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Pilgrim International Ltd

United Kingdom

sales@pilgrim-international.co.uk
+44 (0)161 785 7700

For more detailed information please visit:
pilgrim-international.co.uk

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pilgrim-international.co.uk/contact/find-an-agent

Pilgrim International Ltd

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Bolting and Positioning

Telephone: +44 161 785 7700 | e-mail: sales@pilgrim-international.co.uk

Hydraulically installed bolts designed specifically to remove uncertainty and increase asset performance.

Radial Fit Bolts

Removing uncertainty by safe and faster installation, longer product life, predictable and reduced maintenance downtime with lower overall costs.

How it Works

The principle of the Radial Fit Bolt features a combination of a taper bodied bolt and matching taper bored sleeve.

During installation the bolt is positioned into the coupling holes in a clearance condition, by using the hydraulic tooling provided, the sleeve expands by drawing the bolt through the sleeve to provide a true interference fit. The nuts are positioned and the bolt is hydraulically tensioned. For removal the bolt and the sleeve are separated using either the oil injection method or the removal bridge. The sleeve reduces in diameter to its original size leaving the bolt assembly free to slide out of the coupling hole in a clearance condition.

Select your variant

All Radial Fit Bolts are made to order and there are two design options when choosing the correct Radial Fit.

Standard Bolt

This bolt is longer than the Compact versions allowing for the hydraulic equipment to utilise the threaded area prepared for the nuts. Generally used in slower rotating applications, such as Marine propulsion shaft Flanged Couplings.

Compact Bolt

The Compact designed bolt utilises Pilgrim's Unique removable taper threaded Puller for installation, giving the advantage of a shorter bolt and thus improving the aerodynamics for critical high speed applications such as a Steam or Gas Turbine flanged couplings in the Power Generation Sector.

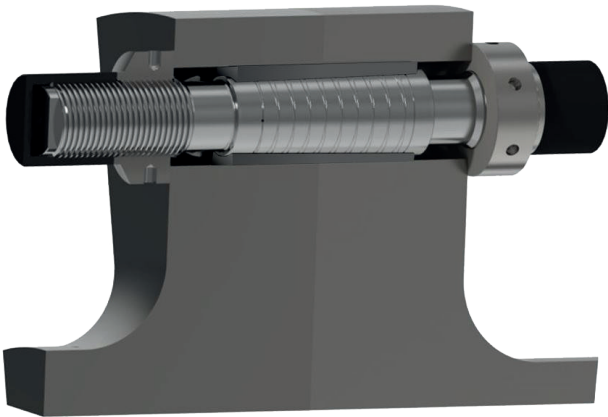


Benefits

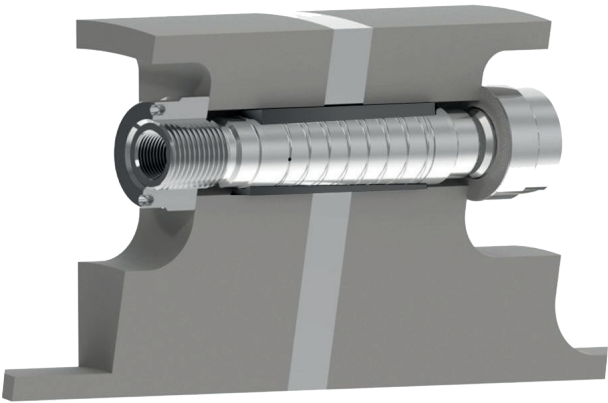
- Fast and trouble free installation and removal
- Allows for accurate planning on critical path activities
- Erradication of seized bolts and associated unplanned costs
- Concentricity established
- Solution for vibration issues
- Coupling slippage eliminated
- Eradicates hole damage such as goring and face damage
- Weight balanced for high speed couplings
- No need for expensive hole re-machning

“ When splitting or rebuilding the turbines couplings, the time savings arising from reduced outage periods can more than cover the costs of Radial Fit Bolting. Furthermore, they do not require the frequent bolt replacement and hole preparation as is the case with conventional fitted bolts ”

Siemens Power Generation Ltd



Standard Radial Fit Bolt



Compact Radial Fit Bolt

Radial Fit Bolt

Case Study: Power Gen

Case Study One

OEM Details:
Coupling:
Number of Bolts:
Bolt Diameter:
Bolt Type:

500MWe Siemens Steam Turbine Generator
Low Pressure to Generator (LP-GEN)
22 off
63.5mm (2.5")
Radial Fit Bolt - Compact

Each traditional clamp bolt takes 50 minutes to remove, unless there is pick-up between the bolt and the coupling hole. Experience confirms that this occurs in 8% of cases. Removal of the Standard bolt in the eventuality of pick-up may take up to one day to remove a bolt, however for comparative purposes we will assume that two bolts have galled on removal, and that their removal is 6 hours. When re-installation occurs there is a need for subsequent machining of the damaged holes. Time estimated for this operation will depend on the amount of damage and equipment used, and will vary between 3

and 7 hours for each hole. For this example it was 5 hours.

Pilgrim Radial Fit bolts were removed from the coupling holes without galling. As Pilgrim Radial Fit bolts are highly repeatable and reliable when re-installation occurred there was no complication and in fact assisted in achieving concentricity of the coupling. The Pilgrim Radial Fit bolts are totally reusable and no cost was estimated for the replacement traditional bolts in this example.

Bolt Type	Removal Time	Installation Time	Total
Traditional Bolts	20 off bolts x 50 mins 16hrs 40 mins	22 off bolts x 60 mins 22hrs	60 hrs 40 mins
	2 off bolts x 360 mins 12hrs	2 Hole Machining x 300 mins 10hrs	
Pilgrim RadialFit Bolts	22 off bolts x 20 mins 7hrs 20 mins	22 off bolts x 20 mins 7hrs 20 mins	14 hrs 40 mins
Comparison: Traditional Vs RadialFit Bolts	21 hrs 20 mins	24hrs 40 mins	46 hrs



Radial Fit Bolt

Case Study: Marine

Case Study Two

Vessel Type:
Number of Bolts:
Flange Types:
Bolt Type:

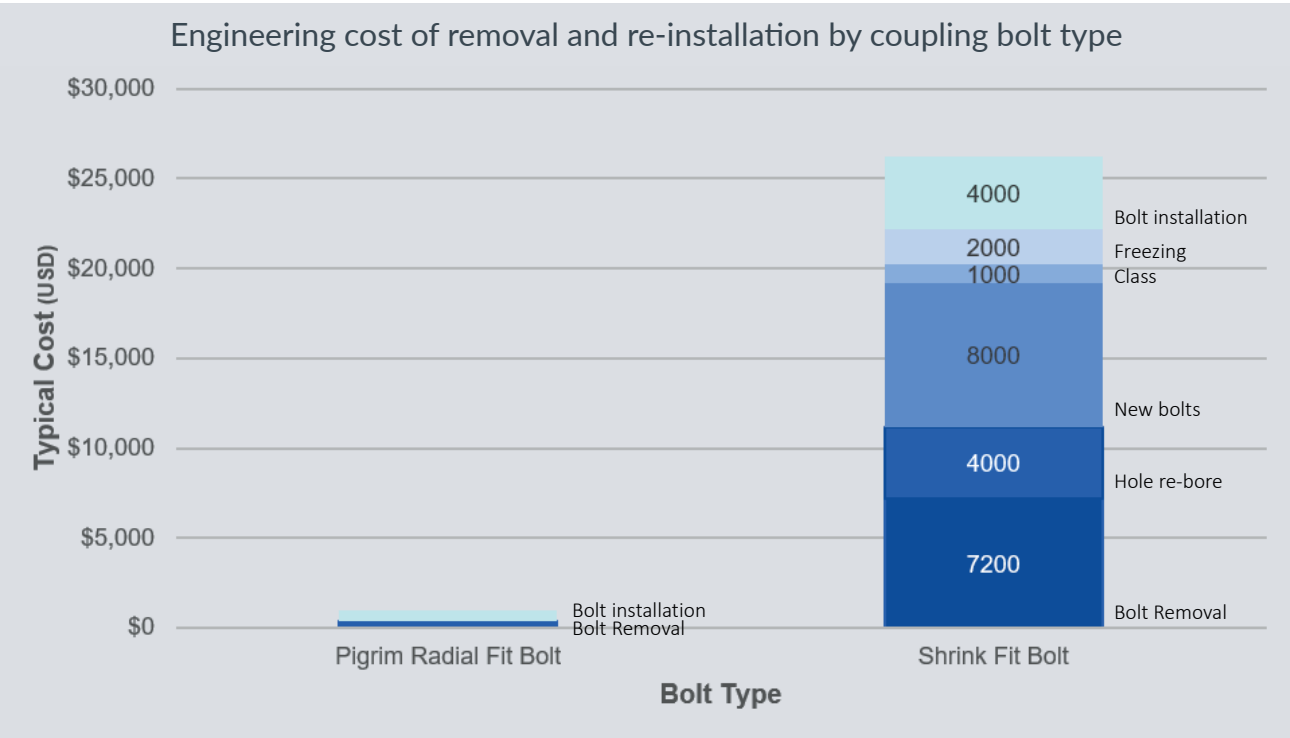
Aframax Tanker
12 off x 2 Flanges (24 off)
Eng. to Int. and Int to Prop.
Radial Fit Bolt - Standard

Engineering life cycle costs comparing the use of Pilgrims Radial Fit Bolts with traditional “shrink fit Bolts”.

Over a twenty year period and with Class required Tail shaft Survey expected every five years including subsequent flange splits, the expected savings for the fleet owner is \$70,000 per vessel.

This excludes the loss of operating time and subsequent loss of revenue.

Calculations based upon the following costs:
Installation time: \$200 per hour
In-situ machining costs: \$200 per hour
Freezing costs: \$100 per hour



Accessories

ClampBolt

Pilgrim’s ClampBolt range are designed with budget in mind, whether its used in conjunction with our premium Radial Fit Bolt design from 40mm dia. Plus or unaccompanied, we deliver a high integrity and bespoke tensioned bolt system. The ClampBolt is installed in a clearance condition and then hydraulically installed by stretching the bolt and manually tightening the nuts giving you a predetermined and optimised clamping force.



End Covers

Commonly used in Marine applications Pilgrim can provide machined steel or rubber End Covers to protect the protruding threat on a Standard Radial Fit Bolt / Clamp Bolt.

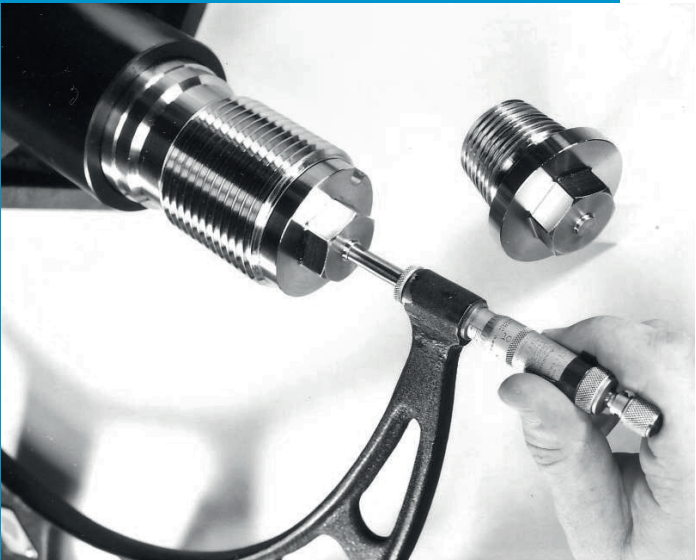


Windage Plates

To aid the improvement of a couplings aerodynamic performance and cleanliness in high speed applications, Pilgrim have several neat designs for windage plates that attach to the end of the hydraulically installed bolts.

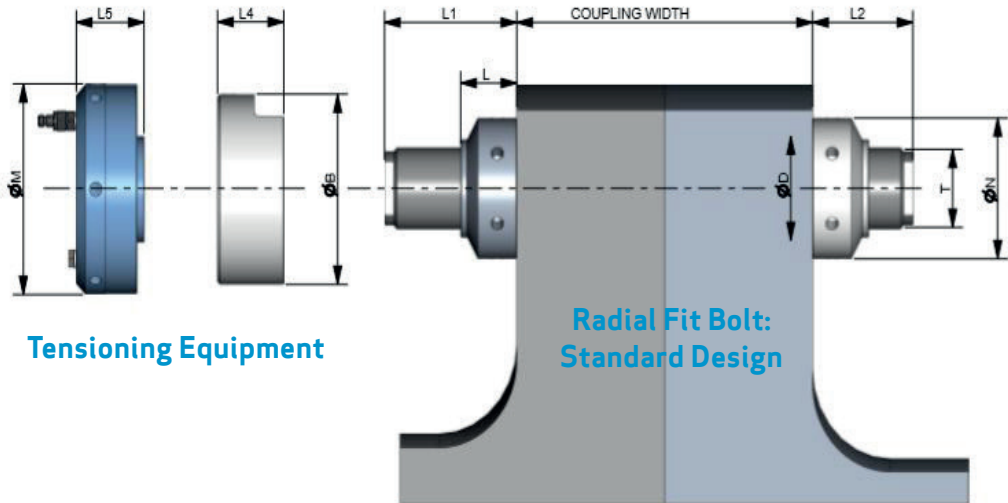
Datum Plugs

Provide a simple aid in measuring the length of the hydraulic Radial Fit Bolt. The Datum Plug provides an accurate and consistent reference point for your measuring system. The bolt length measurement can be taken before and after hydraulic tensioning to verify that the installation and loading has been undertaken correctly.



Radial Fit Bolt - Standard: Marine Range

Where applicable, a combination of Pilgrim Radial Fit Bolts and ClampBolts can be used



The sizes shown in the table are for the standard range of Pilgrim Radial Fit Bolts and are intended for guidance only Special designs are available to suit customers.

Nom Hole Ø D	Thread T	Nut Dia Ø N	Nut Height L	Bolt Stand Outs			Tensioning Gear				Max Applied Load KN
				L1	L2	L3	L4	L5	Ø M	Ø B	
40-44	M33 x 3.5	58	27	68	52	38	32.0	39	90	83.0	308
45-47	M36 x 4.0	63	29	73	55	41	34.5	42	98	89.0	360
48-51	M39 x 4.0	67	32	79	60	44	38.0	45	106	92.0	435
52-54	M42 x4.5	72	34	84	63	46	40.5	48	113	98.0	500
55-58	M45 x 4.5	76	36	89	67	48	42.5	50	120	104.5	588
59-63	M48 x 5.0	82	39	97	73	54	46.5	52	127	111.5	660
64-68	M52 x 5.0	89	42	104	78	57	50.0	54	137	120.5	795
69-72	M56 x 5.5	96	45	111	83	60	53.5	55	147	129.5	924
73-78	M60 x 5.5	102	48	115	88	63	57.0	56	158	139.0	1078
79-83	M64 x 6.0	109	52	123	94	68	61.5	58	166	147.5	1210
84-87	M68 x 6.0	116	55	130	99	71	65.0	61	177	157.0	1390
88-93	M72 x 6.0	122	58	137	104	74	68.5	64	187	166.0	1585
94-97	M76 x 6.0	130	61	144	109	77	72.0	67	197	176.0	1790
98-103	M80 x 6.0	137	64	152	116	82	76.0	70	208	185.5	2008
104-109	M85 x 6.0	147	68	161	123	86	80.5	74	220	198.5	2298
110-116	M90 x 6.0	155	72	170	129	90	85.0	78	232	209.5	2610
117-121	M95 x 6.0	164	76	179	136	94	90.0	82	245	222.5	2938
122-129	M100 x 6.0	172	80	187	142	98	94.5	86	258	234.0	3295
130-135	M105 x 6.0	182	84	199	152	105	99.5	89	270	246.5	3656
136-140	M110 x 6.0	190	88	208	158	109	104.0	92	283	258.0	4050
141-146	M115 x 6.0	199	92	217	165	113	95	100	295	270.0	4450
147-150	M120 x 6.0	208	96	225	171	117	113.5	98	309	282.0	4880

The hydraulically installed **PilgrimBolt** ensuring high integrity joints

The PilgrimBolt is an engineered clearance bolt with a built in hydraulic load-cell maintaining a high retained load. Designed for either blind or through holes where a controlled and accurate pre-load is required.

The clever design and installation leaves the application free from hole and face damage associated with conventional torque tightened clamp bolts.

Design

With a size range of M36 To M120 plus, the PilgrimBolt is a neat and versatile bolt coming in three variants to ensure the easiest of installation and removal in static flanges or slow rotating applications.

All three variants are designed to be pressured up to 33,000 psi and typically operate between -35°C and +120°C.

As standard the Quick Connect hydraulic connection is located on the top side, however if required can be located radially on the load cell.

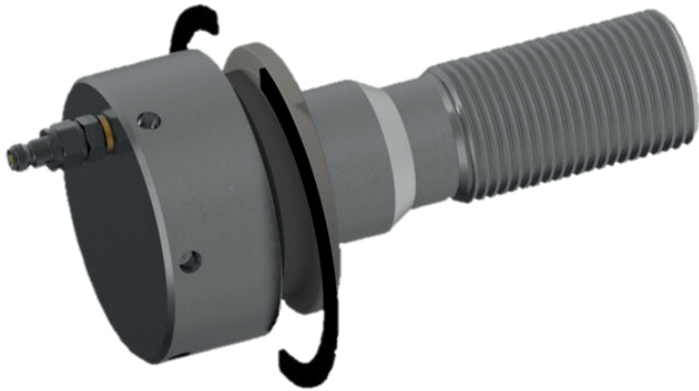
Typical Applications

- Pressure vessel covers typically found in Marine, Defence or Nuclear industries.
- Fin / Stock taper couplings
- Foundation bolting that requires high accuracy and known load retention, such as the optical assembly of a solar Telescope.

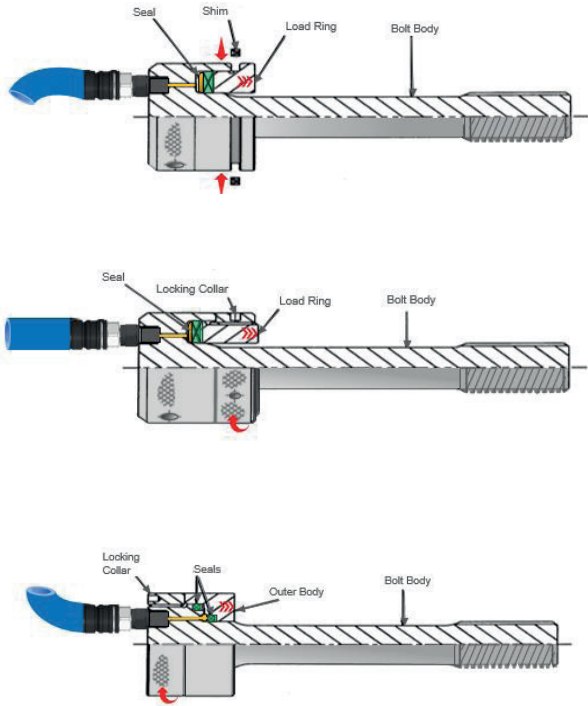


Benefits

- Eradicates flange face damage
- Plug and Play with no need for special bolt tensioning tools
- Suitable for homogenous tightening
- High retained load
- Suited for limited / restricted access areas
- Blind or through hole applications
- Designed for pressures up to 33,000 psi



Shim type PilgrimBolt used for bolting the foundations of a solar telescopes mirror to the optical support structure



Shim

- Compact design
- Lowest cost option of the three variants
- Suitable for Ultrasonic elongation, stress and load testing

Bottom Locking Collar

- Higher retained load than shim type
- Allows for homogenous tightening
- Suitable for Ultrasonic elongation, stress and load testing
- Easy to install

Top Locking Collar

- Retains the highest load of the three variants
- Allows for homogenous tightening
- Suitable for Ultrasonic elongation, stress and load testing
- Easy to install

Bolt Tensioning Kits for accurate and quick installation / removal

Customised for the application, the Pilgrim Bolt Tensioning Kit can be supplied in different configurations to meet the specific needs of the customer.

Each kit supplied is composed of all the required tools for a complete Radial Fit and ClampBolt installation and removal. The Bolt Tensioning Kit is designed for easy operation to allow installation of a single bolt or a simultaneous installation using a dual Bolt Tensioning Kit.

The dual Bolt Tensioning Kit enables two bolt assemblies to be pressurised simultaneously, reducing the maintenance downtime during major or minor shutdowns. The hydraulic heads supplied meets the requirements of the Machinery Directive 2006/42/EC and are CE marked, providing further confidence that the Pilgrim product meets International safety standards.

Each kit features:

Hydraulic Head, Tensioning Bridge , Setting and Removal Bridges, Puller (Compact Bolt design only), Reaction Tool, Tommy Bar, Nut Rotating Ring, Oil injection Adaptor, Turning Mandrel.

Ordering Replacement Parts

In an instance where parts of the Bolt Tensioning Kit gets lost or damaged Pilgrim's refurbishment service is designed to remove uncertainty by offering to inspect and service, including re-warranting the kits ready for the next planned maintenance event. As each Bolt Tensioning kit is specifically designed uniquely for each application it is important to use Genuine Pilgrim Parts at all time. Contact us directly or a local authorised agent / distributor.



Main Features

- Hardened lens ring on oil injection adaptor
- Puller optimised thread and taper for safe operation
- Nut rotating ring: hardened for reliability
- Reaction tool: ergonomically designed
- Mandrel: hardened to maintain accuracy
- Rust preventative treatment: Chemi-blackening
- Tool box included: smart lightweight and durable
- Setting bridge: adjustable (optional)
- Hydraulic head: CE approved
- Material traceability documentation (optional)



Hydraulic Pumps

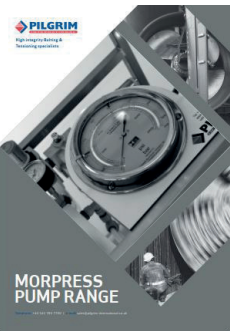
Each Bolt Tensioning Kit requires hydraulic power and Pilgrims MorPress high pressure pump range is designed with this in mind.

Choose between the three hydraulic delivery options:

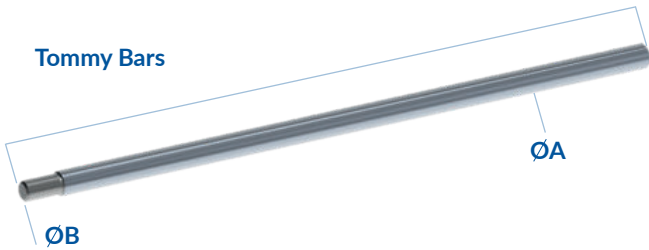
- Air Driven
- Electric
- Hand



Further details on the pump range and associated hydraulic fittings / hoses can be found in the MorPress Pump Range Catalogue. Build your own pump using the simple configuration tool, which will guide you to the optimum pump.



Tommy Bars

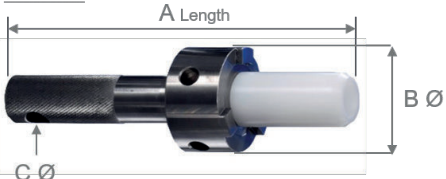


Part No	Legacy Part Numbers		Ø A mm	Ø B mm	L mm
	Pilgrim	HYDROCAM®			
N5200	H9600/15		6.0	5.0	170.0
N5201	H9600/1 & /2	21M_10429-07	8.0	6.0	170.0
N5202	H9600/2 & /3	21M_10310-07	10.0	8.0	170.0
N5203	H9600/3 & /4	21M_10341-07	12.0	10.0	170.0
N5204	H9600/4 & /5	21M_10340-07	14.0	12.0	170.0
N5205	H9600/5 & /6		16.0	14.0	170.0
N5206	H9600/6		18.0	16.0	190.0
N5207	H9600/7		20.0	18.0	190.0
H5208			22.0	20.0	190.0
N5209	H9600/11		24.0	22.0	190.0

Reaction Tools

With the operator in mind, Pilgrim's Reaction Tool is an ergonomically designed tool to aid the safe installation / removal by stopping the rotation of the hydraulically installed bolts while screwing and unscrewing the extension piece better known as a Puller.

M5500



H9746



Part Number	Corresponding Bolt Size (Thread)	Length A (mm)	Diameter Ø B (mm)	Hole C Ø (mm)
M5500_33	M33	145.0	28.70	10.10
M5500_36	M36	155.0	31.70	10.10
M5500_42	M42	158.0	38.25	10.10
M5500_45	M45	160.0	41.25	10.10
M5500_48	M48	161.0	44.25	10.10
M5500_52	M52	170.0	47.00	10.10
M5500_56	M56	169.0	51.00	12.10
M5500_60	M60	191.0	55.00	12.10
M5500_64	M64	194.0	59.00	12.10
M5500_68	M68	197.0	63.00	12.10
M5500_72	M72	199.0	67.00	12.10
M5500_76	M76	207.0	71.00	12.10
M5500_80	M80	226.0	74.00	12.10
M5500_85	M85	230.0	80.00	14.10
M5500_90	M90	232.0	85.00	14.10
H9746	All	225.0	10.00 Sq	N/A

Coupling Hole Alignment Tool (CHAT) reducing unwanted down time by rapidly aligning large couplings.

“ With the CHAT tool it is a one time shot. You install the tool, pump it up and all of the holes are perfectly aligned so you can get all of the bolts/sleeves in with ease ”

Siemens Inc

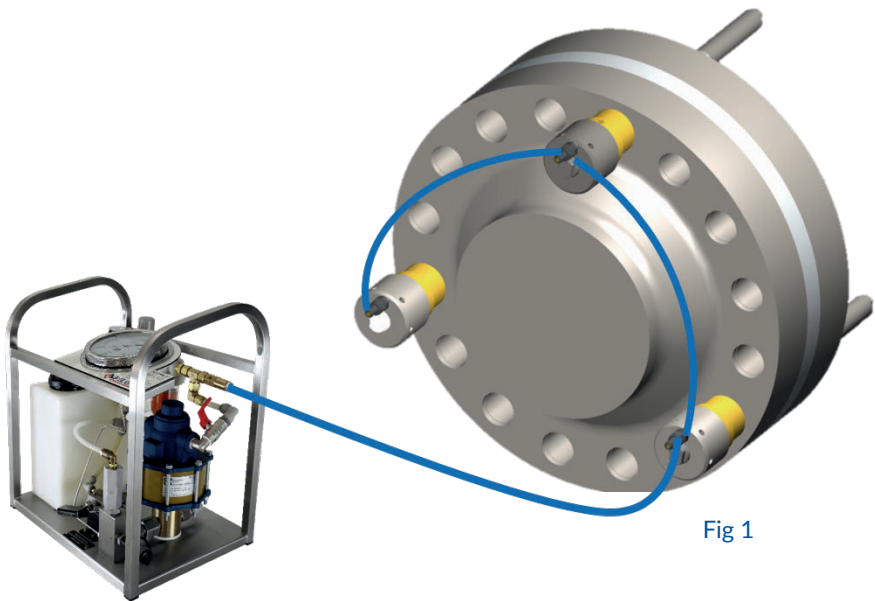


Fig 1

Pilgrim’s (CHAT) Coupling Hole Alignment Tool is a further development from the Pilgrim product portfolio.

Designed in response to OEM Service Teams and End User requirements. It achieves coupling hole alignment quickly and to a tolerance that permits effective bolt installation or removal.

The CHAT hydraulically expanding tool is based upon the same principle as the Radial Fit Bolt saving time and therefore reduces cost during the alignment and closure of shaft couplings. (fig 1) Depending upon coupling size, each CHAT package consists of between 3 and 4 tool assemblies (see fig 2). The tools are inserted into equispaced flange holes and are simultaneously pressurised to align the coupling holes. The coupling faces are then closed using the tools in preparation for installation of the coupling bolts.

Benefits

- Safe & easy to use
- Rapid alignment up to 2.5mm misaligned
- Closes the couplings
- Accurate and reliable
- Saves time
- Suitable for spigotted or plain couplings
- Comes in a lightweight and durable tool box

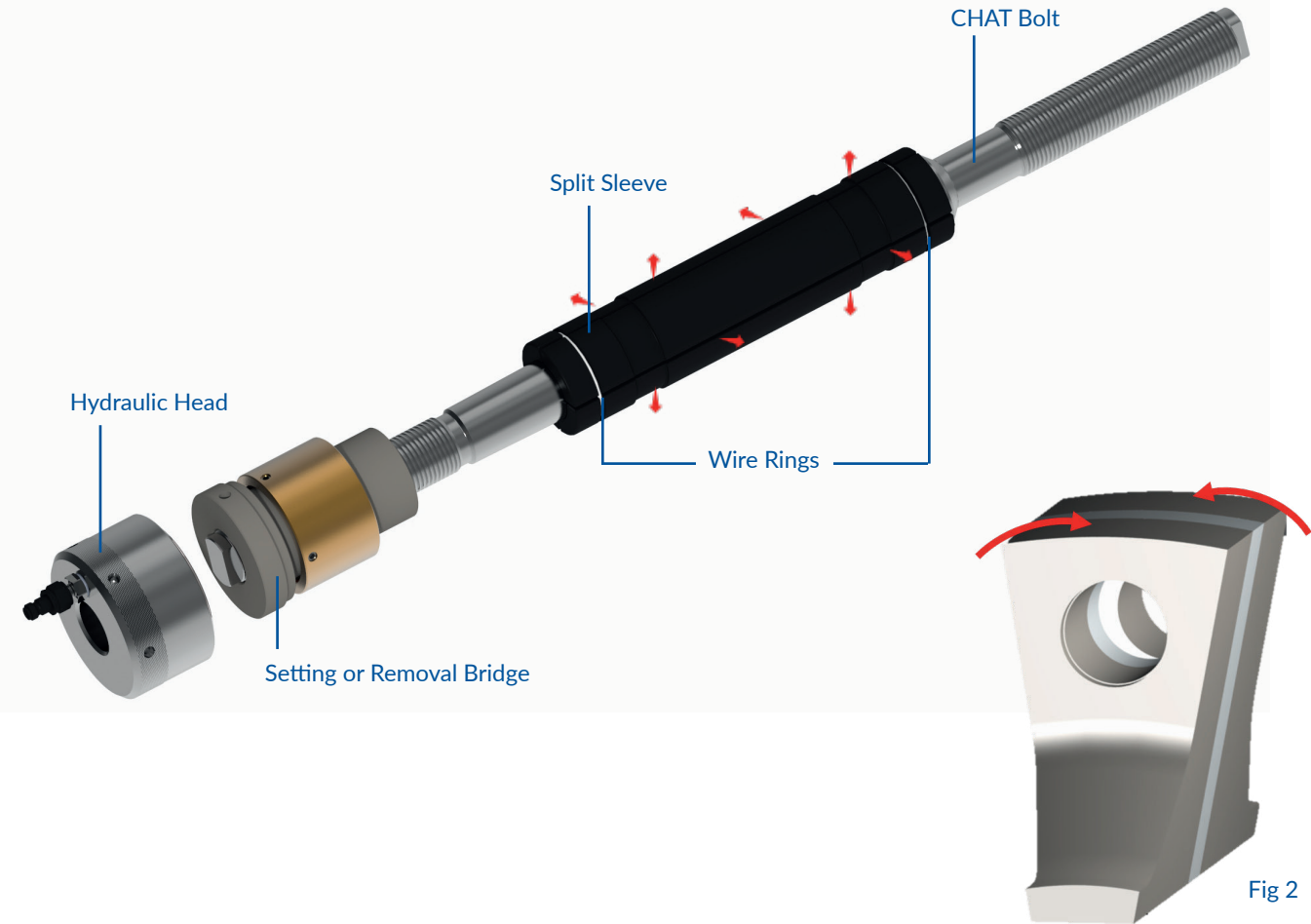


Fig 2

MorGrip Bolt, the original hydraulically installed radial fitted bolt.

A hydraulically actuated bolt designed to provide fast, cost effective and trouble-free installation and removal, eliminating the risk of stuck bolts and associated hole damage.

The MorGrip provides a stark contrast to the installation of traditional shrink fit bolts, which often cause scoring of both the hole and bolt surface on removal. The MorGrip bolt, on the other hand, can be repeatedly installed and removed quickly without damage to either the bolt or the hole. The principle on which the bolt works is based on Poisson's ratio, which establishes that, when a round steel component is stretched within its elastic limit, it's diameter will reduce by a known amount.

Applications

Over many decades the MorGrip bolt has been proven in many applications, including Mine Winders, Steam Turbine and Generator Couplings

How it works

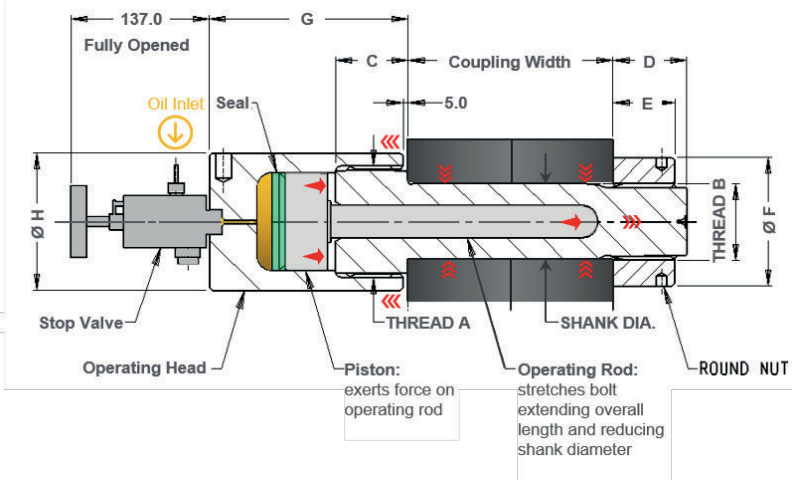
The stretching force is applied through a hardened steel rod located down the centre of the bolt. Operating gear is screwed on to the head of the bolt. When pressurised, this exerts a

force through the rod to stretch the bolt. As the bolt stretches in length it contracts in diameter according to Poisson's ratio. Once pressurised, the bolt can be clearance installed in the hole. A nut is attached (if a through-hole application) and nipped tight. The pressure is then released to bring about a reduction in the length of the bolt and a corresponding increase in its diameter. The reduction in length achieves an axial clamping load as the increase in diameter simultaneously achieves a fitted condition. The bolt is now ready for service. It can be installed remotely from the pump unit by using the stop valve fitted to the operating gear to lock in hydraulic pressure. Removal is the reversal of this procedure.



Benefits

- Through or Blind holes
- Elimination of bolt hole damage
- Quick and reliable installation and removal
- Sea water resistant material options
- Proven design with 1000's of installations
- Repeatable installation and removal
- Full material traceability
- Available in either standard range or bespoke



MorGrip Standard Range

Pt No.	Shank Dia Ø	A	B	C	D	E	F	G	H
MGB043	43-48	M72x6	M42x4.5	60	49	34	75	151	87
MGB048	48-51	M80x6	M48x5	62	53	38	87	157	98
MGB051	51-56	M80x6	M52x5	62	57	42	92	157	98
MGB056	56-59	M90x6	M56x5.5	66	60	45	98	165	110
MGB059	59-64	M90x6	M60x5.5	66	63	48	104	165	110
MGB064	64-67	M100x6	M64x6	69	66	51	110	179	123
MGB067	67-72	M100x6	M68x6	69	69	54	116	179	123
MGB072	72-75	M110x6	M72x6	72	73	58	121	192	136
MGB075	75-80	M110x6	M76x6	72	76	61	127	192	136
MGB080	80-85	M125x6	M80x6	76	79	64	133	201	154
MGB085	85-90	M125x6	M85x6	76	83	68	139	201	154
MGB090	90-95	M140x6	M90x6	85	87	72	150	218	172
MGB095	95-100	M140x6	M95x6	85	91	76	156	218	172
MGB100	100-105	M150x6	M100x6	90	95	80	167	232	186
MGB105	105-110	M150x6	M105x6	90	99	84	173	232	186
MGB110	110-120	M160x6	M110x6	100	103	88	179	258	203
MGB120	120-125	M160x6	M120x6	100	111	96	196	258	203
MGB125	125-130	M190x6	M120x6	110	111	96	196	281	236
MGB130	130-140	M190x6	M130x6	110	119	104	214	281	236
MGB140	140-150	M210x6	M140x6	125	127	112	231	316	264
MGB150	150-160	M210x6	M150x6	125	135	120	243	316	264