Macalloy

July 2016

Post Tensioning System
Macalloy 1030
European Technical Approval

CARES 1244-CPD-1007 UKAS PRODUCT CERTIFICATION

CARES 1055 UKAS MANAGEMENT SYSTEMS

CE

ETA-07/0046

EXPERIENCE INNOVATION QUALITY

CARES
Pembroke House
21 Pembroke Road
Sevenoaks
Kent
TN13 1XR
United Kingdom

Certificate of Constancy of Performance

Certificate Number: 1244-CPD-1007

In compliance with Regulation 305/2011/EU of the European Parliament and of the Council of 9 March 2011 (the Construction Products Regulation or CPR), this certificate applies to the construction product

Macalloy 1030 Post Tensioning Kit, Internal bonded or unbonded bar post-tensioning kit using high tensile plain bar 25 to 40mm and ribbed bar 25 to 50mm in accordance with European Technical Approval Guideline 013

Placed on the market by

Macalloy

Caxton Way Dinnington South Yorkshire S25 3QE

in the factory at

Dinnington

This certificate attests that all provisions concerning the assessment of verification of constancy of performances described in the following standard were applied and that the product fulfils all the prescibed requirements:

ETA - 07/0046

This certificate was first issued on **8-Oct-2007** and remains valid as long as the conditions laid down in the harmonised technical specification in reference or the manufacturing conditions in the factory or the FPC itself are not modified significantly.

Signed on behalf of the Board of Management

Lee Brankley

Lee Brankley
Chief Executive Officer

UK CARES
Pembroke House,
21 Pembroke Road,
Sevenoaks,
Kent, TN13 1XR,
United Kingdom
www.ukcares.com

MEMBER OF EOTA

European Technical Approval ETA-07/0046

Original version in English. Version: May 2012

Trade name:	Macalloy 1030 Post Tensioning System
Holder of approval:	Macalloy Ltd Caxton Way, Dinnington, S25 3QE, United Kingdom
Generic type and use of construction product(s):	Internal bonded or unbonded bar post-tensioning kit using high tensile plain bar 25mm-40mm and ribbed bar 25mm-50mm
Validity from : **to :**	09 May 2012 08 May 2017
Manufacturing plant(s):	Macalloy Ltd Caxton Way, Dinnington, S25 3QE, United Kingdom
This European Technical Approval contains	36 pages including 5 Annexes which form an integral part of the document.

European Organisation for Technical Approvals

Contents

I. LEGAL BASES AND GENERAL CONDITIONS

1. This European Technical Approval is issued by UK Certification Authority for Reinforcing Steels in accordance with the

1. Council Directive of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products (89/106/EEC) amended by Council Directive 93/68/EEC of 22 July 1993.(1)
2. UK implementation of the Construction Products Directive, 89/106/EEC: Statutory Instrument 1991, No 1620 "Building and Buildings, The Construction Products Regulations 1991" — made 15 July 1991, laid before Parliament 22 July 1991, coming into force 27 December 1991, and amended by the Construction Products (Amendment) Regulations 1994 (Statutory Instrument 1994, No 3051).
3. Common Procedural Rules for Requesting, Preparing and the Granting of European Technical Approvals(2).
4. Guideline for European Technical Approval of Post-tensioning Kits for Prestressing of Structures. ETAG013 Edition June 2002.

2. The UK Certification Authority for Reinforcing Steels is authorised to check whether the provisions of this European Technical Approval are met. Checking may take place in the manufacturing plant(s). Nevertheless, the responsibility for the conformity of the products to the European Technical Approval and for their fitness for intended use remains with the holder of the European Technical Approval.

3. This European Technical Approval is not to be transferred to other manufacturers or agents of manufacturers other than those indicated on page 1, or manufacturing plants other than those indicated on page 1 of this European Technical Approval.

4. This European Technical Approval may be withdrawn by UK Certification Authority for Reinforcing Steels according to Article 5.1 of the Council Directive 89/106/EEC.

5. Reproduction of this European Technical Approval including transmission by electronic means shall be in full. However, partial reproduction can be made with the written consent of UK Certification Authority for Reinforcing Steels. In this case partial reproduction has to be designated as such. Texts and drawings of advertising brochures shall not contradict or misuse the European Technical Approval.

6. The European Technical Approval is issued by the approval body in its official language(s). These versions should correspond fully to the version used by EOTA for circulation. Translations into other languages have to be designated as such.

References:

(1) Official Journal of the European Communities No L40, 11.02, 1989, page 12.
(2) Official Journal of the European Communities No L17, 20.01, 1994, page 34.

II. SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1. Definition of product(s) and intended use

1.1 Definition of product(s)

This European Technical Approval (ETA) applies to the post-tensioning kit supplied by Macalloy Ltd: **"Macalloy 1030 Post Tensioning System"**

The kit as supplied comprises:

Tensile element

- Plain bar: prEN 10138-4-Y-1030-H-25,0/40,0-P
- Ribbed bar: prEN 10138-4-Y-1030-H-25,0/50,0-R (cold rolled thread)

Coupling

- Steel fixed threaded coupling device.

Anchorage

- Square steel anchor plate with an unthreaded hole, washer and nut.

Bursting reinforcement*

- Additional reinforcement placed in the anchorage zone complying with EN 10080.

Ducts*

- Steel strip ducts complying with EN 523
- Corrugated plastic ducts complying with ETAG 013 Clause C.3

Filling material*

- Grout complying with EN 447
- Grease complying with ETAG 013 Clause C.4.1
- Wax complying with ETAG 013 Clause C.4.2

**** Not supplied with the kit by the ETA holder***

1.2 Intended use

The PT-system is intended for the prestressing of concrete structures:

- Internal unbonded tendons

Optional use category

- Internal bonded tendons

The provisions made in this ETA are based on an assumed intended working life of 100 years for permanent corrosion protection.

The assumed intended working life cannot be interpreted as a guarantee given by the manufacturer or Approval Body but is to be regarded as a means for choosing appropriate components and materials in relation to the expected, economically reasonable working life of the construction works.

2. Characteristics of product(s) and methods of verification

Macalloy's bar post-tensioning kit "Macalloy 1030 Post Tensioning Systems" is an internal bonded or unbonded system.

The kit supplied by Macalloy comprises plain bar 25mm-40mm diameter and ribbed bar 25mm-50mm diameter complying with prEN 10138, threaded coupler, anchor plate, washer and nut.

The additional components not supplied by Macalloy are specified to comply with ETAG013.

The concrete transfer strength of the system is $f_{cm,\,0,\,cube}$ =35MPa in accordance with EN 206-1: 2000.

2.1 Anchorages

The anchorages consist of steel square end plates, washers and nut. Details are given in Annex A.

2.2 Couplings

The couplers consist of steel tubes with an internal parallel thread. Details are given in Annex B.

2.3 Tendons

The tendons consist of plain and ribbed high tensile bars complying with prEN 10138-4-Y-1030-H and have the following properties:

Diameter mm	**25**	**26.5**	**32**	**36**	**40**	**50***
Characteristic value of maximum force kN	506	568	828	1048	1294	2022
Maximum prestress force	405	454	662	834	1035	1618
* prEN 10138-4-Y-1030-H-50,0-R only (ribbed)						

Table 1 Tendon properties

2.3.1 Tendon elongation under load

The following information can be used to calculate the tendon elongation under load $0.7f_{pk}$ to $0.75\ f_{pk}$.

Bar secant Modulus of Elasticity ($0.05f_{pk}$ to $0.7\ f_{pk}$) = 170 KN/mm^2 approximately.
Bar Modulus of Elasticity within elastic range = 182 KN/mm^{2}approximately.
Typical displacement at fixed anchorage = 1.5mm – 2.0mm.
Typical displacement at coupler = 1mm.

2.3.2 Losses at load transfer from jack to anchorage

Table 2

Diameter (mm)	25 – 36 inclusive	40 – 50 inclusive
*Single stress	1.5 mm	2 mm
*Two or more stressing cycles.	0.6 mm	0.7 mm

*When loaded to 0.7fpk to 0.75fpk

2.4 Friction loss

2.4.1 Friction in the jacks

All jacks supplied by Macalloy Ltd are calibrated against a master gauge before despatch and the loads exerted by the ram are tabulated against the pressure gauge readings. Any friction on the jack is therefore allowed for if the calibration readings are used to control the applied load.

Electrical or mechanical load cells are available for the recalibration of jacks and gauges on site, or to control loading with greater accuracy than that provided by commercial pressure gauges.

Loads calculated from pressure gauge readings based on the jacks ram areas do not include an allowance for friction in the jack. Values should be obtained from the jack supplier.

2.4.2 Friction in the anchorage

There is no friction loss in single bar anchorages.

2.4.3 Friction due to variations in the duct profile or wobble of the duct

(a) Eurocode 2, EN 1992-1-1: 2004, as described below.

$$\Delta P_{\mu}(x) = P_{max}(1 - e^{-\mu.kx})$$

where:

$\Delta P_{\mu}(x)$ (kN) is the loss of load due to friction at distance x from the anchorage.

P_{max} (kN) is the prestressing force immediately after the anchorage (ie at distance x=0).

μ	is the coefficient of friction between bar and duct. $\mu = 0.33$ for smooth bars (unthreaded). $\mu = 0.65$ for fully threaded bars.
k (rad/m)	is the unintentional angular displacement per unit length. The value of k is greater than 0.005 and less than 0.01.
x (m)	is the distance along the tendon from where the prestressing force is at a maximum (i.e. distance from P_o).

2.4.4 Friction due to curvature of the tendon profile

Macalloy 1030 bars are designed to be used as straight bars / tendons. There is therefore no friction loss due to curvature of the tendon profile, when the tendon is placed straight. Unintentional variations in the tendon profile can be assumed to be in the range 0.005 to 0.01 radians per metre. Losses as a result of unintentional variations in the tendon profile can be calculated as above.

2.4.5 Minimum radius of curvature

Macalloy 1030 bars are designed to be used as straight bars / tendons.

2.5 Anchorages

2.5.1 Anchorage spacing and edge distance

The minimum anchorage spacing and edge distance are specified in Annex C.

2.5.2 Concrete strength

The minimum concrete strength is $f_{cm,\,0,\,cube}$ = 35MPa in accordance with EN 206-1: 2000.

2.5.3 Concrete Cover

The concrete cover of the tendon my under no circumstances be less than 20mm or smaller than the concrete cover of the reinforcement installed in the same cross section. The respective standards and regulations on concrete cover valid at the place of use should be considered.

3. Evaluation of Conformity and CE marking

3.1 Attestation of Conformity system

The system of attestation of conformity specified by the European Commission in mandate 98/456/EC is system 1+, with audit testing of samples, described in Council Directive (89/106/EEC) Annex III and is detailed as follows:

a) Tasks for the manufacturer

(1) Factory production control
(2) Further testing of samples taken at the factory by the manufacturer in accordance with a prescribed test plan.

(b) Tasks for the Approved Body:

(1) Initial type testing of the product.
(2) Initial inspection of factory and of factory production control (FPC).
(3) Continuous surveillance, assessment and approval of factory production control (FPC).
(4) Audit testing of samples.

3.2 Responsibilities

3.2.1 Tasks of the manufacturer

3.2.1.1. Factory production control

In accordance with ETAG013 clause 8.2.1.2.1, the manufacturer shall implement a quality management system complying with EN ISO 9001: 2000, including a quality plan that addresses the FPC requirements of ETAG013.

The quality plan shall specifically ensure that purchased product conforms to specified purchase requirements. The type and extent of control applied to the supplier and the purchased product shall be dependent upon the effect of the purchased product on subsequent product realization or the final product.

The manufacturer shall evaluate and select suppliers based on their ability to supply product in accordance with the manufacturer's requirements. Criteria for selection, evaluation and re-evaluation shall be established. Records of the results of evaluations and any necessary actions arising from the evaluation shall be maintained.

In accordance with EN ISO9001: 2000, the manufacturer shall monitor and measure the characteristics of the product to verify that product requirements have been met. This shall be carried out at appropriate stages of the product realization process in accordance with the following test plan (Table 2).

Evidence of conformity with the test plan shall be maintained and shall indicate the person(s) authorizing release of product.

Product release and service delivery shall not proceed until the planned arrangements have been satisfactorily completed.

Test Plan					
Component	**Item**	**Test/ Check**	**Traceability**	**Minimum frequency**	**Documentation**
Bearing plate	material[1]	check	bulk[6]	100 %	"2.2"[1]
	detailed dimensions[5]	test		3 % ≥ 2 specimen	yes
	visual inspection[3]	check		100 %	no
	Strength	check		5%≥ 2 specimen	"3.1"[1]
Nut, washer and coupling	Material[1]	check	full	100 %	"3.1"[1]
	treatment, hardness	test		0,5 % ≥ 2 specimen	yes
	detailed dimensions[5]	test		5 % ≥ 2 specimen	yes
	visual inspection[3]	check		100 %	No
Tensile element (bar) and thread form	material[7]	check	"CE"[2]	100 %	"CE"[2]
	diameter	test		each coil/bundle	no
	visual inspection[3]	check		each bundle	no
	thread form	check		each bundle	no

1 "2.2" : Test report type "2.2" according to EN 10204 (this applies to simple steel bearing plates only)
"3.1" : Inspection certificate type "3.1" according to EN 10204

2 If the basis of "CE"-marking is not available, the prescribed test plan has to include appropriate measures, on y for the time until the harmonised technical specification is available.

3 Visual inspections means e.g.: main dimensions, gauge testing, correct marking or labelling, appropriate performance, surface, fins, kinks, smoothness, corrosion, coating, etc., as given in the prescribed test plan

4 full : full traceability of each component to its raw material.
bulk : traceability of each delivery of components to a defined point.

5 Detailed dimensions mean measuring of all dimensions and angles according to the specification as given in the prescribed test plan

6 Only if the force transfer unit is a "simple" plate. Otherwise appropriate procedures have to be introduced.

Table 3 Test plan

3.2.2 Tasks of approved body

3.2.2.1 Initial type-testing of the product

The results of the tests performed as part of the initial assessment for this European Technical Approval may be used unless there are changes in the manufacturing process or plant. In such cases, the necessary initial type-testing shall be agreed between and UK Certification Authority for Reinforcing Steels and the approved body involved.

3.2.2.2 Initial inspection of factory and of factory production control

The approved body shall audit the manufacturer's factory production control system including the prescribed test plan (Table 2) to ensure that the PT system complies with this ETA.

3.2.2.3 Continuous surveillance

The approved body shall audit the manufacturer's factory production control system including the prescribed test plan (Table 2) at least once a year to ensure that the PT system continues to comply with this ETA.

3.2.2.4 Audit testing of samples

The approved body shall select component samples during surveillance audits and check for compliance with the above test plan (Table 2).

3.2.2.5 Certification

The approved body shall issue a certificate of product conformity as evidence of compliance with this ETA.

3.3. CE marking

The CE marking shall be affixed to the delivery note.

The CE mark shall be accompanied by the following information:

- Name or identifying mark of the producer and plant.
- The last two digits of the year in which the marking was affixed.
- The numbers of the certificates of conformity.
- The ETA number.
- The use categories.
- The number of the approved body involved.
- The product's identity (commercial name).

4. Assumptions under which the fitness of the product(s) for the intended use was favourably assessed

4.1 Manufacturing

The Macalloy 1030 Post Tensioning System shall be manufactured in accordance with this European Technical Approval and the production shall be covered by a current product conformity certificate in accordance with ETAG013.

4.2 Installation

The Macalloy 1030 Post Tensioning System shall be installed by an experienced specialist PT contractor in accordance with the installation instructions given in Annex D using the specified equipment.

Post-tensioning design shall comply with the recommendations given in this ETA and the anchorage shall be detailed in accordance with the bursting reinforcement requirements given in Annex D of this ETA.

Stressing shall not be undertaken until the minimum specified concrete transfer strength has been achieved.

Components supplied by third parties that are included in this ETA (and not supplied by the ETA holder) shall comply with the requirements of this European Technical Approval.

All necessary information to enable satisfactory installation shall be supplied by the ETA holder with the PT kit.

5. Recommendations for the manufacturer.

5.1 Recommendations on packaging, transport and storage

The ETA holder shall package the PT kit components to prevent corrosion, chemical change and mechanical damage during transportation to the end user.

The ETA holder shall give instructions for suitable storage on site to prevent corrosion, chemical change and mechanical damage.

5.2 Recommendations on use, maintenance, repair

5.2.1 Maintenance

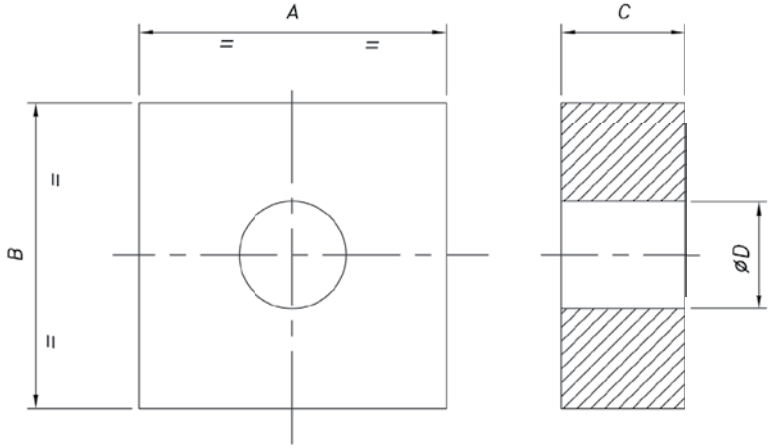
The Macalloy 1030 Post Tensioning bar system requires no maintenance provided that it is protected from mechanical damage and corrosion. Protection may also be required against fire damage.

Occasionally, there may be a requirement to reassess the tensile load in a tendon, some time after installation and stressing. Provided that access can be gained to one end, where a nut and bearing plate exist and that the thread beyond the nut is of sufficient length and not corroded, a jack can be reattached and the load in the tendon assessed.

5.2.2 Repair

If any part of the Macalloy 1030 system suffers from mechanical damage or corrosion, or is subject to extreme heat as a result of a fire, then Macalloy must be contacted to assess the damage. Light surface corrosion is generally permitted provided no pitting corrosion is present.

Annex A Anchorages

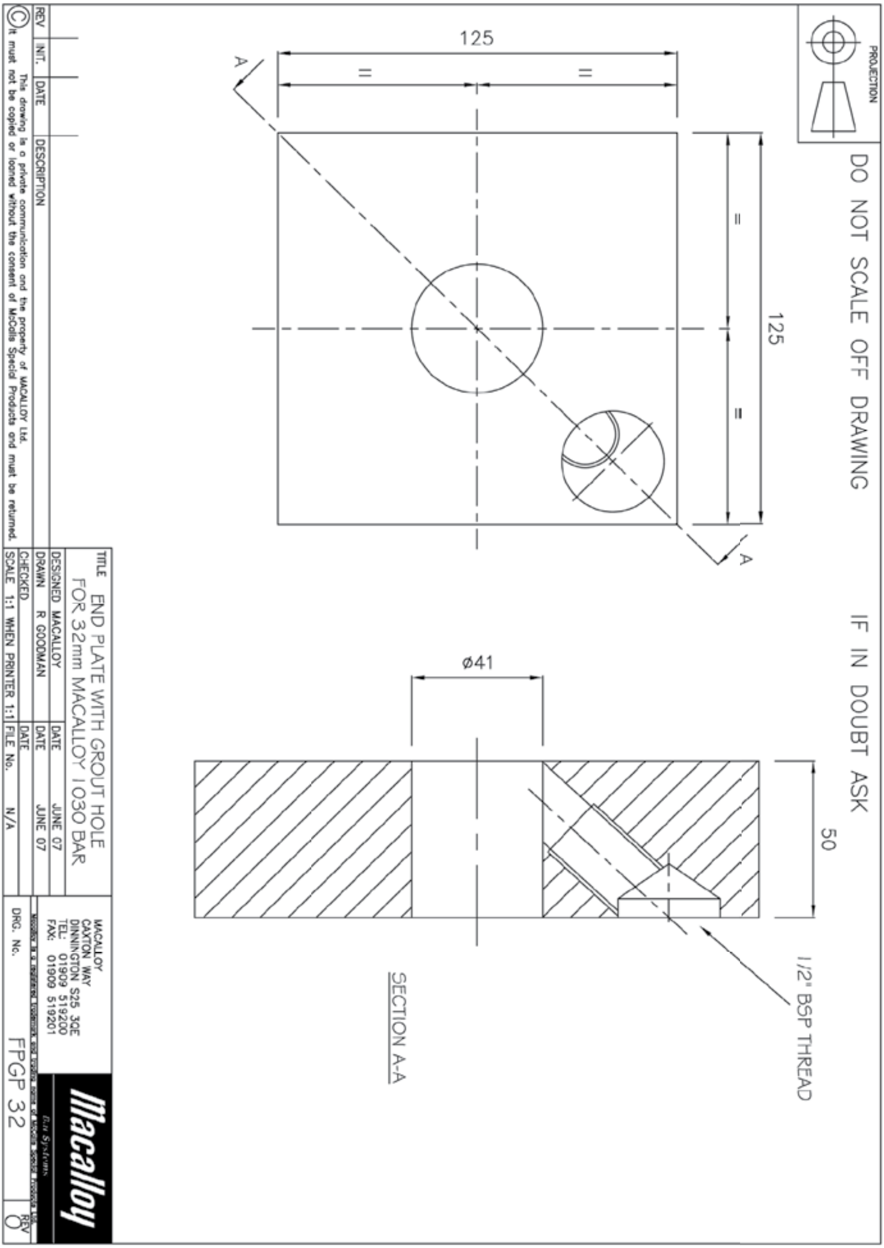


NOM. DIA.	REFER.	A	B	C	ØD
25	FPP 25	100	100	40	34
26.5	FPP 26.5	110	110	40	36
32	FPP 32	125	125	50	41
36	FPP 36	140	140	50	45
40	FPP 40	160	160	60	51
50	FPP 50	200	200	60	61

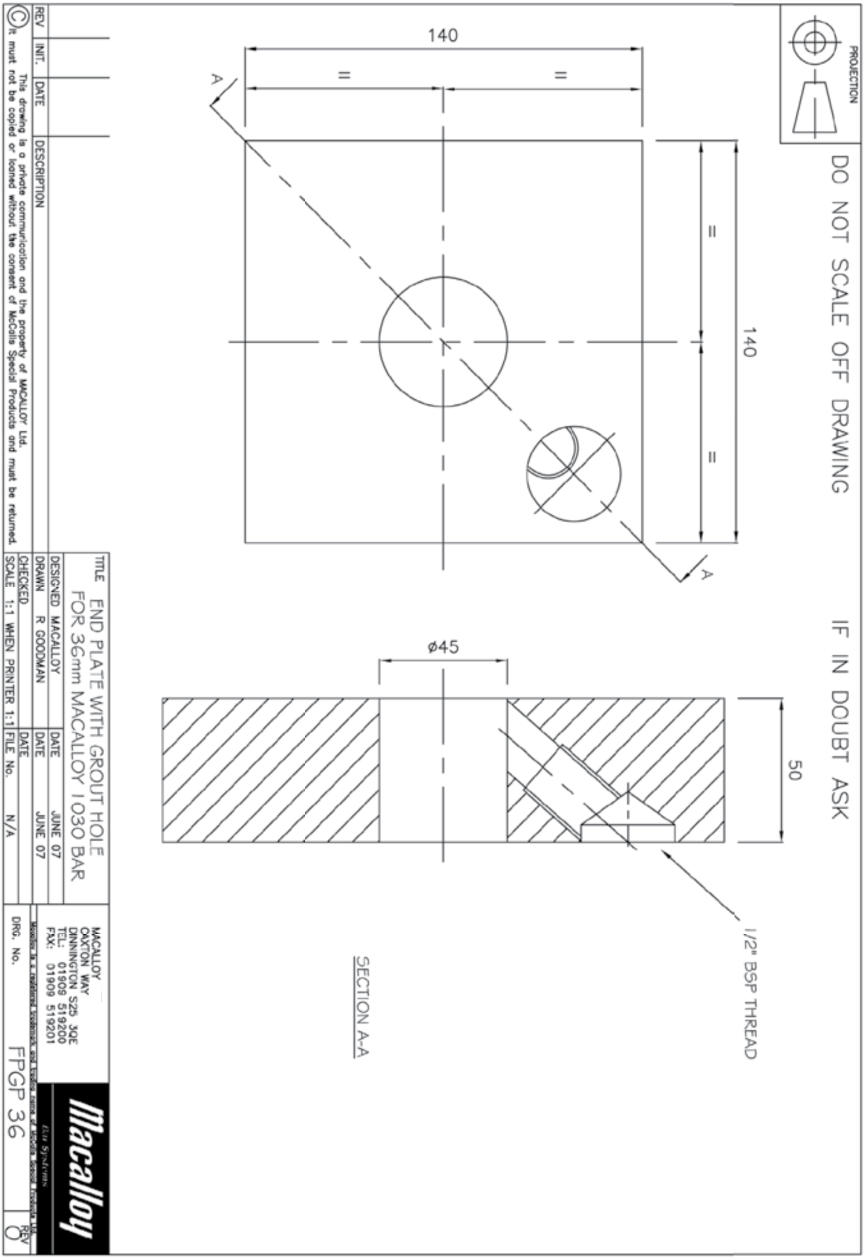
REV	INIT.	DATE	DESCRIPTION

TITLE	STANDARD END PLATE FOR MACALLOY BARS	MACALLOY CAXTON WAY DINNINGTON S25 30E	Macalloy Bar Systems
DESIGNED R GOODMAN	DATE JUNE 2006	TEL: +44 (0) 1909 519200 FAX: +44 (0) 1909 519201	
DRAWN R GOODMAN	DATE JUNE 2006		
CHECKED	DATE	DRG. No. FPP 25–50	REV 0
SCALE	FILE No.		

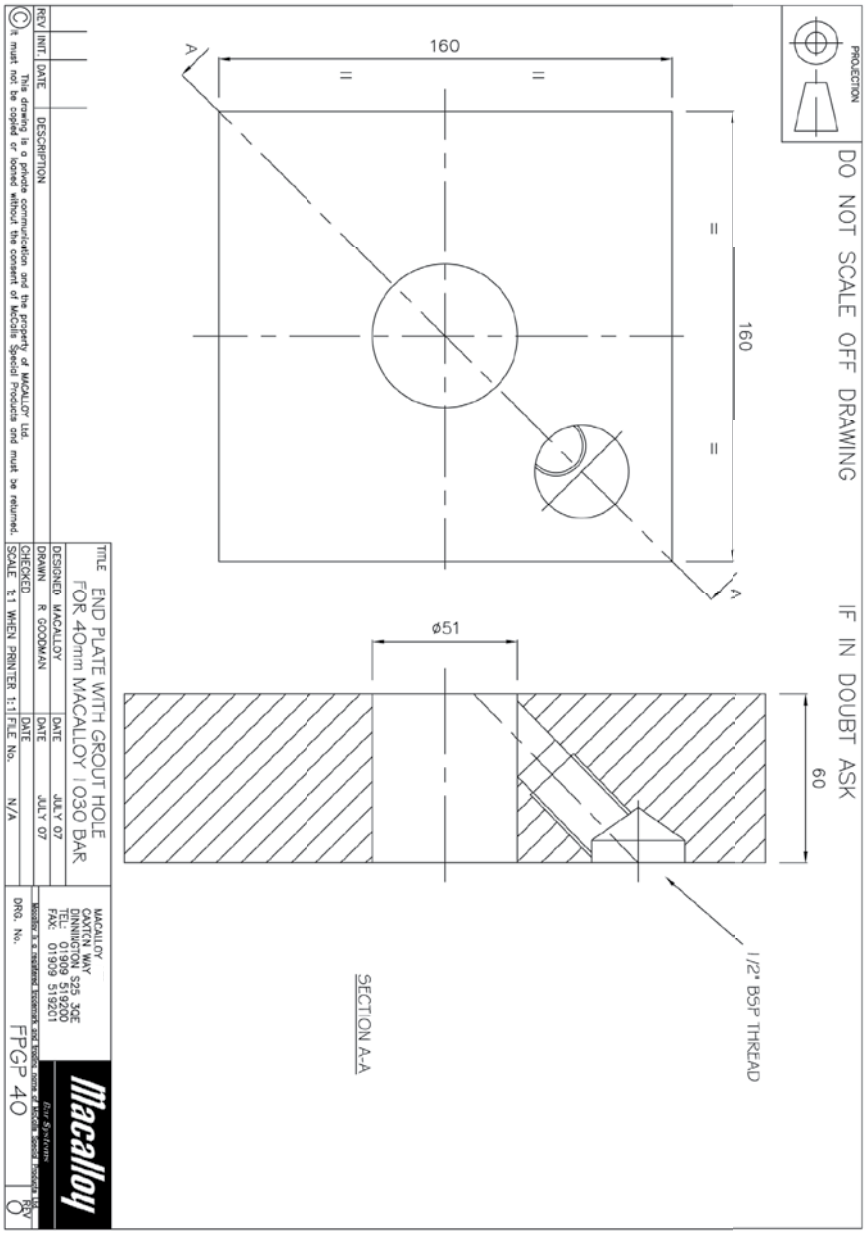
NOTE: Commercially sensitive information that forms part of ETA – 07/0046 has been removed from this drawing.



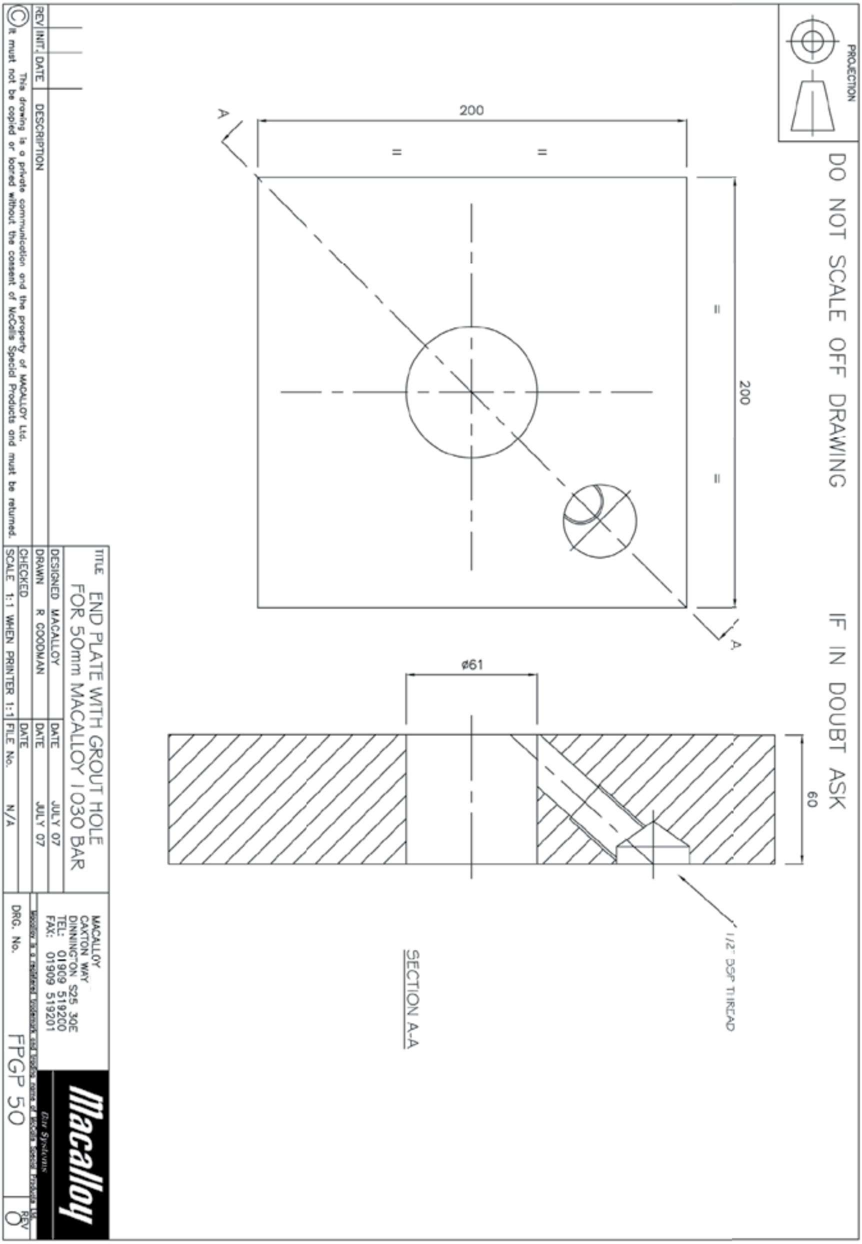
NOTE: Commercially sensitive information that forms part of ETA – 07/0046 has been removed from this drawing.



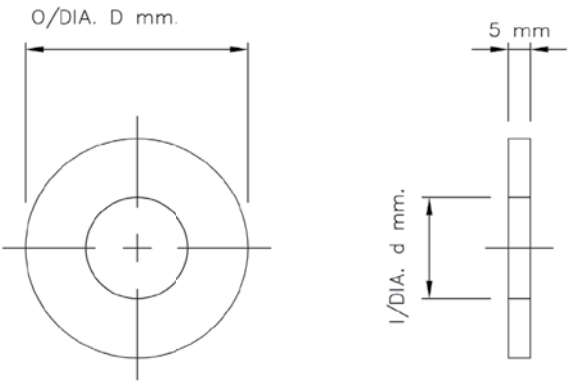
NOTE: Commercially sensitive information that forms part of ETA – 07/0046 has been removed from this drawing.



NOTE: Commercially sensitive information that forms part of ETA – 07/0046 has been removed from this drawing.



NOTE: Commercially sensitive information that forms part of ETA – 07/0046 has been removed from this drawing.

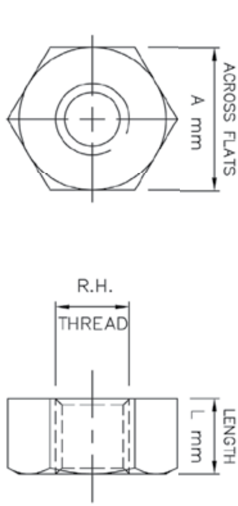


NOMINAL BAR DIAMETER mm	WASHER REFERENCE mm	OUTSIDE DIAMETER D mm	INSIDE DIAMETER d' mm
25	FSW 25	60	31
26.5	FSW 26.5	65	32
32	FSW 32	70	38
36	FSW 36	75	42
40	FSW 40	90	47
50	FSW 50	105	57

REV	INIT.	DATE	DESCRIPTION

TITLE	MACALLOY WASHERS 25 DIA. ~ 50 DIA.	MACALLOY CAXTON WAY DINNINGTON S25 3QE	Macalloy Bar Systems
DESIGNED R GOODMAN	DATE JUNE 2006	TEL: +44 (0) 1909 519200	
DRAWN R GOODMAN	DATE JUNE 2006	FAX: +44 (0) 1909 519201	
CHECKED	DATE	DRG. No. FSW 25–50	REV 0
SCALE	FILE No.		

NOTE: Commercially sensitive information that forms part of ETA – 07/0046 has been removed from this drawing.



NOM. BAR DIA. mm	NUT REF.	WIDTH A/F A mm	LENGTH L mm
25	FN25	46	34.5
26.5	FN26.5	50	38.5
32	FN32	56	43.0
36	FN36	62	48.0
40	FN40	72	53.0
50	FN50	90	73.5

REV | INIT. | DATE | DESCRIPTION

TITLE: FORGED AND TAPPED MACALLOY NUTS 25 DIA. – 50 DIA.

DESIGNED: R GOODMAN | DATE: JUNE 2006
DRAWN: R GOODMAN | DATE: JUNE 2006
CHECKED | DATE
SCALE | FILE No.

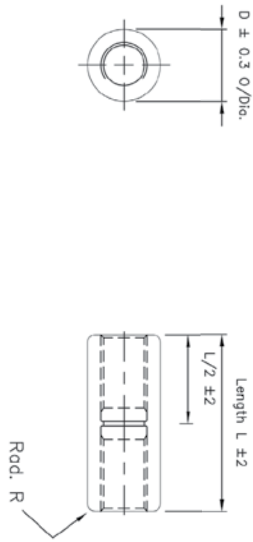
MACALLOY
CAXTON WAY
DINNINGTON S25 3QE
TEL: +44 (0) 1909 519200
FAX: +44 (0) 1909 519201

Macalloy Bar Systems

DRG. No. FN 25–50 | REV 0

NOTE: Commercially sensitive information that forms part of ETA – 07/0046 has been removed from this drawing.

Annex B Couplings



NOM. BAR DIA. mm	COUPLER REF.	OUTSIDE DIA. D mm	LENGTH L mm
25	FC25	42.5	85
26.5	FC26.5	42.5	90
32	FC32	50	115
36	FC36	57.5	130
40	FC40	62.5	140
50	FC50	76	170

REV | INT. | DATE | DESCRIPTION

TITLE MACALLOY COUPLERS 25 DIA. – 50 DIA.

DESIGNED R GOODMAN DATE JUNE 06
DRAWN R GOODMAN DATE JUNE 06
CHECKED DATE
SCALE FILE No.

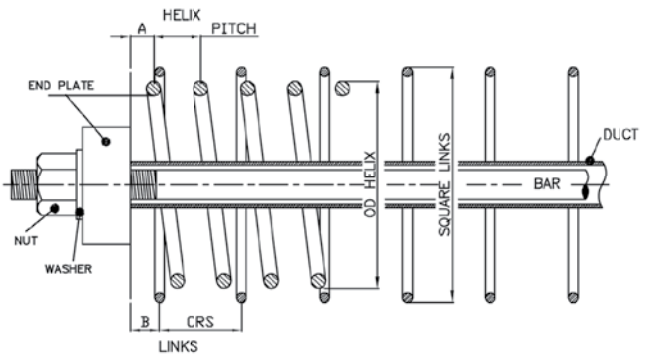
MACALLOY
CAXTON WAY
DINNINGTON S25 3QE
TEL: +44 (0)1909 519200
FAX: +44 (0)1909 519201

Macalloy Bar Systems

DRG. No. FC 25–50 REV 0

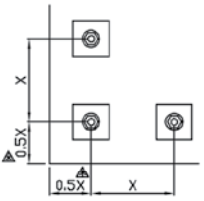
NOTE: Commercially sensitive information that forms part of ETA – 07/0046 has been removed from this drawing.

Annex C Bursting Reinforcement



NOMINAL BAR DIAMETER	CONCRETE PRISM X–SECTION	HELIX					LINKS					RECOMMENDED DUCT INSIDE DIAMETER
		BAR ø	A	PITCH	OD	TURNS	BAR ø	B	CRS	SQU.	No.	
25	220x220	12	20	40	175	4	8	25	70	199	6	38
26.5	230x230	12	20	40	180	4	8	25	70	205	6	40
32	240x240	12	20	40	190	5	8	30	70	216	7	48
36	260x260	12	20	40	210	6	8	30	70	235	7	54
40	290x290	12	20	40	240	7	10	35	75	265	8	60
50	355x355	12	20	40	300	8	12	40	80	330	9	75

MINIMUM ANCHORAGE SPACING AND EDGE DISTANCE



NOMINAL BAR DIAMETER	X
25	220
26.5	230
32	240
36	260
40	290
50	355

⚠ PLUS ANY ADDITIONAL REQUIRED COVER BEYOND 10mm

NOTES:

ALL MIMENSIONS IN mm.

ALL REINFORCEMENT TO EN 10080: 2005
MIN. CHARACTERISTIC PROPERTIES AS FOLLOWS:
YIELD STRENGTH 460 N/mm²
TENSILE/ YIELD RATIO 1.08
ELONGATION AT FRACTURE A5 14%
ELONGATION AT MAX. FORCE Agt 5%.

HELIX – SHAPE CODE 77 TO
EN ISO 3766: 2003

LINKS – SHAPE CODE 51 TO
EN ISO 3766: 2003, WHERE LENGTH A=B.

CONCRETE TO BE IN ACCORDANCE WITH
EN 206–1: 2000.
MINIMUM MEAN COMPRESSIVE STRENGTH AT FULL PRESTRESS Fcm,o,cube 35 N/mm.²

THE ABOVE REINFORCEMENT AND EDGE DISTANCES MAY BE MODIFIED IN ACCORDENCE WITH NATIONAL REGULATIONS AND RELEVANT APPROVAL OF THE LOCAL AUTHORITY TO PROVIDE EQUIVALENT PERFORMANCE

REV	INIT.	DATE	DESCRIPTION
B	RJG	MAR 07	BS REFS REMOVED, CONCRETE CUBE STRENGTH ADDED.
A	RJG	MAY 06	NOTES CHANGED TO INCLUDE EUROPEAN STANDARDS.

TITLE

END BLOCK REINFORCEMENT

DESIGNED	MACALLOY	DATE	JUNE 2006
DRAWN	MACALLOY	DATE	JUNE 2006
CHECKED		DATE	
SCALE	N.T.S.	FILE No.	

MACALLOY
CAXTON WAY
DINNINGTON S25 3QE
TEL: +44 (0) 1909 519200
FAX: +44 (0) 1909 519201

Macalloy Bar Systems

DRG. No. ETAG END BLOCK REV. B

SITE PRACTICE GUIDANCE NOTES FOR

MACALLOY 1030 POST TENSIONING BAR SYSTEM

Document QP23-1

Rev 0, June 2006

Macalloy Ltd
Caxton Way, Dinnington S25 3QE
Telephone: +44 (0) 1909 519200 Fax: +44 (0) 1909 519201
Website: www.macalloy.com Email: sales@macalloy.com

CONTENTS

1. INTRODUCTION

This guide provides site personnel with advice on the handling, storage, installation, safety and certification requirements for the correct use of Macalloy 1030 Post Tensioning Bars. Further information and advice is available from Macalloy Ltd.

The Macalloy 1030 Post Tensioning system complies with the requirements of ETAG 013, Guideline for European Technical Approval of Post Tensioning Kits for Prestressing of Structures (these are commonly called Post Tensioning Systems), for internal bonded and un-bonded tendons for concrete and composite structures.

A jack operating instruction guide is also available on request.

Stressing jacks together with auxiliary equipment are available for hire.
A full site stressing service is available. Further details and quotations are available on request.

A design data booklet is available, which contains further technical details and design data. It is primarily aimed for use by designers, specifiers and consultant engineers. A copy of the Design Data booklet is available on request.

2. RECOMMENDATIONS FOR HANDLING AND USE

2.1 Bar Handling

Macalloy 1030 Post Tensioning Bars should be stored on suitable battens, raising them above the ground. The battens should be at a minimum of 3m centres along the bar length. The bars should be protected using temporary covers. During handling, car should be taken to avoid local damage or bending. While light rusting is not harmful to the bars, deep corrosion pitting must be avoided.

Macalloy 1030 bars should not be welded, subject to local heating or splashed with weld metal. All of which can change the metallurgical properties of the steel.

Bar threads must be clean before being engaged into a female thread. Bar threads can be lightly oiled to assist assembly. Superficial damage to the threads may be repairable by experienced personnel. However, re-cutting the thread form on site is impossible. The thread form is a proprietary one designed to be robust on site.

2.2 Tendon Handling

All female threads should be clean before assembly. Lightly oiling internal threads may aid assembly.

Bars should be engaged to the mid point of all couplers.

Bars should protrude by at least two thread form pitches beyond the nut or threaded plate – see Figure 1.

2.3 Maintenance

The Macalloy 1030 Post Tensioning bar system requires no maintenance provided that it is protected from mechanical damage and corrosion. Protection may also be required against fire damage.

Occasionally, there may be a requirement to reassess the tensile load in a tendon, some time after installation and stressing. Provided that access can be gained to one end, where a nut and bearing plate exist and that the thread beyond the nut is of sufficient length and not corroded, a jack can be reattached and the load in the tendon assessed.

2.4 Repair

If any part of the Macalloy 1030 system suffers from mechanical damage or corrosion, or is subject to extreme heat as a result of a fire, then the manufacturer must be contacted to assess the damage. Light surface corrosion is generally permitted provided no pitting corrosion is present.

3. DUCTS

Steel ducts should be in accordance with EN 523: 1997 and EN 524: 1997.

Plastic ducts should be in accordance with the requirements of ETAG013. The duct should be large enough to allow both the insertion of the bar and to facilitate grouting. Normally a maximum tendon to duct area ratio of 0.4 to 0.45 should be used. This ratio is defined as the cross sectional area of steel bar, divided by the internal cross sectional area of the duct. This ratio can be increased (i.e. duct inside diameter decreased) provided that grouting trials show that the duct can be satisfactorily grouted.

4. CALCULATION OF BAR AND THREAD LENGTHS

4.1 Bar Lengths

Calculation of the overall length of bar is by measurement along the tendon profile and adding the thickness of both end plates plus an allowance for attaching the prestressing jack at one or both ends of the bar. When jacking at one end only, allowance must be made for a nut or tapped plate to be fitted at the opposite end. Table 4 provides details of the allowances necessary for attaching the prestressing jacks.

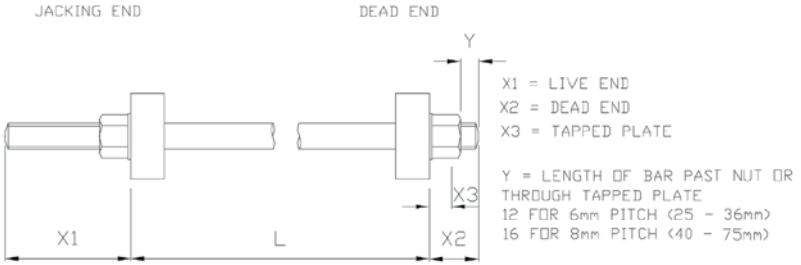


Figure 1 - BAR LENGTH CALCULATION

Table 4 - JACKING ALLOWANCE

Tendon	25	26.5	32	36	40	50
Jacking one end only X1 + X2 mm (min)	131	144	162	177	201	256
Jacking both ends 2 x X1 mm (min)	164	182	210	230	260	332
Tapped Plate One end X1 + X3 mm (min)	94	103	117	127	146	181

4.2 Thread Lengths

The thread length at a jacking end must allow for attaching the jack plus elongation of the bar under working load.

The standard jacking thread is 250mm long which caters for tendon lengths up to 18m jacked one end or 36m jacked both ends. Additional thread length is needed for longer tendons at the rate of 25mm extra thread for each 5m of bar when jacked at one end or 10m of bar if jacked at both ends.

Standard thread lengths for jacking ends, dead ends and coupled joints are listed in Table 5.

Table 5 - STANDARD THREAD LENGTHS

Bar dia mm	25	26.5	32	36	40	50
Jacking End mm	250	250	250	250	250	250
Dead End mm	100	100	100	100	100	100
Coupled Joint mm	45	50	60	65	75	85

2.3 Maintenance

The Macalloy 1030 Post Tensioning bar system requires no maintenance provided that it is protected from mechanical damage and corrosion. Protection may also be required against fire damage.

Occasionally, there may be a requirement to reassess the tensile load in a tendon, some time after installation and stressing. Provided that access can be gained to one end, where a nut and bearing plate exist and that the thread beyond the nut is of sufficient length and not corroded, a jack can be reattached and the load in the tendon assessed.

2.4 Repair

If any part of the Macalloy 1030 system suffers from mechanical damage or corrosion, or is subject to extreme heat as a result of a fire, then the manufacturer must be contacted to assess the damage. Light surface corrosion is generally permitted provided no pitting corrosion is present.

3. DUCTS

Steel ducts should be in accordance with EN 523: 1997 and EN 524: 1997.

Plastic ducts should be in accordance with the requirements of ETAG013. The duct should be large enough to allow both the insertion of the bar and to facilitate grouting. Normally a maximum tendon to duct area ratio of 0.4 to 0.45 should be used. This ratio is defined as the cross sectional area of steel bar, divided by the internal cross sectional area of the duct. This ratio can be increased (i.e. duct inside diameter decreased) provided that grouting trials show that the duct can be satisfactorily grouted.

4. CALCULATION OF BAR AND THREAD LENGTHS

4.1 Bar Lengths

Calculation of the overall length of bar is by measurement along the tendon profile and adding the thickness of both end plates plus an allowance for attaching the prestressing jack at one or both ends of the bar. When jacking at one end only, allowance must be made for a nut or tapped plate to be fitted at the opposite end. Table 4 provides details of the allowances necessary for attaching the prestressing jacks.

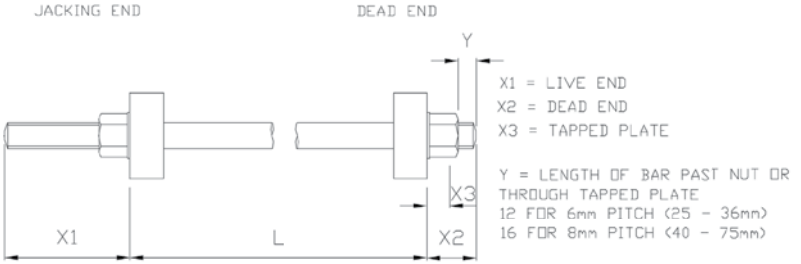


Figure 1 - BAR LENGTH CALCULATION

Table 4 - JACKING ALLOWANCE

Tendon	25	26.5	32	36	40	50
Jacking one end only X1 + X2 mm (min)	131	144	162	177	201	256
Jacking both ends 2 x X1 mm (min)	164	182	210	230	260	332
Tapped Plate One end X1 + X3 mm (min)	94	103	117	127	146	181

4.2 Thread Lengths

The thread length at a jacking end must allow for attaching the jack plus elongation of the bar under working load.

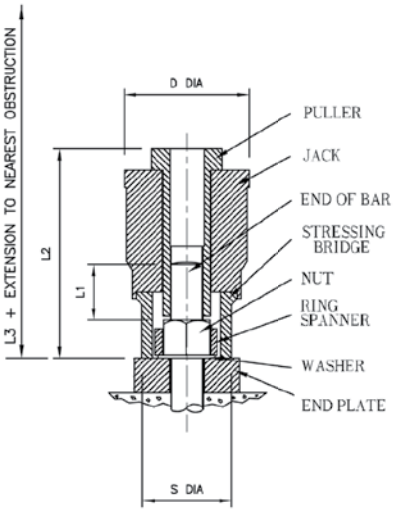
The standard jacking thread is 250mm long which caters for tendon lengths up to 18m jacked one end or 36m jacked both ends. Additional thread length is needed for longer tendons at the rate of 25mm extra thread for each 5m of bar when jacked at one end or 10m of bar if jacked at both ends.

Standard thread lengths for jacking ends, dead ends and coupled joints are listed in Table 5.

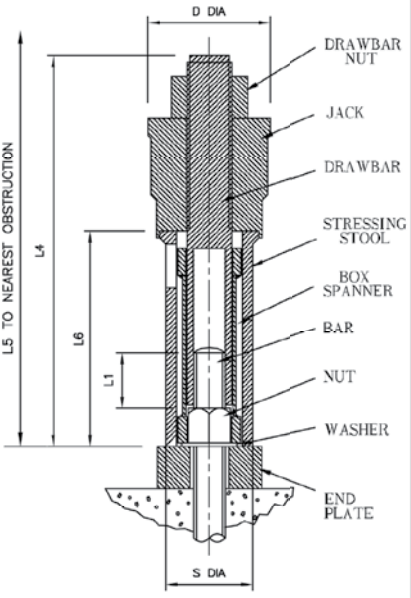
Table 5 - STANDARD THREAD LENGTHS

Bar dia mm	25	26.5	32	36	40	50
Jacking End mm	250	250	250	250	250	250
Dead End mm	100	100	100	100	100	100
Coupled Joint mm	45	50	60	65	75	85

DO NOT SCALE IF IN DOUBT ASK



JACK WITH STRESSING BRIDGE AND PULLER



JACK WITH STRESSING STOOL AND DRAWBAR
(FOR RECESSED ANCHORAGES)

JACK TYPE	WEIGHT	MAX. LOAD	BAR DIA.	MINIMUM BAR CENTRES	D DIA	S.DIA	L1	L2	L3	L4	L5	L6
3000	50 KGS	3000KN	50	160	250	187	90	330	450	865	1300	500
1000	26 KGS	1000KN	40 36 32	120 116 114	176	125	75 65 60	301	385 370 360	564	859	300
450	15 KGS	450KN	26.5 25	90 88	129	100	50 45	281	340 330	566	870	300

ALL JACKS HAVE 50 STROKE

REV	INIT.	DATE	DESCRIPTION

TITLE STRESSING ARRANGEMENT
MK 450, 1000 & 3000 JACKS

DESIGNED	R GOODMAN	DATE	02/08/07
DRAWN	R GOODMAN	DATE	02/08/07
CHECKED		DATE	
SCALE		FILE No.	

MACALLOY
CAXTON WAY
DINNINGTON
S25 3QE
TEL: +44 (0) 1909 519200
FAX: +44 (0) 1909 519201

Macalloy
Bar Systems

DRG. No. JACKS REV 0

5.4 Checks to be made before Stressing

Before stressing is carried out, it must be verified that the tendon and the conditions of tensioning are as per the specification and design details. In particular:

(1) The concrete, jointing material and bearing material, as applicable, have gained the required strength. It is recommended that the appropriate test certificates are attached to the stressing records.
(2) The test certificates for the bars to be stressed are available.
(3) The space for the jack must be sufficient.
(4) The element or structure should posses the required strength of degree of freedom under the pre-stressing force.
(5) The tendons shall be free to move in the ducts and the bars must be in the correct location in relation to the anchorage zone reinforcement.
(6) The surface to support the jack must have the correct shape and inclination.
(7) The anchorages must be in their correct position and alignment. Misalignment of anchor plates up to 2 degrees can be accommodated without any loss of anchorage strength. Any misalignment in excess of this must be rectified by the use of suitable tapered plates or by re-bedding the plates.
(8) A valid and signed jack calibration certificate must be supplied before the jack is used. The certificate must relate the actual force the jack exerts to the indicated hydraulic pressure or force. This calibration requirement is to ensure that the friction developed within the jack is taken account of. New calibration tests should be undertaken if either jack or gauge is replaced, or after 100 stressing operations, or after one weeks use, whichever is sooner.
(9) The jack should at all times be supported independently and never permitted to hang on the bar, which could cause damage to the threads and induce bending into the bar.
(10) The hydraulic hose should connect the jack and pump in an easy curve and should never be trapped against a sharp edge. Damaged hydraulic hoses must not be used for stressing.

5.5 The Stressing Operation

Prior to stressing, all calibrated pressure or force gauges should be treated with care as rough handling during transit or on site can upset the calibration.

Tendons must be stressed in the sequence indicated by the approved stressing schedules, which also indicated the stressing force. If the elongation of the tendon or the relevant force does not agree with the stressing instruction, the engineer responsible shall be consulted.

It is recommended that during stressing gauge readings are checked against the bars measured extension. The zero extension reading should be taken when the jack is just starting to take load and all the slack in the bar is taken up. A correlation between force and extension can be made by making use of the Modulus of Elasticity value given on the bar test certificate. Note that when stressing short tendons, the errors in measuring extension are larger than those measured for long tendons.

The stressing operation should be carried out under a steady and smooth increase in pressure and elongation of the pre-stressing steel. Constant watch must be maintained and should any irregularity occur (sharp noise etc), the operation must be stopped and the cause investigated.

The stressing operation should not be carried out at temperatures below 0 degrees C, without the approval of the engineer.

Documentation recording the stressing operation, as indicated in Section 8, must be maintained.

During stressing the nut should be tightened against the washer as the bar extends.

During the stressing operation, it may be necessary to partially or completely de-tension the tendon. This should be carried out in a controlled and progressive manor, while the jack is in place. The full load in the bar should be taken by the jack, while the nut is wound back from the bearing plate, the load should then be progressively released until the bar is completely de-stressed. If the jack ram extension runs out prior to the complete de-stressing, the nut should be wound tightly against the bearing plate, prior to the operation being repeated.

6. FINAL OPERATIONS

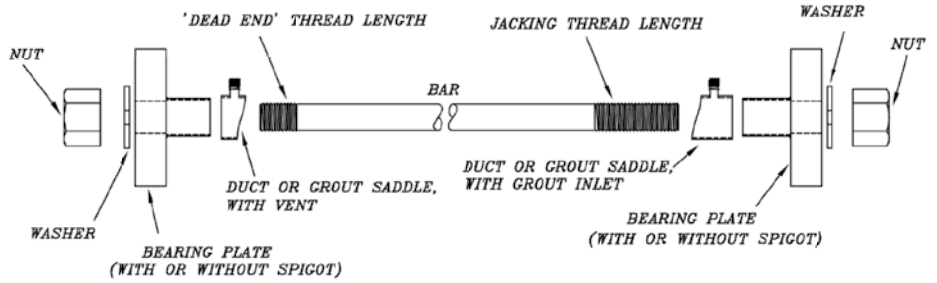
6.1 Grouting

Unless other forms of corrosion protection are used, grout should be pumped under pressure between the duct and bar. The grout and grouting procedures should be in accordance with EN 446 and EN 447. Special grout requirements are covered by ETAG013.

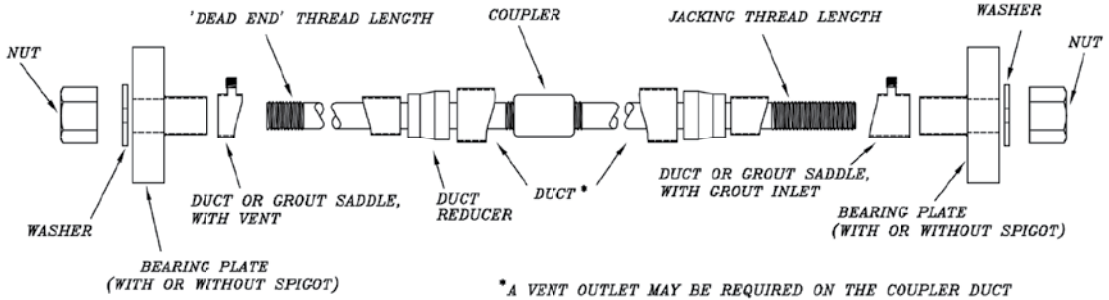
For 25mm and 26.5mm bar diameters, reference should be made to drawing 'Grout 25 & 26.5'. Grout should be injected between the bar and duct via a duct or grout saddle, with a grout inlet. Air is then vented via an air vent or similar duct or grout saddle with grout vent. The grout inlet should generally be positioned at the lower end of the tendon and the air vent at the higher end. If the tendon is horizontal, it is acceptable to grout as shown. For horizontal tendons with couplers, a grout vent may be required at the highest point of the duct over the coupler, in order to fully encapsulate the bar and prevent air pockets.

For 32mm to 50mm bar diameters, inclusive, reference should be made to drawing 'GROUT 35-50'. Grout should be injected between the bar and duct via bearing plates with inclined grout holes. The grout inlet should be at the lowest end of the tendon with the grout being injected into the bottom of the duct. The air vent hole should be at the highest end of the tendon, venting from the top of the duct.

TENDON WITHOUT COUPLER



TENDON WITH COUPLER



*A VENT OUTLET MAY BE REQUIRED ON THE COUPLER DUCT IF THE COUPLER DUCT IS OF A LONG LENGTH

REV	INIT.	DATE	DESCRIPTION

TITLE: TYPICAL TENDON ASSEMBLY 25mm & 26.5mm BAR DIAMETER

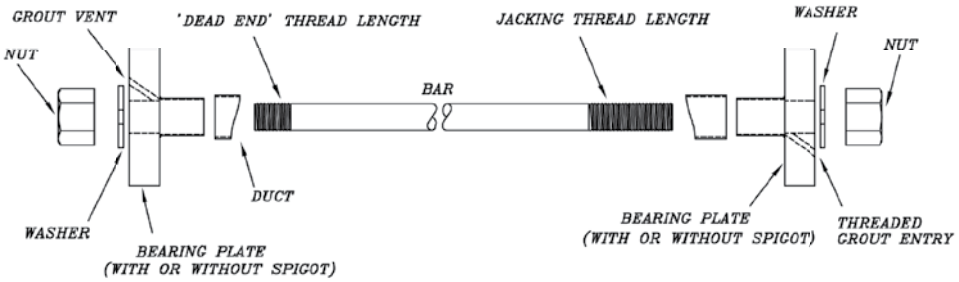
DESIGNED	MACALLOY	DATE	JULY 2007
DRAWN	MACALLOY	DATE	JULY 2007
CHECKED		DATE	
SCALE	1:4 WHEN PRINTER 1:1	FILE No.	N/A

MACALLOY
CAXTON WAY
DINNINGTON S25 3QE
TEL: 01909 519200
FAX: 01909 519201

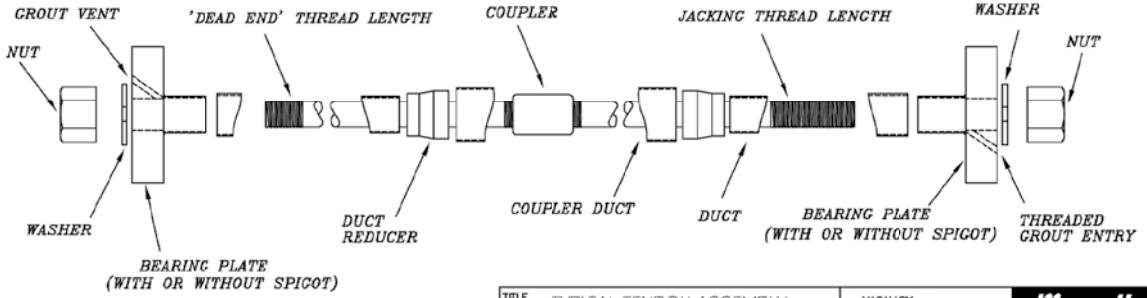
Macalloy

DRG. No. GROUT 25 & 26.5 REV 8

TENDON WITHOUT COUPLER



TENDON WITH COUPLER



REV	INIT.	DATE	DESCRIPTION

TITLE	TYPICAL TENDON ASSEMBLY 32mm TO 50mm (INC) BAR DIAMETER		
DESIGNED	MACALLOY	DATE	JULY 2007
DRAWN	MACALLOY	DATE	JULY 2007
CHECKED		DATE	
SCALE	1¢ WHEN PRINTER 1:1	FILE No.	N/A

MACALLOY
CAXTON WAY
DINNINGTON S25 3QE
TEL: 01909 519200
FAX: 01909 519201

Macalloy

DRG. No. GROUT 32 -50 REV 8

6.2 Cutting off Excess Bar Thread

Excess bar thread may be cut off after stressing by sawing or disc cutting.

When disc cutting, a liberal supply of water is needed over the bar during the operation to limit the heat developed and surrounding bars should be protected from sparks or spatter. The cut must take no longer than 20 seconds and be at least 25mm from the nut.

6.3 Protection to Anchorage

Consideration to the corrosion protection of all exposed or outside surfaces should be made e.g. the bearing plate, nut, washer and bar end.
If required, the bearing plate and washer may be hot dip galvanized to EN ISO 1461: 1999. The nut and bar should not be hot dip galvanized. The bearing plate, nut, washer and bar end can, if necessary, be painted with a suitable paint system. An anchor head cap can, if necessary be fitted over the bar end, nut and washer and bolted to the bearing plate, with a gasket between the two. It is common to fill anchor head caps with a corrosion inhibiting grease or similar.

7. Documentation

A quality assurance plan should be implemented prior to the start of work on site. The recommended minimum requirements of such a plan are detailed in Annex D3 of ETAG 013.

It is useful to set out a project data sheet as a means of producing a permanent record of the work carried out, the desired load and extension values for each Macalloy bar and the measurements taken during jacking. The following layout can be adopted.

Proposed Project Data Sheet & Stressing Record

Project:

.....

Section or Bay Reference: .....

Date of Stressing .....

Concrete:

Date Cast .....

Cube Crushing Strength :
..... N/mm^2 at ....days.
..... N/mm^2 at ....days.
..... N/mm^2 at ....days.

Prestressing / Post Tensioning Steel:

Macalloy 1030 nominal bar diameter .....

Characteristic ultimate tensile stress: 1030 N/mm″
Minimum 0.1% proof stress: 835 N/mm″
Nominal cross sectional area: .....mm″
Characteristic failure load: .....kN
Minimum 0.1% proof load: .....kN
Modulus of elasticity: .....kN/mm″ (taken from test certificate)
Relaxation at 70% UTS after 1000 hrs: 3% typicall.

Tendon:

Type: bonded un-bonded internal external (circle one)
Corrosion protection: grout plastic duct & grout Denso tape Denso tape & duct
Other (specify) .....
Duct dimensions: .....
Unintentional deviation / wobble coefficient.....rad/m.
Duct support spacing.....

Anchorages:

Anchor bearing plate size – live (stressing end) .....
Anchor bearing plate size – dead end .....
Spacing: .....
Min edge distance: .....

Stressing Record

		Calculated	Measure Values					
Bar Mark	Dia (mm)	Extension (mm)	Initial Ram Position	Load	Final Ram Position	Load	Total Extension	Remarks
1								
2								
3								
4								
5								

Annex E References

EN 1992-1-1: 2004 Eurocode 2: Design of concrete structures
prEN 10138: Prestressing steels, (1999)
EN 10080: 2005 Steel for the reinforcement of concrete – Weldable reinforcing steel
EN 10025: 2004 Hot rolled products of structural steels
EN 523 Steel strip sheaths for prestressing tendons - Terminology, requirements, quality control, (1997)
prEN 10255 Non-alloy steel tubes suitable for welding or threading, (1996)
EN 524 – Parts 1 to 6: Steel strip sheaths for prestressing tendons - Test methods – Part 1: Determination of shape and dimensions; Part 2: Determination of flexural behaviour; Part 3: To and fro bending test; Part 4: Determination of lateral load resistance; Part 5: Determination of tensile load resistance; Part 6: Determination of leak tightness (Determination of water loss), (1997)
EN 445 Grout for prestressing tendons, Test methods; (1996)
EN 446 Grout for prestressing tendons, Grouting procedures; (1996)
EN 447 Grout for prestressing tendons, Specifications for common grout, (1996)
prEN 934-4 Admixtures for concrete, mortar and grout – Part 4: Admixtures for grout for prestressing tendons – Definitions, requirements and conformity, (1999)
EN 10204 Metallic products; type of inspection documents, (2004)
EN 206-1:2000 Concrete – Part 1: Specification, performance, production and conformity

Navia River Viaduct, Spain
Post Tensioning
Sub-Contractor BBR PTE

Millau Viaduct, France
Architect - Fosters and Partners
Contractor - Eiffage

Izmit Bay Bridge
Main Contractor IHI

Yavuz Sultan Selim Bridge
(aka Third Bosphorus Bridge)
Designer Hyundai & SK Engineering JV
Installation and Stressing by Intekno

This publication provides the technical details currently used by Macalloy in the manufacture of its components.
The company reserves the right to amend technical details as and where necessary in line with its policy of continuous development.

Macalloy, Caxton Way, Dinnington, Sheffield S25 3QE, U.K. Tel: +44 (0)1909 519200. Fax: +44 (0)1909 519201

Website: www.macalloy.com Email: sales@macalloy.com