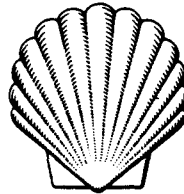


VOID

**SHELL OIL COMPANY
ENGINEERING STANDARDS**



**DESIGN STANDARD 5-I
INSULATION**

AUGUST 1959

ABS-061217

I N D E X

DESIGN STANDARD

PAGE NO.

5-1.1 GENERAL

5-1.1.1 Scope 1

5-1.2 HOT SERVICE

5-1.2.1	Insulation Requirements	1
5-1.2.2	Insulation Thicknesses	1
5-1.2.3	Personnel Protection Insulation	2
5-1.2.4	Steam Trap Insulation	2
5-1.2.5	Steam Tracing Insulation	2

5-1.3 COLD SERVICE

5-1.3.1	Insulation Requirements	2
5-1.3.2	Insulation Thicknesses	3

CHARTS APPENDED

CHART NO. 1 - Hot Service - Recommended Insulation Thicknesses

CHART NO. 2 - Cold Service - Recommended Insulation Thicknesses

5-1.1 GENERAL

5.1.1.1 SCOPE

This standard covers the Engineering design of insulation systems for piping, vessels, exchangers, tanks, pumps, compressors, and turbines in hot and cold services. It is intended to provide a basic guide for consideration of recurring insulation design problems and to inform engineers of preferred design procedures.

5-1.2 HOT SERVICE

5-1.2.1 INSULATION REQUIREMENTS

- .1 Hot service piping and equipment shall be insulated to conserve energy, maintain process stability, protect personnel, or for a combination of these reasons. In general, hot service insulation shall be applied on piping operating above 150°F and on equipment operating above 170°F. In addition, any hot surfaces of large area such as vessels and exchangers which operate below 170°F shall be considered to determine the need for insulation for process stability.
- .2 Valves, flanges and fittings, except unions, in steam and boiler feed water services shall be insulated. Valves, flanges and flanged fittings in other services shall not be insulated except where required for personnel protection, unless specified by Shell. Welded and screwed fittings, except unions, in insulated lines shall be insulated.

5-1.2.2 INSULATION THICKNESSES

- .1 Insulation thicknesses for hot service piping, vessels, exchangers, pumps, compressors, and turbines shall be in accord with appended chart No. 1. The recommended thicknesses are based upon personnel protection requirements. The need for additional thickness for energy conservation or process stability shall be considered.
- .2 Insulation thickness for hot service tanks 12 feet OD or less shall be 1 inch and shall be $1\frac{1}{2}$ inches for tanks over 12 feet OD. The density of the insulation for tanks over 12 feet OD shall be dependent upon economic factors and specified by Shell for each installation.
- .3 Insulation thicknesses recommended in appended Chart No. 1 are based on an insulating material having approximate thermal conductivity values of 0.44 at 200°F and 0.58 at 600°F. Materials with other conductivity values may be substituted provided there is a corresponding adjustment in insulation thicknesses.

5-1.2.3 PERSONNEL PROTECTION INSULATION

- .1 Insulation thicknesses for personnel protection shall be such that the external surface temperature of the insulation shall be a maximum of 150°F for piping and 170°F for other equipment. The effect of weatherproof coverings shall not be considered in establishing the insulation thicknesses.
- .2 Insulation for personnel protection shall generally be applied to hot surfaces which can be inadvertently contacted by personnel in normal performance of their duties. Such hot surfaces shall be insulated to a height 7 feet above normal walking or standing surfaces.
- .3 Unless specified by Shell internally insulated equipment such as cat cracker vessels and lines, reformer and desulphurizer reactors, etc., shall not be insulated for personnel protection by the insulation contractor even though their surface temperatures exceed 170°F. Personnel protection for these hot surfaces shall be applied, when required by Shell.
- .4 Personnel protection on equipment from which it is desirable to dissipate heat, such as steam condensate knockout drums and exchangers with cooling water on one side, shall be expanded metal guards instead of insulation.

5-1.2.4 STEAM TRAP INSULATION

Steam traps and their outlet piping shall not be insulated except for personnel protection or where the outlet piping is arranged so that a liquid head of condensate can collect. Inlet piping to traps shall be insulated.

5-1.2.5 STEAM TRACING INSULATION

- .1 Piping or equipment which is steam traced shall be covered with oversized insulation to include the Tracer Lines. Insulation thicknesses shall be selected from appended Chart No. 1 with the thickness for pipe insulation based on the size used.
- .2 Steam traced systems shall be completely insulated including equipment, valves, flanges fittings and tracer line loops.

5-1.3 COLD SERVICE

5-1.3.1 INSULATION REQUIREMENTS

Cold service equipment and piping shall be completely insulated to conserve energy, maintain process stability, protect personnel, prevent moisture condensation, or for a combination of these reasons. In general, cold service insulation shall be applied on equipment and piping operating at 50°F, or less which are part of a refrigeration system or contain fluids which are cooled by a refrigeration system.

ABS-061220

5-1.3.2 INSULATION THICKNESSES

- .1 Insulation thicknesses for cold service equipment shall be in accord with appended Chart No. 2. The recommended thicknesses, which are based upon prevention of moisture condensation, will in general be adequate for energy conservation, process stability, and personnel protection requirements. When additional thicknesses are necessary, the required insulation thicknesses shall be calculated.

Insulation thicknesses recommended in appended Chart No. 2 are based on an insulating material having approximate thermal conductivity values of 0.3⁵ at 0°F and 0.39 at 70°F. Materials with other conductivity values may be substituted provided there is a corresponding adjustment in insulation thicknesses.

HOT SERVICE - RECOMMENDED INSULATION THICKNESSES

FOR COMBINATION OF ENERGY CONSERVATION, PERSONNEL PROTECTION, AND PROCESS STABILITY

VESSELS, EXCHANGERS, PUMPS, COMPRESSORS, AND TURBINES FOR INSULATION SURFACE TEMPERATURES OF 170°F.					
INSULATION THICKNESS, INCHES	1	1½	2	2½	3
MAXIMUM TEMPERATURE, °F	600	800	950	1100	1200

PIPING FOR INSULATION SURFACE TEMPERATURES OF 150°F.								
INSIDE UNIT AREAS								
PIPE SIZE INCHES	INSULATION THICKNESS, INCHES							
	1	1½	2	2½	3	3½	4	4½
	MAXIMUM TEMPERATURE, °F.							
1 Down	650	850	1100	1200				
1½	550	750	900	1200	1200			
2	550	750	900	1150	1200			
3	500	700	850	1150	1200	1200		
4	500	650	800	1000	1150	1200		
6	430	600	800	900	1050	1200		
8		600	750	900	1050	1200	1200	
10		600	750	900	1000	1150	1200	
12		600	750	850	1000	1100	1200	
14		550	700	800	950	1050	1150	1200
16		550	700	800	900	1050	1150	1200
18		550	700	800	900	1000	1150	1200
20		550	650	800	900	1000	1100	1200
22		550	650	800	900	1000	1100	1200
24		550	650	750	850	950	1100	1200
OUTSIDE UNIT AREAS								
Thicknesses shall be selected on individual basis for each refinery depending upon economic factors, personnel protection, and process stability.								

NOTES

1. The above tables are based on 80°F. ambient still air and on an insulating material having approximate thermal conductivity values of 0.44 at 200°F. and 0.58 at 600°F.
2. The above tables do not include the insulating effect of final coverings which can be expected to further reduce insulation surface temperatures.

ABS-061222

COLD SERVICE - RECOMMENDED INSULATION THICKNESSES
FOR COMBINATION OF ENERGY CONSERVATION, PROCESS STABILITY, PERSONNEL PROTECTION,
AND CONDENSATION PREVENTION

PIPING, VESSELS, EXCHANGERS, PUMPS, AND COMPRESSORS											
IRON PIPE SIZE INCHES	INSULATION THICKNESS, INCHES										
	1	1½	2	2½	3	3½	4	4½	5	5½	6
	MINIMUM TEMPERATURE, °F										
1 Down	50	25	-10	-25	-70						
1½	50	30	15	-15	-45						
2	50	30	15	-15	-45	-90					
3	50	30	15	-10	-35	-60					
4	50	30	20	0	-30	-55					
6	50	45	25	0	-25	-45	-70				
8		45	25	0	-15	-35	-60				
10		45	30	10	-10	-25	-50				
12		45	30	15	-5	-25	-45	-65			
14		45	30	15	0	-25	-40	-55			
16		45	30	20	0	-25	-35	-55			
18		45	30	20	0	-25	-35	-50			
20		50	30	20	0	-25	-35	-45	-65		
24		50	30	20	0	-25	-35	-45	-65		
30		50	30	20	5	-10	-25	-40	-60		
Vessel OD Inches											
36		50	30	20	10	-5	-25	-40	-55		
42		50	30	25	10	-5	-20	-35	-55		
48		50	30	25	10	-5	-20	-35	-50		
54		50	35	25	10	-5	-20	-35	-50		
60		50	40	25	10	-5	-20	-30	-50		
66		50	40	25	10	-5	-15	-30	-50		
72		50	40	25	10	0	-15	-30	-50		
78		50	40	25	10	0	-15	-30	-45	-65	
84		50	40	25	10	0	-15	-30	-45	-65	
96		50	40	25	10	0	-15	-30	-45	-65	
108		50	40	25	10	0	-15	-30	-45	-60	-75
120		50	40	25	10	0	-15	-30	-45	-60	-75
144		50	40	25	10	0	-15	-30	-45	-60	-75
Over 144 To Flat		50	40	25	15	0	-10	-25	-40	-55	-65

NOTES

1. The above tables are based on 90°F. ambient still air, 80% relative humidity, and on an insulating material having approximate thermal conductivity values of 0.35 at 0°F. and 0.39 at 70°F.
2. The above tables are based on the prevention of moisture condensation.
3. The above tables do not include the insulating effect of final covering.

ABS-061223

