

6. PIGS & DARTS for TUBING & PIPE

v 15.6.2009

6.0. Introduction

We often have general enquiries from customers on pigs and darts, so first we provide an overall view and guidance on the range of possibilities. We have quite an extensive range, as can be seen from the subsequent listings.

6.0.1. Nomenclature. There are two broad classes.

We refer to the scraper, wiper, foam and flex dart types (and we do not mind whether you call them pigs or darts, but preferably not plugs because of confusion with solid darts). These are usually used for the at-surface cleaning, in a variety of ways, of tubing, rather than sent down-hole, though there can be exceptions. These, in larger sizes, are also used in tubes and pipes and also in non-oil applications.

We also refer to the cement, acid and solid darts, which are used in down-hole operation to control the passage of cement (or occasionally acids or other fluids) into the well bore for operations such as blocking off water-producing perforations.

The former are relatively simple and cheap, and are usually available ex stock. The latter are more complex to design and produce as they consist of a burst disc welded into a steel body, over-moulded with rubber. Cement darts are quite often tailored for the individual well (for 2-3/8" tubing and bigger, they always are) and in any case need to be carefully selected to be appropriate. They are therefore not as cheap, and are mostly produced to requirement.

6.0.2. Scraper, Wiper and Foam Darts Pigging Guide

We have developed a range of different pigs over the years, so a summary *in approximate order of increasing toughness* explains them.

1. Foam wiper type. P/N 133xxx series. The softest. Made of green foam with chevrons. Mostly intended for ensuring a film of anti-rust treatment is applied in the coil. So not intended to scrape all fluid cleanly off.
2. Foam cylinder type. P/N 1230xx series. Same foam, but white, and because cylindrical, much tougher. Any use requiring displacement of fluid. Probably the best for minimum bypass. Will clean off soft deposits, but foam will flex to move past stuck deposits.
3. Wiper dart type. P/N 124xxx (was 1231xx) series. In orange PU elastomer. Polychevron design. Tougher still. Also for fluid displacement and rather better at cleaning out. There is probably not a lot of difference between the effectiveness of 2. & 3. and it is noticeable from sales patterns that some people and companies prefer one while others prefer another. Some latched on to darts early and so used the chevron elastomer, which was available a year or two before the foam was established.
4. Scraper dart type. P/N 120xxx series. In the same but green PU elastomer. Design has 5 discs of PU on a central core ie much thicker (approx 1/4") lips. Scrapes better than above types. Passing one of these through after any of the above gets yet more rubbish scraped from tubing walls. But previously less popular with operatives because harder to insert, so we are now providing a redesigned front end to make this easier.
5. Turbo type. P/N 136xxx series. Based on Kevlar reinforced bonded abrasive. 'Propeller' blade design mounted on a central core. The propellers do not turn individually but cause turbulent flow as the dart progresses through the tubing, spinning the whole dart.
 - a) Coarse for primary clean of harder deposits.
 - b) Polisher for a finer finish.

Sized for the tubing and its max wall thickness, so these are made up as required, not stocked. The OD and the thickness of the Kevlar propeller are also different for the Coarse and Polish grades. Effective, and ideal in parallel tubing. Since most tubing is tapered we also developed the following.

6a. Scraper, Abrasive Polish SiC Foam type. P/N 12103x series. Consists of the same foam as 2. with a fine grade silicon carbide moulded to the wall of the cylinder. The earlier mesh type we used to offer proved difficult for us to make consistently. We have replaced this with the same design as below but with fine grade SiC; this gives better wall contact than the mesh. Polish darts are colour coded green.

6b. Scraper, Abrasive Coarse SiC Foam type. P/N 12105x series. Foam cylinder with a coarse SiC bonded in helical strips. Scrapes off hard deposits with some bypass allowing flushing to clean working face. Coarse darts are differentiated by colour coded orange caps. Apart from good wall contact and good abrasion giving good cleaning, the foam core means that these two last will squeeze into the top heavy wall and expand slightly into the lower thinner wall in taper strings and still be as effective. We think this is the best for the heaviest duty.

6.0.3. Cement Darts Guide

Being more complex, these always take at least a few days to produce to order, though we keep a range of cores and components in stock to facilitate this process. In complexity, they are another matter entirely compared to the cleaning darts and there is a great variety available. For a given tubing size there is often a multiple of choices to be made; all are the same price so that is not a deciding factor, but there is often a choice of pressures, and bores and allowance for wall taper. We guide customers through this when asked, but illustrate the process as follows.

For example, for 1.50" tubing you can use 12mm, 13mm, 16mm and 20mm bore darts. But a wall of 0.125" , for example, is probably a limitation and inclines us away from recommending the 20mm bore; this is because the metal OD of 26mm is close to the limit of the tubing bore ($1.5" - 2 \times 0.125" = 1.250"$ or 31.75mm) if one makes proper allowance for some 2-3mm for a weld bead; it is even closer if there are butt welds in the tubing, as you might lose 4-6mm on the diameter. A dart would just squeeze through a 4mm reduction (at 27.75mm) under pressure, but would stick at a 6mm reduction. But if the restrictions do not apply, you could choose this size, and might wish to if you need a wide bore; the size exists because they have been required. Generally one would choose from the 12, 13, and 16mm bore darts.

If you have a tool below the landing point of the dart, which might need a ball release to be passed after the cementing operation, the choice can be limited by such a tool and ball. One would not choose a 12mm dart, which cannot accept even a 1/2" ball, unless one can manage with a 3/8" ball. For this reason we now tend not to recommend this size except for a simple operation.

This means the choice is perhaps dictated by the available pressures. Please note these do change with time as foil stocks used for the burst discs are used up and change.

Experience enables appropriate choices to be made, but even then care is called for. A job was planned in its entirety based on new clean 1.75" tubing, on 24mm bore darts and a comprehensive tool set above and below the cementing region. A late realisation was made that a join would have to be made in the tubing offshore; this invalidated the choice of a 24mm dart in favour of a 20mm one; this in turn invalidated the assembled tool string because the chosen ball would not pass. It delayed the job while the tools were changed, but at least it was eventually successful and not a disaster.

All cement darts need some sort of landing point, but not necessarily a specific plug catcher. Such darts will land on any restriction which prevents the metal head passing. However, ideally it will be a narrow straight tube section, not tapered which could allow the dart to tip over and be bypassed. Ideally, too, it would have a 45 degree chamfer at the bottom, as the darts have a 45 degree chamfer on their heads; however, if the tube is parallel, the precise angle should not matter.

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The list is continually developing as new sizes of tubing are brought into use, as special wall thicknesses are used, as new burst pressures are required, as new materials are available and in general as experience grows and new demands are made. If the list does not contain what is desired, please ask.

AVAILABILITY We try to keep a stock of the more commonly used pigs and darts, but because of the changing nature of demands this is not always practicable. For the burst disc darts and shear pigs we therefore keep a number of discs, bodies, noses and raw materials in ready access. We can usually supply a few within a few days. It is, however, not wise to rely on instant manufacture. The now standard high temperature versions cannot be produced quickly because of the nature of the materials; it is essential to plan ahead.

IN EMERGENCY We formerly produced cement darts in the old materials quickly, but properties are inferior; those who used them tended to re-experience (and it has happened) all the reasons why we upgraded. If, however, you have an imminent blowout and need a rupturable plug urgently as part of the solution, then we could sometimes supply these (and it has been done) within hours in the middle of the night. We no longer stock the old materials, but to compensate usually now have a few darts available in made up form, so it is still worth asking us.

6.1. Foam Sponge PU Chevron Wiper Pigs, green, with Sealed Faces, orange

We make darts of PU Foam Sponge , as the cylindrical sort, but shaped similarly to a wiper dart, the aim being to enable such a dart to act as a wiper while being flexible and extrudable enough to pass through a restriction. They are effectively softer and can be used to leave a film of eg anti-rust treatment on tubing.

The basic versions are now listed here, but special designs have been made. The extreme of this has been a dart with the ability to wipe a 2 7/8" tube, but pass a restriction and then wipe a 2" tube. All such are job-specific and designed and made accordingly.

NOTE: Pigs based on foam should not be subjected to >2000psi or collapse may occur.

p/n 133030	1.00" CT	10 chevron
p/n 133031	1.25" CT	10 chevron
p/n 133032	1.50" CT	10 chevron
p/n 133033	1.75" CT	10 chevron
p/n 133034	2.00" CT	8 chevron
p/n 133035	2.375" CT	5 chevron
p/n 133039	2.625" CT	5 chevron
p/n 133036	2.875" CT	5 chevron
p/n 133037	3.50" CT	5 chevron
p/n 133038	4.50" CT	5 chevron

6.2. Foam Sponge PU Cylinder Pigs, white, with, Sealed Driving Face, orange

This type of pig is mostly used to give a clean wipe to the tube in the yard in pre- or post-servicing to remove condensate, residues or flush water. It has not been unknown for them to be used as a top dart behind cement downhole, however.

More recently, we have been supplying larger versions for cleaning Drill Pipe, and indeed other forms of tubing in non-oil applications. This series can be extended to supply other sizes of tubing or pipe, and different wall thicknesses.

NOTE: Pigs based on foam should not be subjected to >2000psi or collapse may occur.

p/n 123030	1.00" CT	
p/n 123031	1.25" CT	
p/n 123032	1.50" CT	
p/n 123033	1.75" CT	
p/n 123034	2.00" CT	
p/n 123035	2.375" CT	
p/n 123039	2.625" CT	
p/n 123036	2.875" CT	
p/n 123037	3.50" CT	
p/n 123038	4.50" CT	
p/n 123058	4.00" OD DP	250WT
p/n 123059	4.50" OD DP	250WT
p/n 123060	5.00" OD DP	250WT
p/n 123061	5.50" OD DP	250WT
p/n 123062	6.00" OD DP	250WT
p/n 123063	6.50" OD DP	250WT

6.3. Elastomer PU Wiper Pigs

These darts are used for cleaning tubing before or after a job or for inspection in the yard and are effective at sweeping through liquids and residues. They are also used in cementing jobs as a top dart to push cement down behind the cementing dart, keeping it coherent and minimising mixing with the driving fluid; however, if circulation is to be maintained, the top dart must be another cementing dart. In some simpler cementing jobs these wiper darts have been used alone to displace cement. They may of course be used to displace any fluid within the tubing, not just cement. We also now make solid metal cored darts as top darts.

Material: These are standard in 75A orange polyurethane. If required they can also be, and have been, made in other materials.

Sizes: They come in two lengths. The normal standard is a 5-chevron length but some prefer the 10-chevron; however, the latter have never been requested in the larger sizes above 2.00". Other lengths or diameters on request.

Note that darts may be required to suit different wall thicknesses from those currently available. Where necessary, we will make a variation; please ask. The size indicated in the list is that for which a brushing fit has been designed. If a parallel string is being used, this is ideal. For the commoner taper strings, choose the dart for the wall of least thickness; thus a 109 will work with a 156/125/109 string but will obviously require a squeeze to start it in the 156 section. In the yard, reverse pigging may be desirable where possible, so that the lips are at maximum effectiveness in the wider bore. In the extreme case it is not possible to have one pig of this type which will suit a taper from 190 to 109 without a loss of effectiveness in the wider bore or undue squeeze in the narrower bore sections. We have developmental possibilities if this is a problem; please ask.

It is suggested that you specify the tubing wall thickness where there is a choice of dart. If not otherwise specified, we will supply the unmarked size as being generally more appropriate, regarding the * marked size as on special request.

NOTE: Wiper darts can also be, and have been, supplied for standard tubing as well as coil tubing. Please ask. Sizes and tolerances may vary.

6.3.1. Standard - 5-chevron Wiper Dart

Wiper darts are available as 5- or 10- chevron lengths as standard. Others have occasionally been supplied on request for special purposes. They are good general purpose cleaning darts. The range is currently being extended for use in drill pipe and other tubing. There has been some confusion in nomenclature so the items have been renumbered to avoid use of subscripts. Please ask for any particular sizes not yet listed

6.3.1.1. Wiper Darts for CT

p/n 124000	was 123120	0.875" CT	WT109
p/n 124010	was 123121	1.00" CT	WT098
p/n 124020	was 123122	1.25" CT	WT098
p/n 124030	was 123123a	1.50" CT	WT098
p/n 124031	was 123123b		WT156*
p/n 124040	was 123124a	1.75" CT	WT109
p/n 124041	was 123124b		WT098*
p/n 124042	was 123124c		WT156/204*
p/n 124050	was 123125a	2.00" CT	WT109
p/n 124051	was 123125b		WT156*
p/n 124060	was 123126	2.375" CT	WT156
p/n 124070	was 123130	2.625" CT	WT156
p/n 124080	was 123127a	2.875" CT	WT156
p/n 124081	was 123127b		WT190*
p/n 124090	was 123128	3.50" CT	WT190
p/n 124100	was 123129	4.50" CT	WT250

6.3.1.2. Wiper Darts for DP

p/n 124200	-	1.50" DP	WT200
p/n 124210	-	2.375" DP	WT186
p/n 124220	-	2.875" DP	WT203
p/n 124222	-	2.875" DP	WT276
p/n 124230	was 123156a**	3.50" DP	WT219
p/n 124231	was 123156b	3.50" DP	WT254
p/n 124232	was 123156c	3.50" DP	WT449
p/n 124240	-	3.875" DP	WT347
p/n 124250	was 123157a	4.00" DP	WT250
p/n 124253	was 123157b	4.00" DP	WT380
p/n 124260	was 123158a	4.50" DP	WT250
p/n 124270	-	4.75" DP	WT375
p/n 124080	was 123159a	5.00" DP	WT250
p/n 124282	was 123159b	5.00" DP	WT362
p/n 124290	was 123160a	5.50" DP	WT250
p/n 124291	was 123161a**	5.50" DP	WT361
p/n 124292	-	5.50" DP	WT415
p/n 124300	-	5.5625" DP	WT294
p/n 124310	-	5.75"DP	WT375
p/n 124320	-	6.625" DP	WT280
p/n 124321	was 123162a**	6.625" DP	WT330

** Previous accidental confusion over these part numbers / descriptions. Do not carry forward from past records.

6.3.2. Long length - 10-chevron Wiper Dart

While these longer darts could be supplied outside the range below, we only list those so far required. Generally, the shorter form suffices in larger sizes. For 2.625" CT and greater no tooling is currently available.

p/n 124110	was 106008	1.00" CT	WT109
p/n 124120	was 106001	1.25" CT	WT098
p/n 124130	was 106002a	1.50" CT	WT098
p/n 124131	was 106002b		WT156*
p/n 124140	was 106003a	1.75" CT	WT109
p/n 124141	was 106003b		WT098*
p/n 124142	was 106003c		WT156-204*
p/n 124150	was 106004a	2.00" CT	WT109
p/n 124151	was 106004b		WT156*
p/n 124161	was 106005	2.375" CT	WT156

6.4. Elastomer PU Scraper Pigs

Function: based on a series of linked rubber discs, rather than the chevrons of the wiper dart, these are harder to insert than the wiper darts, but scrape tubing walls more thoroughly. They ought to be chosen for the relevant wall thickness or they may not fit.

Versions for 1.75" and above have not been requested: it is said that as the wiper darts in these sizes have a thicker lip than their equivalents in the smaller sizes, they give a good wiping action; this is a rationalisation of a reluctance by operators to use them, not a proven fact. Where tests have been done, in the 1.25" size, several extra pounds of rubbish were removed by a scraper dart from a coil which had just previously been pigged with a wiper dart.

Material: polyurethane 75A one piece moulding. They could also be made in harder grades to give an even firmer scrape.

p/n 120041	1.25" CT	WT098	green
p/n 120042	1.50" CT	WT098	green
p/n 120043	1.75" CT	WT109	green

Also, now experimentally available with a chevron front end followed by five disc sections; this makes it easier to load. Please enquire for any size required.

p/n 120241	1.25"CT	WT098	black
p/n 120242	1.50"CT	WT098	black
p/n 120243	1.75"CT	WT109	black

6.5. Hippo Turbo Pigs

Section v 20.10.2006

These pigs are useful for removal of stuck deposits or wall polishing tubing.

136021	Turbo pig 1.25" Coarse 087-102WT 24mm	HTC-24
136022	Turbo pig 1.25" Coarse 109-118WT 23mm	HTC-23
136023	Turbo pig 1.25" Coarse 125-134WT 22mm	HTC-22
136024	Turbo pig 1.25" Coarse 156WT 21mm	HTC-21
136025	Turbo pig 1.25" Coarse 175WT 20mm	HTC-20
136031	Turbo pig 1.25" Polish 087-102WT 27mm	HTP-27
136032	Turbo pig 1.25" Polish 109-118WT 26mm	HTP-26
136033	Turbo pig 1.25" Polish 125-134WT 25mm	HTP-25
136034	Turbo pig 1.25" Polish 156WT 24mm	HTP-24
136035	Turbo pig 1.25" Polish 175WT 23mm	HTP-23
136041	Turbo pig 1.50" Coarse 095-109WT 30mm	HTC-30
136042	Turbo pig 1.50" Coarse 118-125WT 29mm	HTC-29
136043	Turbo pig 1.50" Coarse 134WT 28mm	HTC-28
136044	Turbo pig 1.50" Coarse 156WT 27mm	HTC-27
136045	Turbo pig 1.50" Coarse 175WT 26mm	HTC-27
136046	Turbo pig 1.50" Coarse 188WT 25mm	HTC-26
136051	Turbo pig 1.50" Polish 095-109WT 33mm	HTP-33
136052	Turbo pig 1.50" Polish 118-125WT 32mm	HTP-32
136053	Turbo pig 1.50" Polish 138WT 31mm	HTP-31
136054	Turbo pig 1.50" Polish 156WT 30mm	HTP-30
136055	Turbo pig 1.50" Polish 175WT 29mm	HTP-29

136056	Turbo pig 1.50" Polish 188WT	28mm	HTP-28
136061	Turbo pig 1.75" Coarse 109WT	36mm	HTC-36
136062	Turbo pig 1.75" Coarse 118-134WT	35mm	HTC-35
136063	Turbo pig 1.75" Coarse - WT	34mm	HTC-34
136064	Turbo pig 1.75" Coarse 156-175WT	33mm	HTC-33
136065	Turbo pig 1.75" Coarse 188WT	32mm	HTC-32
136066	Turbo pig 1.75" Coarse 204WT	31mm	HTC-31
136071	Turbo pig 1.75" Polish 109WT	39mm	HTP-39
136072	Turbo pig 1.75" Polish 118-134WT	38mm	HTP-38
136073	Turbo pig 1.75" Polish - WT	37mm	HTP-37
136074	Turbo pig 1.75" Polish 156-175WT	36mm	HTP-36
136075	Turbo pig 1.75" Polish 188WT	35mm	HTP-35
136076	Turbo pig 1.75" Polish 204WT	34mm	HTP-34
136081	Turbo pig 2.00" Coarse 109-118WT	42mm	HTC-42
136082	Turbo pig 2.00" Coarse 125-134WT	41mm	HTC-41
136083	Turbo pig 2.00" Coarse 156WT	40mm	HTC-40
136084	Turbo pig 2.00" Coarse 175WT	39mm	HTC-39
136085	Turbo pig 2.00" Coarse 188WT	38mm	HTC-38
136086	Turbo pig 2.00" Coarse 204WT	37mm	HTC-37
136091	Turbo pig 2.00" Polish 109-118WT	45mm	HTP-45
136092	Turbo pig 2.00" Polish 125-134WT	44mm	HTP-44
136093	Turbo pig 2.00" Polish 156WT	43mm	HTP-43
136094	Turbo pig 2.00" Polish 175WT	42mm	HTP-42
136095	Turbo pig 2.00" Polish 188WT	41mm	HTP-41
136096	Turbo pig 2.00" Polish 204WT	40mm	HTP-40
136101	Turbo pig 2.375" Coarse 109WT	52mm	HTC-52
136102	Turbo pig 2.375" Coarse 118-125WT	51mm	HTC-51
136103	Turbo pig 2.375" Coarse 134WT	50mm	HTC-50
136104	Turbo pig 2.375" Coarse 156WT	49mm	HTC-49
136105	Turbo pig 2.375" Coarse 175-188WT	48mm	HTC-48
136106	Turbo pig 2.375" Coarse 204WT	47mm	HTC-47
136111	Turbo pig 2.375" Polish 109-118WT	55mm	HTP-55
136112	Turbo pig 2.375" Polish 125-134WT	54mm	HTP-54
136113	Turbo pig 2.375" Polish 156WT	53mm	HTP-53
136114	Turbo pig 2.375" Polish 175WT	52mm	HTP-52
136115	Turbo pig 2.375" Polish 188WT	51mm	HTP-51
136116	Turbo pig 2.375" Polish 204WT	50mm	HTP-50

6.6. SiC Abrasive Scraper Pigs

6.6.1. Polishing Type, with fine Silicon Carbide, and green sealed face

These pigs give an extra clean abrasive wipe and polish to tubing or pipe, in the yard in pre- or post-servicing to remove surface rust or hard residues, or in fixed pipelines. They accommodate to different wall thicknesses.

NOTE: Pigs based on foam should not be subjected to >2000psi or collapse may occur.

p/n 121030	1.00" CT
p/n 121031	1.25" CT
p/n 121032	1.50" CT
p/n 121033	1.75" CT
p/n 121034	2.00" CT
p/n 121035	2.375" CT
p/n 121039	2.625" CT
p/n 121036	2.875" CT
p/n 121037	3.50" CT
p/n 121038	4.50" CT
p/n 121042	4.00" DP
p/n 121043	4.50" DP
p/n 121044	5.00" DP
p/n 121045	5.50" DP
p/n 121046	6.00" DP
p/n 121047	6.50" DP

6.6.2. Cutting Type, with coarse Silicon Carbide, and orange sealed face

These pigs give a cutting action on material stuck to tubing or pipe. They are used in the yard in pre- or post-servicing to remove surface rust or hard cement residues, or in fixed pipelines. They accommodate to different wall thicknesses. There is some bypass through the flutes, which gives a jetting action in removing residues. They may well be followed by a polishing pig or a wiper pig.

NOTE: Pigs based on foam should not be subjected to >2000psi or collapse may occur.

p/n 121050	1.00" CT
p/n 121051	1.25" CT
p/n 121052	1.50" CT
p/n 121053	1.75" CT
p/n 121054	2.00" CT
p/n 121055	2.375" CT
p/n 121059	2.625" CT
p/n 121056	2.875" CT
p/n 121057	3.50" CT
p/n 121058	4.50" CT
p/n 121062	4.00" DP
p/n 121063	4.50" DP
p/n 121064	5.00" DP
p/n 121065	5.50" DP
p/n 121066	6.00" DP
p/n 121067	6.50" DP

Customer remark:

"Since I tried these, I persuaded xxx to use them, because it is surprising how much rubbish you can remove if you use the right tools for the job!"

6.10. Cement Darts with Burst Discs

Cement darts contain a bursting disc which bursts under given conditions at a pressure which is reliably known in advance. Thus cement may be discharged from coil tubing in a controlled manner. The technique is not limited to cement and may be used for any fluid or fluidised solids, but is most usually used for cementing. Cement darts are based mostly on nickel foils which are not suitable for strong acids - see the Acid Darts section 6.6 - but acid darts are suitable as cement darts. Darts may be adapted in various ways to suit customer operating needs, and often have been.

Materials: Generally based on nickel foil welded between stainless steel flanges and with a nose and body encapsulated in polyurethane, shaped to provide a seal with the tubing. Some are now based where required on Alloy 600, Alloy C-276 or SS316.

Stock: We try to keep some of the range of sizes usually in stock. This means the metal cores carrying the disc, **not the made up dart**. This is not entirely practicable as the ranges have grown. Particularly for the large sizes - 2 3/8", 2 7/8" and 3 1/2" tubing - the cores are not stocked, though for these we keep standard parts from which to make up the desired cores for the required pressure.

Choosing Your Cement Dart

Considerations of tubing diameter to be used, its wall thickness and its variation in a string, the preferred dart bore and the effects of related equipment operations, dart shape, and operational temperatures and pressures will all affect the choice of dart. The following notes will, it is hoped, give some useful guideposts. We prefer that you do the job successfully, quite as much as you and your client, so please ask for the latest information.

Dart Cone Tail Shape

Previous standard darts, the 12mm series, do align in the tubing so that when burst there is a through passage for a fluid. But if it is desired to pass an object such as a ball through the tubing to trigger a lower tool or packer release, the alignment may not be adequate. Further, the tail end of the standard dart could cause a ball to lodge to one side and not be swept through the tubing. The cone tail shape overcomes this by both centering one dart behind another and enabling a ball to be directed into the through hole as it is swept along, even in horizontal sections. This feature is standard in all wider-bore darts.

Burst Pressures

Pressures are calculated values, confirmed by burst testing. It is possible to have other values; those listed represent current stock materials. As these are used up and renewed from time to time, some changes occur.

Temperature

We formerly offered cement darts suitable to 120C (with p/n 1xxxxx) and to 160C (with p/n 2xxxxx). As we have had feedback on dart usage and performance, it is evident that the greater wear and cut resistance of the higher temperature dart is desirable even at low temperatures. It protects against some of the possibilities of wear and cut, especially in tight systems, and as the rubber bonds better to the steel core, there is reduced chance of shrugging off the rubber; bypass is thereby limited. We had 3 or 4 reports of problems in about 150-200 hundred darts over 2 years or so; but none with the HT darts. We therefore now supply p/n 2xxxxx 160C darts in all circumstances.

On request we can now offer special darts suitable to 180C.

Scheme of Part Numbers for CT Darts

The dart range has been substantially expanded to accommodate various customer requirements, as a result of which we re-numbered the range in 1994. Former part numbers are no longer given. Former 12mm versions with a cone tail added are now withdrawn as their function is better performed by 13mm or 16mm bore darts. Original variations of 12mm 1.25" nose types are not listed; now all have as standard a heavier-weight nose, which facilitates launch by encouraging the dart to keep head-down in some wider bore launch systems.

The first need was to have a wider range of **bore sizes**, especially the largest size that can be fitted within a given tubing diameter, in order to achieve greater volume flows and to enable the passage of trigger balls to lower tools in the string. This leads to the following general scheme of part numbers. Those underlined are in existence; large bore sizes marked 'na' are not physically possible in the tubing; most smaller bore sizes are not wanted in larger tubing sizes; and the 12 are the re-numbered originals from which the range has been developed. As the need arises, others than those underlined will be provided; this may also involve larger bore sizes.

CT Size	<u>Bore</u> mm (top) or inch (below)									
	12	13	16	20	24	27	29	36	44	60
<u>inch</u>	0.472	0.512	0.630	0.787	0.945	1.063	1.142	1.417	1.732	2.362
1.00	na	<u>22315-</u>	na	na						
1.25	<u>2240--</u>	<u>22415-</u>	<u>22420-</u>	na	na					
1.50	<u>22500-</u>	<u>22515-</u>	<u>22520-</u>	<u>22530-</u>	na	na				
	<u>22501-</u>	<u>22516-</u>	<u>22521-</u>	<u>22531-</u>						
1.75	<u>2260--</u>	<u>22615-</u>	<u>2262--</u>	<u>22631-</u>	<u>2264--</u>	na	na			
				<u>22632-</u>						
				<u>22633-</u>						
2.00	<u>2270--</u>	<u>2271--</u>	<u>2272--</u>	<u>2273--</u>	<u>2274--</u>	<u>2275--</u>	na	na		
2.375	<u>2280--</u>			<u>2283--</u>	<u>2284--</u>	<u>2285--</u>	<u>22855-</u>	<u>2286--</u>	na	na
2.625	<u>2330--</u>				<u>2334--</u>	<u>2335--</u>	<u>23355--</u>	<u>2336--</u>	na	na
2.875	<u>2290--</u>				<u>2294--</u>	<u>2295--</u>	<u>22955--</u>	<u>2296--</u>	<u>2297--</u>	na
3.50	<u>2300--</u>							<u>2306--</u>	<u>2307--</u>	<u>2308--</u>
4.50	<u>2310--</u>							<u>2316--</u>	<u>2317--</u>	<u>2318--</u>
Max ball size (inch)	7/16	1/2	9/16	11/16	7/8	1	1 1/8	1 3/8	1 5/8	2 1/4

The second requirement is to cope with tubing of different **wall thickness**. Ideally, it is desirable to make a dart with flexible enough lips to cope with all likely wall thicknesses, but, with only a few mm of rubber around the core, it is not easy to achieve flexibility with enough toughness; it has at present been found necessary to make slightly different dart diameters to allow the use of two or three wall thickness ranges eg. 098-109 & 125-156. Thus, in the detailed listings which follow, there may be more than one dart for a given CT diameter, a given bore and a given pressure, depending on wall thickness range. It is quite likely that different tapered strings will require variations to suit the particular string, so it is most important that the requirements are clearly understood when placing orders; we would prefer that you nominate the string details so we may check the suitability.

Effect of Temperature on Burst Pressure

Discs are rated at nominal value $\pm 5\%$ at 20C, and each production batch is tested and certified to be within the limits. However, discs are used downhole at higher temperatures than 20C, and the following temperature coefficients have been used to calculate the burst pressure range at various temperatures.

These values apply to nickel discs as currently used, and to no others unless expressly stated. The product label will indicate any future variation if applicable.

<u>TC</u>	<u>Coeff</u>	<u>1000psi</u>	<u>2000psi</u>	<u>3000psi</u>	<u>4000psi</u>	<u>5000psi</u>
20	1.00	950-1050	1900-2100	2850-3150	3800-4200	4750-5250
30	0.99	936-1034	1872-2069	2807-3103	3743-4137	4679-5171
40	0.97	922-1019	1843-2037	2765-3056	3686-4074	4608-5145
50	0.96	912-1008	1824-2016	2736-3024	3648-4032	4560-5040
60	0.95	903- 998	1805-1995	2708-2993	3610-3990	4513-4988
70	0.94	893- 987	1786-1974	2679-2961	3572-3948	4465-4935
80	0.93	884- 977	1767-1953	2651-2930	3534-3906	4418-4883
90	0.92	874- 966	1748-1932	2622-2898	3496-3864	4370-4830
100	0.91	865- 956	1729-1911	2594-2867	3458-3822	4323-4778
110	0.90	855- 945	1710-1890	2565-2835	3420-3780	4275-4725
120	0.89	846- 935	1691-1869	2537-2804	3382-3738	4228-4673
130	0.88	836- 924	1672-1848	2508-2772	3344-3696	4180-4620
140	0.88	831- 919	1663-1838	2494-2756	3325-3675	4156-4594
150	0.87	827- 914	1653-1827	2480-2741	3306-3654	4132-4568
160	0.87 *	822- 908	1653-1827	2480-2741	3306-3654	4132-4568
170	0.86	817- 903	1634-1806	2451-2709	3268-3612	4085-4515
180	0.85	808- 893	1615-1785	2423-2678	3230-3570	4038-4463
190	0.85	803- 887	1606-1775	2408-2662	3211-3549	4014-4436
200	0.84	798- 882	1596-1764	2349-2646	3024-3528	3990-4410

* The former polymer withstands 120C; a first improved form stands up to 140C; further improvements have been tested able to withstand 160C. This is now the standard used in cement darts. In consequence, we no longer list either the 120C or 140C forms.

6.10.1. CT Burst Disc Darts, 12mm Bore (No cone at tail)

1.25" CT, 098-125 WT; 12mm bore, metal OD 22mm, rubber OD 28 mm

p/n 224001	1000psi	yellow
p/n 224002	2000psi	orange
p/n 224003	3000psi	red
p/n 224004	4000psi	blue
p/n 224005	5000psi	black
p/n 224006	6000psi	brown

1.50" CT, 098-125 WT; 12mm bore, metal OD 22mm, rubber OD 35mm

p/n 225001	1000psi	yellow
p/n 225002	2000psi	orange
p/n 225003	3000psi	red
p/n 225004	4000psi	blue
p/n 225005	5000psi	black
p/n 225006	6000psi	brown

1.50" CT, 109-156 WT; 12mm bore, metal OD 22mm, rubber OD 32.5 mm

p/n 225011	1000psi	yellow
p/n 225012	2000psi	orange
p/n 225013	3000psi	red
p/n 225014	4000psi	blue
p/n 225015	5000psi	black
p/n 225016	6000psi	brown

1.75" CT, 109-156 WT; 12mm bore, metal OD 26mm, rubber OD 39 mm

p/n 226001	1000psi	yellow
p/n 226002	2000psi	orange
p/n 226003	3000psi	red
p/n 226004	4000psi	blue
p/n 226005	5000psi	black
p/n 226006	6000psi	brown

2.00" CT, 109-156 WT; 12mm bore, metal OD 30mm, rubber OD 45.5 mm

p/n 227001	1000psi	yellow
p/n 227002	2000psi	orange
p/n 227003	3000psi	red
p/n 227004	4000psi	blue
p/n 227005	5000psi	black
p/n 227006	6000psi	brown

6.10.2. CT Burst Disc Darts, 13mm Bore

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1.00" CT, 095-125 WT; 13mm bore, metal OD 19mm, rubber OD - mm - in plan

p/n 223152a etc

1.25" CT, 095-156 WT; 13mm bore, metal OD 19mm, rubber OD 28mm

p/n 224152a	1275psi	yellow
p/n 224151a	1500psi	white
p/n 223153c	1800psi	red
p/n 224155d	2450psi	salmon
p/n 224154b	2800psi	orange
p/n 224156b	3800psi	green
p/n 224157b	4500psi	blue
p/n 224158b	5600psi	black

1.50" CT, 098-134 WT; 13mm bore, metal OD 19mm, rubber OD 34mm

p/n 225152a	1275psi	yellow
p/n 225151a	1500psi	white
p/n 225153c	1800psi	red
p/n 225155d	2450psi	salmon
p/n 225154b	2800psi	orange
p/n 225156b	3800psi	green
p/n 225157b	4500psi	blue
p/n 225158b	5600psi	black

1.50" CT, 109-175 WT; 13mm bore, metal OD 19mm, rubber OD 32.5mm (Model ref 10359)

p/n 225162a	1275psi	yellow
p/n 225161a	1500psi	white
p/n 225153c	1800psi	red
p/n 225165d	2450psi	salmon
p/n 225164b	2800psi	orange
p/n 225166b	3800psi	green
p/n 225167b	4500psi	blue
p/n 225168b	5600psi	black

1.75" CT, 190-220 WT; 13mm bore, metal OD 19mm, rubber OD 34mm

p/n 226152a	1275psi	yellow
p/n 226151a	1500psi	white
p/n 226153c	1800psi	red
p/n 226155d	2450psi	salmon
p/n 226154b	2800psi	orange
p/n 226156b	3800psi	green
p/n 226157b	4500psi	blue
p/n 226158b	5600psi	black

6.10.3. CT Burst Disc Darts, 16mm Bore

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1.25" CT, 087-125 WT; 16mm bore, metal OD 22mm, rubber OD 28 mm

p/n 224201a	1350psi	yellow
p/n 224210a	2000psi	white
p/n 224203a	2350psi	orange
p/n 224204a	3000psi	salmon
p/n 224205a	3300psi	red
p/n 224206b	4530psi	blue
p/n 224208a	6700psi	black

1.25" CT, tba WT; 16mm bore, metal OD 22mm, rubber OD -- mm - in plan

p/n 224211a etc

1.50" CT, 087-134 WT; 16mm bore, metal OD 22mm, rubber OD 34 mm

p/n 225201a	1350psi	yellow
p/n 225210a	2000psi	white
p/n 225203a	2350psi	orange
p/n 225204a	3000psi	salmon
p/n 225205a	3300psi	red
p/n 225206b	4530psi	blue
p/n 225208a	6700psi	black

1.50" CT, 125-175 WT; 16mm bore, metal OD 22mm, rubber OD 32 mm

p/n 225211a	1350psi	yellow
p/n 225220a	2000psi	white
p/n 225213a	2350psi	orange
p/n 225214a	3000psi	salmon
p/n 225215a	3300psi	red
p/n 225216b	4530psi	blue
p/n 225218a	6700psi	black

1.75" CT, 190-220 WT; 16mm bore, metal OD 22mm, rubber OD 34 mm

p/n 226201a	1350psi	yellow
p/n 226210a	2000psi	white
p/n 226203a	2350psi	orange
p/n 226204a	3000psi	salmon
p/n 226205a	3300psi	red
p/n 226206b	4530psi	blue
p/n 226208a	6700psi	black

We have also supplied 1500psi, 1800psi, 2750psi forms in the 16mm type.

6.10.4. CT Burst Disc Darts, 20mm Bore

1.50" CT, 087-125 WT; 20mm bore, metal OD 26mm, rubber OD 34 mm

p/n 225301	1100psi	yellow
p/n 225308	1400psi	violet
p/n 225302	1850psi	white
p/n 225307	2500psi	orange
p/n 225303	3000psi	salmon
p/n 225304	3650psi	red
p/n 225305	4100psi	blue
p/n 225305m	4500psi	brown
p/n 225306	5200psi	black
p/n 225306m	7000psi	ginger *
p/n 225306p	7500psi	ginger *
p/n 225309	9500psi	green *

* These have reduced bore 18mm for adequate wall strength

1.50" CT, 125-156 WT; 20mm bore, metal OD 26mm, rubber OD 32 mm

p/n 225311	1100psi	yellow
p/n 225318	1400psi	violet
p/n 225312	1850psi	white
p/n 225317	2500psi	orange
p/n 225313	3000psi	salmon
p/n 225314	3650psi	red
p/n 225315	4100psi	blue
p/n 225316	5200psi	black

And others as full list for 1.50" 087-125

1.75" CT, 109-156 WT; 20mm bore, metal OD 26mm, rubber OD 39 mm

p/n 226311	1100psi	yellow
p/n 226318	1400psi	violet
p/n 226312	1850psi	white
p/n 226317	2500psi	orange
p/n 226313	3000psi	salmon
p/n 226314	3650psi	red
p/n 226315	4100psi	blue
p/n 226316	5200psi	black

And others as full list for 1.50" 087-125

1.75" CT, 125-175 WT; 20mm bore, metal OD 26mm, rubber OD 38.3 mm

p/n 226321	1100psi	yellow
p/n 226328	1400psi	violet
p/n 226322	1850psi	white
p/n 226327	2500psi	orange
p/n 226323	3000psi	salmon
p/n 226324	3650psi	red
p/n 226325	4100psi	blue
p/n 226326	5200psi	black

And others as full list for 1.50" 087-125.

1.75" CT, 175-204 WT; 20mm bore, metal OD 26mm, rubber OD 34 mm

p/n 226331	1100psi	yellow
p/n 226338	1400psi	violet
p/n 226332	1850psi	white
p/n 226337	2500psi	orange
p/n 226333	3000psi	salmon
p/n 226334	3650psi	red
p/n 226335	4100psi	blue
p/n 226336	5200psi	black

And others as full list for 1.50" 087-125.

6.10.5. CT Burst Disc Darts, 24mm Bore

1.75" CT, 109-156 WT; 24mm bore, metal OD 31mm, rubber OD 39 mm

p/n 226401	1000psi	yellow
p/n 226402	1500psi	green
p/n 226403	2000psi	white
p/n 226404	2400psi	salmon
p/n 226405	3000psi	red
p/n 226406	4250psi	blue
p/n 226407	5000psi	black

2.00" CT, 109-175 WT; 24mm bore, metal OD 31mm, rubber OD 46 mm

p/n 227401	1000psi	yellow
p/n 227402	1500psi	green
p/n 227403	2000psi	white
p/n 227404	2400psi	salmon
p/n 227405	3000psi	red
p/n 227406	4250psi	blue
p/n 227407	5000psi	black

2.375" CT, 125-190 WT; 24mm bore, metal OD 31mm, rubber OD 54 mm

p/n 228401	1000psi	yellow
p/n 228402	1500psi	green
p/n 228403	2000psi	white
p/n 228404	2400psi	salmon
p/n 228405	3000psi	red
p/n 228406	4250psi	blue
p/n 228407	5000psi	black

6.10.6. CT Burst Disc Darts, 27mm Bore

2.00" CT, 125-175 WT; 27mm bore, metal OD 34mm, rubber OD 45 mm

p/n 227501	800psi	yellow
p/n 227502	1400psi	green
p/n 227503	1800psi	white
p/n 227504	2200psi	orange
p/n 227505	2600psi	salmon
p/n 227506	3000psi	red
p/n 227508	3400psi	violet
p/n 227507	4000psi	blue

2.375" CT, 125-190 WT; 27mm bore, metal OD 34mm, rubber OD 54 mm

Note: cores as for 2": see 22855- (29mm bore) and 22860- (36mm bore) for longer cores.

p/n 228501	800psi	yellow
p/n 228502	1400psi	green
p/n 228503	1800psi	white
p/n 228504	2200psi	orange
p/n 228505	2600psi	salmon
p/n 228506	3000psi	red
p/n 228508	3400psi	violet
p/n 228507	4000psi	blue

2.375" CT, 156-250 WT; **29mm bore**, metal OD 40mm, rubber OD 53 mm

p/n 228551	1000psi	yellow
p/n 228552	1500psi	white
p/n 228553	2000psi	orange
p/n 228554	2500psi	salmon
p/n 228555	3000psi	red
p/n 228556	3500psi	green
p/n 228557	4000psi	blue

2.625" CT, not made in 27mm: suitable darts are at p/n 233--- out of number sequence. See **6.10.7**.

2.875" CT, 190 WT; 27mm bore, metal OD 34mm, rubber OD 65 mm

Note: cores as for 2" but special length: see 22960- (36mm bore) for preferred cores.

p/n 229501	800psi	yellow
p/n 229502	1400psi	green
p/n 229503	1800psi	white
p/n 229504	2200psi	orange
p/n 229505	2600psi	salmon
p/n 229506	3050psi	red
p/n 229508	3400psi	violet
p/n 229507	4000psi	blue

6.10.7. CT Burst Disc Darts, 36mm Bore

All the darts of this size can be tailored, if necessary, to almost any required pressure. These darts are suitable as both acid and cement darts.

2.375" CT, 109-190 WT; 36mm bore, metal OD 46 mm, rubber OD 55mm

p/n 228601	1000psi	yellow
p/n 228602	1500psi	white
p/n 228603	2000psi	orange
p/n 228604	2500psi	salmon
p/n 228605	3000psi	red
p/n 228606	3500psi	green
p/n 228607	4000psi	blue
p/n 228608	4500psi	violet
p/n 228609	5000psi	black
p/n 228610	5500psi	ginger
p/n 228611	6000psi	brown

2.625" CT, 109-204 WT; bore 36mm, metal OD 46mm, rubber OD 58mm

p/n 233601	1000psi	yellow
p/n 233602	1500psi	white
p/n 233603	2000psi	orange
p/n 233604	2500psi	salmon
p/n 233605	3000psi	red
p/n 233606	3500psi	green
p/n 233607	4000psi	blue

2.875" tubing, WT; bore 36mm, metal OD 46mm, rubber OD -mm - in plan

p/n 229601	1000psi	yellow
p/n 229602	1500psi	white
p/n 229603	2000psi	orange
p/n 229604	2500psi	salmon
p/n 229605	3000psi	red
p/n 229606	3500psi	green
p/n 229607	4000psi	blue
p/n 229608	4500psi	violet
p/n 229609	5000psi	black
p/n 229610	5500psi	ginger
p/n 229611	6000psi	brown

3.50" tubing, bore 36mm, metal OD 46mm, rubber OD 78mm - in plan

p/n 230601	1000psi	yellow
p/n 230602	1500psi	white
p/n 230603	2000psi	orange
p/n 230604	2500psi	salmon
p/n 230605	3000psi	red
p/n 230606	3500psi	green
p/n 230607	4000psi	blue
p/n 230608	4500psi	violet
p/n 230609	5000psi	black
p/n 230610	5500psi	ginger
p/n 230611	6000psi	brown

6.10.8. CT Burst Disc Darts, 44mm Bore

All the darts of this size can be tailored, if necessary, to almost any required pressure. These darts are suitable as both acid and cement darts.

2.875" tubing, bore 44mm, metal OD 58mm, rubber OD -mm -in plan

p/n 229701	1000psi	yellow
p/n 229702	1500psi	white
p/n 229703	2000psi	orange
p/n 229704	2500psi	salmon
p/n 229705	3000psi	red
p/n 229706	3500psi	green
p/n 229707	4000psi	blue
p/n 229708	4500psi	violet
p/n 229709	5000psi	black
p/n 229710	5500psi	ginger
p/n 229711	6000psi	brown

3.50" tubing, 254 WT; bore 44mm, metal OD 58mm, rubber OD 78mm

p/n 230701	1000psi	yellow
p/n 230702	1500psi	white
p/n 230703	2000psi	orange
p/n 230704	2500psi	salmon
p/n 230705	3000psi	red
p/n 230706	3500psi	green
p/n 230707	4000psi	blue
p/n 230708	4500psi	violet
p/n 230709	5000psi	black
p/n 230710	5500psi	ginger
p/n 230711	6000psi	brown

6.11. Acid Darts with Burst Discs

Acid darts are made to withstand concentrated hydrochloric acid and mild hydrofluoric acid, or mixtures of these acids used in well workover. The foil used in the disc is Alloy C-276.

Though this is exceptionally corrosion resistant, it should not be assumed totally resistant, particularly if the acid mixture is say hydrofluoric with a strong oxidising acid such as nitric acid. Please consult us if you have any particularly powerful mixture.

All Acid Darts are suitable for use as Cement darts. The reverse is not true.

This is a new list and is expanding as demand occurs, but in principle all the sizes of the cement dart ranges are possible as acid darts. The pressure ratings are likely to differ. Please ask.

However, the cement darts in the larger sizes (**2 3/8"**, **2 5/8"**, **2 7/8"** and **3 1/2"** of sections **6.4.7.** and **6.4.8.**) are designed for dual use as acid or cement darts, and are not separately listed in this section.

1.25 CTU; 098-125WT; 12mm bore		
p/n 244004	4000psi	blue
p/n 244006	6000psi	brown
1.50 CTU; 098-125WT; 12mm bore		
p/n 245004	4000psi	blue
p/n 245006	6000psi	brown
1.75 CTU; 109-156WT; 12mm bore		
p/n 246004	4000psi	blue
p/n 246006	6000psi	brown
2.00 CTU; 109-156WT; 12mm bore		
p/n 247004	4000psi	blue
p/n 247006	6000psi	brown
1.50 CTU, 087-109 WT; 20mm bore, OD 34mm		
p/n 245305	4100psi	blue
1.50 CTU, 125-156 WT; 20mm bore, OD 32mm		
p/n 245315	4100psi	blue
1.75 CTU, 109-156 WT; 20mm bore, OD 39mm		
p/n 246315	4100psi	blue
1.75 CTU, 125-175 WT; 20mm bore, OD 38.3mm		
p/n 246325	4100psi	blue

6.13. Solid Core Plug Darts

Darts may be provided with a solid steel (or aluminium, on request) core. This is useful if it is desired deliberately to drive cement and plug the tubing, as in certain abandonment operations. It can also be useful to use such a dart as a trigger, to activate a spring mechanism for example. Small sizes can also be considered instead of a ball for release activation, especially in long horizontal or even up-inclined sections where a ball is less reliably driven.

These darts are described as matching the cement or acid darts with which, or instead of which, they are commonly used. This means that they are somewhat curiously described as say 20mm bore type, though they have no bore.

p/n 223031	1.00"CT	WT - tba	BD13mm type	Rubber OD tba mm
p/n 223041	1.25"CT	WT 098 -125	BD12mm type	Rubber OD 28mm
p/n 223042	1.25"CT	WT 098 -156	BD13mm type	Rubber OD 28mm
p/n 223043	1.25"CT	WT 087 -125	BD16mm type	Rubber OD 28mm
p/n 223051	1.50"CT	WT 098 -134	BD12mm type	Rubber OD 35mm
p/n 223052	1.50"CT	WT 109 -156	BD12mm type	Rubber OD 32.5mm
p/n 223053	1.50"CT	WT 098 -134	BD13mm type	Rubber OD 35mm
p/n 223054	1.50"CT	WT 109 -156	BD13mm type	Rubber OD 32.5mm
p/n 223055	1.50"CT	WT 087 -134	BD16mm type	Rubber OD 34mm
p/n 223056	1.50"CT	WT 125 -175	BD16mm type	Rubber OD 32mm
p/n 223057	1.50"CT	WT 087 -125	BD20mm type	Rubber OD 43mm
p/n 223058	1.50"CT	WT 109 -156	BD20mm type	Rubber OD 32mm
p/n 223061	1.75"CT	WT 109 -156	BD12mm type	Rubber OD 39mm
p/n 223062	1.75"CT	WT 190 -220	BD13mm type	Rubber OD 34mm
p/n 223063	1.75"CT	WT 190 -220	BD16mm type	Rubber OD 34mm
p/n 223064	1.75"CT	WT 109 -156	BD20mm type	Rubber OD 39mm
p/n 223065	1.75"CT	WT 125 -175	BD20mm type	Rubber OD 38.3mm
p/n 223066	1.75"CT	WT 109 -156	BD24mm type	Rubber OD 39mm
p/n 223071	2.00"CT	WT - tba	BD12mm type	Rubber OD tba mm
p/n 223072	2.00"CT	WT 109 -175	BD24mm type	Rubber OD 46mm
p/n 223073	2.00"CT	WT 125 -175	BD27mm type	Rubber OD 46mm
p/n 223081	2.375"CT	WT 125 -190	BD24mm type	Rubber OD 54mm
p/n 223082	2.375"CT	WT 125 -190	BD27mm type	Rubber OD 54mm

This range can be extended when required.