Specification for Indirect Type Oilfield Heaters

API SPECIFICATION 12K
EIGHTH EDITION, OCTOBER 2008

EFFECTIVE DATE: APRIL 1, 2009

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Upstream Segment

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1 Scope

This specification covers minimum requirements for the design, fabrication, and shop testing of oilfield indirect type fired heaters used in the production of oil, gas, and their associated fluids. They are usually located at some point on the producing flow-line between the wellhead and pipeline. Heater components covered by this specification include the pressurized coils, the shell, heater bath, firetube and the firing system.

Termination of a heater coil shall be at the first bevel when coils are furnished beveled for welding, or the face of the first fitting when fittings are furnished as the inlet or outlet connection to the coil. All fittings and valves between the inlet and outlet of the coil are to be considered within the coil limit.

Heaters outside the scope of this specification include steam and other vapor generators, reboilers, indirect heaters employing heat media other than water solutions, all types of direct fired heaters, shell-and-tube bundles or electrical heating elements, and coils operating at temperatures less than –20°F.

2 References

API Specification 5L, *Specification for Line Pipe*

API Specification 6A, *Specification for Wellhead and Christmas Tree Equipment*

API Specification 12B, *Specification for Bolted Tanks for Storage of Production Liquids*

API Recommended Practice 14E, *Recommended Practice for Design and Installation of Offshore Production Platform Piping Systems*

ASME B2.1 [1], *Standard Welding Procedure Specification (WPS)*

ASME B16.11, *Forged Steel Fittings, Socket-Welding and Threaded*

ASME B16.5, *Pipe Flanges and Flanged Fittings*

ASME B31.3, *Process Piping*

ASME B36.10, *Welded and Seamless Wrought Steel Pipe*

ASME *Boiler and Pressure Vessel Code, Sections V and IX—Welding and Brazing Qualifications*

ASTM A36 [2], *Standard Specification for Carbon Structural Steel*

ASTM A53, *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless*

ASTM A105, *Standard Specification for Carbon Steel Forgings for Piping Applications*

ASTM A106, *Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service*

ASTM A194, *Standard for Medium Carbon Alloy Steel Nuts*

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[1] ASME International, 3 Park Avenue, New York, New York 10016, www.asme.org.
[2] ASTM International, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania 19428, www.astm.org.

ASTM A234, *Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service*

ASTM A283, *Low and Intermediate Tensile Strength Carbon Steel Plates of Structural Quality*

ASTM A285, *Standard Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength*

ASTM A307, *Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength*

ASTM A515, *Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service*

ASTM A516, *Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service*

ASTM A570, *Standard Test Method for Water Absorption of Plastics*

ASTM B569, *Standard Specification for Brass Strip in Narrow Widths and Light Gage for Heat-Exchanger Tubing*

NACE MR 0175 [3], *Sulfide Stress Corrosion Cracking Resistant Metallic Materials for Oil Field Equipment*

3 Definitions

Heating of oil and gas streams close to the wellhead is normally done for the purpose of preventing hydrate or wax formation. Wellstream heating may also be done to prevent liquids from condensing in the gathering line or to facilitate subsequent fluid separations.

An indirect type oilfield heater employs a water solution, maintained below the boiling point, as the heating medium for the purpose of heating the process fluids in the coils. Refer to Figure 1, entitled Typical Indirect Heater Assembly, showing general arrangement of heater components, piping and instrumentation.

3.1
burner system
System for firing the heater designed for the specific fuel to be used (either natural or forced draft design).

NOTE When multiple U-tubes are used, they should be designed to use separate burners, pilots and stacks. The burner system includes the firing accessories. Intake flame arrestors and other optional burner accessories as listed in Annex A may also be included.

3.2
choke
Device to restrict and control the flow rate of well fluids, it may have a positive fixed orifice with removable bean or an adjustable variable orifice, located upstream of the coil, between passes in the coil bundle, or on the coil outlet.

NOTE A submerged or long nose choke may be used with pressure reduction taking place within the water bath to minimize hydrate formation.

3.3
coil area
Heat transfer area and is normally calculated using the outside surface area of the pipe.

[3] NACE International (formerly the National Association of Corrosion Engineers), 1440 South Creek Drive, Houston, Texas 77218-8340, www.nace.org.

3.4
coils
Also referred to as a tube bundle, the device through which fluid to be heated is passed.

NOTE One or more coils which may be typically arranged as a single pass coil, split pass coil, or spiral coil, illustrated in Figure 2. The single pass coil is normally a serpentine pattern with only one flow path. This coil may also be arranged to provide two or more parallel flow paths for reduced pressure drop, but it is still referred to as a single pass coil. The split pass coil may be designed for two pressure ratings, allowing for a choke to be located between the two coil sections. Split pass coils are used when it is necessary to use two heating stages to minimize hydrate formation within the coil. The spiral coil is generally used on smaller heaters and is normally a single pass coil. Multiple coils may be used if more than one well stream is processed in the same heater shell.

3.5
fill connection
Connection on the top of the shell provided with a pressure-vacuum venting device.

NOTE If a water saver is furnished, the fill and vent connection may be integral with it.

3.6
firebox
Complete assembly consisting of the firetube, mounting flange, intake and stack adaptors.

3.7
firetube
Consisting of one or more U-tubes fired, normally by natural gas, at one end and exhausting through a vertical stack.

NOTE In larger heaters, the firetube may consist of a large diameter first pass firetube and multiple return tubes manifolded into a common stack. The firetube is that portion of the firebox in contact with the heater bath.

3.8
fusion
Melting together of filler material and base material, or of base material only, which results in coalescence.

3.9
heat density
Heat released through the cross section of the firetube, expressed as BTU/hr/in.^{2} of cross sectional area.

3.10
heat flux
Applied to the average transfer rate through the firetube, expressed as BTU/hr/ft^2 of exposed area.

3.11
heater bath
Indirect heating medium, limited to water or water solutions.

NOTE When freezing is possible, ethylene glycol may be added for anti-freeze protection. Other additives to the water bath may include corrosion inhibitors.

3.12
intake flame arrestor
Device placed on the air intake of the firetube to prevent propagation of flame from inside the firetube to the outside atmosphere, consisting of a corrugated aluminum cell mounted in a metal housing which attaches to the firebox.

3.13
linear indication
Closed surface area marking or denoting a discontinuity requiring evaluation, whose longest dimension is at least three times the width of the indication.

3.14
removable
Total component is field replaceable without welder assistance.

3.15
rounded indication
Closed surface area marking or denoting a discontinuity requiring evaluation, whose longest dimension is at least three times the width of the indication.

3.16
shell
Normally a horizontal vessel which contains the coil, firetube and heater bath.

3.17
slag inclusion
Nonmetallic solid material entrapped in weld metal or between weld metal and base metal.

3.18
spark arrestor
Device placed on the exhaust of the stack to prevent sparks from being emitted to the outside atmosphere, consisting of a metallic wire screen attached across the top diameter of the stack.

3.19
stack downdraft diverter
Device attached to the top of the stack designed to reduce the effects of wind currents on the burner system.

3.20
stack flame arrestor
Device placed on the exhaust of the stack to prevent propagation of flame from inside the firetube to the outside atmosphere, normally consisting of a corrugated aluminum or stainless steel cell mounted in a metal housing which attaches to the top of the stack.

3.21
stack rain shield
Device attached to the top of the stack to prevent rain from falling directly into the stack. It may also serve as a stack downdraft diverter.

3.22
undercut
Groove melted into the basic material adjacent to the toe or root of a weld and left unfilled by weld material.

3.23
water saver
Chamber that may be directly connected to the heater shell to permit the shell to be completely filled with water.

NOTE The water in this chamber exists at a lower temperature than the heater bath which reduces evaporation losses. It may also be referred to as an economizer or expansion tank. Its capacity should be sufficient to contain the water expansion between ambient and operating temperatures.

4 Materials

4.1 General

Material to be used in the construction of indirect heaters is listed in this section. When specified by the purchaser, pressure retaining components exposed to hydrogen sulfide shall meet the requirements of NACE MR01 75.

4.2 Coils

Materials for indirect heater coils, including the fuel gas preheat coil if used, shall be seamless pipe conforming to one of the following specifications:

a) API 5L Grade B, seamless;

b) ASTM A53 Grade B, seamless;

c) ASTM A106 Grade B or Grade C, seamless.

4.3 Flanges

Flanges and clamp type connectors shall conform to ANSI/ASME B16.5 or API 6A. Material shall conform to the following specifications:

a) ANSI flanges: ASTM A105;

b) API flanges and clamp type connectors: API 6A;

c) Type API 6B (2,000 psi to 5,000 psi), API Type 4 material;

d) Type API 6BX (10,000 psi), API Type 2 material;

e) Type API 6BX (15,000 psi), API Type 3 material.

4.4 Fittings

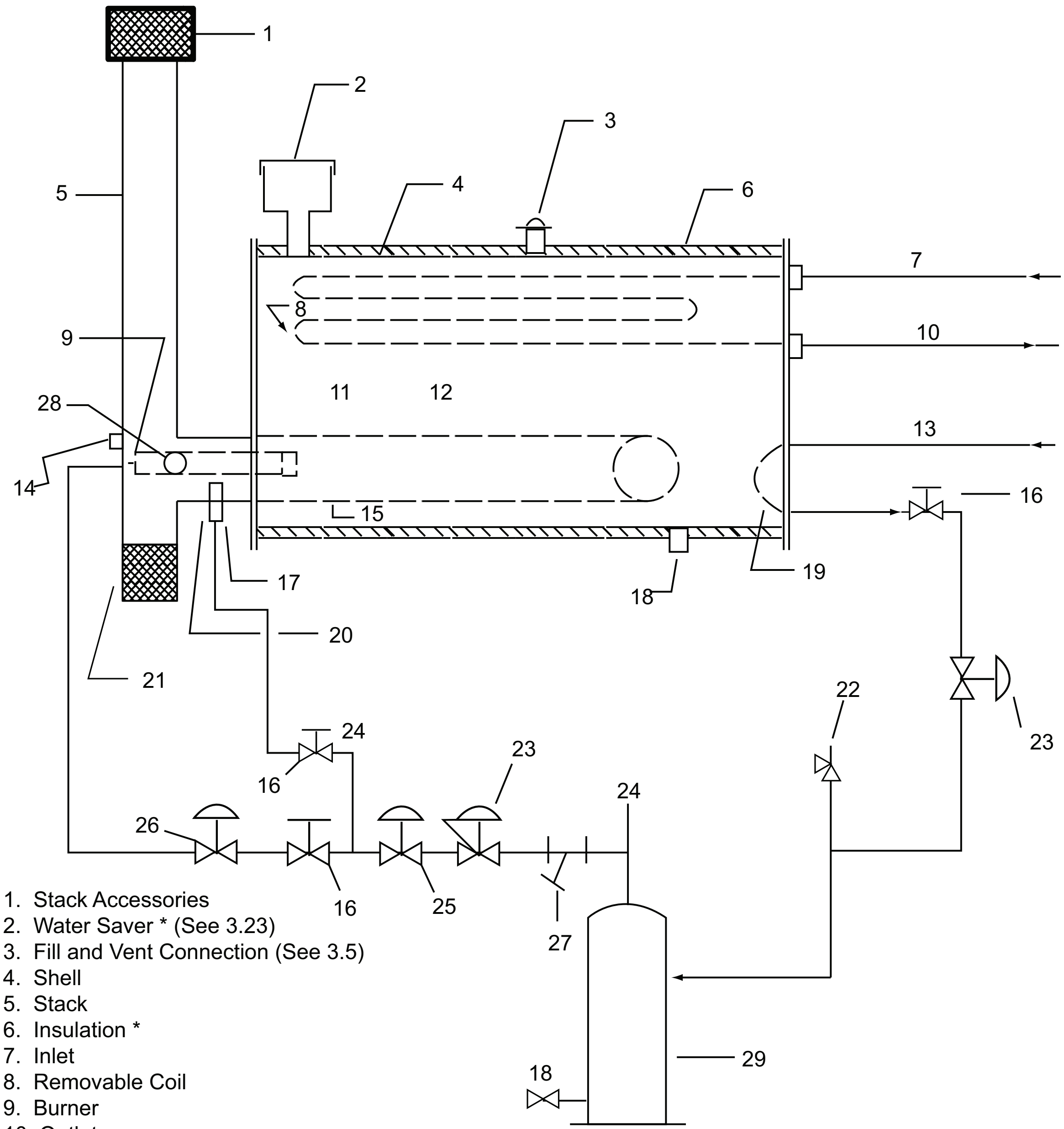
Fittings such as couplings, return bends, ells, tees, etc., shall conform to ASTM A234 Grade WPB or WPC, or to the manufacturer's standard as appropriate. The flow area of return bends, ells, and tees shall not be less than 90% of the flow area of the coil pipe.

4.5 Proprietary Fittings

Material for fittings such as chokes, valves and unions shall conform to the fitting manufacturer's standards. Where components are to be welded, the heater manufacturer shall obtain chemical and mechanical properties for the material sufficient to establish properly qualified welding procedures as required by Section 6.

4.6 Bolting

Bolting for flanges and other pressure retaining connections shall conform to ASTM A193, Grade B7 with nuts conforming to ASTM A194, Grade 2H. Where service conditions require bolting having lower tensile strength, flange working pressure shall be de-rated in accordance with ANSI/ASME B16.5 or API 6A. Bolting for heater shells, stacks, etc., shall conform to Annex A of API 12B or ASTM A307.



1. Stack Accessories
2. Water Saver * (See 3.23)
3. Fill and Vent Connection (See 3.5)
4. Shell
5. Stack
6. Insulation *
7. Inlet
8. Removable Coil
9. Burner
10. Outlet
11. Temperature Controller (TC)
12. Temperature Indicator (TI)
13. Fuel Gas
14. Stack Sample Port *
15. Removable Firetube
16. Hand Control Valve (HCV)
17. Pilot
18. Drain
19. Preheat Coil *
20. Pilot Shutdown Device *
21. Intake Flame Arrestor *
22. Relief Valve (PSV)
23. Pressure-reducing Regulator (PCV)
24. Pressure Indicator (PI)
25. Shut-down Valve (SDV)
26. Temperature Control Valve (TCV)
27. Strainer (STR)
28. Lighting Hole
29. Fuel Gas Scrubber *

* Optional Item

Figure 1—Typical Indirect Heater Assembly

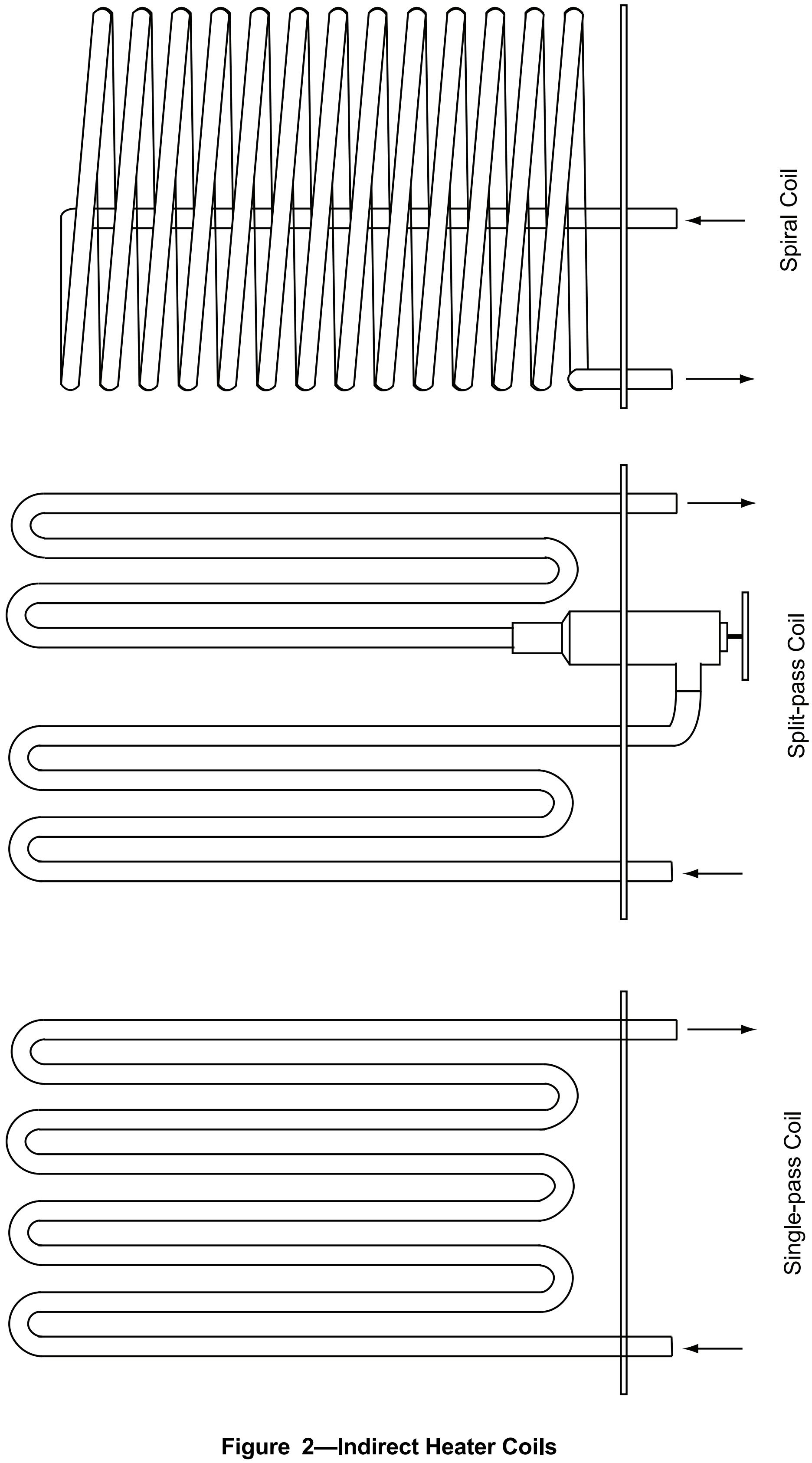


Figure 2—Indirect Heater Coils

4.7 Shells, Firetubes and Stacks

Material for shells, structural supports, firetubes, and stacks shall be selected from applicable ASTM or API specifications for weldable carbon steel.

Materials suitable for these applications include but are not limited to the following.

a) Plate: ASTM A36; ASTM A283 Grade C; ASTM A285 Grade C; ASTM A515; ASTM A516.

b) Pipe: API 5L Grade B; ASTM A53 Grade B; ASTM A106 Grade B. Pipe may be either seamless or welded.

c) Sheet: ASTM B569; ASTM A570.

d) Shapes: ASTM A36.

5 Design

5.1 Coil Design

The minimum design requirements for indirect heater coils shall be in accordance with the following.

5.1.1 Coil Working Pressure

The minimum required thickness or maximum working pressure shall be determined in accordance with the following equations which are based on ANSI/ASME B31.3.

The following nomenclature is used in coil design calculations.

T is the nominal wall thickness of pipe as listed in ANSI B36.10, or from manufacturer's schedules for other than listed thickness.

t_m is the minimum wall thickness of pipe as listed in the pipe specification. For nominal thicknesses listed in ANSI B36.10, t_m = 0.875 (T). For thicknesses not listed in ANSI B36.10, pipe may be ordered and certified to minimum wall thickness. In all cases, t_m shall be equal to or greater than t_r.

t_r is the required wall thickness, as calculated for internal pressure, including mechanical, corrosion and erosion allowances.

C is the sum of mechanical allowances for thread depth plus corrosion allowance plus erosion allowance in inches. For threaded pipe, the threat allowance shown in Table 3 shall be used.

P is the maximum non-shock internal working pressure, psig.

Y is the coefficient of 0.4 when T is less than $D/6$. When T is equal to or greater than $D/6$,

$Y = \frac{d}{d+D}$.

D is the outside diameter of pipe, in.

d is the nominal inside diameter of pipe, in. For calculating Y, $d = D - 2T$.

The required wall thickness (t_r) for maximum non-shock internal working pressure (P) shall be calculated by Equation (1).

$$t_r = \frac{PD}{2(S+PY)} + C \quad (1)$$

The maximum internal working pressure (P) may be calculated by Equation (2).

$$P = \frac{2S(t_m - C)}{D - 2Y(t_m - C)} \quad (2)$$

5.1.2 Design Temperature

The maximum design temperature rating shall be 250°F.

5.1.3 Working Pressure of Flanges, Valves, and Fittings

Pressure rating for flanges attached to coils shall be determined in accordance with ANSI/ASME B16.5 or API 6A. Pressure ratings for clamp type connectors attached to coils and valves, chokes or fittings with flanged or clamp type connections shall be determined in accordance with API 6A. The nominal bore of the butt-weld flanges and fittings shall be the same as the nominal inside diameter of the pipe to which they are welded, provided the bore does not exceed the maximum permitted by the applicable specification.

Pressure ratings for proprietary valves, fittings, unions and chokes attached to or supplied with coils shall be the rating supplied by the manufacturer of the component. Where the component is classified only by test pressure, the maximum working pressure shall not exceed 67% of the test pressure.

Pressure ratings for forged steel socket-welded and threaded couplings and fittings attached to or supplied with coils shall not exceed the applicable pressure class of the fitting as described in ANSI/ASME B16.11.

5.1.4 Internal Working Pressure

The maximum internal working pressure for various commonly used nominal pipe sizes is tabulated in Table 2. Where a coil assembly contains components such as unions, chokes, flanges, etc., having a lower working pressure, the coil shall be rated at the lowest working pressure of any component.

5.1.5 Higher Coil Working Pressure

Heather coils for pressures greater than those determined in accordance with Equation (2) shall not be furnished under this specification.

5.1.6 Coil Removal

The coil section shall be removable from the shell opposite from the firebox end to facilitate inspection and repair. The coil section shall be adequately supported for normal operation and shipment.

5.2 Shell Design

The minimum requirements for indirect heater shells shall be in accordance with the following (see Annex E).

5.2.1 Shell Working Pressure

The shell shall be designed to operate at or near atmospheric pressure. In no case shall the operating pressure exceed 1 psig.

5.2.2 Shell Form

The shell may be either cylindrical with flat end closures that may either be welded or bolted to the shell, or rectangular with a structural framework to which flat plates are welded on the top, bottom, and sides.

5.2.3 Minimum Thickness

The minimum thickness of cylindrical and rectangular shells shall be $^{3}/_{16}$ in. in the case of plate or 7-gage (0.1793-in. nominal) in the case of sheet. These minimum thicknesses also apply to end closures for cylindrical shells. The minimum thickness shall be increased as necessary to meet design requirements.

5.2.4 Allowable Stresses

The allowable stresses used in all structural calculations shall be in accordance with the *American Institute of Steel Construction Manual*. Allowable shear stress is 40% of the specified minimum yield, allowable tensile and compression stresses are 60% of the specified minimum yield, and allowable bending stresses are 66% of the specified minimum yield strength. Specified minimum yield strength is to be taken from the appropriate material specification.

5.2.5 Support Design

Cylindrical shells are normally supported on two saddles or with angle legs. Rectangular shells are normally supported on a structural steel skid. Consideration shall be given to supports to ascertain structural integrity. The manufacturer shall consider loads imposed by testing, lifting, transportation, wind, earthquake, and normal operation.

5.2.6 Suggested Guidelines

Some suggested structural design procedures and guidelines are given in Annex E.

5.3 Standard Firebox Rating

Firebox ratings for heaters conforming to this specification shall be as listed in Table 4 and specified on the purchase order, unless otherwise agreed upon between the purchaser and manufacturer. The firebox shall be removable from the shell opposite from the coil end to facilitate inspection and repair. The firebox shall be adequately supported for normal operation and shipment.

Table 1—Maximum Allowable Coil Stress (*S*)

Material Specification	Grade	Maximum Allowable Stress –20°F to 250°F psi
API 5L	B	20,000
ASTM A53	B	20,000
ASTM A106	B	20,000
ASTM A106	C	23,300

5.4 Firetube Heat Flux

The average heat flux (BTU/hr/ft^2 of exposed area) should be within range of 10,000 to 12,000 for glycol/water bath. The heat flux may be increased for fresh water bath applications.

EXAMPLE

8 $^5/_8$-in. OD firetube having 44.3 ft^2 of firetube surface and rated @ 500,000 BTU/hr.

$$\text{Average Heat Flux} = \frac{\text{Firetube Rating (BTU/hr)}}{\text{ft}^2 \text{ of Firetube Surface}} = \frac{500{,}000}{44.3} = 11{,}287 \text{ BTU/hr/ft}^2$$

5.5 Firetube Heat Density

Firetube heat density (heat released through the cross-sectional area of the firetube) is regulated by the burner mixer and burner nozzle. Heaters conforming to this specification will have a maximum heat density of 15,000 BTU/hr/in.^{2} for natural draft burners.

EXAMPLE

8 $^5/_8$-in. OD, 0.188-in. wall, firetube rated for 500,000 BTU/hr

Cross Sectional Area = 53.42 in.^{2}

Assume 70% Efficiency

$$\text{Heat Density} = \frac{\text{Firetube Rating (BTU/hr)}}{(\text{Cross Sectional Area, in.}^2)\ (\text{Efficiency})} = \frac{500{,}000}{53.42 \times 0.70} = 13{,}371 \text{ BTU/hr/in.}^2$$

5.6 Stack Height

The height of the stack shall be no less than required to provide draft sufficient to overcome the pressure drop in firetube, stack, returns, and any stack or flame arrestors. The operating site elevation shall be considered in the draft calculations. The purchaser shall advise the manufacturer of the site elevation.

6 Fabrication, Testing and Painting

6.1 General

The manufacturer of the completed indirect heater shall be responsible for assuring that all material, design, fabrication procedures, examinations, inspections and tests required by this specification have been met. The purchaser may make any investigations necessary to satisfy him/herself of compliance by the manufacturer and may reject any item that does not comply with this specification.

6.2 Coil Fabrication

The following specific requirements shall apply to coils, including fuel gas preheat coils, and all pressure retaining parts within the scope of this specification attached to coils.

6.2.1 Welding Processes

The following welding processes as defined by Section IX of the ASME *Boiler and Pressure Vessel Code,* hereinafter referred to as the ASME Code, are acceptable: shielded metal arc (SMAW), submerged arc (SAW), gas metal arc (GMAW) including flux core (FCAW), and gas tungsten arc (GTAW).

Table 2—Maximum Coil Working Pressure (*P*)
$C = 0$
$t_m = 0.875T$

Nominal Pipe Size in.	*T* Nominal Wall in.	*P* Maximum Working Pressure psig Grade B S = 20,000	*P* Maximum Working Pressure [a] psig Grade C S = 23,300
1 XS	0.179	5,270	—
2 Std	0.154	2,380	—
2 XS	0.218	3,440	—
2 XXS	0.436	7,340	8,560
2 1/2 Std	0.203	2,600	—
2 1/2 XS	0.276	3,610	—
2 1/2 XXS	0.552	7,770	9,050
2 1/2	0.750	10,720	12,490
2 1/2	0.875	12,530	14,600
3 Std	0.216	2,260	—
3 XS	0.300	3,200	—
3 XXS	0.600	6,820	7,940
4 Std	0.237	1,920	—
4 XS	0.337	2,770	—
4 XXS	0.674	5,860	6,830
6 Std	0.280	1,530	—
6 XS	0.432	2,400	—
6 XXS	0.864	5,030	5,860
8 Std	0.322	1,350	—
8 XS	0.500	2,120	—
8 XXS	0.875	3,830	4,460

[a] Maximum working pressure (*P*) has been rounded up to the next higher unit of 10 psig.

Table 3—Thread Allowance for Pipe Wall Thickness Calculations

Nominal Pipe Size in.	Thread Depth in. [a]
1/2 – 3/4	0.0571
1 – 2	0.0696
2 1/2 – 8	0.1000

[a] From ASME B2.1-1968.

6.2.2 Welding Procedure Specifications

Each manufacturer shall prepare or obtain detailed written welding procedure specifications (WPS) outlining all essential, nonessential and supplementary essential variables as required by Section IX of the ASME Code. Materials used in welding that are not classified under the ASME P-number base material groupings shall be qualified in accordance with the methods specified in Section IX. It is the responsibility of the heater manufacturer to justify any base material and/or filler metal groupings that are not classified in Section IX.

Table 4—Standard Firebox Rating Based on Heat Input to the Water Bath

BTU/hr	BTU/hr
100,000	2,000,000
250,000	2,500,000
500,000	3,000,000
750,000	3,500,000
1,000,000	4,000,000
1,500,000	5,000,000

6.2.3 Welding Procedure Qualifications

Each manufacturer shall qualify the procedures they intend to use in production by producing weldments and having mechanical tests performed as required by Section IX of the ASME Code. Where controlled hardness is required by NACE MR 0175, the maximum hardness of the base materials, the weld metal, and the heat affected zone may be determined on the procedure qualification. The results of all tests shall be recorded and certified on procedure qualification records (PQRs) by the manufacturer to support each WPS. Qualification by one manufacturer shall not qualify a WPS for any other manufacturer.

6.2.4 Welder Qualifications

Each manufacturer shall qualify all welders and welding operators employed in coil welding in accordance with the requirements of Section IX of the ASME Code. The results of all tests shall be recorded and certified on a welder performance qualification (WPQ) by the manufacturer for each welder and welding operator. Qualification of individuals employed by one manufacturer shall not qualify them for employment by any other manufacturer without requalification.

6.2.5 Pipe Bends

Pipe may be bent by any hot or cold method which will result in arc surfaces free of cracks and substantially free of buckles. The minimum center-line radius of bends shall be 1 $^1/_2$ times the nominal pipe size.

Flattening of a bend as measured by the difference between the maximum and minimum diameter at any cross section shall not exceed 8% of the nominal outside diameter. The minimum wall thickness of a bend after bending shall not be less than the minimum wall thickness (t_m) as defined in 5.1.1.

After cold bending, stress relieving is required when the extreme fiber elongation of the outside periphery of the bend exceeds 15%. Stress relieving, when required, will be done in accordance with the provisions for heat treatment as described in ANSI/ASME B31.3.

6.2.6 Nondestructive Examination

All components and welds shall as a minimum be visually examined during and after fabrication. Visual examination is the observation of the portion of components, joints and other piping elements that are exposed to view before, during, or after manufacture, fabrication, assembly, or testing to assure compliance with this specification and the manufacturer's drawings.

In addition, coils fabricated from extra strong (XS) pipe through double-extra strong (XXS) pipe inclusive shall have 10% of the circumferential butt welds radiographed. The weld selection is to be random and each weld selected is to be radiographically examined over its entire length. The method of radiography shall be in accordance with the latest edition of the ASME Code, Section V, Article 2. The limits of imperfections are given in Table 5.

Any defective weld shall require two additional welds of the same kind, by the same welder, be given the same type of examination. If the two items are found satisfactory, the defective item shall be repaired or replaced and reexamined and all the items represented by the additional examination shall be accepted. However, should the additional weld examination reveal a defect, all the welds shall either be repaired or replaced and reexamined as required or fully examined and repaired or replaced as necessary, and reexamined as necessary to meet the requirements of this section.

In addition, coils fabricated from pipe having a wall thickness greater than double-extra strong (XXS) shall have 100% of the circumferential butt welds radiographically examined. Each circumferential butt weld is to be radiographically examined over its entire length. The method of radiography shall be in accordance with the latest edition of the ASME Code, Section V, Article 2. The limits of imperfections are given in Table 5.

Table 5—Limitations on Imperfections in Circumferential Butt Welds Visual and Radiographic Examination

Section	5.2.6 Visual	5.2.6.1 Random	5.2.6.2 100%
Cracks	none permitted	none permitted	none permitted
Lack of fusion	none permitted (Note 1)	none permitted	none permitted
Incomplete penetration	Note 1 and Note 2	Note 2	none permitted
Internal porosity	N/A	Note 4	Note 3
Slag inclusion or elongated indications	N/A	Note 6	Note 5
Undercutting	lesser of 1/32 in. or $T/4$	lesser of 1/32 in. or $T/4$	lesser of 1/32 in. or $T/4$
Surface porosity and exposed slag inclusion	none permitted		
Concave root surface (suck-up)	Note 1, Note 7		
Reinforcement or protrusion	Note 8		

NOTE 1 Applicable only where the interior surface at the weld is accessible for direct visual examination.

NOTE 2 The depth of incomplete penetration shall not exceed the lesser of 1/32 in. or $0.2T$. The total length of such imperfections shall not exceed 1.5 in. in any 6 in. of weld length.

NOTE 3 Criteria as given in the latest edition of the ASME Code, Section VIII, Division 1, Appendix 4.

NOTE 4 Porosity shall not exceed the following: for T not over 1/4 in., same as note (2); for T greater than 1/4 in., 1.5 times the limits of Note 2.

NOTE 5 The developed length of any single slag inclusion or elongated indication shall not exceed $T/3$. The total cumulative developed length of slag inclusions and/or elongated indications shall not exceed T in any $12T$ length of weld. The width of a slag inclusion shall not exceed the lesser of 3/32 in. or $T/3$.

NOTE 6 The developed length of any single slag inclusion or elongated indication shall not exceed $2T$. The total cumulative developed length of slag inclusions and/or elongated indications shall not exceed $4T$ in any 6 in. length of weld. The width of a slag inclusion shall not exceed the lesser of 1/8 in. or $T/2$.

NOTE 7 Concavity of the root surface shall not reduce the total thickness of the joint, including reinforcement, to less than the T.

NOTE 8 The height is measured from the surfaces of the adjacent components. The lesser of two measurements, in any plane through the weld, shall not exceed the applicable value below. Weld metal shall merge smoothly into the component surfaces.

T, in.	Weld Reinforcement or Internal Weld Protrusion, in.
1/4 and under	0.0625
over 1/4 to 1/2	0.125
over 1/2 to 1	0.15625
over 1	0.1875

Defective welds shall be repaired or replaced and the new work shall be reexamined by the same method, to the same extent, and by the same acceptance criteria as required for the original work.

6.2.7 Telltale Holes

When specified by the purchaser, return bends in heater coils shall be drilled with telltale holes to provide some positive indication when the thickness has been reduced by corrosion or erosion. The depth shall be 50% ± 0.015 in. of the minimum wall thickness (t_m) of the pipe as defined in 5.1.1. The drill shall be a 60° tapered drill with a diameter of from 1/16 in. to 3/16 in. The depth shall be measured at the tip of the drill. The hole shall be drilled normal to the surface where deterioration is expected. When safety drilling is specified on the purchase order, 180° return bends shall be drilled as indicated in Figure 3 or in other locations as specified by the purchaser.

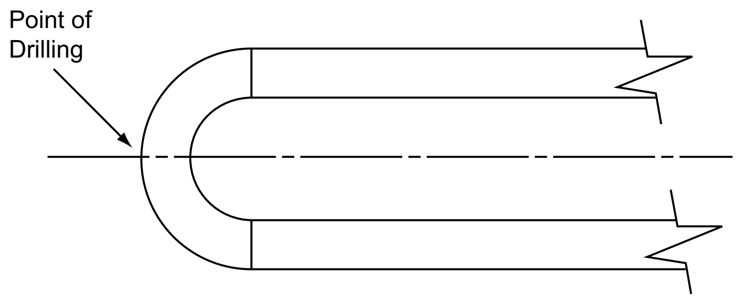


Figure 3—Safety Drilling of Return Bends

6.2.8 Post Weld Heat Treatment

When the nominal wall thickness of a welded joint is equal to or greater than 3/4 in., the welded joints shall be stress relieved in accordance with the provisions for heat treatment as described in ANSI/ASME B31.3.

6.2.9 Hydrostatic Test

Heater coils shall be hydrostatically tested to one and one-half times the maximum internal working pressure as calculated by Equation (2) of 5.1.1 with no allowance for corrosion or erosion, or the limiting maximum working pressure as determined by 5.1.4. Where test pressures higher than specified above are required, the maximum coil working pressure shall be reduced if required to assure that the test pressure will not cause any material to be stressed above 90% of the minimum specified yield strength. Following the application of the hydrostatic test pressure, a visual inspection shall be made of all welded joints. This inspection shall be made at a pressure not less than two-thirds of the test pressure. Any leaks revealed during this visual inspection will be repaired by welding after the water is drained. The coil shall be retested. It is recommended that the liquid temperature during hydrostatic test be not less than 60°F.

6.3 Shell, Firetube, Stack and Accessories

Shell, firetube, stack and accessories shall be fabricated and assembled using good workmanship to assure compliance with the manufacturer's drawings and this specification. The completed heater shell shall be leak tested after the coil(s) and firetube(s) have been installed, examined for excessive distortion of flat sections, and any deficiencies repaired.

6.4 Painting

Before shipment, heaters shall be mechanically cleaned of rust, grease, loose scale, and weld spatter, and the outside of the shell coated with one application of a good grade of commercial metal primer. Finish coats or special painting systems shall be applied if so agreed upon between the purchaser and the manufacturer.

7 Marking

7.1 Nameplate

Indirect heaters furnished to this specification shall be identified by two corrosion resistant nameplates, one on the shell and one on the coil.

7.2 Shell Nameplate

One nameplate of corrosion resistant material shall be securely attached to the shell bearing the information in items 1 through 9, as shown in Figure 4:

1) Specification 12K;
2) manufacturer's name;
3) manufacturer's serial number;
4) year built;
5) shell weight empty, in pounds (excluding coil weight);
6) firebox rating, in British thermal units per hour;
7) firebox area, in square feet;
8) shell size, OD × length;
9) additional markings desired by the manufacturer or requested by the purchaser are not prohibited.

Manufactured in Accordance with API Specification 12K

Manufacturer ____________________

Serial Number ____________________

Year Built ____________________

Shell Weight Empty ____________________ lb

Shell Size ____________________ OD (in ft) × length (in ft)

Firebox Area ____________________ ft^2

Firebox Rating ____________________ BTU/hr

____

____

Figure 4—Indirect Heater Shell Nameplate Format

7.3 Coil Nameplate

One nameplate of corrosion resistant material shall be securely attached to the coil cover plate bearing the information in items 1 through 9, as shown in Figure 5:

1) Specification 12K;

2) manufacturer's name;

3) manufacturer's serial number;

4) year built;

5) coil pipe size and schedule for each section;

6) coil area, in square feet;

7) coil weight empty, in pounds;

8) coil maximum working pressure, pound-force per square inch gauge;

9) additional markings desired by the manufacturer or requested by the purchaser are not prohibited.

Manufactured in Accordance with API Specification 12K

Manufacturer ______________________________

Serial Number______________________________

Year Built ______________________________

Coil Weight Empty ___________________________lb

Coil	Size/schedule	Coil Area (ft^2)	Max Press (psig)

Figure 5—Indirect Heater Coil Nameplate Format

7.4 Coil Connection

It is recommended that the coil connections be permanently marked as inlet and outlet, particularly in the case of split-pass coils.

8 Inspection and Rejection

8.1 Inspection Notice

Where inspection is required by the purchaser, the extent of such inspection should be stated on the purchase order. Where the inspector representing the purchaser desires to inspect heaters purchased or witness any specification tests or evaluate the results of any nondestructive examinations, the manufacturer shall give reasonable notice of the time at which such inspections should be made.

8.2 Inspection by Purchaser

While work on the contract of the purchaser is being performed, the inspector representing the purchaser shall have free entry at all times to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford, without charge, all reasonable facilities to satisfy the inspector that the material is being manufactured in accordance with this specification. All inspections shall be made at the place of manufacture prior to shipment unless otherwise specified on the purchase order, and shall be so conducted as not to interfere unnecessarily with the manufacturer's operations.

8.3 Rejection

Material which shows injurious defects on initial inspection or subsequent to acceptance at manufacturer's works, or which proves defective when properly applied in service, may be rejected, and the manufacturer so notified. If tests that require the destruction of material are made, the purchaser shall pay for material and tests complying with all of the provisions of this specification, but shall not pay for material or tests which fail to meet the specifications.

8.4 Compliance

The manufacturer shall be responsible for complying with all of the provisions of this specification. The purchaser may make any investigation necessary to be assured of compliance by the manufacturer and may reject any material that does not comply with this specification.

Annex A
(informative)

Indirect Heater Design Information

Field ____________________ Geographical Location ____________________

Service ____

Design Conditions

Gas Rate SCFH ____________________ Sp. Gravity __________ @ 60°F

Condensate/Oil Rate BPH ____________________ API Gravity __________

Water Rate BPH ____________________ Sp. Gravity __________ @ 60°F

Well Shut-in Pressure ______________ psig Inlet Pressure ______________ psig

Outlet Pressure ______________ psig Site Elevation ______________ ft

If Sour Gas: H_2S __________ Mol%, CO_2 __________ Mol%

Inlet Flowing Temperature ______________________________ °F Minimum

Outlet Flowing Temperature ______________ °F ______________ psig

Fuel Gas Available _____ Yes _____ No Pressure __________ psig

Fuel Gas Source ______________ High Heating Value (HHV) ______________ BTU/SCF

Other Fuel: Specify ____

NOTE Flow rates should be maximum instantaneous rates based on expected flow surges.

Design Requirements

Coil Bundle: Single ____________________ Split ____________________

Coil Working Pressure: Preheat ______________ psig, Expansion ______________ psig

Coil Corrosion Allowance _____ Yes _____ No in. ____________________

Choke Required: Mfg. Standard ______________ Other ______________

Type Choke ______________ Adjustable ______________ Diaphragm

Paint Required: Mfg. Standard ______________ Special: Specify ______________

Regulatory Requirements/Limitations Such as: Stack Height, Emissions, API RP 14C:

Specify ____

Optimal Requirements

Coil Connections: Flanged ____________ Threaded ____________ Other ____________

Companion Flange Bolted On (CFBO) _____ Yes _____ No, Bore ____________ in.

Skid Mounted * ____________ Lifting Lugs ____________

Insulation: Specify ____________

Shell Lifting Lugs _____ Yes _____ No

Intake Flame Arrestor ____________ Stack Flame Arrestor ____________

Stack Spark Arrestor ____________ Stack Down Draft Diverter ____________

* If so, state how unit will be loaded, unloaded, and supported in normal operation.

Stack Rain Shield ____________ Stack Gas Sample Connection ____________

Fuel Gas Scrubber ____________ Electric Spark Ignitor ____________

Pilot Flame Failure Shutdown ____________

Telltale Holes _____ Yes _____ No

Fuel Gas Regulator ____________

Other Accessories ____________

Water Bath Additive ____________

Controls: Mfg. Standard ____________ Other ____________

NACE MR 0175 Required ____________

Manufacturer's Heater Data

Firetube Capacity ____________ BTU/hr

Firetube Size ____________ in. OD Surface Area ____________ ft^2

Coil No.	Size and Schedule	Material	Coil Area ft^2	Max. W.P psig	Limited by
1	______	______	______	______	______
2	______	______	______	______	______
3	______	______	______	______	______

Water Bath Capacity ____________ gal, Empty Shipping Weight ____________ lb

Annex B
(informative)

Gas Flow Rate

B.1 Gas Throughput

Gas throughput should be analyzed based on factors such as pressure drop available, presence of sands or other solids, and presence of liquids. Single phase gas flow is normally limited by the amount of available pressure drop while two phase flow with liquids and solids present may be limited by an erosional velocity.

B.2 Flow Rates

Flow rates for a single phase gas stream, free of entrained solids, may be approximated from the values given in Table B.1 for a wide range of nominal pipe sizes and flowing pressures, based on actual flowing velocities of 80 ft/s. and 120°F. These flow rates should be used with caution since corrosion and erosion conditions are not always recognized to be present. These rates may produce high pressure drops when liquids are present and excessive erosion when solids are present.

Table B.1—Gas Flow Rate

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
	Operating Pressure of Coil psig									
	6,000	**5,000**	**4,000**	**3500**	**3,000**	**2,000**	**1500**	**1,000**	**750**	**500**
Nominal Pipe Size in.	**Gas Throughput to Provide 80 ft/s Coil Velocity @ 120°F MMSCFD**									
1 XS	—	12	11	9	8	6	4	2	1.5	1
2 Std	—	—	—	—	—	25	18	11	8	5.7
2 XS	—	—	—	—	33	22	16	10	7	5
2 XXS	30	28	25	23	20	13	10	6.5	4	2
2 1/2 Std	—	—	—	—	—	36	26	17	12	8
2 1/2 XS	—	—	—	53	47	32	23	15	11	7
2 1/2 XXS	41	38	34	31	28	19	13	9	6	4
3 Std	—	—	—	—	—	53	40	25	18	11
3 XS	—	—	—	—	74	47	36	22	16	10
3 XXS	70	65	58	54	46	31	23	14	10	7
4 Std	—	—	—	—	—	95	70	43	30	20
4 XS	—	—	—	—	130	85	60	38	27	18
4 XXS	—	123	110	101	90	61	44	28	20	13
6 Std	—	—	—	—	—	—	158	100	73	47
6 XS	—	—	—	—	—	197	143	90	66	42
6 XXS	—	291	257	236	210	142	103	65	47	31
8 Std	—	—	—	—	—	—	274	173	126	82
8 XS	—	—	—	—	—	345	250	158	115	74
8 XXS	—	—	—	466	415	281	203	128	93	60

The velocity of a single phase gas stream may be determined by the following equation:

$$V_g = \frac{60\ Q_g T Z}{d_i^2 P} \tag{B.1}$$

where

V_g is the gas velocity, ft/s;

Q_g is the gas flow rate, MMSCFD (14.7 psia and 60°F);

T is the operating temperature, °R;

Z is the gas compressibility;

d_i is the pipe inside diameter, in.;

P is the operating pressure, psia.

Annex C
(informative)

Combustion Efficiency

C.1 General

Proper operation of any heater depends on efficient burner performance and adequate firetube design and is commonly expressed as combustion efficiency. Good burner performance depends on proper adjustment of fuel gas pressure, primary and secondary air and the gas orifice size. Good firetube design depends on heat flux, heat density, bath temperature and firing accessories.

C.2 Heater Performance

Heater performance can be easily determined by an analysis and temperature of the flue gas taken from the base of the stack. Figure C.1 is a convenient chart for estimating combustion efficiency in a heater, based on residual oxygen (O_2) content and exit temperature of the stack gas, employing a methane-rich fuel gas with a high (or gross) heating valve (HHV) of approximately 1050 BTU/SCF. This chart assumes the residual level of combustibles in the flue gas is below 0.1% which is the maximum level for safe and efficient operation. While this chart is limited to natural gas, there is no intent to preclude other fuels.

C.3 Minimum Stack-gas Temperature

If a sulfur-free fuel gas is used with uninsulated stacks, a minimum exit flue gas temperature of 250°F should be maintained to avoid internal stack corrosion. If sulfur is present in the fuel gas, the minimum exit flue gas temperature should be maintained in the range of 300°F to 400°F for sulfur contents ranging from approximately 0.05% to 1.0% by volume in the fuel gas. This 300°F to 400°F temperature range can be reduced by roughly 50°F for insulated stacks.

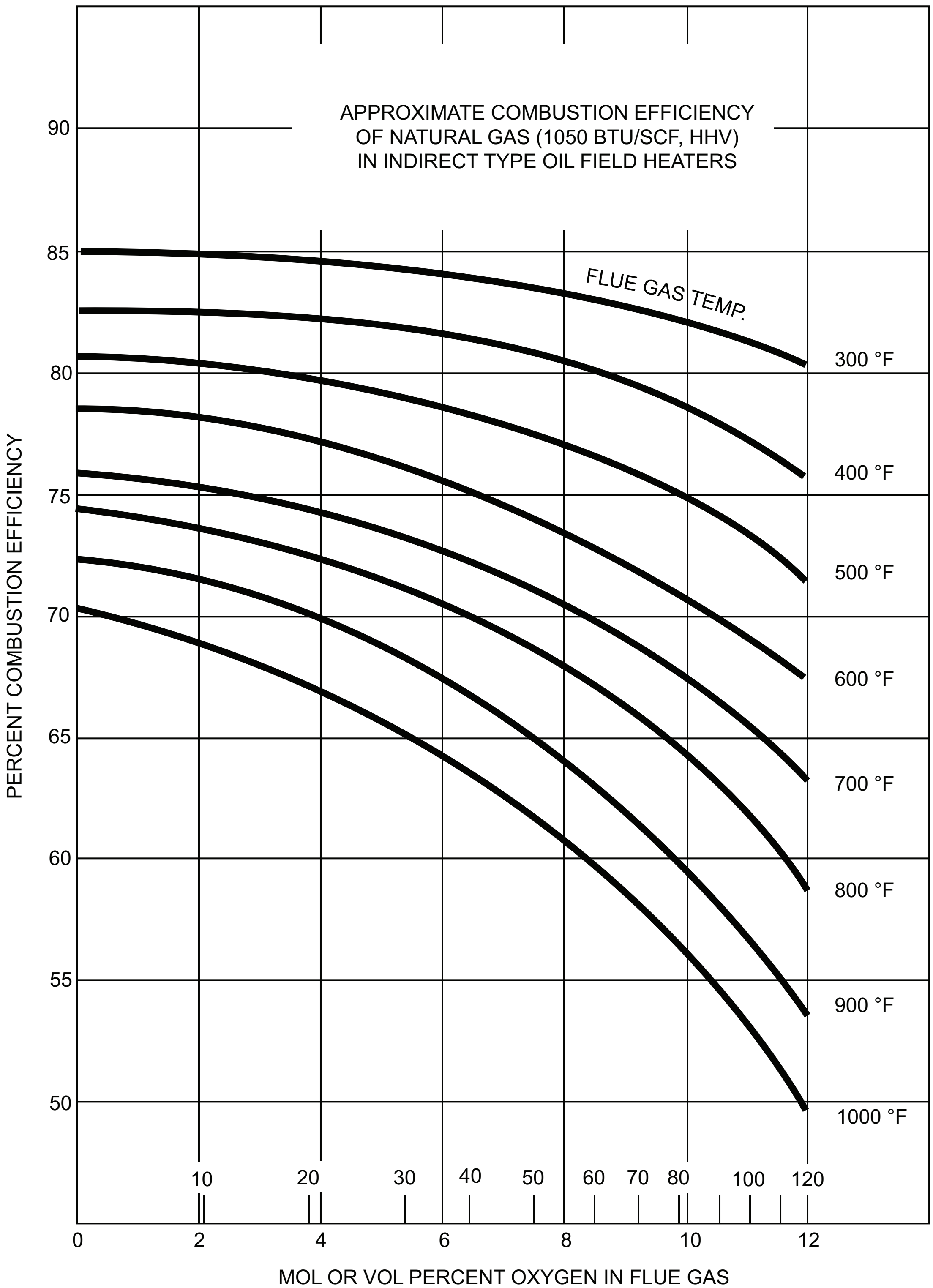


Figure C.1—Approximate Combustion Efficiency of Natural Gas (1,050 BTU/SCF, HHV) in Direct Type Oilfield Heaters

Annex D
(informative)

Heat Transfer

D.1 General

It is often necessary to perform heat transfer calculations in connection with indirect type oilfield heaters. This annex is intended to give some guidelines for determining the BTU/hr rating and required area of coils.

D.2 Basic Heat Transfer Equation

The basic heat transfer equation that may be used in indirect heater sizing is as follows:

$$Q = U_o(A)(T_m) \text{ or } A = \frac{Q}{U_o\,(T_m)} \qquad \text{(D.1)}$$

where

Q is the total heat transfer (heat required), BTU/hr;

U_o is the overall heat transfer coefficient, BTU/hr-ft^2-°F;

A is the total heat transfer area (coil area), ft^2;

T_m is the log mean temperature difference, °F.

D.3 Heat Required

For high pressure gas streams, the heat required may be determined from the following equation:

$$Q = 109.8(G)\,(h_2 - h_1) \text{ or } Q = M(c)\,(T_2 - T_1) \qquad \text{(D.2)}$$

where

Q is the heat required (total heat transfer), BTU/hr;

G is the gas flow rate, MMSCFD;

$h_2 - h_1$ is the enthalpy difference at initial temperature and final temperature, BTU/lb-mol;

M is the gas mass flow rate, lb/hr;

c is the specific heat at average or mean temperature, BTU/lb-°F;

$T_2 - T_1$ is the temperature difference of inlet and outlet flowing temperature °F.

For oil and/or water streams the heat required may be approximated from the following equations.

For oil/water emulsions:

$$Q = W\,[6.44 + 8.14\,(X)]\,(T_2 - T_1) \tag{D.3}$$

The above equation is based on 35° API oil with a specific heat of 0.52 BTU/lb-°F and 1.0 specific gravity water with a specific heat of 1.0 BTU/lb-°F.

For oil or water:

$$Q = F(p)(c)(T_2 - T_1) \tag{D.4}$$

where

Q is the heat required (total heat transfer), BTU/hr;

W is the emulsion flow rate, bbl/day;

X is the percent by volume of water in emulsion, expressed as a fraction;

$T_2 - T_1$ is the temperature difference between initial temperature and final temperature, °F;

F is the liquid flow rate, gal/hr;

p is the liquid specific weight, lb/gal;

c is the specific heat of liquid at mean or average temperature, BTU/lb-°F.

D.4 Overall Heat Transfer Coefficient

The overall heat transfer coefficient is normally established by the manufacturer, based on laboratory and field experience, or it may be determined using such publications as *Standard of Tubular Exchanger Manufacturer's Association* which involve a detailed calculation. This calculation could take into account several factors such as film coefficient of fluid outside tubes, film coefficient of fluid inside tubes, fouling resistance, tube wall resistance, thermal conductivity of tube wall, etc. Addition of glycol to the water bath will lower the overall heat transfer coefficient. A detailed explanation of the calculations is beyond the scope of this specification.

D.5 Log Mean Temperature Difference

The log mean temperature difference between the fluid in the shell side and the fluid in the coil side can be determined from the following equation:

$$T_m = \frac{\mathrm{GTD} - \mathrm{LTD}}{\ln(\mathrm{GTD}/\mathrm{LTD})} \tag{D.5}$$

where

T_m is the log mean temperature difference, °F;

GTD is the greater temperature difference = (water bath temperature) – (inlet fluid temperature);

LTD is the least temperature difference = (water bath temperature) – (outlet fluid temperature);

ln is the natural logarithm.

The water bath and fluid temperatures must be known or assumed for the calculations.

D.6 Coil Area

The coil area required for an indirect type oilfield heater can be calculated using the basic heat transfer equation listed in D.2. A heater should be selected which has a firebox rating and a coil area at least equal to or greater than that calculated. It must be noted that the heat required as determined from equations in D.3 is only the heat input required to the flow stream. No provision is made for heat loss from the vessel which is usually small.

Annex E
(informative)

Structural Design Guidelines

E.1 Saddles

Saddles for cylindrical shells should be designed in such a manner that excessive stresses are not induced in the shell. Some useful guidelines and references may be found in Section VIII, Division 1, of the ASME Code. Caution is advised when angle legs are used to support the shell, because they may overstress the shell. The saddles or legs shall be adequate to support the heater assembly under normal operating conditions. No more than two saddles should be used on a cylindrical shell.

E.2 Rectangular Heaters

Rectangular heaters should be supported by a structural steel skid. The skid should be designed to support 150% of the dry weight of the entire heater assembly with the skid supported at its ends. It should also support the heater assembly under normal operating conditions. The user should inform the manufacturer how the skid will be transported, unloaded, and supported under normal operating conditions. Deflection should be limited to $L/400$, where L is the length of the skid. The same considerations apply to skid mounted cylindrical heaters.

E.3 Rectangular Shells

Rectangular shells should be supported by a rigid frame that will limit deflection in the top, bottom and sides to $L/500$ with 1 $^1/_2$ psi internal pressure or full of water, whichever is greater. The dimension L is the length of the longest side or the distance between rigid structural frame members, whichever is less. Cylindrical shells should be designed for 1 $^1/_2$ psi of internal pressure or full of water, whichever is greater.

E.4 Flat End Deflection

The deflection of flat end closures should be limited to the diameter divided by 500 with 1$^1/_2$ psi internal pressure or full of water, whichever is greater.

E.5 Lifting Lugs

Heaters that are furnished with insulation shall also be furnished with two lift lugs unless lifting lugs are furnished on skid-mounted units. Each lug should be designed for 75% of the empty weight of the entire assembly. A maximum lift angle of 30° with the vertical shall be assumed. The effect of the lugs on the shell should be investigated and reinforcement should be provided if required. The lugs should be designed for double shear tear-out and tension on the net section at the pin hole. The lifting lugs on skid-mounted heaters, if furnished, should be designed as above, except that each lug should be designed for 50% of the empty weight of the entire assembly. Many manufacturers attach lift lugs to various components on the heater assembly that are intended for lifting that component only; however, they may not be suitable for lifting the total assembly.

E.6 Wind Forces

Wind forces on the stack can cause a moment on the cover plate which should be investigated.

E.7 Evaluations

Piping and coil loads may need to be evaluated. The firetube becomes buoyant when immersed in the heater bath and must be restrained from floating.

Annex F
(informative)

Corrosion Guidelines

F.1 Considerations

The following guidelines are recommended for determining corrosion considerations for an applicable heater.

Well streams that contain water as a liquid and any or all of the following gases are considered to be corrosive and should be considered under these specifications (see API 14E, NACE MR 0175):

a) oxygen—O_2;

b) carbon dioxide—CO_2;

c) hydrogen sulfide—H_2S.

The following guidelines are not mandatory but may be used to judge the extent of the corrosive environment, with respect to carbon steels.

a) Oxygen:

   1) less than 0.005 ppm in natural brine—non-corrosive;

   2) from 0.005 pm to 0.025 ppm requires consideration;

   3) greater than 0.025 ppm in natural brine—corrosive.

b) Carbon dioxide:

   1) less than 600 ppm in natural brine—non-corrosive;

   2) from 600 ppm to 1200 ppm requires consideration;

   3) greater than 1200 ppm in natural brine—corrosive.

c) Hydrogen sulfide.

   1) No lower limit of hydrogen sulfide has been identified as being non-corrosive. With hydrogen sulfide present, the environment should be considered corrosive.

   2) NACE MR 0175 (latest edition) should be used for all cases of hydrogen sulfide content for judgment of the possibility of sulfide stress cracking (SSC).

Some of the other factors that influence corrosion include: temperature, pressure, fluid velocities, metal stress and heat treatment, surface condition, and time.

F.2 Corrosive Environment Practices

If the environment is judged as being subject to SSC from the criteria of NACE MR 0175 as stated above, then all provisions of this NACE standard as apply to the pressure retaining coils and accessories shall be followed.

If the environment is judged as corrosive from any of the other criteria stated above, the intent of this specification will be met provided any one or combination of the following practices are used.

a) An allowance for corrosion to the parts may be made according to ASME *Section VIII, Division 1, Appendix E*, *Suggested Good Practices Regarding Corrosion Allowance*.

b) Corrosion effects may be disregarded provided they can be shown to be negligible or entirely absent on a historical basis. However, the system should be monitored periodically for possible new corrosion.

c) Corrosion effects may be reasonably controlled with chemical inhibitor treatments.

Post weld heat treatment should be considered for coils handling hydrocarbons containing hydrogen sulfide and/or carbon dioxide. Post weld heat treatment may be required by other sections of this specification regardless of corrosion considerations.

Annex G
(informative)

Use of the API Monogram by Licensees

G.1 Scope

The API Monogram Program allows an API Licensee to apply the API Monogram to products. The API Monogram Program delivers significant value to the international oil and gas industry by linking the verification of an organization's quality management system with the demonstrated ability to meet specific product specification requirements. The use of the Monogram on products constitutes a representation and warranty by the Licensee to purchasers of the products that, on the date indicated, the products were produced in accordance with a verified quality management system and in accordance with an API product specification.

When used in conjunction with the requirements of the API License Agreement, API Q1, in its entirety, defines the requirements for those organizations who wish to voluntarily obtain an API License to provide API monogrammed products in accordance with an API product specification.

API Monogram Program Licenses are issued only after an on-site audit has verified that the Licensee conforms to the requirements described in API Q1 in total, and the requirements of an API product specification. Customers/users are requested to report to API all problems with API monogrammed products. The effectiveness of the API Monogram Program can be strengthened by customers/users reporting problems encountered with API monogrammed products. A nonconformance may be reported using the API Nonconformance Reporting System available at https://ncr.api.org. API solicits information on new product that is found to be nonconforming with API specified requirements, as well as field failures (or malfunctions), which are judged to be caused by either specification deficiencies or nonconformities with API specified requirements.

This annex sets forth the API Monogram Program requirements necessary for a supplier to consistently produce products in accordance with API specified requirements. For information on becoming an API Monogram Licensee, please contact API, Certification Programs, 1220 L Street, N. W., Washington, D.C. 20005 or call 202-962-4791 or by email at certification@api.org.

G.2 References

In addition to the referenced standards listed in Section 2 of this document, this annex references the following standard:

API Specification Q1

For Licensees under the Monogram Program, the latest version of this document shall be used. The requirements identified therein are mandatory.

G.3 API Monogram Program: Licensee Responsibilities

G.3.1 For all organizations desiring to acquire and maintain a license to use the API Monogram, conformance with the following shall be required at all times:

a) the quality management system requirements of API Q1;

b) the API Monogram Program requirements of API Q1, Annex A;

c) the requirements contained in the API product specification(s) for which the organization desires to be licensed; and

d) the requirements contained in the API Monogram Program License Agreement.

G.3.2 When an API-Licensed organization is providing an API monogrammed product, conformance with API specified requirements, described in API Q1, including Annex A, is required.

G.3.3 Each Licensee shall control the application of the API Monogram in accordance with the following.

a) Each Licensee shall develop and maintain an API Monogram Marking Procedure that documents the marking/ monogramming requirements specified by the API product specification to be used for application of the API Monogram by the Licensee. The marking procedure shall define the location(s) where the Licensee shall apply the API Monogram and require that the Licensee's License number and date of manufacture be marked on monogrammed products in conjunction with the API Monogram. At a minimum, the date of manufacture shall be two digits representing the month and two digits representing the year (e.g. 05-07 for May 2007) unless otherwise stipulated in the applicable API product specification. Where there are no API product specification marking requirements, the Licensee shall define the location(s) where this information is applied.

b) The API Monogram may be applied at any time appropriate during the production process but shall be removed in accordance with the Licensee's API Monogram Marking Procedure if the product is subsequently found to be nonconforming with API specified requirements. Products that do not conform to API specified requirements shall not bear the API Monogram.

c) Only an API Licensee may apply the API Monogram and its License to API monogrammable products. For certain manufacturing processes or types of products, alternative Monogram marking procedures may be acceptable. The current API requirements for Monogram marking are detailed in the API Policy Document, *Monogram Marking Requirements*, available on the API Monogram Program website at http://www.api.org/certifications/monogram/.

d) The API Monogram shall be applied at the licensed facility.

e) The authority responsible for applying and removing the API Monogram shall be defined in the Licensee's API *Monogram Marking Procedure*.

G.3.4 Records required by API product specifications shall be retained for a minimum of five years or for the period of time specified within the product specification if greater than five years. Records specified to demonstrate achievement of the effective operation of the quality system shall be maintained for a minimum of five years.

G.3.5 Any proposed change to the Licensee's quality program to a degree requiring changes to the quality manual shall be submitted to API for acceptance prior to incorporation into the Licensee's quality program.

G.3.6 Licensee shall not use the API Monogram on letterheads or in any advertising (including company-sponsored web sites) without an express statement of fact describing the scope of Licensee's authorization (License number). The Licensee should contact API for guidance on the use of the API Monogram other than on products.

G.4 Marking Requirements for Products

These marking requirements apply only to those API Licensees wishing to mark their products with the API Monogram.

G.4.1 Manufacturers shall mark equipment on the nameplate with the information identified in Section 7 of this specification, as a minimum, including "API Spec 12K."

G.4.2 As a minimum, equipment should be marked with English (Imperial) units.

G.4.3 Nameplates shall be made of a corrosion-resistant material and shall be located as indication in the marking section of this specification. If the location is not identified, then G.3.3 a) of this annex shall apply.

G.4.4 Nameplates may be attached at the point of manufacture or, at the option of the manufacturer, at the time of field erection.

G.4.5 The API Monogram shall be marked on the nameplate, in addition to the marking requirements of this specification. The API Monogram License number shall not be used unless it is marked in conjunction with the API Monogram.

G.5 API Monogram Program: API Responsibilities

G.5.1 The API shall maintain records of reported problems encountered with API monogrammed products. documented cases of nonconformity with API specified requirements may be reason for an audit of the Licensee involved, (also known as audit for “cause”).

G.5.2 Documented cases of specification deficiencies shall be reported, without reference to Licensees, customers or users, to API Subcommittee 18 (Quality) and to the applicable API Standards Subcommittee for corrective actions.

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