Cast Connex®

HSC

High-Strength Connector™

Design Manual

ANSI/AISC 341-10
ANSI/AISC 360-10

Cast ConneX®

High-Strength Connector Design Manual

for
ANSI/AISC 341-10 & ANSI/AISC 360-10

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First Edition

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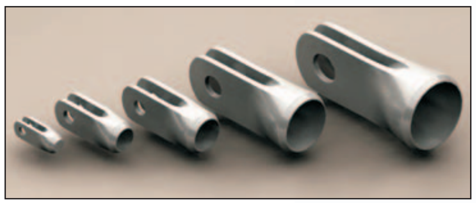
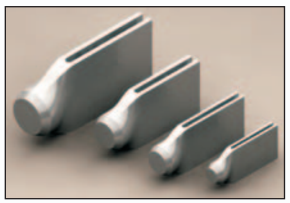
Cast Connex Corporation has established itself as the North American industry leader in the supply of standardized and customized structural steel components. The company's business model is based on providing simple and easy to implement solutions for common yet complex engineering challenges.

Cast ConneX® products include a range of pre-engineered cast steel connectors for use with hollow structural section members. The company also offers design and manufacturing management services for custom designed cast or forged steel components.

Cast Connex Corporation retains the exclusive license rights to intellectual property developed at the University of Toronto for cast steel structural connectors.





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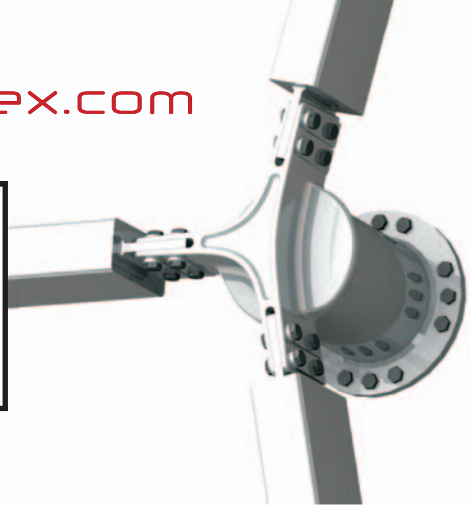


Or contact us at:

+1 416 806 3521

info@castconnex.com

A message from Cast Connex:

On behalf of everyone at Cast Connex Corporation, I would like to thank you for choosing to specify our High-Strength Connectors. I am confident that you, along with every stakeholder in your project, will be satisfied with your choice.

Our company's mission is to provide the steel construction industry with simple solutions to complex engineering challenges. We do so by looking at every challenge that you face as an opportunity for us to make your job easier while simultaneously making the structures we all occupy safer and more affordable. In the grander scheme of things, we hope that our innovative products and services will help to foster the growth and prosperity of the steel construction industry at large, so that we all may benefit.

Again, I thank you for your business. Our team looks forward to working with you.

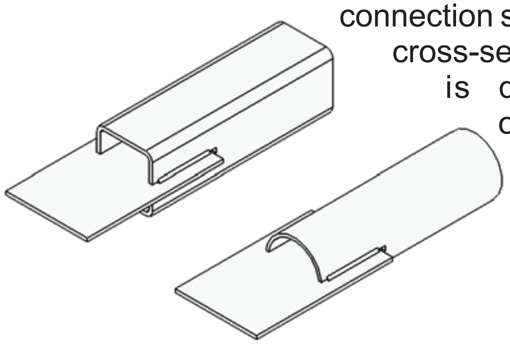
Sincerely,

Carlos de Oliveira, M.A.Sc., P.Eng.
CEO
Cast Connex Corporation

Cast ConneX®

About High-Strength Connectors

Concentrically braced frames are amongst the most popular lateral force resisting systems for medium- to low-rise steel structures. In the event of an earthquake, the diagonal brace members of braced frames dissipate seismic energy through yielding in tension and inelastic buckling in compression. This cyclic yielding and buckling imparts arduous loading on the brace's connections. Consequently, North American design codes require that seismic bracing connections be detailed such that they are significantly stronger than the nominal cross-sectional capacity of the brace member. The degree to which the connection strength must surpass the nominal cross-sectional yield capacity of the brace is dependant on the expected overstrength of the brace. Detailing connections to provide this strength can be rather difficult, particularly when dealing with hollow structural section (HSS) members, which are the preferred bracing elements due to their efficiency in carrying compressive loads, their improved aesthetic appearance, and the wide range of sections sizes that are readily available in North America.



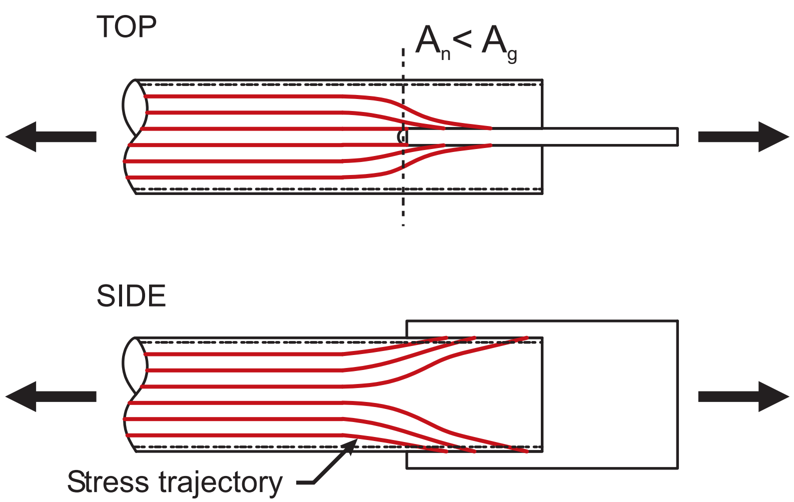


Figure 1: Shear-lag in conventional slotted HSS-to-gusset connections

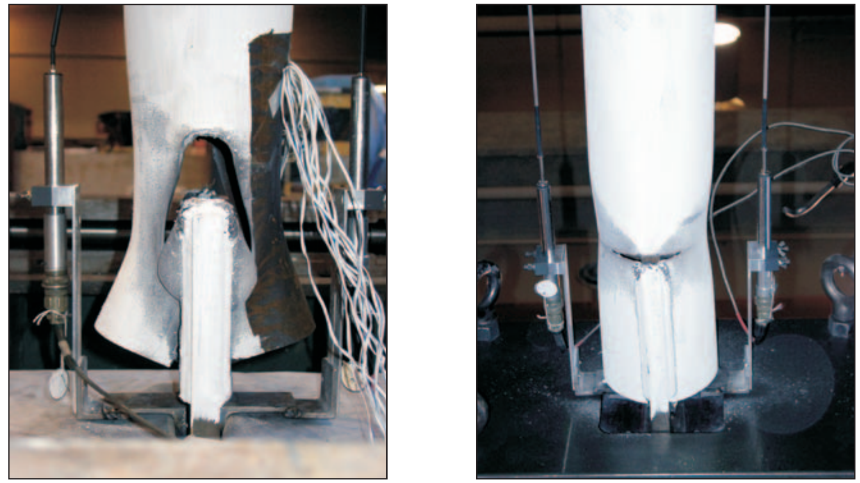


Figure 2: Typical slotted HSS-to-gusset connection failures: tear-out failure (left); net-section fracture (right) [images courtesy of the University of Toronto]

End connections for HSS brace members are typically achieved through a gusset connection between the brace end and the beam-column intersection. In wind loaded bracing connections, a shear-lag inducing slotted HSS-to-gusset connection can be accommodated since axial loads are typically well below the cross-sectional capacity of the brace (Figure 1). However, both in the laboratory and in the field as witnessed during post-earthquake reconnaissance, conventional slotted HSS-to-gusset connections have been shown to be prone to failure when subjected to inelastic loading (Figure 2).

Recognizing the need for a simple solution to the seismic brace connection dilemma, a research team at the University of Toronto led by Professors Jeffrey A. Packer and Constantin Christopoulos developed standardized cast steel seismic-resistant connectors shaped to eliminate shear-lag in the HSS bracing connections. The geometric freedom that casting manufacturing provides allowed for the design of a connector that accommodates bolted or welded connection to a gusset plate on one end and complete joint penetration (CJP) welded connection to a round HSS brace member on the other. Thus, in practice, the cast connectors can be welded to round HSS member braces in the shop, with the brace-connector assembly being bolted or welded to the gussets in the field. The resulting seismic-resistant connector technology is patent pending in the US, Canada, and abroad.

Each Cast ConneX® High-Strength Connector™ is standardized to accommodate all round HSS and Pipe members of a given outer diameter, regardless of their wall thickness or grade of steel. The use of a double-shear bolted connection halves the number of bolts that would otherwise be required in a spliced brace connection; spliced connections are sometimes specified to eliminate the need for field welding in conventional seismic-resistant reinforced brace connections. The specification of a CJP shop weld between the connector and the round HSS eliminates the need for field welding of the demand-critical welds between the gusset plate and the brace member, if so desired (Figure 3). Alternatively, four fillet welds applied in the field can be used to fasten the connector to the gusset.

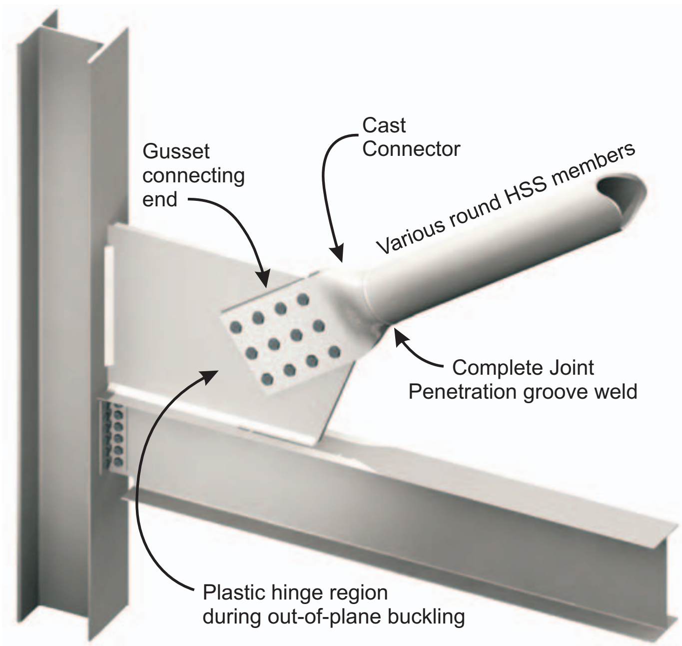
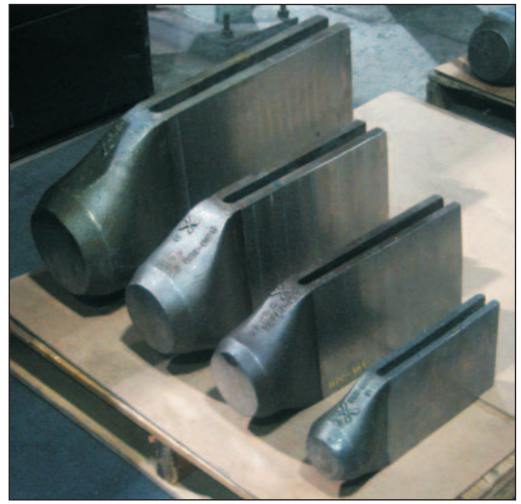


Figure 3: High-Strength Connector shown in field-bolted configuration



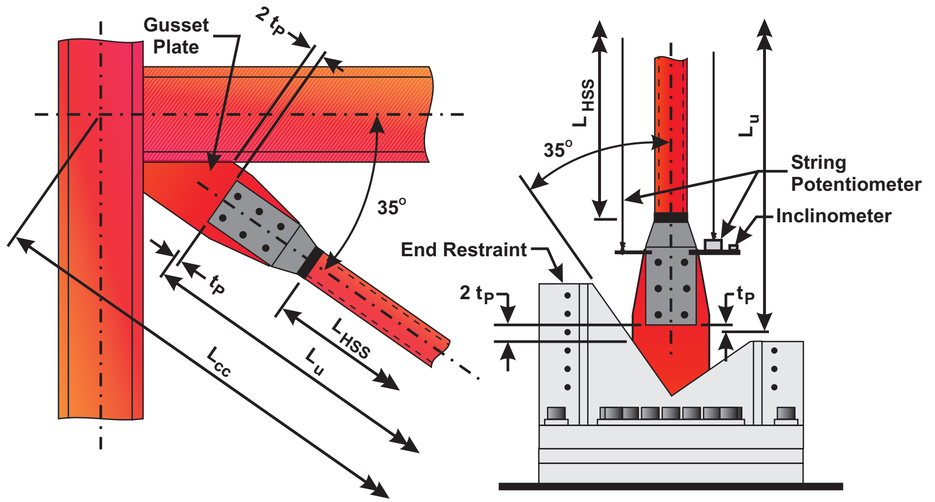
The connectors themselves are manufactured to ASTM A958 Grade SC8620 Class 80/50, and are each subjected to a battery of non-destructive testing to ensure their quality, including:

- visual examination,
- magnetic particle inspection,
- and ultrasonic testing.

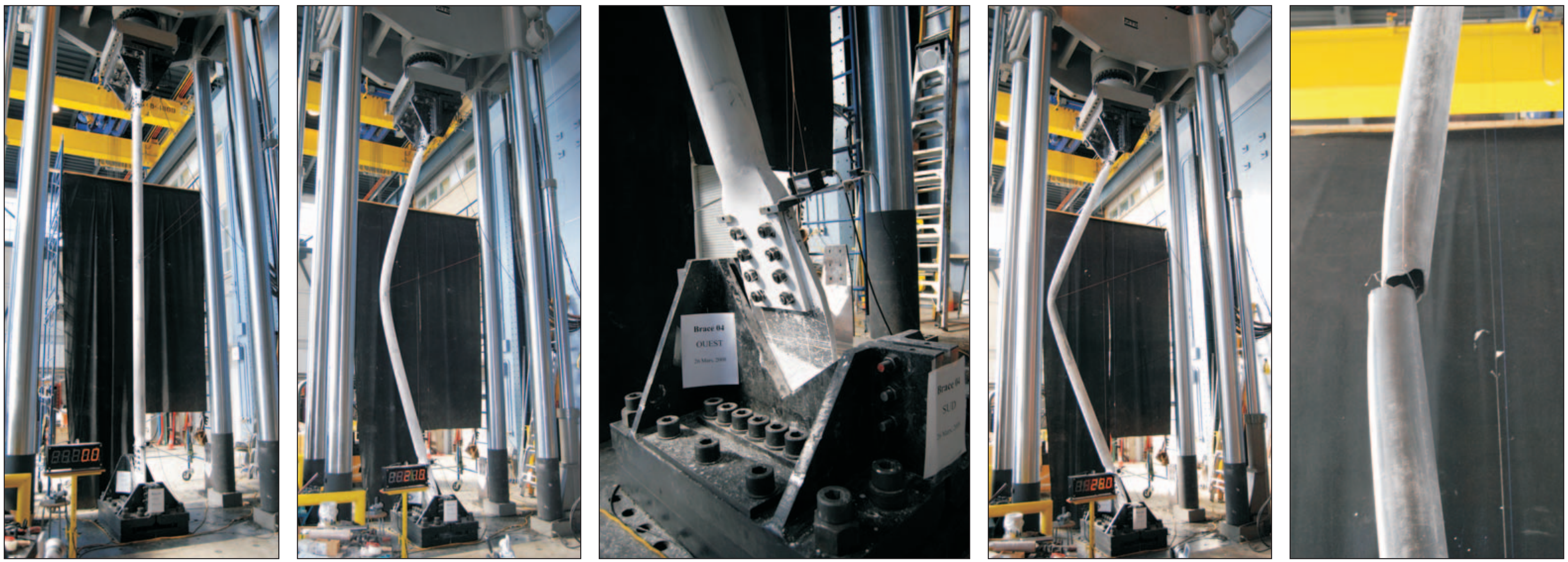
Some of the many benefits of the High-Strength Connector system are summarized below:

- connections designed using the connectors inherently satisfy North American seismic design provisions for energy dissipating braced frames,
- a single standardized connector works for all round HSS of a given outer diameter, regardless of the section's wall thickness, vastly simplifying connection design and detailing,
- the double-shear bolted connection halves the number of bolts that would otherwise be required in a spliced, field-bolted connection,
- complex geometry is “cast in” to the components, reducing fit-up time in fabrication,
- the connectors eliminate the additional pieces that would otherwise be required for field-bolted, spliced connections, simplifying site erection and logistics,
- the more compact connection reduces the potential for interferences with other building elements,
- structural safety is improved through the use of pre-tested, standardized components and potential errors in connection design are avoided,
- round HSS members are accommodated, which provides a superior response over square HSS,
- and the connectors provide an improved aesthetic in comparison to the fabricated alternative.

Testing of full-scale brace assemblies equipped with Cast ConneX® High-Strength Connectors™ has been carried out by researchers at the University of Toronto and École Polytechnique in Montreal. These tests confirmed that High-Strength Connectors meet the requirements for seismic-resistant bracing connections.



A thorough summary of the development and testing carried out at the University of Toronto is described in the **ASCE Journal of Structural Engineering, 134(3), 374-383**. A paper on the full-scale testing carried out at École Polytechnique in Montreal was presented at the **14th World Conference of Earthquake Engineering**. A more detailed report on the testing has also been published jointly by **École Polytechnique in Montréal and the University of Toronto**. All of these publications and more are available for download at www.castconnex.com.



(a) (b) (c) (d) (e)

Figure 4: Full-scale cyclic inelastic testing of a HSS 168x13 brace equipped with HSC-168 connectors: (a) undeformed; (b) experiencing inelastic buckling; (c) plastic hinge formation in free length of gusset plate; (d) localization of plastic hinge in HSS member; (e) fracture of brace at mid-length after the formation of a local buckle in the tube wall.

Designing with High-Strength Connectors

The use of Cast ConneX® High-Strength Connectors™ (HSC) vastly simplifies the design, detailing, and fabrication of HSS brace member connections that meet the requirements of ANSI/AISC 341-10 in Special Concentrically Braced Frames (SCBF) and Ordinary Concentrically Braced Frames (OCBF).

Special and Ordinary Concentrically Braced Frames

There are several options available to engineers for the lateral force resisting system (LFRS) of steel structures. Concentrically braced frames (CBF) are, in many cases, the most efficient choice of LFRS for medium- to low-rise steel structures for a variety of reasons. First, fabrication cost and erection time are both greatly reduced through the use of simple shear connections throughout the entire structure. Additionally, the nature of the bracing system itself, consisting of several diagonal braces located intermittently throughout the structure, allows for great design versatility. There is additional design flexibility in the variety of brace configurations that are at the designer's disposal (chevron, V, X, single brace, etc). Braced frames are also very stiff in comparison to other LFRS, reducing lateral displacements and thus lessening second-order effects.

Regardless of the CBF configuration, its response in a design-level earthquake is always the same, that is, the brace elements will fully yield in tension and buckle in compression (Figure 5). This yielding and buckling will occur cyclically throughout the duration of the strong ground motion. It is imperative that the brace connections, along with the other elements of the LFRS, are able to resist the forces that will develop during the cyclic tensile yielding and compressive buckling of the brace elements. This is the essence of "Capacity Design".

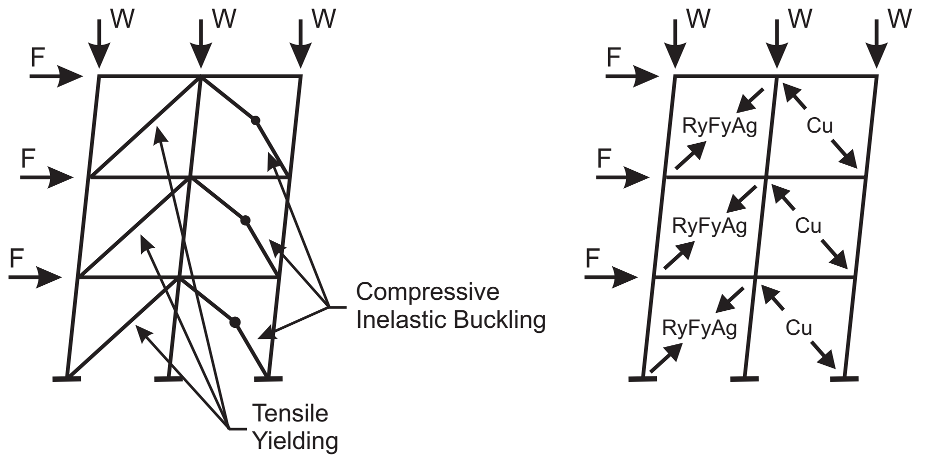


Figure 5: Illustration of the plastic mechanism formed in a concentrically braced frame during strong-ground motion (left) and forces developed in a ductile concentrically braced frame during an earthquake (right) [adapted from Tremblay, R. (2003). Achieving a stable inelastic seismic response for multi-story concentrically braced steel frames. *AISC Engineering Journal, 40(2), 111-129.*]

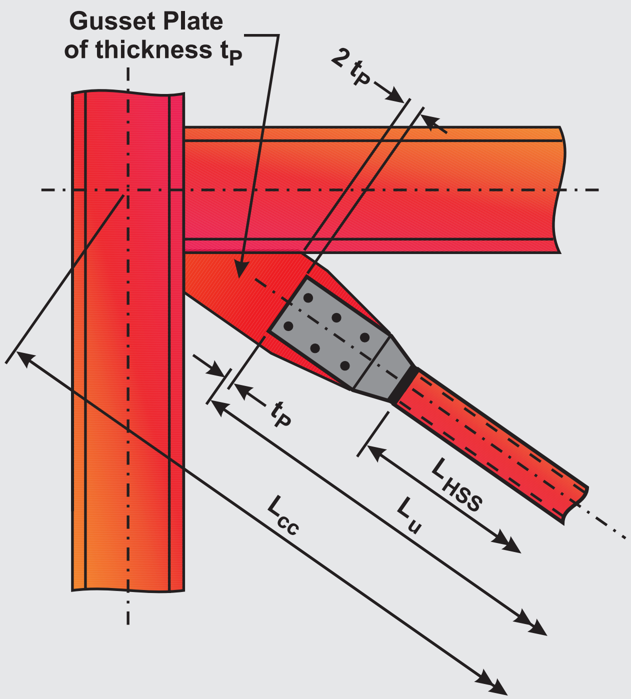
Brace Member Selection

The specification of HSC components in a structure does not change the way in which the engineer designs the other elements of the seismic-resistant braced frame in any way. For both SCBF and OCBF systems, the engineer should follow the governing building code to determine the appropriate story forces due to the design-level earthquake and subsequently size the elements of the LRFS following the requirements set out in the prevailing building code and ANSI/AISC 341-10. The only additional requirement is that the engineer should specify round HSS or Pipe members having outer diameters corresponding to those of the available line of HSC for the bracing elements of braced frames that are to be equipped with HSC. If the required brace member capacity cannot be achieved using round HSS or Pipe (i.e. all round HSS members having sufficient cross-sectional properties to carry the required load do not meet the D/t and/or KL/r requirements set out for ductile, seismic-resistant brace members), then the engineer should either provide additional braced frames on the particular story in question to reduce the required brace forces in each frame or

USER NOTE:

On the unbraced length of diagonal bracing elements

A common engineering practice in preliminary sizing of the brace members in braced frames where the engineer can rely on the compressive capacity of the brace is to assume the unbraced length of the brace in compression is its center-to-center length as measured from the centers of the beams and columns to which either end of the brace connects (Lcc below). While this is a conservative estimate for the purpose of sizing the brace members themselves, it is unconservative for the estimation of the compressive forces which will develop in the brace during the design-level earthquake. Thus, when determining the compressive force the brace connections and other elements of the LFRS must be capable of transmitting, the unbraced length of the brace element should be taken as the distance measured from the center of each of the "free lengths" just beyond the ends of the HSC components (dimension labeled Lu in the illustration below).



specify heavier brace elements (i.e. wide-flange sections), in which case a conventional, seismic-resistant brace connection must be used.

Although the responsibility for designing and detailing structural steel connections varies from region to region, once the elements of the LFRS have been set by the structural engineer of record, the corresponding HSC for each brace member should be specified on the structural drawings to ensure they are utilized by the fabricator that is contracted for the project.

Brace Connection Design using HSCs

As per ANSI/AISC 341-10, the required tensile strength of bracing connections in SCBF and in some OCBF must be equal to or exceed the expected yield strength of the bracing member, given by RyFyAg (LRFD) or RyFyAg/1.5 (ASD). For SCBF, the required compressive strength of the brace connection must be equal to or exceed 1.1RyPn (LRFD) or (1.1/1.5)RyPn (ASD), where Pn is the nominal compressive strength of the brace. In these expressions, RyFy is the expected yield stress of the brace material. For HSS produced to ASTM A500 (Grade B or C), Ry must be taken as 1.4. For Pipe produced to ASTM A53, Ry must be taken as 1.6.

The use of Cast ConneX® High-Strength Connectors™ makes providing the aforementioned connection resistance very simple.

At one end, the connectors are designed with a circular shape and beveled preparation to allow for complete joint penetration shop welding to a range of tubular braces of a given outer diameter for the full development of their expected yield strength. At the other end, the connectors are shaped such that a double shear bolted connection or longitudinal fillet welds can be used for connecting the shop-welded brace-connector assembly to conventional gusset plates secured to the beam-column intersection (Figure 6).

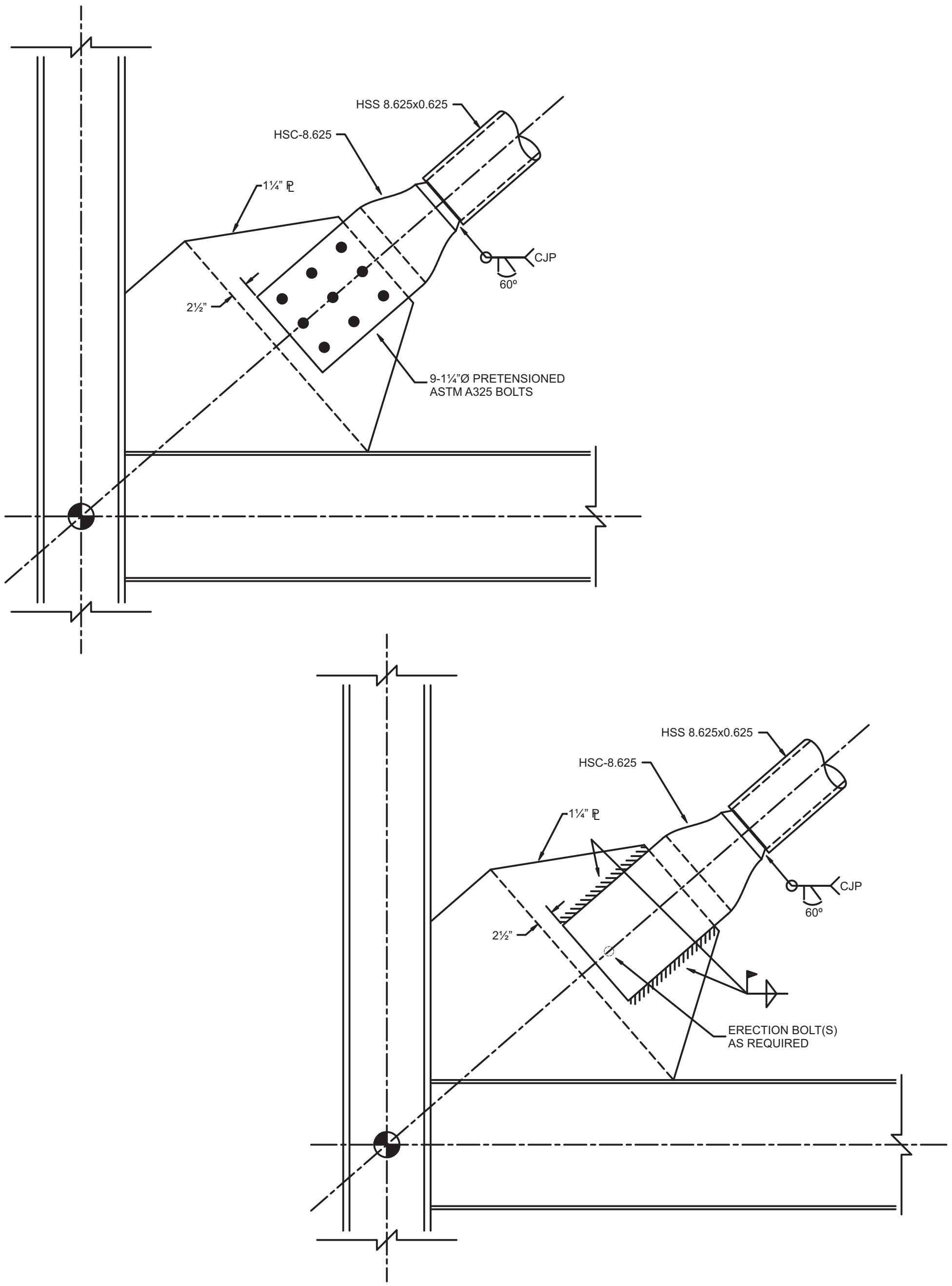


Figure 6: Field bolted (top) and field welded (bottom) brace connection configurations using High-Strength Connectors

An additional requirement for the use of HSC in SCBF is that a free length of gusset plate should be provided beyond the ends of each connector to accommodate the inelastic end rotations that will be induced during out-of-plane buckling of the brace. The ANSI/AISC 341-10 commentary suggests that the width of this hinge-region should be at least twice the thickness of the gusset plate. This detail is illustrated below for various brace angles (Figure 7).

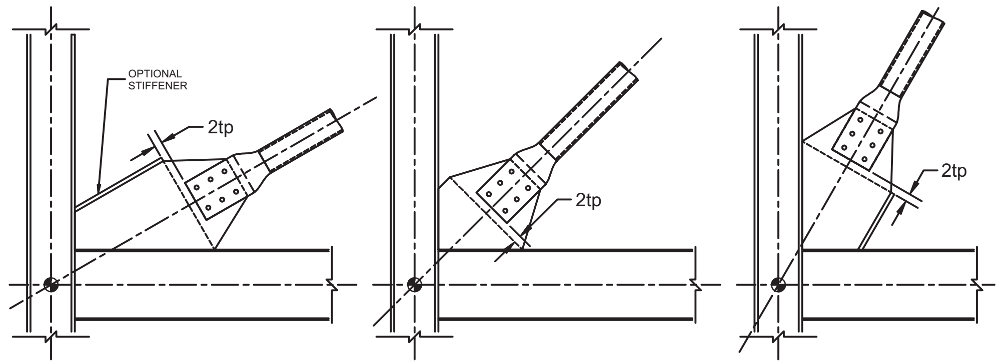


Figure 7: Gusset plate detailing to accommodate out-of-plane inelastic deformation of a brace for various bracing angles [adapted from Astaneh-Asl, A., Goel, S.C., and Hanson, R.D., (1985). Cyclic out-of plane buckling of double-angle bracing. *ASCE Journal of Structural Engineering, 111(5): 1135-1153.*]

Although the use of HSC makes the design of seismic-resistant brace end connections straightforward, detailing the gusset plate to which the brace-assembly connects remains a complex issue. Detailing of the gusset must be carried out with a clear understanding of the loads which must be transmitted and with an appreciation for the stability issues which may arise.

An excellent practical resource that discusses the design of gusset plates in seismic-resistant braced frames is the December 2006 issue of Steel Tips, entitled "*Seismic Detailing of Gusset Plates for Special Concentrically Braced Frames*" by Abolhassan Astaneh-Asl, Michael L. Cochran, and Rafael Sabelli. Steel Tips is published by the Structural Steel Educational Council (SSEC).

Design Table and Detailing Assumptions

The design tables provided in this User Manual present suggested bolted connection details for the connection between a given HSC and gusset plate for a variety of HSS or Pipe brace members, each having a unique expected yield strength [RyFyAg (LRFD) or RyFyAg/1.5 (ASD)]. For every unique HSS or Pipe element, a suggested detail for both bearing-type or slip-critical bolted connection is indexed by: number of bolts required, bolt diameter (3/4”, 7/8”, 1”, 1 1/4”, or 1 1/8”), and bolt grade (ASTM A325 or ASTM A490). For clarity, indices for slip-critical connection details are followed by a suffix, “SB”. Regardless of whether the connection is bearing-type or slip-critical, **ANSI/AISC 341-10 requires that all seismic-resistant bolted connections have pretensioned high-strength bolts.** Because pretensioning of bolts is labor intensive, the number of bolts in each of the suggested connection details has been minimized.

It is the responsibility of the Engineer of Record to confirm the connection resistance for each detail prior to use. As the connection resistance is often governed by “block shear rupture,” changes to the gauge and pitch of bolts indicated in the details can adversely affect the resistance of the connection.

For the details provided, the following material properties were assumed (unless otherwise noted) and can be assumed by an engineer confirming the resistance of any connection detail provided or for detailing their own connection:

HSC	Fy = 50 ksi, Fu = 80 ksi
Gusset	Fy = 36 ksi, Fu = 58 ksi

Material of equal or higher strength than that which is listed above (or noted on the connection detail) for the gusset plate must be provided if a detail provided in this user manual is to be followed.

Bolt capacities for bearing-type connections are calculated according to ANSI/AISC 360-10. High-Strength Connectors have been designed such that bolt threads are excluded from the shear planes.

Slip-critical connection details are provided for use when warranted and have been calculated according to ANSI/AISC 360-10 for oversized holes, allowing for the use of fillers, and based on Class B contact surfaces [ϕ = 0.85 (LRFD); Ω = 1.76 (ASD); h_f = 0.85; μ = 0.50]. ANSI/AISC 341-10 permits the use of oversized holes in slip-critical connections provided the holes are oversized in one ply only. If the connection designer opts to use fillers as a means to reduce the thickness of the gusset plate, the capacity of the bolted connection at the reduced gusset plate must be confirmed by the Engineer of Record. High-Strength Connectors are supplied with faying surfaces that have been blast-cleaned. **The faying surfaces of the gusset plate must also be Class B if the designer wishes to use the Class B slip-critical connection details provided in this Manual.**

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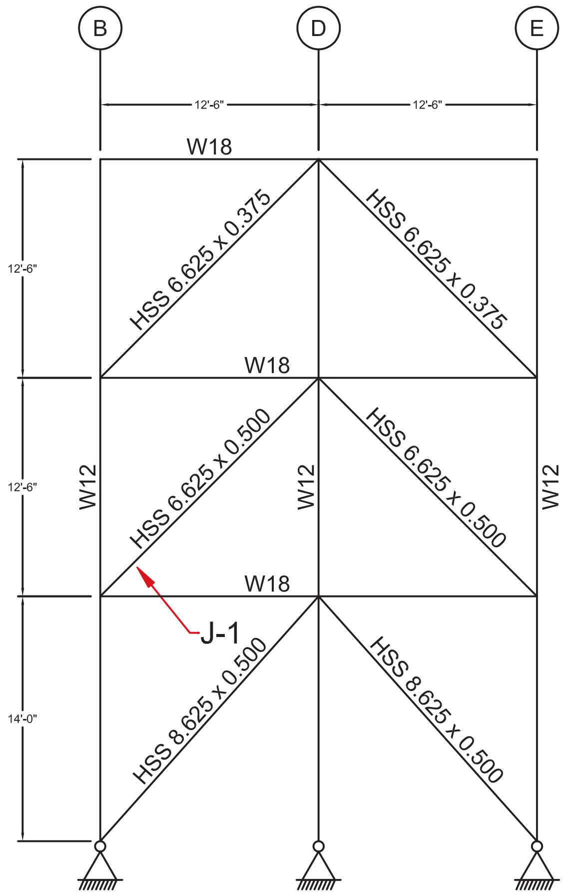
Sample Connection Design

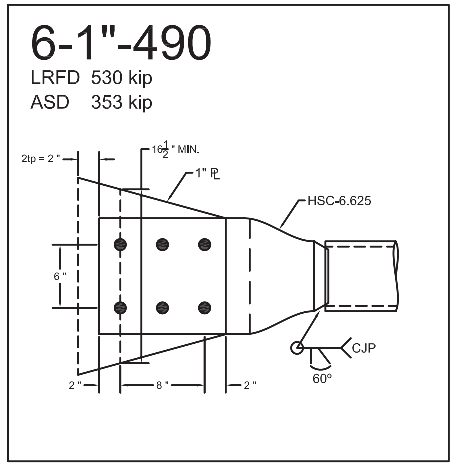
Assume that an engineer has sized all of the main structural members in a SCBF according to the governing building code and ANSI/AISC 341-10, and that these members are as shown below.

Detail a bearing-type brace end connection for the HSS 6.625x0.500 brace element at Joint J-1 assuming the HSS member is produced according to ASTM A500, Grade B and that pretensioned ASTM A490 bolts of 1-inch diameter are to be used.

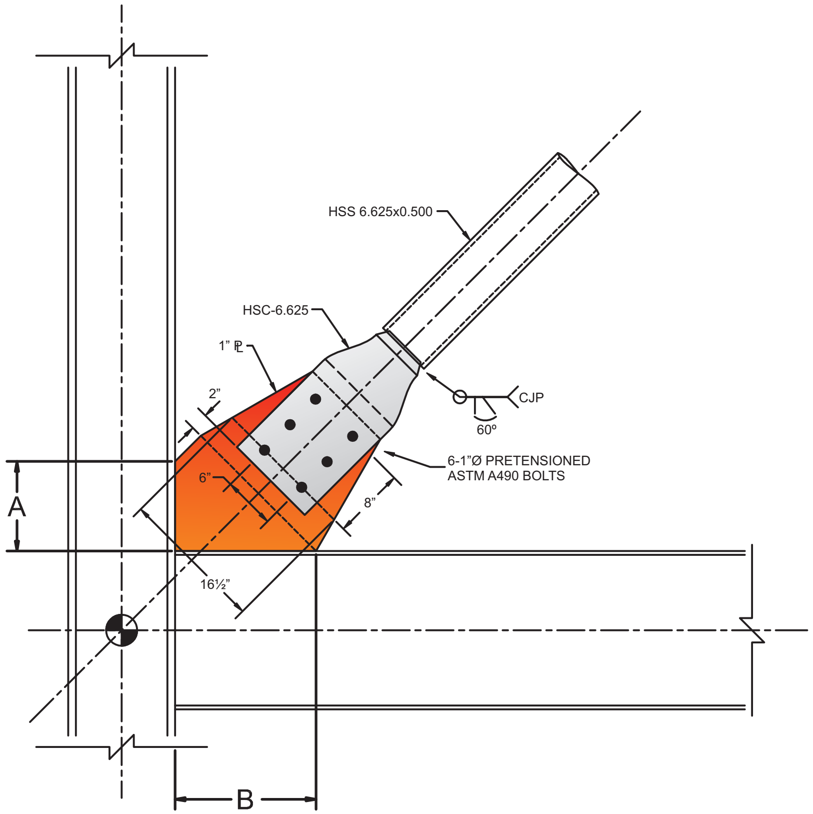


Using High-Strength Connectors and this User Manual, the design procedure is simple:

As the HSS brace member has an outer diameter of 6.625-inches, we must specify HSC-6.625 connectors. We begin by opening the User Manual to the HSC-6.625 design table and find the ASTM A500 Grade B, HSS 6.625x0.500 section on the table. Reading across the row, we can see that for 1-inch, ASTM A490 bolts in a bearing-type connection, the required connection detail index is **6-1”-490**. Flipping to detail 6-1”-490 in the HSC-6.625 section of the manual **(be careful to look in the correct section of the manual as there may be other details with the same index in other sections of the manual)**, we find the detail that is shown below.



We know that, according to ANSI/AISC 341-10, an HSS 6.625x0.500 brace member produced to ASTM A500, Grade B has an expected yield strength of RyFyAg = (1.4)(42 ksi)(9.00 in^2) = 529 kip (LRFD) (note that this information is also provided in the design table). As the connection detail shows a resistance of 530 kip (LRFD) (which should be confirmed by the connection designer prior to using the detail), we know that the detail selected is suitable. We then simply insert the detail into the drawing using the minimum net-section dimension given and the rules for the 2tp free length.

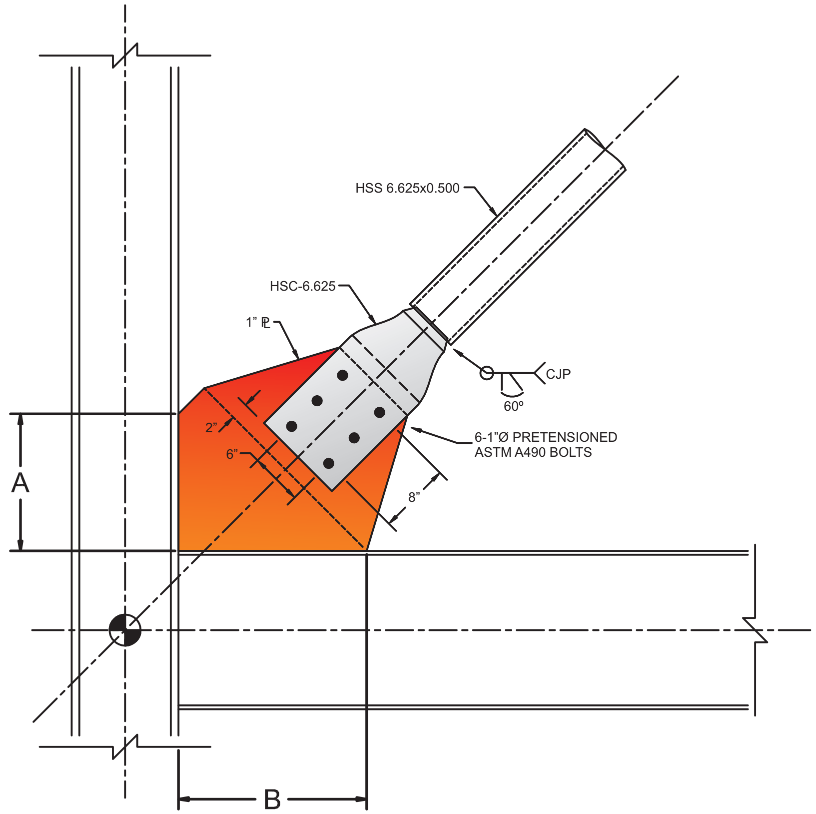


The design of the brace end connection is now complete.

The next step involves checking the adequacy of the gusset and detailing the connection between the gusset and beam, column, or beam and column, which should be done in accordance to ANSI/AISC 341-10 and ANSI/AISC 360-10. When detailing these connections, it is best to consider the preferences of local fabricators and erectors with respect to field bolting versus field welding, erection practices, etc.

Adequacy checking and detailing of the gusset connection is outside of the scope of this User Manual. An excellent practical resource that discusses the design of gusset plates in seismic-resistant braced frames is the December 2006 issue of Steel Tips, entitled "*Seismic Detailing of Gusset Plates for Special Concentrically Braced Frames*" by Abolhassan Astaneh-Asl, Michael L. Cochran, and Rafael Sabelli. Steel Tips is published by the Structural Steel Educational Council (SSEC).

In all likelihood, the resulting connections between the gusset and the beam, column, or beam and column will require larger dimensions "A" and "B" than were provided based on using the optimized connection detail provided in this User Manual. When increasing the size of the gusset, be sure to respect the 2tp requirements, as illustrated below.

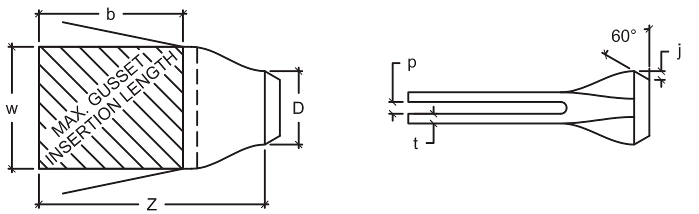


The final check that must be carried out by the designer is to **confirm that the brace can be installed in the field**. Refer to the Site Erection section of this User Manual for more information on field installation of braces equipped with HSC. Depending upon beam and gusset dimensions and erection details, the gusset dimensions may require adjustment to meet this very important criteria.

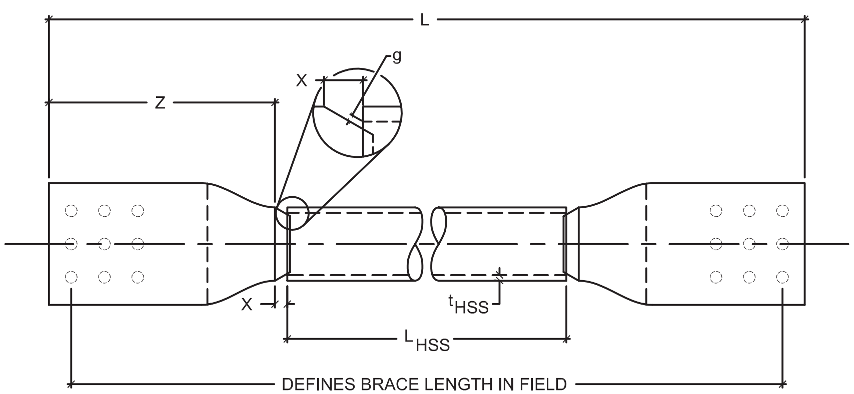
Fabrication with High-Strength Connectors

Detailing

The following figures, table, and equations are meant to assist in detailing HSC brace assemblies. Electronic versions of HSC geometry (top and side) are available upon request at info@castconnex.com.



	Z [in.]	D [in.]	b [in.]	w [in.]	t [in.]	p_{min} [in.]	p_{max} [in.]	j [in.]
HSC-4.000	14 1/4	4	10	7	1/2	9/16	5/8	5/8
HSC-5.563	19 1/16	5 9/16	13	9	5/8	13/16	7/8	9/16
HSC-6.625	20 3/8	6 5/8	13	11	7/8	1 1/16	1 1/8	13/16
HSC-8.625	27 1/8	8 5/8	17 1/2	14	1	1 5/16	1 3/8	7/8



$$L_{HSS} = L - 2[Z + X]$$
$$X = 2g + t_{HSS} \cdot \sqrt{3}$$

When using these equations to estimate the length of HSS required for a given brace, note that the actual t_{HSS} can be significantly thinner than the nominal value. Refer to the relevant HSS or Pipe specification for more information.

Fitting

When fitting a bolted brace assembly, it is important to note that the actual length of the brace is set by the distance between the bolt pattern at each end of the brace and that the **HSC should be carefully aligned in all directions (including roll) prior to welding.** For brace assemblies which are to be field bolted, some users have found it helpful to drill the bolt patterns into the HSC after having welded both connectors to the hollow section as this has allowed for improved control of brace length. However, other methods for fitting have also been successful.

Figure 8: Fitting of HSC brace assembly. Fitter simultaneously ensures:
1) the HSC connectors are level and in-line
2) the appropriate weld root gap is provided at the joints
3) the overall length of the brace assembly is correct

Drilling

HSC are produced with steel that is very tough. As a result, drilling should be carried out using a high quality carbide-tipped tool operated at the correct drill speed. When drilling, the tool should past through both HSC flanges. Failure to clear the slug produced during the drilling of the first flange before starting the second core may result in tool fracture.

Welding

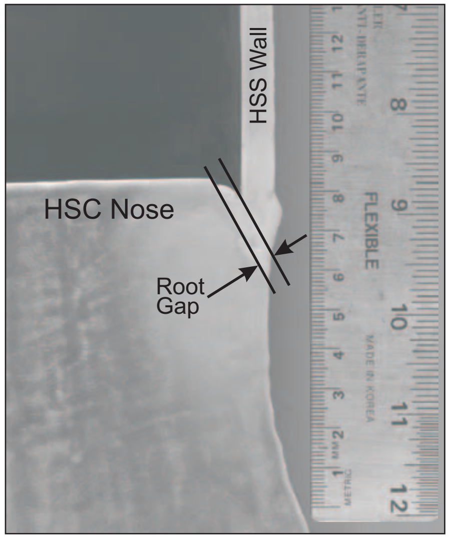
HSC are manufactured using material produced to ASTM A958 Grade SC8620 Class 80/50. **Heat treatment for this material may include quenching and tempering (QT).** As a result, it is important to follow good welding practices for QT materials for welds applied to HSC in the shop (and potentially in the field with respect to fillet welds applied between the HSC and gusset plate). In all seismic applications, **the welded joints must meet all of the requirements stipulated in ANSI/AISC 341-10, AWS D1.1, and AWS D1.8 for seismic-resistant demand critical welded connections.**

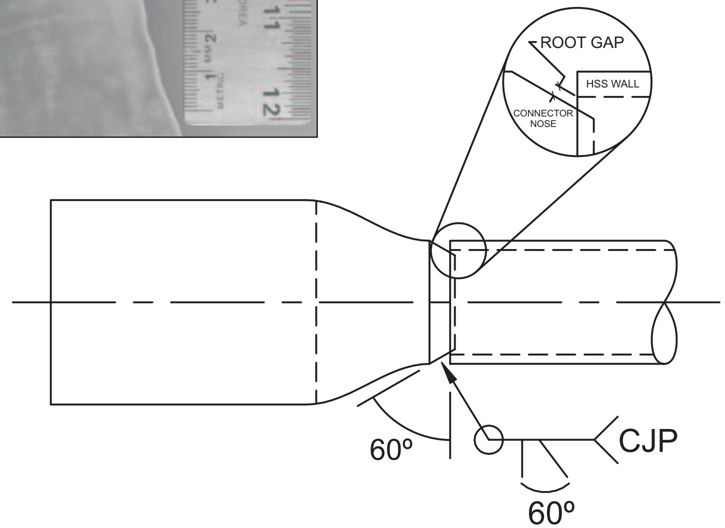
Although ASTM A958 Grade SC8620 Class 80/50 is a weldable base metal with both mechanical and chemical properties similar to those of a standard wrought steel grades, it is not a pre-approved base metal according to the American Welding Society (AWS). Because of this, and because of the nature of the weld that must be applied between the HSC and the HSS or Pipe member (described below), **the Engineer of Record must approve a Welding Procedure Specification (WPS) and a Procedure Qualification Record (PRQ) must be produced.**

<u>Demand Critical Complete Joint Penetration Groove Weld</u>

The demand critical weld between the HSC and the HSS or Pipe member **must provide complete joint penetration** (CJP). WPS outlining a procedure for a CJP weld applied from one side on steel backing (backing is provided by the nose of the HSC which protrudes into the hollow section as shown below), with a 60 degree vee or bevel joint, and with a root gap commensurate with the thickness of the HSS or Pipe wall have been successfully applied and accepted in the past. Note that the significant mass of the HSC in the region of the CJP typically necessitates the application of pre-heating prior to welding.

HSC are supplied with a 60º weld preparation, thus HSS or Pipe members need only be square-cut to the appropriate length (refer to the Fitting section of this User Manual) and tack-welded to the HSC prior to CJP welding. Past users have welded successfully using a motorized turning roll.





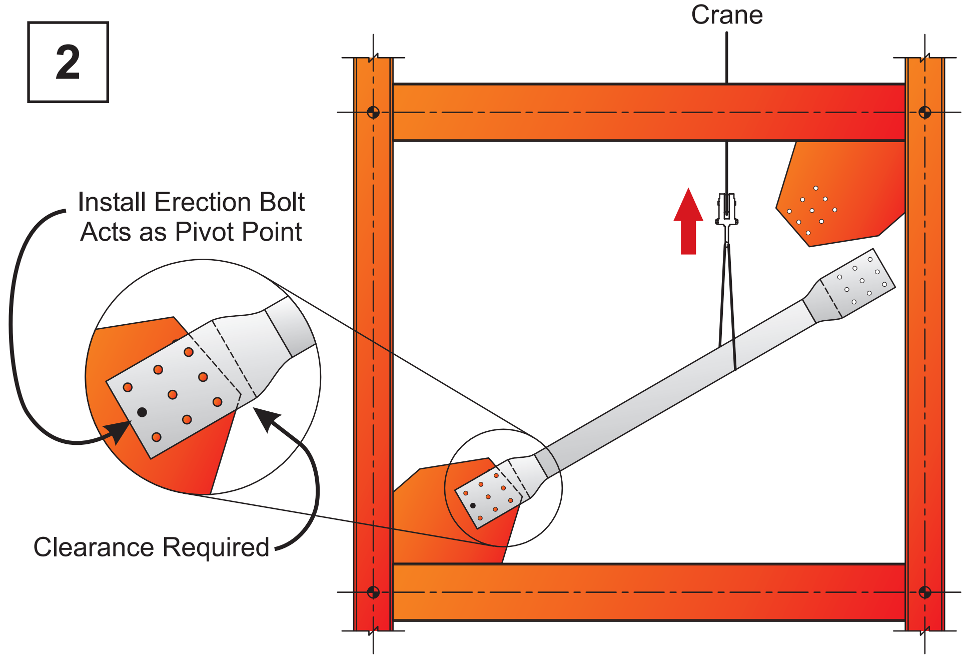
WARNING: If the Complete Joint Penetration Groove Weld between the HSC and the hollow section brace element is not applied correctly, or if the fillet welds that may be applied in the field between the HSC and gusset plate are not applied correctly, fracture of these welds or of the base metal may occur during a seismic event or as a result of high-cycle fatigue. CAST CONNEX CORPORATION, ITS AFFILIATES, SUBSIDIARIES OR RELATED COMPANIES, ASSUME NO LIABILITY WHATSOEVER WITH RESPECT TO THE QUALITY OF ANY WELDS APPLIED TO HSC BY ANY END USER OF THE HSC PRODUCT.

Site Erection

It is quite common for the beams and columns in a steel braced frame to be erected prior to the installation of the brace member. In these cases, the designer should ensure that the brace can be installed in the field given the specific geometry of the frame, gusset plates, and brace assembly. The diagrams below illustrate the most common sequence for brace installation in this circumstance and should help the designer understand some of the constraints that arise in this situation.

Depending on the specifics of a given project, the erection schemes for primary structural steel elements can vary widely, particularly with respect to braced frames. Whenever possible, the design team should consult with the contractors involved in the project to gain an understanding of their preferred practices and any specific erection constraints. The images below are only meant to make users of this manual aware of some of the issues that may arise and do not present the only possible erection scheme for braced frames.

2



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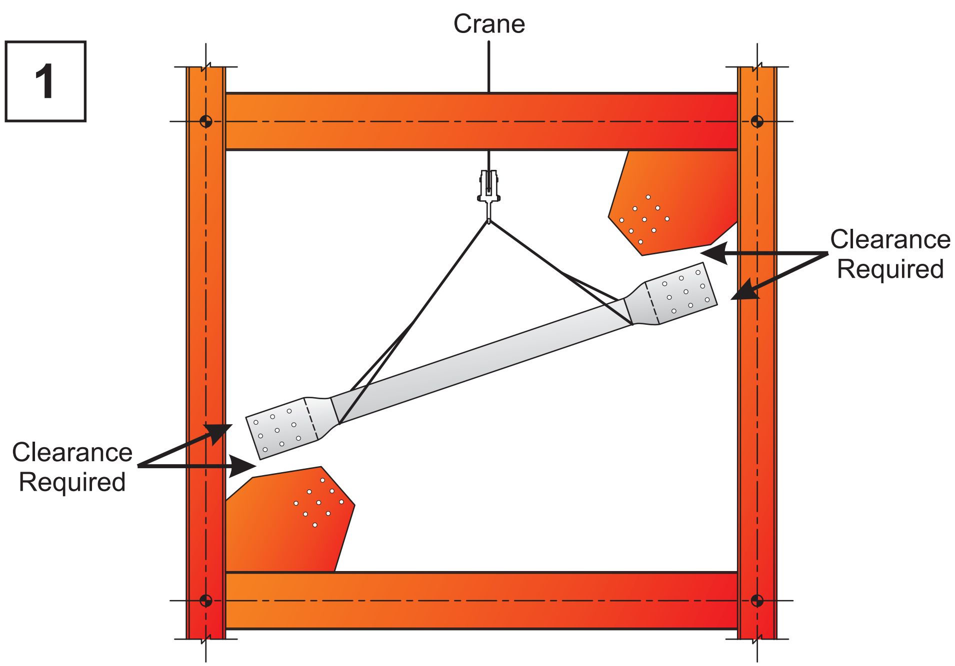

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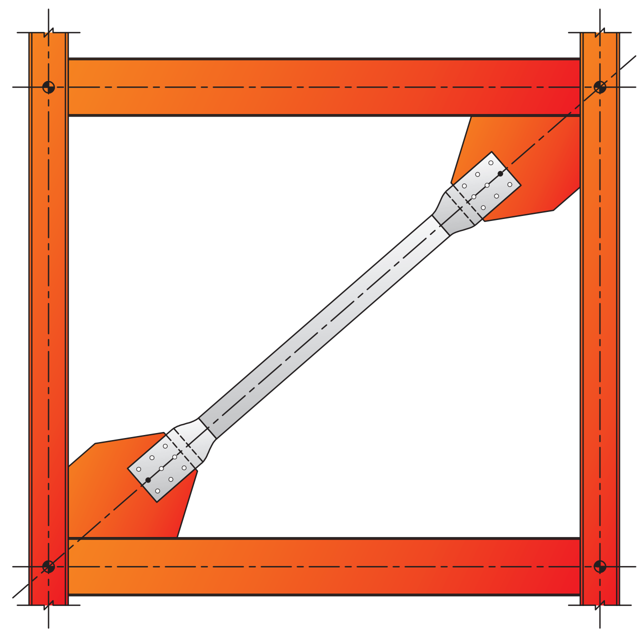

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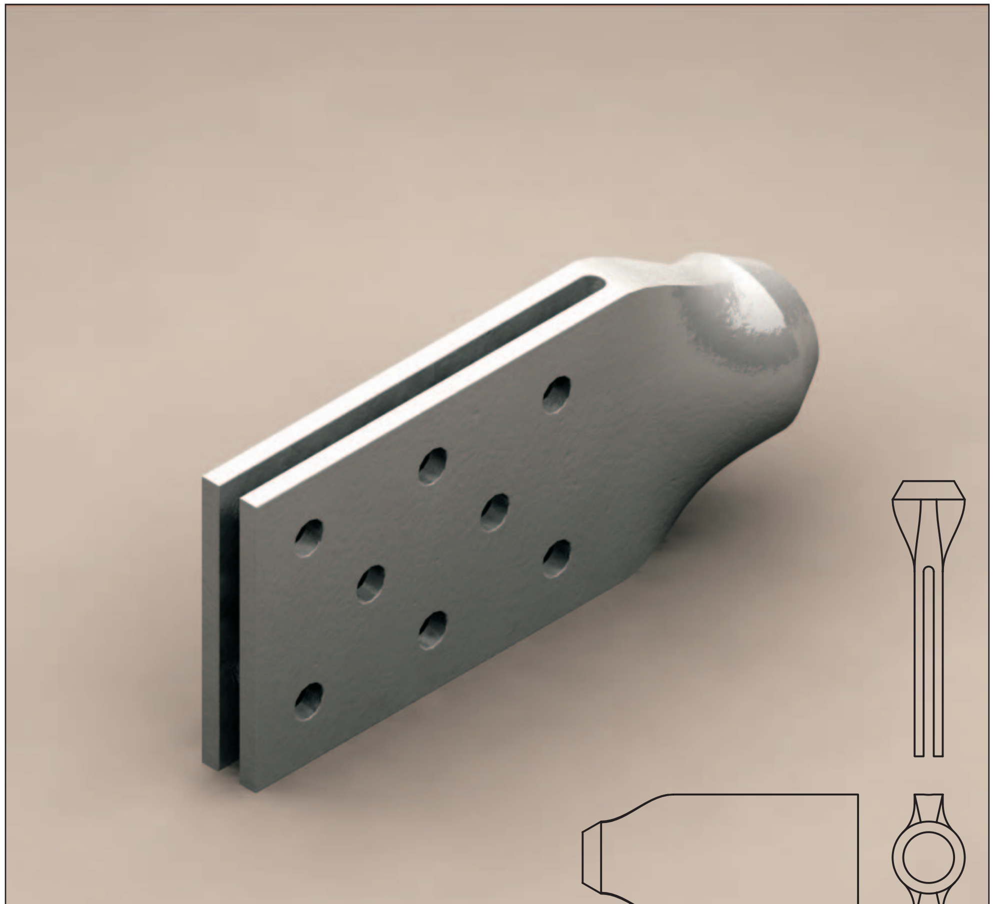
Design Tables

Cast ConneX®

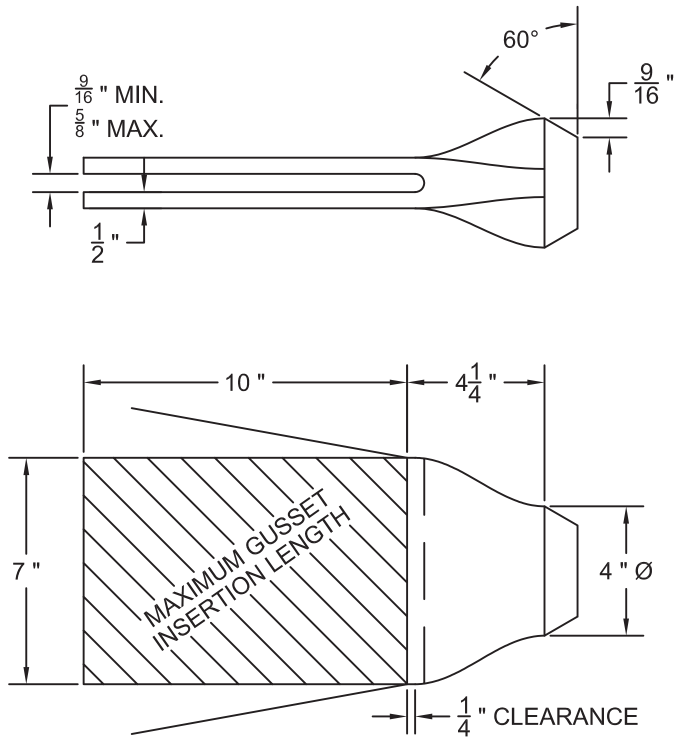
High-Strength Connector™

Product No.

HSC-4.000



Bolt pattern shown is an example only. All HSC are supplied without bolt holes.
This is an artists rendition of this particular HSC. Actual appearance may vary.



HSC-4.000

ANSI/AISC 341-10

$$\frac{D}{t} \le \frac{0.038 \cdot E}{Fy}$$

ASTM A500
Grade B

Fy = 42 ksi
Ry·Fy = 59 ksi

thus D/t ≤ 26.2

Shape	Wall Thickness, t		D/t	Area, A	Ry·Fy·A	BEARING-TYPE CONNECTIONS[1] Detail Number					
						A325			A490		
						Bolt Size			Bolt Size		
	Nominal	Design[3]									
	in.	in.		in.^{2}	kip	3/4	7/8	1	3/4	7/8	1
HSS 4.000	0.337	0.313	12.8	3.63	213	6-3/4"-325	5-7/8"-325	4-1"-325	5-3/4"-490	5-7/8"-490	4-1"-490
	0.313	0.291	13.7	3.39	199	6-3/4"-325	5-7/8"-325	4-1"-325	5-3/4"-490	5-7/8"-490	4-1"-490
	0.250	0.233	17.2	2.75	162	5-3/4"-325	4-7/8"-325	3-1"-325	5-3/4"-490	4-7/8"-490	3-1"-490
	0.237	0.220	18.1	2.62	154	4-3/4"-325	4-7/8"-325	3-1"-325	4-3/4"-490	4-7/8"-490	3-1"-490
	0.226	0.210	19.0	2.50	147	4-3/4"-325	4-7/8"-325	3-1"-325	4-3/4"-490	4-7/8"-490	3-1"-490
	0.220	0.205	19.6	2.44	143	4-3/4"-325	4-7/8"-325	3-1"-325	4-3/4"-490	4-7/8"-490	3-1"-490
	0.188	0.175	22.9	2.10	124	4-3/4"-325	3-7/8"-325	3-1"-325	4-3/4"-490	3-7/8"-490	3-1"-490

Shape	Wall Thickness, t		D/t	Area, A	Ry·Fy·A	CLASS B SLIP-CRITICAL CONNECTIONS[1, 2] Detail Number					
						A325			A490		
						Bolt Size			Bolt Size		
	Nominal	Design[3]									
	in.	in.		in.^{2}	kip	3/4	7/8	1	3/4	7/8	1
HSS 4.000	0.337	0.313	12.8	3.63	213	**X**	**X**	**X**	8-3/4"-490-SB	6-7/8"-490-SB	5-1"-490-SB
	0.313	0.291	13.7	3.39	199	**X**	**X**	5-1"-325-SB	7-3/4"-490-SB	5-7/8"-490-SB	4-1"-490-SB
	0.250	0.233	17.2	2.75	162	8-3/4"-325-SB	6-7/8"-325-SB	4-1"-325-SB	6-3/4"-490-SB	5-7/8"-490-SB	4-1"-490-SB
	0.237	0.220	18.1	2.62	154	7-3/4"-325-SB	5-7/8"-325-SB	4-1"-325-SB	6-3/4"-490-SB	4-7/8"-490-SB	3-1"-490-SB
	0.226	0.210	19.0	2.50	147	7-3/4"-325-SB	5-7/8"-325-SB	4-1"-325-SB	6-3/4"-490-SB	4-7/8"-490-SB	3-1"-490-SB
	0.220	0.205	19.6	2.44	143	7-3/4"-325-SB	5-7/8"-325-SB	4-1"-325-SB	6-3/4"-490-SB	4-7/8"-490-SB	3-1"-490-SB
	0.188	0.175	22.9	2.10	124	6-3/4"-325-SB	4-7/8"-325-SB	3-1"-325-SB	5-3/4"-490-SB	4-7/8"-490-SB	3-1"-490-SB

1. Connections must have pretensioned high-strength bolts. The following are suggested bolt lengths:
   2¾" Long bolt for 3/4" and 7/8" A325 or A490
   3" Long bolt for 1" A325 or A490
2. Tabulated values for slip-critical connections assume Class B contact surfaces with μ = 0.50, D_u = 1.13, and h_{sc} = 0.85. High-Strength Connectors are supplied with Class B surfaces. Surface treatment of gusset plate is required to achieve Class B slip resistance in connection.
3. Design wall thickness for ASTM A500 HSS sections taken as $0.93 \cdot t_{nominal}$.

X Connector tabs not large enough to accommodate the number of bolts required

HSC-4.000

ANSI/AISC 341-10

$$\frac{D}{t} \leq \frac{0.038 \cdot E}{Fy}$$

ASTM A500
Grade C

Fy = 46 ksi

Ry·Fy = 64 ksi

thus D/t ≤ 24.0

Shape	Wall Thickness, t		D/t	Area, A	Ry·Fy·A	BEARING-TYPE CONNECTIONS[1] Detail Number					
						A325			A490		
	Nominal	Design[3]				Bolt Size			Bolt Size		
	in.	in.		in.^{2}	kip	3/4	7/8	1	3/4	7/8	1
HSS 4.000	0.337	0.313	12.8	3.63	234	6-3/4"-325	5-7/8"-325	4-1"-325	6-3/4"-490	5-7/8"-490	4-1"-490
	0.313	0.291	13.7	3.39	218	6-3/4"-325	5-7/8"-325	4-1"-325	5-3/4"-490	5-7/8"-490	4-1"-490
	0.250	0.233	17.2	2.75	177	5-3/4"-325	4-7/8"-325	4-1"-325	5-3/4"-490	4-7/8"-490	4-1"-490
	0.237	0.220	18.1	2.62	169	5-3/4"-325	4-7/8"-325	3-1"-325	5-3/4"-490	4-7/8"-490	3-1"-490
	0.226	0.210	19.0	2.50	161	5-3/4"-325	4-7/8"-325	3-1"-325	5-3/4"-490	4-7/8"-490	3-1"-490
	0.220	0.205	19.6	2.44	157	5-3/4"-325	4-7/8"-325	3-1"-325	5-3/4"-490	4-7/8"-490	3-1"-490
	0.188	0.175	22.9	2.10	135	4-3/4"-325	3-7/8"-325	3-1"-325	4-3/4"-490	3-7/8"-490	3-1"-490

Shape	Wall Thickness, t		D/t	Area, A	Ry·Fy·A	CLASS B SLIP-CRITICAL CONNECTIONS[1, 2] Detail Number					
						A325			A490		
	Nominal	Design[3]				Bolt Size			Bolt Size		
	in.	in.		in.^{2}	kip	3/4	7/8	1	3/4	7/8	1
HSS 4.000	0.337	0.313	12.8	3.63	234	**X**	**X**	**X**	**X**	**X**	**X**
	0.313	0.291	13.7	3.39	218	**X**	**X**	**X**	8-3/4"-490-SB	6-7/8"-490-SB	5-1"-490-SB
	0.250	0.233	17.2	2.75	177	8-3/4"-325-SB	6-7/8"-325-SB	5-1"-325-SB	7-3/4"-490-SB	5-7/8"-490-SB	4-1"-490-SB
	0.237	0.220	18.1	2.62	169	8-3/4"-325-SB	6-7/8"-325-SB	5-1"-325-SB	6-3/4"-490-SB	5-7/8"-490-SB	4-1"-490-SB
	0.226	0.210	19.0	2.50	161	8-3/4"-325-SB	6-7/8"-325-SB	4-1"-325-SB	6-3/4"-490-SB	5-7/8"-490-SB	4-1"-490-SB
	0.220	0.205	19.6	2.44	157	7-3/4"-325-SB	5-7/8"-325-SB	4-1"-325-SB	6-3/4"-490-SB	4-7/8"-490-SB	4-1"-490-SB
	0.188	0.175	22.9	2.10	135	6-3/4"-325-SB	5-7/8"-325-SB	4-1"-325-SB	5-3/4"-490-SB	4-7/8"-490-SB	3-1"-490-SB

1. Connections must have pretensioned high-strength bolts. The following are suggested bolt lengths:
   2¾" Long bolt for 3/4" and 7/8" A325 or A490
   3" Long bolt for 1" A325 or A490
2. Tabulated values for slip-critical connections assume Class B contact surfaces with μ = 0.50, D_u = 1.13, and h_{sc} = 0.85. High-Strength Connectors are supplied with Class B surfaces.
   Surface treatment of gusset plate is required to achieve Class B slip resistance in connection.
3. Design wall thickness for ASTM A500 HSS sections taken as $0.93 \cdot t_{nominal}$.

X Connector tabs not large enough to accommodate the number of bolts required

$$\frac{D}{t} \leq \frac{0.038 \cdot E}{Fy}$$

ASTM A53
Grade B

Fy = 35 ksi thus D/t ≤ 31.5

Ry·Fy = 56 ksi

Shape	Wall Thickness, t		D/t	Area, A	Ry·Fy·A	BEARING-TYPE CONNECTIONS[1] Detail Number					
						A325			A490		
	Nominal	Design[3]				Bolt Size			Bolt Size		
	in.	in.		in.^{2}	kip	3/4	7/8	1	3/4	7/8	1
Pipe 3½											
XS	0.318	0.296	13.5	3.44	193	5-3/4"-325	5-7/8"-325	4-1"-325	5-3/4"-490	5-7/8"-490	4-1"-490
STD	0.226	0.210	19.0	2.50	140	4-3/4"-325	4-7/8"-325	3-1"-325	4-3/4"-490	4-7/8"-490	3-1"-490

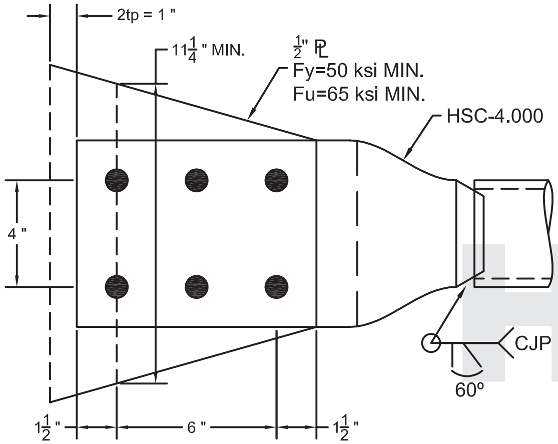
Shape	Wall Thickness, t		D/t	Area, A	Ry·Fy·A	CLASS B SLIP-CRITICAL CONNECTIONS[1, 2] Detail Number					
						A325			A490		
	Nominal	Design[3]				Bolt Size			Bolt Size		
	in.	in.		in.^{2}	kip	3/4	7/8	1	3/4	7/8	1
Pipe 3½											
XS	0.318	0.296	13.5	3.44	193	**X**	**X**	5-1"-325-SB	7-3/4"-490-SB	5-7/8"-490-SB	4-1"-490-SB
STD	0.226	0.210	19.0	2.50	140	7-3/4"-325-SB	5-7/8"-325-SB	4-1"-325-SB	5-3/4"-490-SB	4-7/8"-490-SB	3-1"-490-SB

1. Connections must have pretensioned high-strength bolts. The following are suggested bolt lengths:
   2¾" Long bolt for 3/4" and 7/8" A325 or A490
   3" Long bolt for 1" A325 or A490
2. Tabulated values for slip-critical connections assume Class B contact surfaces with μ = 0.50, D_u = 1.13, and h_{sc} = 0.85. High-Strength Connectors are supplied with Class B surfaces. Surface treatment of gusset plate is required to achieve Class B slip resistance in connection.
3. Design wall thickness for ASTM A53 Pipe sections taken as $0.93 \cdot t_{nominal}$.

X Connector tabs not large enough to accommodate the number of bolts required

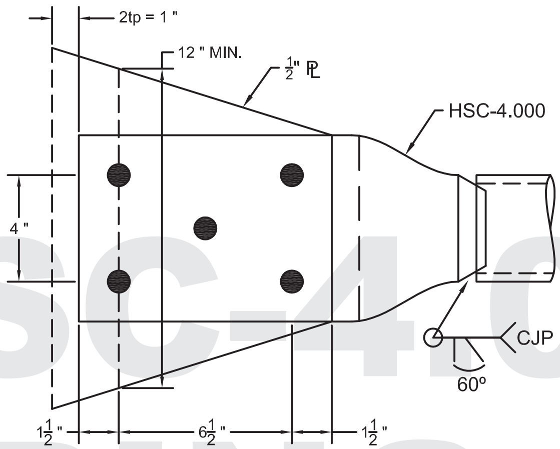
6-3/4"-325

LRFD 235 kip
ASD 156.4 kip



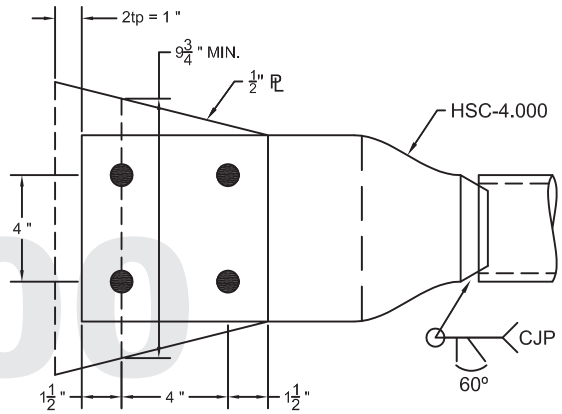
5-3/4"-325

LRFD 194.4 kip
ASD 129.3 kip



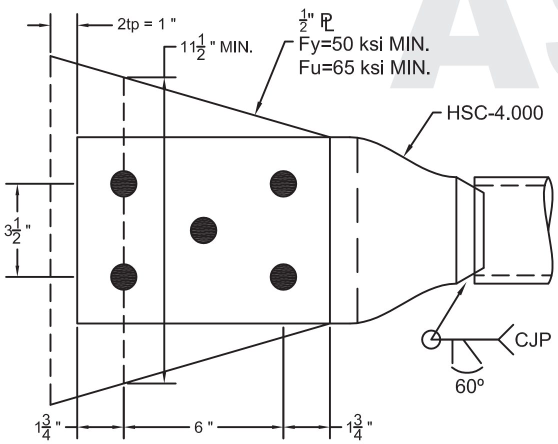
4-3/4"-325

LRFD 156.6 kip
ASD 104.4 kip



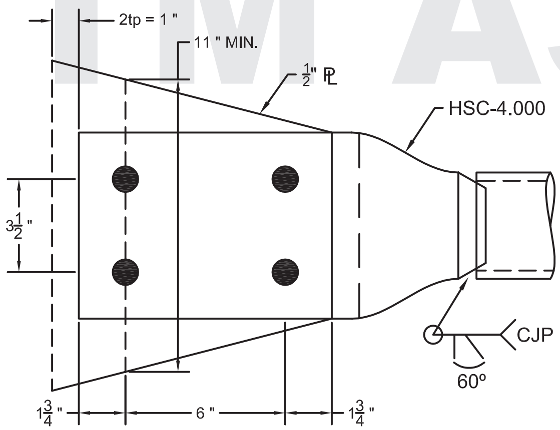
5-7/8"-325

LRFD 235 kip
ASD 156.4 kip



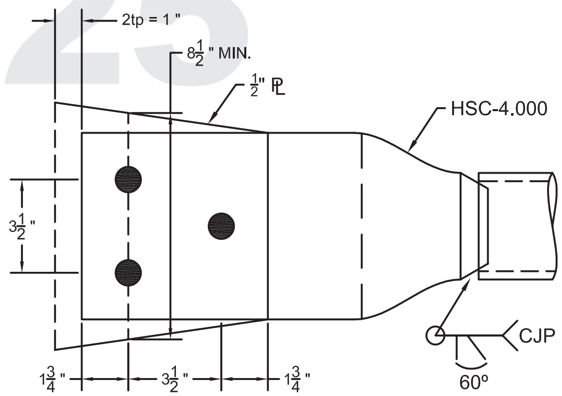
4-7/8"-325

LRFD 178.2 kip
ASD 118.6 kip



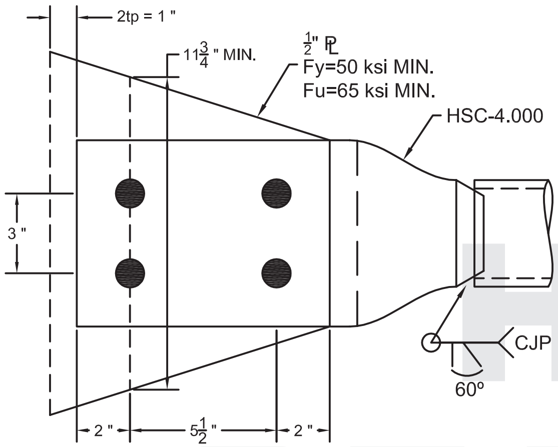
3-7/8"-325

LRFD 137.0 kip
ASD 91.4 kip



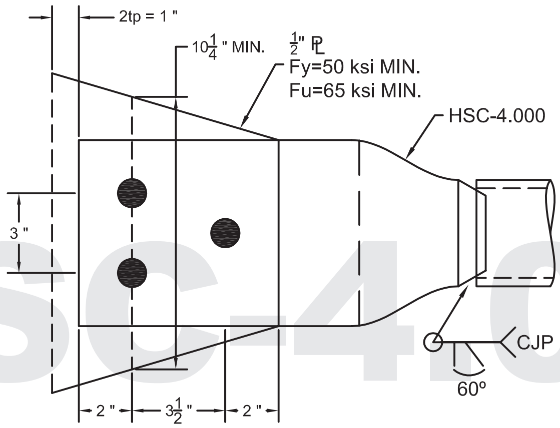
4-1"-325

LRFD 234 kip
ASD 156.0 kip



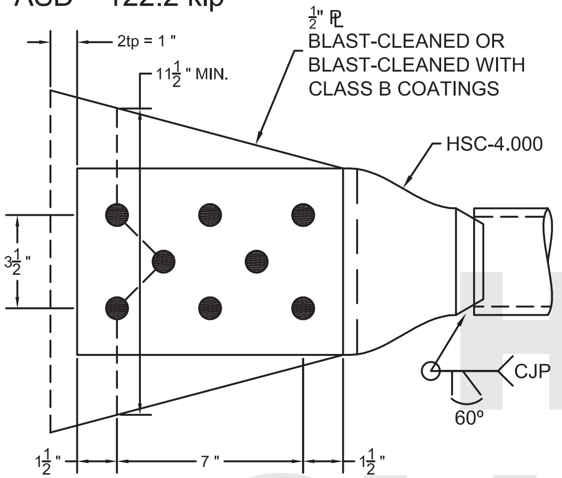
3-1"-325

LRFD 171.0 kip
ASD 114.0 kip



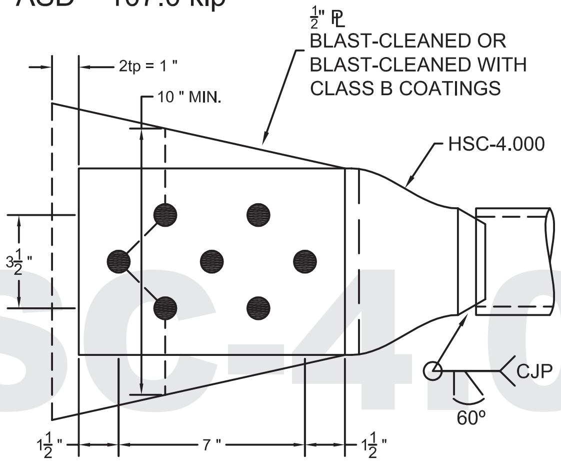
8-3/4"-325-SB

LRFD 182.9 kip
ASD 122.2 kip



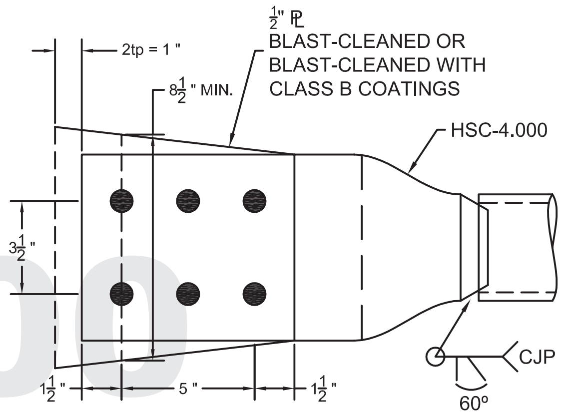
7-3/4"-325-SB

LRFD 160.0 kip
ASD 107.0 kip



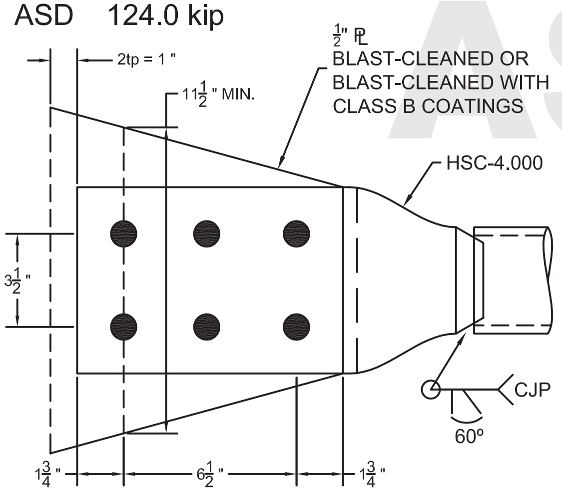
6-3/4"-325-SB

LRFD 137.2 kip
ASD 91.6 kip



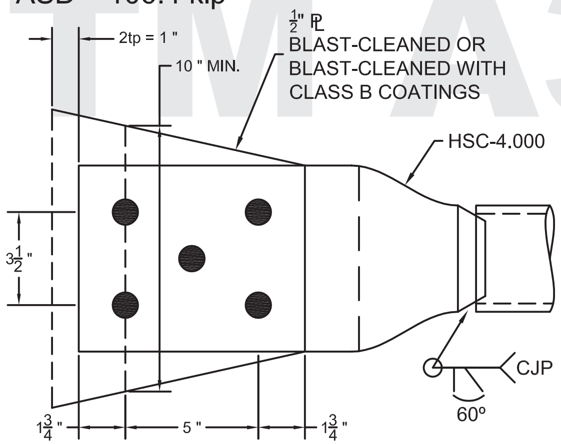
6-7/8"-325-SB

LRFD 186.3 kip
ASD 124.0 kip



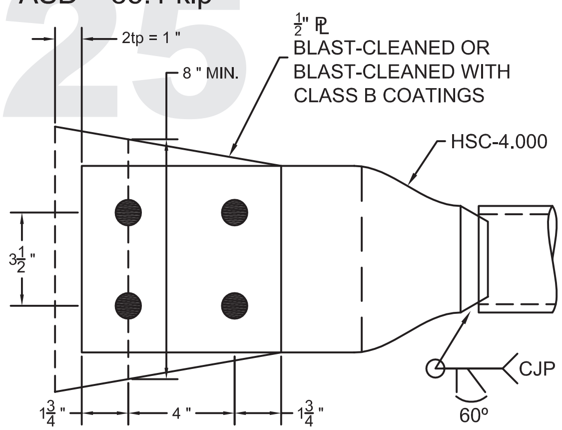
5-7/8"-325-SB

LRFD 159.2 kip
ASD 106.4 kip



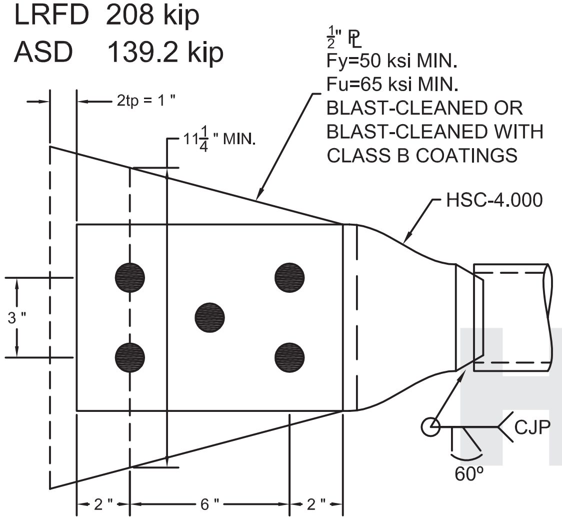
4-7/8"-325-SB

LRFD 127.4 kip
ASD 85.1 kip



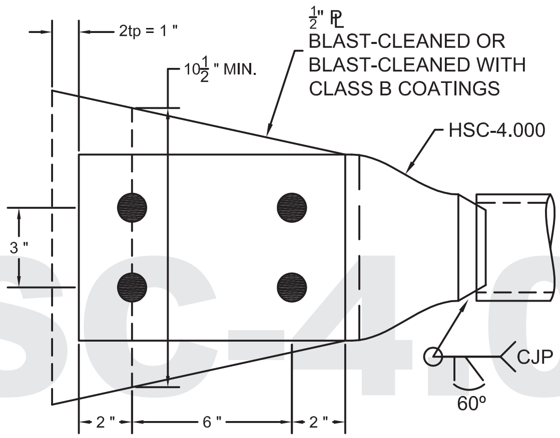
5-1"-325-SB

LRFD 208 kip
ASD 139.2 kip



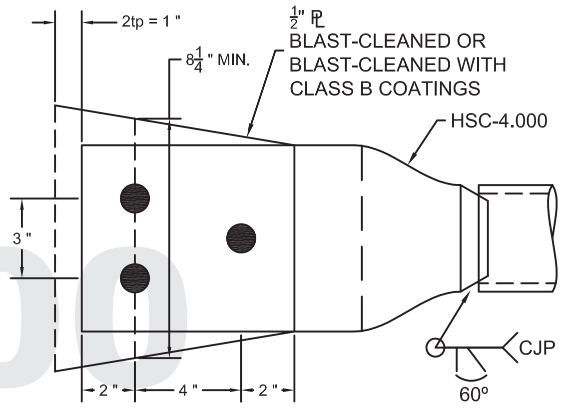
4-1"-325-SB

LRFD 166.6 kip
ASD 111.3 kip

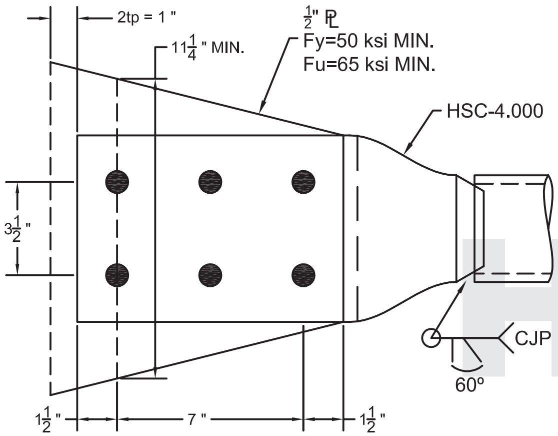


3-1"-325-SB

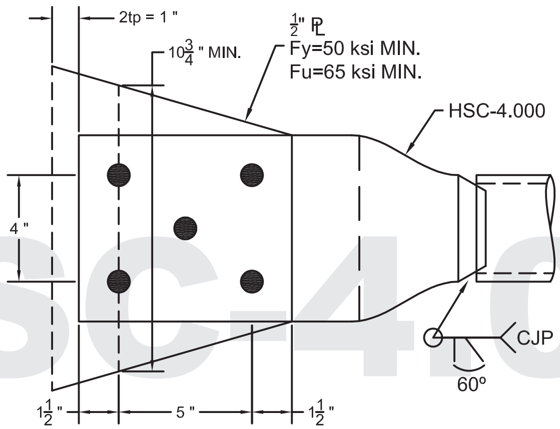
LRFD 124.9 kip
ASD 83.4 kip



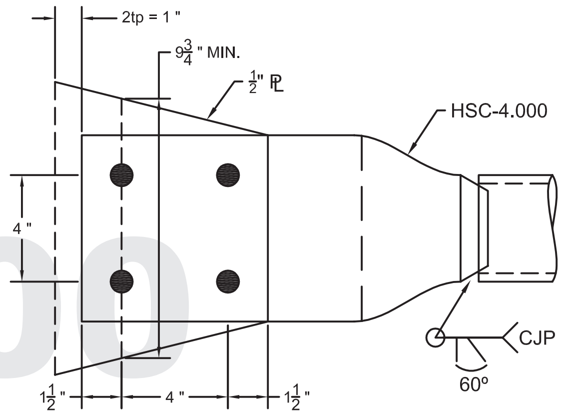
6-3/4"-490
LRFD 235 kip
ASD 156.4 kip



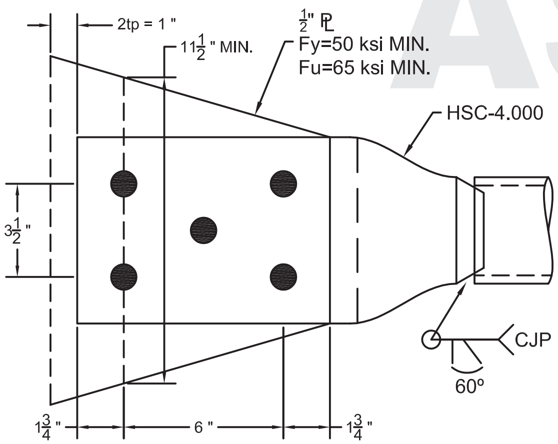
5-3/4"-490
LRFD 219 kip
ASD 146.3 kip



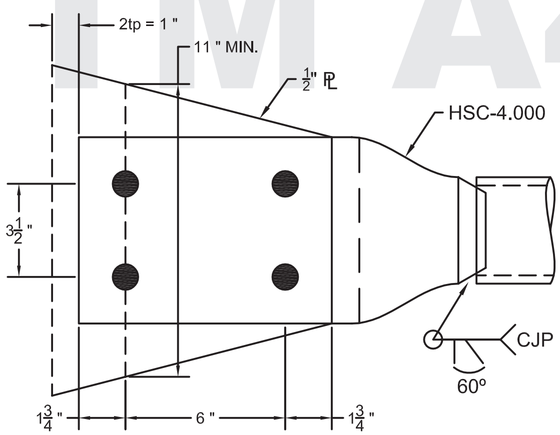
4-3/4"-490
LRFD 156.6 kip
ASD 104.4 kip



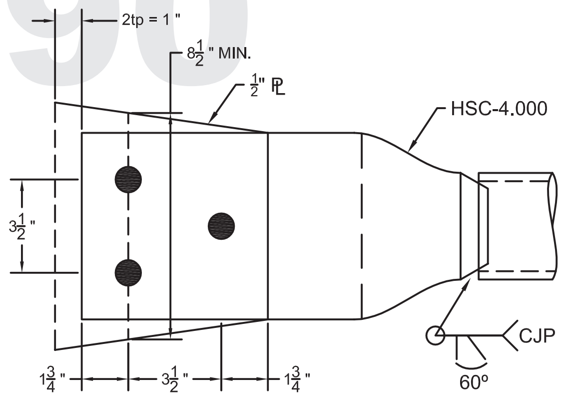
5-7/8"-490
LRFD 235 kip
ASD 156.4 kip



4-7/8"-490
LRFD 178.2 kip
ASD 118.6 kip



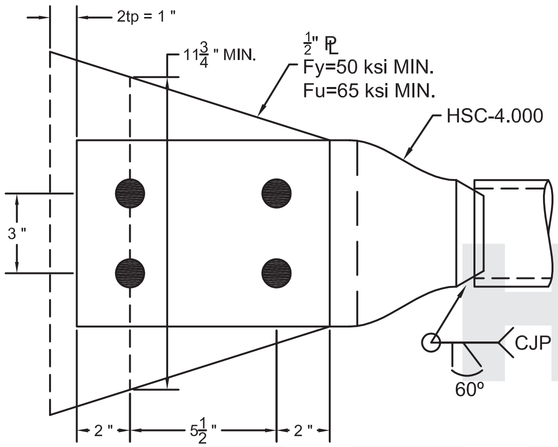
3-7/8"-490
LRFD 137.0 kip
ASD 91.4 kip



4-1"-490

LRFD 234 kip

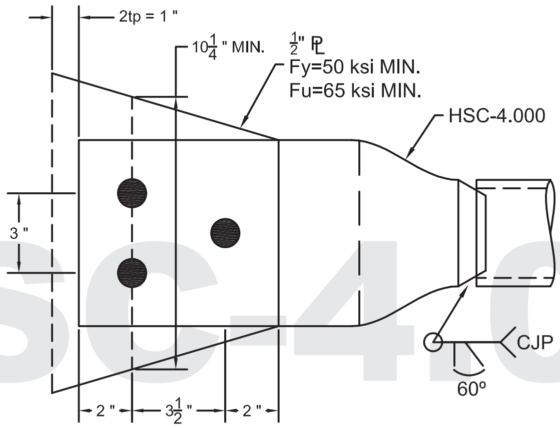
ASD 156.0 kip



3-1"-490

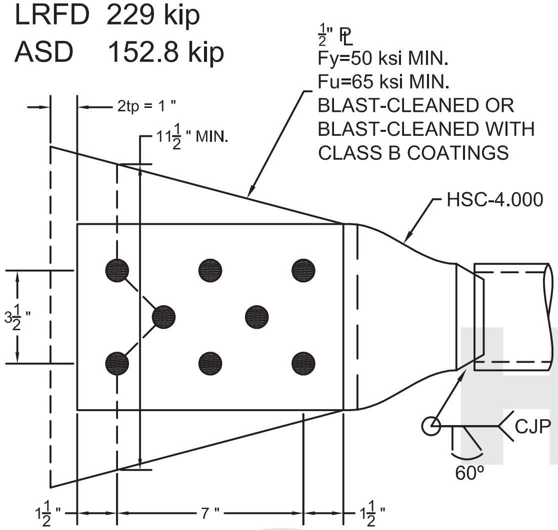
LRFD 171.0 kip

ASD 114.0 kip



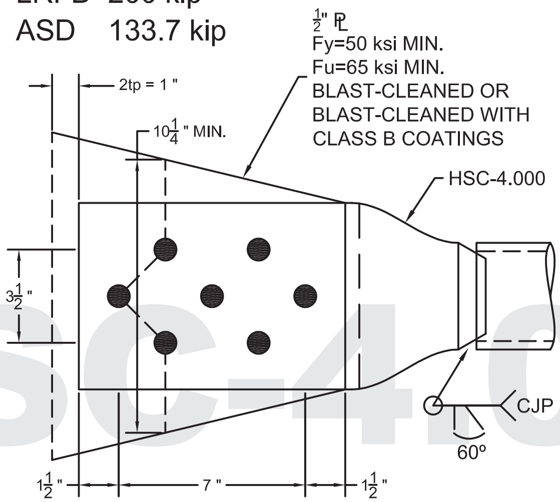
8-3/4"-490-SB

LRFD 229 kip
ASD 152.8 kip



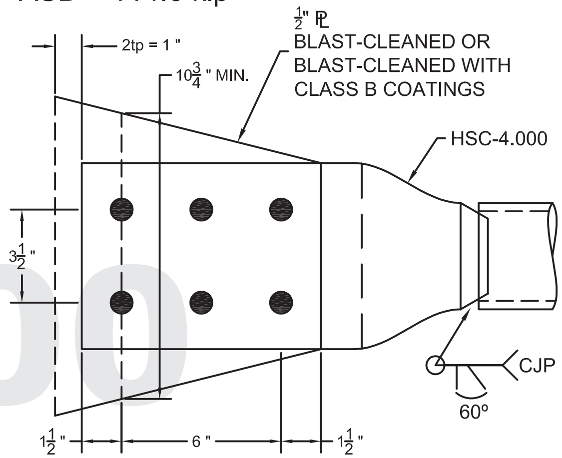
7-3/4"-490-SB

LRFD 200 kip
ASD 133.7 kip



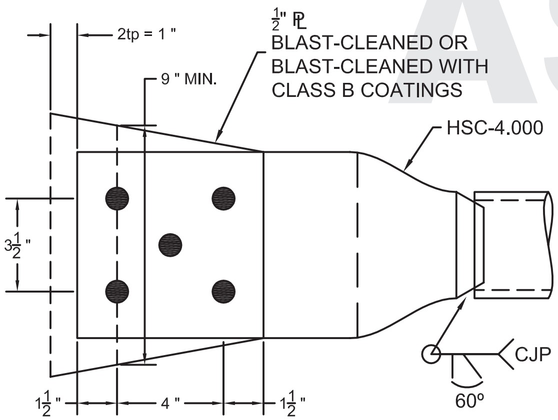
6-3/4"-490-SB

LRFD 171.4 kip
ASD 114.6 kip



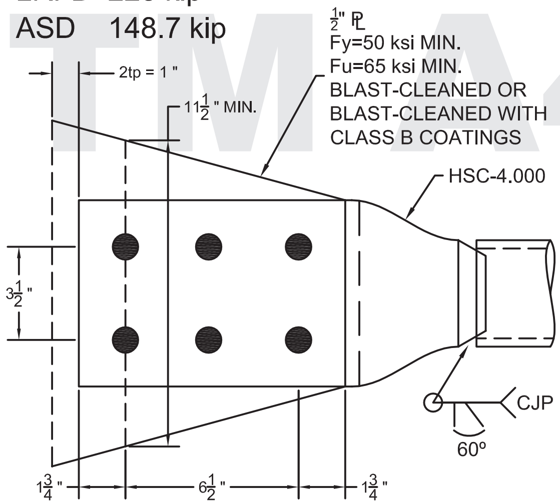
5-3/4"-490-SB

LRFD 142.9 kip
ASD 95.5 kip



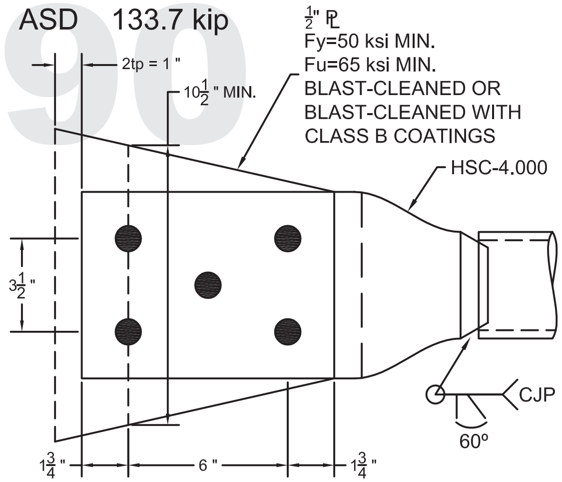
6-7/8"-490-SB

LRFD 223 kip
ASD 148.7 kip



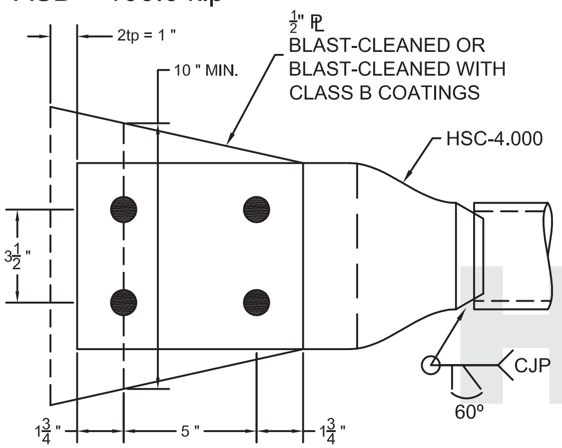
5-7/8"-490-SB

LRFD 200 kip
ASD 133.7 kip



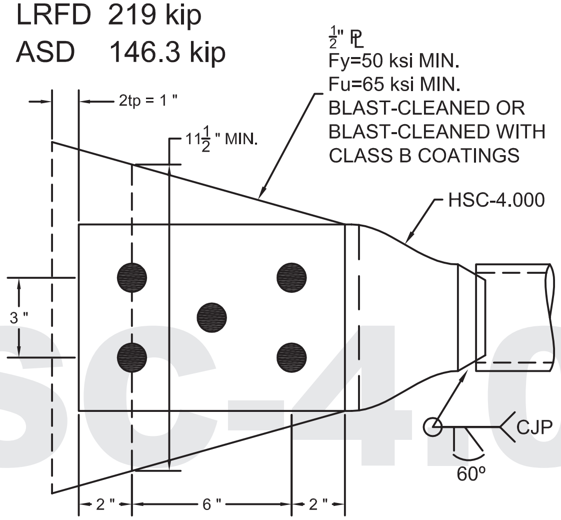
4-7/8"-490-SB

LRFD 159.9 kip
ASD 106.6 kip



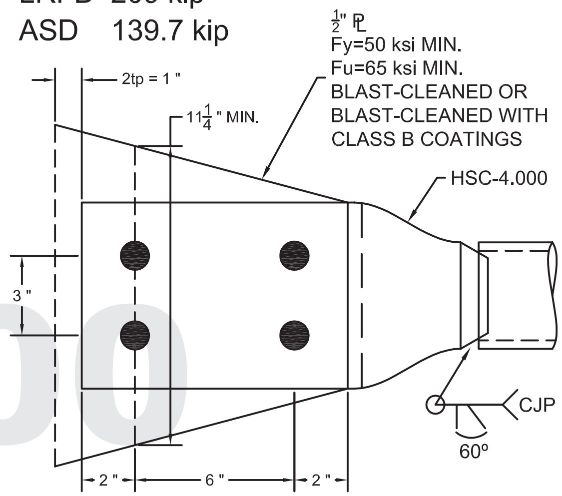
5-1"-490-SB

LRFD 219 kip
ASD 146.3 kip



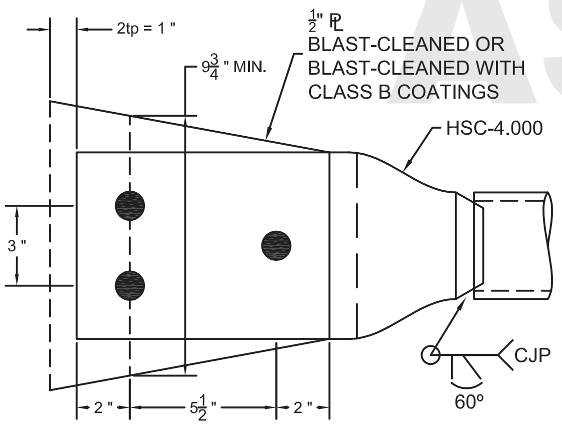
4-1"-490-SB

LRFD 209 kip
ASD 139.7 kip



3-1"-490-SB

LRFD 156.6 kip
ASD 104.4 kip

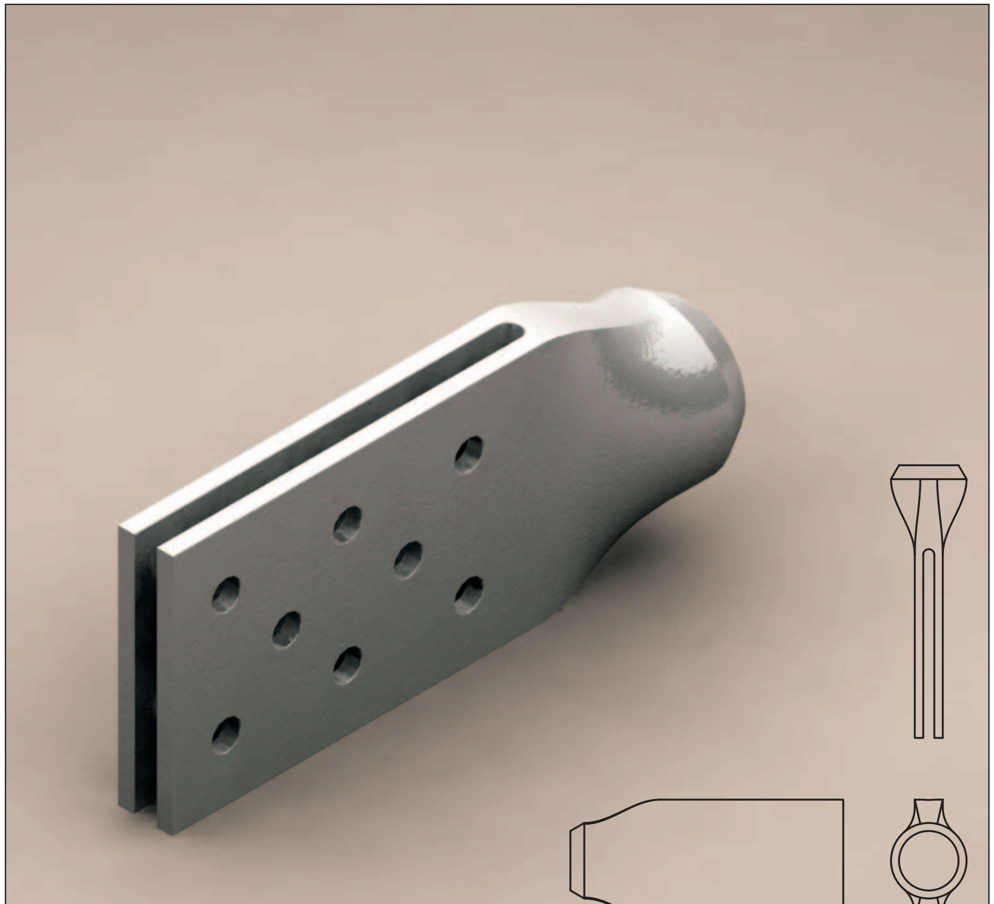


Cast ConneX®

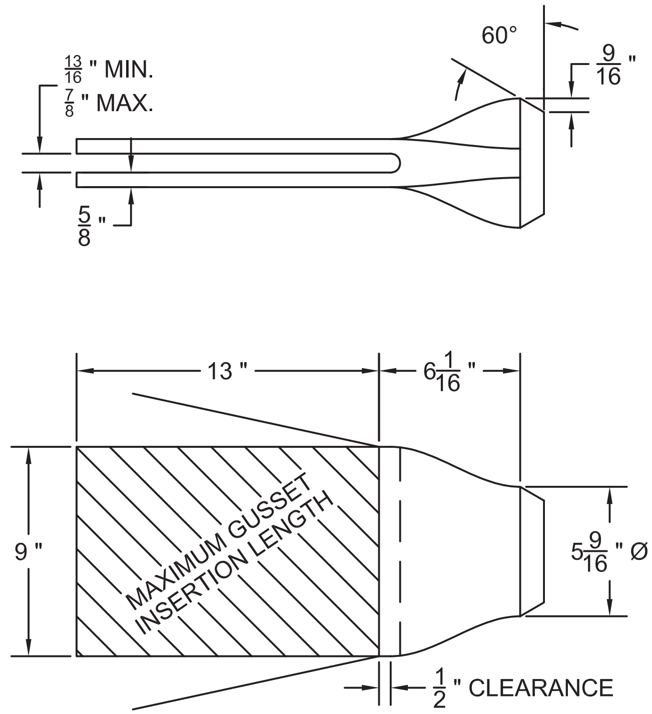
High-Strength Connector™

Product No.

HSC-5.563



Bolt pattern shown is an example only. All HSC are supplied without bolt holes.
This is an artists rendition of this particular HSC. Actual appearance may vary.



$$\frac{D}{t} \leq \frac{0.038 \cdot E}{Fy}$$

ASTM A500
Grade B

Fy = 42 ksi thus D/t ≤ 26.2

Ry·Fy = 59 ksi

Shape	Wall Thickness, t		D/t	Area, A	Ry·Fy·A	BEARING-TYPE CONNECTIONS[1] Detail Number					
						A325			A490		
	Nominal	Design[3]				Bolt Size			Bolt Size		
	in.	in.		in.^{2}	kip	3/4	7/8	1	3/4	7/8	1
HSS 5.563	0.375	0.349	15.9	5.71	336	9-3/4"-325	7-7/8"-325	5-1"-325	7-3/4"-490	5-7/8"-490	5-1"-490
	0.258	0.240	23.2	4.01	236	6-3/4"-325	5-7/8"-325	4-1"-325	5-3/4"-490	4-7/8"-490	4-1"-490

Shape	Wall Thickness, t		D/t	Area, A	Ry·Fy·A	CLASS B SLIP-CRITICAL CONNECTIONS[1, 2] Detail Number					
						A325			A490		
	Nominal	Design[3]				Bolt Size			Bolt Size		
	in.	in.		in.^{2}	kip	3/4	7/8	1	3/4	7/8	1
HSS 5.563	0.375	0.349	15.9	5.71	336	15-3/4"-325-SB	11-7/8"-325-SB	**X**	12-3/4"-490-SB	9-7/8"-490-SB	8-1"-490-SB
	0.258	0.240	23.2	4.01	236	11-3/4"-325-SB	8-7/8"-325-SB	6-1-325-SB	9-3/4"-490-SB	6-7/8"-490-SB	5-1"-490-SB

1. Connections must have pretensioned high-strength bolts. The following are suggested bolt lengths:
   3¼" Long bolt for 3/4" and 7/8" A325 or A490
   3½" Long bolt for 1" A325 or A490
2. Tabulated values for slip-critical connections assume Class B contact surfaces with μ = 0.50, D_u = 1.13, and h_{sc} = 0.85. High-Strength Connectors are supplied with Class B surfaces. Surface treatment of gusset plate is required to achieve Class B slip resistance in connection.
3. Design wall thickness for ASTM A500 HSS sections taken as $0.93 \cdot t_{nominal}$.

X Connector tabs not large enough to accommodate the number of bolts required

HSC-5.563

ANSI/AISC 341-10

$$\frac{D}{t} \le \frac{0.038 \cdot E}{Fy}$$

ASTM A500
Grade C

Fy = 46 ksi

Ry·Fy = 64 ksi

thus D/t ≤ 24.0

Shape	Wall Thickness, t		D/t	Area, A	Ry·Fy·A	BEARING-TYPE CONNECTIONS[1] Detail Number					
						A325			A490		
						Bolt Size			Bolt Size		
	Nominal	Design[3]				3/4	7/8	1	3/4	7/8	1
	in.	in.		in.^{2}	kip						
HSS 5.563	0.375 0.258	0.349 0.240	15.9 23.2	5.71 4.01	368 258	10-3/4"-325 7-3/4"-325	8-7/8"-325 5-7/8"-325	6-1"-325 4-1"-325	8-3/4"-490 6-3/4"-490	6-7/8"-490 4-7/8"-490	5-1"-490 4-1"-490

Shape	Wall Thickness, t		D/t	Area, A	Ry·Fy·A	CLASS B SLIP-CRITICAL CONNECTIONS[1, 2] Detail Number					
						A325			A490		
						Bolt Size			Bolt Size		
	Nominal	Design[3]				3/4	7/8	1	3/4	7/8	1
	in.	in.		in.^{2}	kip						
HSS 5.563	0.375 0.258	0.349 0.240	15.9 23.2	5.71 4.01	368 258	**X** 12-3/4"-325-SB	12-7/8"-325-SB 9-7/8"-325-SB	**X** 7-1"-325-SB	13-3/4"-490-SB 10-3/4"-490-SB	10-7/8"-490-SB 7-7/8"-490-SB	8-1"-490-SB 5-1"-490-SB

1. Connections must have pretensioned high-strength bolts. The following are suggested bolt lengths:
   3¼" Long bolt for 3/4" and 7/8" A325 or A490
   3½" Long bolt for 1" A325 or A490
2. Tabulated values for slip-critical connections assume Class B contact surfaces with $\mu = 0.50$, $D_u = 1.13$, and $h_{sc} = 0.85$. High-Strength Connectors are supplied with Class B surfaces. Surface treatment of gusset plate is required to achieve Class B slip resistance in connection.
3. Design wall thickness for ASTM A500 HSS sections taken as $0.93 \cdot t_{nominal}$.

X Connector tabs not large enough to accommodate the number of bolts required

HSC-5.563

ANSI/AISC 341-10

$$\frac{D}{t} \leq \frac{0.038 \cdot E}{Fy}$$

ASTM A53
Grade B

Fy = 35 ksi

Ry·Fy = 56 ksi

thus D/t ≤ 31.5

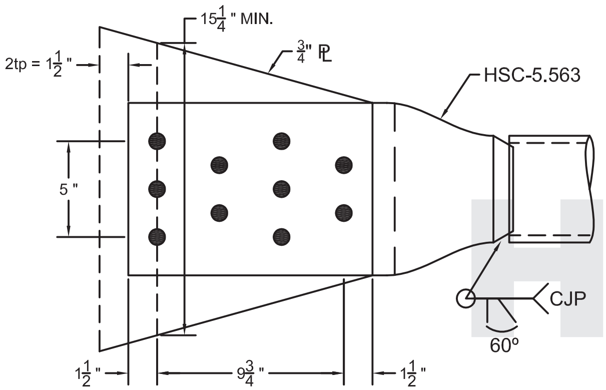
Shape	Wall Thickness, t		D/t	Area, A	Ry·Fy·A	BEARING-TYPE CONNECTIONS[1] Detail Number					
						A325			A490		
						Bolt Size			Bolt Size		
	Nominal	Design[3]									
	in.	in.		in.^{2}	kip	3/4	7/8	1	3/4	7/8	1
Pipe 5											
XS	0.375	0.349	15.9	5.71	320	9-3/4"-325	6-7/8"-325	5-1"-325	7-3/4"-490	5-7/8"-490	5-1"-490
STD	0.258	0.240	23.2	4.01	225	6-3/4"-325	5-7/8"-325	4-1"-325	5-3/4"-490	4-7/8"-490	3-1"-490

Shape	Wall Thickness, t		D/t	Area, A	Ry·Fy·A	CLASS B SLIP-CRITICAL CONNECTIONS[1, 2] Detail Number					
						A325			A490		
						Bolt Size			Bolt Size		
	Nominal	Design[3]									
	in.	in.		in.^{2}	kip	3/4	7/8	1	3/4	7/8	1
Pipe 5											
XS	0.375	0.349	15.9	5.71	320	14-3/4"-325-SB	11-7/8"-325-SB	8-1"-325-SB	12-3/4"-490-SB	8-7/8"-490-SB	8-1"-490-SB
STD	0.258	0.240	23.2	4.01	225	10-3/4"-325-SB	8-7/8"-325-SB	6-1-325-SB	8-3/4"-490-SB	6-7/8"-490-SB	5-1"-490-SB

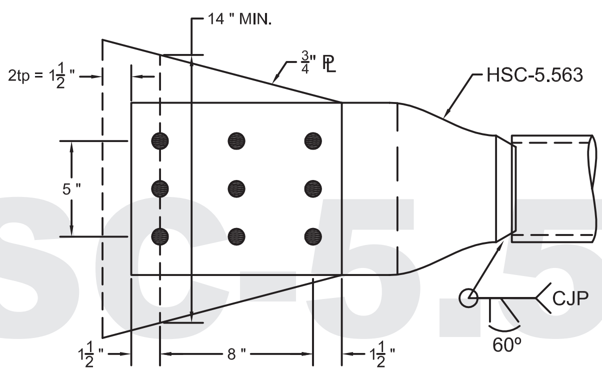
1. Connections must have pretensioned high-strength bolts. The following are suggested bolt lengths:
   3¼" Long bolt for 3/4" and 7/8" A325 or A490
   3½" Long bolt for 1" A325 or A490
2. Tabulated values for slip-critical connections assume Class B contact surfaces with μ = 0.50, D_u = 1.13, and h_{sc} = 0.85. High-Strength Connectors are supplied with Class B surfaces.
   Surface treatment of gusset plate is required to achieve Class B slip resistance in connection.
3. Design wall thickness for ASTM A53 Pipe sections taken as $0.93 \cdot t_{nominal}$.

X Connector tabs not large enough to accommodate the number of bolts required

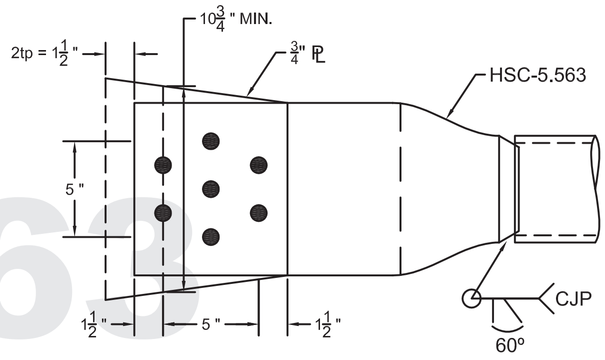
10-3/4"-325
LRFD 371 kip
ASD 247 kip



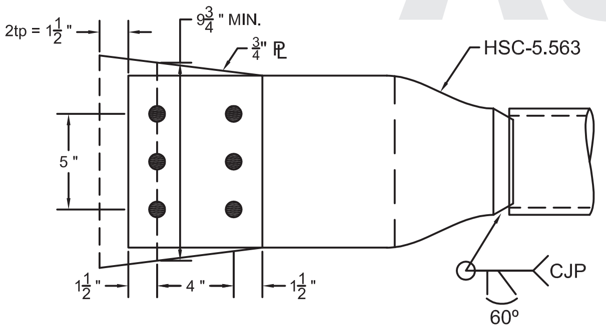
9-3/4"-325
LRFD 340 kip
ASD 226 kip



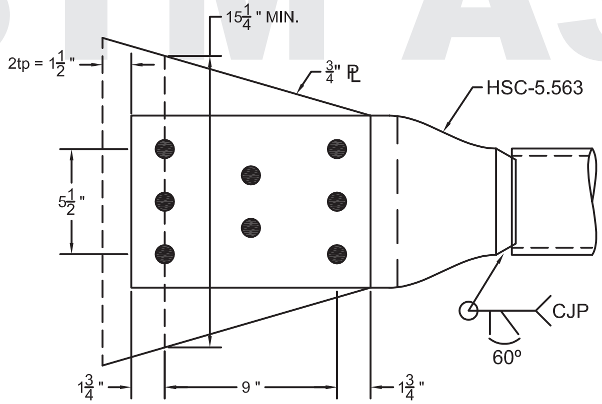
7-3/4"-325
LRFD 261 kip
ASD 173.8 kip



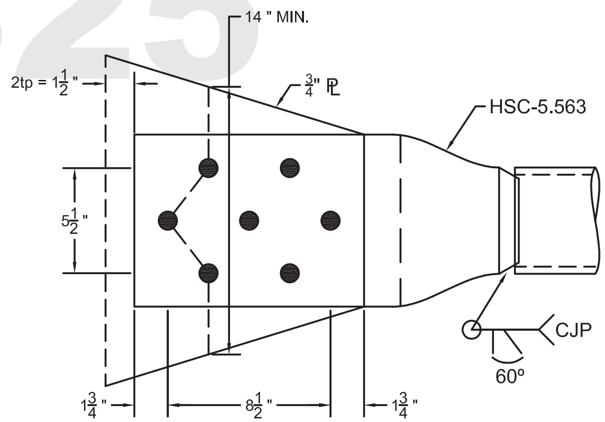
6-3/4"-325
LRFD 237 kip
ASD 157.6 kip



8-7/8"-325
LRFD 371 kip
ASD 247 kip

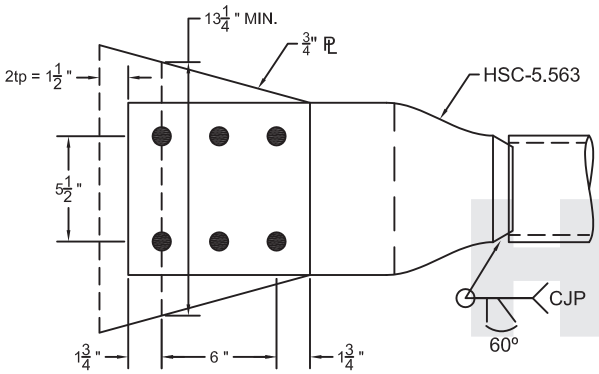


7-7/8"-325
LRFD 340 kip
ASD 226 kip



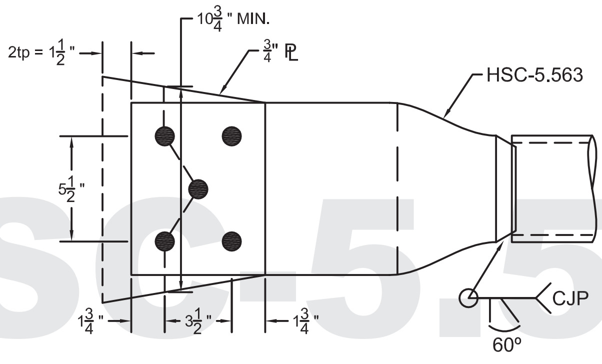
6-7/8"-325

LRFD 322 kip
ASD 214 kip



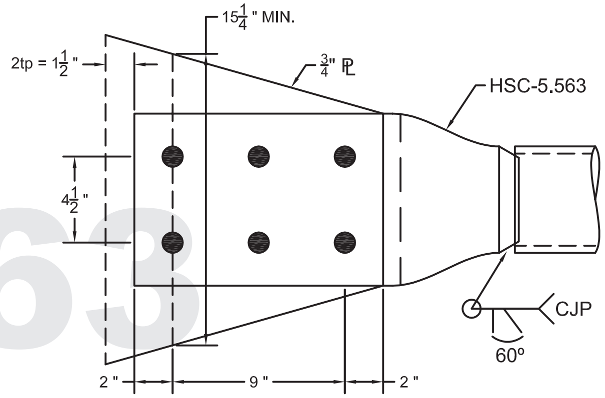
5-7/8"-325

LRFD 261 kip
ASD 173.8 kip



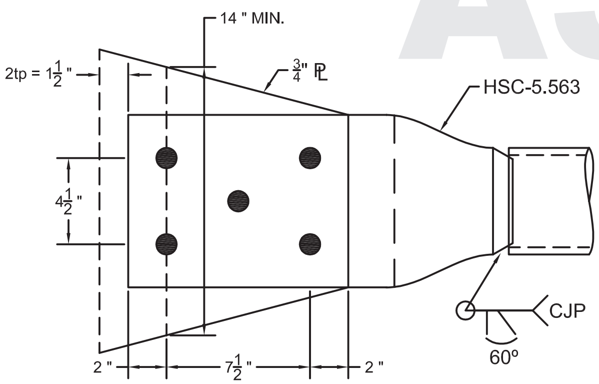
6-1"-325

LRFD 371 kip
ASD 247 kip



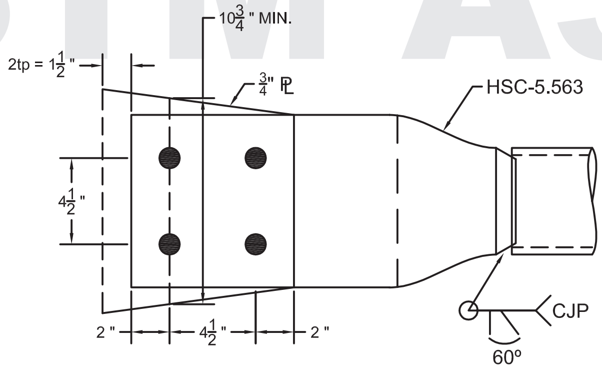
5-1"-325

LRFD 340 kip
ASD 226 kip



4-1"-325

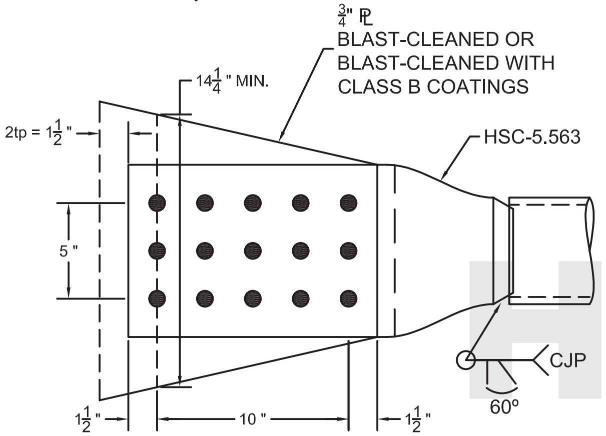
LRFD 261 kip
ASD 173.8 kip



15-3/4"-325-SB

LRFD 343 kip

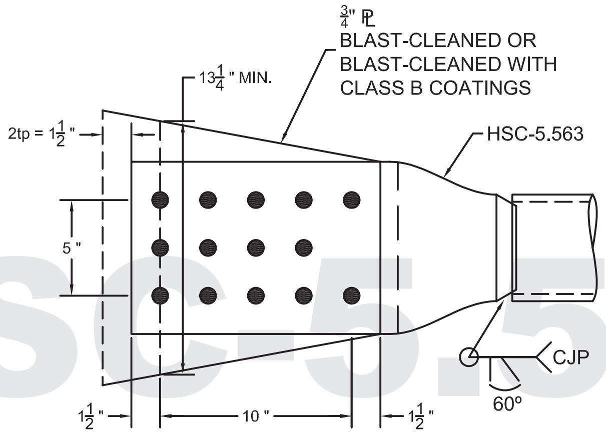
ASD 229 kip



14-3/4"-325-SB

LRFD 320 kip

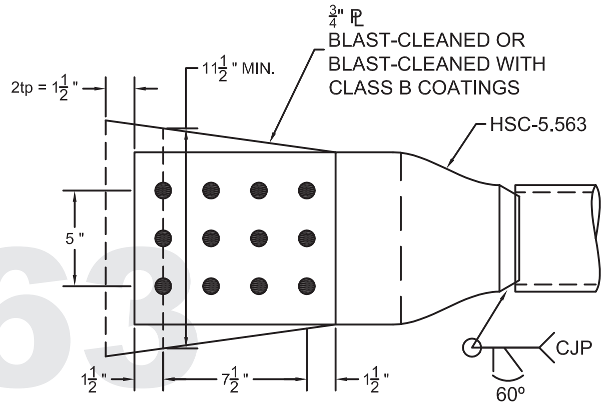
ASD 214 kip



12-3/4"-325-SB

LRFD 274 kip

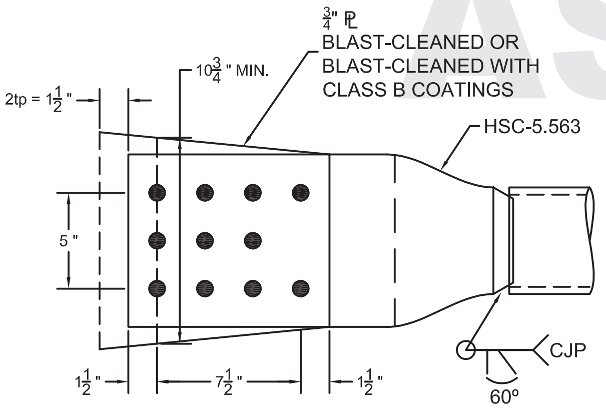
ASD 183.4 kip



11-3/4"-325-SB

LRFD 251 kip

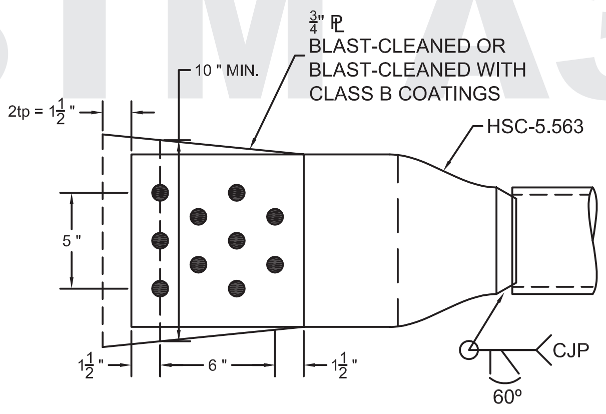
ASD 168.1 kip



10-3/4"-325-SB

LRFD 229 kip

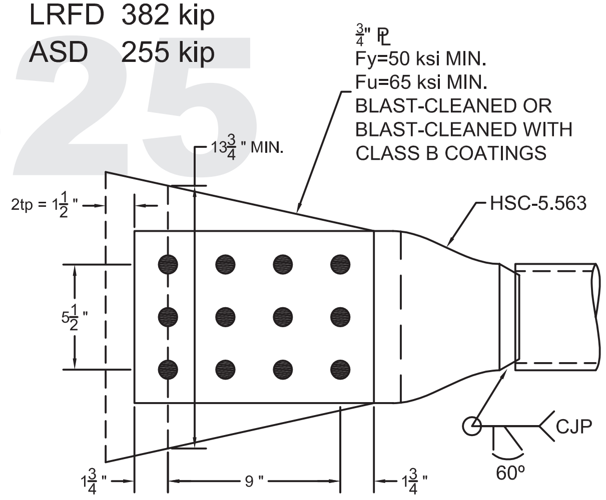
ASD 152.8 kip



12-7/8"-325-SB

LRFD 382 kip

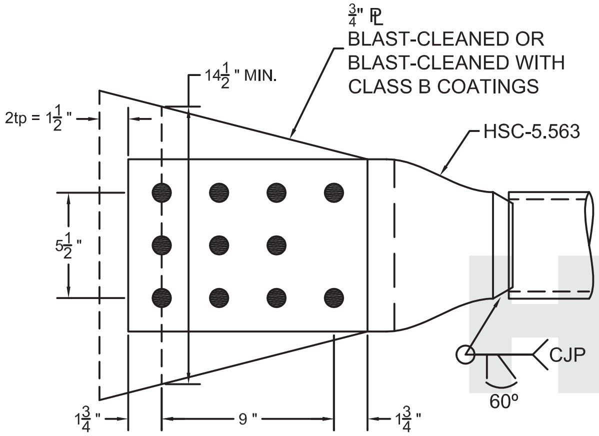
ASD 255 kip



11-7/8"-325-SB

LRFD 350 kip

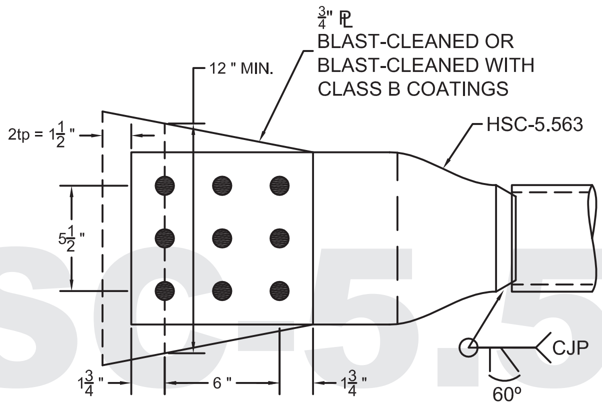
ASD 234 kip



9-7/8"-325-SB

LRFD 287 kip

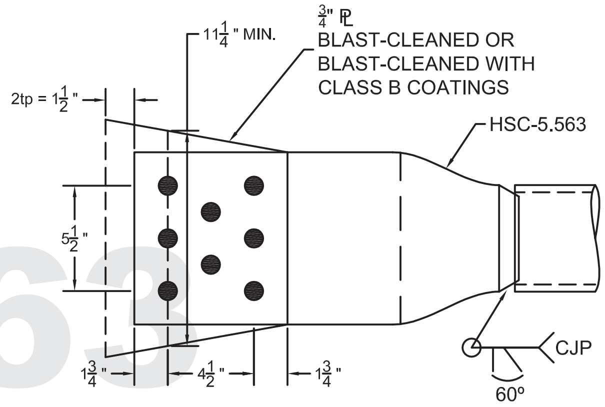
ASD 191.6 kip



8-7/8"-325-SB

LRFD 255 kip

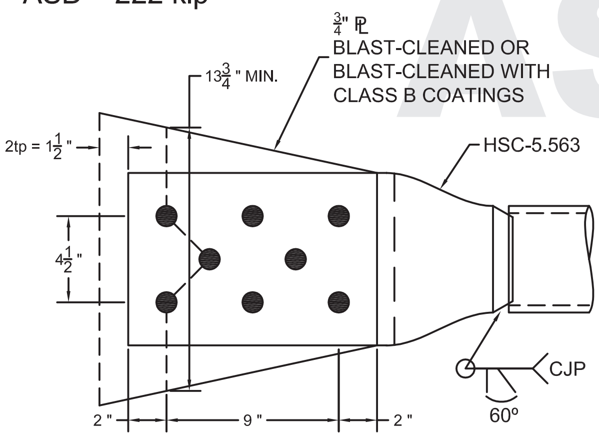
ASD 170.3 kip



8-1"-325-SB

LRFD 333 kip

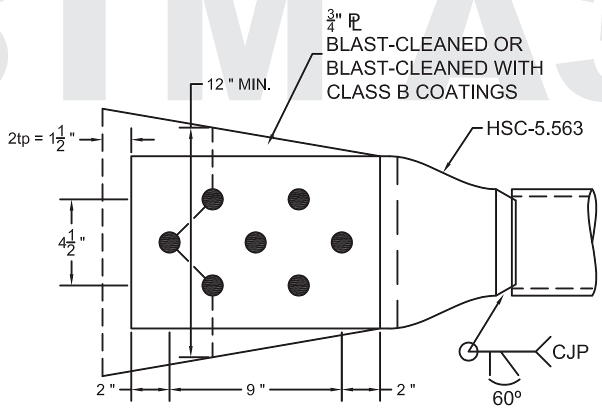
ASD 222 kip



7-1"-325-SB

LRFD 291 kip

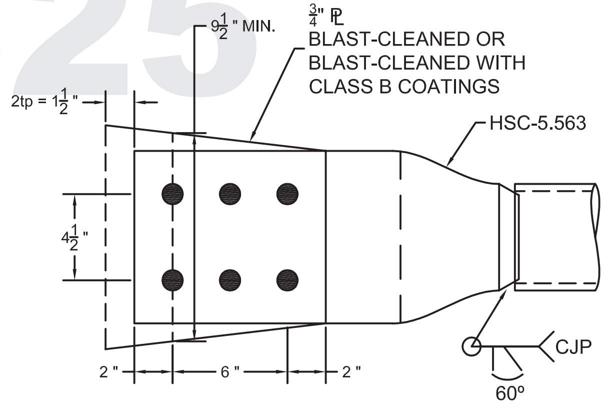
ASD 194.0 kip



6-1"-325-SB

LRFD 250 kip

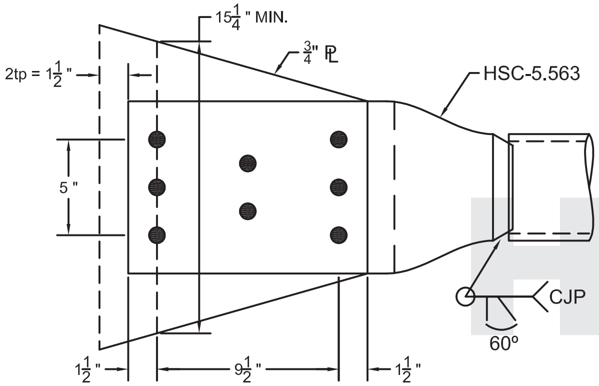
ASD 167.0 kip



8-3/4"-490

LRFD 371 kip

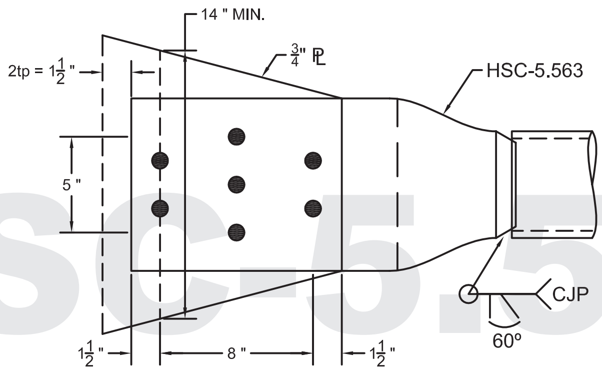
ASD 247 kip



7-3/4"-490

LRFD 340 kip

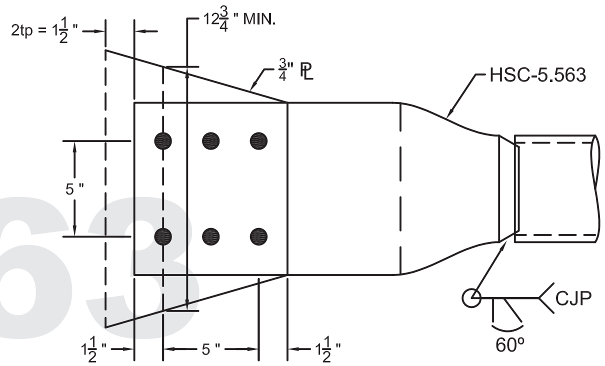
ASD 226 kip



6-3/4"-490

LRFD 261 kip

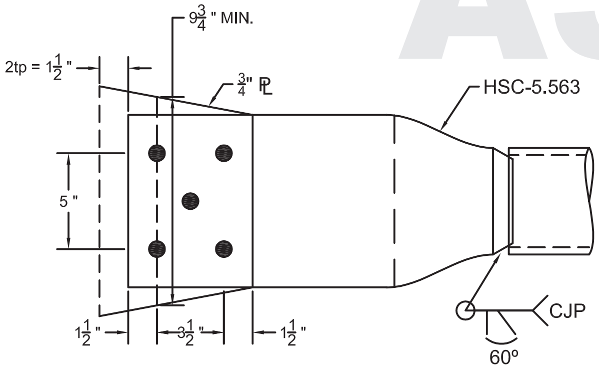
ASD 173.8 kip



5-3/4"-490

LRFD 237 kip

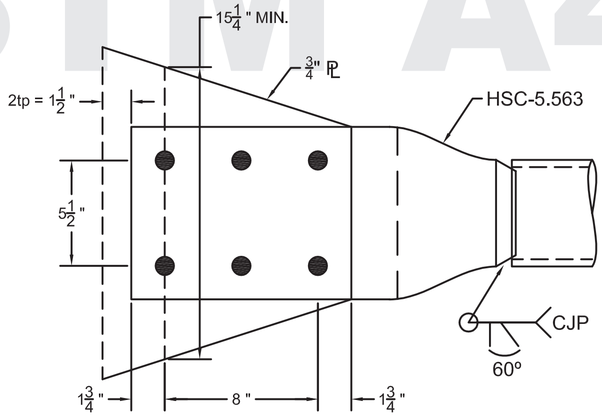
ASD 157.6 kip



6-7/8"-490

LRFD 371 kip

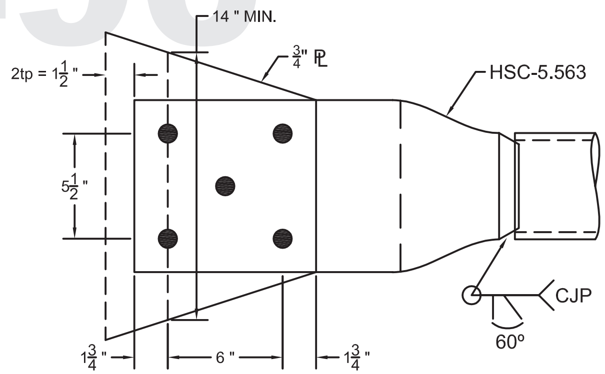
ASD 247 kip



5-7/8"-490

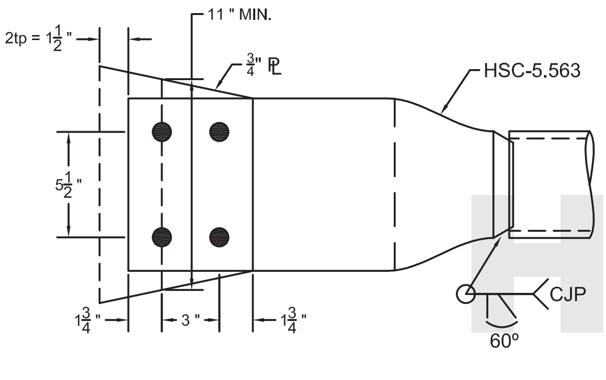
LRFD 337 kip

ASD 225 kip



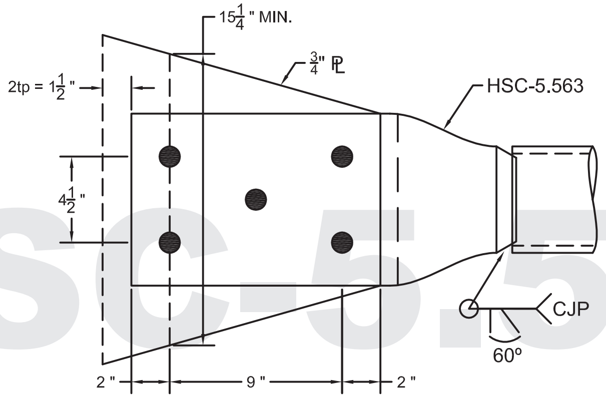
4-7/8"-490

LRFD 262 kip
ASD 175 kip



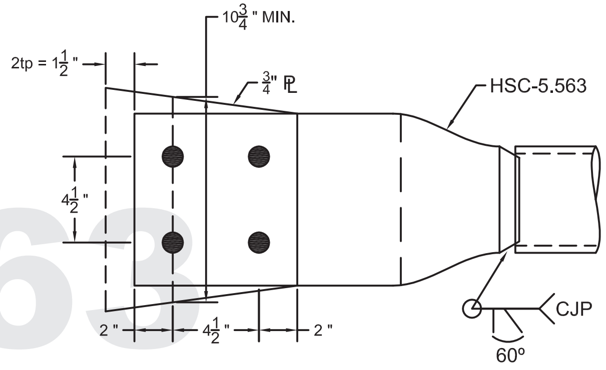
5-1"-490

LRFD 371 kip
ASD 247 kip



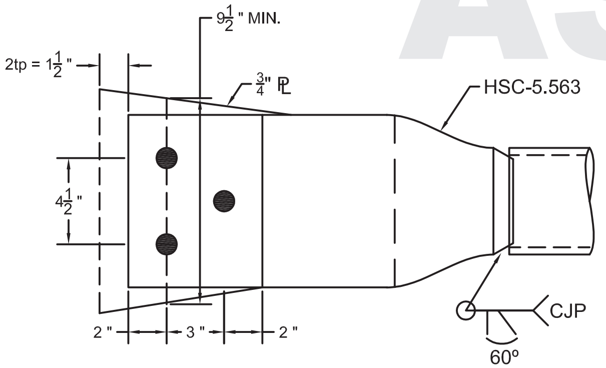
4-1"-490

LRFD 261 kip
ASD 173.8 kip



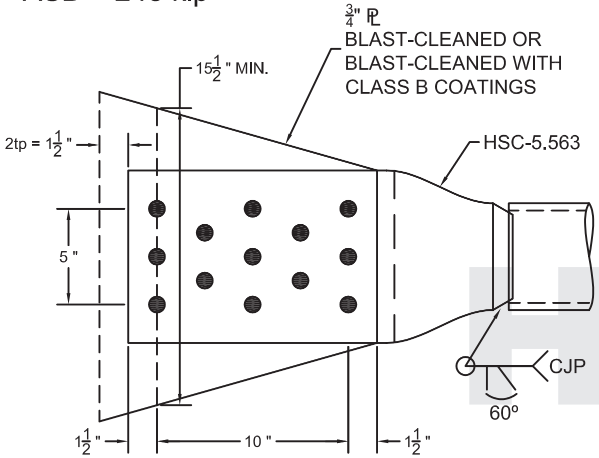
3-1"-490

LRFD 231 kip
ASD 153.6 kip



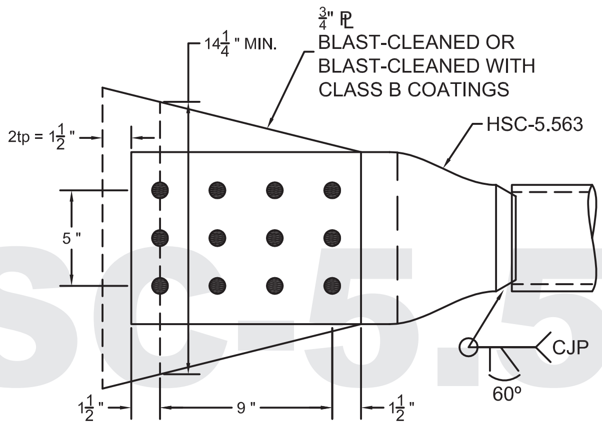
13-3/4"-490-SB

LRFD 371 kip
ASD 248 kip



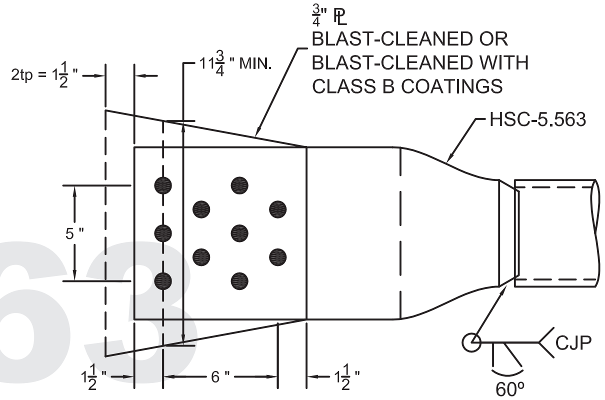
12-3/4"-490-SB

LRFD 343 kip
ASD 229 kip



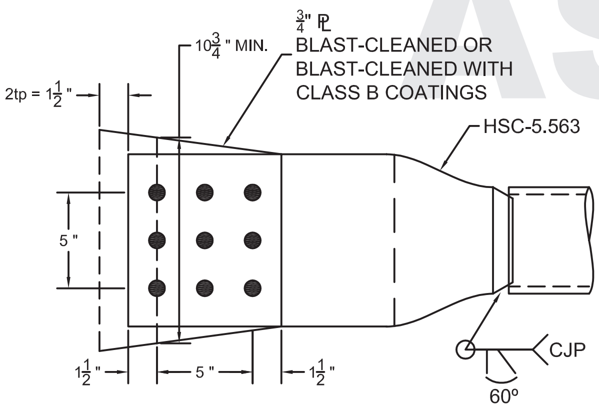
10-3/4"-490-SB

LRFD 284 kip
ASD 189.5 kip



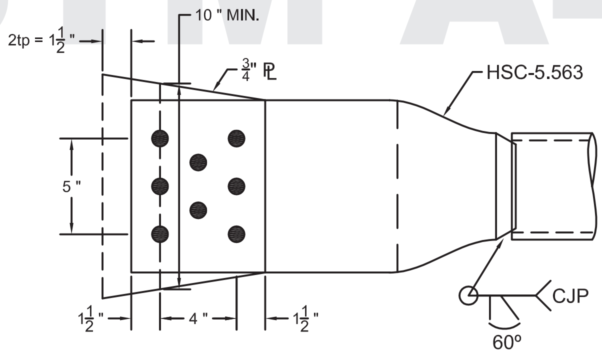
9-3/4"-490-SB

LRFD 257 kip
ASD 171.9 kip



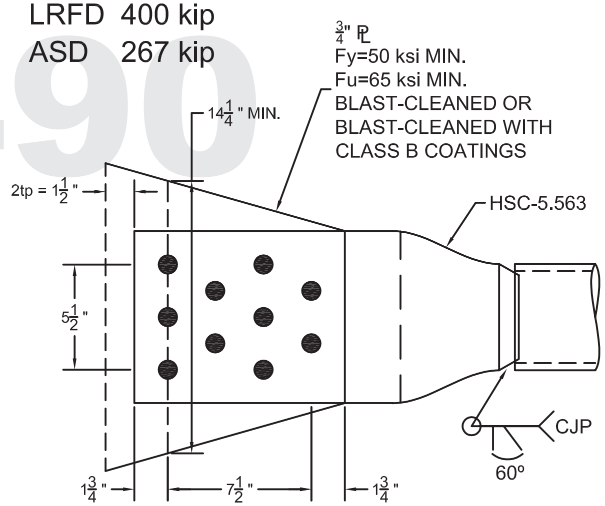
8-3/4"-490-SB

LRFD 229 kip
ASD 152.8 kip



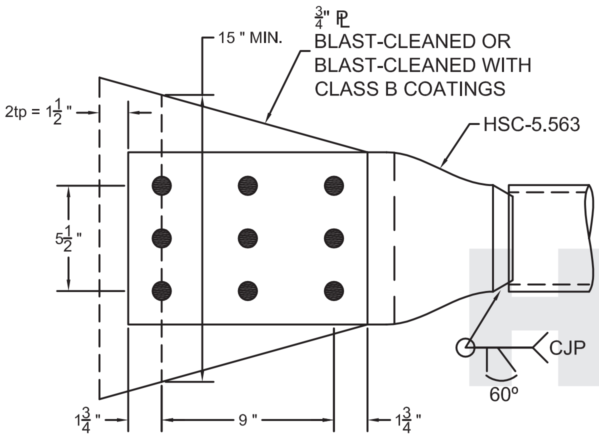
10-7/8"-490-SB

LRFD 400 kip
ASD 267 kip



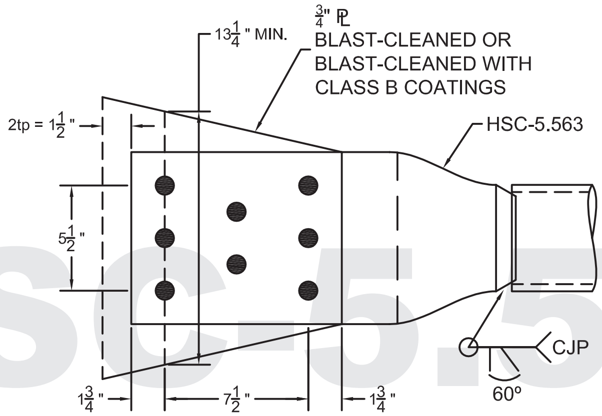
9-7/8"-490-SB

LRFD 360 kip
ASD 241 kip



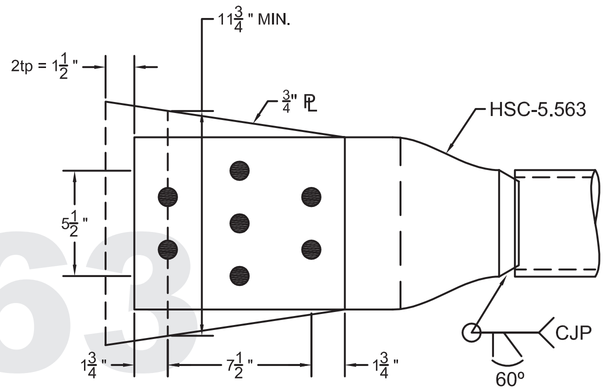
8-7/8"-490-SB

LRFD 320 kip
ASD 214 kip



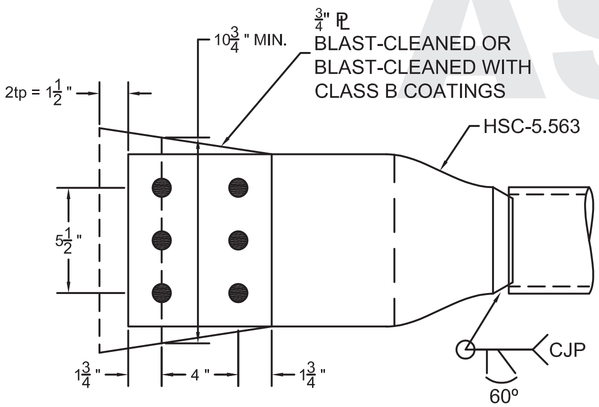
7-7/8"-490-SB

LRFD 280 kip
ASD 187.2 kip



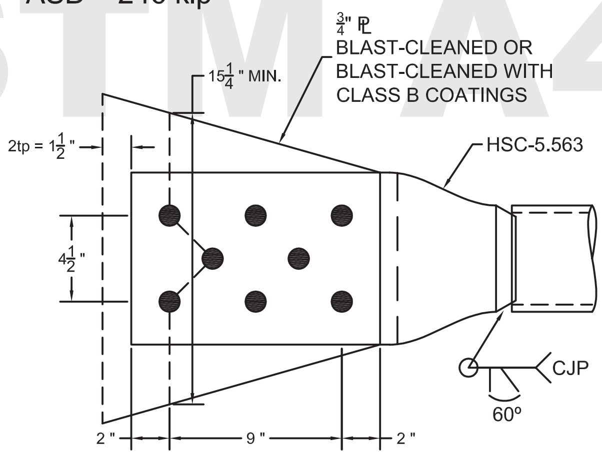
6-7/8"-490-SB

LRFD 240 kip
ASD 160.4 kip



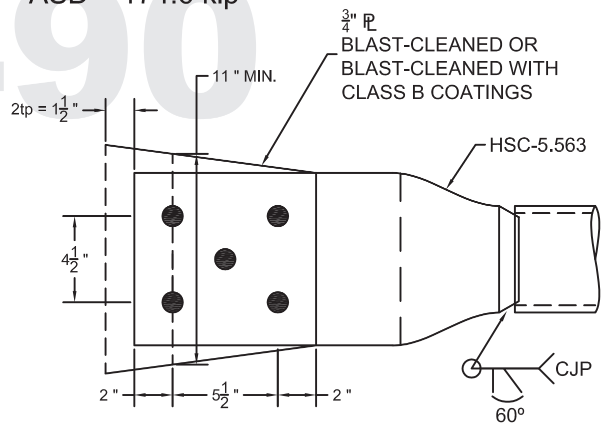
8-1"-490-SB

LRFD 369 kip
ASD 246 kip



5-1"-490-SB

LRFD 261 kip
ASD 174.6 kip

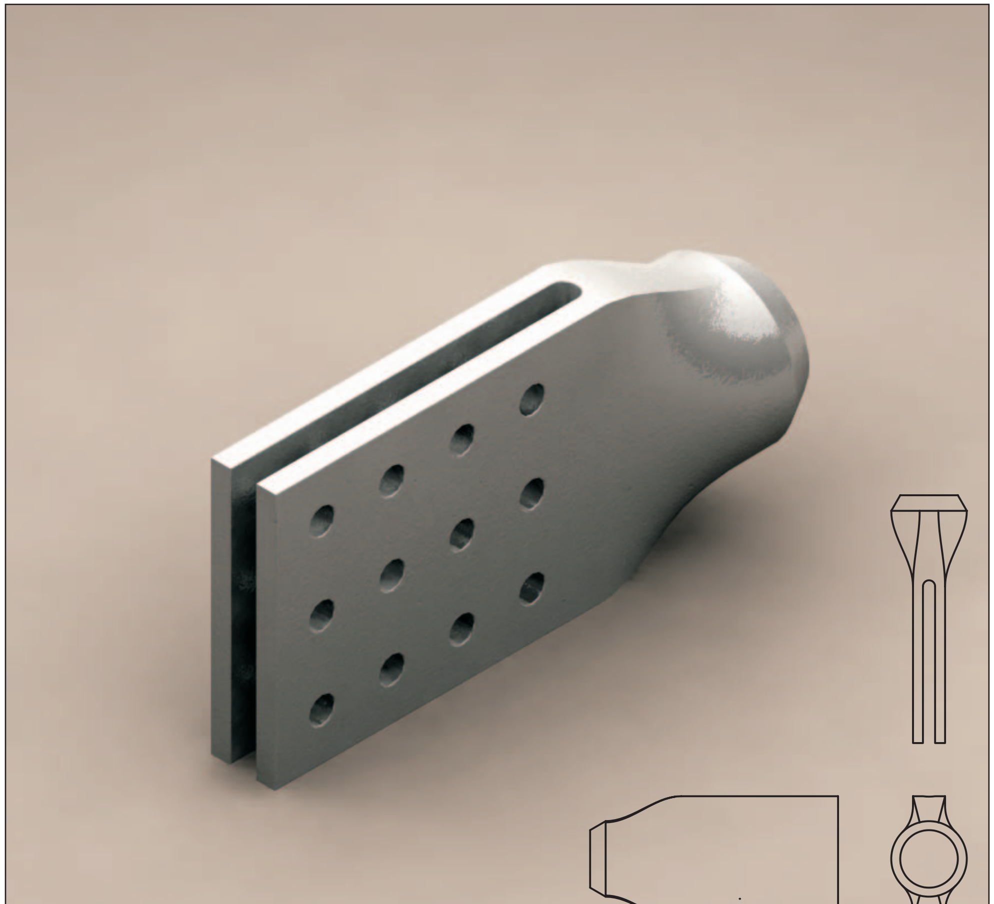


Cast ConneX®

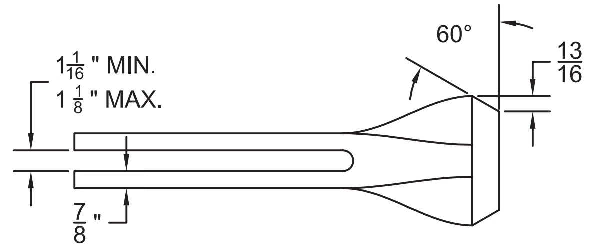
High-Strength Connector™

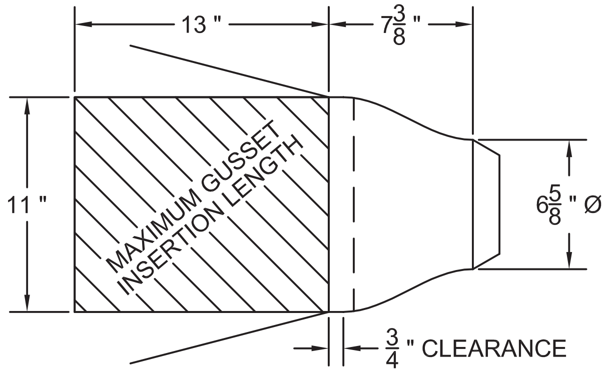
Product No.

HSC-6.625



Bolt pattern shown is an example only. All HSC are supplied without bolt holes.
This is an artists rendition of this particular HSC. Actual appearance may vary.





HSC-6.625

ANSI/AISC 341-10

$$\frac{D}{t} \leq \frac{0.038 \cdot E}{Fy}$$

ASTM A500
Grade B

Fy = 42 ksi

Ry·Fy = 59 ksi

thus D/t ≤ 26.2

Shape	Wall Thickness, t Nominal	Wall Thickness, t Design[3]	D/t	Area, A	Ry·Fy·A	BEARING-TYPE CONNECTIONS[1] Detail Number A325 Bolt Size			A490 Bolt Size		
	in.	in.		in.²	kip	3/4	7/8	1	3/4	7/8	1
HSS 6.625	0.500	0.465	14.2	9.00	529	14-3/4"-325	10-7/8"-325	8-1"-325	11-3/4"-490	8-7/8"-490	6-1"-490
	0.432	0.402	16.5	7.85	462	12-3/4"-325	9-7/8"-325	7-1"-325	10-3/4"-490	7-7/8"-490	6-1"-490
	0.375	0.349	19.0	6.88	404	11-3/4"-325	8-7/8"-325	6-1"-325	9-3/4"-490	6-7/8"-490	5-1"-490
	0.312	0.290	22.8	5.77	340	8-3/4"-325	7-7/8"-325	5-1"-325	7-3/4"-490	6-7/8"-490	4-1"-490
	0.280	0.260	25.4	5.21	306	8-3/4"-325	6-7/8"-325	5-1"-325	7-3/4"-490	5-7/8"-490	4-1"-490

Shape	Wall Thickness, t Nominal	Wall Thickness, t Design[3]	D/t	Area, A	Ry·Fy·A	CLASS B SLIP-CRITICAL CONNECTIONS[1, 2] Detail Number A325 Bolt Size			A490 Bolt Size		
	in.	in.		in.²	kip	3/4	7/8	1	3/4	7/8	1
HSS 6.625	0.500	0.465	14.2	9.00	529	**X**	**X**	**X**	20-3/4"-490-SB	15-7/8"-490-SB	11-1"-490-SB
	0.432	0.402	16.5	7.85	462	**X**	15-7/8"-325-SB	12-1"-325-SB	17-3/4"-490-SB	12-7/8"-490-SB	9-1"-490-SB
	0.375	0.349	19.0	6.88	404	18-3/4"-325-SB	13-7/8"-325-SB	10-1"-325-SB	15-3/4"-490-SB	11-7/8"-490-SB	8-1"-490-SB
	0.312	0.290	22.8	5.77	340	15-3/4"-325-SB	11-7/8"-325-SB	9-1"-325-SB	12-3/4"-490-SB	9-7/8"-490-SB	7-1"-490-SB
	0.280	0.260	25.4	5.21	306	14-3/4"-325-SB	10-7/8"-325-SB	8-1"-325-SB	11-3/4"-490-SB	8-7/8"-490-SB	6-1"-490-SB

1. Connections must have pretensioned high-strength bolts. The following are suggested bolt lengths:

4" Long bolt for 3/4" and 7/8" A325 or A490

4¼" Long bolt for 1" A325 or A490

2. Tabulated values for slip-critical connections assume Class B contact surfaces with $\mu = 0.50$, $D_u = 1.13$, and $h_{sc} = 0.85$. High-Strength Connectors are supplied with Class B surfaces. Surface treatment of gusset plate is required to achieve Class B slip resistance in connection.
3. Design wall thickness for ASTM A500 HSS sections taken as $0.93 \cdot t_{nominal}$.

X Connector tabs not large enough to accommodate the number of bolts required

HSC-6.625

ANSI/AISC 341-10

$$\frac{D}{t} \leq \frac{0.038 \cdot E}{Fy}$$

ASTM A500
Grade C

Fy = 46 ksi thus D/t ≤ 24.0

Ry·Fy = 64 ksi

Shape	Wall Thickness, t		D/t	Area, A	Ry·Fy·A	BEARING-TYPE CONNECTIONS[1] Detail Number					
						A325			A490		
	Nominal	Design[3]				Bolt Size			Bolt Size		
	in.	in.		in.²	kip	3/4	7/8	1	3/4	7/8	1
HSS 6.625	0.500	0.465	14.2	9.00	580	15-3/4"-325	11-7/8"-325	9-1"-325	12-3/4"-490	9-7/8"-490	7-1"-490
	0.432	0.402	16.5	7.85	506	13-3/4"-325	10-7/8"-325	8-1"-325	11-3/4"-490	8-7/8"-490	6-1"-490
	0.375	0.349	19.0	6.88	443	12-3/4"-325	9-7/8"-325	7-1"-325	9-3/4"-490	7-7/8"-490	6-1"-490
	0.312	0.290	22.8	5.77	372	10-3/4"-325	7-7/8"-325	6-1"-325	8-3/4"-490	6-7/8"-490	5-1"-490

Shape	Wall Thickness, t		D/t	Area, A	Ry·Fy·A	CLASS B SLIP-CRITICAL CONNECTIONS[1, 2] Detail Number					
						A325			A490		
	Nominal	Design[3]				Bolt Size			Bolt Size		
	in.	in.		in.²	kip	3/4	7/8	1	3/4	7/8	1
HSS 6.625	0.500	0.465	14.2	9.00	580	**X**	**X**	**X**	**X**	15-7/8"-490-SB	**X**
	0.432	0.402	16.5	7.85	506	**X**	**X**	**X**	18-3/4"-490-SB	13-7/8"-490-SB	10-1"-490-SB
	0.375	0.349	19.0	6.88	443	20-3/4"-325-SB	15-7/8"-325-SB	11-1"-325-SB	16-3/4"-490-SB	12-7/8"-490-SB	9-1"-490-SB
	0.312	0.290	22.8	5.77	372	17-3/4"-325-SB	12-7/8"-325-SB	9-1"-325-SB	14-3/4"-490-SB	10-7/8"-490-SB	8-1"-490-SB

1. Connections must have pretensioned high-strength bolts. The following are suggested bolt lengths:
   4" Long bolt for 3/4" and 7/8" A325 or A490
   4¼" Long bolt for 1" A325 or A490
2. Tabulated values for slip-critical connections assume Class B contact surfaces with $\mu = 0.50$, $D_u = 1.13$, and $h_{sc} = 0.85$. High-Strength Connectors are supplied with Class B surfaces.
   Surface treatment of gusset plate is required to achieve Class B slip resistance in connection.
3. Design wall thickness for ASTM A500 HSS sections taken as $0.93 \cdot t_{nominal}$.

X Connector tabs not large enough to accommodate the number of bolts required

HSC-6.625

ANSI/AISC 341-10

$$\frac{D}{t} \le \frac{0.038 \cdot E}{Fy}$$

ASTM A53
Grade B

Fy = 35 ksi

Ry·Fy = 56 ksi

thus D/t ≤ 31.5

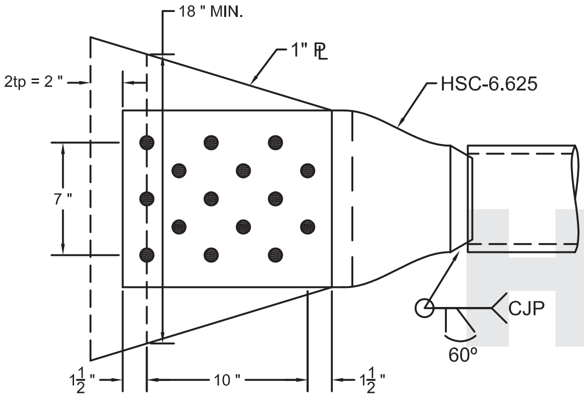
Shape	Wall Thickness, t		D/t	Area, A	Ry·Fy·A	BEARING-TYPE CONNECTIONS[1] Detail Number					
						A325			A490		
	Nominal	Design[3]				Bolt Size			Bolt Size		
	in.	in.		in.^{2}	kip	3/4	7/8	1	3/4	7/8	1
Pipe 6											
XS	0.432	0.402	16.5	7.85	440	12-3/4"-325	9-7/8"-325	7-1"-325	9-3/4"-490	7-7/8"-490	5-1"-490
STD	0.280	0.260	25.4	5.21	292	8-3/4"-325	6-7/8"-325	5-1"-325	6-3/4"-490	5-7/8"-490	4-1"-490

Shape	Wall Thickness, t		D/t	Area, A	Ry·Fy·A	CLASS B SLIP-CRITICAL CONNECTIONS[1, 2] Detail Number					
						A325			A490		
	Nominal	Design[3]				Bolt Size			Bolt Size		
	in.	in.		in.^{2}	kip	3/4	7/8	1	3/4	7/8	1
Pipe 6											
XS	0.432	0.402	16.5	7.85	440	20-3/4"-325-SB	15-7/8"-325-SB	11-1"-325-SB	16-3/4"-490-SB	11-7/8"-490-SB	9-1"-490-SB
STD	0.280	0.260	25.4	5.21	292	13-3/4"-325-SB	10-7/8"-325-SB	8-1"-325-SB	11-3/4"-490-SB	8-7/8"-490-SB	6-1"-490-SB

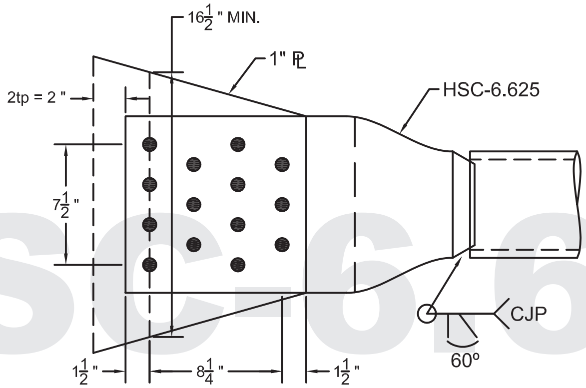
1. Connections must have pretensioned high-strength bolts. The following are suggested bolt lengths:
   4" Long bolt for 3/4" and 7/8" A325 or A490
   4¼" Long bolt for 1" A325 or A490
2. Tabulated values for slip-critical connections assume Class B contact surfaces with μ = 0.50, D_u = 1.13, and h_{sc} = 0.85. High-Strength Connectors are supplied with Class B surfaces.
   Surface treatment of gusset plate is required to achieve Class B slip resistance in connection.
3. Design wall thickness for ASTM A53 Pipe sections taken as $0.93 \cdot t_{nominal}$.

X Connector tabs not large enough to accommodate the number of bolts required

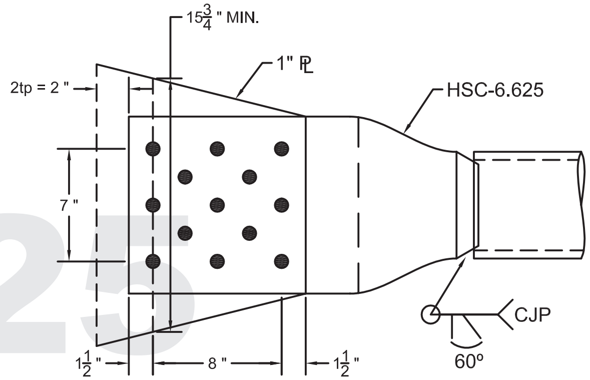
15-3/4"-325
LRFD 583 kip
ASD 388 kip



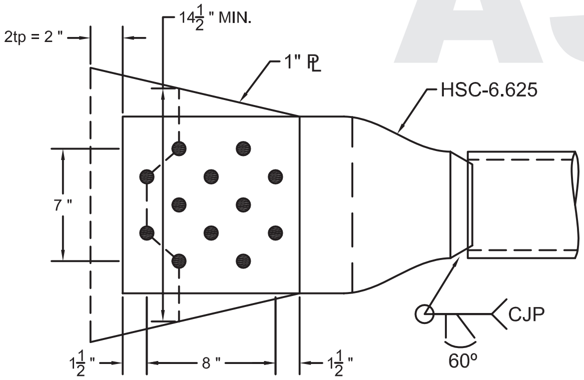
14-3/4"-325
LRFD 535 kip
ASD 356 kip



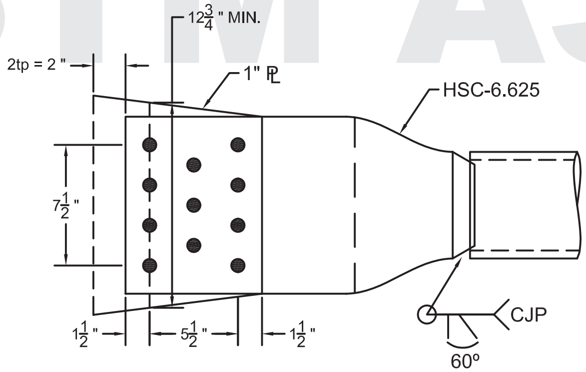
13-3/4"-325
LRFD 510 kip
ASD 340 kip



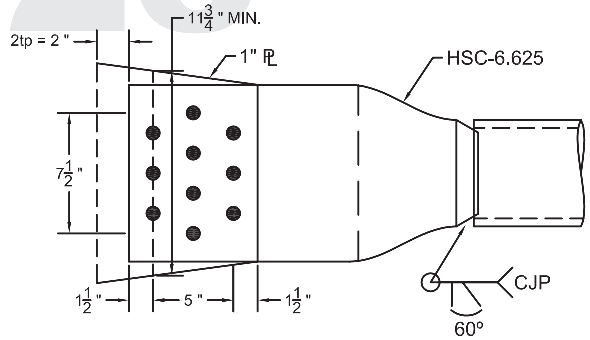
12-3/4"-325
LRFD 470 kip
ASD 313 kip



11-3/4"-325
LRFD 413 kip
ASD 275 kip

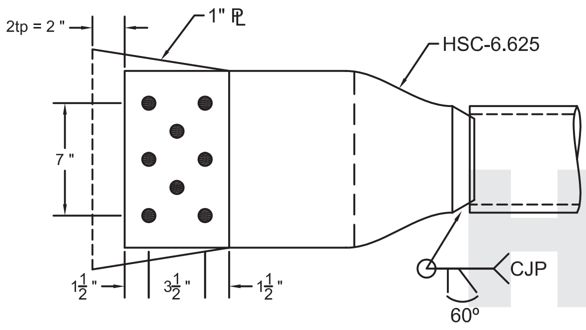


10-3/4"-325
LRFD 381 kip
ASD 253 kip



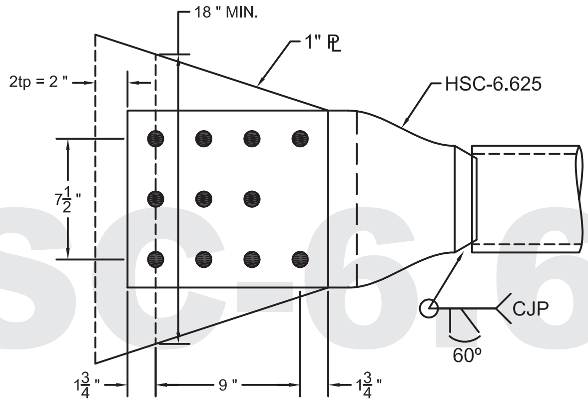
8-3/4"-325

LRFD 356 kip
ASD 237 kip



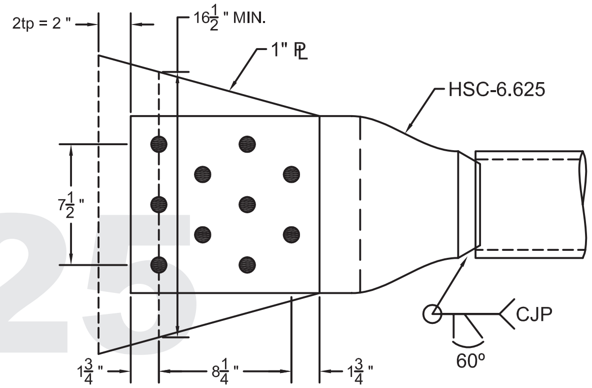
11-7/8"-325

LRFD 583 kip
ASD 388 kip



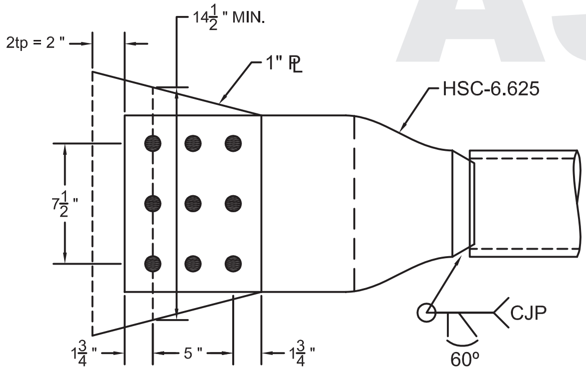
10-7/8"-325

LRFD 535 kip
ASD 356 kip



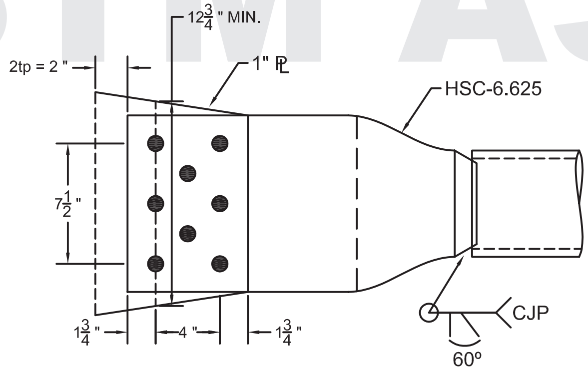
9-7/8"-325

LRFD 463 kip
ASD 309 kip



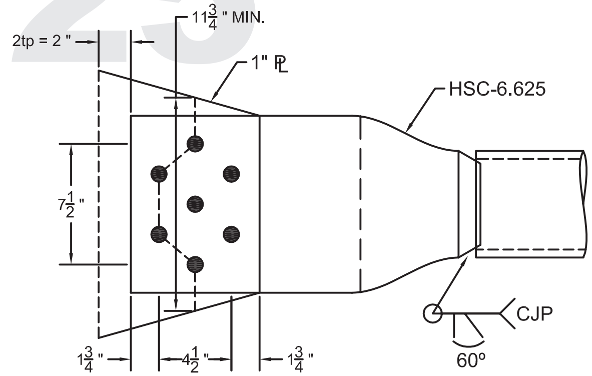
8-7/8"-325

LRFD 413 kip
ASD 275 kip



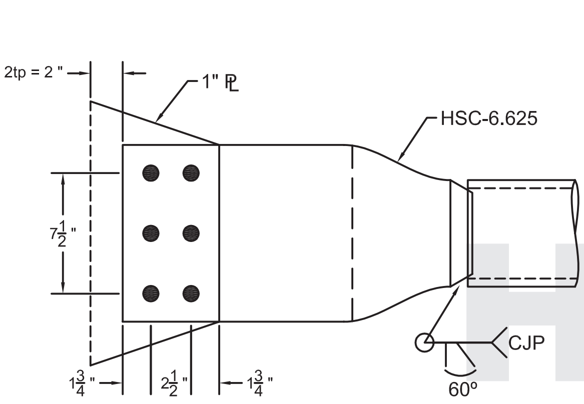
7-7/8"-325

LRFD 381 kip
ASD 253 kip



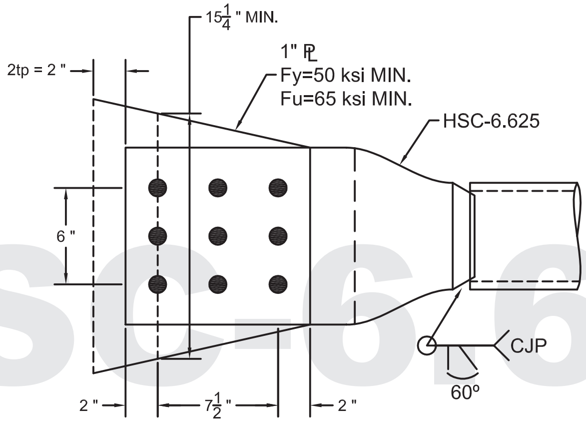
6-7/8"-325

LRFD 356 kip
ASD 237 kip



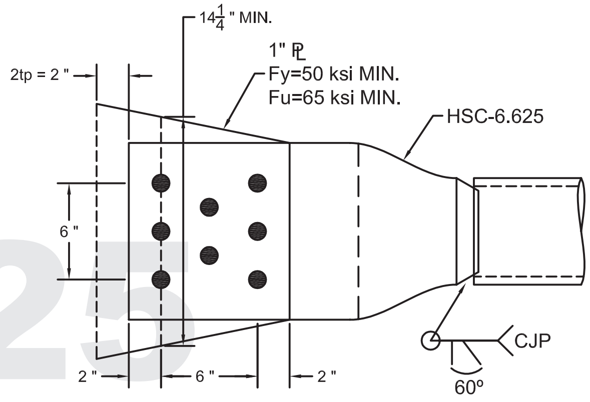
9-1"-325

LRFD 588 kip
ASD 392 kip



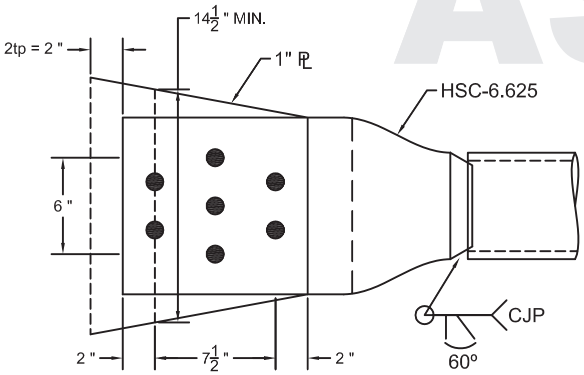
8-1"-325

LRFD 539 kip
ASD 360 kip



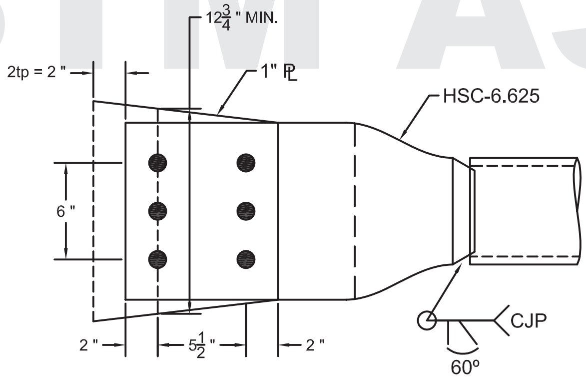
7-1"-325

LRFD 470 kip
ASD 313 kip



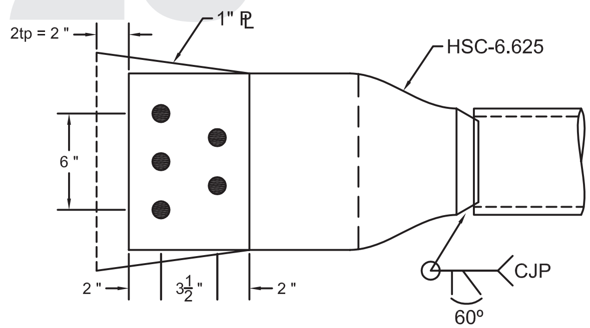
6-1"-325

LRFD 412 kip
ASD 274 kip



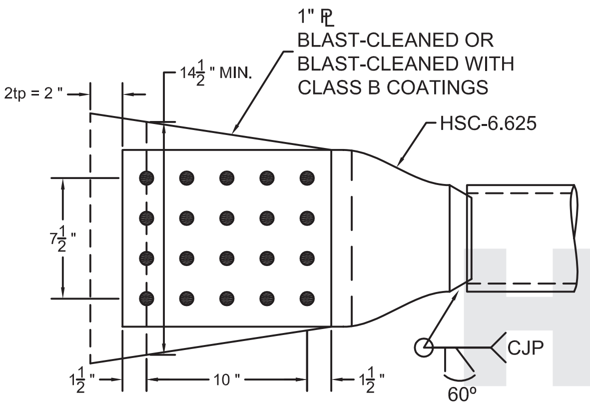
5-1"-325

LRFD 340 kip
ASD 227 kip



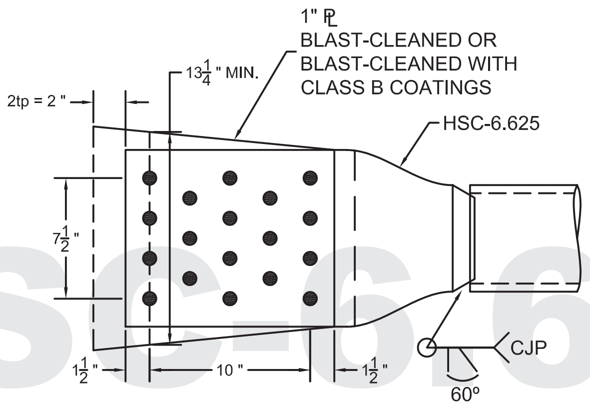
20-3/4"-325-SB

LRFD 457 kip
ASD 306 kip



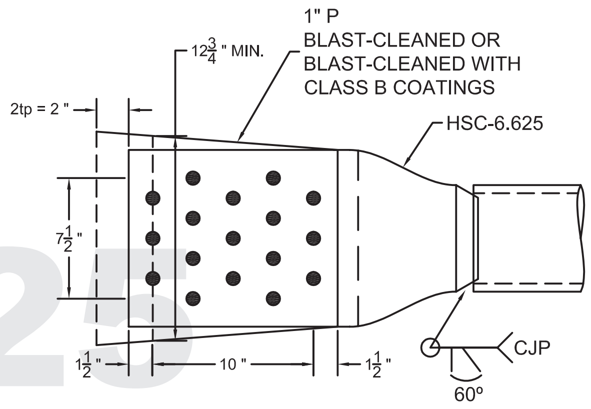
18-3/4"-325-SB

LRFD 411 kip
ASD 275 kip



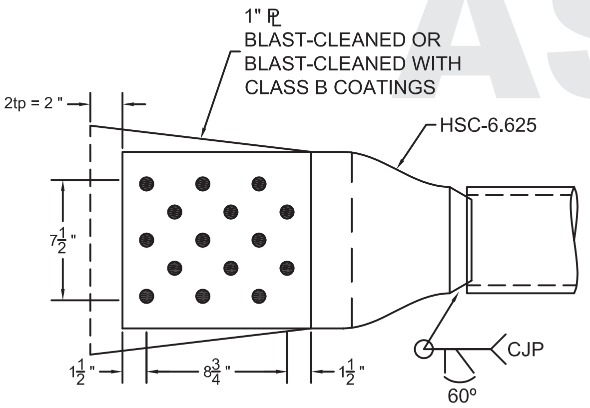
17-3/4"-325-SB

LRFD 389 kip
ASD 260 kip



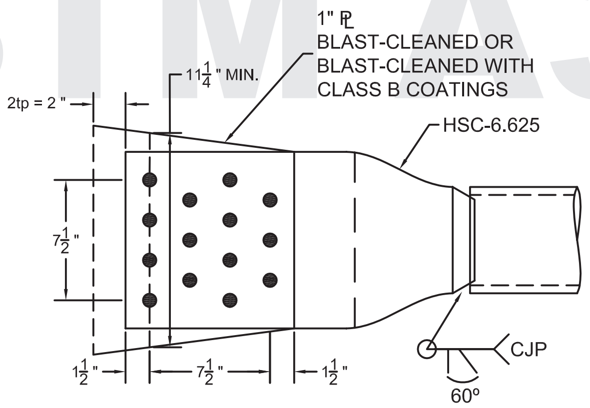
15-3/4"-325-SB

LRFD 343 kip
ASD 229 kip



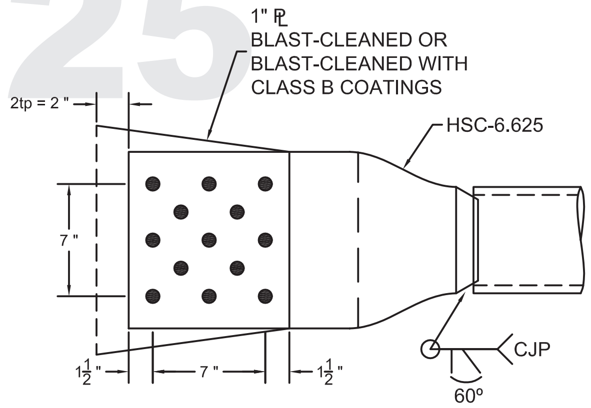
14-3/4"-325-SB

LRFD 320 kip
ASD 214 kip



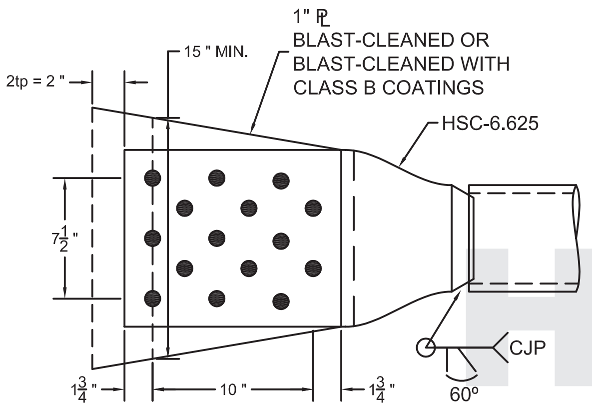
13-3/4"-325-SB

LRFD 320 kip
ASD 214 kip



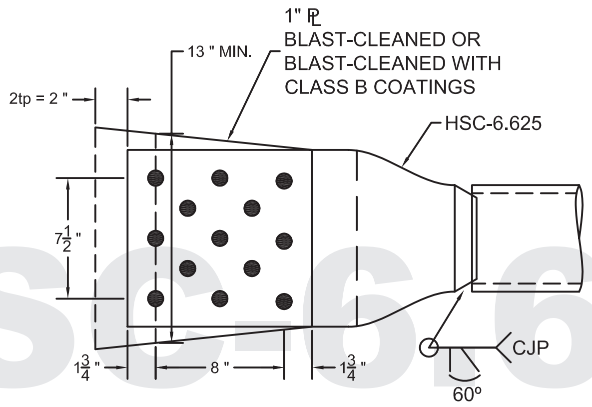
15-7/8"-325-SB

LRFD 478 kip
ASD 319 kip



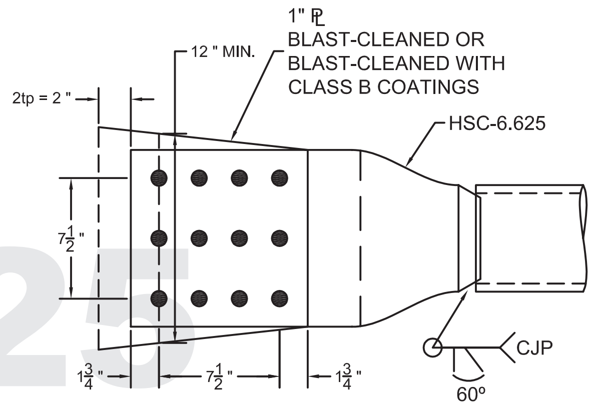
13-7/8"-325-SB

LRFD 414 kip
ASD 277 kip



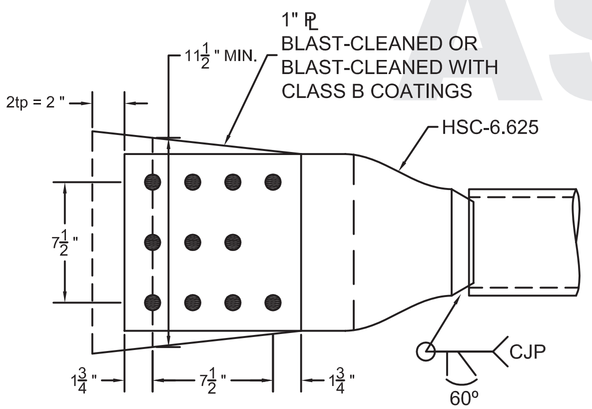
12-7/8"-325-SB

LRFD 382 kip
ASD 255 kip



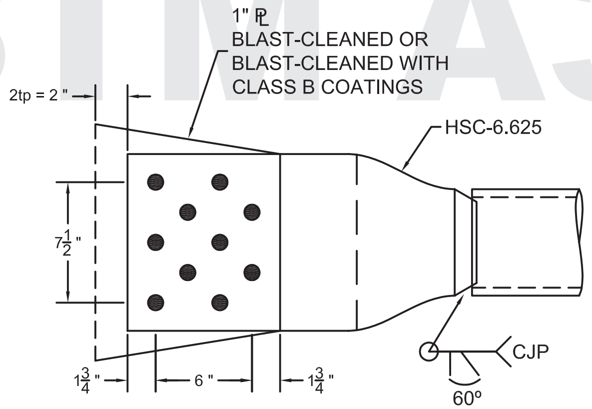
11-7/8"-325-SB

LRFD 350 kip
ASD 234 kip



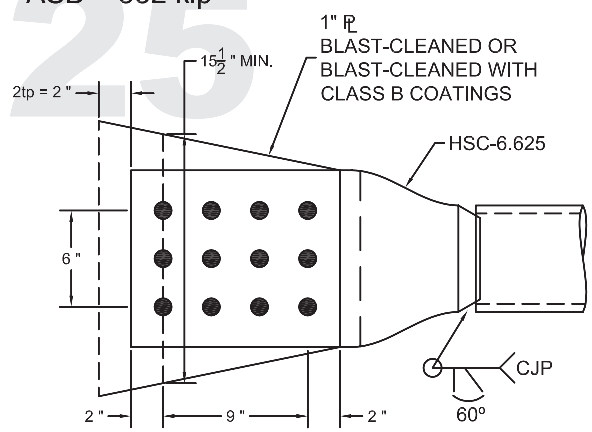
10-7/8"-325-SB

LRFD 318 kip
ASD 213 kip



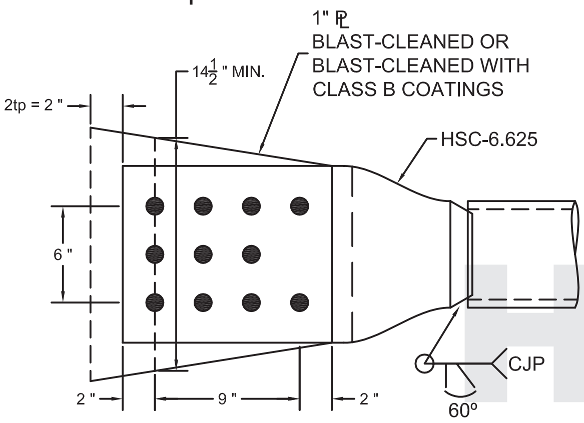
12-1"-325-SB

LRFD 498 kip
ASD 332 kip



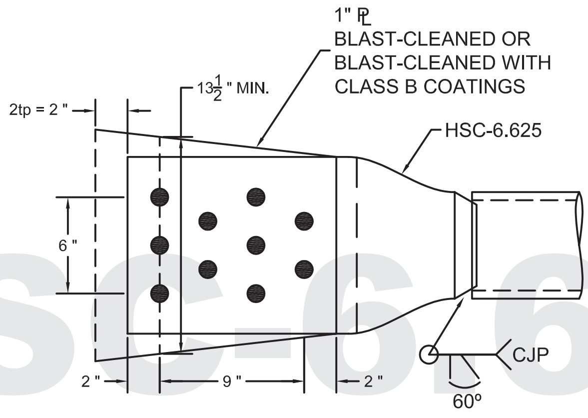
11-1"-325-SB

LRFD 458 kip
ASD 306 kip



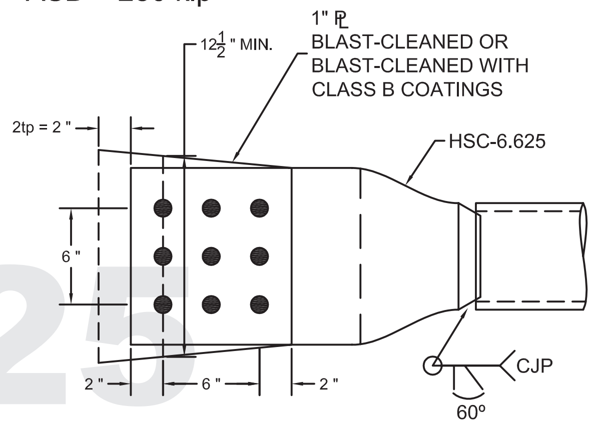
10-1"-325-SB

LRFD 416 kip
ASD 278 kip



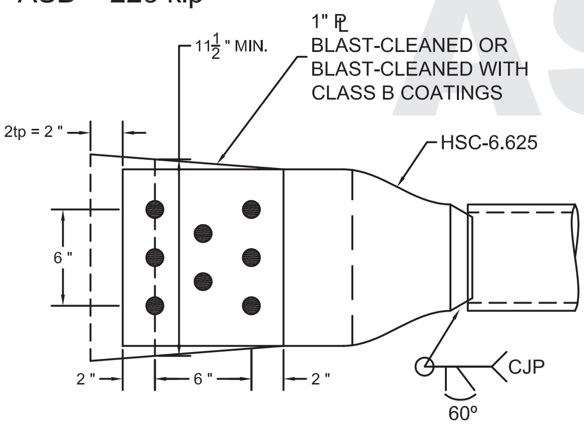
9-1"-325-SB

LRFD 375 kip
ASD 250 kip



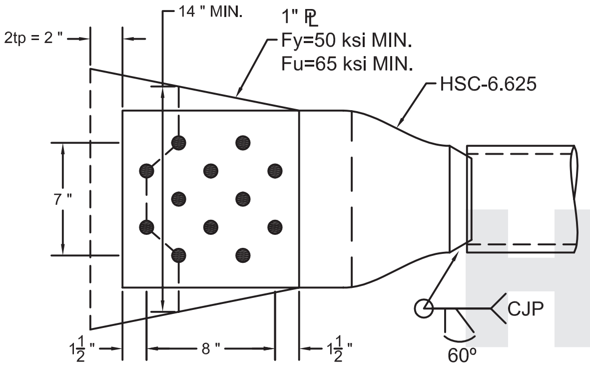
8-1"-325-SB

LRFD 333 kip
ASD 223 kip



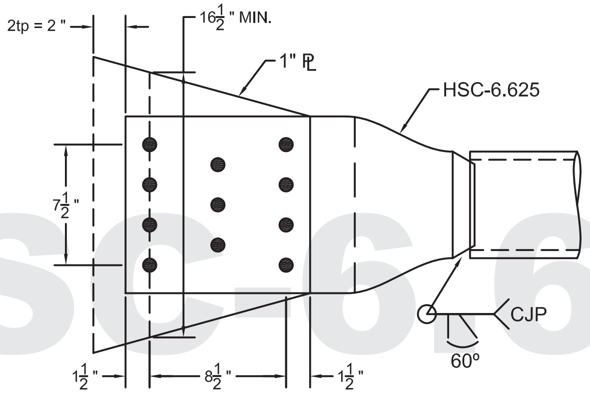
12-3/4"-490

LRFD 580 kip
ASD 387 kip



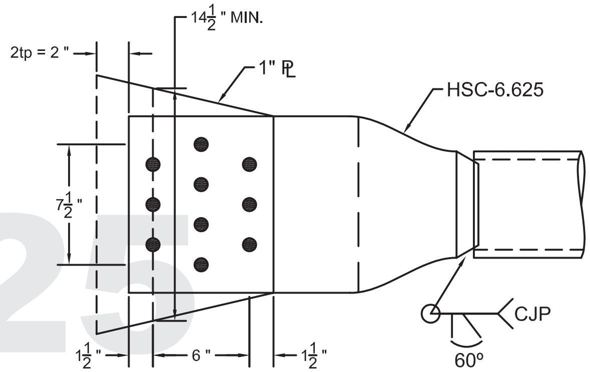
11-3/4"-490

LRFD 535 kip
ASD 356 kip



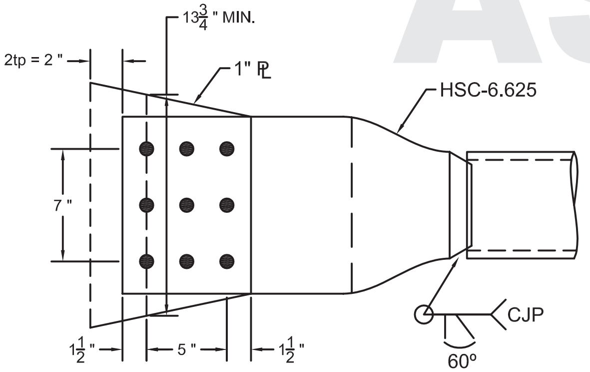
10-3/4"-490

LRFD 463 kip
ASD 309 kip



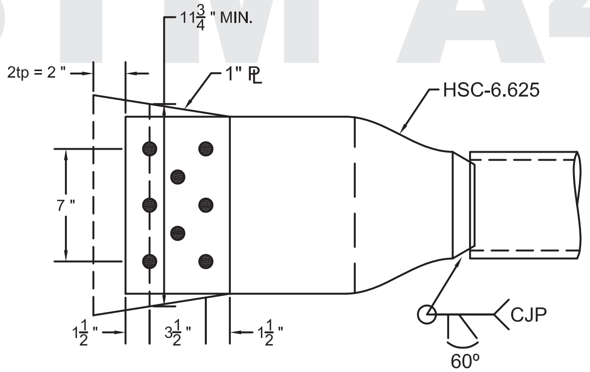
9-3/4"-490

LRFD 444 kip
ASD 296 kip



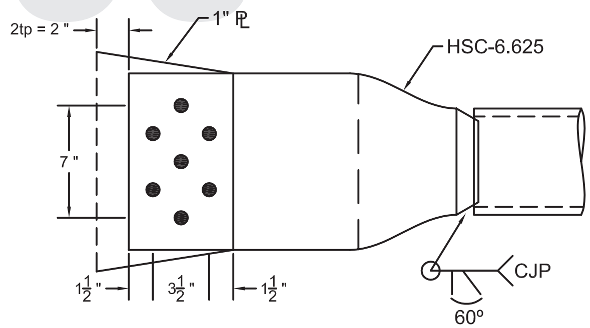
8-3/4"-490

LRFD 381 kip
ASD 253 kip



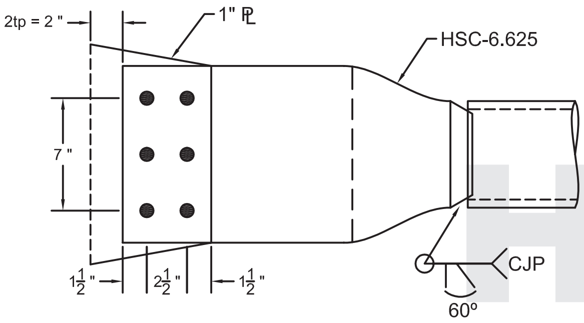
7-3/4"-490

LRFD 342 kip
ASD 228 kip

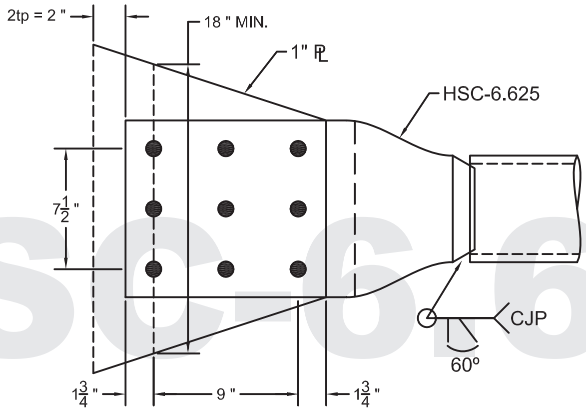


HSC-6.625 BEARING-TYPE ASTM A490

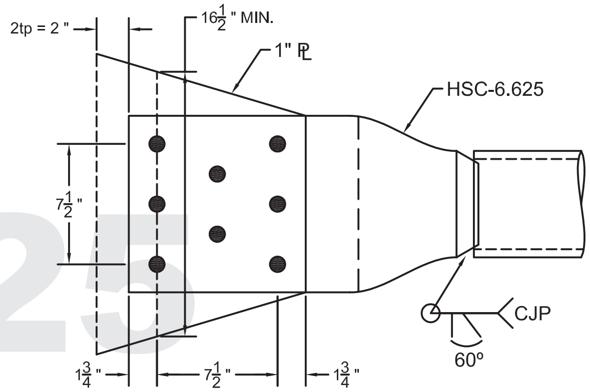
6-3/4"-490
LRFD 334 kip
ASD 223 kip



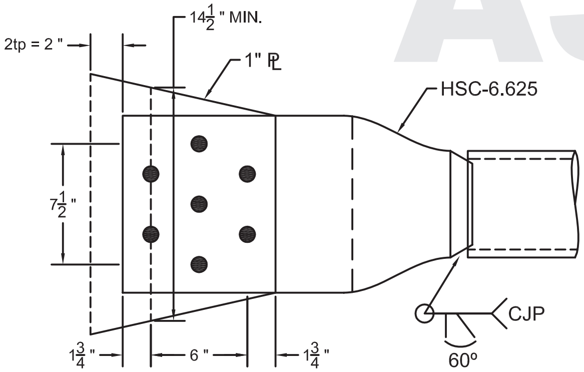
9-7/8"-490
LRFD 583 kip
ASD 388 kip



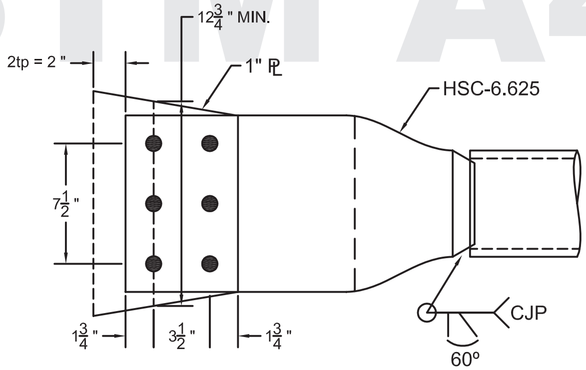
8-7/8"-490
LRFD 535 kip
ASD 356 kip



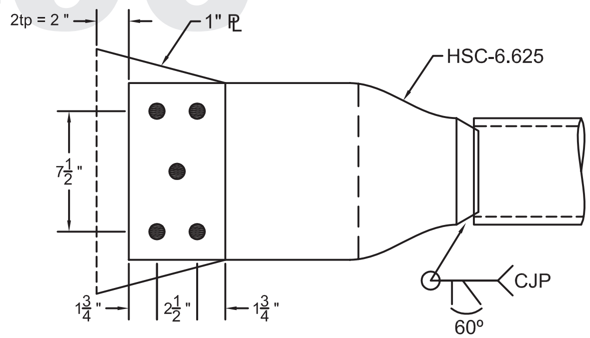
7-7/8"-490
LRFD 462 kip
ASD 308 kip



6-7/8"-490
LRFD 413 kip
ASD 275 kip

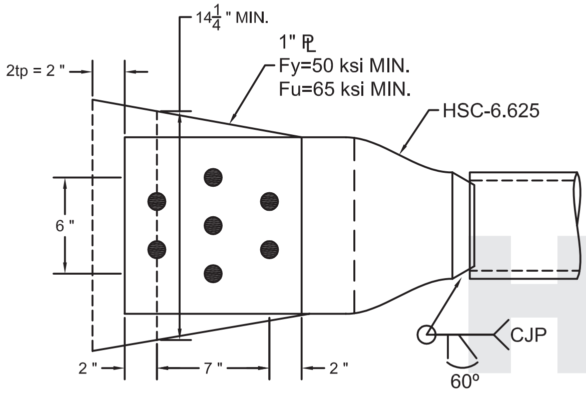


5-7/8"-490
LRFD 356 kip
ASD 237 kip



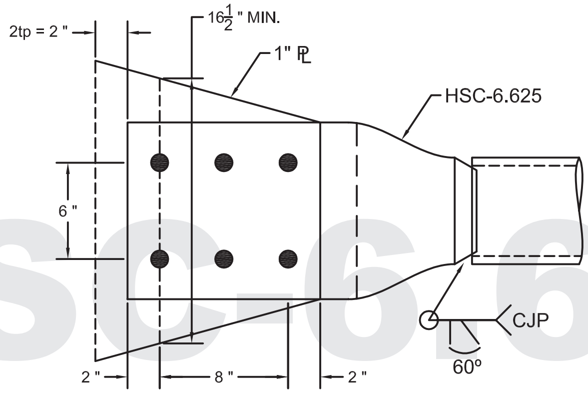
7-1"-490

LRFD 584 kip
ASD 389 kip



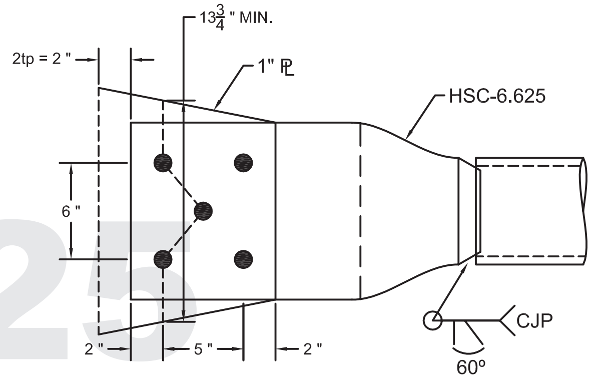
6-1"-490

LRFD 535 kip
ASD 356 kip



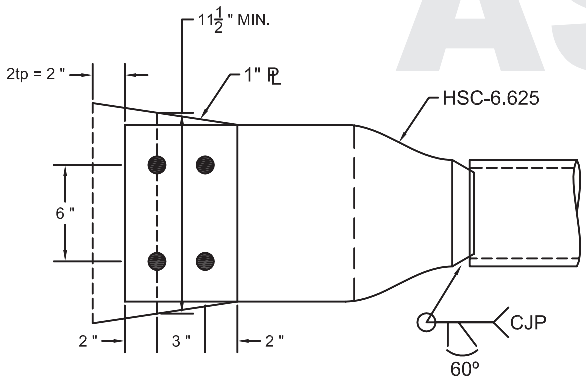
5-1"-490

LRFD 441 kip
ASD 294 kip



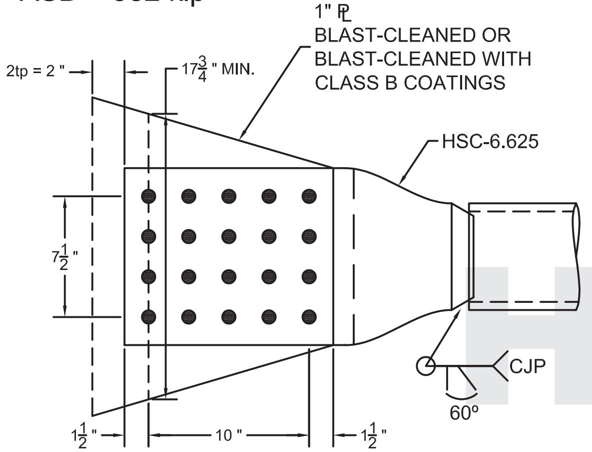
4-1"-490

LRFD 355 kip
ASD 237 kip



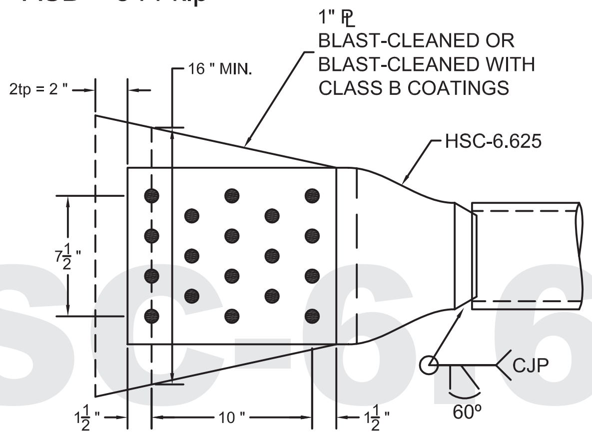
20-3/4"-490-SB

LRFD 571 kip
ASD 382 kip



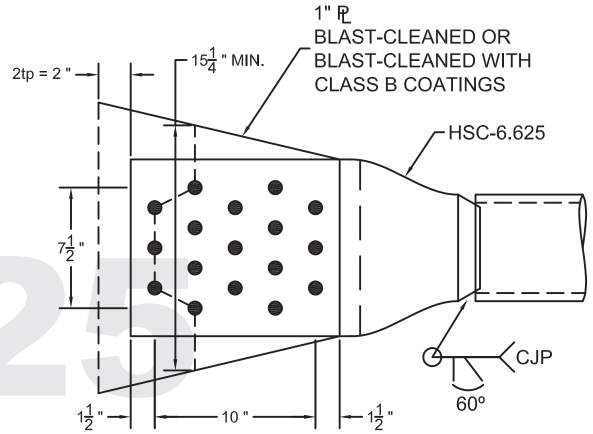
18-3/4"-490-SB

LRFD 514 kip
ASD 344 kip



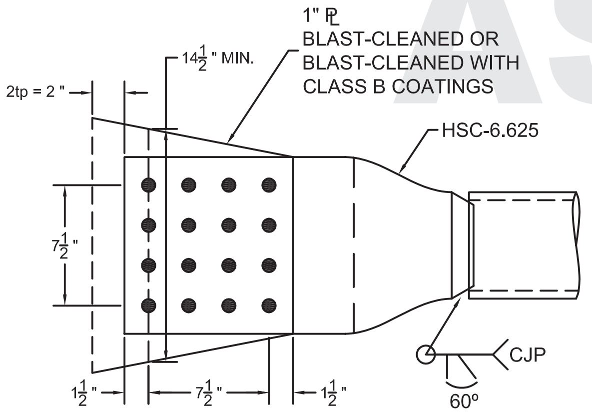
17-3/4"-490-SB

LRFD 486 kip
ASD 325 kip



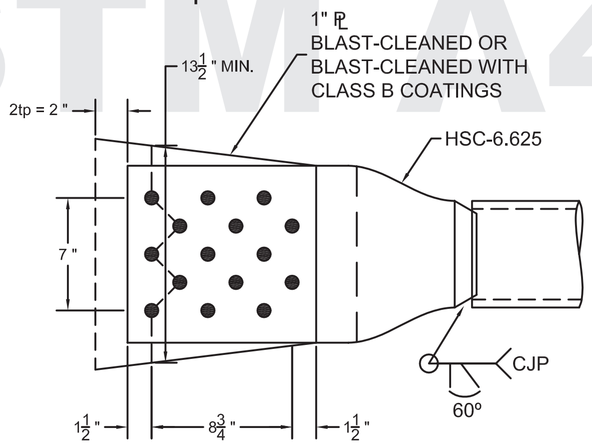
16-3/4"-490-SB

LRFD 457 kip
ASD 306 kip



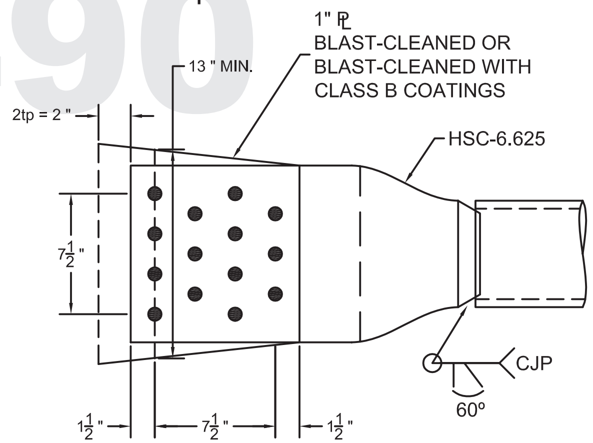
15-3/4"-490-SB

LRFD 429 kip
ASD 287 kip

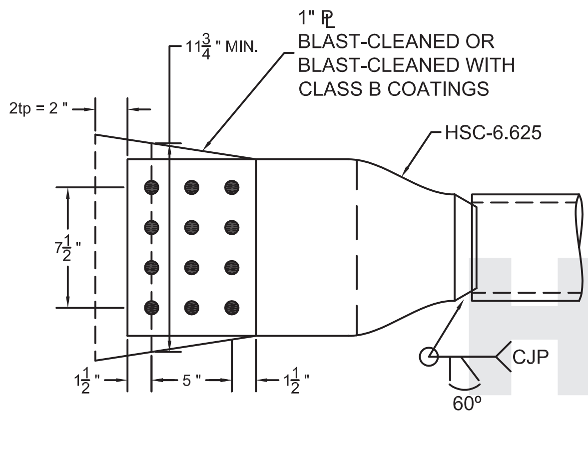


14-3/4"-490-SB

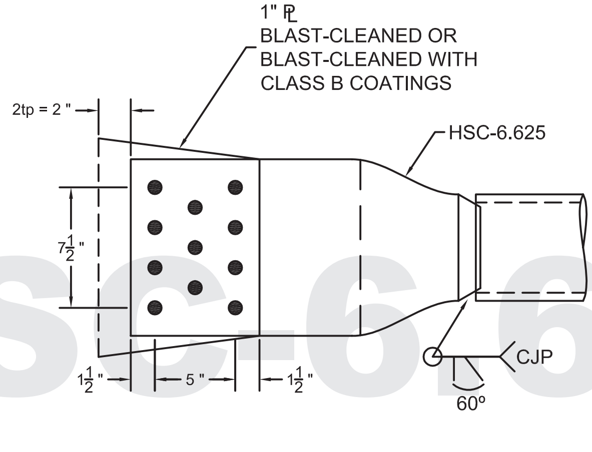
LRFD 400 kip
ASD 267 kip



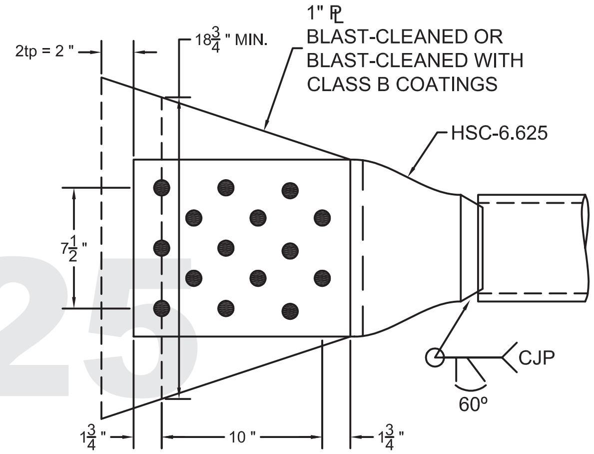
12-3/4"-490-SB
LRFD 343 kip
ASD 229 kip



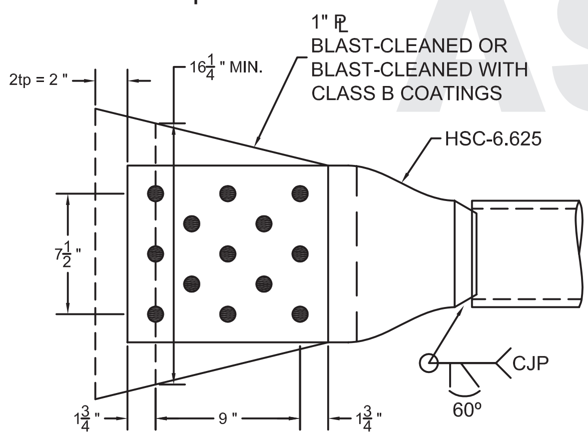
11-3/4"-490-SB
LRFD 314 kip
ASD 210 kip



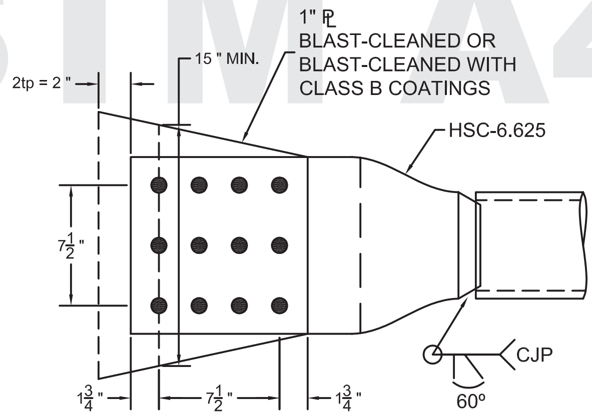
15-7/8"-490-SB
LRFD 600 kip
ASD 401 kip



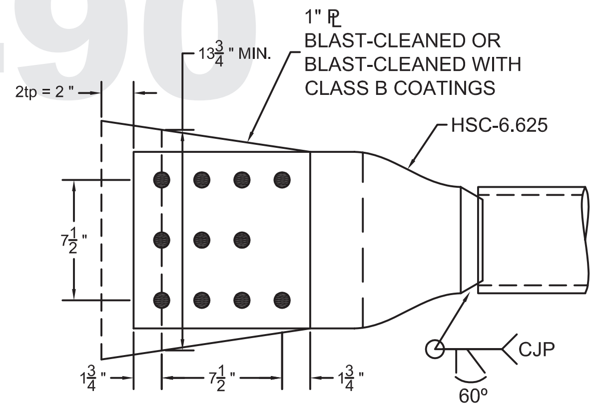
13-7/8"-490-SB
LRFD 520 kip
ASD 348 kip



12-7/8"-490-SB
LRFD 480 kip
ASD 321 kip

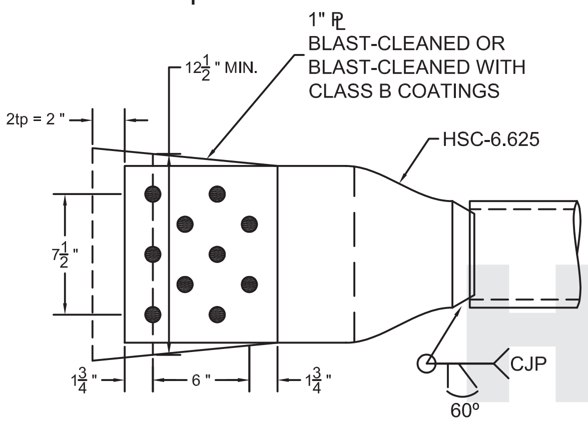


11-7/8"-490-SB
LRFD 440 kip
ASD 294 kip



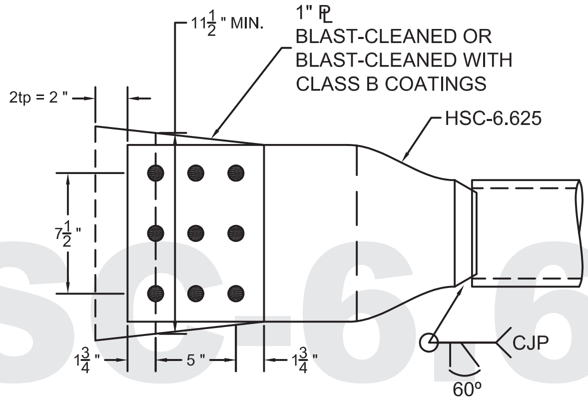
10-7/8"-490-SB

LRFD 400 kip
ASD 267 kip



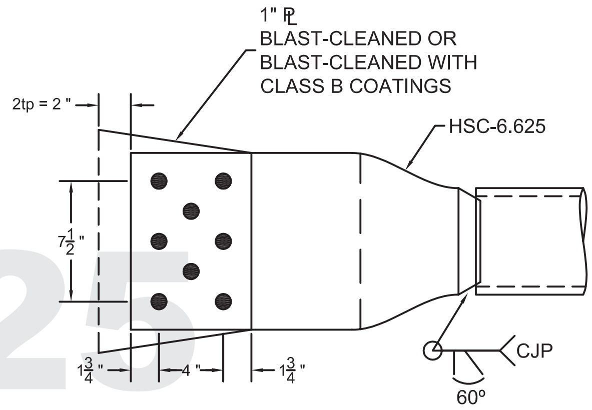
9-7/8"-490-SB

LRFD 360 kip
ASD 241 kip



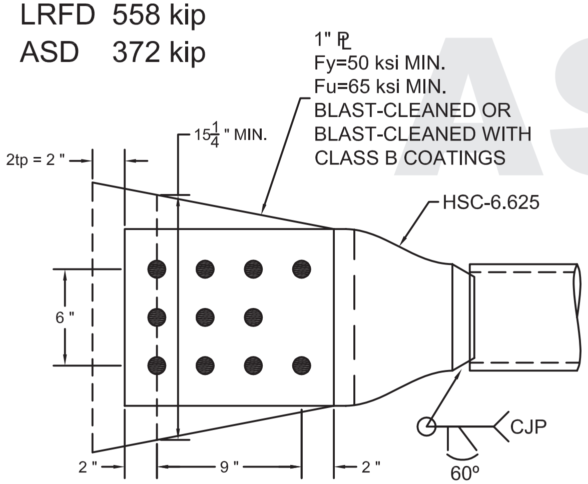
8-7/8"-490-SB

LRFD 320 kip
ASD 214 kip



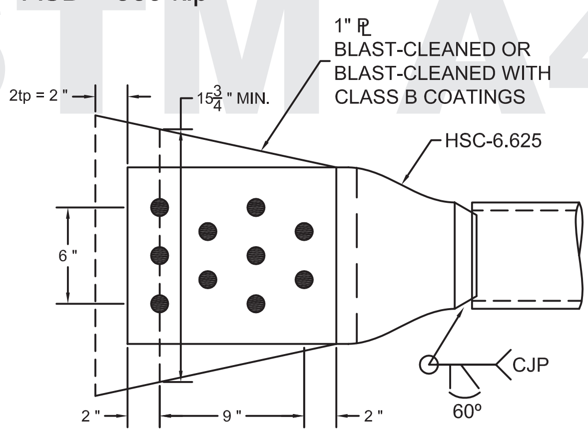
11-1"-490-SB

LRFD 558 kip
ASD 372 kip



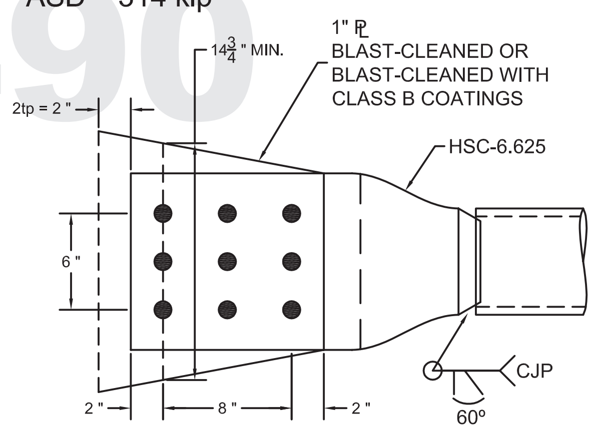
10-1"-490-SB

LRFD 509 kip
ASD 339 kip



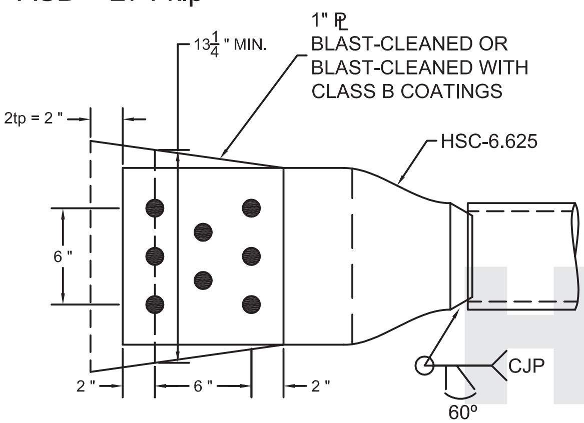
9-1"-490-SB

LRFD 470 kip
ASD 314 kip



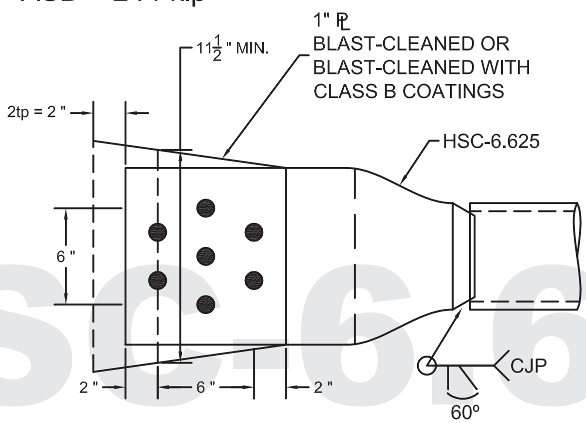
8-1"-490-SB

LRFD 411 kip
ASD 274 kip



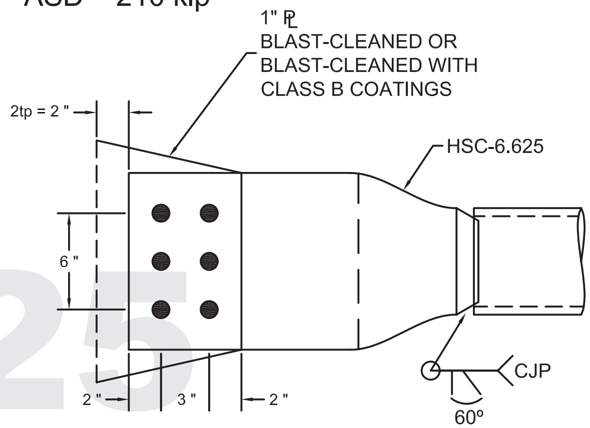
7-1"-490-SB

LRFD 366 kip
ASD 244 kip



6-1"-490-SB

LRFD 314 kip
ASD 210 kip



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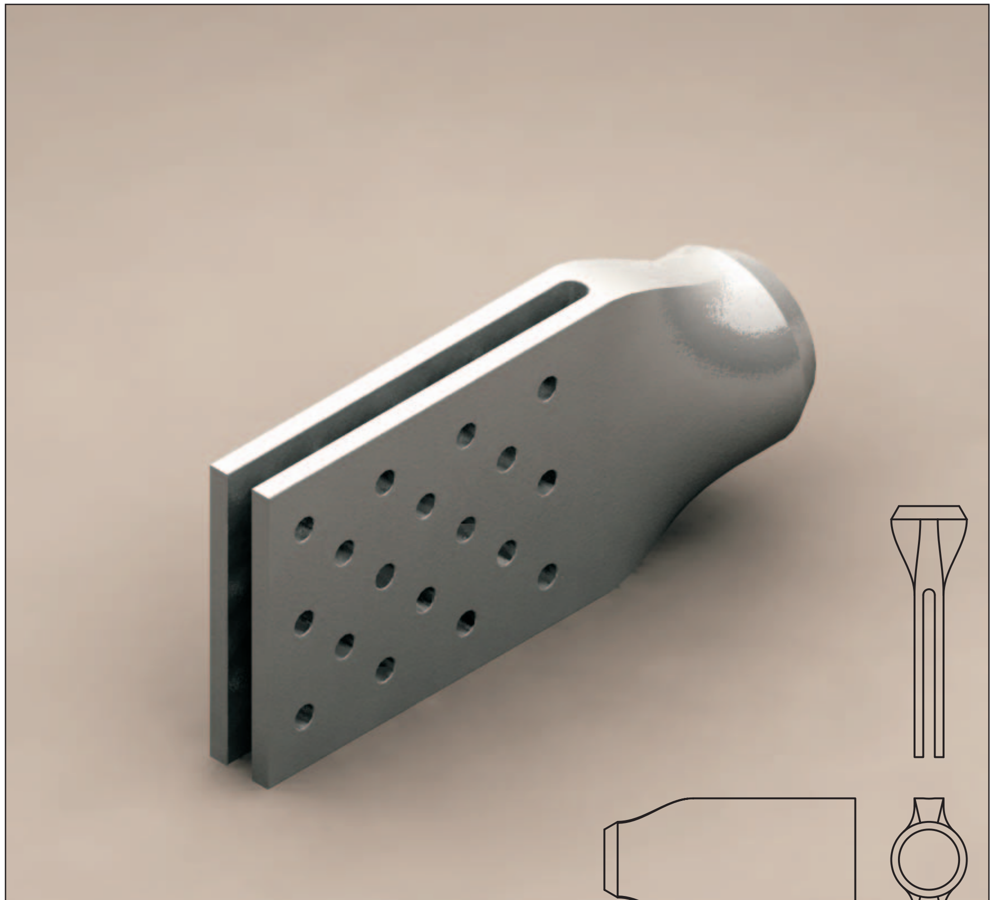
Cast ConneX®

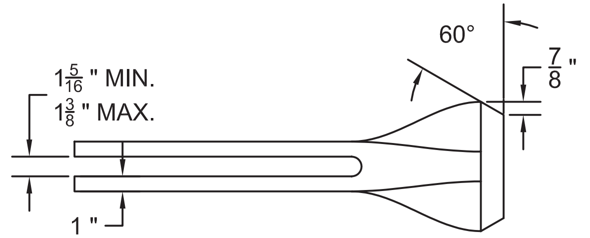
High-Strength Connector™

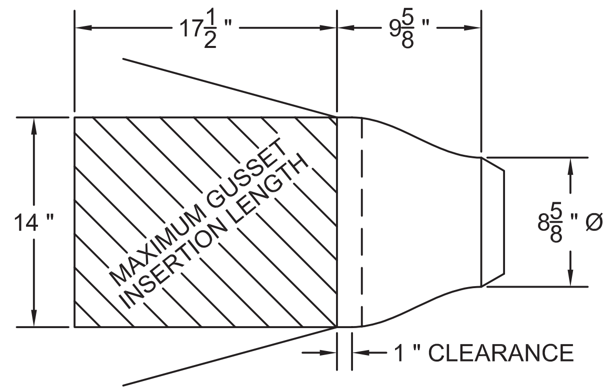
Product No.

HSC-8.625



Bolt pattern shown is an example only. All HSC are supplied without bolt holes.
This is an artists rendition of this particular HSC. Actual appearance may vary.





HSC-8.625

ANSI/AISC 341-10

$$\frac{D}{t} \leq \frac{0.038 \cdot E}{Fy}$$

ASTM A500
Grade B

Fy = 42 ksi

Ry·Fy = 59 ksi

thus D/t ≤ 26.2

Shape	Wall Thickness, t		D/t	Area, A	Ry·Fy·A	BEARING-TYPE CONNECTIONS[1] Detail Number					
						A325			A490		
	Nominal	Design[3]				Bolt Size			Bolt Size		
	in.	in.		in.^{2}	kip	1	1⅛	1¼	1	1⅛	1¼
HSS 8.625	0.625	0.581	14.8	14.69	864	13-1"-325	10-1 1/8"-325	8-1 1/4"-325	10-1"-490	8-1 1/8"-490	7-1 1/4"-490
	0.500	0.465	18.5	11.92	701	10-1"-325	8-1 1/8"-325	7-1 1/4"-325	8-1"-490	7-1 1/8"-490	6-1 1/4"-490
	0.375	0.349	24.7	9.07	533	7-1"-325	6-1 1/8"-325	5-1 1/4"-325	7-1"-490	5-11 1/8"-490	4-1 1/4"-490

Shape	Wall Thickness, t		D/t	Area, A	Ry·Fy·A	CLASS B SLIP-CRITICAL CONNECTIONS[1, 2] Detail Number					
						A325			A490		
	Nominal	Design[3]				Bolt Size			Bolt Size		
	in.	in.		in.^{2}	kip	1	1⅛	1¼	1	1⅛	1¼
HSS 8.625	0.625	0.581	14.8	14.69	864	**X**	**X**	**X**	17-1"-490-SB	14-1 1/8"-490-SB	11-1 1/4"-490-SB
	0.500	0.465	18.5	11.92	701	17-1"-325-SB	16-1 1/8"-325-SB	13-1 1/4"-325-SB	14-1"-490-SB	11-1 1/8"-490-SB	9-1 1/4"-490-SB
	0.375	0.349	24.7	9.07	533	13-1"-325-SB	12-1 1/8"-325-SB	10-1 1/4"-325-SB	11-1"-490-SB	9-1 1/8"-490-SB	7-1 1/4"-490-SB

1. Connections must have pretensioned high-strength bolts. The following are suggested bolt lengths:
   4¾" Long bolt for 1" A325 or A490
   5" Long bolt for 1¼" and 1⅛" A325 or A490
2. Tabulated values for slip-critical connections assume Class B contact surfaces with μ = 0.50, D_u = 1.13, and h_{sc} = 0.85. High-Strength Connectors are supplied with Class B surfaces. Surface treatment of gusset plate is required to achieve Class B slip resistance in connection.
3. Design wall thickness for ASTM A500 HSS sections taken as $0.93 \cdot t_{nominal}$.

X Connector tabs not large enough to accommodate the number of bolts required

HSC-8.625

ANSI/AISC 341-10

$$\frac{D}{t} \leq \frac{0.038 \cdot E}{Fy}$$

ASTM A500
Grade C

Fy = 46 ksi

Ry·Fy = 64 ksi

thus D/t ≤ 24.0

Shape	Wall Thickness, t		D/t	Area, A	Ry·Fy·A	BEARING-TYPE CONNECTIONS[1] Detail Number					
						A325			A490		
						Bolt Size			Bolt Size		
	Nominal	Design[3]				1	1⅛	1¼	1	1⅛	1¼
	in.	in.		in.^{2}	kip						
HSS 8.625	0.625	0.581	14.8	14.69	946	14-1"-325	11-1 1/8"-325	9-1 1/4"-325	11-1"-490	9-1 1/8"-490	7-1 1/4"-490
	0.500	0.465	18.5	11.92	768	11-1"-325	9-1 1/8"-325	7-1 1/4"-325	9-1"-490	7-1 1/8"-490	6-1 1/4"-490

Shape	Wall Thickness, t		D/t	Area, A	Ry·Fy·A	CLASS B SLIP-CRITICAL CONNECTIONS[1, 2] Detail Number					
						A325			A490		
						Bolt Size			Bolt Size		
	Nominal	Design[3]				1	1⅛	1¼	1	1⅛	1¼
	in.	in.		in.^{2}	kip						
HSS 8.625	0.625	0.581	14.8	14.69	946	**X**	**X**	**X**	**X**	15-1 1/8"-490-SB	12-1 1/4"-490-SB
	0.500	0.465	18.5	11.92	768	20-1"-325-SB	17-1 1/8"-325-SB	**X**	15-1"490-SB	12-1 1/8"-490-SB	10-1 1/4"-490-SB

1. Connections must have pretensioned high-strength bolts. The following are suggested bolt lengths:

4¾" Long bolt for 1" A325 or A490

5" Long bolt for 1¼" and 1⅛" A325 or A490

2. Tabulated values for slip-critical connections assume Class B contact surfaces with μ = 0.50, D_u = 1.13, and h_{sc} = 0.85. High-Strength Connectors are supplied with Class B surfaces.
Surface treatment of gusset plate is required to achieve Class B slip resistance in connection.

3. Design wall thickness for ASTM A500 HSS sections taken as $0.93 \cdot t_{nominal}$.

X Connector tabs not large enough to accommodate the number of bolts required

HSC-8.625

ANSI/AISC 341-10

$$\frac{D}{t} \leq \frac{0.038 \cdot E}{Fy}$$

ASTM A53
Grade B

Fy = 35 ksi thus D/t ≤ 31.5

Ry·Fy = 56 ksi

BEARING-TYPE CONNECTIONS[1]
Detail Number

Shape	Wall Thickness, t Nominal	Wall Thickness, t Design[3]	D/t	Area, A	Ry·Fy·A	A325 Bolt Size			A490 Bolt Size		
	in.	in.		in.^{2}	kip	1	1⅛	1¼	1	1⅛	1¼
Pipe 8											
XS	0.500	0.465	18.5	11.92	668	10-1"-325	8-1 1/8"-325	7-1 1/4"-325	8-1"-490	6-1 1/8"-490	5-1 1/4"-490
STD	0.322	0.299	28.8	7.83	439	7-1"-325	5-1 1/8"-325	4-1 1/4"-325	5-1"-490	4-1 1/8"-490	4-1 1/4"-490

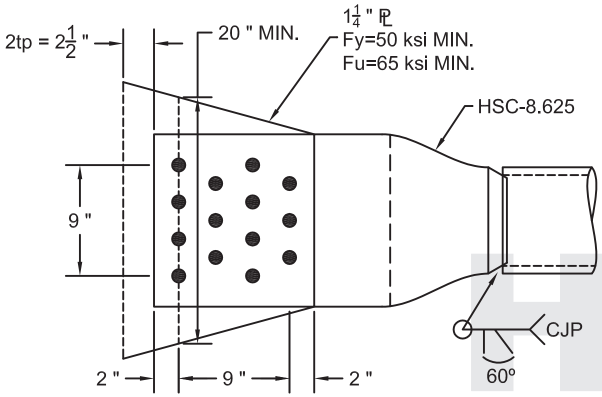
CLASS B SLIP-CRITICAL CONNECTIONS[1, 2]
Detail Number

Shape	Wall Thickness, t Nominal	Wall Thickness, t Design[3]	D/t	Area, A	Ry·Fy·A	A325 Bolt Size			A490 Bolt Size		
	in.	in.		in.^{2}	kip	1	1⅛	1¼	1	1⅛	1¼
Pipe 8											
XS	0.500	0.465	18.5	11.92	668	17-1"-325-SB	15-1 1/8"-325-SB	12-1 1/4"-325-SB	13-1"-490-SB	11-1 1/8"-490-SB	9-1 1/4"-490-SB
STD	0.322	0.299	28.8	7.83	439	11-1"-325-SB	10-1 1/8"-325-SB	8-1 1/4"-325-SB	9-1"-490-SB	7-1 1/8"-490-SB	6-1 1/4"-490-SB

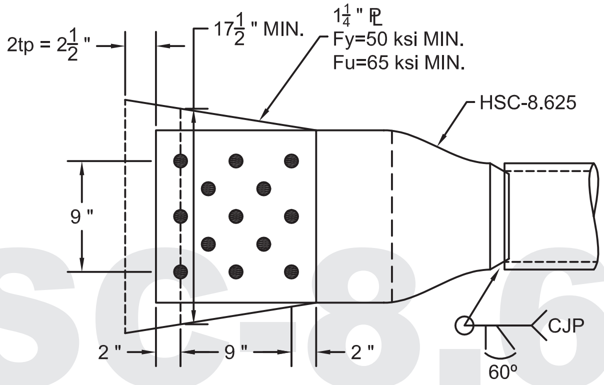
1. Connections must have pretensioned high-strength bolts. The following are suggested bolt lengths:
   4¾" Long bolt for 1" A325 or A490
   5" Long bolt for 1¼" and 1⅛" A325 or A490
2. Tabulated values for slip-critical connections assume Class B contact surfaces with μ = 0.50, D_u = 1.13, and h_{sc} = 0.85. High-Strength Connectors are supplied with Class B surfaces. Surface treatment of gusset plate is required to achieve Class B slip resistance in connection.
3. Design wall thickness for ASTM A53 Pipe sections taken as $0.93 \cdot t_{nominal}$.

X Connector tabs not large enough to accommodate the number of bolts required

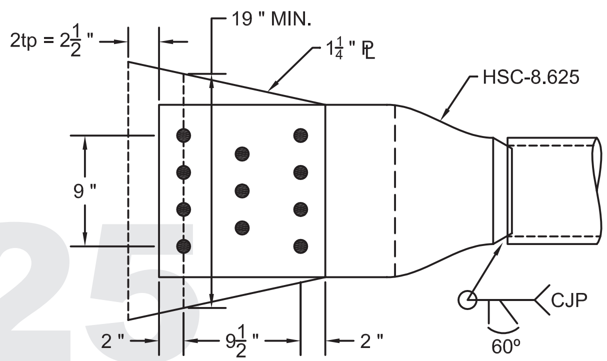
14-1"-325
LRFD 960 kip
ASD 640 kip



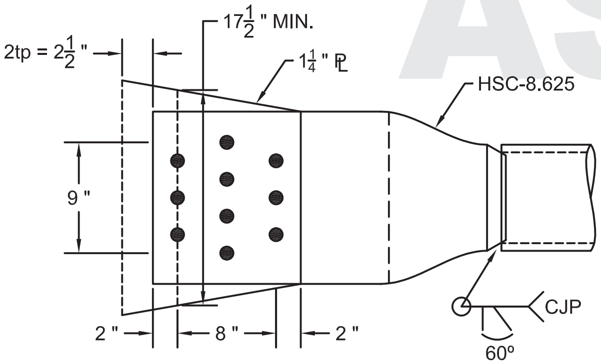
13-1"-325
LRFD 872 kip
ASD 581 kip



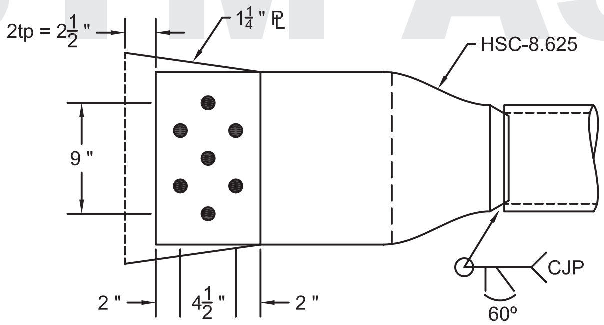
11-1"-325
LRFD 770 kip
ASD 512 kip



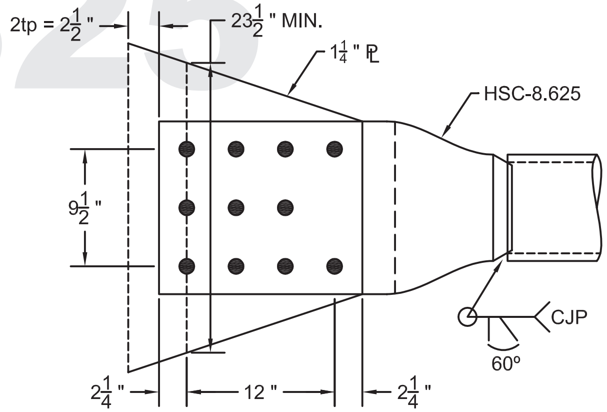
10-1"-325
LRFD 709 kip
ASD 472 kip



7-1"-325
LRFD 549 kip
ASD 366 kip

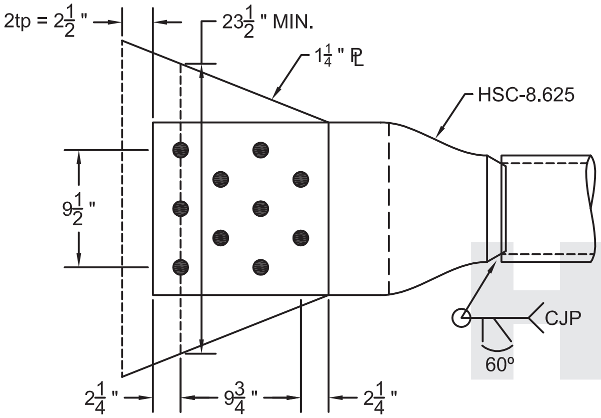


11-1 1/8"-325
LRFD 952 kip
ASD 633 kip



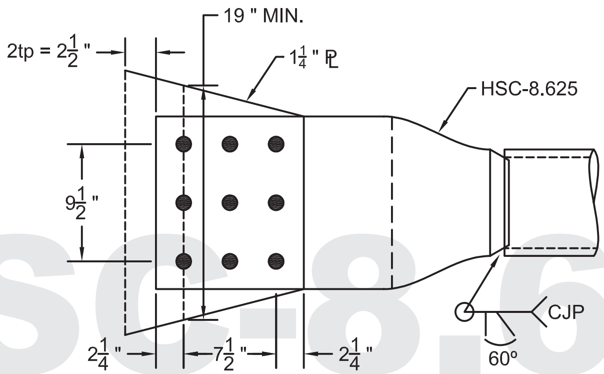
10-1 1/8"-325

LRFD 873 kip
ASD 582 kip



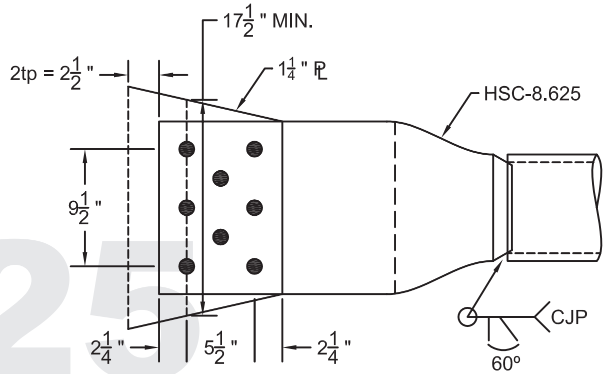
9-1 1/8"-325

LRFD 770 kip
ASD 512 kip



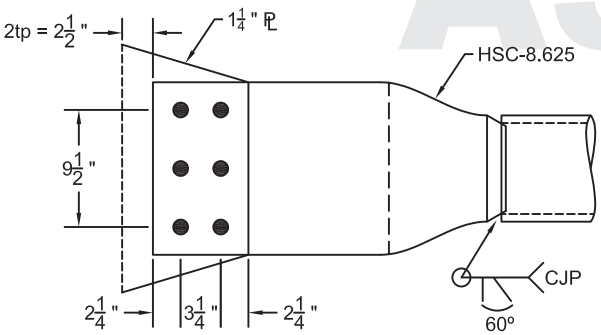
8-1 1/8"-325

LRFD 701 kip
ASD 468 kip



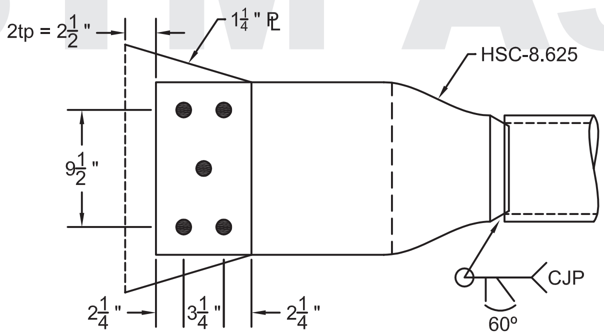
6-1 1/8"-325

LRFD 567 kip
ASD 377 kip



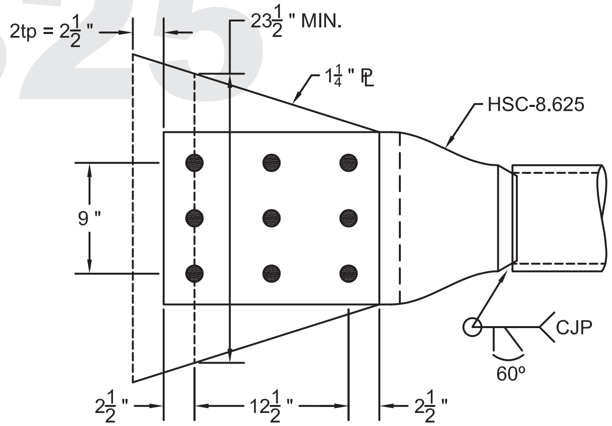
5-1 1/8"-325

LRFD 507 kip
ASD 338 kip



9-1 1/4"-325

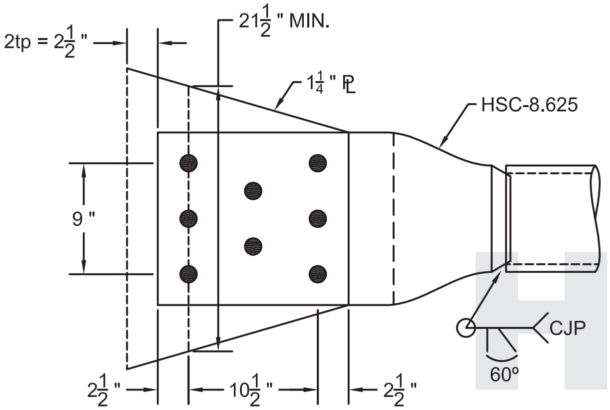
LRFD 952 kip
ASD 633 kip



8-1 1/4"-325

LRFD 871 kip

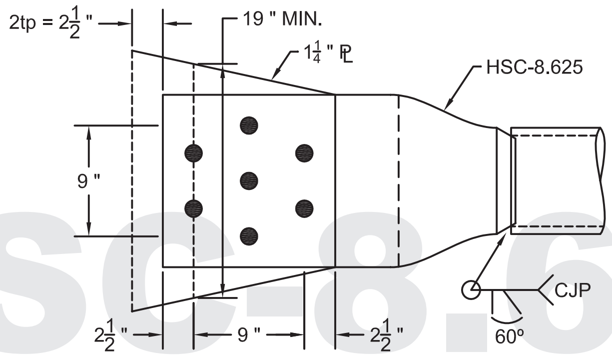
ASD 579 kip



7-1 1/4"-325

LRFD 780 kip

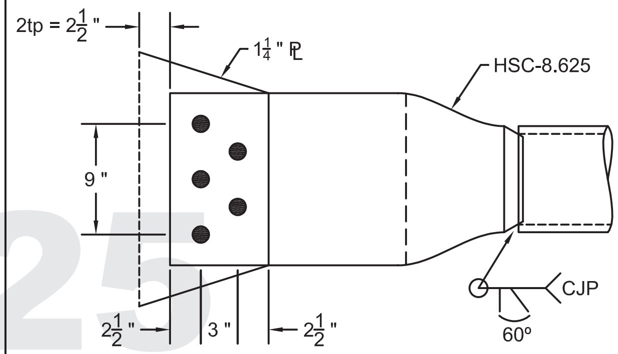
ASD 519 kip



5-1 1/4"-325

LRFD 547 kip

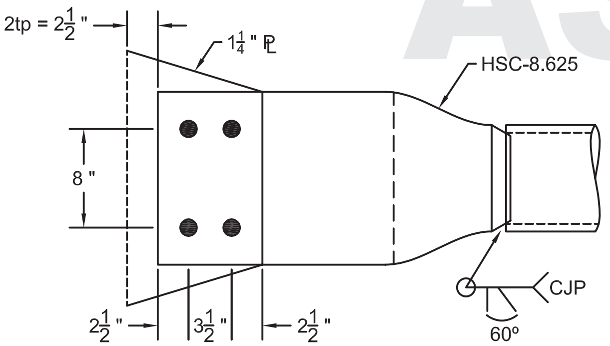
ASD 365 kip



4-1 1/4"-325

LRFD 498 kip

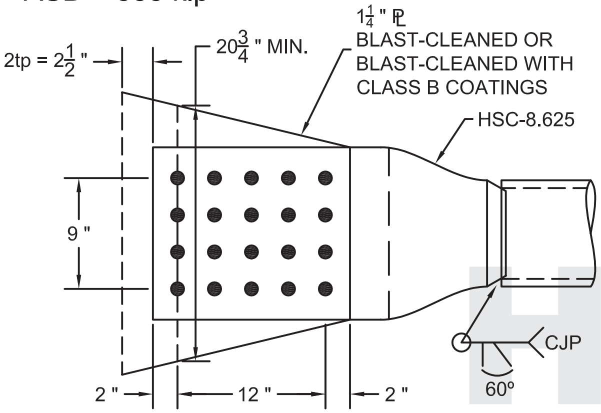
ASD 332 kip



20-1"-325-SB

LRFD 832 kip

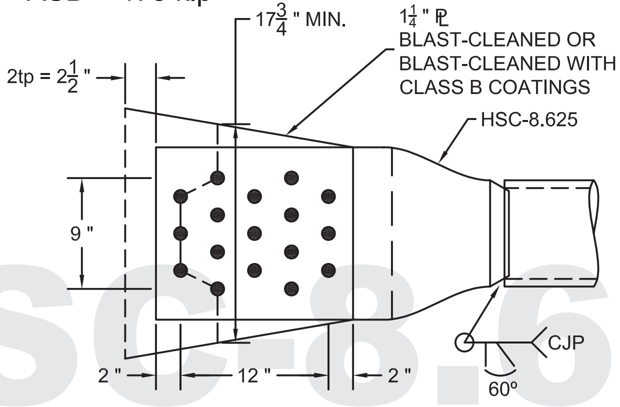
ASD 555 kip



17-1"-325-SB

LRFD 708 kip

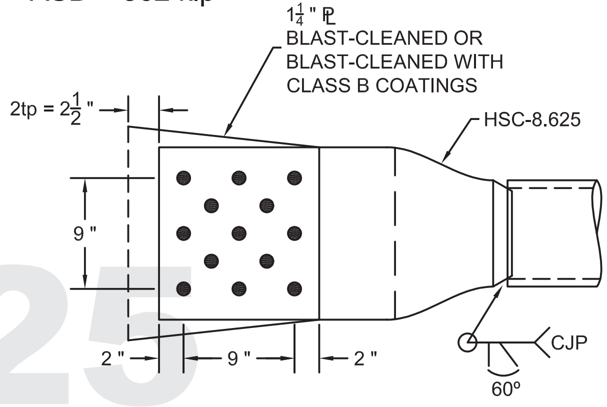
ASD 473 kip



13-1"-325-SB

LRFD 541 kip

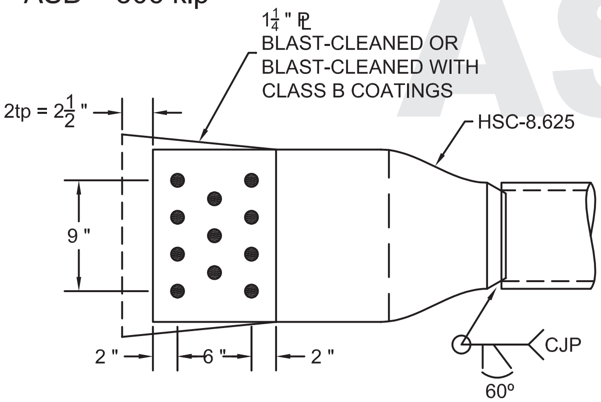
ASD 362 kip



11-1"-325-SB

LRFD 458 kip

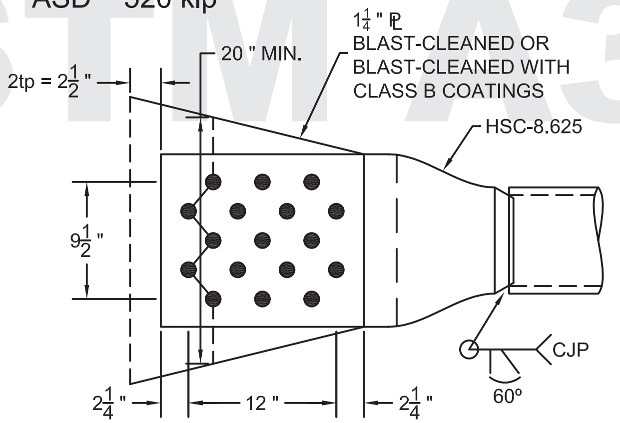
ASD 306 kip



17-1 1/8"-325-SB

LRFD 777 kip

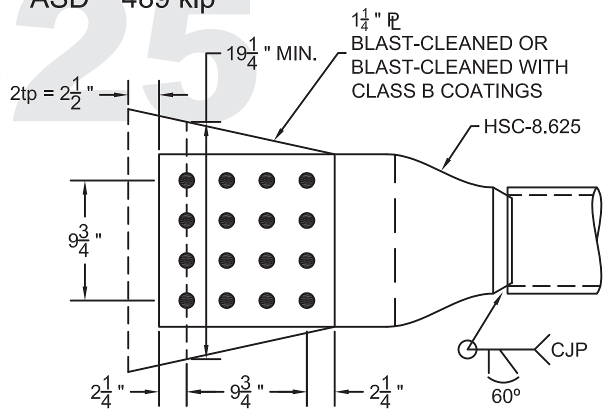
ASD 520 kip



16-1 1/8"-325-SB

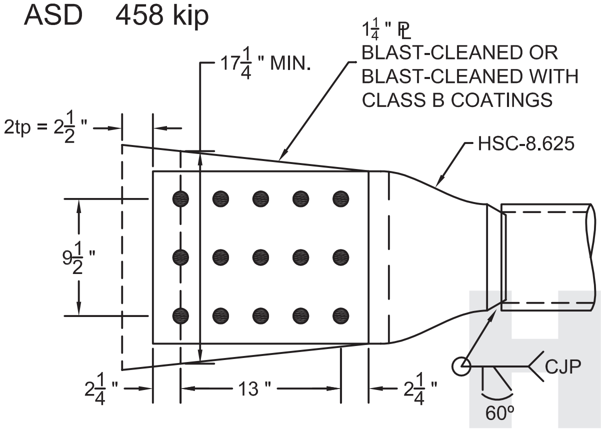
LRFD 732 kip

ASD 489 kip



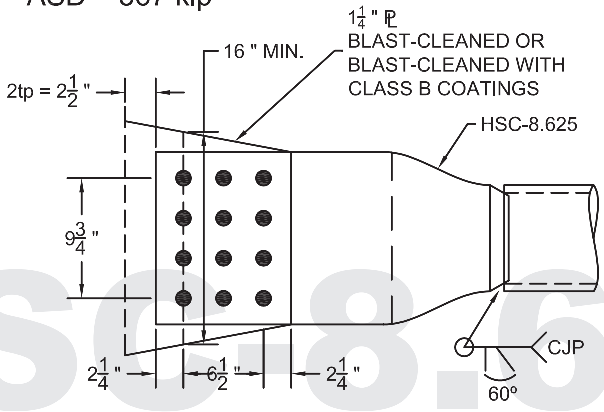
15-1 1/8"-325-SB

LRFD 686 kip
ASD 458 kip



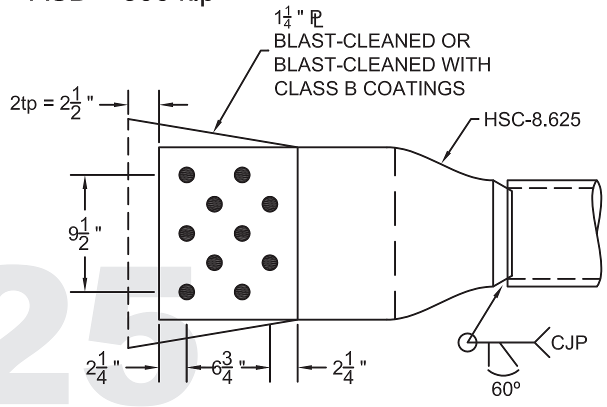
12-1 1/8"-325-SB

LRFD 549 kip
ASD 367 kip



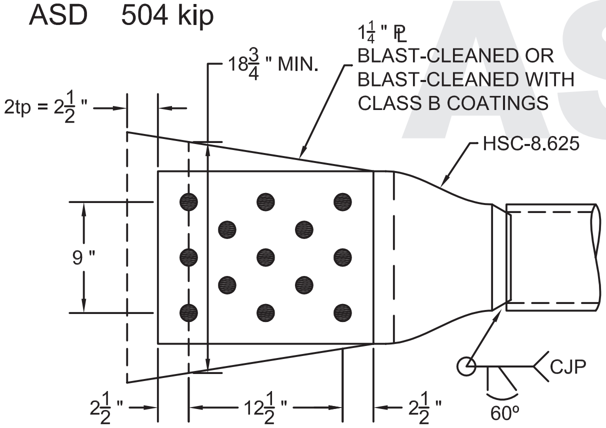
10-1 1/8"-325-SB

LRFD 457 kip
ASD 306 kip



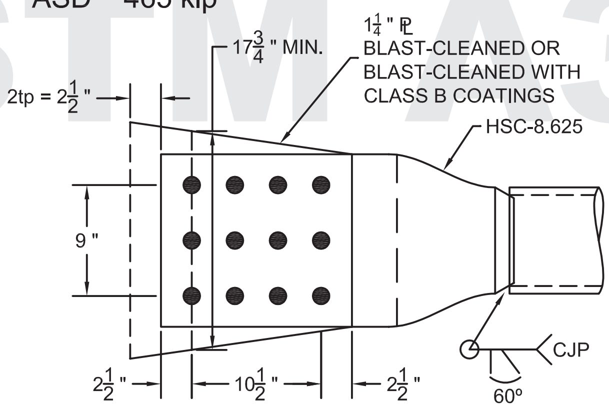
13-1 1/4"-325-SB

LRFD 754 kip
ASD 504 kip



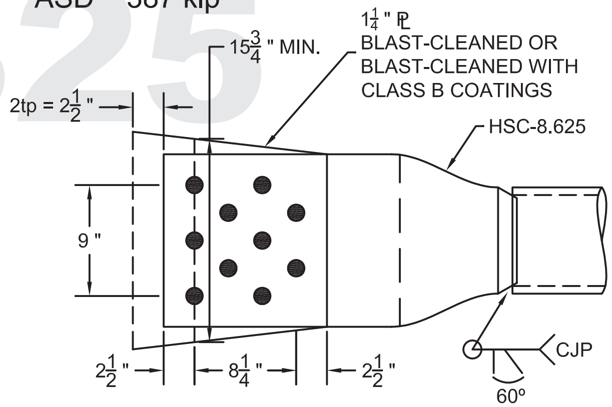
12-1 1/4"-325-SB

LRFD 696 kip
ASD 465 kip



10-1 1/4"-325-SB

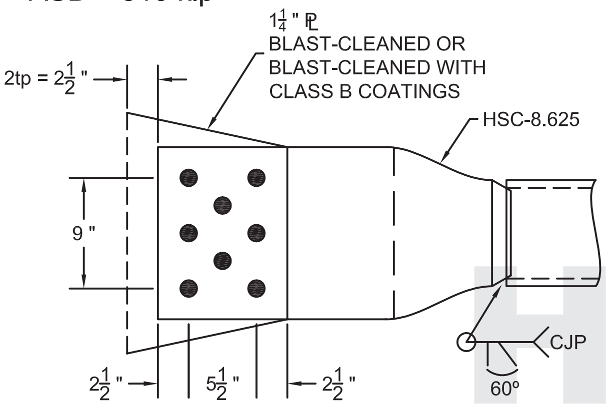
LRFD 580 kip
ASD 387 kip



8-1 1/4"-325-SB

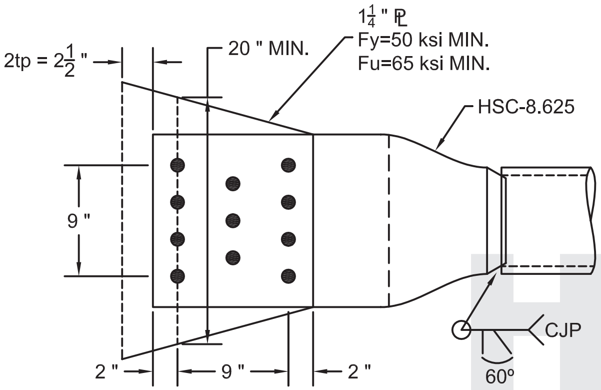
LRFD 464 kip

ASD 310 kip



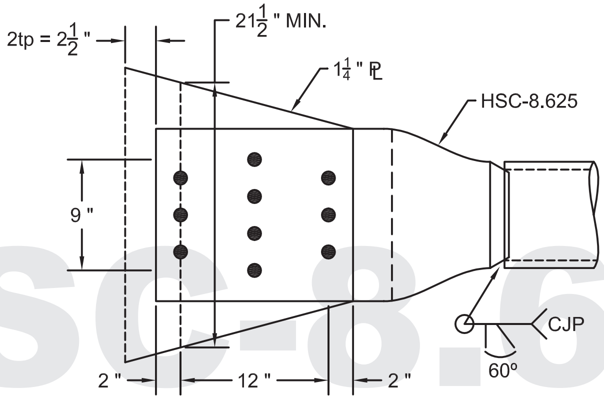
11-1"-490

LRFD 960 kip
ASD 640 kip



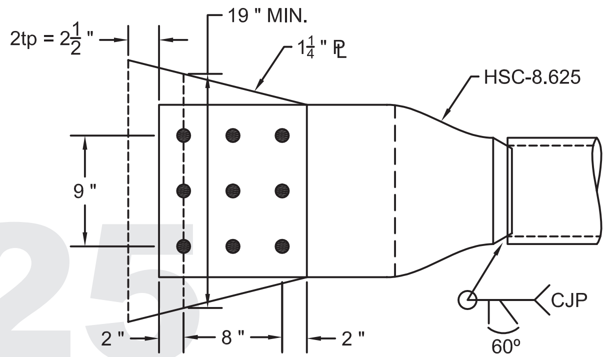
10-1"-490

LRFD 871 kip
ASD 579 kip



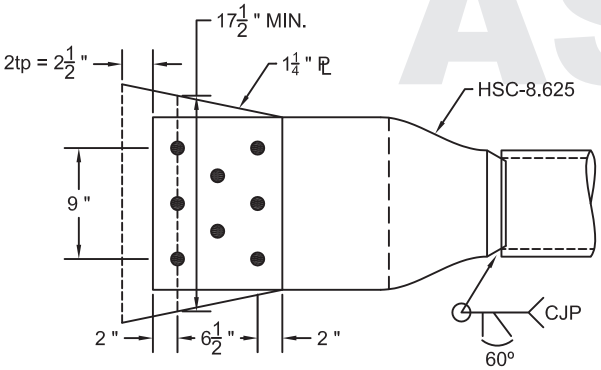
9-1"-490

LRFD 770 kip
ASD 512 kip



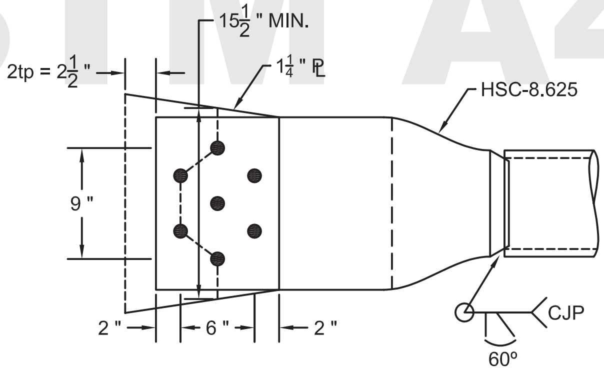
8-1"-490

LRFD 709 kip
ASD 472 kip



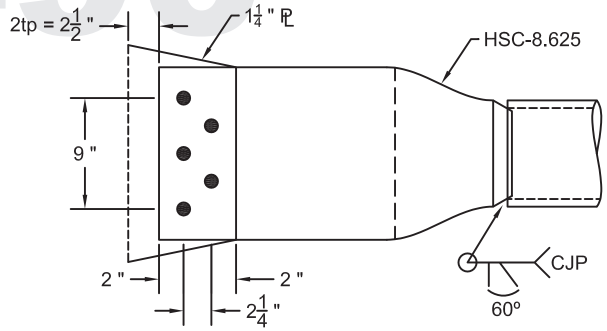
7-1"-490

LRFD 627 kip
ASD 418 kip



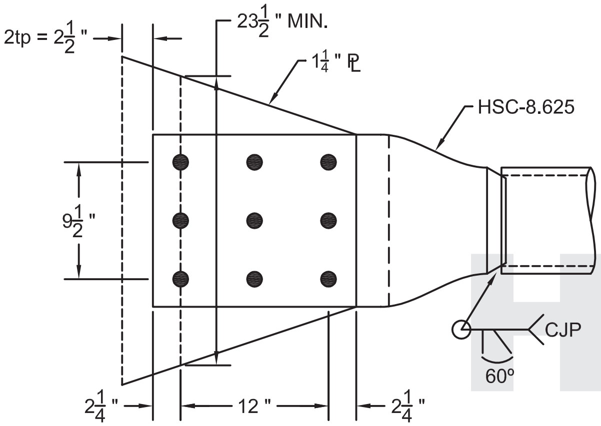
5-1"-490

LRFD 495 kip
ASD 330 kip



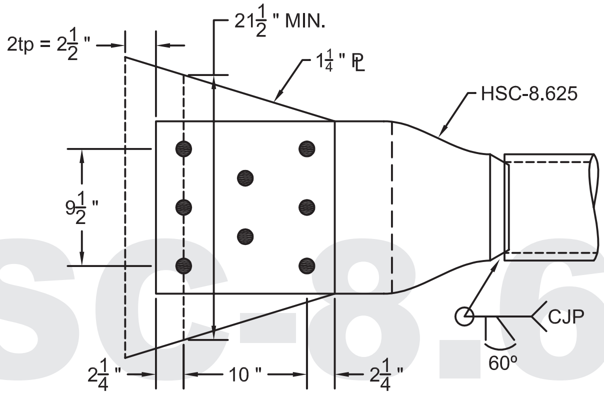
9-1 1/8"-490

LRFD 952 kip
ASD 633 kip



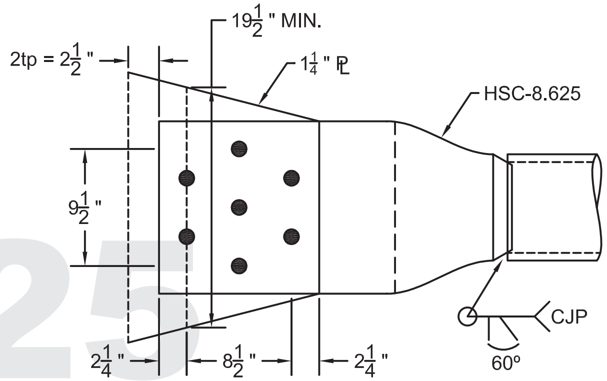
8-1 1/8"-490

LRFD 871 kip
ASD 579 kip



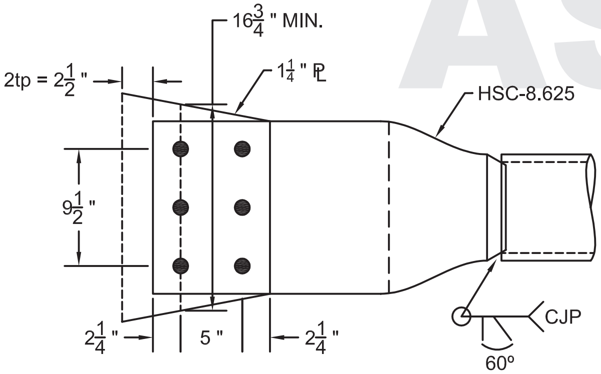
7-1 1/8"-490

LRFD 790 kip
ASD 525 kip



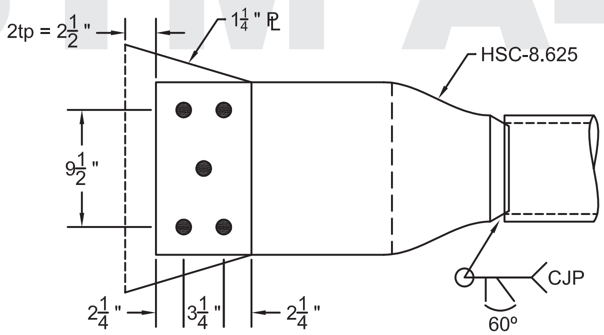
6-1 1/8"-490

LRFD 678 kip
ASD 451 kip



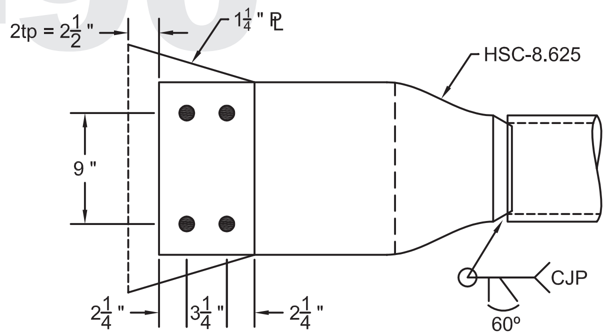
5-1 1/8"-490

LRFD 567 kip
ASD 377 kip



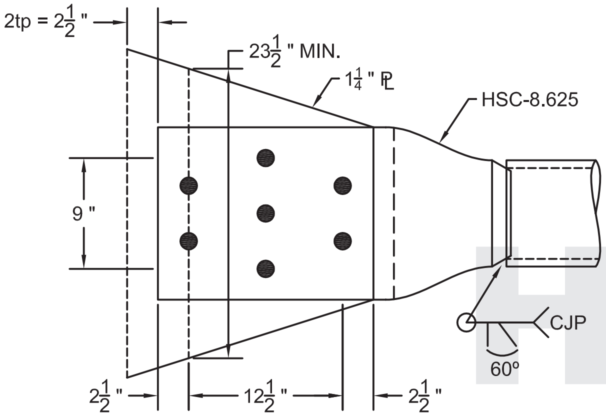
4-1 1/8"-490

LRFD 501 kip
ASD 334 kip



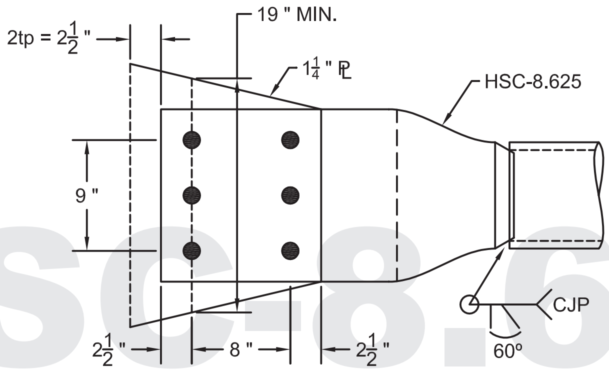
7-1 1/4"-490

LRFD 952 kip
ASD 633 kip



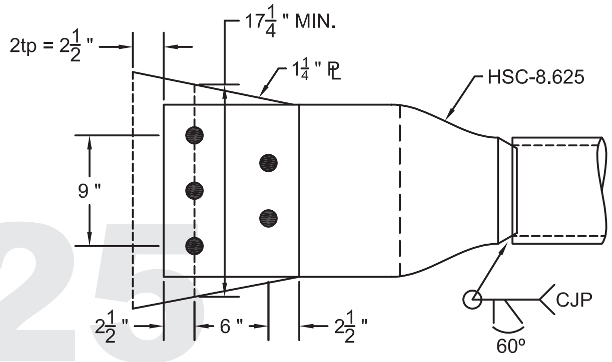
6-1 1/4"-490

LRFD 770 kip
ASD 512 kip



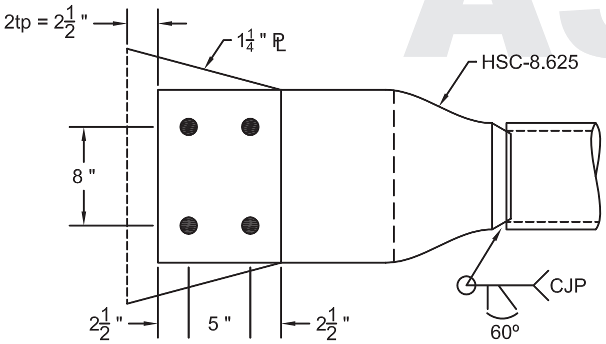
5-1 1/4"-490

LRFD 691 kip
ASD 461 kip



4-1 1/4"-490

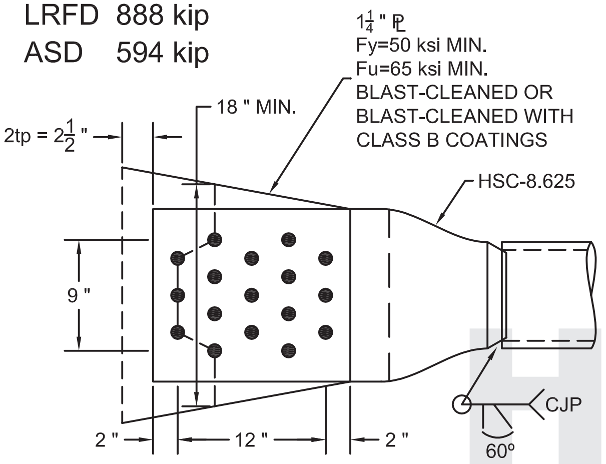
LRFD 559 kip
ASD 372 kip



17-1"-490-SB

LRFD 888 kip

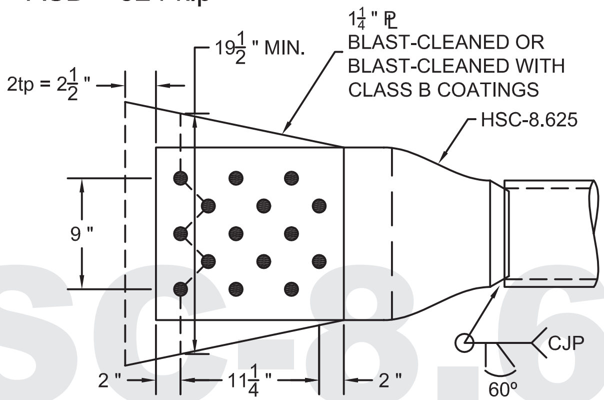
ASD 594 kip



15-1"-490-SB

LRFD 784 kip

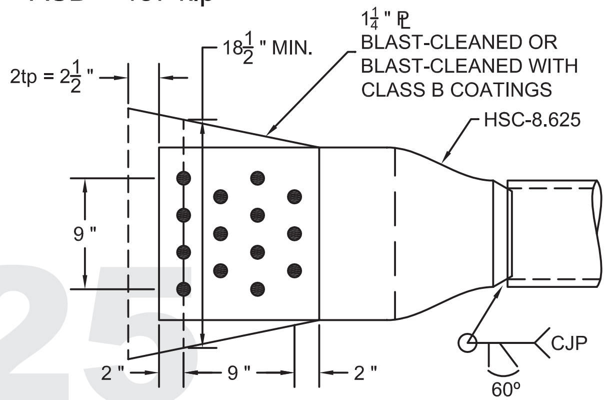
ASD 524 kip



14-1"-490-SB

LRFD 731 kip

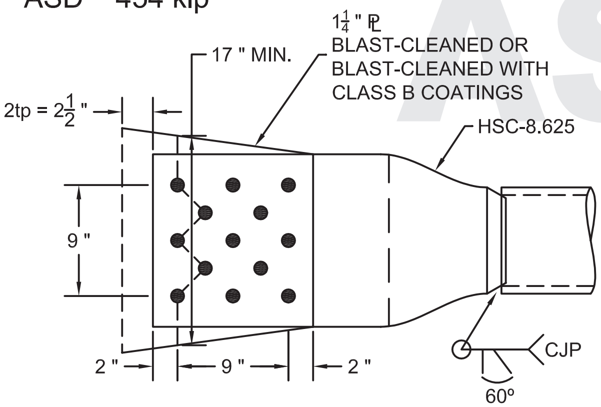
ASD 487 kip



13-1"-490-SB

LRFD 679 kip

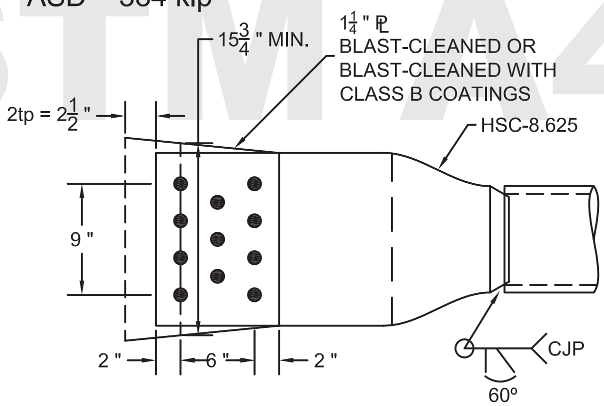
ASD 454 kip



11-1"-490-SB

LRFD 575 kip

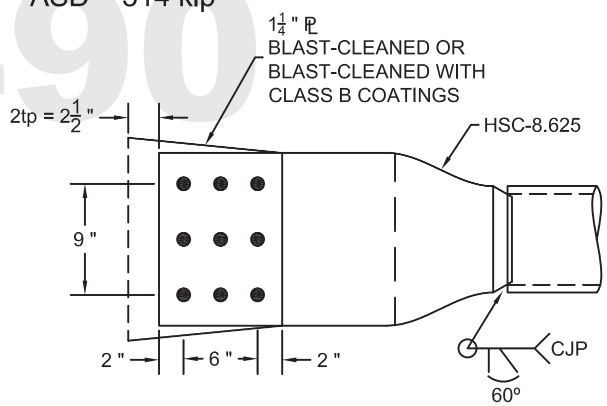
ASD 384 kip



9-1"-490-SB

LRFD 470 kip

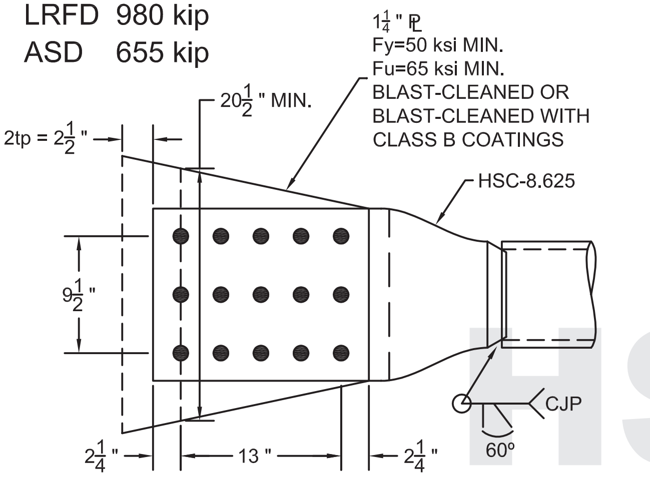
ASD 314 kip



15-1 1/8"-490-SB

LRFD 980 kip

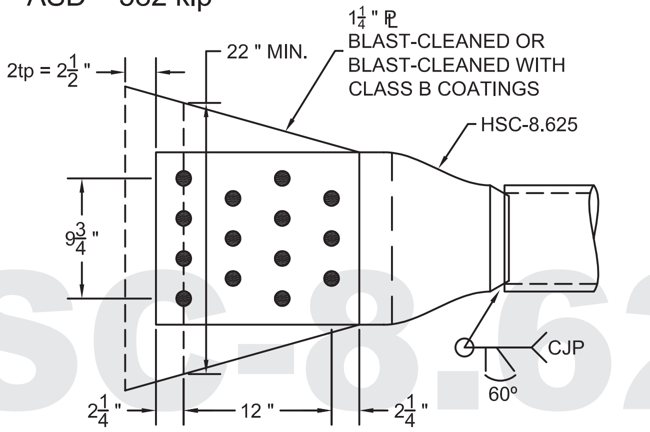
ASD 655 kip



14-1 1/8"-490-SB

LRFD 873 kip

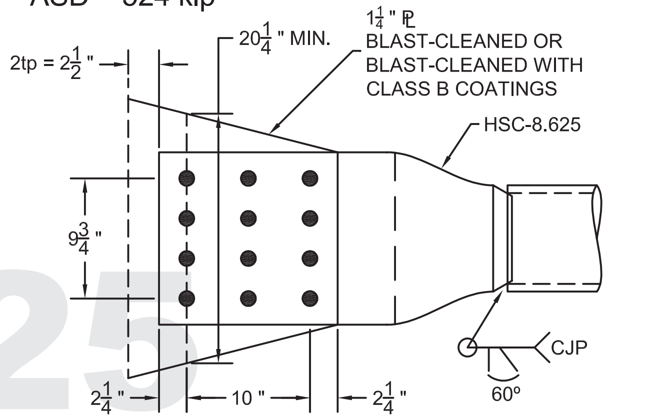
ASD 582 kip



12-1 1/8"-490-SB

LRFD 784 kip

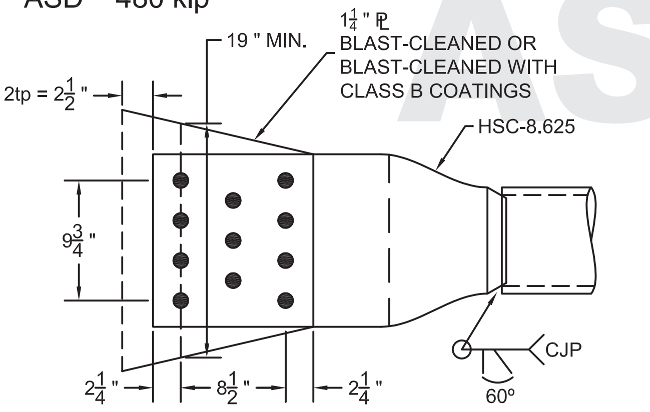
ASD 524 kip



11-1 1/8"-490-SB

LRFD 718 kip

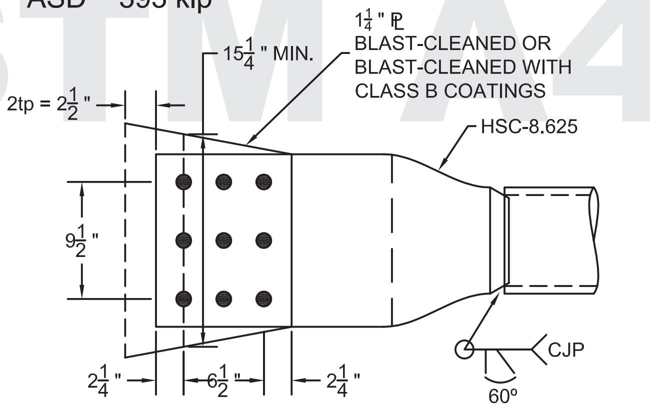
ASD 480 kip



9-1 1/8"-490-SB

LRFD 588 kip

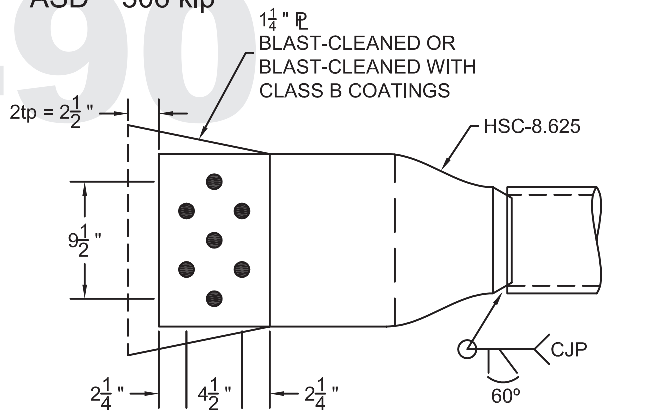
ASD 393 kip



7-1 1/8"-490-SB

LRFD 457 kip

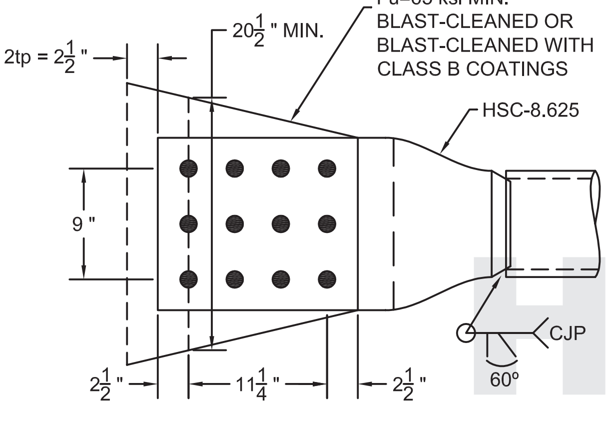
ASD 306 kip



12-1 1/4"-490-SB

LRFD 964 kip

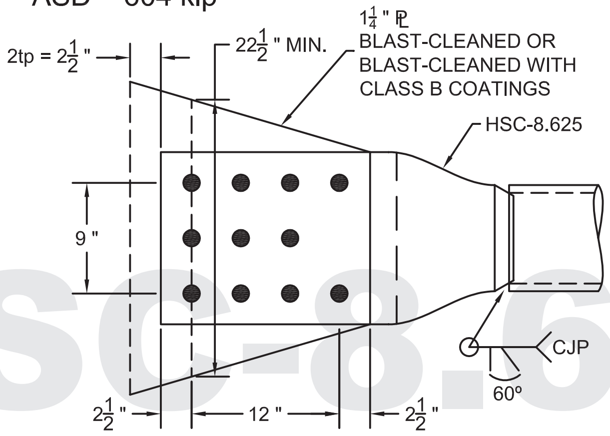
ASD 642 kip



11-1 1/4"-490-SB

LRFD 907 kip

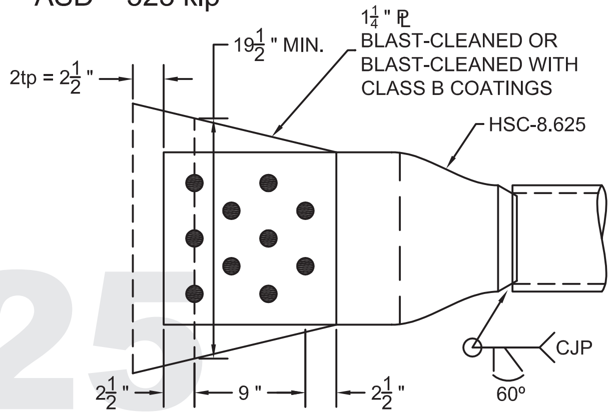
ASD 604 kip



10-1 1/4"-490-SB

LRFD 785 kip

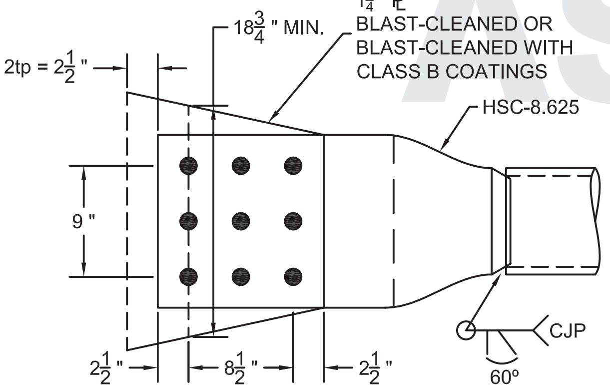
ASD 523 kip



9-1 1/4"-490-SB

LRFD 749 kip

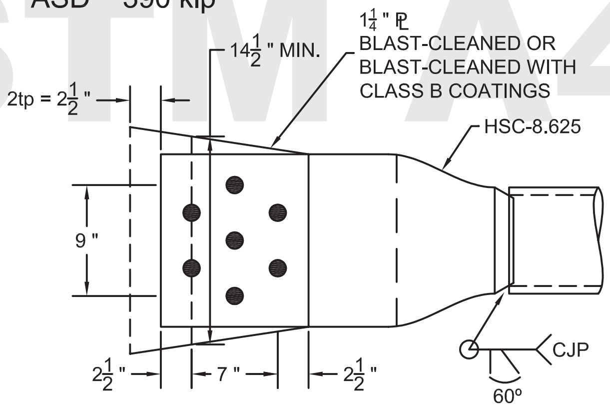
ASD 501 kip



7-1 1/4"-490-SB

LRFD 583 kip

ASD 390 kip



6-1 1/4"-490-SB

LRFD 500 kip

ASD 334 kip