MARS SPACE CONSTRUCTION, LLC

CONTENTS
PIPE STRESS ANALYSIS & PIPE SUPPORTS

Section

Section 12

PIPING STRESS ANALYSIS AND PIPE SUPPORT DESIGN

12.1 INTRODUCTION

Piping systems are used as media of rt anspo1·tin g process and utility materials in various plant operations. The materials can be gaseous, liquid, or in the form of pellets, powder, or slurry. In all cases, an internal pressure differential or change in the elevation of the piping is r quired to move the material inside the pipe from one point to another. The material can be hot, cold or near atmospheric temper a.tures. Loaas acting on the piping are from the weight of the material being transported, the weight of the pipe, and the insulation of the system itself including such concentrated loads as valves, flanges, strainers, in-line pumps and various other similar components. External forces which act on the piping can be from wind or ea r thquake and induced reactions from mechanical vibrations.

All of the above loadings d velop restraining forces within the wall of the pipe itself, The intensity of this force related to the area of metal to which it is appli d (i. e. pow1ds of force per square inch of area) can be referred to as the "stress" acting at a particular section in the pipe. The maximum stress permitted to act on piping within refineries and chemical plants is governed by a "Code for Pressure Piping" known as the ANSI (American National Standards Institute) B31. 3-1973. The procedure used to determine the stress levels is a stress analysis.

12. 2 STRESS ANALYSIS

12. 2. 1 General

Two basic types of stress analyses are performed on piping systems: (1) the piping materials group prepares specifications which give wall thickness requirements to withstand certain pressures and temperatures within code-allowable stresses; (2)the piping flexibility analyst, commonly called the "stress analyst," reviews all piping for expansion and weight-induced stresses and other miscellaneous stresses.

12.2.2 Stress and Strain

As previously mentioned the intensity of a force (F) acting on an area (A) is known as the unit stress and is commonly expressed in (pounds per square inch or psi):

$$\text{Unit Stress (S)} = \frac{F}{A}$$

When a system undergoes an applied stress it elongates or compresses. The total elongation or compression, call it (Δ), divided by the total length (L) of the body is known as the unit strain.

Unit Strain $= \frac{\Delta}{L}$ inches per inch

Now, it is known that the relationship of stress to strain is ganerally constant for most materials, that is $\frac{\text{STRESS}}{\text{STRAIN}} = E$. This is known as Hooke's Law.

Figure 12-1 shows an idealized stress versus strain relationshlp.

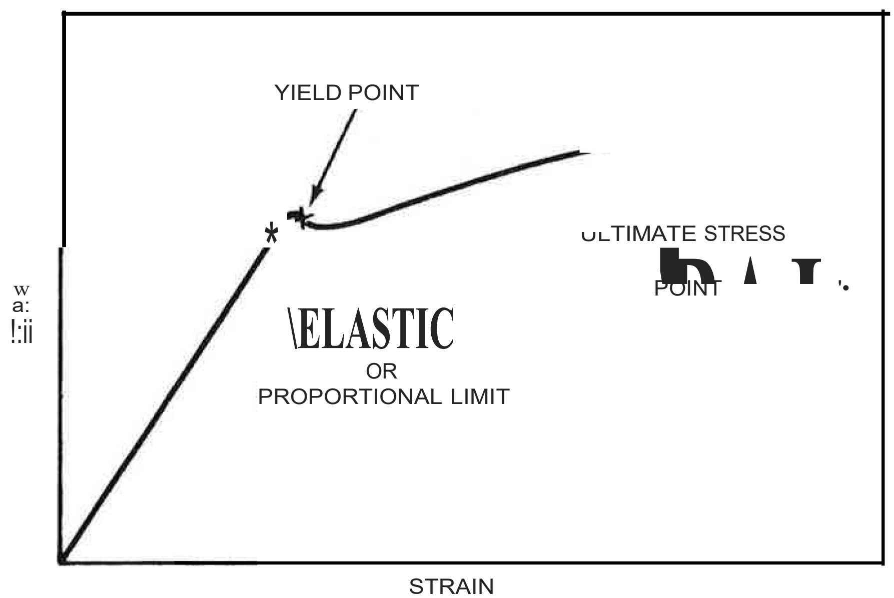


Figure 12-1. Idealized Stress versus Strain Relationship.

(I) Up to the proportional limit, as stress (or load) is increased, the strain (or elongation) increases linearly,

(2) When the stress exceeds the elastic !unit the strain increases at a greaterr a te; the material then becomes permanently stretched and will no longer behave in a per fectly elastLc manner.

(3) As the stress is increased fu r th er , the member elongates abnormally until the maximum stress withstood by the member is achieved. This is called the ultimate srt eng th of the material.

{4} If load is maintained on the member after the ultimate stress is reached, the member continues elongating until it breaks.

For future reference, the yield point and ultimate stress are synonymous with yield strength and ultimate tensile st ength. The value (E) is known as Young's Modulus and is generally a constant, below the stress whe.re yielding of the material occu s. The value of the constant (E) for some piping materials at 70°F is:

MATERIAL	E
Carbon Steel	$29,9 \times 10^6$ psi.
Stainless Steel	$28,3 \times 10^6$ psi.
Alumim11n	$10,6 \times 10^6$ psi
Copper	16.0 psi
Cast Iron	13.4 psi

As the temperature of a material increases the value o E decreases, meaning that less stress is required to produce a given strain. As a material gets colder just the opposite is true, at least to temperatures down to low atmospheric.

12.2.3 Types of Stress

Themanner in which a force or load is applied to a pipe determines the type of stress it undergoes. The types 0£ stresses that are most commonly dealt with are tensile, compressive, shearing, and bending stresses andare shown in Figure 12-2.

To show actual stress and strain values assmne that L = 100 inches, F -= 1000 pounds and the member stressed is a 6-inch, schedule 40 pipe (area of metal cross-section = 5,58 sq. in).

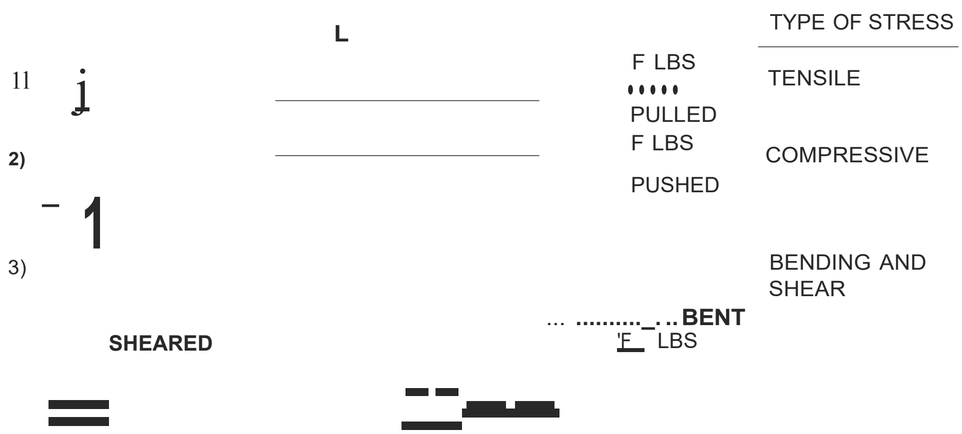


Figure 12-2. Examples of Types of Stresses

For tension or compression:

$$\text{UNIT STRESS} = \frac{F}{A} = \frac{1000}{5.58} = 179.2 \text{ psi}$$

$$\text{UNIT STRAIN} = \frac{\text{Unit Stress}}{E} = \frac{179.2}{29.9 \times 10^6} = 5.99 \times 10^{-6} \text{ in.}/\text{in.}$$

$$\text{TOTAL STRAIN } (\Delta) = L \times \text{UNIT STRAIN}$$

$$= 100 \times 5.99 \times 10^{-6} = 0.000599 \text{ inch}$$

To evaluate shearing stress, the area of metal being sheared laterally is the same as for tensile stress, therefore the indicated shear stress is the same, since $S = \frac{F}{A}$

In order to evaluate bending stress we must determine a bending moment (M) in the pipe and a special property of the pipe cross-section called section modulus or "Z." The formula for bending stress is $S_B =$ where Z can be obtained for every pipe size from piping catalogues such as in Tube Turn. It is beyond the scope of this program to explain section modulus but bending moments should be further clarified. Simply stated, when a force acts sideways on a member to cause it to bend the force causes a "bending moment" to act on the member. This moment varies proportionately with the size of the force and the distance from the point on the member where the force is applied. This relation is shown by the formula M = FX where X is the distance to a point where the bending stress is desired from F, the applied force. From the formula for bending stress previously given it is apparent that the maximum bending stress occurs at the location of the maximum bending moment or where X = L. The bending stress is $S_B = \frac{FL}{Z}$ and Z for a 6-inch schedule 40 pipe is 8.5 in.^{3},

$$\frac{1000 \times 100}{8.5} = 11,765 \text{ psi}$$

In preparing a piping specification, the wall thickness of any size pipe generally depends on a limiting pressure and temperature combination. The stress in the pipe wall due to

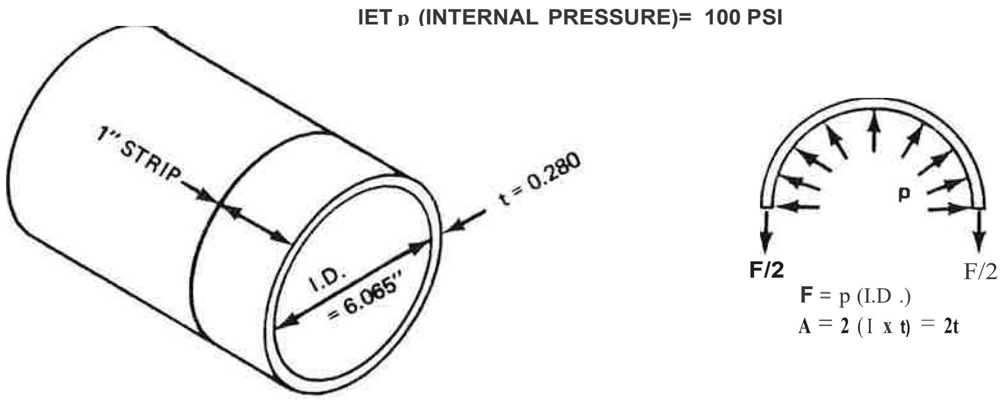


Figure 12-3. Hoop Stress from Internal Pressure.

internal pressure is a tensile stress and is commonly called hoop stress. Its value is calculated as follows.

$$F = 6.065 \times 100 = 606.5 \text{ lbs}$$

$$A = 2 \times 1 \times 0.280 = 0.56 \text{ sq. in.}$$

$$S = \frac{F}{A} = \frac{606.5}{0.56} = 1083 \text{ psi}$$

Without corrosion allowance this pipe would be within the code-allowable stress at about 1050°F.

12.2.4 Allowable Stress

When a stress analysis of a piping system is completed the maximum stress of the system has to be compared to what is known as the allowable stress permitted by code (ANSI B31. 3).

The allowable stress depends on the material the pipe is made from and the maximum service temperature that it will be subjected to. The allowable stress is determined as the lowest of the .following:

(1) 1/3 of the ultimate tensile strength

(2) 2/3 of the yield strength

(3) The stress producing a creep rate of O. 01 percent in 1000 hours

(4) 67 percent of the average stress producing rupture in 100, 000 hours (roughly eleven years of continuous operation)

(5) 80 percent of the minimum stress producing rupture in 100,000 hours

Allowable stresses also depend on whether the stress is primary (sustained) or secondary (self-limiting). An example of a sustained stress is onecaused by weight or internal pressure. A self-limiting stress is onecaused by thermal expansion. The allowable stress for sustained stresses is that for the basic material as previously described while for thermal expansion or flexibility it is roughly 1.5 to 2.5 times as much. For piping flexibility though, the allowable stress is really a stress range, This means that any pre-stressing of a piping system by cold springing uses up part of the allowable stress range, permitting only the remainder to be useful in comparing it to the final hot expansion stress. This will be discussed further later.

12 3 THERMAL EXPANSION

As a pipe is heated from normal atmospheric temperature (70°F is used as the usual base for figuring expansions) to the service temperature, it expands, and, likewise when it gets colder it contracts. This is true for virtually all materials. Water and printer's metal are twomaterials that do not follow this rule, since they expand upon cooling to the solid state. Expansion or contraction causes a piping system to be sprung between its end connections. The end connections are nozzles to pumps, turbines and compressors, vessels, heaters and air fans, or connections to other piping systems.

An example of a sprung piping system is shown in Figure 12-4.

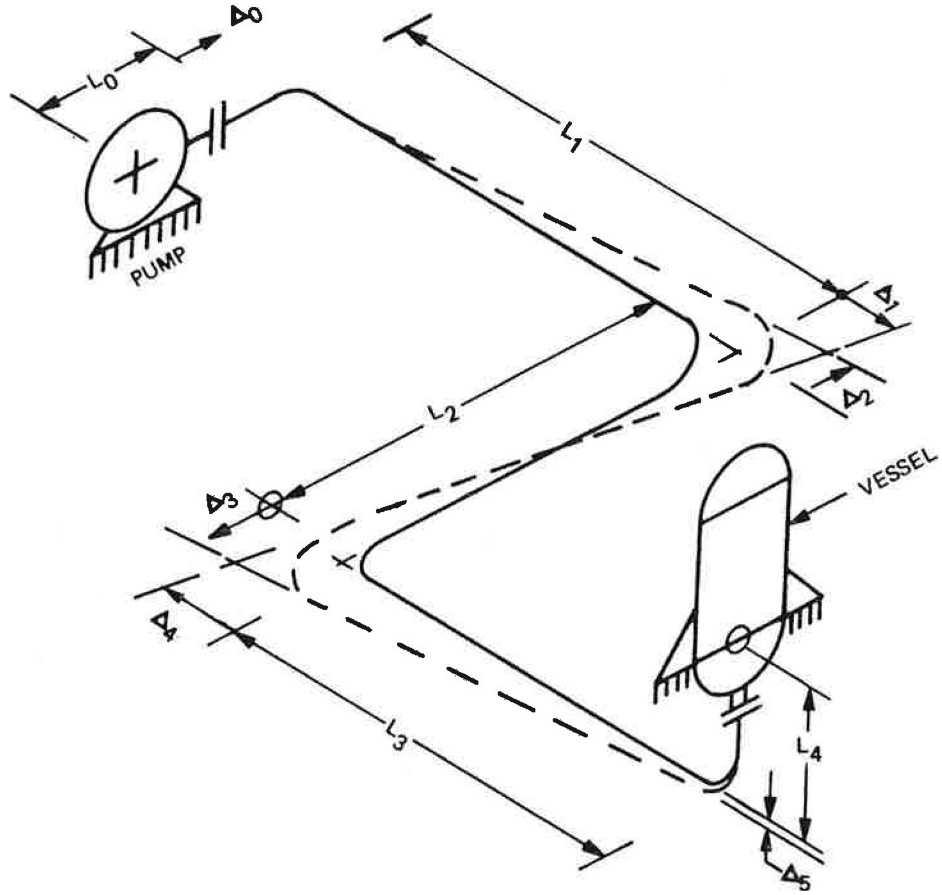


Figure 12-4.

As you can see, the various lengths have increased by the amounts shown by the synibol delta /L\). These increases in length whe n restrained from free movement cause a bending of the pipe to occur and therefore induce bending moments and srt esses. The actual expansions Ll L, .1 2, L13, etc,, are computed by multiplying the lengths by the mean coefficient of expansion, Therefore, $L1 = \frac{L}{100} a$, usually L1 is calculated in inches, L is the length of pipe in feet, and a is in inches per 100 feet,

4 REACTIONS ON EQUIPMSNT

Restraint of free thermal expansion induces reactions such as forces and bending moments in the piping and on equipment. Not only is it imperative to limit bending stresses in piping to the allowable, but reactions on equipment, especially rotating equipment, must be limited as well.

Reactions on equipment are often limited by published loads on manufacturer's drawings. Where allowable loadings are not given, it is up to the judgment of the stress analyst to limit the loadings by rules of thumb developed through years of successful application. Equipment that require close scrutiny of imposed loads are: pumps, turbines, compressors, air fans, and heaters. The stress analyst usually prepares calculations for pipe reactions on all rotating equipment operating above 250°F. Stresses in piping systems connected to equipment that are sensitive to reactions also must be well below the allowable permitted because high stresses are generally caused by high reactions, Sometimes the reactions on equipment can be reduced below the allowable by using cold spring. As previously stated, this method does not reduce stresses, because the stress range is merely shifted and not reduced by cold spring. But the reactions are reduced since the final forces and moments are a function of the actual amount of system elongation being re strained. Moreover, if the total elongation is split up so that part of it is used to pre-deform the system then the deflection at either time from neutral position, during cold spring or final operation, is less than the total.

For example, if it takes 100 pounds to deflect a cantilever beam 1 inch, then if the 1-inch deflection is split into 1/2-inch cold spring and 1/2-inch final movement, the force to cold spring or cause the final movement would be 1/2 x 100 = 50 lbs, (See Figure 12-5.)

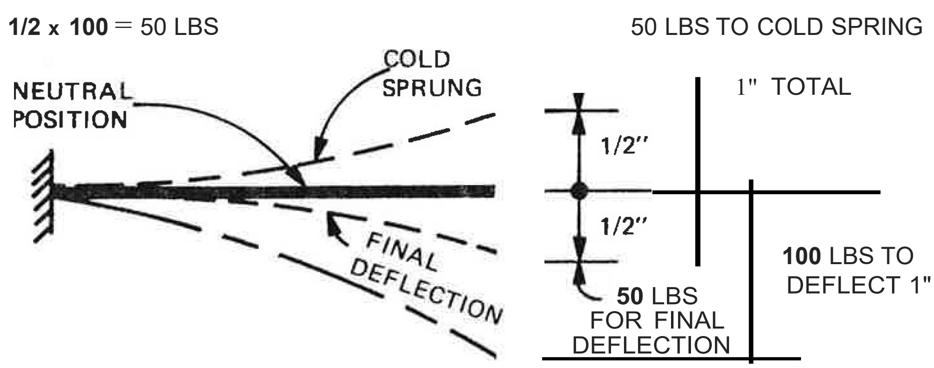


Figure 12-5.

12.5 FLEXIBILITY OF PIPING

For piping to absorb expansion or contraction within the Hxed terminals of a system the routing of the pipe must include at least one offset of sufficient length. A pipe cannot be routed in a straight line between terminals and yet absorb the effect of large temperature changes, The following example shows the forces and stresses set upby a straight pipe undergoing a temperature change.

Assume a 6 inch schedule *4-0* carbon steel pipe held between two fixed points 10 feet or 120 inches apart. If the pipe is heated up l00°F a compressive stress and reaction is set up. From formulas previously given

$$\text{UNIT STRESS} = \frac{\text{Restraining Force}}{\text{Area}} = \frac{F}{A}$$

$$\text{UNIT STRAIN} = \frac{\text{Total Elongation estrained}}{\text{Total Length}} = \frac{Ll}{L}$$

$$\text{From } E = \frac{\text{UNIT STRESS}}{\text{UNIT STRAIN}} \text{ or } \frac{F/A}{Ll/L} = \frac{FL}{All}$$

Since $\Delta l = \Delta T$

Then $E = \dfrac{F}{ALT\alpha} \qquad \dfrac{F}{AT\alpha}$

And $F = AE\alpha T$, where

α = coefficient of expansion, in/in/°F

T = total temperature change, °F

L & E described before F, lbs,

F, lbs.

NOTE: The restraining force does not depend on the length "L" of the system. Now by substituting,

$$F = 5.58 \times 29.6 \times 10^{6} \times 6.5 \times 10^{-6} \times 100 = 107,300 \text{ lbs.}$$

and $S = \dfrac{F}{A} = \dfrac{107300}{5.58} = 19,240$ psi.

Whereas the stress appears to be reasonable, although slightly higher than allowable, the reactive force is tremendous and would most likely deform or break its attachment. For small temperature changes, if the total elongation is very small and can be tolerated by equipment deformation, a direct routing may be permissible.

Since most equipment will only tolerate much smaller reactive forces and moments, piping must be routed with care to absorb the thermal expansion between fixed points. To evaluate whether a piping system is flexible enough, the stress analyst has several methods to approximate stresses and reactions. The first method is crude and employs the equations of the simple and guided cantilevers.

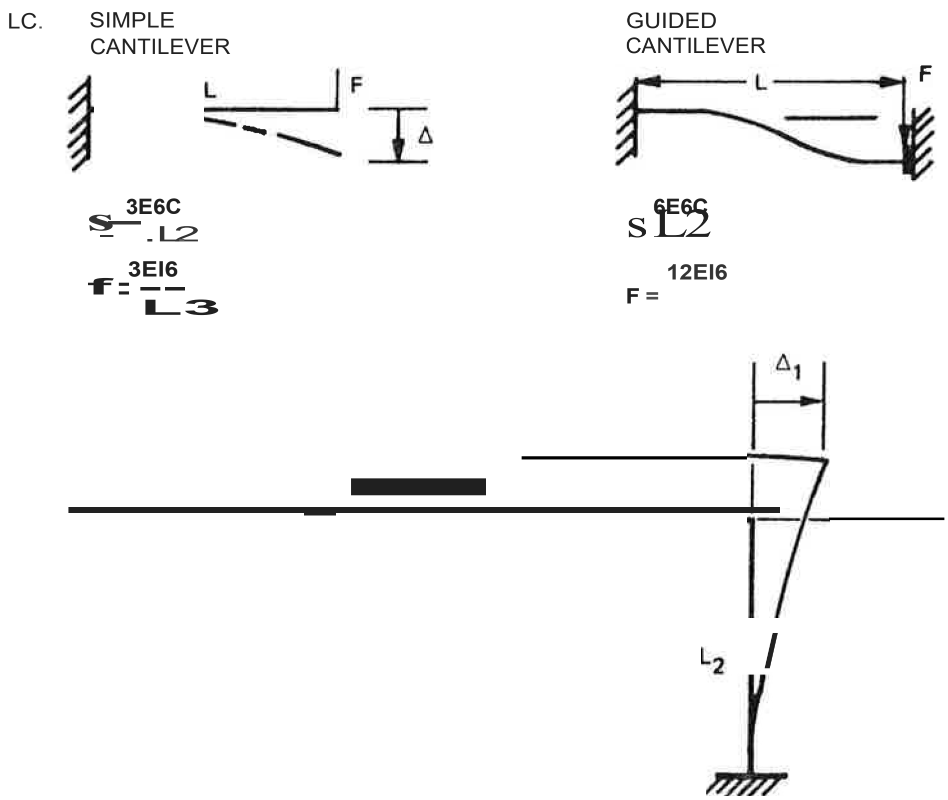


Figure 2 -6

In the above example L_1 is adjudged *to* be similar *to* a guided cantilever deflected by **6.** $_2$ and the length, L_2, is close *to* a simple cantilever deflected by $_1$. The formula is then applied and the approximate stress andforce are calculated. What-ever assumptions are made, they should be on the conservative side. In recent years a better tool has been developed to give closer approximations. This tool is the "Table for Expansion Loop Sizing." Offse sin piping systems are compared to one -half of an expansion loop and the force and stress estimates are made by direct interpolation from the tables. The reason that the expansion loop table gives such a close approximation is because it employs the effect of pipe elbow flexibility. This elbow flexibility comes from the irnattening effect" of the elbow c oss-section under an applied moment.

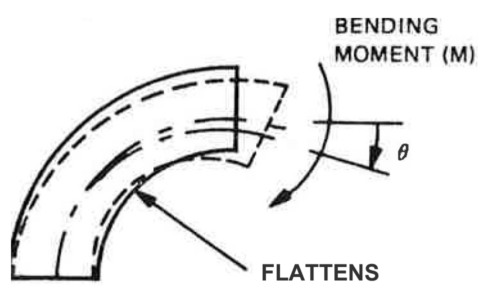


Figure 12-7

As the elbow flattens its moment of inertia or, let's say, measure of stiffness decreases. Therefore it can be thought of as a partial hinge. When two elbows are connected by a straight length of pipe, the total system becomes the major unit of flexibility in piping.

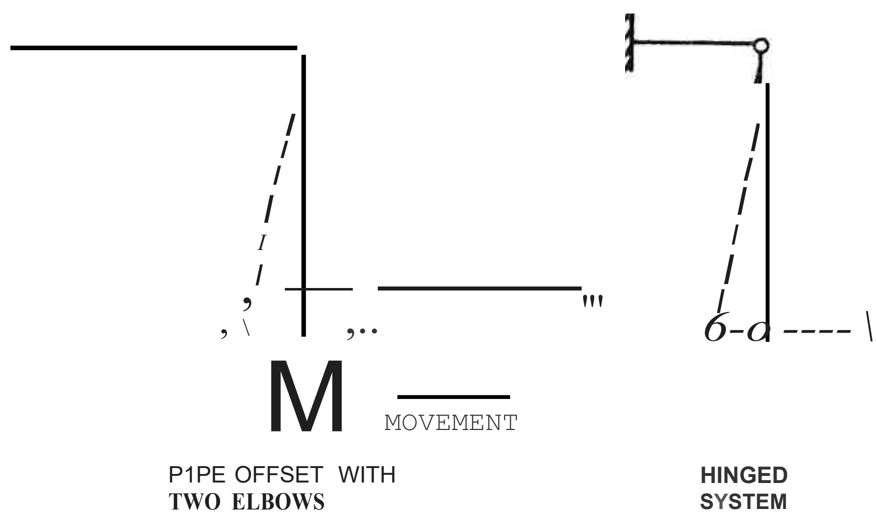


Figure 12-8. Closely Equivalent Systems.

The elbow itself absorbs some of the system elongation " " but generally only a very small per centage. Therefore, the system's flexibility is not increased greatly by simply adding elbows but rather by adding offs ts with elbows at each end. The rotation of each elbow linked together with the straight pipe accounts fot- the largest percentage of the deflection ".1"•

12. 6 STRESS RAISERS

When stresses ofpiping systems are calculated a special factor or multiplier must be included, This additional multiplier is called an intensification factor because the true stress is larger than the basic calculated stress due to a "stress raiser." Stress raisers may come from sharp reentrant angles such as at the junction of a stub-in tee to the main header or at the weld junctions of mitered elbow . When elbows flatten, a stress raiser also appears in the more sharply bent portions. These intensification factors can be computed by formulas in the B31. 3 code and are assigned the symbol "i".

The final stress at anypoint of a piping system is the calculated stress times this intensification factor. The smaller the radius of the elbow or bend the higher the "i". Mitered elbows have g eater i's than smooth elbows or bends. As the mitered ells have more sections, the i's will approach that of a smooth bend.

12.7 COMPARISON OF EXPANSION LOOPS AND TYPES OF ELBOWS

The force to deflect and the stresses induced in an expansion loop when absorbing movements from thermal expansion are not only functions of its size and shape but are also related to the type of elbows or bends used with.in it. The following exa.inple s show this relationship for two different pipe sizes.

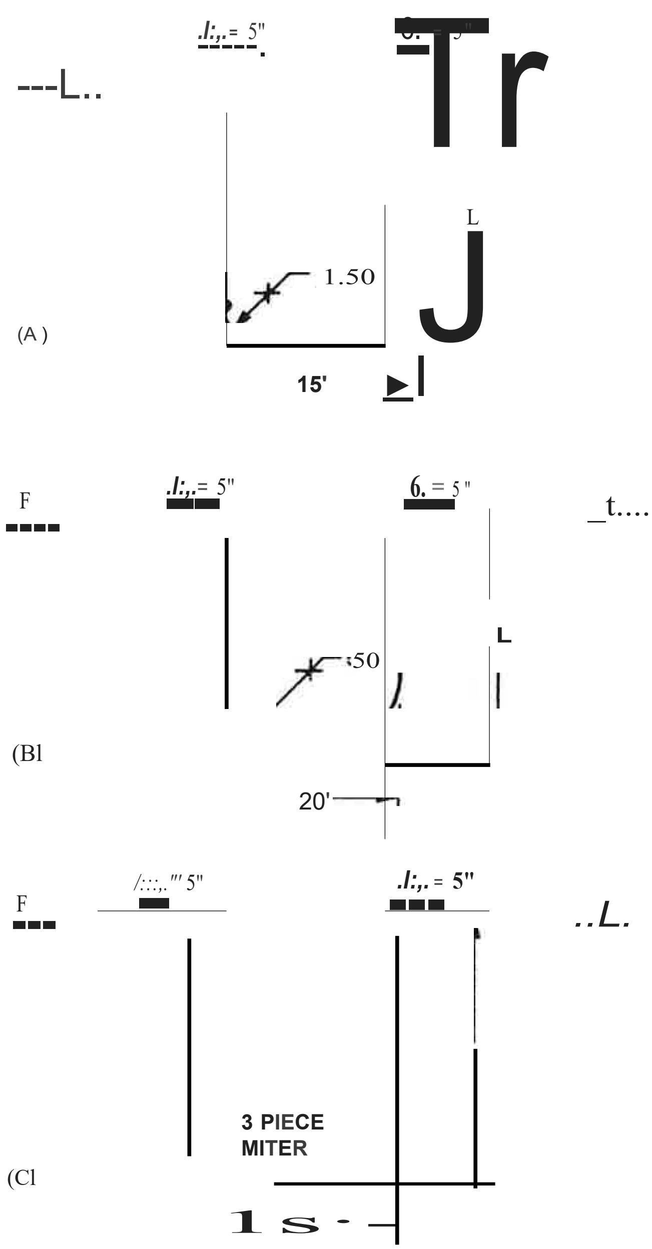
From Figure 12-9 we can conclude that:

(1) A given size expa sion loop with bends can absorb the greatest amount of expansion within the gi ven allowable stress. Thedrawbacks are that greater anchor force is needed and it is more difficult to fit into pipeways.

(2) The expansion loop with 3- piece mitered elbows (Figure 12-9 C) may be used. Although its length may present difficulties, it can be shortened by making the elbow with 4, 5, or 6 mitered sections.

12.8 8 *HOW*TOIMPROVE FLEXIBILITY

Offse ts. From previous discussions we have seen that expansions within a system between fixed points are absorbed by o.ffs e ts within the system. Wealso know that bending stresses andforces are re.Lated to the length of the offset



	6" Sch. 40	24" O. 250 Wall
(A) L =	21. 8	29. 8
F =	566 lb.	2135 lb.
(B) L =	14. 1	22. 4'
F =	1965	6259
if L =	21. 8	29. 8
F =	740	3090
(C) L =	33. 4	67. 1
F =	252	657

- to compare with 1. 5 D ell loop

Note:

1) All loops stressed to 20, 000 psi

2) Width of 5 D bend Loop = 20' for 24" pipe. This width difference from other loops shown affects loadings negligibly. "L" is the most effective dimension.

Figure 12-9

absorbing the move nt. These offsets, to be most *effi-*
cient, should be located at right angles to the imposed expansion or move nt.

(I) <u>Single Pb.ne Systern</u>

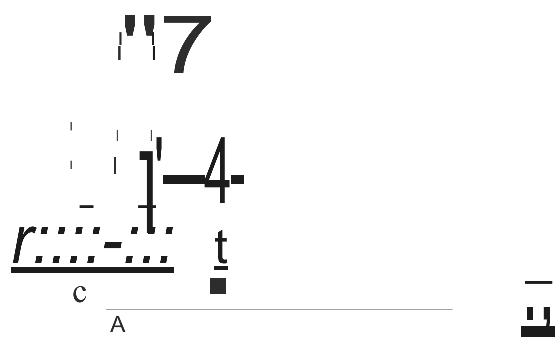


Figure 12-10.

(a) Asswne that offset "B" is too short to absorb expansion of "A".

(b) Adding loop "C" is very ineffective in improving the flexibility of the system to absorb the expansion of "A".

(c) Adding loop "D" (at right angles to expansion of **"A")** is the most efficient means of improving flexibility.

(2) <u>Multi-Plane System</u>

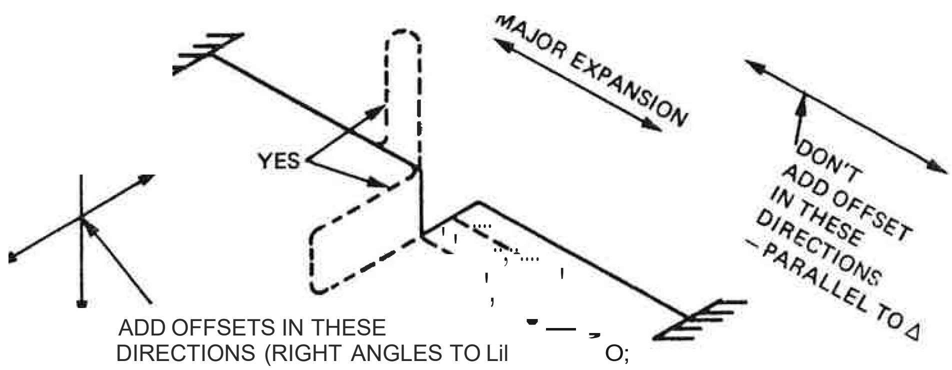


Figure 12-11.

12.9 EXPANSION ABSORBING DEVICES

If a piping system cannot employ offsets or loops to absorb expansion because of space limit ations, either expansion joints or couplings may be utilized.

(1) <u>Expansion Joints.</u> These are made up of flexible bellows or convolutions to contain pressure, yet,

allow £or axial movement or angulation. The draw-back to their use is that high anchor forces are required to contain the pressure force and spring force 0£ bellows. Tandem units, with tie-rods, at right-angle to movement provide a simpler solution.

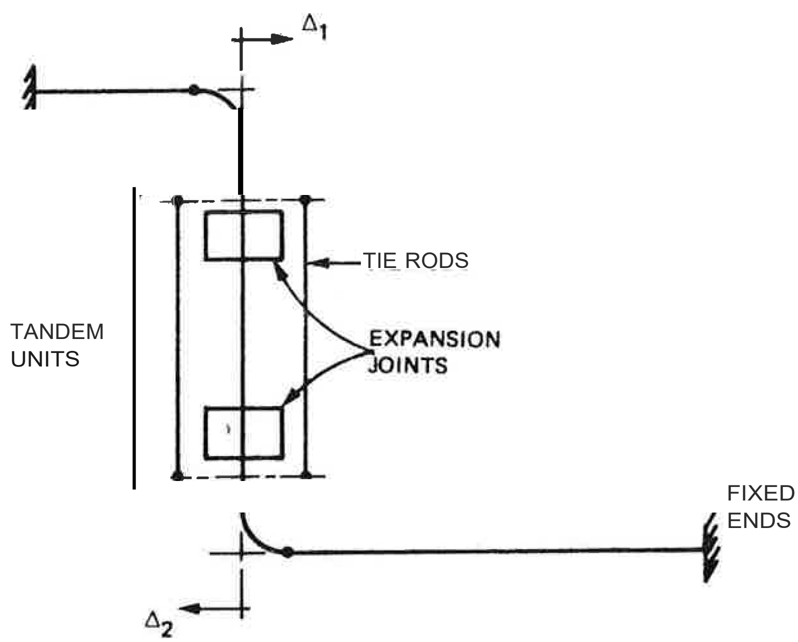


Figure 12-12.

Expansion joints are easily damaged from weld splatter which leaves pin holes, stress corrosion cracking from the presence of chlorides, and mishandl ng. The convolutions generally are O. 032 to O. 062 inch thick and are made of stainless steel.

(2} Couplings. Nor m al l y when couplings are used to absorb equipment or pipe movements they are used in pairs as in the tandem unit of (1). Although small axial movements can be accommodated by couplings - say, up to 3/8 inch each - their major use is in tankage areas or in cooling water lines where tank settlement and buried header settlement affecting connecting lines can be handled by the lateral deflection of a tandem unit. Dresser couplings and their equivalents may require tie rods across them to contain the pressure thrust. Victaulic and similar types of couplings are self containing, that is, their bolted-on clamp fits into machine grooves in the end of each adjoining pipe to prevent blowing apart. The drawback of couplings is that their leak-proof integrity depends on rubber gaskets bearing on the outer pipe surface. Therefore, their use is avoided in hydrocarbon service, except in areas away rf om process units such as tankage areas.

12. 10 CONTROLLING PIPE EXPANSION

If a length of pipe resting on pipe supports is heated it tends to expand from its center toward each end, Now if this pipe starts at a pump discharge at one end and runs the full length of the unit's pipeway, say 400 feet, and operates at 350°F, the expansion of 1/2 of its length would be 4. 6 inches, Obviously this expansion would create quite a problem around the pump. Therefore, to protect it from expansion, the pipe would be anchored in the pipeway near the pump and all the movement in the pipeway would be thrust into an expansion loop midway along the pipeway with an anchor near the far end of the pipeway to protect clearances between pipes.

The :rrnvements in interconnecting pipeways require control such that their expansion doesn't cause pipe interferences among lines entering from adjacent process units. (See Figure 12-13.)

Expansion of piping in pipeways can create clearance problems between adjacent branch lines connected to the pipeway, All branch lines are checked out for this interference as shown on Figure 12-14. Lines are never allowed to touch each other, therefore, after move nts, lines should have a minimum of 1-inch clear. Sometimes cold springing of

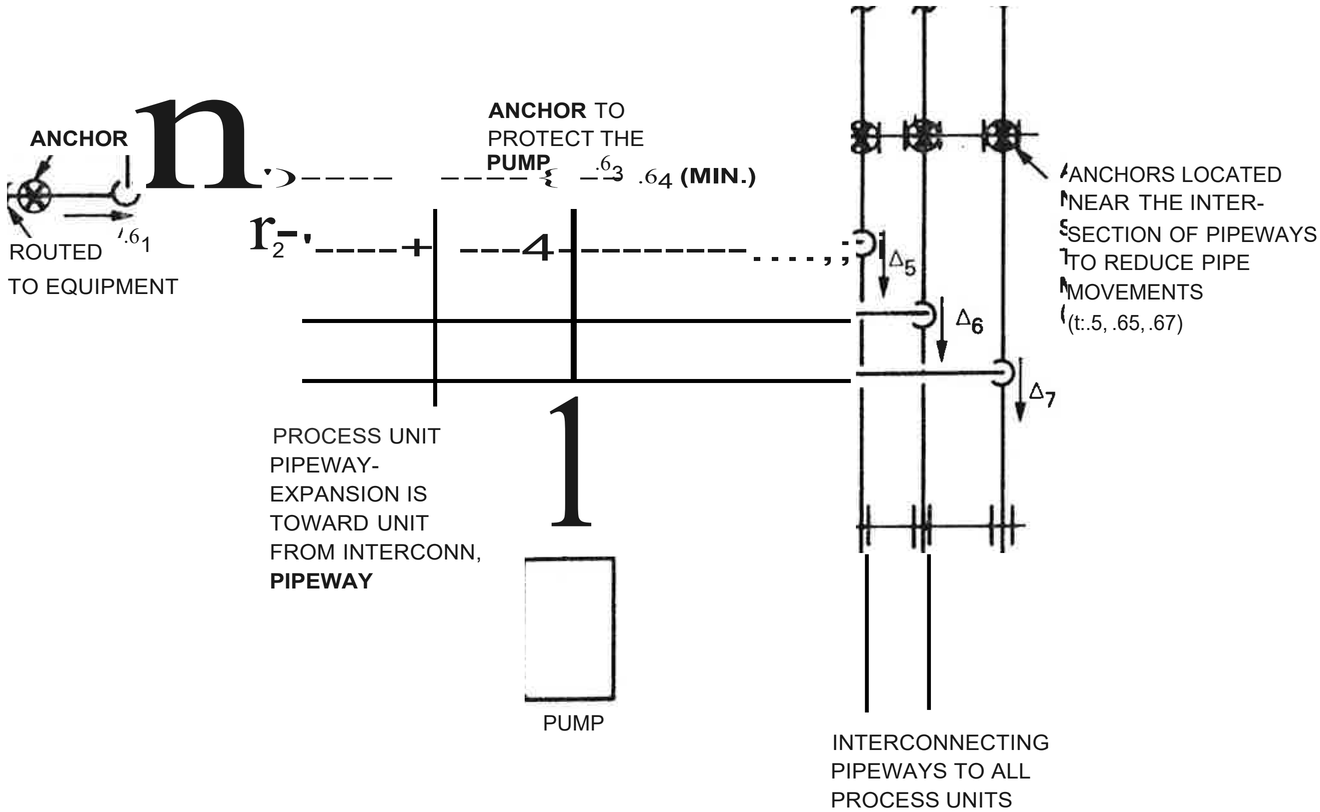


Figure 12-13.

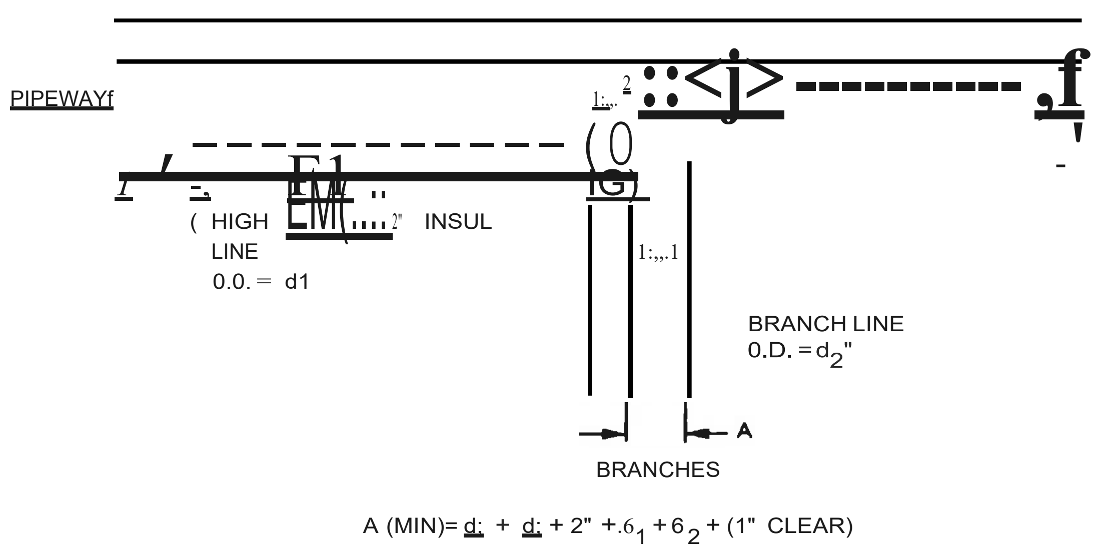


Figure 12-14,

branch lines can be utilized to provide the necessary clear- anc,e For method and rotation of cold spr inging, see P . S. A. Standard C-723.

12. 11 DESIGN CONDITIONS AFFECTING PIPE FLEXIBILITY REQUIREMENTS

The following design conditions affect pipe flexibility require- ments.

(1) Normal operating temperatures

(2) Upse t temperatures listed in line designation table column uncle r EXP

(3) Settlement of equipment foundations or pipe supports

(4) Frost heave affecting foundations or pipe supports

(5) Steam out of piping or equipment (usually taken at 300°F)

(6) Steam tracing (usually taken at 300°F)

(7) Wind loading

(8) Earthquake effect

(9) Buried pipe with temperature increase or decrease greater than say 20°F

(10) Two-phase flow (slug flow)

12. 12 ELIMINATING STRESS PROBLEMS IN PLANT LAYOUT

The following objectives should be considered in order to eliminate stress problems during plant layout.

(1) Ptunp locations relative to connected equipment - See Figure 12-15

(2) Routing of overhead vapor line to exchangers and air fans - See Figure 12-15

(3) Routing of connecting pipe from fractionating columns to strippers - See Figure 12-16

(4) Avoidance of direct routing of pipe bet\.veen equip- nt - See Figure 12-16

(5) Locating large heavy lines in pipeways near stanchion columns - See Figure 12-17

(6) Location of steam header in pipeway servicing tur- bines - See Figure 12-17

(7) Piping between pwnps operating at high temperature or subject to steam out, See P.S.A. StdC-732 (being prepared}

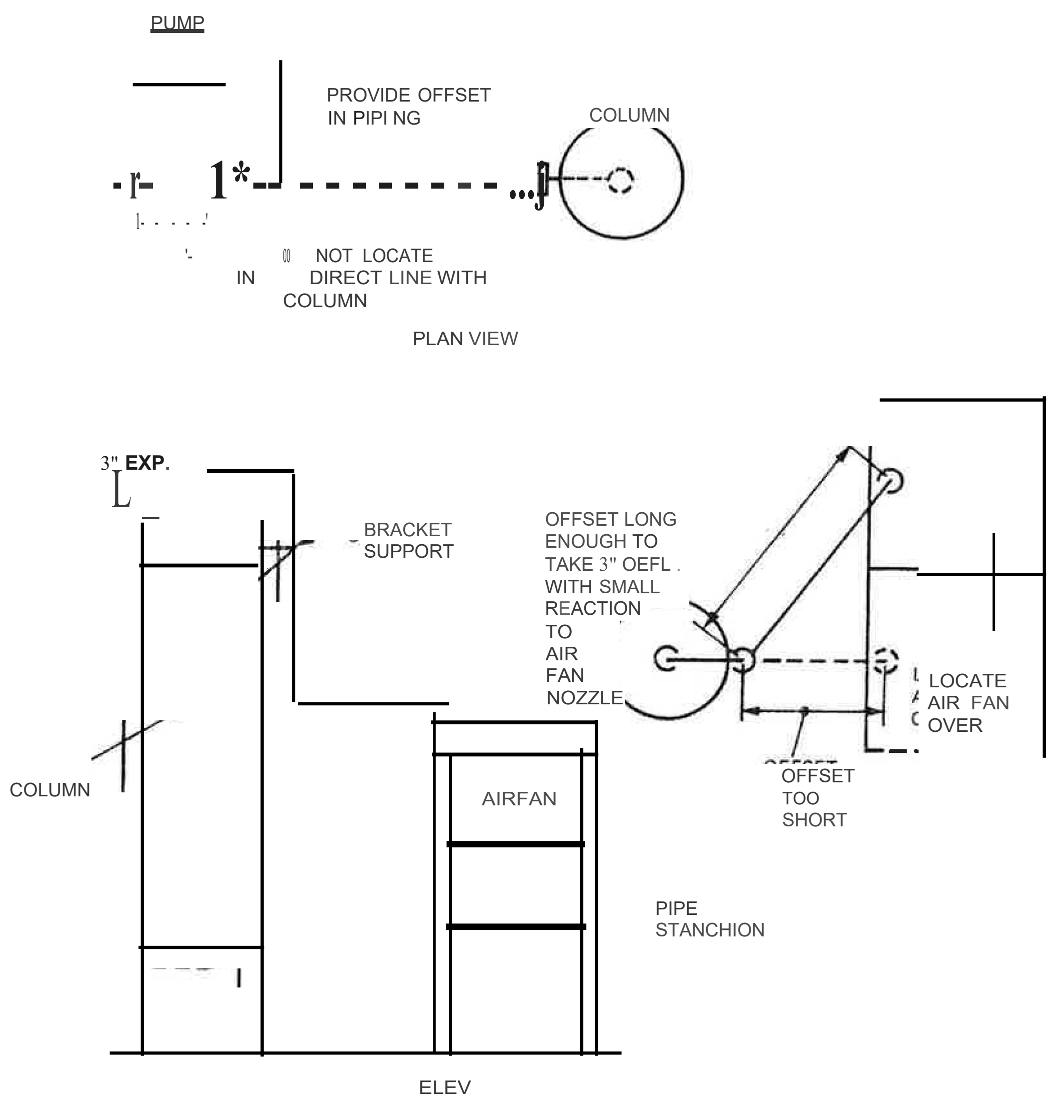

PUMP
PROVIDE OFFSET
IN PIPI NG
COLUMN
NOT LOCATE
IN DIRECT LINE WITH
COLUMN
PLAN VIEW
3" EXP.
BRACKET
SUPPORT
OFFSET LONG
ENOUGH TO
TAKE 3" OEFL .
WITH SMALL
REACTION
TO
AIR
FAN
NOZZLE
LOCATE
AIR FAN
OVER
COLUMN
AIRFAN
OFFSET
TOO
SHORT
PIPE
STANCHION
ELEV

Figure 12-15.

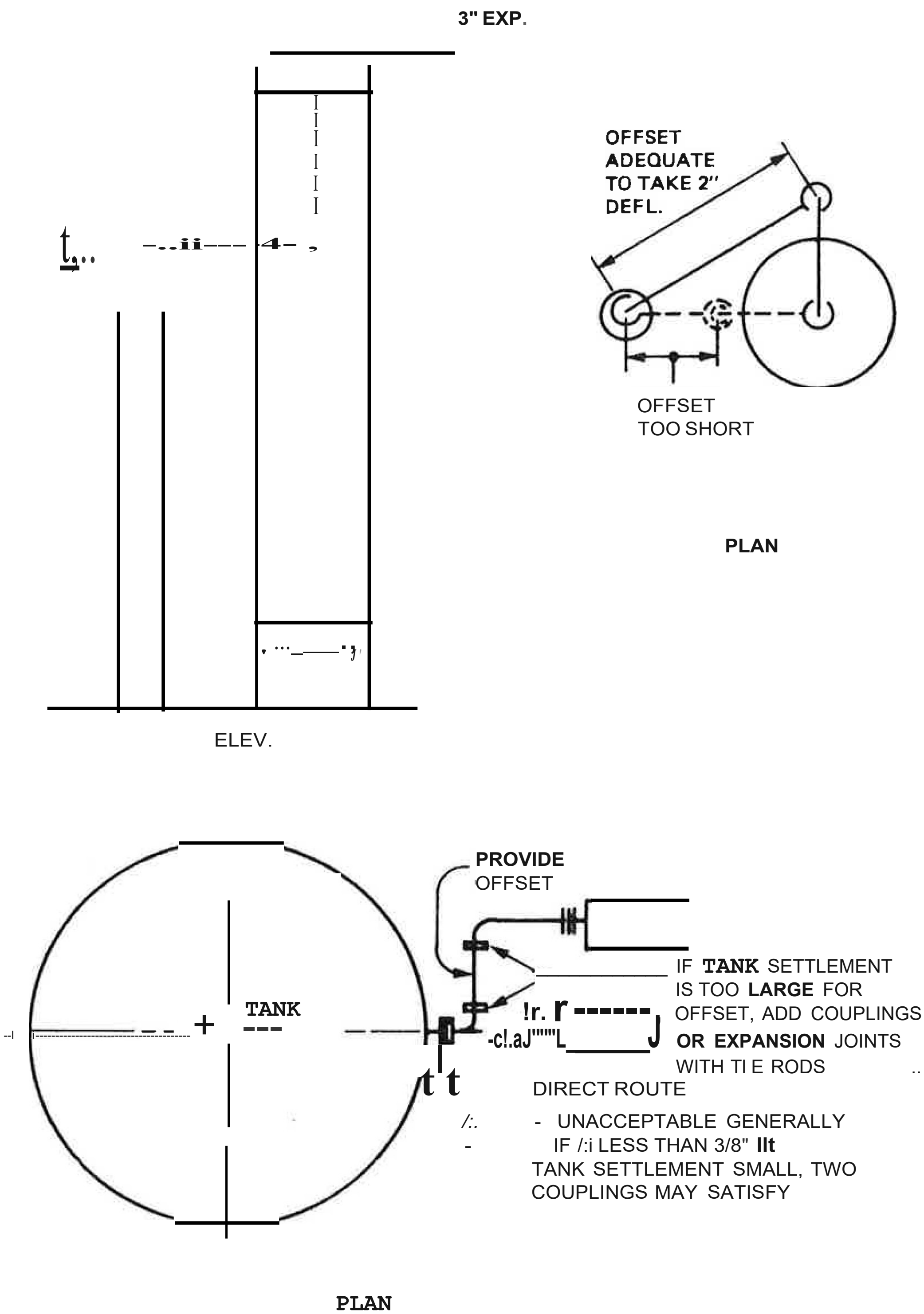

3" EXP.
ELEV.
OFFSET ADEQUATE TO TAKE 2" DEFL.
OFFSET TOO SHORT
PLAN
PROVIDE OFFSET
TANK
IF TANK SETTLEMENT IS TOO LARGE FOR OFFSET, ADD COUPLINGS OR EXPANSION JOINTS WITH TIE RODS
DIRECT ROUTE
- UNACCEPTABLE GENERALLY
IF LESS THAN 3/8"
TANK SETTLEMENT SMALL, TWO COUPLINGS MAY SATISFY
PLAN

Figure 12-16.

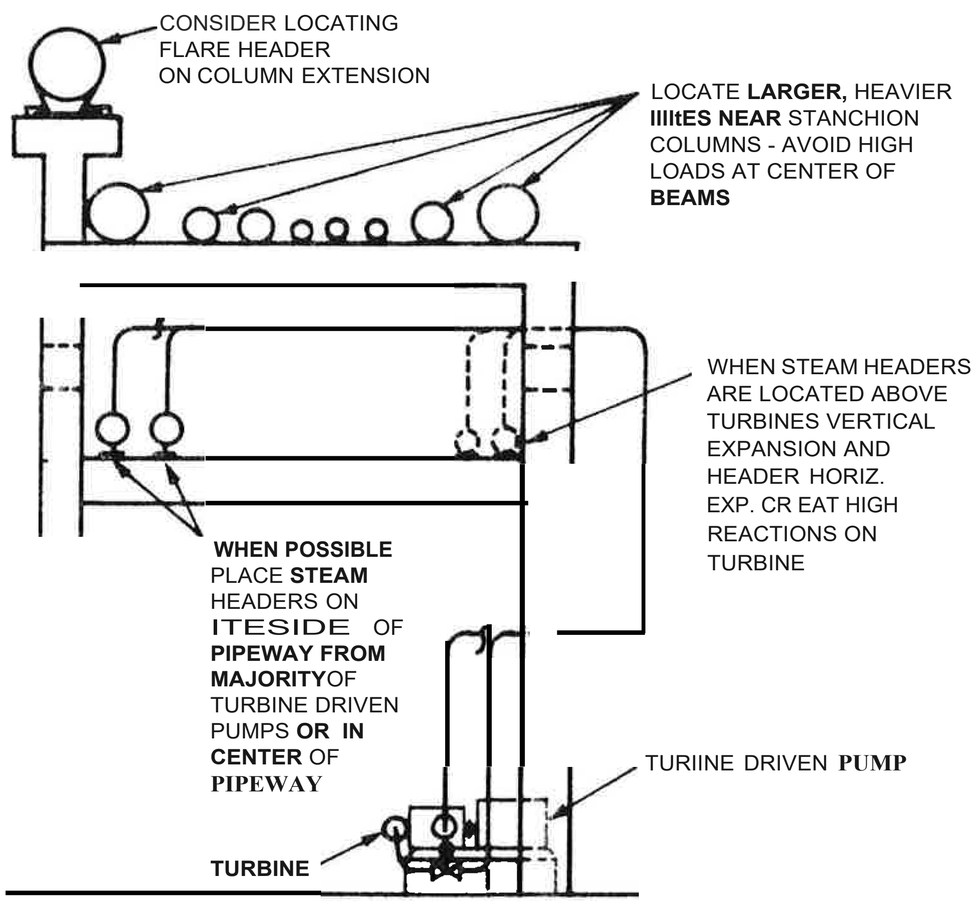

CONSIDER LOCATING
FLARE HEADER
ON COLUMN EXTENSION
LOCATE LARGER, HEAVIER
IIIItES NEAR STANCHION
COLUMNS - AVOID HIGH
LOADS AT CENTER OF
BEAMS
WHEN STEAM HEADERS
ARE LOCATED ABOVE
TURBINES VERTICAL
EXPANSION AND
HEADER HORIZ.
EXP. CR EAT HIGH
REACTIONS ON
TURBINE
WHEN POSSIBLE
PLACE STEAM
HEADERS ON
ITESIDE OF
PIPEWAY FROM
MAJORITYOF
TURBINE DRIVEN
PUMPS OR IN
CENTER OF
PIPEWAY
TURIINE DRIVEN PUMP
TURBINE

Figure 12-17.

(8) Piping inlet and outlet manifolds to airfans (See P. S. A. Std. C-717 and C-718)

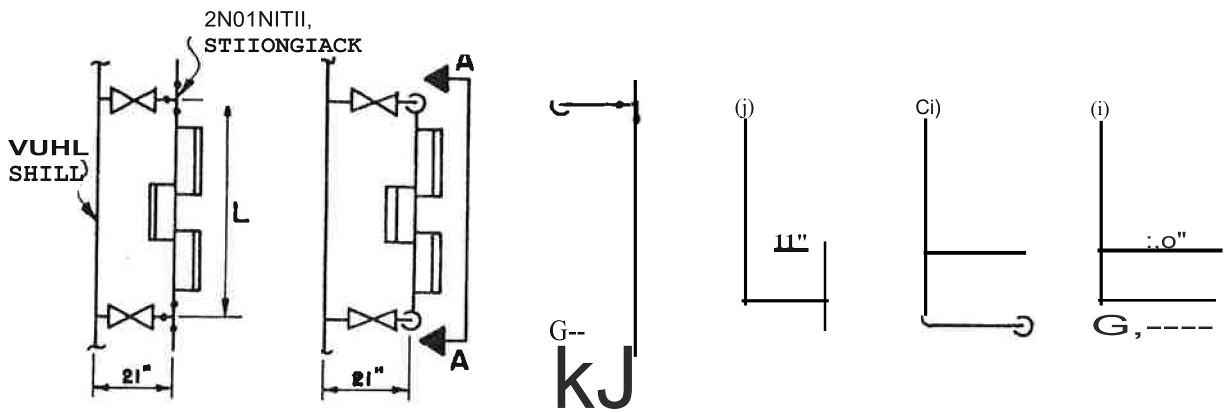
(9) Instrumentation piping on vessels (See P. S. A. Std. C-706)

(10) Providing adequate clearance between branch lines to high temperature headers and adjacent branches to headers of other services - See Figure 12-14

(11) Stacked exchanger nozzle flexibility requirements - See P.S.A. Std. C-715

<u>USEFUL PIPING STRESS ANALYSIS STANDARDS</u>

- Standard support symbols '<;- 707
- Cold spring notations C-723
- In-line purn.p supports C-729
- Thermal expansion of steels E-M-542 and 543



TYPE 1

TYPES 2,3,4 AS

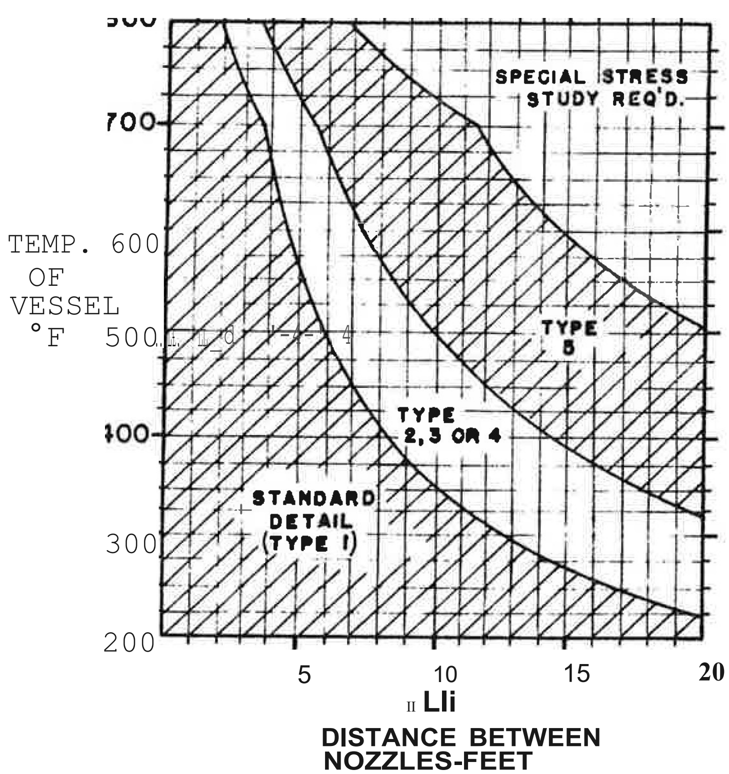
TYPE 2

TYPE 3

TYPE 4

TYPE 5

SECTION **A-A**
DETAILS



Instructions:

1. Enter chart with distance between nozzles and vessel temperature.
2. Intersection determines type of detail required. A detail of higher number is also acceptable.
3. Points falling to right of area for detail 5 require special stress studies.

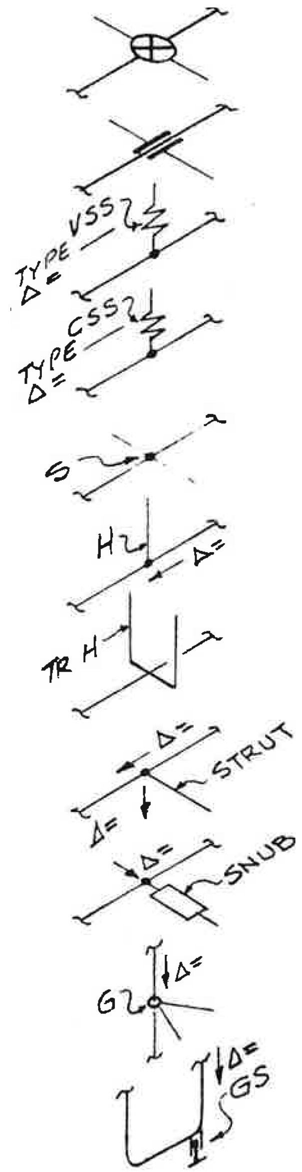
Ref Par. 6.04a) D.G. C-

No.	DATE	REVISIONS	BY	CH'K	AP'P
0	6/	Issued as Eng Standard	JHS		JBK

ORIGIN
R&C ENGR
SF
VESSEL

PIPING STRESS ANALYSIS
INSTRUMENT STRONGBACK
FLEXIBILITY REQUIREMENT

STANDARD DRAWING NO.
C-706 0

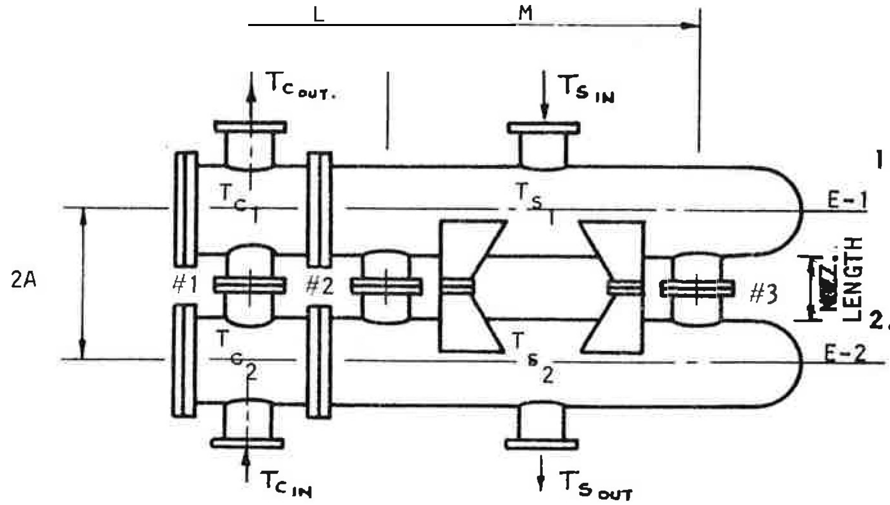


SYMBOL	DESCRIPTION	COMMENTS
	Anchor	**Axial** Anchor only. Allows lateral movement. No description required with the symbol
	Guide	Stops lateral movement only or limits movement. No description required with the symbol
	Variable load spring support	Used where <3" and load variation unharmful. Give Δ
	Constant load spring support	Used where Δ>3" and/or load variation harmful to system. Give Δ
	Solid, resting type, support	Any of several resting type supports
	Single rod hanger	Any of several solid hangers. Deflection may be limited. Give
	Trapeze Hanger	Same as for H
	Guide Strut	If reactions greater than wind load, state amount. Give Δ's
	Hydraulic type Vibration snubber	Allows for slow thermal expansion. Give axial Δ and max. reaction.
	Vertical line guide	Give axial Δ and direction of stop, if required
	Socket Guide	Give Vertical Δ

NOTE: Δ, • Pipe **expansion** or other induced movements

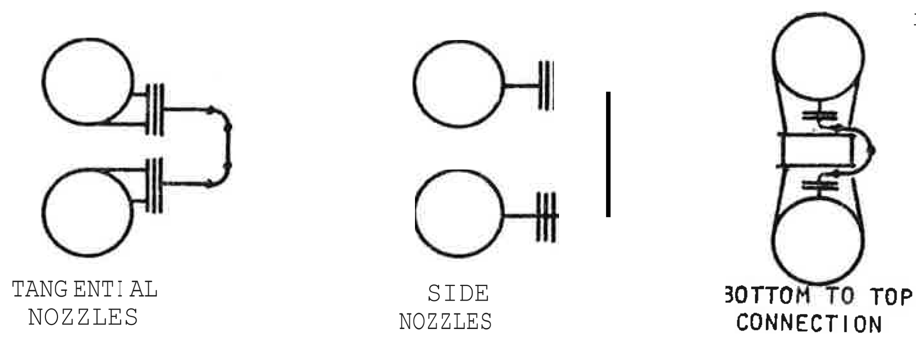
Ref Psr. 7.16a) D.G. C-5

1								
&	6/71	Issued as Engineering Standard			J			1
No.	DATE	REVISIONS	BY	CHK	DESIGN SUPV	ENG.	PROJ ENGR	APP
SCALE	DESIGNED	DRAWN						
DESIGN R&C ENGR SF VESSEL	BECHTEL	PIPING **STRESS** ANALYSIS / STANDARD SUPPORT SYMBOLS			JOB No.		DRAWING No c-707	REV. 0



WHERE:

1. T_{S_1}, T_{S_2}, T_{C_1}, and T_{C_2} are average she!1 and channel temperatures. See L-512, for aver. dimensions 2A, L&M.
2. For arr'g't shown assume (H) x Difference in shell axial expansions act on nozzle #3, since #l acts generally in a **very** rigid shell with **flanges** adding further rigidity.



NOZZLE ARRANGEMENTS USED TO INCREASE FLEXIBILITY

NOTES:

1. Letting $Tc = \frac{Tc_1 + Tc_2}{2}$ and $Tsm = \frac{Ts1 + Tsz}{2}$, then

if Tsm - Term < 200°F and if Ts1 - Tsz < 100°F

the exchangers may be directly connected per Std. L512 based upon past experience, but, if either is exceeded, the nozzle arrangement should be revised such that pipe elements can be included to absorb the differential expansions. Include in a piping flexibility calculation the 9pring constants of nozzle rotation from C-716. Neglect effect of saddle supports in calculation.

REF.:

1. D.G. C-5 - Par. 6.08b)& 7,20b)
2. Ref. Eng. Std. L-512 "Dimensional Guide for Shell and Tube Exchangers"

No	DATE	REVISIONS	BY	CHK'D	DESIGN SUPV	ENG'G	PROJ ENGR	APPR
0	6/71	Issued as Engineering Standard						

SCALE | DESIGNED | DRAWN

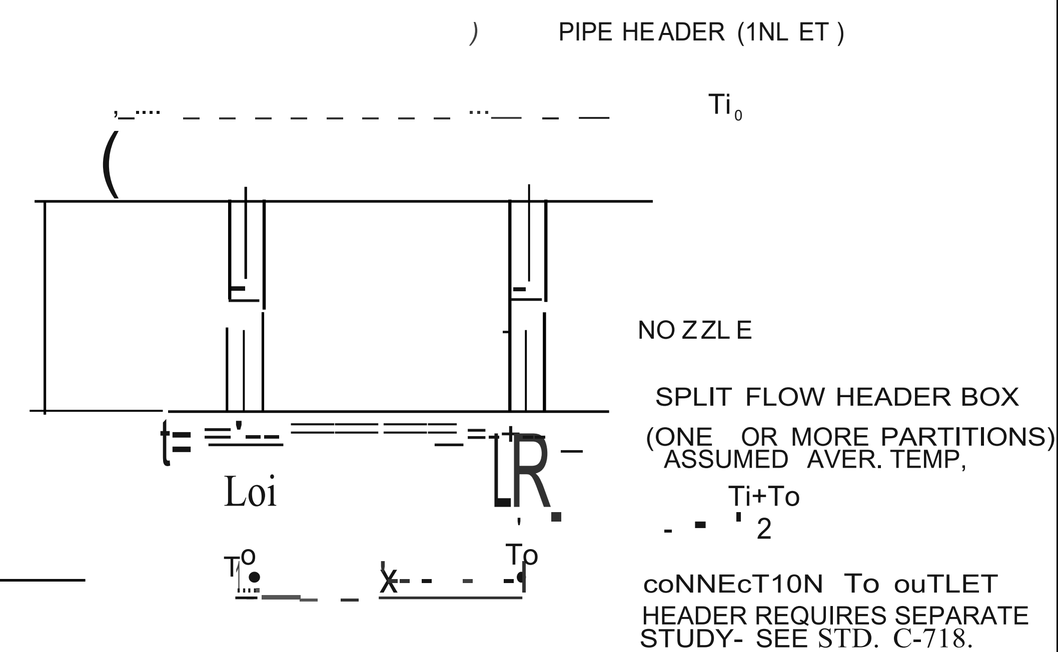
ORIGIN: R & C PRESS VESS

BECHTEL

PIPING STRESS ANALYSIS
STACKED CXCHANGE
NOZZLE FLEXIBILITY
REQUIREMENTS

JOB No. STANDARD

DRAWING No. C-715 | REV.



DESIGN BASIS:

1. WHERE TOTAL DIFFERENTIAL EXPANSION (Δ) OF THE AIR FAN HEADER **BOX 8** PIPE HEADER **BETWEEN** NOZZLES (X FT) IS 1/4S OR LESS, "J..." **MAY BE** FITTING **MAKEUP.**

2. WHERE !J.. IS GREATER THAN 16, THE **MINIMUM** LENGTH OF "y _" MAY BE CALCULATED BY THE FOLLOWING FORMULA:

WHERE: E= 30×10^6 PSI (C. S.)

$$\ell = \sqrt{\frac{6E}{S}} \times \frac{\sqrt{\Delta D}}{2}$$

S= 60,000 PSI (C. S.)

Δ= EXPANSION BETWEEN NOZZLES- IN.

D= 0.D. OF PIPE-IN.

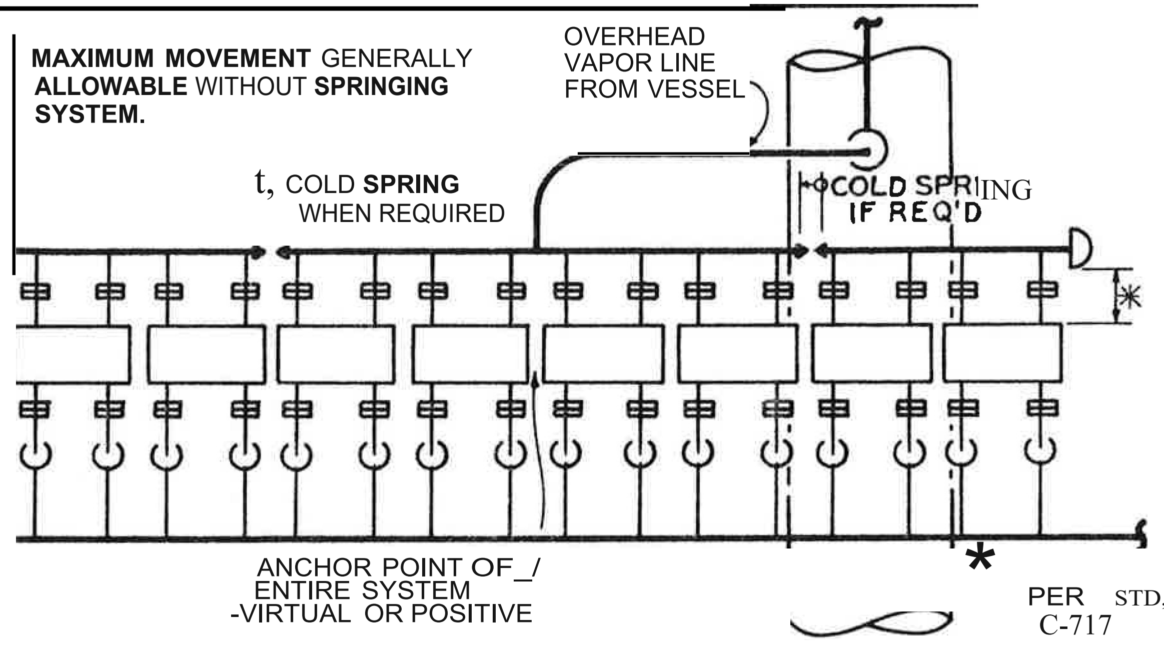
$\therefore$ ℓ = 27 (INCHES)

NOTE: SIS BASED ON THE ALLOWABLE TOTAL STRESS FOR 1000 CYCLES OF STRESS REVERSAL FOR **CARBON** STEEL **(FROM ASME** SECT. EII, DIVISION 2)- REDUCED BY 23,000 PSI TO ALLOW FOR PRESSURE, STRESS **RAISERS,** ETC.

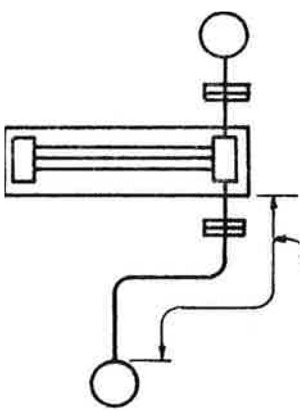
Ref Par. 5.41 D.G. C-5

No	DATE	REVISIONS	BY	CHK D	DESIGN SUP'V	ENG II	PROJ ENGII	APPA
1	6/71	Issued as Engineering Standard			JM:,			

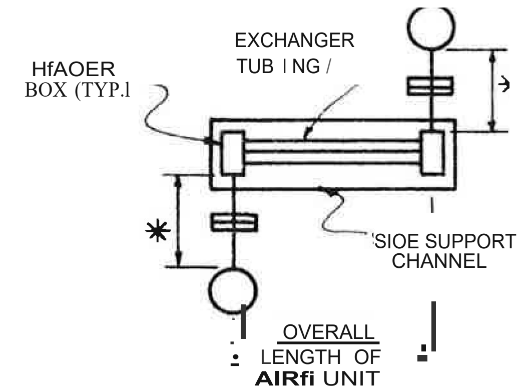
SCALE	DESIGNED	DRAWN P.8	CHIEF ENGII
ORIGIN R&C ENGR S.F. Vessel	PIPING STRESS ANALYSIS AIR FAN COOLER NOZZLE LENGTH COMPUTATION		JOB No. DRAWING No C-717 REV. 0



TYPICAL PIPING ARRANGEMENT
OF AIR FANS WITH INLET 8 OUTLET AT SAME END



TYPICAL PIPING FOR AIR FANS WITH INLET a OUTLET **AT SAME END**



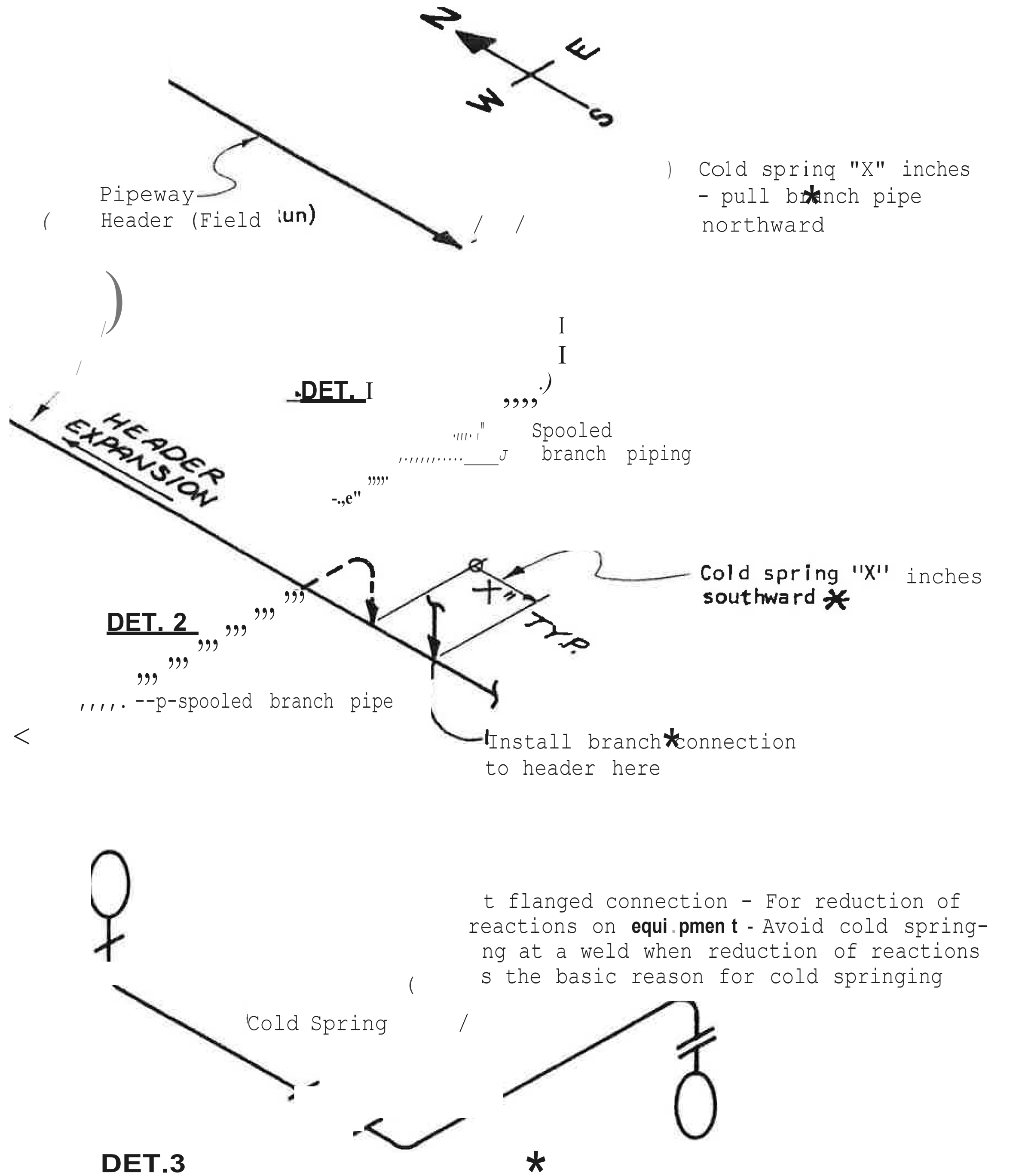
TYPICAL PI PING FOR AIR FANS WITH INLET a OUTLET AT OPPOSITE ENDS

NOTE:

1. When pipe header expansion exceeds amount specifically permitted by air fan design, cold spring header to provide additional clearance required.
2. When nozzles are at same end of air fan provide flexibility to one pipe header as shown.
3. When inlet & outlet are at opposite ends use minimum nozzle length permitted by C-717, Ref Par. 5.43 D.G. C-5

No.	DAU	II(VIIIONI	IY	CHK I	i;t;IIGN	ENG R	PROJ ENGR	
△								
△								
△0		Issued as Englneerin Standard			JMS	ENG	JBK	

SCALI	DUIGNIO	OIIAWN .D & .	CHIf IN JBK
OIIIGIN R&C Engr. S,F, Vessel	BECHTEL	PIPING STRESS ANALYSIS AIR FAN PIPING SYSTEM DESIGN	J0I No. STANDARD; OIIAWING Ho. C-718; 0

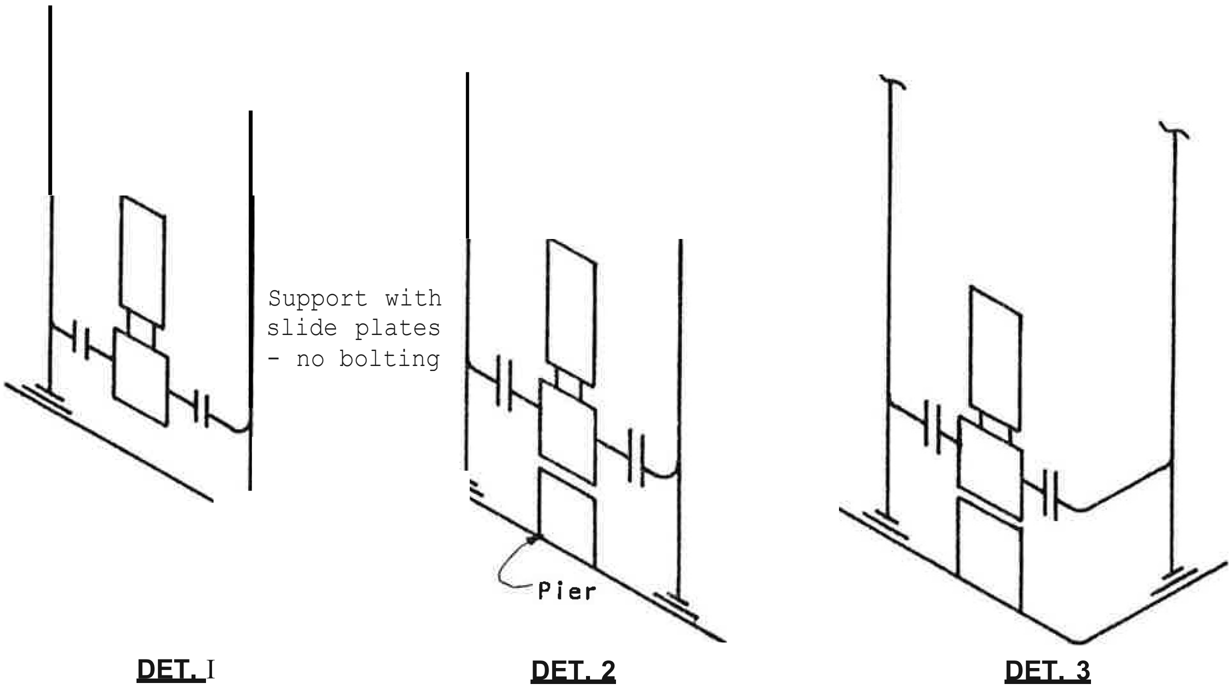


* Add these notations to Iso or piping dwg.

Ref. Par 5,25, 6.092 g), 7,08 d) D.G. C-5

No.	DATE	REVISIONS	BY	CHK D	DIVISION SUPV	ENG R	PROJ ENGR	APPR
0	6/-11	Issued as Engineering Standard (was Fig. I)						

SCALE		DESIGNED	DRAWN	CHIEF ENGR	
ORIGIN: R&C ENG SF VESSEL	BECHTEL	PIPING STRESS ANALYSIS COLD SPRING NOTATIONS	JOB No. STANDARD	DRAWING No c-723	REV. (J



Notes:

1. Where the in-line pump horsepower is 75 H.P. or less use method shown on Det. I.

2. Where in-line pump horsepower is greater than 75 H.P. use method shown on Det. 2.

3. Where piping is eccentric, support as shown in Det. 3.

4. Where frost heave will affect piping detrimentally put all supports on foundations extending below the frost line.

5. Previous investigations have shown that earthquake loadings on typical systems are acceptable.

D. G. C-5 Ref. Par. 5.105 & 6.05

No.	DATE	REVISIONS		BY	CHK D	DESIGN SUPV	ENG R	PROJ ENGR	APPR
0	6/71	Issued as Engineering Standard (was Fig.7)				JMS			

SCALE | DESIGNED | DRAWN | CHIEF ENGR

ORIGIN: R&C ENG SF VESSEL

BECHTEL

PIPING STRESS ANALYSIS
IN-LINE PUMP SUPPORTS

JOB No. STANDARD

DRAWING No. C-729 REV. 0

Notes, 1. Carbon Steel (C.S.) • Carbon-Moly Steel - Low Chrome Steels (thru 3% Cr.)
2. Low Chrome (L.Cr.) • Intermediate Alloy Steels (5% Cr. Mo. thru 9% Cr.Mo.)
3. High Chrome (H.Cr.) • Straight Chromium Stainless Steels; 12% Cr. 17% Cr. and 27 Cr.

EXPANSION IN "/100'

°F	C.S.	L.Cr.	H.Cr.	°F	C.S.	L.Cr.	H.Cr.	°F	C.S.	L.Cr.	H.Cr.
70	0	0	0	570	4.3	4.0	3.7	1000	8.9	8.1	7.4
100	0.3	0.3	0.3	80	4.4	4.1	3.7	10	9.0	8.2	7.5
20	0.4	0.4	0.4	90	4.5	4.2	3.8	20	9.1	8.3	7.6
40	0.6	0.5	0.5	600	4.6	4.2	3.9	30	9.2	8.4	7.7
50	0.7	0.7	0.6	10	4.7	4.3	4.0	40	9.4	8.5	7.8
60	0.8	0.8	0.7	20	4.8	4.4	4.1	50	9.5	8.6	7.9
200	1.0	0.9	0.9	30	4.9	4.5	4.2	60	9.6	8.7	8.0
10	1.1	1.0	0.9	40	5.0	4.6	4.2	70	9.7	8.8	8.0
20	1.2	1.1	1.0	50	5.1	4.7	4.3	80	9.8	8.9	8.1
30	1.2	1.2	1.1	60	5.2	4.8	4.4	90	9.9	9.0	8.2
40	1.3	1.3	1.1	70	5.3	4.9	4.5	1100	10.0	9.1	8.3
50	1.4	1.3	1.2	80	5.4	5.0	4.6	10	10.2	9.2	8.4
60	1.5	1.4	1.3	90	5.5	5.1	4.7	20	10.3	9.2	5.5
70	1.6	1.5	1.4	700	5.6	5.1	4.7	30	10.4	9.3	8.6
80	1.7	1.6	1.4	10	5.7	5.2	4.8	40	10.5	9.4	8.7
90	1.7	1.6	1.5	20	5.8	5.3	4.9	50	10.6	9.5	8.8
300	1.8	1.7	1.6	30	6.0	5.4	5.0	60	10.7	9.6	8.8
10	1.9	1.8	1.6	40	6.1	5.5	5.1	70	10.8	9.7	8.9
20	2.0	1.9	1.7	50	6.2	5.6	5.2	80	10.?	9.8	9.0
30	2.1	2.0	1.8	60	6.3	5.7	5.3	90	11.0	9.9	9.1
40	2.2	2.0	1.9	70	6.4	5.8	5.3	1200	11.1	10.0	9.2
50	2.3	2.1	1.9	80	6.5	5.9	5.4	10	11.2	10.1	9.3
60	2.4	2.2	2.0	90	6.6	6.0	5.5	20	11.L	10.2	9.4
70	2.4	2.3	2.1	800	6.7	6.1	5.6	30	11.L	10.3	9.5
80	2.5	2.3	2.2	10	6.8	6.2	5.7	40	11.6	10.L	9.6
90	2.6	2.4	2.2	20	6.9	6.3	5.8	50	11.1	10.5	9.7
400	2.7	2.5	2.3	30	7.0	6.4	5.9	60	11.8	10.6	9.8
10	2.8	2.6	2.4	40	7.1	6.5	6.0	70	11.9	10.7	9.8
20	2.9	2.7	2.5	50	7.3	6.6	6.1	80	12.0	10.9	9.9
30	3.0	2.8	2.5	60	7.4	6.7	6.1	90	12.1	11.0	10.0
40	3.1	2.8	2.6	70	7.5	6.8	6.2	1300	12.2	11.1	10.1
50	3.2	2.9	2.7	80	7.6	6.9	6.3	10	12.3	11.2	10.2
60	3.3	3.0	2.8	90	7.7	7.0	6.4	20	12.L	11.3	10.3
70	3.3	3.1	2.9	900	7.8	7.1	6.5	30	12.6	11.4	10.4
80	3.4	3.2	2.9	10	7.9	7.2	6.6	40	12.7	11.5	10.5
90	3.5	3.3	3.0	20	8.0	7.3	6.7	50	12.8	11.6	10.6
500	3.6	3.4	3.1	30	8.1	7.4	6.8	60	12.9	11.7	10.7
10	3.7	3.4	3.2	40	8.2	7.5	6.9	70	13.0	11.8	10.7
20	3.8	3.5	3.2	50	8.4	7.6	7.0	80	13.1	11.9	10.8
30	3.9	3.6	3.3	60	8.5	7.7	7.0	90	13.2	12.0	10.9
40	4.0	3.7	3.4	70	8.6	7.8	7.1	1400	13.3	12.1	11.0
50	4.1	3.8	3.5	80	8.7	7.9	7.2				
60	4.2	3.9	3.6	90	8.8	8.0	7.3				

Rev.	Date	Description
A		
b.		
b.		
A	DA.Tk1nls1	Issued as Engineering Standard

BECHTEL ENGINEERING STANDARD
THERMAL EXPANSION OF
CARBON & CHROME ALLOY STEELS

BECHTEL CORPORATION

DR. Dk, | CH'K. | Ok. SUP. | ENG. | CHIEF ENG.
DATE 5"-23-% | JOB No.
DRAWING No. E-:·:-51.i2 | REV. 0

Notes: 1. A,1st ani t Le StainlP-ss Steel (18-8) = 18% Cr. - e0 Ni.
2. A'c!stenitic Stainless Steel (25-12) = 25% Cr. - 12% Ni
J. bstenitic :...tainless Steel (25-20) = 25% Cr. - 20,; Ni.

E.'Z?A:JSION IN "/1·JO'

°F	18-8	25-12	25-20
1 0 0	0.4	0.J	0.J
20	0.5	o.s	o.s
h0	o.8	0.7	0.7
6 0	1.0	0.9	0.9
2L	1.2	1.1	1.0
	1.s	1.J	1.2
20	1.7	1.6	1.4
	1.8	1.7	1.5
40	1.9	1.8	1.6
50	2.0	1.9	1.7
	2.2	2.0	1.8
60	2.3	2.1	1.9
70	2.h	2.2	2.0
BO	2..5	2.J	2.1
90	2.7	2.5	2.3
1 0			
JOO	2.6	2.4	2.2
20	2.9	2.6	2.4
30	J.O	2.7	2.5
40	J.1	2.9	2.6
SO	J.2	J.O	2.7
60	J.}	J.1	2.8
10	3.4	3.2	2.9
80	J.61	J.J	J.O
90	J.7r	3.4	J.1
400	J.8t	J.5	J.2
10	J.9r	J.6	J.J
20	4.oi	J.7	J.4
JO	4.q	J.9	J.5
40	4.J	4.0	J.6
so	4-hi	4.1	J.7
60	4.5	[illegible]	3..8
70	4.7	4.3	J.9
80	4.e	4.5	4.0
90	4.9	4.6	4.1
soo	5.0	4.7	4.2
10	5.1	4.8	4.4
20	s.J	4.9	4.5
JO	5-4	5.1	4.6
hO	5..5	5.2	4-7
SO	5.6	5.3	4.8
60	5.8	5-4	4.9

°F	18-8	25-12	25-20
57'0	5.9	5.5	
80	6.o	5-7	5.1
90	6.1	5.8	5.2
600	6.2	5.9	5.3
1.)	6.4	6.0	5.4
20	6.5	6.1	S.6
30	6.6	6.4	5.8
40	6.7		
50	6.9	6.5	5.9
60	7.0	6.6	6.o
70	7.1	6.7	6.1
80	7.J	6.9	6.2
90	7.4	7.0	6.J
700	7.5	7.1	6.4
10	7.6	7.2	6.6
20	7.B	7.3	6.7
40			
JO	7.9	7.5	6.8
50	8.2	7.7	7.0
60	8.3	7.8	7.1
70	8.4	7.9	7.J
80	8.5	8.1	7.4
90	8.7	8.2	7.5
800	8.8	8.3	7.6
10	8,9	8.4	7.7
20	9.1	8.6	7.8
JO	9.2	8.7	8.0
40	9-3	8.e	8.1
so	9.5	8.9	8.2
60	9.6	9.1	8.J
70	9.7	9.2	8.4
80	9.9	9.J	8.5
90	10.0	9.4	8.7
900	10.1	9.6	8.8
10	10.3	9.7	8.9
20	10.4	9.8	9.0
JO	10.5	9.9	9.1
40	10.7	10.1	9.J
so	10.e	10.2	9.4
60	10.9	10.J	9.5
70	11.1	10.4	9.6
80	11.2	10.6	9-7
90	11.J	10.1	9.8

°F	lt-8	25-12	25-20
10	11.6	10.9	10.0
20	11.8	11.1	1J.11
JO	11.9	11.2	10.2
40	12.0	11.J	10.J
so	12.2	11.5	10.h
60	12.3	11.6	1J.5
70	1.2)	11.7	10.7
80	1?.6	11.8	10.8
90	12.7	12.0	10.9
1lJO	12.8	12.1	11.1
10	13.O	12.2	11.2
20	13.1	12.4	11.4
JO	13.J	12.5	11.5
40	13.4	12.6	11.6
50	13.5	12.8	11.7
70	13.7	12.9	11.51
60	13.8	13.0	12.0
80	13.9	13.1	12.1
90	14.1	1J.3	12.2
1200	lu.2	1J.4	12.3
10	14.J	13.5	12.4
20	14.5	1J.6	12.5
JO	14.6	1J.8	12.8
40	14.7	1J.9	12.9
50	14.9	Jli.O	13.0
60	15.0	14.1	13.1
10	15.2	14.2	13.2
80	15.3	14.4	13.4
90	15.4	14.s	13.5
lJOO	15.6	14.6	13..6
10	15.7	14.7	13.7
20	15.8	1lh8	1J.8
JO	16.0	15.0	1J.9
40	16.1	15.1	llr.::C..
50	16..2	15.2	lh.?
60	16.4	15.3	14.J
70	16.5	15-4	lli.4
eo	16.7	15.6	14.5
90	16..8	15.7	14.7
1400	16..9	15.8	

o>.r£s/n/s .. Iss,_;_e-, as Engineerine: St n:ld ard

DR.	CH'IC.	Dlt. SUP.	ING,	CHIO ENG.	
Dlt.	DATE S·Z3-	JOI Ho.			
CH' i• I(\	Jk!ff	DRAWINQ Na.		II.EV.	
ENG.	CHIO IHG.	E-M-543		0	

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THK tMA L EXf'A:ISIOilJ OF
Au.:.iTEIHTIC STADILE.:..iS STEELS

•ECHTIl:L COIIP011ATION

12.13 PIPE SUPPORT DESIGN

The preceding section has covered methods of providing flexibility in piping to limit stresses and reactions both to itself and to connections of sensitive equipment. This section is devoted to discussing methods of support for piping to limit stresses, reactions and deflections in piping and likewise protect connections to sensitive equipment.

12.13.1 Spacing of Supports

Although the normal spans utilized in pipeways are between 20 and 25 feet, occasionally there is a need for spacing supports to some abnormal span. Bechtel Standard L-518 provides a table showing maximum allowable pipe spans in pipeways for 2- through 24-inch nominal pipe size and for branch piping for 3/4-inch nominal diameter and larger. These spans were based on carbon steel piping at 450°F temperature. For other materials and higher temperatures special consideration should be given to determining allowable spans.

12.13.2 Overhangs

In pipeways. the end span of a run of pipe requires special treatment. Permissible overhangs are shown in the charts of

SPACING OF PIPE SUPPORTS HANGERS

MAXIMUM ALLOWABLE SPANS IN PIPEWAYS ♦

PIPE SIZE.	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"
DEFL.	.76"	.G3"	.77"	.84"	.76"	.80	.70"	.67"	.63"	,60"	3"	.41"
FT.	25	30	36	44	48	55	56	57	59	GI	66	70

MAXIMUM ALLOWABLE SPANS FOR BRANCH LINES*

PIPE SIZE	3/4"	1"	1½"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"
DEFL.	.29"	.49	.74"	I.0f"	1.06"	1.3"	1.18"	.75"	.79"	.64"	.91"	.74"	.G2"	.72	.38"
FT.	10	13	17	20	25	30	35	35	40	40	45	45	45	50	50

♦ Normal spans for general pipeway design shall be within 20' tO 25'.

* Lines from pipeway to other lines and/or equipment,

NOTES

1. Calculations of pipe spans are based on:

   a) 3/4" through 1½" Pipes, Wall Thickness Sch. 80
      2" through 6" Pipes, Wall Thickness Sch. 40
      8" through 12" Pipes, Wall Thickness Sch. 30
      14" through 24" Pipes, Wall Thickness Sch. 20

   b) Pipes filled with water and insulated for 4S0°F.

   Spans in the tables above are limited by longitudinal bending stress of 9000 PSI and by acceptable pipe deflection between supports determined from past experience.

2. Supporting of the end span of a continuous run of pipe in the main pipeway shall be given special consideration•

No.	DATE	REVISIONS	BY	CH'K	APP'D
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ORIGIN R&C ENG (SF) PIPE SUPPORT 10/10/68

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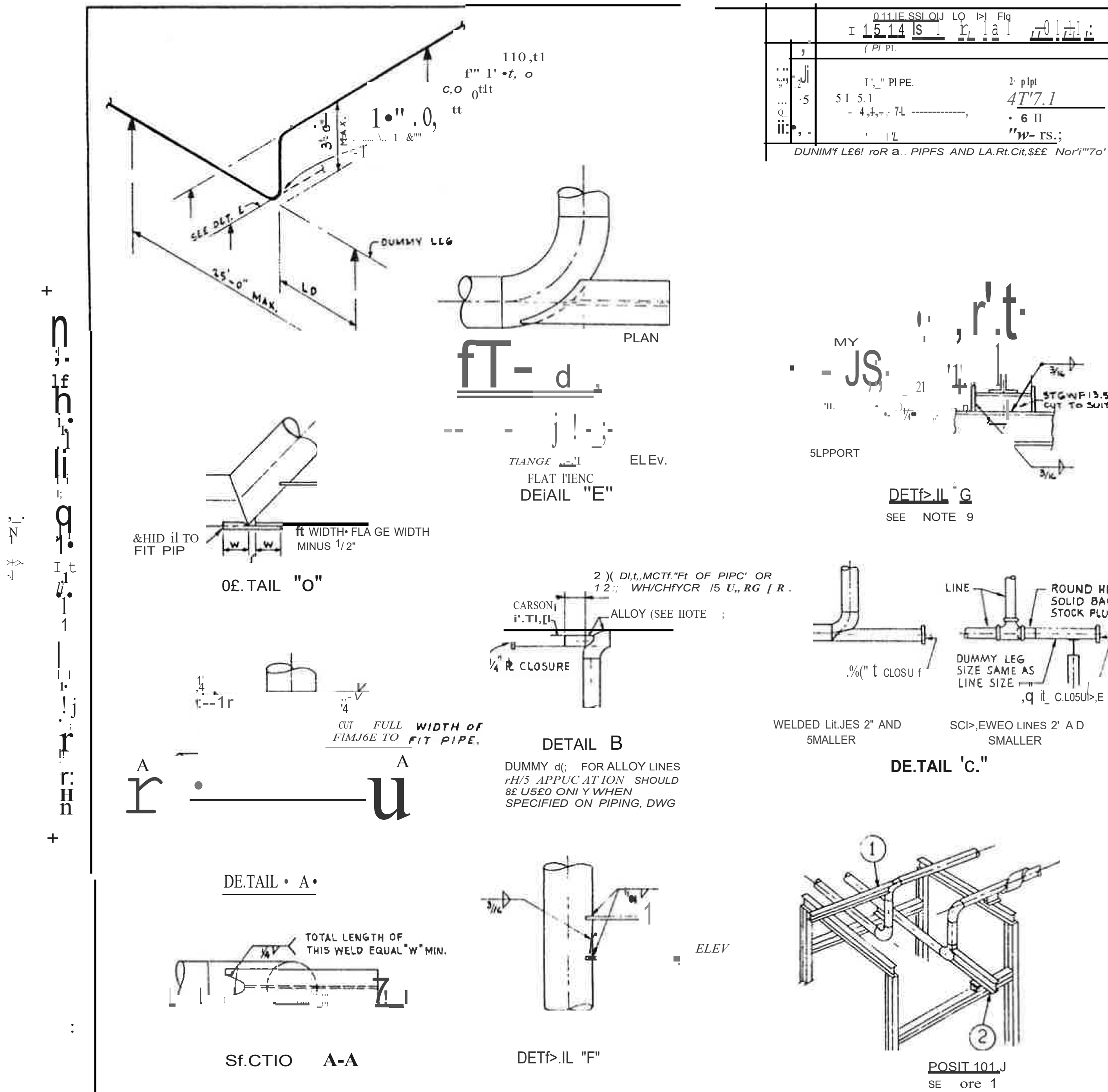
BECHTEL ENGINEERING STANDARD
TABLE OF ALLOWABLE PIPE SPANS FOR
PIPEWAYS AND FOR BRANCH LINES

JOB No. STANDARD — SPEC DES. GUIDE No. L-518 — REV 2

SHEET 1 OF 1



SIZE C

t-.J OT f. c ·

RE.FEli!. TO STANO.ARD DWG. L- 2 OI/El\I!A14CING PIPE LIH1TATIONS.

'• :f TltE CL.RI/ES ON D\JC,, L-532 1HD1CATE LINE OVE"-!!ANG TO BE U:CESS 1 \IE THERE All:[TWO ALTERNATIVES,

(.l) "HOUTE THE LINE.
{b) A,OD DUHHV PPORT LEG AS 5110\IN L0\1£111 POSITIO" ? OR UPPER POSITION \.!J WH I Cit[VER S HOST ECO NOH I CAL

2. DUMMY LEGS FOR WELDED LINES SIIALL !IE FABRICATED ',;ITH 111[SPOOL, PART!CLLARLY AUDY LINES A,tl LINES REQJlfl:ING C.TI\ESS RELIEVING.

J. FOR LINES WITH !lJTT WELD 01'. SOCl<.ET l.'(LD FITTINGS [:("fEt-ll SUPPORT LEG PH DETAIL "A".

. FOR LINES WITH. ITERED ELB TttE I' IPE-B{,IJ,I CONNECTION IS TU !IE KADE PER DET.t.! "D" TO PREVENT ATTACHMENT WELD FROH OVERLA1'PIJIIG PIP£ HIF! "1[ll.1. A 1,,i,. TllllK tTTACHHENT PLATE IS ll' fD.

S, FOR SlIES OF OUMHY LEG HEHBEl'.S, SEE TA.lILE.,

DUHH'T' LEGS Of PIPE ARE USED FOR SUPPOIH Of ALLOY °IPES w'HEN RE QUI R.ED THf ALLOY SHALL lll.f cit 'S..,,._ l'IAIf'lilAL A3' Ht£, 1f1 . THE SIZE Of DUHHY LEGS lilll BE SHOliIN ON PIPING DRAI,/ING

7. FOR ALTERN ATE CONFI GURAT I OM HAKE llOTTOH OF F'LANGE "X" F'LUS11 WITH e.o.L.

B. A LINE EXTENDED ACROSS SUPPORT WITH END CAPPED RESULTS IN A DEAD LEG ANO SHOULD NOT F.IE USED UNLESS A DEF'INITE FUTURE EXTENSION OF T1E LINE IS FORESEEN. IN SUCtl C.a.SES A FLANGE .a.ND LL HID SHOULD BE COHSIDEII.ED,

?. ADD S.tiD9LE fl'[fll DETML "li," TO SUP'PUHS ute9.y LtGS Otl INSI.A.AT'fD IIN'fS.

10 DUHHY LEG SIZES F"Ofl LINES 8" ANtl LAAGEII. lilll SHOW OH PIPING tlll..a.WtNG ANO/OIi: I SO T!I IC S _

△		REVD & REDRAWN		
SCALE NONE	DESIGNED		DRAWN	E. S. W.

ENGINEERING STANDARD

DETAIL OF **DUMMY** SUPPORT LEG
FOR PIPE LINES WITH EXCESSIVE OVERHANG

STD. L-539 5

Bechtel Standard L- 32. Where the overhang is excessive, either dummy legs must be added or additional beams or other manner of support must be employed. Refer to Standard L-539 for Dummy Support Attachments.

12. 13. 3 <u>Restraints (Guides, Anchors. and Stops)</u>

A restraint may be defined as a device which prevents, limits, or resists the thermal displacement of piping. Of course, all supports upon which the pipe rests tend to restrain movem.ent in at least onedirection, but let us disregard this idea while discussing guides, stops, and anchro s.

The use of restraints may be required for the following reasons:

- To protect sensitive equipment
- To control pipe movements
- To maintain axial alignment
- To ensure cor ect function of e xpa ns io n loops
- To avoid overstrain of reduced line sections
- To isolate mechanical vibration

- To prevent disengagement of flexible couplings

- To ensure predictability of the system

There are several other cases where restraints may be used. The previous instances are the most common ones. Specific types of restraints are used in the following ways.

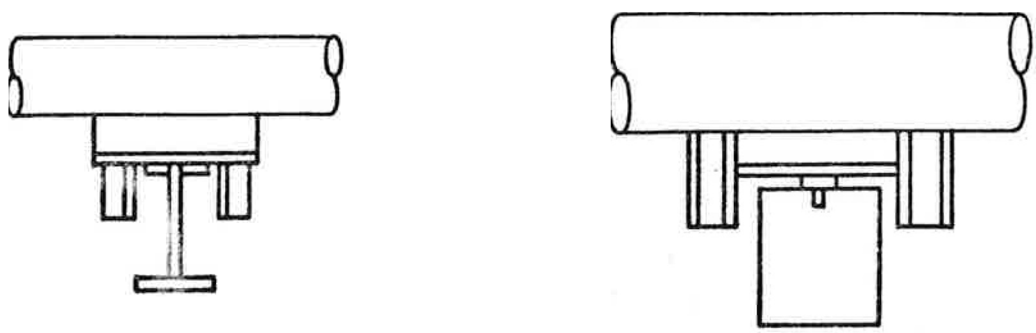
<u>Guides:</u> A long length of pipe under direct axial compression constitutes a weak column subject to buckling. The ability of the pipe to move axially against elastic and frictional resistance is impaired, and a state of stress capable of buckling the pipe is mo e readily achieved,

To prevent this condition, we must inc-orporate some form of lateral restraint, such as a guide, along the line length. We must take care, however, to ensure that guides are not placed near areas of directional change or areas where flexibility is necessary.

<u>Anchors:</u> Anchors as generally understood are rigid devices which maintain points of full fixation preventing any rotation and translation at the point. Seldom is this type of anchor used, therefore the term anchor has been used to indicate an "axial" stop.

This device prevents translatory movement in the axial direction, but normally permits rotation of the pipe. Anchors are used primarily to protect equipment from reaction overload and to limit movement.

An anchor, in most cases, also acts as a support. Refer to Bechtel Standard Drawing M-624 for Anchor and Guide Details.



ANCHORS

Figure 12-18

12.13.4 Frictional Forces

A pipe subject to thermal movement will produce a horizontal force on supporting members due to frictional resistance. This force is independent of line temperature and is little affected by the amount of movement taking place.

The sum of the forces exerted by the pipe upon various supporting members will react at the line anchor. We should therefore space loops and anchors in long runs of pipe so that there are approximately equal amounts of pipe on each side of an anchor. In this way, we can balance frictional forces and make anchor loads more reasonable.

We can also employ various types of contact faces (Figure 12-19) in supporting the system which will reduce frictional forces.

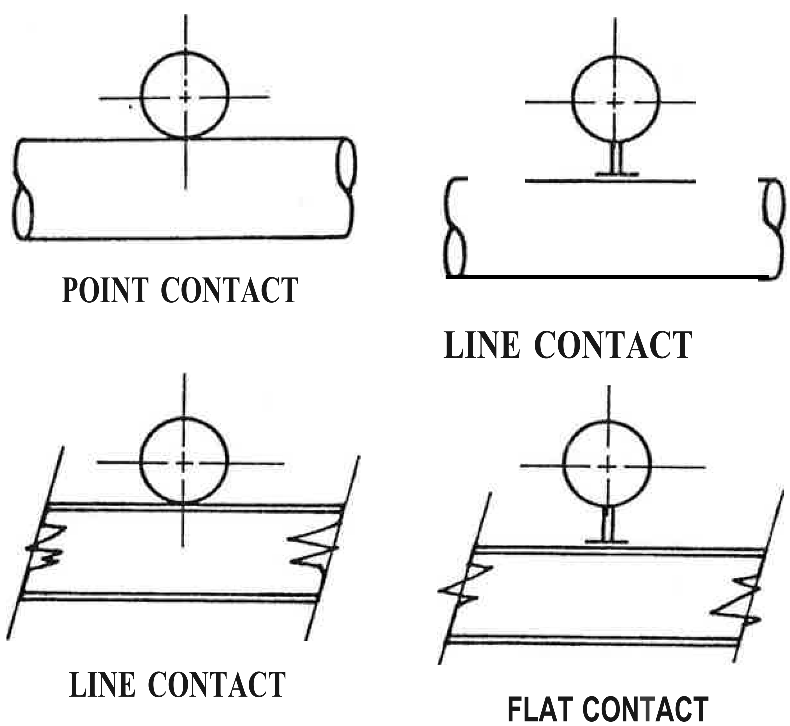


Figure 12-19. Types of Contact Faces.

The friction coefficient can vary from O. 1 to O. 75, depending upon surface conditions; but it is normally from O. 2 to 0. 3, or a little higher if the line is guided.

Rollers, self-lubricating bearing plates, and Teflon plates may be used to reduce frictional forces *if* the support members, equipment, or anchors will otherwise be ove -loaded.

12. 13. 5 Lines from Vertical Vessels

Lines hanging from vertical vessels are usually supperted close to the vessel nozzles for at least tworeasons:

- To minimize differential expansion
- To allow disengagement of piping with support still provided

Apply the following rules when routing lines adjacent to vertical vessels:

The distance from the pipe to the vessel shell varies according to Bechtel Engineering Standard Drawings M-600, Notes 1 & 2. The designer should attempt to keep the piping as close to the vessel shell as possible. This proximity reduces the moment acting upon the vessel shell at support and guide locations.

Lines must be guided at certain intervals to prevent vibration or sway from wind. The extent of this provision depends upon the pipe size. Bechtel Standards regarding guide spacing must be used where possible. For application and details refer to Standard Drawings M-600, M-601 and M-602. For Minimum Spacing of Lines Located radially on Vertical Vessels, see Std. Dwg. M-612.

12, 13, 6 Stress Relieved Vessels

All piping systems related to stress-relieved vessels must be given special priority. The pressure vessel job supervisor will provide a list of stress-relieved vessels with required due dates established by the vessel fabricator for stress relief work. These dates will be marked on tags placed on vessel models.

All design work must be completed six (6) weeks prior to these critical dates. The stress department will review and approve work. The pipe support group will complete detailing and issue all vessel attachments to the vessel fabricator four (4) weeks prior to the actual stress relief work.

Field welding is not permitted on stress- relieved vessels. No changes to pipe routing are allowed after the expiration of these dates; if there are unavoidable design changes, the revision must be coordinated with the stress department and vessel fabricator immediately to avoid serious problems, additional back charges, or delays in delivery.

The procedure for defining and locating vessel attachments required on stress-relieved vessels is shown on Bechtel Standard Drawing M-610. See Figure 12-20 for a typical pipe support detail sent to vessel fabricators.

12.13.7 Miscellaneous Design Guides

The following miscellaneous Pipe Support Design Guides are attached to Section 12 for your information.

(1) Supports for Utility Lines from Vessels and Platforms M-603

(2) Supports for Heater Piping M-607

(3) Supports for Guides for Vertical Lines M-608

(4) Typical Hanger Supports M-609

(5) Supports for Control Valve Manifolds M-611

(6) Typical Isometric Pipe Support Mark-Up M-613

LIST OF MATERIAL

ffiii NO.	1l~O. 11!0D.	DESCRIPTION		OII D I 11
M-4		LIN. FT. 8 WF 24	BY VESSEL FAB. & FIELD	
M:S		LIN. FT. ST4WF 8.5	BY FIELD	
M-5		LIN. FT. ST 4 WF 8.5	BY VESSEL FABRICATOR	
M-7		SQ. FT. 3/8" PL	BY VESSEL FAB. & FIELD	
M-9		5/8" HEX NUT	I:>'/ FIELD	
M-12		5/8 x 1 1/2" MACH. BOLT & HEX NUT	5Y FIELD	
M-12		5/8 x 2" MACH. BOLT & HEX NUT	y FIE:LO	

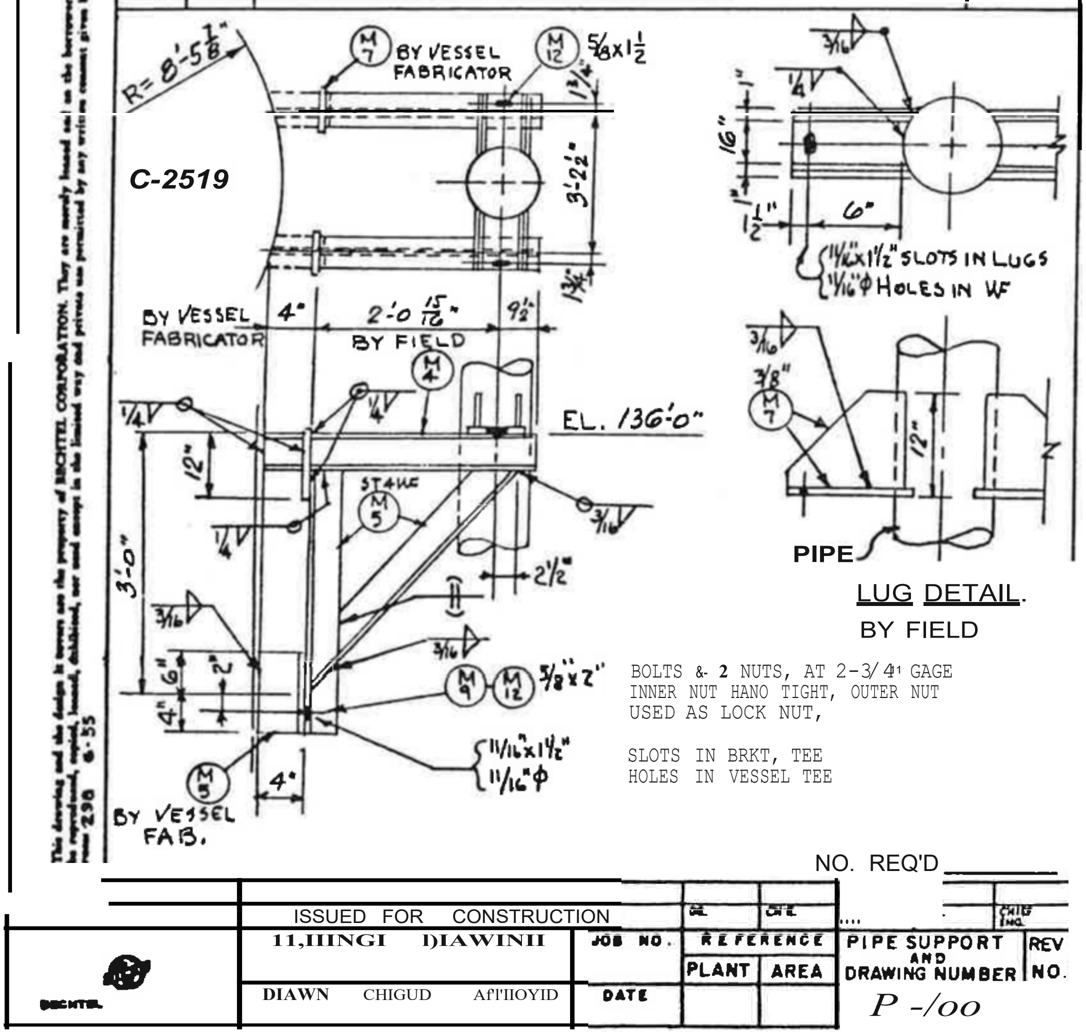
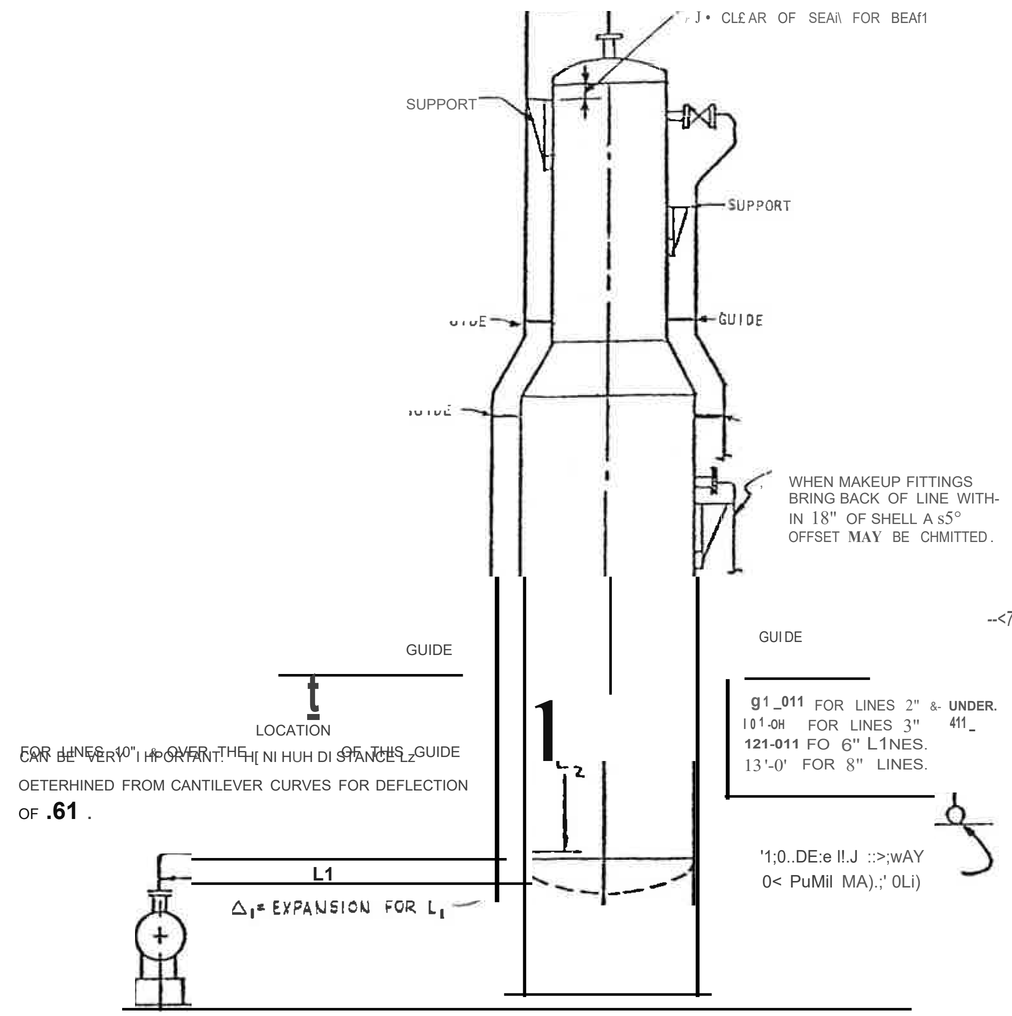
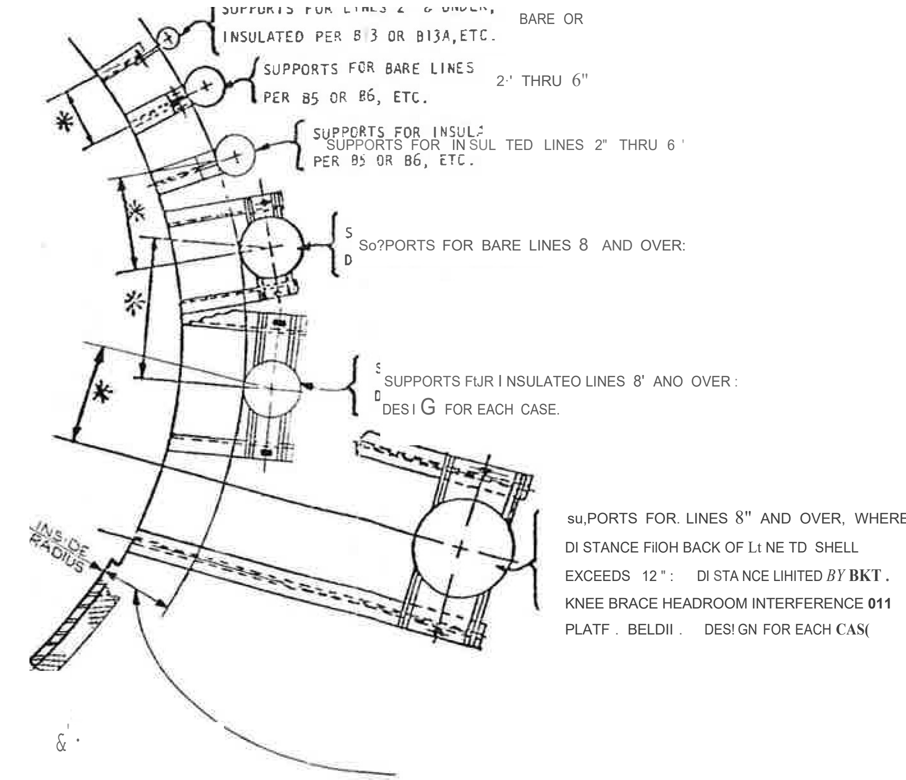


Figure 12-20.





1. 12" TO BACK OF LINE WHEN SHELL THICKNESS "A" PLUS INSULATION THICKNESS "B" DOES NOT EXCEED 6".
2. WHERE "A" PLUS "B" EXCEEDS 6", BACK OF LINE MUST BE MINIMUM 6" CLEAR OF INSULATION.

FOR MINIMUM SPACING SEE STD. DWG. M-612.

LINES WHICH ARE RADIALLY LOCATED AROUND A VERTICAL VESSEL ARE PREFERRED TO THE TANGENTIALLY LOCATED ARRANGEMENT SHOWN ON M-601. RADIALLY LOCATED LINES REQUIRE LESS PIPE AND FEWER FITTINGS TO PROVIDE FLEXIBILITY BETWEEN SUPPORTS AND NOZZLES AND USE SIMPLER SUPPORTS OF STANDARD DESIGN. THE PIPES SHOULD BE LOCATED, IF POSSIBLE, ON PLATFORM-FREE SEGMENTS OF THE VESSEL PERIMETER. BY LOCATING PIPES CLOSER TO THE VESSEL SHELL, THE RESULTING VESSEL SHELL STRESSES ARE MINIMAL AND SMALL LINES CAN PENETRATE PLATFORMS WITHOUT BLOCKING THEM. THE MAXIMUM ALLOWABLE STRESSES PRODUCED MUST BE DETERMINED BY DESIGN GUIDE C-1. "LOCAL STRESSES IN CYLINDRICAL SHELLS DUE TO EXTERNAL LOADINGS." LINES AND SUPPORT ARRANGEMENT SHOWN ON M-601 ARE USED ON SMALLER DIAMETER VESSELS.

SUPPORTS ON STRESS RELIEVED VESSELS

PIPE SUPPORTS FOR VESSELS STRESS RELIEVED DUE TO SHELL THICKNESS ONLY CAN BE FIELD WELDED, WHEN APPROVED BY THE PROJECT ENGINEER. VESSELS STRESS RELIEVED FOR PROCESS REASONS MUST HAVE ALL ATTACHMENTS TO THE SHELL WELDED IN PLACE BY THE VESSEL FABRICATOR BEFORE STRESS RELIEVING. ALL PIPING, INCLUDING UTILITY LINES, MUST BE COMPLETED AT THE EARLIEST POSSIBLE DATE TO PERMIT LOCATING AND DESIGNING THE SUPPORT ATTACHMENTS TO BE PROVIDED BY THE VESSEL FABRICATOR.

WHEN LOCATING SUPPORTS OR GUIDES ON A VESSEL, CARE SHOULD BE TAKEN TO ENSURE THAT THE ATTACHED MEMBER DOES NOT INTERFERE WITH A VESSEL WELD SEAM, INSULATION SUPPORT RING OR VESSEL VACUUM STIFFENER RINGS.

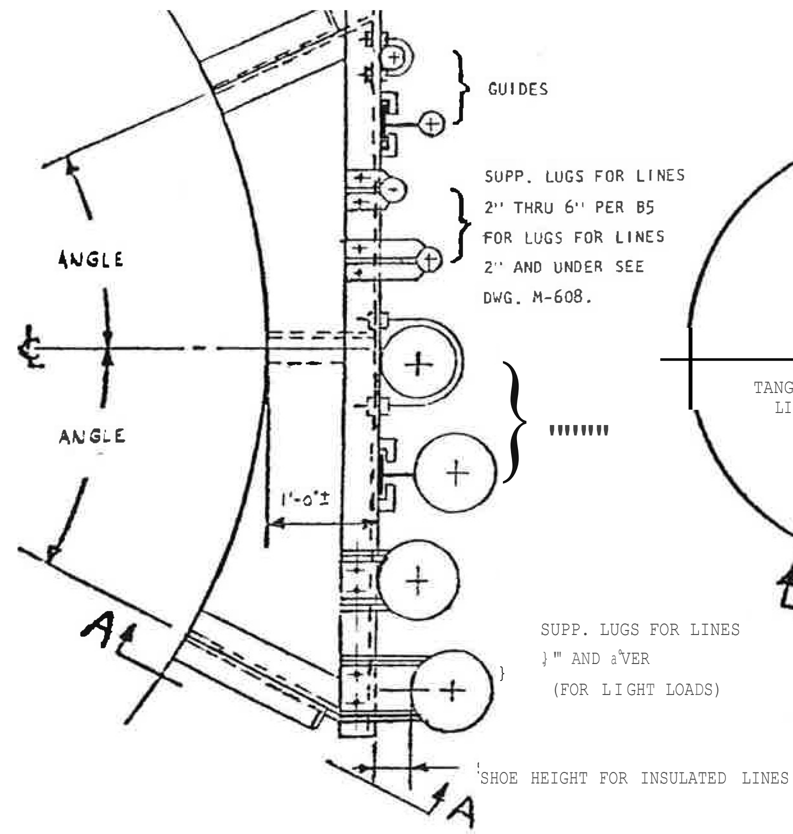
0	9/71	REISSUED AS ENGINEERING STD. WAS L-600	JT	JH	JH		

BECHTEL
SAN FRANCISCO

ENGINEERING STANDARD
REFINERY AND CHEMICAL DIVISION

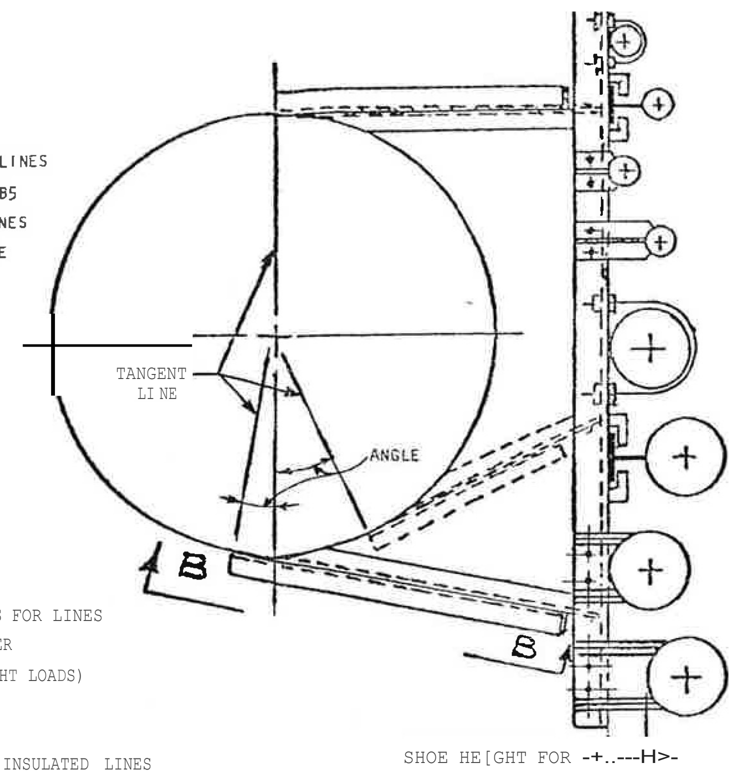
GUIDE FOR DESIGNING SUPPORTS FOR RADIALLY LOCATED LINES FROM COLUMNS

STD. M-600

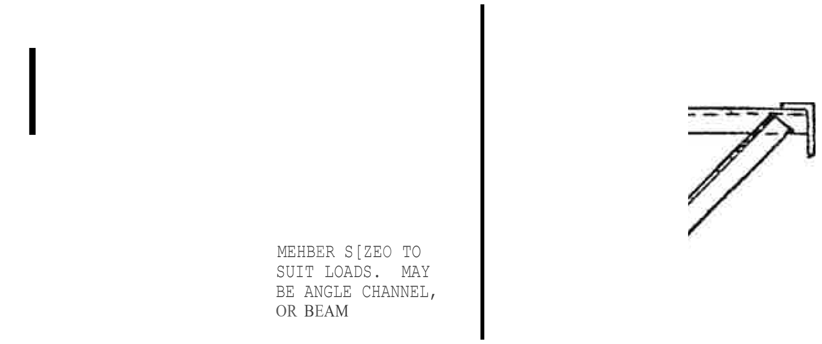


SUPPC.RT GULDE #.:

(ALTERNATE OR ADDIT[ONAL BRACKETS SHOWN OOHED)

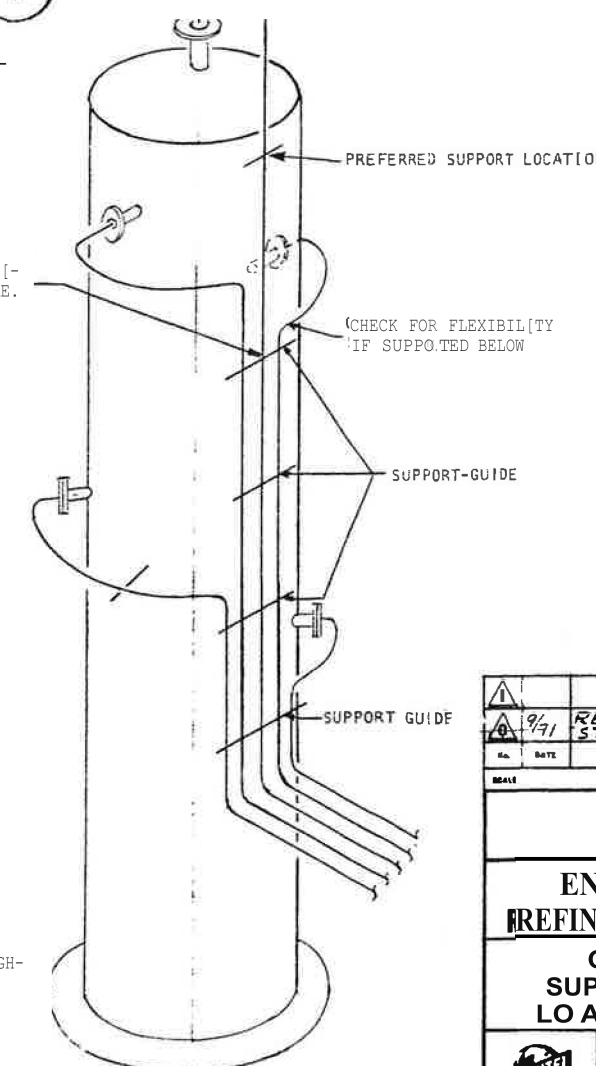


SUPPORT GUIDE #2



A·A

B-B



SUPPORT GUIDE #1

THIS TYPE OF SUPPORT USING RADIAL BRACKETS IS USED ON LARGE DIAMETER VESSELS AND HEATERS WITH PIPES LINED UP AS SHOWN. ITS MAIN DISADVANTAGE IS DUE TO THE SMALL LOADS THE VESSEL OR HEATER SHELL CAN TAKE WITH RADIALLY LOCATED BRACKETS. THE ALLOWABLE LO ADS MUST FOLLOW THE TABLES SHOWN IN "LOCAL STRESSES IN CYL!NORICAL SHELLS". FOR VESSELS 9'-0' O!A1IETER AND OVER, RING SEGMENTS ARE NORMALLY REQUIRED TO PREVENT OVERSTRESSING THE SHELL. THE OTHER DISADVANTAGES ARE SHARED WITH THE #2 SUPPORT. AMONG THEM ARE (!) THEY ARE LOCATED AT APPROXIMATELY EQUAL VERTICAL DISTANCES ON THE VESSEL ANO THEREFORE, BECAUSE THEY MAY SUPPORT MORE THAN ONE LINE PER SUPPORT, THE SUPPORT LO ATION MAY NOT BE THE BEST FOR A PARTICULAR LINE. THIS COULD REQUIRE ADDITIONAL FLEXIBILITY IN THE LINE. WHICH MEANS ADDITIONAL PIPE ELBOWS, (2) THEY REQUIRE A CONSIDERABLE SEGMENT Of THE VESSEL PERIMETER ALLOTTED TO PIPING AND FREE OF PLATFORMS. TH!S IS NOT A DISADVANT GE, BUT SHOULD BE STANDARD PRACTICE EXCEPT THAT LINES LOCATEO CONCENTRI-CALLY AND CLOSE TO VESSEL COULD PENETRATE THE PLATFORM.

SUPPORT GUIDE #2

THI;; TYPE OF SUPPORT USING TANGENTIAL B ACKET IS MOST ADAPTABLE TO SMALL DIAMETER VESSELS AND IS LIMITED IN LOADS BY THE SUPPORT!NG MEMBERS THEMSELVES ANO THE WELDS ATTAO:iNG THEM TO THE VESSEL.

:ONCLUSIONS:

THESE SUPPORTS ARE SATISFACTORY FOR SMALL DIAMETER VESSELS WHERE TANGENTIAL BRACKETS MAY BE USED DR WHEN THE VESSEL SHELL IS THICK ENOUGH-FOR LARGE DIAMETER VESSELS OR WHERE LINES REQUIRE EXCESSIVE PIPING ANO ELBOWS TO GAIN THE REQUIRED FLEXIBILITY, THE LINES SHOULD BE ROUTED CONCENTRICALLY AS SHOW ON DWG. M-600.

OTE:

SEE M-600 FOR WELDING TO STRESS RELIEVED VESSELS.

0	9/71	REISSUED AS ENGR'G. STD. WAS L-601	JJH

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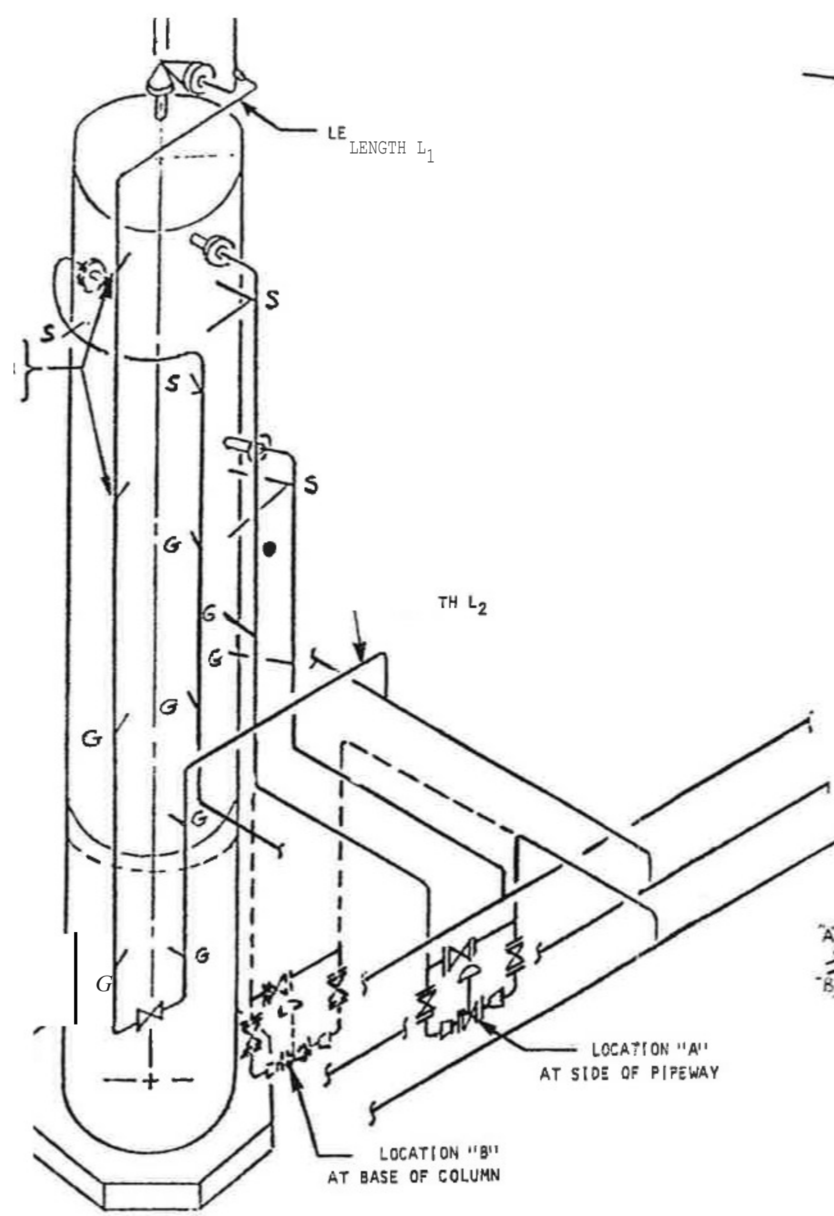
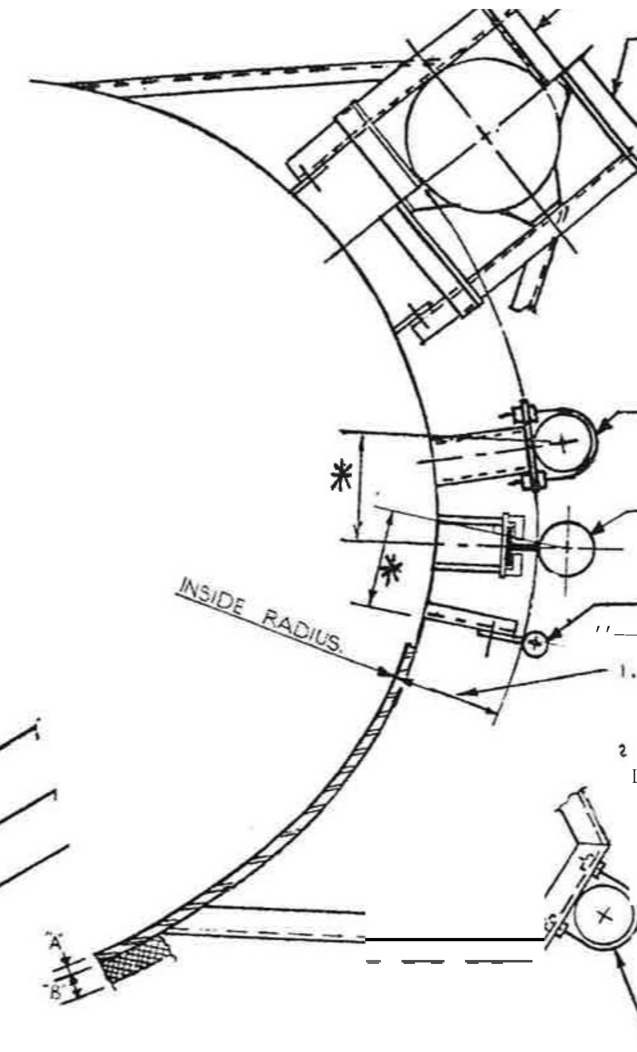
REFINERY AND CHEMICAL DIVISION

GUIDE FOR DESIGNING SUPPORTS FOR TANGENTIALLY LO ATED LINES FROM COLUMNS

STD. M-601 0





GUIDES SHOWN ARE TYPICAL FOR RADIALLY LOCATED LINES, STANDARD VERTICAL SPACINGS ARE SHOWN IN TABLE ON THE STANDARD GUIDE DETAILS EXCEPT FOR THE LOCATION OF THE BOTTOM GUIDE WHICH IS SHOWN ON DRAWING M-600,

NOTE 1

THE LOCATION 0 THE SUPPORT FOR A RELIEF PURGE LINE IS ALMOST ALWAYS CRITICAL FOR THE FOLLOWING REASONS:

(I) THE RISER FROH THE VALVE NEAR GRADE IS USUALLY AT A1\61ENT TEMPERATURE WHICH MEANS BELOW FREEZING IN SOME PLACES IN THE WINTER BECAUSE THE PURGING OPERATION IS NOT FREQUENT.

(2) THE VESSEL HELL 1'IAY BE HOT OVER MOST OF ITS LENGTH RESULTING IN CONSIDERABLE EXPANSION FROM SKIRT TO CONNECTION TO THE RELiEF VALVE.

THE LOCATION OF THE SUPPORT THEN MUST SE SELEC're:D SO THAT ENGTH L1 WILL.TAltE THE VESSEL GRO1,'TH ABOVE THE SUPPORT ANO LENGTH L2 WILL TAKE THE VESSEL GROWTH BELOW THE SUPPORT. IF NO LOCATION CAN SE FOU D, EITHER OR BOTH LENGTH L1 NO Lz MUST SE INCREASED TO SUIT OR AN EXPANSION LOOP PROV1 EO.

CONTROL VALVE ASSEHBLY LOCATIONS

LOCATION "A" IS PREFERABLE BECAUSE THE HORI lONTAL UINE RIJN FROM COLUHN TO THE VALVa ASSEMP.LV IS USUALLY LONG ENOUGH TO MAKE PRING SUPPORTS UNNECESSARY. IN POSIT1ON "B" A DOUBLE SPRING SUPPORT IS USUALLY REQ IRED WHEN TH! VESSEL IS HOT ANO THE LI NE AT THE LOW TEMPERATURES COMHON TO REFLUX LINES. THE DOUBLE SP,ING REQUIRES A HEIGHT ABO E GRADE TO CENTER OF CONTROL VALVE OF ABOUT 3'•0".

⚠	9/71	REISSUED AS ENGR'G. STD. WAS L-602	-T	JJH	JJH	9/71	SC			

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ENGINEERING STANDARD
REFINERY AND CHEMICAL DIVISION

GUIDE FOR DESIGNING
GUIDES FOR RADIALLY LOCATED
LINES FROM COLUMNS

STD. M-60 2 0

PIPE SIZE	1'/z"	z"	-:,"	4"	re"	8"	10"	IZ"	14-"		ia··	e.o"	,t·	Z.4"
1 1/2"	ti	''	'''	,,,	12"	13"	14-	15"	15"	''..	11-	ia·	I'f"	io"
e"	C,"	(o"	,,	7"	12"	13"	14	15"	1 /	1 i;,"	17"	18"	1q"	20"
3"	G,"	"	8"	8"	IZ"	1:3"	/4"	15"	1 ··	17"	18"	I'I"	e0"	ZI"
4"	G"	7"	cf'	e,'	13"	14	15P	''O	17"	!8"	rq"	e0"	21"	ez"
"	,t·	12"	1'2"		14"	15"	··	11"	18	1q"	20"	cl"	ZZ"	23"
8"	13	15"	13"	14	15"	/6"	17'	l8	1q··	i.o"	e.l,,	2.Z"	ZJ'	e4"
10"	14	14	14"	JS"		11"	,a"	1q"	Zo"	2,1"	zt	Z3"	e4"	25"
1,··	IS"	15"	15	'''	17"	18"	1cf"	20··	21"	2f	23	Z4"	'ZS"	21,"
14	15	J5"	li	17"	IB"	I'1"	20"	ZI"	21	2Z"	25	24	25A	a,"
16	lGi"	1'3"	17"	113	1q"	20"	2.1"	2e"	et·	23"	24"	z5"	zrs,"	z.7u
le"	17	17	IB"	1q"	2.0"	21•'	zi·	23"	23"	24"	es·	e,	Z7"	Z8"
Zo"	,e:	18	1q·•	2d'	21"	2-ZN	z3"	24	Z4"	es"		27"	2d"	ZC,"
et•	1q"	I'l "	o·	e,"	ZZ"	z3"	24A	2 S"	,,,,	2,,,	27	ZS·	i'J"	°30"
z4•	C.0·	20"	2.1"	2Z"	7..3	24"	Z.S"	1J:/		z.7M	Z.a'''	z.q"	,3a•	31

DIMENSIONS ABOVE ARE FOR BARE LINES ONLY. THICKNESS OF INSULATION ON ADJACENT LINES MUST BE ADDED TD TABLE VALUES AS RE UlRED•. BACK OF LINES ASSUMED AT 1'-0" + FROM VESSEL SHELL. SEE DRAWING M-600 AND H-602.

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6							r
A	1/71	REISSUED AS EMG. STO. WAS L-612.	.rr	JJH	JJ,4	IIIII,.,,,	
6	DA.TI	REVISrnNs	DI.	CN"L	,.·.	O.	

OIIQIN
R&C ENG(SF)
PIPE
SUPfORT

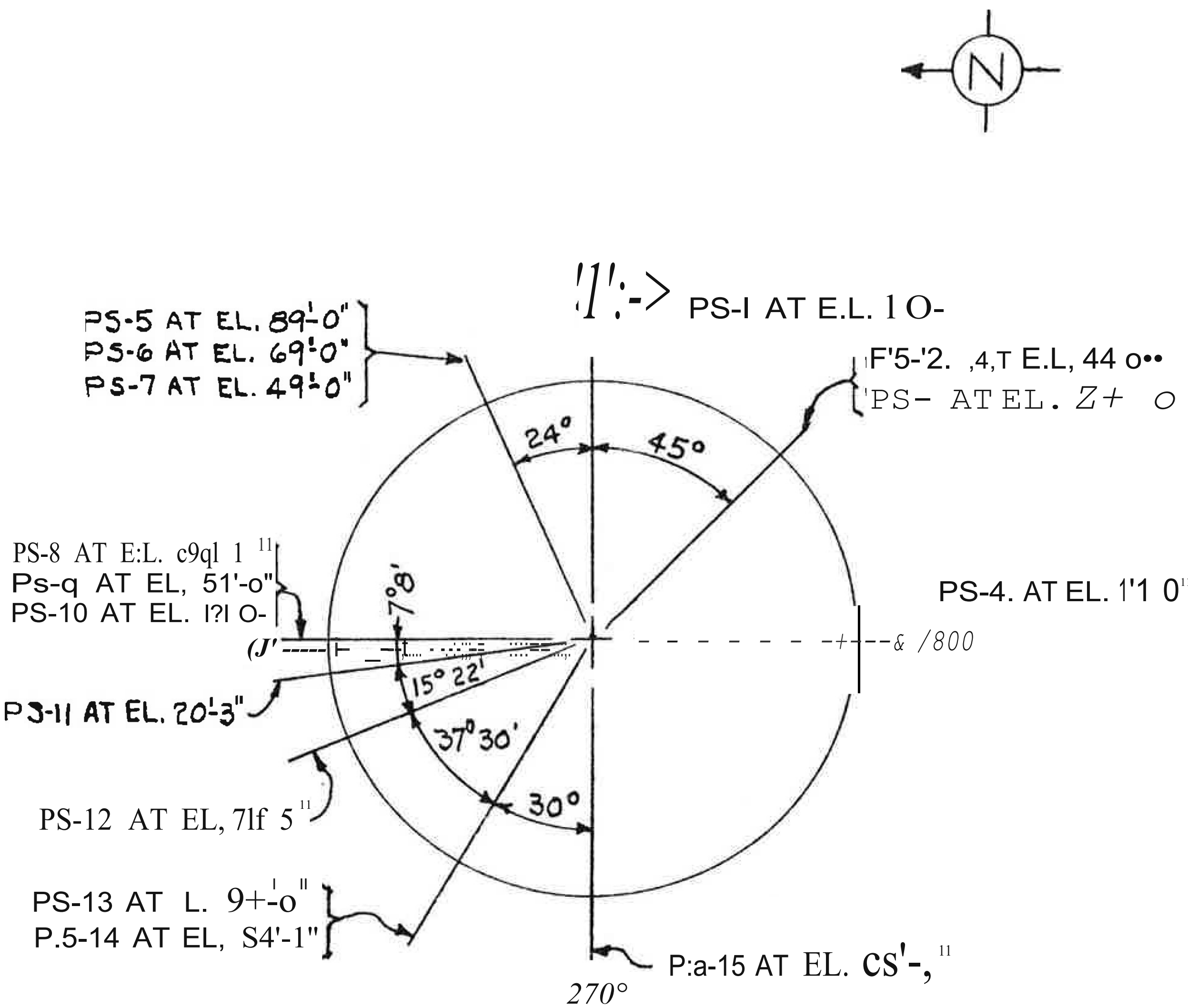
tl!

MINIMUM SPACING OF VERTICAL
RADIALLY LOCATED LINES ON
VERTICAL VESSELS

JOINe. STD.

MAWING Ne. M--612

''''. 0



ELEVATIONS ARE TO VESSEL BASE "X" • 0'-0"

The above is typical of location drawings sent to vessel fabricators for shop fabricating and installing supports on stress relieved vessels. This drawing and prints of the supports showing the portions attached to the vessel must be in the fabricators possession for installation prior to the stress relieving of the vessel.

▲	9/71	REISSUED AS EMG. STANDARD. WAS L-610.	Jr	JJH
	DATE	REVISIONS		CN'L

ORIGIN: R&C ENG (SF) — PIPE SUPPORT

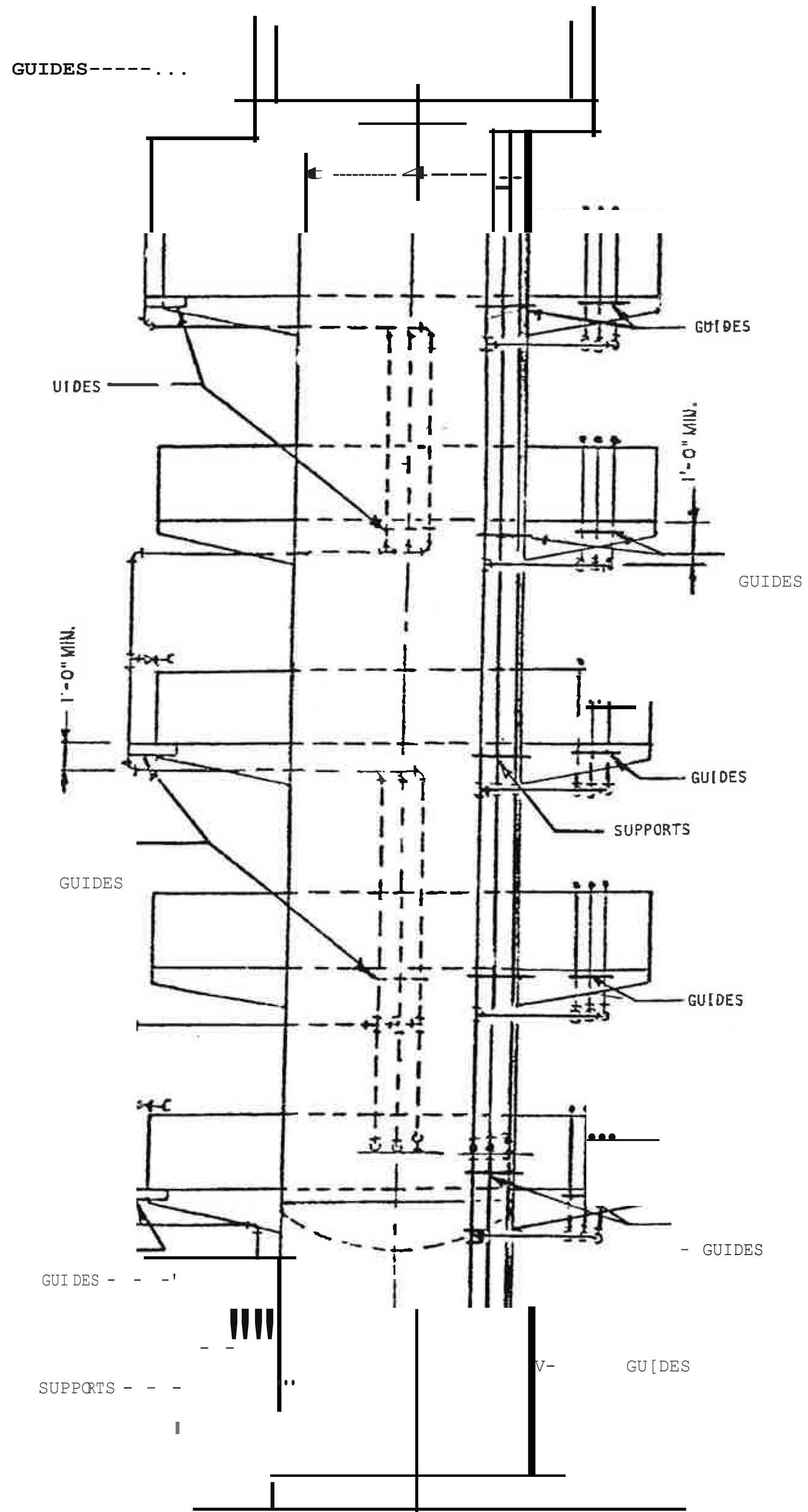
BECHTEL

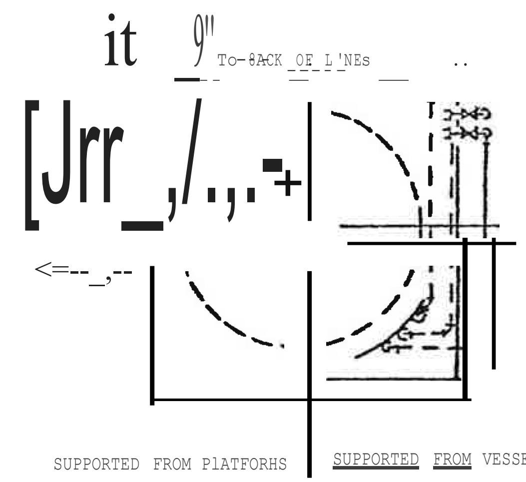
TYPICAL LOCATION DRAWING OF PIPE SUPPORTS FOR STRESS RELIEVED VESSELS

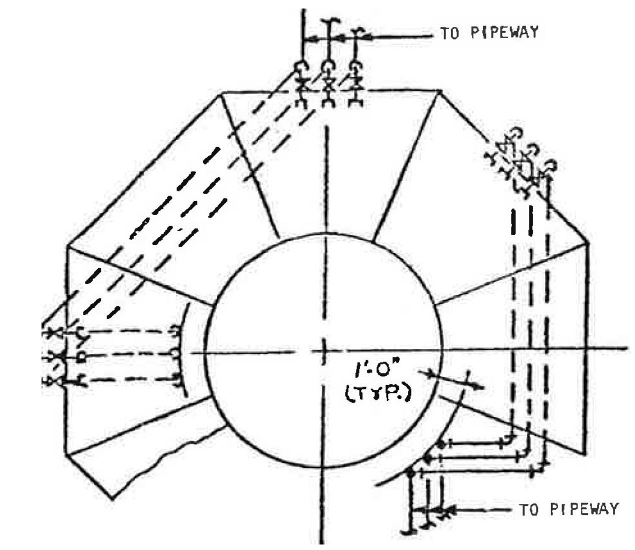
DR. / SUP.: JJH — ENG. — CHIEF ENG.

STD

DRAWING No.	REV.
H - 610	0







FOR GUIDES: USE STANDARD DWGS. G2, G2A, OR G28.

FOR SUPPORTS: USE STANDARD DWGS. B13, B13A, or BIJB.

SUPPORTING AND GUIDING L[NES **FROM** vEss:=L

T IS METHOD [S PREFERRED BECAUSE THE SUPPORTS CAN BE LOCATED ON THE VESSEL WHICH [S CAPABLE Oo TAKING THE SUPPORT LOADS ANO **BY** SUPPORT[G ABOUT THE MID POINT OF T E VESSEL,THE BRANCHES TO THE PLATFORM 0 R1/NS TO THE PIPEWAY ONLY HAVE TO BE FLEXIBLE ENOUGH FOR HALF THE TOTAL VESSEL GROIIT4. THE L[NES ARE GUIDED ABOVE ANO BELOW THE SUPPORT AT STANDARD INTERVALS. TO GI VE RIGIDITY TO THE 1405E CONNECTIONS THE FIELD FASTENS EACH HOSE CONNECTION TO THE PLATFORM HANO RAIL. BECAIJ E OF THIS, SU[OES ONLY SHOULD BE PROVIDED FOR Tf!E RISERS FROM THE UNDERSIDE OF THE PLATFORMS. UTILITY UNES BEING SMALLAt ,J LOCATED CLOSE TO SHELL CAN PENETRATE PLATFORMS W1THOUT BLOCKING THEM.

SUPFORTING D r;i;iDING LINES FROM PLATFORMS

THIS [S THE LEAST DESIRABLE METHOD OF SUPPORTING UT[LITY LINES AND SHOULD BE EMPLOYED ONLY ASA LAST RESORT. BESIDES REQU[R!NG MORE PIPE AND FITTINGS IT MUST BE REMEMBERED THAT THE PLATFORMS ARE NOT DES["GNEO FOR PIPE LOADS Altll I'ffi(['

REQUIRE STRENGTHEN NG.

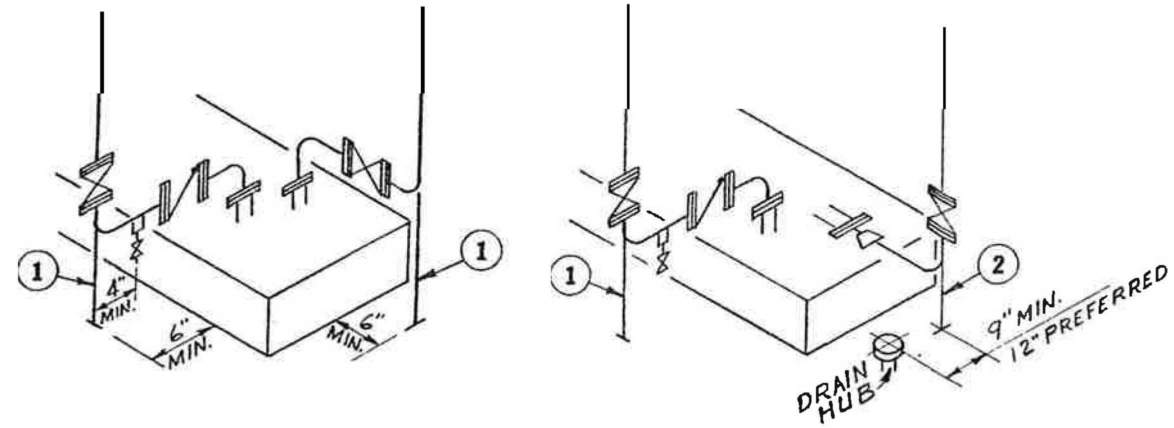
	9/71	REISSUED AS ENGINEERING STD, WAS L-603	JT	JJH	JJH		

BECHTEL
SAN FRANCISCO

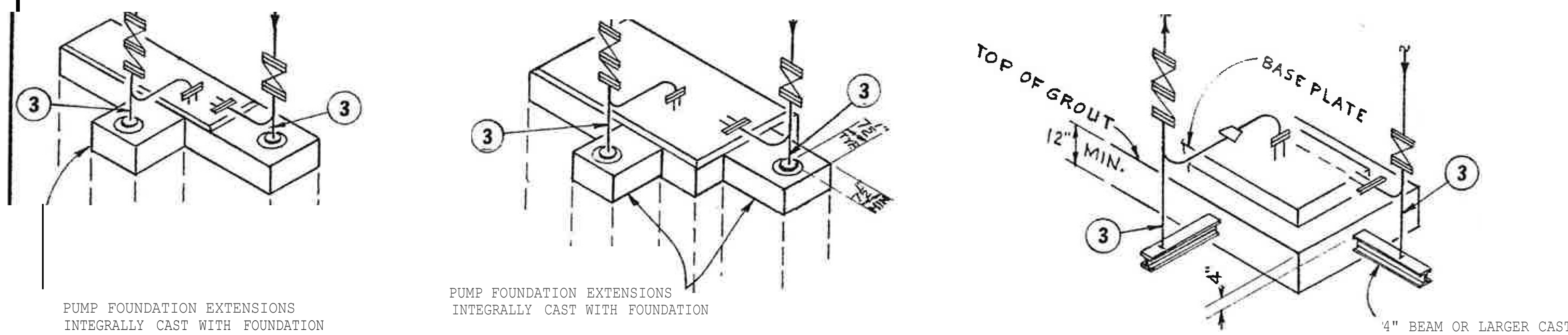
ENGINEERING STANDARD
REFINERY AND CHEMICAL DIVISION

GUIDE FOR DESIGNING SUPPORTS FOR UTILITY LINES FROM VESSEL AND PLATFORMS

STD.	M- 603	0



MINl1V1U1\i1 GRADE SETTLEMENT AND NO FROST HEAVE CONDITIONS.



PUMP FOUNDATION EXTENSIONS INTEGRALLY CAST WITH FOUNDATION

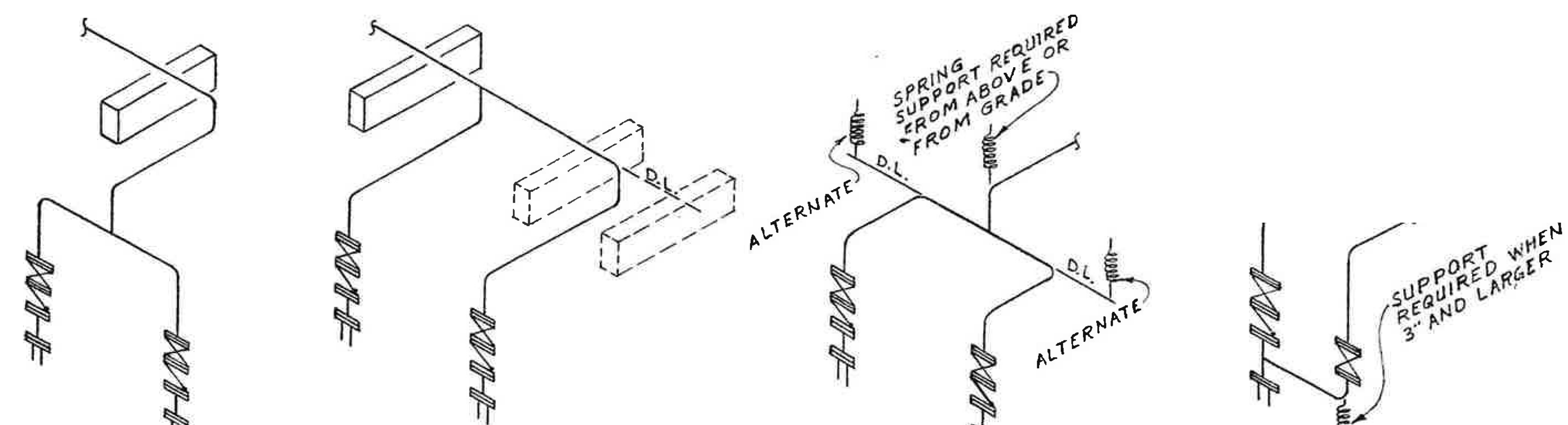
PUMP FOUNDATION EXTENSIONS INTEGRALLY CAST WITH FOUNDATION

4" BEAM OR LARGER CAST IN OR FASTENED TO PUMP FOUNOATION

FROST HEAVE OR GRADE SETTLEMENT CONDITIONS.

	0	0	0
4" AND SMALLER	L4A OR L4H	L4A OR L4H	L4A OR L4H
6" AND LARGER	ADJUSTABLE OR SPRING	ADJUSTABLE OR SPRING	ADJUSTABt·E

SUCTlotJ ANO DISCHARGE PIPING, 4" AND SMALLER, MAY BE SUPPORTED BY A SOL ID BASE SUPPORT, LINES 6" AND LARGER SHOULD BE SUPPORTED BY **AN** ADJUSTABLE SUPPORT OR, IN SOME CASES, BY A SPRiNG SUPPORT,



"A" "8" "C" "0"

I/HEN THE LINES ARE RUN VERTICALLY FROM TOP SUCTIONS OR TOP DISCHARGES (SEE A, B, CANO D), THE PUMPS MUST BE CAPABLE OF SUPPORTING THE VERTICAL LOADS IMPOSED. PIPING ARRANGEMENTS "A" AND "B" IMPOSE VERTICAL LOADS ONLY ON PUMPS,

PIP ING ARRANGEMENTS "C" AND "D" PLACE ECCENTRIC LOADS ON THE PUMP NOZZLES INDUCING MOMENTS WHICH CAN CAUSE EXCESS-I VE PUMP WEAR AND MA I NTENANCE OR PUMP DRI VER MISALIGNMENT UNLESS THE MOMENTS ARE REMOVED WITH ADDITIONAL SUPPORTS,

No.	DATE	REVISIONS	BY	DESIGN SUPV	ENGR	PROJ ENGR	APPR
0	5/72	REISSUED AS ENGRG. STANDARD WAS L-605	JT	JJH			

SCALE | DESIGNED | DRAWN | CHIEF ENGR

BECHTEL
SAN FRANCISCO

ENGINEERING STANDARD
REFINERY AND CHEMICAL DIVISION

GUIDE FOR DESIGNING SUPPORTS FOR PUMP PIPING

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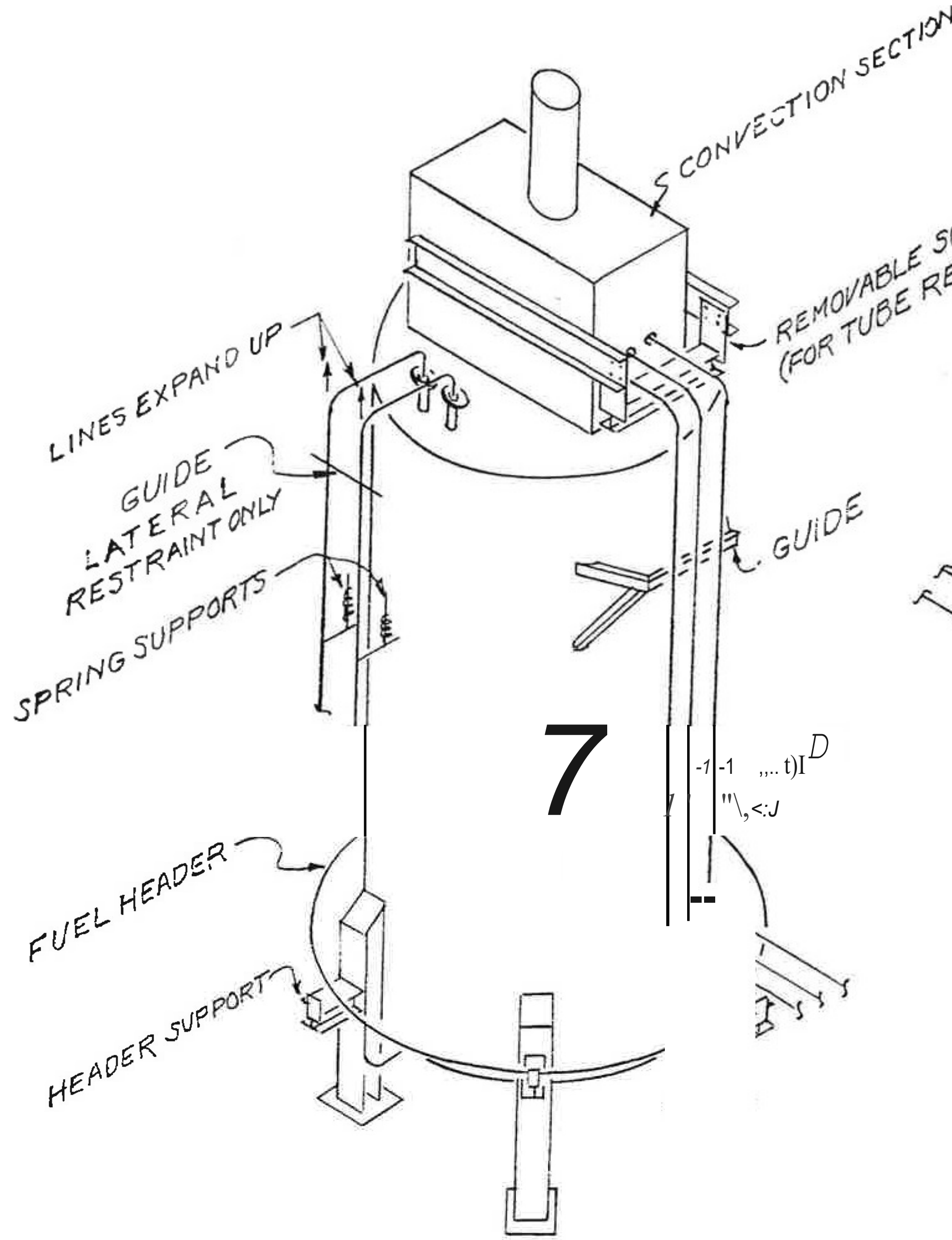
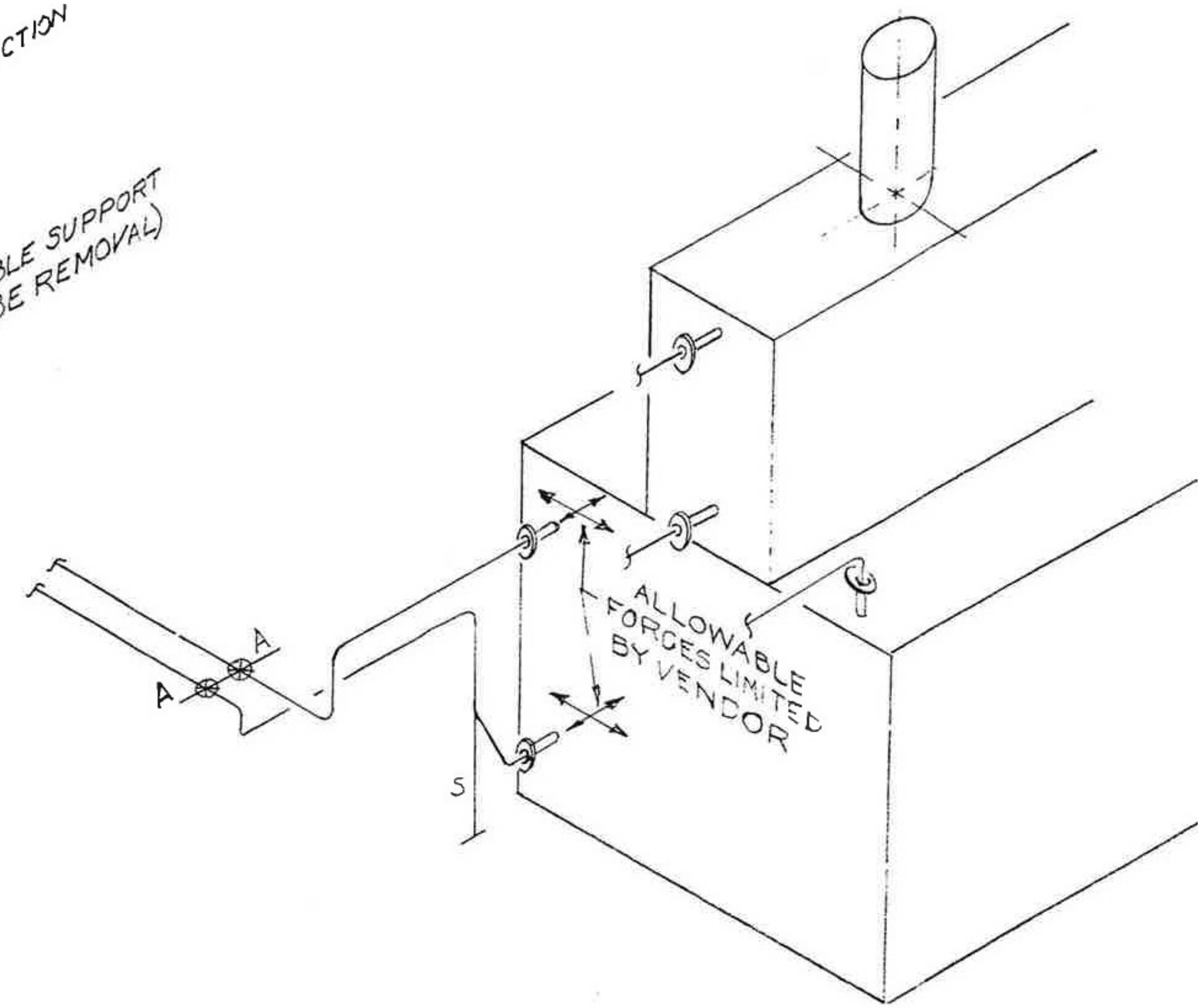


CYLI D"ICAL I--lcAill2



RECTANGULAR HEATER

REISSUtO AS tN fl.J t. fHG

STD WAS" I -607

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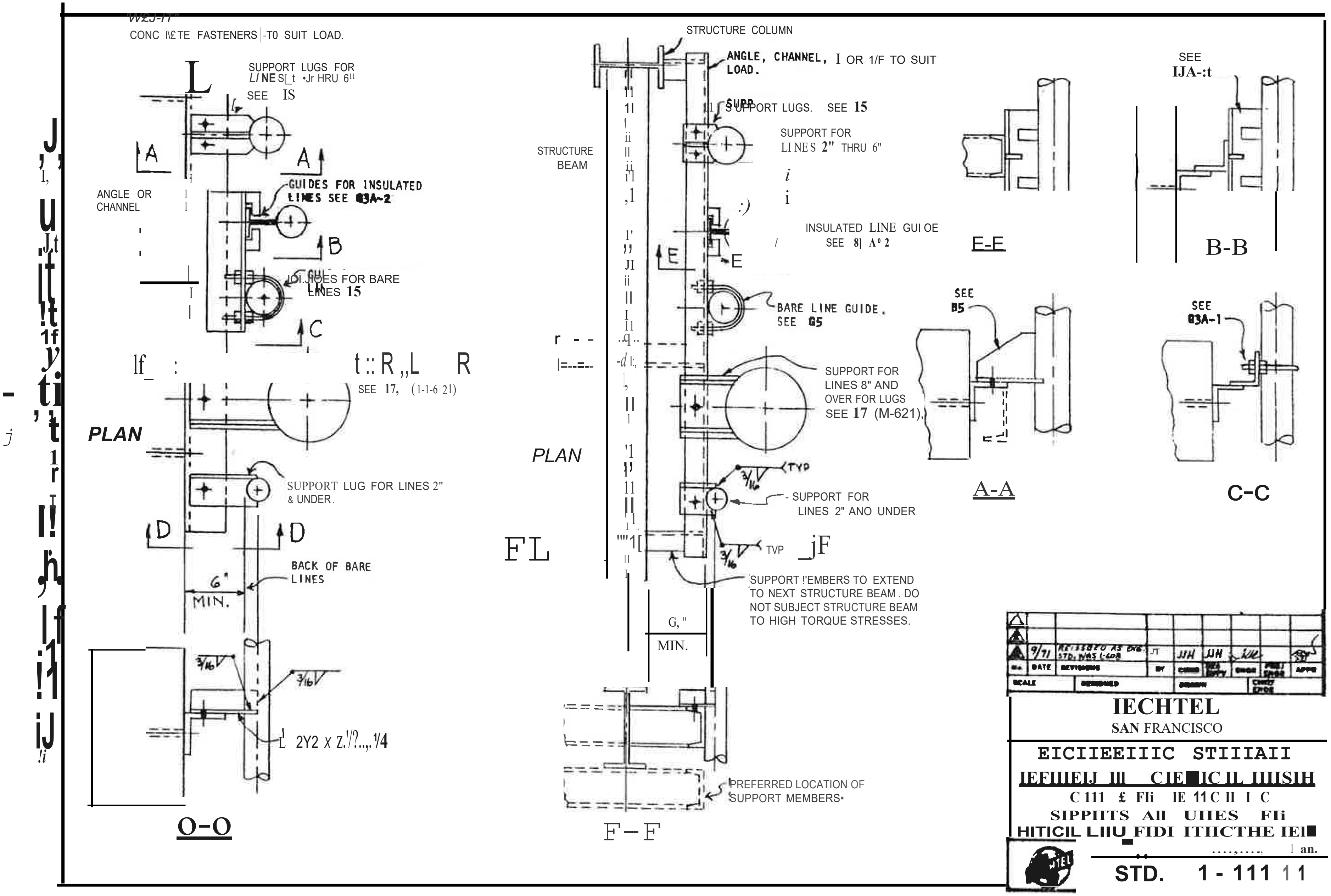
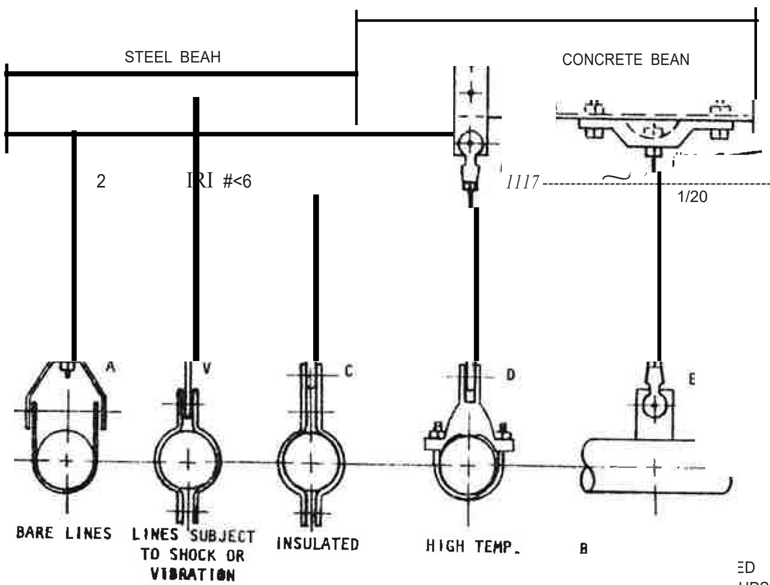
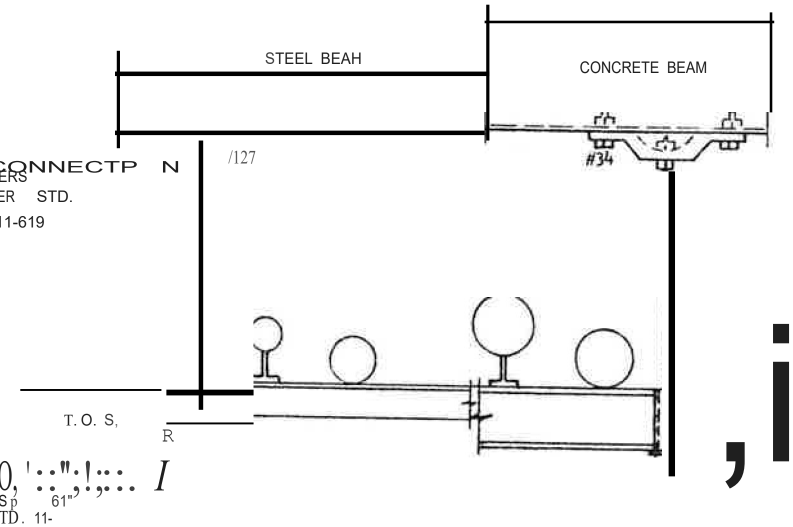
REFINERY AND CHEMICAL DIVISION

GUIDE FOR DESIGNING SUPPORTS FOR HEATER PIPING

ST B. | M- 60 7 | 0


CONCRETE FASTENERS TO SUIT LOAD.
SUPPORT LUGS FOR LINES 2" THRU 6"
ANGLE OR CHANNEL
GUIDES FOR INSULATED LINES SEE B3A-2
GUIDES FOR BARE LINES 15
SEE 17, (1-1-6 21)
PLAN
SUPPORT LUG FOR LINES 2" & UNDER.
BACK OF BARE LINES
6" MIN.
D-D
STRUCTURE COLUMN
ANGLE, CHANNEL, I OR 1/F TO SUIT LOAD.
SUPPORT LUGS. SEE 15
SUPPORT FOR LINES 2" THRU 6"
STRUCTURE BEAM
INSULATED LINE GUIDE SEE B3A-2
BARE LINE GUIDE, SEE B5
SUPPORT FOR LINES 8" AND OVER FOR LUGS SEE 17 (M-621)
PLAN
TYP
SUPPORT FOR LINES 2" AND UNDER
SUPPORT MEMBERS TO EXTEND TO NEXT STRUCTURE BEAM. DO NOT SUBJECT STRUCTURE BEAM TO HIGH TORQUE STRESSES.
MIN.
PREFERRED LOCATION OF SUPPORT MEMBERS
F-F
E-E
B-B
SEE B5
SEE B3A-1
A-A
C-C
SAN FRANCISCO
STD.





TRAPEZE TYPE Ho\NGERS ARE TO BE USED FOR SUPPORTING ALL MULTIPLE HORIZONTAL LINE,S TIIEY HAY ALSO BE USED FOR SUPPORTING SINGLE I.INES LOCATED TOO CLOSE TO UtiDERSICE OF BEAMS FOR CLAHP **WINDERS ANO** FOil HOT LINES WITH CONSIDERABLE THERMAL t10VEHENTS.

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NOTE: HOT LINES REQUIRE LONGER ROOS THAN COLO LINES BECAUSE Of THEIR THEIUIAL 110VEHENT. A LINE **WITH A** LARGE THERMAL 110VEHENT IIOULD BE RESTRAINED WITH A SHORT ROD AND COULD CAUSE ROD RAIi.URE,

lo	DATE	REVISIONS	BY	CHKD	DES			APPR

SCALE | DESIGNED | DRAWN | CHIEF

IEGHTEL
SAN FRANCISCO

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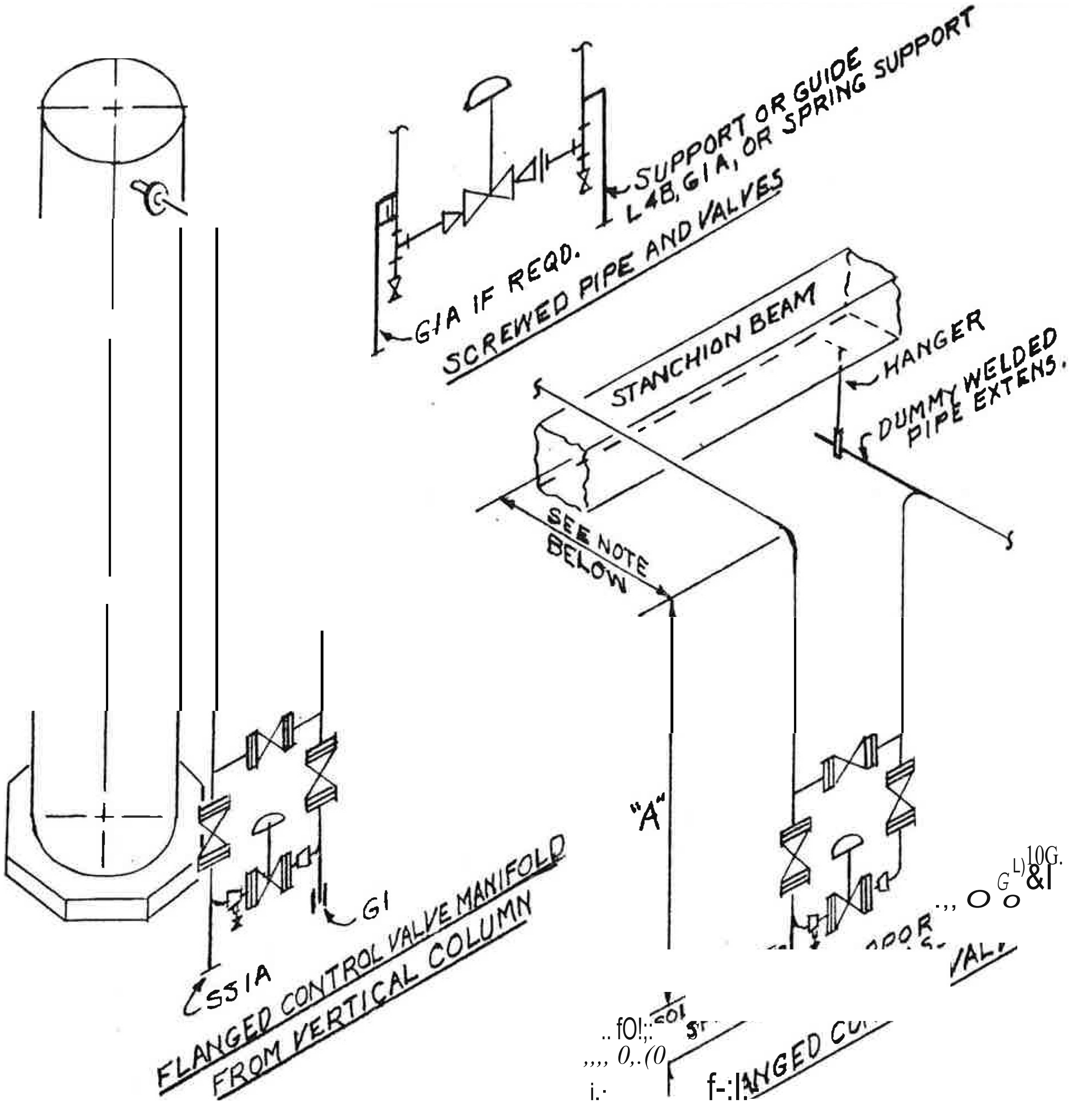


Note: For control valve assemblies located in pipeways:

A. Overhang, 2'-0" or less beyond beam, a guide Gl may be provided if the vertical Leg "A" can take the horizontal expansion in the system without exerting high lateral forces on the guide.

B. When the expansion or forces are too large for the guide or the overhang is between 2'-0" and 10'-0" spring supports may be used.

C. When the overhangs are 10'-0" and over solid supports Type L4A may be used.

Note: Control valve assemblies must be designed for supporting or guiding from the elbow (referred) or on screwed pipe, above the tee.

A	9/71	REISSUED AS ENG. STANDARD. WAS L- 11	.Jf	JJ	JJH
	DATE	REVISIONS			DR. SUP. / ENG. / CHIEF ENG.

ORIGIN
R&C ENG (S
PIPE
SUPPORT

BECHTEL

GUIDE FOR DESIGNING
SUPPORTS FOR
CONTROL VALVE MANIFOLDS

JOIN.. STD.

DIA.WIIG No.
M-61 J
0

PIPE SIZE	1'/z"	z"	-:,"	4"	re"	8"	10"	IZ."	14-"		ia··	e.o"	,t·	Z.4"
l1/2"	ti	''	''''	,,,	12"	13"	14-	15"	15"	"'" ..	11-	ia·	I'f"	io"
e"	C,"	(o"	,,	7"	12"	13"	14	15"	1 /	1 i;,"	17"	18"	1q"	20"
3"	G,"	"	8"	8"	IZ"	1:3"	/4"	15"	1 ··	17"	18"	I'I"	e0"	ZI"
4"	G"	7"	cf'	e,'	13"	14"	15P	''o	17"	!8"	rq"	e0"	21"	ez"
"	,t·	12"	1'2"		14"	15"	··	11"	18	1q"	20"	cl"	ZZ"	23"
8"	13	15"	13"	14	15"	/6"	17'	l8	1q··	i.o"	e.l,,	2.Z"	ZJ'	e4"
10"	14	14	14"	JS"		11"	,a"	1q"	Zo"	2,1"	zt	Z3"	e4"	25"
1,··	IS"	15"	15	'''	17"	18"	1cf"	20··	21"	2f	23	Z4"	'ZS"	21,"
14	15	J5"	li	17"	IB"	I'1"	20"	ZI"	21	2Z"	25	24	25A	a,"
16	lGi"	1'3"	17"	113	1q"	20"	2.1"	2e"	et·	23"	24"	z5"	zrs,"	z.7u
le"	17	17	IB"	1q"	2.0"	21•'	zi·	23"	23"	24"	es·	e,	Z7"	Z8"
Zo"	,e:	18	1q·•	2d'	21"	2-ZN	z3"	24	Z4"	es"		27"	2d"	ZC,"
et•	1q"	I'l "	o·	e,"	ZZ"	z3"	24A	2 S"	,,,,	2,,,	27	ZS·	i'J"	°30"
z4•	C.0·	20"	2.1"	2Z"	7..3	24"	Z.S"	1J:/		z.7M	Z.a"'	z.q"	,3a•	31

DIMENSIONS ABOVE ARE FOR BARE LINES ONLY. THICKNESS OF INSULATION ON ADJACENT LINES MUST BE ADDED TD TABLE VALUES AS RE UlRED•. BACK OF LINES ASSUMED AT 1'-0" + FROM VESSEL SHELL. SEE DRAWING M-600 AND H-602.

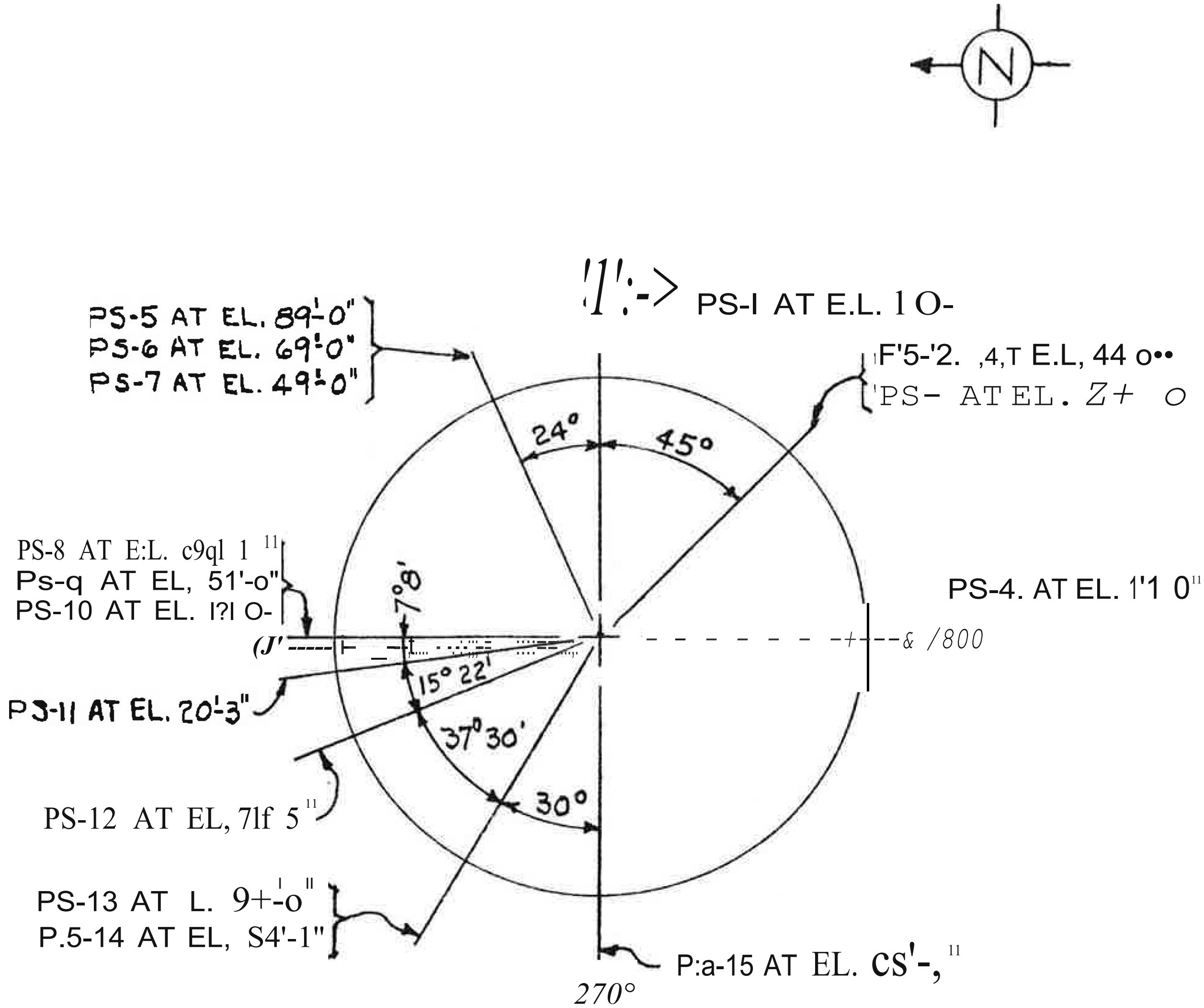
A	'7/71	REISSUED AS EMG. STO. WAS L-612.	.fr	JJH	JJ,4	
6	DA.Tl	REVISrnNs	DI.	CN"L		O.

OIIIQIN R&C ENG(SF) PIPE SUPfORT

MINIMUM SPACING OF VERTICAL RADIALLY LOCATED LINES ON VERTICAL VESSELS

JOINe. STD.

MAWING Ne. M--612



ELEVAT\ONS ARE. TO VESSE.L 8 A5 E \\X" • 0'-o"

The above is typical of location drawings sent to vessel fabricators for shop fabricating and installing supports on stress relieved vessels. This drawing and prints of the supports showing the portions attached to the vessel must be in the fabricators possession for installation prior to the stress relieving of the vessel.

9/71	REISSUED AS EMG. STANDARD. WAS L-610.	Jr	JJII	JJH	
DATE	REVISIONS		CN'L	DR. SUP.	ENG. / CHIEF ENG.

ORIGIN R&C ENG (SF)

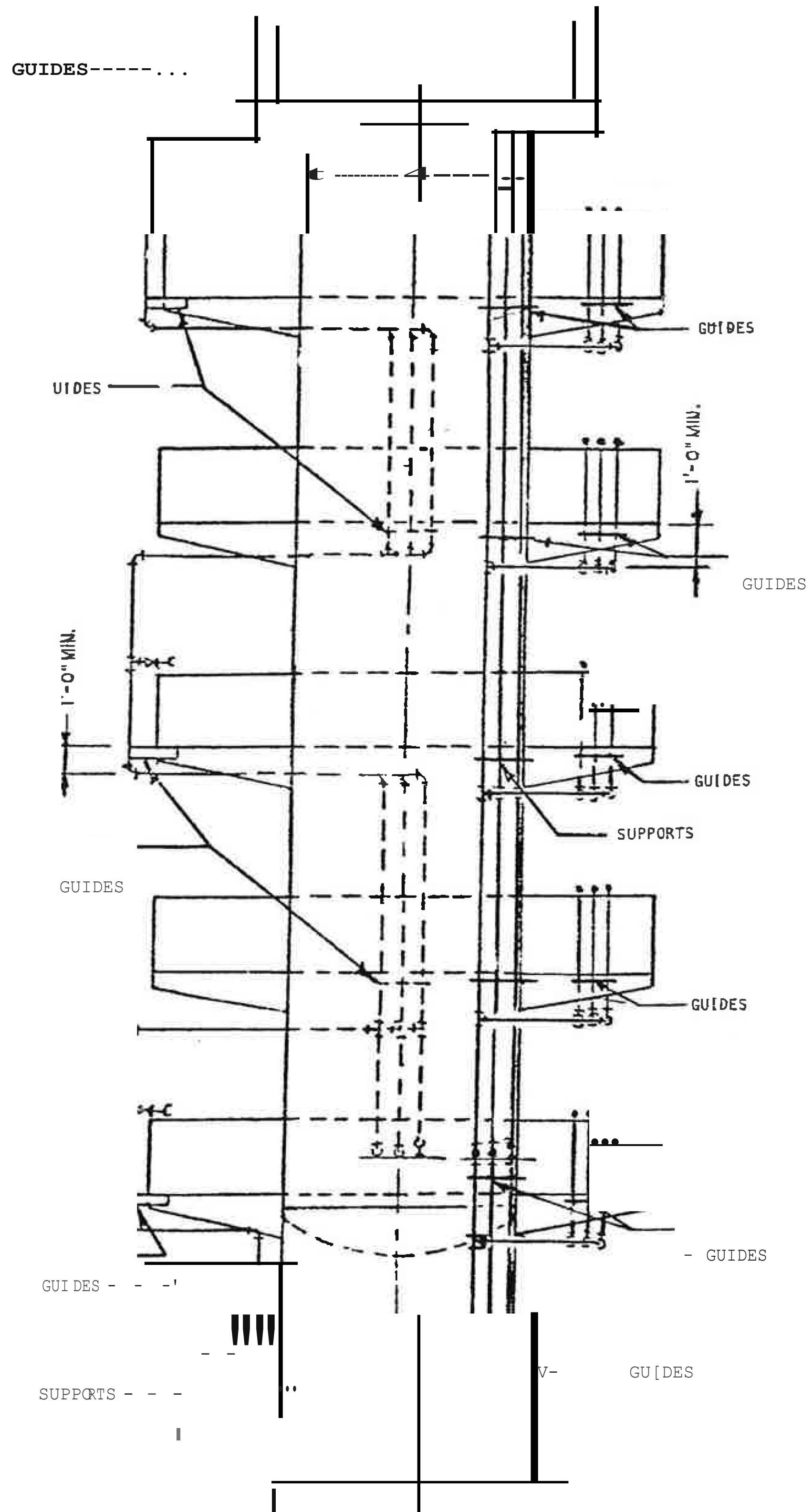
PIPE SUPPORT

BECHTEL

TYPICAL LOCATION DRAWING OF PIPE SUPPORTS FOR STRESS RELIEVED VESSELS

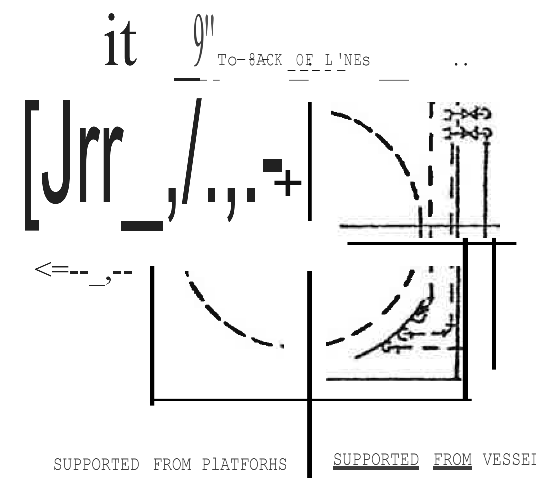
1011... STD

DRAWING No. H - 610 REV. 0



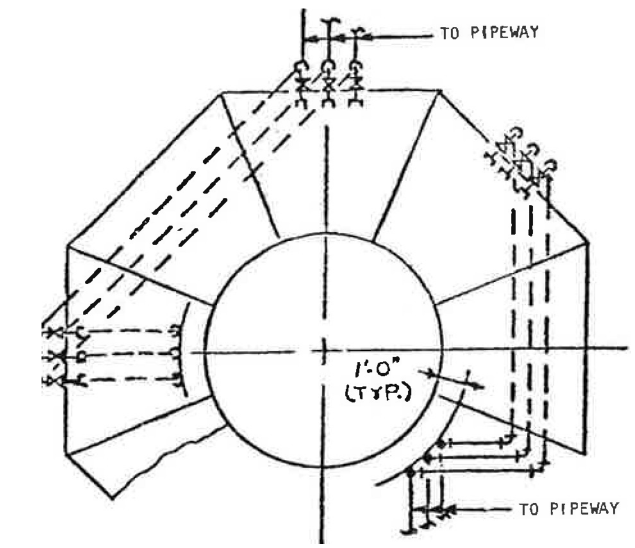
SUPPORTED FROM PLATFORMS | SUPPORTED FROM VESSEL

FOR GUIDES: USE STANDARD DWGS. G2, G2A, OR G28.
FOR SUPPORTS: USE STANDARD DWGS. B13, B13A, or BIJB.



SUPPORTED FROM PLATFORHS | SUPPORTED FROM VESSEL

TOP PLATFORM



SUPPORTED FROM PLATFORMS | SUPPORTED FROM VESSEL

LOWER PLATFORMS

SUPPORTING AND GUIDING L[NES FROM vEss:=L

T IS METHOD [S PREFERRED BECAUSE THE SUPPORTS CAN BE LOCATED ON THE VESSEL WHICH [S CAPABLE Oo TAKING THE SUPPORT LOADS ANO BY SUPPORT[G ABOUT THE MID POINT OF T E VESSEL,THE BRANCHES TO THE PLATFORM 0 R1/NS TO THE PIPEWAY ONLY HAVE TO BE FLEXIBLE ENOUGH FOR HALF THE TOTAL VESSEL GROIIT4. THE L[NES ARE GUIDED ABOVE ANO BELOW THE SUPPORT AT STANDARD INTERVALS. TO GI VE RIGIDITY TO THE 1405E CONNECTIONS THE FIELD FASTENS EACH HOSE CONNECTION TO THE PLATFORM HANO RAIL. BECAIJ E OF THIS, SU[OES ONLY SHOULD BE PROVIDED FOR T!E RISERS FROM THE UNDERSIDE OF THE PLATFORMS. UTILITY UNES BEING SMALLAt ,J LOCATED CLOSE TO SHELL CAN PENETRATE PLATFORMS W1THOUT BLOCKING THEM.

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REQUIRE STRENGTHEN NG.

	9/71	REISSUED AS ENGINEERING STD, WAS L-603	JT	JJH	JJH			

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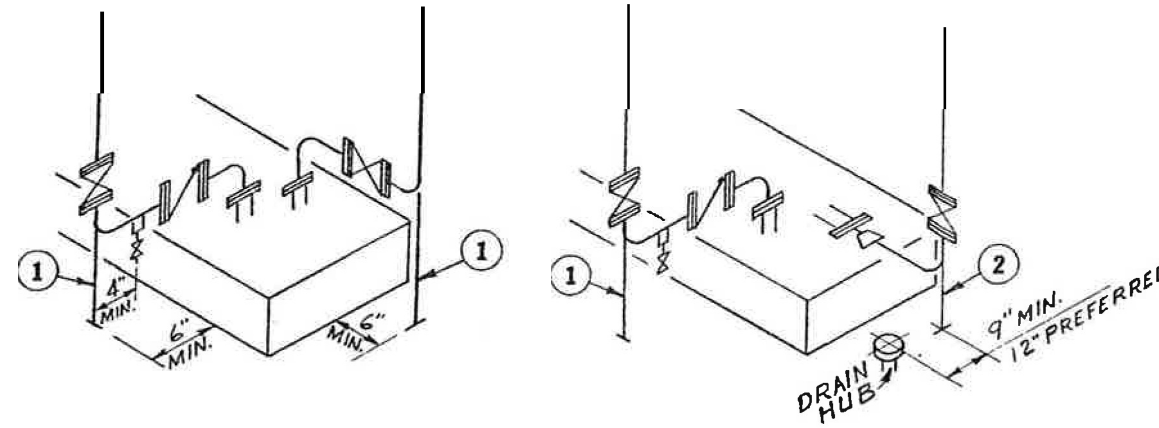
SAN FRANCISCO

ENGINEERING STANDARD
REFINERY AND CHEMICAL DIVISION

GUIDE FOR DESIGNING SUPPORTS FOR UTILITY LINES FROM VESSEL AND PLATFORMS

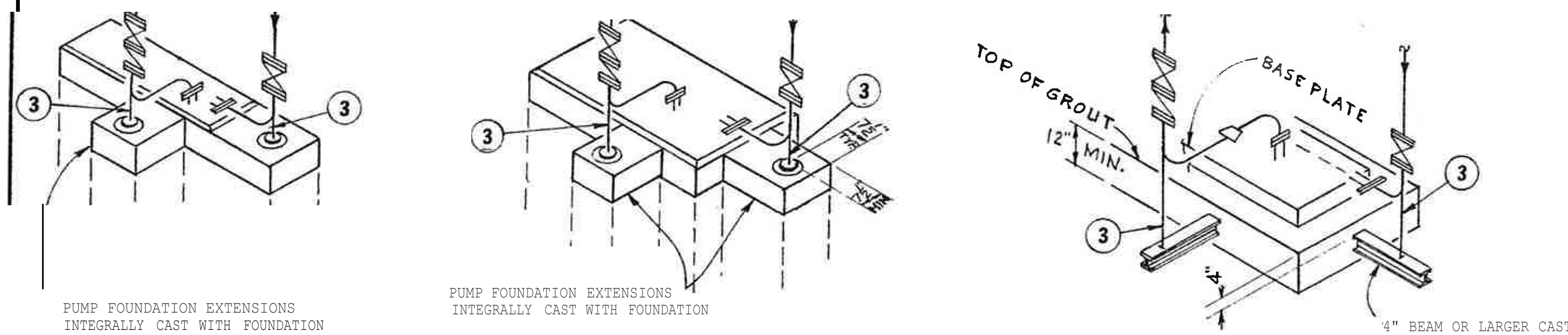
STD. M- 603 0



MINI1V1U1\i1 GRADE SETTLEMENT AND NO FROST HEAVE CONDITIONS.

	0	0	0
4" AND SMALLER	L4A OR L4H	L4A OR L4H	L4A OR L4H
6" AND LARGER	ADJUSTABLE OR SPRING	ADJUSTABLE OR SPRING	ADJUSTABt·E

SUCTlotJ ANO DISCHARGE PIPING, 4" AND SMALLER, MAY BE SUPPORTED BY A SOL ID BASE SUPPORT, LINES 6" AND LARGER SHOULD BE SUPPORTED BY **AN** ADJUSTABLE SUPPORT OR, IN SOME CASES, BY A SPRiNG SUPPORT,

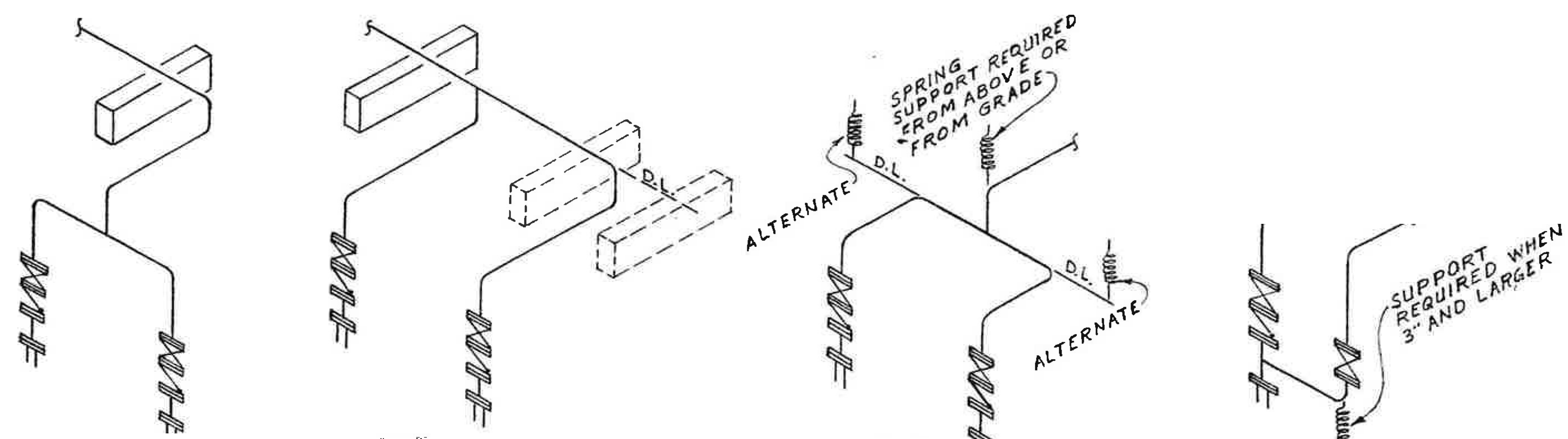


PUMP FOUNDATION EXTENSIONS INTEGRALLY CAST WITH FOUNDATION

PUMP FOUNDATION EXTENSIONS INTEGRALLY CAST WITH FOUNDATION

4" BEAM OR LARGER CAST IN OR FASTENED TO PUMP FOUNOAT ION

FROST HEAVE OR GRADE SETTLEMENT CONDITIONS.



"A" "8" "C" "0"

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No.	DATE	REVISIONS	BY	DESIGN SUPV	ENGR	PROJ ENGR	APPR
0	5/72	REISSUED AS ENGRG. STANDARD WAS L-605	JT	JJH			

SCALE	DESIGNED	DRAWN	CHIEF ENGR

BECHTEL
SAN FRANCISCO

ENGINEERING STANDARD
REFINERY AND CHEMICAL DIVISION

GUIDE FOR DESIGNING SUPPORTS FOR PUMP PIPING

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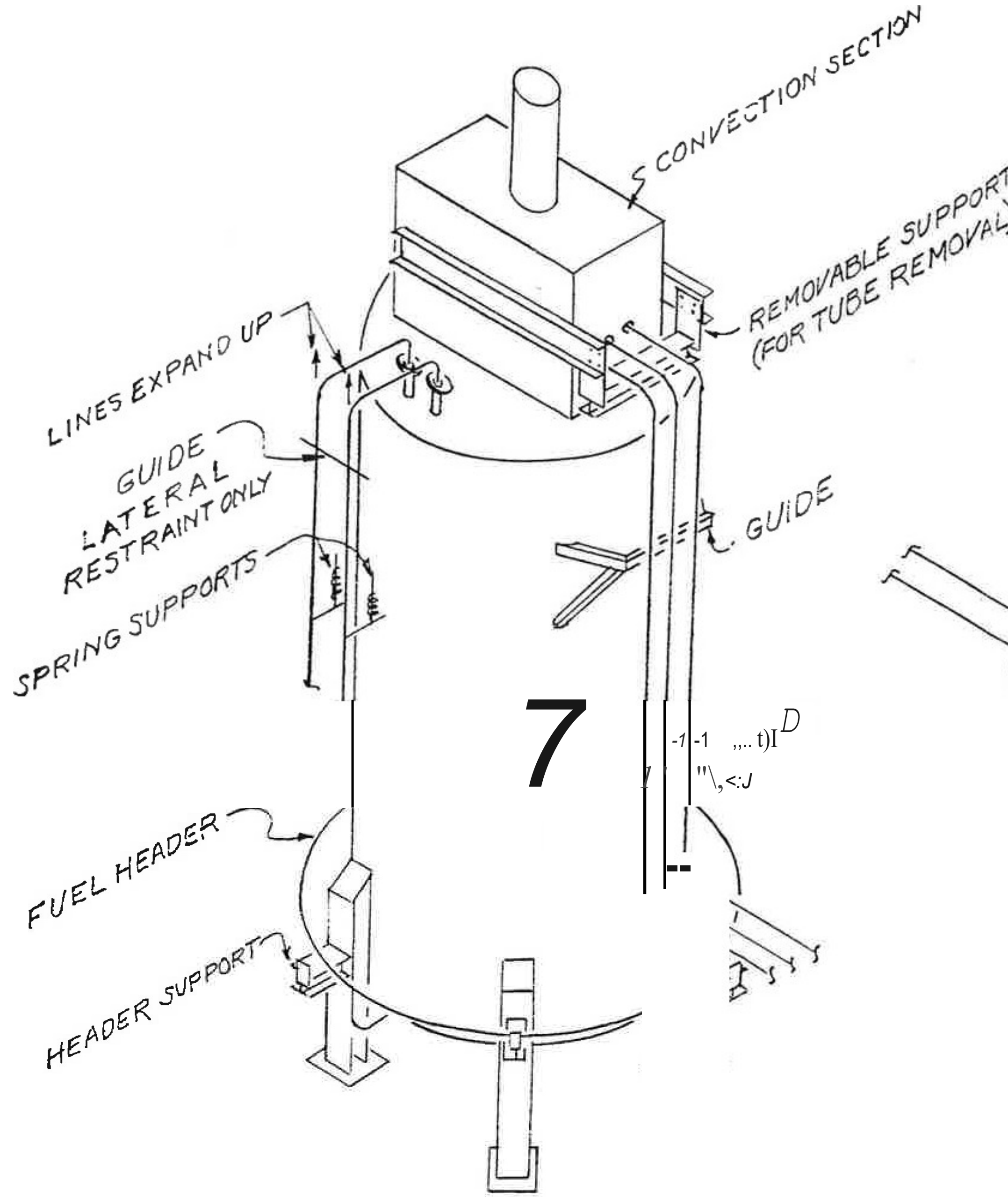
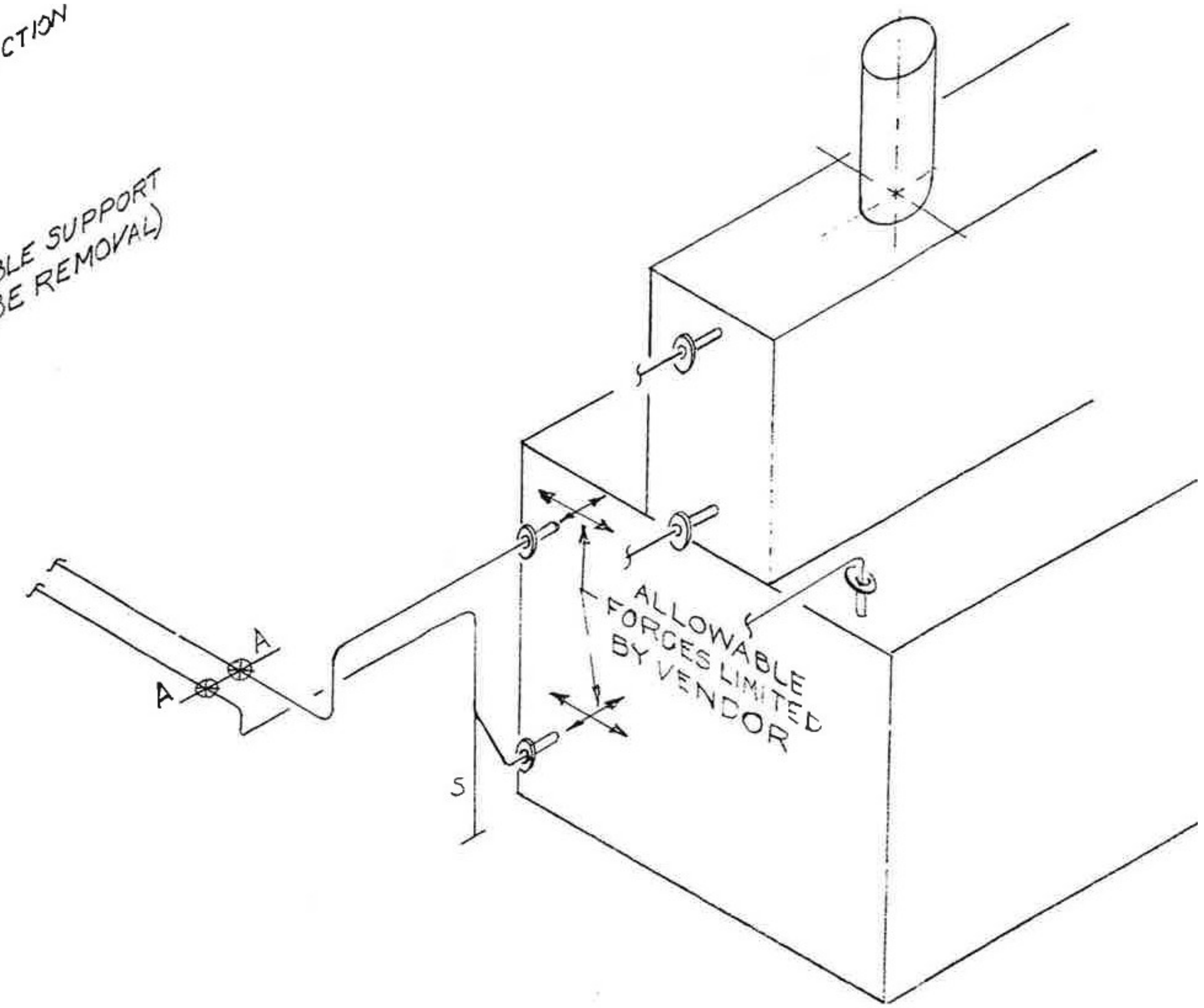
STD.	M-605	0



CYLI D"ICAL l--lcAill2



RECTANGULAR HEATER

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0	STD WAS" I -607

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ENGINEERING STANDARD
REFINERY AND CHEMICAL DIVISION

GUIDE FOR DESIGNING SUPPORTS FOR HEATER PIPING

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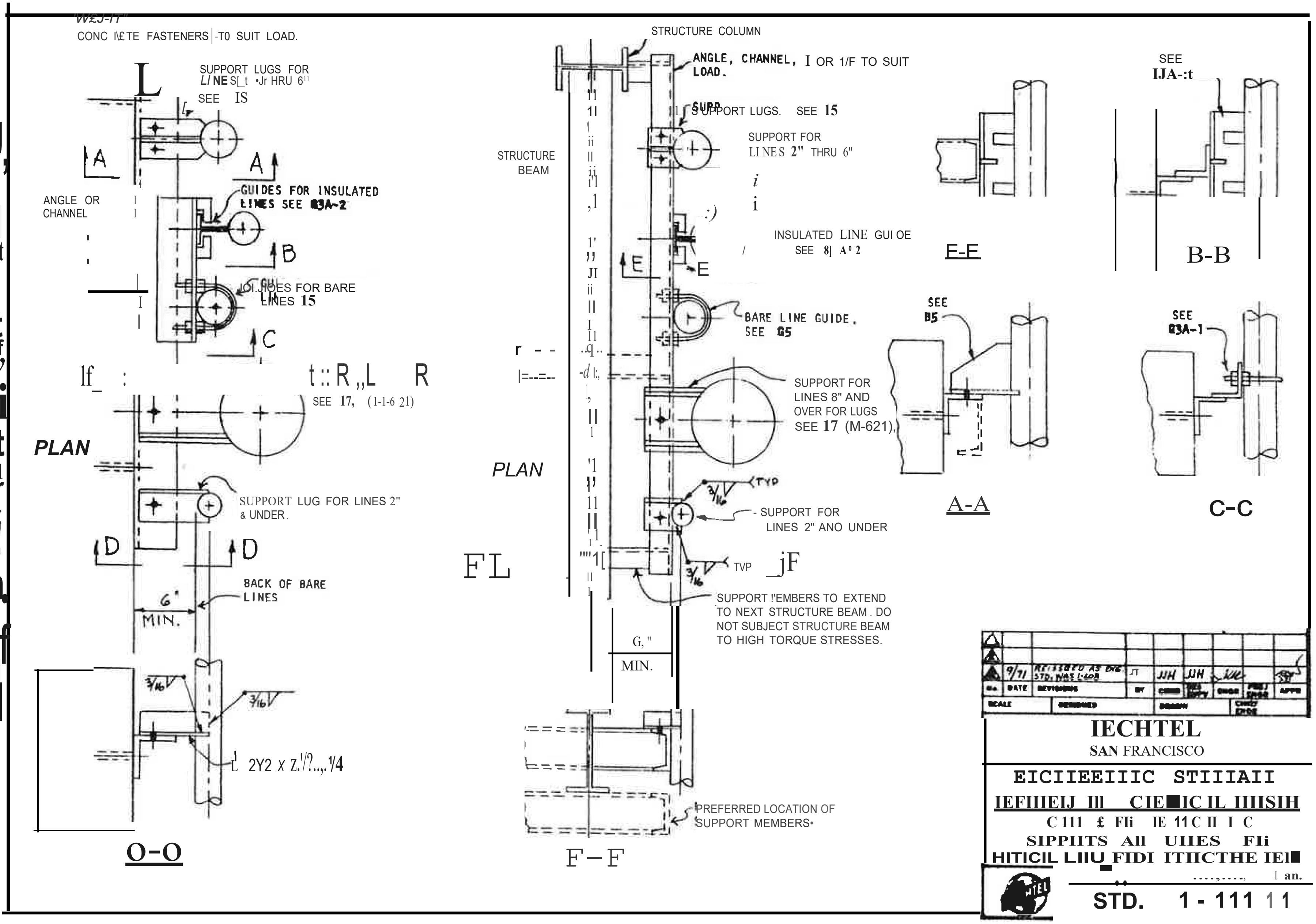
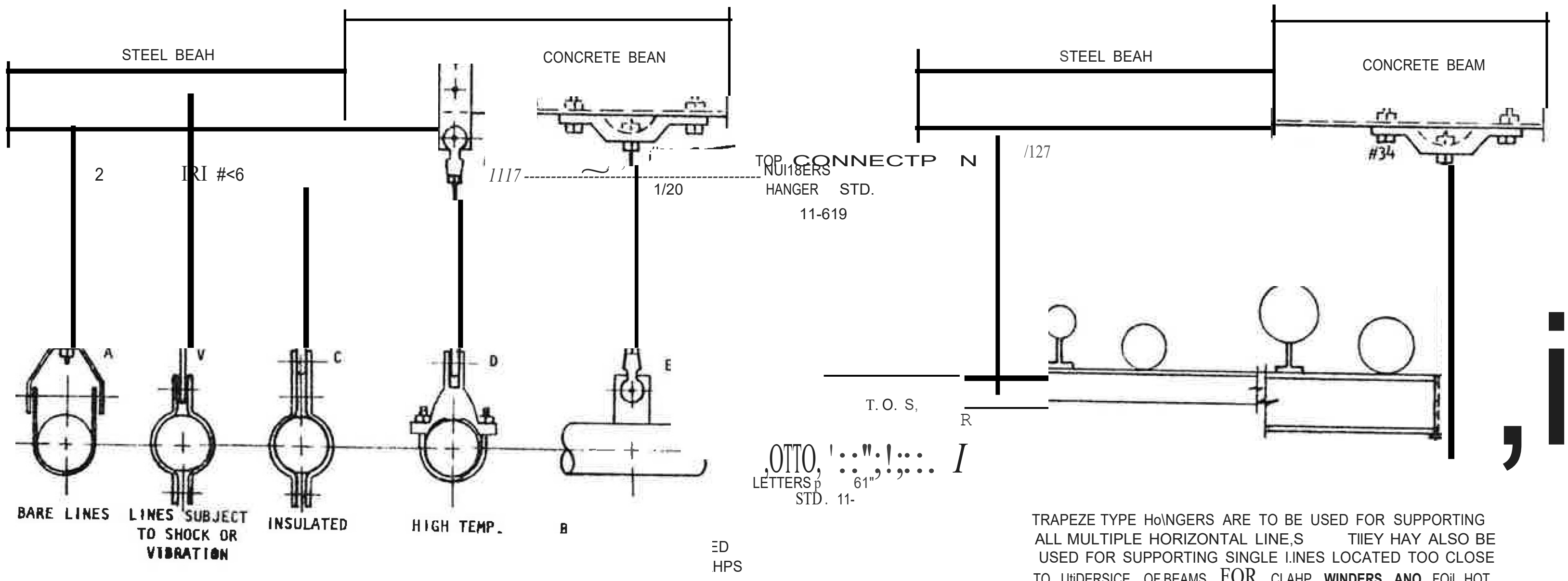

CONCRETE FASTENERS TO SUIT LOAD.
SUPPORT LUGS FOR
ANGLE OR
CHANNEL
GUIDES FOR INSULATED
LINES SEE
GUIDES FOR BARE
LINES 15
SEE 17,
PLAN
SUPPORT LUG FOR LINES 2"
& UNDER.
BACK OF BARE
LINES
6"
MIN.
O-O
STRUCTURE COLUMN
ANGLE, CHANNEL, I OR 1/F TO SUIT
LOAD.
SUPPORT LUGS. SEE 15
SUPPORT FOR
LINES 2" THRU 6"
STRUCTURE
BEAM
INSULATED LINE GUIDE
BARE LINE GUIDE.
SEE
SUPPORT FOR
LINES 8" AND
OVER FOR LUGS
SEE 17 (M-621)
PLAN
TYP
SUPPORT FOR
LINES 2" AND UNDER
TYP
SUPPORT MEMBERS TO EXTEND
TO NEXT STRUCTURE BEAM. DO
NOT SUBJECT STRUCTURE BEAM
TO HIGH TORQUE STRESSES.
MIN.
PREFERRED LOCATION OF
SUPPORT MEMBERS.
F-F
E-E
B-B
A-A
C-C
SEE
SAN FRANCISCO
STD.



TRAPEZE TYPE Ho\NGERS ARE TO BE USED FOR SUPPORTING ALL MULTIPLE HORIZONTAL LINE,S TIIEY HAY ALSO BE USED FOR SUPPORTING SINGLE I.INES LOCATED TOO CLOSE TO UtiDERSICE OF BEAMS FOR CLAHP **WINDERS ANO** FOil HOT LINES WITH CONSIDERABLE THERMAL t10VEHENTS.

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9/71								
No	DATE	REVISIONS	BY	CHKD	DES	ENGR	PROJ ENGR	APPR
SCALE	DESIGNED		DRAWN		CHIEF ENGR			

IEGHTEL
SAN FRANCISCO

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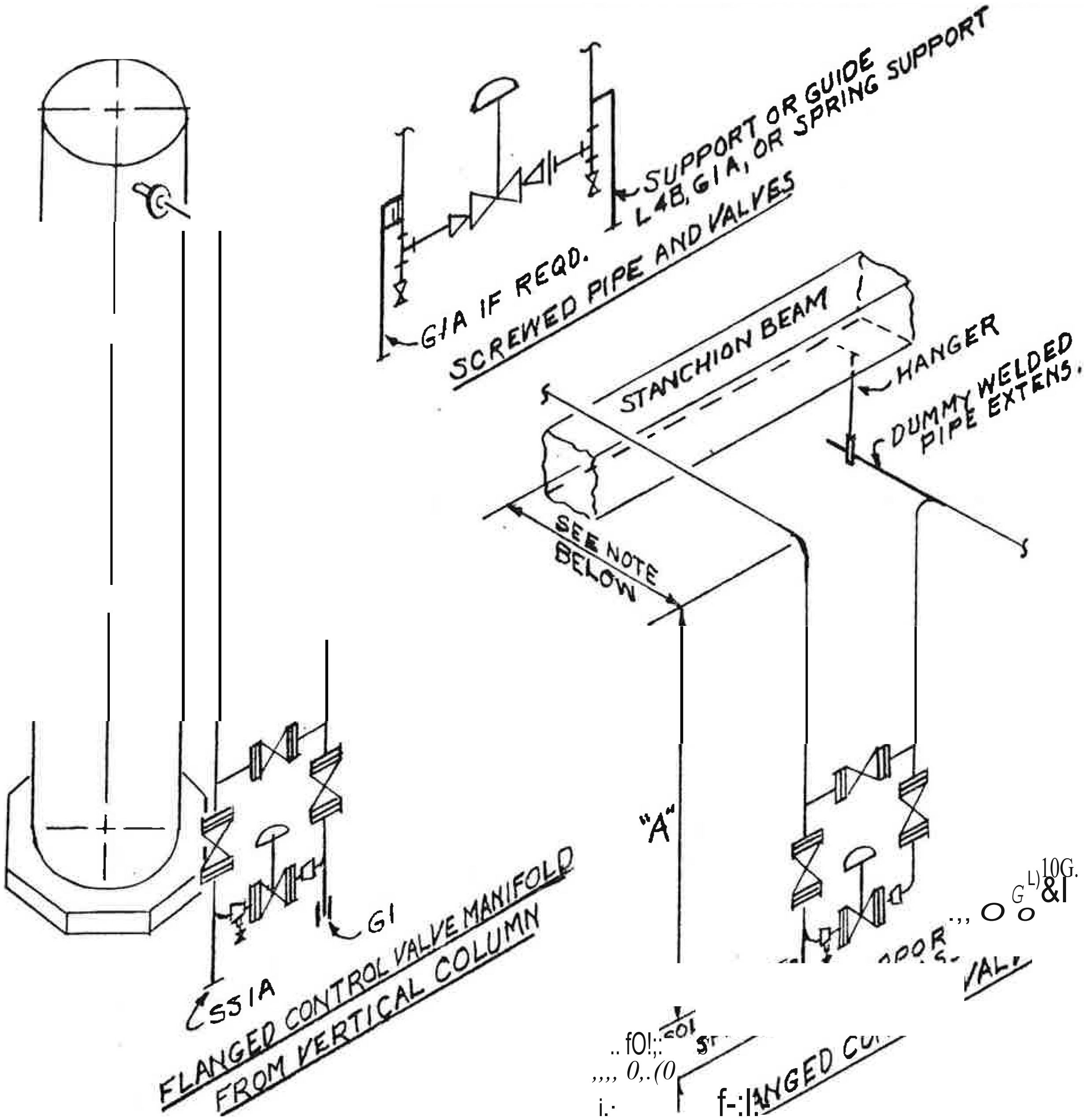


Note: For control valve assemblies located in pipeways:

A. Overhang, 2'-0" or less **beyond** beam, a guide Gl may be provided if the vertical Leg "A" can take the horizontal expansion in the system without exerting high lateral forces on the guide.

B. When the expansion or forces are too large for the guide or the overhang is between 2'-0" and 10'-0" spring supports may be used.

C. When the overhangs are 10'-0" and over solid supports Type L4A may be used.

Note: Control valve assemblies must be designed for supporting or guiding from the elbow (preferred) or on screwed pipe, above the tee.

A	9/71	REISSUED AS ENG. STANDARD. WAS L-11	Jf	JJ	JJH
	DATE	REVISIONS			DR. SUP. / ENG. / CHIEF ENG.

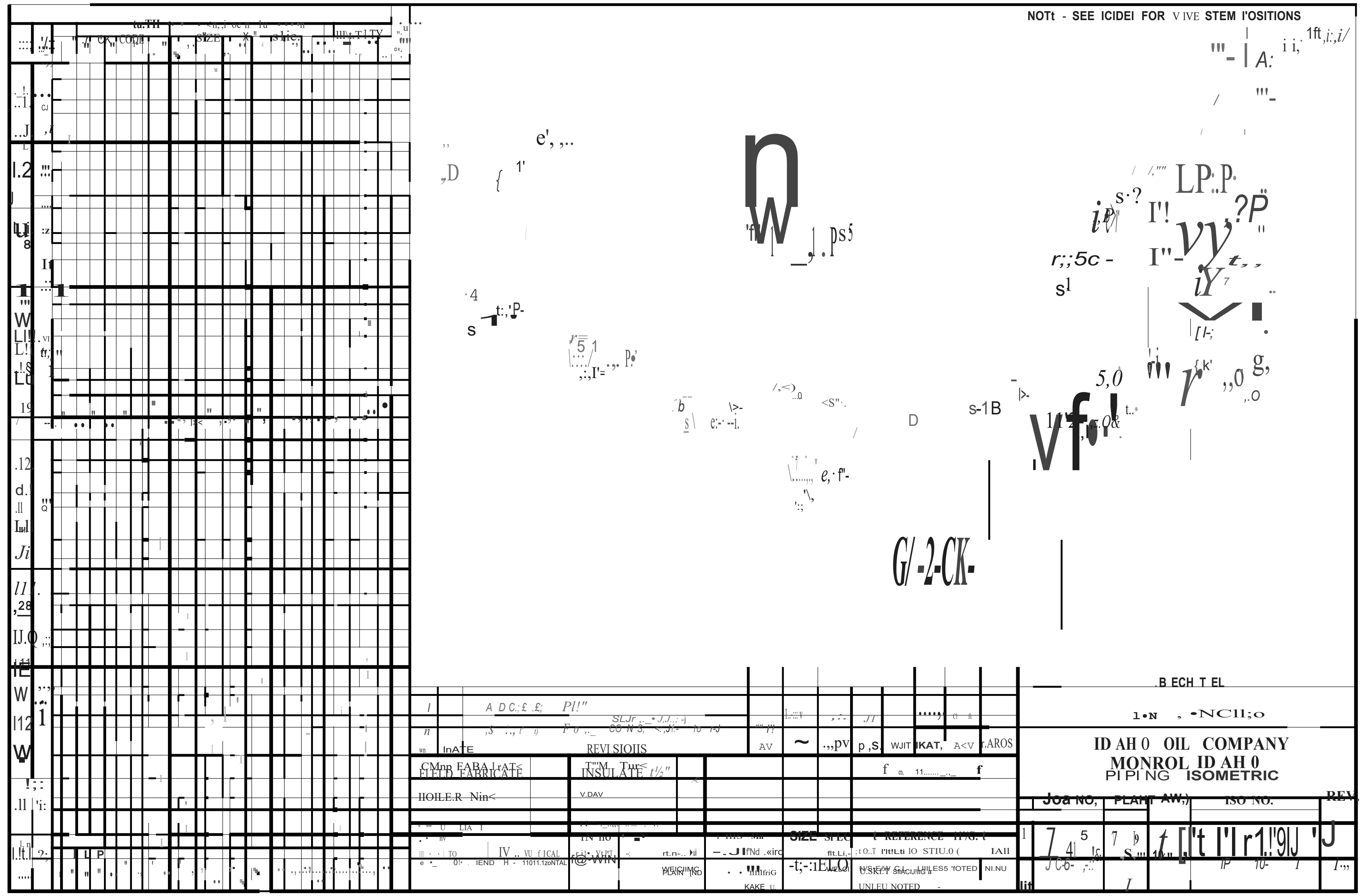
ORIGIN R&C ENG (S PIPE SUPPORT

BECHTEL

GUIDE FOR DESIGNING SUPPORTS FOR CONTROL VALVE MANIFOLDS

JOIN. STD.

DWG No. M-61J — 0



ONE Of THE FOLLOWING PIPE SUPPORT STAMPS IS PLACED ON THE PIPING ISOMETRIC WHEN CONVENIENT:

NO PIPE SUPPORTS REQUIRED

THIS INDICATESTHATTHE PIPE IS SELF-SUPPORTING OR THAT THE EXISTING SUPPORTS ARE SUFFICIENT.

FIELD TO SUPPORT

SUPPORTS ARE REQUIRED AND LINES ARE SUPPORTED BY THE FIELD USING STANDARD DRAWING M-628 AS A GUIDE.

PIPE SUPPORTS **BY** FIELD

THIS STAMP IS INTENDED FOR ISO METRICS WHERE PIPE FABRI CATOR USUALLY SUPPLIES WELDID ATTACHMENTS BUT DU£ TO SCHEDULE ETC., FIELD WILL FABRI CATE COMPLETE P. S. AND ATTACH.

PIPE SUPPORTS ATTACHED BY FIELD

THIS STAMP IS PUT ON PIPING ISOMETRICS WHERE STANDARD DRAWINGS AND SPECIFICATIONS DICTATE SHOP TO ATTACH BUT DUE TO SCHEDULE OR PROCUREMENT CONVENIENCE, FIELD IS INSTRUCTED TO RECEIVE FABRICATED P. S. AND ATTACH TO PIPE.

NO \',"E:.:: , :=: : SU?PORT ATTACH:.;.::-<=-, P.:C:QUiRED BY PIPE FAGi'<ICATOR

THIS STAMP IS INTENDED FOR ALLOY PIPES AND STRESS RELIEVED. PIPES. PIPE SUPPORTS ARE REQUIRED BUT FIELD WILL SUPPLY AND ATTACH, E.G., CLAMPED SHOES, BRACKETS OR GUIDES.

PIPE SUPPORT ATTACHMENT FABRICATED AND WELDED I3Y PIPE FABRICATOR

REQUIRED FOR ________________ ONLY.

THIS STAMP DIRECTS PIPE FABRICATOR TO MAKE AND ATTACH CERTAIN PIPE SUPPORTS ONLY. REMAINING PIPE SUPPORTS SHOWN ON THE ISOMETRIC WILL BE MADE AND ATTACHED BY THE FIELD.

No	DATE	REVISIONS	BY	DESIGN SUPV	ENGR	PROJ ENGR	APPR
1	5/72	REISSUED AS ENGRG. STANDARD. WAS L-613	JT	JJH			

SCALE NONE | DESIGNED | DRAWN | CHIEF ENGR

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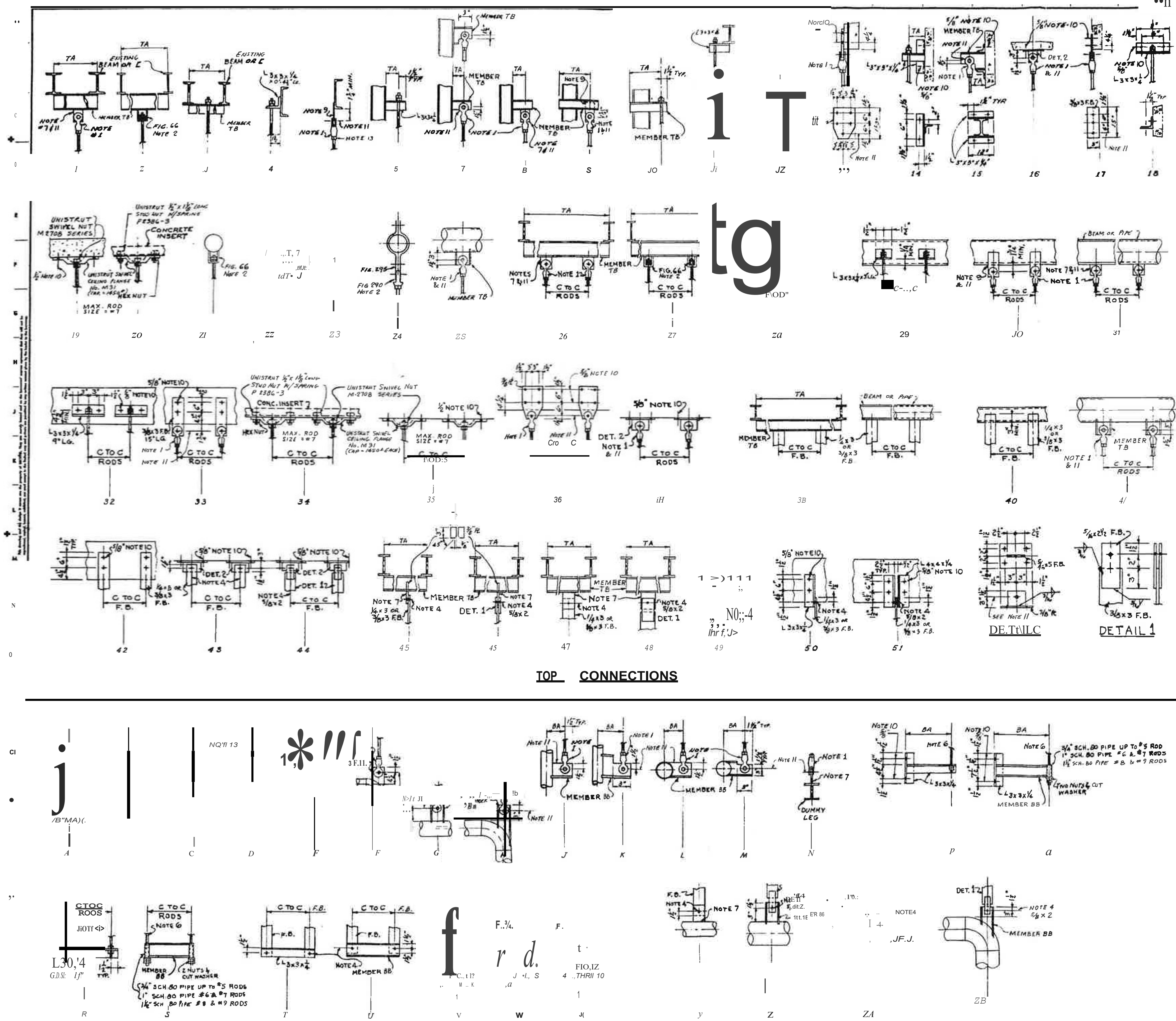
REFINERY AND CHEMICAL DIVISION

TYPICAL MARKED-UP PIPING ISOMETRIC

JOB No	DRAWING No.	
STD.	M - 613	0

17 × 22 "C" SIZE



TOP CONNECTIONS

BOTTOM CONNECTIONS

NOTES

1. FORGED STEEL CLEVIS WITH PIN GRINNELL FIG. 299. PIN DIAMETER IS 1/8" LARGER THAN ROD SIZE. ORDER BY SPECIFYING ROD SIZE
2. m m11 £rJ;1,W mNNGE[111r£G 290. ORDER BY SPECIFYING ROD SIZE.
3. W.ul !t:f&rRMf GR, ¶ff Pr % r1"ft J im NELL E.G•• BERO!N·PA SO, P(-SUP RT CORP.• MAY BE SUBSTITUTED.

BOLTS SHALL BE 5/8 X 1-1/2 SQ. HD. MACH. BOLTS WITH ONE HEX NUT UNLESS OTHERWISE NOTED

5. WHEN "TA" "TB" "BA" OR "BB" IS NOT SPECIFIED. EXISTING ITTL IS AVAILABLE.
6. ROD SIZES,

ROD NUMBER REPRESENTS THE SIZE OF ROD REQ'D IN EIGHTHS OF AN INCH. 3-Jli" 4•112" 5-5/t" 6-J/4" NM' 1!-1" 'i-1-1/lr" FLAT BARS, A•l14",J" B•J1?'xJ"

7. STANDARD R. SIZI' UNLESS OTHERWISE NOTED, {•3-0J3 W ,-·r
8. il1'1il1R1ii 'li'mltI 1 h 6 FILLET
9. STANDARD .JD TIERWISE NOTED, "'a..;- l±J.....:'.t. - u:j----C.. ıVi
10. ALL CONCRETE FASTENERS SHALL BE WEJ-IT EXPANSION BOLTS X l-1/2" LONG. FOR SIZE SEE DETAIL
11. HOLES IN STEEL MEMBERS SHALL BE 1/16" LARGER THAN NOMINAL DIAMETER OF ROD, BOLT OR PIN.
12. SYMBOL ILLUSTRATION,

H9B-6-8
TA·3'-6"TB• C6X8.2

STANDARD HANGERS

H9B+8
FA•J"-fl' TB•C6X8. 2

FULL CODE AS IT APPEARS ON PIPING ISOMETRIC OR ORTHOGRAPHIC PIPING DRAWING

HANGER ... L NUMBER ... IAL LETTER ... SIZE. SEE NOTE 6. ... TOM CONNECTION ... M CONN. OF E ... LUSIVE AND Y.

H 9 3 · 6 - I
IA • J'-6" TB•C6X8.2

All NOTES FOR TA TB BA BB C·C RODS AND SIZE ii' TOP PIPE

13. A HEX NUT IS TO BE USED FOR LOCKING THE WELDLESS EYE NUT. FIG. 290 AND THE FORGED STEEL CLEVIS. FIG. 299 TO PREVENT ROTATION OF THE HANGER ROD.

REISSUED AS ENGINEERING STANDARD. WAS L-619

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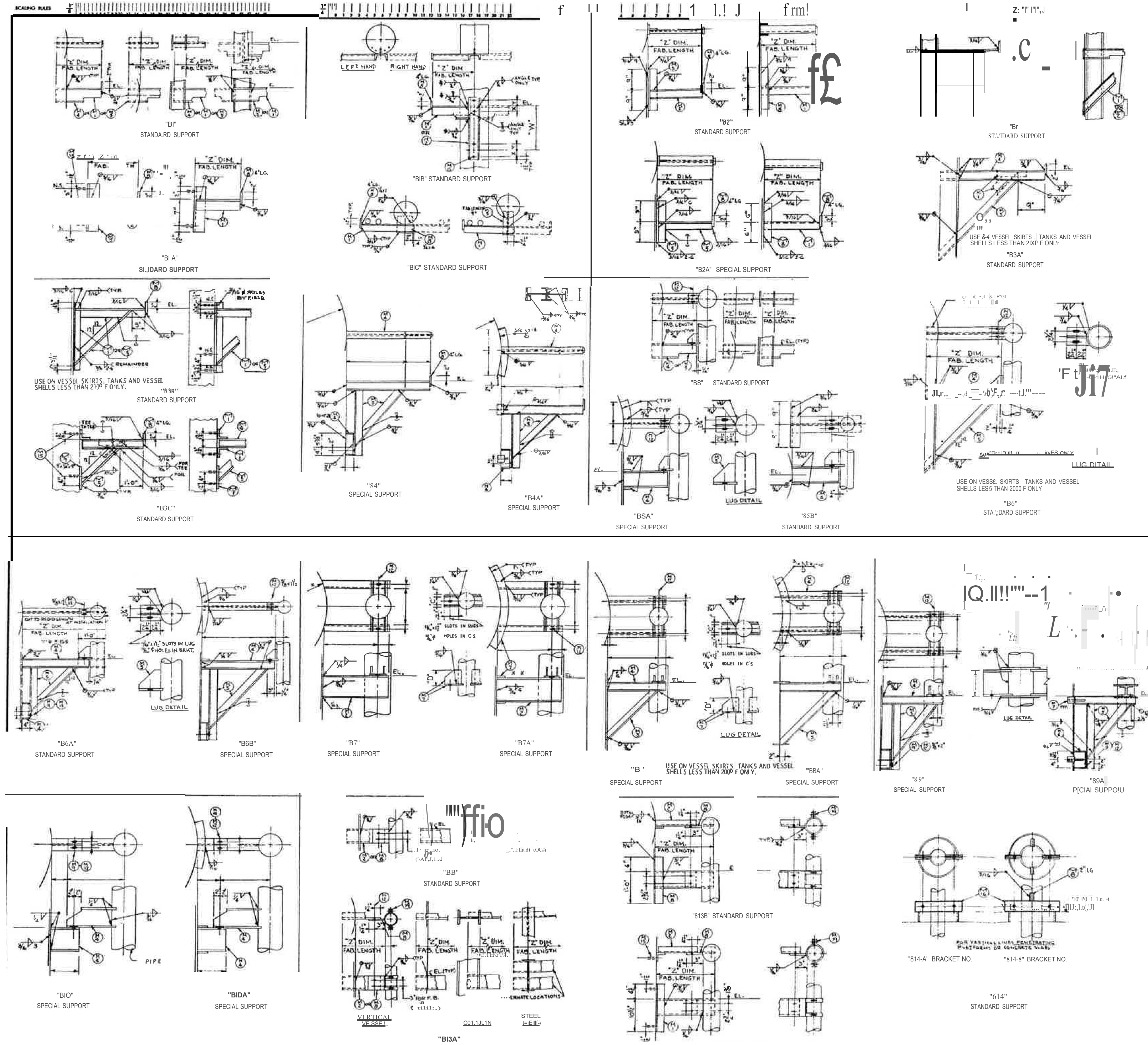
SUPPORT GUIDE & DETAILS
PIPE HANGERS
STD. M-619 0

SIZE E



"STANDARD SUPPORT"

85-H ... ORTHOGRAPHIC PIPING DWG

- BRACKET
- BRACKET SERIAL NUMBER
- MEMBER AND SIZE (VARIABLE) SHOWN IN TABULATION ON PIPE SUPPORT STANDARD
- FABRICATED LENGTH (VARIABLE) SHOWN ON PIPE SUPPORT STANDARD
- 85-2-C SUPPORT TYPE AND DRAWING NO. FOR PIPE SUPPORT STANDARD (APPEARS ON LOWER RIGHT HAND CORNERS OF PIPE SUPPORT STANDARD)

"SPECIAL SUPPORT"

- PROJECT PLANT NUMBER (IF ANY)
- 20-PH2 SUPPORT NUMBER (APPEARS ON LOWER RIGHT HAND CORNER OF PIPE SUPPORT DETAIL SHEET)

SPECIAL SUPPORTS ... AVAILABLE IN THE ... OF DESIGN AND SOME FABRICATION INFORMATION.

USE THIS DRAWING AS A SUPPORT SELECTION GUIDE ONLY. FOR SUPPORT DETAILS AND LIMITATIONS SEE SUPPORT DETAIL DRAWING ISSUED FOR THE JOB OR THE SUPPORT DETAIL DRAWING IN PIPE SUPPORT STANDARD BOOK

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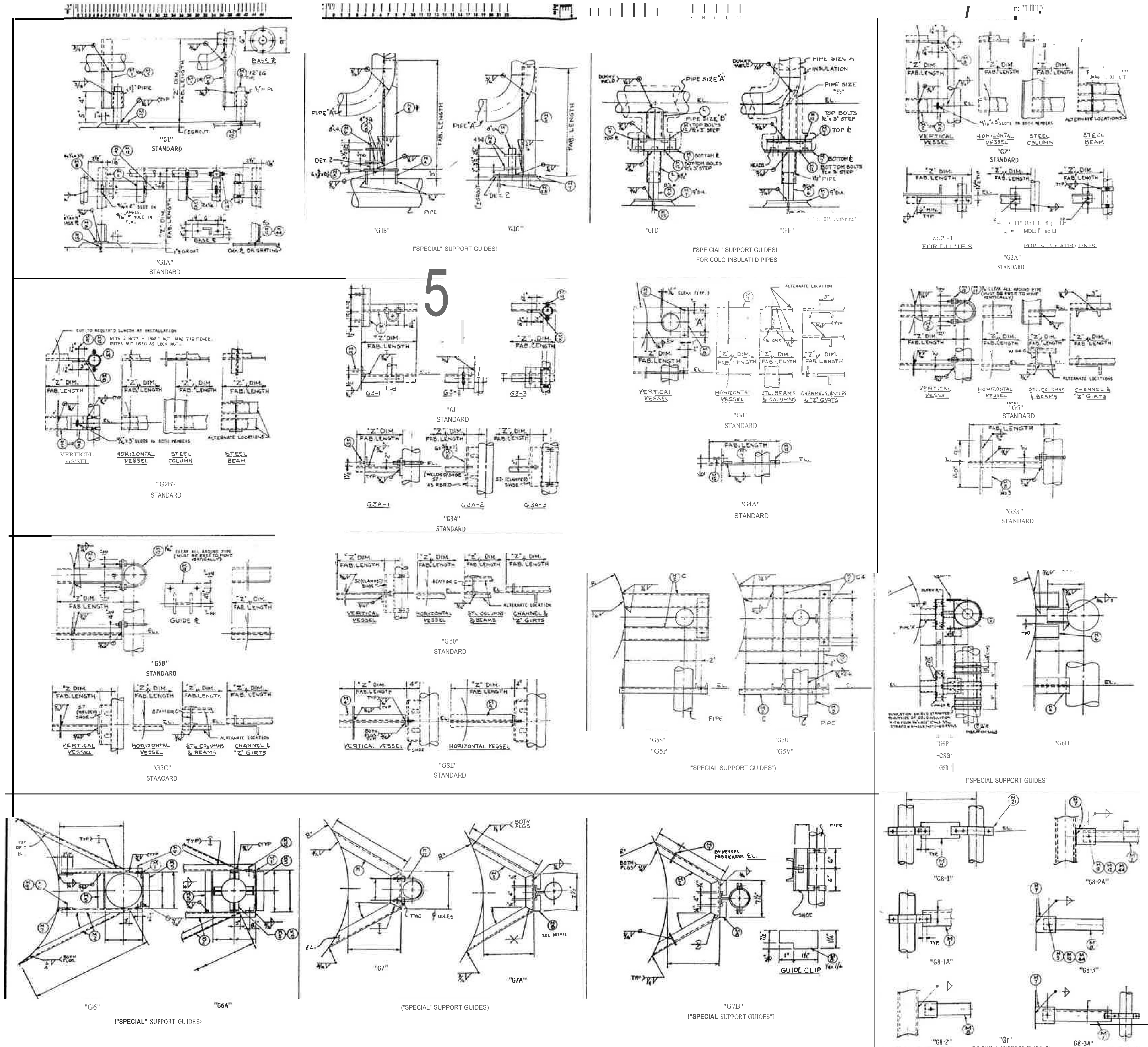
REFINERY AND CHEMICAL DIVISION

SUPPORT GUIDE
PIPE SUPPORT BRACKETS

STD. M-621 0

SIZE E



"STANDARD SUPPORT"

CSF — 4 ORTHOGRAPHIC PIPING DRAWING

VARIABLE GUIDE TYPE — SUPPORT DATA — FABRICATED OR VARIABLE — SUPPORT STANDARD

G1 GUIDE FROM GRADE

G2 GUIDE FOR SMALL LINES

G3 GUIDE FOR SMALL AND INTERMEDIATE SIZE LINES

G4 PLATE GUIDE

G5 GUIDE FOR INTERMEDIATE AND LARGE LINES

"SPECIAL SUPPORT"

20-PS-12

- PROJECT PLANT NUMBER (IF ANY)
- PIPE SUPPORT
- SUPPORT SERIAL NUMBER

SUPPORT NUMBER APPEARS ON LOWER RIGHT HAND CORNER OF PIPE SUPPORT DETAIL SHEET

TRANSPARENCIES OF THE SPECIAL SUPPORTS SHOWN BY FORM NUMBER ARE AVAILABLE IN THE FILES. THESE REQUIRE THE ADDITION OF DESIGN, AND SOME FABRICATION INFORMATION.

USE THIS DRAWING AS A SUPPORT SELECTION GUIDE ONLY. FOR DESIGN DETAILS AND LIMITATIONS SEE SUPPORT DETAIL DRAWING ISSUED FOR THE JOB OR THE PIPE SUPPORT STANDARD

NO.	DATE	REVISIONS	BY					APP'D
0	5/72	REISSUED AS ENGINEERING STANDARD. WAS L-622						

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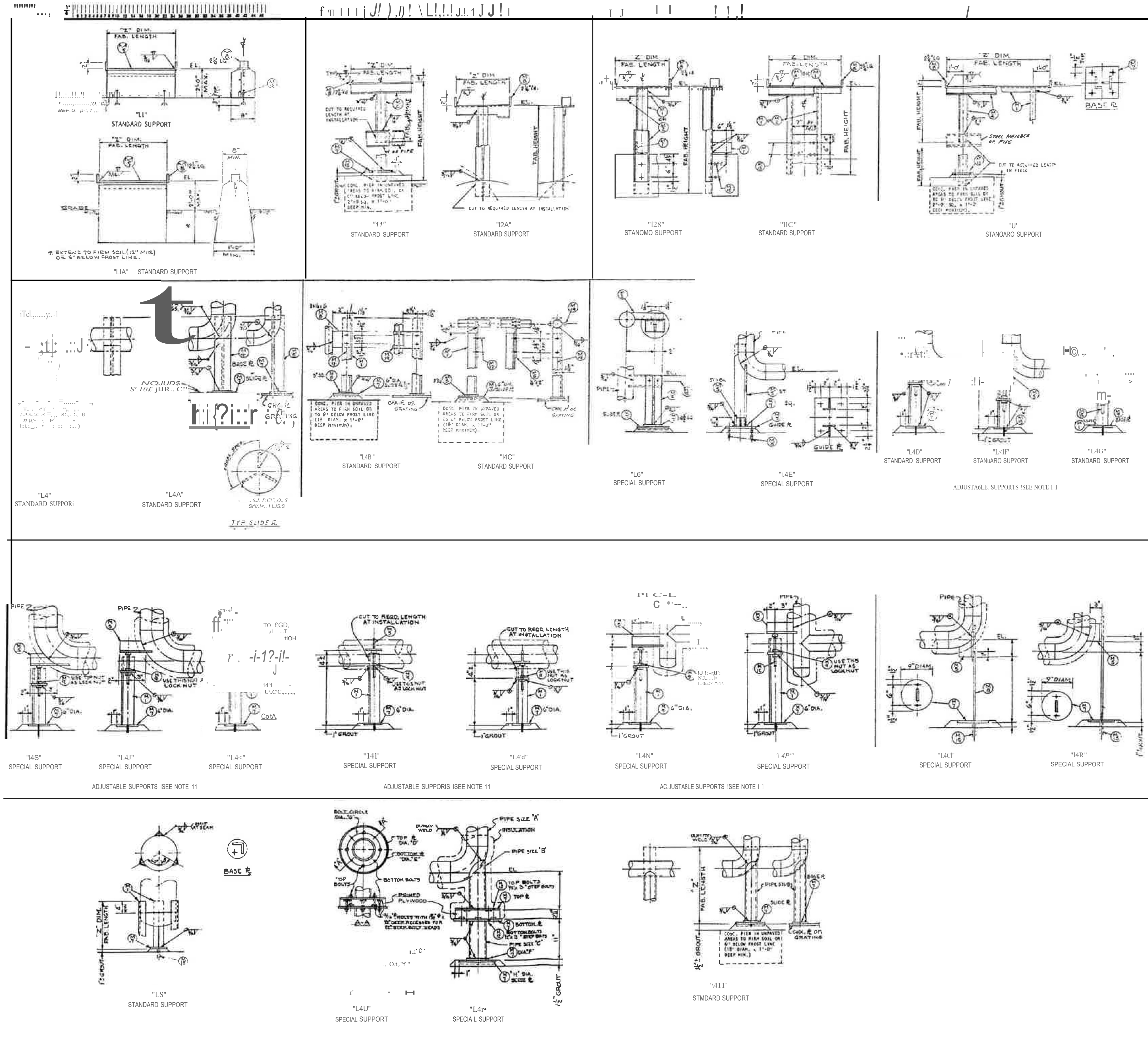
ENGINEERING STANDARD
REFINERY AND CHEMICAL DIVISION
SUPPORT GUIDE
GUIDES FOR VERTICAL PIPES



"STANDARD SUPPORT"

L2-2-C — FULL CODE AS IT APPEARS ON PIPING ISOMETRIC OR ORTHOGRAPHIC PIPING DRAWING

- LOW SUPPORT OR SLEEPER
- SERIAL NUMBER & TYPE (*)
- SERIAL LETTER
- MEMBER AND SIZE (VARIABLE) SEE TABULATION ON PIPE SUPPORT STANDARD
- FABRICATED LENGTH (VARIABLE) SEE TABULATION ON PIPE SUPPORT STANDARD
- FABRICATED HEIGHT IN FEET (WHEN SHOWN)

L2A-2-C6 — DETAIL SHEET NO. (APPEARS ON LOWER RIGHT HAND CORNER OF PIPE SUPPORT STANDARD)

(*)
- L-1 & 1A - SLEEPERS
- L-2, L2A THRU L2C - STANCHIONS
- L3 - BENTS
- L4, 4A, 4B & 4C - DRIP LEG AND VALVE MANIFOLD SUPPORTS
- L4D - PUMP SUCTION LINE SUPPORT
- L4F THRU L4R - TURBINE STEAM LINE SUPPORTS
- L5 - SUPPORT FOR SMALL POTS

"SPECIAL SUPPPORT"

20-PS-12
- PROJECT PLANT NUMBER (IF ANY)
- PIPE SUPPORT
- SUPPORT SERIAL NUMBER
- SUPPORT NUMBER (APPEARS ON LOWER RIGHT HAND CORNER OF PIPE SUPPORT DETAIL SHEET)

TRANSPARENCIES OF THE SPECIAL SUPPORTS SHOWN BY FORM NUMBER ARE AVAILABLE IN THE FILES. THESE REQUIRE THE ADDITION OF DESIGN AND SOME FABRICATION INFORMATION.

NOTE 1

ADJUSTABLE SUPPORTS SHOWN ARE FOR PIPE SIZES OF 3" THRU 12" AT ROTATING EQUIPMENT ONLY. AFTER ALIGNMENT LOCKNUT SHALL BE TACK WELDED.

USE THIS DRAWING AS A SUPPORT SELECTION GUIDE ONLY. FOR DESIGN DETAILS AND LIMITATIONS SEE SUPPORT DETAIL DRAWING ISSUED FOR THE JOB OR THE PIPE SUPPORT STANDARD

No.	Date	Revisions	By					
0	5/72	REISSUED AS ENGINEERING STANDARD WAS L-623	JT	JJH	JJH			

SCALE NONE

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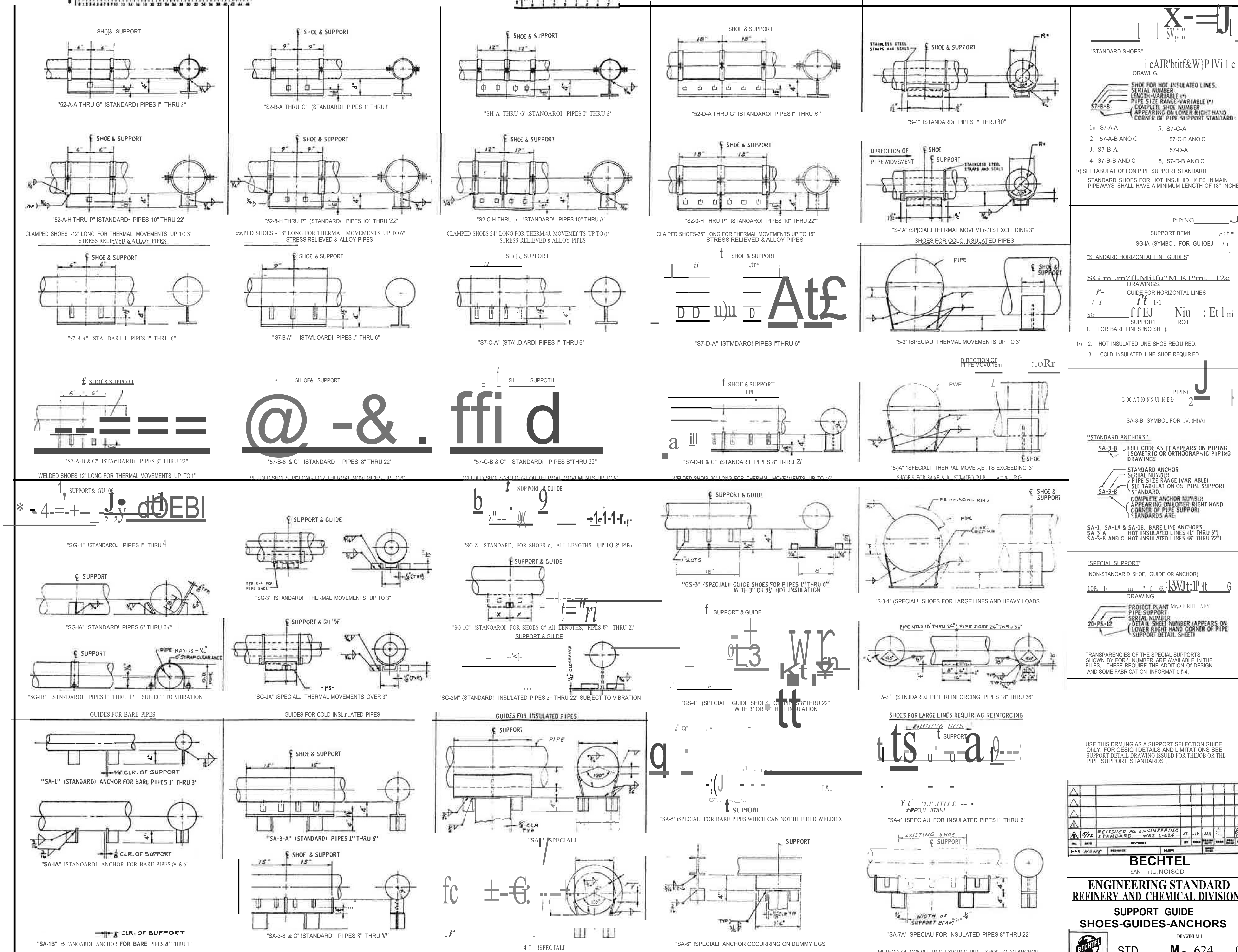
REFINERY AND CHEMICAL DIVISION

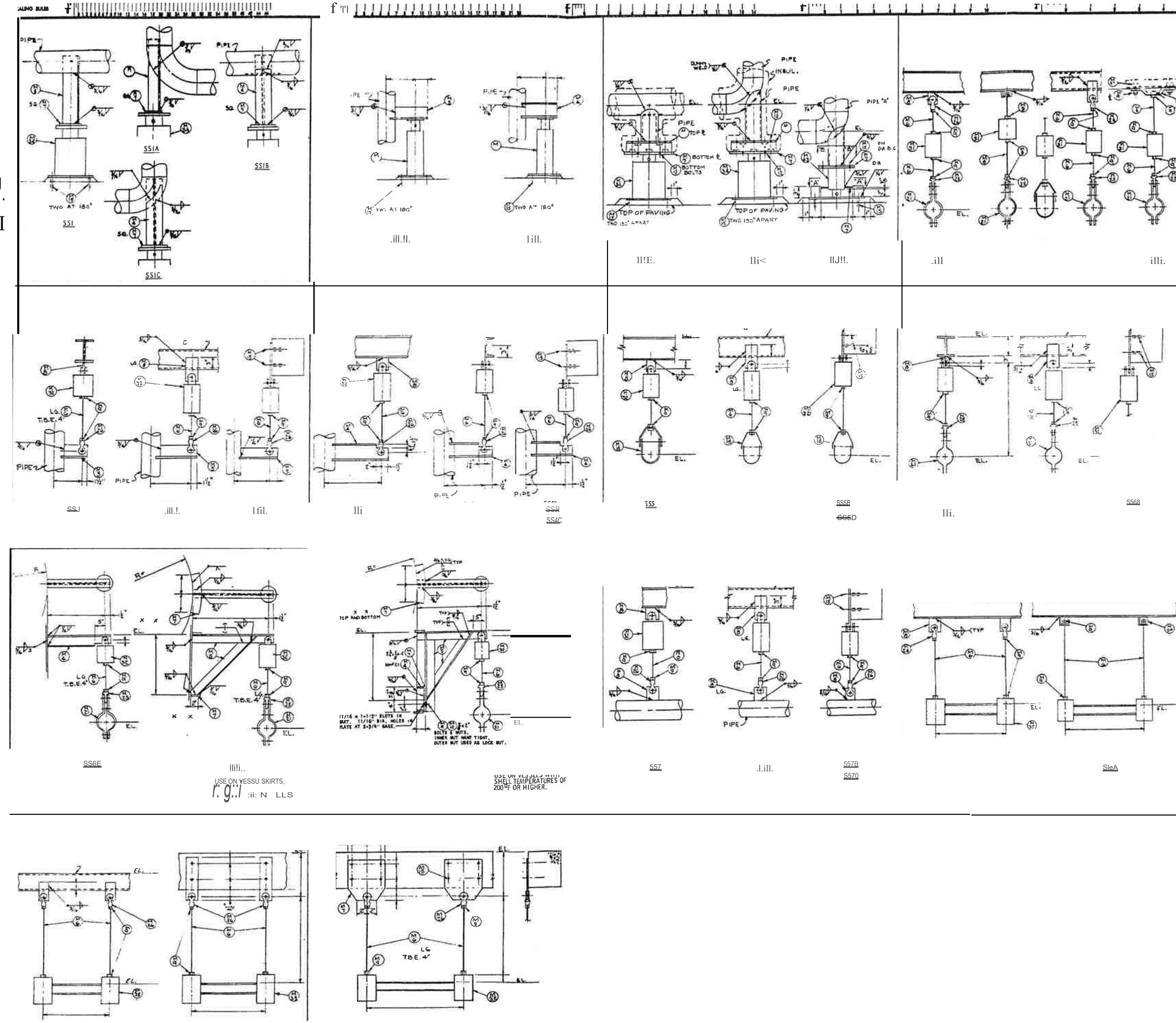
SUPPORT GUIDE

STANCHIONS, LOW SUPPORTS AND SLEEPERS

STD. M-623



SIZE E
SHOE & SUPPORT
"S2-A-A THRU G" (STANDARD) PIPES 1" THRU 8"
"S2-B-A THRU G" (STANDARD) PIPES 1" THRU 8"
"S2-D-A THRU G" (STANDARD) PIPES 1" THRU 8"
"S-4" (STANDARD) PIPES 1" THRU 30"
STAINLESS STEEL STRAPS AND SEALS
"S2-A-H THRU P" (STANDARD) PIPES 10" THRU 22"
CLAMPED SHOES -12" LONG FOR THERMAL MOVEMENTS UP TO 3"
STRESS RELIEVED & ALLOY PIPES
"S2-B-H THRU P" (STANDARD) PIPES 10" THRU 22"
"S2-C-H THRU P" (STANDARD) PIPES 10" THRU 22"
CLAMPED SHOES-24" LONG FOR THERMAL MOVEMENTS UP TO 9"
"S2-D-H THRU P" (STANDARD) PIPES 10" THRU 22"
CLAMPED SHOES-36" LONG FOR THERMAL MOVEMENTS UP TO 15"
DIRECTION OF PIPE MOVEMENT
"S-4A" (SPECIAL) THERMAL MOVEMENTS EXCEEDING 3"
SHOES FOR COLD INSULATED PIPES
"S7-A-A" (STANDARD) PIPES 1" THRU 6"
"S7-B-A" (STANDARD) PIPES 1" THRU 6"
"S7-C-A" (STANDARD) PIPES 1" THRU 6"
"S7-D-A" (STANDARD) PIPES 1" THRU 6"
PIPE
"S-3" (SPECIAL) THERMAL MOVEMENTS UP TO 3"
"S7-A-B & C" (STANDARD) PIPES 8" THRU 22"
WELDED SHOES 12" LONG FOR THERMAL MOVEMENTS UP TO 1"
"S7-B-B & C" (STANDARD) PIPES 8" THRU 22"
"S7-C-B & C" (STANDARD) PIPES 8" THRU 22"
"S7-D-B & C" (STANDARD) PIPES 8" THRU 22"
"S-3A" (SPECIAL) THERMAL MOVEMENTS EXCEEDING 3"
SUPPORT & GUIDE
"SG-1" (STANDARD) PIPES 1" THRU 4"
"SG-3" (STANDARD) THERMAL MOVEMENTS UP TO 3"
SEE S-4 FOR PIPE SHOE
"SG-2" (STANDARD) FOR SHOES ON ALL LENGTHS, UP TO 8" PIPE
SLOTS
"GS-3" (SPECIAL) GUIDE SHOES FOR PIPES 1" THRU 6" WITH 3" OR 3½" HOT INSULATION
REINFORCING RING
"S-3-1" (SPECIAL) SHOES FOR LARGE LINES AND HEAVY LOADS
"SG-1A" (STANDARD) PIPES 6" THRU 24"
"SG-1C" (STANDARD) FOR SHOES OF ALL LENGTHS, PIPES 8" THRU 24"
PIPE SIZES 18" THRU 24" / PIPE SIZES 26" THRU 36"
PIPE RADIUS + 1/16" O" STRAP CLEARANCE
"SG-1B" (STANDARD) PIPES 1" THRU 1" SUBJECT TO VIBRATION
"SG-3A" (SPECIAL) THERMAL MOVEMENTS OVER 3"
"SG-2M" (STANDARD) INSULATED PIPES 2" THRU 22" SUBJECT TO VIBRATION
"GS-4" (SPECIAL) GUIDE SHOES FOR PIPES 8" THRU 22" WITH 3" OR 3½" HOT INSULATION
"S-5" (STANDARD) PIPE REINFORCING PIPES 18" THRU 36"
GUIDES FOR BARE PIPES
GUIDES FOR COLD INSULATED PIPES
GUIDES FOR INSULATED PIPES
SHOES FOR LARGE LINES REQUIRING REINFORCING
CLR. OF SUPPORT
"SA-1" (STANDARD) ANCHOR FOR BARE PIPES 1" THRU 3"
"SA-3-A" (STANDARD) PIPES 1" THRU 6"
"SA-5" (SPECIAL) FOR BARE PIPES WHICH CAN NOT BE FIELD WELDED.
"SA-4" (SPECIAL) FOR INSULATED PIPES 1" THRU 6"
"SA-1A" (STANDARD) ANCHOR FOR BARE PIPES 1" & 6"
EXISTING SHOE
SUPPORT
"SA-1B" (STANDARD) ANCHOR FOR BARE PIPES 8" THRU 1"
"SA-3-B & C" (STANDARD) PIPES 8" THRU 22"
ANCHORS FOR LARGE BARE AND INSULATED PIPES
"SA-6" (SPECIAL) ANCHOR OCCURRING ON DUMMY LEGS
WIDTH OF SUPPORT BEAM
"SA-7A" (SPECIAL) FOR INSULATED PIPES 8" THRU 22"
METHOD OF CONVERTING EXISTING PIPE SHOE TO AN ANCHOR.
"STANDARD SHOES"
SHOE FOR HOT INSULATED LINES.
SERIAL NUMBER
LENGTH-VARIABLE (*)
PIPE SIZE RANGE-VARIABLE (*)
COMPLETE SHOE NUMBER APPEARING ON LOWER RIGHT HAND CORNER OF PIPE SUPPORT STANDARD.
1. S7-A-A 5. S7-C-A
2. S7-A-B AND C S7-C-B AND C
3. S7-B-A S7-D-A
4. S7-B-B AND C 8. S7-D-B AND C
STANDARD SHOES FOR HOT INSULATED LINES IN MAIN PIPEWAYS SHALL HAVE A MINIMUM LENGTH OF 18" INCHES
"STANDARD HORIZONTAL LINE GUIDES"
GUIDE FOR HORIZONTAL LINES
1. FOR BARE LINES (NO SHOE).
2. HOT INSULATED LINE SHOE REQUIRED
3. COLD INSULATED LINE SHOE REQUIRED
"STANDARD ANCHORS"
FULL CODE AS IT APPEARS ON PIPING ISOMETRIC OR ORTHOGRAPHIC PIPING DRAWINGS.
STANDARD ANCHOR
SERIAL NUMBER
PIPE SIZE RANGE (VARIABLE)
(SEE TABULATION ON PIPE SUPPORT STANDARD.
COMPLETE ANCHOR NUMBER APPEARING ON LOWER RIGHT HAND CORNER OF PIPE SUPPORT STANDARDS ARE:
SA-1, SA-1A & SA-1B, BARE LINE ANCHORS
SA-3-A HOT INSULATED LINES (1" THRU 6")
SA-3-B AND C HOT INSULATED LINES (8" THRU 22")
"SPECIAL SUPPORT"
(NON-STANDARD SHOE, GUIDE OR ANCHOR)
DRAWING.
PROJECT PLANT
PIPE SUPPORT
SERIAL NUMBER
DETAIL SHEET NUMBER (APPEARS ON LOWER RIGHT HAND CORNER OF PIPE SUPPORT DETAIL SHEET)
TRANSPARENCIES OF THE SPECIAL SUPPORTS SHOWN BY FOR 1 NUMBER ARE AVAILABLE IN THE FILES. THESE REQUIRE THE ADDITION OF DESIGN AND SOME FABRICATION INFORMATION.
USE THIS DRAWING AS A SUPPORT SELECTION GUIDE ONLY. FOR DESIGN DETAILS AND LIMITATIONS SEE SUPPORT DETAIL DRAWING ISSUED FOR THE JOB OR THE PIPE SUPPORT STANDARDS.
REISSUED AS ENGINEERING STANDARD. WAS L-624
SCALE NONE
BECHTEL
SAN FRANCISCO
ENGINEERING STANDARD
REFINERY AND CHEMICAL DIVISION
SUPPORT GUIDE
SHOES-GUIDES-ANCHORS
STD. M-624 0



SIZE I

ALL SPRING SUPPORTS ARE SPECIAL. TRANSPARENCIES OF THE SUPPORTS SH... NUMBER ARE AVAILABLE IN THE FILES. SOME REQUIRE THE ADDITION OF DESIGN AND FABRICATION INFORMATION.

"SPECIAL SUPPORT"

20-PS-12 — FULL CODE AS IT APPEAR PIPING ISOMETRIC OR ORTHOGRAPHIC PIPING DRAWING

- PROJECT PLANT NUMBER (IF ANY)
- PIPE SUPPORT
- SUPPORT SERIAL NUMBER

20-PS-12 — DETAIL SHEET NUMBER (APPEARS ON LOWER RIGHT HAND CORNER OF PIPE SUPPORT DETAIL SHEET)

All TYPE "C" SPRING HANGERS SHOULD BE ORDERED COMPLETE WITH TOP FASTENER. EITHER PIN WITH COTTER OR BOLT AND NUT.

TYPE "F" SPRINGS SHOULD BE ORDERED COMPLETE WITH LOAD FLANGE.

GUIDE ONLY. FOR DESIGN DETAILS AND LIMITATIONS SEE SUPPORT DETAIL DRAWINGS ISSUED FOR THE JOB OR THE SUPPORT DETAIL DRAWINGS IN THE PIPE SUPPORT STANDARD BOOK. FOR METHOD OF INSTALLING SPRINGS SEE STANDARD SPECIFICATION M-504 "SPRING SUPPORTS FOR PIPING: FIELD INSTALLATION PROCEDURES".

No.	Date	Revision	By
0	5/72	REISSUED AS ENGINEERING STANDARD. WAS L-625	

SCALE: NONE

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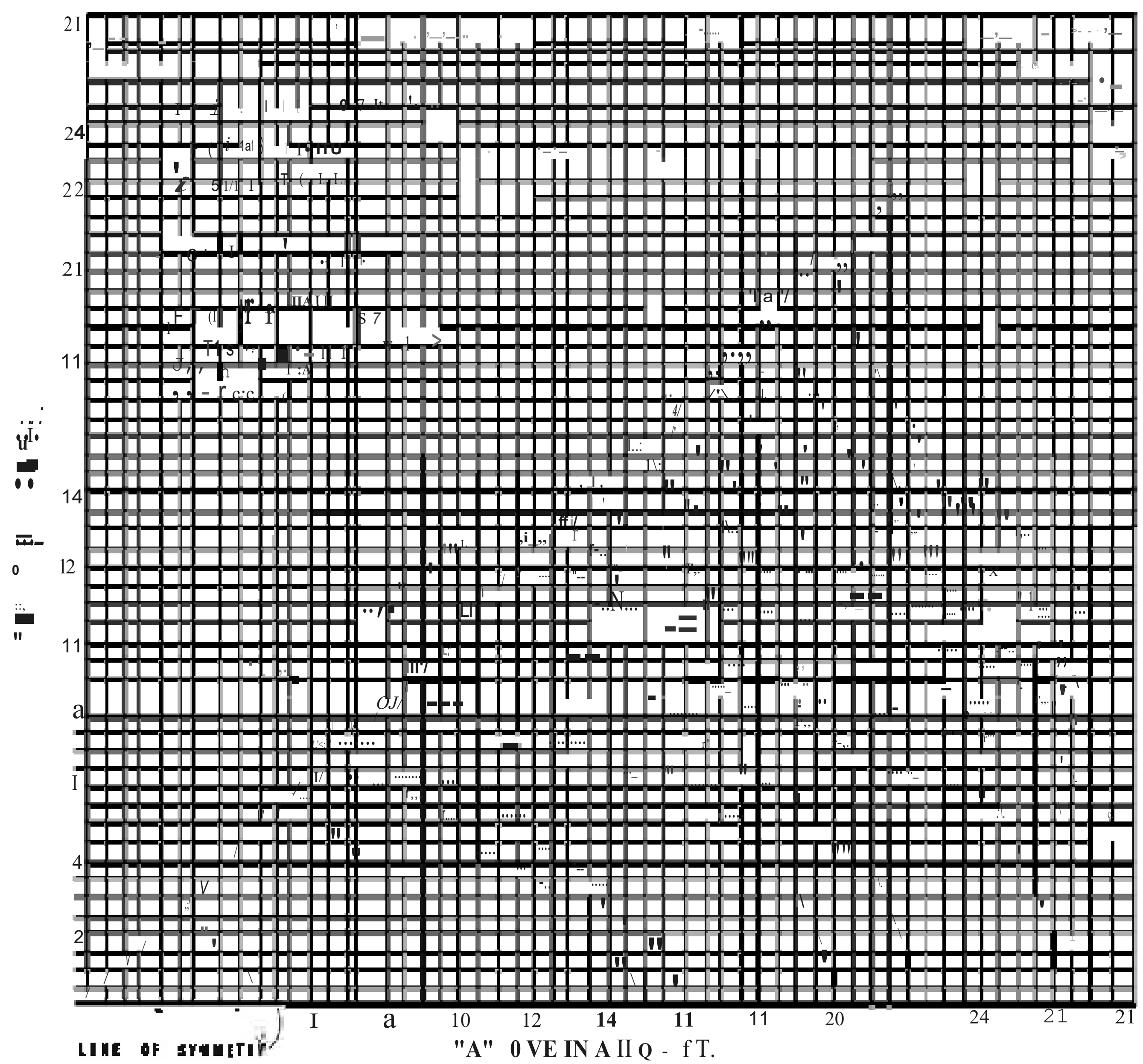
ENGINEERING STANDARD
REFINERY AND CHEMICAL DIVISION

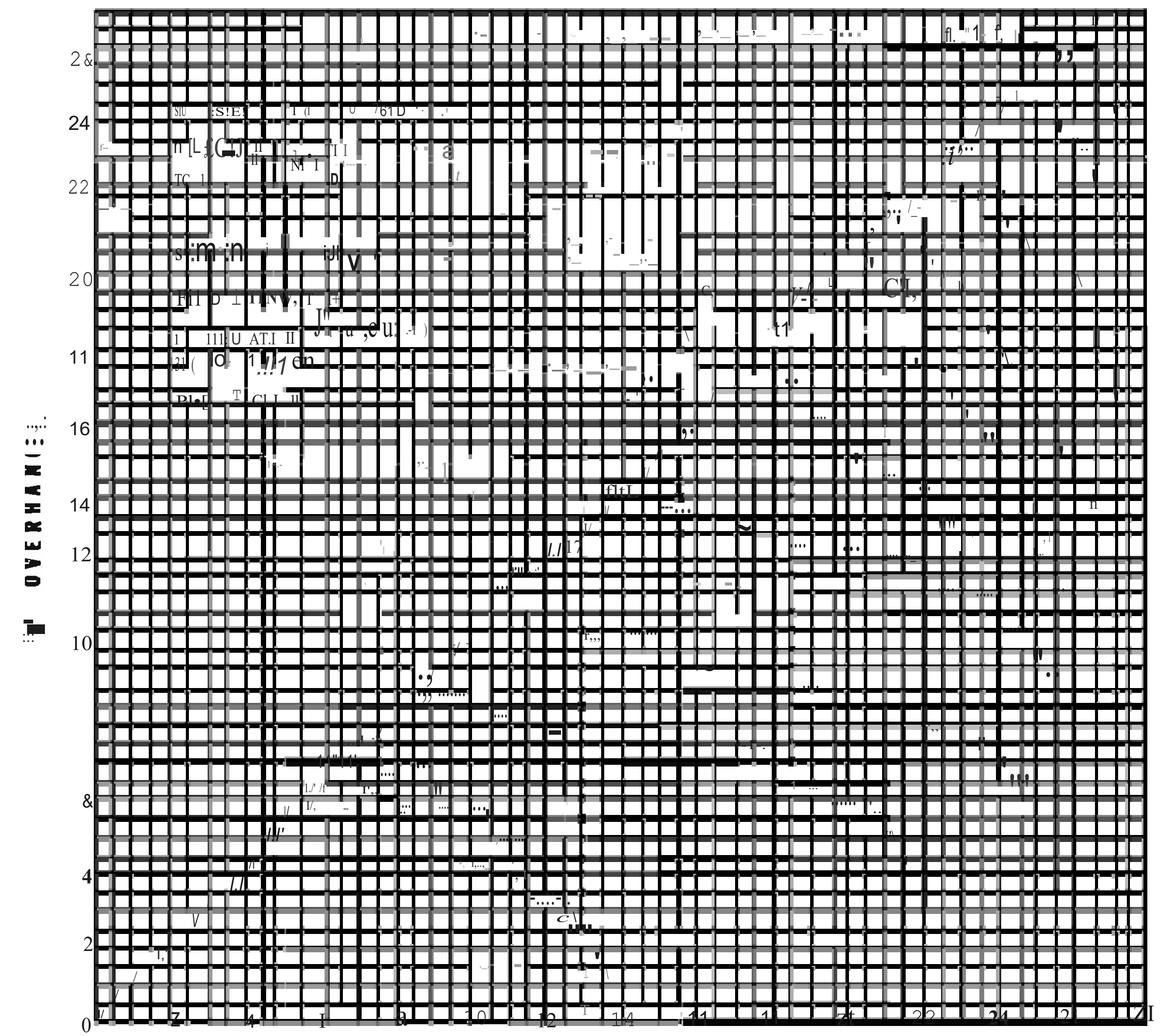
SUPPORT GUIDE
PIPE SUPPORT SPRINGS

STD. M-625 0



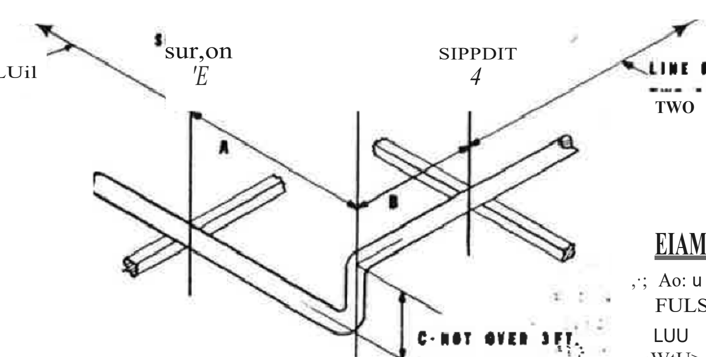
EFFECTIVE WT. -INCL. WATER & INSUL.

PIPE	LIS/ FT	PIPE	LIS/ FT	PIPE	LIi/ FT
1"	2.27	•••	24.21	11"	117.I
__!_f	3.45	I..	37.27	11"	144.1
2"	4.51	11"	51.51	21"	177.1
3"	1.45	12"	71.21	24"	252.1
4"	12.27	14"	II.II		



EFFECTIVE W_T. INCL. WATER & INSUL.

I"	2.17	I"	34.13	11"	115.1
$1\frac{1}{2}$"	4.71	I"	51.51	11"	217.1
Z"	6.37	11"	71.11	21"	251.3
3"	12.41	12"	[illegible]	24"	353.4
4"	11.21	14"	127.1		



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Ao: u : : 1" • I I: 13',I" TNf IIITUSECTION PIINT FULS U DV[All :H P£ CUUI UHi I".

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PIPE	1IS/ FT	PIPE	1IS/ FT	PIPE	IS/FT

NOTE

CIIIHS CIVl THE **MUIMU** ULOWAILE OVEINUC llf AN UISIPPOIHD PIPE

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