



Reinforcing Steel Contractors

Bartec Engineers Manual

In Partnership With:



Dextra



A Murray & Roberts company



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1. PRODUCT NAME



BARTEC® MECHANICAL COUPLER
SPLICING SYSTEM*

* Patent No. EP 0 327 770

®: Registered trademark no. 552583



2. MANUFACTURER / SUPPLIER

Dextra Manufacturing Co., Ltd.

247 Sarasin Road

Lumpini

Pathumwan

Bangkok 10330

Thailand

Email: thailand@dextragroup.com

Web: www.dextragroup.com

Murray & Roberts Steel

30 Industry Road, Olifantsfontein, Midrand
South Africa

Tel: +27 11 697 0000

Fax: +27 11 697 0030

E-Mail: info.steel@murrob.com

Web: www.steel.murrob.com

The BARTEC® system is the easiest way of connecting two bars that cannot be turned, a feature known as “Position splicing”.

The BARTEC® system conveniently uses the same coupler to do standard splices or position splices. The difference between both splices is limited to the length of the thread done on the bar. The same bar end preparation can accommodate either a coupler to create a mechanical splice, or a plate to create a mechanical anchorage.

3. PRODUCT DESCRIPTION

A. Basic description:

The BARTEC® reinforcing bar end preparation system is a patented cold-upsetting and threading process that guarantees an ultimate tensile strength of the bar connection larger than that of the parent bar.



B. Basic use:

The BARTEC® bar end preparation is suitable to make mechanical splices and mechanical anchorages with reinforcing bars ISO 6935, EN 10080, BS 4449, DIN 488, ASTM A615, ASTM A706, NF A35-016, NEN 6008, NBN A24-302, SIA 162101, GB 1499, IS 1786 and Önorm B4200 bars in diameters 16 through 40.

Mechanical connections are a quicker, safer and more convenient alternative to lap splicing and field butt-welding.

Typical applications include monolithic structures, splicing of reinforcement bars in columns and beams, diaphragm wall cages, core walls, top-down construction, temporary openings and obstructions, etc.

Headed bars conveniently replace hooked bars as end anchorage in congested areas. They can also be used to reduce lapping length, or as confinement or shear reinforcement where placing of stirrups is difficult.

Typical applications include development of reinforcement, column-beam knee joints, column heads, pile feet, cantilevered members, corbels, etc.

C. Composition and materials:

BARTEC® couplers are manufactured from 20MV6, 30Mn4 or S45c steel grades or equivalent. For weldable couplers, grade S235 (equivalent to St37 or SS41) is also used. For lock-nuts, any steel grade is acceptable, since they are non load-bearing elements.

BARTEC® anchor plates are manufactured from steel grade S45c, S50c or equivalent.

D. Surface condition:

The surface condition of BARTEC® couplers complies with ACI 318 (1999) § 7.4.2, with ACI 349 (1985) § 7.4, with ASME Section III Division 2 § CC-4360 and with B.S. 5400 Part 7 § 4.5. Weldable couplers furthermore comply with ANSI/AWS D1.1-88 § 3.2.1.

E. Corrosion protection:

BARTEC® couplers can be galvanised or epoxy-coated by any means. Protect their internal threads before processing.

F. Limitations:

BARTEC® couplers must be fixed onto reinforcing bar ends exclusively processed on a Dextra forging & threading machine. The shortest bar that can be processed is 50 cm. The use of mechanical connections is governed by building codes and standards.

4. TECHNICAL DATA

A. Applicable standards, guides and codes:

BARTEC® couplers comply with all major building codes and standards:

For **general construction**, the splicing of reinforcing bars is governed by (among others):

- The British Standards Institution, in its standard BS 8110 (1997), Part 1, Section 3, chapter 3.12.8.
- The Association Française de Normalisation (AFNOR), in its standard NF A35-020 (1999).

The most relevant regulation governing **overlapping or lap-splicing (among others) is:**

- **B.S. 8110:** Part 1: 1997 § 3.12.8.16.2: “Bars in tension. The only acceptable form of full-strength butt joint for a bar in tension comprises a mechanical coupler (...).”

The most relevant regulations governing **staggering (among others) is:**

- **B.S. 8110:** Part 1: 1997 § 3.12.8.9: “Laps and joints. Connections transferring stress may be lapped, welded or joined with mechanical devices. They should be placed, if possible, away from points of high stress and should preferably be staggered.”

For the building of **highways and bridges**, the splicing of reinforcing bars is also governed by the British Standards Institution, in its standard BS 5400 and by the American Association of State Highways and Transportation Officials (A.A.S.H.T.O.) in its Standard Specifications for Highway Bridges, Section 8.32, as well as by the various departments of transportation of each U.S. state.

For the construction of **nuclear safety-related structures**, the splicing of reinforcement bars is governed by (among others):

- The British Nuclear Fuel Ltd (BNFL), in its standard BNF.ES.0039.

B. Approvals

BARTEC® mechanical splices and anchorages have been approved by the most demanding international regulators:

- The UK Cares (Report 5011)
- CalTrans
- AFCAB (Report M99/002)
- The Concrete Institute of Russia
- DIBT Germany (Z1.5-204)

C. Safety factors:

On a design point of view, BARTEC® mechanical connections have been computed to far surpass all the requirements of the standards and codes cited above.

The BARTEC® splicing system achieves full strength of reinforcement bars grade 500 in the most demanding definition of “full strength”, which is to prove an ultimate tensile strength higher than the actual ultimate tensile strength of the bar.

It does so by having a thread engagement length superior to the 0.8d of standard ISO screw and nut systems, and by not reducing the cross-section area of the bar.

APPLICABLE TENSILE STRESS AND LOAD SPECIFICATIONS UNDER MOST COMMON SPLICE STANDARDS

Country	UK	GERMANY	FRANCE	USA		SUPPORTIVE TEST DATA OF BARTEC MECHANICAL SPLICES	
Standard	BS 8110 (1997)	DiN 1045 (2001)	NF A35-020 (1999)	ACI 318 (1999)		Bar-break has been achieved on bars up to	
Rebar grade (MPa)	500	500	500	414			
Application	General §3.12.8.16.2	Zulassung richtlinie §3.1.3.1	General §4.3	General (Type 1) §12.14.3.4	Seismic (Type 2) §21.2.5 & 6		
Criteria	108% Fy	Min (130% fy, 95% Fu actual)	95% Fu actual	125% Fy	Max (100% Fu, 125% fy act)		
Stress (MPa)	540	650*	570 to 665**	517.5	580 to 690		
Load (kN) Nominal for bar dia	kN	kN	kN	kN	kN	kN/ MPa	Nominal cross-section areas (mm ²)
12	61	73.5	64.4 to 75.1	58.5	65.5 to 78	88.0 / 778	113
14		100.1	87.8 to 102.4			91.0 / 591	154
16	108.5	130.7	114.6 to 133.7	103.5	116.5 to 138	161.2 / 802	201
18							255
20	169.5	204.1	179 to 208.8	147	182 to 216	258.1 / 822	314
22				200.3	220 to 262	234.1 / 616	380
25	265	319	280 to 326.8	285 to 339	392 / 800	491	
28		400.4	351 to 409.6	334	357 to 425	461.2 / 748	616
32	434	522.6	458.3 tp 534.7	424	466 to 555	601.4 / 748	804
36				520.8	590 to 702	643.4 / 623	1018
40	678.8	816.4	716 to 835.2			940.2 / 748	1257
45				751.2	922 to 1,097	1,016.0 / 639	1590
50	1,060		1,119 to 1,305.4			1,305.7 / 665	1963
56			1,404 to 1,638	1,335.50	1,453 to 1,700	1,608.3 / 653	2463

* The acceptance criteria of 95% Fu actual may sometimes be lower and reduce this value.

** The acceptance criteria of 95% Fu actual is high and thus predominates. Values stated here correspond to minimum and maximum actual tensile strength of respectively 600 and 700 N/mn².

*** The acceptance criteria of 90% Fu actual is high and thus predominates. Values stated here correspond to minimum and maximum actual tensile strength of respectively 600 and 700 N/mn².

5. CSIR REPORTS

Date tested: 07 June 2007
 Certificate No: T11094/6/8/11100/01
 Testing Machine: 1000kN Amsler Universal
 Test Type: Destruction in tension
 Tested By: CSIR
 DMS Ref.: Jhb Gen Gen:14102.1

The bar was in turn installed in the 1000kN Amsler Universal testing machine using suitable fittings. A gradually increasing tensile load was applied to each specimen until failure occurred.

Type A: Two bars standard threaded and fully joined with BARTEC® coupler.

Type B: One bar standard threaded and one bar extended threaded joined with BARTEC® coupler.

Type C: Either A or B above with one bar 'undone' / unscrew thread by 360°.

Test results:

Maximum loads for the Ø 16 mm cold forged coupled bars manufactured by Cisco

Specimen description	Maximum load carried (kN)	Mode of failure
1. Type A	143.2	The bar fractured
2. Type B	146.2	The bar fractured
3. Type C	140.9	The bar fractured

Maximum loads for the Ø 20 mm cold forged coupled bars manufactured by Cisco

Specimen description	Maximum load carried (kN)	Mode of failure
1. Type A	213.9	The bar fractured
2. Type B	203.4	The bar fractured
3. Type C	212.5	The bar fractured

Maximum loads for the Ø 25 mm cold forged coupled bars manufactured by Cisco

Specimen description	Maximum load carried (kN)	Mode of failure
1. Type A	347.6	The bar fractured
2. Type B	356.0	The bar fractured
3. Type C	347.4	The bar fractured

Maximum loads for the Ø 32 mm cold forged coupled bars manufactured by Cisco

Specimen description	Maximum load carried (kN)	Mode of failure
1. Type A	560.4	The bar fractured
2. Type B	597.4	The bar fractured
3. Type C	503.8	The bar fractured

Maximum loads for the Ø 40 mm cold forged coupled bars manufactured by Cisco

Specimen description	Maximum load carried (kN)	Mode of failure
1. Type A	799.8	The bar fractured
2. Type B	806.4	The bar fractured
3. Type C	807.6	The bar fractured

6. MANUFACTURING PROCESS

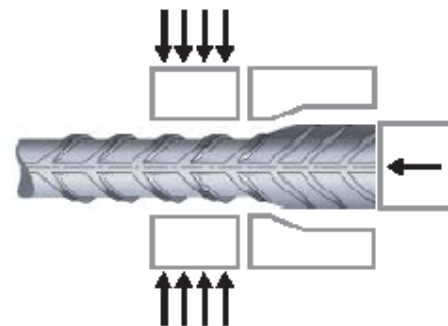
1. Cutting

The end of the reinforcing bar is sawn square.



2. Cold Forging

The sawn end of the reinforcing bar is enlarged by a patented cold forging process. The core diameter of the bar is increased to a pre-determined diameter.



3. Threading

Finally, the thread is mechanically cut onto the enlarged end of the bar.



7. BAR ENDS PREPARATION

Reinforcing bars are individually prepared by having a BARTEC® thread made on one or both of their ends by a Dextra threading machine. The threading machine is preferably installed at a fabricator's workshop.

8. INSTALLATION

The mechanical connection is achieved by screwing the coupler onto one bar, and then screwing in the second bar. Contrary to taper threads, no torque wrench is necessary, and miss-assembly by crossing threads is impossible.

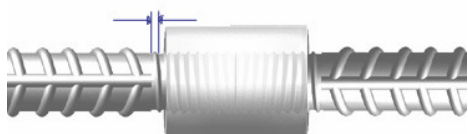
Assembly instructions provided by Dextra must be followed. Isometric parallel threads have equal resistance in tension and compression. Therefore, the performance of the BARTEC® splice will not be affected if the two bars are not in butt-to-butt contact. Since the safety ratio on the thread engagement length is designed to be at least one pitch, a gap between both bars is admissible.

Max gap between bars

Bar size \varnothing	Max gap (mm)
16	2.5
20	3
25	3.5
32	4
40	4.5

Visual inspection of the splice is easily accomplished:

Maximum one thread pitch visible outside the coupler



Bars that are not properly aligned may still be connected if this misalignment is within reasonable limits, depending on the length of bar and on their stiffness. Large bars must always be properly aligned.

Approximate admissible misalignment (mm)

Bar size	Bars < 2 m	Bars > 2 m
16	10	18
20	10	15
25	8	15
32	5	8

9. COLOUR IDENTIFICATION

The plastic caps that protect the Threads of BARTEC® couplers are colored to enable a quick identification of the bar size and prevent miss matching of threads:

Colour of plastic caps

Bar size	Colour
16	Lavender
20	Orange
25	Clear
32	Pink
40	Light Blue

10. CUSTOMS CODE

The usual international customs code for mechanical couplers is 73.08.90.90.00-7 ("Parts of structures, of iron or steel"). However, national preferences may be followed.

11. QUALITY ASSURANCE

BARTEC® couplers are manufactured according to strict technical specifications and under a production process that has been certified to satisfy to the ISO 9001 quality assurance standard.

They are warranted to be free from manufacturing defects and to perform in accordance with the manufacturer's specifications providing that they are installed in accordance with the manufacturer's instructions.



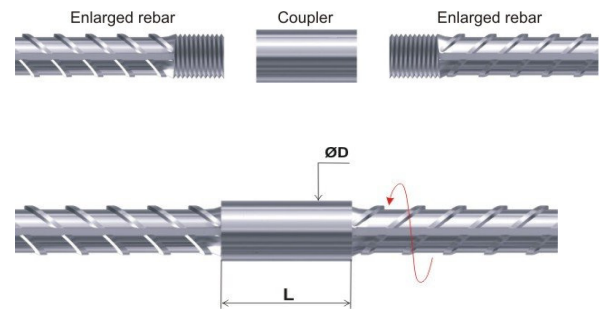
Full traceability of the couplers production batches and raw materials is guaranteed.

12. SYSTEM DESCRIPTION

The BARTEC® mechanical splice system consists of enlarging the reinforcing bar ends by cold-upsetting prior to threading them. The bars are cut square before the enlarging operation. The combination of the square cutting and the cold-upsetting reduces the length of the bar by approximately 40 to 75 mm on each end, depending on the bar size. Extra-long threads are used to assist alignment, or when joining bars that cannot be turned. All applications can thus be fulfilled by only one model of couplers, reducing inventory management to a minimum.

STANDARD SPLICES - TYPE A

Standard BARTEC® splices are accomplished by use of a standard female coupler matching the thread size made on the bars. They are available in diameters 16 through 40.



See Assembly instruction PT02BAR (available on request).

Dimensions of Standard splices

Product Code	Bar size	Approximate external dimensions		Thread size
		D (mm)	L (mm)	
FPBS1620001	16	28	40	M20 x 2.5
FPBS2024001	20	34	48	M24 x 3.0
FPBS2530001	25	42	60	M30 x 3.5
FPBS3236001	32	52	72	M36 x 4.0
FPBS4045001	40	65	90	M45 x 4.5

TRANSITION SPLICES

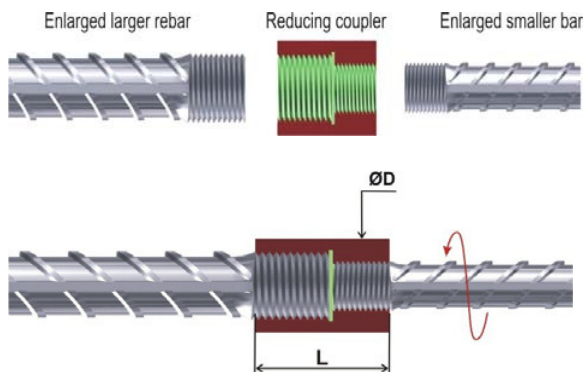
When there is a need to splice bars of different sizes, it is allowable in most cases (Ref table below) to reduce the size of the larger bar and to use a standard coupler.



BARTEC® Direct Transitions

Transition	Feasibility	Thread
14/12 16/12 16/14 20/16 25/20 32/25 36/32 45/40 56/50	OK	M14 on \varnothing 14 M14 on \varnothing 16 M16 on \varnothing 16 M20 on \varnothing 20 M24 on \varnothing 25 M30 on \varnothing 32 M36 on \varnothing 36 M45 on \varnothing 45 M56 on \varnothing 56
40/32 50/40 56/45	Possible, but need one extra machining step on the larger bar to remove excess material.	M36 on \varnothing 40 M45 on \varnothing 50 M52 on \varnothing 56
20/18 22/20 25/22 28/25 32/28 40/36 50/45	NO The larger bar is not large enough to accommodate the Bartec thread. Use of a transition coupler is necessary.	

However, the BARTEC® system proposes special reducing couplers that conveniently avoid the difficult task of planning in advance the need of transitions.



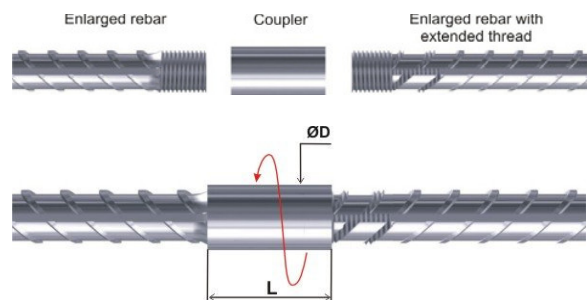
See Assembly instruction PT05BAR (available on request).

Dimensions of Transition splices

Product Code	Bar size	Approximate external dimensions		Max Weight W (kg.)
		D (mm)	L (mm)	
FPBR1616001	TC 14-12	28	42	0.129
FPBR1820001	TC 18-16	34	44	0.222
FPBR2020001	TC 20-16	34	48	0.228
FPBR2022001	TC 20-18	34	48	0.220
FPBR2224001	TC 22-20	36	54	0.260
FPBR2524001	TC 25-20	42	60	0.437
FPBR2527001	TC 25-22	42	60	0.773
FPBR2830001	TC 28-25	48	66	1.049
FPBR3230001	TC 32-25	52	72	0.788
FPBR3233001	TC 32-28	52	72	0.761
FPBR3636001	TC 36-32	60	84	1.232
FPBR4042001	TC 40-36	65	90	1.507
FPBR4030001	TC 40-25	65	90	1.623
FPBR4036001	TC 40-32	65	90	1.584
FPBR4545001	TC 45-40	80	104	2.845

POSITION SPLICES - TYPE B

When both bars would be a burden to rotate, for example because of their size, shape or length, the BARTEC® splice system simply extends the thread onto the ribs of the bar, thereby enabling the coupler to be fully screwed onto it. It is then unscrewed from one bar and back onto the second bar to accomplish the connection. They are available in diameters 16 through 40.



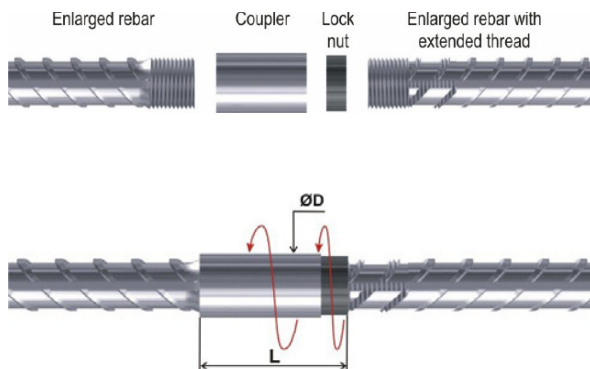
Dimensions of Position splices - Type B

Product Code	Bar Size	Approximate external dimensions		Thread size
		D (mm)	L (mm)	T (mm)
FPBS1620001	16	28	40	M20 X 2.5
FPBS2024001	20	34	48	M24 X 3.0
FPBS2530001	25	42	60	M30 X 3.5
FPBS3236001	32	52	72	M36 X 4.0
FPBS4045001	40	65	90	M45 X 4.5

See Assembly Instruction PT03BAR (available on request).

POSITION SPLICES - TYPE C

When neither bar can be rotated, or if the angular position of the second bar matters, BARTEC® position splices type C are the answer. This is a variant of the position splice type B that bears an additional lock-nut. They are also available in diameters 16 through 40.



Dimensions of Position splices type C

Product Code		Bar Size	Approximate external dimensions		Thread size
Coupler	Lock Nut		D (mm)	L (mm)	T (mm)
FPBS1620001	FPBL1620001	16	28	53	M20 x 2.5
FPBS2024001	FPBL2024001	20	34	64	M24 x 3.0
FPBS2530001	FPBL2530001	25	42	80	M30 x 3.5
FPBS3236001	FPBL3236001	32	52	96	M36 x 4.0
FPBS4045001	FPBL4045001	40	65	120	M45 x 4.5

See Assembly Instruction PT04BAR (available on request).

GENERAL INFORMATION

- No reduction of the ductility of the reinforcing bar
- Tensile failure guaranteed to occur away from the joint
- No reduction of the nominal cross section area of the parent bar
- Couplers are individually marked to allow full traceability of the material
- Parallel-thread system (in order to eliminate the risk of cross-threading and avoid the use of torque wrench)

Lock nuts, end anchors, weldable couplers and shutter positioning BARTEC® plates are available on request.

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Tel: +27 11 697 0000

Fax: +27 11 697 0010

E-mail: info@reinforcingsteelcontractors.co.za

Web: www.reinforcingsteelcontractors.co.za



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