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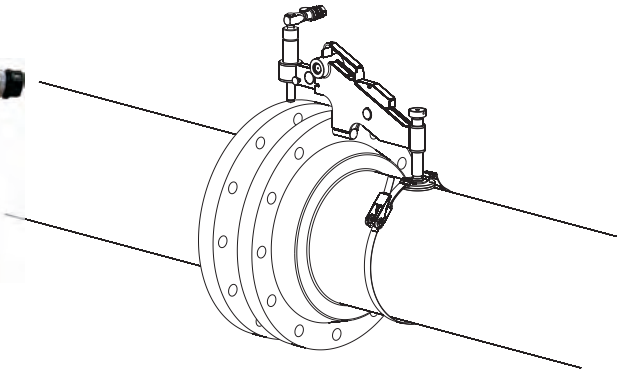
液(油)壓法蘭定心器
操作說明

FSA-4TM, FSA-9TM & FSA-9TE



中文
English
Ver.24

1. 安全預防措施

不遵守以下的注意事項和警告將引起設備損失及人員傷害。

重要事項 :未滿18歲人員不得擅自操作。操作SUN RUN油壓設備前請先仔細閱讀並了解相關操作手冊、安全事項和警告事項。
操作人員負有油壓設備週邊之人員及環境之安全責任。

警告事項 : 為確保避免人員傷害和設備作業損失，請確認所有油壓設備及週邊配件，使用最大壓力為 700 bar(10,000psi).

警告事項: 操作人員於使用期間為避免傷害，需全程配戴安全防護措施。

危險事項: 為避免人員傷害，請於操作過程中手、腳遠離液(油)油壓缸和液壓設備。

警告事項 : 系統操作壓力絕不可超過最低壓力元件之值最低值。系統中應加裝壓力錶藉以監測系統中的壓力並了解使用狀態。

警告事項 : 禁止超載使用。
超載使用易造成設備損害及人員損傷。液(油)壓缸設計最大使用壓力為 700 bar (10,000psi)。

危險事項 : 液(油)壓設備應遠離火或熱源
高溫會軟化包裝和密封材料，導致液壓油洩漏；高溫同時也會造成油管材質與包裝變質。為確保最好狀態，不要將液(油)壓設備暴露於 65°C(150°F)高溫。在電焊場所時亦應注意防止電焊火花噴到油管。

警告事項: 請勿操作未潤滑的滑塊及**4**支滑動插銷。並使用較好的潤滑油。

警告事項: 避免損壞油壓管。捲收油管時，避免油管強烈彎曲或打結。使用彎曲或打結油管易引起背壓。強烈彎曲或打結的油管亦易引起內部損壞或提早油管老化。

重要事項**:** 液壓設備必需由合格的液壓技工進行維修。需要修理時，請連繫就近的**SUN RUN**服務據點並使用**SUN RUN** 液壓油保固方為有效。

危險事項: 不要用手對油管施加壓力(包括拉或舉高) 高壓下洩漏的液壓油會穿透皮膚造成嚴重傷害。當液壓油侵入皮膚請立即就診。

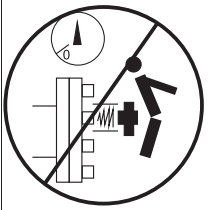
警告事項: 液(油)壓缸只能在已連接好的液壓油路中使用；快速接頭尚未確實連接時禁止使用或加壓，否則高壓情況下接頭的油封及鋼珠會高速噴出造成人員傷亡。

重要事項: 千萬不要利用油管來提攜其他油壓設備(例如:小型油壓缸、泵浦..等)

警告事項: 除了墊塊，千萬不可以手指置於動作中的撐開器。

警告事項: 撐開器的把手是用來當撐開器回縮時使使用者不直接握住撐開器。可使手指免於卡在二片夾片中。

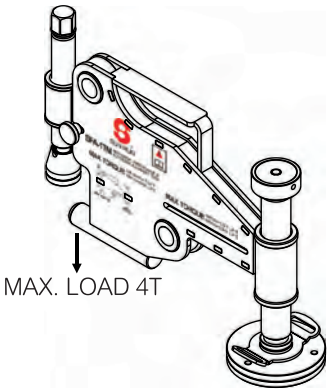
危險事項: 千萬不要使用榔頭或其他楔型斧撐開夾縫。



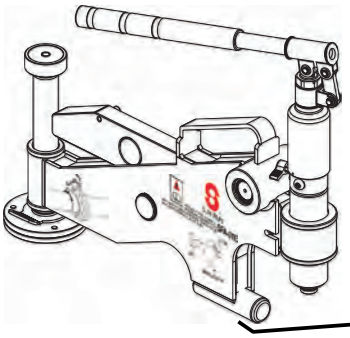
切勿在拉伸或拆卸過程中站立於螺栓同軸位置。如果螺栓出現問題、鬆脫或損壞的零件可能會射出，如此可能會導致嚴重的人員傷亡。非必要或壓力穩定情況下，才允許操作者到加壓拉伸器附近持續觀察壓力計。

2. 規範

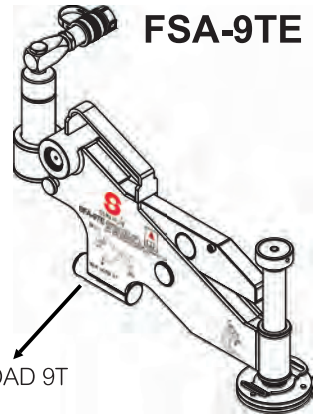
FSA-4TM



FSA-9TM



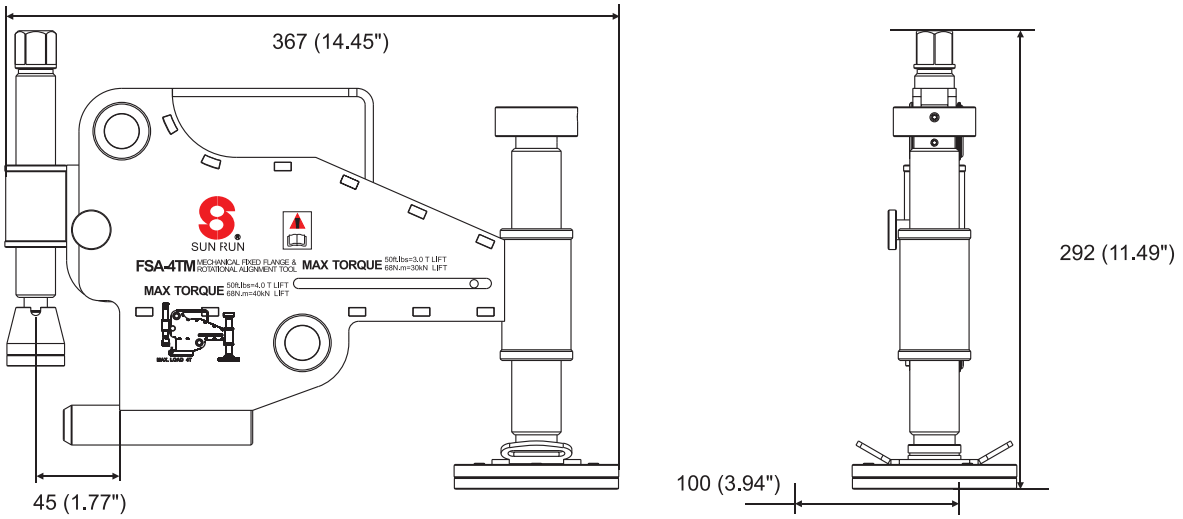
FSA-9TE



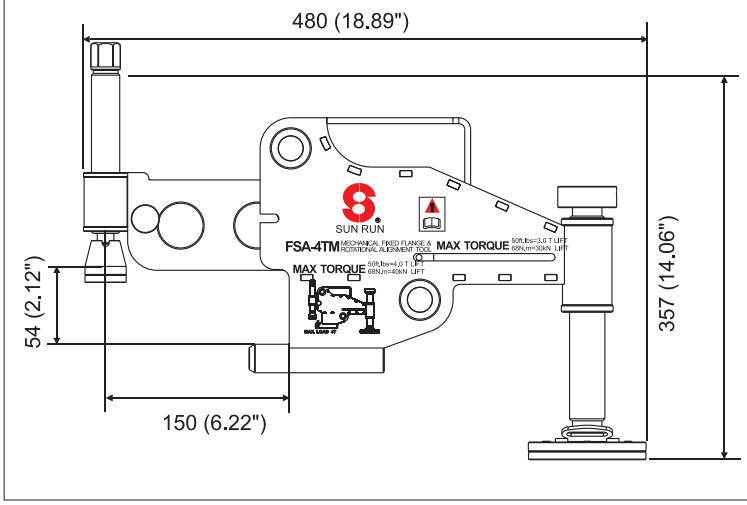
Model Mumber 型號	Max. Lifting Force 最大舉升力 kN / ton	Min. Bolt Size 最小螺栓尺寸 in / mm	Flande Wall Thickness (including gap between flanges) 法蘭厚度（包含法蘭兩片墊片） in / mm	Wt. 重量 (kg)
FSA-4TM	40/ 4	0.95 / 24	1.18 - 5.23 / 30 - 133	8.6
FSA-9TM	90/ 10	1.40 / 35.5	3.66 - 9.00 / 93 - 228	16.5
FSA-9TE	90/ 10	1.40 / 35.5	3.66 - 9.00 / 93 - 228	16.5

2. 規範

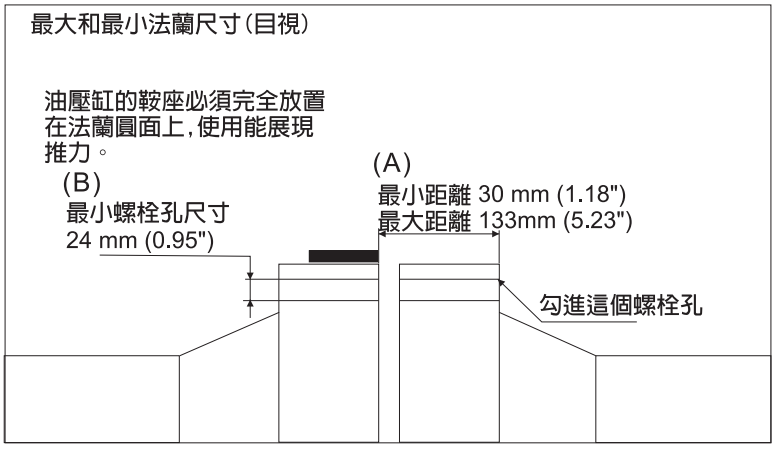
FSA-4TM 最小延伸 mm (inch)



FSA-4TM 最大延伸 mm (inch)

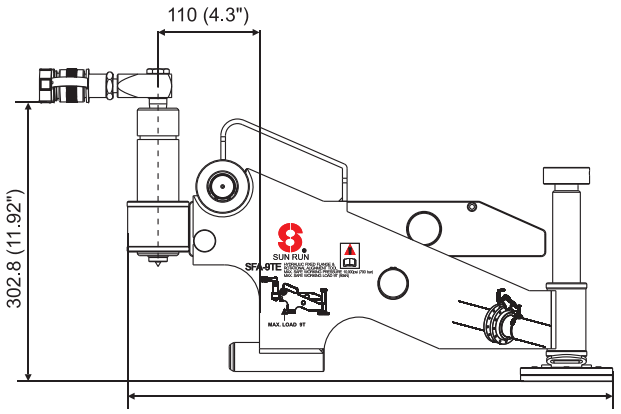


應用範圍:
二個基本尺寸A 和 B，決定FSA-4TM 是否可用於此類法蘭結上校正同心。假如法蘭結需校正同心的放在 30mm(1.18 inch) 及 133 mm(5.23 inch) 如圖 (A)所示，有一個24mm(0.95 inch)螺栓孔或比(B)更大的則FSA-4TM 即可附掛和校正同心(見右圖)。
見22-26頁: 法蘭樣式、等級和尺寸。

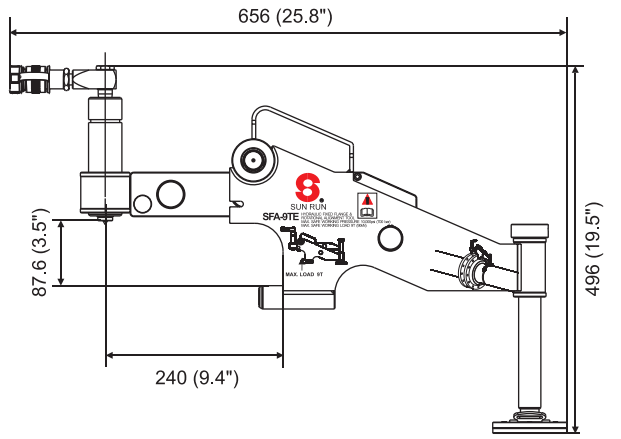


2. 規範

FSA-9TM/ 9TE 最小延伸 in mm (inch)



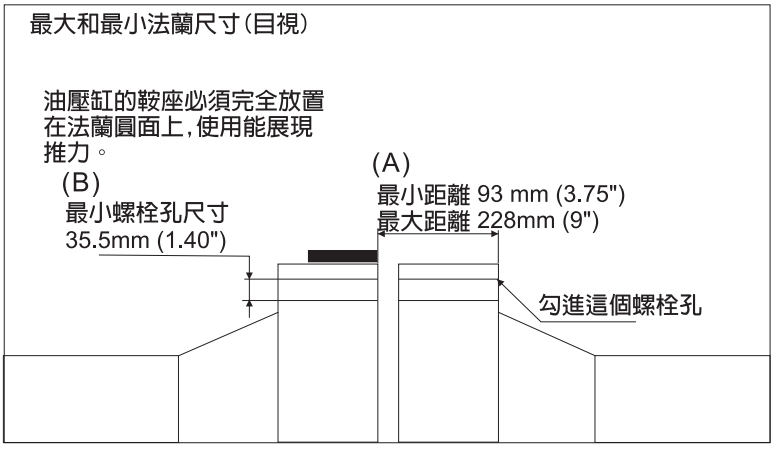
FSA-9TM/ 9TE 最大延伸 in mm (inch)



應用範圍:

二個基本尺寸A 和 B，決定FSA-9TM/ 9TE 是否可用於此類法蘭結上校正同心。
假如法蘭結需校正同心的放在 93mm(3.75 inch) 及 228 mm(9 inch) 如圖 (A)所示, 有一個35.5mm(1.40 inch)螺栓孔或比(B)更大的則FSA-9TM /9TE即可附掛和校正同心 (見右圖)。

見22-26頁: 法蘭樣式、等級和尺寸。



3. 設備清單

FSA-4TM 組包括: 1* 內部發泡保護之工具箱 1* 定心工具 1* 使用操作說明 1* 背帶和棘輪 1* 扭力扳手 20-110 N.m (2.04-11.22 kg.m) 套筒22 mm	FSA-9TE/ 9TM 組包括: 1* 內部發泡保護之工具箱 1* 定心工具和6T液(油)壓缸 1* 使用操作說明 1* 背帶

4. 操作

4.1操作前置作業

4.1.2 FSA-4TM (圖4.1.2)

1. FSA-4TM應能穩固的將舉勾完全插入較低的最大法蘭錯位螺栓孔內。
2. 當定心器架在螺栓孔上後，放鬆升降桿需且平穩地的站在管線上。
3. 拔出兩翼固定器，使用兩邊可伸展出些許工作距離。
4. 將油壓缸穩固地插入前端軸套。順時針轉動前端油壓缸及軸套直到油壓缸前端接觸到法蘭的圓弧面。
5. 將扭力扳手設置 50 lbf.ft (最大) 和工具上的螺栓連結，並將螺栓轉至法蘭面帶動法蘭結的調整

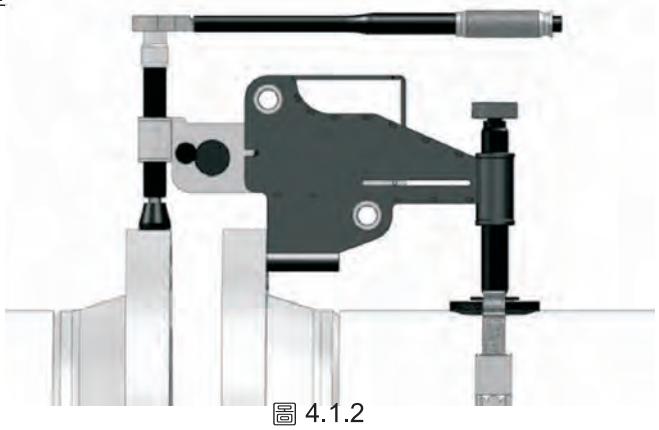
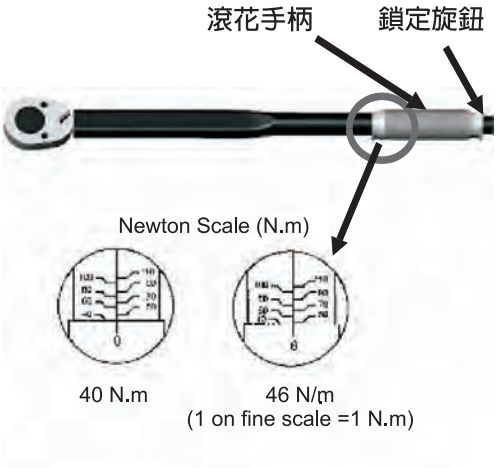


圖 4.1.2

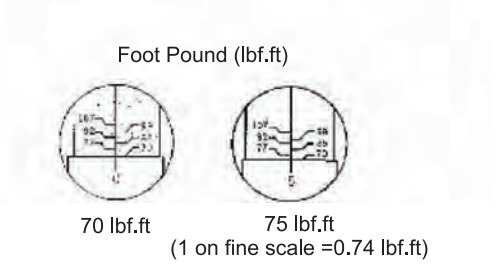
如何操作扭力扳手

將扭力扳手平衡的放置左手邊,
逆時針將鎖定旋鈕轉開,不要讓
滾花手柄鎖住。.
利用滾花手柄設定扭力值
(見右例: 40-46 N.m).



1. 從精準刻度0轉至40.
2. 欲設定置46,只需再轉動6個刻度.
3. 欲鎖住手柄,順時針轉動即可.

正確安裝扭力扳手連結至 定心器FSA-4TM.
放置扭力扳手直到感覺或聽到"CLICK"聲.
欲設置 lbf.ft 單位,也同 N.m 步驟.



棘輪棘齒扭力在"CLICK"時不要硬拉。適用於低扭矩的設定。
如果棘輪棘齒扭力扳手尚未使用一段時間：
在多次低扭矩操作下 ，可於內部重塗潤滑劑。
在不使用情況下,將扭矩設置為最小扭矩值。不要把手柄設定在最低扭矩值。
您的棘輪棘齒扭矩扳手是一種精密測量儀器，並應及時校正
不要使用任何清潔液體,因為有可能會傷害裡面的精準零件,只需擦拭即可。

1. 不要嘗試扭轉已鎖住的棘輪棘齒扭力扳手
2. 不要將棘輪棘齒轉低於最低刻度或轉高於最高刻度

4. 操作

4.1操作前置作業

4.1.3 FSA-9TM/ 9TM (圖4.1.3)

1.FSA-9TE/ 9TM 應能穩固的將舉勾完全插入較低的法蘭螺栓孔內；
如此才能使相對的法蘭螺栓孔獲得水平舉起。

2.當定心器架在螺栓孔上後，放鬆升降桿需且平穩地的站在管線上。

3.拔出兩翼固定器，使用兩邊可伸展出些許工作距離。

4.將油壓缸穩固地插入前端軸套。順時針轉動前端油壓缸及軸套直到油壓缸前端接觸到法蘭的圓弧面。

5.油壓缸底軸套應完全穩靜地置於法蘭圓弧面上。油管和泵浦接上搭配使用的定心器油缸上。

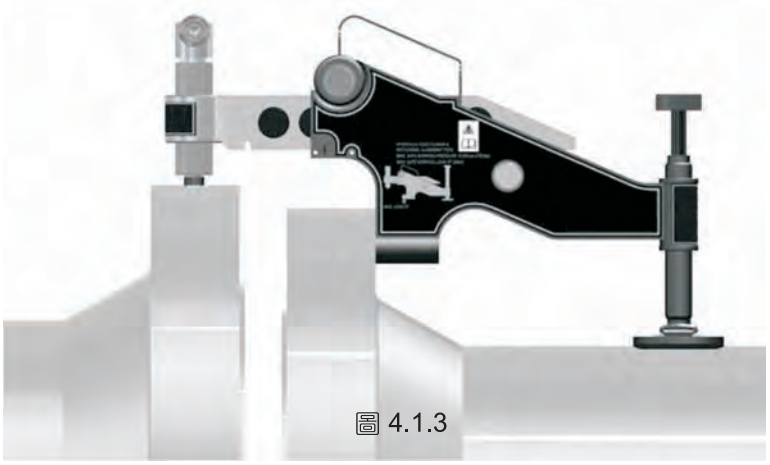
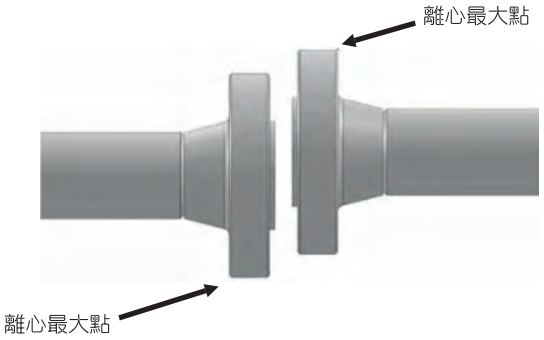


圖 4.1.3

4. 操作

4.2 安裝及操作

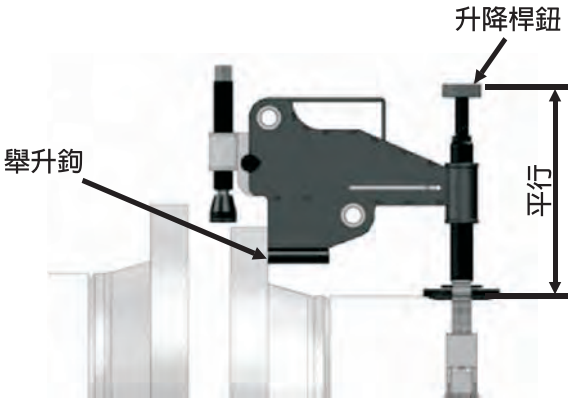
4.2.1量出離心最大位置. 依步驟 1 (右圖) 無論在上方法蘭結或是下方法蘭結均可得知；如箭頭所示。



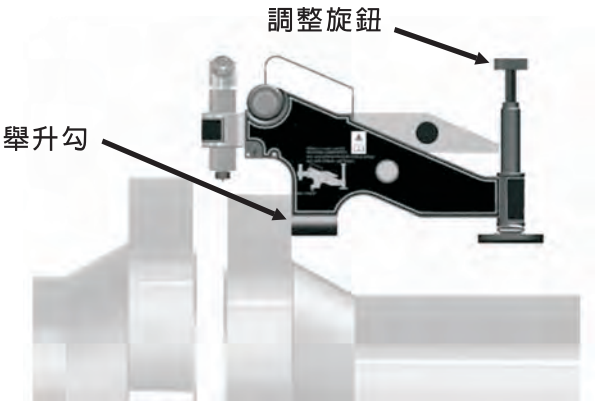
4.2.2 舉升鉤應如 步驟2(右圖) 所示，前引於離心最大位置的螺栓孔。

FSA-4TM

順時針旋轉升降桿扭,使升降桿可以碰觸於法蘭管上。當要矯正法蘭盤時,定心器應被舉置於水平上。



FSA-9TM/ 9TE



4. 操作

4.2 安裝及操作

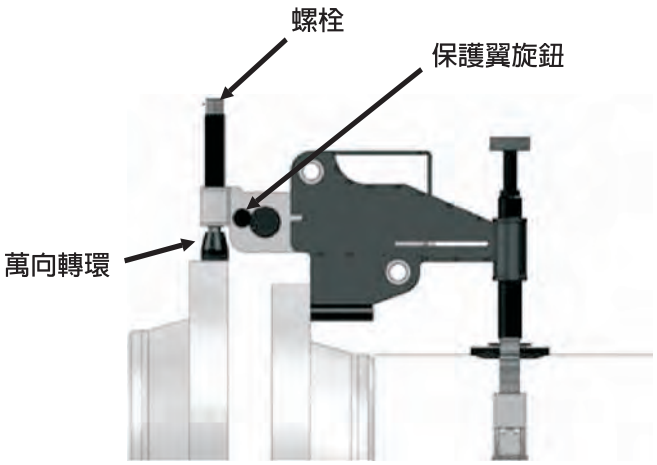
4.2.3

FSA-4TM

當舉升鉤持持續舉升至螺栓孔位置時，升降桿應放鬆與舉升鉤同時上升。(見右圖)
將延伸翼拉伸到需要的位置。

旋轉調整軸套直到能頂到對面法蘭的表面。

在這個時候,要確認定心器平穩的安裝在法蘭上並且摩擦墊須完全接觸在最高法蘭面上。

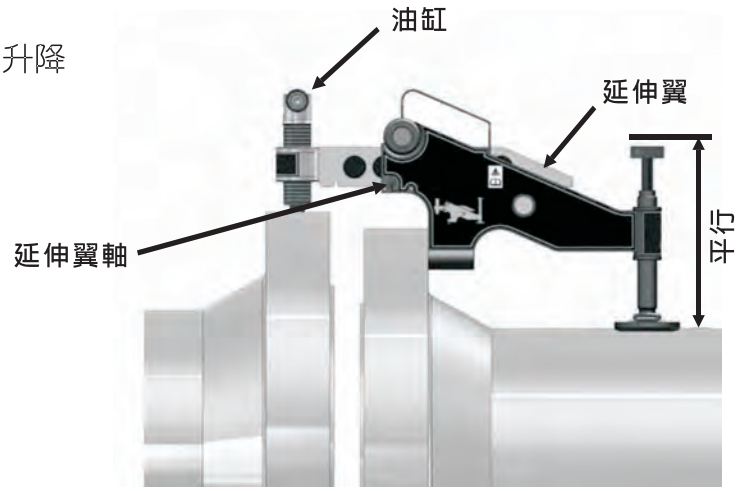


FSA-9TM/ 9TE

當舉升鉤持持續舉升至螺栓孔位置時，升降桿應放鬆與舉升鉤同時上升。(見右圖)
將延伸翼拉伸到需要的位置。

油壓缸 / 順時針旋轉調整軸套直到能頂到對面法蘭的表面。

當預備校正定心時，
油壓管及泵浦已連接完成。



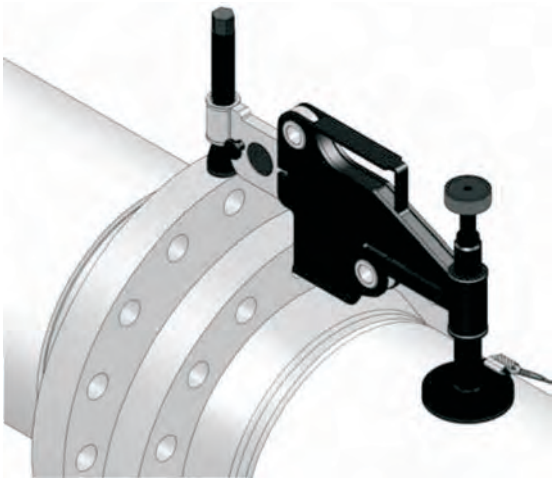
4. 操作

4.2 安裝及操作

4.2.4

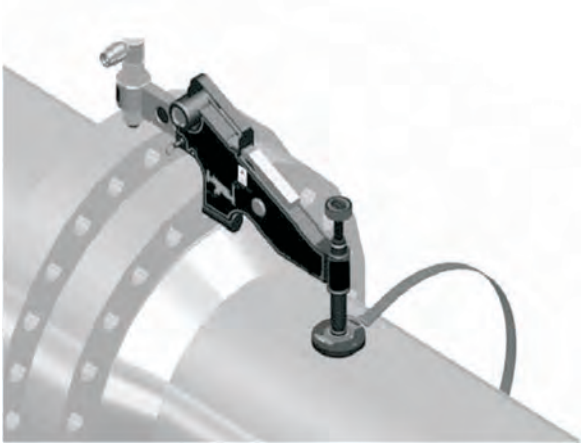
FSA-4TM

將肩帶鉤從法蘭上基準面垂下 (如右圖所示)。



FSA-9TM / 9TE

將背帶連接掛勾,穿過基準面(如右圖)



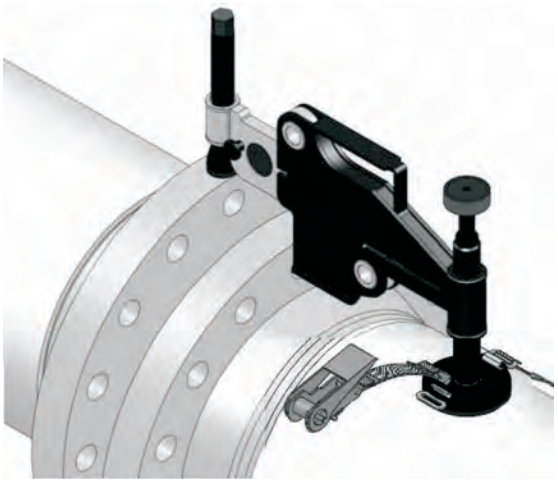
4. 操作

4.2 安裝及操作

4.2.5

FSA-4TM

將棘輪式扣環從另一側法蘭基準面垂下
(如右圖所示)。



FSA-9TM/ 9TE

將機械棘輪掛勾,穿過基準面反方向
(如右圖)

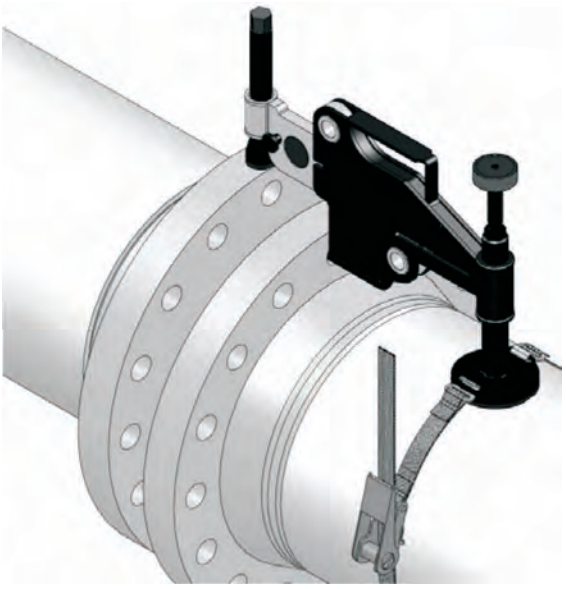
4. 操作

4.2 安裝及操作

4.2.6

FSA-4TM

將背帶穿越至棘輪式扣環（如右圖所示），
並將背帶拉緊,使定心器能穩固在法蘭管上。



FSA-9TM / 9TE

將打開的背帶穿過機械棘輪(如右圖)
利用機械棘輪將背帶調緊

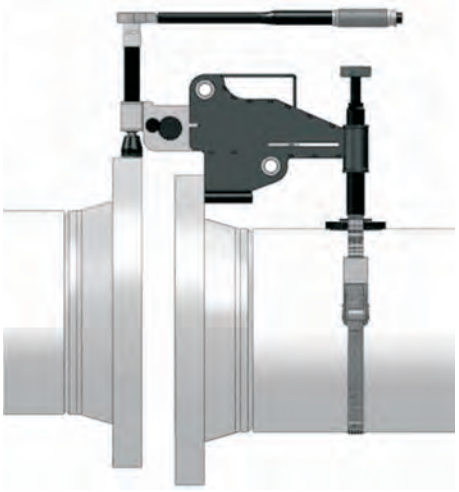
4. 操作

4.2 安裝及操作

4.2.7

FSA-4TM

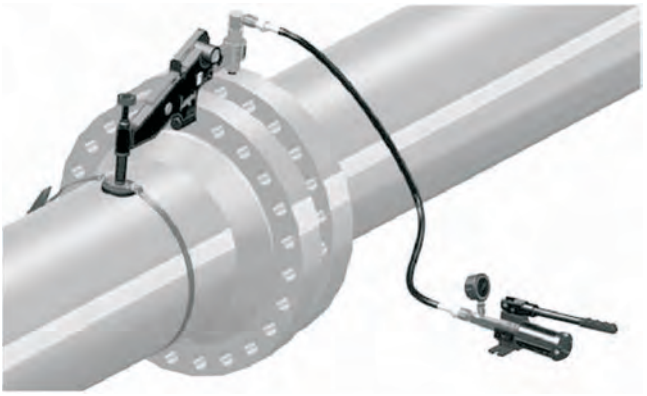
將棘輪棘齒扭力扳手調至扭矩值為 14 lbf.ft (19N.m) 且和螺栓連接。



FSA-9TM / 9TE

確實確認手動泵,油管和油缸連接正確無疑

操作手動泵,直至法蘭開始調整



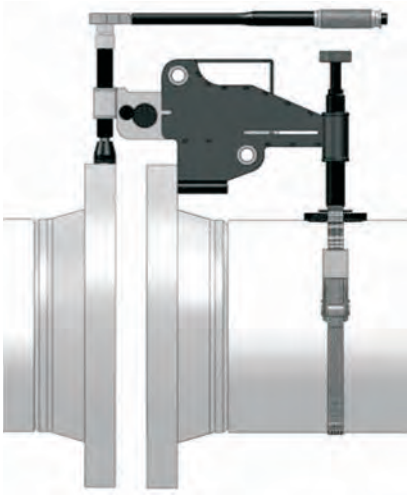
4. 操作

4.2 安裝及操作

4.2.8

FSA-4TM

順時針方向轉動棘輪棘齒扭力扳手,將螺栓鎖緊
直到法蘭校正動作完成。
或聽到棘輪棘齒扭力扳手" CLICKS ",即完成。



如果棘輪棘齒扭力扳手已發出聲響,但法蘭結仍呈
錯位狀態,此時可以將棘輪棘齒扭力扳手的扭矩值
調至24.2 lbf.ft(33 N.m) 或最大值50 lbf.ft(67.8 N.m)
直到法蘭結已完全校正完畢。

一旦法蘭結對準,可將螺栓插入且拴緊。
更換所有的螺栓後(除了 FSA-4TM 所占的螺栓孔
)依步驟2-8倒回操作,將定心器移開。
插入最後一根螺栓且拴緊。

最大安全工作負載力矩
50 lbf.ft(67.8 N.m).
若將力矩值超過50 lbf.ft(67.8 N.m)
則會對定心工具本身造成危險。

FSA-9TM / 9TE

再一次將螺栓調緊並插入
在所有螺栓都放置完後,依步驟2-4將
定心器取下。
插入最後一隻螺栓並鎖緊

當從法蘭取下調整工具時,注意不要讓組件掉落,
此動作可預防操作者或路人的安全。

5. 維修檢測

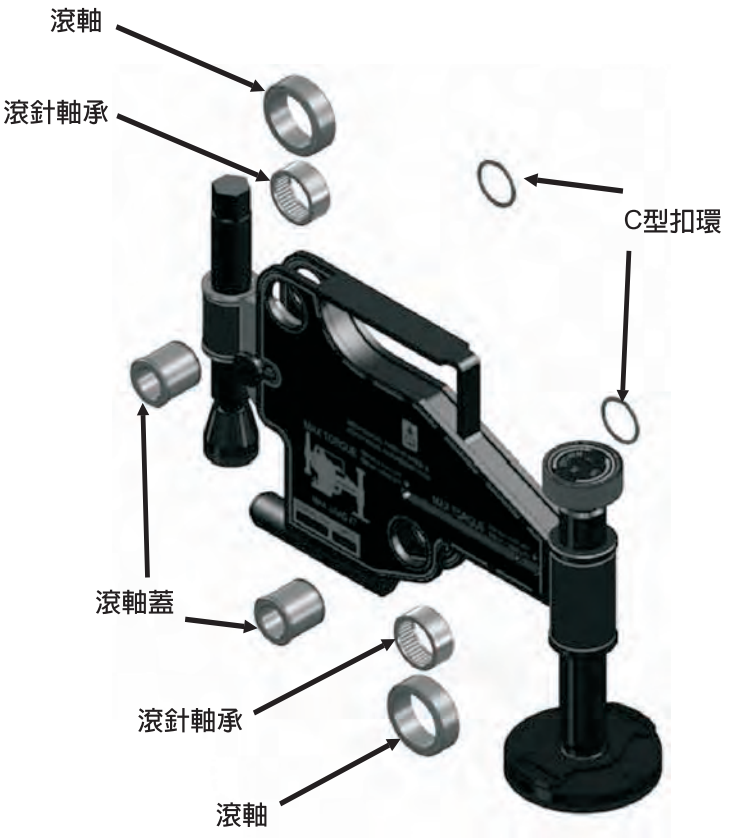
FSA-4TM

A.在工作桌上放置工具盤。

B.利用一個小的一字螺絲起子,翹起C型扣環尾端並逆時針旋轉然後移除。

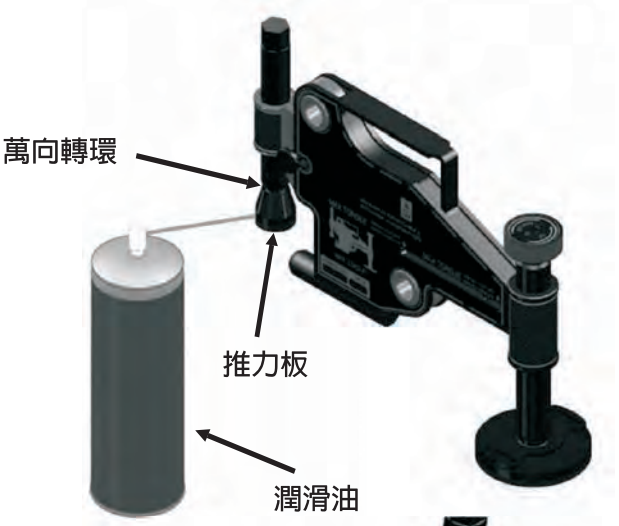
C.轉動滾軸蓋並取出,才能將滾軸和滾針軸承取下檢查。

D.檢查滾軸蓋、滾軸和滾針軸承是否有損傷。若沒有損傷,清理乾淨後,依步驟B~D倒回操作組裝。

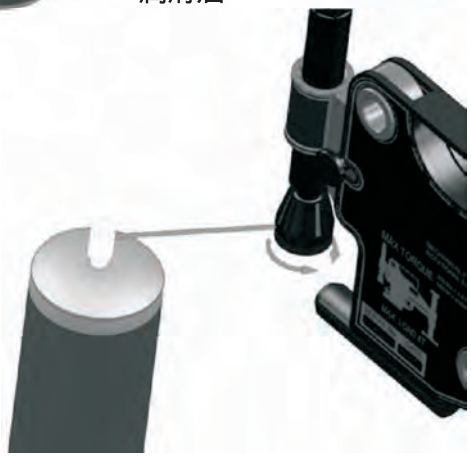


E.重要的是,推力軸承不受汙垢和腐蝕性物質的影響,而能自由的轉動。

F.利用潤滑油如:WD40或類似相關性質的潤滑油,噴塗至萬向轉環和推力板間(如右圖所示)



G.在使用定心器校正法蘭結時,確保推力板能自由的旋轉。

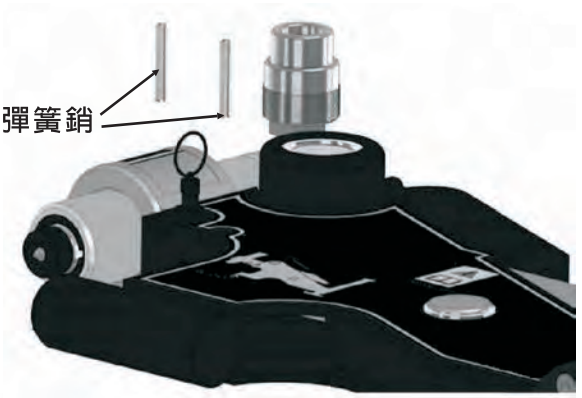


5. 維修檢測

FSA-9TM/ 9TE

A.在工作桌上放置工具盤。

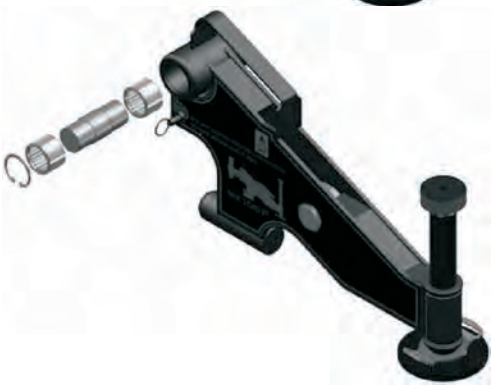
B.取下本體上的兩個彈簧銷。



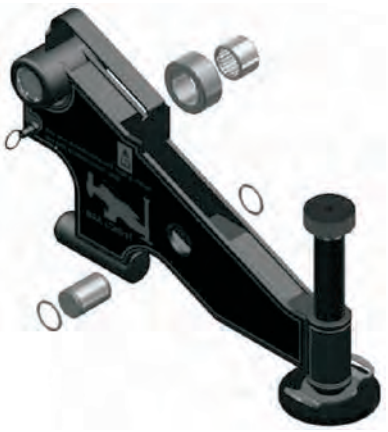
C.(見右圖)延伸翼此時可從本體前向前移出。

D.利用C扣鎳子將C扣取出。

E.檢查滾針軸承外蓋及滾針軸承在內部轉動時是否有卡住或髒污情形。
清除後應略塗薄油。



F.從本體側邊和底部將C型保護扣環和滾動軸取出。
滾動軸和滾針軸承可從定心器上取出(如右圖)
檢查滾動軸及滾針軸承在內部轉動時是否有卡住或髒汙情型。
清除後應略塗薄油。
再反覆B~F步驟重新組裝。



6. 無校直判定步驟

法蘭定心器不可用於未經無校直判定步驟的法蘭管線。

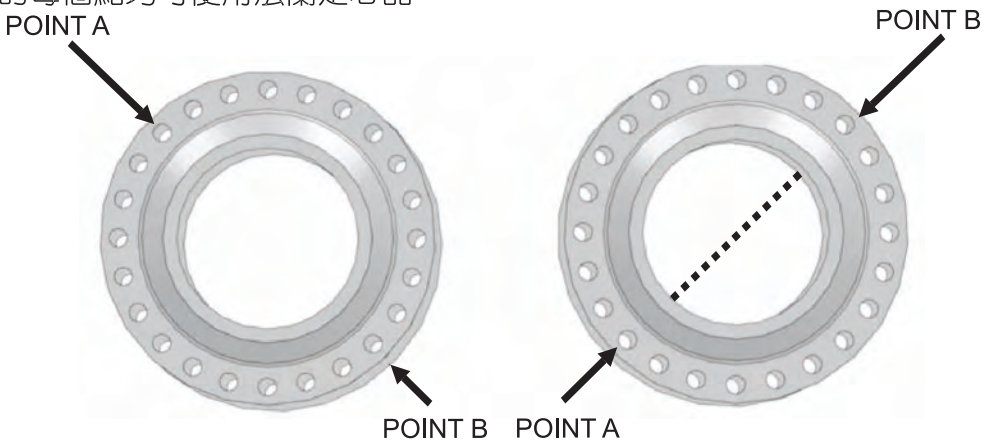
6.1 橫向偏離

6.1.1

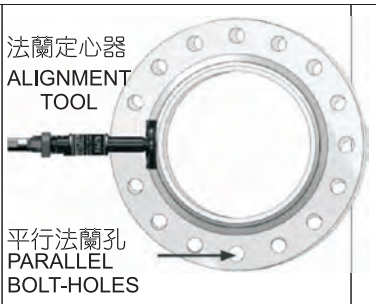
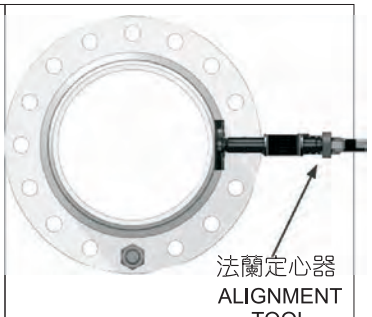
每個第二螺栓都必需鬆開移除。
持續此動作直到產生錯位。
一個法蘭接合面一旦有問題(或斷裂)即可能偏離中心校直點或發生無法預期的情況。
接著未必發生無校直情形，直到只剩下少數幾個螺栓。無校直情況即顯而易見。

6.1.2

任何的錯位方向點在下圖例子中可清楚看見
法蘭定心器應當附在無校直的最大離心點，像是A或B。
案例中的每個點均可使用法蘭定心器。



6.2 離心問題

			
法蘭是已校正定心而無庸至疑的，但操作者經常未將二個相對應的螺栓孔連接在一起造成離心問題。 安裝步驟在任何突發意外狀況時相同。 法蘭定心器可附掛在法蘭結表面任何由於離心所引起的螺栓孔造成相同角度，可接近的點。	在法蘭結表面選擇最容易或最易接近的點。 當兩面法蘭為校正同心但確出現依序離心狀況時法蘭定心器則用來將法蘭推回同心直到一對螺栓孔成為同行方向。	插入螺栓後放掉法蘭定心器荷載將會轉移到插入的螺栓上。	重複步驟2和3,在法蘭結其餘的螺栓孔平行校正後皆插入螺栓。

7.問題解決

問題	原因	解決
當FSA-4TM校正同心於法蘭結面時推力板與圓表面產生滑動	A.有砂礫或髒污在延伸翼、滾軸或軸承內，造成延伸翼滑動延伸	A.確認滾軸能自由轉動且無像是砂礫或髒污阻擋轉動。 在法蘭結校正時,確定延伸翼有足夠的空間延展。
FSA-4TM附掛在法蘭結上功能正常，但法蘭結無法校正同心	A. 可能是靠近法蘭上的某些物質阻礙了作用。 B. 造成法蘭結需要超過4.0 tons (40kN) 的壓力來校正同心。	A. 確認法蘭結面是否有阻礙物。而予以清除。 B. 假如法蘭結需要超過4.0tons (40kN)的力量來校正同心，請找尋其他替代方式。
當螺栓被鎖緊,推力板在法蘭結周圍是擰緊的	A. 有砂礫或髒污在萬向轉環或推力板內	A. 檢查推力板是否能自由轉動如果不能 ,在萬向轉環和推力板間的空隙噴入潤滑液使其潤滑進而轉動。

7.問題解決

問題	原因	解決
FSA-9TE/9TM 附掛在法蘭結上功能正常，但無法達到全壓。	空氣可能從油壓工具中洩掉	A. 利用油管將手動泵和FSA-9TE/9TM連接一起。 B. 將手泵浦的洩壓閥關掉,持續操作手泵浦,當達低壓時,油缸全延展。 C. 將工具直立於地面上，持液壓泵浦於工具之上，將泵浦上的洩壓閥鎖緊，搖動泵浦使油壓缸完全揚程。油壓泵仍在工具上方，打開洩壓閥使油壓缸完全回縮。當油壓缸回縮則油壓系統內的空氣會被透過通氣孔被推出。 D. 重覆上述1-3步驟3~4次以確保空氣完全被移除，則工具即可產生工作壓力。
當FSA-9TE/9TM校正同心於法蘭結面時摩擦墊與圓表面產生滑動	有砂礫或髒污在延伸翼、滾軸或軸承內，造成延伸翼滑動延伸	A. 確認滾軸能自由轉動且無像是砂礫或髒污阻擋轉動。 B. 確認延伸翼在校正同心時，不會滑動。 C. 確認在FSA-9TE/9TM校正同心時可有足夠的延伸。
FSA-9TE/9TM 附掛在法蘭結上功能正常，但法蘭結無法校正同心	A. 可能是油壓系統內存有空氣，阻礙了法蘭面上的力量。 B. 可能是靠近法蘭上的某些物質阻礙了作用。造成法蘭結需要超過9.0 tons(90kN) 的壓力來校正同心。	A. 確認法蘭結面是否有阻礙物。而予以清除。 B. 假如法蘭結需要超過9.0tons (90kN)的力量來校正同心，請找尋其他替代方式。

8.適用範圍

8.1 Bs10 法蘭適用

CLASS A																																				
NPS	3 1/2"	4"	5"	6"	7"	8"	9"	10"	12"	13"	14"	15"	16"	17"	18"	19"	20"	21"	22"	23"	24"	26"	27"	29"	30"	33"	35"	36"	39"	42"	45"	48"	54"	60"	66"	72"
TOOL	FSA-1TM																				FSA-1TM					FSA-4TM				FSA-4TM						

CLASS D																																						
NPS	4"	5"	6"	7"	8"	9"	10"	12"	13"	14"	15"	16"	17"	18"	19"	20"	21"	22"	23"	24"	29"	30"	33"	35"	36"	39"	42"	45"	48"	54"	60"	66"	72"	78"	84"	96"	108"	120"
TOOL	FSA-1TM															FSA-4TM														FSA-9TE/9TM								

CLASS E																																				
NPS	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	5"	6"	7"	8"	9"	10"	12"	13"	14"	15"	16"	17"	18"	19"	20"	21"	22"	23"	24"	27"	29"	30"	33"	35"	36"	39"	42"	45"	48"
TOOL						FSA-1TM																FSA-4TM												FSA-9TE/9TM		

CLASS F																																				
NPS	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	5"	6"	7"	8"	9"	10"	12"	13"	14"	15"	16"	17"	18"	19"	20"	21"	22"	23"	24"	27"	29"	30"	33"	35"	36"	39"	42"	45"	48"
TOOL			FSA-1TM													FSA-4TM																	FSA-9TE/9TM			

CLASS H																										
NPS	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	5"	6"	7"	8"	9"	10"	12"	13"	14"	15"	16"	17"	18"	19"	20"	21"	22"	23"	24"
TOOL			FSA-1TM									FSA-4TM														

CLASS J																										
NPS	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	5"	6"	7"	8"	9"	10"	12"	13"	14"	15"	16"	17"	18"	19"	20"	21"	22"	23"	24"
TOOL			FSA-1TM					FSA-4TM											FSA-9TE/9TM							

CLASS K																							
NPS	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	5"	6"	7"	8"	9"	10"	12"	13"	14"	15"	16"	17"	18"	19"	20"
TOOL			FSA-1TM						FSA-4TM							FSA-9TE/9TM							

CLASS R																							
NPS	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	5"	6"	7"	8"	9"	10"	12"	13"	14"	15"	16"	17"	18"	19"	20"
TOOL			FSA-1TM				FSA-4TM									FSA-9TE/9TM							

CLASS S																							
NPS	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	4 1/2"	5"	6"	7"	8"	9"	10"	11"	12"	13"	14"	15"	16"
TOOL	FSA-1TM											FSA-4TM			FSA-9TE/9TM								

CLASS T																				
NPS	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	4 1/2"	5"	6"	7"	8"	9"	10"	11"	12"	13"
TOOL	FSA-1TM						FSA-4TM					FSA-9TE/9TM								

Color	Meaning
Blue	適用於 FSA-1TM TOOL
Green	適用於 FSA-4TM TOOL
Pink	適用於 FSA-9TM/9TE TOOL
Grey	不適用任型號

API6BX 焊頸法蘭適用

CLASS 10K	NPS	1 13-16"	2 1-16"	2 9-16"	3 1-8"	4 1-16"	5 1-8"	7 1-16"	9"	11"	13 5-8"	16 3-4"
	TOOL	FSA-1TM		FSA-4TM				FSA-9TE/9TM				
CLASS 15K	NPS	1 13-16"	2 1-16"	2 9-16"	3 1-8"	4 1-16"	5 1-8"	7 1-16"	9"	11"	13 5-8"	16 3-4"
	TOOL	FSA-1TM		FSA-4TM		FSA-9TE/9TM						
CLASS 20K	NPS	1 13-16"	2 1-16"	2 9-16"	3 1-8"	4 1-16"	5 1-8"	7 1-16"	9"	11"	13 5-8"	16 3-4"
	TOOL	FSA-4TM		FSA-9TE/9TM								

API6B 焊頸法蘭適用

CLASS 2K	NPS	2 1-16"	2 9-16"	3 1-8"	4 1-16"	5 1-8"	7 1-16"	9"	11"	13 5-8"	16 3-4"	21 1-4"
	TOOL	FSA-1TM			FSA-4TM							
CLASS 3K	NPS	2 1-16"	2 9-16"	3 1-8"	4 1-16"	5 1-8"	7 1-16"	9"	11"	13 5-8"	16 3-4"	21 1-4"
	TOOL	FSA-1TM		FSA-4TM			FSA-9TE/9TM					
CLASS 5K	NPS	2 1-16"	2 9-16"	3 1-8"	4 1-16"	5 1-8"	7 1-16"	9"	11"	13 5-8"	16 3-4"	21 1-4"
	TOOL	FSA-1TM		FSA-4TM		FSA-9TE/9TM						

	適用於 FSA-1TM TOOL
	適用於 FSA-4TM TOOL
	適用於 FSA-9TM/9TE TOOL
	不適用任型號

8.2 ASME B16.5 法蘭適用

CLASS 150	NPS	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	24"
	TOOL					FSA-1TM								FSA-4TM						
CLASS 300	NPS	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	24"
	TOOL				FSA-1TM								FSA-4TM				FSA-9TE/9TM			
CLASS 400	NPS	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	24"
	TOOL					FSA-1TM			FSA-4TM						FSA-9TE/9TM					
CLASS 600	NPS	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	24"
	TOOL				FSA-1TM				FSA-4TM					FSA-9TE/9TM						
CLASS 900	NPS	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	24"
	TOOL	FSA-1TM			FSA-4TM								FSA-9TE/9TM							
CLASS 1500	NPS	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	24"
	TOOL	FSA-1TM			FSA-4TM						FSA-9TE/9TM									
CLASS 2500	NPS	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	24"
	TOOL	FSA-1TM			FSA-4TM					FSA-9TE/9TM										

	適用於 FSA-1TM TOOL
	適用於 FSA-4TM TOOL
	適用於 FSA-9TM/9TE TOOL
	不適用任型號

ASME B16.47 法蘭適用

CLASS 150	NPS	22"	26"	28"	30"	32"	34"	36"	38"	40"	42"	44"	46"	48"
	TOOL	FSA-4TM						FSA-9TE/9TM						
CLASS 300	NPS	22"	26"	28"	30"	32"	34"	36"	38"	40"	42"	44"	46"	48"
	TOOL	FSA-4TM							FSA-9TE/9TM					
CLASS 400	NPS	22"	26"	28"	30"	32"	34"	36"	38"	40"	42"	44"	46"	48"
	TOOL	FSA-4TM							FSA-9TE/9TM					
CLASS 600	NPS	22"	26"	28"	30"	32"	34"	36"	38"	40"	42"	44"	46"	48"
	TOOL	FSA-4TM							FSA-9TE/9TM					
CLASS 900	NPS	22"	26"	28"	30"	32"	34"	36"	38"	40"	42"	44"	46"	48"
	TOOL	FSA-9TE/9TM												

DIN WELD NECK FLANGE RANGE OF APPLICATION

CLASS PN16	NPS	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	7"	8"	10"	12"	14"	16"	18"	20"	24"	28"	32"	36"	40"	48"	56"	72"	80"		
	TOOL	FSA-1TM															FSA-4TM							FSA-9TE FSA-9TM		
CLASS PN25	NPS	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	7"	8"	10"	12"	14"	16"	18"	20"	24"	28"	32"	36"	40"		
	TOOL					FSA-1TM											FSA-4TM									
CLASS PN40	NPS	1/2"	2"	2 1/2"	3"	4"	5"	6"	7"	8"	10"	12"	14"	16"	18"	20"											
	TOOL	FSA-1TM											FSA-4TM													
CLASS PN64	NPS	3/4"	1"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	7"	8"	10"	12"	14"	16"											
	TOOL		FSA-1TM							FSA-4TM																
CLASS PN100	NPS	1/2"	3/4"	1"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	7"	8"	10"	12"	14"											
	TOOL			FSA-1TM					FSA-4TM					FSA-9TE/9TM												
CLASS PN160	NPS	3/8"	1/2"	3/4"	1"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	7"	8"	10"	12"											
	TOOL				FSA-1TM				FSA-4TM				FSA-9TE/9TM													

	適用於 FSA-1TM TOOL
	適用於 FSA-4TM TOOL
	適用於 FSA-9TM/9TE TOOL
	不適用任型號

8.3 SPO 法蘭適用

		2 1/2"	3"	3 1/2"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"	26"	28"	30"	32"	34"	36"	38"	40"	42"	44"	46"	48"
CLASS 150	NPS																											
	TOOL											FSA-1TM										FSA-4TM						
CLASS 300	NPS																											
	TOOL							FSA-1TM						FSA-4TM							FSA-9TE/9TM							
CLASS 600	NPS																											
	TOOL									FSA-4TM					FSA-9TE/9TM													
CLASS 900	NPS																											
	TOOL								FSA-4TM				FSA-9TE/9TM															
CLASS 1500	NPS																											
	TOOL				FSA-4TM				FSA-9TE/9TM																			
CLASS 2500	NPS	2 1/2"	3"	3 1/2"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"													
	TOOL			FSA-4TM				FSA-9TE/9TM																				
CLASS 5000	NPS	2 1/2"	3"	3 1/2"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"													
	TOOL					FSA-4TM			FSA-9TE/9TM																			
CLASS 7500	NPS	2 1/2"	3"	3 1/2"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"													
	TOOL		FSA-4TM					FSA-9TE/9TM																				
CLASS 10000	NPS	2 1/2"	3"	3 1/2"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"													
	TOOL				FSA-4TM					FSA-9TE/9TM																		
CLASS 15000	NPS	2 1/2"	3"	3 1/2"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"													
	TOOL	FSA-4TM						FSA-9TE/9TM																				

	適用於 FSA-1TM TOOL
	適用於 FSA-4TM TOOL
	適用於 FSA-9TM/9TE TOOL
	不適用任型號

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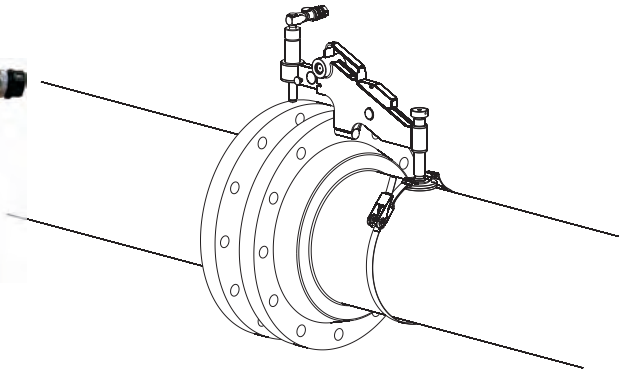
FAX:886-7-6217575

OPERATING INSTRUCTIONS HYDRAULIC FLANGE ALIGNMENT TOOL

FSA-4TM, FSA-9TM & FSA-9TE



中文
English
Ver.24

1.SAFETY ISSUES

Failure to comply with the following cautions and warnings could cause equipment damage and personal injury.

IMPORTANT : Minimum age of the operator must be 18 years The operator must have read and understood all instructions, safety issues, cautions and warnings before starting to operate the SUN RUN equipment. The operator is responsible for this activity towards other persons.

WARNIGN : To avoid personal injury and possible equipment damage, make sure all hydraulic components withstand the maximum pressure of 700 bar(10,000psi).

WARNING: Always wear safety glasses. The operator must take precaution against injury due to failure the tool or workpiece.

DANGER: To avoid personal injury keep hands and feet away from cylinder and workpiece during operation.

IMPORTANT : Minimize the risk of overloading. Use hydraulic gauges in each hydraulic system to indicate safe operating loads. It is your window to what is happening in the system.

WARNING : Do not overload equipment. Overloading cause equipment failure and possible personal injury.

CAUTION : Make sure that all system components are protected from external sources of damage, such as excessive heat, flame, moving machine parts, sharp edges and corrosive chemicals.

CAUTION: Don't operate the equipment without lubricating the wedge and the 4 slide pins. Use high quality grease.

CAUTION: Avoid sharp bends and kinks that will cause severe back-up pressure in hoses. Bends and kinks lead to premature hose failure.

WARNING: Immediately replace worn or damaged parts with genuine SUN RUN parts. SUN RUN parts are designed to fit properly and withstand rated loads.

DANGER: Do not handle pressurized hoses. Escaping oil under pressure can penetrate the skin causing serious injury. If oil is injected under the skin, see a doctor immediately.

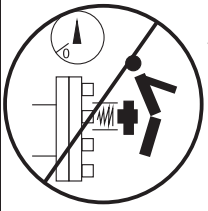
WARNING: Never pressurize uncoupled couplers. Only use hydraulic equipment in a coupled system.

IMPORTANT: Do not lift hydraulic equipment by the hoses or couplers. Use the carrying handle or other means of safe transport.

WARNING: Never place fingers in a joint held by activated wedge unless a safety block is located into the joint.

CAUTION: The handle of the wedge is there to stop operators holding spread plates as the wedge is retracted. This will stop fingers becoming jammed between plates.

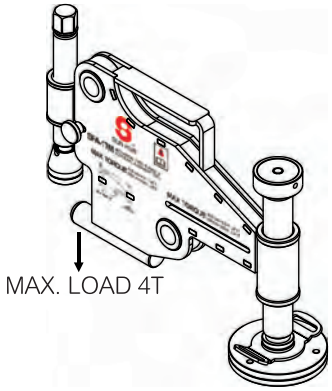
CAUTION: Never hammer or force wedge to access gap.



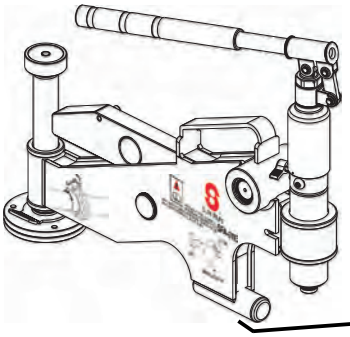
Never stand in-line with the bolt axis while tensioning or de-tensioning is in progress. If the bolt should fail, serious personal injury or death could result if loose or broken parts become projectiles. All personnel must be aware of this potential hazard at all times.

2. PRODUCT DESCRIPTION

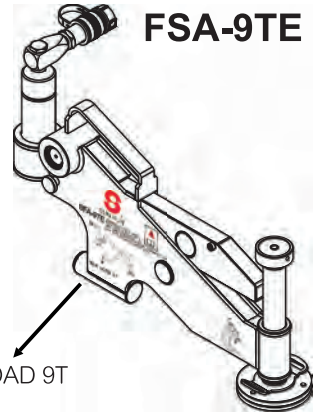
FSA-4TM



FSA-9TM



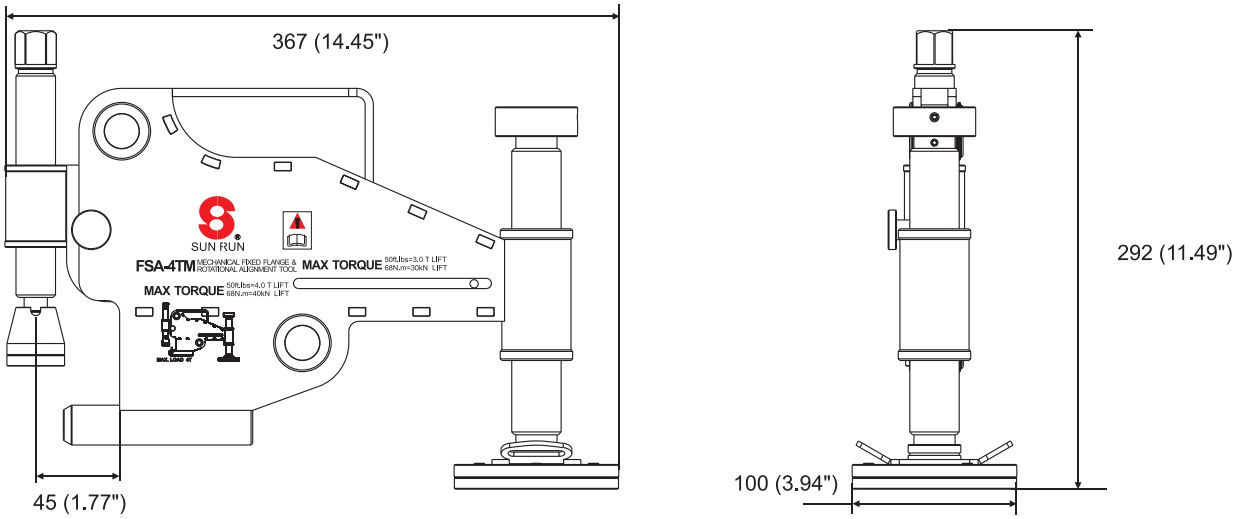
FSA-9TE



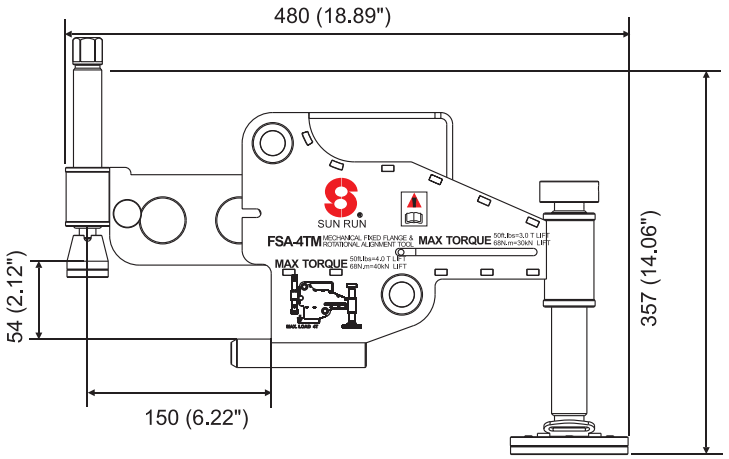
Model Mumber	Max. Lifting Force kN / ton	Min. Bolt Size in / mm	Flande Wall Thickness (including gap between flanges) in / mm	Wt. (kg)
FSA-4TM	40/ 4	0.95 / 24	1.18 - 5.23 / 30 - 133	8.6
FSA-9TM	90/ 10	1.24 / 31.5	3.66 - 9.00 / 93 - 228	16.5
FSA-9TE	90/ 10	1.24 / 31.5	3.66 - 9.00 / 93 - 228	16.5

2. PRODUCT DESCRIPTION

Minimum extension FSA-4TM in mm (inch)

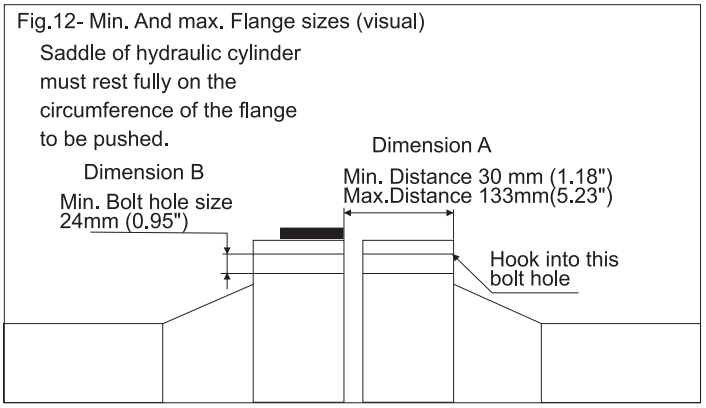


Maximum extension FSA-4TM in mm (inch)



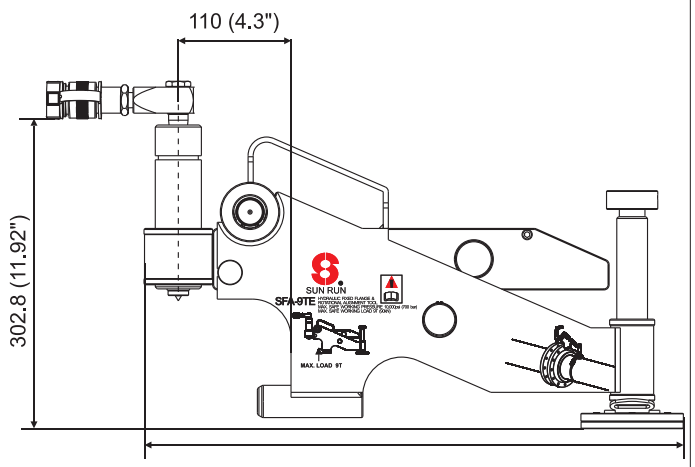
APPLICATION RANGE:

Two basic dimensions, A and B, will determine if the FSA-4TM can be used to align the joint. If the flange joint to be aligned is between 30mm(1.18 inch) and 133mm(5.23 inch) as illustrate by (A), has a bolt hole size of 24mm(0.95 inch) or greater (B), then the FSA-4TM can be attached and alignment achieved . See chart as below: by flange type, class and diameter.

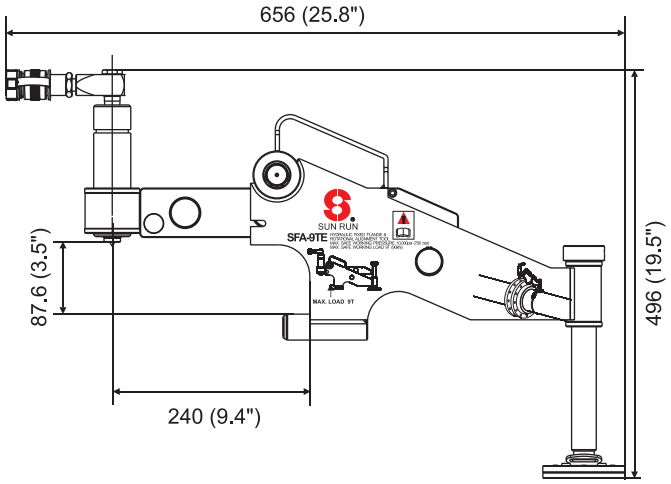


2. PRODUCT DESCRIPTION

Minimum extension FSA-9TE/9TM in mm (inch)



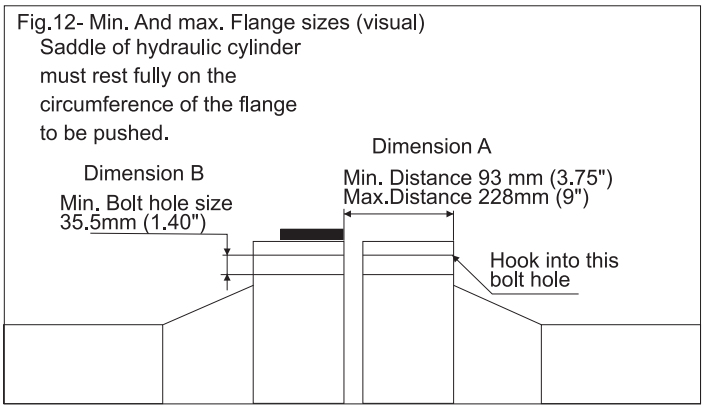
Maximum extension FSA-9TE/9TM in mm (inch)



APPLICATION RANGE:

Two basic dimensions, A and B, will determine if the FSA-9TE/9TM can be used to align the joint. If the flange joint to be aligned is between 93mm(3.75 inch) and 228mm(9 inch) as illustrate by (A), has a bolt hole size of 35.5mm(1.40 inch) or greater (B), then the FSA-9TE/9TM can be attached and alignment achieved . See chart as below: by flange type, class and diameter.

Fig.12- Min. And max. Flange sizes (visual)



3. LIST OF EQUIPMENT

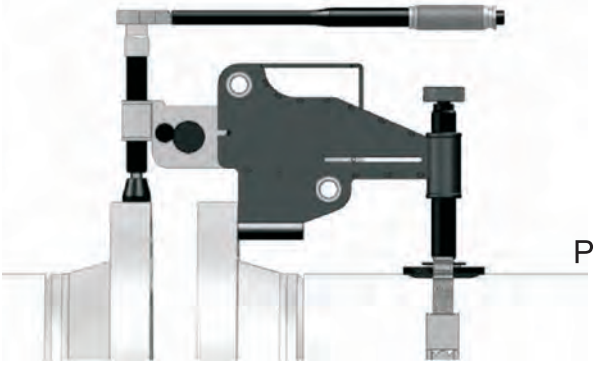
FSA-4TM set includes:	FSA-9TE/9TM set includes:
1* Carrying case 1* FSA-4TM Tool 1* 20-110 N.m (2.04-11.22 kg.m) Torque Wrench with 22 mm Socket. 1* Instruction Manual 1* Ratchet & Strap	1* Carrying case 1* FSA-9TE Tool c/w 6T Hydraulic Cylinder 1* Instruction Manual

4. INSTALLATION AND OPERATION

4.1 HOW THE ALIGNMENT WORKS

4.1.2 FSA-4TM (Pic 4.1.2)

1. The FSA-4TM is secured to the lower of the two flanges by fully inserting the lift hook into the bolt-hole at the point of greatest misalignment.
2. The drop leg is adjusted down onto the pipe while the tool is held up level in the bolt hole.
3. The wing retaining screw loosened to allow the wing to be extended out .
4. The screw bolt is turned clockwise until the friction pad comes into contact with the circumference of the opposite flange .
5. The torque wrench is set to 50 lbf.ft (max), attached to the screw bolt and turned to screw down on the flange, bringing the joint into alignment.



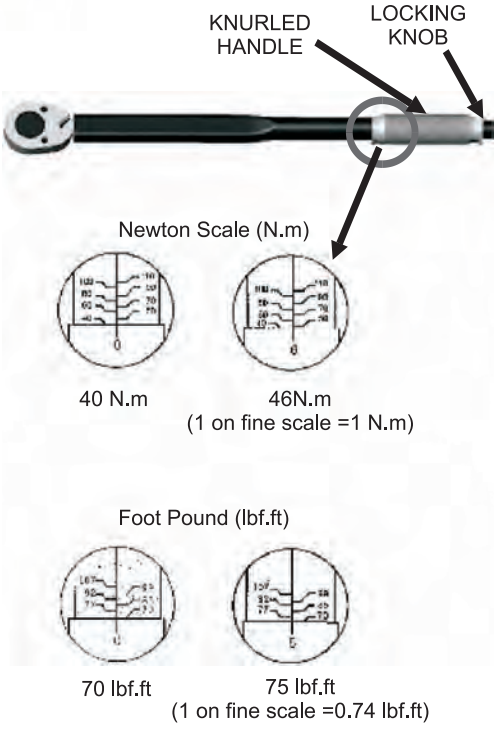
Pic 4.1.2

How to use the torque wrench

Balance the wrench in your left hand and unlock the knurled handle by turning the locking knob anti-clockwise. Set the torque amount by turning the knurled handle - see example 40-46 N.m.

1. Turn the handle till 0 on fine scale reach 40 N.m on base scale.
2. To set 46 turn handle till fine scale reach6
3.Lock handle by turning the locking knob clockwise.

Install the proper socket and attach to the tool. Pull handle till you feel and/or hear the wrench click. Setting of lbf.ft scale is done in the same way as above.



Do not pull after the wrench clicks. Use special care at low torque settings.
If the wrench has not been used for some time: operate it several times at low torque to allow internal lubricant to recoat. When not in use set to lowest torque setting.
Don't turn handle below lowest torque setting . Your torque wrench is a precision measuring instrument and should be treated as such. Clean only by wiping, do not use any type of cleaner which may affect the special internal lubricant with which this wrench is packed at the factory.

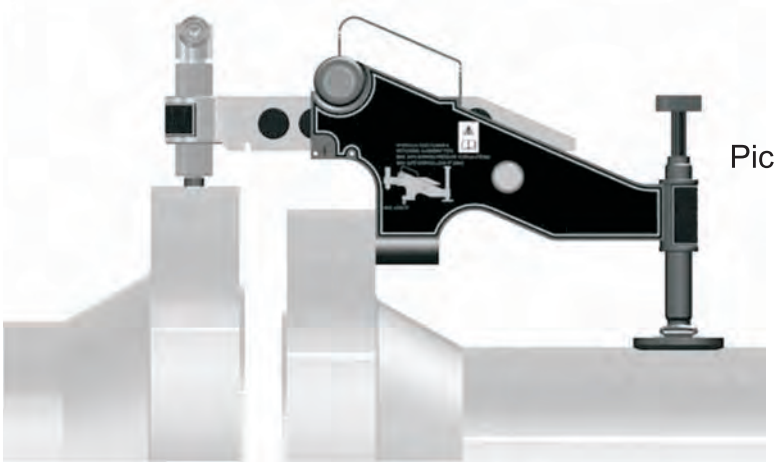
1. Do not attempt to turn the grip while it is locked
2. Do not turn the grip more than one turn below the lowest scale reading or above the highest scale reading.

4. INSTALLATION AND OPERATION

4.1 HOW THE ALIGNMENT WORKS

4.1.3 FSA-9TM/9TE (Pic 4.1.3)

1. The FSA-9TE/9TM is secured to the lower of the two flanges by fully inserting the lift hook into the bolt-hole which is parallel with the bolt-hole at the point of greatest misalignment.
2. The drop leg is adjusted down onto the pipe while the tool is held up level in the bolt hole.
3. The release knob should be loosened to allow the wing to be extended out to the required distance.
4. The hydraulic cylinder should then be adjusted down onto the circumference of the flange opposite by rotating it in a clockwise direction.
5. The hydraulic hose and pump are attached to the cylinder and the hand pump is primed, bringing the joint into alignment.

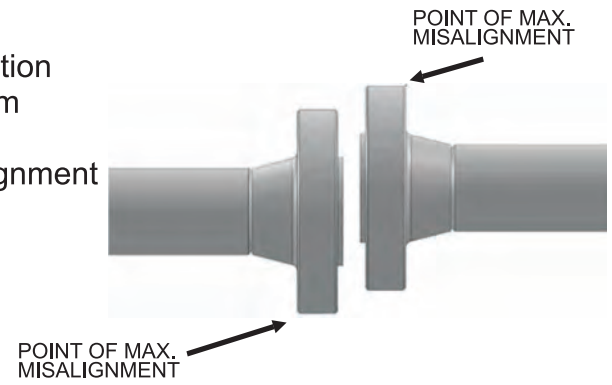


Pic 4.1.3

4. INSTALLATION AND OPERATION

4.2 INSTALLATION AND OPERATION

4.2.1 Carry out the Flange Misalignment Determination Procedure to determine the points of maximum misalignment.
In this example the points of maximum misalignment are at the top and bottom of the joint.

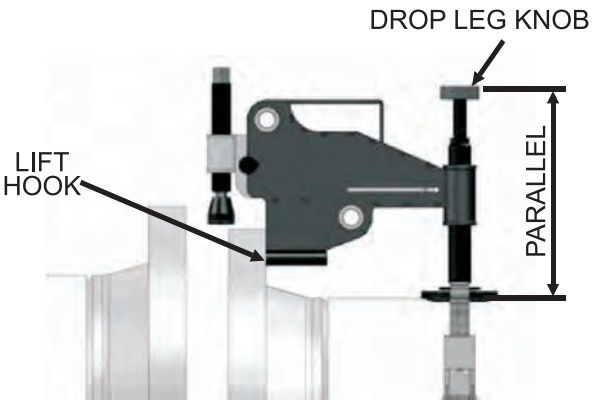


4.2.2 Guide the lift hook into the bolt-hole at the maximum point of misalignment.

FSA-4TM

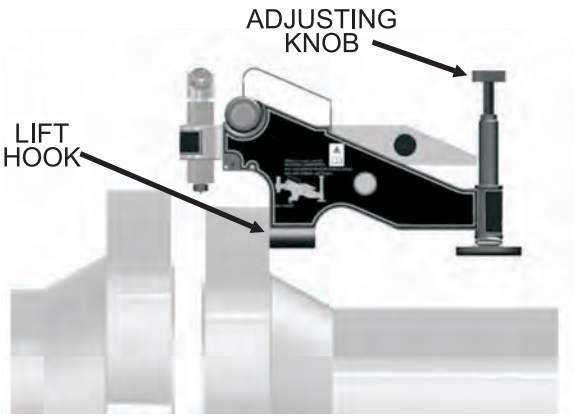
Adjust the drop leg down onto the pipe by turning the adjusting knob in a clockwise direction. The tool should be held up level within the bolt-hole during adjustment.

The tool must be parallel to the pipe at all times.



FSA-9TM/ 9TE

Adjust the drop leg onto the pipe (using the adjusting knob)
while holding the lift hook up level with the bolt-hole.



4. INSTALLATION AND OPERATION

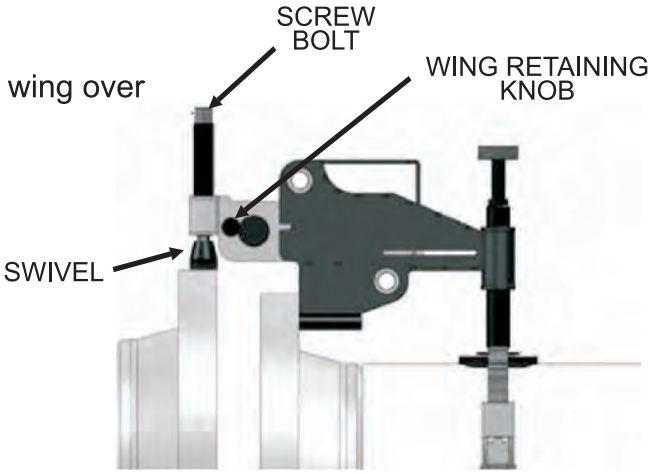
4.2 INSTALLATION AND OPERATION

4.2.3

FSA-4TM

Loosen the wing retaining knob and extend the wing over to the opposite flange.

Rotate the screw bolt onto the surface of the opposite flange. Ensure that the tool is sitting level and that the friction pad on the base of the swivel is in full and even contact with the surface of the opposite flange .



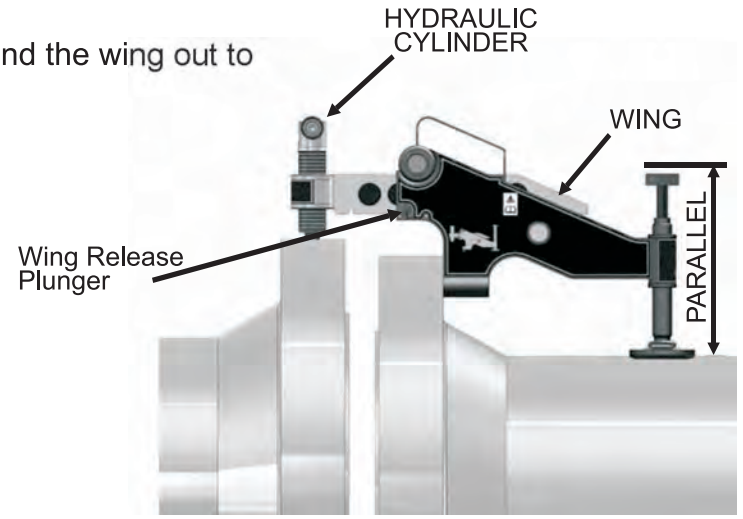
FSA-9TM/9TE

Loosen the wing release knob and extend the wing out to the required distance.

Rotate the hydraulic cylinder down until the base of the cylinder located onto the surface of the opposite flange.

Ensure that the tool is sitting level and that the cylinder is in full and even contact with the surface of the opposite flange.

Ensure tool is parallel to pipe.

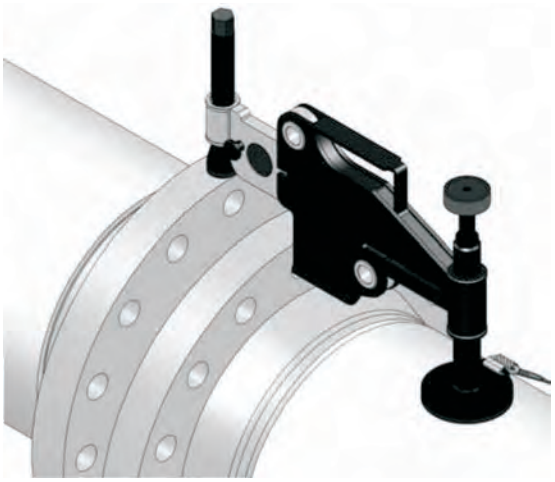


4. INSTALLATION AND OPERATION

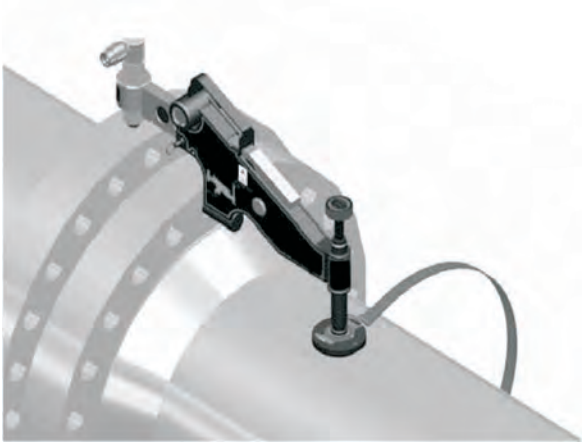
4.2 INSTALLATION AND OPERATION

4.2.4

FSA-4TM
Attach the hook of the strap through the buckle on top of the base plate as shown.



FSA-9TM/ 9TE
Attach the hook on the strap through the base plate as shown.

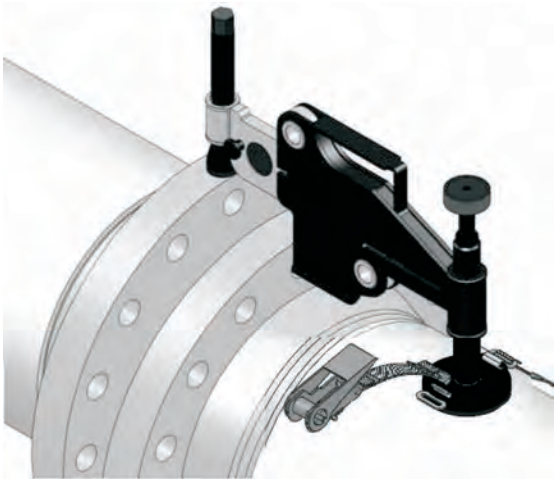


4. INSTALLATION AND OPERATION

4.2 INSTALLATION AND OPERATION

4.2.5

FSA-4TM
Now place the hook of the ratchet mechanism through the opposite side of the buckle as show.



FSA-9TM/ 9TE
Now place the hook of the ratchet mechanism through the base on the opposite side as show.

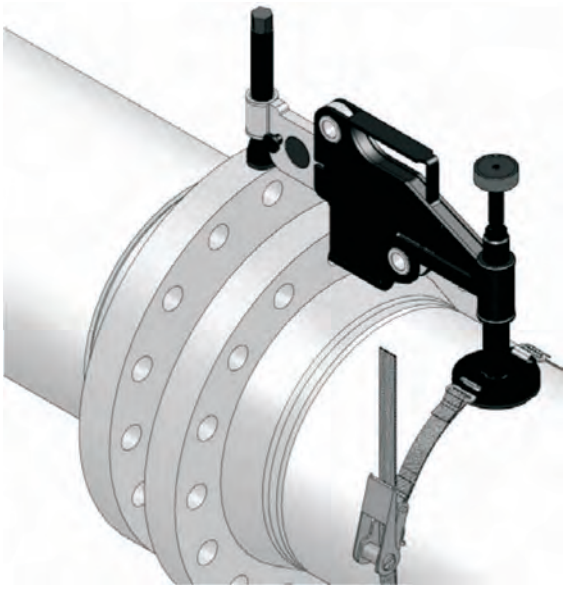
4. INSTALLATION AND OPERATION

4.2 INSTALLATION AND OPERATION

4.2.6

FSA-4TM

Feed the open end of the strap through the ratchet mechanism as shown. Tighten the strap using the ratchet mechanism.



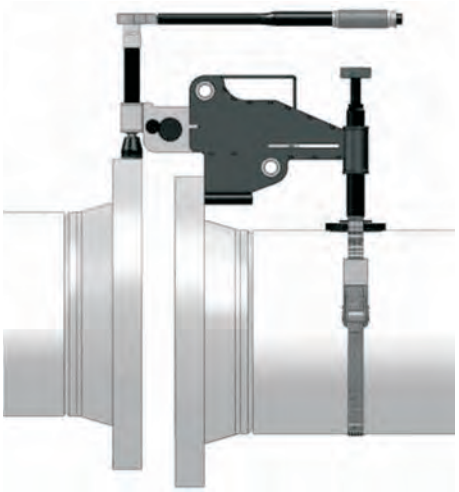
FSA-9TM/ 9TE

Feed the open end of the strap through the ratchet mechanism as shown. Tighten the strap using the ratchet mechanism.

4. INSTALLATION AND OPERATION

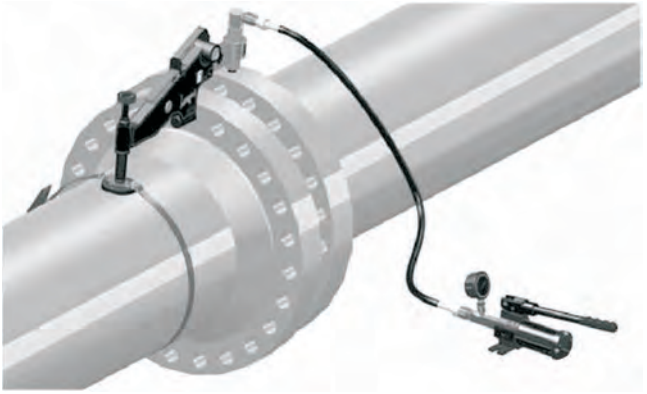
4.2.7

FSA-4TM
The torque wrench should be set at 14 lbf.ft (19N.m) then attached to the screw bolt.



FSA-9TM/9TE
Connect the hydraulic pump to the hydraulic hose, and the hose to the hydraulic adjusting cylinder.

Prime the pump until the joint comes into alignment.

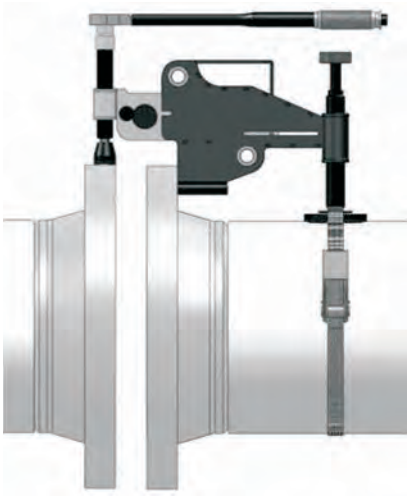


4. INSTALLATION AND OPERATION

4.2.8

FSA-4TM

Tighten the screw bolt in a clockwise direction until the flanges come into alignment ; or the torque wrench "clicks".



If the torque wrench has clicked and the flanges are still mis-aligned adjust the torque wrench up to 24.2 ft/lbs(33 Nm) and continue until a maximum torque setting of 50 ft/lbs(67.8 Nm) is reached or the flanges are aligned.

Once in alignment the bolts may be inserted and tightened.

After replacing all of the bolts (apart from the bolt which will go into the bolt-hole in which the **FSA-4TM** is located), remove the tool by reversing step 2-8.
Insert the last bolt and tighten.

The maximum safe working load is 50 lbf.ft(67.8 N.m) exceeding 50 lbf.ft will result in damage to the tool.

FSA-9TM /9TE

Once in alignment the bolts may be inserted and tightened.

After replacing all of the bolts, remove the tool by reversing steps 2 - 4.

Insert the last bolt and tighten.

Care should be taken not to drop any of the component parts when removing them from the flange joint. This action will prevent injuries to either the operator's lower limbs, or to passers-by.

5. EXAMINATION, MAINTENANCE AND STORAGE

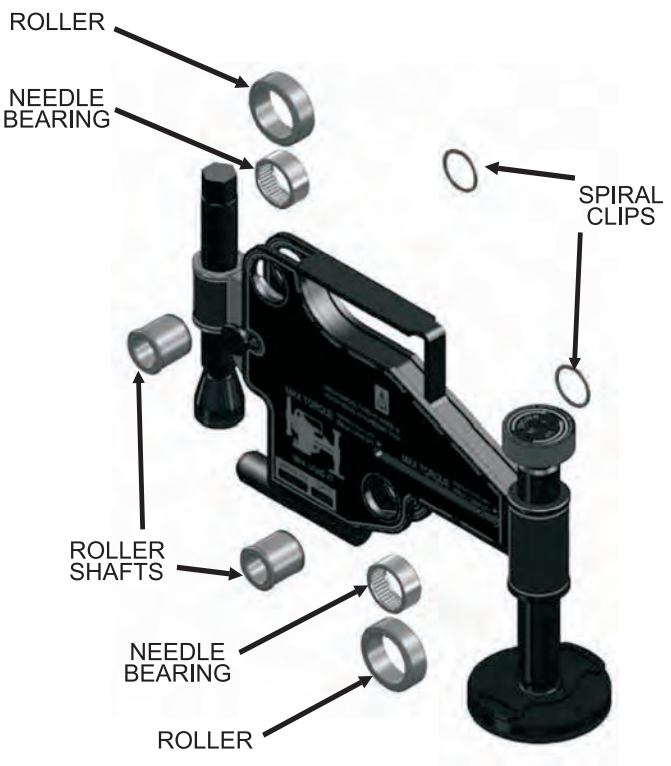
FSA-4TM

5.1 Secure the tool upright on a bench.

5.2 Using a small flat screw driver, lever out the end of the spiral clips and then rotate anti-clockwise and remove.

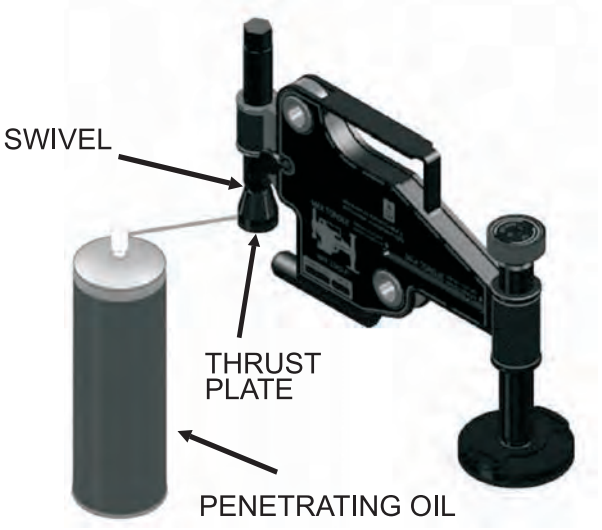
5.3 Slide the roller shafts out in order to remove the rollers and bearings for examination.

5.4 Inspect the roller shafts, rollers and bearings for damage. If there is no damage present then they can be cleaned, greased and re-assembled by reversing steps 1-4.



5.5 It is important that the thrust bearing is free from dirt and corrossion and rotates freely.

5.6 With the use of a penetrating oil such as WD 40 or similar. Spray the oil between the thrust plate and the swivel as shown opposite.



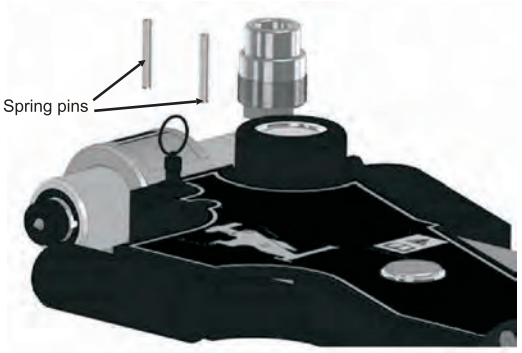
5.7 Ensure the thrust plate rotates freely before using the tool to align a flange joint.

5. EXAMINATION, MAINTENANCE AND STORAGE

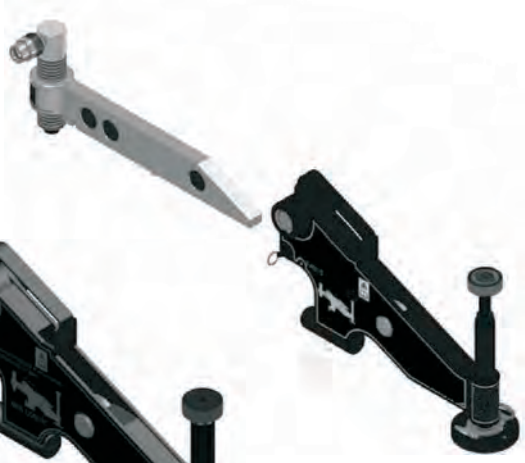
FSA-9TM/ 9TE

5.1 Place the tool on a work bench and secure it in an upright position.

5.2 Remove 2 off the spring pins on the front of the main body as show.



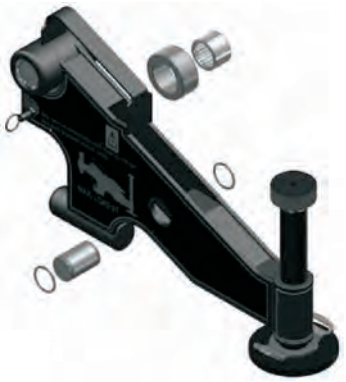
5.3 The wing can now be removed from the main body by sliding it forward.



5.4 Remove the circlip using a circlip pliers (not illustrated)

5.5 Remove the shaft and two bearings.
Inspect the bearing housing, shaft, and needle bearings for any sign of damage, dirt or grit. Clean then smear a small amount of grease onto the sharft and into the needle bearing.

5.6 Remove the spirol retaining clips from the lower shaft and slide the shaft out from the main body.
The roller and needle bearing can be removed through the upper section of the tool as shown.
Inspect the roller, shaft and needle bearing for any sign of damage dirt or grit. Clean and then smear a small amount of grease onto the shaft and into the needle bearing.



5.7 Re-assemble by reversing steps 2-6.

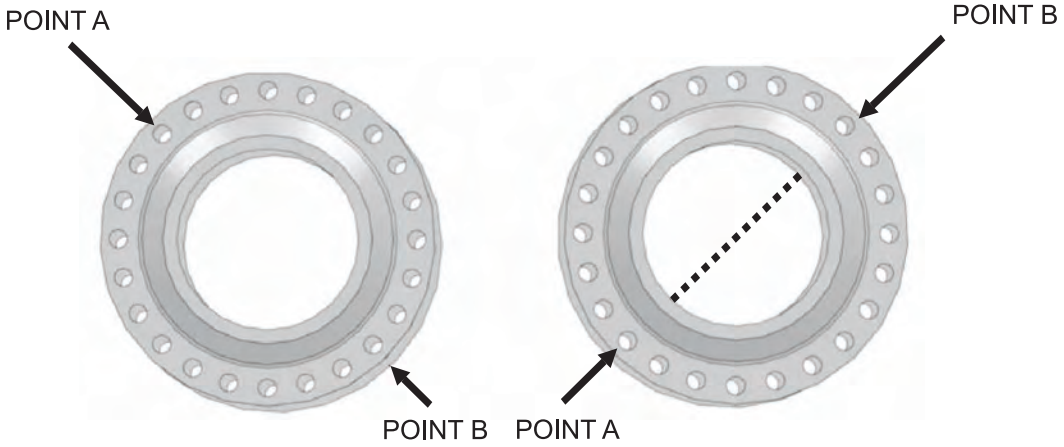
6. FLANGE MISALIGNMENT DETERMINATION PROCEDURE

The tool being used must not be attached to a flanged joint prior to the misalignment procedure being carried out.

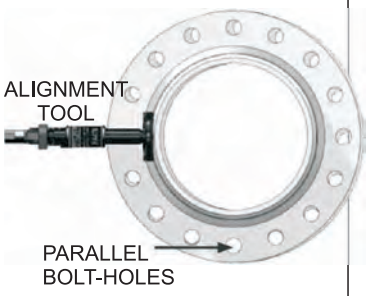
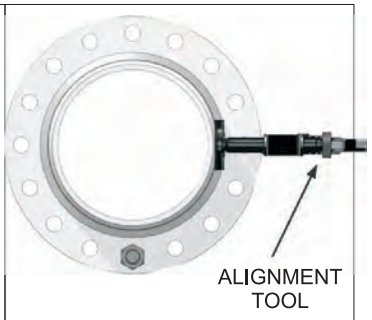
6.1 LATERAL MISALIGNMENT

6.1.1
Loosen and remove every second bolt around the flange, continue with this until misalignment occurs.
A flanged joint, once broken down, may spring out of alignment at any point, or in any direction around its circumference. Misalignment may not occur until only a few bolts remain.

6.1.2
At this point the direction of any misalignment should become obvious. The alignment tool being used should be attached at the maximum point of misalignment (point A or B in the examples shown below.)



6.2 ROTATIONAL (TWIST) MISALIGNMENT

			
If the outer circumference of the flanges are in alignment but the operator is unable to fit the bolt into any two corresponding bolt-holes then rotational misalignment may have occurred. In this case the alignment tool can be attached to the most accessible point as misalignment occurs at all bolt-holes to the same degree.	Attach the alignment tool at the most accessible/ convenient point (as shown in sections) and use it to push the flanges out of alignment until one pair of bolt-holes becomes parallel.	Insert the bolt into the aligned bolt-hole and release the alignment tool. The load will transfer onto the bolt.	Repeat steps 1 and 2 at other points around the flange until all of the remaining bolt-holes are parallel and the rest of the bolts can be inserted.

7. TROUBLE SHOOTING

Problem	Cause	Solution
The thrust plate is sliding along the circumference of the opposite flange as the tool is aligning the joint.	Git or Dirt on wing, rollers or bearing. Wing is at full extension.	Ensure the rollers are rotating freely and that there is no restrictions to the rollers on the wing surfaces such as grit or dirt. Ensure the wing has sufficient travel left in order to allow the joint to align.
The tool is attached and appears to be functioning properly, but the joint will not align.	A. There may be something restricting the joint from alignment. B. The joint may require more than 4.0 tons (40kN) force to align.	A. Check the area around the joint to establish if there is an obstruction to the joint. B. If the joint requires more force than that of the 4.0T (40kN)tool, then another method of aligning should be adopted.
The thrust plate is twisting on the circumference of the flange when the screw bolt is tightened.	A. There may be Grit or Dirt within the swivel / thrust plate.	A. Check the thrust plate rotates freely. If the thrust plate is not rotating then spray penetrating liquid into the gap between the swivel and thrust plate in order to loosen it.

7. TROUBLE SHOOTING

Problem	Cause	Solution
The tool is advancing but does not reach full pressure.	Air could be present in the hydraulic system.	A. Connect the hand pump to the tool with the hydraulic hose. B.Close the release valve on the pump, and prime the pump until the hydraulic cylinder is fully extended and a small pressure is achieved. C.With the hand pump held above the tool and in an upright position, open the release valve causing any air that is within the system to be forced up through the pump and vented into the oil working pressure. D.Repeat steps 1-3 three or four times to ensure that all air is removed from from the system and the tool will reach full working pressure.
The friction pad is sliding on the circumference of the opposite flange as the FSA-9TE/9TM is aligning the joint.	Grit or dirt on wing, rollers or bearings, wing is at full extension.	A. Ensure the rollers are rotating freely and that there is no restriction to the rollers on the wing surfaces such as dirt or grit. B. Check that the wing is not at full extension when aligning the joint. C. Ensure that there is enough extension left to allow the FSA-9TE/9TM to expand as the joint is aligned.
FSA-9TE/9TM is attached and appears to be functioning properly, but the joint will not align.	A. There may be air in the hydraulic system restricting the force on the flanges. B. There may be something restricting the joint at a point close to the flanges. The joint may require morethan 9.0 tons (90kN) pressure to align.	A. Check the area around the joint to establish if there is an obstruction to the joint. B. If the joint requires more force than that of the 9.0 tons(90kN) of the tool then another method to align the joint should be adopted.

8. RANGE OF APPLICATION

10.1 Bs10 FLANGE RANGE OF APPLICATION

<table>
<tr><td rowspan="2">CLASS A</td><td>NPS</td><td>3 1/2"</td><td>4"</td><td>5"</td><td>6"</td><td>7"</td><td>8"</td><td>9"</td><td>10"</td><td>12"</td><td>13"</td><td>14"</td><td>15"</td><td>16"</td><td>17"</td><td>18"</td><td>19"</td><td>20"</td><td>21"</td><td>22"</td><td>23"</td><td>24"</td><td>26"</td><td>27"</td><td>29"</td><td>30"</td><td>33"</td><td>35"</td><td>36"</td><td>39"</td><td>42"</td><td>45"</td><td>48"</td><td>54"</td><td>60"</td><td>66"</td><td>72"</td></tr>
<tr><td>TOOL</td><td colspan="18">FSA-1TM</td><td colspan="2"></td><td colspan="2">FSA-1TM</td><td></td><td></td><td></td><td colspan="2">FSA-4TM</td><td colspan="2"></td><td colspan="7">FSA-4TM</td></tr>
</table>

<table>
<tr><td rowspan="2">CLASS D</td><td>NPS</td><td>4"</td><td>5"</td><td>6"</td><td>7"</td><td>8"</td><td>9"</td><td>10"</td><td>12"</td><td>13"</td><td>14"</td><td>15"</td><td>16"</td><td>17"</td><td>18"</td><td>19"</td><td>20"</td><td>21"</td><td>22"</td><td>23"</td><td>24"</td><td>29"</td><td>30"</td><td>33"</td><td>35"</td><td>36"</td><td>39"</td><td>42"</td><td>45"</td><td>48"</td><td>54"</td><td>60"</td><td>66"</td><td>72"</td><td>78"</td><td>84"</td><td>96"</td><td>108"</td><td>120"</td></tr>
<tr><td>TOOL</td><td colspan="15">FSA-1TM</td><td colspan="14">FSA-4TM</td><td colspan="9">FSA-9TE/9TM</td></tr>
</table>

<table>
<tr><td rowspan="2">CLASS E</td><td>NPS</td><td>1 1/4"</td><td>1 1/2"</td><td>2"</td><td>2 1/2"</td><td>3"</td><td>3 1/2"</td><td>4"</td><td>5"</td><td>6"</td><td>7"</td><td>8"</td><td>9"</td><td>10"</td><td>12"</td><td>13"</td><td>14"</td><td>15"</td><td>16"</td><td>17"</td><td>18"</td><td>19"</td><td>20"</td><td>21"</td><td>22"</td><td>23"</td><td>24"</td><td>27"</td><td>29"</td><td>30"</td><td>33"</td><td>35"</td><td>36"</td><td>39"</td><td>42"</td><td>45"</td><td>48"</td></tr>
<tr><td>TOOL</td><td colspan="5"></td><td colspan="16">FSA-1TM</td><td colspan="12">FSA-4TM</td><td colspan="3">FSA-9TE/9TM</td></tr>
</table>

<table>
<tr><td rowspan="2">CLASS F</td><td>NPS</td><td>1 1/4"</td><td>1 1/2"</td><td>2"</td><td>2 1/2"</td><td>3"</td><td>3 1/2"</td><td>4"</td><td>5"</td><td>6"</td><td>7"</td><td>8"</td><td>9"</td><td>10"</td><td>12"</td><td>13"</td><td>14"</td><td>15"</td><td>16"</td><td>17"</td><td>18"</td><td>19"</td><td>20"</td><td>21"</td><td>22"</td><td>23"</td><td>24"</td><td>27"</td><td>29"</td><td>30"</td><td>33"</td><td>35"</td><td>36"</td><td>39"</td><td>42"</td><td>45"</td><td>48"</td></tr>
<tr><td>TOOL</td><td colspan="2"></td><td colspan="13">FSA-1TM</td><td colspan="17">FSA-4TM</td><td colspan="4">FSA-9TE/9TM</td></tr>
</table>

<table>
<tr><td rowspan="2">CLASS H</td><td>NPS</td><td>1 1/4"</td><td>1 1/2"</td><td>2"</td><td>2 1/2"</td><td>3"</td><td>3 1/2"</td><td>4"</td><td>5"</td><td>6"</td><td>7"</td><td>8"</td><td>9"</td><td>10"</td><td>12"</td><td>13"</td><td>14"</td><td>15"</td><td>16"</td><td>17"</td><td>18"</td><td>19"</td><td>20"</td><td>21"</td><td>22"</td><td>23"</td><td>24"</td></tr>
<tr><td>TOOL</td><td colspan="2"></td><td colspan="9">FSA-1TM</td><td colspan="15">FSA-4TM</td></tr>
</table>

<table>
<tr><td rowspan="2">CLASS J</td><td>NPS</td><td>1 1/4"</td><td>1 1/2"</td><td>2"</td><td>2 1/2"</td><td>3"</td><td>3 1/2"</td><td>4"</td><td>5"</td><td>6"</td><td>7"</td><td>8"</td><td>9"</td><td>10"</td><td>12"</td><td>13"</td><td>14"</td><td>15"</td><td>16"</td><td>17"</td><td>18"</td><td>19"</td><td>20"</td><td>21"</td><td>22"</td><td>23"</td><td>24"</td></tr>
<tr><td>TOOL</td><td colspan="2"></td><td colspan="5">FSA-1TM</td><td colspan="11">FSA-4TM</td><td colspan="8">FSA-9TE/9TM</td></tr>
</table>

<table>
<tr><td rowspan="2">CLASS K</td><td>NPS</td><td>1"</td><td>1 1/4"</td><td>1 1/2"</td><td>2"</td><td>2 1/2"</td><td>3"</td><td>3 1/2"</td><td>4"</td><td>5"</td><td>6"</td><td>7"</td><td>8"</td><td>9"</td><td>10"</td><td>12"</td><td>13"</td><td>14"</td><td>15"</td><td>16"</td><td>17"</td><td>18"</td><td>19"</td><td>20"</td></tr>
<tr><td>TOOL</td><td colspan="2"></td><td colspan="6">FSA-1TM</td><td colspan="7">FSA-4TM</td><td colspan="8">FSA-9TE/9TM</td></tr>
</table>

<table>
<tr><td rowspan="2">CLASS R</td><td>NPS</td><td>1"</td><td>1 1/4"</td><td>1 1/2"</td><td>2"</td><td>2 1/2"</td><td>3"</td><td>3 1/2"</td><td>4"</td><td>5"</td><td>6"</td><td>7"</td><td>8"</td><td>9"</td><td>10"</td><td>12"</td><td>13"</td><td>14"</td><td>15"</td><td>16"</td><td>17"</td><td>18"</td><td>19"</td><td>20"</td></tr>
<tr><td>TOOL</td><td colspan="2"></td><td colspan="4">FSA-1TM</td><td colspan="9">FSA-4TM</td><td colspan="8">FSA-9TE/9TM</td></tr>
</table>

<table>
<tr><td rowspan="2">CLASS S</td><td>NPS</td><td>1/2"</td><td>3/4"</td><td>1"</td><td>1 1/4"</td><td>1 1/2"</td><td>2"</td><td>2 1/2"</td><td>3"</td><td>3 1/2"</td><td>4"</td><td>4 1/2"</td><td>5"</td><td>6"</td><td>7"</td><td>8"</td><td>9"</td><td>10"</td><td>11"</td><td>12"</td><td>13"</td><td>14"</td><td>15"</td><td>16"</td></tr>
<tr><td>TOOL</td><td colspan="11">FSA-1TM</td><td colspan="2">FSA-4TM</td><td colspan="10">FSA-9TE/9TM</td></tr>
</table>

<table>
<tr><td rowspan="2">CLASS T</td><td>NPS</td><td>1/2"</td><td>3/4"</td><td>1"</td><td>1 1/4"</td><td>1 1/2"</td><td>2"</td><td>2 1/2"</td><td>3"</td><td>3 1/2"</td><td>4"</td><td>4 1/2"</td><td>5"</td><td>6"</td><td>7"</td><td>8"</td><td>9"</td><td>10"</td><td>11"</td><td>12"</td><td>13"</td></tr>
<tr><td>TOOL</td><td colspan="6">FSA-1TM</td><td colspan="5">FSA-4TM</td><td colspan="9">FSA-9TE/9TM</td></tr>
</table>

(light blue)	SUITABLE FOR FSA-1TM TOOL
(light green)	SUITABLE FOR FSA-4TM TOOL
(pink)	SUITABLE FOR FSA-9TM/9TE TOOL
(grey)	NOT SUITABLE FOR TOOLS

8. RANGE OF APPLICATION

API6BX WELD NECK FLANGE RANGE OF APPLICATION

CLASS 10K	NPS	1 13-16"	2 1-16"	2 9-16"	3 1-8"	4 1-16"	5 1-8"	7 1-16"	9"	11"	13 5-8"	16 3-4"
	TOOL	FSA-1TM		FSA-4TM				FSA-9TE/9TM				
CLASS 15K	NPS	1 13-16"	2 1-16"	2 9-16"	3 1-8"	4 1-16"	5 1-8"	7 1-16"	9"	11"	13 5-8"	16 3-4"
	TOOL	FSA-1TM		FSA-4TM		FSA-9TE/9TM						
CLASS 20K	NPS	1 13-16"	2 1-16"	2 9-16"	3 1-8"	4 1-16"	5 1-8"	7 1-16"	9"	11"	13 5-8"	16 3-4"
	TOOL	FSA-4TM		FSA-9TE/9TM								

API6B WELD NECK FLANGE RANGE OF APPLICATION

CLASS 2K	NPS	2 1-16"	2 9-16"	3 1-8"	4 1-16"	5 1-8"	7 1-16"	9"	11"	13 5-8"	16 3-4"	21 1-4"
	TOOL	FSA-1TM			FSA-4TM							
CLASS 3K	NPS	2 1-16"	2 9-16"	3 1-8"	4 1-16"	5 1-8"	7 1-16"	9"	11"	13 5-8"	16 3-4"	21 1-4"
	TOOL	FSA-1TM		FSA-4TM			FSA-9TE/9TM					
CLASS 5K	NPS	2 1-16"	2 9-16"	3 1-8"	4 1-16"	5 1-8"	7 1-16"	9"	11"	13 5-8"	16 3-4"	21 1-4"
	TOOL	FSA-1TM		FSA-4TM		FSA-9TE/9TM						

	SUITABLE FOR FSA-1TM TOOL
	SUITABLE FOR FSA-4TM TOOL
	SUITABLE FOR FSA-9TM/9TE TOOL
	NOT SUITABLE FOR TOOLS

8. RANGE OF APPLICATION

10.2 ASME B16.5 FLANGE RANGE OF APPLICATION

CLASS 150	NPS	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	24"
	TOOL					FSA-1TM								FSA-4TM						
CLASS 300	NPS	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	24"
	TOOL				FSA-1TM								FSA-4TM				FSA-9TE/9TM			
CLASS 400	NPS	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	24"
	TOOL					FSA-1TM			FSA-4TM						FSA-9TE/9TM					
CLASS 600	NPS	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	24"
	TOOL				FSA-1TM				FSA-4TM					FSA-9TE/9TM						
CLASS 900	NPS	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	24"
	TOOL	FSA-1TM			FSA-4TM								FSA-9TE/9TM							
CLASS 1500	NPS	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	24"
	TOOL	FSA-1TM			FSA-4TM						FSA-9TE/9TM									
CLASS 2500	NPS	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	24"
	TOOL	FSA-1TM			FSA-4TM				FSA-9TE/9TM											

	SUITABLE FOR FSA-1TM TOOL
	SUITABLE FOR FSA-4TM TOOL
	SUITABLE FOR FSA-9TM/9TE TOOL
	NOT SUITABLE FOR TOOLS

8. RANGE OF APPLICATION

ASME B16.47 FLANGE RANGE OF APPLICATION

CLASS 150	NPS	22"	26"	28"	30"	32"	34"	36"	38"	40"	42"	44"	46"	48"
	TOOL	FSA-4TM						FSA-9TE/9TM						
CLASS 300	NPS	22"	26"	28"	30"	32"	34"	36"	38"	40"	42"	44"	46"	48"
	TOOL	FSA-4TM							FSA-9TE/9TM					
CLASS 400	NPS	22"	26"	28"	30"	32"	34"	36"	38"	40"	42"	44"	46"	48"
	TOOL	FSA-4TM							FSA-9TE/9TM					
CLASS 600	NPS	22"	26"	28"	30"	32"	34"	36"	38"	40"	42"	44"	46"	48"
	TOOL	FSA-4TM							FSA-9TE/9TM					
CLASS 900	NPS	22"	26"	28"	30"	32"	34"	36"	38"	40"	42"	44"	46"	48"
	TOOL	FSA-9TE/9TM												

DIN WELD NECK FLANGE RANGE OF APPLICATION

CLASS PN16	NPS	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	7"	8"	10"	12"	14"	16"	18"	20"	24"	28"	32"	36"	40"	48"	56"	72"	80"		
	TOOL	FSA-1TM															FSA-4TM							FSA-9TE/9TM		
CLASS PN25	NPS	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	7"	8"	10"	12"	14"	16"	18"	20"	24"	28"	32"	36"	40"			
	TOOL					FSA-1TM											FSA-4TM										
CLASS PN40	NPS	1/2"	2"	2 1/2"	3"	4"	5"	6"	7"	8"	10"	12"	14"	16"	18"	20"											
	TOOL	FSA-1TM											FSA-4TM													
CLASS PN64	NPS	3/4"	1"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	7"	8"	10"	12"	14"	16"											
	TOOL		FSA-1TM							FSA-4TM																
CLASS PN100	NPS	1/2"	3/4"	1"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	7"	8"	10"	12"	14"											
	TOOL			FSA-1TM					FSA-4TM					FSA-9TE/9TM												
CLASS PN160	NPS	3/8"	1/2"	3/4"	1"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	7"	8"	10"	12"											
	TOOL				FSA-1TM				FSA-4TM				FSA-9TE/9TM													

	SUITABLE FOR FSA-1TM TOOL
	SUITABLE FOR FSA-4TM TOOL
	SUITABLE FOR FSA-9TM/9TE TOOL
	NOT SUITABLE FOR TOOLS

8. RANGE OF APPLICATION

10.3 SPO FLANGE RANGE OF APPLICATION

CLASS 150	NPS	2 1/2"	3"	3 1/2"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"	26"	28"	30"	32"	34"	36"	38"	40"	42"	44"	46"	48"
	TOOL											FSA-1TM										FSA-4TM					
CLASS 300	NPS	2 1/2"	3"	3 1/2"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"	26"	28"	30"	32"	34"	36"	38"	40"	42"	44"	46"	48"
	TOOL							FSA-1TM						FSA-4TM							FSA-9TE/9TM						
CLASS 600	NPS	2 1/2"	3"	3 1/2"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"	26"	28"	30"	32"	34"	36"	38"	40"	42"	44"	46"	48"
	TOOL									FSA-4TM					FSA-9TE/9TM												
CLASS 900	NPS	2 1/2"	3"	3 1/2"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"	26"	28"	30"	32"	34"	36"	38"	40"	42"	44"	46"	48"
	TOOL								FSA-4TM				FSA-9TE/9TM														
CLASS 1500	NPS	2 1/2"	3"	3 1/2"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"	26"	28"	30"	32"	34"	36"	38"	40"	42"	44"	46"	48"
	TOOL				FSA-4TM				FSA-9TE/9TM																		
CLASS 2500	NPS	2 1/2"	3"	3 1/2"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"												
	TOOL			FSA-4TM				FSA-9TE/9TM																			
CLASS 5000	NPS	2 1/2"	3"	3 1/2"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"												
	TOOL					FSA-4TM			FSA-9TE/9TM																		
CLASS 7500	NPS	2 1/2"	3"	3 1/2"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"												
	TOOL		FSA-4TM				FSA-9TE/9TM																				
CLASS 10000	NPS	2 1/2"	3"	3 1/2"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"												
	TOOL				FSA-4TM				FSA-9TE/9TM																		
CLASS 15000	NPS	2 1/2"	3"	3 1/2"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"												
	TOOL	FSA-4TM					FSA-9TE/9TM																				

	SUITABLE FOR FSA-1TM TOOL
	SUITABLE FOR FSA-4TM TOOL
	SUITABLE FOR FSA-9TM/9TE TOOL
	NOT SUITABLE FOR TOOLS