliance with the intent of paragraph 2.3C.
3. Maximum ambient temperature for which motor is designed.
4. Time rating.
5. Bearing type.
6. Efficiency at full load.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements for integral horsepower motors, provide products by one of the following:
1. General Electric.
2. Baldor/Reliance.
3. Toshiba
4. TECO Westinghouse.

2.2 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

2.3 MOTOR CHARACTERISTICS

A. Speed and Size:
1. Speed and horsepower ratings are indicated on the Drawings.
2. Furnish motors sufficiently sized for the particular application and with full-load rating not less than required by the driven equipment at specified capacity.
3. Size motors so as not to overload at any point throughout the normal operating range.
4. Provide motors designed and rated for variable frequency drive applications where required.

B. Voltage:
1. Single phase: 115 volts for 120-volt nominal system voltage and 277 volts (refer to mechanical schedules).
2. Three phase: 460 volts for 480-volt nominal system voltage.

C. Frequency: 60 hertz.

D. Service Factor: According to NEMA MG 1-12.47 but not less than 1.15.

E. Acceleration Time: For integral horsepower motors, the calculated acceleration time of the combined motor and driven load shall not exceed 4 seconds at 90 percent of rated voltage.

F. Efficiency:
1. Provide single-speed NEMA Design B Premium efficiency induction motors having minimal full-load motor efficiency no less than those listed in the latest edition of NEMA MG 1 Section 12.60 (EFFICIENCY LEVEL OF PREMIUM EFFICIENCY ELECTRIC MOTORS). Motors and manufacturers shall be officially listed and labeled by the NEMA Premium program.
2. Base motor efficiencies on a statistically valid control procedure conforming to ANSI/IEEE 112-84, Test Method B (Dynamometer), using NEMA MG 1).
3. For motors rated at a horsepower not listed in the NEMA guidelines the motors shall conform to the next higher nominal motor horsepower efficiency rating.

2.4 DESIGN TYPE

A. Motors Larger than 1/2 Horsepower: 3-phase, NEMA Design Letter B, squirrel-cage induction motors.

B. Motor Driven by Variable Frequency Drives (VFDs): Inverter duty motors.

2.5 MOTOR INSULATION

A. Class. Use Class F insulation system meeting the requirements of NEMA MG Part 31 and made of non-hygroscopic materials for motors 10 HP and larger.

B. Temperature Rise B Temperature Rise: NEMA MG 1-12.41 for fractional horsepower motors and NEMA MG 1-12.42 for integral horsepower motors.

C. Outdoor Suitability:
1. Where motors must be suitable for outdoor installation, insulation must withstand 1 full week (168 hours) of testing in a chamber maintained at 100 percent relative humidity and 40°C ambient temperature.
2. Immediately after the test period, insulation system must have a minimum resistance of 1.5 megohms.
3. Coat inside circumference of the stator and the outside circumference of the rotor and shaft with the same moisture-resistant insulation system.

D. VFD Motors: Inverter duty type and capable of withstanding repeated peaks of 1600 volts at 0.1 microsecond rise time. Comply with NEMA MG-1 Part 31.

2.6 LEADS

A. Use not less than ASTM B 173, Class G, stranded copper conductors with insulation the same as or better than specified in the preceding Motor Insulation paragraph.

B. Provide permanent identification numbers on leads according to NEMA MG 1-2.02.

C. Use crimp-on, solderless copper terminals on leads and place heat-shrink insulation sleeves or covers between leads and terminals.

2.7 ENCLOSURE

A. Indoors:
1. Open drip-proof (ODP).
2. Use steel frame for motors smaller than 3/4 horsepower and up to 10 HP, and cast-iron frame for motors over 10 horsepower.

B. Motors 5 HP and greater that are driven by variable frequency drives, provide motor with factory mounted AEGIS shaft grounding ring.

2.8 BEARINGS

A. Motors 1/6 Horsepower and Larger:
1. Antifriction:
a. Supply motors with grease-lubricated antifriction ball bearings conservatively rated for long life under the total radial and thrust loads produced by the actual combination of motor-driven equipment.
b. Provide each motor with suitable lubrication fittings and pressure relief devices suitable for in-service lubrication.
2. Oil Lubricated: If the driven equipment Section specifies oil-lubricated bearings for motors, include a suitable sight gauge on each bearing with maximum and minimum levels clearly indicated.

2.9 HARDWARE

A. Use structural bolts, washers, nuts, pins, and similar items manufactured of high-strength steel. Use only hexagon-head bolts and hexagon nuts.

B. Use corrosion-resistant materials or protect hardware from corrosion by hot-dip galvanizing, chrome plating, or cadmium plating.

2.10 NAMEPLATES

A. Main Nameplate: Provide each motor with a stainless steel nameplate meeting the requirements of NEMA MG 1-10.38, and the National Electrical Code, Section 430-7. Identify energy-efficient motors in accordance with MG-1-12.54.2.

B. Bearings Nameplate: When bearings are oil lubricated, include oil type information on a suitable nameplate. Indicate bearing data if nonstandard.

C. Attachment: Attach the nameplates to the motor with stainless steel fastening pins or screws.

2.11 CONDUIT BOX

A. For each motor not supplied with a cord and plug, provide a conduit box suitably sized for the motor lead terminations, in accordance with the National Electrical Code, Section 430-12. Include a grounding lug for motors 1/6 horsepower and larger. Supply a gasket suitable for the motor enclosure type and application.

2.12 PAINT

A. Manufacturer's standard shop paints for prime and finish coats are acceptable.

2.13 NOISE

A. Provide integral horsepower motors with overall sound power levels meeting the requirements of MG 1-12.49.

2.14 STARTERS

A. Provide starters for any motor not equipped with VFD.

2.15 MOTOR HEATERS

A. Provide motor heaters on all motors larger than 5 HP that are located in exterior, unconditioned, or semi conditioned spaces. Heaters shall be controlled off a normally closed contact from the motor starter.
   1. Type. Electric resistance, silicon rubber clad or equivalent non-oxidizing exterior, with maximum surface temperature of 130ºC(266ºF). Alternatively, provide two stainless steel sheathed conventional space heaters, each with the rated watts at the specified voltage equal to twice the required value, and connected in series.
   2. Wattage. As required to avoid condensation during shutdown, but not less than twice the value given in the Appendix of IEEE Standard 43, paragraph A 1.3 (twice the length in feet multiplied by the diameter in feet divided by 35).
   3. Voltage. 230 volts, single phase, 60 hz but operated at 120V

PART 3 - EXECUTION

3.1 INSTALLATION

A. Properly install and align motors in the locations as shown on Drawings. Use crimp-on, solderless copper terminals on the branch circuit conductors. For motors 20 horsepower and larger, use 5300 Series 3M motor lead splicing kit or approved equivalent.

B. Nameplate must be in full view when motor and equipment are installed.

C. If a motor horsepower rating larger than indicated is offered as a substitute and is accepted, provide required changes in size of conductors, conduits, motor controllers, overload relays, fuses, circuit breakers, switches, and other related items at no change in contract price.

3.2 FIELD TESTING

A. Provide instruments, labor and personnel required to perform motor inspection and testing.

B. Inspect all motors for damage, moisture absorption, alignment, freedom of rotation, proper lubrication, oil leaks, phase identification, and cleanliness. Report abnormalities to Owner's Representative before energizing.

C. Measure full load current and full load voltage.

D. Complete and submit Motor Test Report forms to Owner's Representative.

E. After installation has been thoroughly checked and found to be in proper condition with thermal overloads in motor controllers properly sized and all controls in place, energize the equipment at system voltage for operational testing.

END OF SECTION 23 05 13

# SECTION 23 05 15 - VARIABLE FREQUENCY DRIVES

## PART 1 - GENERAL

### 1.1 WORK INCLUDED

A. Furnish complete the variable frequency drive (VFD) units as specified herein. All features described shall be included within the VFD enclosure.

### 1.2 RELATED WORK

A. Section 23 00 10, Mechanical General Provisions.

B. Section 23 05 13, Common Motor Requirements for HVAC Equipment.

C. Section 23 73 13, Air Handling Units.

D. Section 26 00 00, Electrical General Provisions.

E. Section 28 31 00, Fire Alarm System.

### 1.3 SUBMITTALS

A. Submit complete product data, shop drawings, and wiring diagrams, including the rated input current of the VFD. Data shall clearly indicate the current distortion produced by the VFD (submittal will not be approved prior to receiving this information). See paragraph 2.2E for requirements. Make submittals under the provisions of Section 23 00 00 and Division 01.

B. Product Data:
1. Provide literature that indicates dimensions, weights, capacities, performance, gages and finishes of materials, and electrical characteristics and connection requirements.
2. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory installed and field installed wiring. Coordinate submittal with Direct Digital Controls supplier for interface with building control system.
3. Ratings, including voltage and continuous current or horsepower.

C. Shop Drawings:
1. Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
2. Dimensioned drawings. Outline dimensional drawings of each size and type of variable frequency drive (VFD) proposed for use on this project. Include top and bottom views showing conduit entry and exit space, front and side elevations showing arrangement of devices, ventilation and cooling provisions, required clearances, and connection details. Include weight of each size and type of VFD proposed for use on this project, and mounting provisions.

D. Prior to Installation, Startup, and Testing:
1. Submit manufacturer's written installation instructions.
2. Submit written procedures for field testing to be performed under Part 3 of this Section. Procedures shall include prerequisite and initial conditions, a list of required test instruments, and forms for documentation of test results. Testing forms shall include the range of acceptance values for each recorded parameter.
3. Operation and Maintenance Manuals. Submit O&M manuals in accordance with the requirements of Section 23 00 00 and Division 01. Include instructions for routine service, spare parts lists, and wiring diagrams.

E. Following Installation, Startup, and Testing. Submit the following information for record purposes in accordance with the requirements of Division 01, Submittals, prior to Owner acceptance.

1. Records. Final as-built drawings and information for items listed in paragraph 1.3B and 1.3C, this Section.
2. Certified factory production test reports, as specified in Part 3, this Section.
3. Manufacturer's Field Start-up Report and Certification, as specified in Part 3, this Section.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. UL Compliance:
1. Comply with UL 508,
2. Comply with UL 60947-4-1A for Motor Starters and Contactors.

C. IEEE Compliance:
1. Comply with IEEE 112-B, Test Procedure for Polyphase Induction Motors and Generators.
2. Comply with IEEE 519, Harmonic Control in Electrical Power Systems.
3. Comply with ANSI/IEEE C62.41, Surge Voltages in Low-Voltage AC Power Circuits.

D. NEMA Compliance:
1. Comply with NEMA ICS 7.0, AC Adjustable Speed Drives.
2. Comply with NEMA MG-1 for Motors.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. ABB.

B. Danfoss.

2.2 VFD UNIT

A. The variable frequency drive (VFD) motor controller shall convert 480 Volt, three-phase, 60 Hertz power to adjustable voltage (0 - 480V) and frequency (0 - 60 Hz.) three-phase, AC power for stepless motor speed control with a capability of 10:1 speed range.

B. The adjustable frequency controller shall be a space vector sine-coded Pulse-Width Modulated (PWM) or IGBT design. Modulation methods which incorporate "gear-changing" techniques are not acceptable.

C. The controller shall be suitable for use with any standard or high-efficiency NEMA-B squirrel-cage induction motor(s) having a 1.15 Service Factor. At any time in the future, it shall be possible to substitute any standard motor (equivalent horsepower, voltage and RPM) in the field.

D. The variable frequency control shall operate satisfactorily when connected to a bus supplying other solid state power conversion equipment which may be causing up to 10 percent total harmonic voltage distortion and commutation notches up to 36,500 volt microseconds, or when other VFD's are operated from the same bus.

E. The VFD shall be provided with a harmonic filter that limits the current distortion to 5% or less. The resultant power factor with the addition of the filter shall be a minimum of 97%.
1. Assume the following input power conditions:
   a. 98% power factor.
   b. Nominal voltage and frequency.

F. Any inverter that generates sufficient electrical line noise to interfere with operation of sensitive building equipment (including computers) shall be field modified or replaced by the inverter supplier at no additional cost to the Owner.

G. The VFD shall be provided with a DDC System Interface/JCI Metasys Protocol Interface.

H. The VFD shall include RFI/EMI filters to prevent high frequency noise interference from migrating back onto the power system and RFI interference with other equipment.

2.3 SCHEDULE

A. In general, capacities of equipment and electrical characteristics are shown in schedules on the Drawings. Reference shall be made to the schedules for such information. One controller shall control the speed of one motor only. The capacities shown are minimum capacities. Variations in the capacities of the scheduled equipment supplied under this contract will be permitted only with the written direction of the Owner.

B. Where rating of driven equipment furnished for this project is larger than scheduled or indicated on Drawings, provide variable speed drive suitable for driven equipment. Coordinate submittal data and unit selections with submittal data for driven equipment.

C. Provide VFDs as follows unless otherwise specified on the equipment schedule:
1. For equipment that is redundant provide VFD without a constant speed bypass.
2. For equipment that is not redundant provide VFD with integral constant speed bypass.

D. Refer to the Drawing Schedules for sizes and ratings of the motors. Refer to other Sections for description of motors and their use.

2.4 BASIC DESCRIPTION

A. The controller shall produce an adjustable AC voltage/frequency output. It shall have an output voltage regulator to maintain correct output V/Hz. despite incoming voltage variations.

B. The controller shall have a continuous output current rating of 100 percent of motor nameplate current.

C. The VFD shall be of the Pulse-Width Modulated type and shall consist of a full-wave diode bridge converter to convert incoming fixed voltage/frequency to a fixed DC voltage. The Pulse Width Modulation strategy shall be of the space vector type implemented in a microprocessor which generates a sine-coded output voltage.

D. The inverter output shall be generated by power transistors which shall be controlled by six identical base driver circuits. The VFD shall not induce excessive power losses in the motor. The worst case RMS motor line current measured at rated speed, torque and voltage shall not exceed 1.05 times the rated RMS motor current for pure sine wave operation. The drive shall produce an output volts/Hertz pattern to produce adequate starting torque under all conditions and operate smoothly at all operating speeds on variable torque load.

2.5 FEATURES

A. The door of each power unit shall include a "POWER ON” light, a VFD fault light, a VFD run light, stop pushbutton, start pushbutton, a fault reset pushbutton, a "HAND-OFF-AUTOMATIC" selector switch, and a manual speed control potentiometer.

B. The VFD shall be software programmable to provide automatic restart after any individual trip condition resulting from overcurrent, overvoltage, undervoltage, or overtemperature. For safety, the drive shall shut down and require manual reset and restart if the automatic reset/restart function is not successful within a maximum of three attempts within a short time period.

C. Automatic restart after drive trip or utility failure. Software selectable if not desired.

D. Speed profile. Individual adjustable settings for start, stop, entry, slope, and minimum and maximum speed points.

E. Process signal inverter. Software selectable to allow speed of drive to vary inversely with input signal.

F. A critical speed avoidance circuit will be included for selection of two critical speeds with a rejection band centered on that speed. The drive will ignore any speed signals requiring drive operation within the rejection band.

G. Proportional and integral setpoint process controller with menu driven selection and programming via door-mounted keypad.

H. Pick up a spinning load. The VFD shall be able to determine the motor speed and resume control of a motor which is spinning without tripping.

I. A door-mounted membrane keypad with integral 2-line, 24-character LCD display shall be furnished, capable of controlling the VFD and setting drive parameters, and shall include the following features:

J. The digital display must present all diagnostic message and parameter values in English engineering units when accessed, without the use of codes.

K. The digital keypad shall allow the operator to enter exact numerical settings in English engineering units. A plain English user menu shall be provided in software as a guide to parameter setting, (rather than codes). Drive parameters shall be factory set in EEPROM and resettable in the field through the keypad. Means of password security shall be available to protect drive parameters from unauthorized personnel. The EEPROM stored drive variables must be able to be transferred to new boards to reprogram spare boards.

L. Input circuit breaker, interlocked with the enclosure door, with through-the-door handle to provide positive disconnect of incoming AC power.

M. Constant speed bypass shall be provided to allow the motor to run across the line in the event of VFD shutdown. The transfer from the VFD to the line shall be accomplished manually by means of a selector switch. The bypass circuitry shall be enclosed separate from the VFD in a NEMA-1 cabinet.

N. The bypass cabinet shall include a door-interlocked input circuit breaker, a VFD output contactor, a full-voltage starting contactor (both contactors electrically interlocked), a thermal overload relay to provide motor protection, a phase loss/undervoltage relay and a control power transformer. Mounted on the cabinet door shall be a two line LCD display to indicate status of the bypass operation (i.e. VFD output contactor failure or bypass contactor failure, etc), VFD bypass selector switch, motor fault light, power "ON" light, motor "ON" VFD light, and motor "ON LINE" light. The VFD and the bypass shall both be provided with a BacNet/Johnson Controls Protocol interface. The bypass shall have four digital inputs for individual safety interlocks, damper end switch interface and provide voltage and current reading on all 3 phases as well as KW.

O. The drive shall be provided with two isolated form C alarm contacts to indicate VFD failure and run status to the DDC.

P. The drive shall be capable of Fire Alarm Shutdown.

Q. The VFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to setpoint without safety tripping or component damage (flying start).

R. Normally the digital display shall simultaneously display:
1. Speed demand in percent.
2. Output current in amperes.
3. Frequency in Hertz or RPM.
4. Control Mode: Manual/Automatic.
5. Total three-phase KW or output volts.\

2.6 SERVICE CONDITIONS

A. The controller shall be designed and constructed to operate within the following service conditions:

1. Elevation. To 3300 Feet.
2. Ambient Temperature Range. 0°C to 40°C.
3. Atmosphere. Non-Condensing relative humidity to 95 percent.
4. AC Line Voltage Variation. -30 percent to +10 percent.
5. AC Line Frequency Variation. 3 Hertz.
6. Output Frequency. Shall be able to operate at the rated motor horsepower up to 90 hertz without damage to the VFD.

2.7 ENCLOSURE

A. VFD components shall be factory mounted and wired on a dead front, grounded, NEMA-1 enclosure. NEMA 12 enclosure is acceptable in lieu of NEMA 1 enclosure. Enclosure shall be UL listed as a plenum rated VFD.

B. Finish. Apply a finish to enclosure cabinet, trim, and doors. Exterior and interior metal surfaces shall be cleaned and finished with electrostatically applied "powder coat" thermoset enamel baked over a rust-inhibiting phosphatized coating.

2.8 PROTECTIVE FEATURES AND CIRCUITS

A. The controller shall include the following protective features:
1. Single phase fault or 3-phase short circuit on VFD output terminals without damage to any power component.
2. Static instantaneous overcurrent and overvoltage trip with inverse overcurrent protection.
3. Static overspeed (overfrequency) protection.
4. Line loss and undervoltage protection.
5. Power unit overtemperature protection.
6. Electronic motor overload protection.
7. Responsive action to motor winding temperature detectors or thermostatic switches.
8. Isolated operator controls.
9. Input line circuit breakers.
10. Be insensitive to incoming power phase sequence.
11. Have desaturation circuit to drive inverter section transistor base current to zero in event of controller fault.
12. Have DC bus discharge circuit for protection of operator and service personnel with an indicator lamp.
13. Input line noise suppression with line reactor.
14. Individual transistor overcurrent protection.

2.9 PARAMETER SETTINGS

A. The following system configuring settings shall be provided, without exception, field adjustable through the keypad/display unit or via the serial communication port only.

B. Motor Nameplate Data:
1. Motor frequency.
2. Number of poles.
3. Full load speed.
4. Motor volts.
5. Motor full load amps.
6. Motor KW.
7. Current minimum.
8. Current maximum.

C. VFD Limits:
1. Independent accel/decel rates.
2. No load boost.
3. Vmin, Vmax, V/Hz.

4. Full load boost.
5. Overload trip curve select (Inverse or Constant).
6. Min/Max speed (frequency).
7. Auto reset for load or voltage trip select.
8. Slip compensation.
9. Catch-A Spinning-Load select.
10. Overload trip time set.

D. VFD Parameters:
1. Voltage loop gain.
2. Voltage loop stability.
3. Current loop stability.

E. Controller Adjustments:
1. PID control enable/disable.
2. Setpoint select.
3. Proportional band select.
4. Reset time select.
5. Rate time select.
6. Input signal scaling.
7. Input signal select (4-20mA/0-5 Volts).
8. Auto start functions: On/Off, Delay On/Off, Level Select On/Off.
9. Speed Profile: Entry, Exit, Point Select.
10. Min, Max Speed Select.
11. Inverse profile select (allows VFD speed to vary directly or inversely with input signal.)

2.10 DIAGNOSTIC FEATURES AND FAULT HANDLING

A. The VFD shall include a comprehensive microprocessor based digital diagnostic system which monitors its own control functions and displays faults and operating conditions. Microprocessor systems must be products of the same manufacturer as the VFD (to assure single source responsibility, availability of service and access to spare parts).

B. A "FAULT LOG" shall record, store, display and print upon demand, the following for the 3 most recent events:
1. VFD mode (Auto/Manual).
2. Date and Time stamped for each fault
3. Elapsed time (since previous fault).
4. Type of fault.
5. Reset mode (Auto/Manual).

C. A "HISTORIC LOG" shall record, store, display and print upon demand, the following control variables at 2.7 M/Sec. intervals for the 10 intervals immediately preceding a fault trip:
1. VFD mode (manual/auto/inhibited/tripped/etc.).
2. Speed demand.
3. VFD output frequency.
4. Drive inhibit (On/Off).
5. Feedback (motor) Amps.
6. VFD output volts.
7. Type of fault:
   a. Inverter O/Temp.
   b. Over Voltage.
   c. Detection Error.
   d. Earth Leakage.
   e. Watchdog.
   f. PSU Power Fail.
   g. Manual Test.

h. Out of Sat 1-6.
i. Software Fault.
j. Waveform Gen.
k. Remote Watchdog.
l. Thermistor.
m. Sustained O/L.
n. Bypass SCR Trip.

D. The fault log record shall be accessible via a RS485 serial link as well as line by line on the keypad display.

2.11 SYSTEM OPERATION

A. With the H-O-A switch in the "HAND" position, the drive shall be controlled by the manual speed potentiometer on the drive door.

B. With the H-O-A switch in "AUTOMATIC", the drive shall start remotely through the EMS and its speed shall be controlled by a 4-20mA, internally isolated signal from the local Powers Control Panel.

C. With the H-O-A switch in the "OFF" position, the run circuit will be open and the VFD will not operate.

2.12 QUALITY ASSURANCE AND FACTORY TESTS

A. The controller shall be subject to, but not limited to, the following quality assurance controls, procedures and tests:
1. Power transistors, SCR's and diodes shall be tested to ensure correct function and highest reliability.
2. Controller will be functionally tested with a motor to ensure that if the drive is started up according to the instruction manual provided, the unit will run properly.

B. Manufacture of VFD shall certify in shop drawings that VFD and equipment motors are compatible. Contractor shall provide VFD manufacturer complete motor data prior to submittal of shop drawings.

C. Manufacturer shall provide a 3 year warranty on parts and labor to owner for each VFD from date of acceptance by Owner.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under the provisions of Section 23 00 00.

B. Deliver products on site in factory fabricated protective containers, with factory installed shipping skids and lifting lugs. Inspect for damage.

C. Store in clean dry place, elevated above grade, and protected from weather, sunlight, dirt, moisture, corrosion, and construction traffic.

D. Handle carefully to avoid damage to components, enclosures, and finish. Use only lifting eyes and brackets provided for that purpose. Damaged products shall be rejected and shall not be installed on the project.

3.2 PREPARATION

A. Verify that surfaces are ready to receive Work.

B. Verify that field measurements are as shown on Shop Drawings and as instructed by manufacturer.

C. Verify that required utilities are available, in the proper location, and ready for use.

3.3 INSTALLATION

A. Install VFD in accordance with manufacturer's published, printed instructions.

B. Mounting.
1. Mount VFD on unistrut frame anchored to wall.
2. Height. In general, mount units so that operating handle is approximately 60 inches above finished floor. Where grouped, align tops of units.
3. Ensure that proper clearance is provided for enclosure as required per NEC Table 110.26(A)(1) for working clearance and dedicated equipment space. Ensure that proper clearance is provided for enclosure as required by manufacturer for proper cooling of VFD.

C. Coordinate with Division 26 to complete raceway, power wiring, and grounding in accordance with the requirements of the NEC and the recommendations of the VFD manufacturer as outlined in the installation manual.

D. Contractor shall verify the existence and proper installation and operation of auxiliary contact on all disconnects located between the load and the drive. Auxiliary contact shall command the VFD to shut down as required to protect the VFD from damage. Any disconnects found lacking this function shall be corrected prior to the startup of the equipment.

E. Interface:
1. Controls. Coordinate with the controls supplier to accomplish proper interface with the building automation system (BAS) direct digital controls (DDC). Refer to Division 23 for Direct Digital Controls.
2. Fire Alarm. Coordinate with Division 28 and the fire alarm supplier to accomplish proper interface with the fire alarm system, as indicated on the Drawings. Refer to Division 28, Fire Alarm System.
3. Shutdown. Coordinate with other divisions to accomplish proper interface for shutdown of VFD, as indicated on the Drawings and as specified in the construction documents.

F. Immediately prior to final acceptance, replace all air filters in VFD and clean inside of drives.

G. Manufacturer shall provide start-up services and training as follows:
1. Start-up for Contractor to verify correct installation and proper operation, including power and controls wiring connections..
2. Start-up for Controls Vendor to verify that VFD correctly responds to control command functions and provides alarm condition to control center.
3. Provide a report for each VFD indicating start-up is complete and/or noting any deficiencies found with the installation. VFD report must be provided to engineer prior to substantial completion.
4. Provide minimum two-day training, four (4) hours per day for up to twelve (12) people. The course shall be classroom instruction complete with visual aids, documentation, circuit diagrams and hands-on training. This course shall not be construed as a sales meeting, but rather as a school to familiarize the Owner with the care, troubleshooting, and servicing of the VFD.

END OF SECTION 23 05 15

# SECTION 23 05 19- METERS AND GAUGES FOR HVAC PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes the following for hydronic piping:
   1. Thermometers.
   2. Gauges.
   3. Pressure and Temperature Taps.

### 1.2 SUBMITTALS

A. Product Data: For each type of product indicated, submit detailed shop drawings and manufacturer's data, including:
   1. Measurement tolerances.
   2. Range.
   3. Accuracy.
   4. Device dimensions and connection sizes (include schedule indicating stem length versus pipe diameter).
   5. Scales.
   6. Materials of construction.
   7. Valves that will be used for isolating gauges.

B. Submit a schedule for each device to be installed, including:
   1. Location.
   2. Pressure or temperature range of device and fluid measured.
   3. Temperature or pressure of fluid.
   4. Pipe size and bulb length of thermometers.
   5. Type of valve used with the Pressure Gauge.

C. Operation and maintenance data.

### 1.3 QUALITY ASSURANCE

A. Thermometers: Calibrate against standards traceable to the NIST and guaranteed accurate to plus or minus one scale division.

B. Pressure Gauges: ASME B40.1 Grade 2A accuracy 0.5 percent of scale range.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

A. Products meeting all requirements of this specification Section of the following manufacturers are acceptable:
   1. Thermometers: Ashcroft, Dwyer, Marsh Instrument, Trerice, Weiss, Weksler
   2. Pressure Gauges: Ashcroft, Dwyer, Trerice, Weiss, Weksler
   3. Pressure/Temperature Taps: Peterson Engineering Company, Sisco or Trerice

### 2.2 BIMETAL THERMOMETERS

A. Construction: All stainless steel bi-metal type construction with 5 inch dial.

B. Window: Glass.

C. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

D. Dial: Black figures on white background with black pointer.

E. Stem: Stainless steel thermowell installation, ¼-inch diameter, minimum 2-1/2 inch straight or angle form of length to suit installation.

F. Coil: Bimetallic, hermetically sealed with silicone dampened

G. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

H. Furnish thermometers for services in the following ranges and divisions:
   1. Chilled Water: 0 to 100 degrees F or 25 to 125 degrees F, 1 degree divisions
   2. Heating Hot Water: 20 to 240 degrees F, 2 degree divisions

2.3 THERMOWELLS

A. Manufacturers: Same as manufacturer of thermometer being used.

B. Description: Brass or stainless steel with pressure and temperature ratings suitable for their application. Wells for insulated piping shall have a 2-1/2 inch lagging protrusion. Locate thermometer wells so the sensing bulb will give a true and correct reading. Install thermometer so as not to cause undue restriction in small piping. Where wells are located in pipelines 1-1/2 inch and smaller, provide a section of pipe of such diameter that the net area of the pipeline will not be reduced by the thermometer well.

2.4 PRESSURE GAUGES

A. Direct-Mounting, Dial-Type Pressure Gauges: Indicating-dial type complying with ASME B40.100.
   1. Case: Liquid-filled type, polypropylene case, 4-1/2 inch diameter, solid front with blow-out back.
   2. Bourdon Tube: Bronze or 316 stainless steel with brass or stainless steel socket.
   3. Movement: 300 series stainless steel rotary type with stainless steel bushings
   4. Dial: White face with black figure.
   5. Pointer: Red or black, micro adjustable.
   6. Window: Molded Acrylic.
   7. Ring: Fiberglass polypropylene.
   8. Accuracy: Grade A, plus or minus 0.5 percent of middle half scale.
   9. Gauge Ranges
      a. Provide 0 - 160 psi gauges for 150 psi chilled/hot water service.

B. Pressure-Gauge Fittings:
   1. Valves: NPS 1/4 brass or stainless-steel needle type.
   2. Siphons: NPS 1/4 coil of brass or stainless steel tubing with threaded ends.
   3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.5 PRESSURE AND TEMPERATURE TAPS:

A. Taps. Provide 1/2" solid brass fittings which will receive either a pressure or temperature probe, with valve core of Nordel and fitted with a color coded cap and gasket. P/T Taps shall be rated for 275 degrees F. and 1000 psig. Provide long stem type for insulated pipe.

B. Instruments. Provide two each, No. 500 "Pete's Plug" pressure gauge adapters with four gauges and probes and four each 5" stem pocket thermometers: Two each, thermometers for chilled water, when applicable. Applicable meaning the system is being installed as part of the project. “Pete’s Plugs” to match insulation thickness.

PART 3 - EXECUTION

3.1 THERMOMETER INSTALLATIONS

A. Provide thermometers and thermometer wells in the following locations:
   1. Inlet and outlet of each air handling unit coil connection.
   2. As shown on Drawings and control schematics.

B. Install direct-mounting thermometers and adjust vertical and tilted positions.

C. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees where thermometers are indicated.

3.2 GAUGE INSTALLATIONS

A. Provide pressure gauges in the following locations:
   1. Inlet and outlet of each air handling unit coil.
   2. Supply and return piping connections of coils (where shown on details).
   3. As shown on Drawings and control schematics.

B. Install direct-mounting pressure gauges in piping tees with pressure gauge located on pipe at most readable position.

C. Install needle-valve in piping for each pressure gauge for fluids.

D. Provide fittings as necessary to install pressure gauge in the vertical position.

3.3 PRESSURE AND TEMPERATURE TAP INSTALLATIONS

A. Provide pressure and temperature taps at the following locations:
   1. Inlet and outlet of each coil connection.
   2. Inlet and outlet of each hydronic control valve
   3. Where shown in details on mechanical drawings.

B. Provide liquid filled gauges upstream and downstream of all pumps.

3.4 CONNECTIONS

A. Install thermometers and gauges adjacent to machines and equipment to allow service and maintenance for thermometers, gauges, machines, and equipment.

3.5 ADJUSTING

A. Adjust faces of meters and gauges to proper angle for best visibility.

END OF SECTION 23 05 19

# SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. This Section includes requirements for furnishing and installing heating water, chilled water piping, condensate piping valves and appurtenances, including fittings and strainers.

B. Related Sections:
   1. Section 23 05 53, Identification for HVAC Piping and Equipment, for valve tags and schedules.

### 1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data showing compliance with requirements of Part 2. Clearly indicate piping, equipment, materials of construction, pressure rating and which options are to be provided.

### 1.3 DELIVERY, STORAGE, AND HANDLING

A. Protect all piping, valves, fittings, etc. before installation in accordance with manufacturer's written instructions.

B. Piping shall be sent from the factory with capped ends and shall be stored on supports off of the ground with ends covered to prevent nesting of insects, birds and other animals, or the accumulation of dirt and debris in and around the piping components.

### 1.4 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to HVAC valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:
   1. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
   1. Ball Valves: Provide an insulated stem extension.
   2. Butterfly Valves: With extended neck.

F. Valve-End Connections:
   1. Flanged: With flanges according to ASME B16.1 for iron valves.
   2. Solder Joint: With sockets according to ASME B16.18.
   3. Threaded: With threads according to ASME B1.20.1.

### 2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Check Valves: Apco, Crane, Kitz, Mission, Milwaukee, Mueller, Nibco, Powell, Stockham and Weco.
2. Globe Valves: Crane, Kitz, Milwaukee, Nibco, Powell, or Stockham.
3. Butterfly Valves: Bray, Clow, Demco, DeZurik, Crane, Kitz, Milwaukee, Nibco, Pratt, or Stockham.
4. Ball Valve: Apollo, Crane, DeZurik, Kitz, Milwaukee, Nibco, or Watts.
5. Strainers: Armstrong, Keckley, Mueller Spirax or Watts.

## 2.3 CHECK VALVES

A. For pipe 2 inches in diameter and smaller, furnish 150-pound (class 150) screwed, horizontal, swing check valve, all bronze construction, with screwed cap.

B. For pipe 2-1/2 to 10 inches in diameter, provide 125-pound (class 125), lugged style, drill and tapped, double door valve, with cast iron body and aluminum bronze doors, Buna-N seat, and Type 316 stainless steel spring.

## 2.4 GLOBE VALVES

A. For pipe 2 inches in diameter and smaller, provide 150-pound (class 150) screwed, rising stem, globe valve with bronze body, TFE disc, union bonnet.

B. For pipe 2-1/2 through 10 inches in diameter, provide 125-pound (class 125) flanged, OS&Y globe valve, with cast iron body, renewable bronze trim.

## 2.5 BUTTERFLY VALVES

A. For pipe 2-1/2 through 12 inches in diameter, furnish 200-pound flanged or tapped lug type butterfly valve with ductile iron body, stainless steel stem, aluminum-bronze disc with EPDM liner. Provide lever-operated valves 6 inches and smaller. Furnish valves 8 inches and larger with totally enclosed worm gear operators. Provide valves with enclosed worm gear operators with chain wheel and chain on valves installed higher than 84 inches above floor. Use valves designed for drip-tight shutoff in dead end service against 200 psi.

B. Where balancing valve is shown, provide butterfly valve with position lock operator (memory stop) for valves 6 inches and smaller and worm gear operator with memory stop for valves 8 inches and larger.

## 2.6 BALL VALVES

A. For pipe 2 inches in diameter and smaller, provide 600 psi WOG screwed, two piece bronze or forged brass body, Teflon seat, full port, stainless steel stem and ball. Provide extension stem and insulated handle for valves installed in insulated piping. Where ball valves are used as balancing valves, provide valve with memory stop.

## 2.7 STRAINERS

A. For pipe 2 inches in diameter and smaller, use 125-pound (class 125) cast bronze screwed Y-type strainer with 12-mesh stainless steel screen. Provide full size blowoff ball valve where shown on drawings.

B. For pipe 2-1/2 inches and larger, provide 150-pound (class 150) cast steel or iron flanged Y-type strainer with 0.045 inch stainless steel screen through 4, and 1/8 inch stainless steel screen for 6 inches and larger. Provide full size blowoff ball valve where shown on drawings.

PART 3 - EXECUTION

3.1 STORAGE:

A. Protect all piping, valves, fittings, etc. before installation in accordance with manufacturer's written instructions. All piping shall be sent from the factory with capped ends and shall be stored on supports with ends covered to prevent nesting of insects, birds and other animals, or the accumulation of dirt and debris in and around the piping components.

3.2 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.3 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Provide clearance for access to valves, fittings and equipment for operation and maintenance.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full stem movement and with operators and stems upright or horizontal.

F. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

G. All piping shall be clean when it is installed.

H. Check Valves. Install lugged check valves between flat flange and full-face gasket. Install check valves a minimum three to four pipe diameters downstream of pump discharge or elbows to avoid flow turbulence.

3.4 ISOLATION VALVES

A. Provide piping systems with line size shutoff valves located at the risers, at main branch connections at each floor and at branch takeoffs serving equipment, and at other locations as indicated and required for isolation of piping or equipment.

B. At air handling units, where multicoil (stacked) arrangement is used, provide each supply and return line to and from each stacked coil section with a union, pressure gauge and thermometer well and a balancing valve (with memory stop) for balancing, and valves for isolation of each coil.

3.5 DRAIN VALVES AND VENTS

A. Install drain valves at all low points and at base of all risers of water piping systems so that these systems can be entirely drained.

B. Install 2 inch drain for 2 inch pipes and larger.

C. Install a line size drain valve for pipes smaller than 2 inches.

D. Provide hose adapter and cap on all drain lines.

E. Provide automatic vents with isolation valves or manual vents at locations as indicated on Drawings and all high points in piping systems.

3.6 TESTING

A. Apply a hydraulic pressure 1-1/2 times the operating pressure, 150-psig minimum, and carefully check for leaks.

B. Remove or isolate valves, expansion joints, strainers and equipment that are rated at pressures less than test pressure.

C. Repair all leaks and retest the system until proven leak tight.

3.7 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 23 05 23

# SECTION 23 05 48 - VIBRATION ISOLATION FOR HVAC PIPING AND EQUIPMENT

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes requirements for furnishing, installing, and adjusting vibration isolation, for mechanical equipment and piping, including bases of structural steel and concrete, with steel pouring forms and concrete reinforcing bars.

B. Related Sections Include:
   1. Section 23 21 13, Hydronic Piping and Fittings.

### 1.2 SUBMITTALS

A. Product Data: Submit product data showing type, size, load, deflection, and other required information. Include clearly outlined procedures for installing and adjusting isolators. Submit Drawings for each item of equipment with complete isolation installation information.

### 1.3 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 23 00 10.

B. Include copies of approved submittals and any submittal comments.

C. Provide tab for each major type of equipment (air handling units, piping, fans, etc.). Provide schedule of vibration isolator type with location and load on each. Include data on each isolator type that corresponds to:
   1. Spring diameter.
   2. Deflection.
   3. Compressed spring height.
   4. Point location of each isolator.
   5. Calculated load at each point.
   6. Field static deflection.

D. Include copy of written certification from factory representative as required in Part 3 of this specification.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Amber/Booth Company, Inc.
   2. Kinetics Noise Control
   3. Korfund Dynamics
   4. Mason Industries.
   5. Metraflex
   6. Vibration Eliminator Co., Inc.

2.2 ISOLATOR DESIGN

A. Materials:
1. Design and treat vibration isolators for resistance to corrosion.
2. Steel components shall be PVC coated or phosphatized and painted with industrial-grade, corrosion-resistant enamel.
3. Furnish zinc-electroplated or cadmium plated nuts, bolts and washers.

B. Design:
1. All spring isolators must be completely stable in operation and must be designed for not less than 30 percent reserve deflection beyond actual operation conditions.

2.3 ISOLATOR TYPES

A. Design of isolator types listed is based on model numbers manufactured by Kinetics Noise Control, unless otherwise indicated. Subject to compliance with requirements provide named product.

B. Type SH: Spring hanger consisting of a rectangular steel box, coil spring, spring retainers, neoprene-impregnated fabric washer, and steel washer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. Installation of vibration isolators must not cause any change of position of equipment, piping or duct work resulting in stresses or misalignment.

D. The contractor shall not install any equipment, piping, duct or conduit which makes rigid connections with the building unless isolation is not specified. “Building” includes, but is not limited to, slabs, beams, columns, studs and walls.

E. Isolate pumped water-piping systems with spring-type vibration isolators as indicated in schedule.

F. All open-type spring isolators shall be restrained as recommended by the manufacturer.

G. Install full line size flexible connectors at the suction and discharge connection of each piece of equipment as indicated in schedule below. All connectors to be suitable for use at the pressure and temperature encountered at point of operation. Do not insulate Type REJ flex pump connectors installed in heating hot water systems.

3.2 APPLICATION

A. The following is a schedule of equipment and piping on a typical project that requires vibration isolation and base isolators of the types specified. Refer to Drawings for equipment scheduled for the Project. Any equipment, system or condition that may be altered, added, or changed; or that is not specifically described in the Contract Documents shall be isolated in a manner specified for similar equipment, system or condition in order to comply with these Specifications.

B. Provide isolation for the following piping systems:

| Piping Systems | Isolator Type | Minimum Deflection (inches) |
|---|---|---|
| Air Handling Units: | | |
| Supply/Return piping connections | REJ | |
| First two hangers adjacent to equipment | SH | 1 |

3.3 STOCK REQUIREMENTS

A. The isolation manufacturer's representative must maintain an adequate stock of springs and isolators of type used so that changes required during construction and installation can be made.

3.4 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 23 05 48

# SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

## PART 1 - GENERAL

### 1.1 SUMMARY

A. This section includes:
   1. Equipment labels.
   2. Warning signs and labels.
   3. Pipe labels.
   4. Stencils.
   5. Valve tags.
   6. Warning tags.
   7. Duct labels.

### 1.2 SUBMITTAL

A. Product Data: For each type of product indicated.

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

C. Valve numbering scheme.

D. Valve Schedules: For each piping system to include in maintenance manuals.

### 1.3 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

### 1.4 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 23 00 10.

B. Valve Tags
   1. Provide three-ring binder including valve tag information (8-1/2 x 11 inch paper).
   2. Each service shall be individually tabbed in the binder.
   3. For each valve tag, indicate service, function, valve position (NC or NO), floor, room location and nearest column numbers.

C. Equipment Labels
   1. Provide three ring binder including equipment label information (8-1/2 x 11 inch paper).
   2. Each type of equipment (pumps, AHUs, etc) shall be individually tabbed in the binder.
   3. For each item of equipment to be labeled, provide equipment identification number, floor, room location, and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Acceptable Manufactures: Subject to compliance with requirements, provide products by one of the following:
   1. Brady Corporation.
   2. Marking Services, Inc.
   3. Seton Identification Products.

2.2 EQUIPMENT LABELS

A. Labels for Equipment:
1. Material and Thickness: 3-ply Plastic, and having predrilled or stamped holes for attachment hardware. White background, black lettering.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 x 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 DUCT LABELS

A. Identify ductwork with stencil.

B. Letter Color: Black.

C. Lettering Size: At least 1-1/2 inches high.

D. Paint: Shall meet VOC requirements per Division 09 painting specification.

E. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

2.5 VALVE TAGS

A. Provide valves with 1 1/2 inch diameter stainless steel or brass valve tag with stamped and black-filled numbers. Service designations shall be 1/4 inch letters, and valve numbers shall be 1/2 inch letters. Service designations shall be approved by Architect/Engineer. Secure tags to valves by use of brass "S" hooks and brass chain. Secure chain to valve by use of copper or monel meter seals.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment. Use fasteners for all equipment labels where possible. Where it is not possible to use fasteners, use adhesive.

B. Locate equipment labels where accessible and visible.

3.3 VALVE TAG

A. Install valve tags for all major valves. This shall include branch isolation and balancing valves, isolation valves for equipment such as air handling units, etc.

3.4 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces; and locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
   3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   4. At access doors, manholes, and similar access points that permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   6. Spaced at maximum intervals of 50 feet along each run, and each change of direction. Reduce intervals to 25 feet in areas of congested piping and equipment.
   7. Do not label drain piping where the floor drain is located adjacent to the equipment.

B. Provide pipe labels for the following piping systems:
   1. Chilled Water Systems
   2. Heating Hot Water Systems
   3. Steam Systems
   4. Drain lines

3.5 DUCT LABEL INSTALLATION

A. Identify ductwork with stencil.

B. Identify exhaust fan number, air handling unit number, service and area served.

C. Locate identification at air handling unit or fan, at each side of penetration of structure or enclosure at each obstruction, every 20 feet on long horizontal runs. Provide identification for the following ductwork:
   1. All exhaust (restroom, laboratory, kitchen, etc) and relief ductwork.
   2. All supply air ductwork served by Air Handling Units
   3. All outside air ductwork, including pretreated outside air ducts.
   4. All return air ductwork, not including return air boots and transfer ducts.

END OF SECTION 23 05 53

# SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

## PART 1 - GENERAL

### 1.1 SUMMARY

A. This Section includes TAB to produce design objectives for the following:
   1. Air Systems:
      a. Air Handling Units.
   2. Verifying that automatic control devices are functioning properly.
   3. Reporting results of activities and procedures specified in this Section.

### 1.2 SUBMITTALS

A. Strategies and Procedures Plan: Submit 3 copies of TAB strategies and step-by-step procedures as specified in paragraph 3.2, Preparation of this Section. Include a complete set of report forms intended for use on this Project.

B. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

C. Warranties specified in this Section.

### 1.3 QUALITY ASSURANCE

A. TAB Firm Qualifications: TAB firm certified by AABC, NEBB or TABB.

B. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
   1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
   2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard forms from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

### 1.4 SCOPE OF WORK

A. Testing, adjusting, and balancing (TAB) of the air conditioning systems, related ancillary equipment will be performed by an impartial technical TAB firm selected and employed by the Owner.

B. As a part of this Contract, the Contractor and/or Mechanical Subcontractor shall make any changes required for correct balance as required by the TAB firm, at no additional cost to the Owner.

C. The Mechanical Subcontractor shall provide and coordinate services of qualified, responsible subcontractors, suppliers and personnel as required to correct, repair, replace any and all deficient items or conditions found during the testing, adjusting and balancing period.

D. Contract completion schedules shall provide sufficient time to permit the completion of TAB services.

E. The Drawings and Specifications have indicated valves, dampers, and miscellaneous adjustment devices for the purpose of adjustment to obtain optimum operating conditions, and it will be the responsibility of the Contractor to install these devices in a manner that will leave them accessible and readily adjustable. Should any such device not be readily accessible, the Contractor shall provide access as requested by the TAB firm. Also, any malfunction encountered by TAB personnel and reported to the Contractor or the Inspector shall be corrected by the Contractor immediately so the balancing work can proceed.

F. Contractor must insure that the necessary systems are scheduled to be in operations for TAB firm so that the access for balancing to diffusers, dampers etc., is not restricted. Contractor must schedule and coordinate activities so that TAB firm is not restricted from performing work, including access to damper operators and air devices.

1.5 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.6 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
   1. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine system and equipment installations to verify that they are complete and that testing, adjusting, and commissioning specified in individual Sections have been performed.

D. Examine system and equipment test reports.

E. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

F. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

G. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.

H. Examine equipment for installation and for properly operating safety interlocks and controls.

I. Examine automatic temperature system components to verify the following:
   1. Dampers, valves, and other controlled devices are operated by the intended controller.
   2. Dampers and valves are in the position indicated by the controller.
   3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
   4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
   5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
   6. Sensors are located to sense only the intended conditions.
   7. Sequence of operation for control modes is according to the Contract Documents.
   8. Controller set points are set at indicated values.
   9. Interlocked systems are operating.
   10. Changeover from heating to cooling mode occurs according to indicated values.

J. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

## 3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:
   1. Permanent electrical power wiring is complete.
   2. Hydronic systems are filled, clean, and free of air.
   3. Automatic temperature-control systems are operational.
   4. Equipment and duct access doors are securely closed.
   5. Balance, smoke, and fire dampers are open.
   6. Isolating and balancing valves are open and control valves are operational.
   7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.

8. Windows and doors can be closed so indicated conditions for system operations can be met.

## 3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in [AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems"] [NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems"] [SMACNA's TABB "HVAC Systems - Testing, Adjusting, and Balancing"] and this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

## 3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

E. Check airflow from the outside-air terminal units and the return- and exhaust-air inlets, through the supply-fan discharge and dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling unit components.

L. Check for proper sealing of air duct system.

## 3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
   1. Measure fan static pressures to determine actual static pressure as follows:
      a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
      b. Measure static pressure directly at the fan outlet or through the flexible connection.
      c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
      d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
   2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
      a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
   3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
   4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
   5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
   6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

B. Measure terminal outlets and inlets without making adjustments.
   1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

## 3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
   1. Set outside-air dampers at a minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
   2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
   3. Measure total system airflow. Adjust to within indicated airflow.

4. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
5. Record the final fan performance data.

## 3.7 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:
   1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.

## 3.8 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
   1. Include a list of instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to certified field report data, include the following:
   1. Fan curves.
   2. Manufacturers' test data.
   3. Field test reports prepared by system and equipment installers.
   4. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
   1. Title page.
   2. Name and address of TAB firm.
   3. Project name.
   4. Project location.
   5. Architect's name and address.
   6. Engineer's name and address.
   7. Contractor's name and address.
   8. Report date.
   9. Signature of TAB firm who certifies the report.
   10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
   11. Summary of contents including the following:
      a. Indicated versus final performance.
      b. Notable characteristics of systems.
      c. Description of system operation sequence if it varies from the Contract Documents.
   12. Nomenclature sheets for each item of equipment.
   13. Data for terminal units, including manufacturer, type size, and fittings.
   14. Notes to explain why certain final data in the body of reports varies from indicated values.
   15. Test conditions for fans and pump performance forms including the following:
      a. Settings for outside-, return-, and exhaust-air dampers.
      b. Conditions of filters.
      c. Cooling coil, wet- and dry-bulb conditions.
      d. Face and bypass damper settings at coils.
      e. Fan drive settings including settings and percentage of maximum pitch diameter.

f. Inlet vane settings for variable-air-volume systems.
g. Settings for supply-air, static-pressure controller.
h. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Balancing stations.
6. Position of balancing devices.

## 3.9 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

C. END OF SECTION 23 05 93

# SECTION 23 07 00 - INSULATION - GENERAL

## PART 1 - GENERAL

### 0.1 WORK INCLUDED

A. This Section specifies the general requirements for furnishing and installing insulation. These requirements apply to all other Mechanical Division sections specifying insulation.

B. All the ductwork and piping in pump rooms, mechanical rooms and equipment rooms including areas without ceilings is to be considered as exposed piping or ductwork. This also includes penthouses.

### 0.2 RELATED WORK

A. Internal insulation for air units is specified in the sections on air handling units. The units do not require external insulation.

B. Insulation. Refer to specific sections on individual insulation types.

### 0.3 FIRE HAZARD RATING

A. All equipment, duct and piping insulation used on the project must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50 as determined by test procedures ASTM E 84, NFPA 255 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements.

### 0.4 QUALITY ASSURANCE:

A. Applicator shall be a company specializing in insulation application with minimum 5 years' experience.

### 0.5 SUBMITTALS

A. Product Data. Submit product data on each insulation type, adhesive and finish to be used in the work. Include manufacturer's installation instructions, list of materials and thickness for equipment scheduled.

B. Shop Drawings: Show details for the following:
   1. Application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Insulation application at pipe expansion joints for each type of insulation.
   3. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   4. Removable insulation at piping specialties, equipment connections, and access panels.
   5. Application of field-applied jackets.
   6. Application at linkages of control devices.
   7. Field application for each equipment type.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers are listed under individual specification sections.

2.2 INSULATION

A. Insulate in accordance with appropriate specification section.

PART 3 - EXECUTION

3.1 COMMON INSULATION REQUIREMENTS

A. All materials shall be delivered to the site shall be dry, undamaged and maintained in good condition throughout the progress of the project.

B. Insulation shall not be installed until all testing and inspection of pipe, duct, etc. has been completed and approved by Engineer/Owner's representative.

C. Insulate valves, fittings, flanges and special items in accordance with appropriate specification section.

D. Replace insulation damaged by either moisture or other means. Insulation which has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation. Also replace any damage caused by the condensation.

E. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

F. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

G. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

H. Install insulation with longitudinal seams at top and bottom of horizontal runs.

I. Install multiple layers of insulation with longitudinal and end seams staggered.

J. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

K. Keep insulation materials dry during application and finishing.

L. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

M. Install insulation with least number of joints practical.

N. Where vapor barrier is indicated, seal joints, duct wrap seams, vapor retarder (ASJ) film seams and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier coating/mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier coating/mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

O. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

3.2 ACCESSORIES

A. Installation of accessories such as jacketing, bands, adhesives, insulation shields, coatings, finishes, etc. is specified under individual specification sections.

END OF SECTION 23 07 00

# SECTION 23 07 13 – EXTERNAL DUCT INSULATION

## PART 1 - GENERAL

### 1.1 SUMMARY

A. This Section provides for furnishing and the installation of external insulation on all single wall low, medium and high pressure supply ductwork, all outside air ductwork, all relief and return air duct work in non air conditioned spaces. It also includes insulating the tops of all supply diffusers.

B. External insulation of concealed and exposed ducts is included in this section. Internal acoustic duct linings are not permitted except where shown on drawings.

C. All the ductwork exposed to view in public spaces, in mechanical and pump rooms, crawl space and equipment rooms including all areas without ceilings is to be considered as exposed ductwork.

D. Consider space above ceilings air-conditioned if floor above is air-conditioned. Consider vertical chases not used for return air and vertical chases leading to spaces not air-conditioned as un-air conditioned spaces.

### 1.2 RELATED WORK

A. Section 23 07 00, HVAC Insulation.

B. Section 23 31 13, Ductwork.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

A. Fiberglass:
   1. CertainTeed.
   2. JohnsManville.
   3. Owens-Corning.

### 2.2 INSULATION

A. Provide insulation with minimum thickness and installed “R” valves in accordance with ASHRAE Standard 90.1-2004 tables 6.8 2 A & B, but not less than thickness specified below and as required to prevent condensation.

B. Concealed Duct, Round or Rectangular: Provide flexible glass fiber insulation with factory-applied, reinforced foil scrim kraft (FSK) facing vapor barrier, 1.0-pound density, 2 inches thick. A K factor of 0.27 at 75°F mean is required.

C. Exposed Round Duct: Provide end grain fiberglass insulation adhered to ASJ vapor barrier, 1.0-pound density, 2 inches thick. A K factor of 0.27 at 75°F mean is required.

D. Exposed Rectangular Duct: Provide rigid board duct insulation of 2 inches thick fiberglass. A minimum density of 6 pounds per cubic foot is required. Provide an integral, UL labeled, reinforced All Service Jacket (ASJ) on the outside surface. A K factor of 0.23 at 75°F mean is required.

E. Standing Seams: Insulate standing seams and stiffeners which protrude through insulation with 6-pound density, 1-1/2 inch thick, faced duct insulation, flexible blanket or rigid insulation to match duct insulation. As a vapor seal on exposed edges , use glass cloth with vapor barrier coating. Insulation should not prevent adjustment of damper operators.

F. Supply Diffusers and Grilles: Provide the same as for the duct insulation, except 1 inch thick.

## 2.3 COATINGS AND ADHESIVES

A. Coating. Childers CP-30 low-odor vapor barrier coating.

B. Adhesive. Childers CP-82 vapor barrier adhesive.

C. Glass Cloth. No. 10 white glass cloth.

## 2.4 ALUMINUM JACKET

A. Prefabricated jacket of Type 3003-H14 aluminum alloy, 0.016 inch thick, with factory-applied 2 mil moisture barrier.

# PART 3 - EXECUTION

## 3.1 GENERAL

A. Do not apply insulation until ductwork has been tested.

B. Verify surfaces are clean, foreign material removed, and dry.

C. Where trapeze hangers are used, provide strip of non-compressible insulation between ductwork and hanger.

## 3.2 FIRE SAFETY REQUIREMENTS

A. Do not extend duct coverings through walls or floors required to be fire stopped or required to have fire resistance rating. Interrupt duct coverings in the immediate vicinity of heat sources such as electric resistance or fuel-burning heaters.

3.3 CONCEALED DUCT, ROUND OR RECTANGULAR

A. Insulation shall be wrapped, in accordance with manufacturer's recommendations, on the ductwork with all circumferential joints butted and longitudinal joints overlapped a minimum of 2 inches.

B. Adhere insulation to ductwork with 4 inch wide strips of adhesive at 8 inches on center. In addition, secure insulation to the bottom of rectangular ductwork over 24 inches wide by the use of mechanical fasteners at no more than 18 inches on center. Weld stick clips to duct work to secure insulation.

C. On circumferential joints, the 2 inch flange on the facing shall be stapled with outward clinching steel staples on 2 inch centers, and taped with a minimum 3 inch wide strip of glass fabric and coating. Cover all seams, joints, pin penetrations and other breaks with coating reinforced with glass fabric.

3.4 EXPOSED ROUND DUCT

A. All exposed ductwork in public areas and mechanical rooms shall be wrapped in accordance with manufacturer's recommendations. Firmly butt all joints together and seal longitudinal laps of factory-applied vapor barrier jacket with adhesive. Cover butt joints with a 4 inch wide strip of factory-supplied vapor barrier jacket facing adhered with adhesive. For ventilated or unconditioned equipment spaces increase scheduled insulation thickness by 1/2 inch.

B. Install aluminum jacket on all insulated ductwork installed in crawl space.

3.5 EXPOSED RECTANGULAR DUCT

A. Exposed ductwork shall be covered with rigid board insulation in accordance with manufacturer's recommendations.

B. Fill and point up all joints, perforations and exposed edges with coating reinforced glass fabric adhered with adhesive.

C. Securely fasten insulation to metal surface with adhesive and mechanical fasteners on 12 inch centers.

D. Sheet metal screws and discs or other approved fasteners may be used. For ventilated or unconditioned mechanical rooms increase scheduled insulation thickness by 1/2 inch.

3.6 SUPPLY DIFFUSERS

A. Insulate the tops of all supply diffusers and uninsulated plenums on slot diffusers and grille, the same as the ductwork but 1 inch thick insulation. Neatly tape the exposed edges of the insulation to the diffuser perimeter to seal exposed insulation edges. At the Contractors option, provide factory applied molded insulation blanket on diffusers. Line return air transfer ducts with 1 inch dual density type acoustical insulation. Coat exposed edges of insulation liner with sealant.

3.7 TRANSFER DUCTS

A. Line return air transfer ducts with 1/2 inch dual density type acoustical insulation. Coat exposed edges of insulation with sealant.

B. Install insulation as specified for ductwork on heating coil casings at all ductwork installations and terminal units.

END OF SECTION 23 07 13

# SECTION 23 07 19 - PIPING INSULATION

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes:
   1. Piping insulation for Chilled and Heating Water Piping within building envelope, other than Crawl Spaces and wet areas.
   2. Furnishing and installation of insulation.
   3. Jackets and accessories.

### 1.2 REFERENCES

A. ANSI/ASTM C 195 - Mineral Fiber Thermal Insulation Cement.

B. ANSI/ASTM- C 547 - Mineral Fiber Preformed Pipe Insulation.

C. ANSI/ASTM C 552 - Cellular Glass Block and Pipe Thermal Insulation.

D. ASTM B 209 - Aluminum and Aluminum-alloy Sheet and Plate.

E. ASTM C 449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.

### 1.3 QUALITY ASSURANCE

A. Applicator. Company specializing in piping insulation application with five years minimum experience.

B. Materials. UL/ULC Classified per UL 723 or Flame spread/fuel contributed smoke developed rating of 25/50 in accordance with ASTM E84.

### 1.4 SUBMITTALS

A. Refer to Specification 23 07 00.

B. Submit product data on insulating materials, including manufacturer's safety and installation instructions.

C. Include product description, list of materials and thickness for each service, and locations.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:
   1. Fiberglass
      a. Owens-Corning.
      b. JohnsManville.
      c. Knauff Insulation
   2. Flexible Elastomeric
      a. Armacell; AP Armaflex.
      b. RBX Corporation.
   3. Phenolic Foam
      a. Dyplast
      b. Resolco Insulphen
      c. ITW

### 2.2 INSULATION

A. Type P1: Furnish fiberglass insulation with factory applied, all service reinforced vapor barrier (ASJ) jacket having integral laminated aluminum vapor barrier and self-sealing labs. Jacketing shall have a maximum water vapor permeance of 0.02 perms. Insulation shall be in accordance with ANSI/ASTM C 547 with a "K" factor of 0.23 BTU-in/hr-ft2-°F at 75°F. Insulation shall be certified by Greenguard Gold.

B. Type P2. Furnish closed-cell expanded rubber materials complying with ASTM C534, Type 1 for tubular materials. Insulation shall have a maximum “K” factor of 0.27 Btu-in./h-ft2- °F at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.

C. Type P5. Furnish minimum 2.5-pound density rigid closed-cell phenolic foam insulation with factory applied all service reinforced vapor barrier (ASJ) jacket having integral laminated aluminum vapor barrier. Insulation shall be in accordance with ASTM C-1126 with a maximum “K” factor of 0.15 BTU-in/hr-ft2-°F at 75°F.

## 2.3 INSULATION SHIELDS AND SADDLES

A. Field Fabricated:
1. Use high compression strength Phenolic Foamglas blocks (HLB 1600) that will support the bearing area at hangers and supports.
2. Further support insulation at hangers and supports with a shield of galvanized metal extending not less than 2 inches on either side of the support bearing area, covering at least half of the pipe circumference, and conforming to the schedule below.
3. When pipe is guided at top and bottom, metal shields should cover the whole pipe circumference.
4. Adhere metal shield to insulation so that metal will not slide with respect to insulation. Furnish vapor barrier and sealant where used on low temperature service (below 100°F).

| Pipe Diameter | Insulated Section Length in Inches | Minimum U.S. Standard Gauge of Metal Shield |
|---|---|---|
| 2 1/2” and smaller | 14 | 16 |
| 3” to 4” | 14 | 16 |
| 6” to 12” | 24 | 14 |

5. At Contractor's option, factory-made insulation shields may be provided as made by Anvil Fig 168, equivalent by Pipe Shields, Inc., or equal. Insulation should extend at least 1 inch beyond metal. Select proper shield for service and pipe span.
6. For Type P2 insulation, factory-made insulation shields such as Armafix IPH may be used at Contractor’s option.
7. For Type P5 insulation, use minimum 5 pound density insulation or denser as required by manufacturer at all pipe supports.

B. Saddles: Fit piping 2 inches through 10 inches operating at high temperatures with Anvil Figure 161 through 164 protection saddles, or similar saddles of proper design for specified insulation thickness. Fit pipe sizes over 10 inches with Anvil Figure 163A through 165A or similar saddle as required by insulation thickness specified.

C. All shields are to be secured by 2 stainless steel bands, 1/2 inch wide by 0.015 inch thick with matching seals

## 2.4 JACKETS

A. PVC Jackets: Provide molded or mitered covers for flanges, valves and fittings similar to Schuller Zeston 2000.

## 2.5 SEALANT, ADHESIVE AND FINISH

A. Fiberglass - High Temperature (Above 100ºF):
   1. Lap Adhesive. Same as low temperature.
   2. Finish: Furnish Childers CP-10/11 or Foster 46-50 weather barrier mastic with reinforcing mesh.
   3. Cement: Furnish Ryder One Coat on insulated fittings, flanges and valves.
   4. Primer and Finish. Furnish Childers CP-50A MV1 diluted 50% with water to prime cement prior to applying coating.
   5. Lagging Adhesive: Used in conjunction with canvas or glass lagging cloth to protect equipment/piping indoors. Foster 30-36 Sealfas, Childers CP-50AMV1 Chil Seal or approved equal.]

B. Flexible Elastomeric
   1. Adhesive: Furnish Armaflex 520 BLV Low VOC Adhesive, Foster 85-75, or Childers CP-82 to seal longitudinal labs and to adhere butt joint covers.
   2. Finish: Furnish Armaflex WB or Foster 30-64 water based latex enamel finish.

C. Phenolic Foam - Low Temperature (Below 70ºF):
   1. Flashing Sealant: Furnish Childers CP 76 or Foster 95-44 elastomeric sealant at valve covers, anchors and hangers.
   2. Lap Adhesive: Furnish Childers CP-82 or Foster 85-20 to seal longitudinal laps of the vapor barrier jacket and to adhere butt joint covers.
   3. [Vapor Barrier Coating: Furnish Childers CP-38 or Foster 30-80 with reinforcing mesh on all insulated fittings, flanges, and valves. Coating permeance shall be no greater than 0.013 perms at 43 mils dry as tested by ASTM E96. Coating must comply with MIL-C-19565C, Type II and be QPL listed. All ASJ seams shall be coated with vapor barrier coating to prevent moisture ingress. Outdoors: Foster 30-90; Childers CP-35 only. White]

D. Reinforcing Mesh: Fiberglass or polyester. 10 strands by 10 strands per square inch. Similar to Foster Mast A Fab or Childers Chil Glas #10

2.6 FITTINGS

A. Provide pre-molded fittings and elbows molded in two matching half sections of same insulation thickness as adjoining piping. As an alternative, provide mitered sections of insulation equivalent in thickness and composition to that installed on straight pipe runs. No insert or blanket insulation allowed.

2.7 PRIMER

A. Polyguard RG-CHW for surface temperatures less than 130F, RG-2400 LT for piping with surface temperatures between 130F and 250F. Application thickness shall be 25 mils.

B. Global Encasement Rust Inhibition Primer. Application thickness shall be minimum 3 mils (dry)

C. Sherwin Williams Pro-Cryl Universal Acrylic Primer. Application thickness shall be minimum 3 mils (dry).

2.8 ALUMINUM JACKET

A. Piping. Furnish for finishing interior insulated pipe, a prefabricated jacket of ASTM B209 aluminum, 0.020 inch thick, with factory-applied 2-mil moisture barrier.

B. Valves, Fittings and Flanges. Provide complete coverage of all valves, fittings and flanges, provide aluminum covers, 0.020 inch thick, ASTM B209 aluminum.

C. Straps and Seals. Furnish 1 inch x 0.010 inch, ASTM B209 aluminum strapping and seals for applying aluminum jacket and covers to provide completely weather tight covering of all insulation including caps, flanges and end of lines.

D. Metal Jacketing Sealant: Furnish 1/8” bead of Foster 95-44 or Childers CP-76 underneath all metal jacketing laps to prevent water entry on outdoor applications.

PART 3 - EXECUTION

3.1 PIPE

A. Pressure testing of piping systems shall be complete prior to application of insulation.

B. Prior to insulating piping,
   1. Remove all oil, grease, cutting oils, dirt and other contaminants. Use suitable solvents, steam cleaning with detergent, or fresh water wash with detergent. Follow with thorough fresh water rinse.
   2. Provide primer coat on all chilled and heating hot water steel piping in accordance with manufacturer's recommendations, to include field welds and over factory applied paint/coating, in total compliance with mechanical identification section and compatible with and approved by the insulation manufacturer. Painting must be completed and approved prior to installation of insulation.

C. Butt insulation joints firmly together. Seal longitudinal laps and butt strips with sealant.

D. Type P5 Phenolic Foam - Low Temperature:
   1. Where piping is interrupted by fittings, flanges, valves or hangers and at intervals not to exceed 25 feet on straight runs, an isolating vapor seal shall be formed between the vapor barrier jacket and the bare pipe by liberal application of the vapor barrier sealant to the exposed joint faces carried continuously down to and along 4 inches of pipe and up to an along 2 inches of the jacket.

E. Type P2.
   1. Provide finish as specified on all insulation.

3.2 VALVES, FLANGES AND FITTINGS

A. Low Temperature:
   1. Insulate all valves, flanges and fittings with molded fitting covers secured with wire. Thickness of insulation shall be equal to that adjoining piping.
   2. Finish with two coats vapor barrier coating reinforced with reinforcing mesh. The application shall provide a minimum dry film thickness of 37 mils.

B. High Temperature:
   1. Omit insulation at screwed unions and at valves smaller than 1-1/2 inches.
   2. On concealed (other than mechanical and pump rooms) piping, insulate fittings and valves 2-1/2 inches IPS and larger, with pre-molded fitting covers. Thickness of insulation shall be equal to that of adjoining pipe. Finish with mastic reinforced with reinforcing mesh.
   3. On concealed piping, insulate fittings and valves 2 inches IPS and smaller with pre-molded fitting covers with a thickness equal to or greater than adjoining straight pipe. Finish with mastic reinforced with reinforcing mesh.
   4. In exposed (mechanical, pump and equipment rooms) area, insulate all fittings, flanges and valves with pre-molded fitting covers. Thickness of insulation shall be equal to that of adjoining pipe. Finish with mastic reinforced with reinforcing mesh.
   5. Omit insulation on heating hot water flexible pump connectors or expansion joints.

3.3 CONTROL VALVE COVERS - LOW TEMPERATURE SERVICE ONLY

A. Fabricate special covers, complete with troweled-on vapor seal, shaped to accommodate the valve stem. Insulation thickness shall be same thickness as adjoining pipe.

B. Seal covers to valve insulation proper with adhesive so that the seal may be broken with a knife blade without damage to either part. Arrange so that cover can be removed and replaced as necessary for operation of the valve. Finish valve cover with two coats of vapor barrier coating and reinforcing mesh.

3.4 SHIELDS AND HANGERS

A. When the insulation is jacketed in aluminum, install a length of 40-pound roofing felt 1/2 inch longer than the insulation shield between shield and jacket.

B. Where piping hangers or anchors must be in direct contact with pipe, seal off the pipe insulation on both sides of the hanger by carrying the vapor seal down to the bare pipe. Apply insulation around the hanger ring or anchor and pipe and carry vapor barrier upward and outward along the hanger rod or anchor members to a point not less than 12 inches from the adjacent pipe. Draw wire loops tight over the vapor barrier jacket, with ends of wire bent down. Take care to avoid puncturing the vapor seal. Finish insulation as specified for flanges, and seal over adjacent vapor barrier jacket.

3.5 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. Continue insulation with vapor barrier through penetrations.

C. In exposed piping areas, locate insulation and cover seams in least visible locations. For outdoor installations seal jacket lap with 1/8” bead of metal jacketing sealant underneath each lap to prevent infiltration of water beneath jacket. On horizontal piping place over lap at side of pipe arranged so that water will run off of jacket and not into seam lap.

D. On insulated piping with vapor barrier, insulate fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.

E. Neatly finish insulation at supports, protrusions, and interruptions. Use 1-1/2 inch Type P2 insulation to insulate drains gauges, thermometers, and strainers.

3.6 PIPING INSULATION APPLICATION AND THICKNESS SCHEDULE

A. Provide insulation with minimum thickness and conductivity values in compliance with ASHRAE standard 90.1-2013, Table 6.8.3A&B, but not less than thicknesses specified in this specification and as required to prevent condensation. Where multiple materials are listed for a single service and location, it is the Contractor’s option to choose from the allowable insulations.

| Service | Location | Insulation Type | Pipe Sizes | Insulation Thickness-Inches |
|---|---|---|---|---|
| Chilled Water | Interior | P5 | 1-1/2” and smaller | 1 |
| Chilled Water | Interior | P5 | 2” to 6” | 1-1/2 |
| | | | | |
| AHU/FCU Condensate Drains | Interior | P2 | All sizes | 1 |
| Heating Hot Water | Interior | P1 | 1-1/4” and smaller | 1-1/2 |
| Heating Hot Water | Interior | P1 | 1-1/2” to 4” | 2 |
| | | | | |
| Supports, protrusions, drains, gauges, thermometers and strainers | Interior/ Exterior | P2 | All Sizes | 1-1/2 |

3.7 ALUMINUM JACKET

A. Apply aluminum jacket and covers according to manufacturer’s recommendations, using aluminum strapping and metal jacketing sealant to provide completely weathertight covering. Completely encapsulate insulation on all piping, valves, flanges, reducers, etc.

B. Provide aluminum jacket for all piping within 84 inches of finished floor in air handler mechanical rooms, pump rooms, penthouses and exposed occupied spaces in the building. Do not install jacketing on AHU Condensate drains unless noted otherwise. Do not install jacketing on flexible pump connectors or expansion joints.

END OF SECTION 23 07 19

# SECTION 23 07 19.19 - PIPING INSULATION (CALCIUM SILICATE)

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes:
   1. Piping insulation for high temperature piping including steam, condensate, and boiler feedwater piping.
   2. Furnishing and installation of insulation.
   3. Jackets and accessories.

### 1.2 REFERENCES

A. ANSI/ASTM C 533 - Calcium Silicate Block and Pipe Thermal Insulation.

B. ASTM B 209 - Aluminum and Aluminum-alloy Sheet and Plate.

### 1.3 DELIVERY, STORAGE, AND HANDLING

A. Store materials (insulation, jacketing, sealant) in an area protected from the weather. Keep all materials dry before and during installation. Handle all materials carefully to prevent damage to insulation or jacketing.

### 1.4 QUALITY ASSURANCE

A. Applicator. Company specializing in piping insulation application with five years minimum experience.

B. Materials. Flame spread/fuel contributed smoke developed rating of 25/50 in accordance with ASTM E84.

### 1.5 SUBMITTALS

A. Refer to Specification 23 07 00.

B. Submit product data on insulating materials, including manufacturer's safety and installation instructions, and as required by Section 1.5D.

C. Include product description, list of materials and thickness for each service, and locations.

D. Product Data:
   1. Submit product data on each insulation type, adhesive and finish to be used in the work. Include manufacturer’s installation instructions, list of materials and thickness for piping scheduled.
   2. Submit insulation jacket surfaces temperatures by pipe size based on job site operating conditions.
   3. Refer to equipment schedules for fluid temperatures.

E. Shop Drawings: Show details for the following:
   1. Application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Insulation application at pipe expansion joints for each type of insulation.
   3. Insulation application at elbows, fittings, flanges, valves, and specialties.
   4. Removable insulation at piping specialties, equipment connections, and access panels.

5. Application of field-applied jackets.
6. Application at linkages of control devices.
7. Field application for each equipment type.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

A. These specifications are based on Thermo-12 Gold of Johns Manville Corporation and designate the type and quality of work intended under this Section. Products of other manufacturers proposed as equivalent quality must be submitted for written approval. Supporting technical data, samples, published specifications must be submitted for comparison.

### 2.2 INSULATION

A. Type P4: Calcium Silicate molded sectional piping insulation with a “K” factor of 0.40 BTU-In/Hr.-degree F at 100°F and 0.50 BTU-In/Hr.-degree F at 400°F.

### 2.3 FLANGES AND FITTINGS

A. Provide molded or mitered calcium silicate fitting covers at flanges, valves, and fittings.

### 2.4 INSULATION SHIELDS AND SADDLES

A. Field Fabricated:
1. Further support insulation at hangers and supports with a shield of galvanized metal extending not less than 2 inches on either side of the support bearing area, covering at least half of the pipe circumference, and conforming to the schedule below.
2. When pipe is guided at top and bottom, metal shields should cover the whole pipe circumference.
3. Adhere metal shield to insulation so that metal will not slide with respect to insulation.

| Pipe Diameter | Insulated Section Length in Inches | Minimum U.S. Standard Gauge of Metal Shield |
|---|---|---|
| 2 1/2” and smaller | 14 | 16 |
| 3” to 4” | 14 | 16 |
| 6” to 12” | 24 | 14 |
| 14” and larger | 24 | 12 |

4. At Contractor's option, factory-made insulation shields may be provided as made by Anvil Fig 168, equivalent by Pipe Shields, Inc., or equal. Insulation should extend at least 1 inch beyond metal. Select proper shield for service and pipe span.

B. Saddles: Fit piping 2 inches through 10 inches operating at high temperatures with Anvil Figure 161 through 164 protection saddles, or similar saddles of proper design for specified insulation thickness. Fit pipe sizes over 10 inches with Anvil Figure 163A through 165A or similar saddle as required by insulation thickness specified.

C. All shields are to be secured by 2 stainless steel bands, 1/2 inch wide by 0.015 inch thick with matching seals

### 2.5 JACKETS

A. Provide aluminum jacketing meeting requirements of Section 23 07 19.13.

2.6 BANDING

A. Stainless steel bands, 3/4 inch wide by 0.02 inch thick with matching seals.

2.7 CONTROL VALVE COVERS

A. Provide reusable one piece asbestos free removable insulation covers for all valves and piping specialties such as strainers, filters and pressure power pumps. The covers shall be constructed out of chemical resistant silicone coated fiberglass with a minimum of 11# density fiberglass mat and Kevlar thread & seam closure. The covers shall be capable of withstanding 500°F similar to Jacket provided by Spence.

2.8 CEMENTS AND COATINGS

A. Insulating Cement: Use CalCoat-127 or approved equal insulating cement to point up insulation on pipe to form a smooth, even surface.

B. Coating: Provide Childers [Chil Seal CP-50AHV2, Ak-Cryl CP-9] reinforced with 10 inch x 10 inch glass cloth as a final finish where jacketing is not specified.

C. Adhesive: CalBond Gold High Temperature Glue or approved equal to adhere insulation sections to each other where required at fittings, valves, and joints as required where banding will not secure insulation seams. Adhering insulation to piping is not permitted.

PART 3 - EXECUTION

3.1 PIPE

A. Insulation shall be applied to piping with all joints tightly fitted to eliminate voids. Stager joints and butt insulation firmly together. Where necessary, point up joints with insulating cement to form a smooth even surface.

B. Insulation sections shall be secured with stainless steel bands with no less than 3 bands per section of insulation.

C. Where aluminum jacketing is not required finish piping with coating specified in Part 2 with glass cloth per manufacturers recommendation.

D. Aluminum jacketing shall be applied with all laps positioned to shed water and seams filled with silicone sealant. All laps shall be a minimum of 2 inches. Aluminum jacketing shall be secured using bands and seals as specified. Band spacing shall be two bands equally spaced per section of insulation. This will usually mean 9 inches or 12 inches on center.

E. Insulate flanges and fittings in a manner similar to that for piping using materials in Part 2.

F. Insulate valves, strainers, and other specialties requiring access with removable reusable covers specified in Part 2.

3.2 PREPARATION

A. Tests of the piping system shall be completed prior to insulation application.

B. All piping shall be cleaned of foreign substances and free of surface moisture prior to insulation application.

3.3 SHIELDS AND HANGERS

A. When the insulation is jacketed in aluminum, install a length of 40-pound roofing felt 1/2 inch longer than the insulation shield between shield and jacket.

B. Where piping hangers or anchors must be in direct contact with pipe, seal off the pipe insulation on both sides of the hanger by carrying the vapor seal down to the bare pipe. Apply insulation around the hanger ring or anchor and pipe and carry vapor barrier upward and outward along the hanger rod or anchor members to a point not less than 12 inches from the adjacent pipe. Draw wire loops tight over the vapor barrier jacket, with ends of wire bent down. Take care to avoid puncturing the vapor seal. Finish insulation as specified for flanges, and seal over adjacent vapor barrier jacket.

3.4 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. Continue insulation through penetrations.

C. In exposed piping areas, locate insulation and cover seams in least visible locations. For outdoor installations seal jacket lap with suitable outdoor silicone sealant to prevent infiltration of water beneath jacket. On horizontal piping place over lap at side of pipe arranged so that water will run off of jacket and not into seam lap.

D. Insulate fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.

3.5 PIPING INSULATION APPLICATION AND THICKNESS SCHEDULE

A. Provide insulation with minimum thickness and conductivity values in compliance with ASHRAE standard 90.1-2010, Table 6.8.3A, but not less than thicknesses scheduled below.

| Service | Location | Insulation Type | Pipe Sizes | Insulation Thickness-Inches |
|---|---|---|---|---|
| Steam Condensate | Any | P4 | All | 5 |
| Steam (15 psig and less) | Any | P4 | All | 5 |
| Vent Piping | Any | P4 | All | 2 |

3.6 ALUMINUM JACKET

A. Apply aluminum jacket and covers according to manufacturer’s recommendations, using aluminum strapping and seals to provide completely weathertight covering. Completely encapsulate insulation on all piping, valves, flanges, reducers, etc.

B. Provide aluminum jacket for all piping within 84 inches of finished floor in air handler mechanical rooms, pump rooms and penthouses.

END OF SECTION 23 07 19.16

# SECTION 23 09 00 - INSTRUMENTATION AND CONTROL FOR HVAC

## PART 1 - GENERAL

### 1.1 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

B. See Section 23 09 93, Sequence of Operations for HVAC Controls, for requirements that relate to this Section.

C. The scope included herein shall be priced by the BAS contractor and submitted directly to the general contractor for the project.

### 1.2 SUBMITTALS

A. Product Data: For each control device indicated.

B. Shop Drawings:
1. Schematic flow diagrams.
2. Power, signal, and control wiring diagrams.
3. Details of control panel faces.
4. Damper schedule.
5. Valve schedule.
6. DDC System Hardware: Wiring diagrams, schematic floor plans, and schematic control diagrams.
7. Control System Software: Schematic diagrams, written descriptions, and points list.

C. Software and firmware operational documentation.

D. Field quality-control test reports.

E. Operation and maintenance data.

### 1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. In other Part 2 paragraphs where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

## 2.2 CONTROL SYSTEM

A. Available Manufacturers:
   1. Johnson Controls, Inc.; Controls Group. – Factory Branch Location (no exceptions)

B. The entire controls system in the scope of this project shall be integrated to the UTHSC-wide Johnson Controls ADX server at the centralized location. All building points, programming, graphics, sequences, etc. shall be stored on this controls server.

C. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.

D. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

## 2.3 DDC EQUIPMENT

A. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source for supervisory controllers.
   1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation.
   2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
      a. Global communications.
      b. Discrete/digital, analog, and pulse I/O.
      c. Monitoring, controlling, or addressing data points.
      d. Software applications, scheduling, and alarm processing.
      e. Testing and developing control algorithms without disrupting field hardware and controlled environment.

B. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
   1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
   2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
      a. Global communications.
      b. Discrete/digital, analog, and pulse I/O.
      c. Monitoring, controlling, or addressing data points.
   3. Local operator interface provides for download from or upload to operator workstation.

C. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.

1. Binary Inputs: Allow monitoring of on-off signals without external power.
2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights, or override via the on-board integral display and pushbuttons.
5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer, or override via the on-board integral display and pushbuttons.
6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
7. Universal I/Os: Provide software selectable binary or analog outputs.

D. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
1. Output ripple of 5.0 mV maximum peak to peak.
2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

E. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
1. Minimum dielectric strength of 1000 V.
2. Maximum response time of 10 nanoseconds.
3. Minimum transverse-mode noise attenuation of 65 dB.
4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

## 2.4 UNITARY CONTROLLERS

A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
3. Enclosure: Dustproof rated for operation at 32°F to 120°F.

## 2.5 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. RTDs and Transmitters:
1. Accuracy: Plus or minus 0.5°F at calibration point.
2. Wire: Twisted, shielded-pair cable.

3. Insertion Elements in Ducts: Single point; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
4. Averaging Elements in Ducts: use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
5. Room Sensor Cover Construction: Manufacturer's standard locking covers.
6. Acceptable Manufacturers: Johnson Controls or Approved Equal.

C. Humidity Sensors: Bulk polymer sensor element.
1. Accuracy: 3 percent full range with linear output.
2. Room Sensor Range: 20 to 80 percent relative humidity.
3. Room Sensor Cover Construction: Manufacturer's standard locking covers.
4. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
5. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.
6. Acceptable Manufacturers: Johnson Controls or Approved Equal.

D. Pressure Transmitters/Transducers:
1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
b. Output: 4 to 20 mA.
c. Duct Static-Pressure Range: 0- to 5-inch wg.
2. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
3. Acceptable Manufacturers: Johnson Controls or Approved Equal.

E. Room Sensor Cover Construction: Manufacturer's standard locking covers~~, no display~~.

F. Room sensor accessories include the following:
1. Insulating Bases: For sensors located on exterior walls.
2. Guards: Locking; heavy-duty, transparent plastic; mounted on separate base.
3. Adjusting Key: As required for calibration and cover screws.

## 2.6 HUMIDISTATS

A. Duct-Mounting Humidistats: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.
1. Acceptable Manufacturers: Johnson Controls or Approved Equal.

## 2.7 ACTUATORS

A. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
1. Dampers: Size for running torque calculated as follows:
a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft of damper.
d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.

f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.

2. Coupling: V-bolt and V-shaped, toothed cradle.
3. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
4. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
5. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
6. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
7. Run Time: 12 seconds open, 5 seconds closed.
8. Acceptable Manufacturers: Johnson Controls or Approved Equal.

## 2.8 DAMPERS

A. Dampers: AMCA-rated, opposed-blade design; 0.108 inch minimum thick, galvanized-steel or 0.125 inch minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064 inch thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.
   1. Secure blades to 1/2 inch diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
   2. Operating Temperature Range: From -40°F to +200°F.
   3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
   4. Acceptable Manufacturers: Johnson Controls, Ruskin, or Approved Equal.

## 2.9 VALVES

A. Ball Valves (1/2 through 2 in.):
   1. Ball Valves shall have forged brass bodies.
   2. Valves shall have available either Chrome Plated Brass Balls or 300 Series Stainless Steel Balls in all sizes.
   3. Valves shall have available either Nickel Plated Brass Stems or 300 Series Stainless Steel Stems with a blow-out proof stem design in all sizes.
   4. Valves shall have Graphite reinforced Polytetrafluoroethylene (PTFE) seats with Ethylene Propylene Diene Monomer (EPDM) O-ring backing.
   5. Stem seals shall be double EPDM O-rings.
   6. Flow Characterization Disk shall be manufactured from Amodel AS-1145HS Polyphthalamide Resin and rated for 50 psid maximum differential pressure and shall be inserted against the casting of the valve.
   7. All ball valves with internal pipe thread end connections shall be rated to 580 psi maximum static pressure at 203°F (95°C) fluid temperature.
   8. All ball valves with sweat end connections or press end connection shall be rated to 300 psig maximum static pressure at 203°F (95°C) fluid temperature
   9. All valves shall be rated for service with hot water, chilled water and 50% glycol solutions.
   10. Ball Valves with stainless steel balls and stems shall be rated for use with 15 psig saturated steam.
   11. Flow Characteristics shall be equal percentage on the control port. Bypass port on three-way valves shall have linear flow characteristics.
   12. Valves shall have a maximum leakage specification of 0.01% of maximum flow for the control port, ANSI/FCI 70-2, Class 4 and 1% of maximum flow, bypass port.
   13. Valves shall be maintenance free
   14. Valves shall be provided with a 5 year warranty.

15. Valves shall be rated for 200 psid closeoff pressure.
16. Valve actuators shall be UL-recognized or CSA-certified.
17. Acceptable Manufacturers: Johnson Controls VG1000 Series Ball Valves or Approved Equal.

B. Butterfly Valves (2 through 20 in.):
1. Butterfly Valves shall have cast iron bodies meetings ASTM A126 Class B requirements and meet ASME class 125/150 flange requirements and shall be fully lugged.
2. Butterfly Valves seat shall be Ethylene Propylene Diene Monomer (EPDM).
3. Butterfly Valve disk shall be Ductile Iron with Nylon 11 coating.
4. Butterfly Valve stems shall be Stainless Steel.
5. Flow Characteristics shall be equal percentage up to 70° of disk rotation.
6. All valves shall be rated for service with hot water, chilled water and 50% glycol solutions.
7. Valves shall be maintenance free.
8. Valve shall be provided with a 3 year warranty.
9. Valve electric actuators shall be UL-recognized or CSA-certified.
10. Acceptable Manufacturers: Johnson Controls VF Series Butterfly Valves or Approved Equal.

C. Pressure Independent Valves (1/2 through 2 in., where specified):
1. Valves bodies shall be manufactured from forged brass and shall be nickel plated
2. Valves shall have a stem and ball manufactured from chrome plated brass
3. Valve seat shall be fiberglass reinforced with Teflon®
4. Characterizing disk shall be brass for 1/2 and 3/4 in. valves, and Tefzel® for sizes 1 through 2 in. valves
5. Valves shall pressure ratings of 600 psi for 1/2, 3/4 and 1 in. size valves, and pressure rating of 400 psi for 1-1/4, 1-1/2 and 2 in. size valves
6. Closeoff Pressure rating shall be 200 psid
7. Valves shall have a maximum leakage specification of 0.01% of maximum flow per ANSI/FCI 70-2,
8. Class 4 with a 50 psid differential pressure applied.
9. Valves shall be maintenance free.
10. Valves shall be provided with a 5 year warranty.
11. Valve actuators shall be UL-recognized or CSA-certified.
12. Acceptable Manufacturers: Johnson Controls P1000 Series Pressure Independent Valves or Approved Equal.

## 2.10 DUCT AIRFLOW MEASURING STATIONS

A. Thermal Dispersion Flow Sensors:
1. The single probe airflow-measuring sensor shall be duct mounted with an adjustable sensor insertion length of up to eight inches. The transmitter shall produce a 4-20 mA or 0-10 VDC signal linear to air velocity. The sensor shall be a thermal dispersion and utilize one temperature sensor and a heated thermistor. The sensor pair shall measure the air temperature and airflow velocity. Include digital controller display.
2. Accuracy: Plus or minus 2% at 40 to 4,000 feet per minute (FPM).
3. Probe Construction: Airfoil-shaped aluminum.
4. Acceptable Manufacturers: Johnson Controls AD-1252 or Approved Equal.

PART 3 - EXECUTION

3.1 INSTALLATION

1. Johnson Controls, Inc.; Controls Group – Factory Branch Location

B. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

C. Install labels and nameplates to identify control components according to Section 23 05 53, Identification for HVAC Piping and Equipment.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:
1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
4. Test each point through its full operating range to verify that safety and operating control set points are as required.
5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
6. Test each system for compliance with sequence of operation.
7. Test software and hardware interlocks.

C. DDC Verification:
1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check instrument tubing for proper fittings, slope, material, and support.
5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
6. Check temperature instruments and material and length of sensing elements.
7. Check control valves. Verify that they are in correct direction.
8. Check control dampers. Verify that proper blade alignment, either parallel or opposed, has been provided.
9. Check DDC system as follows:
    a. Verify that DDC controller power supply is from emergency power supply, if applicable.
    b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    c. Verify that spare I/O capacity has been provided.
    d. Verify that DDC controllers are protected from power supply surges.

D. At the conclusion of the project, the controls contractor shall utilize a performance verification tool to scan the completed system for analysis of the installation, configuration, and

performance of the BMS revealing the current system status as well as improvement opportunities in the spirit of continuous commissioning:

1. Inventory: Provide a site inventory that includes a listing of all supervisory and field controllers with key attribute data including model numbers, firmware versions, available security updates (lack of), CPU and memory performance data, battery conditions, integrations, controlled equipment, and device and point counts.
2. Performance: Provide a performance scan that summarizes the configuration and performance in different categories including:
    a. A Security category shall include information about controllers that may be out of date with the latest security updates available. In addition, user accounts used to access the system shall be analyzed against the latest security rules to ensure lead users are aware of anomalies and opportunities for improvement.
    b. An Energy Performance and Savings category shall reveal potential energy savings opportunities by ensuring equipment is operating on a schedule and nightly setbacks, and search for opportunities where specialized equipment can offer improved energy savings.
    c. An Occupant Comfort category shall watch for temperature, pressure, and carbon dioxide values that deviate from desired set points that could lead to occupant discomfort.
    d. A System Maintenance and Reliability category shall look for items that help to keep the system running efficiently and reliably. These items include overridden control points, duplicate BACnet identifiers, control points creating excessive alarms, and opportunities to provide information that is more valuable by adding control points and trends to the existing system.
    e. A Standards category shall analyze use of the operator authorization categories for better management of user access to alarms and control points.
3. Feature Utilization: Performance verification shall provide a feature assessment that looks for underutilized system features that might provide additional efficiencies moving forward. This includes features that provide energy savings, productivity enhancements and operational savings, and optimized equipment startup and control that may lead to additional energy savings and equipment reliability.
4. Provide all reports as specified at the end of commissioning phase. Systems or software programs without the ability to deliver these reports must submit a detailed plan of alternate documents to be provided in order to meet these requirements.

E. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

## 3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section, Demonstration and Training.

END OF SECTION 23 09 00

# SECTION 23 21 13 - HYDRONIC PIPING AND FITTINGS

## PART 1 - GENERAL

### 0.1 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
   1. Hot-water heating piping.
   2. Chilled-water piping.
   3. Condensate-drain piping.
   4. Air-vent piping.

B. Related Specifications
   1. Section 23 05 19, Meters and Gauges, for HVAC Piping for thermometers and gauges.
   2. Section 23 05 23, General Duty Valves for HVAC Piping, for valves
   3. Section 23 05 48, Vibration Isolation for HVAC Piping and Equipment.

### 0.2 SUBMITTALS

A. Product Data: For each type of the following:
   1. Pipe
   2. Fittings and accessories

B. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Field quality-control test reports.

D. Submit certification of welder’s qualifications to perform the required welding operations within 6 months of submittal.

E. Operation and maintenance data.

### 0.3 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

B. Provide domestic manufactured piping and fittings.

### 0.4 DELIVERY, STORAGE, AND HANDLING

A. Protect piping, valves, fittings, etc. before installation in accordance with manufacturer’s written instructions.

B. Piping shall be shipped from the factory with capped ends and stored on supports with ends covered at all times to prevent nesting of insects, birds, and other animals. Protect piping from accumulation of dirt and debris in and around piping/components.

### 0.5 OPERATION AND MAINTENANCE DATA

A. Operation and maintenance manuals shall include the following information:
   1. The approved submittal with all approved items present (not a partial resubmittal)
   2. Chemicals used in cleaning, flushing, inhibiting, and final water treatment.
   3. Water quality test reports from the cleaning process.

PART 1 -PRODUCTS

1.1 STEEL PIPING AND FITTINGS

A. 2 inches and less in diameter. ASTM A 53, Grade B, standard-weight seamless black steel pipe with standard-weight seamless steel welded fittings, satisfying ASTM A 234, Grade WPA or WPB, ANSI B16.9. Bushings are not allowed.

B. 2-1/2 inches to 10 inches in diameter. ASTM A 53, Grade B, standard-weight seamless black steel pipe with standard-weight seamless steel welded fittings, satisfying ASTM A 234, Grade WPA or WPB, ANSI B16.9. Bushings are not allowed.

1.2 COPPER PIPING AND FITTINGS

A. ASTM B88, hard drawn Type L seamless copper tube with wrought copper fittings, ASTM B16.22.

1.3 JOINTS

A. Screwed (Steel Piping, 2” and smaller):
1. Make screwed joints using machine-cut ANSI taper pipe threads.
2. Apply suitable joint compound, such as Teflon tape to the male threads only.
3. Ream pipe to full inside diameter after cutting. All-thread nipples are not permitted.

B. Dissimilar Metals: Make joints between copper and steel pipe and equipment along with steel pipe and ductile iron pipe using insulating unions.
1. Provide insulating unions as manufactured by Crane, EPCO Sales, Inc. or approved equivalent.

C. Solder Joints (Copper Piping):
1. Prior to making joints, cut pipe square and ream to full diameter. Clean exterior of pipe and socket. Apply thin coat of suitable fluxing compound to both pipe and socket, and fit parts together immediately.
2. Heat assembled joint only as required to cause the solder to flow. Run the joint full, slightly beaded on the outside, and wipe to remove excess solder.
3. Utilize lead free solder. Use silver brazing alloy or Sil-Fos on refrigerant piping and on underground piping.

D. Welded (Steel Piping, 2-1/2” and larger):
1. Make welded joints as recommended by the standards of the American Welding Society.
2. Ensure complete penetration of deposited metal with base metal.
3. Provide filler metal suitable for use with base metal.
4. Keep inside of fittings free from globules of weld metal.
5. Do not use mitered joints.
6. Use standard weld elbow fittings for changes of direction or cut a standard elbow for odd angles.

1.4 JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. Gasket Material: Thickness, material, and type suitable for fluid to be handled, and working temperatures and pressures.

1.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Hart Industries International, Inc.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
e. Zurn Plumbing Products Group; AquaSpec Commercial Products Division.
2. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180°F.

D. Dielectric Couplings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Calpico, Inc.
b. Lochinvar Corporation.
2. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225°F.

1.6 UNIONS

A. Use 150-pound standard (300-pound WOG) malleable iron, ground joint unions with bronze seat. Provide flanged union joints on piping larger than 2-1/2 inches.

1.7 BRANCH CONNECTIONS

A. For Pipe 2 inches and smaller, use threaded fittings for steel pipe. For threaded piping, use straight size of reducing tee.

B. For 2-1/2 Inches through 20 inches. For welded piping, when branch size is the same as and one size smaller than header size, use welding tee. Use Weldolet when branch is two or more sizes smaller than header. For threaded branch connections, use thread-o-let welded to header.

1.8 GASKETS

A. Provide gaskets between flanges of all flanged joints. Inside diameter of gaskets shall conform to nominal pipe size. Gaskets shall be ring type between raised face flanges and full face between flat face flanges with punched bolt holes and pipe opening.

B. Gaskets shall be cut from 1/8 inch thick non-metallic, non-asbestos gasket material suitable for operating temperatures from -150°F to +750°F. Garlock or equal. For pipe smaller than 6 inches, use 1/16 inch thick gasket.

1.9 FLOOR AND CEILING PLATES

A. Provide chrome-plated floor and ceiling plates around pipes exposed to view and passing through walls, floors, partitions, or ceilings in finished areas. Size plates to fit pipe or insulation and securely lock in place.

PART 2 -EXECUTION

2.1 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the top of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

N. Install valves according to the appropriate section.

O. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

P. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

Q. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

R. Identify piping as specified in the above referenced specification section.

S. Support piping adequately to maintain line and grade, with due provision for expansion and contraction.

T. Use only long radius elbows on steel and copper piping unless a short radius elbow is specifically shown on the drawings.

U. Slope condensate drain piping at a minimum 1/8 inch per foot in the direction of flow.

2.2 WELDING

A. Weld and fabricate piping in accordance with ANSI Standard B31.9, latest edition, Code for Pressure Piping. Machine beveling in shop is preferred. Field beveling may be done by flame cutting to recognized standards.

B. Align piping and equipment so that no part is offset more than 1/16 inch. Set all fittings and joints square and true, and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.

C. Do not permit any weld to project within the pipe so as to restrict it. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.

D. Do not split, bend, flatten or otherwise damage piping before, during or after installation.

E. Remove dirt, scale and other foreign matter from inside piping before tying in sections, fittings, valves or equipment.

2.3 OFFSETS AND FITTINGS

A. Because of the small scale of drawings, the indication of all offsets and fittings is not possible. Carefully investigate the structural and finish conditions affecting the work and take such steps as may be required to meet such conditions.

B. Install all piping close to walls, ceilings and columns so piping will occupy the minimum space. Provide proper space for covering and removal of pipe, special clearances, and for offsets and fittings.

C. Install piping as to not obstruct any equipment or architectural access doors.

2.4 ISOLATION VALVES

A. Provide piping systems with line size shutoff valves located at the risers, at main branch connections at each floor and at branch takeoffs serving equipment, and at other locations as indicated and required for isolation of piping or equipment.

B. At air handling units, where multicoil (stacked) arrangement is used, provide each supply and return line to and from each stacked coil section with a union, pressure gauge and thermometer well and a balancing valve (with memory stop) for balancing, and valves for isolation of each coil. Refer to mechanical details for additional requirements.

2.5 DRAIN VALVES AND VENTS

A. Install drain valves at all low points and at base of all risers of water piping systems so that these systems can be entirely drained.

B. Install 2 inch drain for 2 -inch pipes and larger.

C. Install a line size drain valve for pipes smaller than 2 inches.

D. Provide hose adapter and cap on all drain lines.

E. Provide automatic vents with isolation valves or manual vents at locations as indicated on Drawings and all high points in piping systems.

2.6 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

2.7 EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to the above referenced specification section. Refer to drawings for additional requirements.

2.8 CLEANING OF PIPING SYSTEMS

A. Cleaning of piping system must be performed by the mechanical contractor. Cleaning chemicals, procedure, water testing, reporting, and consultation must be provided by a qualified water treatment company specializing in this type of work. Qualified water treatment vendor will have the following features.

1. Operating in the business of industrial water treatment for minimum 5 years.
2. Certified to the ISO 9000 quality standard.
3. Manufacture and deliver their own products.
4. Provide technical specialist(s) for onsite water testing, reporting, and consultation.
5. Have the ability to perform offsite analytical laboratory work and reporting if necessary.

B. Acceptable vendors should include, but not be limited to the following companies:
1. ChemCal, Inc.
2. GE Water & Process Technologies
3. Nalco Company

C. Minimum velocity of 10 feet per second for steel piping must be maintained in the pipes during flushing period.
1. Do not use building pumps for circulating water.
2. Provide temporary pumps as required to achieve minimum velocities.
3. Remove flow meters from building piping during flushing operation.
4. Provide means (instrumentation) during flushing period to prove to the Owner that the minimum velocities are maintained in the pipes.
5. For copper piping, maintain the flushing velocity between 3 (min) and 5 (max) feet per second. Limit temperature of water inside piping to a maximum 140°F.

D. Submit a detailed plan for the Engineer’s and Owner's review and approval describing in full detail the individual steps associated with this process before any piping is installed.
1. Refer to Submittal section above for further requirements.

E. Clean piping systems thoroughly. Purge pipe of construction debris and contamination before placing the systems in service. Provide temporary connections and valves as required for cleaning, purging and circulating. Provide temporary relief valves to protect the piping system if recommended by the pipe cleaning subcontractor.

F. Install temporary strainers in front of pumps, tanks, water still, solenoid valves, control valves, and other equipment where permanent strainers are not indicated. Keep these strainers in service until the equipment has been tested, then remove either entire strainer or straining element only. Fit strainers with a line size blowoff valve.

G. Provide bypasses at the following equipment as close as feasibly possible to the equipment (no more than 10 feet total of piping at each piece of equipment) and isolate equipment as required (temporary blind flanges or similar):

1. Hydronic coils

H. Chemicals shall remove mill scale, oil, and greases as well as passivate surfaces with a protective oxide film. NOTE: All residuals of the cleaning and passivating chemicals must be totally blown-down prior to system startup.
   1. Alkaline cleaner/penetrant/dispersant chemical. This product must be in liquid form and capable of removing mill scale, oils, greases, debris, and byproducts of construction. It shall be fed at the vendor's recommended dosage rate based on the volumes of the systems treated.
   2. Passivating chemical. This product must be in liquid poly-phosphate form and capable of laying down a protective oxide film on metal surfaces after treatment with the cleaning chemical. It shall be fed at the vendor's recommended dosage rate based on the volumes of the systems treated.
   3. Antifoam chemical. This product must be in liquid form and capable of controlling or eliminating foam in water systems.

I. Special requirements, if any, are specified in the appropriate Sections for each type of piping.

J. After systems have been flushed and cleaned; as required by specifications, provide written certification from the cleaning contractor that the systems are clean and ready for use.

K. Provide water sample to TECO for approval.

2.9 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:
   1. Leave joints, including welds, uninsulated and exposed for examination during test.
   2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
   3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
   4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
   5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:
   1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
   2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
   3. Isolate expansion tanks and determine that hydronic system is full of water.
   4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure, minimum 150 psig. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
   5. After hydrostatic test pressure has been applied for at least 24 hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
   6. Prepare written report of testing.

C. Perform the following before operating the system:
   1. Open manual valves fully.
   2. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).

3. Set temperature controls so all coils are calling for full flow.
4. Verify lubrication of motors and bearings.

2.10 PIPING APPLICATION SCHEDULE

A. Provide piping and fittings meeting the requirements of Part 2 as identified in the table below:

| Service | Pipe Sizes | Pipe Material |
|---|---|---|
| Chilled Water Piping | 2” and smaller | Copper, Steel |
| Chilled Water Piping | 2-1/2” and larger | Steel |
| Heating Hot Water Piping | 2” and smaller | Copper, Steel |
| Heating Hot Water Piping | 2-1/2” and larger | Steel |
| Condensate Piping | All | Copper, Galvanized Steel |
| Air-vent Piping | All | Copper, Steel |

END OF SECTION 23 21 13

# SECTION 23 22 13 - STEAM AND STEAM CONDENSATE PIPING

## PART 1 - GENERAL

### 1.1 WORK INCLUDED

A. Steam piping system.

B. Steam condensate piping system.

### 1.2 RELATED WORK

A. Section 23 00 10, Mechanical General Provisions.

B. Section 23 05 29, Hangers and Supports for HVAC Piping and Equipment.

C. Section 23 05 53, Identification of HVAC Piping and Equipment.

D. Section 23 07 19 Piping Insulation.

E. Section 23 07 19.16, FoamGlas Insulation

F. Section 23 07 19.19, Calcium Silicate Insulation

G. Section 23 22 16, Steam and Steam Condensate Specialties.

### 1.3 REFERENCES

A. ANSI/ASME SEC 9 - Welding and Brazing Qualifications.

B. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300.

C. ANSI/ASME B31.9 - Building Services Piping.

D. ANSI/AWS A5.8 - Brazing Filler Metal.

E. ANSI/AWS D1.1 - Structural Welding Code.

F. ASTM A135 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

G. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

H. ASTM B32 - Solder Metal.

### 1.4 REGULATORY REQUIREMENTS

A. Conform to ANSI/ASME B31.9.

1.5 QUALITY ASSURANCE

A. Welding Materials and Procedures: Conform to ANSI/ASME SEC 9, and applicable state labor regulations.

B. Welders Certification: In accordance with ANSI/AWS D1.1.

1.6 SUBMITTALS

A. Product Data: For each type of the following:

1. Pipe
2. Fittings and accessories

B. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Cleaning/Flushing Plan: This must be submitted and approved prior to any piping being installed. Plan, including all steps to be taken to ensure the piping installation will be cleaned properly prior to: service, circulation through equipment, or connection to another system. This shall include, but not be limited to:

1. A step by step explication of the process.
2. Drawing(s) indicating flow (gpm) values required to meet the minimum velocity in each pipe.
3. Drawing(s) indicating locations of the required temporary connections, valves, strainers, and bypasses.
4. Cutsheet of the temporary pump to be used during flushing.
5. Water treatment and pipe cleaning chemicals.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect piping, and fittings, etc. before installation in accordance with manufacturer’s written instructions.

B. Piping shall be shipped from the factory with capped ends and stored on supports off the ground with ends covered at all times to prevent nesting of insects, birds, and other animals. Any pipe found to be without end-caps or not raised off of the ground should be cleaned by the contractor prior to installation.

C. Protect piping from accumulation of dirt and debris in and around piping/components.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

A. Piping systems shall conform to the following requirements.

1. Piping systems designed for steam pressure below 15 psig are low pressure steam systems.
2. Piping systems designed for steam pressures from 15 psig up to and including 125 psig are medium pressure steam.

B. Condensate Return, Pumped Condensate Return Piping, Boiler Feed Water:

1. All piping shall be Schedule 80 black steel piping.
2. Fittings on piping 2-1/2" and larger shall be extra heavy butt welding type. Flanges shall be 150# welding neck type. Extra strong Weld-O-Lets, Thread-O-Lets, or shaped nipples may be used only when take-off is 1/3 or less nominal size of main.
3. Screwed fittings around traps and for piping 2" and smaller shall be 125# black cast iron. (300# for unions).
4. Control and Isolation valves shall have flanged connections.

C. Low and Medium Pressure Steam Piping:

1. All piping shall be Schedule 40 black steel piping, except sizes 1" and smaller shall be Schedule 80.
2. Fittings on piping 2-1/2" and larger shall be standard weight butt welding type. Flanges shall be 150# welding neck type. Standard weight Weld-O-Lets, Thread-O-Lets, and shaped nipples may be used only when take-off is 1/3 or less nominal size of main. Bushings shall not be used.
3. Screwed fittings around traps and for piping 2" and smaller shall be 125 lb. black cast iron. (250 lb. for unions.)

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. After completion, fill, clean, and treat systems.

### 3.2 INSTALLATION

A. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.

B. Install piping to conserve building space and not interfere with use of space, other work, or equipment.

C. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

D. Provide clearance for installation of insulation and access to valves and fittings.

E. Provide access where valves and fittings are not exposed.

F. Slope steam piping one inch in 40 feet (0.25 percent) in direction of flow. Use eccentric reducers to maintain bottom of pipe level.

G. Slope steam condensate piping one inch in 40 feet (0.25 percent). Provide drip trap assembly at low points and before control valves. Run condensate lines from trap to nearest condensate receiver. Provide loop vents over trapped sections.

H. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

I. Install valves with stems upright or horizontal, not inverted.

## 3.3 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections. Install dielectric unions where joining dissimilar materials.

B. Install valves for shut-off and to isolate equipment, part of systems, or vertical risers.

C. Install valves for throttling, bypass, or manual flow control services.

## 3.4 CLEANING AND FLUSHING OF STEAM SYSTEMS

A. Steam and condensate systems shall be thoroughly cleaned before placing in operation to rid systems of rust, dirt, piping compound, mill scale, oil, grease, any and all other material foreign to water being circulated.

B. Extreme care shall be exercised during construction to prevent dirt and other foreign matter from entering the pipe or other parts of systems. Pipe stored on the project shall have open ends capped and equipment shall have openings fully protected. Before erection, each piece of pipe, fitting, or valve shall be visually examined and dirt removed.

C. Chemicals, feeding devices, and water technician services shall be furnished by a single reputable manufacturer who will be responsible for the complete cleaning and flushing of the systems. Add a temporary line with drain and isolate the building steam and condensate piping from the campus distribution piping to allow for proper circulation and cleaning of the new piping in the new tunnel and/or in the new or modified building piping system(s). All heat exchangers (coils, boilers, shell & tube heat exchangers, etc.) shall be bypassed during the flushing/cleaning process.

D. Systems shall be cleaned with a chemical compound specifically formulated for the purposes of removing the above listed foreign matter. These chemicals shall be injected to the systems, circulated and completely flushed out. Repeat the process if required. After each flushing, remove and thoroughly clean all strainers.

E. Provide certificate from water treatment contractor of cleanliness of system.

## 3.5 PIPE PRESSURE TESTS

A. Test the system as specified in ANSI Code for Pressure Piping, and carefully check for leaks. After leaks are repaired, retest system; repeat repair and test until proved tight.

B. Pressure testing shall be performed following the completion of postweld heat treatment nondestructive examinations, and all other fabrication, assembly and erection activities required to provide the system or portions thereof subjected to the pressure test with pressure retaining capability.

C. Preparation for Testing

1. All joints including welds not previously pressure tested shall be left uninsulated and exposed for examination during the test. By prior agreement the complete system (as approved in the submittal process) or portions thereof subject to test may be insulated prior to the test period provided an extended holding time pressurization of the system is performed to check for possible leakage through the insulation barrier.
2. Equipment that is not to be subjected to the pressure test shall be either disconnected from the system or isolated by a blank or similar means. Valves may be used for this purpose provided that valve closure is suitable for the proposed test pressure.

D. Hydrostatic Testing

1. Water shall normally be used as the test medium. Test water shall be clean and shall be of such quality as to minimize corrosion of the materials in the piping system.
2. Provide high point vents and/or drains as required to fill and drain the piping system.
3. The test equipment shall be examined before pressure is applied to ensure that it is tightly connected. All low-pressure filling lines and all other items not subject to the test pressure shall be disconnected or isolated by valves or other suitable means.
4. The hydrostatic test pressure at any point in the piping system shall not be less than 1.5 times the design pressure, but shall not exceed the maximum allowable test pressure of any non isolated components, such as vessels, pumps, or valves. The pressure shall be continuously maintained for a minimum time of 10 minutes and may then be reduced to the design pressure and held for such time as may be necessary to conduct the examinations for leakage. Examinations for leakage shall be made of all joints and connections. The piping system shall show no visual evidence of weeping or leaking.
5. Repairs shall be made to the piping system failing the test. The repaired system shall be retested as indicated above.

END OF SECTION 23 22 13

# SECTION 23 22 16 - STEAM AND STEAM CONDENSATE SPECIALTIES

## PART 1 - GENERAL

### 1.1 WORK INCLUDED

A. Steam traps.

B. Steam pressure reducing valves.

C. Steam relief valves.

D. Sediment strainers.

E. Gauges and gauge connections.

F. Thermometer and thermometer wells.

G. Isolation Valves

### 1.2 RELATED WORK

A. Section 23 07 00, General Insulation

B. Section 23 07 16, Equipment Insulation

C. Section 23 07 19 Piping Insulation

D. Section 23 07 19.19 Piping Insulation (Cal Sil)

E. Section 23 05 20, Piping Specialties.

F. Section 23 22 13, Steam and Steam Condensate Piping.

### 1.3 REFERENCES

A. ANSI/ASTM - Boilers and Pressure Vessels Code.

B. ASTM A105 - Forgings, Carbon Steel, for Piping Components.

C. ASTM A126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

D. ASTM A216 - Steel Casings, Carbon, Suitable for Fusion Welding, for High Temperature Service.

E. ASTM A395 - Ferric Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.

F. ASME B31.9 - Building Services Piping.

1.4 REGULATORY REQUIREMENTS

A. Conform to ASME B31.9 - Building Services Piping.

1.5 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

1.6 SUBMITTALS

A. Submit shop drawings and product data for manufactured products and assemblies required for this project.

B. Include product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.

C. Submit schedule indicating manufacturer, model number, size, location, rated capacity, and features for each specialty.

D. Submit manufacturer's installation instructions.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

1.8 EXTRA STOCK

A. Provide two service kits for each size and type of steam trap.

PART 2 - PRODUCTS

2.1 STEAM TRAPS

A. Acceptable Manufacturers
1. Armstrong
2. Spirax/Sarco
3. Substitutions: Under provisions of Section 23 00 10.

B. INVERTED BUCKET TRAPS
1. Cast iron or semi-steel body and bolted cover for 250 psig WSP; provide access to internal parts without disturbing piping; with top test plug and bottom drain plugs, stainless steel bucket, stainless steel seats and plungers, and stainless steel lever mechanism with knife edge operating surfaces, integral inlet strainer of monel or stainless steel.

C. FLOAT AND THERMOSTATIC TRAPS
1. ASTM A126, cast iron or semi-steel body and bolted cover for 250 psig WSP; provide access to internal parts without disturbing piping; with bottom drain plug, stainless steel or

bronze bellows type air vent, stainless steel float, stainless steel lever and valve assembly.

D. THERMOSTATIC TRAPS
1. Pressure balanced type with ASTM A216 WCB cast steel body and bolted or screwed cover, and integral ball joint union, for 300 psig WSP; monel or stainless steel bellows, stainless steel valve and seat; integral stainless steel strainer.
2. Freeze proof type with cast iron body for 300 psig WSP, bronze bellows, stainless steel valve and seat, external adjustment.
3. Bi-metallic type with ASTM A105 forged steel body and cover, for 300 psig WSP, bi-metal element with stainless steel components, integral Type 304 stainless steel strainer screen, 1/4 inch blow down valve.

## 2.2 STEAM PRESSURE REDUCING VALVES

A. Acceptable Manufacturers
1. Spirax Sarco
2. Leslie
3. Masoneilan
4. Spence Engineering

B. All pressure reducing valves shall be capable of maintaining the set pressure from zero to the maximum steam flow within reasonable limits when subjected to usual steam pressure fluctuations. They shall be single seated valves with stainless steel trim, with renewable valve, lugs and seats. Valve bodies shall be cast steel for high pressure service and cast iron for medium and low pressure service. These valves shall be self contained type with upstream and downstream pressure gauges and shall be installed as per manufacturer's recommendations. Valve capacities are scheduled on the drawings. Pressure reduction is single stage (100 to 15 psig. Station shall consist of two PRV's. Discharge pressure shall be adjustable to any value between 10 psig and 75% of the supply pressure.

C. All pressure regulators 2-1/2" and larger shall have flanged connections and those 2" and smaller may have screwed connections. Unions shall be installed on each side of any screwed pattern regulators installed.

D. Each reducing valve shall be preceded by a sediment strainer complete with a full-sized blow off valve with threaded end for hose connection.

E. Provide valves with insulating covers. Refer to section 23 07 18.

## 2.3 STEAM RELIEF VALVES

A. Acceptable Manufacturers
1. Crane
2. Spirax Sarco
3. Consolidated
4. Spence Engineering

B. Relief valves 2" and smaller shall be cast bronze with stainless steel spring and ball bearings and arranged for screwed connections. Provide with stainless steel whetted trimmings. The safety relief valve shall be rated for 250 psi and 400°F..

C. Relief valves 2-1/2" and larger shall be ASME Section I or VIII stamped valves. The valves shall be rated for 250 PSIG maximum pressure and 400°F temperature. The valves shall be cast iron body with stainless steel trim. The valves shall have flange connections.

D. The pressure at which each relief valve shall open is designated on the Drawings. When such valves are ordered by the Contractor, he shall definitely specify the pressure at which each relief valve is to be set. Each valve shall have a metal tag attached stamped with the valve identification plus the pressure setting.

2.4 STEAM ISOLATION VALVES

A. Acceptable Manufacturers:
1. Crane,
2. DeZurik,
3. Nibco,
4. Powell
5. Stockham

B. 2” and larger
1. Provide class 125 flange iron body gate valves with solid wedge, bolted bonnet and outside screw and yoke. The valve shall be an all steel body with steel stem and cast iron handle.
2. Provide class 125 flange iron body gate valve with solid wedge, bolted bonnet and non-rising stem. The stem shall be steel construction and have cast iron handle.

C. Smaller than 2”
1. Provided treated class 125 bronze gate valve. Gate valve shall be [rising , non-rising] silicon bronze stem with bronze body and wedges. Valve handle shall be equipped with iron handle.

2.5 SEDIMENT STRAINERS

A. Acceptable Manufacturers
1. Spirax Sarco
2. Crane

B. Each drip trap assembly, each control valve, for steam and each pressure reducing valve assembly regardless of its size shall be preceded by a sediment strainer. The arrangement of these sediment strainers shall be such that the screens may be removed for cleaning with ease through a gasketed plug.

C. Sediment strainers shall be placed in steam piping systems wherever shown on the Drawings and at such other points as may be required for the removal of foreign material from the piping systems.

D. Strainers in low and medium pressure steam piping systems 2-1/2" and larger shall be flanged iron body strainers having bolted covers. These strainers shall be suitable for operating pressures as high as 125 psig.

E. Sediment strainers in low and medium pressure steam piping systems 2" and smaller shall be arranged for screwed pipe connections. Full sized blow off valves shall be installed on all strainers in steam, condensate and hot water lines and a drain shall be installed from each valve to the nearest floor drain.

## 2.6 GAUGES AND GAUGE CONNECTIONS

A. Acceptable Manufacturers
   1. Ashcroft
   2. Dwyer
   3. Trerice,
   4. Weiss
   5. Weksler
   6. Spirax Sarco

B. Furnish and install, where noted or indicated on the accompanying Drawings or called for elsewhere in these specifications. Pressure gauge shall be 4” in diameter dial with units marked in psi. Provide pressure gauges appropriate pressure gauges for service of use. The pressure gauges shall have the ability to operate up to 400°F.

C. Provide gauges with lever handle union shutoff cocks. All gauge connections shall be made up with brass pipe, nipples and brass screw fittings.

## 2.7 THERMOMETER AND THERMOMETER WELLS

A. Acceptable Manufacturers
   1. Ashcroft,
   2. Dwyer,
   3. Trerice,
   4. Weiss
   5. Weksler

B. Thermometer wells and thermometers shall be located where noted on the accompanying Drawings and where called for in other sections. Thermometer test wells only shall be installed in a vertical position in horizontal lines and at 45 degrees, in vertical lines to hold a fluid in the well.

# PART 3 - EXECUTION

## 3.1 INSTALLATION AND APPLICATION

A. Install specialties in accordance with manufacturer's instructions.

B. Install float and thermostatic traps to drain condensate from convertors, heating coils, steam separators, flash tanks, steam jacketed equipment, and direct steam injected equipment.

C. Install inverted bucket steam traps to drain condensate from steam main headers and branch lines.

D. Size steam traps to handle minimum of two times maximum condensate load of apparatus served.

E. Traps used on steam mains and branches shall be minimum 3/4 inch size.

F. Install steam traps with union or flanged connections at both ends.

G. Provide gate valve and strainer at inlet, and gate valve [and check valve] at discharge of steam traps.

H. Provide minimum 10 inch long dirt pocket of same pipe sizes as apparatus return connection between apparatus and steam trap.

I. Remove thermostatic elements from steam traps during temporary and trial usage, and until system has been operated and dirt pockets cleaned of sediment and scale.

J. Provide pressure reducing stations with pressure reducing valve, valved bypass, strainer and pressure gage on upstream side, relief valve and pressure gage on downstream side of pressure reducing valve.

K. Pressure reducing station shall be one or two stages as indicated, to produce flat reduced pressure curve over range of capacity.

L. Rate relief valves for pressure upstream of pressure reducing station, for full operating capacity. Set relief at maximum 20 percent above reduced pressure.

M. Terminate relief valves to outdoors. Provide drip pan elbow with drain connection to nearest floor drain.

N. When several relief valve vents are connected to a common header, header cross section area shall equal sum of individual vent outlet areas.

END OF SECTION 23 22 16

# SECTION 23 31 13 - DUCTWORK

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Perform Work required to provide and install ductwork, flexible duct, hangers, supports, sleeves, flashings, vent flues, and all necessary accessories as indicated in the Contract Documents. Provide any supplementary items necessary for proper installation

B. Section Includes:
   1. Rectangular ducts and fittings.
   2. Sheet metal materials.
   3. Sealants and gaskets.
   4. Hangers and supports.

C. Related Sections:
   1. Section 23 05 93, Testing, Adjusting, and Balancing for HVAC, for testing, adjusting, and balancing requirements for metal ducts.

### 1.2 DEFINITIONS

A. Low Pressure: Up to 3 inches w.g. positive or negative static pressure and velocity equal to 1500 fpm. Constructed and tested for +3 inches W.G.

B. Medium Pressure: Over 3 inches w.g. through 6 inches w.g. positive or negative static pressure and velocity greater than 1500 fpm. All medium pressure ductwork shall be constructed and tested for +6 inches w.g.

C. High Pressure: Over than 6 inches w.g. positive static pressure and velocity greater than 2500 fpm.

D. Duct Size. The supply, return and exhaust duct sizes shown on drawings are clear inside sheet metal dimensions. Include proper allowances for acoustical lining, where indicated in plans or specifications.

### 1.3 GUARANTEE

A. Guarantee all ductwork for 1 year from the date of final acceptance. The guarantee will cover workmanship, noise, chatter, whistling or vibration. Ductwork shall be free from pulsation under all conditions of operation.

### 1.4 CONTRACTOR COORDINATION

A. Erect all ducts in the general locations shown on the drawing(s), but conform to all structural and finish conditions of the building. Before fabricating any ductwork, Contractor to check the physical conditions at the job site and make all necessary changes in cross sections, offsets and similar items, whether they are specifically indicated on drawing(s) or not. Do not obstruct the induced air plenum opening at VAV boxes and service access spaces for VAV boxes and other equipment.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

### 1.5 STANDARDS AND CODES

A. Except as otherwise indicated, sheet metal ductwork material, fabrication and installation shall comply with second edition of SMACNA HVAC Construction Standards Metal and Flexible, except where indicated otherwise. All air distribution devices (such as dampers) included in this Section shall comply with the second edition of SMACNA HVAC Construction Standards Metal and Flexible.

B. In addition, construct ductwork and all air distribution devices to the following:

1. IMC International Mechanical Code
2. NFPA 90A Installation of Air Conditioning and Ventilating Systems.
3. NFPA 90B Installation of Warm Air Heating and Air Conditioning Systems

1.6 SUBMITTALS

A. Product Data
   1. Submit product data for each product. Refer to Section 23 00 10.
   2. Provide acoustical data on insulated flexible ductwork as indicated in Part 2.

B. Delegated-Design Submittal. Include the following for each system furnished on the project.
   1. System name and type
   2. Duct system design pressure.
   3. Sheet metal thicknesses and materials.
   4. Reinforcement details and spacing.
   5. Seam and joint construction and sealing.
   6. Fittings, construction and details.
   7. Hangers and supports, including materials, fabrication, methods for duct and building attachment.

C. Ductwork shop drawings. Provide CAD-generated shop drawings of mechanical rooms and building ductwork drawn at a minimum scale of ¼ inch per foot. Include the following as a minimum:
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Factory and shop fabricated duct and fittings.
   3. Duct layout indicating sizes, configuration and pressure classes.
   4. Elevations of top and bottom of ducts.
   5. Dimensions of main duct runs from building grid lines.
   6. Reinforcement and spacing.
   7. Penetrations through fire-rated and other partitions.
   8. Equipment installation based on equipment being used on Project.
   9. Duct accessories, including access doors and panels, fire dampers and smoke dampers.

D. Welding certificates. For duct welders including procedures and standards of acceptance

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Spiral Ductwork. Gowco, McCorvey, United McGill, Lindab (supply duct only).

B. Sheet Metal Products. McCorvey Sheet Metal Works, Gowco, United McGill, Flexmaster

2.2 APPLICATION

A. Ductwork shall be constructed in accordance with the following as a minimum. Refer to drawings for any deviations from this table.

| SYSTEM | MATERIAL | MINIMUM PRESSURE CLASSIFICATION (1) |
|---|---|---|
| **Supply Systems**: | | |
| Untreated outside air intake, louver to AHU plenum | 304 Stainless Steel | Medium Pressure |
| Supply ductwork downstream of terminal boxes | Galvanized Steel | Low Pressure |
| Supply ductwork downstream of single zone VAV AHUs(1) | Galvanized Steel | Medium Pressure |
| Mixed air AHU plenum | Galvanized Steel | Medium Pressure |
| Treated outside air to AHU(2) | Galvanized Steel | Medium Pressure |
| | | |

B. Notes to Table:
   1. From air handling unit (AHU) to terminal boxes.
   2. From pretreatment AHU to AHU.

2.3 DUCT MATERIAL AND CONSTRUCTION

A. General. Noncombustible or conforming to requirements for Class I air duct materials or UL 181. All ductwork indicated on the Drawings, specified or required for the air conditioning and ventilating systems shall be of materials as hereinafter specified unless indicated otherwise on Drawings. All air distribution ductwork shall be fabricated, erected, supported, etc., in accordance with all applicable standards of SMACNA where such standards do not conflict with NFPA 90A and where class of construction equals or exceeds that noted herein

B. Galvanized Steel Ducts. Constructed of G-60 coated galvanized steel meeting requirements of ASTM A 653 or ASTM A 527. Stencil coils of sheet steel throughout on 10 foot centers with gage and manufacturer's name. All materials associated with the duct system shall be galvanized steel including stiffeners, fasteners, etc.

C. Stainless Steel Ducts. Type 304 or 316L as indicated in application schedule. For round ductwork, butt-welded (solid welded) longitudinal seam only. Spiral lockseam and Spiral lockseam with standing rib is not acceptable.

D. Fasteners. Rivets, bolts or sheet metal screws.

E. Sealant.
   1. Sealant shall be water based, latex UL 181B-M sealant with flame spread of 0 and smoke developed of 0. Sealants shall be similar to Foster 32-19, Childers CP-146, Hard Cast Iron Grip 601, Ductmate Pro Seal or Design Polymerics DP 1010.
   2. Scrim tape shall be fiberglass open weave tape, 3 inches wide, with maximum 20/10 thread count.

F. Hangers and Supports.
   1. Support ductwork with 1” 16 gauge straps as indicated in these specifications.

2.4 RECTANGULAR DUCTS AND FITTINGS GENERAL REQUIREMENTS

A. General Fabrication Requirements: Comply with SMACNA based on indicated static-pressure class unless otherwise indicated. In no case shall the ductwork be less than 26 gage for low pressure ductwork, 24 gage for medium pressure ductwork.

B. Transverse Joints: Select joint types and fabricate according to SMACNA Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA. Snaplock longitudinal seams (L2) are not acceptable.

D. Fittings:
1. Select types and fabricate according to SMACNA Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA.
2. Construct bends and elbows per SMACNA Figure 2-2, “Rectangular Elbows”, Type RE1 with radius of not less than 1-1/2 times width of duct on centerline. Where not possible or where indicated on construction documents, construct Type RE2 rectangular elbows with welded-in-place double wall airfoil turning vanes (whether specifically shown on drawings or not), or short radius type RE1 radius elbows.
3. Construct tees per SMACNA Figure 2-5, “Divided Flow Branches”, Type 2, Type 3, Type 4A or 4.
4. Construct branch connections per SMACNA Figure 2-6, “Branch Connection”. Use 45 degree entry, 45 degree lead in, conical or bellmouth connections only.
5. Unless indicated on construction document details, transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence. Divergence upstream of equipment shall not exceed 30 degrees. Convergence downstream of equipment shall not exceed 45 degrees.
6. Bullhead tees are not permitted.

2.5 ROUND AND OVAL DUCTS AND FITTINGS GENERAL REQUIREMENTS

A. General Fabrication Requirements: Comply with SMACNA Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated. In no case shall the ductwork be less than 24 gage.

B. Transverse Joints: Select joint types and fabricate according to SMACNA Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA. Use flanged joints for ducts larger then 48 inches in diameter.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA. Utilize spiral seam or butt weld seams only. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

D. Fittings:
1. Fittings shall have a wall thickness not less then that specified for longitudinal-seam straight duct or 26 gage, whichever is more stringent.
2. Tees and Laterals: Select types and fabricate according to SMACNA Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA. Utilize 90 degree tee with oval to round tap, 45 degree lateral tap, or conical fitting only. Wye fittings may be utilized where specifically indicated on drawings and details.
3. Elbows: Construct elbows with radius of not less than 1-1/2 times width of duct on centerline. Provide minimum 5 gore elbows on all 90 deg elbows, 3 gore elbows on 45 degree elbows. Continuously welded stamped long radius elbows may be utilized on ductwork up to and including 12-inches in diameter.
4. Bullhead tees are not permitted.

2.6 INSULATED FLEXIBLE DUCTWORK

A. Use for connection to diffusers, grilles and terminal boxes as indicated in specifications and details.

B. Construct the inner liner of coated steel helix and a PE or CPE liner substantially bonded together to prevent the duct from collapsing or kinking in short radius bends. Provide fiberglass insulation providing minimum R-4.2 thermal conductance and 3 pound minimum density around inner jacket consisting of fiberglass reinforcement and aluminum foil vapor barrier outer jacket. Use duct rated at minimum working pressure of 10 inches of water positive and 1 inches of water maximum negative pressure (4-12 in I.D.), and 6 inches of water positive and 1/2 inch of water maximum negative pressure (14- 16 I.D.),. Provide duct listed by U.L. at flame spread rate of not over 25 and smoke developed rate of not over 50, and complying with NFPA Standard 90A and 90B. The entire assembly shall be listed by Underwriters Laboratories under U.L. Standard 181 as a Class I flexible air duct.

2.7 INTERNAL ACOUSTIC DUCT LINING

A. Internal insulation with JohnsManville Permacote Linacoustic standard fiberglass duct liner with factory-applied edge coating. Insulation shall have a composite, abrasion resistant airstream surface with EPA-registered, anti-microbial coating that will not support microbial growth.

B. Duct Lining used on the project must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50 as determined by test procedures ASTM E 84, NFPA 255 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements. The liner shall meet the Life Safety Standards as established by NFPA 90A and 90B.

C. Provide insulation thicknesses as follows:
   1. Provide 1/2 inch insulation on all return air transfer ductwork.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Construction Standards. Use construction methods which follow the requirements outlined SMACNA publications, as well as SMACNA Balancing and Adjusting publications, unless indicated otherwise in these specifications or accompanying drawings.

B. Reinforcement. Reinforce ducts having one side equal to 25 inches or more in accordance with recommended construction practice of SMACNA.

C. Plenum Construction. Construct plenum chambers of not less than No. 20 U.S. gage metal reinforced with galvanized structural angles.

D. Cross Breaking or Beading. Cross break or bead sheet metal for rigidity, except ducts which are 12 inches or less in the longest dimension.

E. Interior Painting. Interior painting of metal ductwork exposed to view through grilles, registers, and other openings is specified in the Section on painting. Do not install grilles, registers, or similar items until painting is complete.

F. Ductwork Openings. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

G. Ductwork Location. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities, including access to electrical and control panels.

H. Instrument Test Hole Fitting. Provide Duro Dyne Model TH-1 instrument test ports with heavy-duty zinc-plated heavy-gage cap, instant-release wing nut, neoprene expansion plug, flat neoprene mounting bracket and mounting holes. Provide fittings to air balance contractor.

I. Provide transitions at equipment and air device connections as per SMACNA standards. Where equipment requires an oval inlet and a round flex duct is routed to the equipment, provide insulated round to oval transition.

J. Install duct mounted electric and hot water coils, provided in other specification sections, if required.

K. Refer to mechanical details for information on terminal box connections, diffuser connections, fume hood connections, lab-trac equipment, etc.

3.2 SEAM AND JOINT SEALING

A. All duct systems (except welded exhaust ductwork and double wall flue) shall be sealed. Duct shall be thoroughly cleaned prior to application of sealant. All transverse joints, longitudinal seams and duct wall penetrations shall be sealed. All ductwork shall be sealed as per seal Class A of SMACNA Standards irrespective of the duct pressure classifications.

B. Duct to be sealed with mastic, 3" skrim tape and more mastic to completely imbed cloth.

3.3 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports." Unless indicated otherwise in specifications.

B. Hanger Spacing. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing. Install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection. Do not use wire to support ductwork.

C. Horizontal Ducts Up to 40 Inches. Support horizontal ducts up to and including 40 inches in their greater dimension by means of 16 gage band 1” strap attached to the ducts by means of screws, rivets or clamps, and fastened to inserts with toggle bolts, beam clamps or other approved means. Use clamps to fasten hangers to reinforcing on sealed ducts.

D. Horizontal Ducts Larger Than 40 Inches. Support horizontal ducts larger than 40 inches in their greatest dimension by means of hanger rods bolted to angle iron (or equivalent unistrut) trapeze hangers. Place supports on at least 8'-0" centers according to the following:

| **Angle Length** | **Angle** | **Rod Diameter** |
|---|---|---|
| 4’-0” | 1-1/2” x 1-1/2” x 1/8” | 1/4” |
| 6’-0” | 1-1/2” x 1-1/2” x 1/8” | 1/4” |
| 8’-0” | 2” x 2” x 1/8” | 5/16” |
| 10’-0” | 3” x 3” x 1/8” | 3/8” |

The trapeze is to be placed on the exterior of non-compressible insulation between hanger and ductwork.

E. Vertical Ducts. Support ducts to ensure rigid installation. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Fig. 4-7, Fig 4-8, Fig 4-9 "Riser Supports – From Floor”. Support vertical ducts where they pass through the floor lines with 1-1/2 inches x 1-1/2 inches x 1/4 inch angles for ducts up to 60 inches. Above 60 inches, the angles must be increased in strength and sized on an individual basis considering space requirements. Support vertical duct drops more than 6 feet in length with angle iron frames attached to ducts.

F. Refer to drawings for additional hanger details and requirements. Note that not all hangers are shown on the drawings are in the BIM model. The Contractor shall coordinate all hangers with the structure and other trades.

3.4 FLEXIBLE DUCTWORK

A. Medium Pressure Flexible Ductwork

1. Refer to details for maximum length of flexible ductwork upstream of terminal box.
2. Do not use flexible ductwork for changes in direction of airflow.
3. Provide two stainless steel work clamps on inner core and seal connection with duct sealant. The insulation and outer jacket shall be slipped over inner core connection to point where insulation abuts insulation on duct or terminal box. The insulation connections shall be sealed by embedding scrim tap and sealant to form a vapor barrier.

3.5 FLASHING

A. Where ducts pass through roofs or exterior walls, provide suitable flashing to prevent rain or air currents from entering the building. Provide flashing not less than No. 26 gage stainless steel or 16 ounce copper.

3.6 DUCT LINING

A. Fiberglass acoustical lining is not permitted to be installed on this project except as indicated in this specification or specifically shown on drawings.

B. Install per manufacturer's recommendations. Keep internal lining clean during construction by keeping ends of ductwork sealed during storage and construction.

3.7 TESTS

A. Allowable Leakage. Test ductwork for leaks in accordance with SMACNA before concealing or insulating as indicated below. Arrange for the Owner's Representative to witness the test.
   1. Low pressure ductwork. Test low pressure ductwork at +3 inches W.G. Maximum allowable leakage = 1%.
   2. Medium pressure ductwork. Test medium pressure ductwork at +6 inches W.G. Maximum allowable leakage = 1%.
   3. Test the following ductwork:
      a. Medium pressure ductwork:
         1) Ductwork served by individual air handling units, medium and low pressure.
         2) Ductwork served pretreatment outside air handling units.

B. Equipment. Provide equipment necessary for performing tests, including rotary blower, orifice section and U-tube gage board complete with cocks and rubber tubing.

3.8 CLEANING

A. Protect all ductwork and equipment from dirt during storage, installation and prior to grille, diffuser installation with protective covering at each end. Ductwork exposed to dirt and dust due to inadequate protection will have to be removed, cleaned and reinstalled.

B. Do not operate any air handling units or fan coil units during construction without filters.

C. Provide temporary filters on return air ductwork during construction to protect ductwork from dust.

D. Provide temporary filters on exhaust grilles during construction to protect ductwork from dust.

END OF SECTION 23 31 13

# SECTION 23 33 00 - AIR DUCT ACCESSORIES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. This Section includes:
   1. Fire dampers.
   2. Duct access doors.
   3. Conical spin-in fittings.
   4. Turning vanes.
   5. Duct accessory hardware.

### 1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

### 1.3 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

## PART 2 - PRODUCTS

### 2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Exposed-Surface Finish: Mill phosphatized.

C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

### 2.2 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Greenheck Fan Corporation.

2. Nailor Industries Inc.
3. Prefco; Perfect Air Control, Inc.
4. Ruskin Company.
5. Vent Products Company, Inc.

B. Fabricate in accordance with NFPA 90A and UL 555 and as indicated.

C. Curtain-type Dampers:
1. Galvanized steel with interlocking blades.
2. Stainless steel closure springs and latches for horizontal installations.
3. Configure with blades out of air stream except for low pressure ducts up to 12” in height.

D. Fusible Links:
1. UL 33 and shall separate at 165°F.
2. Provide adjustable link straps for combination fire/balancing dampers.

## 2.3 ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Flexmaster U.S.A., Inc.
2. Nailor Industries Inc.
3. Vent Products Company, Inc.

B. Provide Flexmaster U.S.A. Inc., Inspector Series Model SDSM low leakage spin-in access doors for sheet metal applications.

C. Construct outer frame of a single piece of 24 gage G90 galvanized steel roll formed and notched for spin-in applications. Entry side shall be roll formed and double hammed for safe entry and exit.

D. 24 gage draw quality steel inner door filled with a 1 inch thick polystyrene insulation and held in place by a galvanized steel backplate.

E. A continuous .375 inch wide by .1875 inch thick open cell adhesive neoprene gasket shall be installed in the door frame to provide a positive seal upon insertion and locking of the door. The leakage characteristics, when tested by an independent ADC Certified Laboratory shall be as follows:

| Operating Pressure | Leakage Rates - All Door Sizes |
|---|---|
| 6" w.g. | Less than .10 cfm |
| 10" w.g. | Less than .25 cfm |

F. The door shall be held secure with evenly spaced cast aluminum cam latches for even pressure against the gasket.

G. Provide a heavy duty cable to permanently attach the door to the outer frame.

H. Where duct size permits, access door size shall be 18 inches in diameter or 18 inch x 16 inch for oval and rectangular doors.

I. Doors at zone heating coils shall be minimum 10 inch x 12 inch.

## 2.4 CONICAL SPIN-IN FITTINGS AND TAPS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Flexmaster, USA, Inc.
   2. Buckley Air Products.

B. Furnish conical spin-in fittings with quadrant dampers at all round runout ducts serving diffusers and grilles.

C. Fabricate conical fitting of 26-gage galvanized sheet metal with a minimum overall length of six inches, factory sealed for high pressure requirements. Provide 24-gage damper plate with locking quadrants.

## 2.5 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Ductmate Industries, Inc.
   2. Nexus PDQ; Division of Shilco Holdings Inc.
   3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

## 2.6 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Ductmate Industries, Inc.
   2. Duro Dyne Inc.
   3. METALAIRE, Inc.
   4. SEMCO Incorporated.
   5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
   1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

## 2.7 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Drill temporary test holes for balancing in ducts as required. Cap with neoprene plugs, threaded plugs, or threaded or twist-on metal caps. Provide neat patch on external duct insulation and label as “Test Plug”.

C. Provide permanent test holes in ductwork upstream and downstream of all coils, fans, and locations as indicated on drawings. Test holes shall be factory fabricated, airtight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

D. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
   1. Install steel volume dampers in steel ducts.
   2. Install aluminum volume dampers in aluminum ducts.

D. Set dampers to fully open position before testing, adjusting, and balancing.

E. Install fire and smoke dampers according to UL listing.

F. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
   1. Downstream from manual volume dampers, control dampers, turning vanes, and equipment.
   2. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream

from dampers and inward operation for access doors installed downstream from dampers.
3. At each change in direction and at maximum 50-foot spacing.
4. Upstream of turning vanes.
5. Elsewhere as indicated.

G. Install access doors with swing against duct static pressure.

H. Label access doors according to Section 23 05 53, Identification for HVAC Piping and Equipment, to indicate the purpose of access door.

I. Install flexible connectors to connect ducts to equipment.

J. For fans developing static pressures of 5 inch w.g. and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

K. Connect terminal units to supply ducts directly or with maximum 12 inch lengths of flexible duct. Do not use flexible ducts to change directions.

L. Connect diffusers or light troffer boots to low-pressure ducts directly or with maximum 60 inch lengths of flexible duct clamped or strapped in place.

M. Install duct test holes where required for testing and balancing purposes.

## 3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

END OF SECTION 23 33 00

SECTION 23 73 13 – AIR HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED WORK

A. Section 23 05 53, Identification for HVAC Piping and Equipment.

B. Section 23 05 13, Common Motor Requirements for HVAC Equipment.

1.2 PERFORMANCE

A. Unit capacities and characteristics are scheduled on drawings. Each air handling unit shall have physical dimensions suitable to fit space allotted to the unit, with clearances as required for maintenance, access and coil pull.

1.3 QUALITY ASSURANCE

A. Fan Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal for air foil wheels.

B. Sound Ratings: AMCA 301; tested to AMCA 300.

C. Fabrication: Conform to AMCA 99.

D. Filter Media: ANSI/UL 900 listed, Class I or Class II.

E. Air Coils: Certify capacities, pressure drops and selection procedures in accordance with ARI 410.

1.4 STRUCTURAL REQUIREMENTS

A. Provide field assembled units. Provide additional bracing for large unit casing as required for structural integrity.

B. Furnish units with sealing and fastening hardware supplied by the manufacturer. Include written instructions needed to complete field assembly of the components.

C. Provide units designed and constructed so that coils, panels, fan housing and fans can be removed without affecting the structural integrity of the unit.

1.5 PRESSURE RANGES DEFINED

A. Low Pressure Units: Total static pressures up to 2 inches w.g.

B. Medium Pressure Units: Total static pressures above 2 and up to 6.0 inches w.g.

1.6 SUBMITTALS

A. Submit shop drawings and product data. Product data shall include complete description of air handling unit construction, including materials of construction, material thicknesses, insulation thickness and “K” values, fan curves, and coil performance data.

B. Provide shop drawings indicating complete unit assembly, dimensions, weight loading at support points, required clearances, construction details, access door dimensions, and field connection locations and sizes for both coil, condensate and duct connections. Separate section drawings are not acceptable. Indicate locations of factory mounted electrical junction boxes and disconnect switches.

C. Show compliance in submittal with Section 23 05 48, Vibration Isolation for HVAC Piping and Equipment, and Section 23 05 13, Common Motor Requirements for HVAC Equipment.

D. Provide product data including dimensions, weights (dry and wet), capacities, ratings, fan performance, motor electrical characteristics, gages and finishes of materials. Individual component computer type drawings are not acceptable. Provide complete assembly drawings.

E. Submit fan curves with specified operating point clearly plotted and at scheduled RPM. Fan performance shall include the effects of inlet screens, safety screens and other system effects.

F. Submit sound power levels for fan outlet, inlet and casing radiation at rated capacity.

G. Submit product data of filter media, filter performance data, filter assembly and filter frames.

H. Submittal shall include dimensional drawing of insulated condensate drain piping including cleanable trap for each air unit.

I. Provide statement of compliance for leakage and deflection requirements.

J. Provide information on fan airflow monitoring stations. Submit calibration curves prior to unit shipment.

K. Contractor shall submit 1/4 inch scale drawing of each mechanical room for review by owner and engineer. Drawing shall show coil pull spaces and coordination of all ductwork, all chilled water, heating water and condensate piping and trap, electrical conduit, electrical and control panels, etc. installed in mechanical room. Provide plan and elevation views detailing installation.

L. Contractor shall submit plan indicating methods for Delivery, Storage and Handling of Air Handling Units prior to shipping of units.

## 1.7 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 23 00 10.

B. Include installation instructions, assembly views, lubrication instructions and replacement parts list.

C. Provide tab for each air handling unit provided.
   1. Include copy of approved submittals (with all comments corrected).
   2. Include factory vibration test results for fans, fan bearings and motors per Section 23 05 93.
   3. Provide copy of calibration curve for each fan airflow monitoring station.
   4. Provide copy of any leakage or deflection test results performed during the project.
   5. Provide copy of manufacturer's AHU Inspection report.

## 1.8 EXTRA FILTERS

A. For each air handling unit, provide the following spare filters at project completion:
   1. Two sets of Filters.

## 1.9 DELIVERY, STORAGE AND HANDLING

A. All handling and storage procedures shall be per manufacturer's recommendations and these specifications. Refer to Part 3 of this specification for additional information.

B. During shipment, it's the responsibility of the manufacturer to ensure AHUs are wrapped with a tight sealing membrane, including electrical components. Wrapping membrane shall cover entire AHU during shipping regardless of size or shape. Units shall be protected against rain, snow, wind, dirt, road salt/chemicals, rust and corrosion.

C. Coordinate delivery of units with project schedule. Units may not be stored outside and exposed to elements (even if under protective tarps). Store units protected from weather inside building or a warehouse and under protective tarps. Units shall be protected from rain and other sorts of moisture while in transit and on-site.

D. Storage procedures and protection shall be approved by Owner and Engineer as indicated under Submittals.

PART 2 - PRODUCTS

2.1 PRODUCTS OF MANUFACTURERS

A. Standard AHUs. Products of Manufacturers listed below complying with each of the requirements of the specifications are acceptable:
   1. York Custom
   2. Haakon
   3. Energy Labs.

2.2 FABRICATION AND DESIGN

A. Contractor shall take careful consideration to the dimensions of the units in the drawings as dimensions shown are maximum dimensions and are not to be exceeded. The manufacturer shall submit AHU drawings on bid day for review and approval of contractor and engineer.

B. Fabricate units with fan and coil sections plus accessories, including heating coil sections, filter section, cooling coil section as scheduled.

C. Factory fabricate air handling units of sizes, capacities and configuration as indicated and specified. See drawings for additional information on component layouts.

D. Base performance on sea level conditions.

2.3 CASING

A. Construction:
   1. Casing shall be constructed of double wall, side, roof and floor panels, not lighter than 20-gage inner panel and 18 gauge outer panel for foam insulation, galvanized steel and protected with the manufacturer's standard finish.
   2. Exterior panels must be removable from the outside of the unit without affecting the structural integrity of the unit.
   3. Floors shall be of thermal break construction.

B. Provide an additional 0.125 inch aluminum diamond tread plated liner walk-on surface in unit access areas (sections with access doors) for all units with supply CFMs greater than 10,000 CFM.

C. Base Rail.
   1. Provide continuous structural base rail channels beneath unit assembly for structural rigidity of assembly. Provide 6 inch minimum C-welded structural steel channel (formed or mechanically fastened bases are not acceptable). Vertical and horizontal unit sections supporting fan sections, coil sections or other unit components shall be designed to support loads without deflecting the perimeter base or sections. The manufacturer shall submit data in accord with Submittals Paragraph 1.6 indicating support points of unit assembly.
   2. Base rail height shall be calculated to confirm that the unit height is sufficient for condensate trapping.

D. Access: As indicated on the AHU component diagrams, provide access to entry for sections of the unit by full height (max 72” tall) hinged access doors big enough to permit access to and removal of internal parts and entry for cleaning. Access door insulation shall be same thickness as that of air handling unit walls. Provide full perimeter gasketing on the door or casing to seal access panels. As indicated on the AHU component diagrams, provide fan, filter and coil section with access doors with latches, hinges, and exterior and interior handles as manufactured by Ventlock, Allegis, Southco or approved equal. Minimum clear width of door shall be 18 inches at coil sections (upstream and downstream of cooling and heating coils) and minimum 24 inches at fan sections. Provide access sections as indicated on AHU Component Diagrams on the Construction Documents. Provide an access section with a door on

left and right side of each coil, unless otherwise specified on drawings. Refer to drawings for additional information on access locations. Access doors shall open against pressure unless otherwise noted. Provide viewing window in access doors in the fan and coil sections. Windows shall be double-pane tempered glass.

1. On units with dual fans and that are directly against a wall, provide an access door on the front of the unit to help facilitate maintenance of both fans and motors.

E. Coil Connections Panels: Provide removable panels through which piping may pass. Use rubber grommets to seal airtight around pipes on inside and outside of units. Grommets shall completely pass from outside of unit to inside of unit, and seal all insulation inside casing from airstream.

F. Finish: G90 Galvanize all parts of the unit, both inside and out, including supports.

G. Insulation: Provide foam insulation as indicated below. All panels (roof, walls, floor) and access doors shall have a minimum thermal resistance, R of 12.1 (Hr-ft2-F/BTU):
1. Foam Insulation: Unit shall be completely insulated throughout the entire unit, with all panels and structural frame members insulated with a minimum 2 inches of foam insulation.

H. Drain Pans: Provide a minimum 14 gauge, Type 316 stainless steel double-bottom IAQ type drain pan with minimum 2 inch thick uncompressed insulation in the sealed space between two pans. Extend the drain pan a minimum of 12 inches from the downstream of each coil face. Provide coil section access door to drain pan for inspection and cleaning.
1. Inside chilled water coil section pan shall be all-welded stainless steel construction, with slopes in two directions towards condensate connection for complete drainage of condensate. IAQ drain pan is required. Hot water coil section pan liner may be galvanized steel or stainless steel.
2. Provide a stainless steel large threaded drain connection on side at the low point of the chilled water pan. Provide galvanized or stainless steel connection on hot water pan. Coordinate the condensate drain location with project drawings.
3. When two or more cooling coils are used, with one stacked above the other, individual drain pans of stainless steel, with copper or stainless steel drains piped to the main drain pan shall be provided beneath each of the coils.
4. Provide walkable grating in drain pan section with a non-skid surface and meets 25/50 Fire Spread/Smoke Development Rating per ASTM E84.

I. Test and Balancing Ports. Provide a permanent factory-installed sealable port on each section of unit to allow for testing and balancing of system, except where port would be blocked by filters or coils. TAB ports may be located in the access doors of the unit.

J. Leakage and Deflection Requirements:
1. Leakage requirements: The unit shall be constructed to for an allowable leakage of 0.5% of the rated unit airflow at a total static pressure of ±10 inch w.g. Provide statement of compliance with submittal that unit is constructed to meet this requirement.
2. Deflection requirements: The unit shall be constructed so the maximum panel deflection shall not exceed an L/240 ratio when tested at a total static pressure of ±10 inch w.g. ‘L’ is defined as the height of the unit on the sides, width of the unit on top panels and the smaller of width or height for the ends. Provide statement of compliance with submittal that unit is constructed to meet this requirement.
3. The intent of the leakage and deflection requirements are that the units shall meet the above requirements despite the disassembly and reassembly process in the field. The contractor shall follow the strict recommendations of the manufacturer for knockdown reassembly, and the manufacturer shall supervise reassembly process such that requirements above are upheld.

## 2.4 FAN SECTION

A. Fans should be designed for quiet, slow-speed operation under specified rating conditions. Provide minimum Class II construction. Fan speed shall be able to be increased 10% without exceeding maximum fan RPM.

B. Wheels. Provide the following:
   1. Single width single inlet (SWSI) plenum fans

a. All SWSI plenum fans shall have airfoil blades, flat blades are not acceptable. Fan blades shall be continuously welded to the backplate and inlet shroud, and securely keyed to the fan shaft.
   1. Coat all non-aluminum fan parts with enamel paint; all fan wheel hardware and fasteners shall be cadmium plated or stainless steel.

C. Scrolls: Provide fan scrolls of galvanized steel or air dried phenolic painted construction. Housing shall be of heavy gauge and continuously welded. Rigidly secure the scrolls in the casing to prevent vibration.

D. Shafts: Provide tubular or solid hot rolled steel, ground and polished, with keyway and protectively coated with lubricating oil.

E. Bearings:
   1. Provide fan with self-aligning ball or roller type bearings selected for L-10 200,000 hours minimum life under actual load and speed conditions.
   2. Furnish adjustable block or flange mount bearings for accurate alignment of fan wheels in the scrolls.
   3. Bearing shall be lubricated type with lubrication fitting mounted on the fan base within the unit, with copper tubing between fitting and bearing.
   4. Bearing shall be supported by structural shapes, or die-formed sheet structural members, or support plates securely attached to the unit casing.
   5. Bearings may not be fastened directly to the unit sheet metal casing.

F. Statically and dynamically balance fan, motor and drive assembly over entire speed range. Air handling units, fans, bearings and fan sheaves shall be balanced to ISO-1940 G6.3 standards or to a maximum of 7 mil peak to the horizontal and vertical plane as measured at the fan mounting leg. Filter out measurements shall be taken in the horizontal and vertical and axial planes. Measurements shall not exceed 9.5 mils horizontally, vertical planes and axial planes. Submit factory balance data with O&M Manuals for each air handling unit assembly.

G. Drive:
   1. Direct Drive: Provide SWSI plenum fan with a shaft connected to the motor shaft. Fan selections shall be selected with an 1800 rpm motor and the design point must be within the ranges of 50-85Hz. If a fan is submitted to have a design operating point higher than 60 Hz, provide compliance documentation by the motor manufacturer with submittal that fan motor can operate at a higher rpm than the rated motor speed. Provide non-overloading fan for operation at 60HZ on all AHUs with VFD electrical bypass.

a. Multiple direct drive fans: Provide multiple direct drive fans in an arrangement as indicated on the drawings. Fan selection shall be made so that if one fan becomes inactive the remainder of the fans will operate out of the surge region. Vertical counterbalanced backdraft dampers or a removable plate shall be provided at the inlet of each fan to close section if the fan becomes inactive.

H. Motors:
   1. Provide motors rated for “inverter ready” and shaft grounding rings per Section 23 05 13, Common Motor Requirements for HVAC Equipment.
   2. Mount the fan drive motor on an adjustable base and arrange for positive and easy adjustment of drive alignment and belt tension.
   3. Provide fan motors that will not overload when scheduled fan rpm is increased 10 percent. Submit a fan curve for each scheduled unit showing operating points at scheduled conditions and at scheduled rpm increased 10 percent. Minimum motor sizes as scheduled must be provided without exception. Where larger than scheduled motor sizes are provided, the mechanical contractor shall provide motor VFD or Starter, conduit, wiring, disconnect, etc. suitable in accordance with NEC as required for increase in motor nameplate horse power.
   4. Air Handler Fan Section shall include a factory mounted external mounted electrical junction box for single point electrical connection (for each motor). The air-handling unit manufacturer shall provide wiring between the motor and the junction box, so that field penetrations are not required

for powering the motor. All wiring shall be done in accordance with the latest NEC guidelines. All wiring (for motors) shall be 600V rated type MTW/THWN stranded copper in EMT or plenum rated metallic (galvanized) flexible conduit (max 3 feet). The junction box shall be at least 6 inches x 6 inches, and be located at least 5 inches above the unit baserail on the drive side of the unit. For all electrical penetrations, seal conduit and wiring connections at motor and junction box air tight to prevent condensation within motor and junction box and conduit. Isolate junction box as required to prevent sweating.

5. Provide shaft grounding rings for all VFD driven motors.

I. Vibration Isolation: Provide internal vibration isolators designed specifically to isolate vertical plenum fans from excessive vibration. Completely isolate entire fan and motor assembly.

J. SWSI Plenum Fans:
1. Inlet panels shall be of heavy-gauge reinforced steel construction. The inlet panel incorporates a removable spun inlet cone designed for smooth airflow into the accompanying inlet retaining ring of the fan wheel.
2. Plug fans installed in walk-in units shall be provided with a fan shut down switch in the access doors of the fan section and section upstream of the fan section.
3. Plenum fans (including those in fan array) shall be mounted on a structural steel frame with spring isolators.

K. Airflow Monitoring (Measuring) Station:
1. For each air handling unit fan (supply fan, exhaust fan, etc), provided a piezometer ring airflow measuring system. The system shall consist of a piezometer ring mounted on the throat (inlet venturi) and a static pressure tap mounted on the face of the inlet cone. The piezometer ring shall consist of multiple pressure taps on the inlet venturi and piped to a termination plate inside the air handling unit for field supplied differential pressure transducer by Division 23 09 00, Instrumentation and Control for HVAC.
2. The airflow monitoring station shall have an accuracy of 5% of actual flow.
3. The airflow monitoring station shall provide no resistance to airflow. Probes installed in the fan inlet venturi which restrict airflow are not allowed.
4. Probes shall be constructed of aluminum, with 1/4 inch nylon tubing utilized between taps and termination plate.
5. Termination plate shall utilize 1/8-27 NPTF connections and mounted on fan structure.
6. Manufacturer shall provide all calibration curves for airflow monitoring stations prior to unit shipment.

## 2.5 COILS

A. Provide each coil section with 18inch wide hinged access doors (refer to AHU component drawing for additional details on access door widths) with latches. Enclose coils with headers and return bends fully contained within casing. Each coil shall be individually removable from 316L stainless steel tracks. Where coils are “multiple stack”, each coil shall be able to be removed without removing other coil. Air gap between stacked coils is not acceptable. Provide access panels for coil section to allow removal of coil.

B. Standards: Supply products of leading manufacturers with dependable published ratings, or equal. Certify performance in accordance with latest edition AHRI Standard 410. Submit coil descriptive literature and rating information for review.

C. Fabrication: Construct coils of copper 5/8” OD tubes, 0.035” thick, aluminum fins bonded to the tubes.
1. Mount in a stainless steel casing permitting removal of coil from unit.
2. Fins may be either plate type, with tubes mechanically bonded into the fins, or ribbon type, helically wound on individual tubes. Provide a tight, mechanical bond between fins and tubes. Use a minimum of six and a maximum of eight fins, 0.006” thick, per linear inch of tube.
3. Design coil section to prevent condensate carryover at design face velocities: Provide minimum coil face area or maximum face velocity as scheduled. Maximum 6 rows.

4. Each coil may only have a single supply and return connection. The maximum height of a single coil is 60-inches. Any unit requiring a cooling coil greater than 60-inches tall shall utilize a stacked coil, with each coil having a supply and return connection. Each coil shall be removable as indicated above.

D. Water Coils, Chilled Water: Balance the circuits for equal pressure drop of no more than 20 feet on coils of eight rows or fewer.
1. Arrange each circuit for counter flow cooling with bottom supply connections. Provide drain and vent connections at bottoms and top. Locate coil headers at the same end of the coil.
2. Select water coil for approximately 3 to 4 feet per second velocity (2 fps minimum, 5 fps maximum). Provide 1/2 inch diameter tubes with minimum .0.020 inch tube wall for 1/2 inch tubes, 0.025 inch tube wall for 5/8 inch tube, and .006 inch aluminum fins. Each coil shall be tested at the factory under water at not less than 350 psi air pressure and shall be suitable for 300 psi working pressure. Submit data indicating tube wall thickness at straight and all U-bends.
3. Supply and return connections shall be clearly and permanently identified.

E. Heating Coils, Hot Water: Provide hot water coils one or two rows deep, except where noted otherwise. Design and construct heating water coils and heating coil sections the same as cooling coils.

## 2.6 FILTER SECTION

A. Slide Racks. Provide and arrange for filters as indicated on drawings in galvanized filter slide racks to permit easy removal of filters from both sides of filter section. Filter racks shall be separated by a minimum of 1-inch to allow for installation of filter gauge tube. Provide filter access doors on both left and right side of unit. Filter access section shall be sized as required to house filters specified. Filter access doors shall be sized as required for removal of all filters in the unit.

B. Front Loading Filter Racks. Where indicated, provide and arrange for filters in galvanized filter racks to permit front loading removal of filters. Filter racks shall allow for removal of both sets of filters when specified and be separated by a minimum of 1-inch to allow for installation of filter gauge tube.

C. Design pleated filtering element for low pressure drop and high efficiency at a maximum net face velocity of 500 feet per minute. The element must also have a high dust load capacity.

D. Fabricate filters using dimensions to suit the arrangement and size of filter slides or racks in which filters are installed.

E. Provide the following filter sizes only”24x24, 12x24, or 20x20. No special filter dimensions will be allowed.

F. Replacement Filters. Furnish spare sets of all air conditioning system filters as indicated in this Section.

G. Provide magnahelic gauge with dry set of contacts for each filter bank in the filter section. Magnahelic gauge shall be connected so it displays the pressure drop across the associated filter bank and also as required with the BAS system as indicated in the drawings.

H. Pressure probes shall be installed across each filter bank and not across the entire filter section. AHU manufacturer to provide adequate space between the filters to allow for pressure probes to be installed between the pre-filter and final filter.

## 2.7 CONVENIENCE RECEPTACLE

A. Provide 120V GFCI convenience receptacle located near the fan section on the exterior of the unit. The receptacle shall be wired independent of the switch for the lights and any other AHU electrical requirements and all wiring shall be in EMT conduit or galvanized flexible metal conduit.

2.8 LIGHTS

A. Vapor proof LED lights (ceiling or wall mounted at a maximum of 88 inches above floor) shall be provided in each compartment with access doors. Lights shall be controlled by one light switch located at the supply air fan access door. Wire lights to junction box for 120V connection by Division 26. Lights to be wired independent of convenience receptacle and any other AHU electrical requirements. All wiring shall be in EMT conduit or galvanized flexible metal conduit. Seal connection at junction box the same as required for motor connections.

2.9 DAMPERS

A. Provide damper at outside air inlet, outlet or relief/exhaust air outlet as indicated on drawings. Dampers shall be of low leak design having aluminum blades. The damper blades shall be provided with a PVC coated polyester fabric mechanically locked into the blade edge. The jamb is a flexible metal, compression type. Leakage shall not exceed 4 CFM/square foot at 1 inch w.g. Size dampers for a maximum velocity of 1000 feet per minute and minimum of 150 feet per minute.

2.10 FAN ARRAY FANS:

A. The multiple fan array systems shall include multiple, direct driven, arrangement 2 plenum fans as indicated in the drawing schedules and component diagrams. All fans shall be constructed per AMCA requirements for the duty specified class II. The fan array shall be selected to operate at a system Total Static Pressure that does not exceed 90% of the specified fan's peak static pressure producing capability at the specified fan/motor speed. Each fan/motor cube or cell shall include a minimum 10 gauge, G 90 Galvanized steel intake wall, .100 aluminum spun fan inlet funnel, and a 10 gauge G90 Galvanized steel motor support plate rail and structure.

B. Each fan/motor assembly shall be dynamically balanced to meet AMCA standard 204-96, exceeding category BV-4, to meet or exceed an equivalent Grade G.55, producing a maximum rotational imbalance of .022" per second peak, filter in ( .55mm per second peak, filter in). Copies of the certified balancing reports shall be provided with the unit O&M manuals at the time of shipment.

C. The fan array shall consist of 2 fans and motors, spaced in the air way tunnel cross section to provide a uniform air flow and velocity profile across the entire air way tunnel cross section and components contained therein. There shall be no blank off plates or "spacers" between adjacent fan columns or rows to position the fans across the air way tunnel.

D. Each individual fan/motor in the multiple fan array shall be provided with an integral back flow prevention device (isolation damper) that prohibits recirculation of air in the event a fan becomes disabled. The system effects for the back flow prevention device(s) shall be included in the criteria for TSP determination for fan selection purposes, and shall be indicated as a separate line item SP loss in the submittals. Submitted AHU performance that does not indicate allowance for system effects for the back flow prevention device(s) and the system effect for the fan and motor enclosure in which each fan is mounted , will be returned to the contractor disapproved and will need to be resubmitted with all of the requested information included for approval. Back Draft Damper performance data that is per AMCA ducted inlet and discharge arrangements will not be accepted. Damper data must be for the specific purpose of preventing back flow in any disabled fan cube and that is mounted directly at the inlet of each fan. Motorized dampers for this purpose are required. The actuator to be provided by the BAS Contractor. Submitted fan performance data which only reflect published performance for individual fans in AMCA arrangement "A" free inlet and discharge will not be accepted. AHU Manufacturers that do not manufacture the fans being submitted on must provide certified performance data for fans as installed in the AHU unit with Back Draft damper effects included.

E. All motors in the fan array shall be powered individually. Provide factory mounted junction box per Paragraph 2.4 for each motor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Manufacturer shall deliver the air handling units with “knockdown” considerations for ease of installation / rigging. Special construction considerations include:

1. Units to be loosely built, all roof and wall pieces will need to be disassembled and sealed in the field.

2. When loosely assembling the unit at the factory, do not caulk wall to roof, wall to floor, corner joints, wall to wall, or at split angles to allow removal of complete panels at the jobsite. All parts and panels shall be specifically sized to fit through the smallest rigging path on-site to minimize disassembly/reassembly time.

3. Manufacturer shall ship caulk loose for field-use. All additional hardware required for reassembly shall be shipped loose.

4. Reassemble the sections together for all air handlers in their footprint under the direction of the manufacturer.

5. Additional unit section or component splits required for installation during construction shall be the responsibility of the manufacturer without additional cost to the Owner.

6. Caulking must be done in the field per construction details in the installation manuals provided by the AHU manufacturer.

7. The unit manufacturer is to provide on-site supervision of disassembly/reassembly process by a Factory Representative Installation Supervisor. The unit manufacturer shall provide a written acceptance letter to UTHSC stating the unit was assembled and complies with manufacturer’s assembly requirements.

B. Refer to Delivery, Storage and Handling in Part 1 of this specification for additional requirements. If damage to air handling unit casing, motor or accessories is determined from moisture, the contractor shall replace the damaged equipment with an equal, brand new piece of equipment. Rotate fans periodically as recommended by manufacturer. Provide owner a monthly report indicating date fan rotated for each air unit.

C. Install in conformance with AHRI 435.

D. Assemble units in accordance with manufacturer’s installation instructions. Isolate all ducts connected to the air handling unit with flexible duct connections. Units shall be protected from dust, dirt, water, and debris during construction.

E. Contractor to field coordinate installation of piping and insulation to allow access doors/panels to fully open. Chilled and heating water piping to coil connections shall be installed to permit operation and maintenance of all valves and pumps from mechanical room floor. Valves shall not be installed at heights greater than seven feet above finished floor. Where multi-coil (stacked) arrangement is used, provide each supply and return line to and from each coil section with a union, thermometer well, valve for balancing and isolation valves as indicated on details.

F. Any openings made in the units for addition of controls components shall be sealed air tight, both inside and out. No insulation shall be exposed to the airstream.

G. Do not operate units for any purpose, temporary or permanent, until interior of ductwork and air handling unit is clean, filters are in place, bearings lubricated, fan has been test run under observation and Owner’s permission is received.

3.2 START-UP TESTING

A. AHU Inspection:

1. A manufacturer's factory-trained and/or factory-employed service technician shall perform an inspection of each unit and installation prior to startup. The technician shall inspect and verify the following as a minimum:
   a. Damage of any kind.
   b. Installation in accordance of the manufacturer's requirements.
   c. Proper reassembly and sealing of unit segments at shipping splits.
   d. Removal of shipping bolts and restraints.
   e. Sealing of piping, controls and electrical penetrations.
1. The manufacturer's technician shall provide a report to the A/E and Owner summarizing any problems found and correction recommendations.

B. Deflection and Leakage Testing (field):
   1. Factory test all AHU's to verify compliance with casing leakage and panel deflection requirements. Owner and engineer reserve the right to select unit to be tested.
   2. Perform test on a fully assembled unit with sections joined per manufacturer's installation instructions. Use of additional material (tape, sealant, caulk) is not acceptable.

END OF SECTION 23 73 13

SECTION 26 05 00

ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials and equipment required for complete and functioning electrical systems as required by the contract documents.

B. New Work. The work includes, but is not limited to, the following principal systems and equipment:

1. 480/277 volt distribution.

2. 208/120 volt distribution.

3. Panelboards-Distribution, Branch Circuit and Electronic Grade.

4. Luminaires, lamps and ballasts.

5. Fire alarm system.

6. Lighting controls.

7. Grounding and bonding system.

C. Demolition. Refer to plans for scope of work.

1.2 APPLICABLE PROVISIONS

A. Provisions Specified Elsewhere. Unless modified in this Section, General and Supplementary General Conditions, applicable provisions of Division 01 - General and other provisions of contract documents apply to work of Division 26 - Electrical.

B. Application. Provisions of this Section apply to every section of Division 26 - Electrical, except where specifically modified.

C. Work covered by this Section shall be accomplished in accordance with applicable provisions of the Contract Documents and addenda or directives which may be issued herewith, or otherwise.

1.3 RELATED WORK

A. Plumbing – Division 22.

B. Heating, Ventilation and Air Conditioning – Division 23.

1.4 REFERENCE CODES AND STANDARDS

A. Standards of the following organizations may be referenced in the specification. Unless noted otherwise, references are to standards or codes current at the time of bidding.

B. Association of Edison Illuminating Companies (AEIC).

C. American National Standards Institute (ANSI).

D. Institute of Electrical and Electronics Engineers (IEEE).

E. Insulated Cable Engineers Association (ICEA).

F. National Electrical Code (NEC).

G. National Electrical Manufacturers Association (NEMA).

H. National Electrical Safety Code (NESC).

I. National Fire Protection Association (NFPA).

J.Underwriters' Laboratories (UL).

K. ASHRAE/IESNA 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings.

1.5 REGULATIONS AND PERMITS

A. Regulations. Work, materials and equipment must comply with the latest rules and regulations of the following:

1. National Electrical Code (NEC).

2. National Electrical Safety Code (NESC).

3. Occupational Safety and Health Act (OSHA).

4. Americans with Disabilities Act (ADA).

5. Texas Department of Licensing and Regulation (TDLR).

6. Texas Occupational Code.

7. Texas Electrical Safety and Licensing Act – Title 8, Occupations Code Chapter 1305.

8. State and federal codes, ordinances and regulations.

B. Discrepancies. The drawings and specifications are intended to comply with listed codes, ordinances, regulations and standards. Where discrepancies occur, immediately notify the Owner's representative in writing, including a proposed resolution, and ask for an interpretation. Should installed materials or workmanship fail to comply, the Contractor is responsible for correcting the improper installation. Additionally, where sizes, capacities, or other such features are required in excess of minimum code or standards requirements, provide those specified or shown.

C. Permits: Obtain certificates of inspection and other permits required as a part of the work. Submit written evidence to the Owner’s Representative and Architect/Engineer that the required permits and inspections have been secured.

1.6 DRAWINGS AND CONTRACT DOCUMENTS

A. Intent: The intent of the construction Drawings or contract documents, hereinafter referred to as the “Drawings”, is to establish the types of systems and functions, but not to set forth each item essential to the functioning of the system. The Drawings, specifications, and related contract documents are cooperative, and work or materials called for in one and not mentioned in the other shall be provided. Electrical Drawings, are generally diagrammatic and show approximate location and extent of the work. Review pertinent Drawings and adjust the work to conditions shown. Install the work complete, including minor details necessary to perform the function indicated.

B. The Contractor shall carefully investigate structural and finish conditions, and shall coordinate the work in order to avoid interference between the various phases of work. The Contractor

shall be responsible for the proper routing of raceways, subject to prior review by the Owner's Representative. Work shall be organized and laid out in finished portions of the building so that it will be concealed in furred chases, suspended ceilings, and similar elements of the building, unless specifically noted to be exposed. Work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

C. Discrepancies: In case of doubt as to work intended, or if amplification or clarification is needed, or where discrepancies occur between Drawings, specifications, and actual field conditions, immediately notify the Architect/Engineer and the Owner's Representative in writing, requesting an interpretation, and include a proposed solution.

D. Dimensions: Dimensional information related to new structures shall be taken from the appropriate Drawings. Dimensional information related to existing facilities shall be taken from actual measurements made by the Contractor on the site.

E. Outlet and Equipment Locations: Coordinate the actual locations of electrical outlets and equipment with building features and equipment as indicated on architectural, structural, mechanical, telecommunications, audio-visual (AV), security, plumbing, and laboratory Drawings. Review with the Owner's Representative proposed changes in outlet and equipment location. Relocation of outlets before installation of up to 5 feet from the position indicated may be directed without additional cost to the Owner. Remove and replace outlets placed in unsuitable locations, when so requested by the Owner's Representative, and at no additional cost to Owner.

1.7 SUBMITTALS

A. Submit the following in addition to and in accordance with the requirements of the Uniform General Conditions and in Division 01, Submittals.

1. Include inspection and permit certificates and certificates of final inspection and acceptance from the authority having jurisdiction.

2. Manufacturer's standardized schematic diagrams and catalog cuts shall not be acceptable unless applicable portions are clearly indicated and non-applicable portions clearly deleted or crossed out.

3. Schematic, connection and/or interconnection diagrams.

4. Provide submittals as required by individual specification section.

B. Provide the following with each submittal:

1. Catalog cutsheets with manufacturer's name clearly indicated. Applicable portions shall be clearly indicated by arrows, circles, or similar markings and non-applicable portions shall be clearly deleted or crossed out.

2. Line-by-line specification review by equipment manufacturer and contractor with exceptions explicitly defined. number; include manufacturer and identifying model or catalog numbers.

a. Submittal packages for product data, shop drawings, and other required submittals shall be numbered sequentially according to the applicable specification Section number. For example, the first submittal package for Energy-Efficient Dry-Type Transformers shall be identified as Submittal number 262213-01. The second submittal package for Energy-Efficient Dry-Type Transformers would be identified as Submittal number 262213-02. Re-submittal packages shall be identified by an "R" in the sequential numerical suffix.

b. Where directed by the Owner or the Architect to combine submittals into a common package, the submittal data may be organized in one or more 3-ring binders or similar container. Product data, shop drawings, and other submittal data shall be organized in separate tabs according to paragraph 1.07B.3a, above. That is, submittal data in individual tabs of a common submittal package shall be numbered sequentially, according to the applicable specification Section number.

3. Replace rejected items and resubmit with acceptable items in accordance with the requirements of Division One for Submittals, and with the Uniform General Conditions.

C. Within the specified time window after award of contract, submit list of equipment and materials to be furnished.

1. Itemize equipment and material by specification section number; include manufacturer and identifying model or catalog numbers.

2. Replace rejected items with an acceptable item within 2 weeks after notification of rejection.

3. If a satisfactory replacement is not submitted within a two-week period, Owner will notify contractor as to equipment manufacturer or type and make or material to be furnished. Provide designated items at not additional cost to Owner.

D. Installation: Where product data or shop drawings are required, do not install equipment or materials until submittals are accepted by the Architect/Engineer and by Owner's Representative. Use only equipment and materials accepted by the Architect/Engineer and by Owner's Representative. Equipment and materials installed prior to acceptance by the Owner/ Engineer and Owner's Representative shall be removed at no additional cost to Owner and replaced at the Contractor's expense.

E. Startup and Test Procedures:

1. Furnish documentation from equipment manufacturer for the startup and field testing procedures for equipment installed as a part of this project.

2. Startup and testing procedures shall include prerequisite conditions, system and equipment alignments and lineups, sequential steps for execution of the test, shutdown procedures, and criteria for satisfactory test completion and test failure.

3. Startup and testing procedures shall address and demonstrate modes of system or equipment operation, including startup, manual, unattended/automatic, and shutdown procedures, as well as procedures for testing and demonstration of abnormal or emergency operating conditions.

4. Include forms and logs to be used during field testing. Forms and logs shall include the range of permissible values for monitored parameters, as applicable.

F. As-Built and Record Drawings:

1. Maintain a master set of as-built drawings that show changes and other deviations from the Drawings. The markups must be made as the changes are done.

2. At the conclusion of the project, these as-built drawings shall be transferred to AutoCAD electronic files, in a format acceptable to the Owner's Representative, and shall be complete.

3. Prior to final acceptance, deliver to the Owner's Representative the AutoCAD electronic files, the complete set of record drawings showing the as-built condition of

the project, and the actual field set of as-built drawings. Also deliver one set of as-built drawings on CD-Rom or similar electronic media acceptable to the Owner. Drawing files shall be in AutoCAD (.dwg) and Adobe Acrobat (.pdf).

4. Quantity: In accordance with the requirements of Division One and the General Conditions. Where not specified elsewhere, provide 3 hard copies plus one reproducible set.

G. Operating and Maintenance Manuals: As specified in Part 3 of this Section and in Division One, as applicable.

1.8 SUBSTITUTIONS

A. Refer to requirements of Division One for substitution of Material and Equipment.

B. Product manufacturers are listed to establish a level of quality for the products. Substitutions may be allowed if the product is equal to or better than what is listed in the design guidelines, as determined by the Architect/Engineer and owner's Representative upon submittal of comparison products.

C. Samples: When requested by the Owner's Representative or the Architect/Engineer, the Contractor shall provide a sample of the proposed substitute item. When requested, provide samples of both the specified item and the proposed item for comparison purposes.

D. Timeliness: The burden of timeliness in the complete cycle of submittal data, shop drawings, and sample processing is on the Contractor. Time periods for Architect/Engineer processing and review of submittal data, shop drawings, samples, studies, and reports shall be in accordance with the applicable submittal and substitution requirements of Division One and the General Conditions. The Contractor shall allow sufficient time for review of each submission by the office of the design discipline involved after receipt of such submissions by that design discipline. The Contractor is responsible for allowing sufficient time in the construction schedule to cover the aforementioned cycles for processing of submittal data and shop drawings, including time for resubmittal cycles on unacceptable and rejected materials, equipment, components, and systems covered by the data submitted. Construction delays and lack of timeliness in the above regard are the responsibility of the Contractor and will not be considered in requests for scheduled construction time extensions and additional costs to the Owner.

E. Acceptance: Acceptance of materials and equipment will be based on manufacturer's published data and will be tentative subject to the submission of complete shop drawings indicating compliance with the Drawings, specifications, and other applicable Contract Documents, and that adequate and acceptable clearances will exist for entry, servicing, and maintenance. Acceptance of materials and equipment under this provision shall not be construed as authorizing deviations from the Specifications, unless the attention of the Owner's Representative and the Architect/Engineer has been directed in writing to the specific deviations. Data submitted shall not contain unrelated information unless pertinent information is properly identified.

F. Replacement; Should a substitution be accepted, and should the substitute material prove defective, or otherwise unsatisfactory for the service intended within the guarantee period, this material or equipment shall be replaced with the material or equipment originally specified at no additional cost to the Owner.

1.9 CONTRACTOR QUALIFICATIONS

A. An acceptable Contractor for the work under this division must have personnel with experience, training and skill to provide a practical working system.

1. The Contractor may be required to furnish acceptable evidence of having installed not less than three systems of size and type comparable to this project. The systems must have served satisfactorily for not less than 3 years. The superintendent must have had experience in installing not less than three such systems.

2. The Contractor must have personnel with the proper licenses to perform electrical work under this Contract. In accordance with the Texas Electrical Safety and Licensing Act – Title 8, Occupation Code, Chapter 1305, Subchapter D, section 1305.151: “LICENSE REQUIRED. Except as provided by Section 1305.003, a person may not perform electrical work unless the person holds an appropriate license issued or recognized under this chapter.”

B. The Contractor shall follow the safety procedures in addition to, and in accordance with, the requirements of the Project Safety Manual (PSM).

1. The Contractor shall be responsible for training personnel under their employ in areas concerning safe work habits and construction safety. The Contractor shall continually inform personnel on hazards particular to this project and update the information as the project progresses.

2. The Contractor shall secure electrical rooms, to limit access, prior to energizing high voltage (1000V or higher) equipment, and shall control access during the project after energization. The Contractor shall post and maintain warning and caution signage in areas where work is ongoing near energized equipment. The Contractor shall cover energized live parts when work is not being done in the equipment. This includes lunch and breaks.

3. The Contractor shall strictly enforce OSHA lockout/tagout procedures. Initial infractions shall result in a warning. A second infraction shall result in the removal of the workman and his foreman from the site. Continued infractions shall result in removal of the Contractor from the site.

## PART 2 - PRODUCTS

### 2.1 PRODUCT REQUIREMENTS

A. Condition. Provide new products of manufacturers regularly engaged in production of such equipment. Provide the manufacturer's latest standard design for the type of product specified.

B. NEC and UL.

1. Products must conform to requirements of the National Electrical Code. Where Underwriters' Laboratories have set standards, listed products and issued labels, products used must be listed and labeled by UL.

2. Materials and equipment shall be labeled and/or listed as acceptable to the authority having jurisdiction as suitable for the use intended. Where no specifications or specific model numbers are given, provide materials of a standard industrial quality.

C. Space Limitations: Equipment selected must conform to the building features and must be coordinated with them. Electrical installation shall comply with the requirements of Article 110.26 and Article 110.34 of the National Electric Code (NEC) for working space, access, and dedicated equipment space. Do not provide equipment that will not suit arrangement and space limitations. Scaled drawings (1/4” = 1’-0”) of electrical and telecommunication rooms shall be submitted for review by the Architect/Engineer and the Owner’s Representative prior to installing equipment. See paragraph 1.07E above.

D. Factory Finish. Equipment shall be delivered with a hard surface, factory-applied finish so that no additional field painting is required except for touch-up as required.

E. Physical Size of Equipment: Equipment of larger sizes than shown, even though of specified manufacturer, will not be acceptable unless the Contractor demonstrates by product data, shop drawings, and coordination drawings that ample space exists for proper installation, operation, and maintenance.

F. Enclosure: Provide NEMA 1 enclosure for indoor installation and NEMA 3R for outdoor enclosure, unless noted or specified otherwise. The enclosure shall be suitable for the environment per NEC, NEMA and ANSI standards.

G. Conductors in Conduit: Conductors shall be installed in conduit. Exceptions are listed in individual Sections of the Division 26 and Division 28 specifications.

2.2 MANUFACTURER

A. Where two or more units of the same class of material are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer, except as specifically noted in individual Sections of the specifications.

2.3 SUBSTITUTIONS

A. Refer to Division 01 section on Material and Equipment, and to paragraph 1.08 of this Section.

2.4 NAMEPLATES AND DEVICE MARKING

A. Refer to Section 26 05 53, Identification For Electrical Systems.

2.5 AUTOMATED EQUIPMENT AND CONTROLS

A. Equipment and control systems where applicable, shall match, integrate, communicate and cooperate with new and existing systems, such as building automation, energy management, direct digital controls (DDC), fire detection and alarm, circuit breakers, transformers, etc.

PART 3 - EXECUTION

3.1 GENERAL

A. Manufacturer's Recommendations: The manufacturer's published directions shall be followed in the delivery, storage, protection, installation, wiring, and connection of equipment and material. Promptly notify the Architect/Engineer and the Owner's Representative in writing of conflicts between the requirements of the Drawings and specifications and the manufacturer's directions, in accordance with paragraphs 1.05B and 1.06C of this Section. Obtain instructions from the Owner's Representative before proceeding with the work. Should the Contractor the Owner's Representative, he shall bear costs arising in connection with the deficiencies.

B. Site Observation: Site observation by the Architect/Engineer is for the express purpose of verifying compliance by the Contractor with the Drawings, specifications, and other applicable Contract Documents. Site observation by the Architect/Engineer shall not be construed as construction supervision, or indication of approval of the manner or location in which the work is being performed, or as being a safe practice or place. Site observation by the Architect/ Engineer shall not be construed as inspection by the Authority Having Jurisdiction (AHJ) or other applicable code enforcement authority.

C. Installation: Where product data or shop drawings are required, do not install equipment or materials until submittals are accepted by the Architect/Engineer and by the Owner's Representative. Use only equipment and materials accepted by the Architect/Engineer and the Owner's Representative. Equipment and materials installed prior to acceptance by the Architect/ Engineer and Owner's Representative shall be removed at no additional cost to Owner and replaced at the Contractor's expense.

D. Supervision:

1. The Contractor of the work under this Division shall keep a competent superintendent or foreman on the job throughout the period of construction. Refer to Division One requirements and the Uniform General Conditions for additional information concerning supervision.

2. It shall be the responsibility of such superintendent to study the Drawings, specifications, and other applicable Contract Documents, and familiarize himself with the work. He shall coordinate his work with other trades before material is fabricated or installed, and ensure that his work will not cause interference with another trade. Where interferences are encountered, they shall be resolved at the job site by the Contractor. Where interferences cannot be resolved without major changes to the Drawings, the matter shall be referred to the Architect/Engineer and the Owner's Representative for resolution in accordance with paragraphs 1.05B and 1.06C of this Section.

3.2 PROTECTION OF EQUIPMENT AND MATERIALS

A. General:

1. The Contractor shall follow the manufacturer's directions completely in the delivery, storage and handling of equipment and materials.

2. Equipment and materials shall be tightly covered and protected against dirt, water, chemical, physical or weather damage and theft. At the completion of the work, fixtures, equipment and materials shall be cleaned and polished thoroughly and shall be returned to "as new" condition.

3. Electrical cable, wire, and conductors shall be stored to prevent moisture and mechanical damage.

B. Moisture. During construction, protect switchboard, transformers, motors, control equipment, and other items from insulation moisture absorption and metallic component corrosion by appropriate use of strip heaters, lamps or other suitable means. Apply protection immediately on receiving the products and maintain continually.

C. Clean. Keep products clean by elevating above ground or floor and by using suitable coverings.

D. Damage. Take such precautions as are necessary to protect apparatus and materials from damage. Failure to protect materials is sufficient cause for rejection of the apparatus or material in question.

E. Finish. Protect factory finish from damage during construction operations and until acceptance of the project. Satisfactorily restore finishes that become stained or damaged.

F. Weather. Protect equipment and materials from weather and sunlight by use of suitable coverings and storage indoors, or in suitable weather-protected containers. Materials and equipment marked by their manufacturer as suitable for storage outdoors may be stored according to manufacturer's markings. Maintain factory-installed coverings and wrappings until material is to be installed.

3.3 PREPARATION

A. Coordination Drawings: The Contractor shall prepare one complete set of composite drawings. The intent of this process is to define areas of potential conflict and resolve those conflicts prior to fabrication or installation of work. In areas of congestion (where simply overlaying and drafting will create an unreadable product), the plan view scale shall be increased and multiple layered views shall be developed. Elevations of the individual elements shall be established, and elevations shall be drawn to illustrate that the ductwork, piping, raceway, and other systems and components will co-exist within the available space,

and that the proper access to equipment, luminaires, valves, filters, etc. has been established for operation, service, removal and replacement. In addition to the above, the Contractor shall also prepare the following:

1. Electrical/Mechanical Rooms. Prepare 1/4-inch scale coordination drawings of electrical rooms indicating location of equipment. Indicate the exact location of each component in relation to other mechanical, electrical, and plumbing (MEP) components within each room. Include location(s) and quantity of raceway(s) and sleeve(s) stubbed up through floor slab for power, lighting, control, grounding, communications, and low-voltage system(s). These coordination drawings shall take into account the configuration of the mechanical, electrical, and telecommunications equipment which has been proposed for use in the project, particularly where it differs in configuration from the equipment shown on the Drawings.

2. Review: The completed “Composite Drawings” shall be prepared prior to installation. Work that proceeds without appropriate coordination will be subject to removal and relocation at no additional cost to the Owner.

B. Test Procedures:

1. Furnish documentation from equipment manufacturer for the startup and field testing procedures for equipment installed as a part of this project.

2. Startup and testing procedures shall include prerequisite conditions, system and equipment alignments and lineups, sequential steps for execution of the test, shutdown procedures, and criteria for satisfactory test completion and test failure.

3. Startup and testing procedures shall address and demonstrate modes of system or equipment operation, including startup, manual, unattended/automatic, and shutdown procedures, as well as procedures for testing and demonstration of abnormal or emergency operating conditions.

4. Include forms and logs to be used during field testing. Forms and logs shall include the range of permissible values for monitored parameters, as applicable.

## 3.4 SAFETY

A. Implement the following safety procedures in addition to, and in accordance with, the requirements of Division One and the Uniform General Conditions:

1. The Contractor shall be responsible for training personnel under their employ in areas concerning safe work habits and construction safety. The Contractor shall continually inform personnel of hazards particular to this project and update the information as the project progresses.

2. Prior to energizing panelboards within the scope of work, secure affected electrical rooms to limit access to line voltage. Line voltage shall be defined as above 50 volts, for the purpose of controlling access. During and after energization of panelboards, control access to electrical rooms for the duration of the project. Post and maintain warning and caution signage in areas where work is on-going near energized equipment. Cover energized live parts when work is not being done in the equipment. This includes lunch and breaks.

3. Strictly enforce OSHA lockout/tagout procedures. Initial infractions shall result in a warning. A second infraction shall result in the removal of the workman and his foreman from the site. Continued infractions shall result in removal of the Contractor from the site.

3.5 INSPECTION

A. Examination. Examine the areas and conditions under which equipment and systems are to be installed, and notify the Owner's Representative in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

B. Coordination. Carefully investigate structural and finish conditions and coordinate the work in order to avoid interference between the various phases of work. Work shall be organized and laid out so that it will be concealed in furred chases, suspended ceilings, and similar elements in finished portions of the building, unless specifically noted to be exposed. Work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

3.6 INSTALLATION

A. Cooperation with Other Trades. Cooperation with trades of adjacent, related or affected materials or operations, and of trades performing continuations of this work under subsequent contracts, is considered a part of this work in order to effect timely and accurate placing of work and to bring together, in proper and correct sequence, the work of such trades. Provide other trades, as required, templates, patterns, setting plans and shop details for the proper installation of the work and for purposes of coordinating adjacent work. Electrical power connections for mechanical and plumbing equipment are in this Division unless noted otherwise. Verify electrical characteristics of equipment with other Divisions before roughing in the electrical connections.

B. Workmanship. Work shall be performed by workmen skilled in their trade. The installation shall be complete and installed in a neat and workmanlike manner in accordance with NEC 110.12 and FPM accompanying, and as described in ANSI/NECA 1-2000 "Standard Practices for Good Workmanship in Electrical Contracting", and other ANSI approved installation standards.

C. Concrete Equipment Pads.

1. Refer to structural Drawings and specifications for design criteria.

2. Where not otherwise indicated, install 2 inch thick reinforced concrete foundation pads for indoor floor-mounted equipment, except where direct floor mounting is required such as at the metal platform. For equipment mounted outdoors, provide concrete foundations a minimum of 6 inches above grade. Provide reinforcing steel as recommended by the structural engineer and as detailed on the Drawings. Pour pads on roughened floor slabs, sized so that outer edges extend a minimum of 3 inches beyond equipment. Trowel pads smooth and chamfer edges to a 1-inch bevel. Secure equipment to pads as recommended by the manufacturer.

3. Anchor Bolts. Furnish and install galvanized anchor bolts for equipment placed on concrete equipment pads or on concrete slabs. Bolts shall be of the size and number recommended by the manufacturer of the equipment and shall be located by means of suitable templates. When equipment is placed on vibration isolators, the equipment shall be secured to the isolator and the isolator secured to the floor, pad, or support as recommended by the vibration isolation manufacturer.

D. Setting of Equipment. Provide permanent and temporary shoring, anchoring, and bracing required to make parts stable and rigid; even when such shoring, anchoring, and bracing are not explicitly called for.

1. Equipment must be leveled and set plumb.

2. Sheet metal enclosures mounted against a wall shall be separated from the wall not less than 1/4 inch by means of corrosion-resistant spacers, or by 3 inches of air for

freestanding units. Use corrosion-resistant bolts, nuts and washers to anchor equipment.

3. In sufficient time to be coordinated with work under other divisions, provide shop drawings and layout work showing exact size and location of sleeves, openings or inserts for electrical equipment in slabs, walls, partitions and chases.

4. Provide adequate support for freestanding panels, switchboards, enclosures, and other equipment. This shall include bolting to the floor, concrete equipment pad, or solid structural steel to prevent tipping. Install free-standing electrical equipment on concrete equipment pads in accordance with paragraph 3.05C, this Section, except where equipment is noted and designed for mounting directly on the concrete floor slab. Under no condition shall equipment be fastened to non-rigid building steel such as removable platform steel gratings, handrails, etc.

5. Provide racks and supports, independently mounted at structure, to support electrical equipment and systems supplied and installed under this contract. Do not mount or suspend equipment from supports provided for equipment and systems by other Divisions, except where specifically noted or indicated on Drawings.

6. Refer to Section 26 05 29, Metal Framing and supports, for additional requirements.

E. Sealing of Equipment. Seal openings into equipment to prevent entrance of animals, birds and insects, as well as to prevent ingress of moisture, dust, dirt, and similar contaminants.

F. Motors.

1. Motors are specified in Divisions 21, 22 and 23.

2. Electrical work includes the electrical connection of motors, except those which are wired as a part of equipment.

3. Refer to Division 23 and other applicable Divisions for wiring and connection of motors and equipment furnished by those Divisions.

4. The Contractor shall note that the electrical Drawings are based on the equipment scheduled and indicated on the Drawings. Should mechanical equipment be provided requiring changes to the electrical design, the required electrical changes shall be made at no cost to the Owner.

5. Provide interconnecting wiring for the installation of the power required. Provide disconnect switches as required for proper operation, as indicated on the Drawings or required by applicable code. Combination starters, individual starters, and other motor starting apparatus, not specifically scheduled or specified as provided by the equipment manufacturer under the scope of other Divisions shall be provided under the scope of Division 26.

6. Other Divisions will provide complete wiring diagrams indicating power wiring and interlock wiring. Diagrams shall be submitted to the Architect/Engineer for review. Diagrams will be based on accepted equipment and be complete full phase and interlock control drawings, not a series of manufacturer's individual diagrams. They will be followed in detail. For additional clarification, refer to Division 23, Controls.

G. Concealed Work. Conceal electrical work in walls, floors, chases, under floors, underground and above ceilings except:

1. Where shown or specified to be exposed. Exposed is understood to mean open to view.

2. Where exposure is necessary to the proper function.

3. Where size of materials and equipment preclude concealment. Obtain the written consent of the Owner's Representative and the Architect/Engineer to leave materials exposed in finished spaces of the building.

H. Application. Unless otherwise indicated, power will be utilized as follows:

1. 480 volts, three phase: motors 3/4 horsepower and larger.

2. 120 volts, single phase: motors 1/2 horsepower and smaller.

3. 277 volts, single phase: fan powered boxes.

4. 120 volts, single phase: incandescent lighting.

5. 277 volts, single phase: fluorescent and high-intensity-discharge lighting.

6. 120 volts, single phase: convenience outlets, dedicated equipment, lab-track terminal boxes without fans.

7. 208 volts, single and three phase: specialty outlets.

8. 480 volts, three phase: special power and equipment; verify for each unit of equipment.

I. Transformers. Use transformers to change the service to the required utilization voltages.

J. Connections to Equipment - Other than Division 26. For equipment furnished under other Divisions, and for equipment furnished by the Owner, provide final electrical connections to such items of equipment. Obtain detailed shop drawings of equipment from the applicable Division or supplier indicating the exact number and location of rough-in points. Such final shop drawings may indicate adjustments in total number and exact location of rough-in points, and in equipment dimensions. Making adjustments to field conditions is considered a part of the work required.

1. Roughing-in: When roughing-in, provide electrical branch circuits to various items of equipment. Terminate at proper points as indicated on detailed equipment shop drawings, or as directed. Use Drawings accompanying these specifications only for general routing of circuiting. Do not use Drawings accompanying these specifications for rough-in locations.

2. Final Connections: Millwork, casework, and similar equipment will include service fittings such as switches, duplex receptacles, data/communications outlets, and luminaires on the casework or equipment. Provide branch circuit connection to match electrical connection requirements of service fittings.

K. Accessories. Offsets, fittings, expansion joints, anchors and accessories that are required for a complete system shall be provided, even if not specifically indicated on the Drawings or mentioned in the specifications. Offsets, transitions and changes in direction of conduit, cable trays, raceways and busways shall be made to maintain proper headroom. Provide pullboxes, fittings, etc., required as a result of these transitions and changes in direction.

L. Observation prior to cover-up or seal-in of walls and ceilings. Perform the following in accordance with the applicable requirements of Division One and the General Conditions:

1. Prior to the installation of ceiling material, gypsum, plaster, or acoustical board, the Contractor shall notify the Owner's Representative so that arrangement can be made for observation or inspection of the above-ceiling area about to be "sealed" off. The Contractor shall provide advance notice in accordance with the applicable requirements of Division One and the General Conditions. Where not specified,

required, or directed elsewhere, provide not less than 10 working days' advance notice.

2. Above-ceiling areas will be subject to a formal inspection before ceiling panels are installed, or installation is otherwise concealed from view. Electrical work at and above the ceiling, including items supported by the ceiling grid, shall be complete and installed in accordance with contract requirements, including power to luminaires, fans, and other powered items. The purpose of this inspection is to verify the completeness and quality of the installation of the electrical systems and other above ceiling special systems such as cable tray systems. The ceiling supports shall be in place so that access panel and luminaire locations are identifiable, and so that clearances and access provisions may be evaluated.

3. No ceiling materials may be installed until the resulting deficiency list from this inspection is completed and approved by the Owner's Representative.

M. Finish. Coordinate with Division 9 to paint exposed conduit to match adjacent walls, unless otherwise directed.

## 3.7 EXISTING FACILITIES

A. Responsibility. The Contractor shall be responsible for loss or damage to the existing facilities caused by him and his workmen, and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and maintenance of electrical services for new and existing facilities. The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing such temporary protection upon completion of the work.

B. Services. The Contractor shall provide temporary or new services to existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.

C. Access. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, luminaries, air conditioning ductwork and equipment, etc., to provide this access, and shall reinstall same upon completion of work in the areas affected.

D. Existing Devices. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, remove and reinstall in locations approved by the Architect/Engineer devices required for the operation of the various systems installed in the existing construction. This is to include, but is not limited to, temperature controls, system devices, electrical switches, relays, luminaires, fixtures, piping, conduit, etc.

E. Outages. Outages of services as required by the new installation will be permitted, but only at a time approved by the Owner. The Contractor shall coordinate with the Owner's Representative to arrange for service outages. The Contractor shall allow the Owner sufficient time to schedule for required outages, in accordance with the applicable requirements of Division One and the General Conditions. Where not specified, required or directed elsewhere, allow a minimum of 21 working days for the Owner to schedule for required outages. The time allowed for outages will not be during normal working hours or during hours of research and instruction, unless otherwise approved by the Owner's Representative. Costs of outages, including overtime charges, shall be included in the contract amount.

F. Adjacent Facilities. Coordinate work among the various trades to minimize disruption to existing processes, procedures, and equipment in spaces adjacent to areas of demolition and renovation work. Coordinate with Owner's Representative to schedule work producing noise or structure-born vibrations, including but not limited to cutting, drilling, coring, and use of impact tools.

3.8 EQUIPMENT AND DEVICE MARKING

A. Designations. Identify equipment, devices, feeders, branch circuits and similar items with the same designations as indicated on the Drawings.

B. Nameplates. Externally mark electrical equipment with nameplates identifying each and the equipment served. Supply blank nameplates for spare units and spaces.

C. Refer to Section 26 05 53 for additional requirements.

3.9 SLEEVES, PENETRATION, CUTTING AND PATCHING

A. General. Cut and patch walls, floors, etc., resulting from work in existing construction. Provide for the timely placing of sleeves for raceway and exposed cabling passing through walls, partitions, beams, floors and roof while same are under construction. If openings, sleeves, and recesses are not properly installed and cutting and patching become necessary, it shall be done at no expense to the Owner. Secure permission from the Owner's Representative before cutting or patching a constructed or existing wall. Where roofs or walls are fire rated, penetrations shall be completely sealed using UL-listed materials and procedures sufficient to preserve the fire rating. Comply with special requirements of local authorities.

B. Structure. Do not cut or core through structural beams, joists, load-bearing walls, grade beams, or similar load-bearing structure. Where limited space is available above the ceilings below concrete beams or other deep projections, notify the Owner's Representative in writing, including a proposed solution, and request a resolution. Approval shall be obtained from the Owner's Representative and the Architect/Engineer for each penetration.

C. Penetrations.

1. This contract requires core drilling of floor or wall penetrations as indicated on Drawings. Core drilling shall be in accordance with structural specifications. Floor penetrations shall include a sleeve that extends above the floor 2 inches, except where plugs and caps are specified or indicated flush with floor or foundation pad. Electrical penetrations shall be coordinated with structure during design, and shall be made in compliance with structural requirements specified in the structural Drawings and specifications. Field modifications are required to be reviewed and approved by structural engineer prior to installation.

2. Penetrations shall be sealed in accordance with the requirements of Division 7, Firestopping. Coordinate with Division 7 to provide firestopping systems and materials that are compatible with the penetrations for systems and equipment furnished and installed under Division 26.

3. Provide sleeves for conduit penetrations of smoke, fire, and sound rated partitions. Install sleeve with a minimum of 1 inch diameter where penetrating the exterior drywall.

4. Provide proper sizing of sleeves or core-drilled holes to accommodate their through-penetrating items. In general, provide conduit sleeves two standard sizes larger than their through-penetrating items. Provide larger sleeves as required to allow passage of couplings for through-penetrating items.

D. Sealing and Firestopping.

1. Voids between sleeves or core-drilled holes and pipe passing through fire-rated assemblies shall be firestopped to meet the requirements of ASTM E 814, in accordance with Division 7 requirements for Firestopping.

2. Where the routing of cable tray passes through fire-rated walls, floors or other fire-rated boundaries, coordinate with Division 7 to provide removable firestopping system.

3. Furnish and install UL Systems Classified, intumescent material capable of expanding up to 8 to 10 times when exposed to temperatures beginning at 250° F, for the sealing of holes or voids created to extend electrical systems through fire rated floors and walls, in order to prevent the spread of smoke, fire, toxic gas or water.

4. Fire barrier products shall be used to create through-penetration firestop systems as required. Firestop systems shall be listed in the Underwriter's Laboratories Building Materials Discovery, Through Penetration Firestop Systems (XHEZ).

5. Install firestop materials and systems according to their UL Systems Classifications, manufacturer instructions, manufacturer recommendations, and the requirements of applicable Division 7 specifications.

E. Conduit Sleeves. Conduit sleeve shall be two standard sizes larger than the size of conduit it serves, except where "Link Seal" casing seals are used in sleeves through walls below grade. Sleeves in floor shall extend a minimum of two inches above the finished floor. Conduit passing through concrete masonry walls above grade shall have 18-gauge galvanized steel sleeves. Sleeves set in concrete floor construction shall be at least 16-gauge galvanized steel except at conduit supports. Sleeves set in concrete floor construction supporting conduit risers shall be standard weight galvanized steel. Sleeves supporting conduit risers 3 inches and larger shall have three 6 inch long reinforcing rods welded at 120 degree spacing to the sleeve, and shall be installed embedded in the concrete or grouted to existing concrete. Where the conduit passes through a sleeve, no point of the conduit shall touch the sleeve. Seal around penetrations through sleeving as indicated under firestopping as specified herein, and in compliance with the requirements of Division 7 specifications.

F. Penetrations Below Grade. Sleeves penetrating walls below grade shall be standard weight black steel pipe with 1/4-inch thick steel plate secured to the pipe with continuous fillet weld. The plate shall be located in the middle of the wall and shall be two inches wider in radius than the sleeve it encircles. The entire assembly shall be hot-dipped galvanized after fabrication. Seal off annular opening between conduit and sleeve with "Link Seal" casing seal as manufactured by Thunderline Corporation of Wayne, Michigan. Size conduit sleeve to accommodate the casing seal. Use Series 300 casing seals for pipe 3/4-inch through 4-inch and Series 400 casing seals for pipe sized 5-inch and larger.

G. Methods of Cutting: Openings cut through concrete and masonry shall be made with masonry saws and core drills, and at such locations acceptable to the Owner's Representative. Impact type equipment shall not be used except where specifically accepted by the Owner's Representative. Openings in precast concrete slabs for conduits, outlet boxes, etc., shall be core drilled to exact size.

H. Restoration. Restore openings to "as new" condition under the appropriate specification Section for the materials involved, and match remaining surrounding materials and/or finishes.

I. Masonry. Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry. Provide adequate supports during the cutting operation to prevent damage to the masonry caused by the cutting operation. Structural members, supports, etc., shall be of the proper size and shape, and shall be installed in a manner acceptable to the Owner's Representative.

J. Structure. No cutting, boring, or excavating which will weaken the structure shall be undertaken. Coordinate with structure for placement of conduit, sleeves, and the like through beams, joists, slabs, mats, and other structural components and systems prior to forming of those structural components and systems.

K. Watertight. Where sleeves pass through roof or floors requiring waterproof membrane, lead flashing with a density of at least three pounds per square foot shall be built into the membrane a minimum of six inches to provide a watertight installation. Provide other

watertight installation materials as detailed on the Drawings and as specified under Division 7 – Roofing.

L. Escutcheons. Provide heavy chrome-plated or nickel-plated plates on conduit passing through walls and ceilings in finished areas. Escutcheons shall be B&C No. 10, or accepted substitution, chrome-plated steel plates with concealed hinges.

M. Roof Penetrations and Flashings. Furnish and install pipe, conduit and duct sleeves, and flashing compatible with the roofing installation for roof penetrations. Coordinate with Division 7.

3.10 CLEANING, ADJUSTING AND START-UP

A. Cleaning. Clean electrical equipment, components, and devices prior to installation of final finish or covers, prior to startup and testing, prior to final observation by Architect/Engineer and Owner's Representative, and as required under individual Sections of the Division 26 specifications.

B. Adjusting. Adjust equipment, devices, and systems as specified under individual Sections of these Specifications and in accordance with manufacturer's instructions for proper functioning during modes of operation, including emergency and shutdown conditions.

C. Factory Authorized Representative. Where specified for an individual item of electrical equipment, provide a factory authorized representative for adjustment, start-up, and testing of equipment, and instruction of Owner's operating personnel. Certify that these services have been performed by including a properly executed invoice for these services or a letter from the manufacturer.

3.11 TESTING

A. Test Conditions. Use field startup and testing procedures submitted in accordance with paragraph 1.07H of this Section and accepted by the Owner's Representative and the Architect/Engineer. Place circuits and equipment into service under normal conditions, collectively and separately, as necessary to determine satisfactory operation. Perform specified tests in the presence of the Owner's Representative. Furnish instruments, wiring, equipment and personnel required for conducting tests. Demonstrate that the equipment operates in accordance with requirements of the Drawings and specifications. Special tests on certain items, when required, are specified in the individual specification Sections. Where testing is specified or otherwise required to be performed by an independent testing company, use an Owner-approved NETA-certified testing company.

B. Test Conditions. Use field startup and testing procedures prepared in accordance with paragraph 3.03B of this Section. Place circuits and equipment into service under normal conditions, collectively and separately, as necessary to determine satisfactory operation. Perform specified tests in the presence of the Owner's Representative. Furnish instruments, wiring, equipment and personnel required for conducting tests. Demonstrate that the equipment operates in accordance with requirements of the Drawings and specifications. Special tests on certain items, when required, are specified in the individual specification Sections. Where testing is specified or otherwise required to be performed by an independent testing company, use an Owner-approved NETA-certified testing company.

C. Test Dates. Schedule final acceptance tests sufficiently in advance of the contract completion date to permit adjustment and alterations within the number of days allotted for completion of the contract. Inform the Owner's Representative in advance of test dates in accordance with the applicable requirements of Division One and the General Conditions. Where not specified, required, or directed otherwise, allow a minimum of at least 10 working days advance notice.

D. Retests. Conduct retests as directed by the Owner's Representative of such time duration as may be necessary to assure proper functioning of adjusted or altered parts or items of

equipment. Delays resulting from retests do not relieve the Contractor of his responsibility under this contract.

E. Commissioning. Coordinate with commissioning agent, as applicable, for field testing and commissioning of electrical components and systems.

F. Test Reports. Submit copies of test reports to the Architect/Engineer in accordance with Division One requirements.

3.12 OPERATING AND MAINTENANCE MANUALS

A. General. The Contractor shall provide, in loose-leaf binders, complete operating and maintenance data of each manufactured item of equipment used in the electrical work at least four weeks before Architect/Engineer's final review and observation of the project. Descriptive data and printed installation, operating and maintenance instructions for each item of equipment will be included. A complete double index will be provided as follows.

B. Format and content. The Operating and Maintenance Manual will be submitted in quantities and format as specified under Division One for Submittals. Provide quadruplicate where quantity is not specified. Operating and Maintenance Manual shall include:

1. Descriptive data of each system and piece of equipment, including ratings, capacity, performance data, operating curves and characteristics, and wiring diagrams.

2. Full detailed spare parts list, including source of supply for each piece of equipment.

3. Printed instructions describing installation, operation, service, maintenance, and repair of each piece of equipment.

4. Typewritten test reports of tests made of materials, equipment and systems under this Division. Test reports will include the dates of the tests, name of person conducting and witnessing the tests, and record of conditions relative to the tests.

5. Copies of "Reviewed" shop drawings and submittals.

6. Print copies of the record Drawings. Refer to paragraph 1.07I of this Section.

END OF SECTION

SECTION 26 05 19

INSULATED CONDUCTORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies the furnishing and installation of insulated conductors.

1.2 REFERENCE STANDARDS

A. ANSI/UL 83 - Thermoplastic-Insulated Wires and Cables.

B. ICEA S-61-402 (NEMA WC 5) - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

C. CSA C22.2 #124

D. UL Fire Resistance Directory

1.3 SUBMITTALS

A. Provide product data on the following:

1. 600-volt conductor, splicing and terminating materials.

PART 2 - PRODUCTS

2.1 IDENTIFICATION

A. Provide new insulated conductors marked according to NEC Article 310.

2.2 600-VOLT INSULATED CONDUCTORS

A. Size. As shown on the drawings.

B. Construction.

1. Conductor. Soft-drawn, annealed copper. Solid for #12 and #10 and Stranded for all other sizes.

2. Insulation. Unless otherwise noted on the drawings, use THHN/THWN-2 for general wiring. Use XHHW-XHHW-2 for conductors installed below grade.

C. Use. For general wiring use No. 12 minimum. For field-installed control wiring use No. 14 or larger stranded conductors.

D. Listing. Single Conductor. UL 83.

2.3

PART 3 - EXECUTION

3.1 INSTALLATION

A. Protection. Unless otherwise indicated, mechanically protect conductors for systems by installing in raceways. Do not install the conductors until raceway system is complete and

properly cleaned. Use Polywater J cable lubricant when pulling conductors. Do not bend any conductor either permanently or temporarily during installation to radii less than four times the outer diameter of 600-volt insulated conductors, or less than twelve times the outer diameter of the completed 15 kV cable. Do not exceed manufacturer's recommended values for maximum pulling tension.

B. Splices and Terminations. Use pressure-type lugs or connectors for terminations or splices of all stranded conductors. Use ring-tongue type terminators on all control wiring. Below grade terminations shall be waterproof.

C. Appearance. Neatly and securely bundle or cable all conductors in an enclosure using nylon straps with a locking hub or head on one end and a taper on the other.

3.2 600-VOLT INSULATED CONDUCTORS

A. Size. Install conductor sizes as indicated.

B. Home Runs. Provide branch circuit homeruns as indicated on plans. Provide the number of homeruns as indicated on plans. A maximum of 6 phase conductors may be installed in one conduit. Include a separate neutral conductor with each phase conductor for all 120V circuits. Common neutrals are not permitted. For 277V lighting circuits one neutral conductor may be used for three phase conductors. Use home run circuit numbers as indicated for panelboard connections. For isolated ground circuits provide an additional ground conductor as indicated on the panel schedules. Provide No. 10 AWG conductor for the entire circuit length for single-phase, 20 ampere circuits for which the distance from panelboard to the last outlet is more than 100 feet for 120 volt circuits and 200 feet for 277 volt circuits.

C. Color Code. Use factory-colored insulated conductors for No. 10 and smaller conductors and color code larger insulated conductors with an approved field-applied tape. Use different colors for control wiring. Follow the color scheme below.

| Line | 208/120 | 480/277 |
|---|---|---|
| A or L1 | Black | Brown |
| B or L2 | Red | Purple |
| C or L3 | Blue | Yellow |
| Neutral | White | Gray |

| Line | 208/120 | 480/277 |
|---|---|---|
| A or L1 | Black | Brown |
| Ground | Green | Green |
| Switch Leg | Pink | Pink |

Where more than one conductor of the same phase or more than one neutral conductor occur at the same outlet or junction box, these conductors shall be identifiable from each other by use of stripes or distinguishing markings. All wiring associated with isolated ground receptacles (line, neutral, ground) shall have a yellow tracer on each conductor.

D. Field Testing. Insulation resistance of all conductors shall be tested. Each conductor shall have its insulation resistance tested after the installation is completed and all splices, taps and connections are made except connection to or into its source and point (or points) of termination. Insulation resistance of conductors which are to operate at 600 volts or less shall be tested by using a Biddle Megger of not less than 1000 volts d-c. Insulation resistance of conductors rated at 600 volts shall be free of shorts and grounds and have a minimum resistance phase-to-phase and phase-to-ground of at least 10 megohms. Conductors that do

not exceed insulation resistance values listed above shall be removed at Contractor's expense and replaced and test repeated. The Contractor shall furnish all instruments and personnel required for tests, shall tabulate readings observed, and shall forward copies of the test readings to the Owner in accordance with Section 26 05 00. These test reports shall identify each conductor tested, date and time of test and weather conditions. Each test shall be signed by the party making the test.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This section specifies the furnishing and installing of grounding and bonding equipment for electrical systems.

1.2 REFERENCE STANDARDS

A. ANSI/IEEE Std 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.

B. ANSI/UL 467 - Grounding and Bonding Equipment.

C. NFPA 70 - National Electrical Code (NEC).

1.3 SUBMITTALS

A. Product Data. Submit product data sheets, including complete descriptive information on materials and installation methods.

B. Approvals: Secure formal approval of shop drawings and product data prior to ordering material. Secure approvals in sufficient time to allow installation of concealed system components without delaying the project.

C. Testing: Submit documentation for field testing of completed grounding system, as required under paragraph 3.7B of this Section.

D. Note to specifier: edit for Owner preferences on file format and media

E. As-Built Record Drawings. The Contractor shall maintain a master set of As Built record drawings that shows changes and deviations from the Drawings, in accordance with Division One requirements and Section 26 00 00. Deliver As-Built record drawings to Owner upon Owner acceptance of project. Where not specified otherwise in Division 1 or the General and Supplementary Conditions of the construction contract, deliver one set of As-Built record drawings plotted full-scale on mylar with permanent ink, prepared to 1/8- inch scale with 1/8-inch text. Also deliver one set of As-Built record drawings on CD-Rom or similar electronic media acceptable to the Owner. Drawing files shall be in AutoCAD (.dwg) and Adobe Acrobat (.pdf).

PART 2 - PRODUCTS

2.1 GROUND RODS

A. None required

2.2 CONNECTIONS

A. Materials. Unless otherwise noted, provide exothermic welded type grounding connections for bonds and connections made below grade, embedded in structure, or otherwise concealed. For above grade connections not embedded in structure or otherwise concealed, provide mechanical bolted-type connections utilizing high-conductive copper alloy or bronze lugs or clamps. Where required, provide plated connectors which will not cause electrolytic action between the conductor and the connector.

B. Listing. UL 467.

2.3 CONDUCTORS

A. Materials. Provide grounding conductors fabricated from annealed copper with conductivity ≥ 98 percent IACS conductivity.

1. Use solid conductor for No. 12 and No. 10 AWG.

2. Use stranded conductor for No. 8 AWG and larger.

3. Use stranded, tinned, annealed copper cable for #2 AWG or larger installed inside the building or structure.

B. Insulation. Where insulated grounding conductors are specified or required, provide green-colored 600-volt rated insulation, type XHHW, THWN, or RHW. Insulation type shall be compatible with associated power and lighting system conductors.

C. Location and Application.

1. Inside building or structure. Provide insulated copper grounding conductors, except where bare copper grounding conductors are indicated on Drawings or specified in this or other Sections.

PART 3 - EXECUTION

3.1 GENERAL

A. Install grounding system in accordance with the requirements of the National Electrical Code (NEC), Article 250, and other applicable codes and standards. Coordinate installation of grounding and lightning protection system components with structural and civil work and placement of building structural mat.

B. Install grounding conductors continuous, without splice or connection, between equipment and grounding electrodes. Connection to ground busbars is permitted as an exception to the restriction against splices in grounding conductors. Grounding conductors shall be as short and straight as possible, and protected from mechanical damage.

C. Connect grounding electrode conductors to metal water pipe using suitable ground clamp, where metal water pipe is available and accessible and not protected by an insulating anti-corrosion covering. Make connections to flanged piping at street side of flange. Provide bonding jumper around water meter. The grounding electrode conductor shall not be spliced

D. Install fusion welded (exothermic) grounding connectors where they are below grade, concealed, or inaccessible. Above grade at accessible locations, use copper or bronze lugs and clamps. Grounding and lightning protection system connections made in conjunction with placement of the building structural mat shall be exothermic ground connectors.

E. Strap grounding clamps shall not be used. Connections requiring bolting shall be made up with Monel metal bolts, washers and nuts. Connections shall be made only after surfaces have been cleaned, or ground to expose virgin metal.

F. Where grounding conductors are installed in metallic raceway, bond to each end of metallic raceway where grounding conductors enter or exit the metallic raceway system. Metallic raceway systems that would form electrically inductive chokes shall not be used.

G. Conductor connections shall be made by means of solderless connectors such as serrated bolted clamps or split bolt and nut type connectors.

3.2 SYSTEM DESCRIPTION

A. Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing systems.

3.3 EQUIPMENT GROUND

A. Electrical Rooms: Provide a ground bus in electrical rooms, and at other locations indicated on Drawings.

1. Mount busbar as indicated on plans..

2. Connect busbar by grounding conductor to the main ground busbar at the main electrical room. Size grounding conductor as shown on Drawings. Where size is not indicated, use grounding conductor with cross-sectional area equivalent to the ground busbar.

3. Connect to the ground bus noncurrent-carrying metallic parts of electrical equipment and enclosures in the room.

4. Bond grounding conductors to the bus as further indicated on Drawings.

B. Raceway Systems and Equipment Enclosures.

1. Bond cabinets, cable trays, junction boxes, outlet boxes, motors, controllers, raceways, fittings, switchgear, switchboards, panelboards, transformer enclosures, other electrical equipment and metallic enclosures. Bond equipment and enclosures to the continuous-grounded, metallic raceway system in addition to other specific grounding shown. Ground each outlet by the use of an approved grounding clip attached to the outlet box in such a position to be readily inspected upon removal of the cover plate, or by the use of an approved grounding yoke type receptacle.

2. Provide bonding jumpers and grounding conductors throughout the raceway system to ensure electrical continuity of the grounding system and the raceway.

3. Provide grounding-type insulated bushings for metal conduits 1-1/2 inches and larger terminating in equipment enclosures containing a ground bus. Connect the bushing to the ground bus in the equipment enclosure.

4. Provide a green insulated equipment grounding conductor for each feeder and branch circuit. Terminate each end of grounding conductor on a grounding lug, bus, or bushing.

5. Provide internal grounding conductor on liquid tight flexible metal conduit (“sealtite”) with ground bushings.

6. Provide a flexible bonding jumper for isolated metallic piping and ductwork and around expansion fittings and joints.

C. Size. Where grounding and bonding conductors are not sized on Drawings, size the grounding conductors in accordance with NEC Table 250.122. Size bonding jumper so that minimum cross-sectional area is greater than or equal to that of the equivalent grounding conductor as determined from NEC Table 250.122.

D. Taps, Splices and Connections: Make grounding (earth) conductor approximately 2 inches longer than the ungrounded (phase) conductors at both ends.

3.4 FIELD QUALITY CONTROL

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

END OF SECTION

SECTION 26 05 33

RACEWAYS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies the furnishing and installation of electrical raceway systems.

1.2 REFERENCE STANDARDS

A. ANSI/ANSI C80.1 - Rigid Steel Conduit - Zinc-Coated.

B. ANSI/ANSI C80.3 - Electrical Metallic Tubing - Zinc-Coated.

C. ANSI/UL 1 - Flexible Metal Conduit.

D. ANSI/UL 360 - Liquid-tight Flexible Steel Conduit.

E. ANSI/UL 467 - Electrical Grounding and Bonding Equipment.

F. ANSI/UL 797 - Electrical Metallic Tubing.

G. UL 6 - Rigid Metal Conduit.

PART 2 - PRODUCTS

2.1 CONDUIT AND FITTINGS

A. Rigid Metal Conduit.

1. Conduit. Rigid hot-dipped galvanized steel (RGS) conduit with zinc-coated threads and an outer coating of zinc chromate.

2. Fittings. Threaded steel or malleable iron, either cadmium plated or hot-dipped galvanized.

B. Electrical Metallic Tubing (EMT).

1. Conduit. Galvanized electrical steel tubing.

2. Fittings. Steel compression type or steel set screw fittings, either cadmium plated or hot-dipped galvanized. Connectors shall have insulated throat bushings.

C. Rigid Nonmetallic Conduit.

1. Conduit. Schedule 40 polyvinyl chloride (PVC).

2. Fittings. Solvent weld socket type.

D. Flexible Metal Conduit.

1. Conduit. Spiral-wound, square-locked, hot-dipped galvanized steel strip.

2. Fittings. One-screw and two-screw for 1-1/2 inches and larger, double-clamp steel or malleable iron, either cadmium plated or hot-dipped galvanized.

E. Liquid-tight Flexible Steel Conduit.

1. Conduit. Spiral-wound, square-locked, hot-dipped galvanized steel strip plus a bonded outer jacket of PVC.

2. Fittings. Compression type, malleable iron, with insulated throat, either cadmium plated or hot-dipped galvanized.

F. Elbows.

1. Provide large radius elbows.

PART 3 - EXECUTION

3.1 CONDUIT AND FITTINGS

A. Minimum Trade Size. 3/4 inch, except that 1/2-inch flexible metal conduit may be used in lengths not exceeding 72 inches for tap conductors supplying lighting fixtures.

B. Types According to Use.

1. Use hot dipped galvanized rigid steel conduit (RGS) outside above ground where exposed to weather. Use RGS for 5Kv feeders. Rigid aluminum may also be used in lieu of rigid steel.

2. Use EMT in interior walls or ceiling spaces and where exposed in open work areas, mechanical rooms or electrical rooms. Conduit that enters or leaves the top of panelboards or enclosures may be EMT, provided such panelboards and enclosures are located in mechanical or electrical rooms. EMT shall not be used for 5Kv feeders.

3. Conduits may not be embedded in slabs without approval of the owner and the structural engineer.

4. Connect all indoor electrical equipment subject to vibration or movement with flexible metal conduit 24 inches minimum length. Where the equipment is located in a duct or plenum used for environmental air, the length of conduit shall not exceed 4 feet and the conduit shall be flexible metal conduit. Where the equipment is located outdoors or exposed to water, liquid-tight flexible metal conduit shall be used.

5. Transitions.
   a. Continue the heavier, more protective type conduit application not less than 4 inches into the area where lighter, less protective type conduit is permitted.
   b. For below-grade to above-grade outdoor locations, extend concrete encasement around conduit 4 inches above finished grade and slope top away from conduit with a 6-inch-per-foot slope.
   c. For below-grade to above-grade locations using PVC to metal conduit, make the transition from PVC to metal conduit before turning up with RGS elbow.

C. Preparation. Place sleeves in walls and floor slabs for the free passage of cables or conduits. Set sleeves in place a sufficient time ahead of concrete placement so as not to delay the work. Seal all openings and voids around sleeves through floors and walls. Be sure that plugs or caps are installed before concrete placement begins.

D. Installation Requirements.

1. Metallic conduits must be continuous between enclosures such as outlet, junction and pull boxes, panels, cabinets, motor control centers, etc. The conduit must enter and be secured to enclosures so that each system is electrically continuous throughout. Where knockouts are used, provide double locknuts, one on each side. For EMT terminations, provide insulated throat bushings and on rigid metallic conduits, provide nonmetallic insulating bushings for conductor protection. Where feeder conduits, 1-1/2 inches and larger, terminate in equipment having a ground bus, such as in switchgear, motor control centers and panelboards, provide conduit with an insulated grounding bushing and extend a suitable grounding wire to the ground bus.

2. Have rigid nonmetallic conduit adequately solvent welded at joints to form a tight, waterproof connection.

3. Run concealed conduit as directly and with the largest radius bends as possible. Run exposed conduit parallel or at right angles to building or other construction lines in a neat and orderly manner. Conceal conduit in finished areas. Unless otherwise shown, remaining conduit may be exposed. Provide chrome-plated floor and ceiling plates around conduits exposed to view and passing through walls, floors, partitions, or ceilings in finished areas. Select properly sized plates to fit the conduit when securely locked in place.

E. Installation Methods.

1. Install each entire conduit system complete before pulling in any conductors. Clean the interior of every run of conduit before pulling in conductors to guard against obstructions and conduit omissions.

2. Cut all joints square, then thread and ream smooth. Coat cuts, threads or scratches on steel conduit with an approved zinc chromate or with a 90 percent based zinc paint. When dry, draw up tight.

3. Make bends with minimum 24” radius. Make field bends using equipment designed for the particular conduit material and size involved. Bends must be free from dents or flattening. Use no more than the equivalent of four 90-degree bends in any run between terminals and cabinets, or between outlets and junction boxes or pull boxes.

4. Conduit bodies may be used in lieu of conduit ells where ease of installation and appearance warrants their use. Conduit bodies larger than 1 inch may be used only where approved.

5. Securely fasten and support conduit to structure or metal framing using hot-dipped galvanized, malleable iron pipe straps or other approved means. Wires of any type may not be used for securing conduits. Branch circuit raceways which are 1 inch or smaller may be attached to wall studs by use of manufactured clips.

6. Provide a No. 30 nylon pulling line in conduits in which wiring is not installed under this work. Identify both ends of the line by means of labels or tags reading "Pulling Line - Telephone," etc.

7. Suitably cap conduit during construction to avoid water, dirt and trash entrance.

8. Use expansion-deflection fittings on conduit crossing structural expansion joints and on exposed conduit runs where necessary. Provide bonding jumpers across fittings in metal raceway systems.

9. Use expansion fittings in conduit that terminates at sensitive equipment.

10. With a coupling, terminate concealed conduit for future use at structural surfaces. Install a pipe plug flush with the surface.

11. Openings around electrical penetrations of fire-resistance rated walls, partitions, floors or ceilings shall be firestopped to maintain the fire resistance rating using approved methods.

END OF SECTION

SECTION 26 05 37

BOXES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies the furnishing and installation of outlet boxes, junction boxes and pull boxes.

1.2 REFERENCE STANDARDS

A. ANSI/NEMA Publication No. OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers and Box Supports.

B. ANSI/UL 514A - Metallic Outlet Boxes.

C. ANSI/UL 514B - Fittings for Conduit and Outlet Boxes.

1.3 SUBMITTALS

A. Provide product data.

PART 2 - PRODUCTS

2.1 OUTLET BOXES

A. Flush Device Boxes. Provide galvanized steel boxes of sufficient size to accommodate wiring devices to be installed at outlet. Provide an extension ring for the device(s) to be installed. Square or rectangular boxes may be used. Unless otherwise noted, provide minimum 2-1/8- inch deep by 4-inch square minimum size box. For data outlets provide minimum 2-1/8-inch deep by 4-11/16 inch square minimum size box.

B. Exposed or flush Device Boxes. Provide FS or FD cast boxes for surface mounting in areas having exposed rigid metal conduit systems.

C. Boxes for Lighting Fixtures. Provide galvanized steel octagonal boxes with fixture stud supports and attachments as required to properly support ceiling and bracket-type lighting fixtures. Unless otherwise noted, provide 2-1/8-inch deep by 4-inch box.

D. Masonry Boxes. Provide galvanized steel, 3-1/2-inch deep, masonry boxes for all devices installed in masonry walls.

E. Switch Boxes. Not permitted.

F. Listing. UL 514.

2.2 JUNCTION, PULL AND SPLICE BOXES

A. Construction. Provide galvanized steel boxes conforming to NEC Article 314.

B. Interior Spaces. Provide NEMA 1 type boxes at least 4 inches deep

C. Exterior Spaces. Provide NEMA 4X type boxes at least 4 inches deep.

D. Embedded. Provide NEMA 4 cast iron type with flush flanged cover when cast in concrete.

E. Listing. UL 514.

PART 3 - EXECUTION

3.1 OUTLET BOXES

A. Flush Boxes. Unless otherwise indicated, mount all outlet boxes flush within 1/4 inch of the finished wall or ceiling line. Provide galvanized steel extension rings where required to extend the box forward in conformance to NEC requirements. Attach ring with at least two machine screws. Securely fasten outlet boxes. Provide plaster covers for all boxes in plastered walls and ceilings.

B. Fixture Boxes. Where boxes for suspended lighting fixtures are attached to and supported from suspended ceilings, adequately distribute the load over the ceiling support members.

C. Mounting Height. Mounting height of a wall-mounted outlet box means the height from finished floor to horizontal center line of the cover plate. Where outlets are indicated adjacent to each other, mount these outlets in a symmetrical pattern with all tops at the same elevation. Where outlets are indicated adjacent, but with different mounting heights, line up outlets to form a symmetrical vertical pattern on the wall. Verify the final location of each outlet with Owner's representative before rough-in. Remove and relocate any outlet box placed in an unsuitable location.

D. Back-to-Back Boxes. Do not connect outlet boxes back to back unless approval is obtained from the Owner's representative. Where such a connection is necessary to complete a particular installation, fill the voids around the wire between the boxes with sound insulating material.

E. Box Openings. Provide only the conduit openings necessary to accommodate the conduits at the individual location.

3.2 JUNCTION AND PULL BOXES

A. Installation. Install boxes as required to facilitate cable installation in raceway systems. Provide a junction box for terminating of flexible metal conduit to light fixtures. In general provide boxes in conduit runs of more than 100 feet.

B. Covers. Provide boxes so that covers are readily accessible and easily removable after completion of the installation. Include suitable access doors for boxes above inaccessible ceilings. Select a practical size for each box and cover.

C. Colors. Provide boxes with the following covers: Fire Alarm – Red, Emergency – Red, Security – White, Control – Blue.

END OF SECTION

SECTION 26 05 53

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Nameplates and tape labels.

B. Wire and cable markers.

C. Conduit color coding and labeling.

1.2 REFERENCES

A. NFPA 70 – National Electrical Code (NEC).

1.3 SUBMITTALS

A. Provide submittals in accordance with and in additional to Section 26 00 00, Electrical General Provisions, and Division 01, for submittal requirements.

1. Furnish nameplate identification schedules to Owner's Representative for review and acceptance, listing equipment type and nameplate data with letter sizes and nameplate material.

2. Nameplate Schedules. Prior to fabrication of nameplates, furnish to Owner for review and acceptance a schedule of nameplates for electrical equipment. For each equipment and circuit identified, provide 4-line nameplate as follows:
   a. Line 1: Device designation, switchgear or MCC cubicle, switchboard circuit, etc. as indicated on plans, schematics, or schedule Drawings.
   b. Line 2: Leave blank for Owner's use.
   c. Line 3: Source or voltage characteristics, as applicable.
   d. Line 4: Load served.

3. Refer to Parts 2 and 3 of this Section for nameplate requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Equipment Nameplates:

1. For normal power electrical equipment, provide engraved three-layer laminated plastic nameplates, engraved white letters on a black background.

2. For emergency equipment, provide engraved three-layer laminated plastic nameplates with engraved white letters on a red background.

3. For UPS powered equipment, provide engraved three-layer laminated plastic nameplates with engraved white letters on an orange background.

4. For fire alarm system, provide engraved three-layer laminated plastic nameplates with white letters on a yellow background.

5. For security and CCTV system panels, provide engraved three-layer laminated plastic nameplates with white letters on a blue background.

6. Nameplate minimum size shall be 1 inch high by 3 inches long with engraved white letters. Generally, the number and name shall be at least 1/4 inch high and other data at least 1/8 inch high.

B. Conductor Color Tape and Heat Shrink:

1. Colored vinyl electrical tape shall be applied perpendicular to the long dimension of the cable or conductor.

2. In applications utilizing tray cable, heat shrinkable tubing shall be used to obtain the proper color coding for the length of the conductor in the cabinet or enclosure. Variations to the cable color coding due to standard types of conductor or cables are not acceptable.

C. Warning labels: Provide warning labels with black lettering on red background with a minimum of 1/2 inch lettering.

D. Tape Labels: Provide device labels of plastic adhesive tape, with minimum 1/4-inch letters for labeling receptacles, switches, control device stations, junction and pull boxes and manual motor starter units, etc.

1. Normal power. Black letters on clear background. Provide white letters on black background where specifically indicated on Drawings or specified in other Sections.

2. Emergency/standby power. Red letters on clear background. Provide white letters on red background where specifically indicated on Drawings or specified in other Sections.

3. UPS power. Orange letters on clear background. Provide white letters on orange background where specifically indicated on Drawings or specified in other Sections.

4. Provide device label with black letters, one half inch wide tape with one quarter inch high letters, minimum.

5. Manufacturer. Brother type “P-Touch”, or accepted substitution.

E. J-Box and Cover plate Voltage Labels: Black stenciled letters 1/4 inch high. Adhesive back tapes may be used if a clear tape is applied over the label for protection.

## PART 3 - EXECUTION

### 3.1 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials in individually wrapped factory-fabricated fiberboard-type containers.

B. Store materials in a clean and dry space, elevated above grade, and protected from weather and sunlight.

C. Handle materials carefully to avoid damage, breaking, denting and storing. Damaged materials shall be rejected and shall not be installed.

### 3.2 INSTALLATION

A. Degrease and clean surfaces to receive nameplates or tape labels.

B. Install nameplates parallel to equipment lines.

C. Secure plastic nameplates to equipment fronts using stainless steel self-tapping screws or rivets. Use of adhesives shall be per Owner’s approval. Stick-on or adhesives will not be allowed unless the NEMA enclosure rating is compromised, then only epoxy adhesive shall be

used to attach nameplates. Secure nameplate to outside face of flush mounted panelboard doors in finished locations.

D. Designations: Externally mark equipment, feeders, branch circuits and similar items with nameplates with the same designations as indicated on the Drawings.

3.3 WIRE AND CONDUCTOR IDENTIFICATION

A. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, ground busbars and at load connection.

1. Identify with branch circuit or feeder number for power and lighting circuits.

2. Label control conductor with number as indicated on schematic and interconnection diagrams or equipment manufacturer's shop drawings for control wiring.

3. Label grounding conductors at ground busbars, electrical equipment, and test wells with metal tags indicating the cable purpose and point of termination at opposite end of cable. Securely fasten metal tags along the length of the grounding cable or conductor. Place metal tags to avoid creating short circuits, inadvertent grounding paths, or other contact with grounded or energized terminals, conductors, or components.

B. Existing Facilities. Where the Contractor encounters conductor identification in existing electrical distribution systems different from the colors scheduled in this Section, notify the Owner’s Representative in writing and propose a resolution, in accordance with the requirements of Part 1 of Section 26 00 00, Electrical General Provisions.

C. Conductors for power and lighting circuits shall be identified per the following schedule.

D. W

| Conductor | 480/277V | 208/120V | |
|---|---|---|---|
| Phase A | Brown | Black | |
| Phase B | Purple | Red | |
| Phase C | Yellow | Blue | |
| Neutral | Gray | White | |
| Grounding | Green | Green | |

here more than one conductor of the same phase or more than one neutral or ground conductor occurs at the same outlet or junction box, these conductors shall be identifiable from each other by use of stripes or distinguishing markings. The neutral tracer color shall match the phase conductor color with which it is associated.

E. Switch leg conductors. Pink.

1. The color of switch leg conductors shall be pink, marked with tape matching the color of the associated branch circuit phase conductors.

F. Low voltage wiring systems. Conductors for low voltage circuits shall be identified as follows.

1. Fire Alarm. Red

2. Security. Blue and Yellow. Coordinate wiring color with Division 27 and telecommunications supplier

3. Clock. Green and White

4. Telephone. White. Coordinate wiring color with Division 27 and telecommunications supplier

5. Data. Bright Blue. Coordinate wiring color with Division 27 and telecommunications supplier.

6. HVAC Controls. Dark Blue. Coordinate wiring color with Division 23 and controls supplier.

3.4 NAMEPLATES

A. Provide nameplates of minimum letter height as scheduled below. Nameplates shall be same as equipment names indicated on the Drawings.

1. Externally mark electrical equipment with nameplates identifying each and the equipment served.

2. Supply blank nameplates for spare units and spaces.

B. Nameplate Fasteners. Fasten nameplates to the front of equipment by means of stainless steel self-taping screws. Stick-on or adhesives are not allowed unless the NEMA enclosure rating is compromised, then use only epoxy adhesive to attach nameplates.

C. 5 KV-Class Switchgear.

1. On main switches or circuit breakers: 3/8 inch: identify the equipment designation. 1/4 inch: identify system voltage and characteristics (i.e., 4.16 KV, 3PH, 3W).

2. For each switch or circuit: 3/8 inch; identify the circuit or cubicle. 1/4 inch: identify the load served.

D. 480-volt/208-volt Switchboard/switchgear:

1. On the main switches or circuit breakers: 3/8 inch: identify the equipment designation. 1/4 inch: identify the source and voltage characteristics (i.e., 480/277V, 3PH, 4W).

2. For each branch circuit protective device: 3/8 inch: identify the circuit or cubicle. 1/4 inch: identify the load served.

E. Individual Circuit Breakers in Distribution Panelboards, Disconnect Switches, Motor Starters, and Contactors: 1/4 inch: identify source to device and the load it serves, including location.

F. Dry Type Transformers Not in Substations: 3/8 inch: identify equipment designation. 1/4 inch: identify primary and secondary voltages, primary source, and secondary load and location.

G. Panelboards: 3/8 inch: identify equipment designation. 1/4 inch: identify source, voltage and bus rating.

H. Provide complete circuit directory for each new panel board. Provide complete circuit directory for each existing panelboard with circuits added, removed, demolished, moved, renovated, or otherwise altered as part of this project or as work required by or incidental to this project. Refer to Section 26 24 16 for directory requirements.

I. Identification tags on items in finished areas, such as special switches, etc., shall be securely attached on, or in the immediate vicinity, of the item. Supply blank nameplates for spare units and spaces.

3.5 ENCLOSURE COLOR CODING

A. The following systems shall have each enclosure and cover completely painted as follows:

1. Fire Alarm. Red, with black “FA” text.

2. Emergency Power. Red, with black “E” text.

B. The following systems shall have each junction and pull box cover completely painted per the following:

| System | Color of Box Cover |
|---|---|
| Telecommunications | Brown |
| DDC | Green |
| Emergency Power | Red, with black “E” text |
| Security** | White |
| Fire Alarm | Red, with black “FA” text |

**Security shall include, but not be limited to, the following systems:
- Card Access
- Duress Alarms
- Perimeter Door Alarms

C. CCTV

3.6 EQUIPMENT AND DEVICE MARKING

A. Pull, Junction and Outlet Boxes.

1. With 1/2-inch high permanent lettering, identify conduits connected to pull, junction and outlet boxes with the complete circuit number of the conductors contained therein. Identify complete circuit numbers on box cover and on the conduit.

2. Where multiple circuits are contained in a box, identify the circuit conductors with permanent tags which indicate circuit designation. Identify both phase and associated neutral conductors.

3. Boxes and covers containing emergency power or emergency lighting circuits shall be painted red. Factory finish is acceptable in lieu of painting in the field. No other raceway, conduit, boxes, or enclosures shall be painted red.

4. Fire alarm boxes and covers shall be painted red. Using permanent lettering, identify box cover as “F/A” or “FAS”, with fire alarm zone served. Factory finish is acceptable in lieu of painting in the field. No other raceway, conduit, boxes, or enclosures shall be painted red.

B. Power Receptacles: Use a clear plastic tape label, nameplate or engraved device plate to identify power receptacles where the nominal voltage between a pair of contacts is greater than 150 volts with circuit number, voltage and phases. If nameplates are used, attach to wall directly above device plate. Nominal 120 volt power receptacles shall be labeled with the complete circuit number.

C. Snap Switches:

1. Where the equipment served is not in sight of the snap switch, or where snap switch controls dedicated outlets or special equipment, provide a clear plastic tape label or an engraved switch plate to identify equipment served.

2. Where snap switches are grouped together, provide clear plastic tape labels or engraved switch plates to identify non-lighting equipment served.

D. Dedicated Outlets: For dedicated outlets, provide a clear plastic tape label or an engraved cover plate indicating the equipment served. Dedicated is understood to be specific equipment listed by equipment number in the panel schedules or identified on the plans. Dedicated also includes computer outlets.

E. Remote Ballasts: For remote ballasts not within five feet of their luminaire, provide appropriate permanent lettering on both the ballasts and the luminaire to identify which units are mated to the other.

END OF SECTION