

ENGINE PIPING

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1. GENERAL

1.1 This section covers the general requirements for the installation of piping for internal combustion engines. These requirements are listed as a guide, as requirements in the job specification and on job drawings will supersede those in this section.

1.2 Piping arrangements and method of installing the piping and tank shall be approved by the customer to be sure that the installation meets local requirements.

1.3 Piping layouts and materials shall be as specified on job drawings. Options are not acceptable without engineering approval.

1.4 The customer normally provides fuel, water and exhaust piping terminating within 15 feet of the engine. Fuel storage facilities are normally provided by the customer. The customer also should normally arrange for installation of remote radiators.

NOTE: On occasions portions of this work, by agreement with the Area, may be specified as an installer's responsibility in job specifications or papers. In such cases, the job supervisor should not proceed with this work until he has determined through lines of supervision that the Area Office has agreed to accept this responsibility.

1.5 Where pipe larger than 4 inches in diameter is to be installed, special tools are required which are not normally provided for the installer. If, for any reason, the installer is unable to subcontract this type of work, it will be necessary for him to rent the tools and equipment required.

CAUTION: R-3055 Plastic Safety Goggles should be worn when threading pipe or conduit.

1.6 Reference should be made to Handbook 18, Section 13, Thread Cutting on Pipe or Conduit, for detail information on cutting of pipe threads.

2. INSTALLING EQUIPMENT

2.1 Tools

Code	Description	Use
267 Kit	Pipe Threading Kit	All
R-3035	Set, Copper Tubing	Fuel
R-1541	24" Pipe Wrench (Two)	Air
R-1557	Trowel, Pointing, 4"	Exh
R-2195	Pliers, Side-Cutting 8"	Exh
R-3034	Gloves, Acid Resistant	Exh
R-3055	Goggles, Safety, Plastic	Exh

2.2 Materials

Code	Description
R-4097	Compound, Anti-Seize Thread, High Temperature
R-3111	Compound, Permatex #1 (May purchase locally)
R-3050	Compound, Non-Hardening
R-3280	Paint, Aluminum, High Heat
Obtain Locally	Lead, Red or White
Obtain Locally	Paint, Alkyd, Water Base
Obtain Locally	Tri-Sodium Phosphate

3. EXHAUST SYSTEM

3.1 General Engineering Information

3.11 Provide for expansion of 1-1/2 inches per 50 feet of bare pipe or 3 inches per 50 feet of insulated pipe. (Insulated pipe refers to diesel exhaust only)

3.12 Exhaust system condensate drain piping shall have a continuous slope toward drains of at least 1 inch in 20 feet and shall have no pockets or traps.

3.13 Gasoline engine exhaust pipes or silencers shall not be insulated. If necessary to insulate at a conduit crossover because of insufficient clearance from bare pipe, insulate the conduit and not the exhaust. The conduit may also be protected by the use of Transite as covered in Paragraph 3.411.

3.14 Gasoline engine exhaust pipes shall be run on the outside of the building or in a chimney flue which is used for no other purpose.

3.15 A separate exhaust line shall be installed for each engine.

3.16 Diesel engine exhaust lines may be run on the outside of buildings or into an inside flue or chimney equivalent to 8 inches of brickwork with a standard flue lining, or 6 inches of reinforced concrete, with no woodwork within 4 inches of the flue or chimney. This exhaust may also be connected to any flue, chimney or stack in use or previously used for a medium or high heat appliance, including building boilers, provided the chimney or stack is in good condition and impervious to exhaust gases.

3.17 Exhaust pipes shall not be imbedded in walls or floors.

3.2 Spring Hangers

3.21 A solid hanger shall be used to support the upper end of a vertically-mounted flexible exhaust section.

3.22 A spring hanger is required to support the engine end of a horizontally-mounted flexible exhaust section. The spring hanger should be adjusted to the value listed in Table A.

3.3 Clearances to Combustible Materials

3.31 Exhaust piping shall not run closer than 9 inches to combustible materials such as wooden lath and plaster partitions.

3.32 Bare silencers shall not be closer than 12 inches to woodwork or combustible materials. If the silencer is insulated with 3 inches or more of Thermobestos Pipe Insulation, the clearance from the outside of the insulation to the woodwork or combustible material may be reduced to 3 inches.

3.4 Clearances from Bare Exhaust to Conduit

3.41 Twelve (12) inches clearance is required when conduit parallels the bare exhaust line or silencer at the side or below. Refer to Figure 1. Conduit may be anywhere from Position X-Y and clearance A must be 12 inches. Twelve inches clearance is also required when the conduit crosses at right angles to the exhaust line or silencer, either below or at the side.

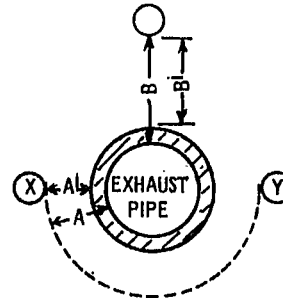


FIG. 1 CLEARANCES FROM EXHAUST TO CONDUIT (PAR. 3.4, 3.5)

3.411 Where the conduit crosses the exhaust line or silencer, the spacing may be reduced at the crossover to the clearances shown in Paragraph 3.5, if the exhaust line or silencer or the conduit is insulated for a distance of 12 inches (on gasoline engines, only the conduit should be insulated) from the center of the crossing. The insulating material should be installed as specified in Paragraph 4. An alternate means of insulating the crossing is to provide a piece of Transite at least 1/4 inch thick between the runs, the Transite extending 12 inches from the midpoint of the crossing in all directions. Asbestosite A or Marinite 36 may be used as alternates to Transite. All are Johns-Manville products.

3.42 Thirty-six (36) inches clearance is required when conduit runs above the bare exhaust line or silencer either parallel to or crossing at right angles. This is clearance B in Figure 1.

TABLE A

SPRING HANGER ADJUSTMENT

Engine KS No.	KW Rating	Pipe Size	Grinnell 268A Hanger No.	Grinnell Type A		Adjust to (See Note)
				Fig. 98	Fig. B-268	
15899	350	6"	3			150
15777	500 & 550	10"	6			400
19583 & 20523	30	3"		1		105
19584 & 20524	45	3"		1		105
19585 & 20525	75	3-1/2"			2	130
19586 & 20526	115	4"			3	150
19587 & 20527	115	5"			4	190

NOTE: The above adjustment values are for standard minimum height of 7'-9". If the center line of the exhaust line is higher than the minimum standard, add the additional pipe weight. EXAMPLE: 4" pipe weighs approximately 11# per foot.

3.5 Clearances from Insulated Exhaust to Conduit

NOTE: The following clearances are from the outside of the insulation to the conduit.

3.51 One (1) inch clearance is required when conduit parallels insulated exhaust line or silencer at the side or below. This is A1 in Figure 1 for conduit anywhere from Position X-Y. The one inch clearance is also required when the conduit crosses at right angles to the insulated exhaust line or silencer either below or at the side.

3.52 Twelve (12) inches clearance is required when conduit runs parallel to an insulated exhaust pipe or silencer above the center line (X-Y). This is B1 in Figure 1.

3.53 Three (3) inches minimum clearance (B1) is required when the conduit crosses above an insulated exhaust pipe or silencer.

3.6 Flexible Section

3.61 Job drawings show the position for the flexible section. It will be horizontal for some engines and vertical for others.

3.62 The flexible section shall be installed without strain or distortion.

NOTE 1: This is extremely important on long flexible exhaust sections furnished with 10 psi or 50 psi diesel engine-alternators. These may be considerably out-of-line from end-to-end and must be rotated for the best fit to the engine exhaust. They should also extend to within 1/16 inch of the engine exhaust flange in the vertical direction. This will prevent excessive pressure on the engine exhaust manifold when flange bolts are tightened. It may be necessary to provide spacers to reduce a large gap, or, it may be necessary to have the flex section rebrazed in a machine shop to line up properly with the engine exhaust connection.

NOTE 2: This is also important on flexible exhaust sections between 200 KW turbine-alternators and the floor-mounted silencer. It may be necessary to provide steel plates under the front feet of the set to prevent the flex section from being distorted, as the exhaust opening in the silencer is slightly higher than the opening in the engine enclosure.

3.63 Flexible exhaust sections for diesel engines shall not be insulated even if the rest of the system is insulated.

3.64 The flexible exhaust section for the 200 KW turbine-alternator is insulated in accordance with the ED-drawings for the set.

3.7 Silencers

3.71 Silencers shall be adequately supported and arranged to be easily removed for cleaning or other maintenance.

3.72 The arrow on a silencer indicates direction of flow. Install the silencer so that the direction of flow is away from the engine.

3.8 Painting

3.81 Paint should be applied only on a surface that has been carefully wire brushed and free from rust, oil, dirt, grease and loose paint.

3.82 Engine exhaust pipe surfaces should be cleaned with an alkaline solution to remove all traces of grease, oil or other surface contaminants before and after removing loose paint, rust and mill scale. An alkaline solution may be prepared by mixing five ounces of tri-sodium phosphate and three ounces of detergent to one gallon of hot water.

CAUTION: Wear R-3055 Safety Goggles and R-3034 Acid Resistant Gloves when preparing and using the alkaline solution.

3.83 Remove loose paint and metallic oxide coatings such as rust and mill scale on engine exhaust pipe surfaces by chipping, scraping or wirebrushing. Existing paint in good condition shall be sanded to roughen its surfaces.

CAUTION: Wear R-3055 Safety Goggles when chipping, scraping or wirebrushing.

3.84 Bare exhaust pipe and silencers for diesel and gasoline engines (within the building) shall be painted in accordance with information on associated ED-drawings. If the ED-drawing does not call for a specific material, paint with one coat of R-3280 Aluminum Paint. Certain paints may require curing by running the engine.

3.85 Painting of exterior exhaust systems is normally arranged for by the customer. These systems will be painted in accordance with information on the associated ED-drawing.

3.9 Joints

3.91 All screw joints shall be made up with R-4097 High Temperature Anti-seize Thread Compound.

4. EXHAUST SYSTEM INSULATION

NOTE: All joints in the exhaust system shall be tight before applying insulation. This is accomplished by running the engine for at least an hour and then tightening all bolts while the system is hot.

4.1 General

4.11 Gasoline engine exhaust systems shall not be insulated.

4.12 Flexible diesel engine exhaust sections shall not be insulated. Expansion joints shall not be insulated.

4.13 When insulating diesel engine exhaust systems, cut out insulation to clear silencer support bars, inspection plates and condensate drains.

4.2 Materials

4.21 Acceptable insulating materials are usually specified on associated ED-drawings. Johns-Manville Thermobestos for 1200°F or Owens-Corning Kaylo Pipe Insulation may be used (Kaylo is rated for 1200°F). Super Fire Felt (900°F) and Roll Fire Felt (1000°F) are not acceptable materials.

4.22 Diesel engine exhaust pipe and silencers up to 14 inches in diameter are insulated with two layers of material, each layer 1-1/2 inches thick. The outer layer is equipped with a canvas jacket. Iron wire (#16AWG) is furnished to secure the inner layer and bands (4 per 3 foot long section) are furnished to secure the outer layer.

4.23 Quad sections may be used in some cases for diesel engine exhaust pipe and silencers over 14 inches in diameter, in accordance with the Job Specification. Detailed installing information is usually not shown on ED-drawings but the Line Engineer has complete ordering information and should detail installing information under Installer's Notes.

4.24 The insulating material used for the 200 KW turbine shall be two 2-1/2 inch thicknesses of Thermobestos (1200°F) or Kaylo. The inner layer is applied with the #16AWG iron wire and the outer layer has canvas on the exterior and aluminum bands are applied to secure the outer layer.

4.25 The exhaust system and silencer, within the building, of the 750 KW turbine, require two 1-3/4 inch thick layers of Thermobestos (1200°F) or Kaylo.

4.26 Insulating Cement is also required. This material will be J-M No. 301 Insulating Cement for a Thermobestos installation, or, Owens-Corning 110 Insulating Cement for a Kaylo Installation.

4.3 Method of Applying Insulation

4.31 Apply the first layer of insulation, butting the joints of each section together. Band this layer with the 16 gauge iron wire, placing the bands about one foot apart.

4.32 The wire bands will consist of three turns of wire on pipe up to and including 6 inches diameter and four turns on larger pipes. Twist loop ends together, bend them over and hammer into the insulation so as to leave no projection.

4.33 Butt the sections of the outer layer tightly together, making the joints occur at a different point than those of the inner layer.

4.34 Band the outer layer with the Pipe Insulation Bands. The bands are placed 1 foot apart unless otherwise indicated.

4.341 A banding tool can be used to apply the bands, or, if such a tool is not available, the clips can be crimped on the bands with the R-2195 Side Cutting Pliers. After the clip is crimped in place, cut off any excess band with the pliers.

4.35 When applying the bands, smooth out the cloth flap on the insulation. This flap will be cemented down with an application of 301 or 110 Insulating Cement after the bands have been applied.

4.36 When the pipe is 4" or smaller, insulate the fittings and the valve bodies with a direct application of 301 Finishing Cement. Make the application as thick as surrounding insulation and blend it in with the surrounding insulation, using the trowel.

4.37 When pipe size is 5 inches and larger, cover the fittings and the odd shapes with pieces of the insulation, and wire in place with the 16 gauge wire. After building up layers of pieces, apply 301 or 110 Insulating Cement over the layers and make the cement coat blend in with surrounding insulation.

4.38 If required to finish over the bands on the outer layer apply a 1/4 inch thick coat of 301 or 110 Insulating Cement.

4.4 Painting Exhaust Pipe Insulation

4.41 The insulation may be painted with a water base alkyd paint which should be obtained locally.

5. COOLING SYSTEM

5.1 Joints

5.11 All joints in water lines shall be made up with R-3050 Non-Hardening Sealing Compound.

5.12 To make up a screw joint first coat the male threads with the R-3050 compound and then thread the sections together.

5.2 Flexible Sections

5.21 The flexible sections shall be installed without distortion or strain.

5.3 Leaks

5.31 The water piping shall not leak solutions of water and rust inhibitor or antifreeze.

5.4 Condensation

5.41 If there is likelihood of damage to apparatus or material by water condensing and dripping from the pipes, cover them with sectional asbestos pipe covering, painted to match the surrounding walls or engine parts.

5.5 Painting

5.51 Water piping shall have a finish to match the surrounding walls or engine parts unless specified otherwise by the telephone company.

6. FUEL SYSTEM

6.1 Joints

6.11 All screw joints in fuel lines shall be made up with R-3111

Permatex #1. After this hardens the joints shall be given a coat of shellac.

NOTE: A mixture of litharge and glycerine may be used instead of R-3111 if the latter is not available. To prepare this mixture simply stir the two ingredients together until a fairly thick paste is obtained.

6.12 To make up a screw joint, first coat the male threads with the R-3111 compound and then thread the sections together.

6.2 Flexible Sections

6.21 The flexible sections shall be installed without distortion or strain. The fuel line flexible sections should not sag more than 1/2 the outside diameter of the flexible hose. This is to eliminate the formation of a trap within the fuel line flexible section.

6.3 Leaks

6.31 There shall be no leaks in the fuel piping.

6.32 Leaks in the suction (supply) line are sometimes difficult to detect. See individual section or manufacturer's manuals for methods. Appreciable quantities of air in fuel overflow lines may indicate a leak in the suction line.

6.4 Liquidometer

6.41 To install the liquidometer refer to the manufacturer's instruction booklet.

6.42 If leaks are detected in the flexible cable attached to the liquidometer gauge, the cable must be repaired by the manufacturer.

6.5 Figure 2 shows assembly of parts located within floor-mounted fuel tank.

7. AIR STARTING PIPING

7.1 Screw joints in the high pressure line should be made up using white lead on male threads.

7.2 In order to minimize leaks, use the R-1541 24 inch pipe wrenches to assemble the joints.

7.3 The pressure in these systems may run as high as 300 pounds per square inch. It is important that pipe thread be continuous. Any piece of pipe with a broken thread should not be used.

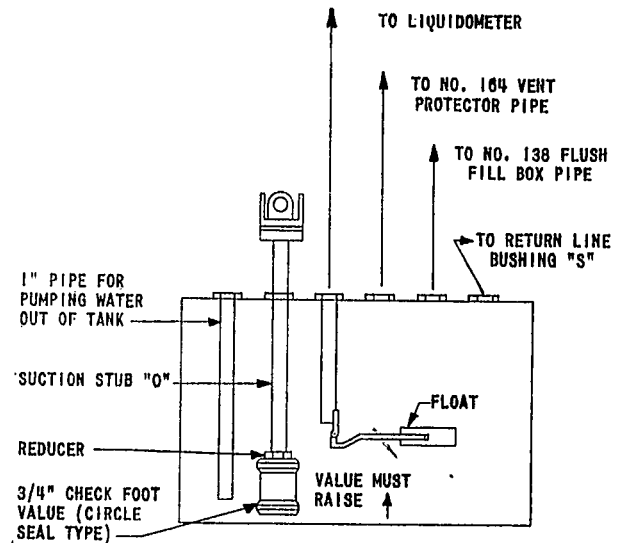


FIG. 2 ASSEMBLY OF PARTS IN FLOOR MOUNTED FUEL TANK (PAR. 6.5)

➔ Arrowed lines indicate new or changed information.

Manager, Product Engineering

Vertical line at side of paragraphs indicates requirements.

Reason for Reissue:

- (1) To remove R-4095 High Heat Gray Paint.
- (2) To expand information on insulating exhaust system.