PLIEGO DE SUBASTA FORMAL NÚM. 23J-01850

FECHA DE PUBLICACIÓN: 14 DE NOVIEMBRE DE 2022

PRÓPOSITO: PARA LA RENOVACIÓN DEL SISTEMA DE AIRE CENTRAL DEL EDIFICIO 7 DEL HOSPITAL DE PSIQUIATRÍA GENERAL DR. RAMÓN FERNÁNDEZ MARINA DE SAN JUAN, ADSCRITO A LA ADMINISTRACIÓN DE SERVICIOS DE SALUD MENTAL Y CONTRA LA ADICCIÓN DEL GOBIERNO DE PUERTO RICO

FECHA DE REUNIÓN PRE-SUBASTA COMPULSORIA:
Jueves, 17 de noviembre de 2022, a la 1:00 pm

FECHA DE INSPECCIÓN OCULAR COMPULSORIA:
Viernes, 18 de noviembre de 2022, a las 2:30 pm

FECHA LÍMITE PARA SOMETER PREGUNTAS:
Martes, 22 de noviembre de 2022, a las 4:00 pm

FECHA DE ENTREGA DE LA OFERTA:
Martes, 6 de diciembre de 2022, a las 10:00 am

FECHA DE APERTURA:
Martes, 6 de diciembre de 2022, a las 11:00 am

I. INSTRUCCIONES GENERALES

1. FORMULARIO

El Licitador presentará su oferta en el formulario provisto para ello. Puede reproducirlo para su récord. Si fuera necesario aclarar o describir más detalladamente su oferta, el Licitador podrá añadir páginas. Las páginas adicionales podrán ser completadas a manuscrito con letra legible o utilizando cualquier medio tecnológico y en papel timbrado del Licitador.

2. TÉRMINOS

El término "días" significará días calendario, a menos que otra cosa así se exprese. Las palabras y frases utilizadas en este pliego se interpretarán según el contexto aceptado por el uso común y corriente; las usadas en el presente incluyen el futuro; el número singular incluye a su vez el plural; y las usadas en el género masculino incluyen también el femenino y el neutro, salvo en los casos que tal interpretación resultare absurda.

3. LICITADORES REGISTRADOS

A todo Licitador que: 1) esté registrado en el RUL; 2) que haya presentado oferta para una subasta; y 3) que luego del acto de apertura no se encuentre elegible, se le concederá un término improrrogable de **cinco (5) días laborables**, contados a partir del acto de apertura, para que someta la información o los documentos correspondientes en el RUL. Durante dicho período no se realizará adjudicación alguna. La secretaria de la Junta de Subastas será responsable de notificar al licitador mediante llamada telefónica y correo electrónico, sobre el término provisto para que actualice sus constancias en el RUL. En caso de que el licitador no actualice sus constancias en el RUL durante el término provisto, **será descalificado**.

El Licitador deberá someter todos los documentos y certificaciones solicitadas. También deberá cumplir con todos los requisitos, términos y condiciones establecidos en el pliego de la subasta al momento de entregar su oferta. No se aceptará ningún documento por parte del Licitador con posterioridad al acto de apertura, a excepción del certificado de elegibilidad del RUL, que estará sujeto a que se presente dentro del término antes dispuesto.

El Licitador inelegible no estará visible en el RUL para ser contratado por las entidades gubernamentales. La inelegibilidad se mantendrá hasta tanto el Licitador cumpla con el requerimiento de información o la presentación de los documentos solicitados. **El Licitador tendrá que contar con el estatus de elegible en el RUL previo a la adjudicación de la subasta**.

4. LICITADORES NO REGISTRADOS

Cuando un Licitador que no esté registrado en el RUL comparezca a un proceso de subasta y presente una oferta, la Junta de Subastas no deberá rechazar la misma por el hecho de que dicho Licitador no esté en el RUL y le concederá un término de **cinco (5) días laborables**, contados a partir del acto de apertura para que someta todos los documentos requeridos ante el RUL. En caso de que el Licitador no entregue los documentos requeridos, **será descalificado**.

5. IMPUGNACIÓN A LA INVITACIÓN DE LA SUBASTA

Cualquier licitador interesado en participar en una subasta formal podrá impugnar **la Invitación a Subasta**, mediante escrito, únicamente cuando no se haya seguido cualesquiera de los procedimientos establecidos en el Reglamento Núm. 9230, *según enmendado*, conocido como "Reglamento Uniforme de Compras y Subastas de la Administración de Servicios Generales del Gobierno de Puerto Rico" o cuando se considere que el termino fijado para efectuar el estudio y preparación de la oferta y la fecha para radicar la oferta no es suficiente. El escrito deberá contener el fundamento por el cual se impugna la invitación, además, deberá estar firmado por el licitador.

El escrito de impugnación deberá ser radicado **personalmente** ante la Administración Auxiliar de Adquisiciones, dentro de los **tres (3) días laborables** siguientes a la fecha de envío por la Junta de Subastas de la Invitación mediante correo electrónico a los licitadores o desde la fecha de publicación de la Invitación en el Registro Único de Subastas (RUS). Si la fecha de envío de la Invitación mediante correo electrónico a los licitadores es distinta a la fecha de publicación de la Invitación en el RUS, se contará a partir de la fecha de envío de ésta última. **Todo escrito de impugnación radicado fuera del término aquí establecido será rechazado de plano**. Deberá notificarse copia del recurso presentado a los licitadores invitados a la subasta formal y a la Junta de Subastas. El escrito de impugnación deberá cumplir con lo establecido en la **Sección 7.3.6** del Reglamento Núm. 9230, *supra*.

6. IMPUGNACIÓN AL PLIEGO DE LA SUBASTA

Si un Licitador interesado en participar en una subasta formal no estuviere de acuerdo con los términos finales, instrucciones, especificaciones o condiciones establecidas **en el pliego** de la subasta, podrá radicar el escrito de impugnación correspondiente **personalmente** ante la Administración Auxiliar del Área de Adquisiciones, dentro de los **tres (3) días laborables** siguientes a la fecha en que la Junta de Subastas hace disponible los pliegos de la subasta, entiéndase, a partir de la publicación del pliego en el RUS. Todo escrito de impugnación del pliego de la subasta radicado fuera del término aquí establecido **será rechazado de plano**. El licitador que presente la impugnación deberá notificarle a la Junta de Subastas. El escrito de impugnación deberá cumplir con lo establecido en la **Sección 7.3.6** del Reglamento Núm. 9230, *supra*.

7. REUNIÓN PRE-SUBASTA: COMPULSORIA

Todo licitador o persona interesada en presentar una oferta para la subasta formal de referencia, tendrá que acceder **COMPULSORIAMENTE** a la reunión pre-subasta. **Todo licitador que presente una oferta y que no haya participado de la reunión pre-subasta será descalificado.**

La reunión pre-subasta será realizada de **modo virtual**, la cual podrá acceder a través de la página "web" de la ASG mediante la siguiente dirección electrónica: www.asg.pr.gov, enlace de "Reforma de Compras". Además, deberá acceder al enlace de la subasta de referencia, el cual le proveerá la opción de conectividad a "Reunión Virtual Pre-subasta". Al conectarse a la Reunión Virtual Pre-Subasta, el licitador deberá registrarse previo al inicio de los procesos. Cualquier licitador que acceda luego de que el miembro asociado de la Junta de Subastas que presida los trabajos, o su representante autorizado, haya finalizado el registro de asistencia en alta voz, será descalificado.

La reunión pre-subasta se llevará a cabo el **jueves, 17 de noviembre de 2022, a la 1:00 pm**. Dicha reunión tendrá el propósito de aclarar a los licitadores las dudas que surjan en torno al pliego de subasta.

Los participantes a esta reunión tendrán que observar normas y conductas que garanticen el respeto y el decoro. No se permitirán comentarios en alta voz; hablar fuera de orden; dirigirse a los funcionarios o demás participantes de forma despectiva, agresiva u ofensiva; o cualquier otra conducta que resulte en alterar el propósito de la reunión. Cualquier manifestación de conducta inapropiada por parte de cualquier licitador o persona interesada en participar en el proceso de subasta formal **constituirá fundamento suficiente para su descalificación**.

Un miembro asociado de la Junta de Subastas o su representante autorizado presidirá la reunión pre-subasta.

La Junta se Subastas se reserva el derecho a convocar a una o más reuniones pre-subastas.

8. INSPECCIÓN OCULAR: (COMPULSORIA)

La inspección ocular se llevará a cabo en las facilidades del Hospital de Psiquiatría General DR. Ramón Fernández Marina de San Juan, el **viernes, 18 de noviembre de 2022, a las 2:30 pm**. Todo licitador o persona interesada en presentar una oferta para la subasta formal de referencia, tendrá que asistir de manera **COMPULSORIA** a la inspección ocular.

Los licitadores o personas interesadas deberán ser puntuales; todo licitador o persona interesada que llegue a la inspección ocular luego de finalizado el registro de asistencia no podrá participar de la misma y se entenderá que no compareció.

La incomparecencia a la inspección ocular compulsoria de los licitadores o personas interesadas en presentar una oferta para la subasta formal de referencia será causa suficiente para su descalificación.

9. FECHA, HORA Y MODO DE ENTREGAR LA OFERTA

Las ofertas tienen que ser presentadas en o antes del **martes, 6 de diciembre de 2022, a las 10:00 am**, de las siguientes **dos (2) formas**:

1. **Físicamente**, en la Oficina de la Junta de Subastas, localizada en el Centro Gubernamental Minillas, Torre Norte, Piso 12, San Juan, Puerto Rico; y,

2. **Electrónicamente**, a la siguiente dirección:ofertas@asg.pr.gov.

El Licitador que no presente su oferta en las **dos (2) formas** aquí requeridas **será descalificado.** No se aceptarán ofertas después de la fecha y hora límite establecida para la entrega de ofertas.

Tanto el sobre que contenga la oferta que se presentará físicamente, así como el correo electrónico en el cual se incluya la oferta a ser sometida de forma electrónica, deberán identificarse de la siguiente forma:

"Atención: Oferta de Subasta Formal Núm. 23J-01850". Además, tanto el sobre como el correo electrónico, deberán incluir la siguiente información: nombre del licitador, nombre de la compañía que representa, dirección postal y número de teléfono de contacto.

Toda oferta recibida sin identificar según lo aquí establecido será tramitada como correspondencia regular. Bajo esta circunstancia, la Junta de Subastas no será responsable si el remitente pierde su oportunidad de presentar la oferta a tiempo, como tampoco podrá requerir que se tome conocimiento de su oferta o imputar que la oferta haya sido divulgada o abierta antes de tiempo.

Se considerará como **oferta oficial el documento presentado físicamente** en la Oficina de la Junta de Subastas. Al recibirse el sobre que contiene la oferta en la Oficina de la Junta de Subastas, se marcará indicando la fecha y hora exacta en que fue recibido, lo que constituirá la fecha y hora oficial de entrega de la oferta.

El correo electrónico **debe incluir una copia fiel y exacta de los documentos de oferta entregados físicamente**. La fecha y hora de recibo de la oferta presentada por correo electrónico, será la impresa en el documento. Como excepción, la Junta de Subastas podrá autorizar la entrega física de anejos complementarios que, por el tamaño de su contenido, sobrepasen el espacio disponible para enviarse mediante correo electrónico.

En el caso de que por alguna razón se haya recibido la oferta de un licitador de forma física, pero no se haya recibido la oferta electrónica a la fecha y hora límite indicadas anteriormente, se le notificará durante el Acto de Apertura al licitador y este tendrá hasta antes de que finalice dicho Acto para enviar la misma. El no cumplir con ambas formas de entrega será fundamento suficiente para su descalificación.

De ocurrir algún evento natural o circunstancia especial que ocasione el cierre de la Junta e impida el recibo de ofertas en la fecha y hora antes indicada, las ofertas se entregarán en el día en que la Junta reanude sus funciones, a la hora dispuesta originalmente, o a cualquier otra que oportunamente se notifique.

Las ofertas que se reciban físicamente fuera de la fecha y hora límite aquí dispuesta se devolverán al licitador informándole su incumplimiento con las condiciones establecidas y su descalificación. Se retendrá el sobre original de envío de la oferta el cual se hará formar parte del expediente de la subasta.

10. CONTENIDO DE LA OFERTA

Todo licitador o persona interesada presentará **físicamente** su oferta en un sobre sellado en la Oficina de la Junta de Subastas.

El sobre que contenga la oferta que se presentará físicamente y el correo electrónico en el cual se incluya la oferta a ser sometida de forma electrónica, deberán incluir los siguientes documentos:

a. Invitación a Subasta debidamente iniciada.
b. Pliego debidamente iniciado.

c. Fianza de Licitación en **original y firmada** ("*Bid Bond*"). La fianza **ORIGINAL** deberá ser sometida junto con la oferta entregada físicamente.
d. Tabla de Ofertar provista **por la Junta de Subastas.**
e. Literatura de cada producto ofertado, **identificado con el número de renglón o partida**, según aplique.
f. Carta del manufacturero, según aplique.
g. Enmiendas al pliego de la subasta debidamente iniciadas, según aplique.
h. Carta de presentación. *Véase* inciso 21.
i. Resolución y/o documento acreditativo vigente del por ciento correspondiente, según establecido en leyes preferenciales y la normativa adoptada a su amparo y emitido por la Junta de Inversión para la Industria Puertorriqueña, si aplica. En cualquier caso, que el licitador no presente dicho documento **junto con su oferta**, no se aplicará a la oferta presentada el por ciento relacionado.
j. Cualquier otro documento requerido en este pliego o en las especificaciones adjuntas.

El Licitador podrá ser descalificado de no adjuntar a su oferta los documentos arriba mencionados.

11. CORRECCIONES A LA OFERTA ("*Typos*")

Toda oferta deberá presentarse en forma legible, clara, completa y precisa. Ofertas múltiples, variadas o ambiguas no serán consideradas. Las correcciones a las ofertas, las cuales surgen como consecuencia de errores, deberán estar refrendadas por el licitador **con su firma o sus iniciales**, de lo contrario, quedará invalidada la oferta para la partida o las partidas correspondientes. No se aceptarán ofertas que incluyan correcciones realizadas con tinta correctiva, tinta blanca, cinta correctiva y/o "liquid paper".

12. DIRECCIONES EN LA OFERTA

La oferta deberá contener la dirección física y postal de la oficina principal del negocio del licitador en Puerto Rico, así como también, el nombre y la dirección del agente residente de la corporación, cuando aplique.

13. FIRMAS EN LA OFERTA

Las ofertas deberán estar refrendadas (bajo la firma) por el licitador que aparece registrado en el RUL, en el espacio provisto para ello en el formulario identificado como **ANEJO I** de este pliego de subasta formal, **"Oferta del Licitador"**. En caso de que el licitador no esté registrado en el RUL, la oferta deberá estar refrendada por la persona que someterá todos los documentos requeridos ante el RUL. Se autoriza la firma electrónica del Licitador en la oferta presentada, en virtud de lo establecido en la Carta Circular ASG Núm. 2020-014 del 19 de mayo de 2020. Los Licitadores no registrados en el RUL, deberán cumplimentar y acompañar su Oferta con el Formulario **ASG 673 (ANEJO 2) ó ASG 674 (ANEJO 3), según corresponda**, los cuales se hacen formar parte de este pliego.

No cumplir con estos requisitos constituirá el rechazo de la oferta.

14. MODIFICACIONES A LAS OFERTAS

Cualquier modificación **que varíe los términos de la oferta previamente sometida** se hará mediante comunicación escrita la cual deberá ser presentada ante la Junta de Subastas y deberá enviarse en un sobre cerrado, debidamente identificado con la información siguiente:

a) Número de la subasta
b) Fecha
c) Hora señalada para la entrega de la oferta
d) Nombre y dirección del suplidor
e) Información en que se indique las razones para la modificación de la oferta

No se admitirán modificaciones presentadas luego de la fecha límite establecida para la presentación de las ofertas.

Toda modificación de oferta será abierta en la fecha y hora señalada para el acto de apertura de la subasta, juntamente con la licitación original.

Cuando la oferta sea modificada, si la modificación y/o enmienda conllevare un aumento en precio de la oferta original, será obligación del licitador, ajustar la fianza de acuerdo con la nueva cuantía. De no hacerlo así, se rechazarán ambas ofertas.

15. RETIRO DE LA OFERTA

a) El retiro de una oferta podrá efectuarse mediante solicitud escrita dirigida a la Junta de Subastas, presentada en cualquier momento previo al acto de apertura.

b) El licitador no podrá presentar una oferta sustituta, una vez retirada su oferta para una compra determinada.

c) Ningún licitador podrá retirar su oferta con posterioridad al acto de apertura de una subasta.

16. FECHA Y HORA DEL ACTO DE APERTURA

Las ofertas se abrirán el **martes, 6 de diciembre del 2022, a las 11:00 am**. Todo licitador o persona interesada en comparecer al acto de apertura, el cual **se realizará de modo virtual**, podrá acceder al mismo a través de la página "web" de la ASG, a través del enlace Reforma de Compras. Además, deberá acceder al enlace de la subasta formal de referencia, el cual le proveerá la opción de conectividad al **"Acto de Apertura Virtual".**

Toda oferta presentada dentro del término dispuesto para la entrega estará bajo la custodia de la Junta de Subastas y **bajo ninguna circunstancia** se abrirá hasta la fecha y hora fijada para el acto de apertura.

Si antes de la fecha del acto de apertura y por razones fuera del control de la Junta de Subastas o de la ASG el sobre resultare abierto, violentado, o deteriorado, la Junta de Subastas se comunicará con el licitador concernido para que éste verifique personalmente el sobre y los documentos que contiene y los vuelva colocar en otro sobre sellado, debidamente identificado, y entregue formalmente la licitación. La fecha de entrega será la fecha de recibo original. El secretario de la Junta de Subastas preparará un acta de las incidencias a la cual unirá el sobre abierto, deteriorado o violentado y el licitador firmará al calce del acta indicando la fecha y la hora de la inspección del sobre.

El acto de apertura público tiene como propósito el que las partes interesadas puedan comprobar qué ofertas se recibieron y conocer la cuantía de cada oferta. El acto de apertura será dirigido por un miembro asociado de la Junta de Subastas o su representante autorizado.

Toda persona que comparezca virtualmente al acto de apertura deberá observar las normas de conducta que establezca durante dicho acto la Junta de Subastas.

17. MARCA, MODELO Y LITERATURA

En aquellas subastas donde aplique, el Licitador indicará en su oferta la **marca y modelo de los bienes incluidos en su oferta**. También **incluirá con su oferta literatura técnica del manufacturero** que permita validar que los bienes incluidos en su oferta cumplen con las especificaciones requeridas en el pliego de subasta formal. Dicha literatura hará referencia a la partida particular de la subasta que aplique.

18. REPRESENTANTE EXCLUSIVO

Si el licitador que ofrece una marca específica es el **representante exclusivo de dicha marca**, tendrá la obligación de mencionarlo en la oferta y remitir la certificación del manufacturero.

19. INFORMACIÓN CONFIDENCIAL

Las ofertas presentadas por los licitadores serán parte del expediente de la subasta en la cual éstos participaron y pasarán a ser propiedad de la Administración, independientemente de que se cancele o adjudique la subasta formal. No obstante, la información confidencial constitutiva de secretos de negocio o cualquier otra información protegida por derechos de autor, entre otras disposiciones legales, no podrá ser divulgada por la Administración, por la Junta de Subastas u otra entidad gubernamental. Debido a ello, **toda información que constituya información confidencial y protegida deberá ser anejada a la oferta por el licitador en una hoja individual que deberá titularse "Información Confidencial y Protegida".**

20. DOCUMENTOS

Todos los documentos que se incluyen como parte del pliego de la subasta formal (incluida la Invitación a Subasta) y los que se emitan posteriormente, formarán parte de este y deberán que ser incluidos, debidamente iniciados, junto con la oferta sometida.

Todos los documentos deben ser presentados en papel tamaño carta, entiéndase, tamaño 8 ½ pulgadas por 11 pulgadas.

21. CARTA DE PRESENTACIÓN

La carta de presentación debe ser clara, concisa, e incluir suficientes detalles para la realización de una evaluación efectiva. El licitador debe asumir que el Gobierno no tiene conocimiento previo sobre su experiencia y tampoco sobre sus prácticas de negocio. Además, la carta de presentación deberá incluir, una breve descripción de lo siguiente:

a) Desempeño pasado: De haber suplido bienes, de haber realizado obras o de haber prestado servicios no profesionales iguales, similares o relacionados a los requeridos en este pliego de subasta formal, deberá proveer el listado de los clientes del sector público y privado a quienes en los pasados dos (2) años suplió los bienes, realizó las obras o prestó los servicios. Deberá proveer además la información de contacto de dichos clientes.

b) Capacidad técnica: Deberá detallar la capacidad, enfoque y conocimientos necesarios (entre otros aspectos técnicos y/o de logística) que posee su empresa, industria o negocio para cumplir con la provisión de los bienes, realización de obras y/o prestación de servicios no profesionales ofertados.

c) Cualquier otra información que el licitador entienda pertinente que la Junta de Subastas deba conocer, para la evaluación correspondiente.

La carta de presentación deberá estar firmada por la persona autorizada en el RUL a esos efectos o por la persona que presentará sus documentos en el RUL (en caso de que no esté registrado). El desempeño pasado y la capacidad técnica serán tomadas en consideración por la Junta de Subastas como parte de los criterios para determinar el *mejor valor*.
La Junta de Subastas y la ASG se reservan el derecho de solicitar a los licitadores, sus clientes o a terceros (incluidos o no por el licitador como referencia) información adicional para corroborar la información suscrita por el licitador en su carta de presentación.

22. ADVERTENCIAS

a. Proveer cualquier tipo de información o documentación falsa o fraudulenta como parte de la oferta presentada para esta subasta formal, será causa suficiente para descalificar o rechazar la oferta de cualquier licitador, así como para cancelar o resolver cualquier orden de compra o contrato otorgado en virtud de esta.

b. La ASG y la Junta de Subastas podrán ordenar la cancelación parcial o total de la subasta formal cuando ello sirva los mejores intereses del Gobierno de Puerto Rico, independientemente de la fase en que se encuentre, siempre que sea previo a la formalización del contrato o de haberse emitido una orden de compra.

c. La ASG podrá enmendar cualquier invitación y/o pliego de la subasta formal cuando ello sirva los mejores intereses del Gobierno de Puerto Rico.

La ASG podrá enmendar el pliego de la subasta formal hasta dos (2) días laborables antes del acto de apertura de las ofertas cuando la enmienda implique cambios o solicitudes adicionales que se deben incluir en la oferta o licitación o, un (1) día laborable antes del acto de apertura de la subasta cuando la enmienda no afecte la presentación de las ofertas.

En casos de **proyectos de obras de construcción** la ASG podrá enmendar el pliego de la subasta formal hasta cinco (5) días laborables antes del acto de apertura de las ofertas cuando la enmienda implique cambios o solicitudes adicionales que se deben incluir en la oferta o licitación o tres (3) días laborables antes del acto de apertura de la subasta cuando la enmienda no afecte la presentación de las ofertas.

d. Ni la Junta de Subastas ni la ASG aceptarán una fianza por una cantidad menor a la aquí establecida. De ser presentada mediante compañía de seguros, la fianza será emitida a favor de la Administración de Servicios Generales y de ser presentada en cheque certificado o giro postal, será emitida a favor del Secretario de Hacienda. El incumplimiento con este requisito conllevará el rechazo de la oferta. Además, cualquier oferta que no incluya entre los documentos presentados la correspondiente Fianza de Licitación en **ORIGINAL Y DEBIDAMENTE FIRMADA**, será rechazada.

La Junta de Subastas y la ASG darán fiel cumplimiento a la política pública de compras preferenciales dispuesta en ley.

e. El Licitador a quien se adjudique la *buena pro* de esta subasta formal, quedará sujeto a lo establecido en la ***Política de Revisión de Contratos*** suscrita por la Junta de Administración y Supervisión Fiscal.

f. La adjudicación de la presente subasta formal no obliga de ningún modo a la ASG a emitir una Orden de Compra y/o suscribir un Contrato.

g. En caso de que los bienes, obras y/o servicios no profesionales a ser adquiridos en esta subasta formal sean parcial o totalmente financiados con fondos federales, el licitador deberá estar registrado y elegible en el ***System for Award Management (SAM)*** al momento de suscribir el contrato y/o emitirse la orden de compra. De no estar registrado y ser elegible, será descalificado.

h. La adjudicación de la presente subasta formal no constituirá el acuerdo formal entre las partes. Será necesario que se suscriba el contrato correspondiente o que la Administración emita una orden de compra suscrita por una persona autorizada.

i. Todo licitador que ofrezca equipo, maquinaria o vehículo que consuma energía eléctrica o combustible para su operación, al hacer su oferta, deberá hacer constar que su equipo, maquinaria o vehículo cumple con los requisitos establecidos por la ***Ley Federal de Conservación de Energía***. Al adjudicarse estas subastas, la Junta de Subastas se atendrá a las normas federales de consumo, conservación y utilidad del bien que se trate y **no será causa de impugnación** el adjudicar la subasta a un licitador

que ofrezca un bien más caro si los ofrecidos por los demás licitadores no cumplen con las normas establecidas por dicha Ley.

II. OFERTAS ADMISIBLES E INADMISIBLES

1. UNIDAD DE PRECIO OFERTADO

La oferta deberá hacerse en dólares y centavos. No serán consideradas ofertas que se expresen en términos de por ciento, en referencia a posibles precios indeterminados, o cantidad de dinero o por cientos "menores" o "en exceso" de la oferta más baja, salvo que así sea dispuesto y requerido en el pliego de la subasta.

2. OFERTAS NO RESPONSIVAS O INACEPTABLES

Al hacer su oferta, el licitador se limitará a ofrecer u ofertar lo que se le solicita dentro de las especificaciones y las condiciones establecidas en el pliego de subasta. Las especificaciones establecen requisitos mínimos. **Cualquier oferta que sobrepase las especificaciones solicitadas podrá ser aceptada, siempre y cuando no altere sustancialmente las características de los bienes, obras o servicios no profesionales solicitados en el pliego de subasta formal, de forma tal que pueda interpretarse como *competencia desleal*.**

La Junta de Subastas no considerará las ofertas que añadan o eliminen especificaciones o condiciones requeridas en el pliego de subasta, o que las alteren, modifiquen o varíen las mismas. Tampoco se considerarán las ofertas que contengan frases, párrafos o comentarios ambiguos, incompletos, indefinidos o que resten certeza a la oferta.

3. DESVIACIONES PERMISIBLES

La Junta de Subastas podrá aceptar desviaciones mínimas en las especificaciones, términos y condiciones de las ofertas recibidas, cuando:

a. ningún licitador ofrezca el bien o servicio no profesional con las especificaciones requeridas;
b. no se afecte el propósito original a que está destinada la subasta; y,
c. el precio cotizado sea competitivo y comparable con el prevaleciente en el mercado.

La Junta de Subastas se reserva el derecho de obviar cualquier informalidad o diferencia de menor importancia en los términos y condiciones si cumple con el propósito para el que se solicitan y resulta beneficioso para el Gobierno de Puerto Rico. Las desviaciones no podrán afectar sustancialmente la calidad, capacidad o características esenciales de los artículos o servicios solicitados.

4. OFERTAS INCOMPLETAS

Ofertas en las que no se completen todos los encasillados incluidos en la "Tabla de Ofertar" podrán ser **rechazadas.** En caso de que el Licitador no desee ofertar para una partida particular, deberá anotar en el encasillado "N/B" – (NO BID).

5. VARIAS OFERTAS POR UN MISMO LICITADOR

No podrá un licitador o empresa comercial someter varias ofertas para una subasta, ya sea a nombre propio o bajo seudónimos, de alguna de sus subsidiarias o sucursales, de algunos o varios de sus socios, agentes, oficiales y entidades a que éstos pertenezcan, porque **se declararán nulas todas y cada una de las ofertas**.

6. RECHAZO GLOBAL

Se podrá rechazar cualquiera o todas las ofertas para una subasta formal en las situaciones siguientes:

a. Cuando los licitadores no cumplan con alguno de los requisitos, especificaciones o condiciones estipuladas.
b. Cuando los precios obtenidos sean irrazonables o los términos resulten onerosos para el Gobierno de Puerto Rico.
c. Cuando las ofertas demuestren que los licitadores controlan el mercado del producto solicitado y se entienda que se han puesto de acuerdo entre sí para ofertar precios excesivos. En tal caso, se realizará el referido correspondiente al Departamento de Justicia.
d. Si los intereses económicos del Gobierno de Puerto Rico pudiesen verse afectados o no existe el presupuesto necesario para cumplir con la obligación.

7. OFERTA LIMITADA

El licitador que entienda que **solamente puede sostener sus precios por un período de tiempo determinado, así lo hará constar en su oferta**, especificando el término (**fecha exacta; día, mes y año**) durante el cual sostiene y/o garantiza la misma. En cualquier caso, que el Licitador no especifique el término durante el cual garantiza su oferta, se entenderá que sostiene su oferta (precio ofertado) hasta la firma del contrato o la emisión de la orden de compra.

Se podrá **ejecutar la Fianza de Licitación** si expirado el término de diez (10) días laborables a partir de la notificación de la adjudicación, el licitador agraciado no presenta la Fianza de Ejecución. Además, se podrá ejecutar si el licitador agraciado se niega a firmar el contrato dentro de los diez (10) días laborables siguientes de habérsele citado para ello.

8. COMPETENCIA ADECUADA

Todo licitador o persona interesada en participar de la presente subasta formal, **ACEPTA Y RECONOCE** que la ASG emite este pliego **para la adquisición e instalación de sistema de altavoz (*page*) para el Hospital de Psiquiatría General DR. Ramón Fernández Marina de San Juan, adscrita a la Administración de Servicios de Salud Mental y Contra la Adicción del Gobierno de Puerto Rico.**

El licitador a quien se adjudique la *"buena pro"* de esta subasta formal no podrá ofrecer a ninguna entidad del Gobierno de Puerto Rico un precio menor al ofertado en este proceso de licitación para el mismo bien, obra o servicio no profesional.

III. CONDICIONES GENERALES

1. TRANSPORTACIÓN, ACARREO Y ENTREGA

Los precios ofertados **incluyen los gastos de transportación y acarreo** hasta la entrega final de los bienes o servicios en el lugar que designe la agencia peticionaria, **libre de cargo adicional para el Gobierno**.

No se autorizará ningún aumento al precio ofertado relacionado a transportación, acarreo y entrega de los bienes, obras o servicios después del término establecido para presentar ofertas. Ello implica que la Administración no considerará solicitudes de enmiendas a contratos u órdenes de compra, presentadas por los licitadores, para aumentar el precio ofertado por dicho concepto (aumento en el mercado en los gastos asociados a transportación, acarreo y entrega) durante el término de la obligación, salvo lo dispuesto en el inciso 3 de la sección III de este pliego.

2. PRECIOS OFERTADOS

Toda persona ofertará basándose en **precios justos y razonables** de conformidad con el tipo de bien, obra o servicio no profesional que se licita.

Los precios ofrecidos por el Licitador **se mantendrán fijos durante la vigencia del contrato** que se otorgue y/o **durante la vigencia de la orden de compra que se emita**, y no estarán sujetos a cambios por aumento en el mercado o de cualquier otra índole, ya sean previsibles o no, salvo lo dispuesto en el inciso 3 de la sección III de este pliego.

3. AJUSTE DE PRECIO (ESCALATION CLAUSE)-

Los precios ofrecidos podrán estar sujetos a cambios por fluctuaciones legales (arbitrios o impuestos), cargos de acarreo en el mercado, o aumento en el precio de la materia prima, siempre y cuando el licitador someta evidencia documentada acreditativa del aumento (no aplica). El aumento en el precio establecido estará sujeto a la aprobación escrita de la Administración de Servicios Generales. Para disminuir precios bastará con la mera notificación escrita.

4. TÉRMINO DE ENTREGA

El Licitador deberá informar en su oferta el término en que se entregarán los bienes, en que se completarán las obras y/o se prestarán los servicios incluidos en su oferta indicando los días, semanas o meses. El licitador no podrá incluir ningún costo adicional al precio ofertado por concepto de gastos relativos a la entrega del bien adquirido, no obstante, deberá desglosar el detalle del precio ofertado.

Cuando un licitador indique que su término de entrega es "inmediato" se entenderá que es en las veinticuatro (24) próximas a la emisión de la orden de compra o de la orden de comienzo.
Las entidades requirentes podrán establecer el término de entrega de los bienes, obras y/o servicios licitados, de acuerdo con su necesidad.

La entrega de los bienes, obras o servicios no profesionales se efectuará dentro del término que haya ofertado el Licitador, a partir del recibo de la orden de compra y/o de la emisión de la orden de comienzo para las obras de construcción.

5. ALMACENAJE

En caso de que el licitador que venda al Gobierno de Puerto Rico tuviera que almacenar los suministros a entregar, el Gobierno no será responsable del precio que pague el licitador por concepto de almacenaje ni por las ganancias que deje de obtener.

6. ARBITRIOS

En proyectos de obras de construcción a ser realizadas en un lugar predeterminado (según establecido en el pliego), el licitador deberá considerar **dentro del precio ofertado**, los costos relacionados al pago de arbitrios, patentes y/o cualquier otro permiso necesario para la realización de la obra.

7. MUESTRAS

En caso de que la Junta de Subastas requiera muestras de los bienes ofertados, el Licitador tendrá **tres (3) días laborables** contados a partir de la solicitud para entregar físicamente en la Oficina de la Junta de Subastas, muestras representativas de los bienes ofertados.

Las muestras solicitadas se proveerán:

a. Libre de costo para el Gobierno;
b. Con las características en las especificaciones requeridas;
c. Provistas del marbete original que identifica la marca del producto y en el envase y/o empaque comercial original;
d. Acompañadas de la literatura del manufacturero.

En el caso que la muestra requerida no sea entregada por el Licitador dentro del término establecido, **será descalificado.**

Si dentro del proceso del examen de las muestras éstas se destruyen o se gastan, el Gobierno no responderá por el costo de éstas.

Si luego del examen, las muestras no se destruyen o no se gastan en su totalidad, el licitador viene obligado a recogerlas dentro de los diez (10) días de haber sido notificado por cualquier medio (teléfono y/o correo electrónico) para ello. Si transcurrido dicho término, el licitador no pasa a recoger las muestras, éstas pasarán a ser propiedad del Gobierno.

En caso del licitador agraciado, sus muestras podrán retenerse para la adecuada administración del contrato. En el caso que se le devuelvan éstas, el licitador agraciado tendrá que tenerlas disponible para inspección en cualquier momento durante la vigencia del contrato.

Las muestras sometidas a evaluación serán representativas del producto que se ofrece y estarán identificadas por renglón, partida, tipo, calidad, estilo y tamaño, así como el número de la subasta y el nombre del licitador.

8. GARANTÍA

Todo licitador deberá incluir con su oferta, copia fiel y exacta de la garantía, emitida por el manufacturero del producto y servicio, la cual detalle de forma clara y precisa el período específico o los términos aplicables a cada garantía, su vigencia, términos, sus limitaciones y condiciones, los trámites requeridos para reclamar la garantía, el nombre de la entidad que proveerá el servicio de reemplazo, subsanación, corrección o reparación del producto o el servicio y los términos de entrega e instalación del producto o servicio. **La garantía deberá establecer en término de días, semanas, meses o años.**

La garantía del producto o servicio deberá detallar claramente qué incluye. El licitador se obligará a honrar la garantía suscrita con la oferta o propuesta, así como la garantía dispuesta por el manufacturero.

El licitador deberá asumir los costos relacionados a la garantía, incluidos los gastos de transporte o envío.

Se considerará de manera preferente la garantía prestada por un manufacturero de Puerto Rico a la garantía prestada por un manufacturero del exterior.

Todo licitador vendrá obligado a honrar al Gobierno de Puerto Rico la garantía del manufacturero, si alguna, independientemente de si se compra o no a través de un distribuidor.

En las "Especificaciones" y "Condiciones Especiales" de este pliego de subasta formal se podrá establecer la garantía mínima (periodo mínimo de garantía) que requiere la ASG para el bien, obra y/o servicio.

En la columna identificada como "Garantía" incluida en la Tabla de Ofertar, el licitador hará constar la garantía ofrecida para el bien, obra y/o servicio ofertado (qué incluye y el periodo de garantía): el licitador podrá ofrecer mayor garantía a la requerida por la ASG, pero no podrá ofrecer una garantía menor.

El ofrecimiento por parte del licitador de una garantía menor a la requerida por la ASG para el bien, obra y/o servicio, podrá conllevar el rechazo de la oferta.

En cualquier caso que, en las "Especificaciones" y "Condiciones Especiales" de este pliego de subasta formal la ASG no establezca garantía mínima para el bien, obra y/o servicio, SERÁ OBLIGACIÓN DEL LICITADOR detallar en la Tabla de Ofertar la garantía incluida para el bien, obra y/o servicio ofertado en término de días, meses, semanas o años.

En cualquier caso que, en las "Especificaciones" y "Condiciones Especiales" de este pliego de subasta formal la ASG se establezca garantía mínima para el bien, obra y/o servicio, y el licitador no indique un término distinto en la Tabla de Ofertar, se entenderá que con la firma de la Oferta acoge dicha garantía mínima como suya.

9. EVALUACIÓN Y ADJUDICACIÓN

A. EVALUACIÓN

La Junta de Subastas, el Especialista en Compras y Subastas y/o el Comité Evaluador de Subastas evaluarán las ofertas y cómo éstas cumplen con los criterios de evaluación establecidos en las especificaciones, los términos y las condiciones indicadas en el pliego de la subasta formal.

Al evaluar las ofertas el Especialista de Compras y Subastas y/o el Comité Evaluador de Subastas podrán tomar en consideración los siguientes criterios:

a. La exactitud con la cual el licitador ha cumplido con las especificaciones, los términos y las condiciones del pliego de la subasta formal.

b. La calidad de los bienes, obras y servicios no profesionales ofrecidos y cómo éstos cumplen con las especificaciones y satisfacen las necesidades establecidas. En las situaciones en que se efectuaron pruebas con muestras suministradas por el licitador, se incluirá la evaluación de la muestra del bien entre los aspectos de este criterio de calidad.

c. Si el precio es competitivo y comparable con el prevaleciente en el mercado. Además, aplicará el porciento (%) de preferencia establecido si la persona o la entidad ha presentado una Resolución de la Junta para la Inversión en la Industria Puertorriqueña o cualquier documento acreditativo de preferencia, según dispuesto en leyes preferenciales.

d. La experiencia del licitador para llevar a cabo trabajos de la naturaleza bajo consideración en obras y servicios no profesionales.

e. El término de entrega más próximo.

f. La capacidad económica y financiera, así como la trayectoria y experiencia previa del licitador para proveer estos servicios o bienes y cumplir con los términos de entrega y garantías del producto o servicio.

g. El período específico o los términos aplicables a cada garantía, sus limitaciones y condiciones, los pasos requeridos para reclamar la garantía, qué entidad proveerá el servicio de reemplazo, subsanación, corrección o reparación del bien o el servicio.

h. Si el licitador es empresa minoritaria o de mujeres, u otra para la cual se deba considerar bajo cualquier ley aplicable.

i. Cualquier otro criterio pertinente que represente el mejor valor para el Gobierno de Puerto Rico.

La Junta de Subastas examinará y evaluará todas las ofertas presentadas antes de adjudicar la subasta. En cualquier momento durante el periodo de evaluación, la Junta por medio de la Secretaría de la Junta podrá

comunicarse con los licitadores o citar a reuniones públicas para obtener aclaraciones sobre las ofertas. Esto se hará constar en el expediente. El propósito de estas aclaraciones no es obtener información adicional que no se presentó originalmente en la oferta, sino obtener una mejor comprensión del contenido proporcionado.

La evaluación o recomendación del Especialista en Compras y Subastas y/o del Comité Evaluador formará parte del expediente de la subasta.

La Junta de Subastas no estará obligada a acoger la evaluación y/o recomendación del Especialista en Compras y Subastas o del Comité Evaluador, si a su entender esta no representa el mejor valor para el Gobierno de Puerto Rico, y así lo hará constar en su Resolución de Adjudicación.

La Junta de Subastas adjudicará la *buena pro* al licitador responsivo que haya ofertado el mejor valor. **El mejor valor no necesariamente será la oferta o propuesta que presente el más bajo costo o precio.**

B. ADJUDICACIÓN

Una vez adjudicado un asunto ante la consideración de la Junta de Subastas, se notificará la determinación final mediante Resolución o Aviso de Adjudicación. La adjudicación (Resolución de Adjudicación) será notificada adecuadamente, mediante correo federal certificado con acuse de recibo o correo electrónico a todas las partes que tengan derecho a impugnar tal determinación, entiéndase, a todos los licitadores presentaron oferta. Cuando se notifique por correo electrónico, se utilizará el correo electrónico dispuesto por el licitador en el Anejo I. Cuando no se haya establecido correo electrónico en el Anejo I, se notificará al correo electrónico utilizado por el licitador para someter la oferta.

La notificación de la adjudicación de la subasta **no constituirá un acuerdo formal entre las partes. Será necesario que se suscriba el contrato correspondiente o se emita una orden de compra.**

10. COMPROMISO POR ADJUDICACIÓN

Ningún Licitador estará autorizado a entregar bienes, realizar obras u ofrecer servicios sin haberse otorgado un contrato y/o sin que se haya emitido una orden de compra o ambos, según determinado por la ASG.

No se considerará al Gobierno de Puerto Rico comprometido ni de ningún modo obligado por adjudicación alguna, hasta tanto se haya formalizado el correspondiente contrato y/o se haya emitido la orden de compra, o ambos, según determinado por la ASG.

11. REVISIÓN ADMINISTRATIVA

La parte adversamente afectada por una decisión de la Junta de Subastas podrá, dentro del término de veinte (20) días a partir del depósito en el correo federal o correo electrónico notificando la adjudicación de la subasta, presentar una solicitud de revisión ante la Junta Revisora de Subastas de la Administración de Servicios Generales.

Si la fecha de archivo en autos de la copia de la notificación de la determinación final de la adjudicación es distinta a la del depósito en el correo federal o correo electrónico, el término se calculará a partir de la fecha del depósito en el correo federal o del correo electrónico.

a) Notificación de la Presentación de Revisión Administrativa

La parte recurrente notificará copia de la solicitud de revisión administrativa a la Administración de la ASG y a la Junta de Subastas. Simultáneamente, notificará también al proveedor que obtuvo la buena pro en la subasta. Este requisito es de carácter jurisdiccional. En el propio escrito de revisión, la parte recurrente certificará a la Junta Revisora su cumplimiento con este requisito. La notificación deberá hacerse por correo certificado con acuse de recibo y correo electrónico. La parte recurrente deberá notificar, además, a todos los licitadores que participaron de la subasta.

12. CANTIDADES A SER COMPRADAS

La orden de compra emitida indicará las cantidades específicas de los bienes, obras y/o servicios a ser adquiridos.

13. MODO DE FACTURAR

Toda factura para el cobro de bienes, obras o servicios que se presente ante las agencias deberá contener la siguiente certificación:

Bajo pena de nulidad absoluta certifico que ningún servidor público ***(del Gobierno de Puerto Rico o indicar nombre de la agencia*** **que emite le orden de compra)** *es parte o tiene algún interés en las ganancias o beneficios producto del contrato objeto de esta factura y de ser parte o tener interés en las ganancias o beneficios productos del contrato, ha mediado una dispensa previa. La única consideración para suministrar los bienes o servicios objeto del contrato ha sido el pago acordado con el representante autorizado de la* (agencia que emite la orden de compras). *El importe de esta factura es justo y correcto, los trabajos han sido realizados, los productos han sido entregados y los servicios han sido prestados y no se ha recibido pago por ellos.*

14. PAGOS

Las agencias procesarán el pago conforme a lo dispuesto en la Carta Circular 1300-02-10 del Departamento de Hacienda, la cual establece que "será responsabilidad de las agencias exigirle al proveedor que entregue las facturas en o antes de diez (10) días después de la finalización, período o fecha de entrega del bien o servicio".

15. LEY DE PREFERENCIA

En todo proceso de compra la ASG y la Junta de cumplirán cabalmente con las políticas de preferencia, consagradas en las siguientes disposiciones legales:

- Ley 14-2004, según enmendada, conocida como "Ley para la Inversión de la Industria Puertorriqueña";

- Ley 129-2005, según enmendada, conocida como "Ley de Reservas en las Compras del Gobierno del Estado Libre Asociado de Puerto Rico";
- Ley 253-2006, conocida como "Ley de Contratos de Selección Múltiple en los Procesos de Compras";
- Ley 42-2018, según enmendada, conocida como "Ley de Preferencia para Contratistas y Proveedores Locales de Construcción".

a. USO DEL POR CIENTO DE PREFERENCIA: El Licitador que interese se le reconozca el por ciento (%) de preferencia asignado, presentará la resolución vigente otorgada por la Junta de Inversión en la Industria Puertorriqueña, por la Compañía de Comercio y Exportación de Puerto Rico o cualquier otro organismo rector juntamente con su oferta, en aras de validar su preferencia. La resolución deberá disponer el renglón o renglones a los cuales se les ha concedido la preferencia.

b. CESIÓN DEL POR CIENTO DE PREFERENCIA: La empresa que haya obtenido el por ciento de preferencia por concepto de manufactura para alguno de sus productos, podrá cederlo a sus agentes establecidos en Puerto Rico mediante carta notarizada en la que indique expresamente que le está cediendo a cada agente el por ciento de preferencia otorgado para dicho producto por la Junta de Inversión en la Industria Puertorriqueña o cualquier otro organismo rector. Dicha carta tendrá que estar aprobada y sellada con el sello oficial de la entidad gubernamental que la emite.

c. APLICACIÓN DEL POR CIENTO DE PREFERENCIA: Se aplicará el por ciento (%) de preferencia a los precios ofertados por el licitador para los bienes, obras y/o servicios.

d. RESOLUCIÓN EMITIDA ACTUALIZADA: En toda compra que se realice bajo un contrato u orden de compra producto de este pliego de subasta, el Licitador que haya obtenido un por ciento (%) preferencial para sus productos, deberá presentar al momento de cada compra, la resolución vigente emitida por la Junta de Inversión en la Industria Puertorriqueña, por la Compañía de Comercio y Exportación de Puerto Rico, o cualquier otro organismo rector. De no presentar la resolución vigente, no podrá disfrutar de los beneficios de dichas leyes.

16. FIANZAS Y/O GARANTÍAS

a. FIANZA DE LICITACIÓN ("*Bid Bond*")

La fianza de licitación será un respaldo provisional que prestará el Licitador con el propósito de asegurarle al Gobierno de Puerto Rico que habrá de sostener su oferta durante todo el procedimiento de la subasta.

Para esta subasta formal se requiere una **fianza de licitación por la cantidad del cinco (5) por ciento del total de la oferta presentada por el licitador**. Ni la Junta de Subastas ni la ASG aceptarán una fianza por un monto menor al aquí establecido o a nombre de otra entidad distinta a la Administración de Servicios Generales y/o Secretario de Hacienda, según sea el caso. Si la fianza de licitación se presenta a través de una compañía de seguros, la fianza se emitirá a favor de la Administración de Servicios Generales; si la fianza de licitación se presenta mediante cheque certificado o giro postal, se emitirá a favor del Secretario de Hacienda.

La fianza de licitación se presentará simultáneamente con la oferta sometida por el licitador físicamente; **en cualquier caso que el licitador no presente el documento y/o instrumento acreditativo de la fianza de licitación en ORIGINAL y FIRMADO será descalificado.**

El incumplimiento de este requisito dará lugar al rechazo de la oferta y la descalificación del licitador.

Cuando se suscriba el contrato o se emita la orden de compra, según aplique, la Junta de Subastas, devolverá todas las fianzas de licitación presentadas, incluida la del licitador agraciado a quien se le haya adjudicado la "buena pro".

La ASG podrá ejecutar la Fianza de Licitación si expirado el término de diez (10) días laborables a partir de la notificación de la adjudicación, el licitador agraciado no presenta la Fianza de Ejecución. Además, se podrá ejecutar si el licitador agraciado se niega a firmar el contrato dentro de los diez (10) días laborables siguientes de habérsele citado para ello.

b. FIANZA DE EJECUCIÓN ("*Performance Bond*")

El Licitador a quien se adjudique la "buena pro" de la subasta formal, deberá presentar una fianza de ejecución ante la Junta de Subastas, **no más tarde de los diez (10) días laborables siguientes a la notificación de la adjudicación.**

Dicha fianza garantizará la ejecución del contrato u orden de compra, según aplique.

Para esta subasta se requiere una **Fianza de Ejecución por la cantidad del cincuenta (50) por ciento del total de la oferta adjudicada**. Ni la Junta de Subastas ni la ASG no aceptará una fianza por un monto menor al aquí establecido o a nombre de otra entidad distinta a la Administración de Servicios Generales y/o Secretario de Hacienda, según sea el caso. Si la fianza de ejecución se presenta a través de una compañía de seguros, la fianza se emitirá a favor de la Administración de Servicios Generales; si la fianza de ejecución se presenta mediante cheque certificado o giro postal, se emitirá a favor del Secretario de Hacienda.

Se podrá ejecutar la Fianza de Ejecución si transcurrido el término dispuesto en la oferta, el licitador agraciado no entrega los bienes, no honra las garantías o no cumple las obligaciones según contratadas, por causas imputables a éste. En adición, el licitador tendrá que responder económicamente por la diferencia en precio se adjudique en segunda instancia o del precio que se obtenga mediante compra excepcional. Si la fianza no cubre dicho exceso, se reclamará el balance al licitador concernido.

17. PENALIDAD POR ENTREGA TARDÍA DE BIENES O EN LA RENDICIÓN DE SERVICIOS NO PROFESIONALES

El licitador con quien la Administración o cualquier entidad gubernamental perfeccione un contrato o al licitador a quien se emita una orden de compra, vendrá obligado a suministrar el bien mueble o servicio ordenado de conformidad con los términos de entrega, especificaciones y otras condiciones estipuladas.

Habido incumplimiento del contrato de parte del licitador por retraso en la entrega del bien mueble o servicio no profesional contratado, la Oficina de Finanzas, al momento de tramitar el pago, podrá hacer un descuento del medio por ciento del valor del contrato incumplido por cada día laborable de retraso; entendiéndose que en ningún momento el importe total a ser descontado por daños y perjuicios excederá el diez por ciento (10%) del importe del contrato para la partida correspondiente. Igualmente, la fianza que garantiza la ejecución del contrato responderá del pago de daños y perjuicios.

La penalidad por entrega tardía de un proyecto de obra de construcción se fijará según dispone el Reglamento Núm. 9230, *supra*.

18. PENALIDADES AL LICITADOR POR INCUMPLIMIENTO DE CONTRATO

El Administrador de la ASG, ante el incumplimiento de contratos y determinación de falta de responsabilidad económica o de otra índole por parte de los contratistas, podrá imponer las penalidades o medidas que estime adecuadas para la protección del interés público, incluyendo, pero sin limitarse a: la confiscación de la fianza o fianzas depositadas en garantía, y; la eliminación del Registro Único de Licitadores (RUL) por el tiempo que estimare pertinente, el nombre de cualquier persona natural o jurídica que incumpliere un contrato o que en otra forma incurra en violación a los términos de la orden.

Además, la ASG se reserva el derecho de aplicar cualesquiera otras sanciones, según provistas en el Reglamento antes mencionado, en la Ley 73-2019, según enmendada, así como también, las pactadas en el contrato otorgado u orden de compra emitida.

Las medidas tomadas en caso de incumplimiento serán impuestas solamente por la ASG, previa investigación de los hechos, mediando notificación adecuada y en observancia del debido proceso de ley.

19. CANCELACIÓN DE ORDEN DE COMPRA POR NEGATIVA A ENTREGAR LOS BIENES, NEGATIVA A REALIZAR LA OBRA O NEGATIVA A PRESTAR LOS SERVICIOS CONTRATADOS

Si el licitador se niega a entregar los bienes ordenados, se niega a realizar la obra contratada o se niega a prestar los servicios contratados, la Administración podrá cancelar la orden de compra y/o contrato relacionado. También podrá emitir una nueva orden de compra y/u otorgar un contrato que considere los mismos bienes, obras y/o servicios a favor de otro licitador, sin perjuicio de la aplicación de cualesquiera otras medidas dispuestas en otras disposiciones legales relacionadas a incumplimiento contractual.

20. CERTIFICACIONES

El licitador deberá incluir con su oferta, **según sea requerido en este pliego de subasta formal**, aquellas certificaciones o licencias necesarias requeridas para suplir los bienes, realizar las obras y/o realizar las prestaciones de servicios considerados en las especificaciones.
Todo licitador deberá cumplir con lo siguiente:

A. CÓDIGO DE ÉTICA PARA CONTRATISTAS:

Todo Licitador deberá cumplir con lo establecido en la Ley Núm. 2-2018, según enmendada, conocida como ***"Código Anticorrupción para el Nuevo Puerto Rico"***. Será requisito indispensable para contratar con el Gobierno que toda persona se comprometa a regirse por las disposiciones del Código de Ética establecido en la ley de referencia.

Además, la persona natural o jurídica que desee participar de la adjudicación de una subasta o en el otorgamiento de algún contrato, con cualquier agencia o instrumentalidad gubernamental, corporación pública, municipio, o con la Rama Legislativa o Rama Judicial, para la realización de servicios o la venta o entrega de bienes, **someterá una declaración jurada**, ante notario público, en la que informará si la persona natural o jurídica o cualquier presidente, vicepresidente, director, director ejecutivo, o miembro de una junta de oficiales o junta de directores, o personas que desempeñen funciones equivalentes para la persona jurídica, ha sido convicta o se ha declarado culpable de cualquiera de los delitos enumerados en la Sección 6.8 de la Ley 8-2017, según enmendada, conocida como "Ley Administración y Transformación de los Recursos Humanos en el Gobierno de Puerto Rico", o por cualquiera de los delitos contenidos en dicho Código. **La declaración jurada se deberá someter solo en aquellos casos donde el licitador no este registrado en el RUL o no tenga el RUL vigente.**

Cualquier persona, sea natural o jurídica, que haya sido convicta por: infracción a los Artículos 4.2, 4.3 o 5.7 de la Ley 1-2012, conocida como ***"Ley Orgánica de la Oficina de Ética Gubernamental"***, por infracción a alguno de los delitos graves contra el ejercicio del cargo público o contra los fondos públicos de los contenidos en los Artículos 250 al 266 de la Ley 146-2012, según enmendada, conocida como ***"Código Penal de Puerto Rico"***, por cualquiera de los delitos tipificados en el Código o por cualquier otro delito grave que involucre el mal uso de los fondos o propiedad pública, incluyendo sin limitarse los delitos mencionados en la Sección 6.8 de la Ley 8-2017, estará inhabilitada de contratar o licitar con cualquier agencia ejecutiva del Gobierno de Puerto Rico por el término aplicable bajo el Artículo 6.8 de la Ley 8-2017. Cuando no se disponga un término, la persona quedará inhabilitada por diez (10) años contados a partir de la fecha en que termine de cumplir la sentencia.

Todo contrato deberá incluir una cláusula de resolución en caso de que la persona que contrate con las agencias ejecutivas resultare convicta, en la jurisdicción estatal o federal, por alguno de los delitos que le inhabilitan para contratar bajo el inciso anterior. En los contratos se certificará que la persona no ha sido convicta, en la jurisdicción estatal o federal, por ninguno de los delitos antes dispuestos. **El deber de informar será de naturaleza continua durante todas las etapas de contratación y ejecución del contrato.**

Todo Licitador queda sujeto a las **sanciones y penalidades establecidas en el Artículo 3.7. — Sanciones y penalidades de la Ley 2-2018**, según enmendada. (3 L.P.R.A. § 1883f) o cualquier otra ley que la sustituya.

B. CÁNONES DE ÉTICA DE SU PROFESIÓN:

Toda persona deberá observar las máximas y los principios de excelencia y honestidad que cobijan su profesión, además de las normas o cánones éticos de la asociación o colegio al cual pertenece y que reglamenta su oficio o profesión, tanto en la relación con sus competidores como con el Gobierno de Puerto Rico.

En el caso de personas que no pertenezcan a un colegio o asociación, o en el caso de asociaciones y colegios que no posean un Código de Ética para sus miembros, deberán observar los principios generales de conducta ética que se consideran razonables en su profesión u oficio.

21. COLABORACIÓN INVESTIGATIVA

Toda persona, licitador o contratista colaborará con cualquier investigación que inicie el Gobierno estatal o federal sobre transacciones de negocios u otorgación de contratos o concesión de incentivos gubernamentales, del cual fue parte o se benefició directa o indirectamente.

22. CLÁUSULA ANTIDISCRIMEN

Ni la Junta de Subastas ni la ASG discriminan por razón de raza, color, género, origen o condición social, ideas políticas o religiosas, edad, nacionalidad, por ser víctima o ser percibida como víctima de violencia doméstica, agresión sexual o acecho, condición de veterano, identidad u orientación sexual, real o percibida, impedimento físico, mental o sensorial.

23. COMUNICACIONES Y ANUNCIOS

Se advierte a todos los licitadores y personas naturales o jurídicas interesadas en participar en este proceso de subasta formal que **está prohibido tener contacto con relación a esta subasta con los funcionarios de la Junta de Subastas y de la ASG, así como de la Administración Auxiliar de Adquisiciones y de la Oficina de Compras**, durante todo el proceso de licitación y hasta que esta subasta este adjudicada por la Junta de Subastas. El incumplir con lo anterior resultará en el rechazo de la oferta.

Comunicaciones con otros representantes del Gobierno respecto a cualquier asunto relacionado a esta subasta formal está prohibido durante todo el proceso de licitación. Cualquiera que incumpla con lo antes indicado, será descalificado y podrá conllevar cualquier otra penalidad impuesta por leyes o reglamentos aplicables.

Toda comunicación se efectuará por medio del siguiente correo electrónico: juntadesubastas@asg.pr.gov.

El licitador deberá enviar toda duda o pregunta relacionada a esta subasta al siguiente correo electrónico: preguntas@asg.pr.gov.

Cualquier información o anuncio relacionado con esta subasta formal será publicado por la Junta de Subastas a través de la página cibernética de la ASG (**www.asg.pr.gov/ReformaCompras/Pages/default.aspx**) y notificado mediante correo electrónico a los licitadores hábiles para participar del proceso. Toda información, anuncio público o enmienda relacionada a esta subasta se hará por escrito con las debidas autorizaciones de la ASG y la Junta de Subastas y emitidos por la Junta.

IV. FORMALIZACIÓN DE CONTRATO CON LA ADMINISTRACIÓN DE SERVICIOS GENERALES

1. FORMALIZACIÓN DEL CONTRATO

En relación a la subasta formal de referencia, la ASG formalizará un contrato. La oferta del licitador agraciado y lo dispuesto en el pliego de la subasta formal constituirá la base del contrato entre el licitador agraciado y la ASG. El contrato se formalizará tan pronto la ASG reciba las garantías y/o fianzas requeridas del licitador.

2. RENEGOCIACIÓN DE LOS PRECIOS, TÉRMINOS Y CONDICIONES DEL CONTRATO (NO LIMITADA A EXTENSIONES DE VIGENCIA DE CONTRATO)

Los precios ofrecidos por el licitador **se mantendrán fijos** durante la vigencia del contrato que se otorgue y no estarán sujetos a cambios por aumento en el mercado o de cualquier otra índole, ya sean previsibles o no, **salvo lo dispuesto en el inciso 3 de la sección III de este pliego de subasta formal.**

Ningún comprador de entidad alguna (incluida la ASG), está autorizado a renegociar los precios, términos y condiciones establecidos en el contrato.

Como excepción, la Administradora de la ASG, *motu propio* o a petición de licitador interesado, podrá autorizar enmiendas a los precios, términos y condiciones establecidos en cualquier contrato, de existir **justa causa** para ello, durante la vigencia del contrato. La ASG realizará el análisis correspondiente para determinar si procede la enmienda propuesta. Los fundamentos que amparan las correspondientes enmiendas deberán constar en escrito relacionado.

3. NEGATIVA A FORMALIZAR EL CONTRATO

La ASG podrá ejecutar la Fianza de Licitación si el licitador agraciado **se niega a firmar el contrato, una vez convocado para ello por parte de la Oficina de Contratos de la ASG.**

4. VIGENCIA DEL CONTRATO

La Administración podrá celebrar cualquier procedimiento de subasta formal con el objetivo de otorgar un contrato, bajo cuyos términos y condiciones, se podrán levantar órdenes de compra relacionadas.

El contrato que se formalice bajo esta subasta tendrá una vigencia de **(no aplica)**, contados a partir de su otorgamiento.

La Administración podrá autorizar enmendar el contrato a los fines de extender su vigencia cumpliendo con lo dispuesto en la Sección 7.3.25 del Reglamento Núm. 9230, *supra*. El suplidor será informado por escrito y con anticipación a la fecha de vencimiento del contrato de la intención de extender éste por parte de la ASG. Las enmiendas se harán mediante escrito de "Enmienda" y deberá contar con las firmas de las partes.

5. ALCANCE DEL CONTRATO

El contrato que se otorgará bajo esta subasta formal cubrirá las necesidades de la agencia requirente, entidades gubernamentales y entidades exentas del Gobierno de Puerto Rico, según definidas en la Ley 73, *supra*. También cubrirá las necesidades de los municipios. El suplidor no podrá negarse a ofrecer los servicios a ninguna entidad gubernamental, exenta y municipios.

6. INSTRUCCIONES DE USO DEL CONTRATO

Al adjudicarse la subasta por la Junta de Subastas, la Administración Auxiliar de Adquisiciones (Unidad de Contratos) formalizará un contrato entre las partes. La Administración Auxiliar de Adquisiciones orientará a los compradores sobre el uso del contrato mediante las "Instrucciones de Uso de Contrato". Las referidas instrucciones incluirán los mismos términos y condiciones que surgen del pliego de la subasta formal y la tabla de ofertar. Las instrucciones constituirán una guía de uso exclusivamente para los compradores.

V. RESCISIÓN DEL CONTRATO

Ningún jefe de agencia gubernamental o instrumentalidad del Gobierno, corporación pública, municipio, o de la Rama Legislativa o Rama Judicial, adjudicará subasta u otorgará contrato alguno para la realización de servicios o la venta o entrega de bienes, a persona natural o jurídica que haya sido convicta o se haya declarado culpable en el foro estatal o federal, en cualquier otra jurisdicción de Estados Unidos de América o en cualquier otro país, de aquellos delitos constitutivos de fraude, malversación o apropiación ilegal de fondos públicos dispuestos en la Ley 2-2018, *supra*, según enmendada. Esta prohibición de adjudicar subastas u otorgar contratos, se extiende a aquellas personas jurídicas cuyos presidentes, vicepresidentes, directores, directores ejecutivos, o miembros de su Junta de Oficiales o Junta de Directores, o persona que desempeñe funciones equivalentes, haya sido convicto o se haya declarado culpable en el foro estatal o federal, en cualquier otra jurisdicción de Estados Unidos de América o en cualquier otro país, de aquellos delitos constitutivos de fraude, malversación o apropiación ilegal de fondos públicos, según enumerados en la referida Ley.

La prohibición para la contratación, subcontratación o adjudicación de una subasta contenida en la Ley 2-2018, *supra*, tendrá una duración de veinte (20) años, a partir de la convicción correspondiente en casos por delito grave, y una duración de ocho (8) años en casos por delito menos grave.

La convicción o culpabilidad por cualquiera de los delitos enumerados en la Ley 2-2018, *supra*, conllevará, además de cualesquiera otras penalidades, la rescisión automática de todos los contratos vigentes a esa fecha entre la persona convicta o declarada culpable y cualesquiera agencias o instrumentalidades del Gobierno estatal, corporaciones públicas, municipios, la Rama Legislativa o la Rama Judicial. Además de la rescisión del contrato, el Gobierno tendrá derecho a exigir la devolución de las prestaciones que hubiese efectuado con relación al contrato o contratos afectados directamente por la comisión del delito.

VI. ESPECIFICACIONES

Las especificaciones incluidas en este pliego de subasta formal son el conjunto de características físicas, funcionales, estéticas y de calidad de cada uno de los bienes, obras y/o servicios que se solicitan, los cuales sirven de guía para describir detalladamente lo que se solicita. Los licitadores vienen obligados a cumplir cabalmente con cada uno de los detalles incluidos en las especificaciones.

El Licitador deberá cumplir con las Especificaciones incluidas en los documentos de esta subasta.

VII. CONDICIONES E INSTRUCCIONES ESPECIALES

1. **Se requiere una garantía mínima para los equipos, materiales y labor de un (1) año. Los compresores deberán estar garantizados**
2. **Todo licitador tiene que cumplir con las especificaciones y el alcance de los trabajos detallados en la tabla de ofertar.**
3. El Contratista mantendrá limpias las áreas de trabajo en todo momento. No se permitirá la disposición de desperdicios en los contenedores de basura del Hospital. Los desperdicios deberán ser removidos periódicamente fuera de las facilidades.
4. El Contratista es responsable de rectificar las medidas y evaluar las condiciones existentes de las facilidades.
5. El Contratista tendrá que entregar a la Agencia Requirente la póliza de Responsabilidad Pública vigente y que respalde este proyecto (endosos).
6. El Contratista tendrá que entregar a la Agencia Requirente la póliza de Corporación del Fondo del Seguro del Estado (CFSE).
7. **Los licitadores deberán entregar junto con su oferta copia del documento de Auto certificación Patronal Plan de Control y Exposición a COVID-19.**
8. El Contratista deberá comunicarse con el encargado del proyecto antes de comenzar labores.
9. Empleados en área de proyecto, deben cumplir con las regulaciones de OSHA.
10. Empleados en área de proyecto, deben tener camiseta identificada con el nombre de la compañía a la cual representan.
11. Los licitadores tendrán que contemplar en su oferta la renta de los equipos necesarios para realizar las labores.
12. El Contratista será responsable de realizar el trabajo de manera que garantice la seguridad de los empleados, pacientes y visitantes del complejo, así como de los empleados del Contratista.
13. Cualquier trabajo realizado por el Contratista que NO este incluido en el Pliego de Subasta u orden de compra será bajo el propio riesgo del contratista y sin costo para la Agencia Requirente.
14. El Contratista deberá tomar fotos de las áreas a impactarse antes y después de completados los trabajos. Las fotos deberán incluirse en la factura.
15. Cualquier rotura de las facilidades públicas o privadas existentes serán reparadas sin costa al dueño o ASSMCA. El Contratista deberá reparar todo daño causado por los trabajos y dejar la infraestructura en su estado original. Esto incluye plafón acústico y techos en "gypsum board".
16. **El Licitador entregará con su oferta la literatura de los equipos ofertados que permitan validar el cumplimiento con las especificaciones.**
17. **El término de entrega más próximo podrá ser tomado en consideración al momento de adjudicar.**

18. El Contratista entregará a la Agencia Requirente una vez emitida la orden de compra un "schedule" detallado de la forma en que realizará los trabajos en cumplimiento con el término dispuesto por el Contratista en su oferta.
19. El Contratista tendrá que cumplir con las leyes y regulaciones ambientales, según aplique.
20. El Contratista será responsable de los arbitrios, impuestos municipales y estatales, según aplique.
21. El Contratista será responsable de conseguir el permiso de construcción o notificación de obra exenta de permiso de construcción por parte de la Oficina de Gerencia de Permiso (OGPe), según aplique.
22. El Contratista tendrá que instalar un rótulo de 4'x 8 con la descripción del proyecto, los logos de ASSMCA, ASG y del Gobierno de Puerto Rico. El rótulo debe ser aprobado por la Agencia Requirente.
23. Se requiere proveer certificación eléctrica por un perito electricista autorizado y certificación de instalación de sistema de aire acondicionado por un técnico de refrigeración autorizado.

Administración de Servicios Generales
Gobierno de Puerto Rico

Anejo I

OFERTA DEL LICITADOR

Fecha: _____

_____
Nombre Compañía / No. Licitador

[ ] Negocio privado , [ ] Corporación, o [ ] Asociación, por la presente somete su oferta.

Seguro Social Patronal: _____

Hacemos constar que hemos leído todas las instrucciones, términos, condiciones y cláusulas del pliego de subastas; que entendemos y aceptamos cumplir con todas las cláusulas contenidas en éstos y en el contrato. Asimismo, certificó que sostendré mi oferta durante todo el proceso de licitación y hasta que cumpla con la entrega de los bienes, la finalización de la obra o se presten los servicios adjudicados.

La dirección sometida con esta oferta es la dirección donde recibimos nuestra correspondencia.

Yo, _____, CERTIFICO que estoy autorizado a firmar esta oferta y mi nombre y firma constan registradas en el Registro de Licitadores.

Nombre en letra de molde	Firma	Puesto o cargo que ocupa

Dirección Postal:

_____
_____
_____

Dirección Física:

_____
_____
_____

Número de Teléfono y Fax:

Correo Electrónico: _____

Corporación Foránea

Nombre del Agente Residente		Número de Teléfono y Fax
	Dirección	

ANEJO II

Administración de Servicios Generales
Gobierno de Puerto Rico

Yo,_____, en mi carácter personal, mayor de edad,
(nombre y apellidos)
_____,_____, y vecino de_____,_____,
(estado civil) (profesión) (ciudad) (país o estado)

CERTIFICO LO SIGUIENTE:

1. Que mi nombre y demás circunstancias personales son las anteriormenteexpresadas.
2. Que comparezco como dueño de negocio de tipo individual.
3. Que el nombre comercial de mi negocio (D/B/A, *si aplica*), es el siguiente,
_____.
4. Que el propósito del negocio individual que represento es proveer los siguientesbienes, obras y/o servicios profesionales o no profesionales: *(escriba a que se dedica)*
_____
_____
_____
5. Que las siguientes personas, **cuyas firmas aparecen en el presente documento más adelante**, están autorizadas a nombre y en representación del negocio, a firmar las ofertas que se sometan como parte de los procesos de compra de bienes y servicios profesionales y no profesionales que se lleven a cabo por las distintas agencias, corporaciones públicas y municipios del Gobierno de Puerto Rico.
6. Que **las firmas de las personas que constan en el presente documento** obligan al negocio que represento en todos los procesos de compra de bienes y servicios profesionales o no profesionales realizados por las agencias de la RamaEjecutiva del Gobierno de Puerto Rico, corporaciones públicas y municipios. De igual forma, dichas personas están autorizadas a firmar ofertas y suscribir todo tipo de documento requerido como parte de dicha comparecencia.

Nombre y Apellidos	Posición	Firma

7. Que suscribo la presente Certificación con el propósito de cumplir con uno de losrequisitos para ingresar al Registro Único de Licitadores (RUL) o al Registro Únicode Proveedores de Servicios Profesionales (RUP) y para cualquier otro propósito administrativo o legal pertinente.

Y PARA QUE ASÍ CONSTE, firmo la presente certificación en_____,
(ciudad)
_____, hoy_____de_____de 20_____.
(país o estado)

_____
FIRMA

Afidávit Número: _____

JURADA Y SUSCRITA ante mí por _____, de las circunstancias personales antes mencionadas, en su carácter de _____ de la _____ (tipo de negocio) y a quien identifico mediante _____.

En _____, _____, hoy ____ de _____ de 20___.

_____
Nombre del (de la) Notario(a)

_____
Firma del (de la) Notario(a)

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ANEJO III

RESOLUCIÓN CORPORATIVA

(no se aceptará Declaración Jurada que tenga borrones, tachaduras o corrector)

Yo_____, mayor de edad, (estado civil) _____, (profesión) _____, y vecino de _____, en calidad de _____ de la (tipo de negocio) _____, certifico, que en reunión celebrada el día _____ de _____ de 20_____, a la cual asistió el quórum reglamentario, se resolvió autorizar a las personas nombradas a continuación, para que cualquiera de ellas, a nombre y en representación de esta Corporación, puedan comparecer a los procesos de compra de bienes y servicios no profesionales realizados por las agencias de la Rama Ejecutiva del Gobierno de Puerto Rico, corporaciones públicas y municipios, así como firmar ofertas y suscribir contratos y todo tipo de documento requerido como parte de dicha comparecencia, por lo que sus firmas, las cuales se hacen constar en este documento, obligan a esta (tipo de negocio) _____.

Nombre y Apellido	Posición	Firma

En mi carácter de _____ de la (tipo de negocio) _____, certifico, además, que la Resolución arriba transcrita no ha sido revocada, anulada o enmendada en forma alguna y que se mantiene vigente con toda su fuerza y vigor.

PARA QUE ASÍ CONSTE, firmo la presente y estampo el sello de la _____ (tipo de negocio).

En _____, _____, hoy ____ de _____ de 20___.

_____
Firma del (de la) Declarante

Sello Negocio

AFIDÁVIT

Afidávit Número: _____

JURADA Y SUSCRITA ante mí por _____, de las circunstancias personales antes mencionadas, en su carácter de _____ de la _____ (tipo de negocio) y a quien identifico mediante _____.

En _____, _____, hoy ____ de _____ de 20___.

_____
Nombre del (de la) Notario(a)

_____
Firma del (de la) Notario(a)

Sello Notarial

HOSPITAL DE PSIQUIATRÍA GENERAL DR. RAMÓN FERNÁNDEZ MARINA SAN JUAN, PUERTO RICO

ASSMCA

Especificaciones:

Reparaciones de Chiller 70 toneladas:

- Remplazo de todos los sensores y transduce (temperatura, ambiental, flujo de agua, refrigeración y otros)
- Remplazo de toda la cablería de los sensores
- Remplazo de un (1) compresor
- Remplazo de los aceites y filtros de todos los compresores
- Descontaminar el sistema de refrigeración
- Remplazo de un (1) fan motor
- Limpieza profunda de coil y chiller
- Programación del Chiller (sistema de control)
- Carga de refrigerante de ser necesario
- Chequeo y mantenimiento general del chiller
- Programación general y start - up
- Acondicionamiento de frame de metal.
- Acondicionamiento de aislamiento de agua helada

Remover y reemplazar Chiller 70 toneladas:

- Ver Anejo V, VI

Remover y reemplazar 6 unidades manejadoras de aire TRANE

- AHU-01 2,290 C.F.M ver Anejo V, VI
- AHU-02 4,225 C.F.M ver Anejo V, VI
- AHU-03 3,405 C.F.M ver Anejo V, VI
- AHU-04 4,020 C.F.M ver Anejo V, VI
- AHU-05 7,000 C.F.M ver Anejo V, VI
- AHU-06 2,650 C.F.M ver Anejo V, VI

Remover y reemplazar 2 bombas de Agua

- Ver Anejo V, VI

Habitaciones de Manejadoras

• Habitación #1

Preparar y pintar habitación 9 x 11 – 12 ½ alto, con piso en pintura "epoxica" con zócalo de 2 pies de altura.,

• Habitación #2

Preparar y pintar habitación 9 x 11 – 12 ½ alto, con piso en pintura "epoxica" con zócalo de 2 pies de altura.,

- **Habitación #3**

Preparar y pintar habitación 8 ½ x 10 ½ – 12 ½ de alto, con piso en pintura "epoxica" con zócalo de 2 pies de altura.

- **Habitación #4**

Preparar y pintar habitación 14 ½ x 7 – 12 ½ de alto, con piso en pintura "epoxica" con zócalo de 2 pies de altura.

- **Habitación #5**

Preparar y pintar habitación 14 ½ x 7 – 12 ½ de alto, con piso en pintura "epoxica" con zócalo de 2 pies de altura.

- **Habitación #6**

Preparar y pintar habitación 12 x 7 – 12 ½ de alto, con piso en pintura "epoxica" con zócalo de 2 pies de altura.

VAC RENOVATIONS AT GENERAL PSYCHIATRIC HOSPITAL

Anejo V

AT

HOSPITAL DE PSIQUIATRÍA GENERAL DR. RAMÓN FERNÁNDEZ MARINA

SAN JUAN, PUERTO RICO

DRAWING INDEX:

OWNER'S:

assmca

DEPARTAMENTO DE SALUD
GOBIERNO DE PUERTO RICO

LOCATION MAP

SCALE = 1:200

SITE

JLMS, CONSULTING ENGINEERS, PSC

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Tel: 787-772-9121 (Fax)
E-mail: j.marrero@jlmpe.com

BID SET DRAWINGS

DATE: June 2, 2021

Project Name:
VAC RENOVATIONS AT GENERAL PSYCHIATRIC HOSPITAL DR. RAMÓN FERNÁNDEZ MARINA
San Juan, Puerto Rico

Rev. #	Date	Revision By	Description

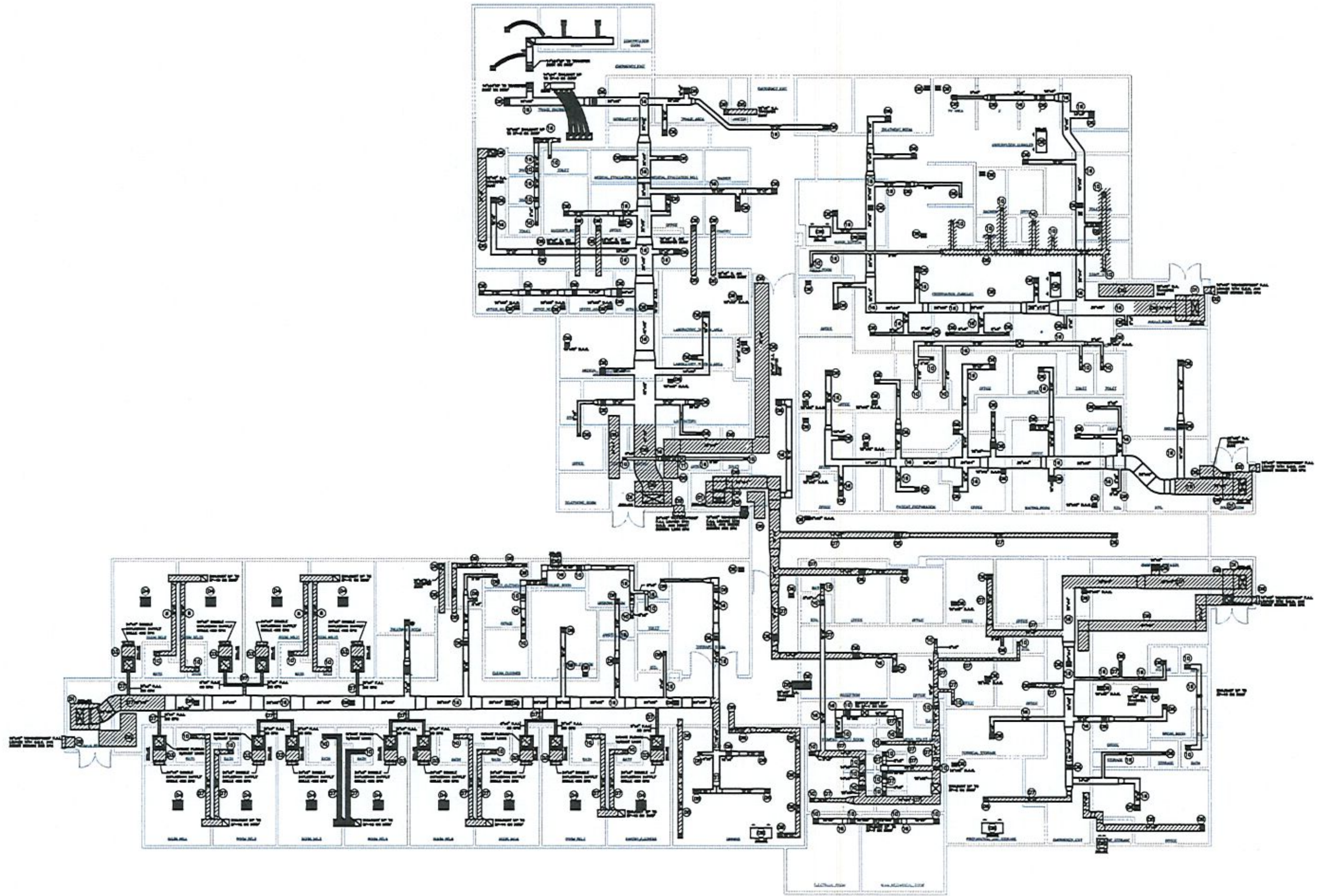
Drawing Name: TITLE SHEET

Owner: ASSMCA

Digital Signature:

Stamp: JOSE L. MARRERO SICARDO — PUERTO RICO

JLMS Project Num: 21-027
Drawing Date: June 2, 2021
Checked By: J. L. Marrero
Scale: Not to Scale
Page: 1 of 14 T-100



EXISTING FLOOR PLAN – VAC DEMOLITION LAYOUT

SCALE: 3/32" = 1'-0"

DEMOLITION SCOPE OF WORK

01. EXISTING AIR HANDLING UNIT (AHU) TO BE REPLACED. (INCLUDING FILTERS, CONTROL PANEL, VIBRATION ISOLATORS, UV LIGHT, AND RE-HEAT COILS. AHU ROOM DRAIN SHALL BE TESTED FOR PROPER DRAINAGE UNCLOG IF NECESSARY. EXISTING CONCRETE PAD TO REMAIN MODIFY AS REQUIRED TO ACCOMMODATE THE NEW EQUIPMENT).
02. EXISTING WEATHERPROOF FRESH AIR INTAKE (F.A.I.) LOUVERS TO BE REPLACED.
03. EXISTING FAN-COIL UNIT TO BE REPLACED. (INCLUDING FILTERS, UV LIGHT AND RE-HEAT COILS).
04. EXISTING CEILING CASSETTE TO REMAIN AS BACK-UP.
05. EXISTING RETURN TRANSFER DUCT TO BE REMOVED. (INCLUDING FIRE DAMPERS, HANGERS AND SUPPORT).
06. EXISTING SUPPLY DIFFUSER TO BE REPLACED.
07. EXISTING DUCTWORK TO BE REMOVED (INCLUDING SUPPORT AND HANGERS. CONTRACTOR SHALL REPLACE ALL EXISTING OBD'S AND PROVIDE NEW ONES AS REQUIRED FOR PROPER AIR BALANCING). SEAL & PATCH EXISTING ROOF OPENING TO MATCH EXISITNG ROOF FINISH.
08. EXISTING MINI-SPLIT UNITS TO REMAIN AS BACK-UP.
09. EXISTING RETURN GRILLE TO BE REPLACED.
10. EXISTING EXHAUST GRILLE TO BE REPLACED.
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20. EXISTING SUPPLY FAN TO BE REPLACED.
21. EXISITNG EXHAUST FAN TO REMAIN.
22. EXISITNG SOLAR WATER HEATER TO REMAIN.

LEGEND:

- EXISTING DUCTWORK AND EQUIPMENT TO BE DEMOLISHED.
- EXISTING DUCTWORK AND EQUIPMENT TO REMAIN.

ABBREVIATIONS:

EF	EXHAUST FAN	FLEX.	FLEXIBLE
CFM	CUBIC FEET PER MINUTE	CONN.	CONNECTION
S.A.	SUPPLY AIR	AHU	AIR HANDLING UNIT
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O.A.	OUTSIDE AIR	O.B.D.	OPPOSED BLADE DAMPER
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OAL	OUTSIDE AIR LOUVER	HWR	COLD WATER RETURN LINE
LCM	LOCAL CONTROL MODULE	BDD	BACKDRAFT DAMPER
GCM	GENERAL CONTROL MODULE	(E)	EXISTING
TYP.	TYPICAL	(N)	NEW
FCU	FAN COIL UNIT	⊕	POINT OF CONNECTION
DWG	DRAWING		

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BID SET DRAWINGS
DATE: June 2, 2021

Project Name:
VAC RENOVATIONS AT GENERAL PSYCHIATRIC HOSPITAL DR. RAMÓN FERNÁNDEZ MARINA
San Juan, Puerto Rico

Rev. #	Date	Revision By	Description

Drawing Name:
EXISTING VAC DEMOLITION LAYOUT

Owner:
ASSMCA

Digital Signature:

Stamp: JOSE L. MARRERO SICARDO, INGENIERO LICENCIADO, PUERTO RICO

JLMS Project Num: 21-027
Drawing Date: June 2, 2021
Checked By: J. L. Marrero
Scale: 1/32"=1'-0"
Page: 2 of 14
VAC-100

DEMOLITION SCOPE OF WORK

(01) EXISTING AIR HANDLING UNIT (AHU) TO BE REPLACED. (INCLUDING FILTERS, CONTROL PANEL, VIBRATION ISOLATORS, UV LIGHT, AND RE-HEAT COILS. AHU ROOM DRAIN SHALL BE TESTED FOR PROPER DRAINAGE UNCLOG IF NECESSARY. EXISTING CONCRETE PAD TO REMAIN MODIFY AS REQUIRED TO ACCOMMODATE THE NEW EQUIPMENT).

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(05) EXISTING RETURN TRANSFER DUCT TO BE REMOVED. (INCLUDING FIRE DAMPERS, HANGERS AND SUPPORT).

(06) EXISTING SUPPLY DIFFUSER TO BE REPLACED.

(07) EXISTING DUCTWORK TO BE REMOVED (INCLUDING SUPPORT AND HANGERS. CONTRACTOR SHALL REPLACE ALL EXISTING OBD'S AND PROVIDE NEW ONES AS REQUIRED FOR PROPER AIR BALANCING). SEAL & PATCH EXISTING ROOF OPENING TO MATCH EXISITNG ROOF FINISH.

(08) EXISTING MINI-SPLIT UNITS TO REMAIN AS BACK-UP.

(09) EXISTING RETURN GRILLE TO BE REPLACED.

(10) EXISTING EXHAUST GRILLE TO BE REPLACED.

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(21) EXISTING EXHAUST FAN TO REMAIN.

(22) EXISITNG SOLAR WATER HEATER TO REMAIN.

EXISTING CHWS & CHWR PIPING DEMOLITION LAYOUT

SCALE: 3/32" = 1'-0"

LEGEND:

- (hatched) EXISTING MECHANICAL EQUIPMENT OR PIPING TO BE DEMOLISHED.
- (solid line) EXISTING CHWS &CHWR PIPE TO REMAIN

ABBREVIATIONS:

EF	EXHAUST FAN	FLEX.	FLEXIBLE
CFM	CUBIC FEET PER MINUTE	CONN.	CONNECTION
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O.A.	OUTSIDE AIR	O.B.D.	OPPOSED BLADE DAMPER
PCU	PACKAGE UNIT	CHWS	CHILLED WATER SUPPLY LINE
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LCM	LOCAL CONTROL MODULE	BDD	BACKDRAFT DAMPER
GCM	GENERAL CONTROL MODULE	(E)	EXISTING
TYP.	TYPICAL	(N)	NEW
FCU	FAN COIL UNIT	⊕	POINT OF CONNECTION
DWG	DRAWING		

"Yo, José Luis Marrero Sicardo, licencia # [illegible], certifico que soy el profesional que diseñó estos planos y las especificaciones complementarias. También certifico que entiendo que dichos planos y especificaciones cumplen con las disposiciones aplicables del Reglamento Conjunto y las disposiciones aplicables de los Reglamentos y Códigos de las Agencias, Juntas Reglamentadoras o Corporaciones Públicas con jurisdicción. Reconozco que cualquier declaración falsa o falsificación de los hechos, que se haya producido sin conocimiento o por negligencia ya sea por mí, mis agentes o empleados, o por otras personas con mi conocimiento, me hacen responsable de cualquier acción judicial y disciplinaria por la OGPe y otras autoridades competentes, incluyendo, pero sin limitarse, a la terminación de la participación en los procedimientos de certificación profesional en la OGPe."

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BID SET DRAWINGS
DATE: June 2, 2021

Project Name:
VAC RENOVATIONS AT GENERAL PSYCHIATRIC HOSPITAL DR. RAMÓN FERNÁNDEZ MARINA
San Juan, Puerto Rico

Rev. #	Date	Revision By	Description

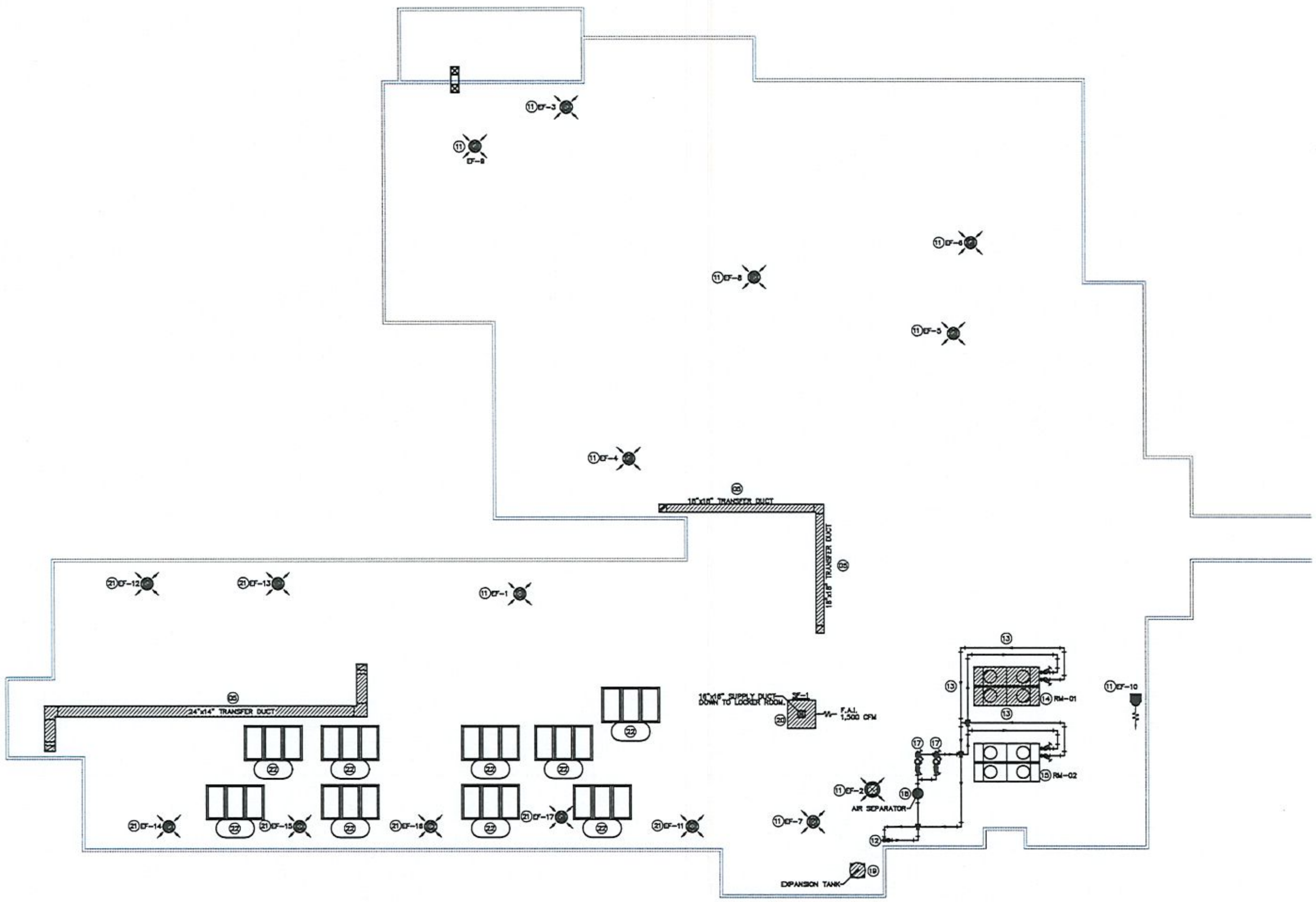
Drawing Name:
EXISTING CHWS & CHWR PIPING DEMOLITION LAYOUT

Owner:
ASSMCA

Digital Signature:

Stamp: JOSE L. MARRERO SICARDO · INGENIERO LICENCIADO · LIC. #[illegible] · PUERTO RICO

JLMS Project Num: 21-027
Drawing Date: June 2, 2021
Checked By: J. L. Marrero
Scale: 3/32"=1'-0"
Page: 1 of 14 VAC-101



DEMOLITION SCOPE OF WORK

01. EXISTING AIR HANDLING UNIT (AHU) TO BE REPLACED. (INCLUDING FILTERS, CONTROL PANEL, VIBRATION ISOLATORS, UV LIGHT, AND RE-HEAT COILS. AHU ROOM DRAIN SHALL BE TESTED FOR PROPER DRAINAGE UNCLOG IF NECESSARY. EXISTING CONCRETE PAD TO REMAIN MODIFY AS REQUIRED TO ACCOMMODATE THE NEW EQUIPMENT).
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EXISTING VAC DEMOLITION ROOF LAYOUT

SCALE: 3/32" = 1'-0"

LEGEND:

- EXISTING DUCTWORK AND EQUIPMENT TO BE DEMOLISHED.
- EXISTING DUCTWORK AND EQUIPMENT TO REMAIN.

ABBREVIATIONS:

EF	EXHAUST FAN	FLEX.	FLEXIBLE
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LCM	LOCAL CONTROL MODULE	BDD	BACKDRAFT DAMPER
GCM	GENERAL CONTROL MODULE	(E)	EXISTING
TYP.	TYPICAL	(N)	NEW
FCU	FAN COIL UNIT	⊕	POINT OF CONNECTION
DWG	DRAWING		

JLMS, CONSULTING ENGINEERS, PSC

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ISSUE FOR CONSTRUCTION
DATE: June 2, 2021

Project Name:
VAC RENOVATIONS AT GENERAL PSYCHIATRIC HOSPITAL DR. RAMÓN FERNÁNDEZ MARINA
San Juan, Puerto Rico

Rev. #	Date	Revision By	Description

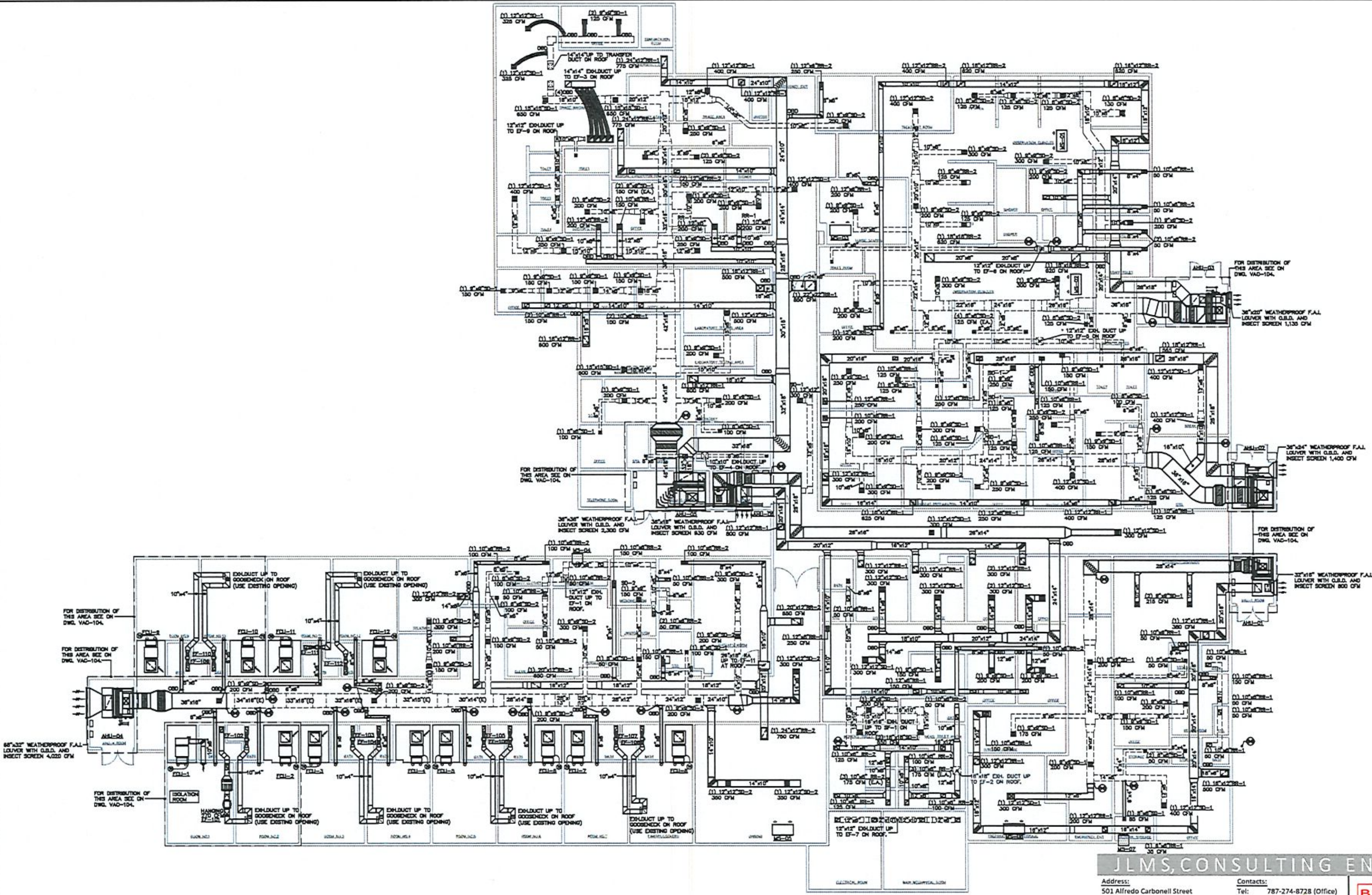
Drawing Name:
EXISTING VAC DEMOLITION ROOF LAYOUT

Owner:
ASSMCA

Digital Signature:

Stamp: JOSE L. MARRERO SICARDO — PUERTO RICO

JLMS Project Num: 21-027
Drawing Date: June 2, 2021
Checked By: J. L. Marrero
Scale: 3/32"=1'-0"
Page: 4 of 14 VAC-102



ABBREVIATIONS:

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TYP.	TYPICAL
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DWG	DRAWING
FLEX.	FLEXIBLE
CONN.	CONNECTION
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B.D.D.	BACKDRAFT DAMPER
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CHWS	CHILLED WATER SUPPLY LINE
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HWS	HOT WATER SUPPLY LINE
HWR	COLD WATER RETURN LINE
BDD	BACKDRAFT DAMPER
(E)	EXISTING
(N)	NEW
⊗	POINT OF CONNECTION

NEW FLOOR PLAN–VAC LAYOUT

SCALE: 1/8" = 1'-0"

LEGEND:

- EXISTING DUCTWORK AND EQUIPMENT TO REMAIN.
- NEW DUCTWORK AND EQUIPMENT TO REMAIN.

NOTES:

1. CONTRACTOR SHALL REPAIR EXISTING DUCTWORK UNIONS, SEALANT, & INSULATION AS REQUIRED TO MATCH EXISTING CONDITION. SANITIZE ENTIRE SYSTEM AFTER COMPLETION. PROVIDE NEW DUCTWORK INSULATION AS PER NOTES ON DRAWING VAC-200.
2. CONTRACTOR SHALL BE RESPONSIBLE OF PROPERLY OVERHAUL (REPAIR, CLEAN, CORROSION TREAT, PAINT) ALL EXISTING VAC EQUIPMENT AND APPURTENANCES TO REMAIN, INCLUDING BUT NOT LIMITED TO: PIPING INSULATION, EF'S, ISOLATORS, AHU'S, CU'S, FCU'S, PU'S, AUTOMATIC CONTROL SYSTEM, ETC. EXISTING EQUIPMENT INTERVENTION BY THE CONTRACTOR SHALL BE COORDINATED WITH OWNER'S REPRESENTATIVES.
3. PLENUM AREAS SHALL COMPLY WITH NFPA-90A. NO PVC PIPING IS ALLOWED IN PLENUMS USED TO CONVEY AIR.
4. CONTRACTOR SHALL FURNISH AND INSTALL SMOKE DETECTORS IF NOT EXISTENT OR DAMAGED.
5. ALL DISCONECT SWITCHES MUST BE REPLACED BY NEW ONES. NEW ELECTRIC REHEAT COILS SHALL BE CONECTED TO EXISTING ELECTRICAL FACILITIES AS PER NEC, COORDINATE WITH ELECTRICAL ENGINEER.
6. FOR REQUIRED AIR BALANCE OF EACH ROOM PLEASE REFER TO AIR FLOW DESIGN CONSIDERATIONS TABLE ON DWG VAC-300

"Yo, Jose Luis Marrero Sicardo, licencia # 14170, certifico que soy el profesional que diseñó estos planos y las especificaciones complementarias. También certifico que entiendo que dichos planos y especificaciones cumplen con las disposiciones aplicables del Reglamento Conjunto y las disposiciones aplicables de los Reglamentos y Códigos de las Agencias, Juntas Reglamentadoras o Corporaciones Públicas con jurisdicción. Reconozco que cualquier declaración falsa o falsificación de los hechos que se haya producido sin conocimiento o por negligencia ya sea por mí, mis agentes o empleados, o por otras personas con mi conocimiento, me hacen responsable de cualquier acción judicial y disciplinaria por la OGPe y otras autoridades competentes, incluyendo, pero sin limitarse, a la terminación de la participación en los procedimientos de certificación profesional en la OGPe."

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BID SET DRAWINGS

DATE: June 2, 2021

Project Name:
VAC RENOVATIONS AT GENERAL PSYCHIATRIC HOSPITAL DR. RAMÓN FERNÁNDEZ MARINA
San Juan, Puerto Rico

Rev. #	Date	Revision By	Description

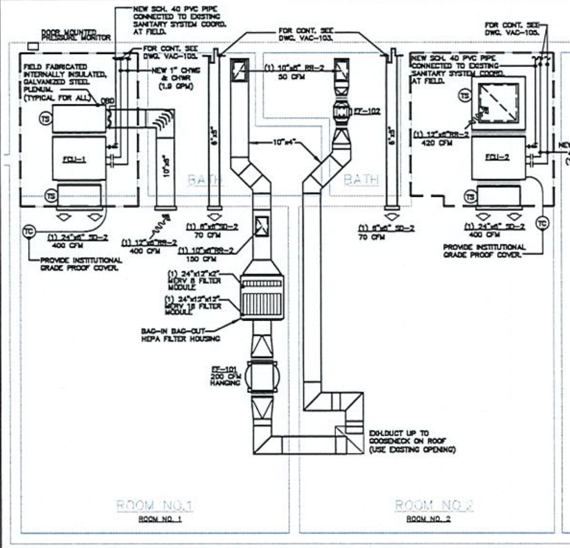
Drawing Name:
FLOOR PLAN- NEW VAC LAYOUT

Owner:
ASSMCA

Digital Signature:

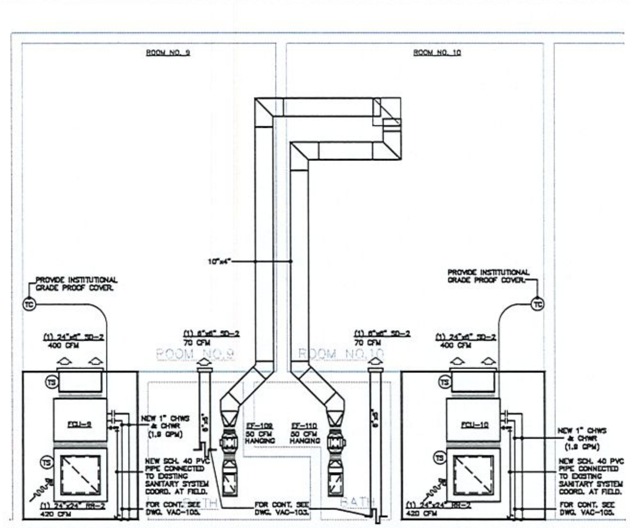
Stamp: JOSE L. MARRERO SICARDO, INGENIERO LICENCIADO, LIC. #14170, PUERTO RICO

JLMS Project Num: 21-027
Drawing Date: June 2, 2021
Checked By: J. L. Marrero
Scale: 1/8"=1'-0"
Page: 5 of 14 VAC-103



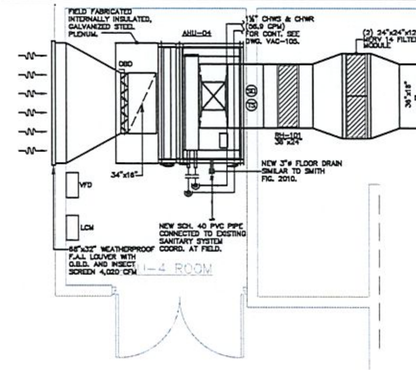
PARTIAL BLOW-UP ROOM #1 & 2 FLOOR PLAN-VAC LAYOUT (APPLIES TO FCU-1 TO 8)

SCALE: 3/8" = 1'-0"



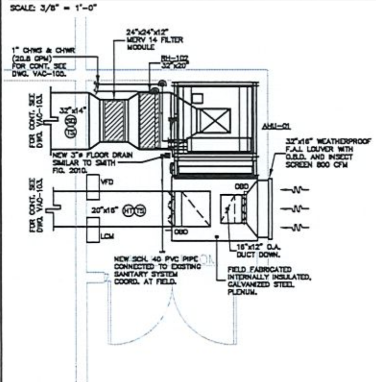
PARTIAL BLOW-UP ROOM #9 & 10 FLOOR PLAN-VAC LAYOUT (APPLIES TO FCU-9 TO 12)

SCALE: 3/8" = 1'-0"



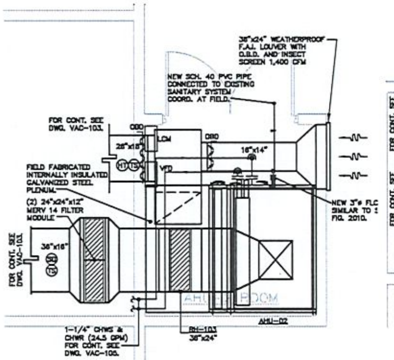
PARTIAL BLOW-UP MECH. ROOM AHU-04 FLOOR PLAN-VAC LAYOUT

SCALE: 3/8" = 1'-0"



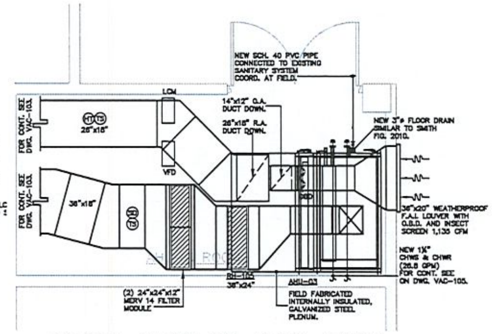
PARTIAL BLOW-UP MECH. ROOM AHU-01 FLOOR PLAN-VAC LAYOUT

SCALE: 3/8" = 1'-0"



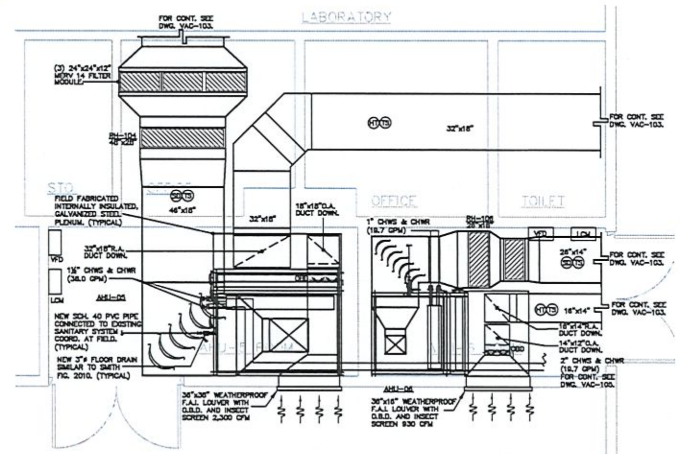
PARTIAL BLOW-UP MECH. ROOM AHU-02 FLOOR PLAN-VAC LAYOUT

SCALE: 3/8" = 1'-0"



PARTIAL BLOW-UP MECH. ROOM AHU-03 FLOOR PLAN-VAC LAYOUT

SCALE: 3/8" = 1'-0"



PARTIAL BLOW-UP MECH. ROOM AHU-05 & 06 FLOOR PLAN-VAC LAYOUT

SCALE: 3/8" = 1'-0"

ABBREVIATIONS:

EF	EXHAUST FAN	FLEX.	FLEXIBLE
CFM	CUBIC FEET PER MINUTE	CONN.	CONNECTION
S.A.	SUPPLY AIR	AHU	AIR HANDLING UNIT
R.A.	RETURN AIR	B.D.D.	BACKDRAFT DAMPER
O.A.	OUTSIDE AIR	O.B.D.	OPPOSED BLADE DAMPER
PCU	PACKAGE UNIT	CHWS	CHILLED WATER SUPPLY LINE
SD	SUPPLY DIFFUSER	CHWR	CHILLED WATER RETURN LINE
RR	RETURN REGISTER	HWS	HOT WATER SUPPLY LINE
OAL	OUTSIDE AIR LOUVER	HWR	COLD WATER RETURN LINE
LCM	LOCAL CONTROL MODULE	BDD	BACKDRAFT DAMPER
GCM	GENERAL CONTROL MODULE	(E)	EXISTING
TYP.	TYPICAL	(N)	NEW
FCU	FAN COIL UNIT		
DWG	DRAWING	(symbol)	POINT OF CONNECTION

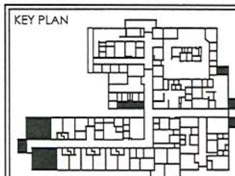
LEGEND:

- (dashed box) EXISTING DUCTWORK AND EQUIPMENT TO REMAIN.
- (solid box) NEW DUCTWORK AND EQUIPMENT.

NOTES:

1. CONTRACTOR SHALL REPAIR EXISTING DUCTWORK UNIONS, SEALANT, & INSULATION AS REQUIRED TO MATCH EXISTING CONDITION. SANITIZE ENTIRE SYSTEM AFTER COMPLETION. PROVIDE NEW DUCTWORK INSULATION AS PER NOTES ON DRAWING VAC-200.
2. CONTRACTOR SHALL BE RESPONSIBLE OF PROPERLY OVERHAUL (REPAIR, CLEAN, CORROSION TREAT, PAINT) ALL EXISTING VAC EQUIPMENT AND APPURTENANCES TO REMAIN, INCLUDING BUT NOT LIMITED TO: PIPING INSULATION, EF'S, ISOLATORS, AHU'S, CU'S, FCU'S, PU'S, AUTOMATIC CONTROL SYSTEM, ETC. EXISTING EQUIPMENT INTERVENTION BY THE CONTRACTOR SHALL BE COORDINATED WITH OWNER'S REPRESENTATIVES.
3. PLENUM AREAS SHALL COMPLY WITH NFPA-90A. NO PVC PIPING IS ALLOWED IN PLENUMS USED TO CONVEY AIR.
4. CONTRACTOR SHALL FURNISH AND INSTALL SMOKE DETECTORS IF NOT EXISTENT OR DAMAGED.
5. ALL DISCONECT SWITCHES MUST BE REPLACED BY NEW ONES, NEW ELECTRIC REHEAT COILS SHALL BE CONECTED TO EXISTING ELECTRICAL FACILITIES AS PER NEC, COORDINATE WITH ELECTRICAL ENGINEER.
6. FOR REQUIRED AIR BALANCE OF EACH ROOM PLEASE REFER TO AIR FLOW DESIGN CONSIDERATIONS TABLE ON DWG VAC-300

KEY PLAN



LEGEND:
- MECHANICAL ROOMS TO BE REFURBISHED.
- TRYPICAL TREATMENT ROOMS.

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BID SET DRAWINGS
DATE: June 2, 2021

Project Name:
VAC RENOVATIONS AT GENERAL PSYCHIATRIC HOSPITAL DR. RAMÓN FERNÁNDEZ MARINA
San Juan, Puerto Rico

Rev. #	Date	Revision By	Description

Drawing Name:
NEW MECHANICAL ROOMS BLOW-UPS-VAC LAYOUT

Digital Signature:

Stamp: JOSE L. MARRERO SICARDO — INGENIERO LICENCIADO — PUERTO RICO

Owner:
ASSMCA

JLMS Project Num: 21-027
Drawing Date: June 2, 2021
Checked By: J. L. Marrero
Scale: 3/8"=1'-0"
Page: 6 of 14

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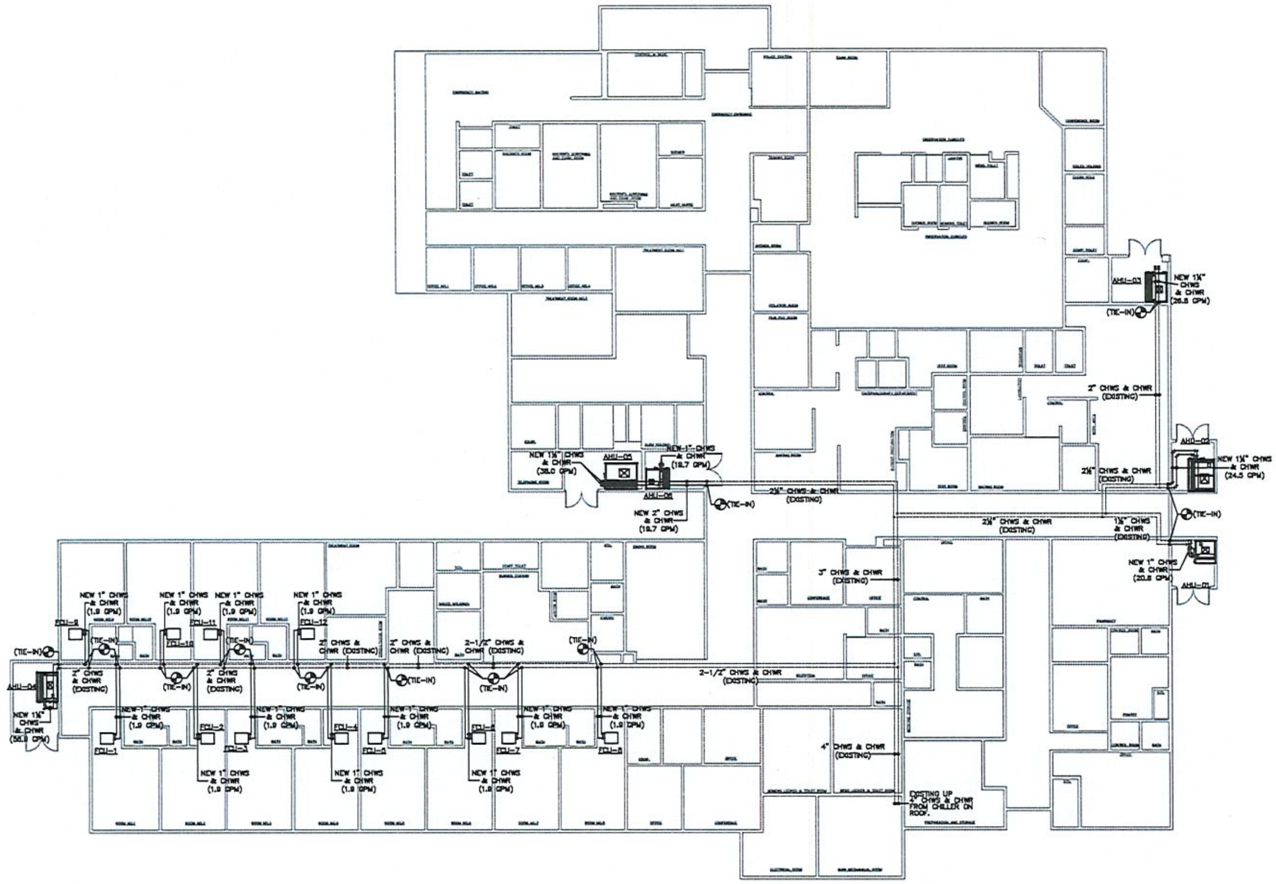

NEW CHWS & CHWR PIPING LAYOUT

SCALE: 3/32" = 1'-0"

ABBREVIATIONS:

EF	EXHAUST FAN	FLEX.	FLEXIBLE
CFM	CUBIC FEET PER MINUTE	CONN.	CONNECTION
S.A.	SUPPLY AIR	AHU	AIR HANDLING UNIT
R.A.	RETURN AIR	B.D.D.	BACKDRAFT DAMPER
O.A.	OUTSIDE AIR	O.B.D.	OPPOSED BLADE DAMPER
PCU	PACKAGE UNIT	CHWS	CHILLED WATER SUPPLY LINE
SD	SUPPLY DIFFUSER	CHWR	CHILLED WATER RETURN LINE
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LCM	LOCAL CONTROL MODULE	BDD	BACKDRAFT DAMPER
GCM	GENERAL CONTROL MODULE	(E)	EXISTING
TYP.	TYPICAL	(N)	NEW
FCU	FAN COIL UNIT	⊕	POINT OF CONNECTION
DWG	DRAWING		

LEGEND:

- EXISTING DUCTWORK AND EQUIPMENT TO REMAIN. (dashed)
- NEW DUCTWORK AND EQUIPMENT. (solid)

NOTES:

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6. FOR REQUIRED AIR BALANCE OF EACH ROOM PLEASE REFER TO AIR FLOW DESIGN CONSIDERATIONS TABLE ON DWG VAC-300

"Yo, José Luis Marrero Sicardo, licencia # [illegible], certifico que soy el profesional que diseñó estos planos y las especificaciones complementarias. También certifico que entiendo que dichos planos y especificaciones cumplen con las disposiciones aplicables del Reglamento Conjunto y las disposiciones aplicables de los Reglamentos y Códigos de las Agencias, Juntas Reglamentadoras o Corporaciones Públicas con jurisdicción. Reconozco que cualquier declaración falsa o falsificación de los hechos que se haya producido sin conocimiento o por negligencia ya sea por mí, mis agentes o empleados, o por otras personas con mi conocimiento, me hacen responsable de cualquier acción judicial y disciplinaria por la OGPe y otras autoridades competentes, incluyendo, pero sin limitarse, a la terminación de la participación en los procedimientos de certificación profesional en la OGPe."

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BID SET DRAWINGS
DATE: June 2, 2021

Project Name:
VAC RENOVATIONS AT GENERAL PSYCHIATRIC HOSPITAL DR. RAMÓN FERNÁNDEZ MARINA
San Juan, Puerto Rico

Rev. #	Date	Revision By	Description

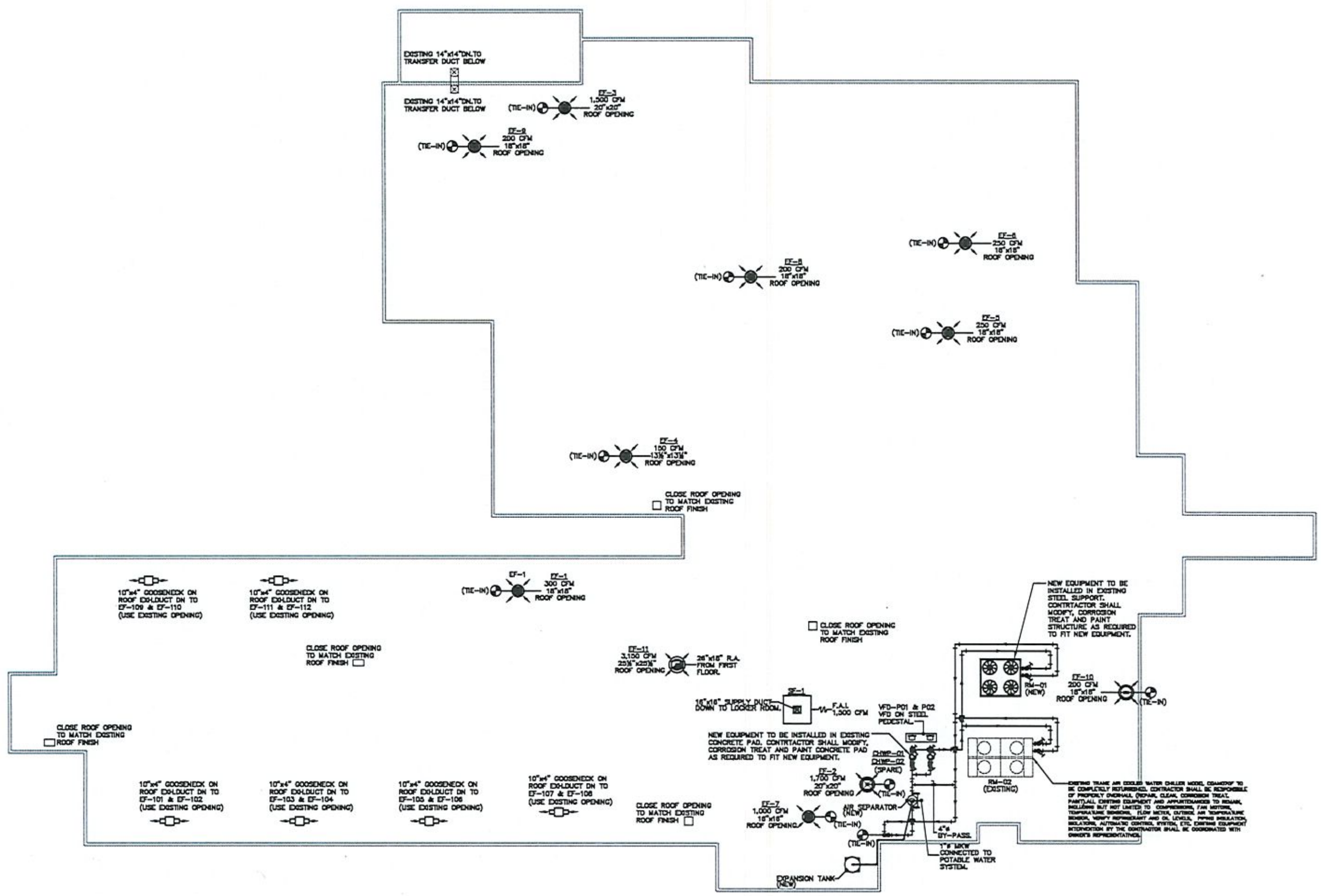
Drawing Name:
NEW CHWS & CHWR PIPING LAYOUT

Owner:
ASSMCA

Digital Signature:

Stamp: JOSE L. MARRERO SICARDO — INGENIERO LICENCIADO — LIC. #[illegible] — PUERTO RICO

JLMS Project Num: 21-027
Drawing Date: June 2, 2021
Checked By: J. L. Marrero
Scale: 3/32"=1'-0"
Page: 7 of 14
VAC-105



NEW VAC ROOF LAYOUT

SCALE: 3/32" = 1'-0"

ABBREVIATIONS:

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LCM	LOCAL CONTROL MODULE	BDD	BACKDRAFT DAMPER
GCM	GENERAL CONTROL MODULE	(E)	EXISTING
TYP.	TYPICAL	(N)	NEW
FCU	FAN COIL UNIT	⊗	POINT OF CONNECTION
DWG	DRAWING		

LEGEND:

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- NEW DUCTWORK AND EQUIPMENT.

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BID SET DRAWINGS

DATE: June 2, 2021

Project Name:
VAC RENOVATIONS AT GENERAL PSYCHIATRIC HOSPITAL DR. RAMÓN FERNÁNDEZ MARINA
San Juan, Puerto Rico

Drawing Name:
NEW VAC ROOF LAYOUT

Owner:
ASSMCA

Digital Signature:

Stamp: JOSE L. MARRERO SICARDO — INGENIERO LICENCIADO — LIC. #14673 — PUERTO RICO

Rev. #	Date	Revision By	Description

JLMS Project Num: 21-027
Drawing Date: June 2, 2021
Checked By: J. L. Marrero
Scale: 3/32"=1'-0"
Page: 8 of 14 — VAC-106

VAC NOTES:

GENERAL:

1. BIDDERS SHALL VISIT THE BUILDING AND ACQUAINT THEMSELVES WITH THE CONDITIONS AS THEY ACTUALLY EXIST AND VERIFY DIMENSIONS, LOCATIONS AND DETAILS REQUIRED TO COMPLETE THE WORK. FAILURE TO VISIT THE PROJECT AREA WILL IN NO WAY RELIEVE THE SUCCESSFUL BIDDER OF FURNISHING ALL MATERIAL AND PERFORMING ALL WORK REQUIRED FOR THE COMPLETION OF THE CONTRACT. VISIT TO THE PROJECT AREA SHALL BE ARRANGED THROUGH THE BUILDING MANAGER.
2. CONTRACTOR SHALL PROVIDE SUITABLE VIBRATION ISOLATION FOR THE SYSTEM AS RECOMMENDED BY MANUFACTURER OF EQUIPMENT SPECIFIED OR PROVIDED.
3. CONTRACTOR SHALL FURNISH AND INSTALL PIPING VALVES, SENSORS, CONTROL SYSTEMS AND ANY OTHER ITEM REQUIRED FOR THE FUNCTIONING AND OPERATION OF THE SYSTEM SHALL FORM PART OF THE WORK TO BE DONE BY THE CONTRACTOR.
4. IT IS THE INTENTION OF THE DRAWINGS TO CALL FOR FINISHED WORK, COMPLETE, TESTED AND READY FOR OPERATION. MINOR DETAILS NOT SHOWN OR SPECIFIED, BUT NECESSARY FOR THE PROPER INSTALLATION AND FOR FUNCTIONING AND OPERATION OF THE SYSTEM SHALL FORM PART OF THE WORK TO BE DONE BY THE CONTRACTOR.
5. CONTRACTOR SHALL PAINT ALL PIPING, PIPE INSULATION, FITTINGS, VALVES AND ALL EQUIPMENT TO BE INSTALLED.
6. THE CONTRACTOR SHALL, WITHOUT EXTRA CHARGE, MAKE REASONABLE MODIFICATIONS IN THE DUCT AND PIPING ARRANGEMENTS AS NEEDED TO PREVENT CONFLICT WITH WORK OF OTHER TRADES OR FOR PROPER EXECUTION OF THE WORK.
7. ALL EQUIPMENT AND MATERIAL SHALL BE INSTALLED WITH THE APPROVAL OF THE OWNER IN ACCORDANCE WITH THE RECOMMENDATIONS OF THE MANUFACTURER AND THE SPECIFICATIONS ISSUED FOR THIS PROJECT.
8. CONTRACTOR SHALL LOCATE IN FULLY ACCESSIBLE POSITIONS ALL EQUIPMENT WHICH MUST BE SERVICED, OPERATED, OR MAINTAINED. CONTRACTOR IS RESPONSIBLE OF COMPLY WITH EACH EQUIPMENT MANUFACTURER RECOMMENDED CLEARANCE.
9. IN CASE OF DISCREPANCY BETWEEN THE EQUIPMENT SPECIFIED AND THE EQUIPMENT SUPPLIED BY THE OWNER, THE CONTRACTOR SHALL ARRANGE FOR THE PROPER INSTALLATION OF THE EQUIPMENT.
10. CONTRACTOR SHALL FURNISH AND INSTALL AIR CONDITIONING EQUIPMENT, DUCTS, INSULATION, PIPING VALVES, SENSORS, CONTROL SYSTEMS AND ANY OTHER ITEM REQUIRED FOR THE PROPER FUNCTIONING AND OPERATION OF THE SYSTEM.
11. MECHANICAL WORK SHALL BE COORDINATED WITH ALL OTHER TRADES.
12. THE MECHANICAL CONTRACTOR SHALL THOROUGHLY EXAMINE ALL AREAS WHERE EQUIPMENT, DUCTWORK, AND PIPING WILL BE INSTALLED AND WILL REPORT ANY CONDITION THAT, IN HIS OPINION, PREVENTS THE PROPER INSTALLATION OF THE MECHANICAL WORK.
13. COORDINATE WITH ELECTRICAL CONTRACTOR FOR POWER CONNECTION TO ALL MECHANICAL EQUIPMENT.
14. ALL WORK SHALL BE PERFORMED IN STRICT ACCORDANCE WITH ALL APPLICABLE STATE AND LOCAL CODES AND ORDINANCES. IN CASE OF CONFLICT BETWEEN THE DRAWINGS/SPECIFICATIONS AND THE CODES AND ORDINANCES, THE HIGHEST STANDARD SHALL APPLY. THE MECHANICAL CONTRACTOR SHALL SATISFY CODE REQUIREMENTS AS A MINIMUM STANDARD WITHOUT ANY EXTRA COST.
15. THE MECHANICAL CONTRACTOR SHALL PROCURE AND PAY FOR ALL PERMITS, FEES AND INSPECTIONS NECESSARY TO COMPLETE THE MECHANICAL WORK.
16. THE MECHANICAL CONTRACTOR SHALL UNCONDITIONALLY WARRANT ALL WORK TO BE FREE OF DEFECTS IN MATERIAL AND WORKMANSHIP FOR A PERIOD OF ONE (1) YEAR FROM THE DATE OF FINAL ACCEPTANCE BY OWNER AND WILL REPAIR OR REPLACE ANY DEFECTIVE WORK PROMPTLY AND WITHOUT CHARGE AND RESTORE ANY OTHER EXISTING WORK DAMAGED IN THE COURSE OF REPAIRING DEFECTIVE MATERIALS AND WORKMANSHIP.
17. THE MECHANICAL CONTRACTOR SHALL COORDINATE CONCRETE SLABS PENETRATION WORKS WITH OWNER, STRUCTURAL ENGINEER AND ARCHITECTURAL DRAWINGS. SEAL PENETRATIONS AND PROVIDE FIRE DAMPERS AS REQUIRED.
18. ALL MATERIAL AND SPECIALTIES REQUIRED FOR THIS WORK SHALL BE NEW (UNLESS OTHERWISE INDICATED), OF FIRST-CLASS QUALITY AND SHALL BE FURNISHED, DELIVERED, ERECTED, CONNECTED AND FINISHED IN EVERY DETAIL, AND SHALL BE SO SELECTED AND ARRANGED AS TO FIT PROPERLY INTO THE BUILDING SPACES. DURING STORAGE ON THE JOB SITE OF CONSTRUCTION, THE CONTRACTOR SHALL KEEP PIPE ENDS PLUGGED OR CAPPED TO PREVENT DIRT OR MOISTURE ENTERING THE PIPE.
19. ROOF "R" VALUE SHALL BE A MINIMUM OF 15.0 HR-SF-°F/BTU.
20. PROVIDE 3M FILM FOR ALL THE WINDOWS TO OBTAIN A PERFORMANCE OF: U=1.04, SHGC=0.29.

INSULATION:

1. ALL INSULATION REQUIRED FOR THE WORK SHALL BE NEW, OF THE FIRST – CLASS QUALITY AND SHALL BE FINISHED, DELIVERY, ERECTED AND FINISHED IN EVERY DETAIL. ALL INSULATION SHALL HAVE A COMPOSITE FIRE HAZARD RATING AS TESTED BY ASTM E-84, NFPA 255, OR UL 723, NOT TO EXCEED 25 FLAME SPREAD AN 50 SMOKE DEVELOPED. ACCESSORIES SHALL HAVE THE SAME COMPONENT RATINGS. ALL INSULATING MATERIAL SHALL HAVE A LABEL INDICATING COMPLIANCE WITH THE ABOVE RATING.
2. EXPOSED AIR DUCT INSULATION SHALL BE 2" THICK JOHNS-MANVILLE NO. 817 (6 lbs/ft³) RIGID FIBERGLASS DUCT INSULATION WITH A FACTORY APPLIED FOIL-SCRIM-KRAFT (FSK) VAPOR BARRIER FACING. COVER ALL INSULATION WITH GLASS FABRIC MESH USING FOSTER SEALFAS MASTIC. INSULATION SHALL HAVE A "K" FACTOR=0.22 Btu-in/hr.-ft²-°F @ 75°F.
3. CONCEALED ARI DUCT INSULATION SHALL BE 1 1/2" THICK JOHNS-MANVILLE R-SERIES MICROLITE FIBER GLASS BLANKET WITH A FACTORY APPLIED FOIL-SCRIM-FRAFT (FSK) VAPOR BARRIER FACING. INSULATION SHALL HAVE A "K" FACTOR= 0.31 Btu-in/hr-ft² @ 75°F.
4. CHILLED WATER PIPING INSULATION MATERIAL SHALL BE TRYMER 2000 POLYISOCYANURATE FOAM INSULATION WITH VAPOR BARRIER 1½" THICK ALL PIPE SIZES. COVER ALL INSULATION WORKS WITH 6 OUNCES CANVAS ADHERED WITH FOSTER 3035. USE AN ALUMINUM JACKET SECURELY ATTACHED IN ALL WEATHER EXPOSED PIPE RUNS AND FITTINGS.
5. AFTER THE INSTALLATION OF PIPING AND BEFORE APPLYING THE INSULATION, THE CONTRACTOR MUST CLEAN ALL PIPING THOROUGHLY AND APPLY TWO COATS OF ANTI CORROSIVE PAINT AS MANUFACTURED BY PORTER #7100.
6. INDOOR DUCTS HANDLING OUTDOOR AIR INSULATION MATERIAL: SAME AS EXPOSED AIR DUCTS INSULATION SHALL NOT BE APPLIED UNTIL ALL SURFACES ARE CLEAN AND DRY.
7. ALL MATERIAL USED FOR DUCTWORK INSULATION SHALL HAVE A FLAME SPREAD INDEX NOT EXCEEDING 25 SMOKE DEVELOPED AND FUEL CONTRIBUTED NOT TO EXCEED 50 WHEN MEASURED AS DETERMINE BY ASTM E-162.
8. INSULATION SHALL BE FURNISHED WITH A FACTORY APPLIED FSK VAPOR BARRIER FACING AND SHALL HAVE AN AVERAGE THERMAL CONDUCTIVITY NOT TO EXCEED 0.25 BTU-IN/SQ.FT.- °F.
9. PROVIDE INTERNAL ACOUSTICAL LINING TO ALL FCU'S FASCIAS.

AIR DISTRIBUTION:

1. DUCTWORK SHELL BE AS FOLLOWS:
   - A– DUCT MATERIAL – SHALL BE GALVANIZED SHEET METAL, AND MANUFACTURED AND INSTALLED IN ACCORDANCE WITH LATEST EDITION OF THE DUCT CONSTRUCTION STANDARDS OF SMACNA FOR THE APPLICABLE PRESSURE CLASS.
   - B– DUCT WORKMANSHIP – ALL DUCTWORK SHALL BE CONSTRUCTED AND ERECTED IN A WORKMANLIKE MANNER. DUCTS SHALL BE STRAIGHT AND SMOOTH ON THE INSIDE WITH NEATLY FINISHED JOINTS, AIRTIGHT, AND SHALL BE FREE FROM VIBRATION UNDER ALL CONDITIONS OF OPERATION. THE INTERNAL ENDS OF SLIP JOINTS SHALL BE MADE IN THE DIRECTION OF AIR FLOW. CHANGES IN DIMENSIONS AND SHAPE OF DUCTS SHALL BE GRADUAL. ALL DUCT SIZES SHALL FALL WITHIN THE LIMITING DIMENSIONS INDICATED ON THE DRAWINGS UNLESS OTHERWISE APPROVED. CURVED ELBOWS, UNLESS OTHERWISE SPECIFIED ON THE DRAWINGS, SHALL HAVE A CENTER LINE RADIUS EQUAL TO 1 1/2 TIMES THE WIDTH OF THE DUCT. AIR TURNS SHALL BE INSTALLED IN ALL ABRUPT ELBOWS AND SHALL CONSIST OF CURVED METAL BLADES OR VANES, ARRANGED TO PERMIT THE AIR TO MAKE THE TURNS WITHOUT APPRECIABLE TURBULENCE. THEY SHALL BE THE MANUFACTURER'S STANDARD PRODUCT AND SHALL BE QUIET WHEN THE SYSTEM IS IN OPERATION. CONFIGURATION OF DUCTS SHALL BE AS INDICATED ON DRAWINGS. DUCT HANGER SHALL BE AS INDICATED ON DRAWINGS.
2. INSTALLATION OF DUCTS SHALL BE BY MEANS OF ANGULAR TRAPEZE AND ROD ACCORDING TO "SMACNA" RECOMMENDATIONS. IF STRAP ARE USED WITH DUCTWORK LESS THAN 24" WIDE, IT SHALL BE ATTACHED TO THE DUCT BY TWO SELF-TAPPING SCREWS. HANGERS AND STRAPS SHALL BE ATTACHED TO THE BEAM BY EXPANSION SHIELDS OR BY GUN NAILS. SCREWS. HANGERS AND STRAPS SHALL BE ATTACHED TO THE BEAM BY EXPANSION SHIELDS OR BY GUN NAILS.
3. ALL CONCEALED DUCTWORK AND PLENUMS ABOVE THE SECOND FLOOR CEILINGS SHALL BE INSULATED.
4. ALL DUCT WORK EQUIPMENT AND PIPING SHALL BE PROVIDED WITH SEISMIC RESTRAINTS IN ACCORDANCE WITH U.B.C.-1997 & N.F.P.A. STANDARDS.
5. ALL SHEETMETAL DUCTWORK SEAMS & JOINTS MUST BE SEALED WITH HIGH PRESSURE DUCT SEALER AS MANUFACTURED BY MINNESOTA MINING & MANUFACTURING CO. MODEL EC-800 OR APPROVED EQUAL. AIR LEAKS MUST BE 5% OR LESS. TEST DUCTWORK BEFORE FINAL CONNECTION TO AHU'S & AIR DISTRIBUTION.
6. FOR EXACT LOCATION OF CEILING DIFFUSERS REFER TO ARCHITECTURAL REFLECTED CEILING PLAN.
7. THE CONTRACTOR MUST FURNISHED & INSTALL U.L. APPROVED FIRE DAMPER WITH 10 GAUGE METAL SLEEVE AND DUCT ACCESS DOOR WHERE SHOWN ON DRAWINGS, AS REQUIRED BY LOCAL BUILDING CODES, OR AS REQUIRED BY N.F.P.A. FIRE DAMPERS SHALL BE CURTAIN TYPE AS MANUFACTURED BY RUSKIN MODEL IOO2 STYLE C OR APPROVED EQUAL.
8. PROVIDE SMOKE DETECTORS AS PER N.F.P.A. 90A.
9. EXPOSED SUPPLY & RETURN DUCTS SERVING SOUND SENSITIVE AREAS SHALL BE DOUBLE WALL, PAINTED AND INTERNALLY INSULATED.
10. ALL EXPOSED DUCTWORK SHALL BE PAINTED AS PER ARCHITECT'S COLOR CODING.
11. CONTRACTOR SHALL BE RESPONSIBLE OF SUBMIT DUCTWORK SHOP DWG. FOR APPROVAL. NO CHANGE ORDER WILL BE ALLOWED FOR DUCTS MODIFICATIONS RESULTING FROM NON-COORDINATED SHOP DRAWINGS.
12. CONNECTION FROM DUCT TO A/C UNIT SHALL BE MADE WITH A CANVAS CONNECTION. CANVAS CONNECTION SHALL BE NEOPRENE-COATED GLASS FABRIC AS MANUFACTURED BY VENT FABRIC (VEN GLASS), DURO DYNECORP. OF EQUAL. MOUNTED ON ANGLE FRAMES SECURELY FASTENED TO DUCTS AND EQUIPMENT WITH ACCESSORIES TO PREVENT COLLAPSING AT 10 IWG OF NEGATIVE PRESSURE. CANVAS CONNECTION SHALL BE AIR TIGHT (NO LEAKAGE OR INFILTRATION) AT INDICATED PRESSURE GLASS.
13. PLENUM SUPPLY AND RETURN AREA SHALL COMPLY WITH NFPA-90A.
14. CONTRACTOR SHALL BE RESPONSIBLE OF RETURN AIR PLENUM SEGREGATION AND PROVIDE REQUIRED AIR PASSAGES FOR PROPER A/C SYSTEM FUNCTIONING.
15. ALL OUTSIDE AIR INTAKES SHALL BE PROVIDED WITH A 30% EFF. DISPOSABLE FILTERS.
16. PROVIDE 1" THICK INTERNAL ACOUSTICAL LINING TO FIRST 10'-0" OF SUPPLY & RETURN DUCTWORK. SIMILAR TO SCHULLER PERMACOUSTICS.
17. COORDINATE DUCT ROUTE WITH SPRINKLERS AND ALL OTHER TRADES. RE-ROUTE AS REQUIRED AT NO EXTRA COST TO THE OWNER.
18. GRILLES AND DIFFUSERS SHALL BE AS MANUFACTURE BY "METAL*AIRE", "BARBER COLMAN", "TUTTLE & BAILEY", "ANEMOSTAT" OR "TITUS". EACH IS TO BE FITTED BY AN AIR STRAIGHTENER AND VOLUME DAMPER.
19. ALL DUCT DIMENSIONS SHOWN ARE NET INTERNAL.

HVAC EQUIPMENT:

1. ALL AIR CONDITIONING EQUIPMENT SHALL BE INSTALLED IN A WORKMANLIKE MANNER MEETING THE ACCEPTED STANDARDS OF THE AIR CONDITIONING INDUSTRY. THE WORK SHALL BE DONE BY SKILLED A/C CRAFTSMEN.
2. MAINTENANCE AND SERVICE CLEARANCES SHALL BE MAINTAIN TO EACH MECHANICAL EQUIPMENT AS PER MANUFACTURERS RECOMMENDATIONS.
3. MECHANICAL EQUIPMENT AT ROOF SHALL BE ANCHORED TO WITHSTAND HURRICANE FORCE WINDS AS PER APPLICABLE CODES.
4. PROVIDE CORROSION PROTECTION TO ALL WEATHER EXPOSED MECH. EQUIPMENT BY MEANS OF FIELD APPLIED PRODUCT. SUBMITT FOR APPROVAL.
5. EQUIPMENT START-UP SHALL BE PERFORMED BY EQUIPMENT MANUFACTURER.
6. ALL EQUIPMENT OFFERED UNDER THESE SPECIFICATIONS SHALL BE LIMITED TO PRODUCTS REGULARLY PRODUCED AND RECOMMENDED FOR SERVICE, IN ACCORDANCE WITH ENGINEERING DATA, RATINGS, OR OTHER COMPREHENSIVE LITERATURE MADE AVAILABLE TO THE PUBLIC AND IN EFFECT AT THE TIME OF OPENING OF BIDS.
7. EQUIPMENT SHALL BE INSTALLED IN STRICT ACCORDANCE OF MANUFACTURE'S INSTRUCTIONS FOR TYPE AND CAPACITY OF EACH PIECE OF EQUIPMENT USE. COORDINATE MECHANICAL EQUIPMENT CONCRETE PADS WITH FINAL EQUIPMENT ARRAGEMENT.
8. CONTRACTOR SHALL BE RESPONSIBLE OF VERIFY ELECTRICAL CONNECTION AT FIELD PRIOR TO EQUIPMENT PURCHASE.

BALANCING:

1. THE A/C CONTRACTOR SHALL PROVIDE AIR AND HYDRONIC SYSTEM BALANCING.
2. PERFORM AIR & HYDRONIC BALANCING BY A INDEPENDENT NEBB OR AABC CERTIFIED AIR BALANCE CONTRACTOR SHALL ACCURATELY BALANCE THE AIR SYSTEMS TO PROVIDE AIR QUALITIES INDICATED ON THE DRAWINGS AND IN THIS SPECIFICATION. OPERATE AUTOMATIC CONTROLS SYSTEM AND VERIFY SET POINTS DURING BALANCING. THE FINAL READING AND ADJUSTMENT SHALL BE PERFORMED WITH THE PRESENCE OF THE OWNER'S REPRESENTATIVE. SUBMIT FIVE (5) COPIES OF THE BALANCE REPORT TO THE ENGINEER FOR APPROVAL. INCLUDE A COPY OF THE BALANCE REPORT AS APPROVED BY THE ENGINEER WITH APPLICATION FOR FINAL CONTRACT PAYMENT.
3. PRESSURIZATION LEAKAGE AND INFILTRATION TEST SHALL BE PERFORMED PER SMACNA STANDARDS AND TECHNICAL SPECIFICATIONS.
4. THE AIR DISTRIBUTION SYSTEM AND DEVICES SHALL BE BALANCED FOR PROPER AIR FLOW. TEST DATA OF THE BALANCING OF THE SYSTEMS SHALL BE SUBMIT TO THE ARCHITECT FOR REVIEW. ALL AIR QUANTITIES SHALL BE SET TO WITHIN 10% OF THE LISTED QUANTITIES. DEFLECTION VANES SHALL BE SET TO ELIMINATE ANY EXCESSIVE AIR MOVEMENT IN THE AREA.
5. THE AIR SIDE BALANCING SHALL INCLUDE:
   1. RECORD MOTOR FULL LOAD AMPS AND ACTUAL OPERATING AMPERAGE.
   2. RECORD SUPPLY, RETURN AND OUTSIDE AIR TEMPERATURES.
   3. MAKE PITOT TUBE TRAVERSE OF MAIN SUPPLY DUCT AND OBTAIN DESIGN CFM AT FAN AND FAN RPM.
   4. RECORD SYSTEM STATIC PRESSURES, RETURN AND DISCHARGE.
   5. FIVE (5) COPIES OF BALANCING REPORTS CONTAINING THE DATA MENTIONED ABOVE AND SHALL BE GIVEN TO THE OWNER'S REPRESENTATIVE.
6. BALANCING WORK SHALL FULLY COMPLY WITH A.A.B.C. OR N.E.B.B.

AUTOMATIC CONTROL SYSTEM:

1. ALL CONTROLLERS SHALL BE FLUSH MOUNTED. ELECTRICAL CONDUITS SHALL RUN INSIDE WALLS.
2. CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING THE CONDUITS AND WIRING FOR THE POWER OF THE LCM FROM THE NEAREST POWER SOURCE.
3. ALL VERTICAL CONTROL CONDUITS MUST RUN CONCEALED INSIDE WALLS AND HORIZONTAL CONTROL IN THE PLENUM BETWEEN REFLECTED CEILING AND BOTTOM OF STRUCTURAL SLAB.
4. ROOM CONDITIONS ARE: 74.0±2°Fdb @ 55±5% RH FOR ALL AREAS. COORDINATE LOCATION OF TEMPERATURE CONTROLLERS AT FIELD WITH OWNER.
5. PROVIDE VANDAL PROOF COVER FOR ALL TEMPERATURE CONTROLLERS.
6. PLASTIC PIPING IS NOT ALLOWED IN RETURN PLENUM AREAS.
7. ALL MOTORS SHALL BE PROVIDED WITH ITS REQUIRED STARTERS FOR THE PROPER ELECTRICAL CONNECTION OF THE EQUIPMENT. COORDINATE WITH ELECTRICAL CONSULTANT.

CONDENSATE DRAIN:

1. COOLING COIL CONDENSATE DRIP PIPING MATERIAL: SHALL BE EXTERIOR INSULATED SCH.40PVC.
2. COOLING COIL CONDENSATE DRIP PIPING MATERIAL RUNNING IN RETURN AIR PLENUMS SHALL BE TYPE "M" COPPER.
3. CONDENSATE DRAIN PIPING INSULATION MATERIAL: SHALL BE CLOSED CELL ELASTOMERIC 3/4" THICK ALL PIPE SIZES. K=0.25 @ 75°F.
4. CONTRACTOR SHALL PROVIDE INDIRECTLY CONNECTED CONDENSATE DRAIN TO A/C UNITS. COORDINATE WITH PLUMBING DRAWINGS.
5. PROVIDE CONDENSATE DRAIN PUMP FOR A/C EQUIPMENT IF REQUIRED PIPE SLOPE IS NOT ATTAINED.
6. CONTRACTOR SHALL BE RESPONSIBLE OF CONNECT 1" INSULATED PVC PIPE FOR EQUIPMENT CONDENSATE DRAIN AND CONNECT TO SANITARY SEWER SYSTEM.

CHILLED WATER PIPING:

1. CHILLED WATER PIPING SHALL BE BLACK STEEL SCHEDULE 40 ASTM A-53.
2. TEST ALL PIPING FOR A PERIOD OF 24 HRS. ALL PIPE TEST SHALL BE WITNESSED AND APPROVED BY THE OWNER'S REPRESENTATIVE. TEST PRESSURE SHALL BE AS PER. WRITTEN SPEC'S.
3. ALL VALVES AND FITTINGS SHALL BE 150 PSI D.W.P.
4. WEATHER EXPOSED CHILLED WATER INSULATION MATERIAL SHALL BE TRYMER 2000 POLYISOCYANURATE FOAM INSULATION WITH VAPOR BARRIER 1½" THICK ALL PIPE SIZES. COVER ALL INSULATION WORKS WITH 6 OUNCES CANVAS ADHERED WITH FOSTER 3035. USE AN ALUMINUM JACKET SECURELY ATTACHED IN ALL PIPE RUNS AND FITTINGS.

SELECTIVE DEMOLITION:

1. IN ORDER TO AVOID DELAYS OR CLAIMS ON HIS BEHALF, THE GENERAL CONTRACTOR SHALL NOTIFY THE OWNER IN WRITING OF ERRORS, COORDINATION DEVIATIONS OR OMISSIONS FROM THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL VERIFY AND BECOME FAMILIAR TO MAKE PART OF HIS RESPONSIBLY, ALL CONTRACT DOCUMENTS AND GENERAL CONDITIONS, AND NOT LIMIT HIMSELF TO EXISTING CONDITIONS. THIS WRITTEN SUBMISSION SHALL BE PRESENTED PRIOR TO HIS FINAL BID. PRIOR TO THE COMMENCEMENT OF THE PROJECT WORK THE CONTRACT SHALL VERIFY ALL THE DIMENSIONS AND THE EXISTING CONDITIONS AT THE PROJECT SITE AND HE/SHE SHALL NOTIFY TO THE ARCHITECT IMMEDIATELY IN WRITING, OF ANY DISCREPANCIES BETWEEN EXISTING CONDITIONS AND THE CONTRACT DOCUMENTS WHICH MIGHT AFFECT THE SCHEDULE AND/OR PERFORMANCE OF THE PROPER DEMOLITION AND CONSTRUCTION WORKS. THE CONTRACTOR SHALL MAKE THE NECESSARY DEMOLITION TO PERFORM THE WORK PRETENDED IN THIS SET OF DRAWINGS.
2. CONTRACTOR SHALL VERIFY ON SITE UTILITIES LOCATION AND STRUCTURE CONDITIONS BEFORE PROCEEDING WITH DEMOLITION.
3. CONTRACTOR SHALL REMOVE AND DEMOLISH EXISTING FACILITIES IN COORDINATION AND ACCORDING TO OWNER INSTRUCTIONS.
4. CONTRACTOR SHALL TAKE MAXIMUM SAFETY PRECAUTIONS IN ORDER NOT TO DAMAGE EQUIPMENT, ADJACENT PROPERTY, BUILDING OR ITEMS NOT TO BE DEMOLISHED OR REMOVED AND AVOIDING INJURIES TO PERSONNEL AND PRIVATE PROPERTY. ANY DAMAGE DONE TO EXISTING WORK TO REMAIN SHALL BE REPAIRED BY CONTRACTOR NO EXPENSE TO THE OWNER.
5. CONTRACTOR WILL BUILT BARRICADE PRIOR TO START DEMOLITION IN ORDER PROTECT AND AVOID INJURIES TO THE PEDESTRIAN AND AND PRIVATE PROPERTIES.
6. CONTRACTOR SHALL REMOVE ANY EXISTING PAVEMENT, WHEN NECESSARY FOR PROPOSED SITE CONSTRUCTION CONDITIONS, AND PROTECT ANY PAVEMENT WHEN CONDITIONS INDICATE THAT ITS REMOVAL IS NOT NECESSARY.
7. DEMOLITION WORK SHALL BE PROPERLY EXECUTED, IS THE CONTRACTOR RESPONSIBILITY TO REPLACE, REBUILT TO ITS ORIGINAL CONDITIONS, ANY UTILITIES, SIDEWALKS, CURBS, STREETS, SEWER SYSTEMS, PRIVATE OR MUNICIPAL FACILITIES AFFECTED BY DURING THE CONSTRUCTION PHASE.
8. EQUIPMENT, ACCESSORIES AND/OR MATERIALS "TO REMAIN" SHALL BE PROPERLY PROTECTED DURING ALL DEMOLITION AND CONSTRUCTION WORKS IN ORDER TO PREVENT ANY POSSIBLE DAMAGE TO THEM.
9. ALL SCRAP MATERIALS (LEAD-BASED PAINT AND ASBESTOS-CONTAINING MATERIALS) FROM THE DEMOLITION WORK SHALL BE DISPOSED OFF AS PER THE TECHNICAL SPECIFICATIONS FOR THE ABATEMENT OF LEAD-BASED PAINT AND ASBESTOS-CONTAINING MATERIALS.
10. THE CONTRACTOR SHALL RELOCATE ANY EXISTING SOIL WASTE OR DRAIN, OR WATER PIPE THAT INTERFERES WITH A PROPOSED FOOTING OR STRUCTURE AS APPROVED BY THE ARCHITECT AND/OR STRUCTURAL DESIGNER.
11. COLD JOINTS BETWEEN EXISTING CONCRETE AND NEW ONES SHALL BE FILLED WITH CONCRESSIVE 1001LPL. THE MAXIMUM PERMISSIBLE TIME BETWEEN PLACING THE EPOXY AND POURING THE CONCRETE IS ONE HOUR.
12. COORDINATE WITH OWNER A LIST OF REMOVED ITEMS TO BE SALVAGED, SCRAPED OR REINSTALLED.
13. ALL DISPOSED MATERIAL MANAGEMENT SHALL BE COMPLY AND ACCORDANCE WITH GOVERNMENT APPROVAL AND REGULATIONS.
14. DEMOLITION WORK SHALL BE COORDINATED WITH THE OWNER TO MINIMIZE INTERFERING WITH THE OPERATIONS.
15. ALL PIPES, VALVES, ETC. OF WATER SUPPLY, SANITARY, DRAINAGE AND STORM SYSTEMS SHALL BE REMOVED, OR REMOVED AND INSTALL NEW; SEE PLUMING DRAWINGS.
16. FOR ELECTRICAL DEMOLITION SEE ELECTRICAL DRAWINGS.
17. IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR TO CORROBORATE THE PLANS DIMENSIONS WITH EXISTING FIELD DIMENSIONS. CONDITION SHALL BE SUBMITTED TO THE OWNER REPRESENTATIVE PRIOR DATE OF BID.
18. ALL EQUIPMENT AND MATERIALS REMOVED SHALL REMAIN THE SOLE PROPERTY OF THE OWNER.
19. ALL SURPLUS MATERIAL AND DEBRIS SHALL BE DISPOSED ON A GOVERNMENT APPROVED DUMP SITE.
20. CONDITIONS FOR CONSTRUCTION BUILDING REMODELATION AS SPECIFIED IN A.I.A. STANDARD GENERAL CONDITIONS OF CONTRACT SHALL BE FULLY REQUIRED.
21. CONTRACTOR SHALL PERFORM DEMOLITION IN STRICT ACCORDANCE WITH SPECIFICATION
22. CONDITIONS SHOWN NOT NECESSARY REPRESENT THE ACTUAL CONDITION – CONTRACTOR SHALL VERIFY EXISTING CONDITION PRIOR TO PROCEED WITH DEMOLITION.
23. CONTRACTOR TO PROVIDE AND INSTALL WATERPROOF ROOF COVERS ON ALL OPENINGS FROM REMOVED EQUIPMENT.
24. CONTRACTOR SHALL FOLLOW ALL CODES AND REGULATIONS FOR THE PROPER DISPOSAL OF THE SELECTED ITEMS.

"Yo, José Luis Marrero Sicardo, licencia # [illegible], certifico que soy el profesional que diseñó estos planos y las especificaciones complementarias. También certifico que entiendo que dichos planos y especificaciones cumplen con las disposiciones aplicables del Reglamento Conjunto y las disposiciones aplicables de los Reglamentos y Códigos de las Agencias, Juntas Reglamentadoras o Corporaciones Públicas con jurisdicción. Reconozco que cualquier declaración falsa o falsificación de los hechos que se haya producido sin conocimiento o por negligencia ya sea por mí, mis agentes o empleados, o por otras personas con mi conocimiento, me hacen responsable de cualquier acción judicial y disciplinaria por la OGPe y otras autoridades competentes, incluyendo, pero sin limitarse, a la terminación de la participación en los procedimientos de certificación profesional en la OGPe."

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BID SET DRAWINGS
DATE: May 28, 2021

Project Name:
VAC RENOVATIONS AT GENERAL PSYCHIATRIC HOSPITAL DR. RAMÓN FERNÁNDEZ MARINA
San Juan, Puerto Rico

Rev. #	Date	Revision By	Description

Drawing Name: VAC NOTES

Owner: ASSMCA

Digital Signature:

Stamp: JOSE L. MARRERO SICARDO — INGENIERO LICENCIADO — PUERTO RICO

JLMS Project Num: 21-027
Drawing Date: May 28, 2021
Checked By: J. L. Marrero
Scale: Not to Scale

AIR HANDLING UNIT AND FAN COIL SCHEDULE

UNIT NO.	SERVING	TOTAL C.F.M.	O. A. C.F.M. MINIMUM	O. A. C.F.M. MAXIMUM	FAN PERFORMANCE E.S.P.	M.H.P.	R.P.M.	VOLTS	P H.	H Z.	COIL PERFORMANCE TOTAL LOAD MBH	SENS LOAD MBH	AIR FILTER TAG	TYPE	FILTER (MERV)	UNIT TYPE	WEIGHT (LBS.)	MANUFACTURER MODEL NO.	REMARKS
AHU-01	PHARMACY BLDG. "7"	2,290	800	800	2	5	1,800	460	3	60	113.70	78.78	PF-02 FF-02	FLAT BAG	8 14	INDOOR VERTICAL UNIT	1,349	CARRIER 39MN SIZE06W	1 TO 16.
AHU-02	WOMEN'S EMERGENCY BLDG. "7"	4,225	1,400	1,400	2	5	1,800	460	3	60	146.30	95.25	PF-03 FF-03	FLAT BAG	8 14	INDOOR VERTICAL UNIT	1,665	CARRIER 39MN SIZE10W	1 TO 16.
AHU-03	WOMEN'S EMERGENCY BLDG. "7"	3,405	1,135	1,135	2	5	1,800	460	3	60	144.60	103.0	PF-05 FF-05	FLAT BAG	8 14	INDOOR VERTICAL UNIT	1,665	CARRIER 39MN SIZE10W	1 TO 16.
AHU-04	INFIRMARY BLDG. "7"	4,020	4,020	4,020	2	5	1,800	460	3	60	285.88	153.32	PF-01 FF-01	FLAT BAG	8 14	INDOOR VERTICAL UNIT	1,665	CARRIER 39MN SIZE10W	1 TO 16.
AHU-05	EMERGENCY OFFICE BLDG. "7"	7,000	2,300	2,300	2	7.5	1,800	460	3	60	232.30	170.85	PF-04 FF-04	FLAT BAG	8 14	INDOOR VERTICAL UNIT	2,159	CARRIER 39MN SIZE14W	1 TO 16.
AHU-06	LABORATORY BLDG. "7"	2,850	930	930	2	5	1,800	460	3	60	96.81	60.00	PF-06 FF-06	FLAT BAG	8 14	INDOOR VERTICAL UNIT	1,369	CARRIER 39MN SIZE06W	1 TO 16.
FCU-1 TO 12	INFIRMARY ROOMS BLDG. "7"	400	0	0	2	–	1,800	460	3	60	9.70	9.10	PF-06 FF-06	FLAT BAG	8 14	INDOOR VERTICAL UNIT	1,369	CARRIER 39MN SIZE06W	1 TO 16.

REMARKS: 1) DOUBLE WALL GALVANIZED STEEL CONSTRUCTION. 2) MIXING BOX SECTION WITH PARALLEL DAMPERS. 3) RIGID FILTER SECTION. 4) COOLING COIL SECTION 5) DRAW-THRU FAN SECTION. 6) ALL SECTION WITH SIDE ACCESS DOORS. 7) 6" PERIMETER BASE RAIL. 8) IAQ STAINLESS STEEL DRAIN PAN. 9) FIXED BELT DRIVES. 10) DISCONNECT SWITCH. 11) HEAVY GAUGE G90 GALVANIZED STEEL CONSTRUCTION. 12) VFD. 13) ANTIMICROBIAL COATING ON INTERIOR CABINETRY. 14) INTERNAL VIBRATION ISOLATORS. 15) TWO WAY CONTROL VALVE (MANUAL BALL VALVE WITH MEMORY STOP, ADJUSTABLE FLOW CIRCUIT SETTER). 16) UV LIGHT.

* CONTRACTOR SHALL BE RESPONSIBLE OF VERIFY ELECTRICAL CONNECTION AT FIELD PRIOR TO EQUIPMENT PURCHASE.

EXHAUST & MAKEUP FAN SCHEDULE

TAG. NO.	LOCATION	TYPE	DRIVE	CFM	S.P. IN W.G.	H.P.	ELECT.	MODEL NO.	MANUFACTURER	ELECTRICALLY INTERLOCKED WITH	ROOF OPENING	REMARKS
EF-1	ROOF	CENT.	BELT	300	0.5	.167	208/1/60	70ACEB	COOK	TIMER	13½"x13½"	B, V, S
EF-2	ROOF	CENT.	BELT	1,700	0.5	.500	208/1/60	150ACEB	COOK	TIMER	19½"x19½"	B, V, S
EF-3	ROOF	CENT.	BELT	1,500	0.5	.250	208/1/60	135ACEB	COOK	TIMER	13½"x13½"	B, V, S
EF-4	ROOF	CENT.	BELT	150	0.5	.167	208/1/60	60ACEB	COOK	TIMER	13½"x13½"	B, V, S
EF-5	ROOF	CENT.	BELT	250	0.5	.250	208/1/60	70ACEB	COOK	TIMER	13½"x13½"	B, V, S
EF-6	ROOF	CENT.	BELT	250	0.5	.167	208/1/60	70ACEB	COOK	TIMER	15½"x15½"	B, V, S
EF-7	ROOF	CENT.	BELT	1,000	0.5	.167	208/1/60	120ACEB	COOK	TIMER	15½"x15½"	B, V, S
EF-8	ROOF	CENT.	BELT	250	0.5	.250	208/1/60	70ACEB	COOK	TIMER	10"x10"	B, V, S
EF-9	ROOF	CENT.	BELT	200	0.5	.250	208/1/60	70ACEB	COOK	TIMER	13½"x13½"	B, V, S
EF-10	ROOF	CENT.	BELT	200	0.5	.250	208/1/60	70ACEB	COOK	TIMER	10"x10"	B, V, S
EF-11	ROOF	CENT.	BELT	3,100	0.75	2.0	208/1/60	180ACEB	COOK	TIMER	26"x26"	B, V, S
EF-102 TO 109 EF-110 TO 112	IN-LINE	CENT.	DIRECT	50	0.25	(24W)	115/1/60	TD-125	SOLER PALAU	TIMER	–	B, S
EF-101	IN-LINE	CENT.	DIRECT	200	1.0	1/4	208/1/60	12CVB	COOK	TIMER	–	B, V, S
SF-1	ROOF	CENT.	BELT	1,500	0.5	0.25	208/1/60	90ASP	COOK	TIMER	25"x25"	B, S

REMARKS: (B). GRAVITY BACKDRAFT DAMPER. (E). EPOXY PAINT PROTECTION. (SP). SPEED CONTROL. (G). GREASE TROUGH. (V). VENTED EXTENSION. (S). STARTER (T). 24/7 PROGRAMMABLE TIME CLOCK LOCATED NEXT TO ELECTRICAL PANEL. (PL). PILOT LIGHT SWITCH LOCATED INSIDE ROOM. (F). FIBER GLASS CONSTRUCTION.

NOTE: 1) CONTRACTOR SHALL BE RESPONSIBLE OF VERIFY ELECTRICAL CONNECTION AT FIELD PRIOR TO EQUIPMENT PURCHASE.
2) PROVIDE START/STOP SWITCH FOR FAN OPERATION. COORDINATE LOCATION AT FIELD.

CHILLED WATER COOLING COIL PERFORMANCE

COIL No.	AIR DATA C.F.M.	VEL. (FPM) MAX.	TYPE	MIN. ROWS	FIN TYPE	F.P.I.	MBH TOTAL	MBH SENS.	EDB °F	EWB °F	LDB °F	LWB °F	P.D.(ftwg)	REFRIGERANT DATA REF.	GPM	EWT	LWT	MANUFACTURER
CC-01	2,290	508.5	FW	6	SINE WAVE	11	113.70	78.78	76.30	65.0	53.14	52.90	9.5	WATER	20.8	44°F	54°F	CARRIER
CC-02	4,225	423.0	FW	6	SINE WAVE	11	146.30	95.25	78.6	67.1	55.3	55.2	0.6	WATER	24.5	44°F	54°F	CARRIER
CC-03	3,405	453.2	FW	6	SINE WAVE	11	134.47	108.72	78.0	68.1	56.3	56.6	3.8	WATER	26.8	44°F	54°F	CARRIER
CC-04	4,020	412.9	FW	6	SINE WAVE	11	285.88	153.32	91.60	76.90	55.54	55.52	4.5	WATER	56.9	44°F	54°F	CARRIER
CC-05	7,000	488.1	FW	6	SINE WAVE	12	190.77	157.21	77.8	65.9	55.2	55.1	1.5	WATER	38.0	44°F	54°F	CARRIER
CC-06	2,850	381.4	FW	6	SINE WAVE	11	96.81	63.72	79.0	67.3	54.3	54.2	8.5	WATER	19.7	44°F	54°F	CARRIER
CC-07 THRU CC-18	400	500.0	FW	3	–	–	9.70	9.10	70.0	59.0	55.1	52.7	10.17	WATER	1.9	44°F	54°F	CARRIER

AIR FLOW DESIGN CONSIDERATIONS			
Space	Pressure	Min. Total Air Changes per Hour	Min. Outside Air Changes per Hour
Clean linen	Positive	4	2
Soil linen	Negative	6	2
Medical Storage	Positive	4	2
Triage	Negative	12	2
Isolation (All)	Negative	12	2
Waiting Room	Negative	12	2
Patient Room	N/R	6	2
Laboratory	Negative	6	2
Procedure Room	Positive	15	3
Pharmacy	Positive	4	2

AIR COOLED WATER CHILLER SCHEDULES

MARKED NO	TONS.	EVAPORATOR FLUID	FLOW G.P.M.	ENT. TEMP.°F	LEAVING TEMP.°F	FOULING FACTOR	MAX. DROP (FT. WG)	NO. CIRCUITS	AIR COOLED CONDENSER AMBIENT AIR TEMP. (°F)	EER (EER) / IPLV (EER)	REFR.	ELECTRICAL CHARACTERISTICS VOLTS	PHASE	CYCLES	START OPTION	MCA	MOCP	ICF	REC. FUSE SIZE	COMPRESSORS QTY.	KW	LRA (EA)	CONDENSER FANS QTY.	KW	FLA(EA)	CONTROL CIRCUIT (SEPARATE POWER SUPPLY) VOLTS	PHASE	CYCLES	FUSE SIZE	WEIGHT (LBS)	MANUFACTURER MODEL	REMARKS
RM-01	100	WATER	200 MAX. 50 MIN.	56	44	0.00010	10.7	2	95	9.6 / 13.6	R410A	460	3	60	ACROSS THE LINE	209.2	250	417.2	225	4	–	280	6	–	5.4	–	–	–	–	4,600	CARRIER 30RB0100S	1 TO 8.
RM-02	70	WATER	EXISTING																												TRANE CGAM070F	

REMARKS:
1) FACTORY APPLIED "E-COAT" TREATMENT FULLY IMMERSED. 2) LOW SOUND. 3) HOT GAS BYPASS. 4) VARIABLE SPEED CONDENSER FANS. 5) HOT GAS BYPASS. 6) PHASE LOSS/VOLTAGE PROTECTION. 7) CONVENIENCE OUTLET. 8) SINGLE POINT.

NOTE: CONTRACTOR SHALL BE RESPONSIBLE OF VERIFY ELECTRICAL CONNECTION AT FIELD PRIOR TO EQUIPMENT PURCHASE.

PUMPS SCHEDULE

MARKED	SYSTEM	LOCATION	G.P.M.	TDH. (FT.)	FLUID TEMP. (MIN)	SIZE	TYPE	MOTOR DATA H.P.	R.P.M.	VOLT	ø	TYPE	MANUFACTURER MODEL	ACCESORIES
CHWP-01	PRIMARY PUMP	ROOF	200 MAX. 50 MIN.	60	44	3"x3"x8"	VERTICAL INLINE	5	1,800	460	3	TEFC	ARMSTRONG SERIES 4300	• MECHANICAL SEAL. • VFD. • HIGH EFF MOTOR. • SENSORLESS CONTROL.
CHWP-02	SPARE PUMP	ROOF	200 MAX. 50 MIN.	60	44	3"x3"x8"	VERTICAL INLINE	5	1,800	460	3	TEFC	ARMSTRONG SERIES 4300	• MECHANICAL SEAL. • VFD. • HIGH EFF MOTOR. • SENSORLESS CONTROL.

*CONTRACTOR SHALL BE RESPONSIBLE OF VERIFY ELECTRICAL CONNECTION AT FIELD PRIOR TO EQUIPMENT PURCHASE.

VARIABLE FREQUENCY DRIVES SCHEDULE

VFD NO.	SERVING	HP	ELECT. CHARACT. V/ PH /HZ.	INPUT SIGNAL	MANUFAC
VFD-P01	CTWP-01	5	460 / 3 / 60	4-20mA	ABB NEMA 4X
VFD-P02	CTWP-02	5	460 / 3 / 60	4-20mA	ABB NEMA 4X
VFD-01	AHU-01	5	460 / 3 / 60	4-20mA	ABB
VFD-02	AHU-02	5	460 / 3 / 60	4-20mA	ABB
VFD-03	AHU-03	5	460 / 3 / 60	4-20mA	ABB
VFD-04	AHU-04	5	460 / 3 / 60	4-20mA	ABB
VFD-05	AHU-05	7.5	460 / 3 / 60	4-20mA	ABB
VFD-06	AHU-06	5	460 / 3 / 60	4-20mA	ABB

ACCESORIES:
1) HAND-OFF-AUTO SELECTOR SWITCH. 2) ELECTRONIC BY-PASS. 3) MOTOR RUNNING OVERLOAD. 4) MANUAL SPEED CONTROL. 5) NEMA-3R ENCLOSURE. 7) 2 YEARS WARRANTY & SERVICE.

*CONTRACTOR SHALL BE RESPONSIBLE OF VERIFY ELECTRICAL CONNECTION AT FIELD PRIOR TO EQUIPMENT PURCHASE.

REHEAT COIL SCHEDULE

NO.	CFM	VEL.MAX (FPM)	W"xH"	KW	MODEL	REMARKS
RC-01	2,290	750	32"x20"	9.0	INDEECO W/SCR CONTROL OPTION "K"	VOLTAGE AS FIELD AVAILABLE
RC-02	4,225	750	36"x24"	13.0	INDEECO W/SCR CONTROL OPTION "K"	VOLTAGE AS FIELD AVAILABLE
RC-03	3,405	750	36"x24"	14.0	INDEECO W/SCR CONTROL OPTION "K"	VOLTAGE AS FIELD AVAILABLE
RC-04	4,020	750	36"x24"	13.0	INDEECO W/SCR CONTROL OPTION "K"	VOLTAGE AS FIELD AVAILABLE
RC-05	7,000	750	48"x28"	22.0	INDEECO W/SCR CONTROL OPTION "K"	VOLTAGE AS FIELD AVAILABLE
RC-06	2,850	750	26"x18"	7.0	INDEECO W/SCR CONTROL OPTION "K"	VOLTAGE AS FIELD AVAILABLE

AIR TERMINALS SCHEDULE

DESIG.	TYPE	MODEL	MANUFACTURER	REMARK
SD-1	SUPPLY DIFFUSER	S-5000	METAL AIRE	ALUMINUM CONSTRUCTION
SD-2	SECURITY SUPPLY DIFFUSER	SCRP	METAL AIRE	HEAVY DUTY STEEL CONSTRUCTION
RR-1	RETURN DIFFUSER	RHD	METAL AIRE	ALUMINUM CONSTRUCTION
RR-2	SECURITY RETURN DIFFUSER	SCRHD	METAL AIRE	HEAVY DUTY STEEL CONSTRUCTION

*DIFFUSERS AND REGISTERS MOUNTING STYLE SHALL MATCH CEILING TYPE, PATTERN AND MATERIAL.
*DIFFUSERS AND REGISTERS COLOR SHALL BE AS PER OWNER'S COLOR CRITERIA.
*PROVIDE TR TRANSITION IF REQUIRED.

NOMENCLATURE

MCA: MIN. CIRCUIT AMPS. (A)
MFA: MAX. FUSE AMPS. (A)
MSC: MAX. STARTING CURRENT (A)
RLA: RATED LOAD AMPS. (A)
OFM: OUTDOOR FAN MOTOR
FLA: FULL LOAD AMPS. (A)
KW: RATED MOTOR OUT PUT (KW)
COP: COEFFICIENT OF PERFORMANCE

ABBREVIATIONS:

EF	EXHAUST FAN
CFM	CUBIC FEET PER MINUTE
S.A.	SUPPLY AIR
R.A.	RETURN AIR
O.A.	OUTSIDE AIR
AHU	AIR HANDLING UNIT
PCU	PACKAGE CONDENSING UNIT
CU	CONDENSING UNIT
SD	SUPPLY DIFFUSER
RR	RETURN REGISTER
N	NECK
OAL	OUTSIDE AIR LOUVER
BDD	BACKDRAFT DAMPER
OBD	OPPOSED BLADE DAMPER
CONC.	CONCRETE
(TYP.)	TYPICAL
SD	SMOKE DETECTOR
CHWS	CHILLED WATER SUPPLY
CHWR	CHILLED WATER RETURN
CHWPP	CHILLED WATER PRIMARY PUMP
CHWSP	CHILLED WATER SECONDARY PUMP
RM	REFRIGERATION MACHINE (CHILLER)
DFD	DUCT FIRE DAMPER
PTAC	PACKAGED TERMINAL AIR CONDITIONERS
Ⓣ	TEMPERATURE CONTROLLER

"Yo, José Luis Marrero Sicardo, licencia # [illegible], certifico que soy el profesional que diseñó estos planos y las especificaciones complementarias. También certifico que entiendo que dichos planos y especificaciones cumplen con las disposiciones aplicables del Reglamento Conjunto y las disposiciones aplicables de los Reglamentos y Códigos de las Agencias, Juntas Reglamentadoras o Corporaciones Públicas con jurisdicción. Reconozco que cualquier declaración falsa o falsificación de los hechos que se haya producido sin conocimiento o por negligencia ya sea por mí, mis agentes o empleados, o por otras personas con mi conocimiento, me hacen responsable de cualquier acción judicial y disciplinaria por la OGPe y otras autoridades competentes, incluyendo, pero sin limitarse, a la terminación de la participación en los procedimientos de certificación profesional en la OGPe."

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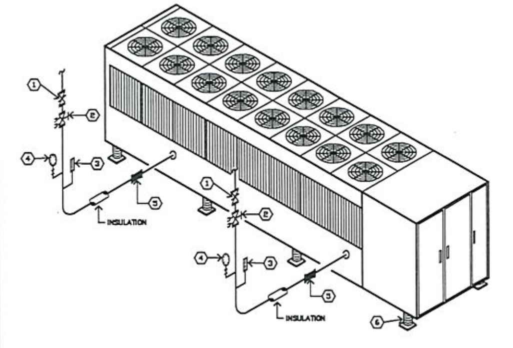
BID SET DRAWINGS
DATE: June 2, 2021

Project Name:
VAC RENOVATIONS AT GENERAL PSYCHIATRIC HOSPITAL DR. RAMÓN FERNÁNDEZ MARINA
San Juan, Puerto Rico

Rev. #	Date	Revision By	Description

Drawing Name: VAC SCHEDULES
Owner: ASSMCA
Digital Signature:
Stamp: JOSE L. MARRERO SICARDO — INGENIERO LICENCIADO — PUERTO RICO

JLMS Project Num: 21-027
Drawing Date: June 2, 2021
Checked By: J. L. Marrero
Scale: Not to Scale
Page: 10 of 14 VAC-300



CHILLER LEGEND

IDENT. NO.	DESCRIPTION
1	BUTTERFLY VALVE
2	SHUTOFF & CIRCUIT BALANCING VALVE ARMSTRONG CBV-T *
3	THERMOMETER WITH WELL AND 1-3/4 EXTENSION NECK
4	PRESSURE GAGE W/COCK VALVE WEISS 0-100 OF SCALE
5	FLEXIBLE CONNECTION
6	RUBBER ISOLATORS AS PER EQUIPMENT REQUIREMENTS

CHILLERS AND HEAT MACHINECONNECTION DETAIL
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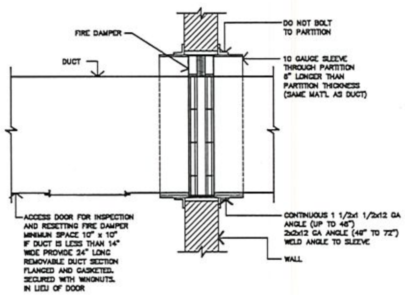


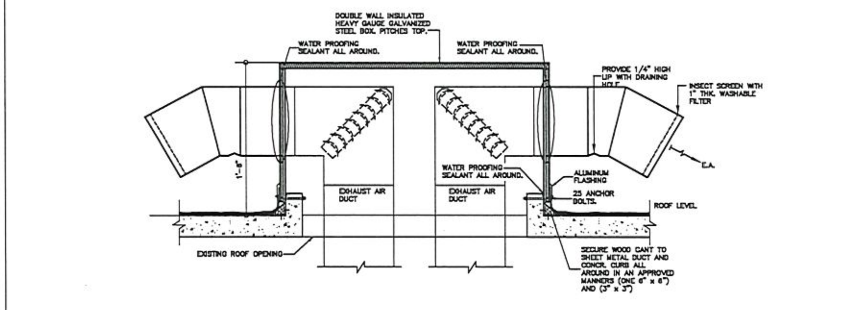
FIRE DAMPER

SPECIFICATIONS:
1- SHALL BE INSTALLED AS REQUIRED BY APPLICABLE CODES.
2- SHALL BE CONSTRUCTED AND TESTED WITH THE CURRENT EDITION OF UL-555 STANDAR FOR FIRE DAMPERS.
3- SHALL BE MARKED WITH A "UL CLASSIFIED 1-1/2 HOUR FIRE PROTECTION RATING" AND "FOR USE IN STATIC SYSTEMS ONLY".
4- EACH FIRE DAMPER SHALL INCLUDE A 165°F FUSIBLE LINK.
5- EACH FIRE DAMPER SHALL INCLUDE A STEEL SLEEVE AND RETAINING ANGLES FURNISHED BY THE MANUFACTURER TO ENSURE APPROPIATE INSTALLATION OR AS SPECIFIED IN THE SCHEDULE BELOW.
6- SUBMITTAL INFORMATION SHALL INCLUDE THE FIRE PROTECTION RATING AND THE MANUFACTURER'S UL INSTALLATION INSTRUCTIONS.
7- EACH FIRE DAMPER SHALL INCLUDE UL INSTALLATION INSTRUCTIONS AND SHALL BE INSTALLED IN ACCORDANCE WITH THESE INSTRUCTIONS.

SCHEDULE FOR FIRE DAMPERS

A- DUCT FIRE DAMPERS (MARKED DFD)
1- INTERIOR DIMENSION - TO MATCH THE DUCT'S INTERIOR DIMENSION SHOWN
2- MOUNTING - VERTICAL
3- BLADES - 24 GAUGE - GALVANIZED CURTAIN TYPE IN AIR STEAM
4- MANUFACTURER: RUSKIN MODEL 1002 STYLE C

FIRE DAMPER INSTALLATION DETAIL
SCALE : N.T.S.



ROOF PENETRATION DETAIL
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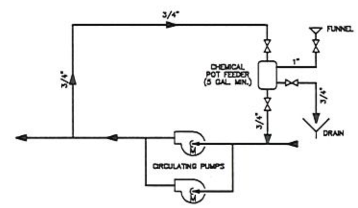

CHEMICAL FEEDER CONNECTION DETAIL
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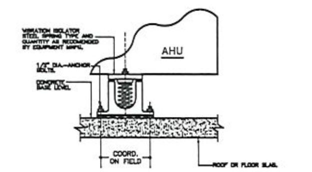

RM, AHU MOUNTING DETAIL
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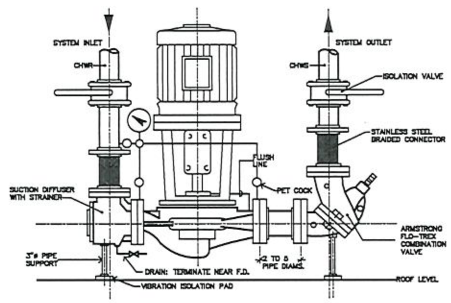

PUMP INSTALLATION DETAIL
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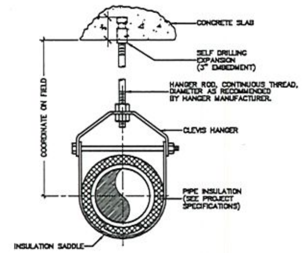

PIPE HANGER
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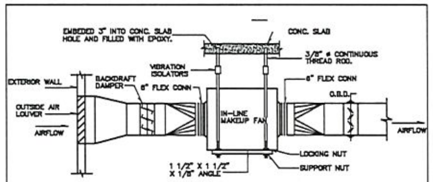

MAKEUP FAN MOUNTING DETAIL
SCALE : N.T.S.

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BID SET DRAWINGS
DATE: June 2, 2021

Project Name:
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San Juan, Puerto Rico

Rev. #	Date	Revision By	Description

Drawing Name:
VAC DETAILS

Owner:
ASSMCA

Digital Signature:

Stamp: JOSE L. MARRERO SICARDO — PUERTO RICO

JLMS Project Num: 21-027
Drawing Date: June 2, 2021
Checked By: J. L. Marrero
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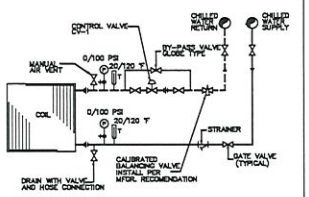
Page: 11 of 14 VAC-400



COIL PIPING SCHEMATIC
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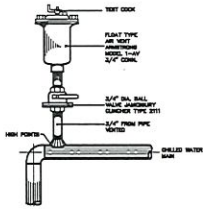

AUTOMATIC AIR VENT DETAIL FOR CHWS & CHWR PIPES
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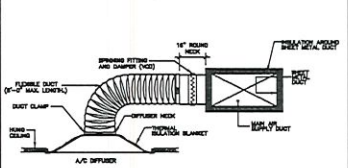
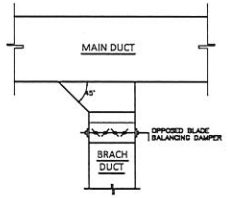


CEILING DIFFUSER & FLEXIBLE DUCT INSTALLATION DETAIL
SCALE : N.T.S.



DETAIL APPLIES TO EACH SUPPLY, RETURN OR EXHAUST DUCT BRANCH.

TYPICAL TAKE-OFF DETAIL
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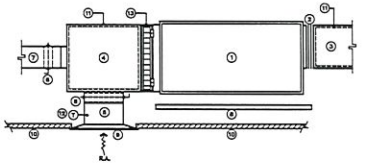
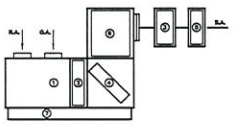


LEGEND:

1. FAN COIL UNIT.
2. FLEXIBLE CONNECTION.
3. SUPPLY AIR DUCT.
4. FIELD FABRICATED GALVANIZED STEEL MIXING PLENUM.
5. R.A. DUCT
6. OPPOSED BLADE BALANCING DAMPER.
7. O.A. DUCT
8. INSULATED GALVANIZED STEEL SECONDARY DRAIN PAN.
9. R.A. GRILLE SEE ARCHITECTURAL DWG'S. FOR DETAILS. (24"x24" MIN.)
10. ARCHITECTURAL CEILING, SEE ARCHITECTURAL DWG'S. FOR DETAILS.
11. 1" THK INTERNAL ACOUSTICAL LINING.
12. PLENUM MOUNTED TEMP. SENSOR.
13. FILTER FRAME WITH 2MR EFF. DISPOSABLE FILTER. PROVIDE AIR TIGHT RUBBER GASKETS AND LOCKING DEVICE DOOR.

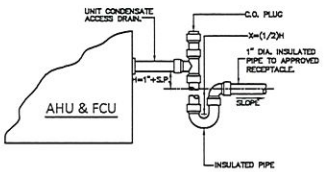
FAN COIL UNIT MOUNTING DETAIL
SCALE : N.T.S.



LEGEND

1. MIXING BOX PLENUM
2. FILTER SECTION (MERV 8, 2" PRE-FILTER).
3. MERV 14, CARTRIDGE FILTER MODULE (DUCT MOUNTED)
4. CHILLED WATER COIL MODULE WITH UV LIGHT
5. RE-HEAT COIL MODULE (DUCT MOUNTED)
6. SUPPLY FAN SECTION.
7. HOUSEKEEPING PAD

VERTICAL AHU'S COMPONENTS
SCALE : N.T.S.



CONDENSATE DRAIN DETAIL
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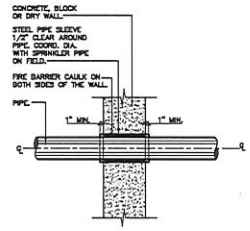

PIPE THROUGH WALL TYPICAL INSTALLATION DETAIL
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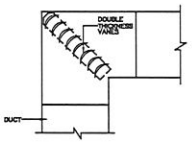

SQUARED VANED ELBOW
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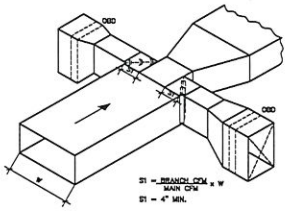
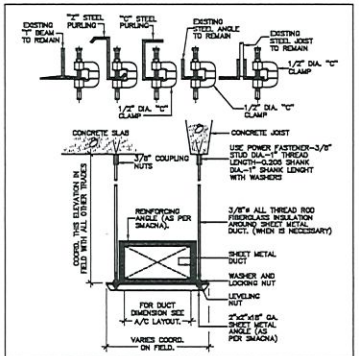


DETAIL APPLIES TO EACH SUPPLY, RETURN OR EXHAUST DUCT SPLITTER.

DOUBLE LATERAL BRANCH TYPICAL DETAIL
SCALE : N.T.S.



SUPPLY,RETURN OR EXHAUST SHEET METALDUCT HANGER DETAIL
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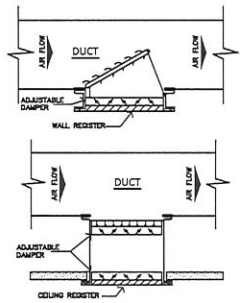
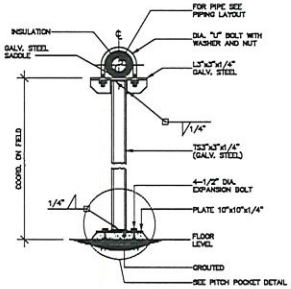


DETAIL APPLIES TO EACH WALL OR CEILING MOUNTED SUPPLY, RETURN OR EXHAUST REGISTER AND DIFFUSER.

SUPPLY DIFFUSER, EXHAUST OR RETURN REGISTER MOUNTING DETAIL
SCALE : N.T.S.



PIPE SUPPORT DETAIL
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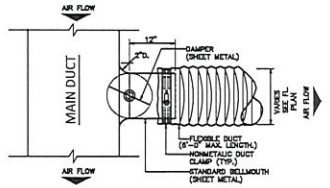

BELLMOUTH & FLEXIBLE DUCT INSTALLATION DETAIL
SCALE : N.T.S.

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BID SET DRAWINGS
DATE: June 2, 2021

Project Name:
VAC RENOVATIONS AT GENERAL PSYCHIATRIC HOSPITAL DR. RAMÓN FERNÁNDEZ MARINA
San Juan, Puerto Rico

Rev. #	Date	Revision By	Description

Drawing Name:
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Stamp:

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Checked by: I.L. Marrero
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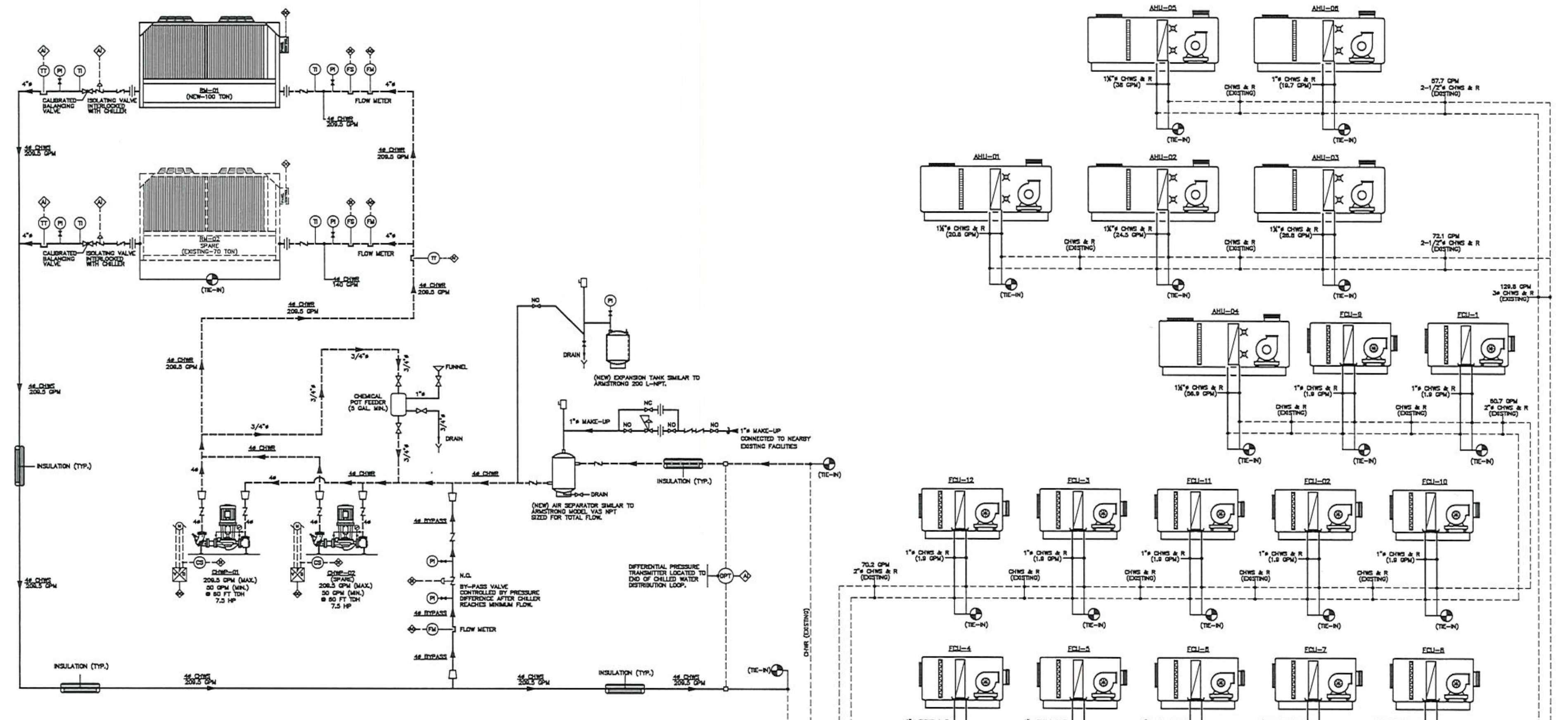
Page: 12 of 14
VAC-401



CHILLED AND WATER GENERATION SYSTEM FLOW AND CONTROL DIAGRAM

SCALE : N.T.S.

SEQUENCE OF OPERATION:

1. A NEW MICROPROCESSOR BASED BUILDING AUTOMATION SYSTEM (BAS) SHALL EXECUTE ALL CONTROL OPERATION ASSOCIATED WITH AIR CONDITIONING AND VENTILATION EQUIPMENT.
2. THE NEW BAS SYSTEM SHALL BE INTELLIGENT AUTOMATION SYSTEM (I/A SYSTEM) BY INVENSYS. BUILDING SYSTEM CONTROL SHALL INCLUDE A LEAST ONE GLOBAL CONTROL MODULE.(GCM)
3. ON COMMAND TO START, THE CHILLER WATER SYSTEM SHALL START.
4. A FLOW SWITCH AT CHILLER INLET SHALL ACTUATE AN ALARM AND SHUTT DOWN THE SYSTEM WHEN WATER FLOW ACROSS THE CHILLER REACHES LOW VALUE.
5. CHWP-01 TO 02 VARIABLE FREQUENCY DRIVE SHALL BE CONNECTED TO TE LCM AN ANALOG OUTPUT DEVICES. PUMPS VFD'S SHALL BE CONTROLLED MANUALLY TO ATTAIN OPTIMUM WATER FLOW.
6. A CURRENT SENSOR LOCATED AT CHWP-01 TO 01B SHALL BE CONNECTED TO THE LOCAL CONTROL MODULE TO INDICATE PUMPS STATUS.
7. A IMMERSION TEMPERATURE SENSOR LOCATED AT SUPPLY AND RETURN CHILLED WATER PIPING SHALL BE CONNECTED TO THE LCM TO MONITOR CHILLED WATER TEMPERATURE.
8. THE TEMPERATURE ANALOG SIGNAL FROM SENSOR INSTALLED IN THE SUPPLY AND RETURN PIPING, SHALL INPUT THE EMS FOR SYSTEM'S OPTIMIZATION AND MONITORING.
9. CURRENT SWITCH SHALL SEND A SIGNAL TO D.D.C. CONTROL PANEL INDICATING PUMP STATUS.
10. UPON SYSTEM'S STARTUP, SHOULD PUMP FAIL TO START AND NO STATUS SIGNAL RECEIVED BY THE BMS, THEN THE LAG PUMP WILL AUTOMATICALLY START.
11. MAGNAHELIC GAGE SHALL INDICATED PRESSURE DROP FOR FILTER BANK.
12. THE GCM SHALL BE CAPABLE OF FUTURE COMMUNICATION VIA ETHERNET, ECHELON, OR REMOTE MODEM.
13. LOCAL CONTROL MODULE (LCM) SHALL BE LONMARK CERTIFIED AND CAPABLE OF DIRECT PEER TO PEER BINDING WITH LONMARK AND LONWORK CERTIFIED DEVICES.
14. SYSTEM SHALL BE MODULAR TO PERMIT EASY EXPANSION BY SIMPLY ADDING MORE CONTROLLERS.
15. SPECIFIED CONTROL SHALL BE LEAST INVENSYS BUILDING SYSTEM I/A SERIES CAPABLE OF COMMUNICATION WITH BACNET, LONWORK,LONMARK,N W8000,FOXBORO AND APPROXIMATELY 600 THIRD PARTY PROPRIETARY PROTOCOL.
16. THE INTELLIGENT AUTOMATION SYSTEM SHALL BE OPEN & INTER OPERABLE WITH BACNE, LONMARK AND TLONWORK NONE INTER OPERABLE SYSTEM WILL BE NOT ACCEPTABLE.
17. CHILLED WATER PUMPS SHALL BE ELECTRICALLY INTERLOCKED WITH CHILLERS.
18. ON COMMAND TO START THE AHU SUPPLY FAN SHALL START.
19. FOR UNIT AHU-01 TO AHU-06 & FCU-1 TO FCU-12: VFD SHALL MODULATE RESPONDING TO RETURN AIR TEMPERATURE SENSOR. CHILLED WATER VALVE SHALL MAINTAIN A CONSTANT SUPPLY AIR TEMPERATURE OF 55° WHEN VFD REACHES MINIMUM FREQUENCY, CHILLED WATER VALVE SHALL MODULATE BASED ON RETURN AIR TEMPERATURE.
20. IN AREAS NOT PROVIDED WITH VARIABLE VOLUME DIFFUSERS, AHU'S VARIABLE FREQUENCY DRIVES SHALL MODULATE BASED ON RETURN AIR TEMPERATURE.
21. A SMOKE DETECTOR LOCATED AT THE SUPPLY DUCT. SHALL STOP THE FAN UPON SENSING SMOKE.
22. A DIFFERENTIAL PRESSURE SWITCH ACROSS THE FILTER TO ACTUATE AN ALARM WHEN THE PRESSURE DROP ACROSS THE FILTER REACHES HIGH VALUE.
23. A RELATIVE HUMIDITY TRANSMITTER LOCATED AT THE RETURN DUCT SHALL BE CONNECTED TO THE LOCAL CONTROL MODULE THROUGH AN ANALOG INPUT DEVICES RETURN RELATIVE HUMIDITY SHALL BE INDICATED AT THE GCM.
24. A TEMPERATURE SENSOR LOCATED AT FAN INLET SHALL BE CONNECTED TO THE LOCAL CONTROL MODULE THROUGH AN ANALOG INPUT DEVICES. COOLING COIL LEAVING TEMPERATURE SHALL BE INDICATED AT THE LCM.
25. RETURN DUCT TEMPERATURE SENSOR SHALL PROVIDE SIGNAL TO LOCAL CONTROL MODULE (LCM).
26. A CURRENT SENSOR LOCATED AT EF'S SHALL BE CONNECTED TO THE LOCAL CONTROL MODULE TO INDICATED FAN STATUS.
27. FOR UNIT AHU-01 TO AHU-06: ROOM TEMPERATURE WILL BE CONTROLLED BY THE RETURN AIR TEMPERATURE MODULATING FAN VFD. ROOM RELATIVE HUMIDITY IN ESCESS OF 55% SHALL ACTIVATE ELECTRIC RE-HEAT COIL.
28. RETURN DUCT TEMPERATURE SENSOR, SHALL BE MODULATE AHU'S VARIABLE FREQUENCY DRIVE AND SHALL PROPORTIONALLY CLOSE THE RETURN AIR DAMPER IN ORDER TO OBTAIN A CONSTANT OUTSIDE AIR VOLUME.
29. ONLY ONE CHILLER AND ONE PUMP OPERATES AT ANY TIME.

[illegible]

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DATE: May 28, 2021

Project Name:
VAC RENOVATIONS AT GENERAL PSYCHIATRIC HOSPITAL DR. RAMÓN FERNÁNDEZ MARINA
San Juan, Puerto Rico

Rev. #	Date	Revision By	Description

Drawing Name:
CHILLED WATER FLOW DIAGRAM

Owner:
GOBIERNO DE PUERTO RICO
DEPARTAMENTO DE SALUD

Digital Signature:

Stamp: JOSE L. MARRERO SICARDO — INGENIERO LICENCIADO — LIC. #14870 — PUERTO RICO

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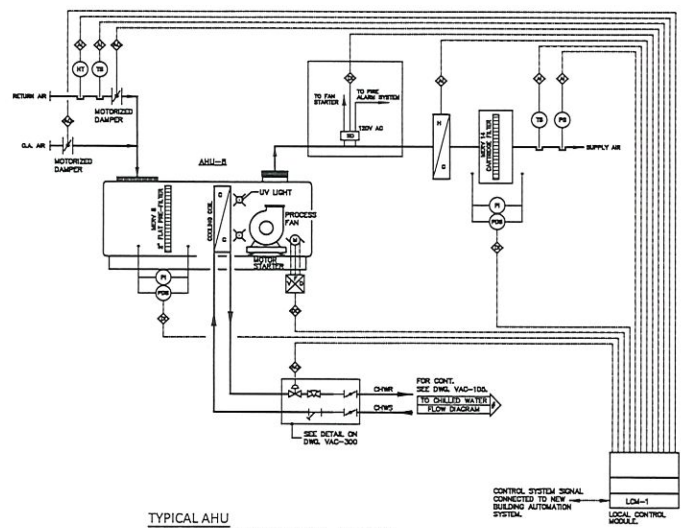
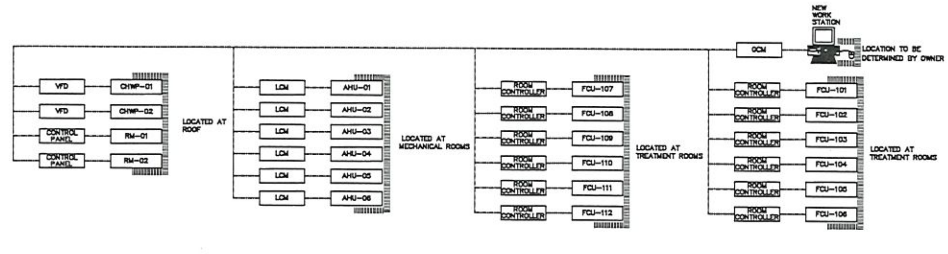
Page: 13 of 14
VAC-500



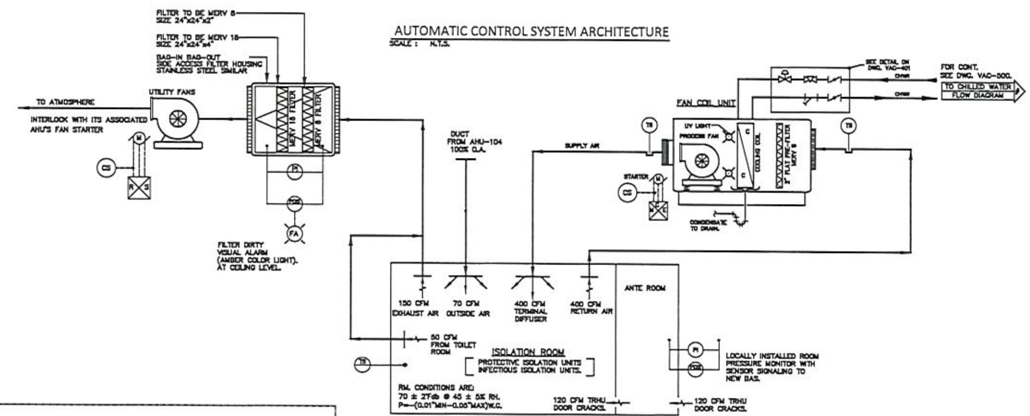
TYPICAL AHU
CONFIGURATION & CONTROL DIAGRAM
SCALE: NOT TO SCALE

LEGEND:

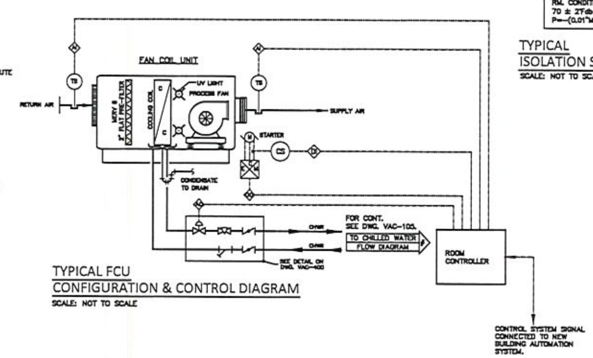
CS	CURRENT SENSOR	AO	ANALOG OUTPUT	FF	FINAL FILTER	ER	EXHAUST REGISTER
DM	DAMPER MOTOR	AI	ANALOG INPUT	PF	PRE FILTER	H	HOOD
FI	FLOW INDICATOR	DO	DIGITAL OUTPUT	SF	SUPPLY FAN	AS	ACID STORAGE
FT	FLOW TRANSMITTER	DI	DIGITAL INPUT	RA	RETURN AIR	CFM	CUBIC FEET PER MINUTE
HS	HAND SWITCH		ELECTRICAL SIGNAL	OA	OUTSIDE AIR	EF	EXHAUST FAN
HT	HUMIDITY TRANSMITTER	SD	SMOKE DETECTOR	EA	EXHAUST AIR	SR	SUPPLY REGISTER
HI	HUMIDITY INDICATOR	MD	MANUAL DAMPER	AHU	AIR HANDLING UNIT	(E)	EXISTING
PDS	PRESSURE DIFFERENTIAL SWITCH		SENSING RELAY	RH	RE-HEAT COIL	(N)	NEW
PI	PRESSURE INDICATOR	HFT	HEPA FILTER TERMINAL	CU	CONDENSING UNIT	AMD	AIR MONITOR DEVICE
TS	TEMPERATURE SENSOR	FH	FUME HOOD	RR	RETURN REGISTER	CH	CANOPY HOOD
VFD	VARIABLE FREQUENCY DRIVE	RM	REFRIGERATION MACHINE		DUCTWORK	CC	COOLING COIL
MD	MANUAL DAMPER		VARIABLE FREQUENCY DRIVE		GATE VALVE		UNIVERSAL UNION
PS	PRESSURE SENSOR		AUTOMATIC AIR VENT		PRES. REGULATOR		CHECK VALVE
LCM	LOCAL CONTROL MODULE		TEMPERATURE-PRESSURE RELIEF VALVE				BUTTERFLY VALVE
GCM	GENERAL CONTROL MODULE	RH-##	RE-HEAT COIL IDENTIFICATION				
CDT	CARBON DIOXIDE TRANSMITTER						
T	THERMOSTAT						



AUTOMATIC CONTROL SYSTEM ARCHITECTURE
SCALE : N.T.S.



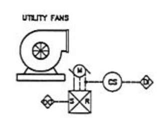
TYPICAL
ISOLATION SUITE CONTROL AND FLOW DIAGRAM
SCALE: NOT TO SCALE



TYPICAL FCU
CONFIGURATION & CONTROL DIAGRAM
SCALE: NOT TO SCALE

ELECTRICAL REQUIREMENTS FOR AUTOMATIC CONTROL SYSTEM

1. CONTRACTOR SHALL PROVIDE DEDICATED 120 VOLT CONNECTION FOR CONTROL SYSTEM IN THE FOLLOWING AREAS:
   - INSIDE MECHANICAL ROOMS OR MECHANICAL CLOSETS
   - NEAR ROOF MOUNTED AIR HANDLING UNITS
   - NEAR TEMPERATURE OR HUMIDYTY TRANSMITTERS
   - NEAR LOCAL CONTROL MODULES
   - NEAR GENERAL CONTROL MODULE
   - NEAR MOTORIZED DAMPERS
   - NEAR PRESSURE DIFFERENTIAL SWITCH
   - NEAR SMOKE DETECTORS
   - NEAR CONTROL VALVES
2. CONTRACTOR SHALL BE RESPONSIBLE OF PROVIDE ELECTRICA CONNECTION FROM THE JUNCTION PROVIDED TO THE CONTROL EQUIPMENT.



NOTE:
FANS STARTER SHALL BE INTERLOCKED WITH ITS ASSOCIATED AIR CONDITIONING EQUIPMENT OR BE PROVIDED WITH STAR STOP SWITCH. SEE SCHEDULE ON DWG. VAC-201.

TYPICAL UTILITY FANS CONTROL DIAGRAM
SCALE : N.T.S.

"Yo, Jose Luis Marrero Ricardo, licencia # 18170, certifico que soy el profesional que diseñó estos planos y las especificaciones complementarias. También certifico que entiendo que dichos planos y especificaciones cumplen con las disposiciones aplicables del Reglamento Conjunto y las disposiciones aplicables de los Reglamentos y Códigos de las Agencias, Juntas Reglamentadoras o Corporaciones Públicas con jurisdicción. Reconozco que cualquier declaración falsa o falsificación de los hechos, que se haya producido con conocimiento o por negligencia en ese por mi, mis agentes o empleados, o por otras personas con mi conocimiento, me hace responsable de cualquier acción judicial y disciplinaria por la OGPe y otras autoridades competentes, incluyendo, pero sin limitarse, a la terminación de la participación en los procedimientos de certificación profesional en la OGPe."

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BID SET DRAWINGS
DATE: June 2, 2021

Rev. #	Date	Revision By	Description

Project Name:
VAC RENOVATIONS AT GENERAL PSYCHIATRIC HOSPITAL DR. RAMÓN FERNÁNDEZ MARINA
San Juan, Puerto Rico

Drawing Name:
AUTOMATIC CONTROLS DIAGRAMS

Owner:
ASSMCA

Digital Signature:

Stamp: JOSE L. MARRERO RICARDO — PUERTO RICO

JLMS Project Num: 21-027
Drawing Date: June 2, 2021
Checked By: J. L. Marrero
Scale: 3/32"=1'-0"
Page: 14 of 14
VAC-501

MECHANICAL TECHNICAL SPECIFICATIONS

Date:	June 2, 2021
From:	José Luis Marrero Sicardo, PE
Project #:	JLMS# 21-027
Project Name:	Replacement of Several AHU's for – Hospital de Psiquiatría General, Rio Piedras, Puerto Rico

DIVISION 15 –MECHANICAL

15050	BASIC MECHANICAL MATERIALS AND METHODS
15100	VALVES
15145	HANGERS AND SUPPORTS
15241	MECHANICAL VIBRATION CONTROLS AND SEISMIC RESTRAINTS
15250	MECHANICAL INSULATION
15510	HYDRONIC PIPING
15540	HVAC PUMPS
15684	AIR-COOLED CHILLERS
15854	CENTRAL-STATION AIR-HANDLING UNITS
15891	METAL DUCTWORK
15932	AIR OUTLETS AND INLETS
15975	CONTROL SYSTEMS EQUIPMENT
15990	TESTING, ADJUSTING, AND BALANCING

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SECTION 15050 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and the Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following basic mechanical materials and methods to complement other Division 15 Sections.

1. Piping materials and installation instructions common to most piping systems.
2. Concrete equipment base construction requirements.
3. Equipment nameplate data requirements.
4. Labeling and identifying mechanical systems and equipment is specified in Division 15 Section "Mechanical Identification."
5. Nonshrink grout for equipment installations.
6. Field-fabricated metal and wood equipment supports.
7. Installation requirements common to equipment specification Sections.
8. Mechanical demolition.
9. Cutting and patching.
10. Touchup painting and finishing.

B. Pipe and pipe fitting materials are specified in piping system Sections.

1.3 DEFINITIONS

A. Pipe, pipe fittings, and piping include tube, tube fittings, and tubing.

B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below the roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

C. Exposed Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

D. Exposed Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

E. Concealed Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

F. 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.

1.4 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
B. Product data for following piping specialties:

1. Mechanical sleeve seals.

2. Identification materials and devices.

C. Samples of color, lettering style, and other graphic representation required for each identification material and device.

D. Shop drawings detailing fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.

E. Coordination drawings for access panel and door locations.

F. Prepare coordination drawings according to Division 1 Section "Submittals" to a 1/4 inch equals 1 foot scale or larger. Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Show where sequence and coordination of installations are important to the efficient flow of the Work. Include the following:

1. Proposed locations of piping, ductwork, equipment, and materials. Include the following:

   a. Planned piping layout, including valve and specialty locations and valve stem movement.
   b. Planned duct systems layout, including elbow radii and duct accessories.
   c. Clearances for installing and maintaining insulation.
   d. Clearances for servicing and maintaining equipment, including space for equipment disassembly required for periodic maintenance.
   e. Equipment service connections and support details.
   f. Exterior wall and foundation penetrations.
   g. Fire-rated wall and floor penetrations.
   h. Sizes and location of required concrete pads and bases.

2. Scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
3. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
4. Reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items.

G. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

1.5 QUALITY ASSURANCE

A. Qualify welding processes and operators for structural steel according to AWS D1.1 "Structural Welding Code--Steel."

B. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions of ASME B31 Series "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.

C. ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

D. Equipment Selection: Equipment of greater or larger power, dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. No additional costs will be approved for these increases, if larger equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of the floor.

C. Protect flanges, fittings, and piping specialties from moisture and dirt.

D. Protect stored plastic pipes from direct sunlight. Support to prevent sagging and bending.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate mechanical equipment installation with other building components.

B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.

C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to closing in the building.

E. Coordinate connection of electrical services.

F. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

G. Coordinate requirements for access panels and doors where mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors."

H. Coordinate installation of identifying devices after completing covering and painting where devices are applied to surfaces. Install identifying devices prior to installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

A. Refer to individual piping system specification Sections for pipe and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

A. Refer to individual piping system specification Sections in Division 15 for special joining materials not listed below.

B. Pipe Flange Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, except where thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125 cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250 cast-iron and steel flanges.

2. ASME B16.20 for grooved, ring-joint, steel flanges.
3. AWWA C110, rubber, flat face, 1/8 inch thick, except where other thickness is indicated; and full-face or ring type, except where type is indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, except where other material is indicated.

D. Plastic Pipe Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, except where other type or material is indicated.

E. Solder Filler Metal: ASTM B 32.

1. Alloy Sn95 or Alloy Sn94: Tin (approximately 95 percent) and silver (approximately 5 percent), having 0.10 percent lead content.

2. Alloy Sn50: Tin (50 percent) and lead (50 percent).
3. Alloy E: Tin (approximately 95 percent) and copper (approximately 5 percent), having 0.10 percent maximum lead content.
4. Alloy HA: Tin-antimony-silver-copper-zinc, having 0.10 percent maximum lead content.
5. Alloy HB: Tin-antimony-silver-copper-nickel, having 0.10 percent maximum lead content.
6. Alloy Sb5: Tin (95 percent) and antimony (5 percent), having 0.20 percent maximum lead content.

F. Brazing Filler Metals: AWS A5.8.

1. BCuP Series: Copper-phosphorus alloys.
2. BAg1: Silver alloy.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements: Manufacturer's standard solvents complying with the following:

1. Acrylonitrile-Butadiene-Styrene (ABS): ASTM D 2235.
2. Chlorinated Poly(Vinyl Chloride) (CPVC): ASTM F 493.
3. Poly(Vinyl Chloride) (PVC): ASTM D 2564.
4. PVC to ABS Transition: Made to requirements of ASTM D 3138, color other than orange.

I. Plastic Pipe Seals: ASTM F 477, elastomeric gasket.

J. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon steel bolts and nuts.

K. Couplings: Iron body sleeve assembly, fabricated to match outside diameters of plain-end pressure pipes.

1. Sleeve: ASTM A 126, Class B, gray iron.
2. Followers: ASTM A 47, Grade 32510 or ASTM A 536 ductile iron.
3. Gaskets: Rubber.
4. Bolts and Nuts: AWWA C111.
5. Finish: Enamel paint.

2.3 PIPING SPECIALTIES

A. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type where required to conceal protruding fittings and sleeves.

1. Inside Diameter: Closely fit around pipe, tube, and insulation.
2. Outside Diameter: Completely cover opening.
3. Cast Brass: One-piece, with set-screw.

a. Finish: Rough brass.
b. Finish: Polished chrome plate.

4. Cast Brass: Split casting, with concealed hinge and set-screw.

a. Finish: Rough brass.
b. Finish: Polished chrome plate.

5. Stamped Steel: One-piece, with set-screw and chrome-plated finish.
6. Stamped Steel: One-piece, with spring clips and chrome-plated finish.
7. Stamped Steel: Split plate, with concealed hinge, set-screw, and chrome-plated finish.
8. Stamped Steel: Split plate, with concealed hinge, spring clips, and chrome-plated finish.
9. Stamped Steel: Split plate, with exposed-rivet hinge, set-screw, and chrome-plated finish.
10. Stamped Steel: Split plate, with exposed-rivet hinge, spring clips, and chrome-plated finish.
11. Cast-Iron Floor Plate: One-piece casting.

B. Dielectric Fittings: Assembly or fitting having insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion.

1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld neck end types and matching piping system materials.
2. Insulating Material: Suitable for system fluid, pressure, and temperature.

3. Dielectric Unions: Factory-fabricated, union assembly for 250-psig minimum working pressure at a 180 deg F temperature.
4. Dielectric Flanges: Factory-fabricated, companion-flange assembly for 150- or 300-psig minimum pressure to suit system pressures.
5. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
   a. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure to suit system pressures.

6. Dielectric Couplings: Galvanized-steel coupling, having inert and noncorrosive, thermoplastic lining, with threaded ends and 300-psig minimum working pressure at 225 deg F temperature.
7. Dielectric Nipples: Electroplated steel nipple, having inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved end types and 300-psig working pressure at 225 deg F temperature.

C. Mechanical Sleeve Seals: Modular, watertight mechanical type. Components include interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve. Connecting bolts and pressure plates cause rubber sealing elements to expand when tightened.

D. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:

1. Steel Sheet-Metal: 24-gage or heavier galvanized sheet metal, round tube closed with welded longitudinal joint.
2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.

3. Cast-Iron: Cast or fabricated wall pipe equivalent to ductile-iron pressure pipe, having plain ends and integral water stop, except where other features are specified.

4. Wall Penetration Systems: Wall sleeve assembly, consisting of housing, gaskets, and pipe sleeve, with 1 mechanical-joint end conforming to AWWA C110 and 1 plain pipe-sleeve end.

a. Penetrating Pipe Deflection: 5 percent without leakage.
b. Housing: Ductile-iron casting having waterstop and anchor ring, with ductile-iron gland, steel studs and nuts, and rubber gasket conforming to AWWA C111, of housing and gasket size as required to fit penetrating pipe.
c. Pipe Sleeve: AWWA C151, ductile-iron pipe.
d. Housing-to-Sleeve Gasket: Rubber or neoprene push-on type of manufacturer's design.

5. Cast-Iron Sleeve Fittings: Commercially made sleeve having an integral clamping flange, with clamping ring, bolts, and nuts for membrane flashing.

a. Underdeck Clamp: Clamping ring with set-screws.

6. PVC Plastic: Manufactured, permanent, with nailing flange for attaching to wooden forms.
7. PVC Plastic Pipe: ASTM D 1785, Schedule 40.
8. PE Plastic: Manufactured, reusable, tapered, cup-shaped, smooth outer surface, with nailing flange for attaching to wooden forms.

2.4 IDENTIFYING DEVICES AND LABELS

A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 15 Sections. Where more than one type is specified for listed application, selection is Installer's option, but provide single selection for each product category.

B. Equipment Nameplates: Metal nameplate with operational data engraved or stamped, permanently fastened to equipment.

1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.
2. Location: An accessible and visible location.

C. Stencils: Standard stencils, prepared for required applications with letter sizes conforming to recommendations of ASME A13.1 for piping and similar applications, but not less than 1-1/4-inch -high letters for ductwork and not less than 3/4-inch -high letters for access door signs and similar operational instructions.
1. Material: Fiberboard.
2. Material: Brass.
3. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.
4. Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated for piping systems, comply with ASME A13.1 for colors.

D. Snap-On Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid snap-on, color-coded pipe markers, conforming to ASME A13.1.

E. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, conforming to ASME A13.1.

F. Plastic Duct Markers: Manufacturer's standard laminated plastic, color coded duct markers. Conform to following color code:

1. Green: Cold air.
2. Yellow: Hot air.
3. Yellow/Green: Supply air.
4. Blue: Exhaust, outside, return, and mixed air.
5. For hazardous exhausts, use colors and designs recommended by ASME A13.1.
6. Nomenclature: Include following:

a. Direction of air flow.

b. Duct service (supply, return, exhaust, etc.).
c. Duct origin (from).
d. Duct destination (to).
e. Design cfm.

G. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white (letter color) melamine subcore, except when other colors are indicated.

1. Fabricate in sizes required for message.
2. Engraved with engraver's standard letter style, of sizes and with wording to match equipment identification.
3. Punch for mechanical fastening.
4. Thickness: 1/16 inch, except as otherwise indicated.
5. Thickness: 1/8 inch, except as otherwise indicated.
6. Thickness: 1/16 inch for units up to 20 square inches or 8 inches long; 1/8 inch for larger units.
7. Fasteners: Self-tapping stainless-steel screws or contact-type permanent adhesive.

H. Plastic Equipment Markers: Laminated-plastic, color-coded equipment markers. Conform to following color code:

1. Green: Cooling equipment and components.
2. Yellow: Heating equipment and components.
3. Yellow/Green: Combination cooling and heating equipment and components.
4. Brown: Energy reclamation equipment and components.
5. Blue: Equipment and components that do not meet any of the above criteria.
6. For hazardous equipment, use colors and designs recommended by ASME A13.1.
7. Nomenclature: Include following, matching terminology on schedules as closely as possible:

a. Name and plan number.
b. Equipment service.
c. Design capacity.
d. Other design parameters such as pressure drop, entering and leaving conditions, and rpm.

8. Size: Approximately 2-1/2 by 4 inches for control devices, dampers, and valves; and 4-1/2 by 6 inches for equipment.

I. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification, with corresponding designations indicated. Use numbers, lettering, and wording indicated for proper identification and operation/maintenance of mechanical systems and equipment.

1. Multiple Systems: Where multiple systems of same generic name are indicated, provide identification that indicates individual system number as well as service such as "Boiler No. 3," "Air Supply No. 1H," or "Standpipe F12."

2.5 GROUT

A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.

1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory-packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS--COMMON REQUIREMENTS

A. General: Install piping as described below, except where system Sections specify otherwise. Individual piping system specification Sections in Division 15 specify piping installation requirements unique to the piping system.

B. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, except where deviations to layout are approved on coordination drawings.

C. Install piping at indicated slope.

D. Install components having pressure rating equal to or greater than system operating pressure.

E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.

F. Install piping free of sags and bends.

G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated.

H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.

I. Install piping to allow application of insulation plus 1-inch clearance around insulation.

J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

K. Install fittings for changes in direction and branch connections.

L. Install couplings according to manufacturer's printed instructions.

M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:

1. Chrome-Plated Piping: Cast-brass, one-piece, with set-screw, and polished chrome-plated finish. Use split-casting escutcheons, where required, for existing piping.
2. Uninsulated Piping Wall Escutcheons: Cast-brass or stamped-steel, with set-screw.
3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
4. Insulated Piping: Cast-brass or stamped-steel, with concealed hinge, spring clips, and chrome-plated finish.
5. Piping in Utility Areas: Cast-brass or stamped-steel, with set-screw or spring clips.

N. Sleeves are not required for core drilled holes.

O. Permanent sleeves are not required for holes formed by PE plastic (removable) sleeves.

P. Install sleeves for pipes passing through concrete and masonry walls, concrete floor and roof slabs, and where indicated.

Q. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, concrete floor and roof slabs, and where indicated.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring where specified.

2. Build sleeves into new walls and slabs as work progresses.

3. Install large enough sleeves to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. PVC Pipe Sleeves: For pipes smaller than 6 inches.
b. Steel Pipe Sleeves: For pipes smaller than 6 inches.
c. Steel Sheet-Metal Sleeves: For pipes 6 inches and larger that penetrate gypsum-board partitions.
d. Cast-Iron Sleeve Fittings: For floors having membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Flashing is specified in Division 7 Section "Flashing and Sheet Metal."

1) Seal space outside of sleeve fittings with nonshrink, nonmetallic grout.

4. Except for below-grade wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants specified in Division 7 Section "Joint Sealants."

R. Above Grade, Exterior Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installation of mechanical seals.

1. Install steel pipe for sleeves smaller than 6 inches.
2. Install cast-iron wall pipes for sleeves 6 inches and larger.
3. Assemble and install mechanical seals according to manufacturer's printed instructions.

S. Below Grade, Exterior Wall, Pipe Penetrations: Install cast-iron wall pipes for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installation of mechanical seals.

T. Below Grade, Exterior Wall, Pipe Penetrations: Install ductile-iron wall penetration system sleeves according to manufacturer's printed installation instructions.

U. Fire Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping sealant material. Firestopping materials are specified in Division 7 Section "Firestopping."

V. Verify final equipment locations for roughing in.

W. Refer to equipment specifications in other Sections for roughing-in requirements.

X. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping system Sections.

1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
3. Soldered Joints: Construct joints according to AWS "Soldering Manual," Chapter 22 "The Soldering of Pipe and Tube."
4. Brazed Joints: Construct joints according to AWS "Brazing Manual" in the "Pipe and Tube" chapter.
5. 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 inside diameter. Join pipe fittings and valves as follows:

a. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
b. Apply appropriate tape or thread compound to external pipe threads (except where dry seal threading is specified).
c. Align threads at point of assembly.
d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
e. Damaged Threads: Do not use pipe or pipe fittings having threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

6. Welded Joints: Construct joints according to AWS D10.12 "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe" using qualified processes and welding operators according to the "Quality Assurance" Article.
7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
8. Plastic Pipe and Fitting Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following standards:
   a. Comply with ASTM F 402 for safe handling of solvent-cement and primers.
   b. Acrylonitrile-Butadiene-Styrene (ABS): ASTM D 2235 and ASTM D 2661.
   c. Chlorinated Poly(Vinyl Chloride) (CPVC): ASTM D 2846 and ASTM F 493.
   d. Poly(Vinyl Chloride) (PVC) Pressure Application: ASTM D 2672.
   e. Poly(Vinyl Chloride) (PVC) Non-Pressure Application: ASTM D 2855.
   f. PVC to ABS (Non-Pressure) Transition: Procedure and solvent cement described in ASTM D 3138.

9. Plastic Pipe and Fitting Heat-Fusion Joints: Prepare pipe and fittings and join with heat-fusion equipment according to manufacturer's printed instructions.

   a. Plain-End Pipe and Fittings: Butt joining.
   b. Plain-End Pipe and Socket-Type Fittings: Socket joining.

Y. Piping Connections: Except as otherwise indicated, make piping connections as specified below.

1. Install unions in piping 2 inches and smaller adjacent to each valve and at final connection to each piece of equipment having a 2-inch or smaller threaded pipe connection.
2. Install flanges in piping 2-1/2 inches and larger adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
3. Dry Piping Systems (Gas, Compressed Air, and Vacuum): Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems (Water and Steam): Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.2 EQUIPMENT INSTALLATION--COMMON REQUIREMENTS

A. Install equipment to provide the maximum possible headroom where mounting heights are not indicated.

B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to the Architect.

C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.

D. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

E. Install equipment giving right-of-way to piping systems installed at a required slope.

3.3 LABELING AND IDENTIFYING

A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
   1. Stenciled Markers: Complying with ASME A13.1.
   2. Plastic markers, with application systems. Install on pipe insulation segment where required for hot noninsulated pipes.
   3. Locate pipe markers wherever piping is exposed in finished spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums), and exposed exterior locations as follows:

      a. Near each valve and control device.
      b. Near each branch, excluding short take-offs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
      c. Near locations where pipes pass through walls, floors, ceilings, or enter inaccessible enclosures.
      d. At access doors, manholes, and similar access points that permit view of concealed piping.
      e. Near major equipment items and other points of origination and termination.
      f. Spaced at a maximum of 50-foot intervals along each run. Reduce intervals to 25 feet in congested areas of piping and equipment.
      g. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

B. Equipment: Install engraved plastic laminate sign or equipment marker on or near each major item of mechanical equipment.

   1. Lettering Size: Minimum 1/4-inch -high lettering for name of unit where viewing distance is less than 2 feet, 1/2-inch -high for distances up to 6 feet, and proportionately larger lettering for greater distances. Provide secondary lettering 2/3 to 3/4 of size of principal lettering.
   2. Text of Signs: Provide text to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to name of identified unit.

C. Duct Systems: Identify air supply, return, exhaust, intake, and relief ducts with duct markers; or provide stenciled signs and arrows, showing duct system service and direction of flow.
   1. Location: In each space where ducts are exposed or concealed by removable ceiling system, locate signs near points where ducts enter into space and at maximum intervals of 50 feet.

D. Adjusting: Relocate identifying devices which become visually blocked by work of this Division or other Divisions.

3.4 PAINTING AND FINISHING

A. Refer to Division 9 Section "Painting" for field painting requirements.

B. Damage and Touch Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.5 CONCRETE BASES

A. Construct concrete equipment bases of dimensions indicated, but not less than 4 inches larger than supported unit in both directions. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psi, 28-day compressive strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS D1.1 "Structural Welding Code--Steel."

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.8 DEMOLITION

A. Disconnect, demolish, and remove work specified under Division 15 and as indicated.

B. Where pipe, ductwork, insulation, or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.

C. Accessible Work: Remove indicated exposed pipe and ductwork in its entirety.

D. Abandoned Work: Cut and remove buried pipe abandoned in place, 2 inches beyond the face of adjacent construction. Cap and patch surface to match existing finish.

E. Removal: Remove indicated equipment from the Project site.

F. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

3.9 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of the trades involved.

B. Repair cut surfaces to match adjacent surfaces.

3.10 GROUTING

A. Install nonmetallic nonshrink grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's printed instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms for placement of grout, as required.

D. Avoid air entrapment when placing grout.

E. Place grout to completely fill equipment bases.

F. Place grout on concrete bases to provide a smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout according to manufacturer's printed instructions.

END OF SECTION 15050

SECTION 15100 - VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes general duty valves common to several mechanical piping systems.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each valve type. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.

C. Maintenance data for valves to include in the operation and maintenance manual specified in Division 1. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility: Comply with the requirements specified in Division 1 Section "Materials and Equipment," under "Source Limitations" Paragraph.

B. ASME Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.

C. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set globe and gate valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store indoors and maintain valve temperature higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use a sling to handle large valves. Rig to avoid damage to exposed parts. Do not use handwheels and stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
B
1. Gate Valves:

a. Crane Company; Valves and Fitting Division.
b. Hammond Valve Corporation.
c. Kitz Corp. of America.
d. Lunkenheimer/Cincinnati Valve Co.
e. Milwaukee Valve Company, Inc.
f. NIBCO Inc.
g. Powell: Wm. Powell Company (The).
h. Red-White Valve Corp.
i. Stockham Valves & Fittings, Inc.

2. Ball Valves:

a. Conbraco Industries, Inc.; Apollo Division.
b. Hammond Valve Corporation.
c. Milwaukee Valve Company, Inc.
d. NIBCO Inc.
e. Stockham Valves & Fittings, Inc.
f. Tyler Pipe.
g. Victaulic Company of America.

3. Swing Check Valves:

a. Cla-Val Co.
b. Crane Company; Valves and Fitting Division.
c. Hammond Valve Corporation.
d. Kitz Corp. of America.
e. Lunkenheimer/Cincinnati Valve Co.
f. Milwaukee Valve Company, Inc.
g. NIBCO Inc.
h. Powell: Wm. Powell Company (The).
i. Red-White Valve Corp.
j. Stockham Valves & Fittings, Inc.
k. Victaulic Company of America.

2.2 BASIC, COMMON FEATURES

A. Design: Rising stem or rising outside screw and yoke stems, except as specified below.
1. Nonrising stem valves may be used only where headroom prevents full extension of rising stems.

B. Pressure and Temperature Ratings: As indicated in the "Application Schedule" of Part 3 of this Section and as required to suit system pressures and temperatures.

C. Sizes: Same size as upstream pipe, unless otherwise indicated.

D. Operators: Use specified operators and handwheels, except provide the following special operator features:

1. Handwheels: For valves other than quarter turn.
2. Lever Handles: For quarter-turn valves 6 inches and smaller, except for plug valves, which shall have square heads. Furnish Owner with 1 wrench for every 10 plug valves.
3. Chain-Wheel Operators: For valves 4 inches and larger, installed 96 inches or higher above finished floor elevation.
4. Gear-Drive Operators: For quarter-turn valves 8 inches and larger.

E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

F. Bypass and Drain Connections: Comply with MSS SP-45 bypass and drain connections.

G. Threads: ASME B1.20.1.

H. Flanges: ASME B16.1 for cast iron, ASME B16.5 for steel, and ASME B16.24 for bronze valves.

I. Solder Joint: ASME B16.18.

1. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg F for gate, globe, and check valves; below 421 deg F for ball valves.

2.3 GATE VALVES

A. Gate Valves, 2-1/2 Inches and Smaller: MSS SP-80; Class 125, 200-psi cold working pressure (CWP), or Class 150, 300-psi CWP; ASTM B 62 cast-bronze body and bonnet, solid-bronze wedge, copper-silicon alloy rising stem, teflon-impregnated packing with bronze packing nut, threaded or soldered end connections; and with aluminum or malleable-iron handwheel.

B. Gate Valves, 3 Inches and Larger: MSS SP-70, Class 125, 200-psi CWP, ASTM A 126 cast-iron body and bonnet, solid cast-iron wedge, brass-alloy stem, outside screw and yoke, teflon-impregnated packing with 2-piece packing gland assembly, flanged end connections; and with cast-iron handwheel.

2.4 BALL VALVES

A. Ball Valves, 4 Inches and Smaller: MSS SP-110, Class 150, 600-psi CWP, ASTM B 584 bronze body and bonnet, 2-piece construction; chrome-plated brass ball, standard port for 1/2-inch valves and smaller and conventional port for 3/4-inch valves and larger; blowout proof; bronze or brass stem; teflon seats and seals; threaded or soldered end connections:

1. Operator: Steel handwheel.
2. Stem Extension: For valves installed in insulated piping.
3. Memory Stop: For operator handles.

2.5 CHECK VALVES

A. Swing Check Valves, 2-1/2 Inches and Smaller: MSS SP-80; Class 125, 200-psi CWP, or Class 150, 300-psi CWP; horizontal swing, Y-pattern, ASTM B 62 cast-bronze body and cap, rotating bronze disc with rubber seat or composition seat, threaded or soldered end connections:

B. Swing Check Valves, 3 Inches and Larger: MSS SP-71, Class 125, 200-psi CWP, ASTM A 126 cast-iron body and bolted cap, horizontal-swing bronze disc, flanged or grooved end connections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. 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.

C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

A. Install valves as indicated, according to manufacturer's written instructions.
B. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.

C. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.

D. Locate valves for easy access and provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above the center of the pipe.

F. Install valves in a position to allow full stem movement.
G. For chain-wheel operators, extend chains to 60 inches above finished floor elevation.

H. Installation of Check Valves: Install for proper direction of flow as follows:
   1. Swing Check Valves: Horizontal position with hinge pin level.

3.3 SOLDERED CONNECTIONS

A. Cut tube square and to exact lengths.

B. Clean end of tube to depth of valve socket with steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket.

C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.
D. Open gate and globe valves to fully open position.

E. Remove the cap and disc holder of swing check valves having composition discs.

F. Insert tube into valve socket, making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to ensure even distribution of the flux.

G. Apply heat evenly to outside of valve around joint until solder melts on contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

3.4 THREADED CONNECTIONS

A. Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.

B. Align threads at point of assembly.

C. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.

D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.5 FLANGED CONNECTIONS

A. Align flange surfaces parallel.

B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

C. For dead-end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

3.6 VALVE END SELECTION

A. Select valves with the following ends or types of pipe/tube connections:

1. Copper Tube Size, 2-1/2 Inches and Smaller: Solder ends, except provide threaded ends for heating hot water and low-pressure steam service.
2. Steel Pipe Sizes, 2-1/2 Inches and Smaller: Threaded or grooved end.
3. Steel Pipe Sizes, 3 Inches and Larger: Grooved end or flanged.

3.7 APPLICATION SCHEDULE

A. General Application: Use gate, ball, and butterfly valves for shutoff duty; globe, ball, and butterfly for throttling duty. Refer to piping system Specification Sections for specific valve applications and arrangements.

B. Domestic Water Systems: Use the following valve types:

1. Gate Valves: Class 125, bronze or cast-iron body to suit piping system.
2. Ball Valves: Class 150, 600-psi CWP, with stem extension.
3. Plug Valves: Neoprene-faced plug, Buna N packing.
4. Globe Valves: Class 125, bronze or cast-iron body to suit piping system, and bronze or teflon disc.
5. Butterfly Valves: Nickel-plated ductile iron, aluminum bronze, or elastomer-coated ductile iron disc; EPDM or Buna N sleeve and stem seals.

6. Bronze Swing Check: Class 125, with rubber seat.
7. Check Valves: Class 125, swing or wafer type as indicated.

C. Heating Water Systems: Use the following valve types:

1. Gate Valves: Class 150, bronze or cast-iron body to suit piping system.
2. Ball Valves: Class 150, 600-psi CWP, with stem extension and memory stop.
3. Plug Valves: Viton or teflon packing.
4. Globe Valves: Class 150, bronze or cast-iron body to suit piping system, and bronze disc.
5. Butterfly Valves: Nickel-plated ductile iron, aluminum bronze, or epoxy-coated ductile iron disc; EPDM or Buna N sleeve and stem seals.
6. Bronze Swing Check: Class 150, with composition seat.
7. Check Valves: Iron swing, wafer, or lift type, as indicated. Swing check shall be Class 150 with bronze seat ring.

3.8 ADJUSTING

A. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

END OF SECTION 15100

SECTION 15145 - HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including the General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes hangers and supports for mechanical systems piping and equipment.

1.3 DEFINITIONS

A. Terminology used in this Section is defined in MSS SP-90.

1.4 PERFORMANCE REQUIREMENTS

A. Design seismic restraint hangers and supports, for piping and equipment.

B. Design and obtain approval from authority with jurisdiction over seismic restraint hangers and supports for piping and equipment.

1.5 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for each type of hanger and support.

C. Submit pipe hanger and support schedule showing manufacturer's Figure No., size, location, and features for each required pipe hanger and support.

D. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

E. Shop drawings for each type of hanger and support, indicating dimensions, weights, required clearances, and methods of component assembly.

F. Licensed Engineer's hanger and support drawings specified in the "Quality Assurance" Article.

G. Licensed Engineer's hanger and support installation report specified in the "Field Quality Control" Article.

1.6 QUALITY ASSURANCE

A. Qualify welding processes and welding operators according to AWS D1.1 "Structural Welding Code--Steel."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

B. Qualify welding processes and welding operators according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

C. NFPA Compliance: Comply with NFPA 13 for hangers and supports used as components of fire protection systems.

D. Listing and Labeling: Provide hangers and supports that are listed and labeled as defined in NFPA 70, Article 100.

1. UL and FM Compliance: Hangers, supports, and components include listing and labeling by UL and FM where used for fire protection piping systems.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

E. Licensed Operators: Use operators that are licensed by powder-operated tool manufacturers to operate their tools and fasteners.

F. Licensed Engineer: Prepare hanger and support design drawings, and calculations for seismic restraint of piping and equipment. Include seal and signature of Registered Engineer, licensed in jurisdiction where Project is located, certifying compliance with specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Hangers, Supports, and Components: Factory-fabricated according to MSS SP-58.

1. Components include galvanized coatings where installed for piping and equipment that will not have a field-applied finish.
2. Pipe attachments include nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.

B. Thermal-Hanger Shield Inserts: 100-psi average compressive strength, waterproofed calcium silicate, encased with sheet metal shield. Insert and shield cover entire circumference of pipe and are of length indicated by manufacturer for pipe size and thickness of insulation.

C. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

D. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

2.2 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36, steel plates, shapes, and bars, black and galvanized.

B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex-head, track bolts and nuts.

C. Washers: ASTM F 844, steel, plain, flat washers.

D. Grout: ASTM C 1107, Grade B, nonshrink, nonmetallic.

1. Characteristics include post-hardening, volume-adjusting, dry, hydraulic-cement-type grout that is nonstaining, noncorrosive, nongaseous and is recommended for both interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Water: Potable.
4. Packaging: Premixed and factory-packaged.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger requirements are specified in the Section specifying the equipment and systems.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping specification Sections.

3.2 HANGER AND SUPPORT INSTALLATION

A. General: Comply with MSS SP-69 and SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible.

C. Install supports with maximum spacings complying with MSS SP-69.

D. Where pipes of various sizes are supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.

E. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Install reinforcing bars through openings at top of inserts.

F. Install concrete inserts in new construction prior to placing concrete.

G. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.

H. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install according to fastener manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.

I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

J. Heavy-Duty Steel Trapezes: Field-fabricate from ASTM A 36 steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.

K. Support fire protection systems piping independent of other piping.

L. Install hangers and supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

M. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so that maximum pipe deflections allowed by ASME B31.9 "Building Services Piping" is not exceeded.

O. Insulated Piping: Comply with the following installation requirements.

1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9.
2. Saddles: Install protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
3. Shields: Install MSS Type 40, protective shields on cold piping with vapor barrier. Shields span an arc of 180 degrees and have dimensions in inches not less than the following:

NPS (Inches)	LENGTH (Inches)	THICKNESS (Inches)
1/4 to 3-1/2	12	0.048
4	12	0.060
5 and 6	18	0.060
8 to 14	24	0.075
16 to 24	24	0.105

4. Pipes 8 Inches and Larger: Include wood inserts.
5. Insert Material: Length at least as long as the protective shield.
6. Thermal-Hanger Shields: Install with insulation of same thickness as piping.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.

B. Grouting: Place grout under supports for equipment, and make a smooth bearing surface.

3.4 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for pipe and equipment supports.

B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for manual shielded metal-arc welding, appearance and quality of welds, methods used in correcting welding work, and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

A. Touching Up: Clean field welds and abraded areas of shop paint and paint exposed areas immediately after erection of hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal is specified in Division 9 Section "Painting."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.7 FIELD QUALITY CONTROL

A. Licensed Engineer's Report: Prepare hanger and support installation report. Include seal and signature of Registered Engineer, licensed in jurisdiction where Project is located, certifying compliance with specifications.

END OF SECTION B15145

SECTION 15241 - MECHANICAL VIBRATION CONTROLS AND SEISMIC RESTRAINTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes vibration isolators, vibration isolation bases, vibration isolation roof curbs, and seismic restraints and snubbers.

1.3 SUBMITTALS

A. Product Data: Indicate types, styles, materials, and finishes for each type of isolator specified. Include load deflection curves.

B. Shop Drawings: Show designs and calculations, certified by a professional engineer, for the following:

1. Design Calculations: Calculations for selection of vibration isolators, design of vibration isolation bases, and selection of seismic restraints.
2. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to the structure and to the supported equipment. Include auxiliary motor slides and rails, and base weights.
3. Seismic Restraint Details: Detail fabrication and attachment of restraints and snubbers.

1.4 QUALITY ASSURANCE

A. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where the Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of vibration isolation bases and seismic restraints that are similar to those indicated for this Project in material, design, and extent.

1.5 PROJECT CONDITIONS

A. Project seismic zone is 4 with a zone factor of 0.40.

B. Building Importance Factor: 1.5.

1.6 COORDINATION

A. Coordinate layout and installation of vibration isolation and seismic-restraint devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate size and location of concrete housekeeping and vibration isolation bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Sections.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. Apex Molded Products Co.
4. B-Line Systems, Inc.
5. Bramec Corp.
6. California Dynamics Corp.
7. Cannon Fabrication, Inc.
8. Diversitech Corp.
9. Fabreeka International, Inc.
10. GMT International Corp.
11. Greene Rubber Co.
12. Isolation Technology, Inc.
13. Karman Rubber.
14. Kinetics Noise Control, Inc.
15. King, H.A., Ltd.
16. Lord Industrial Products.
17. Mason Industries, Inc.
18. Metalastik, Inc.
19. Minor Rubber Co., Inc.
20. Rubatex Corp.
21. Service Rubber Group, Inc.
22. Stock Drive Products.
23. Tech Products Corp.
24. Vibration Eliminator Co., Inc.
25. Vibration Isolation Co., Inc.
26. Wagner Products Corp.

2.2 VIBRATION ISOLATORS

A. Isolator Pads: Oil and water resistant and factory cut to sizes that match requirements of the equipment supported.

1. Rubber Isolator Pads: Elastomer (neoprene or silicone) arranged in single or multiple layers and molded with a nonslip pattern and steel baseplates of sufficient stiffness to provide uniform loading over the pad area.
2. Fiberglass or Cork Isolator Pads: Molded cork or glass fiber not less than 1 inch thick and precompressed through 10 compression cycles at 3 times the rated load.
3. Load Range: From 10 to 50 psig and a deflection not less than 0.08 inch per 1 inch of thickness. Do not exceed a loading of 50 psig.

B. Rubber Isolator Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements, with encapsulated top- and baseplates. Factory-drilled and tapped top plate for bolted equipment mounting. Factory-drilled baseplate for bolted connection to structure. Color-code to indicate capacity range.

C. Spring Isolators: Freestanding, laterally stable, open-spring-type isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 1.2 times the rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to a 1/4-inch-thick, rubber isolator pad attached to the baseplate underside. Size baseplates to limit floor loading to 100 psig.
6. Top Plates: Provide threaded studs for fastening and leveling equipment.
7. Finishes: Manufacturer's standard corrosive-resistant finish.

D. Restrained Spring Isolators: Vertically restrained, freestanding, laterally stable, steel open-spring-type isolators.

1. Housing: Welded steel with resilient vertical limit stops to prevent spring extension due to wind loads or when weight is removed. Factory-drilled baseplate for bolting to structure and bonded to a 1/4-inch-thick, rubber isolator pad attached to the baseplate underside. Provide adjustable equipment mounting and leveling bolt.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 0.8 times the rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Finishes: Baked enamel for metal components on isolators for interior use. Hot-dip galvanized for metal components on isolators for exterior use.

E. Rubber Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to formed-steel housings with threaded connections for hanger rods. Color-code to indicate capacity range.

F. Spring Hangers: Combination spring and elastomeric hanger with coil spring and elastomeric insert in compression.

1. Frame: Formed steel, fabricated for connection to threaded rods and to allow for 30 degrees of angular hanger rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
5. Finishes: Baked enamel for metal components. Color-code to indicate capacity range.

2.3 SEISMIC CONTROLS

A. Thrust Restraints: Combination spring and elastomeric restraints with coil spring and elastomeric insert in compression. Factory set for thrust.
1. Frame: Formed steel, fabricated for connection to threaded rods and to allow for 30 degrees of angular hanger rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
5. Finishes: Baked enamel for metal components. Color-code to indicate capacity range.

B. Manufactured Seismic Snubbers: All-directional, double-acting snubbers.

1. Construction: Interlocking steel members restrained by a 3/4-inch-thick, replaceable, shock-absorbing neoprene insert. Maintain 1/8-inch clearance in all directions between rigid and resilient surfaces.

C. Fabricated Seismic Snubbers: Welded structural-steel shapes designed and fabricated to restrain equipment or vibration isolation bases from excessive movement during a seismic event. Design to resist gravity forces identified by authorities having jurisdiction.

1. Construction: Welded steel shapes conforming to ASTM A 36.
2. Resilient Components: 3/4-inch-thick, replaceable, shock-absorbing neoprene insert.

2.4 VIBRATION ISOLATION BASES

A. Fabricated Steel Bases: Structural-steel bases and rails designed and fabricated by the isolation equipment manufacturer. Include equipment static loadings, power transmission, component misalignment, and cantilever loadings.

1. Fabricate bases to shapes required, with welded structural-steel shapes, plates, and bars conforming to ASTM A 36. Include support brackets to anchor base to isolation units. Include prelocated equipment anchor bolts and auxiliary motor slide bases or rails.
2. Design and fabricate bases to result in the lowest possible mounting height with not less than 1-inch clearance above the floor.
3. Concrete-Filled Inertia Bases: Weld reinforcing bars to the structural frame. Pour concrete into base with relocated equipment anchor bolts.
4. Weld steel angles on frame for outrigger isolation mountings, and provide for anchor bolts and equipment support.
5. Configure inertia bases to accommodate equipment supported.
6. Pump Bases: Size to support pump and piping elbows.
7. Factory Finish: Manufacturer's standard corrosive-resistant finish.

2.5 VIBRATION ISOLATION ROOF CURBS

A. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb designed to resiliently support roof-mounted equipment and to withstand 125-mph wind impinging laterally against the side of the equipment. Design restraints to meet seismic requirements of authorities having jurisdiction.

B. Components: Upper support frame; lower support assembly; freestanding, unhoused, laterally stable steel springs; vertical and horizontal restraints.

1. Lower Support Assembly: Provide a means of attachment to the building structure and include a wood nailer stripe for attachment of roof material and 2 inches of rigid insulation on the inside of the assembly.
2. Spring Isolators: As indicated or scheduled. Include adjustment bolt to permit leveling of equipment after installation. Attach to lower assembly with a rubber isolation pad. Locate spring isolators so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
3. Water Seal: Elastomeric seal conforming to UL Class A roofing materials, attached to the upper support frame, extending down past the wood nailer of the lower support assembly, and counterflashed over the roof materials.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and anchor vibration-, sound-, and seismic-control products according to manufacturer's written instructions and authorities having jurisdiction.

B. Anchor interior mounts, isolators, hangers, and snubbers to vibration isolation bases. Bolt isolator baseplates to structural floors as required by authorities having jurisdiction.

C. Anchor exterior mounts, isolators, hangers, and snubbers to vibration isolation bases. Bolt isolator baseplates to structural supports as required by authorities having jurisdiction.

D. Fill concrete inertia bases, after installing base frame, with 3000-psig concrete, and trowel to a smooth, hard finish. Cast-in-place concrete is specified in Division 3.

E. Install pipe connectors at connections for equipment supported on vibration isolators.

3.2 SEISMIC CONTROL

A. Vibration Isolation Bases: Mount equipment on structural-steel bases or concrete inertia bases.

B. Snubbers: Install the required number of seismic snubbers on each spring-mounted piece of equipment. Locate snubbers as close as possible to the vibration isolators and bolt to supporting structure.

3.3 ADJUSTING AND CLEANING

A. 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 operations.

B. Adjust thrust restraints for a maximum of 1/4 inch of movement at start and stop.

END OF SECTION 15241

SECTION 15250 - MECHANICAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes pipe and duct insulation.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 15 Section "Metal Ductwork" for duct lining.

1.3 DEFINITIONS

A. Hot Surfaces: Normal operating temperatures of 100 deg F or higher.

B. Dual-Temperature Surfaces: Normal operating temperatures that vary from hot to cold.

C. Cold Surfaces: Normal operating temperatures less than 75 deg F.

D. Thermal resistivity is designated by an r-value that represents the reciprocal of thermal conductivity (k-value). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1 inch thick. Thermal resistivity (r-value) is expressed by the temperature difference in degrees Fahrenheit between the two exposed faces required to cause 1 BTU per hour to flow through 1 square foot at mean temperatures indicated.

E. Thermal Conductivity (k-value): Measure of heat flow through a material at a given temperature difference; conductivity is expressed in units of Btu x inch/h x sq. ft. x deg F.

F. Density: Is expressed in pcf.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for each type of mechanical insulation identifying k-value, thickness, and accessories.

C. Samples of each type of insulation and jacket. Identify each sample describing product and intended use. Submit the following sizes of sample materials:

1. Board and Block Insulation: 12 inches square section.
2. Pre-Formed Pipe Insulation: 12 inches long, 2-inch NPS.

D. Material certificates, signed by the manufacturer, certifying that materials comply with specified requirements where laboratory test reports cannot be obtained.

E. Material test reports prepared by a qualified independent testing laboratory. Certify insulation meets specified requirements.

1.5 QUALITY ASSURANCE

A. Fire Performance Characteristics: Conform to the following characteristics for insulation including facings, cements, and adhesives, when tested according to ASTM E 84, by UL or other testing or inspecting organization acceptable to the authority having jurisdiction. Label insulation with appropriate markings of testing laboratory.

1. Interior Insulation: Flame spread rating of 25 or less and a smoke developed rating of 50 or less.
2. Exterior Insulation: Flame spread rating of 75 or less and a smoke developed rating of 150 or less.

B. Field-Constructed Mock-Up: Before installation, erect mock-up of size and at locations indicated to demonstrate workmanship quality. Include method of attachment and finishing for each.

1. Interior and exterior equipment.
2. Interior and exterior duct systems.
3. Interior and exterior piping systems.
4. Retain and protect mock-ups during construction as a standard for judging completed unit of Work.
5. Accepted mock-ups may become part of completed unit of Work.

1.6 SEQUENCING AND SCHEDULING

A. Schedule insulation application after testing of piping and duct systems.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Glass Fiber:

a. CertainTeed Corporation.
b. Knauf Fiberglass GmbH.
c. Manville.
d. Owens-Corning Fiberglas Corporation.
e. USG Interiors, Inc. - Thermafiber Division.

2. Flexible Elastomeric Cellular:

a. Armstrong World Industries, Inc.
b. Halstead Industrial Products.
c. IMCOA.
d. Rubatex Corporation.

2.2 GLASS FIBER

A. Material: Inorganic glass fibers, bonded with a thermosetting resin.

B. Jacket: All-purpose, factory-applied, laminated glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil having self-sealing lap.

C. Board: ASTM C 612, Class 2, semi-rigid jacketed board.

1. Thermal Conductivity: 0.26 Btu x inch/h x sq. ft. x deg F average maximum, at 75 deg F mean temperature.
2. Density: 12 pcf average maximum.

D. Blanket: ASTM C 553, Type II, Class F-1, jacketed flexible blankets.

1. Thermal Conductivity: 0.32 Btu x inch/h x sq. ft. x deg F average maximum, at 75 deg F mean temperature.

E. Preformed Pipe Insulation: ASTM C 547, Class 1, rigid pipe insulation, jacketed.

1. Thermal Conductivity: 0.26 Btu x inch/h x sq. ft. x deg F average maximum at 75 deg F mean temperature.
2. Density: 10 pcf average maximum.

F. Adhesive: Produced under the UL Classification and Follow-up service.

1. Type: Non-flammable, solvent-based.
2. Service Temperature Range: Minus 20 to 180 deg F.

G. Vapor Barrier Coating: Waterproof coating recommended by insulation manufacturer for outside service.

2.3 FLEXIBLE ELASTOMERIC CELLULAR

A. Material: Flexible expanded closed-cell structure with smooth skin on both sides.

1. Tubular Materials: ASTM C 534, Type I.
2. Sheet Materials: ASTM C 534, Type II.

B. Thermal Conductivity: 0.30 Btu x inch/h x sq. ft. x deg F average maximum at 75 deg F.

C. Coating: Water based latex enamel coating recommended by insulation manufacturer.

2.4 INSULATING CEMENTS

A. Mineral Fiber: ASTM C 195.

1. Thermal Conductivity: 1.0 Btu x inch/h x sq. ft. x deg F average maximum at 500 deg F mean temperature.
2. Compressive Strength: 10 psi at 5 percent deformation.

B. Expanded or Exfoliated Vermiculite: ASTM C 196.

1. Thermal Conductivity: 1.10 Btu x inch/h x sq. ft. x deg F average maximum at 500 deg F mean temperature.
2. Compressive Strength: 5 psi at 5 percent deformation.

C. Mineral Fiber, Hydraulic-Setting Insulating and Finishing Cement: ASTM C 449.

1. Thermal Conductivity: 1.2 Btu x inch/h x sq. ft. x deg F average maximum at 400 deg F mean temperature.
2. Compressive Strength: 100 psi at 5 percent deformation.

2.5 ADHESIVES

A. Flexible Elastomeric Cellular Insulation Adhesive: Solvent-based, contact adhesive recommended by insulation manufacturer.

B. Lagging Adhesive: MIL-A-3316C, non-flammable adhesive in the following Classes and Grades:

1. Class 1, Grade A for bonding glass cloth and tape to unfaced glass fiber insulation, sealing edges of glass fiber insulation, and bonding lagging cloth to unfaced glass fiber insulation.
2. Class 2, Grade A for bonding glass fiber insulation to metal surfaces.

2.6 JACKETS

A. General: ASTM C 921, Type 1, except as otherwise indicated.

B. Foil and Paper Jacket: Laminated glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.

1. Water Vapor Permeance: 0.02 perm maximum, when tested according to ASTM E 96.
2. Puncture Resistance: 50 beach units minimum, when tested according to ASTM D 781.

2.7 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth and Tape: Woven glass fiber fabrics, plain weave, presized a minimum of 8 ounces per sq. yd.

1. Tape Width: 4 inches.
2. Cloth Standard: MIL-C-20079H, Type I.
3. Tape Standard: MIL-C-20079H, Type II.

B. Wire: 14 gage nickel copper alloy, 16 gage, soft-annealed stainless steel, or 16 gage, soft-annealed galvanized steel.

C. Corner Angles: 28 gage, 1 inch by 1 inch aluminum, adhered to 2 inches by 2 inches kraft paper.

D. Anchor Pins: Capable of supporting 20 pounds each. Provide anchor pins and speed washers of sizes and diameters as recommended by the manufacturer for insulation type and thickness.

2.8 SEALING COMPOUNDS

A. Vapor Barrier Compound: Water-based, fire-resistive composition.

1. Water Vapor Permeance: 0.08 perm maximum.
2. Temperature Range: Minus 20 to 180 deg F.

B. Weatherproof Sealant: Flexible-elastomer-based, vapor-barrier sealant designed to seal metal joints.

1. Water Vapor Permeance: 0.02 perm maximum.
2. Temperature Range: Minus 50 to 250 deg F.
3. Color: Aluminum.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean, dry, and remove foreign materials such as rust, scale, and dirt.

B. Mix insulating cements with clean potable water. Mix insulating cements contacting stainless-steel surfaces with demineralized water.

1. Follow cement manufacturer's printed instructions for mixing and portions.

3.2 INSTALLATION, GENERAL

A. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each mechanical system.

B. Select accessories compatible with materials suitable for the service. Select accessories that do not corrode, soften, or otherwise attack the insulation or jacket in either the wet or dry state.

C. Install vapor barriers on insulated pipes, ducts, and equipment having surface operating temperatures below 60 deg F.

D. Apply insulation material, accessories, and finishes according to the manufacturer's printed instructions.

E. Install insulation with smooth, straight, and even surfaces.

F. Seal joints and seams to maintain vapor barrier on insulation requiring a vapor barrier.

G. Seal penetrations for hangers, supports, anchors, and other projections in insulation requiring a vapor barrier.

H. Seal Ends: Except for flexible elastomeric insulation, taper ends at 45 degree angle and seal with lagging adhesive. Cut ends of flexible elastomeric cellular insulation square and seal with adhesive.

I. Apply adhesives and coatings at manufacturer's recommended coverage-per-gallon rate.

J. Keep insulation materials dry during application and finishing.

K. Items Not Insulated: Unless otherwise indicated do not apply insulation to the following systems, materials, and equipment:

1. Fibrous glass ducts.
2. Metal ducts with duct liner.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
5. Flexible connectors for ducts and pipes.
6. Vibration control devices.
7. Testing laboratory labels and stamps.
8. Nameplates and data plates.
9. Access panels and doors in air distribution systems.
10. Fire protection piping systems.
11. Sanitary drainage and vent piping.
12. Drainage piping located in crawl spaces, unless indicated otherwise.
13. Below grade piping.
14. Chrome-plated pipes and fittings, except for plumbing fixtures for the disabled.
15. Piping specialties including air chambers, unions, strainers, check valves, plug valves, and flow regulators.

3.3 PIPE INSULATION INSTALLATION, GENERAL

A. Tightly butt longitudinal seams and end joints. Bond with adhesive.

B. Stagger joints on double layers of insulation.

C. Apply insulation continuously over fittings, valves, and specialties, except as otherwise indicated.

D. Apply insulation with a minimum number of joints.

E. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.
2. Cover circumferential joints with butt strips, at least 3 inches wide, and of same material as insulation jacket. Secure with adhesive and outward clinching staples along both edges of butt strip and space 4 inches on center.

3. Longitudinal Seams: Overlap seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches on center.

    a. Exception: Do not staple longitudinal laps on insulation applied to piping systems with surface temperatures at or below 35 deg F.

4. Vapor Barrier Coatings: Where vapor barriers are indicated, apply on seams and joints, over staples, and at ends butt to flanges, unions, valves, and fittings.
5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor barrier coating.
6. Repair damaged insulation jackets, except metal jackets, by applying jacket material around damaged jacket. Adhere, staple, and seal. Extend patch at least 2 inches in both directions beyond damaged insulation jacket and around the entire circumference of the pipe.

F. Roof Penetrations: Apply insulation for interior applications to a point even with the top of the roof flashing. Seal with vapor barrier coating. Apply insulation for exterior applications butted tightly to interior insulation ends. Extend metal jacket for exterior insulation outside roof flashing at least 2 inches below top of roof flashing. Seal metal jacket to roof flashing with vapor barrier coating.

G. Exterior Wall Penetrations: For penetrations of below grade exterior walls, extend metal jacket for exterior insulation through penetration to a point 2 inches from interior surface of wall inside the building. Seal ends of metal jacket with vapor barrier coating. Secure metal jacket ends with metal band. At point where insulation metal jacket contacts mechanical sleeve seal, insert cellular glass preformed pipe insulation to allow sleeve seal tightening against metal jacket. Tighten and seal sleeve to jacket to form a watertight seal.

H. Interior Walls and Partitions Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions. Apply an aluminum jacket with factory-applied moisture barrier over insulation. Extend 2 inches from both surfaces of wall or partition. Secure aluminum jacket with metal bands at both ends. Seal ends of jacket with vapor barrier coating. Seal around penetration with joint sealer. Refer to Division 7 Section "Joint Sealants."

I. Fire-Rated Walls and Partitions Penetrations: Terminate insulation at penetrations through fire-rated walls and partitions. Seal insulation ends with vapor barrier coating. Seal around penetration with firestopping or fire-resistant joint sealer. Refer to Division 7 for firestopping and fire-resistant joint sealers.

J. Floor Penetrations: Terminate insulation underside of floor assembly and at floor support at top of floor.

K. Flanges, Fittings, and Valves - Interior Exposed and Concealed: Coat pipe insulation ends with vapor barrier coating. Apply premolded, precut, or field-fabricated segments of insulation around flanges, unions, valves, and fittings. Make joints tight. Bond with adhesive.

1. Use same material and thickness as adjacent pipe insulation.
2. Overlap nesting insulation by 2 inches or 1-pipe diameter, which ever is greater.
3. Apply materials with adhesive, fill voids with mineral fiber insulating cement. Secure with wire or tape.
4. Insulate elbows and tees smaller than 3 inches pipe size with premolded insulation.
5. Insulate elbows and tees 3 inches and larger with premolded insulation or insulation material segments. Use at least 3 segments for each elbow.
6. Cover insulation, except for metal jacketed insulation, with PVC fitting covers and seal circumferential joints with butt strips.
7. Cover insulation, except for metal jacketed insulation, with 2 layers of lagging adhesive to a minimum thickness of 1/16 inch. Install glass cloth between layers. Overlap adjacent insulation by 2 inches in both directions from joint with glass cloth and lagging adhesive.

L. Hangers and Anchors: Apply insulation continuously through hangers and around anchor attachments. Install saddles, shields, and inserts as specified in Division 15 Section "Supports and Anchors." For cold surface piping, extend insulation on anchor legs a minimum of 12 inches and taper and seal insulation ends.

1. Inserts and Shields: Cover hanger inserts and shields with jacket material matching adjacent pipe insulation.

3.4 GLASS FIBER PIPE INSULATION INSTALLATION

A. Bond insulation to pipe with lagging adhesive.

B. Seal exposed ends with lagging adhesive.

C. Seal seams and joints with vapor barrier compound.

3.5 FLEXIBLE ELASTOMERIC CELLULAR PIPE INSULATION INSTALLATION

A. Slip insulation on the pipe before making connections wherever possible. Seal joints with adhesive. Where the slip-on technique is not possible, cut one side longitudinally and apply to the pipe. Seal seams and joints with adhesive.

B. Valves, Fittings, and Flanges: Cut insulation segments from pipe or sheet insulation. Bond to valve, fitting, and flange and seal joints with adhesive.

1. Miter cut materials to cover soldered elbows and tees.
2. Fabricate sleeve fitting covers from flexible elastomeric cellular insulation for screwed valves, fittings, and specialties. Miter cut materials. Overlap adjoining pipe insulation.

3.6 DUCT INSULATION

A. Install block and board insulation as follows:

1. Adhesive and Band Attachment: Secure block and board insulation tight and smooth with at least 50 percent coverage of adhesive. Install bands spaced 12 inches apart. Protect insulation under bands and at exterior corners with metal corner angles. Fill joints, seams, and chipped edges with vapor barrier compound.
2. Speed Washers Attachment: Secure insulation tight and smooth with speed washers and welded pins. Space anchor pins 18 inches apart each way and 3 inches from insulation joints. Apply vapor barrier coating compound to insulation in contact, open joints, breaks, punctures, and voids in insulation.

B. Blanket Insulation: Install tight and smooth. Secure to ducts having long sides or diameters as follows:

1. Smaller Than 24 Inches: Bonding adhesive applied in 6 inches wide transverse strips on 12 inches centers.
2. 24 Inches and Larger: Anchor pins spaced 12 inches apart each way. Apply bonding adhesive to prevent sagging of the insulation.
3. Overlap joints 3 inches.
4. Seal joints, breaks, and punctures with vapor barrier compound.

3.7 JACKETS

A. Foil and Paper Jackets (FP): Install jackets drawn tight. Install lap or butt strips at joints with material same as jacket. Secure with adhesive. Install jackets with 1-1/2 inches laps at longitudinal joints and 3 inch wide butt strips at end joints.

1. Seal openings, punctures, and breaks in vapor barrier jackets and exposed insulation with vapor barrier compound.

B. Interior Exposed Insulation: Install continuous glass cloth jackets.

C. Install metal jacket with 2 inches overlap at longitudinal and butt joints. Overlap longitudinal joints to shed water. Seal butt joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel draw bands 12 inches on center and at butt joints.

D. Install glass cloth jacket directly over insulation. On insulation with a factory applied jacket, install the glass cloth jacket over the factory applied jacket. Install jacket drawn smooth and tight with a 2 inch overlap at joints. Embed glass cloth between (2) 1/16 inch thick coats of lagging adhesive. Completely encapsulate the insulation with the jacket, leaving no exposed raw insulation.

3.8 FINISHES

A. Paint finished insulation as specified in Division 9 Section "Painting."

B. Flexible Elastomeric Cellular Insulation: After adhesive has fully cured, apply 2 coats of protective coating to exposed insulation.

3.9 APPLICATIONS

A. General: Materials and thicknesses are specified in schedules at the end of this Section.

B. Interior, Exposed Piping Systems: Unless otherwise indicated, insulate the following piping systems:

1. Domestic hot water.
2. Recirculated hot water.
3. Low-temperature hydronic (0 to 34 deg F).
4. Refrigerant suction.
5. Hydronic piping (35 to 99 deg F).
6. Hydronic piping (100 to 250 deg F).
7. High-temperature hydronic, steam, and condensate (250 to 350 deg F).
8. High-temperature hydronic, steam, and condensate (350 to 450 deg F).
9. Diesel engine exhaust.

C. Interior, Concealed Piping Systems: Unless otherwise indicated, insulate the following piping systems:

1. Domestic hot water.
2. Low-temperature hydronic (0 to 34 deg F).
3. Refrigerant suction.
4. Chilled water (35 to 55 deg F).
5. Hydronic piping (35 to 99 deg F).
6. Hydronic piping (100 to 250 deg F).
7. High-temperature hydronic, steam, and condensate (250 to 350 deg F).
8. High-temperature hydronic, steam, and condensate (350 to 450 deg F).
9. Diesel engine exhaust.

D. Exterior, Exposed Piping Systems: Unless otherwise indicated, insulate the following piping systems:

1. Refrigerant suction.
2. Hydronic piping (35 to 99 deg F).
3. Diesel engine exhaust.

E. Exterior, Concealed Piping Systems: Unless otherwise indicated, insulate the following piping systems:

1. Refrigerant suction.
2. Hydronic piping (35 to 99 deg F).
3. Diesel engine exhaust.

F. Duct Systems: Unless otherwise indicated, insulate the following duct systems:

1. Interior concealed supply, return and outside air ductwork.
2. Interior exposed supply, return and outside air ductwork.
3. Exterior exposed supply and return ductwork.
4. Interior exposed and concealed supply fans, air handling unit casings and outside air plenums.

3.10 PIPE INSULATION SCHEDULES

A. General: Abbreviations used in the following schedules include:

1. Field-Applied Jackets: P - PVC, K - Foil and Paper, A - Aluminum, SS - Stainless Steel.
2. Pipe Sizes: NPS - Nominal Pipe Size.

B. Domestic Cold Water and Storm Water All Sizes (Interior): 1/2 inch thick glass fiber, cellular glass, or flexible elastomeric insulation. Field-applied jacket is not required.

INTERIOR DOMESTIC HOT WATER AND RECIRCULATED HOT WATER

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
1/2 TO 1-1/4	GLASS FIBER	1/2	NO	NONE
	CELLULAR GLASS	1	NO	NONE
	FLEXIBLE ELASTOMERIC	1/2	NO	NONE
1-1/2 TO 4	GLASS FIBER	1/2	NO	NONE
	CELLULAR GLASS	1	NO	NONE
	FLEXIBLE ELASTOMERIC	3/4	NO	NONE
5 TO 10	GLASS FIBER	3/4	NO	NONE
	CELLULAR GLASS	1-1/2	NO	NONE
	FLEXIBLE ELASTOMERIC	3/4	NO	NONE
12 TO 36	GLASS FIBER	1	NO	NONE
	CELLULAR GLASS	1-1/2	NO	NONE
	FLEXIBLE ELASTOMERIC	3/4	NO	NONE

INTERIOR LOW-TEMPERATURE HYDRONIC (0 TO 34 DEG F) EXPOSED AND CONCEALED

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
1/2 TO 1-1/4	GLASS FIBER	1	YES	NONE
	CELLULAR GLASS	1	YES	NONE
	FLEXIBLE ELASTOMERIC	3/4	YES	NONE
1-1/2 TO 4	GLASS FIBER	1	YES	NONE
	CELLULAR GLASS	1-1/2	YES	NONE
	FLEXIBLE ELASTOMERIC	3/4	YES	NONE

5 TO 10	GLASS FIBER	1-1/2	YES	NONE
	CELLULAR GLASS	1-1/2	YES	NONE
12 TO 36	GLASS FIBER	2	YES	NONE
	CELLULAR GLASS	2	YES	NONE

INTERIOR REFRIGERANT SUCTION AND DUAL-TEMP HYDRONIC (35 TO 100 DEG F) EXPOSED AND CONCEALED

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
1/2 TO 1-1/4	GLASS FIBER	1	YES	NONE
	CELLULAR GLASS	1	YES	NONE
	FLEXIBLE ELASTOMERIC	3/4	YES	NONE
1-1/2 TO 4	GLASS FIBER	1	YES	NONE
	CELLULAR GLASS	1-1/2	YES	NONE
	FLEXIBLE ELASTOMERIC	3/4	YES	NONE
5 TO 10	GLASS FIBER	1-1/2	YES	NONE
	CELLULAR GLASS	1-1/2	YES	NONE
12 TO 36	GLASS FIBER	1-1/2	YES	NONE
	CELLULAR GLASS	2	YES	NONE

EXTERIOR REFRIGERANT SUCTION AND DUAL-TEMP HYDRONIC (35 TO 100 DEG F) EXPOSED AND CONCEALED

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
1/2 TO 1-1/4	GLASS FIBER	2	YES	(P)(A)(SS)
	CELLULAR GLASS	2	YES	(P)(A)(SS)
	FLEXIBLE ELASTOMERIC	3/4	YES	NONE
1-1/2 TO 4	GLASS FIBER	2	YES	(P)(A)(SS)
	CELLULAR GLASS	2-1/2	YES	(P)(A)(SS)
	FLEXIBLE ELASTOMERIC	3/4	YES	NONE
5 TO 10	GLASS FIBER	2-1/2	YES	(P)(A)(SS)
	CELLULAR GLASS	2-1/2	YES	(P)(A)(SS)
12 TO 36	GLASS FIBER	2-1/2	YES	(P)(A)(SS)
	CELLULAR GLASS	3	YES	(P)(A)(SS)

INTERIOR HYDRONIC (100 TO 250 DEG F) EXPOSED AND CONCEALED

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
1/2 TO 4	GLASS FIBER	1	NO	NONE
	CELLULAR GLASS	1-1/2	NO	NONE
	CALCIUM SILICATE	1-1/2	NO	(P)(K)(A)(SS)
5 TO 10	GLASS FIBER	2	NO	NONE
	CELLULAR GLASS	2-1/2	NO	NONE
	CALCIUM SILICATE	2	NO	(P)(K)(A)(SS)
12 TO 36	GLASS FIBER	2-1/2	NO	NONE
	CELLULAR GLASS	3	NO	NONE
	CALCIUM SILICATE	2-1/2	NO	(P)(K)(A)(SS)
1/2 TO 1-1/4 ONLY	FLEXIBLE ELASTOMERIC	3/4	NO	NONE

INTERIOR HYDRONIC AND L.P. STEAM (250 TO 350 DEG F) EXPOSED AND CONCEALED

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
1/2 TO 1-1/4	GLASS FIBER	1-1/2	NO	NONE
	CELLULAR GLASS	2	NO	NONE
	CALCIUM SILICATE	1-1/2	NO	(P)(K)(A)(SS)
1-1/2 TO 4	GLASS FIBER	2	NO	NONE
	CELLULAR GLASS	2-1/2	NO	NONE
	CALCIUM SILICATE	2	NO	(P)(K)(A)(SS)
5 TO 10	GLASS FIBER	3	NO	NONE
	CELLULAR GLASS	3-1/2	NO	NONE
	CALCIUM SILICATE	3	NO	(P)(K)(A)(SS)
12 TO 36	GLASS FIBER	3-1/2	NO	NONE
	CELLULAR GLASS	4	NO	NONE
	CALCIUM SILICATE	3-1/2	NO	(P)(K)(A)(SS)

INTERIOR HYDRONIC AND H.P. STEAM (350 TO 450 DEG F) EXPOSED AND CONCEALED

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
1/2 TO 1-1/4	GLASS FIBER	2	NO	NONE
	CELLULAR GLASS	2-1/2	NO	NONE
	CALCIUM SILICATE	2	NO	(K)(A)(SS)
1-1/2 TO 4	GLASS FIBER	2-1/2	NO	NONE
	CELLULAR GLASS	3	NO	NONE
	CALCIUM SILICATE	2-1/2	NO	(K)(A)(SS)

5 TO 10	GLASS FIBER	3-1/2	NO	NONE
	CELLULAR GLASS	4	NO	NONE
	CALCIUM SILICATE	3-1/2	NO	(K)(A)(SS)
12 TO 36	GLASS FIBER	4	NO	NONE
	CELLULAR GLASS	4-1/2	NO	NONE
	CALCIUM SILICATE	4	NO	(K)(A)(SS)

INTERIOR HYDRONIC AND H.P. STEAM (350 TO 450 DEG F) EXPOSED AND CONCEALED

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
1/2 TO 1-1/4	GLASS FIBER	3	NO	(A)(SS)
	CELLULAR GLASS	3-1/2	NO	(A)(SS)
	CALCIUM SILICATE	3	NO	(A)(SS)
1-1/2 TO 4	GLASS FIBER	3-1/2	NO	(A)(SS)
	CELLULAR GLASS	4	NO	(A)(SS)
	CALCIUM SILICATE	3-1/2	NO	(A)(SS)
5 TO 10	GLASS FIBER	4-1/2	NO	(A)(SS)
	CELLULAR GLASS	5	NO	(A)(SS)
	CALCIUM SILICATE	4-1/2	NO	(A)(SS)
12 TO 36	GLASS FIBER	5	NO	(A)(SS)
	CELLULAR GLASS	5-1/2	NO	(A)(SS)
	CALCIUM SILICATE	5	NO	(A)(SS)

NOTE: INSTALL OVER FREEZE PROTECTION HEAT TRACING.

INTERIOR DIESEL ENGINE EXHAUST (INCLUDING SILENCER) EXPOSED AND CONCEALED

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
1 TO 1-1/4	CELLULAR GLASS	3	NO	(A)(SS)
1-1/2 TO 4	CELLULAR GLASS	3-1/2	NO	(A)(SS)
5 TO 10	CELLULAR GLASS	4	NO	(A)(SS)
12 TO 36	CELLULAR GLASS	5	NO	(A)(SS)

3.11 DUCT SYSTEMS INSULATION SCHEDULE

INTERIOR CONCEALED HVAC SUPPLY AND RETURN DUCTS AND PLENUMS

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
GLASS FIBER	BLANKET	1-1/2	YES	NONE

INTERIOR EXPOSED HVAC SUPPLY AND RETURN DUCTS AND PLENUMS

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
GLASS FIBER	BOARD - RECT.	1-1/2	YES	NONE
GLASS FIBER	PIPE - ROUND	1-1/2	YES	NONE

EXTERIOR CONCEALED HVAC SUPPLY AND RETURN DUCTS AND PLENUMS

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
GLASS FIBER	BOARD - RECT.	2	YES	NONE
GLASS FIBER	PIPE - ROUND	2	YES	NONE
CELLULAR GLASS	BOARD - RECT.	3	YES	NONE
GLASS FIBER	PIPE - ROUND	3	YES	NONE
FLEXIBLE ELASTOMERIC	SHEET	2	YES	NONE

INTERIOR EXPOSED HVAC SUPPLY FANS, AIR HANDLING UNITS, CASING, AND PLENUMS

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
GLASS FIBER	BOARD	2	YES	NONE

END OF SECTION 15250

SECTION 15510 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes piping systems for hot water heating, chilled water cooling, and condenser water systems; makeup water for these systems; blow-down drain lines; and condensate drain piping. Piping materials and equipment specified in this Section include the following:

1. Pipes, fittings, and specialties.
2. Special-duty valves.
3. Hydronic specialties.

1.3 SYSTEM DESCRIPTION

A. Condenser Water System: This system is a closed piping loop connecting chillers to cooling tower. Circulation is accomplished by parallel, constant volume pumps. Design flow rates and water temperatures are specified in the various equipment specifications and schedules. Control sequences and temperature-reset schedules are specified in temperature-control specifications.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data including rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties, accessories, and installation instructions for each hydronic specialty and special-duty valve specified.

1. Submit flow and pressure drop curves for diverting fittings and calibrated plug valves, based on manufacturer's testing.

C. Shop Drawings detailing pipe anchors, special pipe support assemblies, alignment guides, and expansion joints and loops.

D. Field test reports indicating and interpreting test results for compliance with performance requirements specified in Part 3 of this Section.

E. Maintenance data for hydronic specialties and special-duty valves to include in the operation and maintenance manual specified in Division 1.

1.5 QUALITY ASSURANCE

A. ASME Compliance: Comply with the following provisions:
1. ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
2. Fabricate and stamp air separators and compression tanks to comply with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
3. Welding Standards: Qualify welding processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications."

1.6 COORDINATION

A. Coordinate layout and installation of piping with equipment and with other installations.

B. Coordinate pipe sleeve installation for foundation wall penetrations.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.

D. Coordinate pipe fitting pressure classes with products specified in related Sections.

E. Coordinate size and location of concrete housekeeping pads. Cast anchor-bolt inserts into pad. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.

F. Coordinate installation of pipe sleeves for penetrations in exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 Section "Firestopping" for fire and smoke wall and floor assemblies.

1.7 EXTRA MATERIALS

A. Maintenance Stock: Furnish a sufficient quantity of chemicals for initial system startup and for preventive maintenance for one year from Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Grooved Mechanical-Joint Fittings and Couplings:

   a. Grinnell Supply Sales Co.
   b. Victaulic Company of America.

2. Calibrated Plug Valves:

   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Flow Design, Inc.
   d. Gerand Engineering Co.
   e. ITT Fluid Technology Corp.; ITT Bell & Gossett.
   f. Taco, Inc.

3. Pressure-Reducing Valves:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Grinnell Supply Sales Co.
   d. ITT Hoffman; ITT Fluid Handling Div.

4. Safety Relief Valves:

   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.

c. Conbraco Industries, Inc.
d. ITT Fluid Technology Corp.; ITT McDonnell & Miller.

5. Automatic Flow-Control Valves:

a. Griswold Controls.

6. Compression Tanks:

a. Amtrol, Inc.
b. Armstrong Pumps, Inc.
c. ITT Fluid Technology Corp.; ITT Bell & Gossett.
d. Taco, Inc.

7. Diaphragm-Type Compression Tanks:

a. Amtrol, Inc.
b. Armstrong Pumps, Inc.

8. Air Separators:

a. Amtrol, Inc.
b. Armstrong Pumps, Inc.
c. ITT Fluid Technology Corp.; ITT Bell & Gossett.
d. Taco, Inc.

2.2 PIPE AND TUBING MATERIALS

A. General: Refer to Part 3 "Pipe Applications" Article for identifying where the following materials are used.

B. Steel Pipe, 2-Inch NPS and Smaller: ASTM A 53, Type S (seamless), Grade A, Schedule 40, plain ends.

C. Steel Pipe, 2-1/2- to 12-Inch NPS: ASTM A 53, Type E (electric-resistance welded), Grade A, Schedule 40, plain ends.

1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53, Schedule 40, carbon steel, seamless for 2-inch NPS and smaller and electric-resistance welded for 2-1/2-inch NPS and larger.

2.3 FITTINGS

A. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125, 150, and 300.

B. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.
C. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.

D. Cast-Iron Threaded Flanges: ASME B16.1, Classes 125 and 250; raised ground face, bolt holes spot faced.

E. Wrought-Steel Fittings: ASTM A 234, Standard Weight.

F. Wrought-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.

3. Facings: Raised face.

G. Grooved Mechanical-Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47, Grade 32510 malleable iron; ASTM A 53, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders designed to accept grooved end couplings.

H. Grooved Mechanical-Joint Couplings: Consist of ductile- or malleable-iron housing, a synthetic rubber gasket of a central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

I. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body, steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 250 deg F and pressures up to 150 psig.

J. Packed, Slip, Expansion Joints: 150-psig minimum working pressure, steel pipe fitting consisting of telescoping body and slip-pipe sections, packing ring, packing, limit rods, flanged ends, and chrome-plated finish on slip-pipe telescoping section.

2.4 JOINING MATERIALS

A. Welding Materials: Comply with Section II, Part C of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

B. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.

2.5 VALVES

A. Gate, globe, check, ball, and butterfly valves are specified in Division 15 Section "Valves."

B. Calibrated Plug Valves: 125-psig working pressure, 250 deg F maximum operating temperature, bronze body, plug valve with calibrated orifice. Provide with connections for portable differential pressure meter with integral check valves and seals. Valve shall have integral pointer and calibrated scale to register degree of valve opening. Valves 2-inch NPS and smaller shall have threaded connections and 2-1/2-inch NPS valves shall have flanged connections.

C. Pressure-Reducing Valves: Diaphragm-operated, cast-iron or brass body valve, with low inlet pressure check valve, inlet strainer removable without system shutdown, and noncorrosive valve seat and stem. Select valve size, capacity, and operating pressure to suit system. Valve shall be factory set at operating pressure and have capability for field adjustment.

D. Safety Relief Valves: Brass or bronze body with brass and rubber, wetted, internal working parts; to suit system pressure and heat capacity; according to ASME Boiler and Pressure Vessel Code, Section IV.

E. Brass, Automatic Flow-Control Valves: 150-psig cold working pressure (CWP), 250 deg F maximum operating temperature, brass housing, stainless-steel operating parts; for soldered, threaded, or compression connections. Factory set to automatically control flow rates within plus or minus 5 percent design, while compensating for system operating-pressure differential. Provide quick disconnect valves for flow measuring equipment. Provide metal identification tag with chain for each valve, factory marked with the zone identification, valve model number, and flow rate.

F. Cast-Iron, Automatic Flow-Control Valves: Class 150, cast-iron housing, stainless-steel operating parts; threaded connections for 2-inch NPS and smaller, flanged connections for 2-1/2-inch NPS and larger. Factory set to automatically control flow rates within plus or minus 5 percent design, while compensating for system operating-pressure differential. Provide quick disconnect valves for flow measuring equipment. Provide metal identification tag with chain for each valve, factory marked with the zone identification, valve model number, and flow rate.

2.6 HYDRONIC SPECIALTIES

A. Manual Air Vent: Bronze body and nonferrous internal parts; 150-psig working pressure, 225 deg F operating temperature; manually operated with screwdriver or thumbscrew; with 1/8-inch NPS discharge connection and 1/2-inch NPS inlet connection.

B. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150-psig working pressure, 240 deg F operating temperature; with 1/4-inch NPS discharge connection and 1/2-inch NPS inlet connection.

C. Compression Tanks: Welded carbon steel for 125-psig working pressure, 375 deg F maximum operating temperature. Provide taps in bottom of tank for tank fitting; taps in end of tank for gage glass. Factory test tank with taps fabricated and labeled according to ASME Boiler and Pressure Vessel Code, Section VIII, Division 1. Furnish with the following fittings and accessories:

1. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. unit only; sized for compression-tank diameter. Design tank fittings for 125-psig working pressure and 250 deg F maximum operating temperature.
2. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig working pressure and 240 deg F maximum operating temperature; designed to admit air to compression tank, drain water, and close off system.
3. Gage Glass: Full height with dual manual shutoff valves, 3/4-inch-diameter gage glass, and slotted metal glass guard.

D. Diaphragm-Type Compression Tanks: Welded carbon steel for 125-psig working pressure, 375 deg F maximum operating temperature. Separate air charge from system water to maintain design expansion capacity, by a flexible diaphragm securely sealed into tank. Provide taps for pressure gage and air-charging fitting, and drain fitting. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles. Fabricate and test tank with taps and supports, and label according to ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

E. Air Separators: Welded black steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature; perforated stainless-steel air collector tube designed to direct released air into compression tank; tangential inlet and outlet connections; threaded connections for 2-inch NPS and smaller; flanged connections for 1-1/2-inch NPS and larger; threaded blow-down connection. Provide units in sizes for full-system flow capacity.

F. Chemical Feeder: Bypass-type chemical feeders of 5-gal. capacity, welded steel construction; 125-psig working pressure; complete with fill funnel and inlet, outlet, and drain valves.

1. Chemicals: Specially formulated to prevent accumulation of scale and corrosion in piping system and connected equipment, and based on a water analysis of makeup water.

G. Diverting Fittings: 125-psig working pressure, 250 deg F maximum operating temperature; cast-iron body with threaded ends, or wrought copper with soldered ends. Indicate flow direction on fitting.

H. Y-Pattern Strainers: 125-psig working pressure; cast-iron body (ASTM A 126, Class B), flanged ends for 2-1/2-inch NPS and larger, threaded connections for 2-inch NPS and smaller, bolted cover, perforated Type 304 stainless-steel basket, and bottom drain connection.

PART 3 - EXECUTION

3.1 PIPE APPLICATIONS

A. Condenser Water: Schedule 40 steel pipe with mechanical couplings.

B. Condensate Drain Lines: Type L drawn-temper copper tubing with soldered joints or Schedule 40 PVC pipe with solvent-welded joints.

3.2 VALVE APPLICATIONS

A. General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:

1. Shutoff Duty: Use gate, ball, and butterfly valves.
2. Throttling Duty: Use globe, ball, and butterfly valves.

B. Install shutoff-duty valves at each branch connection to supply mains, at supply connections to each piece of equipment, and elsewhere as indicated.

C. Install throttling-duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.

D. Install calibrated plug valves on the outlet of each heating or cooling element and elsewhere as required to facilitate system balancing.

E. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage.

F. Install check valves on each pump discharge and elsewhere as required to control flow direction.

G. Install safety relief valves on hot water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Pipe discharge to floor without valves. Comply with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for installation requirements.

H. Install pressure-reducing valves on hot water generators and elsewhere as required to regulate system pressure.

3.3 PIPING INSTALLATIONS

A. Install piping according to Division 15 Section "Basic Mechanical Materials and Methods."

B. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

C. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4-inch NPS ball valve, and short 3/4-inch NPS threaded nipple and cap.

D. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

E. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

F. Install branch connections to mains using tee fittings in main with takeoff out bottom of main, except for up-feed risers with takeoff out top of main line.

G. Install unions in pipes 2-inch NPS and smaller, adjacent to each valve, at final connections of each piece of equipment, and elsewhere as indicated. Unions are not required at flanged connections.

H. Install flanges on valves, apparatus, and equipment having 2-1/2-inch NPS and larger connections.

I. Install flexible connectors at inlet and discharge connections to pumps (except in-line pumps) and other vibration-producing equipment.

J. Install strainers on supply side of each control valve, pressure-reducing valve, pressure-regulating valve, solenoid valve, in-line pump, and elsewhere as indicated. Install 3/4-inch NPS nipple and ball valve in blow-down connection of strainers 2-inch NPS and larger.

K. Anchor piping to ensure proper direction of expansion and contraction.

3.4 HANGERS AND SUPPORTS

A. General: Hanger, support, and anchor devices are specified in Division 15 Section "Hangers and Supports." Conform to requirements below for maximum spacing of supports.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet in length.
2. Adjustable roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal runs 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

C. Install hangers for steel piping with the following minimum rod sizes and maximum spacing:

1. 3/4-Inch NPS: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. 1-Inch NPS: Maximum span, 7 feet; minimum rod size, 1/4 inch.
3. 1-1/2-Inch NPS: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. 2-Inch NPS: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. 2-1/2-Inch NPS: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. 3-Inch NPS: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. 4-Inch NPS: Maximum span, 14 feet; minimum rod size, 1/2 inch.
8. 6-Inch NPS: Maximum span, 17 feet; minimum rod size, 1/2 inch.
9. 8-Inch NPS: Maximum span, 19 feet; minimum rod size, 5/8 inch.
10. 10-Inch NPS: Maximum span, 20 feet; minimum rod size, 3/4 inch.
11. 12-Inch NPS: Maximum span, 23 feet; minimum rod size, 7/8 inch.

D. Install hangers for drawn-temper copper piping with the following minimum rod sizes and maximum spacing:

1. 3/4-Inch NPS: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. 1-Inch NPS: Maximum span, 7 feet; minimum rod size, 1/4 inch.
3. 1-1/2-Inch NPS: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. 2-Inch NPS: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. 2-1/2-Inch NPS: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. 3-Inch NPS: Maximum span, 12 feet; minimum rod size, 3/8 inch.

E. Support vertical runs at each floor.

3.5 PIPE JOINT CONSTRUCTION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for joint construction requirements for soldered and brazed joints in copper tubing; threaded, welded, and flanged joints in steel piping; and solvent-welded joints for PVC and CPVC piping.

B. Mechanical Joints: Assemble joints according to fitting manufacturer's written instructions.

C. Heat-Fusion Joints in RTR Pipe: Assemble joints according to fitting manufacturer's written instructions.

3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in system, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points in system, heat-transfer coils, and elsewhere as required for system air venting.

C. Install dip-tube fittings in boiler outlet. Run piping to compression tank with a 2 percent upward slope toward tank. Connect boiler-outlet piping.

D. Install in-line air separators in pump suction lines. Run piping to compression tank with a 2 percent upward slope toward tank. Install drain valve on units 2-inch NPS and larger.

E. Install combination air separator and strainer in pump suction lines. Run piping to compression tank with a 2 percent upward slope toward tank. Install blow-down piping with gate valve; extend to nearest drain.

F. Install shot-type chemical feeders in each hydronic system where indicated; in upright position with top of funnel not more than 48 inches above floor. Install feeder in bypass line, off main using globe valves on each side of feeder and in the main between bypass connections. Pipe drain, with ball valve, to nearest equipment drain.

G. Install compression tanks above air separator. Install gage glass and cocks on end of tank. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.

1. Support tank as detailed on Drawings. In the absence of details, provide support from floor or structure above sufficient for weight of tank, piping connections, and fittings, plus weight of a full tank of water. Do not overload building components and structural members.

H. Install diaphragm-type compression tanks on floor as indicated. Vent and purge air from hydronic system, and charge tank with proper air charge to suit system design requirements.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Piping size for supply and return shall be same size as equipment connections.

B. Install control valves in accessible locations close to equipment.

C. Install bypass piping with globe valve around control valve. Where multiple, parallel control valves are installed, only one bypass is required.

D. Install pressure gage at coil inlet connections.

3.8 FIELD QUALITY CONTROL

A. Testing Preparation: 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 system with clean water. Clean strainers.
4. Isolate equipment that is not subjected to test pressure from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Flanged joints where blinds are inserted to isolate equipment need not be tested.
5. Install relief 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. Testing: Test hydronic piping as follows:

1. Use ambient temperature water as testing medium, except where there is risk of damage due to freezing. Another liquid may be used if it is safe for workers and compatible with piping system components.

2. Use vents installed at the high points of system to release trapped air while filling system. Use drains installed at low points for complete removal of liquid.
3. Examine system to see that equipment and parts that cannot withstand test pressures are properly isolated. Examine test equipment to ensure that it is tight and that low-pressure filling lines are disconnected.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Check to verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, Code for Pressure Piping, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components as appropriate, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

3.9 ADJUSTING AND CLEANING

A. After completing system installation, including outlet fittings and devices, inspect finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.

B. Flush hydronic piping systems with clean water. Remove, clean, and replace strainer screens. After cleaning and flushing hydronic piping system, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers.

C. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.

D. Chemical Treatment: Provide a water analysis prepared by chemical treatment supplier to determine type and level of chemicals required to prevent scale and corrosion. Perform initial treatment after completing system testing.

3.10 COMMISSIONING

A. Fill system and perform initial chemical treatment.

B. Check expansion tanks to determine that they are not air bound and that system is completely full of water.

C. Perform these steps before operating the system:

1. Open valves to fully open position. Close coil bypass valves.
2. Check pump for proper direction of rotation.
3. Set automatic fill valves for required system pressure.
4. Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Check operation of automatic bypass valves.
7. Check and set operating temperatures of boilers, chillers, and cooling towers to design requirements.
8. Lubricate motors and bearings.

END OF SECTION 15510

SECTION 15540 - HVAC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. "CHILLER AND PUMP ACQUISITION FOR ANTIGUO CASINO VENUE" document.

1.2 SUMMARY

A. This Section includes the following categories of HVAC pumps for hydronic systems:
   1. End-suction pumps.

1.3 PERFORMANCE REQUIREMENTS

A. Pump Pressure Ratings: At least equal to system's maximum operating pressure at point where installed, but not less than specified.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
B. Product data including certified performance curves and rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties, and accessories. Indicate pump's operating point on curves.
C. Shop drawings showing pump layout and connections. Include setting drawings with templates, directions for installation of foundation and anchor bolts, and other anchorages.
D. Wiring diagrams detailing wiring for power, signal, and control systems and differentiating between manufacturer-installed wiring and field-installed wiring.
E. Product certificates signed by manufacturers of pumps, certifying accuracies under specified operating conditions and compliance with specified requirements.
F. Maintenance data for pumps to include in the operation and maintenance manual specified in Division 1. Include startup instructions.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with provisions of the following:
   1. ASME B31.9 "Building Services Piping" for piping materials and installation.
   2. Hydraulic Institute's "Standards for Centrifugal, Rotary & Reciprocating Pumps" for pump design, manufacture, testing, and installation.
   3. UL 778 "Standard for Motor Operated Water Pumps" for construction requirements. Include UL listing and labeling.
   4. NEMA MG 1 "Standard for Motors and Generators" for electric motors. Include NEMA listing and labeling.
   5. NFPA 70 "National Electrical Code" for electrical components and installation.
B. Single-Source Responsibility: Obtain each category of pumps from 1 source and by a single manufacturer.
D. Product Options: Drawings indicate sizes, profiles, connections, and dimensional requirements of pumps and are based on the specific types and models indicated. Other manufacturers' pumps with equal performance characteristics may be considered. Refer to Division 1 Section "Product Substitutions."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store pumps in dry location.
B. Retain shipping flange protective covers and protective coatings during storage.
C. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
D. Comply with pump manufacturer's rigging instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
   1. Close-Coupled, End-Suction Pumps:
      a. Armstrong Pumps, Inc.
      b. ITT Fluid Technology Corp.; Bell & Gossett Div.
      c. Taco, Inc.

2.2 PUMPS, GENERAL

A. General: Factory assembled and tested.
B. Types, Sizes, Capacities, and Characteristics: As indicated in "CHILLER AND PUMP ACQUISITION FOR ANTIGUO CASINO VENUE" document.
C. Motors: NEMA MG 1, general purpose, continuous duty, Design B, except Design C where required for high starting torque. Furnish single-, multiple-, or variable-speed motors, with type of enclosures and electrical characteristics indicated. Include built-in thermal-overload protection and grease-lubricated ball bearings. Select each motor to be nonoverloading over full range of pump performance curve.
D. Motors Indicated to Be Energy Efficient: Minimum efficiency as indicated according to IEEE 112, Test Method B. Include motors with higher efficiency than "average standard industry motors" according to IEEE 112, Test Method B, if efficiency is not indicated.
E. Factory Finish: Manufacturer's standard paint applied to factory-assembled and -tested units before shipping.
F. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

2.3 CLOSE-COUPLED, END-SUCTION PUMPS

A. Description: Centrifugal, close-coupled, end-suction, single-stage, bronze-fitted, radially split case design; rated for 175-psig (1200-kPa) minimum working pressure and a continuous water temperature of 225 deg F (107 deg C). Include back-pull-out design, except where other design is indicated, and the following:
   1. Casing: Cast iron, with flanged piping connections, drain plug in bottom of volute, and threaded gage tappings at inlet and outlet flange connections.
      a. Connection Option: Include threaded piping connections, in sizes 2 inches (DN50) and smaller, and unions for casings that are not available with flanges.
   2. Impeller: ASTM B 584, cast bronze, statically and dynamically balanced, closed, overhung, single suction, keyed to shaft, and secured by locking cap screw.
   3. Wearing Rings: Replaceable, bronze casing ring.
   4. Shaft and Sleeve: Steel shaft with bronze sleeve. Include flinger on motor shaft between motor and seals to prevent liquid that leaks past pump seals from entering motor bearings.

5. Seals: Mechanical type. Include carbon-steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and gasket OR Stuffing-box type. Include at least 4 rings of graphite-impregnated braided yarn with bronze lantern ring between center 2 graphite rings, and bronze packing gland.
7. Motor: Direct mounted to pump casing. Include supporting legs as integral part of motor enclosure. Motor to include VFD with electronic by-pass and disconnecting swtch (NEMA 4X).

2.4 PUMP SPECIALTY FITTINGS

A. NOT USED

2.5 GENERAL-DUTY VALVES

A. NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION 15540

SECTION 15684 – AIR-COOLED CHILLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes packaged, rotary-screw and scroll water chillers.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specifications Sections.
B. Product Data for each chiller, including chiller refrigerant, chiller capacity, condenser pressure drop, cooler pressure drop, weights (shipping, installed, and operating), furnished accessories, and electrical characteristics.
C. Shop Drawings showing fabrication and installation of chillers, including plans, elevations, sections, details of components, attachments, and other construction elements. Include the following:
   1. Dimensions.
   2. Weight loadings and distribution.
   3. Clearances for maintenance and operation.
   4. Size and location of field connections.
D. Wiring diagrams detailing wiring for power and control systems and differentiating between manufacturer-installed and field-installed wiring.
E. Coordination Drawings showing the following:
   1. Structural supports.
   2. Piping roughing-in requirements.
   3. Wiring roughing-in requirements. Determine spaces reserved for electrical equipment.
   4. Access requirements around other work, including working clearances to mechanical controls and electrical equipment.
F. Maintenance data for each chiller to include in the operation and maintenance manual.
G. Certification of performance and factory test results specified in "Source Quality Control" Article.

1.4 QUALITY ASSURANCE

A. ARI Compliance: Rate chiller according to ARI 550.
B. ASHRAE Compliance: Conform to ASHRAE 15 for chiller design, construction, leak testing, and installation.
C. ASME Compliance: Comply with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for construction and testing of evaporator and condenser pressure vessels. Label evaporator and condenser with ASME mark.
D. NEC Compliance: Comply with applicable NEC requirements for electrical power and control wiring.
E. Refrigerant Exposure: Monitor machine room and sound audible alarm if refrigerant concentrations exceed 10 ppm.

1.5 WARRANTY

A. The special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of Contract Documents.
   1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Johson Controls
   2. Carrier
   3. Daikin-Mcquay
   4. Trane

2.2 REFRIGERANT

A. HFC-410a

2.3 COMPRESSOR

A. Description: Hermetic or semihermetic, rebuildable, twin-screw compressor.

2.4 MOTOR

A. Refrigerant-cooled, hermetic or semihermetic motor; or open, dripproof induction motor; with the following features:
   1. Overvoltage protection.
   2. Undervoltage protection.
   3. Single-phasing protection.
   4. Current-overload protection.

2.5 EVAPORATOR

A. Description: Shell and tube cooler with refrigerant totally enclosed by shell; water in tubes.
B. Shell Material: Carbon-steel plate.
C. Cooler Tubes: Seamless copper; expanded into tube sheets; individually replaceable; externally finned; with standard, removable, carbon-steel water boxes.
   1. Internal Finish: Internally ribbed or smooth tubes.
D. Refrigerant Working Pressure: 300 psig (2070 kPa).
E. Water Side Working Pressure: 150 psig (1035 kPa).
F. Insulation: Factory-applied, 3/4-inch- (19-mm-) thick, flexible elastomeric insulation. Insulate evaporator, suction lines, and other surfaces where condensation might occur.

2.6 AIR-COOLED CONDENSER

A. Description: Factory assembled, wired, and tested; and consisting of casing, air-cooled condenser coils, fans, and controls integrated with compressor operation.
B. Casing: Weatherproof, constructed of hot-dip galvanized steel with factory-painted finish.
C. Fans: Propeller type, statically and dynamically balanced.
D. Fan Discharge Arrangement: Vertical.
E. Fan Motor: Direct drive, weatherproof, with bearings permanently lubricated, and having built-in current- and thermal-overload protection.
F. Condenser Coil: Copper tubes with mechanically bonded aluminum fins.

2.7 CHILLER OPTIONS

RETAIN PARA AND SUBPARAS BELOW TO SUIT PROJECT.

A. Furnish chillers with the following features:
   1. Remote time clock.
   2. Control transformer.
   3. Indicating lights for chiller status.
   4. Pressure gages.
   5. Audible alarm.
   6. Sound blanketing.
   7. Sound enclosure.

2.8 CONTROLS, GENERAL

A. Manufacturer's standard, microprocessor-based chiller controls.

2.9 TEMPERATURE CONTROLS

A. Compressor Capacity Control: Modulating slide valve to maintain chilled water temperature set point without hunting within throttling range. Include the following features:
   1. Throttling Range: Full load to 10 percent of full load.
   2. Chilled water temperature control.
   3. Chilled water temperature setback.
   4. Load limit controller.
B. HVAC Controls: Furnish appurtenances to monitor and control chilled water set point, to monitor condenser water set point, and to monitor chiller alarms from building's HVAC controls.

2.10 SAFETY CONTROLS

A. Manually reset controls to perform the following functions:
   1. Low evaporator pressure cutout.
   2. Low evaporator temperature cutout.
   3. Low chilled water temperature cutout.
   4. Low oil sump temperature cutout.
   5. Low oil pressure cutout.
   6. High oil temperature cutout.
   7. High condenser pressure cutout.

8. Water-Flow Interlock: Vapor proof water-flow switch to prevent starting of compressor without chilled and condenser water flow.

B. Automatically reset controls to perform the following functions:
   1. Low evaporator pressure cutout.
   2. Low evaporator temperature cutout.
   3. Low chilled water temperature cutout.
   4. Low oil sump temperature cutout.
   5. Low oil pressure cutout.
   6. High oil temperature cutout.
   7. High condenser pressure cutout.
   8. Water-Flow Interlock: Vapor proof water-flow switch to prevent starting of compressor without chilled and condenser water flow.

2.11 POWER CONTROLS

A. Control Panel: Manufacturer's standard, unit mounted, factory wired with a single-point connection, with the following power-control options:
   1. External-overload protection.
   2. Control circuit fuse.
   3. Power terminal block.
   4. Lockout restart timer.
B. Combination controller and disconnect with star-delta (wye-delta) start.
C. Combination controller and disconnect with solid-state start.
D. Combination controller and disconnect with across-the-line start.
   1. Controller listed by Underwriters Laboratories (UL), classified as suitable for installed use and environmental conditions.

2.12 VIBRATION CONTROL

A. Direct isolation (no base) and vibration isolators recommended by manufacturer.

2.13 SOURCE QUALITY CONTROL

A. Verification of Performance: Test each chiller before shipment. Rate each chiller according to ARI 550, "Standard for Centrifugal or Rotary Water-Chilling Packages." Provide a written report indicating Integrated Part-Load Value (IPLV) at ARI standard conditions or Application Part-Load Value (APLV) and test conditions.

PART 3 - EXECUTION
NOT INCLUDED

END OF SECTION 15684

SECTION 15854 - CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes constant-volume, central-station air-handling units with coils for indoor installations.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each central-station air-handling unit specified, including the following:

1. Certified fan-performance curves with system operating conditions indicated.
2. Certified fan-sound power ratings.
3. Certified coil-performance ratings with system operating conditions indicated.
4. Motor ratings and electrical characteristics plus motor and fan accessories.
5. Material gages and finishes.
6. Filters with performance characteristics.
7. Dampers, including housings, linkages, and operators.

C. Shop Drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

D. Wiring diagrams detailing wiring for power and control systems and differentiating between manufacturer-installed and field-installed wiring.

E. Coordination Drawings, including floor plans and sections drawn to scale. Submit with Shop Drawings. Show mechanical-room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

F. Field test reports indicating and interpreting test results relative to compliance with specified requirements.

G. Maintenance data for central-station air-handling units to include in the operation and maintenance manual specified in Division 1 Sections and Division 15 Section "Basic Mechanical Requirements."

1.4 QUALITY ASSURANCE

A. NFPA Compliance: Central-station air-handling units and components shall be designed, fabricated, and installed in compliance with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."

B. UL Compliance: Electric coils, along with complete central-station air-handling unit, shall be listed and labeled by UL.

C. ARI Certification: Central-station air-handling units and their components shall be factory tested according to the applicable portions of ARI 430, "Central-Station Air-Handling Units," and shall be listed and bear the label of the Air-Conditioning and Refrigeration Institute (ARI).

D. UL and NEMA Compliance: Provide motors required as part of air-handling units that are listed and labeled by UL and comply with applicable NEMA standards.

E. Comply with NFPA 70 for components and installation.

F. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

G. Coordination: Coordinate layout and installation of central-station air-handling units with piping and ductwork and with other installations.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver air-handling unit as a factory-assembled module with protective crating and covering.

B. Lift and support units with manufacturer's designated lifting or supporting points.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate size and location of concrete housekeeping bases. Cast anchor-bolt inserts into base.

B. Coordinate size and location of structural-steel support members.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

B. Filters: Furnish 1 set for each central-station air-handling unit.

C. Fan Belts: Furnish 1 set for each central-station air-handling unit fan.

D. Gaskets: Furnish 1 for each sectional joint of each central-station air-handling unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Airtherm Manufacturing Company.
2. Buffalo Forge Co.
3. Carrier Corp.; Carrier Air Conditioning Div.
4. Coil Co., Inc.
5. Dunham-Bush, Inc.
6. Engineered Air.
7. Mammoth, Inc.
8. Miller-Picking Corp.
9. SnyderGeneral Corp.; McQuay Commercial Products Group.
10. Trane Company (The); Commercial Systems Group.

11. U S A Coil & Air Inc.
12. York International Corporation.

2.2 MANUFACTURED UNITS

A. General Description: Factory assembled, consisting of fans, motor and drive assembly, coils, damper, plenums, filters, drip pans, and mixing dampers.

B. Motor and Electrical Components: Refer to Division 15 Section "Motors."

2.3 CABINET

A. Materials: Formed and reinforced galvanized steel panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

1. Outside Casing: Galvanized steel, 0.0516 inch.
2. Outside Casing: Galvanized steel, 0.0635 inch.
3. Outside Casing: Stainless steel, 0.0625 inch.
4. Inside Casing: Galvanized steel, 0.0276 inch.

B. Insulation: Coated, glass-fiber insulation, complying with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," for insulation.

1. Thickness: 1-1/2 inches.
2. Location and Application: Factory applied with adhesive and mechanical fasteners to the internal surface of section panels downstream from and including the cooling coil section.

C. Access Panels and Doors: Same materials and finishes as cabinet and complete with hinges, latches, handles, and gaskets.

1. Fan section shall have inspection and access panels and doors sized and located to allow periodic maintenance and inspections.

D. Drain Pans: Formed sections of galvanized steel sheet. Fabricate pans in sizes and shapes to collect condensate from cooling coils (including coil piping connections and return bends) and humidifiers when units are operating at maximum catalogued face velocity across cooling coil.

1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
2. Drain Connections: Both ends of pan.
3. Pan-Top Surface Coating: Elastomeric compound.
4. Units with stacked coils shall have an intermediate drain pan or drain trough to collect condensate from top coil.

2.4 FAN SECTION

A. Fan-Section Construction: Belt-driven centrifugal fans, consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure, equipped with formed-steel channel base for integral mounting of fan, motor, and casing panels. Mount fan scroll, wheel, shaft, bearings, and motor on structural-steel frame, with frame mounted on base with vibration isolation.

B. Housings: Fabricate from formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff, spun-metal inlet bell, and access doors or panels to allow entry to internal parts and components.

C. Fan Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor power. Fan wheel shall be double-width, double-inlet type with forward-curved blades or backward-curved airfoil blades as indicated.

1. Backward Inclined: Steel or aluminum construction with curved inlet flange, back plate, backward-curved blades, and cast-iron or cast-steel hub.
2. Forward Curved: Black steel with enamel or galvanized finish, and having an inlet flange, back plate, shallow blades with inlet and tip curved forward in direction of airflow, and steel hub.
3. Airfoil Wheel: Steel; with smooth, curved inlet flange; back plate; die-formed, hollow, airfoil blades; and cast-iron or cast-steel hub.
4. Shafts: Hot-rolled steel; turned, ground, and polished, and having keyway to secure to fan wheel hub.
5. Shaft Bearings: Prelubricated and sealed, self-aligning, pillow-block-type ball or roller bearings with the following:

    a. Rated Bearing Life: ABMA 9 or ABMA 11, L-50 of 200,000 hours.

6. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.

    a. Service Factor Based on Fan Motor: 1.5.

7. Pulleys: Cast iron or steel with split, tapered bushing, dynamically balanced at factory.
8. Motor Pulleys: Adjustable pitch, selected so pitch adjustment is at middle of adjustment range at fan design conditions.
9. Belts: Oil resistant, nonsparking, and nonstatic; matched for multiple belt drives.
10. Belt Guards: Fabricate to OSHA/SMACNA requirements, 0.1046 inch thick, 3/4-inch diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated.

    a. Provide belt guards for motors mounted on outside of cabinet.

11. Motor Mount: Adjustable for belt tensioning.
12. Accessories: Provide the following:

    a. Variable inlet vanes.
    b. Discharge dampers.

13. Vibration Control: Install fans on open-spring vibration isolators, minimum 1-inch static deflection, with side snubbers.

D. Fan-Section Source Quality Control: The following factory tests are required.

1. Sound Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
2. Factory test fan performance for flow rate, pressure, power, air density, rotation speed, and efficiency. Establish ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

2.5 MOTORS

A. General: Refer to Division 15 Section "Motors" for general requirements.

B. Torque Characteristics: Sufficient to accelerate driven loads satisfactorily.

C. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range.

D. Temperature Rating: 50 deg C maximum temperature rise at 40 deg C ambient for continuous duty at full load (Class A Insulation).

E. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors.

F. Motor Construction: NEMA MG-1, general purpose, continuous duty, Design B.

1. Bases: Adjustable.

G. Bearings: The following features are required:

1. Ball or roller bearings with inner and outer shaft seals.
2. Grease lubricated.
3. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.

H. Enclosure Type: The following features are required:

1. Open dripproof motors where satisfactorily housed or remotely located during operation.
2. Guarded dripproof motors where exposed to contact by employees or building occupants.

I. Overload Protection: Built-in, automatic reset, thermal overload protection.

J. Noise Rating: Quiet.

K. Efficiency: Energy-efficient motors shall have a minimum efficiency as scheduled according to IEEE 112, Test Method B. If efficiency is not specified, motors shall have a higher efficiency than "average standard industry motors" according to IEEE 112, Test Method B.

L. Nameplate: Indicate full identification of manufacturer, ratings, characteristics, construction, and special features.

M. Starters, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 16 Sections.

2.6 COILS

A. Coil Sections: Common or individual, insulated, galvanized steel casings for heating and cooling coils. Design and construct to facilitate removal and replacement of coil for maintenance and to assure full airflow through coils.

1. Multizone Units: Provide air deflectors and air baffles to balance airflow across coils.

B. Coil Construction: Rigidly supported across full face, pitched to allow drainage.

1. Fins: Aluminum, mechanically bonded to tubes.
2. Tubes: Seamless copper.
3. Coil Casing: Galvanized steel.
4. Headers for Steam and Water Coils: Steel, cast iron, or copper with connections for drain valve and air vent, and threaded piping connections.

C. Water Coils: Drainable with threaded plugs, serpentine with return bends in smaller sizes and with return headers in larger sizes.

D. Coil-Performance Tests: Factory-test cooling and heating coils, except sprayed surface coils for rating according to ARI 410, "Forced-Circulation Air-Cooling and Air-Heating Coils."

2.7 DAMPERS

A. General: Leakage rate, according to AMCA 500, "Test Methods for Louvers, Dampers and Shutters," shall not exceed 2 percent of air quantity at 2000-fpm face velocity through damper and 4-inch wg pressure differential.

B. Mixing Boxes: Parallel-blade galvanized steel damper blades mechanically fastened to steel operating rod in reinforced, galvanized steel cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.

C. Combination Filter/Mixing Box: Parallel-blade galvanized steel damper blades mechanically fastened to steel operating rod in reinforced, galvanized steel cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously. Cabinet support members shall hold 2-inch-thick, pleated, flat permanent or throwaway filters. Provide hinged access panels or doors to allow removal of filters from both sides of unit.

2.8 FILTER SECTION

A. Filters: Comply with NFPA 90A.

B. Filter Section: Provide filter media holding frames arranged for flat or angular orientation, with access doors on both sides of unit.

C. Disposable Filters: 2-inch-thick, viscous-coated fibers encased in fiberboard cell with perforated-metal media support, clean airflow resistance of 0.10 inch wg at face velocity of 300 fpm and ASHRAE 52.1 filter-arrestance efficiency of 70 to 82 percent.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions to receive equipment, for compliance with installation tolerances and other conditions affecting performance of central-station air-handling units.

B. Examine roughing-in of steam, hydronic, condensate drainage piping, and electrical to verify actual locations of connections before installation.

C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install central-station air-handling units level and plumb, according to manufacturer's written instructions.

1. Suspended Units: Suspend units from structural-steel support frame using threaded steel rods and vibration isolation.

B. Arrange installation of units to provide access space around air-handling units for service and maintenance.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. The Drawings indicate the general arrangement of piping, fittings, and specialties. The following are specific connection requirements:

1. Install piping adjacent to machine to allow service and maintenance.
2. Connection piping to air-handling units with flexible connectors.

3. Connect condensate drain pans using 1-1/4-inch NPS, Type M copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
4. Hot- and Chilled-Water Piping: Conform to applicable requirements of Division 15 Section "Hydronic Piping." Connect to supply and return coil tappings with shutoff or balancing valve and union or flange at each connection.

B. Duct installation and connection requirements are specified in other Division 15 Sections. The Drawings indicate the general arrangement of ducts and duct accessories. Make final duct connections with flexible connections.

C. Electrical: Conform to applicable requirements of Division 16 Sections.

1. Connect fan motors to wiring systems and to ground. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
2. Temperature control wiring and interlock wiring is specified in Division 15 Section "Control Systems Equipment."

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

3.5 CLEANING

A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.

B. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.

3.6 COMMISSIONING

A. Manufacturer's Field Inspection: Engage a factory-authorized service representative to perform the following:

1. Inspect field assembly of components and installation of central-station air-handling units including piping, ductwork, and electrical connections.
2. Prepare a written report on findings and recommended corrective actions.

B. Final Checks before Startup: Perform the following before startup:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify that proper thermal overload protection is installed in motors, starters, and disconnects.
3. Perform cleaning and adjusting specified in this Section.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify free fan wheel rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
6. Set zone dampers to fully open position for each zone.
7. Set face-and-bypass dampers to full face flow.
8. Set outside-air and return-air mixing dampers to minimum outside-air setting.
9. Comb coil fins for parallel orientation.
10. Install clean filters.
11. Verify that manual and automatic volume control, and fire and smoke dampers in connected ductwork systems are in fully open position.

C. Starting procedures for central-station air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm.

   a. Replace fan and motor pulleys as required to achieve design conditions.

2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

D. Refer to Division 15 Section "Testing, Adjusting, and Balancing" for air-handling system testing, adjusting, and balancing.

3.7 DEMONSTRATION

A. Engage the services of a factory-authorized service representative to train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

1. Review data in the operation and maintenance manuals. Refer to Division 1 Section "Contract Closeout."
2. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

END OF SECTION 15854

SECTION 15891 - METAL DUCTWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Requirements of the following Division 15 Sections apply to this section:

1. "Basic Mechanical Requirements."
2. "Basic Mechanical Materials and Methods."

1.2 SUMMARY

A. This Section includes rectangular, round, and flat-oval metal ducts and plenums for heating, ventilating, and air conditioning systems in pressure classes from minus 2 inches to plus 10 inches water gage.

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 7 Section "Joint Sealers" for fire-resistant sealants for use around duct penetrations and fire damper installations in fire rated floors, partitions, and walls.
2. Division 8 Section "Access Panels and Doors" for wall- and ceiling-mounted access panels and doors for access to concealed ducts.
3. Division 10 Section "Louvers and Vents" for intake and relief louvers and vents connected to duct systems and installed in exterior walls.
4. Division 15 Section "Mechanical Insulation" for exterior duct and plenum insulation.
5. Division 15 Section "Duct Accessories" for flexible duct materials, dampers, duct-mounted access panels and doors, and turning vanes.
6. Division 15 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
7. Division 15 Section "Nonmetal Ductwork."
8. Division 15 Section "Sound Attenuators" for air system sound control devices.
9. Division 15 Section "Diffusers, Registers, and Grilles."
10. Division 15 Section "Air Terminals," for constant-volume control boxes, variable-air-volume control boxes, and reheat boxes.
11. Division 15 Section "Electric Control Systems" for automatic volume control dampers and operators.
12. Division 15 Section "Pneumatic Control Systems" for automatic volume control dampers and operators.
13. Division 15 Section "Testing, Adjusting, and Balancing."

1.3 DEFINITIONS

A. Sealing Requirements Definitions: For the purposes of duct systems sealing requirements specified in this Section, the following definitions apply:

1. Seams: A seam is defined as joining of two longitudinally (in the direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on the perimeter are deemed to be joints.

2. Joints: Joints include girth joints; branch and subbranch intersections; so-called duct collar tap-ins; fitting subsections; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum, and casing abutments to building structures.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Changes or alterations to the layout or configuration of the duct system must be specifically approved in writing. Accompany requests for layout modifications with calculations showing that the proposed layout will provide the original design results without increasing the system total pressure.

1.5 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data including details of construction relative to materials, dimensions of individual components, profiles, and finishes for the following items:

1. Duct Liner.
2. Sealing Materials.
3. Fire-Stopping Materials.

C. Shop drawings from duct fabrication shop, drawn to a scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same size as the Contract Drawings, detailing:

1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.
2. Duct layout, indicating pressure classifications and sizes in plan view. For exhaust ducts systems, indicate the classification of the materials handled as defined in this Section.
3. Fittings.
4. Reinforcing details and spacing.
5. Seam and joint construction details.
6. Penetrations through fire-rated and other partitions.
7. Terminal unit, coil, and humidifier installations.
8. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.

D. Coordination drawings for ductwork installation in accordance with Division 15 Section "Basic Mechanical Requirements." In addition to the requirements specified in "Basic Mechanical Requirements" show the following:

1. Coordination with ceiling suspension members.
2. Spatial coordination with other systems installed in the same space with the duct systems.
3. Coordination of ceiling- and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
4. Coordination with ceiling-mounted lighting fixtures and air outlets and inlets.

E. Welding certificates including welding procedures specifications, welding procedures qualifications test records, and welders' qualifications test records complying with requirements specified in "Quality Assurance" below.

F. Record drawings including duct systems routing, fittings details, reinforcing, support, and installed accessories and devices, in accordance with Division 15 Section "Basic Mechanical Requirements" and Division 1.

G. Maintenance data for volume control devices, fire dampers, and smoke dampers, in accordance with Division 15 Section "Basic Mechanical Requirements" and Division 1.

1.6 QUALITY ASSURANCE

A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel" for hangers and supports and AWS D9.1 "Sheet Metal Welding Code."

B. Qualify each welder in accordance with AWS qualification tests for welding processes involved. Certify that their qualification is current.

C. NFPA Compliance: Comply with the following NFPA Standards:

1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," except as indicated otherwise.
2. NFPA 96, "Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors for Commercial Cooking Equipment," Chapter 3, "Duct System," for kitchen hood duct systems, except as indicated otherwise.

D. Field-Constructed Mock-Up: Prior to installation of duct systems erect mock-ups representing duct systems pressure classifications greater than 2 inches. Build mock-ups to comply with the following requirements, using materials indicated for final unit of Work.

1. Locate mock-ups on the site. Mock-up may be a representative section of the actual duct system.
2. Include the minimum number of each of the following features and fittings:

a. Five transverse joints.
b. One access door.
c. Two typical branch connections each with at least one elbow.
d. Two typical flexible duct or flexible connector connections for each type duct and apparatus.

3. Perform tests specified in "Field Quality Control." Modify mock-up construction and perform additional tests as required to achieve specified minimum acceptable results.
4. Obtain approval of mock-ups before beginning final fabrication.
5. Retain and maintain mock-ups during construction in undisturbed condition as a standard for judging completed unit of Work.
6. Demolish and remove mock-ups from Project site when directed.
7. Accepted mock-ups that form a part of the actual duct system may remain and become part of completed unit of Work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver sealant and fire-stopping materials to site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle sealant fire-stopping materials in compliance with manufacturers' recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

C. Deliver and store stainless steel sheets with mill-applied adhesive protective paper, maintained through fabrication and installation.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

A. Sheet Metal, General: Provide sheet metal in thicknesses indicated, packaged and marked as specified in ASTM A 700.

B. Galvanized Sheet Steel: Lock-forming quality, ASTM A 527, Coating Designation G 90. Provide mill phosphatized finish for exposed surfaces of ducts exposed to view.

C. PVC-Coated Galvanized Steel: UL-181 Class 1 Listing. Lock-forming quality galvanized sheet steel with ASTM A 527, Coating Designation G 90. Provide with factory-applied, 4-mil, PVC coating on the exposed surfaces of ducts and fittings (exterior of ducts and fittings for underground applications, and the interior of ducts and fittings for fume-handing applications) and 2-mil PVC coating on the reverse side of the ducts and fittings.

D. Carbon Steel Sheets: ASTM A 366, cold-rolled sheets, commercial quality, with oiled, exposed matte finish.

E. Stainless Steel: ASTM A 480, Type 316, sheet form, with No. 4 finish on exposed surface for ducts exposed to view; Type 304, sheet form, with No. 1 finish for concealed ducts.

F. Aluminum Sheets: ASTM B 209, Alloy 3003, Temper H14, sheet form; with standard, one-side bright finish where ducts are exposed to view, and mill finish for concealed ducts.

G. Reinforcement Shapes and Plates: Unless otherwise indicated, provide galvanized steel reinforcing where installed on galvanized sheet metal ducts. For aluminum and stainless steel ducts provide reinforcing of compatible materials.

H. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 DUCT LINER

A. General: Comply with NFPA Standard 90A and TIMA Standard AHC-101.

B. Materials: ASTM C 1071, Type II, with coated surface exposed to airstream to prevent erosion of glass fibers.

1. Thickness: 1/2 inch.
2. Thickness: 1 inch.
3. Thickness: 1-1/2 inch.
4. Density: 1-1/2 pounds.
5. Density: 2 pounds.
6. Density: 3 pounds.
7. Thermal Performance: "K-Factor" equal to 0.28 or better, at a mean temperature of 75 deg F.
8. Fire Hazard Classification: Flame spread rating of not more than 25 without evidence of continued progressive combustion and a smoke developed rating of no higher than 50, when tested in accordance with ASTM C 411.
9. Liner Adhesive: Comply with NFPA Standard 90A and ASTM C 916.
10. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct. Provide fasteners that do not damage the liner when applied as recommended by the manufacturer, that do not cause leakage in the duct, and will indefinitely sustain a 50-pound tensile dead load test perpendicular to the duct wall.

    a. Fastener Pin Length: As required for thickness of insulation, and without projecting more than 1/8 inch into the airstream.
    b. Adhesive For Attachment of Mechanical Fasteners: Comply with the "Fire Hazard Classification" of duct liner system.

2.3 SEALING MATERIALS

A. Joint and Seam Sealants, General: The term sealant used here is not limited to materials of adhesive or mastic nature, but also includes tapes and combinations of open weave fabric strips and mastics.

B. Joint and Seam Tape: 2 inches wide, glass-fiber-fabric reinforced.

C. Tape Sealing System: Woven-fiber tape impregnated with a gypsum mineral compound and a modified acrylic/silicone activator to react exothermically with the tape to form a hard, durable, airtight seal.

D. Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant complying with FS TT-S-001657, Type I; formulated with a minimum of 75 percent solids.

E. Flanged Joint Mastics: One-part, acid-curing, silicone elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

2.4 FIRE-STOPPING

A. Refer to Division 7 Section "Joint Sealers" for fire-stopping.

2.5 FIRE-STOPPING

A. Fire-Resistant Sealant: Provide two-part, foamed-in-place, fire-stopping silicone sealant formulated for use in a through-penetration fire-stop system for filling openings around duct penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

B. Fire-Resistant Sealant: Provide one-part elastomeric sealant formulated for use in a through-penetration fire-stop system for filling openings around duct penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

C. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

D. Products: Subject to compliance with requirements, provide one of the following:

1. "Dow Corning Fire Stop Foam"; Dow Corning Corp.
2. "Pensil 851"; General Electric Co.
3. "Dow Corning Fire Stop Sealant"; Dow Corning Corp.
4. "3M Fire Barrier Caulk CP-25"; Electrical Products Div./3M.
5. "RTV 7403"; General Electric Co.
6. "Fyre Putty"; Standard Oil Engineered Materials Co.

2.6 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder actuated fasteners, or structural steel fasteners appropriate for building materials. Do not use powder actuated concrete fasteners for lightweight aggregate concretes or for slabs less than 4 inches thick.

B. Hangers: Galvanized sheet steel, or round, uncoated steel, threaded rod.

1. Hangers Installed In Corrosive Atmospheres: Electro-galvanized, all-thread rod or hot-dipped-galvanized rods with threads painted after installation.
2. Straps and Rod Sizes: Conform with Table 4-1 in SMACNA HVAC Duct Construction Standards, 1985 Edition, for sheet steel width and gage and steel rod diameters.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports: Steel shapes conforming to ASTM A 36.

1. Where galvanized steel ducts are installed, provide hot-dipped-galvanized steel shapes and plates.
2. For stainless steel ducts, provide stainless steel support materials.
3. For aluminum ducts, provide aluminum support materials, except where materials are electrolytically separated from ductwork.

2.7 RECTANGULAR DUCT FABRICATION

A. General: Except as otherwise indicated, fabricate rectangular ducts with galvanized sheet steel, in accordance with SMACNA "HVAC Duct Construction Standards," Tables 1-3 through 1-19, including their associated details. Conform to the requirements in the referenced standard for metal thickness, reinforcing types and intervals, tie rod applications, and joint types and intervals.

1. Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
2. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

B. Fabricate kitchen hood exhaust ducts with 16-gage, carbon steel sheets for concealed ducts and 18-gage stainless steels for exposed ducts. Weld and flange seams and joints. Conform to NFPA Standard 96.

C. Fabricate dishwasher hood exhaust ducts with 18-gage stainless steels. Weld and flange seams and joints.

D. Acid-Resistant Ducts: Provide factory-fabricated ducts and fittings only; no shop or field fabrication will be allowed. Refer to PVC-Coated Galvanized Steel Sheets in this Section for materials.

E. Static Pressure Classifications: Except where otherwise indicated, construct duct systems to the following pressure classifications:

1. Supply Ducts: 3 inches water gage.
2. Return Ducts: 2 inches water gage, negative pressure.
3. Exhaust Ducts: 2 inches water gage, negative pressure.

F. Crossbreaking or Cross Beading: Crossbreak or bead duct sides that are 19 inches and larger and are 20 gage or less, with more than 10 sq. ft. of unbraced panel area, as indicated in SMACNA "HVAC Duct Construction Standard," Figure 1-4, unless they are lined or are externally insulated.

2.8 RECTANGULAR DUCT FITTINGS

A. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA "HVAC Metal Duct Construction Standard," 1985 Edition, Figures 2-1 through 2-10.

2.9 SHOP APPLICATION OF LINER IN RECTANGULAR DUCTS

A. Adhere a single layer of indicated thickness of duct liner with 90 percent coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve indicated thickness is prohibited.

B. Apply a coat of adhesive to liner facing in direction of airflow not receiving metal nosing.

C. Butt transverse joints without gaps and coat joint with adhesive.

D. Fold and compress liner in corners of rectangular ducts or cut and fit to assure butted edge overlapping.

E. Longitudinal joints in rectangular ducts shall not occur except at corners of ducts, unless the size of the duct and standard liner product dimensions make longitudinal joints necessary.

1. Apply an adhesive coating on longitudinal seams in ducts exceeding 2,500 FPM air velocity.

F. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely around perimeter; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

G. Secure transversely oriented liner edges facing the airstream with metal nosings that are either channel or "Z" profile or are integrally formed from the duct wall at the following locations:

1. Fan discharge.
2. Intervals of lined duct preceding unlined duct.
3. Upstream edges of transverse joints in ducts.

H. Secure insulation liner with perforated sheet metal liner of the same gage specified for the duct, secured to ducts with mechanical fasteners that maintain metal liner distance from duct without compressing insulation. Provide 3/32-inch-diameter perforations, with an overall open area of 23 percent.

I. Terminate liner with duct buildouts installed in ducts to attach dampers, turning vane assemblies, and other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to the duct wall with bolts, screws, rivets, or welds. Terminate liner at fire dampers at connection to fire damper sleeve through fire separation.

2.10 ROUND AND FLAT OVAL DUCT FABRICATION

A. General: "Basic Round Diameter" as used in this article is the diameter of the size of round duct that has a circumference equal to the perimeter of a given sized of flat oval duct. Except where interrupted by fittings, provide round and flat oval ducts in lengths not less than 12 feet.

B. Round Ducts: Fabricate round supply ducts with spiral lockseam construction, except where diameters exceed 72 inches. Fabricate ducts having diameters greater than 72 inches with longitudinal butt-welded seams. Comply with SMACNA "HVAC Duct Construction Standards," Table 3-2 for galvanized steel gages.

C. Round Ducts: Fabricate round supply ducts using seam types identified in SMACNA "HVAC Duct Construction Standards," 1985 Edition, Figure 3-1, RL-1, RL-4, or RL-5. Seams Types RL-2 or RL-3 may be used if spot-welded on 1-inch intervals. Comply with SMACNA "HVAC Duct Construction Standards," Table 3-2 for galvanized steel gages.

D. Flat Oval Ducts: Fabricate flat oval supply ducts with standard spiral lockseams (without intermediate ribs) or with butt-welded longitudinal seams in gages listed in SMACNA "HVAC Duct Construction Standards," Table 3-4.

E. Double-Wall (Insulated) Ducts: Fabricate double-wall insulated ducts with an outer shell, insulation, and an inner liner as specified below. Dimensions indicated on internally insulated ducts are nominal inside dimensions.

1. Thermal Conductivity: 0.27 Btu/sq.ft./deg F/inch thickness at 75 deg F mean temperature.
2. Outer Shell: Base outer shell gage on actual outer shell dimensions. Provide outer shell lengths 2 inches longer than inner shell and insulation, and in gages specified above for single-wall duct.
3. Insulation: Unless otherwise indicated, provide 1-inch-thick fiber-glass insulation. Provide insulation ends where internally insulated duct connects to single-wall duct or noninsulated components. The insulation end shall terminate the insulation and reduce the outer shell diameter to the inner liner diameter.
4. Solid Inner Liner: Construct round and flat oval inner liners with solid sheet metal of the gages listed below. For flat oval ducts, the diameter indicated in the table below is the "basic round diameter."
5. Perforated Inner Liner: Construct round and flat oval inner liners with perforated sheet metal of the gages listed below. Provide 3/32-inch-diameter perforations, with an overall open area of 23 percent. For flat oval ducts, the diameter indicated below is the "basic round diameter."

    a. 3 to 8 inches: 28 gage with standard spiral construction.
    b. 9 to 42 inches: 28 gage with single-rib spiral construction.
    c. 44 to 60 inches: 26 gage with single-rib spiral construction.
    d. 62 to 88 inches: 22 gage with standard spiral construction.

6. Maintain concentricity of liner to outer shell by mechanical means. Retain insulation from dislocation by mechanical means.

2.11 ROUND AND FLAT OVAL SUPPLY AND EXHAUST FITTINGS FABRICATION

A. 90-Degree Tees and Laterals and Conical Tees: Fabricate to conform to SMACNA "HVAC Duct Construction Standards," 1985 Edition, Figures 3-4 and 3-5 and with metal thicknesses specified for longitudinal seam straight duct.

B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from the body onto branch tap entrance.

C. Elbows: Fabricate in die-formed, gored, pleated, or mitered construction. Fabricate the bend radius of die-formed, gored, and pleated elbows 1.5 times the elbow diameter. Unless elbow construction type is indicated, provide elbows meeting the following requirements:

1. Mitered Elbows: Fabricate mitered elbows with welded construction in gages specified below.

    a. Mitered Elbows Radius and Number of Pieces: Unless otherwise indicated, construct elbow to comply with SMACNA "HVAC Duct Construction Standards," Table 3-1.
    b. Round Mitered Elbows: Solid welded and with metal thickness listed below for pressure classes from minus 2 inches to plus 2 inches:

        1) 3 to 26 inches: 24 gage.
        2) 27 to 36 inches: 22 gage.
        3) 37 to 50 inches: 20 gage.
        4) 52 to 60 inches: 18 gage.
        5) 62 to 84 inches: 16 gage.

    c. Round Mitered Elbows: Solid welded and with metal thickness listed below for pressure classes from 2 inches to 10 inches:

        1) 3 to 14 inches: 24 gage.
        2) 15 to 26 inches: 22 gage.

3) 27 to 50 inches: 20 gage.
4) 52 to 60 inches: 18 gage.
5) 62 to 84 inches: 16 gage.

d. Flat Oval Mitered Elbows: Solid welded and with the same metal thickness as longitudinal seam flat oval duct.
e. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems, or exhaust systems for material handling classes A and B; and only where space restrictions do not permit the use of 1.5 bend radius elbows. Fabricate with a single-thickness turning vanes.

2. Round Elbows - 8 Inches and Smaller: Die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend angle configurations or 1/2-inch-diameter (e.g. 3-1/2- and 4-1/2-inch) elbows with gored construction.
3. Round Elbows - 9 Through 14 Inches: Gored or pleated elbows for 30, 45, 60, and 90 degrees, except where space restrictions require a mitered elbow. Fabricate nonstandard bend angle configurations or 1/2-inch-diameter (e.g. 9-1/2- and 10-1/2-inch) elbows with gored construction.
4. Round Elbows - Larger Than 14 Inches and All Flat Oval Elbows: Gored elbows, except where space restrictions require a mitered elbow.
5. Die-Formed Elbows for Sizes Through 8 Inches and All Pressures: 20 gage with 2-piece welded construction.
6. Round Gored Elbows Gages: Same as for nonelbow fittings specified above.
7. Flat Oval Elbows Gages: Same as longitudinal seam flat oval duct.
8. Pleated Elbows Sizes Through 14 Inches and Pressures Through 10 Inches: 26 gage.

D. Double-Wall (Insulated) Fittings: Fabricate double-wall insulated fittings with an outer shell, insulation, and an inner liner as specified below. Dimensions indicated on internally insulated ducts are nominal inside dimensions.

1. Thermal Conductivity: 0.27 Btu/sq.ft./deg F/inch thickness at 75 deg F mean temperature.
2. Outer Shell: Base outer shell gage on actual outer shell dimensions. Provide outer shell lengths 2 inches longer than inner shell and insulation. Gages for outer shell shall be same as for uninsulated fittings specified above.
3. Insulation: Unless otherwise indicated, provide 1-inch-thick fiber-glass insulation. Provide insulation ends where internally insulated duct connects to single-wall duct or noninsulated components. The insulation end shall terminate the insulation and reduce the outer shell diameter to the nominal single-wall size.
4. Solid Inner Liner: Construct round and flat oval inner liners with solid sheet metal of the gages listed below. For flat oval ducts, the diameter indicated in the table below is the "basic round diameter."
5. Perforated Inner Liner: Construct round and flat oval inner liners with perforated sheet metal of the gages listed below. Provide 3/32-inch-diameter perforations, with an overall open area of 23 percent. For flat oval ducts, the diameter indicated in the table below is the "basic round diameter."

a. 3 to 34 inches: 24 gage.
b. 35 to 58 inches: 22 gage.
c. 60 to 88 inches: 20 gage.

6. Maintain concentricity of liner to outer shell by mechanical means. Retain insulation from dislocation by mechanical means.

E. PVC-Coated Elbows and Fittings: Fabricate elbows and fittings as follows:

1. Round Elbows 4 to 8 Inches: 2-piece, die stamped, with longitudinal seams spot welded, bonded, and painted with a PVC aerosol spray.
2. Round Elbows 9 to 26 Inches: Standing seam construction.
3. Round Elbows 28 to 60 Inches: Standard gore construction, riveted and bonded.
4. Other Fittings: Riveted and bonded joints.
5. Couplings: Slip-joint construction with a minimum of a 2-inch insertion length.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION, GENERAL

A. Duct System Pressure Class: Construct and install each duct system for the specific duct pressure classification indicated.

B. Install ducts with the fewest possible joints.

C. Use fabricated fittings for all changes in directions, changes in size and shape, and connections.

D. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.

E. Locate ducts, except as otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Install duct systems in shortest route that does not obstruct useable space or block access for servicing building and its equipment.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Provide clearance of 1 inch where furring is shown for enclosure or concealment of ducts, plus allowance for insulation thickness, if any.

H. Install insulated ducts with 1-inch clearance outside of insulation.

I. Conceal ducts from view in finished and occupied spaces by locating in mechanical shafts, hollow wall construction, or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown.

J. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

K. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

L. Non-Fire-Rated Partition Penetrations: Where ducts pass interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2 inches.

3.2 PVC-COATED DUCT INSTALLATION

A. Install PVC-coated duct and fittings in accordance with the manufacturer's instructions.

B. Seal all joints and seams. Apply sealer to male end connectors before insertion, and afterwards to cover the entire joint and sheet metal screws.

C. Secure couplings with sheet metal screws. Install screws at an interval of 12 inches, with a minimum of 3 screws in each coupling.

D. Repair damage to PVC coating with a PVC aerosol spray.

3.3 UNDERSLAB DUCT INSTALLATIONS

A. Verify undamaged conditions of duct prior to enclosure with fill or encasement.

B. Install underslab ducts in accordance with SMACNA "HVAC Metal Duct Construction Standards," Figures 3-11 and 3-12, and as indicated.

C. Protect ducts from damage by powered vibrators and other equipment used in placement of concrete on or around ducts.

D. Provide temporary protection for duct openings.

3.4 KITCHEN HOOD EXHAUST DUCT INSTALLATIONS

A. Provide for thermal expansion of ductwork through 2,000-deg F temperature range.

B. Install without dips or traps that may collect residues, except where traps have continuous or automatic residue removal.

C. Install access openings at each change in direction and at 50-foot intervals. Locate on sides of duct 1-1/2 inches minimum from bottom, and fit with grease-tight covers of same material as duct.

D. Do not penetrate fire-rated assemblies.

3.5 DISHWASHER EXHAUST DUCT INSTALLATIONS

A. Install dishwasher exhaust duct systems in accordance with SMACNA "HVAC Duct Construction Standards," 1985 Edition, Figure 2-21.

3.6 SEAM AND JOINT SEALING

A. General: Seal duct seams and joints as follows:

B. Pressure Classifications Greater Than 3 Inches Water Gage: All transverse joints, longitudinal seams, and duct penetrations.

C. Pressure Classification 2 and 3 Inches Water Gage: All transverse joints and longitudinal seams.

1. Pressure Classification Less than 2 Inches Water Gage: Transverse joints only.

D. Seal externally insulated ducts prior to insulation installation.

3.7 HANGING AND SUPPORTING

A. Install rigid round, rectangular, and flat oval metal duct with support systems indicated in SMACNA "HVAC Duct Construction Standards," Tables 4-1 through 4-3 and Figures 4-1 through 4-8.

B. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.

C. Support vertical ducts at a maximum interval of 16 feet and at each floor.

D. Upper attachments to structures shall have an allowable load not exceeding 1/4 of the failure (proof test) load but are not limited to the specific methods indicated.

E. Install concrete insert prior to placing concrete.

F. Install powder actuated concrete fasteners after concrete is placed and completely cured.

3.8 CONNECTIONS

A. Equipment Connections: Connect equipment with flexible connectors in accordance with Division 15 Section "Duct Accessories."

B. Branch Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figures 2-7 and 2-8.

C. Outlet and Inlet Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figures 2-16 through 2-18.

D. Terminal Units Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figure 2-19.

3.9 FIELD QUALITY CONTROL

A. The Owner will contract with an independent testing agency to perform, record, and report leakage tests.

B. Remake leaking joints as required and apply sealants to achieve specified maximum allowable leakage.

3.10 FIELD QUALITY CONTROL

A. Disassemble, reassemble, and seal segments of the systems as required to accommodate leakage testing, and as required for compliance with test requirements.

B. Conduct tests, in the presence of the Architect, at static pressures equal to the maximum design pressure of the system or the section being tested. If pressure classifications are not indicated, test entire system at the maximum system design pressure. Do not pressurize systems above the maximum design operating pressure. Give 7 days' advanced notice for testing.

C. Determine leakage from entire system or section of the system by relating leakage to the surface area of the test section.

D. Maximum Allowable Leakage: As described in ASHRAE 1989 Handbook, "Fundamentals" Volume, Chapter 32, Table 6 and Figure 10. Comply with requirements for leakage classification 3 for round and flat oval ducts, leakage classification 12 for rectangular ducts in pressure classifications less than and equal to 2 inches water gage (both positive and negative pressures), and leakage classification 6 for pressure classifications greater than 2 inches water gage and less than and equal to 10 inches water gage.

E. Remake leaking joints as required and apply sealants to achieve specified maximum allowable leakage.

F. Leakage Test: Perform volumetric measurements and adjust air systems as described in ASHRAE 1987 "HVAC Systems and Applications" Volume, Chapter 57 and ASHRAE 1989 "Fundamentals" Volume, Chapter 13, and Division 15 Section "TESTING, ADJUSTING, AND BALANCING."

3.11 ADJUSTING AND CLEANING

A. Adjust volume control devices as required by the testing and balancing procedures to achieve required air flow. Refer to Division 15 Section "TESTING, ADJUSTING, AND BALANCING" for requirements and procedures for adjusting and balancing air systems.

B. Vacuum ducts systems prior to final acceptance to remove dust and debris.

END OF SECTION 15891

SECTION 15932 - AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK:

A. Extent of air outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.

B. Types of outlets and inlets required for project include the following:

1. Ceiling air diffusers.
2. Wall registers and grilles.
3. Louvers.

C. Refer to other Division-15 sections for ductwork and duct accessories required in conjunction with air outlets and inlets; not work of this section.

D. Refer to other Division-15 sections for balancing of air outlets and inlets; not work of this section.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ARI Compliance: Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets".
2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".
3. ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".
4. ADC Seal: Provide air outlets and inlets bearing ADC Certified Rating Seal.
5. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters".
6. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.
7. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:

1. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.
2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.
3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings. Indicate selections on data.

B. Samples: 3 samples of each type of finish furnished.

C. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.

D. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Deliver air outlets and inlets wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 CEILING AIR DIFFUSERS:

A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.

D. Types: Provide ceiling diffusers of type, capacity, and with accessories and finishes as listed on diffuser schedule. The following requirements shall apply to nomenclature indicated on schedule.

1. Diffuser Faces:

a. Round (RD): Round housing, core of concentric rings, round duct connection.
b. Half-Round (H-R): Semi-circular housing, core of concentric half-rings, rectangular duct connection.
c. Square (SQ): Square housing, core of square concentric louvers, square or round duct connection.
d. Rectangular (RCT): Rectangular housing, core of rectangular concentric louvers, square or round duct connection.

e. Panel (PL): Square or rectangular housing extended to form a panel to fit in ceiling system module, core of square or rectangular concentric louvers, square or round duct connection.
f. Perforated (PR): Round, square, or rectangular housing covered with removable perforated panel in frame. Conceal air pattern devices above panel.
g. Linear (LR): Extruded aluminum continuous slot, single or multiple.

2. Diffuser Mountings:

a. Stepped-Down (S-D): Diffuser housing below ceiling with perimeter flange and gasket to seal against ceiling construction.
b. Flush (FL): Diffuser housing above ceiling surface with flush perimeter flange and gasket to seal against ceiling.
c. Lay-In (L-I): Diffuser housing sized to fit between ceiling exposed suspension tee bars and rest on top surface of tee bar.
d. Snap-In (S-I): Diffuser housing sized to fit between ceiling concealed suspension runners, and snap into runners.

3. Diffuser Patterns:

a. Fixed (FX): Fixed position core with concentric rings or louvers for radial air flow around entire perimeter of diffuser.
b. 2 Position (2-P): Manual 2-position core with concentric rings or louvers, upper position for horizontal air flow, lower position for vertical air flow.
c. Adjustable (ADJ): Manual adjustable core with concentric rings or louvers, fully adjustable for horizontal to vertical air flow.
d. Supply and Return (S & R): 2-section core, center position for return, perimeter for supply.
e. 1 Way (1-W): Fixed louver face for 1-direction air flow, direction indicated on drawings.
f. 2 Way (2-W): Fixed louver face for 2-direction air flow, directions indicated on drawings.
g. 3 Way (3-W): Fixed louver face for 3-direction air flow, directions indicated on drawings.
h. 4 Way (4-W): Fixed louver face for 4-direction air flow, directions indicated on drawings.
i. Induction (IND): Internal aspirator designed to mix air drawn into center core with conditioned air.
j. Rearrangeable Core (R-C): Modular directional core which can be rearranged for selected air pattern.

4. Diffuser Dampers:

a. Opposed Blade (O-B): Adjustable opposed blade damper assembly, key operated from face of diffuser.
b. Butterfly (BTFY): Two semicircular flaps connected to linkage adjustable from face of diffuser with key, and with straightening grid.
c. Supply and Return (S & R): For supply and return diffusers, butterfly type damper in return neck, annular adjustable dampers in supply duct.
d. Integral (ITGL): Combination volume control and pattern adjustment for linear diffusers.
e. Fire Damper (F-D): Combination adjustable opposed blade damper and fusible link fire damper with UL approved link and assembly designed to meet requirements of NFPA 90A.

5. Diffuser Accessories:

a. Equalizing Deflectors (E-D): Adjustable parallel blades in frame for straightening air flow.
b. Smudge Ring (S-R): Extension perimeter frame around diffuser, sized so induced air impinges on frame and not on ceiling.
c. Plaster Ring (P-R): Perimeter ring designed to act as a plaster stop and diffuser anchor.
d. Extractor (EXTR): Curved blades mounted on adjustable frame to produce air scooping action in duct at diffuser take-off.

e. Blank-Off Baffles (B-O-B-): Arc segments designed to fit into diffuser housing to divert air flow from impinging on obstruction.
f. Operating Keys (OP-KY): Tools designed to fit through diffuser face and operate volume control device and/or pattern adjustment.

6. Diffuser Finishes:

a. Aluminum Enamel (A-E): Air-dried aluminum enamel prime finish.
b. White Enamel (W-E): Semi-gloss white enamel prime finish.
c. Aluminum Anodize (A-A): Aluminum etched and anodized, covered with clear lacquer finish.

E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering diffusers which may be incorporated in the work include, but are not limited to, the following:

F. Manufacturer: Subject to compliance with requirements, provide diffusers of one of the following:

1. Anemostat Products Div.; Dymanics Corp. of America.
2. Cranes Co.; Div. of Wehr Corp.
3. Krueger Mfg. Co.
4. Titus Products Div.; Philips Industries, Inc.
5. Tuttle & Bailey; Div. of Interpace Corp.

2.2 WALL REGISTERS AND GRILLES:

A. General: Except as otherwise indicated, provide manufacturer's standard wall registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide wall registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device and listed in manufacturer's current data.

C. Wall Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall systems, and that are specifically manufactured to fit into wall construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall construction which will contain each type of wall register and grille.

D. Types: Provide wall registers and grilles of type, capacity, and with accessories and finishes as listed on register and grille schedule. The following requirements shall apply to nomenclature indicated on schedule:

1. Register and Griller Materials:

a. Steel Construction (ST): Manufacturer's standard stamped sheet steel frame and adjustable blades.
b. Aluminum Construction (AL): Manufacturer's standard extruded aluminum frame and adjustable blades.

2. Register and Grille Faces:

a. Horizontal Straight Blades (H-S): Horizontal blades, individually adjustable, at manufacturer's standard spacing.
b. Vertically Straight Blades (V-S): Vertical blades, individually adjustable, at manufacturer's standard spacing.
c. Horizontal 45 Degree Fixed Blades (H-45 Degrees): Horizontal blades, fixed at 45 degrees, at manufacturer's standard spacing.

3. Register and Grille Patterns:

   a. Single Deflection (S-D): 1-set of blades in face.
   b. Double Deflection (D-D): 2-sets of blades in face, rear set at 90 degrees to face set.

4. Register and Grille Dampers:

   a. Opposed Blade (O-B): Adjustable opposed blade damper assembly, key operated from face of register.
   b. Opposed Blade Fusible Link (OBFL): Opposed blade damper with spring closing and UL-listed fusible link for 160 degrees F (71 degrees C).

5. Register and Grille Accessories:

   a. Extractor (EXTR): Curved blades mounted on adjustable frame to produce air scooping action in duct at register or grille take-off.
   b. Plaster Frame (P-F): Perimeter frame designed to act as plaster stop and register or grille anchor.
   c. Operating Keys (OP-KY): Tools designed to fit through register or grille face and operate volume control device and/or pattern adjustable.

6. Register and Grille Finishes:

   a. Aluminum Enamel (A-E): Air-dried aluminum enamel prime finish.
   b. White Enamel (W-E): Semi-gloss white enamel prime finish.
   c. Aluminum Anodize (A-A): Aluminum etched and anodized, covered with clear lacquer finish.

E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering registers and grilles which may be incorporated in the work include, but are not limited to, the following:

F. Manufacturer: Subject to compliance with requirements, provide registers and grilles of one of the following:

1. Anemostat Products Div.; Dynamics Corp. of America.
2. Carnes Co.; Div. of Wehr Corp.
3. Titus Products Div.; Philips Industries, Inc.

2.3 LOUVERS:

A. General: Except as otherwise indicated, provide manufacturer's standard louvers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide louvers that have minimum free area, and maximum pressure drop of each type as listed in manufacturer's current data, complying with louver schedule.

C. Substrate Compatibility: Provide louvers with frame and sill styles that are compatible with adjacent substrate, and that are specifically manufactured to fit into construction openings with accurate fit and adequate support, for weatherproof installation. Refer to general construction drawings and specifications for types of substrate which will contain each type of louver.

D. Materials: Construct of aluminum extrusions, ASTM B 221, Alloy 6063-T52. Weld units or use stainless steel fasteners.

E. Louver Screens: On inside face of exterior louvers, provide 1/2" square mesh anodized aluminum wire bird screens mounted in removable extruded aluminum frames.

F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering louvers which may be incorporated in the work include, but are not limited to, the following:

G. Manufacturer: Subject to compliance with requirements, provide louvers of one of the following:

1. Airline Products Co.
2. Airolite Co.
3. American Warming & Ventilating Inc.
4. Arrow United Industries, Inc.
5. Construction Specialties, Inc.
6. Dowco Corp.
7. Industrial Louvers, Inc.
8. Louvers & Dampers, Inc.
9. Penn Ventilator Co., Inc.
10. Ruskin Mfg. Co.
11. Safe-Air Inc.
12. Snyder (E.G.) Co., Inc.
13. Vent Products Co., Inc.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended function.

B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

C. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling module.

3.3 SPARE PARTS:

A. Furnish to Owner, with receipt, 3 operating keys for each type of air outlet and inlet that require them.

END OF SECTION 15932

SECTION 15975 - CONTROL SYSTEMS EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units that are not supplied with factory-wired controls.

1.3 SYSTEM DESCRIPTION

A. Control system consists of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories connected to controllers to operate mechanical systems according to sequences of operation indicated or specified.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each type of product specified. Include manufacturer's technical Product Data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, installation instructions, and startup instructions.

C. Shop Drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection. Submit damper leakage and flow characteristics, plus size schedule for controlled dampers.

D. Shop Drawings containing the following information for each control system:

1. Schematic flow diagram showing fans, pumps, coils, dampers, valves, and control devices.
2. Each control device labeled with setting or adjustable range of control.
3. Diagrams for all required electrical wiring. Clearly differentiate between factory-installed and field-installed wiring.
4. Details of control panel faces, including controls, instruments, and labeling.
5. Written description of sequence of operation.
6. Trunk cable schematic showing programmable control unit locations and trunk data conductors.
7. Listing of connected data points, including connected control unit and input device.
8. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
9. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
10. Software description and sequence of operation.

E. Wiring diagrams detailing wiring for power, signal, and control systems and differentiating clearly between manufacturer-installed and field-installed wiring.

F. Samples of each type of furnished thermostat cover according to requirements of Division 1.

G. Maintenance data for control systems equipment to include in the operation and maintenance manual specified in Division 1. Include the following:

1. Maintenance instructions and spare parts lists for each type of control device and compressed-air stations.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

H. Field Test Reports: Procedure and certification of pneumatic control piping system.

I. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer specializing in control system installations.

B. Manufacturer Qualifications: Engage a firm experienced in manufacturing control systems similar to those indicated for this Project and that have a record of successful in-service performance.

C. Startup Personnel Qualifications: Engage specially trained personnel in direct employ of manufacturer of primary temperature control system.

D. Comply with NFPA 90A.

E. Comply with NFPA 70.

F. Coordinate equipment selection with Division 16 Section "Fire Alarm Systems" to achieve compatibility with equipment that interfaces with that system.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store equipment and materials inside and protected from weather.

B. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping control devices to unit manufacturer.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.

B. Replacement Materials: Provide one replacement diaphragm or relay mechanism for each unique pneumatic damper motor, valve motor, controller, thermostat, and positioning relay.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Direct Digital Control (DDC) Systems and Components:

a. Alerton Technologies, Inc.
b. American Auto-Matrix, Inc.

c. Andover Controls Corp.
d. Automated Logic Corporation.
e. Barber-Coleman Co.; Environmental Controls.
f. Condyne Technology, Inc.
g. CSI Control Systems International, Inc.
h. Danfoss-EMC, Inc.
i. Demand Technologies, Inc.
j. EDA Controls Corp.
k. Electronic Systems USA, Inc.
l. Functional Devices Inc.
m. G C Controls, Inc.
n. Heat-Timer Corp.
o. Honeywell, Inc.; Commercial Buildings Group.
p. Integrated Energy Controls Corp.
q. Johnson Controls, Inc.; Controls Group.
r. Landis & Gyr Powers, Inc.
s. Luwa Bahnson Inc.
t. Pneuline Controls Co.
u. Robertshaw Controls Co.
v. Scientific-Atlanta; Control Systems Div.
w. Siebe Environmental Controls; Barber-Coleman/Robertshaw Products.
x. SnyderGeneral Corp.
y. Solidyne Corp.
z. Staefa Control System, Inc.
aa. TCS/BASYS Controls.
ab. Teletrol Systems Inc.
ac. Thorn Automated Systems, Inc.
ad. Trane Co. (The); Commercial Systems Group.
ae. Triangle MicroSystems, Inc.

2.2 DIRECT DIGITAL CONTROL (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 back-up power source.

1. Units monitor or control each input/output point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator station.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

a. Global communications.
b. Discrete/digital, analog, and pulse input/output.
c. Monitoring, controlling, or addressing data points.
d. Testing and developing control algorithms without disrupting field hardware and controlled environment.

B. Local Area Networks (LANs): Not less than 60 stations or nodes at minimum 19.2 kB.

1. System Support: Capacity for a minimum of 10 workstations connected to multiuser, multitasking environment with concurrent capability to access DDC network or control units.

C. Software: Update to latest version of software at project completion. Include and implement the following capabilities from the control units:

1. Units of Measure: Inch-pound and SI metric.

2. Load Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, DDC with fine tuning, and trend logging.
3. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
4. Chiller Control Programs: Control function of condenser-water reset, chilled-water reset, and equipment sequencing.
5. Programming Application Features: Include trend point, alarm messages, weekly scheduling, and interlocking.

2.3 CONTROL PANELS

A. Central (Master) Control Panels: Fully enclosed, steel-rack-type cabinet with locking doors or locking removable backs. Match finish of panels and provide multicolor graphic displays, schematically showing system being controlled.

B. Local Control Panels: Unitized cabinet with suitable brackets for wall or floor mounting, located adjacent to each system under automatic control. Provide common keying for all panels.

1. Fabricate panels of 0.06-inch-thick, furniture-quality steel, or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock, with manufacturer's standard shop-painted finish and color.
2. Panel-Mounted Equipment: Temperature and humidity controllers, relays, and automatic switches; except safety devices. Mount devices with adjustments accessible through front of panel.
3. Door-Mounted Equipment: Flush-mount (on hinged door) manual switches, including damper-positioning switches, changeover switches, thermometers, and gages.
4. Graphics: Color-coded graphic, laminated-plastic displays on doors, schematically showing system being controlled, with protective, clear plastic sheet bonded to entire door.

C. Alarm Panels: Indicating light for each alarm point, single horn, ACKNOWLEDGE switch, and TEST switch, mounted in hinged-cover enclosure.

1. Alarm Condition: Indicating light flashes and horn sounds.
2. ACKNOWLEDGE Switch: Horn silent and indicating light steady.
3. Second Alarm: Horn sounds and indicating light steady.
4. Alarm Condition Cleared: System reset and indicating light extinguished.
5. Contacts in alarm panel allow remote monitoring by independent alarm company.

2.4 ANALOG CONTROLLERS

A. Step Controllers: 6-stage or 10-stage type, with heavy-duty switching rated to handle loads, UL listed and operated by electric motor.

B. Electric Outdoor Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range -10 to 70 deg F, and single- or, double-pole contacts.

C. Electronic Controllers: Wheatstone bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.

1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.

D. Fan-Speed Controllers: Solid-state model providing proportional control of motor speed from maximum to minimum of 55 percent (field adjustable). Provide ON-OFF action below minimum fan speed. Design controller to apply full voltage briefly when motor is started to bring motor up to minimum speed rapidly. Equip with filter circuit to eliminate objectionable radio interference.

E. Receiver Controllers: Single- or dual-input models with control-point adjustment direct or reverse acting with mechanical set-point adjustment with locking device, proportional band adjustment, and authority adjustment. Provide proportional control mode.

1. Remote-control-point adjustment shall be plus or minus 20 percent of sensor span, input signal 3 to 13 psi.
2. Proportional band shall extend from 2-1/2 to 40 percent of primary sensor span, authority from 10 to 200 percent of primary sensor span.
3. Suitable for supply air pressure of 18 psi, input signal of 3 to 15 psi, and output signal 0 to 15 psi.

2.5 TIME CLOCKS

A. Seven-day, programming-switch timer with synchronous-timing motor and 7-day dial; continuously charged, nickel-cadmium-battery-driven, 8-hour, power-failure carryover; multiple-switch trippers; minimum of 2 and maximum of 8 signals per day with 2 normally open and 2 normally closed output contacts.

B. Solid-state, programmable time control with 4 separate programs; 24-hour battery carryover; individual ON-OFF-AUTO switches for each program; 365-day calendar with 20 programmable holidays; choice of fail-safe operation for each program; and system fault alarm.

2.6 SENSORS

A. Electronic Sensors: Vibration and corrosion resistant, for wall, immersion, or duct mounting as required.

1. Resistance Temperature Detectors: Platinum.

a. Accuracy: Plus or minus 0.2 percent at calibration point.
b. Wire: Twisted, shielded-pair cable.
c. Insertion Elements in Ducts: Use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
d. Averaging Elements in Ducts: Use where ducts are larger than 9 sq. ft. or where prone to stratification, length as required.
e. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
f. Room Sensors: Match room thermostats, locking cover.
g. Outside Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
h. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

2. Humidity Sensors: Bulk polymer sensor element.
a. Accuracy: 5 percent full range with linear output.
b. Room Sensors: With locking cover matching room thermostats, span of 25 to 90 percent relative humidity.
c. Duct and Outside Air Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

3. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, temperature compensated.

a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
b. Output: 4 to 20 mA.
c. Building Static-Pressure Range: 0 to 0.25 inch wg.
d. Duct Static-Pressure Range: 0 to 5 inches wg.

4. Pressure Transmitters: Direct acting for gas, liquid, or steam service, range suitable for system, proportional output 4 to 20 mA.

B. Pneumatic Transmitters: Vibration and corrosion resistant.

1. Space-Temperature Sensors: Linear-output type, 50 to 100 deg F range, with blank locking covers.

2. Room Return-Air Temperature Sensors: Linear-output type with bimetal sensing element and corrosion-proof construction, 50 to 100 deg F range, designed to be mounted in light troffers.
3. Duct-Mounted or Immersion-Type Temperature Sensors: Range as required for 3- to 15-psi output signal.
4. Temperature Transmitters: Rigid-stem type with bimetal sensing elements except where averaging is required, 3- to 15-psi output signal.

    a. Averaging-Element Sensors: Single- or multiple-unit capillary elements.
    b. Tamperproof Sensors: Corrosion-resistant construction, suitable for mounting on vibrating surface with exposed capillary protected with temperature-compensated armor or protective tubing.
    c. Pipe-Mounted Temperature Sensing Elements: Rod-and-tube type for linear output, with separable wells filled with heat-conductive compound.

5. Space and Duct Humidity Transmitters: 1 pipe, directly proportional, with minimum sensing span of 15 to 75 percent, or 65 to 95 percent relative humidity for 3- to 15-psi output signal, corrosion resistant and temperature compensated, and with factory-calibrated adjustment.
6. Pressure Transmitters: Pressure sensor and transmitter of linear-output type, with range of 0 to 6 inches wg adjustable in 2-inch wg spans, 3- to 15-psi output. One pipe, direct acting for gas, liquid, or steam service.
7. Static-Pressure Transmitters: One pipe, direct acting, double bell, unidirectional with suitable range for expected input, temperature compensated.

    a. Accuracy: 5 percent of full range and 2 percent of full-scale, midrange accuracy.
    b. Output: 3 to 15 psi.

C. Equipment Operation Sensors: As follows:
1. Status Inputs for Fans: Differential-pressure switch with adjustable range of 0 to 5 inches wg.
2. Status Inputs for Pumps: Differential-pressure switch piped across pump with adjustable pressure-differential range of 8 to 60 psi.
3. Status Inputs for Electric Motors: Current-sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.

D. Digital-to-Pneumatic Transducers: Convert plus or minus 12-V dc pulse-width-modulation outputs, or continuous proportional current or voltage to 0 to 20 psi.

E. Valve/Damper Position Indication: Potentiometer mounted in enclosure with adjustable crank-arm assembly connected to damper to transmit 0 to 100 percent valve/damper travel.

F. Water-Flow Switches: Pressure-flow switches of bellows-actuated mercury or snap-acting type, with appropriate scale range and differential adjustment, with stainless-steel or bronze paddle. For chilled-water applications, provide vaporproof type.

2.7 THERMOSTATS

A. Combination Thermostat and Fan Switches: Line-voltage thermostat with 2-, 3-, or 4-position, push-button or lever-operated, fan switch.

1. Label switches "FAN ON-OFF," "FAN HIGH-LOW-OFF," "FAN HIGH-MED-LOW-OFF." Provide unit for mounting on 2-gang switch box.

B. Low-Voltage, ON-OFF Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with either adjustable or fixed anticipation heater.

C. Line-Voltage, ON-OFF Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch type, or equivalent solid-state type, with heat anticipator, integral manual ON-OFF-AUTO selector switch; UL listed for electrical rating.

1. Equip thermostats, which control electric heating loads directly, with OFF position on dial wired to break ungrounded conductors.
2. Dead Band: Maximum 2 deg F.

D. Low-Voltage Modulating Thermostats: Potentiometer, operated by vapor-filled bellows.

E. Remote-Bulb Thermostats: ON-OFF or modulating type, liquid-filled to compensate for changes in ambient temperature, with copper capillary and bulb, unless otherwise indicated.

1. Bulbs in water lines with separate wells of same material as bulb.
2. Bulbs in air ducts with flanges and shields.
3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit, adequately supported.
4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
5. ON-OFF, remote-bulb thermostats with precision snap switches, with electrical ratings required by application.
6. Construct modulating, remote-bulb, potentiometer thermostats so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.

F. Fire-Protection Thermostats: UL listed with fixed or adjustable settings to operate at not less than 75 deg F above normal maximum operating temperature, with the following:

1. Reset: Manual.
2. Reset: Automatic with control circuit arranged to require manual reset at central control panel, with pilot light and reset switch on panel labeled to indicate operation.

G. Pneumatic Room Thermostats: 2-pipe, nonbleed or relay type, fully proportional with adjustable throttling range and tamperproof locking settings, direct or reverse acting as required, factory calibrated at 2.5 psi/deg F. Provide single or dual temperature as required by sequence of operations.

1. Set-Point Adjustment: Minimum 40 deg F set-point adjustment and adjustable dead band.
2. Dual-Temperature Thermostats: Automatic changeover from normal setting to lower unoccupied setting, with manual reset lever to permit return to normal temperatures during unoccupied cycles, with automatic reset to normal during next cycle of operation.

H. Room Thermostat Construction: Manufacturer's standard locking covers.

1. Thermometer: Red-reading glass or spiral bimetal.
2. Guards: Heavy-duty, clear plastic or metal-wire, tamperproof guards.
3. Locking Covers: With only temperature indication visible.
4. Limits: Provide on heating/cooling dual-temperature thermostats, to prevent setting cooling set point below 75 deg F, and heating set point above 75 deg F.

I. Room Thermostat Accessories: As follows:

1. Insulating Bases: For thermostats located on exterior walls.
2. Thermostat Guards: Locking transparent-plastic mounted on separate base.
3. Adjusting Key: As required for device.
4. Aspirating Boxes: Where indicated for thermostats requiring flush installation.

J. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.

K. Airstream Thermostats: 2-pipe, fully proportional, single temperature, with adjustable set point in middle of range and adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.

L. Electric Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.

1. Bulb Length: Minimum 20 feet.
2. Quantity: 1 thermostat for every 20 sq. ft. of coil surface.

M. Electric High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.

1. Bulb Length: Minimum 20 feet.
2. Quantity: 1 thermostat for every 20 sq. ft. of coil surface.

N. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psi, cast housing with position indicator and adjusting knob.

2.8 HUMIDISTATS

A. Pneumatic Room Humidistats: Wall-mounted, proportioning type with adjustable throttling range (5 percent), 30 to 80 percent operating range, cover with finish matching room thermostats with set-point indication.

B. Duct-Mounted Humidistats: Electric insertion, 2-position type with adjustable 2 percent throttling range, 20 to 80 percent operating range, single- or double-pole contacts.

2.9 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or 2-position action.

1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
2. Nonspring-Return Motors for Valves Larger Than 2-1/2 Inches: Size for running torque of 150 inch-pounds and breakaway torque of 300 inch-pounds.
3. Spring-Return Motors for Valves Larger Than 2-1/2 Inches: Size for running and breakaway torque of 150 inch-pounds.
4. Nonspring-Return Motors for Dampers Larger Than 25 sq. ft.: Size for running torque of 150 inch-pounds and breakaway torque of 300 inch-pounds.
5. Spring-Return Motors for Dampers Larger Than 25 sq. ft.: Size for running and breakaway torque of 150 inch-pounds.

B. Pneumatic Valve Operators: Rolling-diaphragm, spring-loaded, piston type with spring range as required. Select operator for full shutoff at maximum pump differential pressure.

C. Pneumatic Damper Operators: Rolling-diaphragm, piston type with adjustable stops and spring return, sized to operate with sufficient reserve power to provide smooth modulating action or 2-position action. Where actuators operate in sequence, provide pilot positioners.

1. Pilot Positioners: Starting point adjustable from 2 to 12 psi and operating span adjustable from 5 to 13 psi.
2. Inlet Vane Operators: High pressure with pilot positioners.

D. Electronic Operators: Select operator for full shutoff at maximum pump differential pressure.

2.10 CONTROL VALVES

A. Control Valves: Factory fabricated, of type, body material, and pressure class indicated. Where type or body material is not indicated, make selection as determined by manufacturer for installation requirements and pressure class, based on maximum pressure and temperature rating of piping system.

B. Globe Pattern: As follows:

1. Up to 2 inches: Bronze body, bronze trim, rising stem, renewable composition disc, screwed ends with backseating capacity repackable under pressure.
2. Over 2 inches: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, renewable seat and disc.
3. Hydronic Systems: As follows:
   a. Rating: Service at 125 psi WSP and 250 deg F.
   b. Internal Construction: Replaceable plugs and seats of stainless steel or brass.
      1) Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom of guided plugs.
      2) Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom of guided plugs.
   c. Sizing: 3-psi maximum pressure drop at design flow rate.
   d. Flow Characteristics: 2-way valves have equal percentage characteristics; 3-way valves have linear characteristics. Select operators to close valves against pump shutoff head.
4. Steam Systems: As follows:
   a. Rating: Service at 125 psi WSP and 250 deg F.
   b. Internal Construction: Replaceable plugs and seats of stainless steel.
      1) Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom of guided plugs.
      2) Double-Seated Valves: Balanced plug; Cage trim provides seating and guiding surfaces for plugs on top and bottom of guided plugs.
   c. Sizing: 10-psi inlet pressure and 5-psi pressure drop.
   d. Sizing: Pressure drop across steam valve at a maximum flow of 80 percent of inlet pressure for low-pressure systems and 42 percent for high-pressure systems.
   e. Flow Characteristics: Modified linear characteristics.

C. Butterfly Pattern: Iron body; bronze, aluminum-bronze, or stainless-steel disc; resilient, replaceable seat for service to 180 deg F wafer or lug ends; extended neck.

1. Rating: Service at 125 psi WSP and 250 deg F.
2. Sizing: 1-psi maximum pressure drop at design flow rate.

D. Terminal Unit Control Valves: Bronze body, bronze trim, 2 or 3 port as indicated, replaceable plugs and seats, union and threaded ends.

1. Rating: Service at 125 psi WSP and 250 deg F.
2. Sizing: 3-psi maximum pressure drop at design flow rate, to close against pump shutoff head.
3. Flow Characteristics: 2-way valves have equal percentage characteristics; 3-way valves have linear characteristics.

4. Operators (2 Position): Synchronous motor with enclosed gear train, dual-return springs, valve-position indicator. Valves spring return to normal position for temperature protection.
5. Operators (Modulating): Self-contained, linear motor, actuator with 60-second full travel, with transformer and single-throw, double-pole contacts.

2.11 DAMPERS

A. Dampers: AMCA-rated, parallel or opposed blade design; form frames from not less than 0.1084-inch galvanized steel with mounting holes for duct mounting; damper blades not less than 0.0635-inch galvanized steel, with maximum blade width of 8 inches.

1. Blades secured 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. Thrust bearings at each end of every blade.
2. Operating Temperature Range: From -40 to 200 deg F.
3. For standard applications as indicated, (as selected by manufacturer's sizing techniques) with optional closed-cell neoprene edging.
4. For low-leakage applications as indicated, provide parallel or opposed blade design (as selected by manufacturer's sizing techniques) with inflatable seal blade edging, or replaceable rubber seals, rated for leakage at less than 10 cfm/sq. ft. of damper area, at differential pressure of 4 inches wg when damper is being held by torque of 50 inch-pounds; test in accordance with AMCA 500.

2.12 AIR SUPPLY

A. Control and Instrumentation Tubing: Seamless copper tubing; Type K, ASTM B 88 or Type ACR, ASTM B 280; with cast-bronze solder-joint fittings, ASME B16.18; or wrought-copper solder-joint fittings, ASME B16.22; soldered or brazed; except forged brass compression-type fittings at connections to equipment.

B. Control and Instrumentation Tubing: Virgin-polyethylene, flame-retardant, nonmetallic tubing, ASTM D 2737, and with flame-retardant harness for multiple tubing; compression or push-on polyethylene fittings.

C. Tank: ASME storage tank with drain test cock, automatic moisture removal trap, tank relief valve, and rubber-cork vibration isolation mounting pads.

D. Duplex Air Compressor: Unit with automatic alternator to equalize running time of each unit, capacity to supply compressed air to temperature control system.

1. Pressure Control: Adjustable electric contacts, set to start and stop both compressors at different pressures.
2. Electrical Alternation Set: With motor starters and disconnect to operate compressors alternately or on time schedule.

E. Simplex Air Compressor: Tank-mounted compressor with capacity to supply compressed air to temperature control system, with starter and disconnect.

1. Pressure Control: Adjustable electric contacts, set to start and stop compressor.

F. Size compressor and tank to operate compressor not more than the following amount of time during a one-hour period:

1. Operating Time: 20 minutes.
2. Operating Time: 30 minutes.

G. Compressor Accessories: Equip with the following:

1. Low-resistance intake air filter.

2. Belt guards.

H. System Accessories: Equip with the following:

1. Air filter rated for 97 percent efficiency at rated air flow.
2. Combination filter/pressure-reducing station or separate filter and pressure-reducing station.

I. Refrigerated Air Drier: Self-contained, refrigerated air drier complete with heat exchangers, moisture separator, internal wiring and piping, and with manual bypass valve.

1. Heat Exchangers: Air to refrigerant coils with centrifugal-type moisture separator and automatic trap assembly.
2. Refrigeration Unit: Hermetically sealed, operating to maintain dew point of 13 deg F at 20 psi, housed in steel cabinet with access door and panel.
3. Accessories: Air-inlet temperature gage, air-inlet pressure gage, ON-OFF switch, HIGH TEMPERATURE light, POWER ON light, refrigerant gage on back, air-outlet temperature gage, air-outlet pressure gage, with contacts for remote indication of power status and high-temperature alarm.

J. Desiccant Drier: Obtains dew point in pneumatic air piping between compressor and tank at least 15 deg F below inlet-air dew point at design conditions.

K. Pneumatic Accessories: As follows:

1. Pressure Gages: Manufacturer's standard, black letters on white background, 2-1/2-inch diameter, flush or surface mounted, with front calibration screw to match sensor, in appropriate units.
2. Instrument Pressure Gages: Manufacturer's standard, black letters on white background, 1-1/2-inch diameter, stem mounted, with suitable dial range.
3. Diaphragm Control and Instrument Valves: 1/4-inch forged brass body with reinforced teflon diaphragm, stainless-steel spring, and color-coded phenolic handle.
4. Gage Cocks: Tee or level handle, bronze, rated for 125 psi.
5. Relays: For summing, reversing, amplifying, highest or lowest pressure selection, with adjustable input/output ratio.
6. Switches: With indicating plates, accessible adjustment, calibrated and marked.

L. Pressure Regulators: Zinc or aluminum castings with elastomeric diaphragm, balanced construction to automatically prevent pressure build-up, and producing flat reduced-pressure curve.

M. Particle Filters: Zinc or aluminum castings with filtration efficiency at rated air flow of 97 percent, quick-disconnect service devices, aluminum or plastic bowl with metal guard and manual drain cock.

N. Combination Filter/Regulators: Zinc or aluminum castings with elastomeric diaphragm, balanced construction to automatically prevent pressure build-up, and producing flat reduced-pressure curve; with threaded pipe connections, quick-disconnect service devices, aluminum or plastic bowl with metal guard and manual drain cock.

O. Airborne Oil Filter: Filtration efficiency of 99.9 percent for particles of 0.025 micrometer or larger particles of airborne lubricating oil.

P. Pressure-Relief Valves: ASME rated and labeled.

1. High Pressure: Size for installed capacity.
2. Low Pressure: Size for installed capacity of pressure regulators and set at 20 percent above low pressure.

Q. Pressure-Reducing Stations: 2 parallel pressure regulators.

2.13 CONTROL CABLE

A. Electronic Cable for Control Wiring: Refer to Division 16 Section "Control/Signal Transmission Media."

B. Optical-Fiber Cable for Control Wiring: Refer to Division 16 Section "Control/Signal Transmission Media."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that conditioned power supply is available to control units and operator workstation. Verify that field end devices, wiring, and pneumatic tubing are installed before proceeding with installation.

3.2 INSTALLATION

A. Install equipment as indicated to comply with manufacturer's written instructions.

B. Install software in control units and operator workstation. Implement all features of programs to specified requirements and appropriate to sequence of operation.

C. Connect and configure equipment and software to achieve the sequence of operation specified.

D. Mount compressor and tank unit on vibration isolation according to Division 15 Section "Vibration Control." Isolate air supply with wire-braid-reinforced rubber hose. Secure and anchor according to manufacturer's recommendations and seismic-control requirements.

1. Pipe manual and automatic drains to nearest floor drain.
2. Supply instrument air from compressor units through filter, pressure-reducing valve, pressure-relief valve, with pressure gages, and shutoff and bypass valves.

E. Verify location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Locate 60 inches above floor.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

F. Provide guards on thermostats in the following locations:

1. Entrances.
2. Public areas.
3. Where indicated.

G. Install damper motors on outside of duct in warm areas, not where exposed to outdoor temperatures.

H. Install labels and nameplates to identify control components according to Division 15 Sections specifying mechanical identification.

I. Install hydronic instrument wells, valves, and other accessories according to Division 15 Section "Hydronic Piping."

J. Install steam and condensate instrument wells, valves, and other accessories according to Division 15 Section "Steam and Condensate Piping."

K. Install refrigerant instrument wells, valves, and other accessories according to Division 15 Section "Refrigerant Piping."

L. Install duct volume-control dampers according to Division 15 Sections specifying air ducts.
M. Install optical-fiber cable according to Division 16 Section "Control/Signal Transmission Media."

3.3 CONTROL AIR PIPING

A. Mechanical Equipment Rooms: Inside mechanical equipment enclosures, in pipe chases, or suspended ceilings with easy access, install the following:

1. Copper tubing with maximum unsupported length of 36 inches, for tubing exposed to view.
2. Polyethylene tubing in metallic raceways or PVC pipe.

B. Terminal single-line connections less than 18 inches in length may be copper tubing, or polyethylene tubing run inside flexible steel protection.

C. Concealed locations, such as pipe chases, suspended ceilings with easy access, install copper or polyethylene bundled and sheathed tubing.

D. In concrete slabs, furred walls, or ceilings with no access, install copper or polyethylene tubing; install polyethylene tubing in EMT or vinyl-jacketed polyethylene tubing.

1. Protect embedded-copper and vinyl-jacketed polyethylene tubing with EMT extending 6 inches above finished slab and 6 inches into slab. Pressure test tubing before and after pour for leak and pinch.
2. Install polyethylene tube in EMT extending 6 inches above floor line; pull tubing into EMT after pour.

E. Purge tubing with dry, oil-free compressed air before connecting control instruments.

1. Bridge cabinets and doors with flexible connections, fastened neatly along hinge side; protect against abrasion. Tie and support tubing neatly.

F. Solder or braze copper tubing, except at instruments or equipment where compression fittings may be used.

G. Number-code or color-code control air piping, except local individual room control tubing, for future identification and servicing of control system.

H. Pressure Gages or Test Plugs: Install on branch lines at each receiver controller and on signal lines at each transmitter, except individual room controllers.

3.4 ELECTRICAL WIRING AND CONNECTIONS

A. Install raceways, boxes, and cabinets according to Division 16 Section "Raceways, Boxes, and Cabinets."

B. Install building wire and cable according to Division 16 Section "Wires and Cables."

C. Install signal and communication cable according to Division 16 Section "Control/Signal Transmission Media."

1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
2. Install exposed cable in raceway.
3. Install concealed cable in raceway.
4. Bundle and harness multiconductor instrument cable in place of single cables where a number of cables follow a common path.
5. Fasten flexible conductors, bridging cabinets and doors, neatly along hinge side; protect against abrasion. Tie and support conductors neatly.
6. Number-code or color-code conductors, except local individual room controls, for future identification and servicing of control system.

D. Connect electrical components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published

torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening requirements specified in UL 486A.

E. Connect manual reset limit controls independent of manual control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

F. Connect HAND-OFF-AUTO selector switches to override automatic interlock controls when switch is in HAND position.

3.5 FIELD QUALITY CONTROL

A. Pressure test control air piping at 30 psi or 1.5 times the operating pressure for 24 hours, with maximum 5-psi loss.

3.6 COMMISSIONING

A. Manufacturer's Field Services: Provide the services of a factory-authorized service representative to start control systems.

B. Test and adjust controls and safeties.
C. Replace damaged or malfunctioning controls and equipment.

D. Start, test, and adjust control systems.

E. Demonstrate compliance with requirements.

F. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

3.7 DEMONSTRATION

A. Manufacturer's Field Services: Provide the services of a factory-authorized service representative to demonstrate and train Owner's maintenance personnel as specified below.

1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
2. Schedule training with Owner with at least 7 days' notice.
3. Provide operator training on data display, alarm and status descriptors, requesting data, execution of commands, and request of logs. Include a minimum of 40 hours' dedicated instructor time on-site.

END OF SECTION 15975

SECTION 15990 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:

1. Balancing airflow and water flow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
2. Adjusting total HVAC systems to provide indicated quantities.
3. Measuring electrical performance of HVAC equipment.
4. Setting quantitative performance of HVAC equipment.
5. Verifying that automatic control devices are functioning properly.
6. Measuring sound and vibration.
7. Reporting results of the activities and procedures specified in this Section.

B. Related Sections include the following:

1. Testing and adjusting requirements unique to particular systems and equipment are included in the Sections that specify those systems and equipment.
2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

1.3 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.

C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

E. Report Forms: Test data sheets for recording test data in logical order.

F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

K. Test: A procedure to determine quantitative performance of a system or equipment.

L. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.

M. AABC: Associated Air Balance Council.

N. AMCA: Air Movement and Control Association.

O. CTI: Cooling Tower Institute.

P. NEBB: National Environmental Balancing Bureau.

Q. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.4 SUBMITTALS

A. Quality-Assurance Submittals: Within 30 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below.

B. Contract Documents Examination Report: Within 45 days from the Contractor's Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3 of this Section.

C. Strategies and Procedures Plan: Within 60 days from the Contractor's Notice to Proceed, submit 2 copies of the testing, adjusting, and balancing strategies and step-by-step procedures as specified in Part 3 "Preparation" Article below. Include a complete set of report forms intended for use on this Project.

D. Certified Testing, Adjusting, and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.

E. Sample Report Forms: Submit 2 sets of sample testing, adjusting, and balancing report forms.

F. Warranty: Submit 2 copies of special warranty specified in the "Warranty" Article below.

1.5 QUALITY ASSURANCE

A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by either AABC or NEBB.

B. Testing, Adjusting, and Balancing Conference: Meet with the Owner's and the Architect's representatives on approval of the testing, adjusting, and balancing strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of testing, adjusting, and balancing team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel. Provide 7 days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:

    a. Submittal distribution requirements.
    b. Contract Documents examination report.
    c. Testing, adjusting, and balancing plan.
    d. Work schedule and Project site access requirements.

e. Coordination and cooperation of trades and subcontractors.
f. Coordination of documentation and communication flow.

C. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.

D. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing."

E. Testing, Adjusting, and Balancing Reports: Use standard forms from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

F. Testing, Adjusting, and Balancing Reports: Use standard forms from SMACNA's "HVAC Systems--Testing, Adjusting, and Balancing."

G. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards.

H. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

I. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.6 PROJECT CONDITIONS

A. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.7 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 testing, adjusting, and balancing activities.
B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.

C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

A. General Warranty: The national project performance guarantee specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. National Project Performance Guarantee: Provide a guarantee on AABC'S "National Standards" forms stating that AABC will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:

C. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:

1. The certified Agent has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.

1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
2. 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 project record documents described in Division 1 Section "Project Record Documents."

D. Examine Architect's and Engineer's design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data, including fan and pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.

G. Examine system and equipment test reports.

H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

J. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

K. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.

L. Examine plenum ceilings, utilized for supply air, to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

M. Examine strainers for clean screens and proper perforations.

N. Examine 3-way valves for proper installation for their intended function of diverting or mixing fluid flows.

O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

P. Examine open-piping-system pumps to ensure absence of entrained air in the suction piping.

Q. Examine equipment for installation and for properly operating safety interlocks and controls.

R. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices operate 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 2-way valves and 3-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 design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to design values.

S. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.2 PREPARATION

A. Prepare a testing, adjusting, and balancing 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 design conditions for system operations can be met.

3.3 GENERAL TESTING AND BALANCING PROCEDURES

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC national standards and this Section. Or

B. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.

C. 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 the insulation Specifications for this Project.

D. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES

A. Prepare test reports for both fans and outlets. 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 the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing 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.

3.5 CONSTANT-VOLUME AIR SYSTEMS' BALANCING PROCEDURES

A. The procedures in this Article apply to constant-volume supply-, return-, and exhaust-air systems. Additional procedures are required for variable-air-volume, multizone, dual-duct, induction-unit supply-air systems and process exhaust-air systems. These additional procedures are specified in other articles in this Section.

B. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the 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 air-handling unit component.

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. Adjust fan speed higher or lower than design with the approval of the Architect. 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 no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.

C. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design airflows within specified tolerances.

1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

    a. Where sufficient space in submains and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submains and branch ducts to design airflows within specified tolerances.

D. Measure terminal outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or the outlet manufacturer's written instructions and calculating factors.

E. Adjust terminal outlets and inlets for each space to design airflows within specified tolerances of design values. Make adjustments using volume dampers rather than extractors and the dampers at the air terminals.

1. Adjust each outlet in the same room or space to within specified tolerances of design quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 FUNDAMENTAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check expansion tank liquid level.
3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation and set at design flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type, unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.

7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.7 HYDRONIC SYSTEMS' BALANCING PROCEDURES

A. Determine water flow at pumps. Use the following procedures, except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Verify with the pump manufacturer that this will not damage pump. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on the manufacturer's pump curve at zero flow and confirm that the pump has the intended impeller size.
2. Check system resistance. With all valves open, read pressure differential across the pump and mark the pump manufacturer's head-capacity curve. Adjust pump discharge valve until design water flow is achieved.
3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on the pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 5 percent of design.

B. Set calibrated balancing valves, if installed, at calculated presettings.

C. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than design flow.

E. Adjust balancing stations to within specified tolerances of design flow rate as follows:

1. Determine the balancing station with the highest percentage over design flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over design flow and proceeding to the station with the lowest percentage over design flow.
3. Record settings and mark balancing devices.

F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures, including outdoor-air temperature.

G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.8 MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating if high-efficiency motor.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.9 CONDENSING UNITS

A. Verify proper rotation of fans and measure entering- and leaving-air temperatures. Record compressor data.

3.10 TEMPERATURE TESTING

A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of 2 successive 8-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.11 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Verify free travel and proper operation of control devices such as damper and valve operators.

F. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.

G. Confirm interaction of electrically operated switch transducers.

H. Confirm interaction of interlock and lockout systems.

I. Verify main control supply-air pressure and observe compressor and dryer operations.

J. Record voltages of power supply and controller output. Determine if the system operates on a grounded or nongrounded power supply.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.12 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans: Plus 5 to plus 10 percent.
2. Air Outlets and Inlets: 0 to minus 10 percent.
3. Heating-Water Flow Rate: 0 to minus 10 percent.
4. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.13 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article above, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend

changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.14 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-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 the instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to the certified field report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.

D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:

1. Title page.
2. Name and address of testing, adjusting, and balancing Agent.
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 testing, adjusting, and balancing Agent who certifies the report.
10. Summary of contents, including the following:

    a. Design versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

11. Nomenclature sheets for each item of equipment.
12. Data for terminal units, including manufacturer, type size, and fittings.
13. Notes to explain why certain final data in the body of reports vary from design values.
14. 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 with single-line diagrams 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. Terminal units.
6. Balancing stations.

F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data: Include the following:

   a. Unit identification.
   b. Location.
   c. Make and type.
   d. Model number and unit size.
   e. Manufacturer's serial number.
   f. Unit arrangement and class.
   g. Discharge arrangement.
   h. Sheave make, size in inches, and bore.
   i. Sheave dimensions, center-to-center and amount of adjustments in inches.
   j. Number of belts, make, and size.
   k. Number of filters, type, and size.

2. Motor Data: Include the following:

   a. Make and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches, and bore.
   f. Sheave dimensions, center-to-center and amount of adjustments in inches.

3. Test Data: Include design and actual values for the following:

   a. Total airflow rate in cfm.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Filter static-pressure differential in inches wg.
   f. Preheat coil static-pressure differential in inches wg.
   g. Cooling coil static-pressure differential in inches wg.
   h. Heating coil static-pressure differential in inches wg.
   i. Outside airflow in cfm.
   j. Return airflow in cfm.
   k. Outside-air damper position.
   l. Return-air damper position.
   m. Vortex damper position.

G. Apparatus-Coil Test Reports: For apparatus coils, include the following:

1. Coil Data: Include the following:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch.
f. Make and model number.
g. Face area in sq. ft.
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data: Include design and actual values for the following:

a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outside-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig.
n. Refrigerant suction temperature in deg F.
o. Inlet steam pressure in psig.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data: Include the following:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Sheave dimensions, center-to-center and amount of adjustments in inches.

2. Motor Data: Include the following:

a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Sheave dimensions, center-to-center and amount of adjustments in inches.
g. Number of belts, make, and size.

3. Test Data: Include design and actual values for the following:

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data: Include the following:

a. System and air-handling unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft.
g. Design airflow rate in cfm.
h. Design velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

J. Air-Terminal-Device Reports: For terminal units, include the following:

1. Unit Data: Include the following:

a. System and air-handling unit identification.
b. Location and zone.
c. Test apparatus used.
d. Area served.
e. Air-terminal-device make.
f. Air-terminal-device number from system diagram.
g. Air-terminal-device type and model number.
h. Air-terminal-device size.
i. Air-terminal-device effective area in sq. ft.

2. Test Data: Include design and actual values for the following:

a. Airflow rate in cfm.
b. Air velocity in fpm.
c. Preliminary airflow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final airflow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data: Include the following:
a. System and air-handling unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data: Include design and actual values for the following:

   a. Airflow rate in cfm.
   b. Entering-water temperature in deg F.
   c. Leaving-water temperature in deg F.
   d. Water pressure drop in feet of head or psig.
   e. Entering-air temperature in deg F.
   f. Leaving-air temperature in deg F.

L. Instrument Calibration Reports: For instrument calibration, include the following:

1. Report Data: Include the following:

   a. Instrument type and make.
   b. Serial number.
   c. Application.
   d. Dates of use.
   e. Dates of calibration.

3.15 ADDITIONAL TESTS

A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

END OF SECTION 15990

TABLA DE COTIZAR

SUBASTA FORMAL NÚM. 23J-01850

RENOVACIÓN DEL SISTEMA DE AIRE CENTRAL DEL EDIFICIO 7 DEL HOSPITAL DE PSIQUIATRÍA GENERAL DR. RAMÓN FERNÁNDEZ MARINA DE SAN JUAN, ADSCRITO A LA ADMINISTRACIÓN DE SALUD MENTAL Y CONTRA LA ADICCIÓN DEL GOBIERNO DE PUERTO RICO

Partida	Descripción	% Preferencia	Precio	Garantía	Término de Entrega
Chiller 70 tonelada #1					
1	Remplazo de todos los sensores y transduce (temperatura, ambiental, flujo de agua, refrigeración y otros)				
2	Remplazo de toda la cablería de los sensores				
3	Remplazo de un (1) compresor				
4	Remplazo de los aceites y filtros de todos los compresores				
5	Descontaminar el sistema de refrigeración				
6	Remplazo de un (1) fan motor				
7	Limpieza profunda de coil y chiller				
8	Programación del Chiller (sistema de control)				

TABLA DE COTIZAR

SUBASTA FORMAL NÚM. 23J-01850

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Partida	Descripción	% Preferencia	Precio	Garantía	Término de Entrega
9	Chequeo y mantenimiento general del chiller				
10	Programación general y start - up				
11	Acondicionamiento de frame de metal				
12	Acondicionamiento de aislamiento de agua helada				
Chiller 70 toneladas #2					
13	Remover y Reemplazar Chiller 70 Toneladas . Ver detalles en las especificaciones.				
6 Unidades manejadoras de aire TRANE					
14	Remover y Reemplazar AHU 2,290 C.F.M . Ver detalles en las especificaciones.				
15	Remover y Reemplazar AHU 4,225 C.F.M . Ver detalles en las especificaciones.				

TABLA DE COTIZAR

SUBASTA FORMAL NÚM. 23J-01850

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Partida	Descripción	% Preferencia	Precio	Garantía	Término de Entrega
16	Remover y Reemplazar AHU 3,405 C.F.M .Ver detalles en las especificaciones.				
17	Remover y Reemplazar AHU 4,020 C.F.M . Ver detalles en las especificaciones.				
18	Remover y Reemplazar AHU 7,000 C.F.M . Ver detalles en las especificaciones.				
19	Remover y Reemplazar AHU 2,650 C.F.M . Ver detalles en las especificaciones.				
Habitaciones de manejadoras de aire TRANE					
20	Habitación #1 Preparar y Pintar 9 x 11 – 12 ½ Alto. Ver detalles en las especificaciones.				
21	Habitación #2 Preparar y Pintar 9 x 11 – 12 ½ Alto.Ver detalles en las especificaciones.				
22	Habitación #3 Preparar y Pintar 8 ½ x 10 ½ – 12 ½ Alto . Ver detalles en las especificaciones.				

TABLA DE COTIZAR

SUBASTA FORMAL NÚM. 23J-01850

RENOVACIÓN DEL SISTEMA DE AIRE CENTRAL DEL EDIFICIO 7 DEL HOSPITAL DE PSIQUIATRÍA GENERAL DR. RAMÓN FERNÁNDEZ MARINA DE SAN JUAN, ADSCRITO A LA ADMINISTRACIÓN DE SALUD MENTAL Y CONTRA LA ADICCIÓN DEL GOBIERNO DE PUERTO RICO

Partida	Descripción	% Preferencia	Precio	Garantía	Término de Entrega
23	Habitación #4 Preparar y Pintar 14 ½ x 7 – 12 ½ Alto . Ver detalles en las especificaciones.				
24	Habitación #5 Preparar y Pintar 14 ½ x 7 – 12 ½ Alto . Ver detalles en las especificaciones.				
25	Habitación #6 Preparar y Pintar 12 x 7 – 12 ½ Alto . Ver detalles en las especificaciones.				
Bombas de Agua					
26	Remover y Reemplazar 2 Bombas de Agua . Ver detalles en las especificaciones.				
Allowance					
27	Allowance		**$25,000.00**		
		Total $			

Término de Entrega: _____