Mechanical Training

John Brean, P.E.
Mechanical Plans Engineer

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Overview

- Code Resources
- Mechanical and Gas Piping Plan Review Checklist
- Special Inspection and Observation
- Items on Civil Drawings, APP 4.01 Requirements
- Items on Architectural Drawings
- Common Mechanical Projects
- Common Mechanical Code Items
- Questions

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Code Resources

- 2018 International Mechanical Code (IMC) with City of Phoenix amendments
- 2018 International Fuel Gas Code (IFGC) with City of Phoenix amendments
- City of Phoenix Mechanical and Fuel Gas Checklists
- IMC and IFGC 2018 Code Commentary *(As Reference Only, Not Code)*
- City of Phoenix Mechanical and Fuel Gas Amendments area located at:

(https://www.phoenix.gov/pdd/codes-ordinances

ICC Web Site: www.iccsafe.org
Support: 1-888-422-7233, ext. 33822
e-mail: support@ecodes.biz
Electronic Media Store: www.ecodes.biz

ICC Code Interpretation
Support: 1-888-422-7233 x4444

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Mechanical Plan Review Checklist

City of Phoenix
PLANNING & DEVELOPMENT DEPARTMENT

Plan Review Checklist
Mechanical

MECHANICAL DRAWINGS

Sealed by a mechanical engineer registered in the State of Arizona (if applicable).

2012 International Mechanical Code with city of Phoenix Amendments (IMC).

- ☐ Site plan documenting location of project.
- ☐ Complete Mechanical floor plan for the entire project area IBC 107.2.1
- ☐ Mechanical energy conservation code compliance for HVAC equipment, duct insulation, controls, economizers, pipe insulation IECC C403.
- ☐ Mechanical layout (A/C units, air-handlers, ducts, diffusers, etc.) IMC 303, 304, 306, 308, 603.
- ☐ Mechanical equipment listings, specifications and weights IMC 301.
- ☐ Cooling load calculations IMC 312.
- ☐ Outside air ventilation calculations IMC 401, 402, 403, Table 403.3.
- ☐ Air-balance schedule IMC 403, 501.4.
- ☐ Air-balance report required to be submitted to Inspector (note on plans) IMC 403.7.
- ☐ HVAC equipment condensate disposal IMC 307.
- ☐ Independent exhaust systems and discharge IMC 501.2, 501.3.
- ☐ Exhaust airflow rates based on Table 403.3 IMC 403.
- ☐ Battery charging ventilation systems IMC 502.4, 503.1, PFC 608.
- ☐ Clothes dryer exhaust systems IMC 504.
- ☐ Commercial cooking grease exhaust systems IMC 506, 507, 508, PFC 609.
- ☐ Hazardous exhaust ventilation systems IMC 510.
- ☐ Make-up air for exhaust systems [sizes and locations] IMC 504.5, 505.2, 508, 510.5.5.

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Contact Planning & Development at (602) 262-7811 voice or (602) 534-5500 TTY.

- ☐ Duct detector automatic shutoff of HVAC systems in excess of 2,000 cfm IMC 606.
- ☐ HVAC duct detector audible/visual alarms and trouble lights IMC 606.4.
- ☐ HVAC automatic shutoff test report required to be submitted to Inspector IMC 606.5.
- ☐ Fire/smoke damper location and specifications IMC 607, IBC 717.
- ☐ Boilers, water heaters and pressure vessels IMC 1001, IBC 1015.3.
- ☐ Refrigeration systems including walk-in freezers/coolers, machinery rooms and mechanical chiller systems IMC 1101, PFC 606, IBC 509.4, Table 509, IBC 1015.4, 1015.5.
- ☐ Hydronic piping system layouts, materials, sizing IMC 1201.
- ☐ Solar water heating systems for space heating/cooling, domestic hot water heating, swimming pool or process heating IMC 1401.
- ☐ Combustion-air openings sizes and locations IMC 701 (other than gas-fired appliances, for gas-fired appliances see International Fuel Gas Code).
- ☐ Identify any mechanical special inspection items (duct detectors, fire and/or smoke dampers, grease duct enclosures) IBC 1705.

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Gas Piping Plan Review Checklist

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Plan Review Checklist
Gas Piping

GAS PIPING

Sealed by a mechanical engineer registered in the State of Arizona (if applicable).

2012 International Fuel Gas Code with city of Phoenix Amendments (IFGC)

- ☐ Provide a scaled site plan clearly documenting project location and gas meter location (IBC 107.2.1)
- ☐ Identify the gas meter as either EXISTING or NEW, documenting capacity.
- ☐ Gas pipe sizing calculations and isometric IFGC 402.3.
- ☐ Provide a floor/roof plan documenting ALL appliances as Existing or NEW and identifying locations IFGC 402.2.
- ☐ Provide a one-line gas pipe, sizing diagram IBC 107.2.1.
- ☐ Detail locations for all gas shutoff valves IFGC 409.
- ☐ Identify ALL second stage regulators (if applicable) IFGC 410.
- ☐ Identify ALL appliance locations and Btu/hr input ratings IFGC 303, 402.
- ☐ Identify the total developed length of piping from the gas meter, or LPG tank, to the most remote appliance on the entire system IFGC 402.
- ☐ Identify the supply pressure and the pressure after each regulator IFGC 402.
- ☐ State the IFGC table number used to size the piping system IFGC 402.4.
- ☐ Identify on the one-line, ALL branch pipe lengths, sizing, and valves IFGC 402.3.
- ☐ Identify ALL gas pipe materials and piping installation requirements, i.e., underground, building wall, roof, etc. IFGC 403, 404.
- ☐ Specify gas pipe support method and spacing IFGC 407.
- ☐ Address gas appliance combustion air and venting IFGC 304, 503.
- ☐ Identify requirements for specific appliances IFGC 601

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Special Mechanical Inspection

City of Phoenix
PLANNING & DEVELOPMENT DEPARTMENT

Special Inspection Certificate
Mechanical/Plumbing

POST AT JOB SITE WITH PERMIT
(General Requirements and Instructions on the backside of form)

TO BE COMPLETED BY REGISTERED DESIGN PROFESSIONAL IN RESPONSIBLE CHARGE		
Project Name:	Project Address:	Permit No. Plan Log No.
Project Owner/Owner's Agent Name:	Mailing Address:	Phone No.
Registered Design Professional of Record Name:	Mailing Address:	Phone No.
Firm Name:	Email Address:	Fax No.

I hereby affirm that I am familiar with the design of this project and have been designated by the Owner/owner(s) Agent as the registered design professional in responsible charge for implementing the Mechanical and/or Plumbing Special Inspections Program required by the City of Phoenix Building Construction Code Sections 110.3.10 and 1704. I have determined that the types of work checked below require Mechanical and/or Plumbing Special Inspection. I understand and agree to inform the project owner, the contractor(s), and the special inspector(s) about all the Mechanical and/or Plumbing Special Inspection Program requirements and limitations, including that the Special Inspector(s) must be independent third-party individual(s) or Registered Design Professional(s) and shall not be the installing contractor(s).

(Seal, Sign, and Date)

YES	NO ✓	TYPES OF WORK REQUIRING SPECIAL MECHANICAL/PLUMBING INSPECTION (Attach Supplement if Necessary)	QUALIFIED SPECIAL INSPECTOR NAME AND ID NUMBER
		Duct Smoke Detectors	
		Fire and Smoke Damper Operation	
		Installation of Grease Duct Enclosure	
		Smoke Control	
		Medical Gas and Vacuum Systems	
		Ambulatory Care Facilities	

All special inspection reports were reviewed and found to be in conformance with the approved construction documents.

Registered Design Professional

In responsible charge_____ _____
Signature **Date**

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- Duct smoke detectors, IMC 606.2
- Fire and smoke damper operation, IMC 607.2
- Installation of grease duct enclosure, IMC 506.3.11
- Smoke control, IMC 513.3
- Medical gas systems, IPC 1202.1
- Ambulatory Care Facilities, IMC 407.1

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Items for On-Site Civil Design

- **On site civil water and sewer plans to include:**
  - Points of Connection from public main to private property
  - Lot Lines depicting properties
  - Identify all streets whether public or private
  - Water and sewer pipe sizing and flow calculations
  - Site Piping Plan
  - Clearances, Horizontal and Vertical
  - Pipe Inverts
  - Pipe Slope
  - Pipe Lengths
  - Pipe Materials
  - Manhole RIM elevations vs. finish floor elevation. Verify need for backwater valve
  - Domestic and landscape water meter sizes and location
  - Water backflow assembly size and location
  - Grading and Drainage, storm water final location
  - If pool, clubhouse, cabana, or recreation room is provided, determine number of plumbing fixtures required per IPC 403.
  - ***Verify civil and plumbing design coordinate, i.e., both must state the same meter, water and sewer line***

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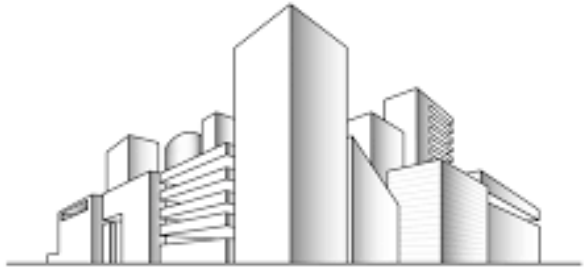
Items for On-Site Civil Design Continued

APP 4.01 (Aquifer Protection Program)

- Private sewer systems that serve multiple private users where *the individual users assume ownership and discharge more than 3,000 gallons per day* must comply with the requirements of the Arizona Administrative Code, Title 18, Chapter 9, Article 3, Part E. (Single family homes, townhouses, condominiums apply. Apartments do not)
- For detail requirements, see web link below (Pages 61 though Page 66) http://apps.azsos.gov/public_services/Title_18/18-09.pdf
- Refer to handouts for instructions and documents that must be completed before issuance of permit. https://www.phoenix.gov/pddsite/Documents/dsd_trt_pdf_00601h.pdf
  - Arizona Administrative Sewage Collection Systems,
  - Summary of Aquifer Protection Program,
  - Privately Owned Sewage Collection Disclaimer Letter,
  - Sewer Private Application for Construction, TRT 00210
  - Sewer Private Construction Authorization, TRT 00206S
  - Outline sewer Demand Report,
  - Sewer Low Slope Installation, TRT 00328
  - Water Demand and Sewer Design Flows.
- Provide sewer analysis calculations on drawings. State the average day demand and peak day demand on calculations.
- Provide as-builts after installation showing pipe size, installation, inverts, manholes, and tie-in to public sewer. Submit all required documentation under seal and signature of the Professional Registrant.

Items in Architectural Design

- Drawing index to match number of mechanical and plumbing sheets
- Listing of Approved Building Codes Used
- Minimum plumbing fixtures, required and provided
- Roof drains and coverage areas
- Roof drain connections to site storm collection system
- Plant and equipment layout
- Equipment Plan, Access, and Clearances
- Roof Access detail plans for access ladder. Either exterior or interior ladder, roof hatch
- Fall and Guard rail protection for personnel accessing and repairing mechanical equipment.
- CO_2 tank location and layout
- Submit approved manufacturer's installation instructions



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Type 1 Grease Hoods and Exhaust Ductwork, IMC 506, 507

- Type I cooking hoods shall be installed where the cooking appliance produces grease or smoke as a result of the cooking process, IMC 507.2
  - Exception: Type I hood is not required for an electric appliance that contains 5 mg/m^3 of grease or less at exhaust flow rate of 500 cfm per UL 710B listing
- Commercial kitchen grease hood and exhaust system compliance details shall be included on Registrant's sealed construction drawings
- Provide exhaust air calculations for grease hood and exhaust fan, IMC 507.5
- Makeup air with electrical interlock
- Field-applied and factory-built grease duct assemblies require special inspection per IBC 1705.19 (2018 Amendments)
- Separate Fire Department permit required for fire suppression system on Type I hoods
- Provide dimension floor plan and elevation of exhaust outlets showing clearances to building openings and air intakes, IMC 506.13.3

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Type 1 Grease Hoods and Exhaust Ductwork Continued

- Exhaust outlets shall be located not less than 10 feet horizontally from parts of the same or contiguous buildings, adjacent buildings and adjacent property lines and shall be located not less than 10 feet above the adjoining grade level. Exhaust outlets shall be located not less than 10 feet horizontally from or not less than 3 feet above air intake openings into any building, IMC 506.3.13.3.
- Type I hoods shall have a clearance to combustibles of 18 inches, IMC 507.2.6
- Contractor to provide duct wrap submittal to architect or engineer and City of Phoenix Building Inspector for review and approval prior to installation.
- Field applied duct wrap must **Only be ASTM E2336** listed, IMC 506.3.11.2.
- Factory built grease duct assemblies shall be listed and labeled for use as a commercial kitchen grease duct assembly in accordance with UL 2221.
- For field-applied and factory-built grease duct assemblies, all through-penetrations to meet ASTM E814 or UL 1497, IMC 506.3.11.3
- All horizontal sections of grease duct shall be sloped back to the hood at a minimum of 1/4 inch per foot or 2 percent, IMC 506.3.7.

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Type 1 Grease Hoods and Exhaust Ductwork Continued

- Grease fans shall be provided with UL 762 listing for grease.
- Type I hoods shall have listed grease filters per UL 1046, IMC 507.2.8
- Any revision to grease duct exhaust or makeup air plan must have revised plan with engineer's seal and signature affixed to the revision and placed on site with the original approved permitted drawings for building inspector review.
- Provide sequence of operation of hood supply air and exhaust air, IMC 508.
- Provide sequence of operation when the fire suppression is activated and how it works in conjunction with the supply fan, exhaust fan, and transmit a notification alarm signal to the building automation system, IMC 507.1.1
- Provide performance test results of exhaust hood and supply air after installation to architect or engineer and City of Phoenix Building Inspector, IMC 507.6

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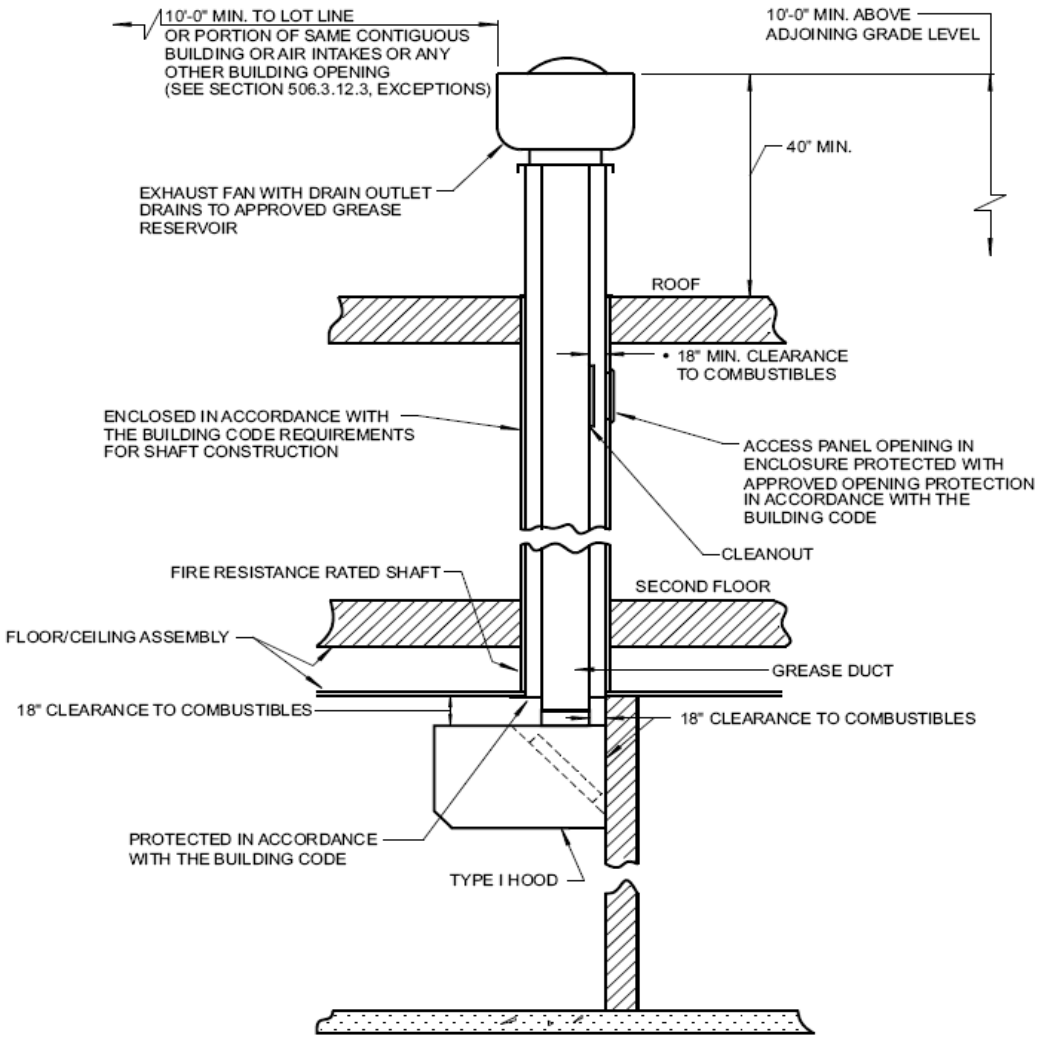
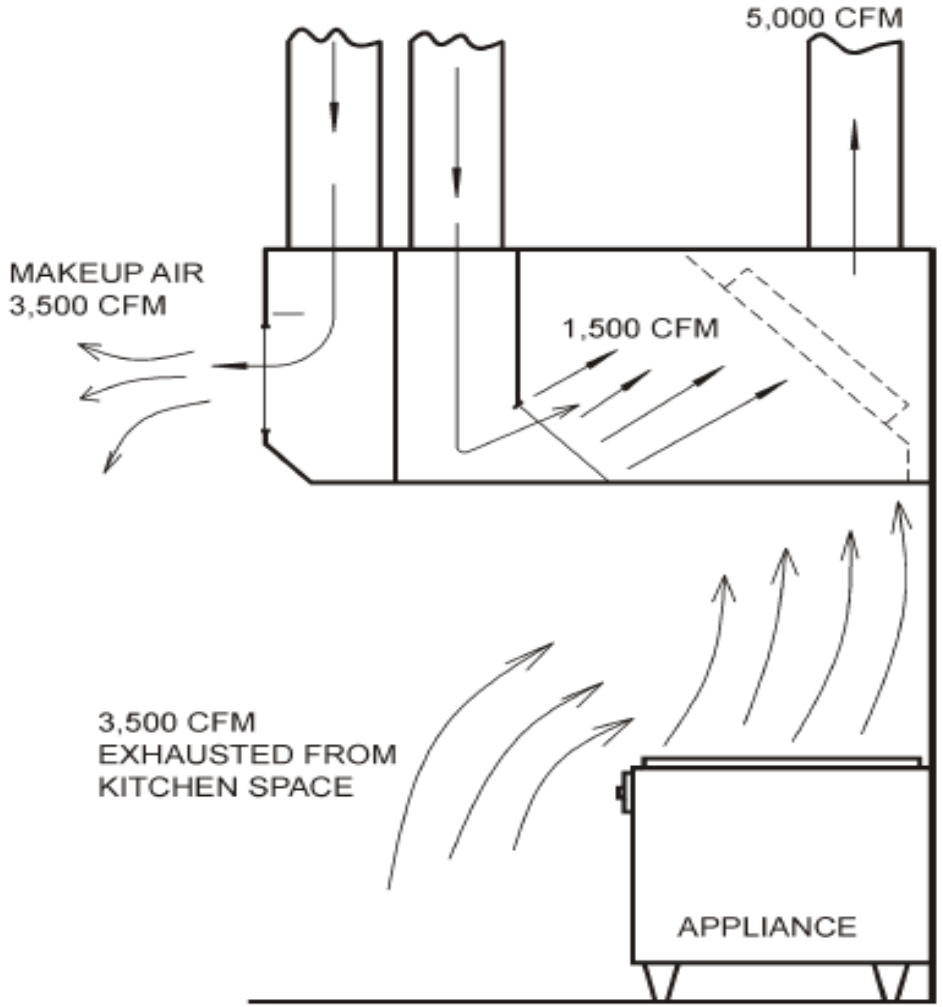
Grease Duct Systems, IMC 506.3 Commercial Kitchen Makeup Air w/Interlocks, IMC 508



For SI: 1 inch = 24.8 mm, 1 foot = 304.8 mm.

Figure 506.3.10(1)
EXHAUST DUCT ENCLOSED BY A VERTICAL SHAFT



For SI: 1 cubic foot per minute = 0.0004719 m^3/s.

Figure 508.1(4)
MAKEUP AIR SUPPLIED TO HOOD

Grease Exhaust and Ductwork Fire

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Type II Kitchen Hoods, IMC 507.3

- Dishwashers and appliances that produce heat or moisture and do not produce grease or smoke
- Appliances that produce products of combustion and do not produce grease or smoke
- If the heat and moisture is accounted for in the HVAC design, then a Type II hood is not required
- Spaces without Type II hoods require a minimum ventilation rate of 0.70 cfm per square foot

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Refrigerator Monitoring

- Refrigeration Machinery room and monitoring required when amount of refrigerant in any circuit exceeds allowable quantities from Table 1103.1
- Group A1 and B1 designed per IMC 1105, IMC 1104.2
- Group A2, B2, A3, B3 per IMC 1105 and 1106, (IMC 1104.2)
- Separate requirements for walk-in coolers, freezers, and industrial spaces per IMC 1104.2.2

- Site Plan and vicinity map with project address and project contact

- Emergency ventilation calculation, IMC 1105.6.3.2
- Q = 100*(G)^1/2
- Q: Air flow in cubic feet per minute (CFM)
- G: Design mass of refrigerant in pounds in largest system in machinery room
- Location of vapor refrigeration detectors IMC 1105.3, IFC 606.8
- Floor plan showing location of an identified switch of the glass break type for off-only control for all refrigerant equipment, IMC 1106.5.1 and IFC 606.9.1
- Floor plan showing all exits and location of an identified switch of the glass break type for on only control for all ventilation equipment, IMC 1106.5.2 and IFC 606.9.2.
- Automatic emergency stops, IFC 606.10.2

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Refrigerator Monitoring Continued

- Material specifications for refrigerant pipe and tubing, IMC 1107.5
- Exhaust ventilation and makeup air ductwork plan, IMC 1105.6.1 and 1105.6.2
- Floor plan showing separation of refrigerant machinery rooms from other portions of building and layout of plant equipment, IMC 1104.2 and 1105.1
- Refrigerant monitoring equipment schedule, IBC 107.2
- Warning and Plant Notification Signs at each door entering and exiting the chiller room for:
  a. Emergency Signage (IFC 606.7)
  b. Refrigerant Monitor Contact ---
  c. In the event of refrigerant leak, Notify ---
  d. Procedure after a refrigerant leak ---
- Certified testing agency to perform test and inspections and prepare test reports, IBC 107.2
- Contractor shall provide owner and local authority having jurisdiction a certified document stating all monitoring, ventilation, and alarm systems are installed in compliance with all IMC, IFC, NEC, and NFPA codes and that all required acceptance tests have been completed.
- Submit final copies to architect or engineer and City of Phoenix Building Inspector, IBC 107.2. Mount approved inspection certificate at main control panel location.
- Separate Fire Department permit required

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Paint Spray Areas

- Provide Material Data Safety Sheet (MSDS) for all fluid that is being used in the paint booth and parts cleaning areas.
- Provide maximum amount of flammable fluids in building and permitted in a control area. This quantity is for the entire floor area, IFC 5003.1.1.1, note d and UBC Table 415.2.5.1.
- Provide spray booth separation by a minimum distance of 3 feet or by a floor/ceiling partition having a minimum fire resistance rating of 1 hour, NFPA 33, 5.3
- Show clearances from spray booth openings showing Class I, Div. II clearances, NFPA 33 figure 6.5.2 and figure 6.5.4, see attached showing clearances.
- Spray booth to be protected by an automatic fire extinguishing system. Provide fire protection design for spray booth, IFC 2404.4.
- Provide fire sprinklers in exhaust ductwork over 75 square inches or 10 inch in diameter, NFPA 91.
- Provide protection of fire sprinklers from residue of spraying operations, IFGC 2405.5.2
- Provide fire extinguishers for spraying areas, IFC 2404.4.1
- Metal parts of spray booths, exhaust ducts, and piping systems conveying Class 1 or Class II shall be electrically grounded per NFPA 70, IFC 5003.9.5

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Paint Spray Areas Continued

- Install grounding to all electrically conductive objects in the area such as flammable cabinets, paint containers, and wash cans, IFC 5003.9.5.
- Provide exhaust ductwork and make-up air plan for spray booth, IBC 107.2
- Hazardous exhaust systems shall be independent of other types of exhaust systems, IMC 510.4
- Spray Booth ventilation shall be designed during operations so that the velocity across the booth opening is not less than 100 feet per minute. Provide calculation on plan showing Spray Booth ventilation is Q (Min) =100 x Area, IFC 2404.7.3
- Provide plan showing exhaust ductwork conveying flammable vapors, discharge shall be 30 feet from combustible walls and operable openings into building, 10 feet above grade, IMC 501.3.1
- Mechanical ventilation shall be kept in operation at all times during spraying operations and time thereafter to allow vapors to be exhausted. Spraying equipment shall be interlocked with the ventilation of the flammable vapor areas such that spraying operations cannot be conducted unless the ventilation system is in operation, IFC 2404.71.
- Exhaust fan motor shall be explosion proof. The rotating element of the exhaust fan shall be nonferrous or non-sparking construction, IFC 2404.7.7
- Provide paint spray booth and exhaust fan submittal to architect or engineer for review and approval prior to order, IBC 107.2.
- Provide final air balance report of paint spray booth exhaust system and make-up air after installation to architect or engineer and City of Phoenix Building Inspector, IBC 107.2.

Compressed Air Systems

- Site Plan and vicinity map with project address and project contacts
- Name of compressible fluid, flow rate, and operating pressure
- Floor plan of all compressed air equipment and piping
- Structural piping support plans
- Piping schematic of entire compressed air system
- Sequence of operation between all compressed air systems and supporting equipment
- Equipment schedules, pipe and fitting schedules, valve schedules
- Welding and Testing requirements and procedures
- Electrical power plan, one-line diagrams, and wiring schematics
- Power panel schedules
- Automatic emergency stops for air compressors

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Underground Natural Gas Piping (Master Meter System)

"Master Meter System" means physical facilities for distributing gas within a definable area where the operator purchases metered gas from a provider to provide gas service to two or more buildings. To obtain approval for a master meter installation, plans must be submitted to the following:

1. Arizona Corporation Commission: 1200 W. Washington St.
   Phoenix, AZ 85007
   (602) 542-4251
2. Local Authority Having Jurisdiction

The following must items must be included in the construction drawings prior to issuance of permit:

a. Approved codes and standards that are used to enforce this installation which are:
   (1) 2018 Uniform Plumbing Code or 2018 International Plumbing Code
   (2) 2018 International Fuel Gas Code
   (3) NFPA 54 – National Fuel Gas Code
b. Site Plan – Gas Piping
c. Site Plan – Gas Venting
d. Natural Gas Pipe Sizing Calculations, showing flow rate & pipe size at each location
e. Material Specifications
f. Construction Specifications

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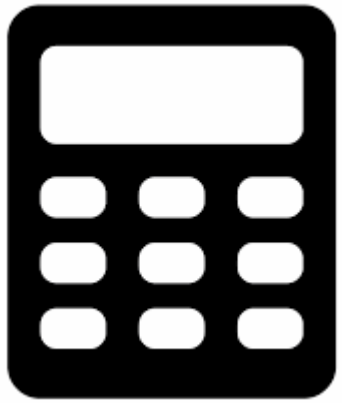
Natural Gas Piping Calculation

- Provide natural gas calculations showing:
  - Complete piping schematic from gas meter to final point of connection
  - Total gas flow in CFH
  - Total equivalent length of pipe
  - Gas flow delivered to each required delivery point
  - Pipe size at each required delivery point
  - Pipe materials and specifications
  - Reference natural gas pipe sizing chart in 2018 IFGC



- It is the responsibility of the design engineer to obtain written confirmation from Southwest Gas Corporation that 2 PSI gas or greater will be provided to this facility. This cannot be confirmed by the contractor after the permit is issued, IFGC 402

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Clothes Dryer Exhaust Ducts in Multi-Family Housing

- Dryer ducts shall not be installed within fire-resistance rated assemblies without protection. Dampers are not allowed in dryer ducts, IMC 504.
- Alternative code compliant methods:
  - Construct a non-rated drop ceiling or soffit and run the dryer ducts horizontal to an exterior wall without penetrating rated assemblies.
  - Build a rated shaft around each dryer duct that enters rated assemblies.
  - Section 504.10 *Common exhaust systems for clothes dryers located in multistory structures*, contains provisions for conveying exhaust from multiple clothes dryers through multiple stories (sub-ducts)
  - **Most Easiest**, Place clothes dryers against outside walls to avoid long duct runs and penetrations of other than exterior walls.
- Each vertical riser shall have a cleanout, IMC 504.3

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Storage and Use of Liquid Carbon Dioxide (CO_2), IMC 502.20

- Fire Department permit required for controls, sensors, alarms, piping and accessories
- Mechanical ventilation equal to 1 cfm/ft^2 floor area
- System shall operate continuously unless alternate designs are approved by the Fire Marshal
- Exhaust intake within 12 inches of floor
- Makeup air required and exhaust outlet shall be located where it will not allow for dangerous accumulation
- In CO2 closet, show ventilation calculations, design, shutdown procedure, and emergency notification procedure
- Ventilation exemption if located in outdoor non-enclosed spaces approved by Fire Marshal

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Swimming Pools

- Fire Provide civil or plumbing site drawing showing point of connections for sewer, water, and natural gas piping.
- Test all sewer, water, and natural gas piping prior to backfill and cover. Call for inspection and witness testing prior to concealing water, sewer, natural gas piping.
- Backwash? Show routing and line size of backwash to approved indirect waste collection system, IBC 107.23.1
- Pool Heater? Show point of connection and line size from existing gas line and routing to new pool heater. Provide natural gas piping calculation, IFGC 402.4
- Pool Drain? Show drain line size, routing from pool drain to an approved waste collection system, IBC 107.2. Provide the required water service with backflow protection and sewer to serve swimming pool.
- Provide natural gas calculation showing complete system piping schematic from gas meter to final point of connection, total gas flow in CFH, total equivalent length of pipe, gas flow delivered to each required delivery point, pipe size at delivery point, pipe materials and specifications, reference natural gas pipe sizing chart in 2018 IFGC.
- Show how boiler room is ventilated and how provide calculation for combustion air, IFGC 304.1

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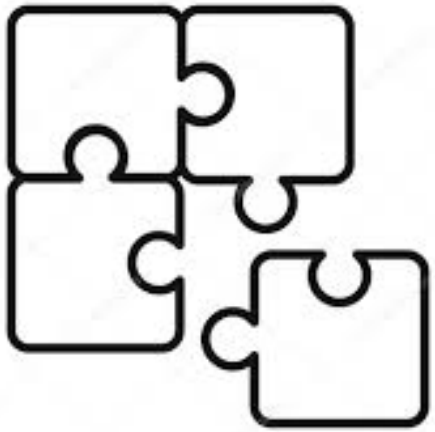
Common Mechanical Issues

- Heating & Cooling Load Calculations
- Ventilation Requirements and Rates
- Natural Ventilation
- Outdoor Air Example
- Outdoor Air Minimum Supply Exception
- Battery Charging Areas
- Duct Mounted Smoke Detection Systems
- Ducts and Air Transfer Openings
- Penetration of Shaft Enclosures
- Combustion Air and Dilution Air



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IMC 312 Heating and Cooling Load Calculations

- Design loads for sizing HVAC systems & equipment required in plan submittal
- Methods based on ASHRAE/ACCA Standard 183 or approved equivalent computation procedure
- Use cooling load weather data for Phoenix, AZ
- Also required by the Energy Conservation Code, IECC 403.2.1

HEATING & COOLING LOAD SUMMARY							
System Name	System Equipment	Calculated Cooling Load		Provided Cooling		Heating Load	
		Sensible MBH	Total MBH	Sensible MBH	Total MBH	Calculated MBH	Provided MBH
Central Plant	Water Chiller	589.1	615.5	610.1	645.2	367.2	390.1

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IMC 401 and 403 Ventilation Requirement and Rates

- Required for every occupied space
- Natural or mechanical ventilation
- When air infiltration in a dwelling unit is less than 5 ACH, which is required by IECC R402.4.1.2, the dwelling unit shall be ventilated by mechanical means
- Use IMC Table 403.3.1.1 for occupant density, ventilation and exhaust flow rates
- Occupant load exception for approved statistical data
- Breathing zone outdoor airflow rate based on number of occupants and *net occupiable floor area*
- Adjustments made based on equipment efficiency
- Nail salons require a source capture system

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IMC 402 Natural Ventilation

- Windows, louvers, doors, or other openings
- Openable area to the outdoors 4% of the floor area, IMC 402.2
- Adjoining spaces opening 8% of interior room floor area or 25 sq. ft., minimum openable area to outdoors based on total floor area being ventilated, IMC 402.3
- Restricted to residential with operable openings and not subject to IECC R402.4.1.2 or commercial with permanent openings

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IMC 403 – Required Outdoor Air Example

Outside Air Calculations						
AHU System	**Area Served**	**Area (sf)**	**IMC 403.3 Occupant Load (persons per 1000 sf)**	**People OSA (CFM/person)**	**Area OSA (CFM/sf)**	**Breathing zone outdoor airflow (cfm)**
AHU-1	Classrooms (9+)	1500	35	10	0.12	705
AHU-2	Office	2500	5	5	0.06	213
AHU-3	Conference room	800	50	5	0.06	248
AHU-4	Cafeteria	2800	100	7.5	0.18	2604

- Assuming a single zone system for each AHU and distribution effectiveness of 1.0, then the zone outdoor airflow is the same as the breathing zone outdoor airflow

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IMC 403.2 – OSA Requirements and Engineered Systems

In IMC 403.2, the code provides an exception for outdoor supply air (OSA) minimum requirements stating, “where the *registered design professional* demonstrates that an engineered ventilation system will prevent the maximum concentration of contaminants, the minimum rate shall be reduced in accordance with an engineered design.”

ASHRAE 62.1, Ventilation for Acceptable Indoor Air Quality, Section 6.3.1.4, Design Approaches, note c, provides an option to determine minimum outdoor air requirements. OSA must be validated by contaminant monitoring and measurement. An acceptable approach and monitoring levels are listed in Appendix B.

If submitting for OSA reduction permit, the engineer must provide on design drawings:

- OSA calculations per IMC 403.3 requirements and OSA calculations per ASHRAE 62.1 Appendix D, Table D-1, for an engineered design system for comparisons.
- A chart for contaminant levels and a statement adhering to contaminant levels as stated in ASHRAE 62.1 Appendix B
- Professional Mechanical Engineer seal and signature on each design sheet
- A note stating that the contractor to submit shop drawings for OSA equipment, control monitoring, and alarms notification for engineer review. Engineer to return submittals to contractor prior to equipment order and start of installation.
- A note stating after installation, contractor to provide copies of indoor air quality report (IAQ) to engineer and building official for review and approval prior to occupancy. Report must state IAQ meets all requirements and is in complete compliance with ASHRAE 62.1, Section 6.3, and Appendix B.

IMC 502.3 – Battery-Charging Areas

- Goal is to prevent hydrogen buildup
- Most common building-related systems
  1. Powered industrial trucks and equipment
  2. Stationary storage battery systems
  3. Uninterrupted power supply (UPS) systems
- Provide exhaust and make-up air calculations for battery charging systems
- Provide sequence of operations and supervision for battery exhaust system if exhaust system becomes inoperable
- For stationary systems regulated by the Fire Code, IFC 1206.2.11.3, the space shall provided with ventilation, IMC 502.4. Ventilation shall be designed to provide air movement across all parts of the floor or ceiling
  1. Ventilation shall limit maximum concentration of flammable gas to 25% of the lower flammable limit (25% LFL) "or" for hydrogen, limit the maximum concentration to 1.0% of the total volume of the room, IMC 502.4.1
  2. Continuous ventilation rate of 1 cubic foot per minute per square foot of floor area, IMC 502.4.2
  3. Mechanical systems shall be monitored and supervised by an *approved* central, proprietary or remote station service or shall initiate and an audible and visual signal at a constantly attended on-site location, IMC 502.4.3

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We don’t need ventilation for these batteries

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IMC 606 Duct Mounted Smoke Detection Systems

- Required in air distribution systems downstream of the air filters and ahead of any branch connections in systems greater than 2,000 cfm
- Provide detail and sequence of operation and shutdown for ac units over 2000 cfm with smoke detectors, IMC 606.2.1
- Supervision required, audible and visual signals
- Smoke detectors to connect to fire alarm system and activate a supervisory alarm upon activation, IMC 606.4.1
- Testing by third party agency or Special Inspector
- Exceptions
  - System incapable of spreading smoke beyond space
  - Area smoke detection system present
- Provide a completed and sealed Special Inspection Certificate for testing of duct mounted smoke detectors, IMC 606.

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IMC 607 – Ducts and Air Transfer Openings

- Detail fire barriers, fire partitions, corridors/smoke barriers, shaft enclosures, horizontal assemblies, and rated assemblies on the plans
- Fire and smoke damper placement shall be detailed on the mechanical plans
- Damper ratings and installation details are required
- Smoke damper actuation methods to be noted
- Special Inspection is required

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IMC 607.5.5 – Penetrations of Shaft Enclosures

- Fire and smoke dampers are both required for penetrations of rated shaft enclosures
- Exception #1 omits need for fire damper at shaft penetrations when
  - steel exhaust subducts extend at least 22 inches vertically with continuous airflow upward to the outside

- Exception #2 omits need for smoke dampers at shaft penetrations, in Group B and R occupancies, when
  - steel exhaust subducts extend at least 22 inches vertically with continuous airflow upward to the outside and the exhaust fan at the upper terminus is provided with standby power

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2018 IFGC 304 – Combustion, Ventilation and Dilution Air

- IMC provides combustion air methods for fuel-burning appliances other than gas-fired appliances
- The requirements for gas-fired appliances are found in the 2018 International Fuel Gas Code (IFGC)
- The following options are allowed, and the method used must be clearly detailed on the plans
    1. Indoor combustion air (50 ft^3/1,000 Btu/hr)
    2. Outdoor combustion air
        a. Two permanent openings method
        b. One permanent opening method
    3. Combination indoor and outdoor
    4. Engineered installations
    5. Mechanical combustion air supply

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Questions?

John Brean, P.E.
Mechanical Plans Engineer
602-534-6498
john.brean@phoenix.gov

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