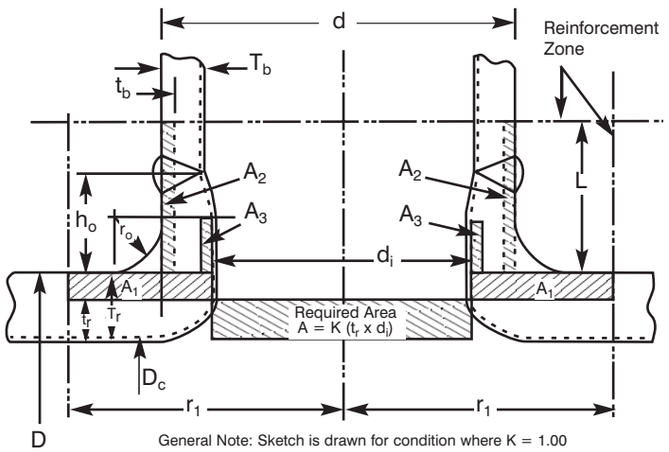
TAYLOR FORGE Engineered Systems

Technical Information and Design Guidelines for Extruded Outlet Headers

Design Calculations for Thickness and Reinforcement



General Note: Sketch is drawn for condition where K = 1.00

ASME B31.4, B31.8, B31.11	ASME B31.1, B31.3
$t_r = \frac{PD}{2SFET}$	$t_r = \frac{PD}{2(SE + PY)}$
$t_b = \frac{Pd}{2SFET}$	$t_b = \frac{Pd}{2(SE + PY)}$

$$K = .6 + \frac{2d}{3D}$$

$$.7 \le K \le 1.0$$

$$2L = 2 \times .7\sqrt{dT_b}$$

NOTE: Area A_3 has been neglected, since its use would only result in a very slight reduction in T_r(min.).

$$d_i = d - 2T_b$$

$$T_r(\text{min.}) = \frac{Kt_r d_i - 2L(T_b - t_b)}{d_i} + t_r$$

S = Specified Minimum Yield Strength
F = Design Factor
E = Longitudinal Weld Joint Factor
T = Temperature Derating Factor (T=1 for B31.11)
D = Nominal Outside Diameter, Pipe
d = Outside Diameter of Branch Pipe
d_i = Inside Diameter of Branch Pipe
t_b = Required Thickness of Branch Pipe
t_r = Required Thickness of Run
T_b = Nominal Thickness of Branch
T_r = Nominal Thickness of Run
r_1 = d_i
r_o = Radius of curvature of external contoured portion of outlet measured in the plane containing the axis of the header and branch.
S = Allowable Stress Value for Material (B31.1 and B31.3)
Y = Coefficient from table 104.1.2 (A) or 304.1.1 (B31.1 and B31.3)

Extruded outlet headers are normally furnished as special fittings per:
ASME B16.9
MSS SP-75
ASTM A-234
ASTM A-860
ASTM A-403
ASTM A-420
CSA Z245.11
ISO 15590
ASME Code

For use in products/ assemblies designed to:
ASME B31.1
ASME B31.3
ASME B31.4
ASME B31.8
ASME B31.11
CSA Z662
ASME Code

All can conform to DOT Regulations (CFR Title 49, Part 192 or Part 195)

Controlled Outside Outlet Radius

$0.05\ d_o \le r_o \le 0.10\ d + 0.50$" for NPS 8 & larger

$0.05\ d_o \le r_o \le 1.25$" for NPS 6 & smaller

No machining is allowed to form outside radius.

Standard Outlet Heights

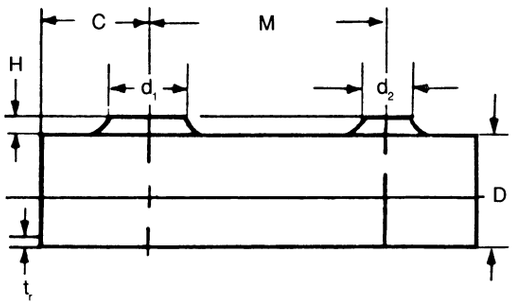
Outlet Size (I.P.S.)	Outlet Height Above Run O.D.	Outlet Size (I.P.S.)	Outlet Height Above Run O.D.
1-1/2"	5/16"	26"	2-1/2"
2"	5/8"	28"	2-3/4"
2-1/2"	11/16"	30"	2-3/4"
3"	7/8"	32"	2-3/4"
3-1/2"	7/8"	34"	2-3/4"
4"	1"	36"	2-3/4"
5"	1-3/16"	38"	2-3/4"
6"	1-1/4"	40"	2-3/4"
8"	1-3/8"	42"	2-3/4"
10"	1-1/2"	44"	2-7/8"
12"	1-5/8"	48"	3"
14"	1-5/8"	52"	3-1/8"
16"	1-3/4"	54"	3-1/4"
18"	1-7/8"	56"	3-3/8"
20"	2-1/16"	60"	3-1/2"
22"	2-1/16"	66"	3-5/8"
24"	2-1/4"	72"	3-3/4"

Flexibility Characteristics of Extruded Headers

ASME Piping Code	B31.1	B31.3	B31.4	B31.8	B31.11
Flexibility Characteristic	h	h	h	h	h
Extruded Outlet/Extruded Welding Tee (as defined in B31) Tc < 1.5 Tr Rc ≥ 0.05 Db	1.0	1.0*	1.0*	1.0*	1.0*
B16.9 Welding Tee Tc ≥ 1.5Tr Rc ≥ 0.125 Db	4.4	4.4	4.4	4.4	4.4
B16.9 Welding Tee (TFES Extruded Tee/ Header) Tc ≥ 1.5Tr Rc ≥ 0.05 Db	3.1	3.1	4.4	3.1**	4.4

Tc = crotch thickness of branch connection measured at the center of the branch
Rc = radius of external portion of outlet
Tr = nominal wall thickness of the mating pipe
Db = outside diameter of branch
* Essentially 1.0, however "h" may be increased by ratio of (1+Rc/Rr) where Rr is run radius
** Equivalent "h" factor when compared to "i" of 0.9 & "h" of 3.1 vs. "i" of 1.12 & "h" of 4.4

Multiple Outlet Headers

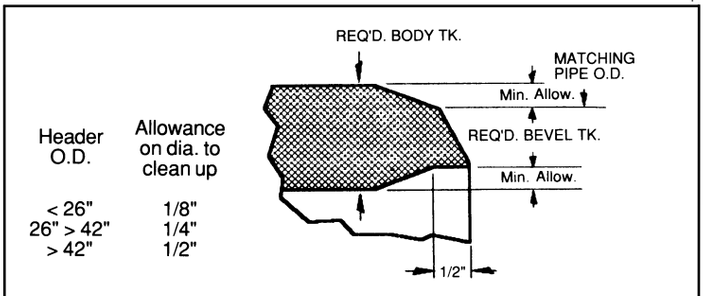


Dimension	Limits	Comments
d_1 or d_2	MIN = 1/2" MAX = D	Full size outlets can be made on headers with certain combinations of diameter and wall thickness.
D	MIN = 4"	Max. run diameter is limited only by material handling capability and shipping restrictions.
C	MIN = d_1 + 2"	Maximum center-to-end dimension is limited only by raw material size and economic considerations.
M	MIN = d_1 + d_2	Maximum center-to-center dimension is limited only by raw material availability and economic considerations. Codes provide for center-to-center dimensions less than d_1 + d_2 by further increasing wall thickness. However, for the most economical fitting, a min. of d_1 + d_2 should be maintained.
t_r	MIN = .250	Maximum wall thickness is a function of run and branch diameters and material.

High-Strength Low-Alloy Material Characteristics for Extruded Headers

TFES Proprietary Material Spec.	TFES ES 5.1.2	TFES AG-80
Product Form	Plate	Seamless Tubular
Yield Strength - Thickness (max)	WPHY60 - 4" WPHY65 - 3.5" WPHY70 - 2.75"	WPHY70 - 10" WPHY80 - 4"
Toughness (CVN's)	30 ft/lbs @ -50F 50 ft/lbs @ -20F	15 ft/lbs @ -50F 20 ft/lbs @ -20F
Carbon Equivalents (max) IIW Pcm CSA	.45 .23 .40	.48* .23 .40
HIC Results	Good	N/A
SSCC Results	Good	Good
NACE MR0175/ISO 15156-2 (Annex A) Compliant	Yes	Yes (WPHY70)
Formability, Machinability, & Weldability	Excellent	Excellent
Grain Size	Fine Grain	Fine Grain
Thru Wall Consistency	Excellent	Excellent
Heat Treatment	Normalize Normalize + Stress Relief Quench & Temper Quench & Temper + Stress Relief	

*. Permitted in MSS SP-75 by agreement between manufacturer and purchaser.



Header Run End Bevel Detail

TAYLOR FORGE
Engineered Systems, Inc.

208 North Iron Street
Paola, Kansas 66071
Telephone: (913) 294-5331
FAX: (913) 294-5337
Web Site: www.tfes.com
E-Mail: engineered@tfes.com