Cranfield UNIVERSITY
Silsoe

SPECIFICATION AND DRAWINGS FOR THE POUNDER RIG

a human-powered drill rig
for constructing shallow small diameter wells
for domestic and agricultural water supply

developed in Uganda and UK
through project funding and support from
Government and People of Uganda, DFID, Danida, Sida, and Unicef

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ABSTRACT

Despite all the efforts to date to improve access to safe domestic water supply and sanitation in less developed countries, still between 1 and 3 billion people lack these essential services. The causes of this situation are complex, and are not to be resolved through technology alone. However, it is widely accepted that two broad sets of conditions (among others) need to be in place in order for the situation to improve – technologies which are affordable and manageable by user communities, and the institutional arrangements by which communities can gain access to such technologies.

This document is one contribution from one project in one country (Uganda) within which an attempt is under way to address these issues.

Part 1 describes the background, objectives, and progress to date of the project "Private Sector Participation in Low Cost Water Well Drilling", which was initiated by Cranfield University (UK) with DFID funding. The aims of the project are: to develop, and transfer to the private sector, technology suitable for affordable shallow well construction; and to research the process of technology transfer and the conditions necessary for its success, in the context of rural water source construction.

Part 2 sets out basic operating instructions for the Pounder Rig, a low-cost, human-powered, drill rig suitable for construction of shallow water wells in a wide range of ground conditions.

Part 3 is the specification of all the components of the Pounder Rig, referenced to the full engineering drawings which follow in **Part 4**.

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A great many individuals and organisations, too numerous to name, have contributed through ideas, encouragement, and interest. They too receive the grateful thanks of the Project Team.

The Project Team consists of Dr Richard Carter (Project Manager), Eng Kerstin Danert (Team Leader – Uganda), Mr Peter Ball (Drilling Consultant), Mr Ezron Rwamwanja (Community Water Supply Specialist), and Mr Jamil Ssebalu (Small Business Specialist).

PART 1 - PRIVATE SECTOR PARTICIPATION IN LOW COST WATER WELL DRILLING

The last two decades of the twentieth century saw an increasing international determination to end the scandal of extreme poverty. Approximately one fifth of the planet's people experience grossly inadequate services, opportunities, and freedoms. One aspect of this situation is the inadequacy of water supply infrastructure, with corresponding consequences for health, as well as the excessive time and energy which women and children in particular have to devote to water collection. Universal access to safe water, near to the home, together with the practice of safe excreta disposal and changes in hygiene behaviour, are the focus of a new drive toward poverty elimination as the twenty first century begins.

Although much good practice was developed during the International Drinking Water Supply and Sanitation Decade (the 1980s), as well as during the 1990s, the problem remains: how to scale up the good practices implemented in relatively small projects and programmes, to meet the urgent needs of still rapidly growing populations. Previously innacessible funds and forces need to be released to meet the enormous challenge which still remains.

Arguably the biggest step forward in water and sanitation development in the twentieth century was the realisation that only participative and community-managed approaches would work. Governments and NGOs simply lacked the resources to meet a large and growing need. The implied shift in roles, of former service providers to facilitators, and of target beneficiaries to actively participating managers, is still taking place; such radical change takes at least a generation to become effective.

At the turn of the century, the private sector is increasingly being looked to as a possible means of meeting part or all of the development targets. In the water supply sector there have been many successful, and other more controversial, experiences of private sector activity in the urban environment. The potential and success of the private sector in rural water service provision is far less evident.

It is against this background that the project "Private Sector Participation in Low Cost Water Well Drilling", initiated by Cranfield University and DFID, was set up. The aims of the project were to investigate the potential of the small scale private sector and to facilitate its success, through development and promotion of a single technology in one country.

Project Starting Points

The project starts from the point of view that private sector providers (implementers) of rural water services, particularly the small business sector, represent a relatively untapped potential. The project sets out on the assumption that if small businesses receive manageable technologies and training in their deployment, training in good business practice, and other forms of support, they can be released to effectively implement water source construction at community level.

The project also assumes that the end users of rural water will be more likely to maintain and sustain their sources if they own them, with real ownership being achieved through the community (or farmer, or school, for example) paying the full cost of source construction.

The logic of this position leads to the need to identify or develop affordable water supply technology – affordable by both small contractors, and by the end-users.

These starting points also raise questions and issues in relation to the entire set of primary and secondary stakeholders involved in the process of private sector service provision. Central and local Governments, their policies, and the incentives (or obstacles) they create for small businesses; local Government and NGOs, and their capacities to manage private sector contractors; and communities themselves, and their adaptability to yet another set of development policies; all take on increasing prominence.

Finally the issue of regulation – encompassing construction quality control, water quality, price regulation, and consumer protection – emerges as a key issue which is crucial to the success of the privatisation of any monopoly.

Project Aims and Objectives

The three-year Project (1998-2001) has two overall aims:

- to develop, and transfer to the private sector, technology suitable for affordable shallow well construction
- to research the process of technology transfer and the conditions necessary for its success, in the context of rural water source construction

Put another way, the project is crucially concerned with implementation and uptake, but at the same time we wish to learn as much as possible from the process, in order to apply lessons in future either in or beyond the rural water sector.

Technology Transfer and Uptake

The first aim of the project is addressed through three main objectives or outputs:

- the design, field testing, and evaluation of a new manual drilling rig (the "Pounder Rig")
- the uptake of the technology by a small number of contractors, and their use of the rig in commercial contracts
- the establishment of a sustainable means by which the rig and subsequent spare parts will be made available in country

This aim is achieved through a flexible and evolving process of participation with project partners and stakeholders. This is explicitly a learning project, not driven according to a blueprint, but initiating discussion and research of key issues and responding to the resulting findings.

Research

The research aim of the project uses the technology transfer and uptake process as a gateway to action research. The process of developing the technology and introducing it

into the private sector, and the concurrent investigation and learning process, are intertwined in such a way that the project informs the research, and the research informs the project. Both benefit.

The overall research question is

"what enabling conditions and external actions are necessary to stimulate and strengthen effective rural water supply service delivery by the private sector?"

In addressing this question, the research is analysing a set of key sub-sectoral aspects, as well as an equally important set of cross-cutting issues. The intention is to draw all these together in an integrated framework which can provide future guidance to projects or programmes in this or other development sectors.

The sub-sectoral aspects and cross-cutting issues being addressed at the present time are as follows:

Sub-sectoral aspects	***Cross-cutting issues***
▪ policy environment ▪ technology evaluation ▪ private sector providers of goods and services ▪ end-user capacities ▪ capacity of client organisations ▪ promotion of technologies and policies	▪ culture ▪ politics ▪ financial aspects ▪ incentives and sustainability ▪ poverty and livelihoods

Project Progress

The project commenced in July 1998. After an initial period of planning and field visits, the focus country was selected in November of that year, and the Cranfield University team commenced work in Uganda. The initial project team consisted of Dr Richard Carter (Project Manager), Eng Kerstin Danert (Team Leader Uganda), and Mr Peter Ball (Drilling Consultant). The key determinants resulting in the selection of Uganda included:

- the policy environment, stressing decentralisation and privatisation
- the extensive and genuine interest and political will to make the project succeed
- the Ugandan recognition and acceptance of the inherent risks in the project

One of the first major activities was the commissioning of four individual Ugandan consultants to undertake baseline/information-gathering studies in the areas of hydrogeology, community water supply, small scale irrigation, and the small business sector. The consultants worked independently, and did not meet one another until the presentation workshop for their findings. The studies were completed in March 1999. These studies moved the foundations of the project from a basis of anecdotal evidence and professional instinct to one of (a limited amount of) hard data and wider independent professional evaluation.

During the first half of 1999, two main activities predominated: (a) design, fabrication and limited UK-based trials of the drilling technology, and (b) building up the partner base in Uganda.

The low-cost drilling technology is based on the traditional Asian manual method known as 'sludging'. This uses a lever to reciprocate a steel pipe vertically in the water-filled borehole, and the palm of the hand of one of the operators to act as a valve, so causing the fluid in the hole to circulate up the pipe, carrying cuttings to the surface. The technology is highly effective in soft ground, and extensively used in the sedimentary alluvial basins of India, Nepal and Bangladesh. We have modified the technology to deal with conditions in African Basement regolith (ie the weathered mantle overlying hard crystalline rocks). Here there is the necessity to penetrate partially weathered rock fragments and hard laterite, as well as softer materials.

By the middle of 1999 equipment was ready to be air-freighted for field trials, and an agreement had been drawn up with National and Local Government for initial partnership arrangements. The centre of gravity of the project shifted from UK to Uganda.

Both up to mid 1999, and more particularly since that time, great emphasis has been placed on building relationships with a large range of stakeholders and interested parties. Although difficult to quantify and evaluate, we believe that the quality of partnerships and participation is crucial to success; lip service to these ideas is not enough.

In the second half of 1999 the prototype rig was field trialled in Mpigi District, with a total of 12 exploratory holes and 5 community water supply wells being completed, logged, and reported. At the same time during this period, a series of studies of the policy environment; small business strengths, weaknesses, and training/support needs; comparative studies of other businesses; and of community perceptions of shallow groundwater; were undertaken, preparatory to future project phases. These studies were undertaken by project consultants and Cranfield University Masters students. At the end of the year a National Forum and Workshop was held to present and receive comment on the progress and direction of the project. This was attended by 80 individuals from a wide range of organisations.

As a consequence of consultants Ronnie Rwamwanja's and Jamil Ssebalu's increasing involvement in, and commitment to, the project goals, they have been drawn into the project team, and now take part fully in project planning and team decisions. Furthermore, they have established an indigenous NGO, TEMBA (Technology, Mobilisation and Business Access) the explicit mission of which is to pursue the project objectives over the longer term, and provide a national base for continuing initiatives in this area.

During the first half of 2000 the project has focused on the strengthening of private contractors, through whom well construction contracts will be implemented over the mid to late part of the year. Memoranda of understanding are being developed with the District and Central Governments, to enable small Pounder Rig drilling contracts to be set up with selected contractors.

A design review of the Pounder Rig was undertaken in late 1999, and the new machine is being fabricated in early 2000. This will be air freighted to Uganda in the second half of 2000.

Before and during the process of contract implementation, there will be a focus on capacity building of both the contractors and the client organisations. In addition, work will take place with the communities which will receive the wells drilled during this period. Monitoring of all new wells drilled will continue throughout the remaining duration of the project.

In tandem with drilling and monitoring, and in conjunction with other consultants and organisations, a methodology for the siting of Pounder Rig wells has been drafted.

Partnerships and Linkages

The progress and success of the project to date has depended to a very high degree on the extent and quality of the partnerships and linkages built up within and beyond the project team. This has been brought about by a combination of mutual willingness and trust, and the investment of considerable time to build and maintain these attributes.

The team itself has been immeasurably strengthened by the addition of two National members, as described above. The establishment of TEMBA is taken as a sign of genuine local ownership of the project and its purpose, and a potentially exciting means of ensuring the sustainability of the outputs.

Relationships with National (Directorate of Water Development) and District (Mpigi) Government have been formalised through a Memorandum of Understanding, but once again the quality of these partnerships would not have been possible without the mutual desire on both sides to make a success of the project.

Capacity Building and Regulation

The key aspect of implementation over the remainder of the project is capacity building. The abilities of small contractors to function as effective, profitable businesses; of local Government clients to manage and facilitate the work of contractors; and of communities to play their part in the process; all require support and training.

Consumer protection – in relation to price, construction quality, and water quality – will be important as Government discovers its regulatory function in relation to the private sector.

Quality control of rigs and well designs will be pursued through the Uganda National Bureau of Standards.

Funding

Core funding for the period July 1998 to June 2001 has been provided through the UK Department for International Development (DFID); funding is allocated through the Knowledge and Research (KAR) programme of the Infrastructure and urban Development Division (IUDD) of DFID.

The Memorandum of Understanding linking the project to DWD and Mpigi District allows for financial and in-kind contributions by both organisations, and these have been forthcoming over the course of the project to date.

Supporting funding was agreed at the end of 1999 by DANIDA through its partnership with DWD. This fund is specifically for monitoring and training activities in relation to the new technology and private sector uptake.

Beyond the Project

The project will complete its three year DFID funding period in June 2001. At this time the research element of the project will also end, and the findings will be written up over the following months as a Doctoral thesis.

It will be important to build on the project experience and apply the research findings over the following years after 2001. It is believed that the potential for rural water supply implementation by the private sector is significant, but the enabling and nurturing of this means of up-scaling service coverage will require a longer period than the three years of the project period.

PART 2 - POUNDER DRILLING - BASIC OPERATING INSTRUCTIONS

[Note: in Parts 2 and 3, page numbers in Arabic numerals refer to the drawings in Part 4]

The Pounder Principle

To dig a hole, the most important requirement is to be able to remove spoil from the bottom of the hole and lift it to the surface. If the ground is hard, it may also be necessary to use a cutting edge and sufficient force to loosen the material at the bottom of the hole. If the ground is soft and likely to collapse, the walls of the hole may need support during construction.

The Pounder technique borrows its spoil removal method from a long practised Asian technique referred to as 'Sludging'. It involves continuous removal of debris by filling the constructed hole with water fed from a small surface pit and inserting steel drill tube to the bottom of the hole. The pipe is then oscillated up and down by hand with the aid of a lever. On the up stroke the palm of a hand seals the pipe top and the water in the pipe is drawn upwards. The pipe is then thrust downwards with the palm lifted and water is ejected from the top of the pipe. When the pipe reaches the bottom of the hole the palm covers the pipe to seal it once more, and the pipe is lifted again. This draws water and debris from the borehole bottom into the pipe to be ejected on the next downstroke.

How does Sludging work? On the upstroke the palm of the hand creates a seal, and the water in the pipe is lifted roughly the height of the stroke. On the downstroke the steel pipe moves faster than the dropping column of water, which is held up by friction and the presence of water in the borehole. The faster speed of descent of the pipe compared to the water column results in water and debris overflowing the open end of the drillpipe.

In soft sands, clays and silts that need little cutting action holes can be 'sludged' simply and quickly with plain galvanized steel water pipe, simple cutting shoes and the practised hand of the driller.

The Pounder technique extends basic sludging by extending the range of soil types which it is possible to penetrate. Pounder drilling has been designed to penetrate limited thicknesses of harder, more consolidated, material which are typical of the weathered zone (regolith) over hard basement rocks. To do so it has had to develop a number of extra attributes.

- Harder ground takes more energy to break and this energy needs to be directed through hard cutting tools. The Pounder rig uses tungsten carbide buttons (tungsten carbide is the second hardest material known to mankind) set in hardened steel drillbits to enable hard formations to be efficiently cut or broken.

- When dissipating energy against a hard layer at depth in a borehole, a very strong drill string (or column of drill pipe) is needed to contain the forces and pressures developed. This means using carbon steel drillpipe which is three times stronger than conventional galvanised steel water pipe.

- When penetration through harder materials is slow, it is impossible to sustain the palm of a hand to work as the suction valve for water and spoil removal. The drillpipe has to oscillate for long periods of time, and as it jars against harder material this makes the hand valve untenable. The Pounder rig replaces the hand with a robust flap valve.

- Because the Pounder combines the basic sludging technique with ground cutting the drillpipe oscillation must be as energy efficient as possible. A system of counterbalancing the drill pipe weight is adopted to achieve this.

The Set Up of the Pounder Rig

Transport

The *Pounder Equipment 70-001 (pp1&2)* is transported on a special *Trolley Frame 40-037 (p22).* This frame allows the major components of the Pounder to be stored and transported. The angled trolley frame allows the Pounder to be wheeled up a pair of stout wooden planks into the body of a typical light pick-up truck 800/1200Kg capacity and simply tied down for safe transport. Close to site the Pounder can be manually wheeled about and manoeuvred into position.

Setting Up

The main components are unloaded and the *Trolley Frame 40-037* unpinned from the *Chassis 40-025 (p9)*. The site is roughly levelled and a robust timber plank (1m long by 200mm wide by 40-50mm thick) is placed on firm soil 0.5m from the intended borehole centre, and levelled along its length. This is the main foundation for the set-up. The centre of the chassis is positioned on this timber and two other timbers are set, one under each end, to allow the corner jacks to level the chassis. The chassis should firmly rest on the central timber and then be levelled along its length to prevent bending or overloading the chassis steelwork when drilling. With the chassis properly level, drilling water will drain off the frame to the settling pit.

At the borehole end (the end with the steel tray) the main settling pit is dug 800 x 800mm square by 300-400mm deep, and a 150mm deep by 150mm wide channel dug down the side of the chassis to the borehole.

The *Pivot Tube 40-009 (p33)* is then placed vertically in the socket in the centre of the chassis, the *Lever 40-020 (p3)* positioned in the yoke at the top of the pivot tube, and *pivot bolt 10-077* is fitted. The 4 *support cables 40-010 (p34)* are then hooked into the 4 eyes on the chassis and evenly tensioned. The *Sludging valve 50-027 (pp37&38)* fitted with 1m length of BP *drillpipe 20-024B (pp76&77)* is hung on the Pivot tube over the *BP Table Bush (p56).* The support cables can be adjusted to perfectly align the drillpipe with the bush. Once again, note that the chassis must be level both along its length and width to allow water to flow correctly – the support cables must not be used to adjust a chassis which is not initially set level.

Setting Conductor Casing

Assemble the *Conductor Casing 20-027 (p66)* by screwing on a *Casing Shoe 20-015 (p67)* and the *Casing Top 20-011 (p57)*. Align the slot in the casing with the feed trench from the settling pit.

In most cases the conductor casing is intended to be driven into place to ensure it is both vertical and firm in the top soil. To produce an acceptably straight and plumb hole requires that the conductor casing is set correctly. Depending on the soil, this can be achieved in a number of ways.

- In soft soils the conductor casing can be simply driven without pre-drilling.
- Alternatively, a hole can be sludged to a nominal depth of 1m and then the conductor casing driven into this hole taking care it is driven both central to the chassis table hole and kept vertical.
- Harder ground might require the hole for the conductor casing to be dug or drilled before the chassis is erected.

Casing can be hammered lightly by connecting the *BP Casing Driver 20-023 (p54)* and oscillating the lever bar. This can be done whilst simultaneously drilling with a bit fitted to a piece of BP Drillpipe of same length as the casing.

Additional 1 metre lengths of *Casing 20-022* can be used to deal with particularly soft or water-logged soil close to the surface. A pumped supply of water (eg from a treadle pump) can be introduced into the annulus between the casing and drillpipe to allow sludging to commence.

Commencement of drilling

In most cases drilling should commence at the minimum diameter of 80mm to allow logging of the formation and to establish the depth and likely yield of groundwater. Samples of the formation should be taken every metre and anything relevant to the hole construction should be recorded on the driller's log. This initially might just be an exercise book – the essential requirement is to record everything in writing. Type of soil, its relative hardness, any water loss into it, and time taken to drill, are all items that are useful to record.

Having drilled an exploratory hole to the specified depth it is relatively easy to ream out the hole (ie enlarge the hole diameter) to a diameter suitable for pump installation.

The lever is operated by a pair of pull ropes, *10-063*, fitted one to each end and led under the rollers on the chassis. The ropes can be tied at different points on the lever. Drillcrew can comfortably pull these ropes to induce the required oscillation. The positioning of the ropes and the choice as to whether to use the counterbalance barrel, *40-050 p36*, are varied as required, in order to keep the drilling action comfortable on the drillcrew and the drilling action working efficiently.

The *Sludging Valve 50-027 (pp37&38)* requires the leather covered valve to sit and seal perfectly on the valve seat. The valve needs periodic cleaning with the finger if the sludging action falters.

When drilling harder material the drillstring needs to be rotated slowly on the up stroke by gently pulling an *Endless Rope Sling 40-008* wrapped around the drillpipe. This is to ensure that the *69mm Button Drilling Bit 30-007, 60mm 30-008, 82mm 30-009 or 100mm 30-010 (pp68,69,70&71)* is constantly drilling new ground and that the drillpipe remains threaded tightly. Rotation must always be clockwise – ie in the direction required to tighten the threads.

Two long *Aluminium Handles 50-042 (p53)* can be threaded into the *Sludging Valve 50-027 (pp37&38)* to facilitate driving the pipe downwards. This improves the sludging stroke, so allowing a greater volume of water to be pushed up through the pipe, and imparts more energy into the cutting action. The key to efficient operation is to use the handles to induce speed on the downstroke only while not expending excessive energy driving the pipe hard into the rock. This is tough work on the drillcrew's hands as well as the Pounder equipment.

The Effect of Water Level in the Hole

The most efficient sludging water flow is seen when the sludging valve is close to the water level. This is why drilling is progressed by use of 1metre lengths of *BP drillpipe 20-024B (pp76&77)*. Add each individual 1m pipe (2 supplied) then remove both and replace with a 3 metre length *20-024A (pp76&77)*.

Head of water prevents collapse of hole

The flooded hole also serves to support the borehole walls from collapse. This works if the water level in the borehole is constantly maintained at least 3m higher than the groundwater rest level in the formation. The pressure induced by 3m head of water is considered the minimum necessary to support unconsolidated borehole walls from collapse. This is an important feature of the Pounder and influences site selection.

In the event of a high water table (ie shallower than 3m) in unconsolidated ground steel or plastic casing needs to be set to support the borehole walls.

Water addition is best done by keeping a 200 litre open topped steel drum at least half full adjacent to the settling pit. This acts as storage, allowing a bucket to be used to quickly top up the settling pit. The larger the settling pit, the less topping up will be needed, but a large pit will require more water at the initial filling. Additions of water must equal the volume of losses – tanks and pits are only buffers.

Preventing undue water loss into the formation.

It seems strange to have to carry water to construct a borehole at the very place that water is needed. However, water is available in most places in the quantities needed for drilling.

Drilling requires a steady regular supply particularly when drilling unconsolidated ground, in order to guarantee borehole wall support.

As the ground formation is drilled above the water rest level it is likely that some water loss will occur and a few bucketfuls will need to be added to the settling pit to keep the hole flooded. When drilling into permeable water bearing formations water will flow out of the settling pit into this formation. The best action is simply to make up all losses by adding water to the settling pit, so keeping the borehole flooded. However this may not always be feasible – for instance where water is being hand carried to site and water carrying capacity cannot keep up with demand.

Where it is known that the borehole has not yet reached the water table it is possible to add fibre such as saw dust, milled grain husks or cow manure to the water flowing into the borehole. This fibre will effectively be drawn to the area of loss, bridging the permeable layer, and so limiting water loss. A few handfuls to several bucketfuls might be required for this to have an effect. These materials should *not* be used in the portion of the hole where screen will be set, as the fibre will be very effective in blocking the screen slots and prevent water entering this part of the well.

If the formation below the water table is unstable and soft to drill (eg sand or gravel) then the choice is to case the hole with temporary casing or to use a drill mud additive. The best type of additive is a polymer, mixed with water at 0.5-1.0% dilution and given at least 30 minutes to thicken – a good use of the 200 litre storage barrel. This mixture is then added to the settling pit. Depending on how viscous or thick the polymer mix becomes it might be necessary to extend the settling pit to ensure any clean settled fluid flows back down the borehole.

The rule about supporting a hole with 3m head of water applies throughout the drilling operation. This might require using polymer to keep a hole full overnight. Polymers are particularly good for this use as their viscous effects break down effectively between 24 and 72 hours after mixing.

Other additives are used in the drilling industry, the most popular being the natural clay, bentonite. This requires 12-24 hours to build viscosity fully and will not break down in the same way as the polymer, making it unsuitable for practical use and difficult to remove from a hole after well screen is positioned.

With the Pounder the best water producing well will be created by making up all the losses with clean water – keeping the water producing formation largely unblocked. The best approach therefore is to ensure a good supply of clean water for drilling. To achieve this, consideration could be given to drilling when rainwater is lying in sufficient quantities. For example a well prepared village or client might dam a convenient depression near the potential drill site weeks in advance of the drilling operation in order to conserve energy which would otherwise be spent in water carrying. A treadle pump could be used to move water efficiently and steadily.

Drilling Consolidated Ground with Water Losses

Drilling into weathered rock or through and around hard layers can result in water losses. Those above the water table can be plugged with fibre, or alternatively cement grout (50kg

sack mixed with 27 litres of water) can be used to permanently plug a fissure that is taking a high volume of water away. This should be left for 12 hours to set and then drilled out.

If a fissure or permeable layer is met below the water table, use of blocking or cementing materials should be avoided. Once more these will permanently block off the water supply flowing through the well screen when it is set. The best strategy in this case is to let the natural water table take over – no head of water is required to support the hole from collapse in this consolidated ground.

The Pounder rig can be fitted with one or a series of *Clack Valves 50-012,50-013 & 50-014 p61* to suit pipe BP,NP & HP. At least one needs to be fitted at the bottom of the pipe or below the water table, and this will allow the water to be lifted up and through the sludging valve if the supply is prolific enough and he strata being drilled become well mixed in the water. In low yielding holes the drillpipe might need to be tripped out (ie removed from the hole) to clean out an accumulation of drilling debris held behind the clack valve. For this reason a short length of *NP pipe* or *HP pipe 20-004,20-005 & 20-006*, p77, of larger diameter and so having a large storage volume, can be used directly behind the drillbit. This is a most effective drilling method as no debris is smeared against the borehole walls, inducing the cleanest, least contaminated, method of well construction.

In-Situ Yield Testing

To check well yield an adapted hand pump piston, *Test Pump Arrangement 50-047 (p58),* can be inserted inside the BP drillpipe on standard 12mm hand pump rod and the oscillating drill stroke can be used to pump the well. There is a choice of footvalve that can be used with the *Test Pump piston 50-044 (p78).* If a clack valve is already fitted into the drill string this will work. If no clack valve is being used the *Footvalve Receiver 50-045 (p79)* can be fitted inside a drillpipe below the water rest level the *Footvalve 50-046* (*p80)* can then be dropped into place and then after pumping can be removed by coupling the recovery threads on the test pump piston and footvalve. The water flow away from the borehole can be channelled and its flow measured in a bucket. This will enable a well yield to be estimated whilst drilling to determine when drilling has reached sufficient depth or whether more water is becoming available.

Handling Drillpipe

The Pounder drillpipes are high quality carbon steel pipes with fine threaded couplings. They should be carefully stored to prevent damage to ends and kept straight. They should *never* be used as lever bars or misused for tasks such as loading the Pounder trolley into the back of the pick-up truck.

Threads should be wiped clean before threading up with a little grease applied to prevent abrasive wear.

Pipes are added in 1metre lengths, then the two 1m lengths are removed to allow a 3m length to be added. The pipe can be held at the table with *BP Lifting Spanner 20-010 (p74)* held firmly in place. Two *Stillsons 10-018* are required to break the drillpipe – one to

hold the lower joint and the other to work the pipe above the ground. Good quality pipe wrenches are required with hard and sharp jaws to grip the carbon steel drillpipe bodies.

To remove 3 metre long drillpipes the lever bar can be swung sideways *(see 70-001 Pounder Rig Assembly, p2)* and the BP lifting spanner used to lift the drillpipe out of the ground. Do not lift more than 3metres length above the chassis floor.

PART 3 - POUNDER RIG SPECIFICATION

ITEM NO	SUB ASSY	PART NO	DESCRIPTION	QTY per Pounder	Drg Size	Page No
1	**70-001**		**Pounder Rig Assembly**	**1**	**A3**	**1,2**
2	**40-020**		**Lever Complete**	**1**	**A3**	**3**
		10-059	Rectangular Deck Plate	6		
			BS Pattern Number 5140 Rectangular Admiralty Deck Plate			
		10-077	Pivot Bolt	1		
			Spring hanger pin for Mitusbushi Fighter Light truck 28.00 diameter x 70mm long effective length			
		10-078	Pivot Bush	1		
			Brass bush for 10-077 28 bore x 34 OD x 70mm long - with internal greaseways			
		40-019	Lever Spokes	4	A4	4
		40-021	Lever Arc	2	A4	5
		40-022	End Bar	2	A4	6
		40-023	Mid Lever Bar	1	A4	7
		40-024	Side Cheeks	2	A4	8
3	**40-025**		**Chassis Complete**	**1**	**A3**	**9**
		40-025/1	80 x 40 x 3 RHS x 3000	2	A3	9
		40-025/2	80 x 40 x 3 RHS x 720	4	A3	9
		40-025/3	60 x 40 x 3 276	2	A3	9
		40-025/4	60 x 40 x 3 336	1	A3	9
		40-025/5	40 x 40 x 3 RHS 720	3	A3	9
		40-025/6	800 x 145 x 3 Sheared Plate	1	A3	9
		40-025/7	60 x 20 x 3 Sheared Plate	4	A3	9
		40-025/8	10 x 10 x 120 Bar	4	A3	9
		40-025/9	70 x 40 x 3 Sheared Plate	2	A3	9
		10-059	Rectangular Deck Plate	4		
			BS Pattern Number 5140 Rectangular Admiralty Deck Plate			
		10-068	Ball Bearing	4		
			RHP 6205 2RS greased & sealed single row radial ball bearing			
		10-069	M12 Bolt	4		
			x 30 long Grade 88 BS standard 3692			
		40-026	Pivot Socket	1	A4	11
		40-027	Table Tube	1	A4	12
		40-028	Base Plate	1	A4	13
		40-030	Roller Tube	2	A4	14
		40-031	Roller Supports	4	A4	15
		40-032	Bearing Pin	4	A4	16

ITEM NO	SUB ASSY	PART NO	DESCRIPTION	QTY per Pounder	Drg Size	Page No
		40-034	Gusset	2		17
		40-048	Table Bush Clamp Base	2		18
		40-049	Table Clamp Plate	2		18
		40-035	Jack Screw	4	A4	19
		40-046	Prop pivot	2	A4	20
		40-047	Jockey Wheel Mount	2	A4	21
4	**40-037**		**Trolley Complete**	**1**	**A3**	**22**
		10-003	M12 Nylock *M12 Din 985*	2		
		10-033	30 dia washer	4		
			Form A			
		10-035	M30 Nut	4		
			M30 Din 934			
		10-043	Jockey Wheel	2	A4	23
		10-045	M16 Nylock Nut	4		
			M16 Din 985			
		10-070	M12 Bolt x 90 long	2		
			M12 Din 933			
		10-071	Pneumatic Wheel	0		
			8" launching trolley wheel plastic fitted with pneumatic 400 x 8 tyre 25 bore			
		10-072	Pin & Clip	4		
			Sparex S73 Top Link Pin 3/4" dia x 76mm long			
		10-073	Spring Clip	2		
			Grip Clip 6mm dimeter to suit shaft 20-32mm diameter			
		40-033	Wheel Axle	2	A4	24
		40-038	Main Prop	2	A4	25
		40-039	Angle Brace	2	A4	26
		40-040	Brace Mounts	4	A4	27
		40-041	Brace Locators	4	A4	28
		40-042	Long Prop Mount	2	A4	29
		40-043	Short Prop Mounts	2	A4	30
		40-044	Steel Wheel	2	A3	31
		40-045	Cross Brace	1	A4	32
5	**40-009**		**Pivot Tube Complete**	**1**	**A3**	**33**
			BP base tube 2090 long	1	A3	33
			40 x 10 x 155 long flat	1	A3	33
			40 x 10 x 225 long flat	1	A3	33
			50 x 10 x 110 long flat	1	A3	33
		10-066	2" BSP Steel Locknut	3		
		40-010	Support Cables	4	A4	34
		40-015	Stabiliser Tube	1	A4	35

ITEM NO	SUB ASSY	PART NO	DESCRIPTION	QTY per Pounder	Drg Size	Page No
6	**40-050**		**Counterbalance Barrel**	**1**	**A3**	**36**
		10-059	Rectangular Deck Plate	**1**		
			BS Pattern Number 5140 Rectangular Admiralty Deck Plate			
		10-016	Chain Connector	1		
			Grade 80 component connector for 7mm chain			
		10-017	7mm chain x 2m	1		
			Din 5684-8 Grade 80 short link steel chain - 1500Kg safe working load			
		10-069	M12 x 30 Bolt	6		
			M12 Din 931			
			40 x 60 RHS x 555 long	1	A3	36
			50 x 115 x 10 BMS flat	4	A3	36
7	**50-027**		**Sludging Valve**	**1**	**A3**	**37,38**
		10-017	7mm Chain x 2m	1		
			Din 5684-8 Grade 80 short link steel chain - 1500Kg safe working load			
		10-044	M8 x 50 Cap Screw	1		
			Grade 8.8 Din 912			
		10-045	M16 Nylock Nut	2		
			Din 985 M16			
		10-046	M20 x 50 Long Bolt	1		
			Grade 8.8 Din 931			
		10-047	20 dia spring washer	1		
			Din 127B			
		10-048	M6 x 20 Screw	2		
			Din 84			
		10-049	M6 Nylock	2		
			Din 985 M6			
		10-051	25 bore x 50 od x 1.3mm belville	1		
			Free height 2.8mm - full deflection 1.5mm with load of 168kgs			
		10-052	M8 Nylock	1		
			Din 985 M8			
		10-063	M16 Lock Nut	2		
		50-028	BP box threaded pipe x 160 long	1	A4	39
		50-029	Valve Studs	2	A4	40
		50-031	Spacers	2	A4	42
		50-032	Valve Support	1	A4	43
		50-033	Valve Seat	1	A4	44
		50-034	Hinge Cover	1	A4	45
		50-035	Valve Cover	1	A4	46
		50-036	Valve Top	1	A4	47
		50-037	Valve Sides	6	A4	48
		50-038	Inner Bush	1	A4	49
		50-039	Outer Bush	1	A4	50
		50-040	Swivel Block	1	A4	51
		50-041	Handle Bush	2	A4	52
		50-042	Handles	2	A4	53

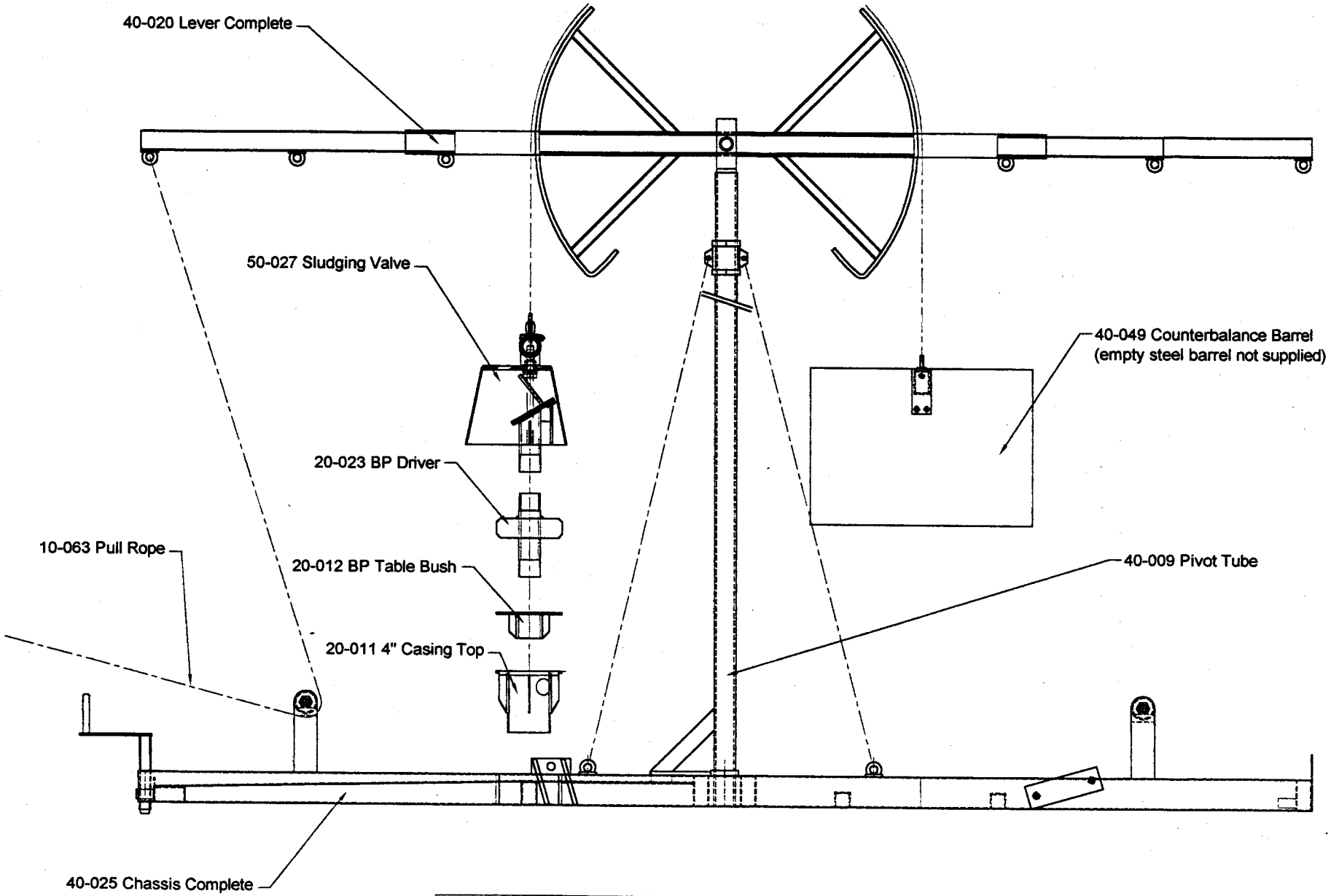
ITEM NO	SUB ASSY	PART NO	DESCRIPTION	QTY per Pounder	Drg Size	Page No
8	**20-023**		**BP Casing Driver**	**1**	**A4**	**54**
		20-013	BP casing weight	1	A4	55
		20-022	BP Drive Sub	1		
			170 long effective BP Drillpipe - 20-024	1		
	20-012		**BP Table Bush**	**1**	**A4**	**56**
		20-020	Table Bush Fins	4	A4	56
		20-021	Table Bush Plate	1	A4	56
9	**20-011**		**4" casing Top**	**1**	**A3**	**57**
		10-061	1.1/4 BSP Steel Socket halved	1		57
		20-017	Casing Blank	1		57
		20-018	Casing Plate	1		57
		20-019	Casing Fins	4		57
10	**50-047**		**Test Pump Arrangement**	**1**	**A3**	**58**
		10-040	Retaining Rings	2		
		10-075	Bobbin	2		
			SKAT Part C2088			
		50-044	Test Pump Piston	1	A4	78
		50-045	Footvalve Receiver	1	A4	79
		10-064	35mm bore x 5mm wall Nitrile 'O' ring	2		
		50-046	Footvalve	1	A4	80
11	**20-004**		**BP drillpipe - with footvalve**	**2**	**A4**	**59**
		10-040	Spiral Ring	2		
		20-004	BP pipe base	2	A4	59
		50-012	Clack valve assy	2	A4	61
		50-015	BP Valve - Laser Cut	2	A4	62
		50-018	Valve Seat - Laser cut	2	A4	63
		50-021	Valve Seat Hinge	4	A4	64
		50-024	Valve Hinge	2	A4	65
12	**20-005**		**NP drillpipe - with footvalve**	**1**	**A4**	**59**
		20-005	NP Pipe Base	1	A4	59
		10-041	Spiral Ring	2		
		50-013	Clack valve assy	1	A4	61
		50-016	NP Valve - Laser Cut	1	A4	62
		50-019	Valve Seat - Laser cut	1	A4	63
		50-022	Valve Seat Hinge	1	A4	64
		50-025	Valve Hinge	2	A4	65
13	**20-006**		**HP drillpipe - with footvalve**	**1**	**A4**	**59**
	20-006		HP Pipe Base	1	A4	59
		10-042	Spiral Ring	2		
		50-014	Clack valve assy	1	A4	61
		50-017	HP Valve - Laser Cut	1	A4	62
		50-020	Valve Seat - Laser cut	1	A4	63
		50-023	Valve Seat Hinge	1	A4	64
		50-026	Valve Hinge	2	A4	65

ITEM NO	SUB ASSY	PART NO	DESCRIPTION	QTY per Pounder	Drg Size	Page No
			Accessories			
14	**20-027**		**4" starter Casing**	**1**	**A4**	**66**
			114mm OD x 5mm wall seamless steel pipe thread with Right Hand ODEX style flush coupled threads			
15	**20-015**		**4" casing shoe**	**1**	**A4**	**67**
`			*114mm OD x 5mm wall seamless steel pipe thread with Right Hand ODEX style flush coupled box thread one end 100mm effective length - shoe end with 45 deg internal cutting edge*			
16	**30-007**		**69mm x BP drillbit**	**1**	**A4**	**68**
17	**30-008**		**60mm x BP drillbit**	**1**	**A4**	**69**
18	**30-009**		**82mm x NP drillbit**	**1**	**A3**	**70**
19	**30-010**		**100mm x HP drillbit**	**1**	**A3**	**71**
20	**30-012**		**BP-NP Sub Adapter**	**1**	**A3**	**72**
21	**30-013**		**BP- HP Sub Adapter**	**1**	**A3**	**73**
22	**20-010**		**BP lifting Spanner**	**2**	**A4**	**74**
		20-009	BP lifting piece	1	A4	75
23	**20-024A**		**BP x 3m Drillpipe**	**9**	**A3**	**76,77**
24	**20-024B**		**BP x 1m Drillpipe**	**2**		**76,77**
25	**10-063**		**Pull Rope**	**2**		
			6/10 metre rope - large & comfortable diameter for hand pulling			
26	**40-008**		**Endless rope sling**	**1**		
			6/10 metre long 3 strand 10mm + diameter spliced into an 'endless' sling			
27	**10-018**		**24" Stillson pipe wrench**	**2**		

PART 4 – THE POUNDER RIG DRAWINGS

Please note that the scale drawings which follow will not automatically reproduce to correct scale when printed. However, all individual parts drawings are dimensioned. Only assembly drawings are not dimensioned. When printed to correct scale the outer box around an A4 drawing is 190mm by 277mm and the outer box around an A3 drawing is 400mm by 277mm. Each drawing clearly has A4 or A3 shown in the top right hand corner.

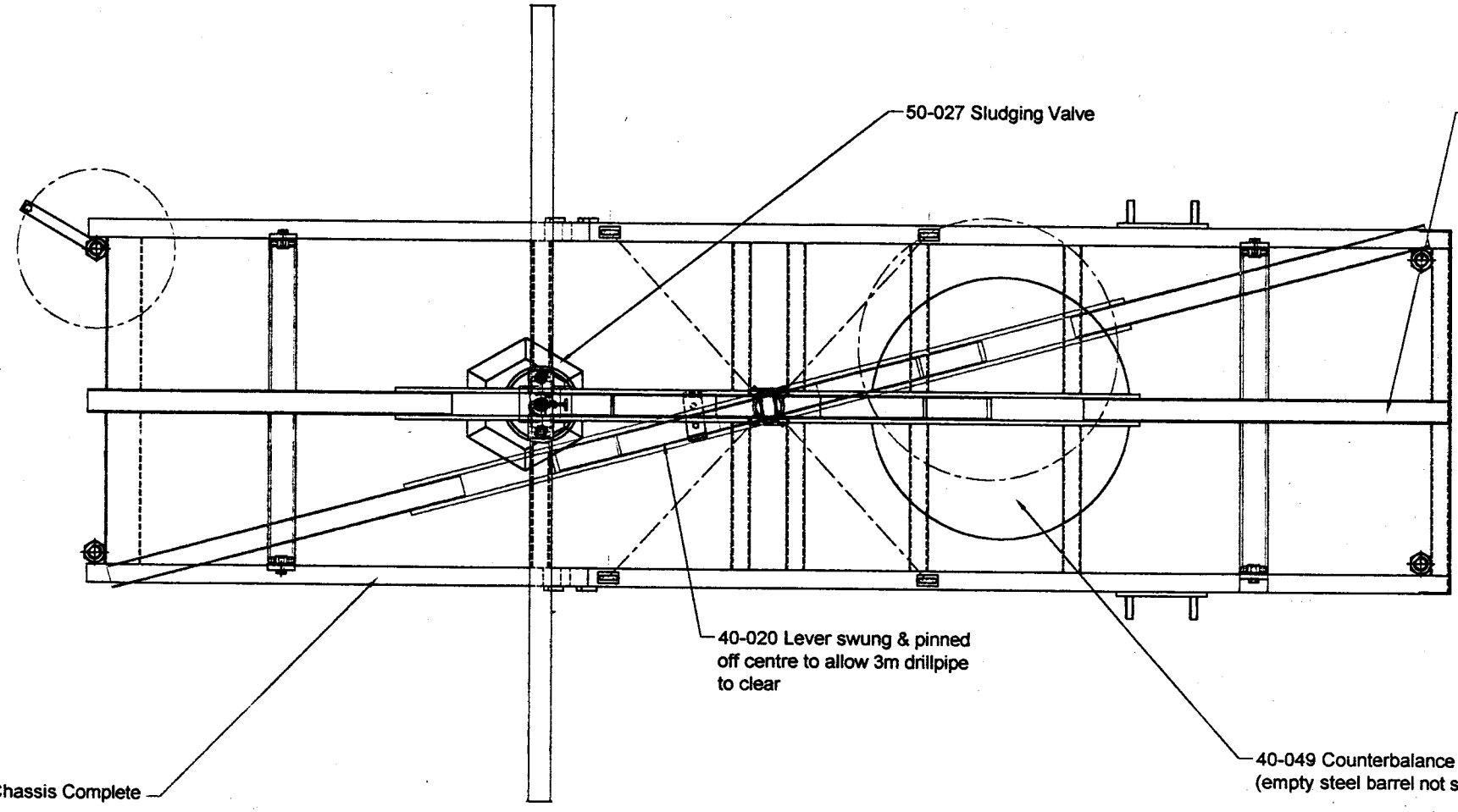
A3



DRAFT

NOTES	DRAWN BY: Peter Ball	DATE: 18.5.2000	TITLE: Pounder Rig Assy
	19 JUN 2000	SCALE: 1:10	Pounder Rig
		DRG No. 70-001	SHT. 1 OF. 2

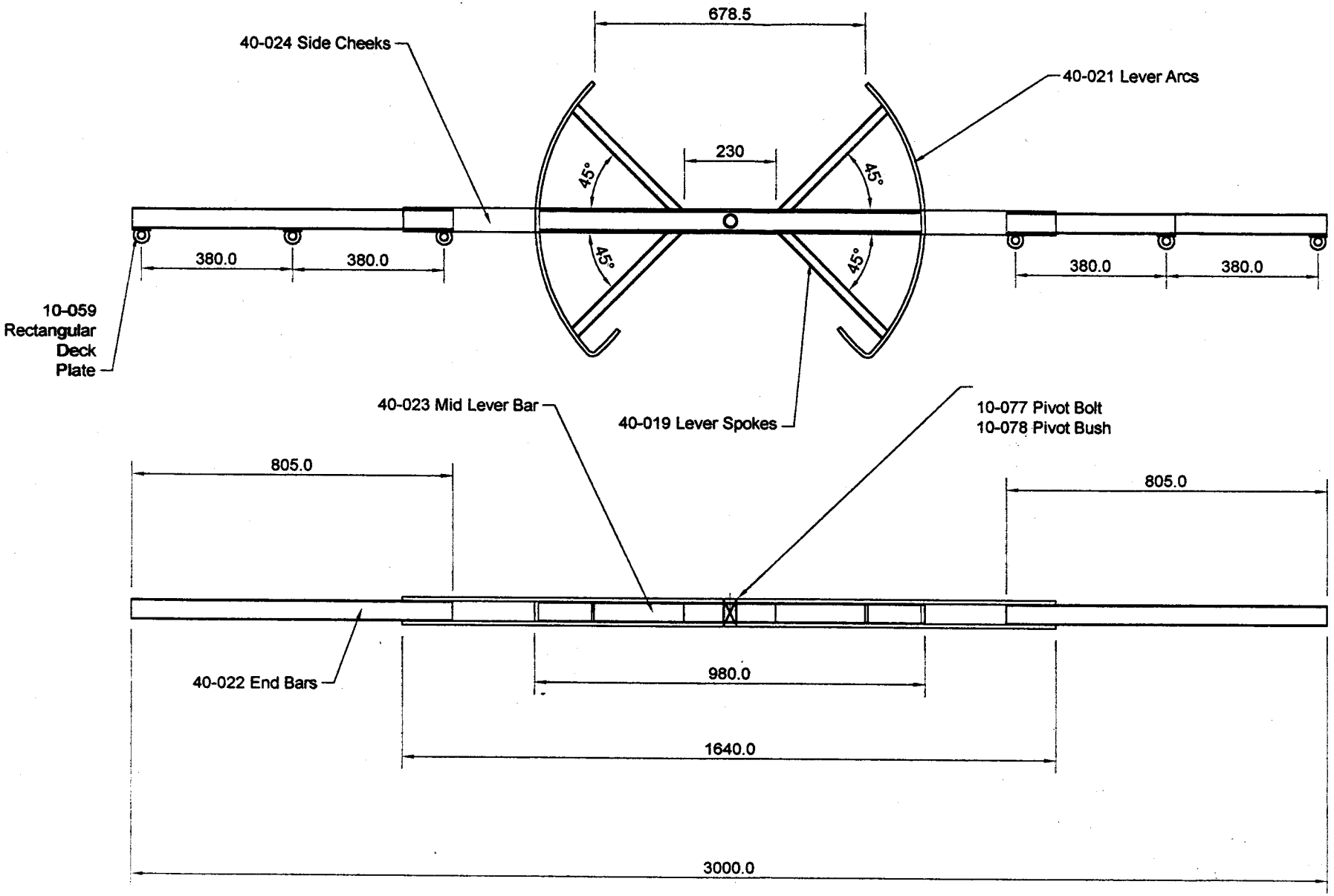
A3



DRAFT

NOTES	DRAWN BY: Peter Ball	DATE: 18.5.2000	TITLE: Pounder Rig Assy
	19 JUN 2000	SCALE: 1:10	Pounder Rig
		DRG No.	70-001 SHT. 2 OF. 2

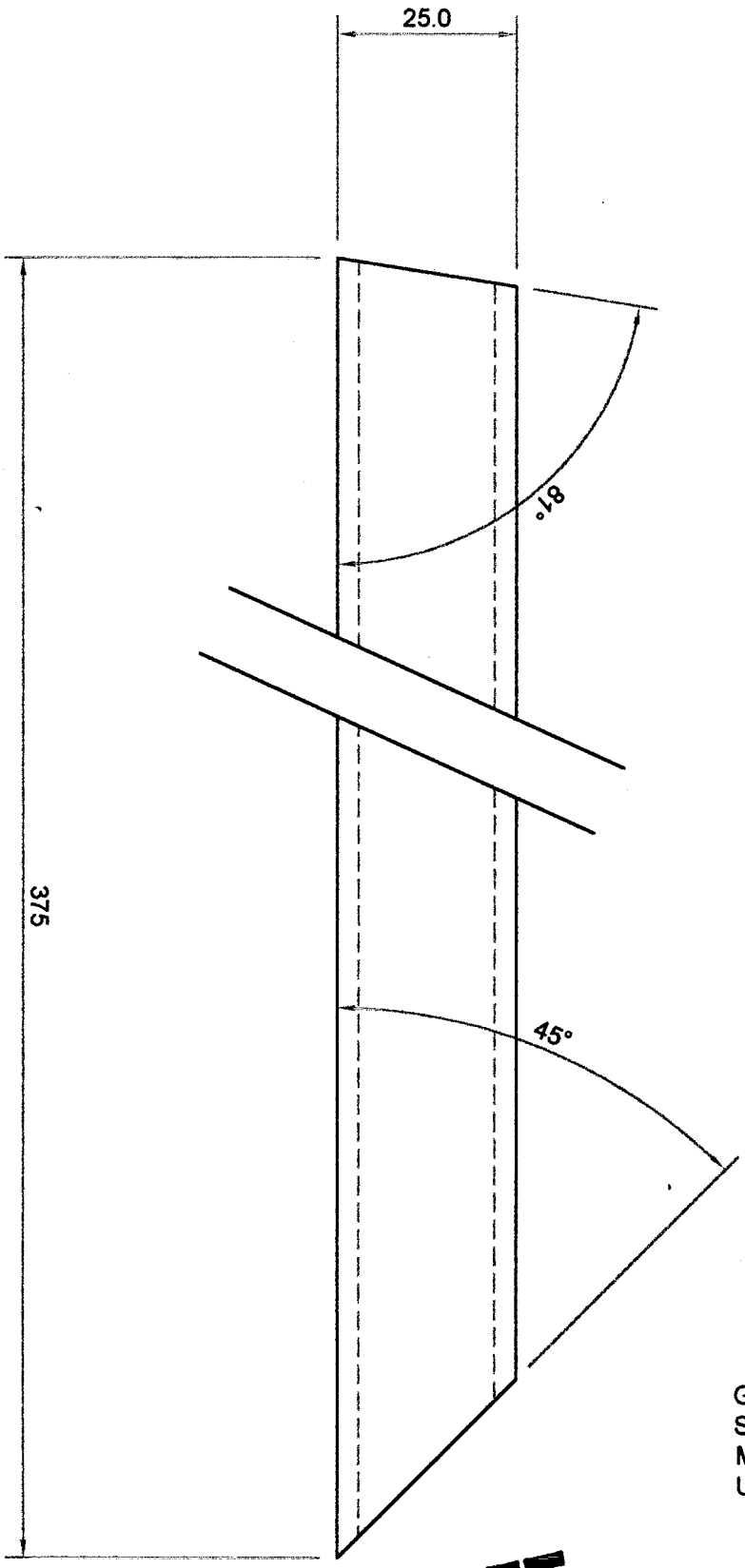
A3



DRAFT

NOTES	DRAWN BY: Peter Ball	DATE: 26.4.2000	TITLE: Lever Complete Pounder Rig
	19 JUN 2000	SCALE: 1:10	
		DRG No. 40-020	SHT. 1 OF. 1

A4



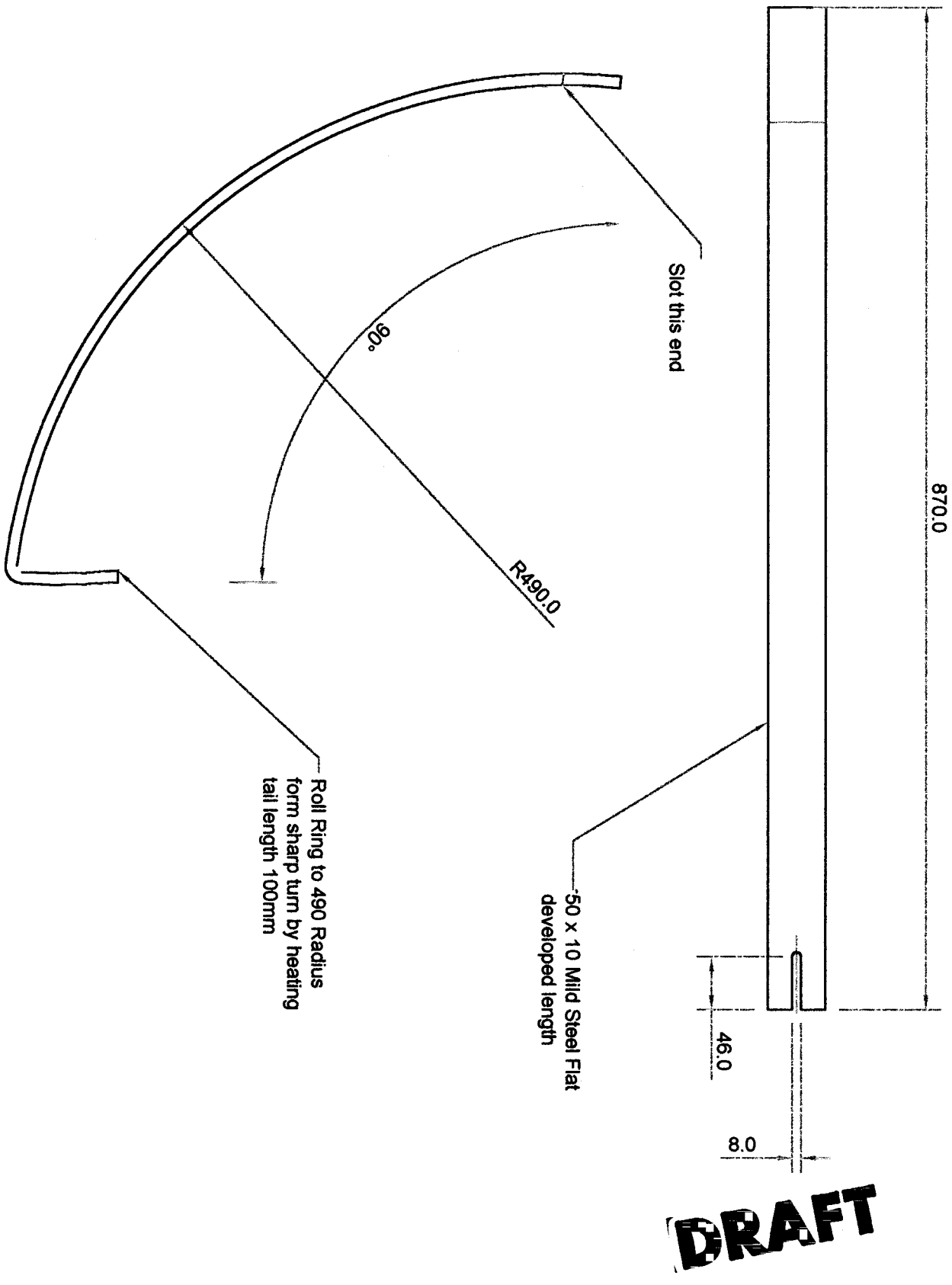
General Tolerances:
Sawn & Sheared + or - 1mm
Machined + or - .1mm
Unless Specified Different

DRAFT

MATERIAL: 5 x 25 x 3mm RHS 43C

NOTES	DRAWN BY: Peter Ball	DATE: 26.4.2000	TITLE: Lever Spokes Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 40-019	SHT. 1 OF. 1

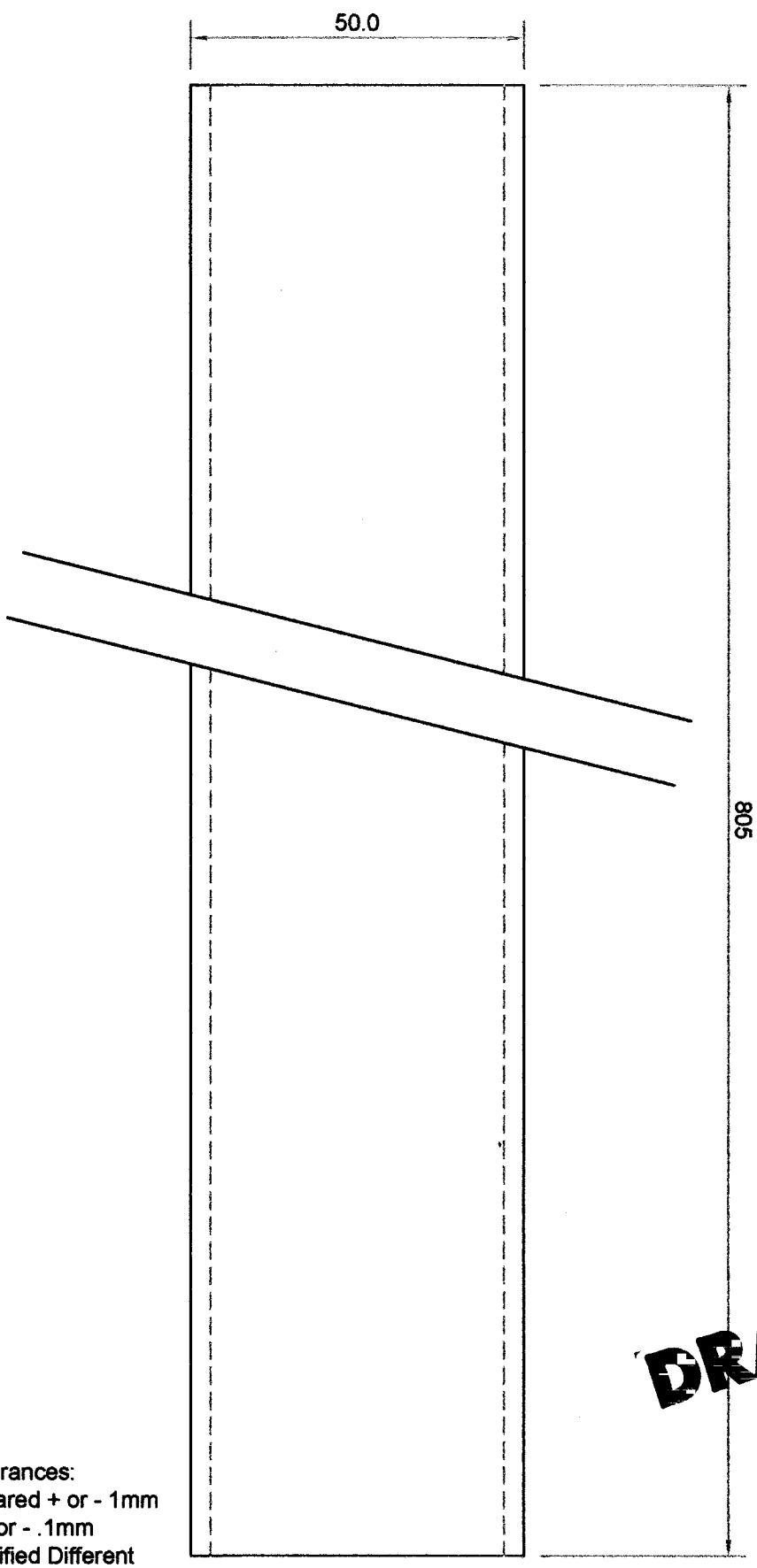
A4



DRAFT

NOTES	DRAWN BY: Peter Ball	DATE: 8.1.2000	TITLE: Lever Arcs Pounder Rig
	19 JUN 2000	SCALE: 1:5	
		DRG No. 40-021	SHT. 1 OF. 1

A4



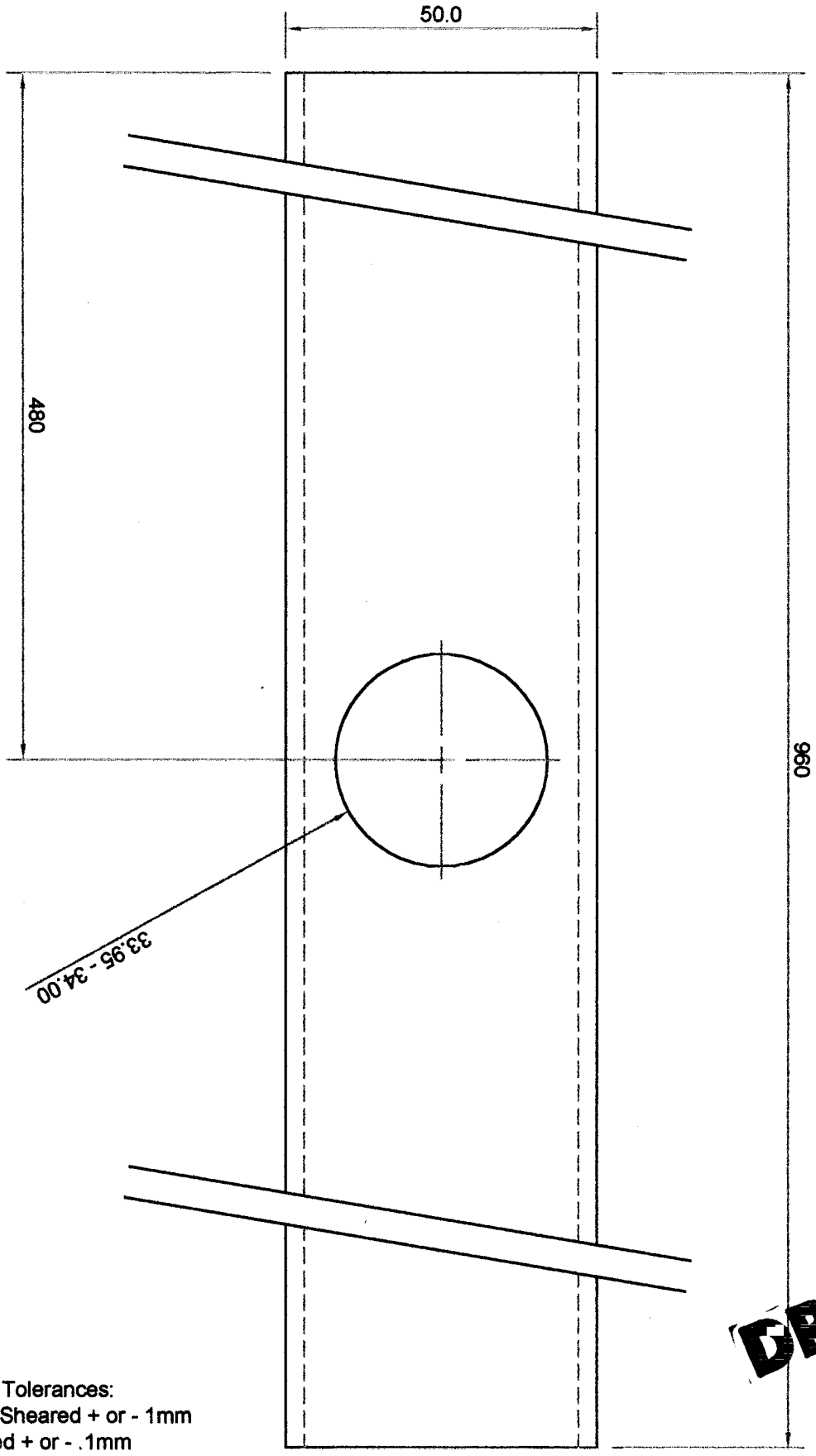
DRAFT

General Tolerances:
Sawn & Sheared + or - 1mm
Machined + or - .1mm
Unless Specified Different

MATERIAL: 50 x 50 x 3mm RHS 43C

NOTES	DRAWN BY: Peter Ball	DATE: 26.4.2000	TITLE: End Bars Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 40-022	SHT. 1 OF. 1

A4



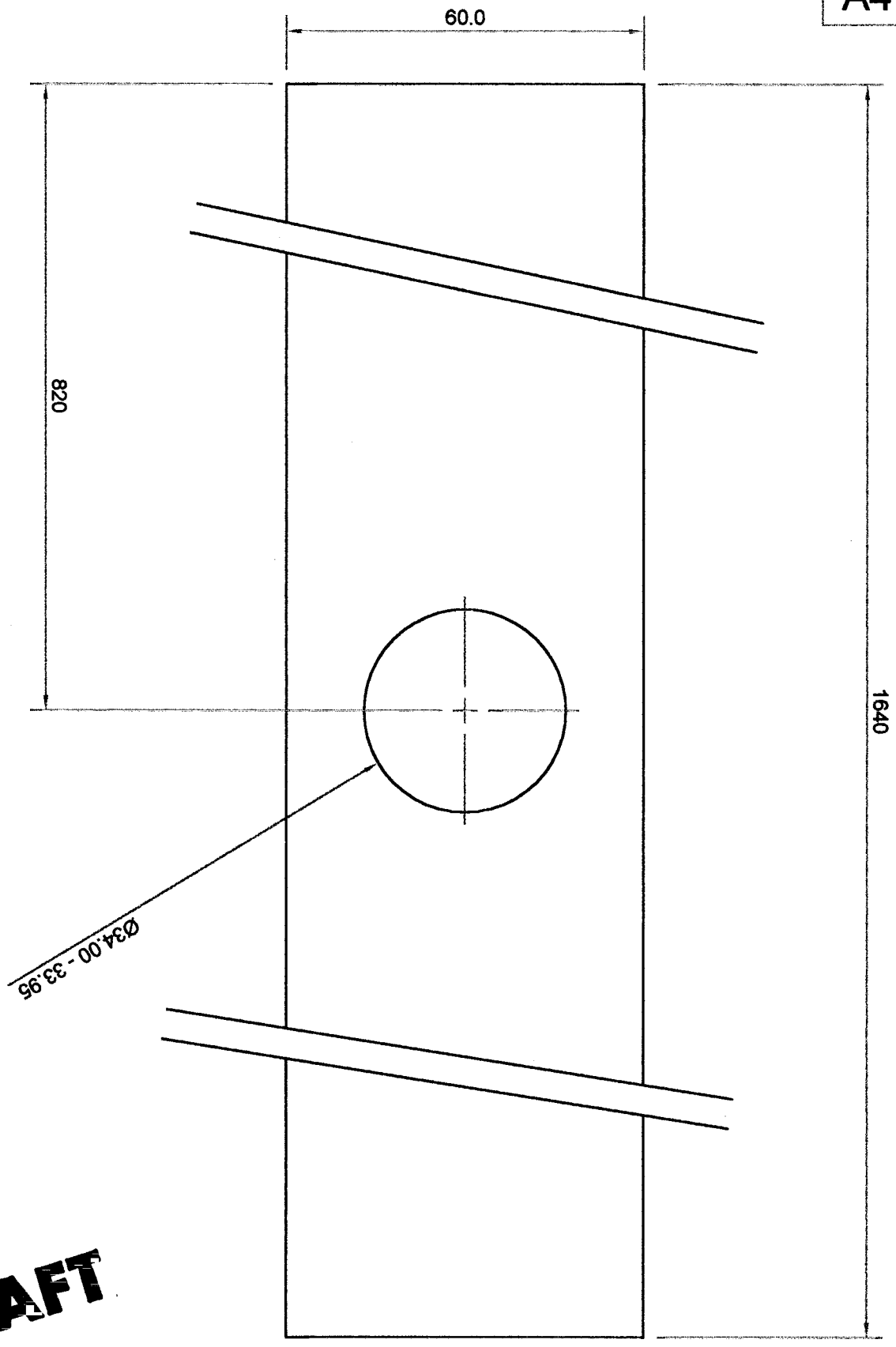
DRAFT

General Tolerances:
Sawn & Sheared + or - 1mm
Machined + or - .1mm
Unless Specified Different

MATERIAL: 50 x 50 x 3mm RHS 43C

NOTES	DRAWN BY: Peter Ball	DATE: 26.4.2000	TITLE: Mid Lever Bar Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 40-023	SHT. 1 OF. 1

A4

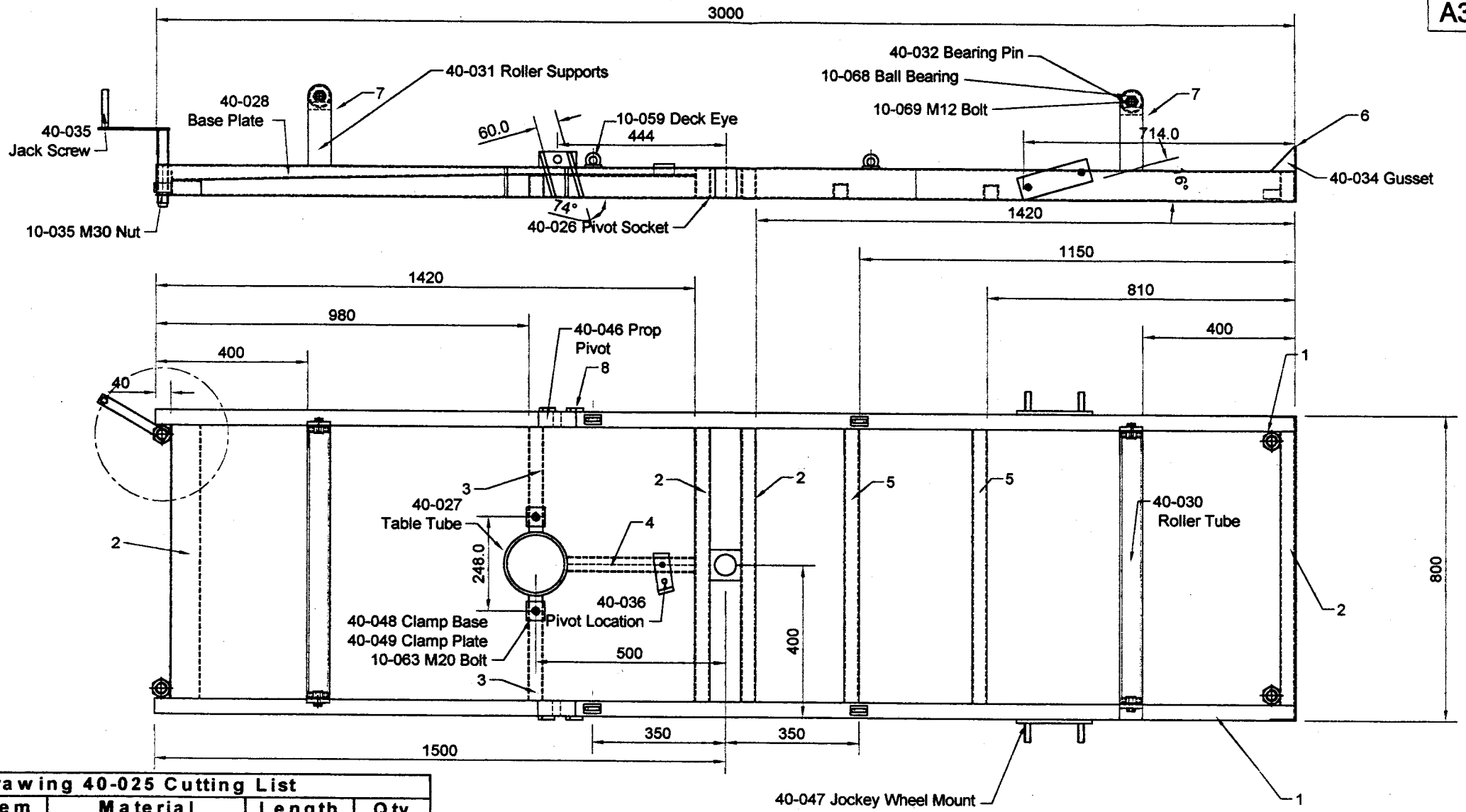


DRAFT

MATERIAL: 60 x 10 BMS Flat

NOTES	DRAWN BY:	DATE:	TITLE
General Tolerances: Sawn & Sheared + or - 1mm Machined + or - .1mm Unless Specified Different	Peter Ball	26.4.2000	Side Cheeks Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 40-024	SHT. 1 OF. 1

A3



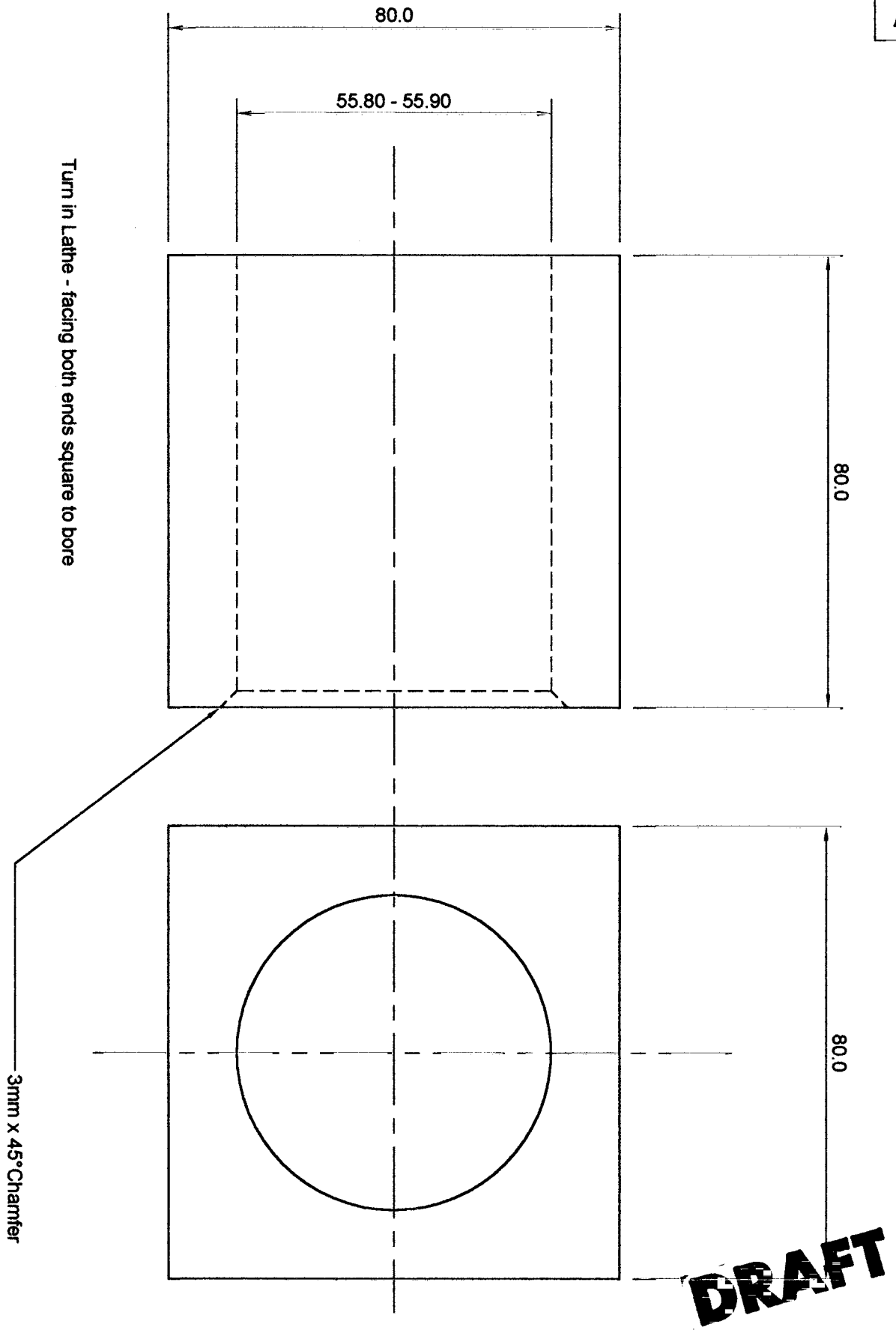
Drawing 40-025 Cutting List			
Item	Material	Length	Qty
1	80 x 40 x 3 RHS	3000	2
2	80 x 40 x 3 RHS	720	4
3	60 x 40 x 3 RHS	276	2
4	60 x 40 x 3 RHS	336	1
5	40 x 40 x 3 RHS	720	3
6	800 x 145 x 3	Sheared	1
7	60 x 20 x 3	Sheared	4
8	10 x 10	120	4
9	70 x 30 x 3	Sheared	2

DRAFT

NOTES

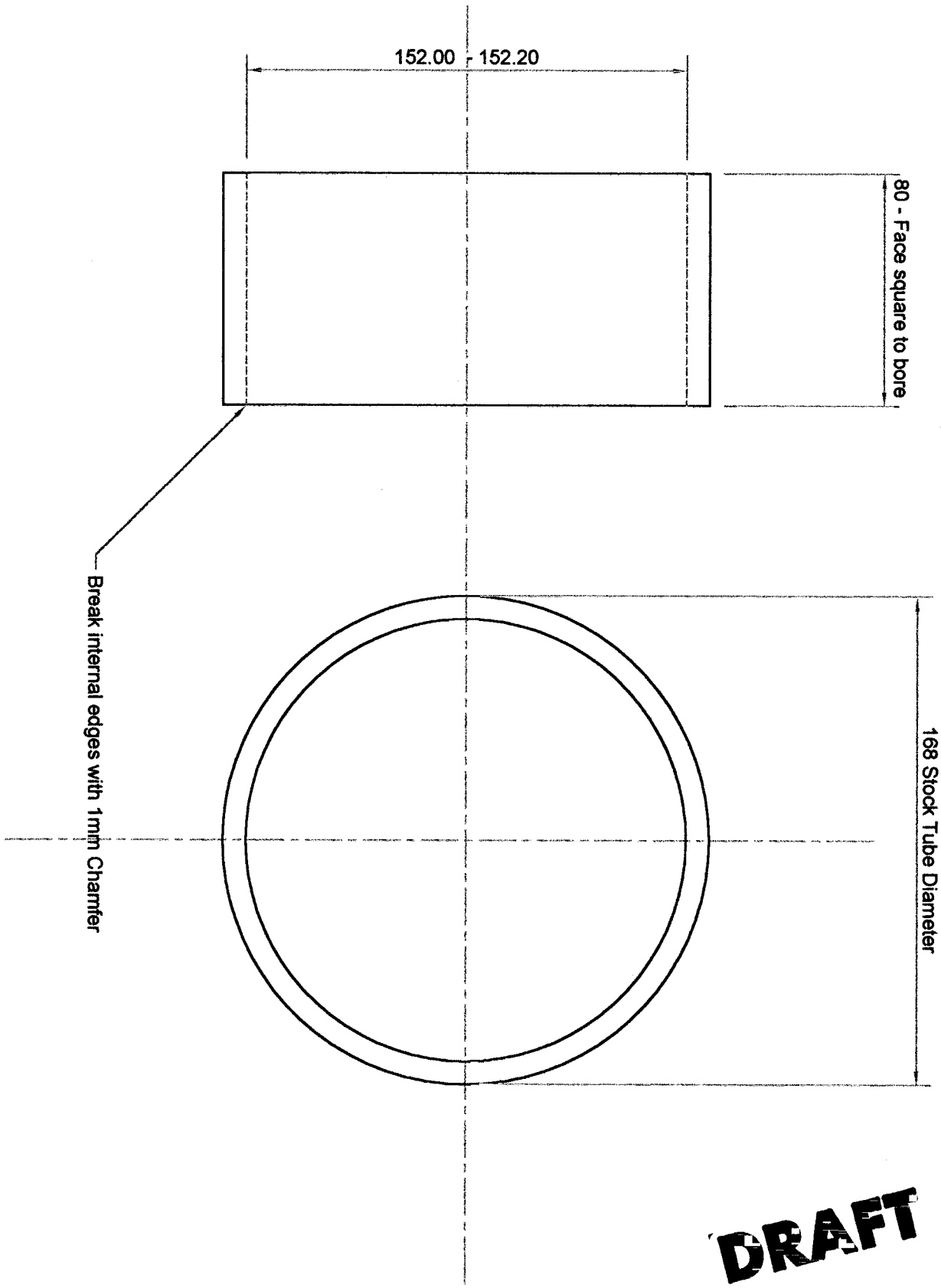
DRAWN BY: Peter Ball	DATE: 17.2.2000	TITLE: Chassis Complete Pounder Rig	
19 JUN 2000	SCALE: 1:10		
	DRG No. 40-025	SHT. 1 OF. 1	

A4



NOTES	DRAWN BY:	DATE:	TITLE
From 80 Square Mild Steel Square	Peter Ball	8.1.2000	Pivot Socket Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 40-026	SHT. 1 OF. 1

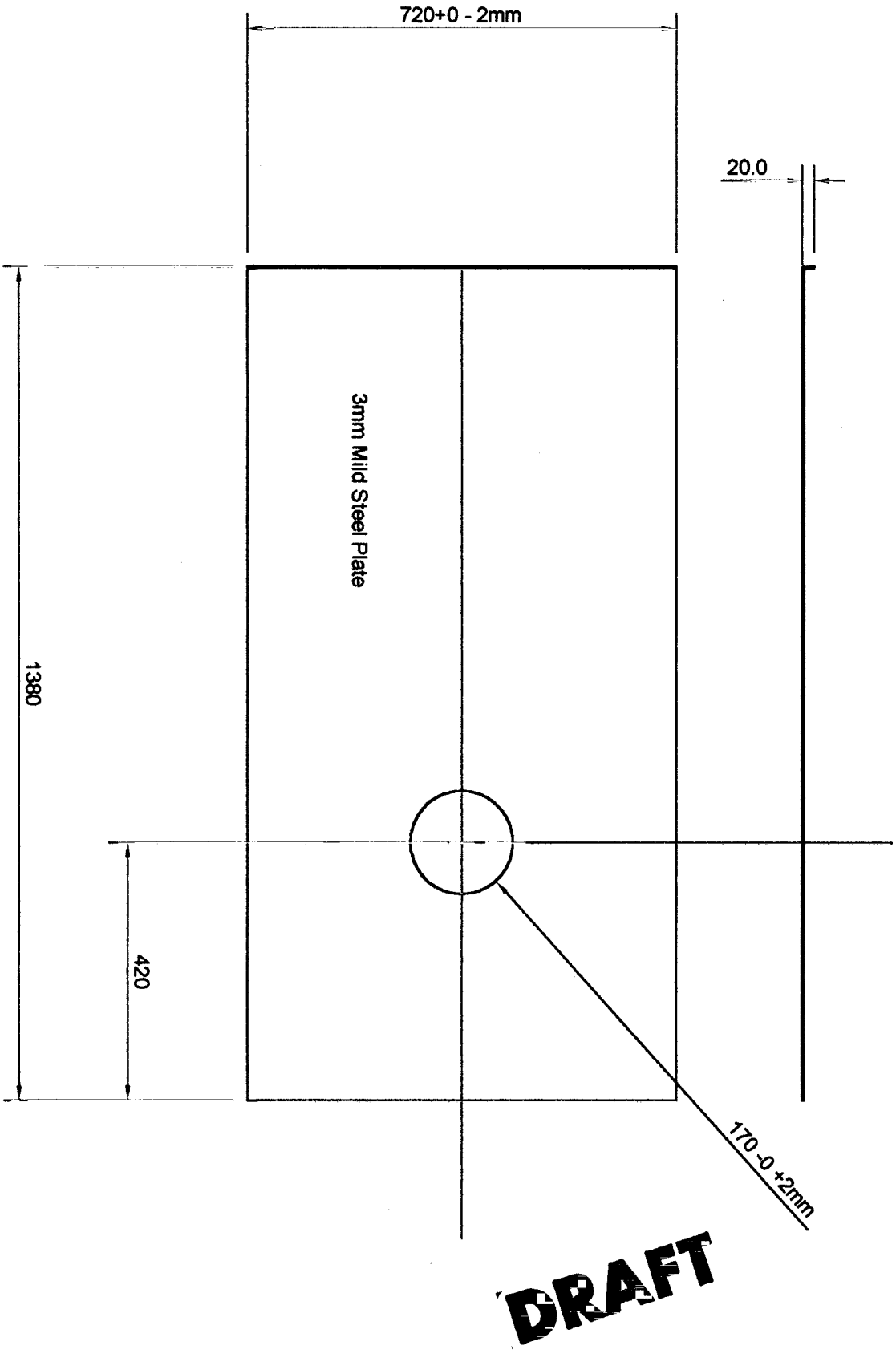
A4



DRAFT

NOTES	DRAWN BY:	DATE:	TITLE
From Mild Steel Tube 168Ø Stock	Peter Ball	19.2.2000	Table Tube Pounder Rig
	19 JUN 2000	SCALE: 1:2	
		DRG No. 40-027	SHT. 1 OF. 1

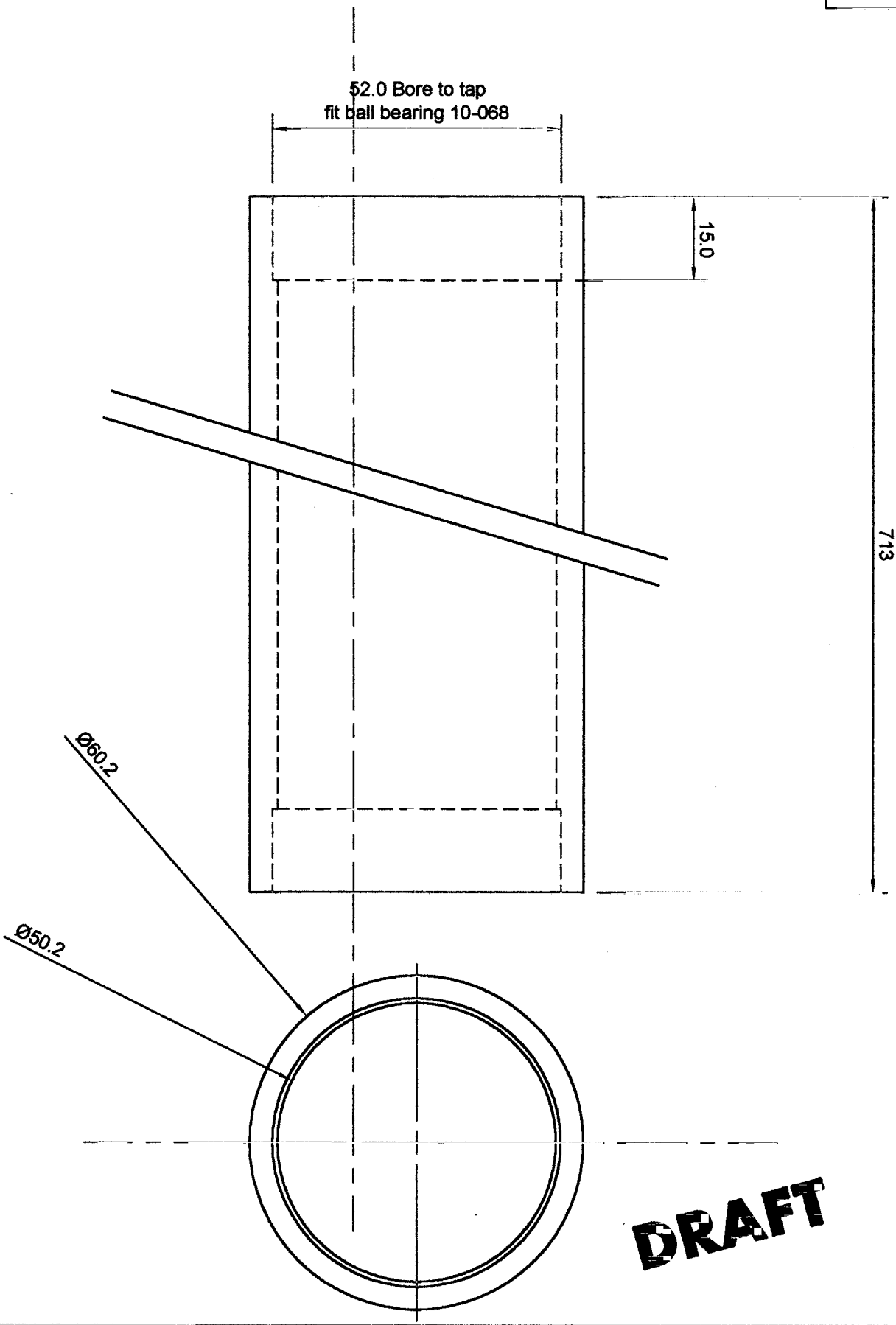
A4



DRAFT

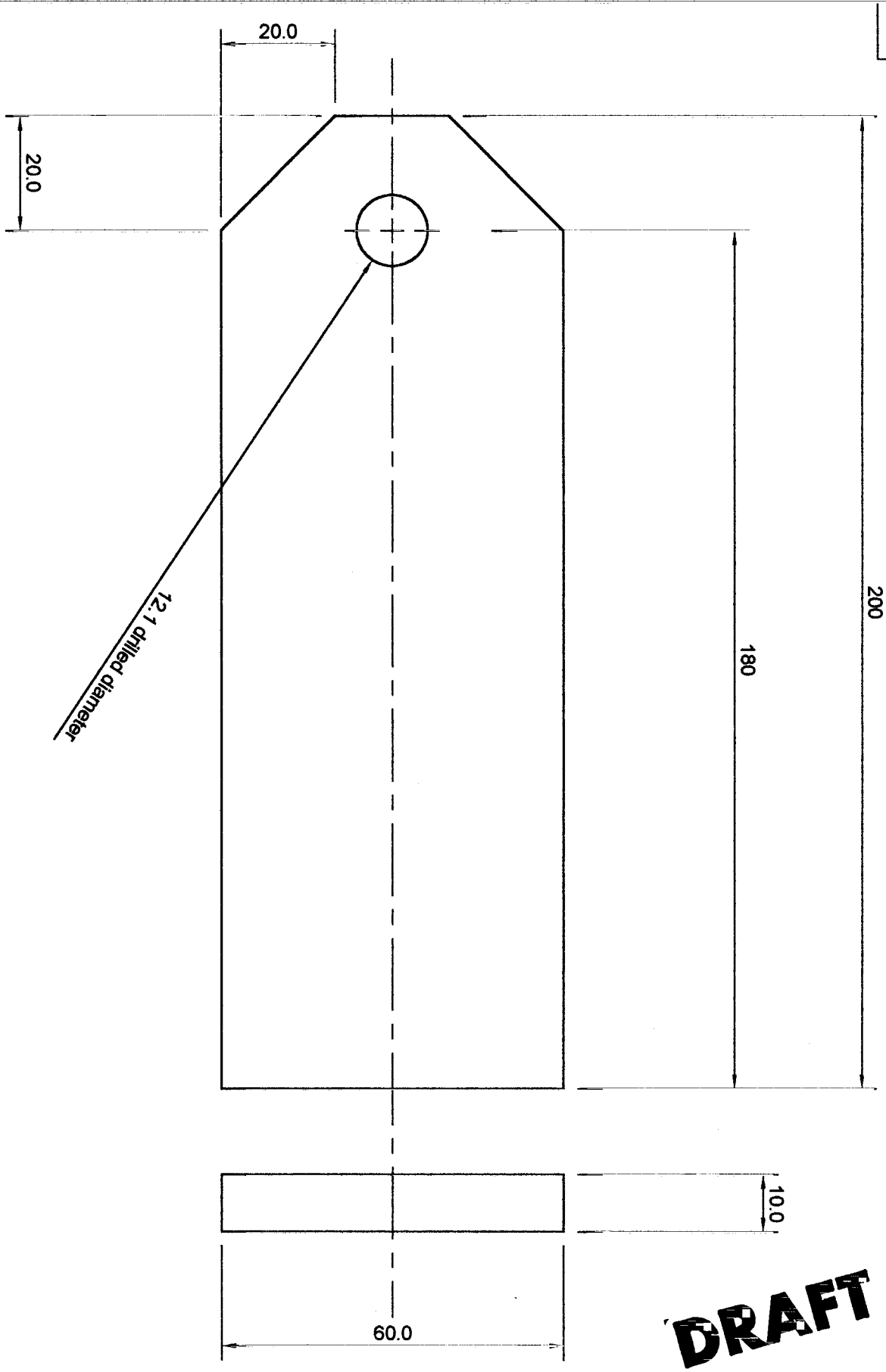
NOTES	DRAWN BY: Peter Ball	DATE: 8.1.2000	TITLE Base Plate Pounder Rig
	19 JUN 2000	SCALE: 1:10	
		DRG No. 40-028	SHT. 1 OF. 1

A4



NOTES	DRAWN BY:	DATE:	TITLE
From 60.2Ø x 5mm wall Mild Steel Tube	Peter Ball	10.1.2000	Roller Tube
		SCALE: Full	Pounder Rig
	19 JUN 2000	DRG No. 40-030	SHT. 1 OF. 1

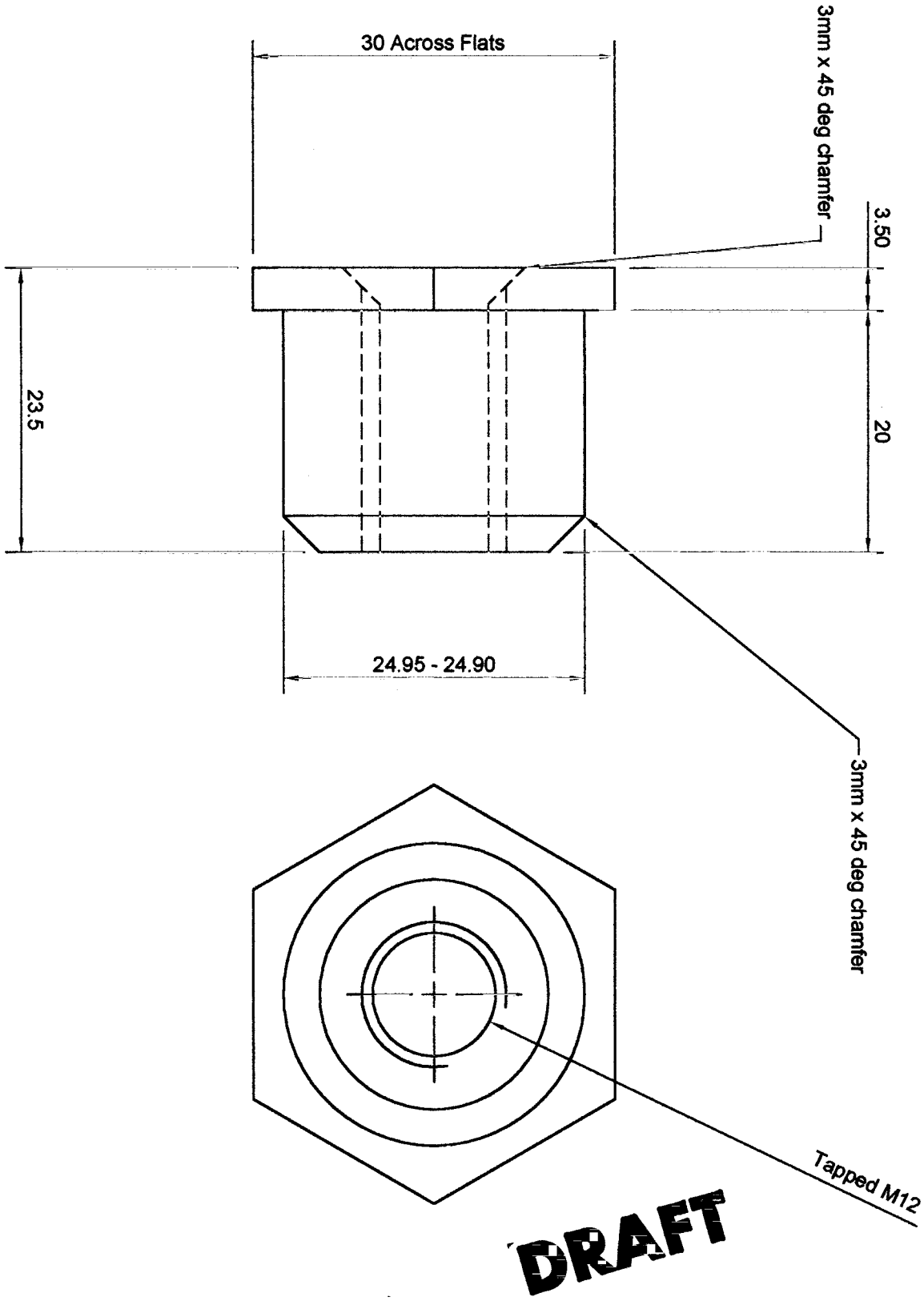
A4



DRAFT

NOTES	DRAWN BY:	DATE:	TITLE
From 60 x 10mm Mild Steel Flat Bar	Peter Ball	10.1.2000	Roller Supports Pounder Rig
	19 JUN 2000	SCALE: NTS	
		DRG No. 40-031	SHT. 1 OF. 1

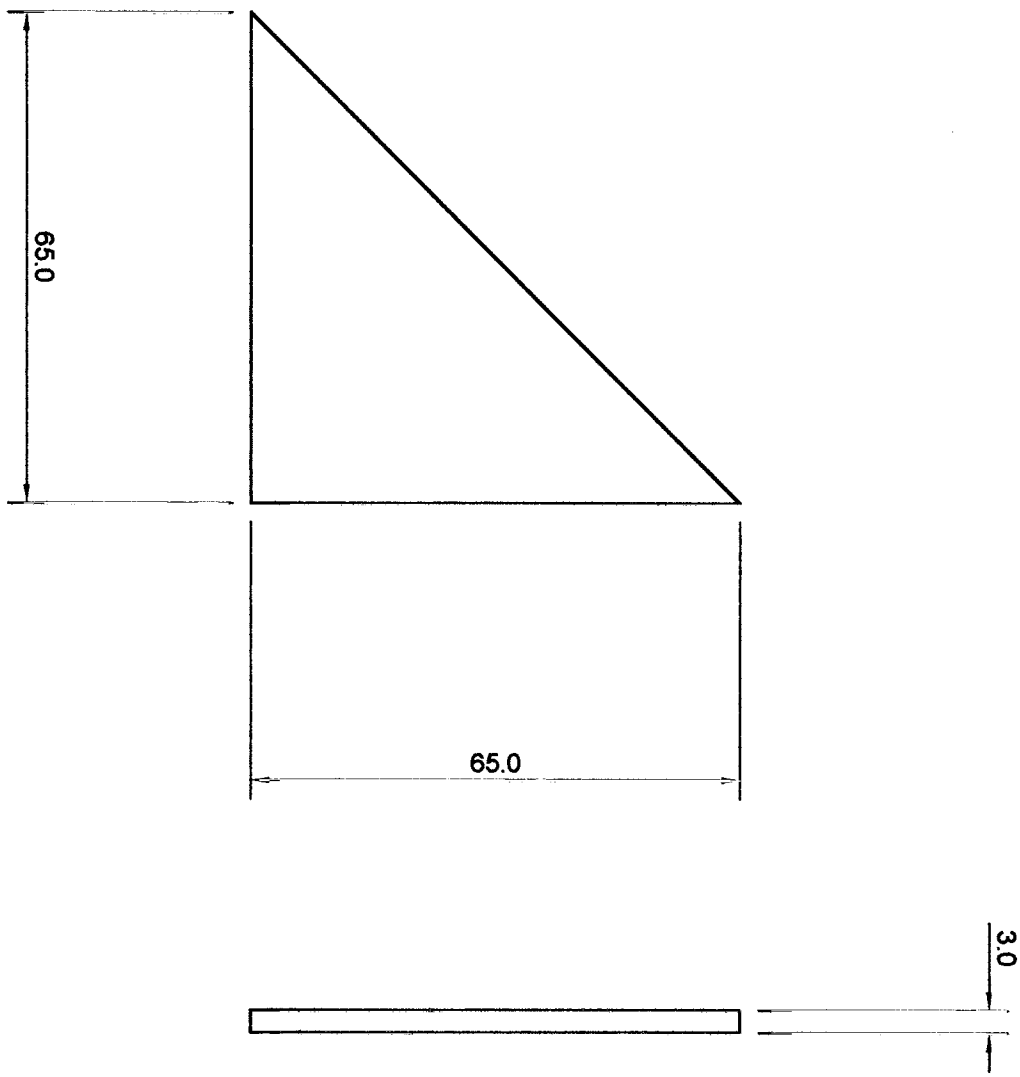
A4



DRAFT

NOTES	DRAWN BY:	DATE:	TITLE
Base material 30AF Hexagon mild Steel Bar	Peter Ball	19.2.2000	Bearing Pin Pounder Rig
	19 JUN 2000	SCALE: 1:.5	
		DRG No. 40-032	SHT. 1 OF. 1

A4



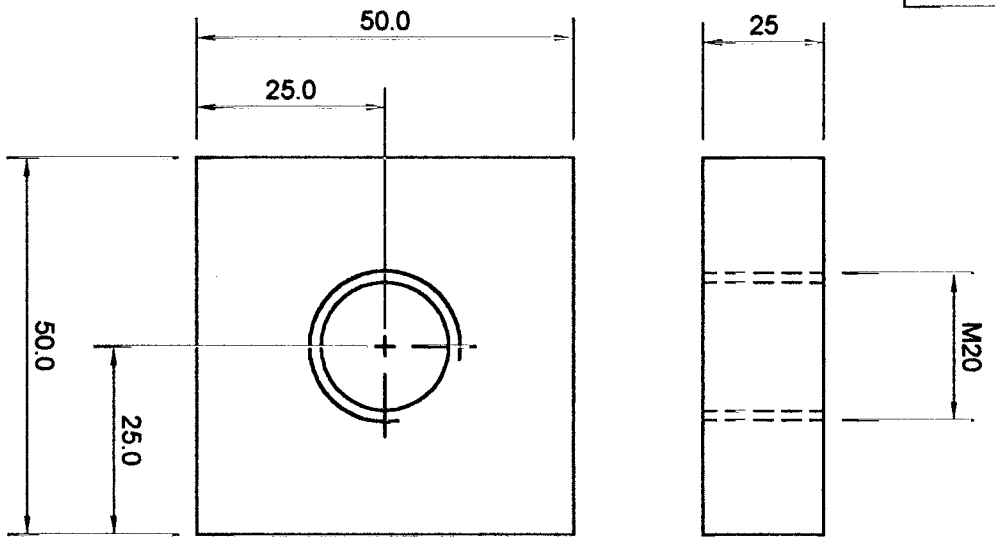
DRAFT

Material:3mm Mild steel plate

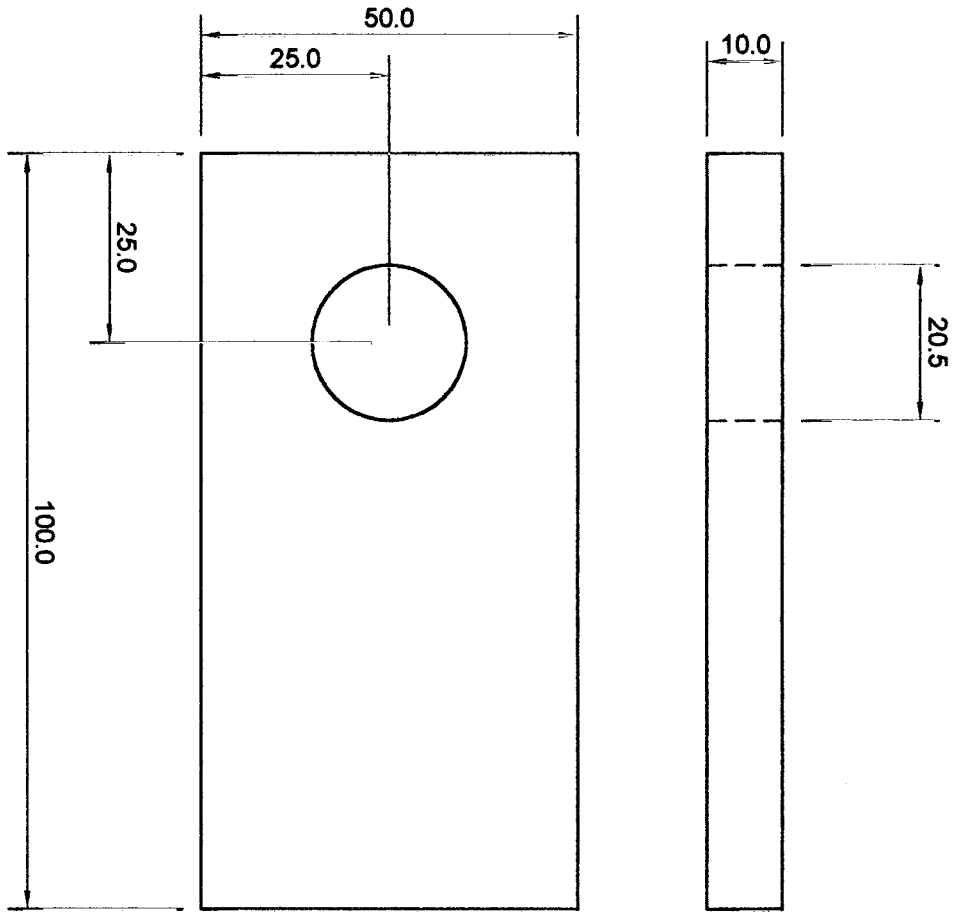
NOTES	DRAWN BY: Peter Ball	DATE: 26.4.2000	TITLE Gusset Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 40-034	SHT. 1 OF. 1

A4

Clamp Base 40-048



Clamp Plate 40-049

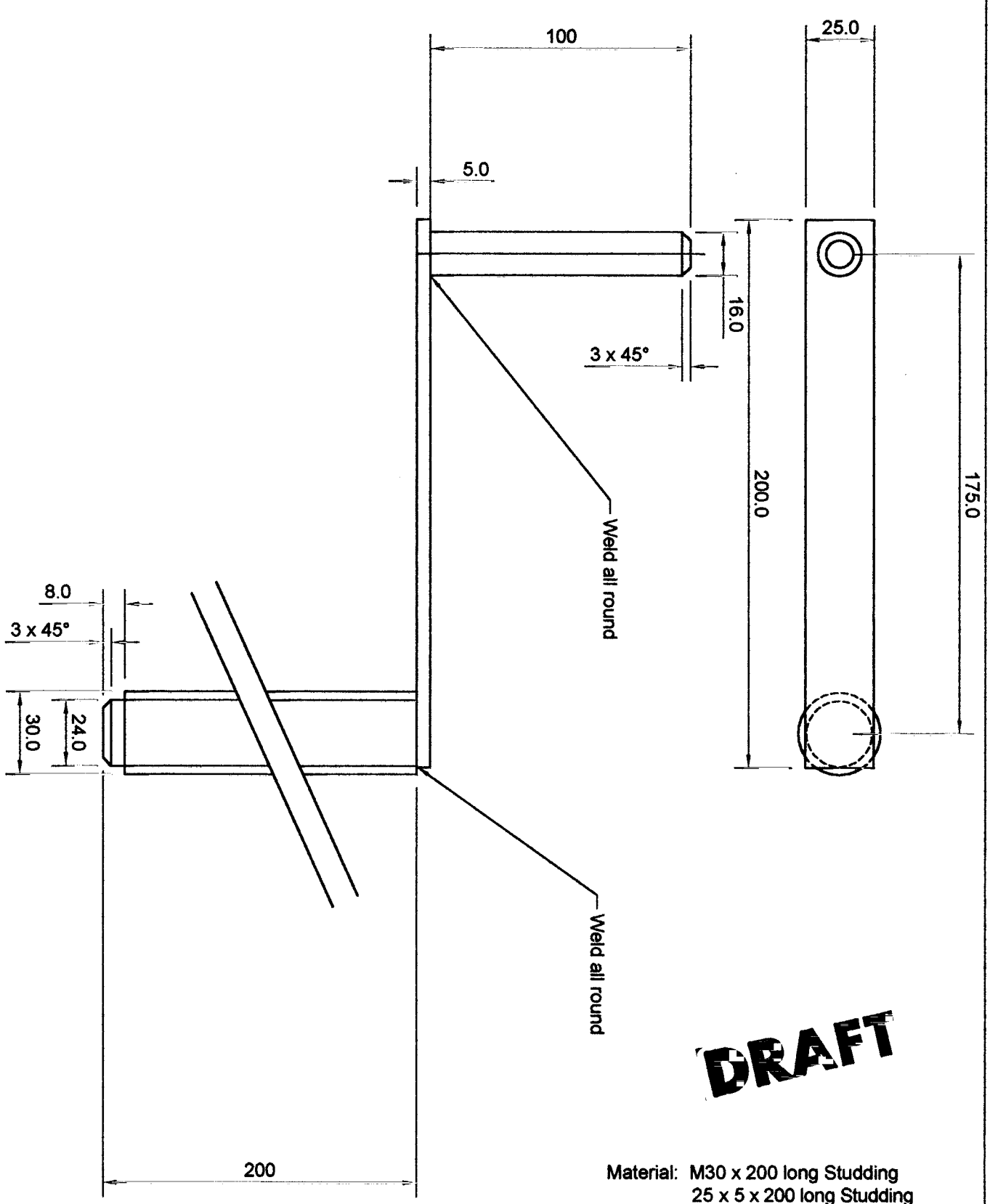


DRAFT

MATERIAL: 50 x 25 BMS Flat
50 x 10 BMS Flat

NOTES	DRAWN BY: Peter Ball	DATE: 2.5.2000	TITLE: Table Bush Clamp Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 40-048 & 049	SHT. 1 OF. 1

A4

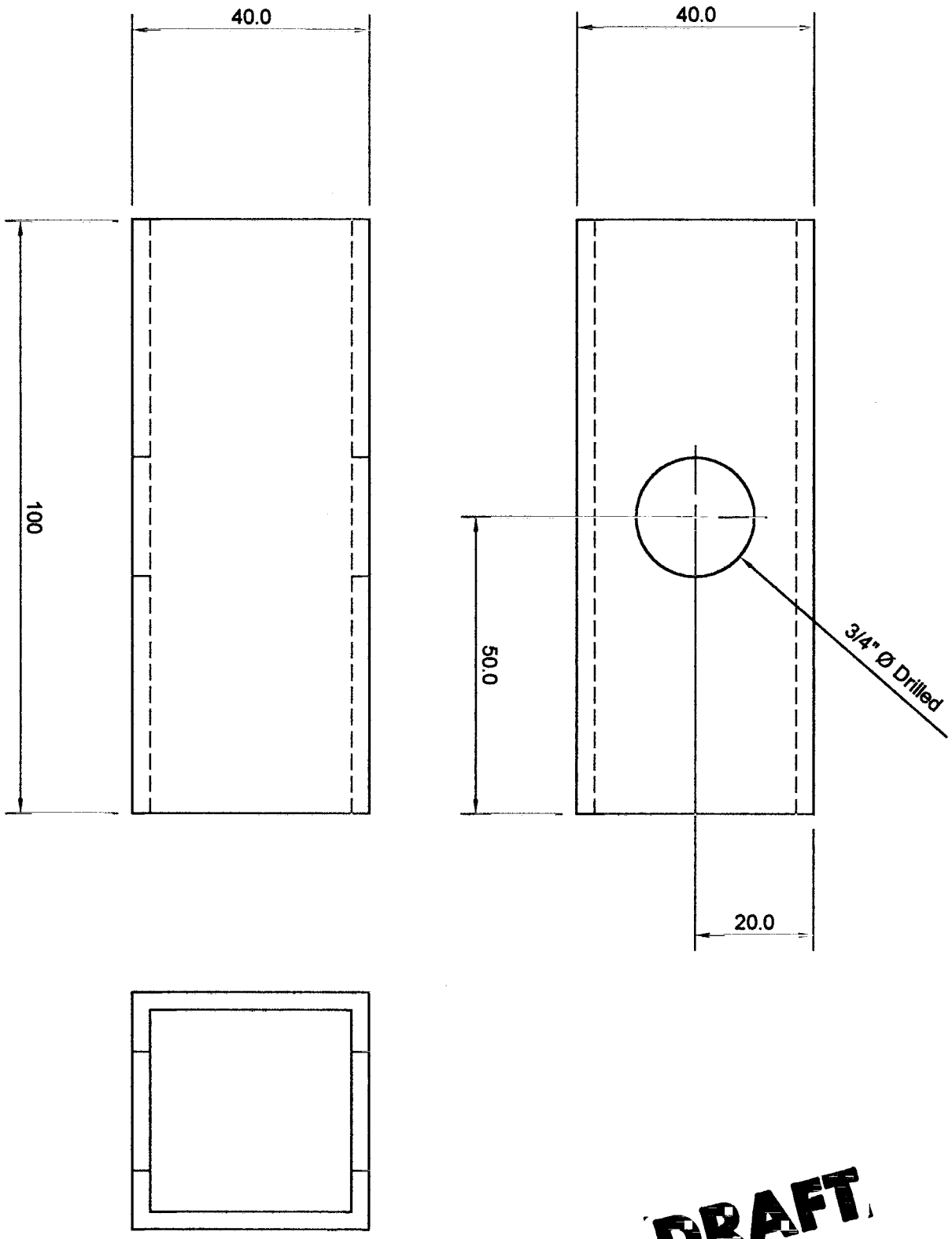


DRAFT

Material: M30 x 200 long Studding
25 x 5 x 200 long Studding
16Ø x 100 BMS

NOTES	DRAWN BY:	DATE:	TITLE
General Tolerances: Sawn & Sheared + or - 1mm Machined + or - .1mm Unless Specified Different	Peter Ball 19 JUN 2000	26.4.2000 SCALE: Full	Jack Screw Pounder Rig
		DRG No. 40-035	SHT. 1 OF. 1

A4

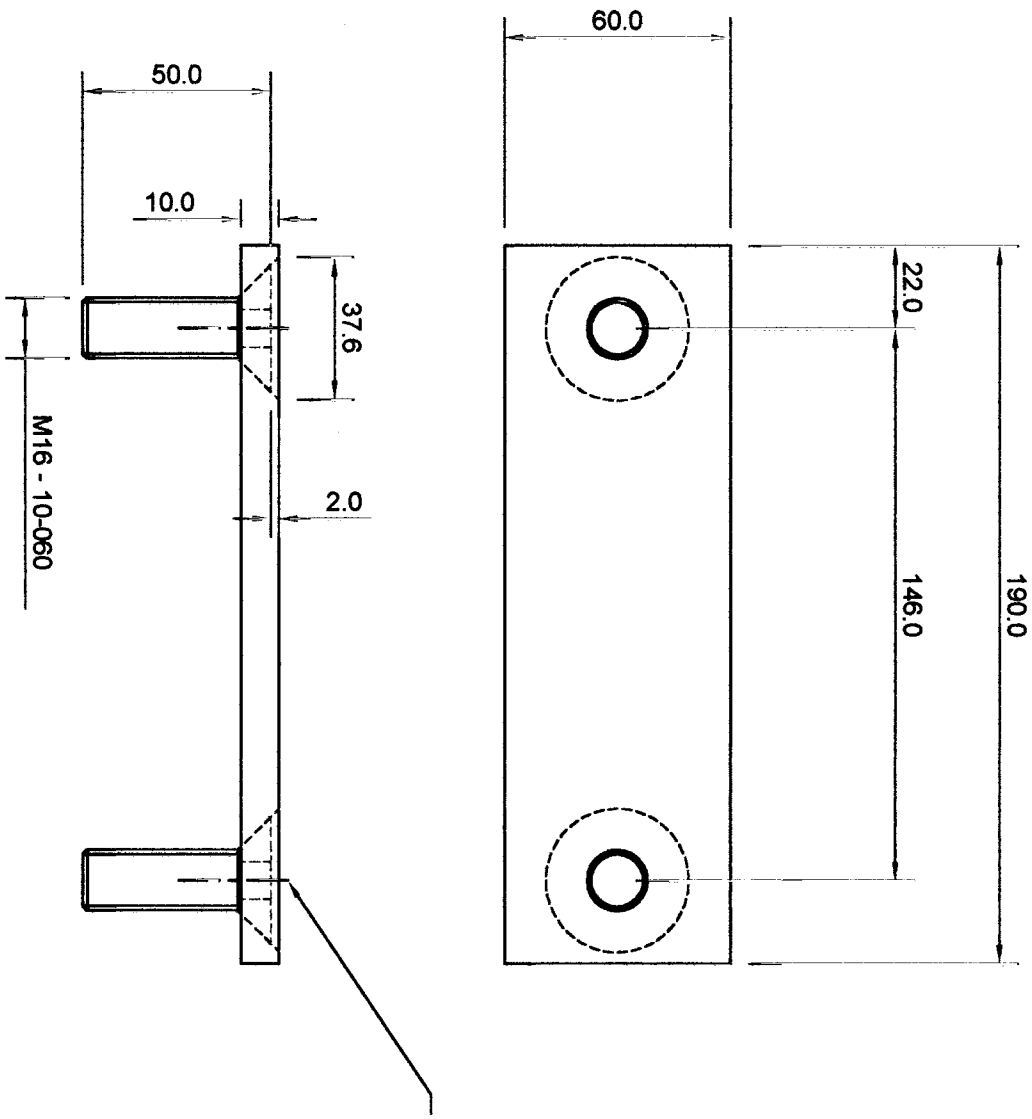


DRAFT

Material: 40 x 40 x 3mm Wall 43C RHS

NOTES	DRAWN BY: Peter Ball	DATE: 26.4.2000	TITLE Prop Pivot Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 40-046	SHT. 1 OF. 1

A4

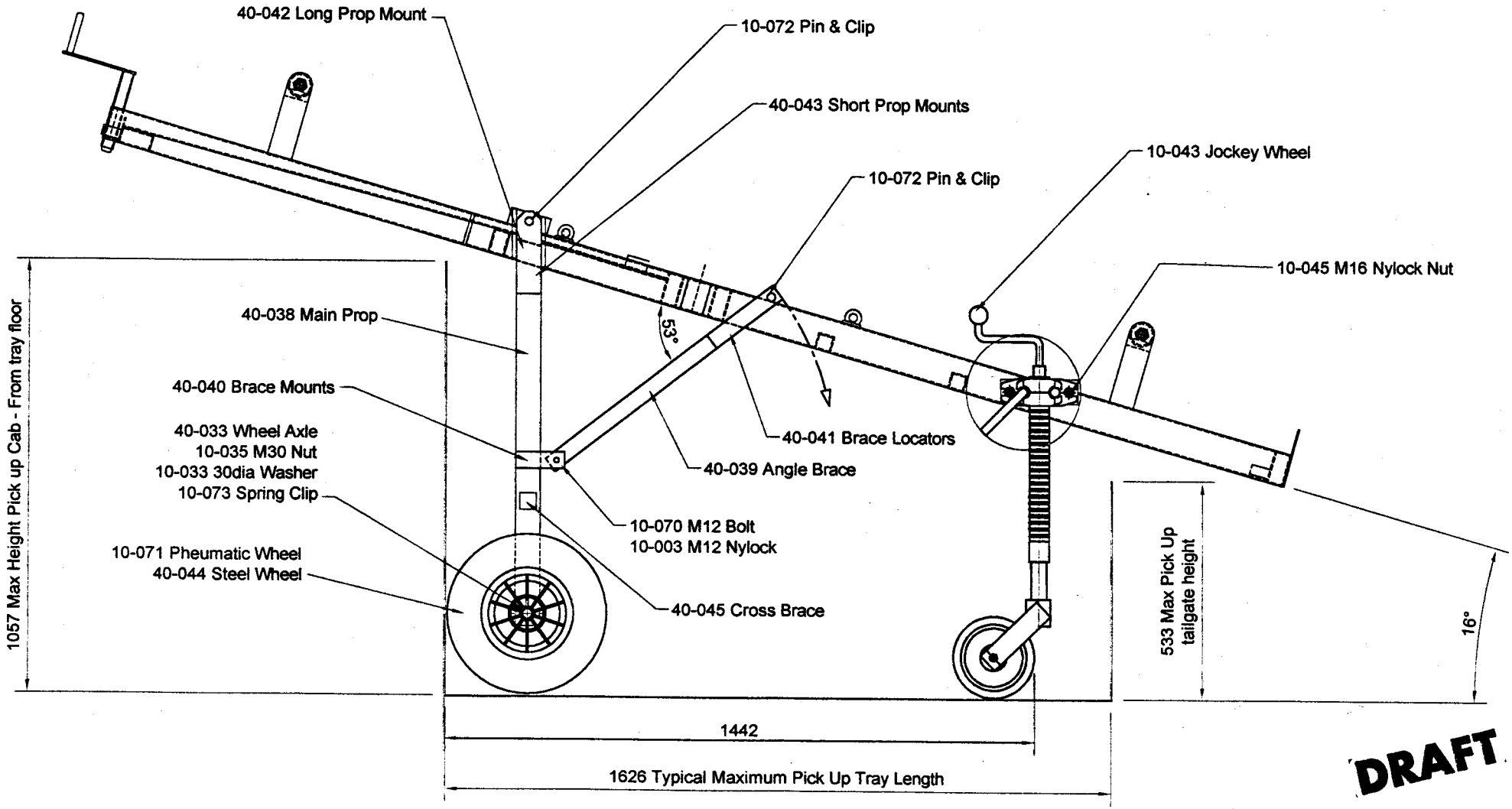


DRAFT

Material: 60 x 10 BMS Flat

NOTES	DRAWN BY: Peter Ball	DATE: 26.4.2000	TITLE Jockey Wheel Mount Pounder Rig
	19 JUN 2000	SCALE: 1:2	
		DRG No. 40-047	SHT. 1 OF. 1

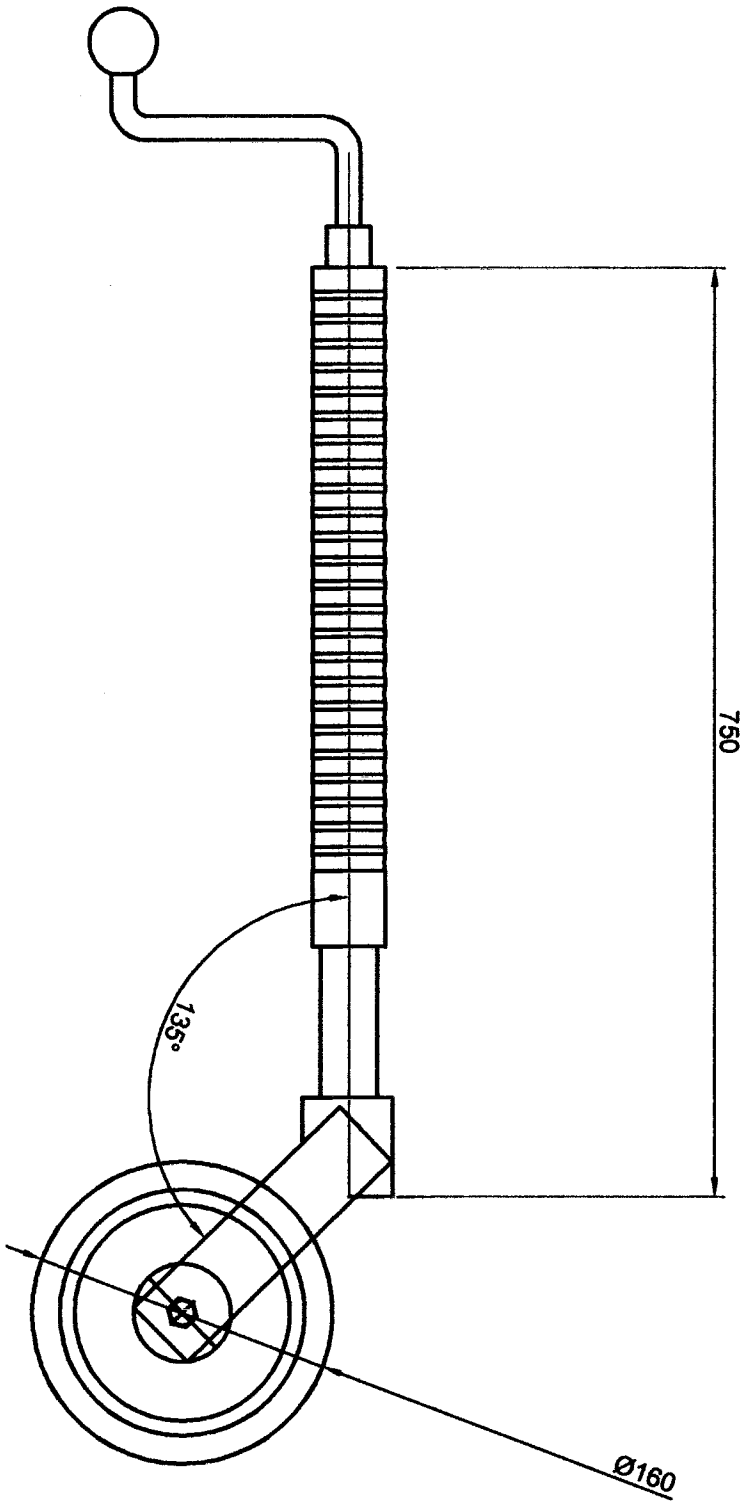
A3



DRAFT

NOTES	DRAWN BY: Peter Ball	DATE: 19.2.2000	TITLE: Trolley Complete Pounder Rig
	19 JUN 2000	SCALE: 1:10	
		DRG No. 40-037	SHT. 1 OF. 2

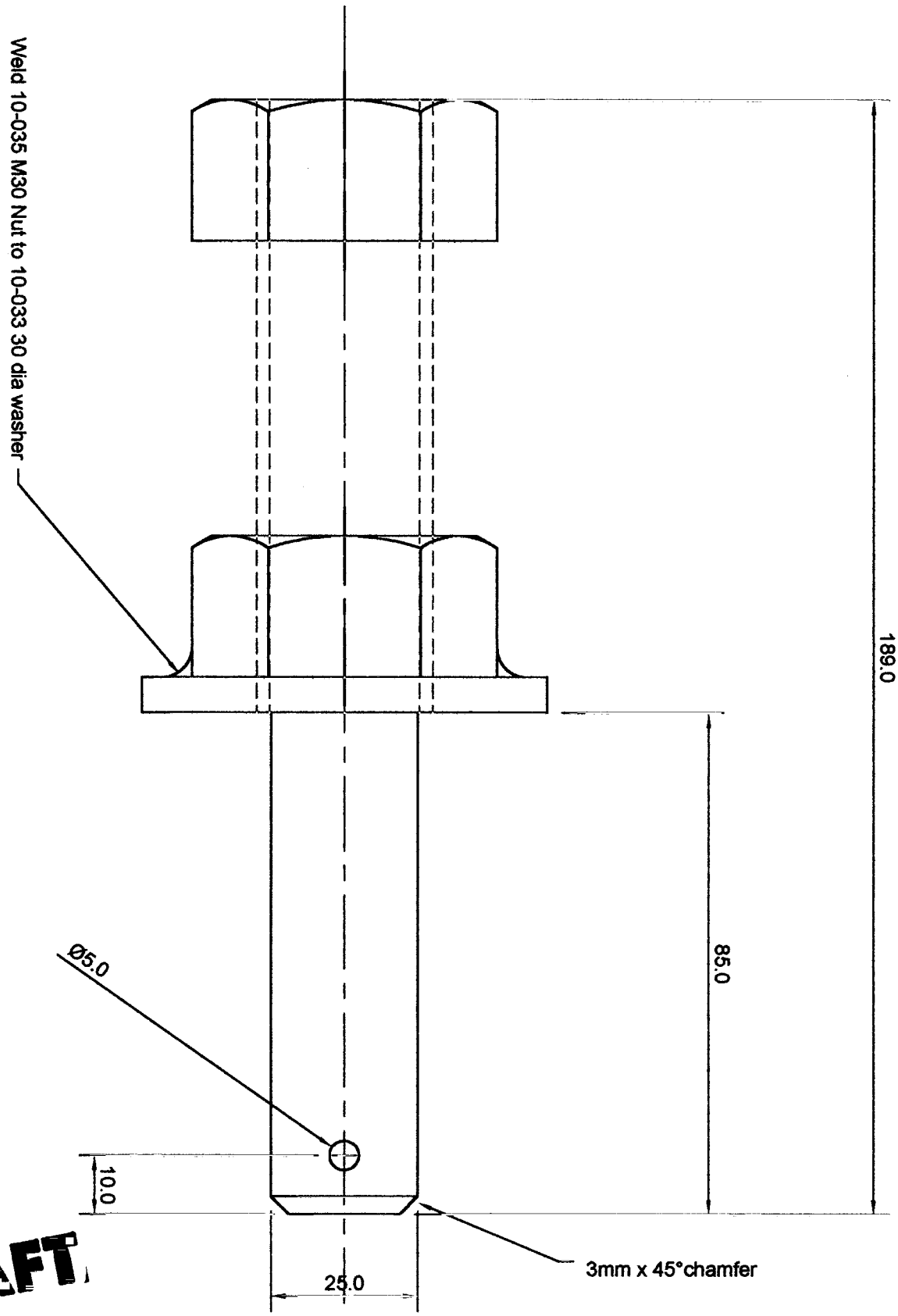
A4



DRAFT

NOTES	DRAWN BY: Peter Ball	DATE: 9.2.2000	TITLE: Jockey Wheel Pounder Rig
	19 JUN 2000	SCALE: 1:5	
		DRG No. 10-043	SHT. 1 OF. 1

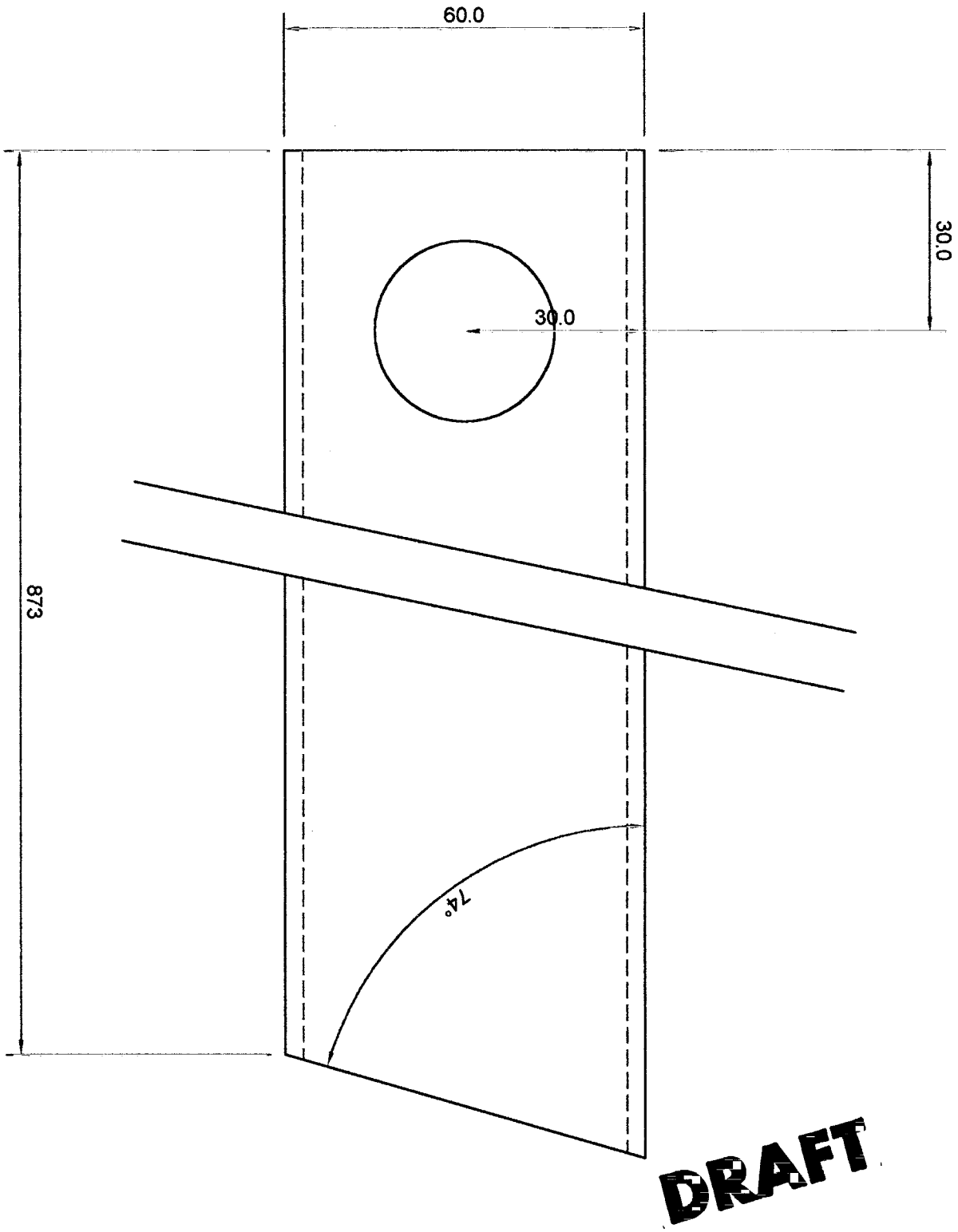
A4



DRAFT

NOTES	DRAWN BY:	DATE:	TITLE
From M30 x 50 High Tensile Studding	Peter Ball	11.1.2000	Wheel axle
	19 JUN 2000	SCALE: Full	Pounder Rig
		DRG No. 40-033	SHT. 1 OF. 1

A4

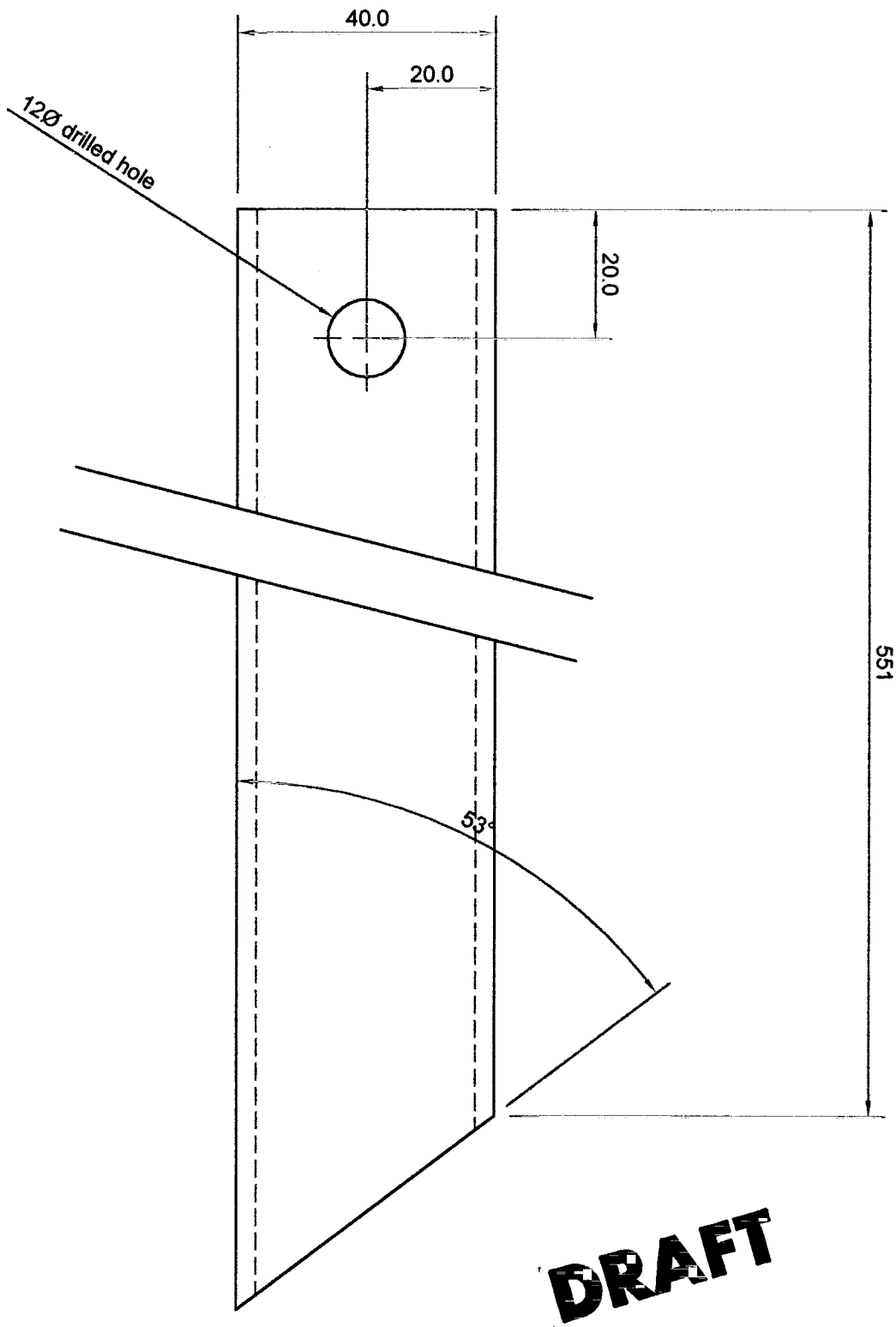


DRAFT

Material: 60 x 40 x 3mm RHS 43C

NOTES	DRAWN BY: Peter Ball	DATE: 26.4.2000	TITLE: Main Prop Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 40-038	SHT. 1 OF. 1

A4

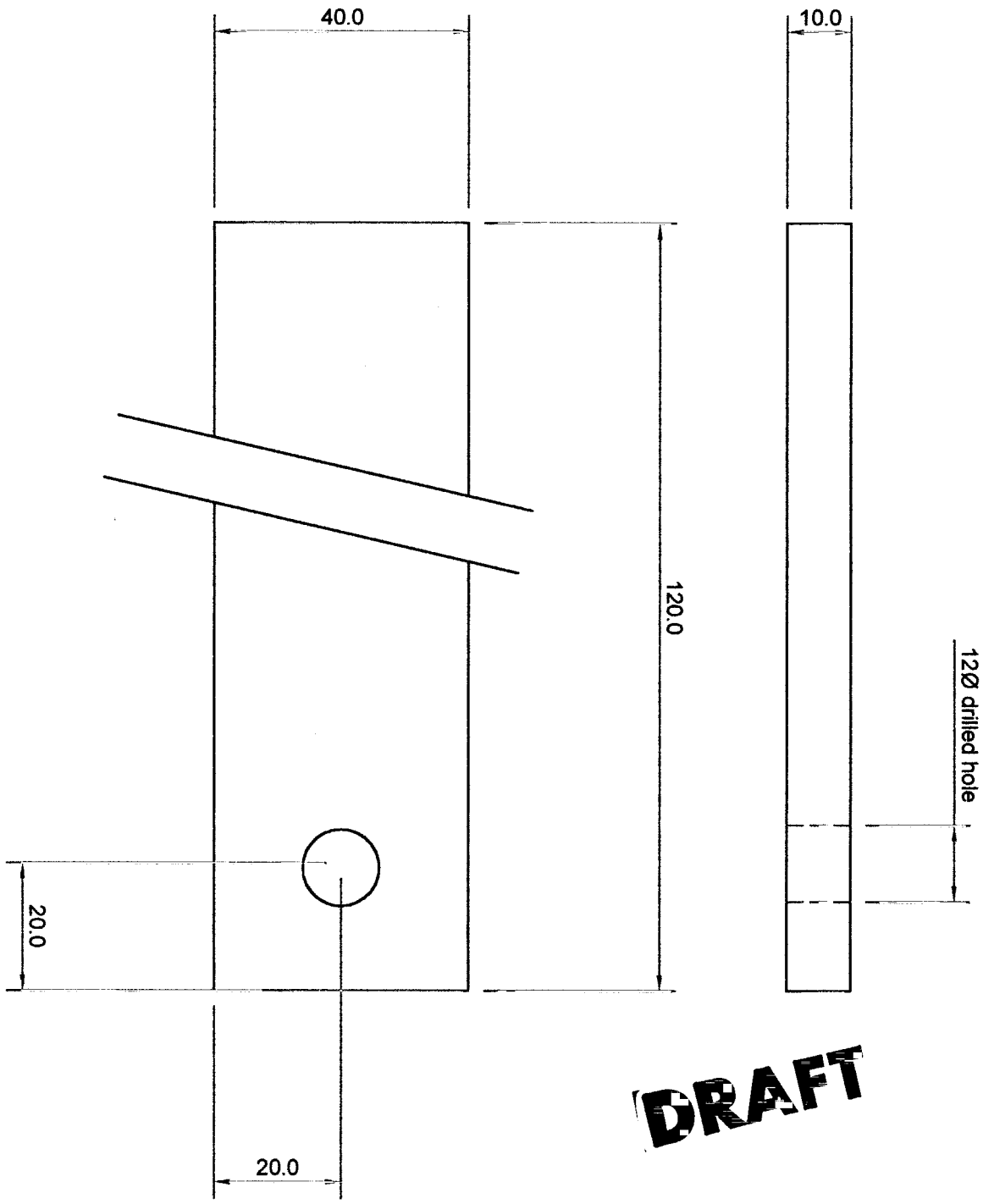


DRAFT

Material: 40 x 40 x 3mm RHS 43C

NOTES	DRAWN BY: Peter Ball	DATE: 26.4.2000	TITLE: Angle Brace Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 40-039	SHT. 1 OF. 1

A4

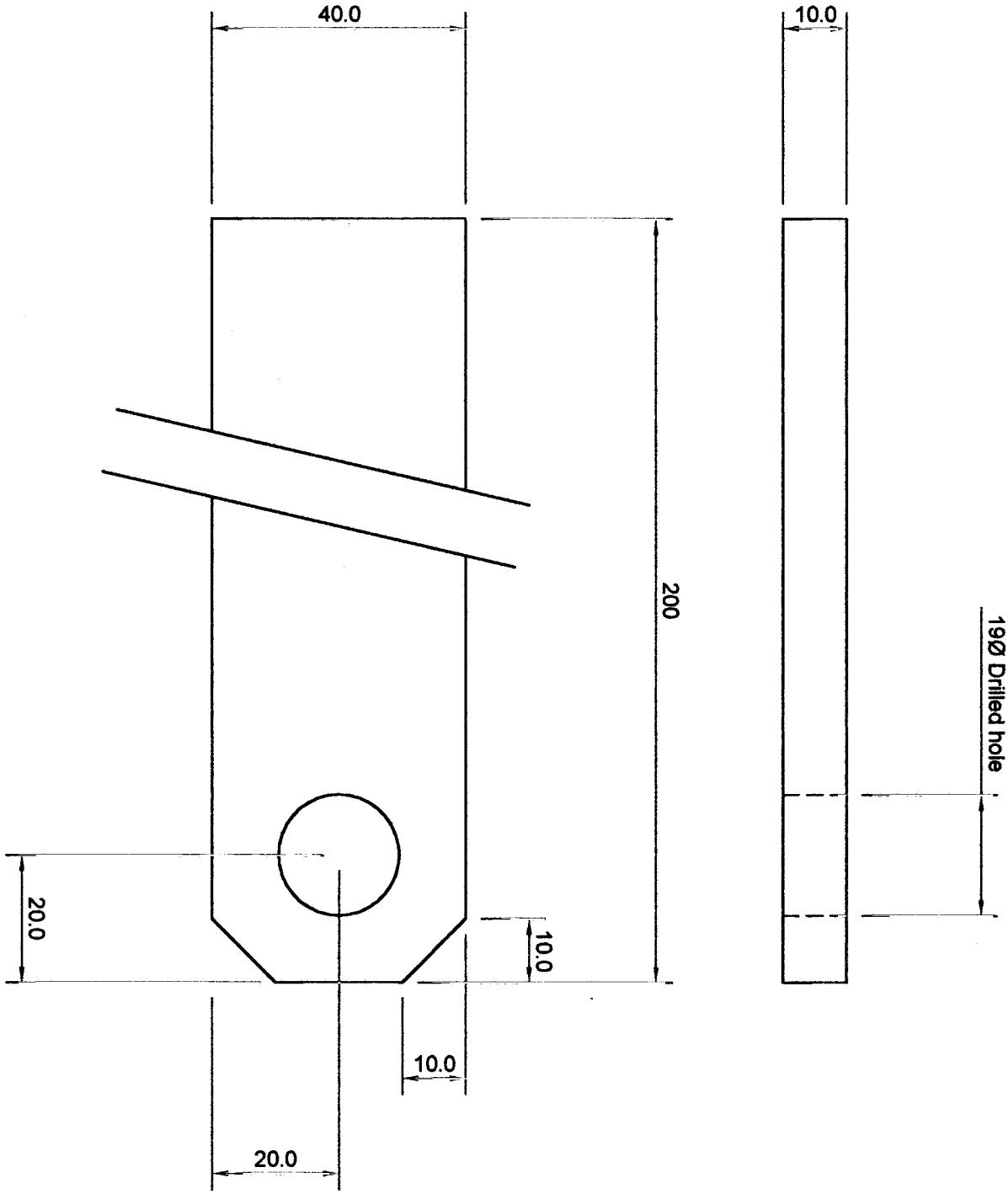


DRAFT

Material: 40 x 10 x 120 BMS flat

NOTES	DRAWN BY: Peter Ball	DATE: 26.4.2000	TITLE: Brace Mounts Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 40-040	SHT. 1 OF. 1

A4

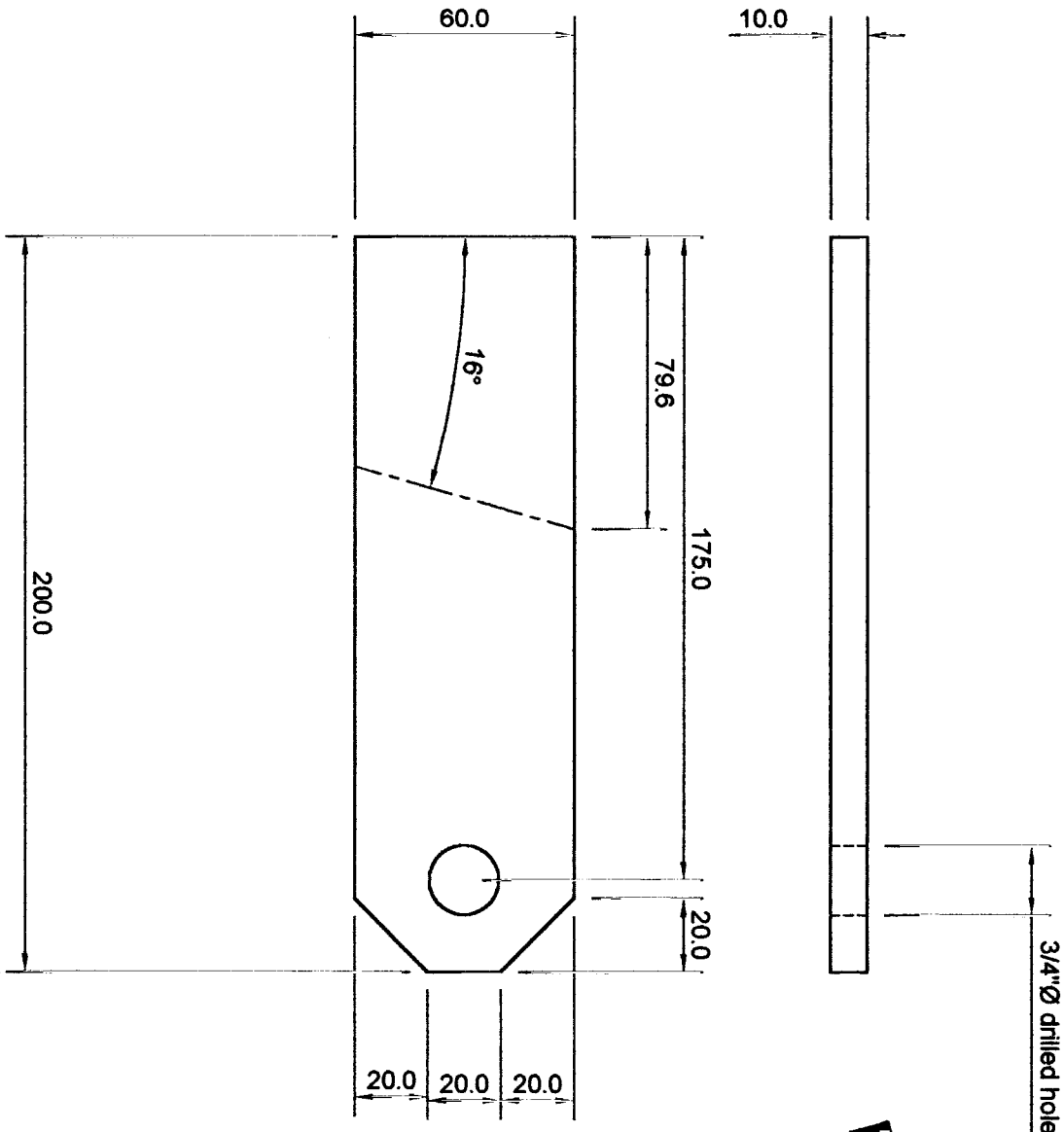


DRAFT

Material: 40 x 10 x 200 BMS flat

NOTES	DRAWN BY: Peter Ball	DATE: 26.4.2000	TITLE: Brace Locators Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 40-041	SHT. 1 OF. 1

A4

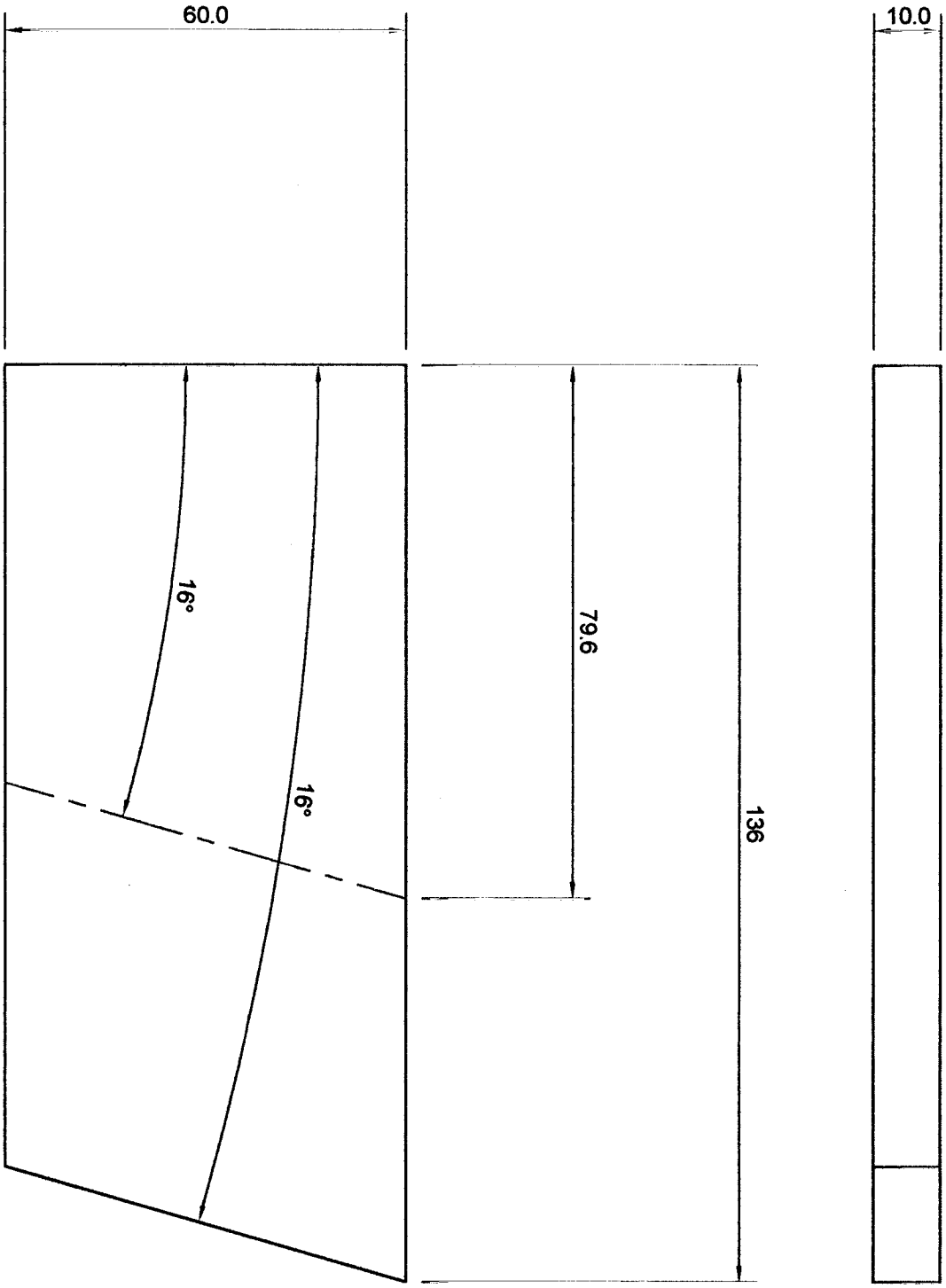


DRAFT

Material: 60 x 10 x 200 BMS Flat Bar

NOTES	DRAWN BY: Peter Ball	DATE: 26.4.2000	TITLE Long Prop Mount Pounder Rig
	19 JUN 2000	SCALE: 1:2	
		DRG No. 40-042	SHT. 1 OF. 1

A4

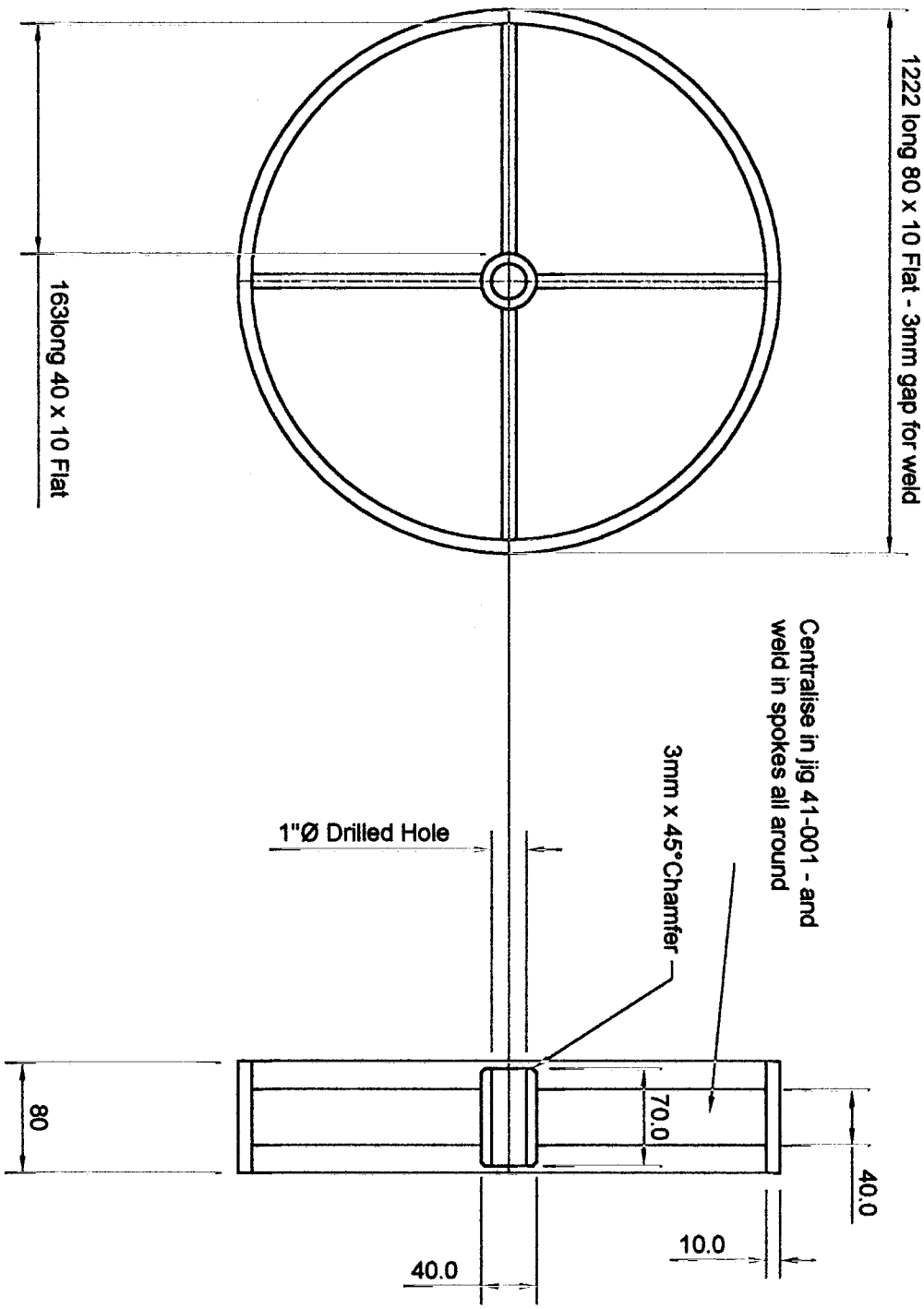


DRAFT

Material: 60 x 10 x 136 BMS Flat Bar

NOTES	DRAWN BY: Peter Ball	DATE: 26.4.2000	TITLE: Short Prop Mounts Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 40-043	SHT. 1 OF. 1

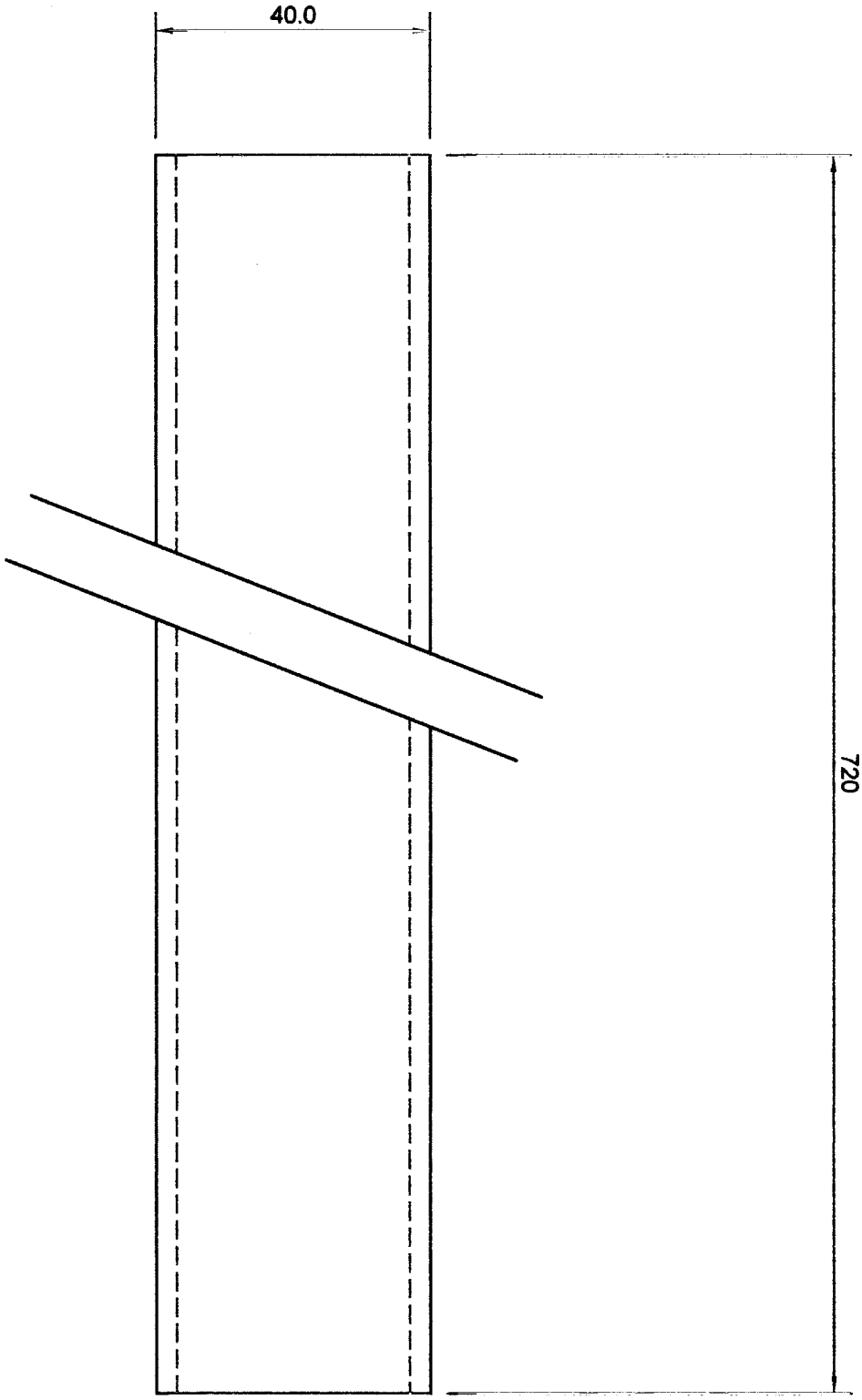
A4



DRAFT

NOTES	DRAWN BY: Peter Ball	DATE: 20.5.2000	TITLE Steel Wheel Pounder Rig
	19 JUN 2000	SCALE: 1:5	
		DRG No. 40-044	SHT. 1 OF. 1

A4

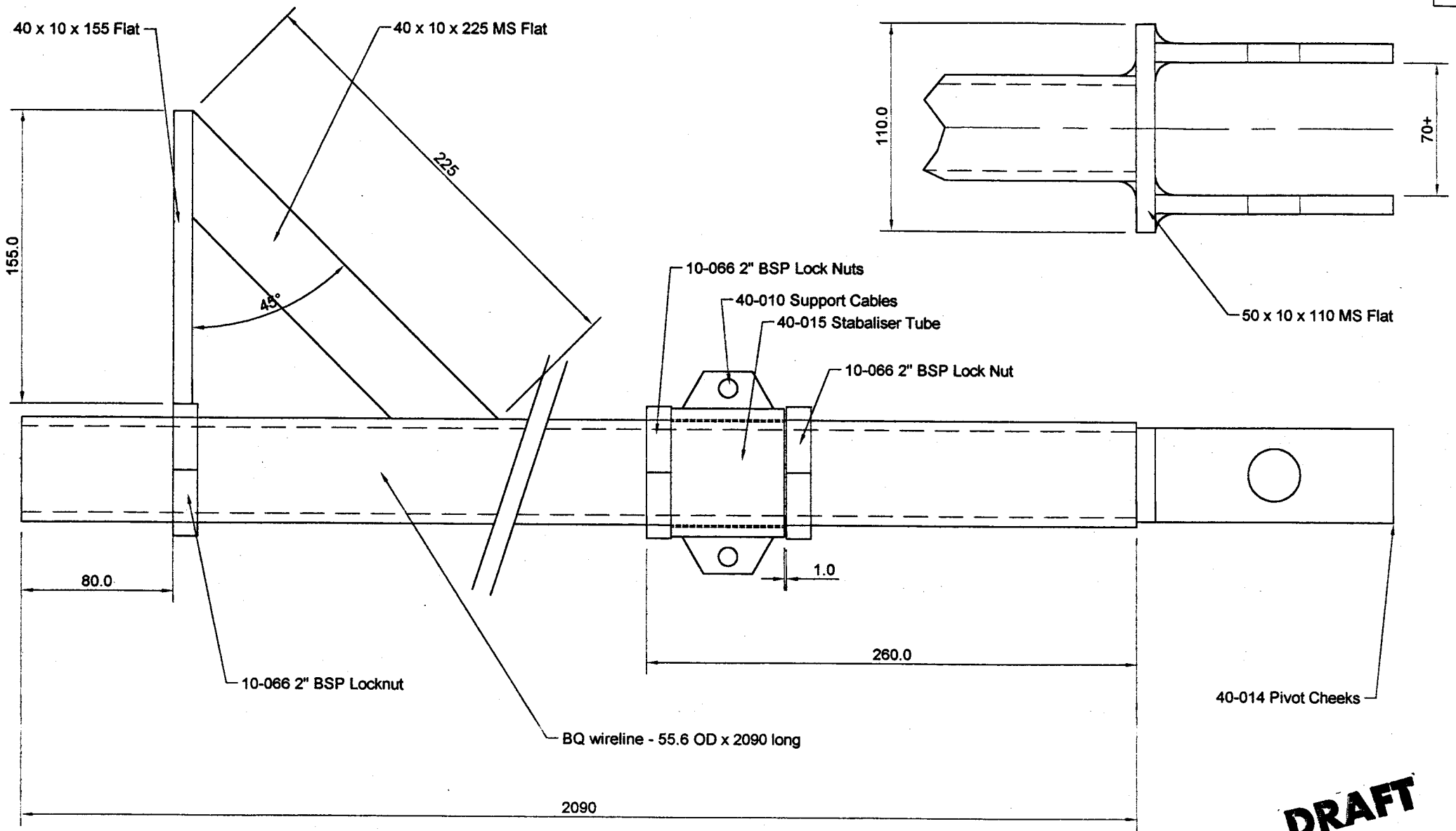


DRAFT

Material: 40 x 40 x 3mm RHS 43C

NOTES	DRAWN BY: Peter Ball	DATE: 26.4.2000	TITLE Cross Brace Pounder Rig
	19 JUN 2000	SCALE: full	
		DRG No. 40-045	SHT. 1 OF. 1

A3

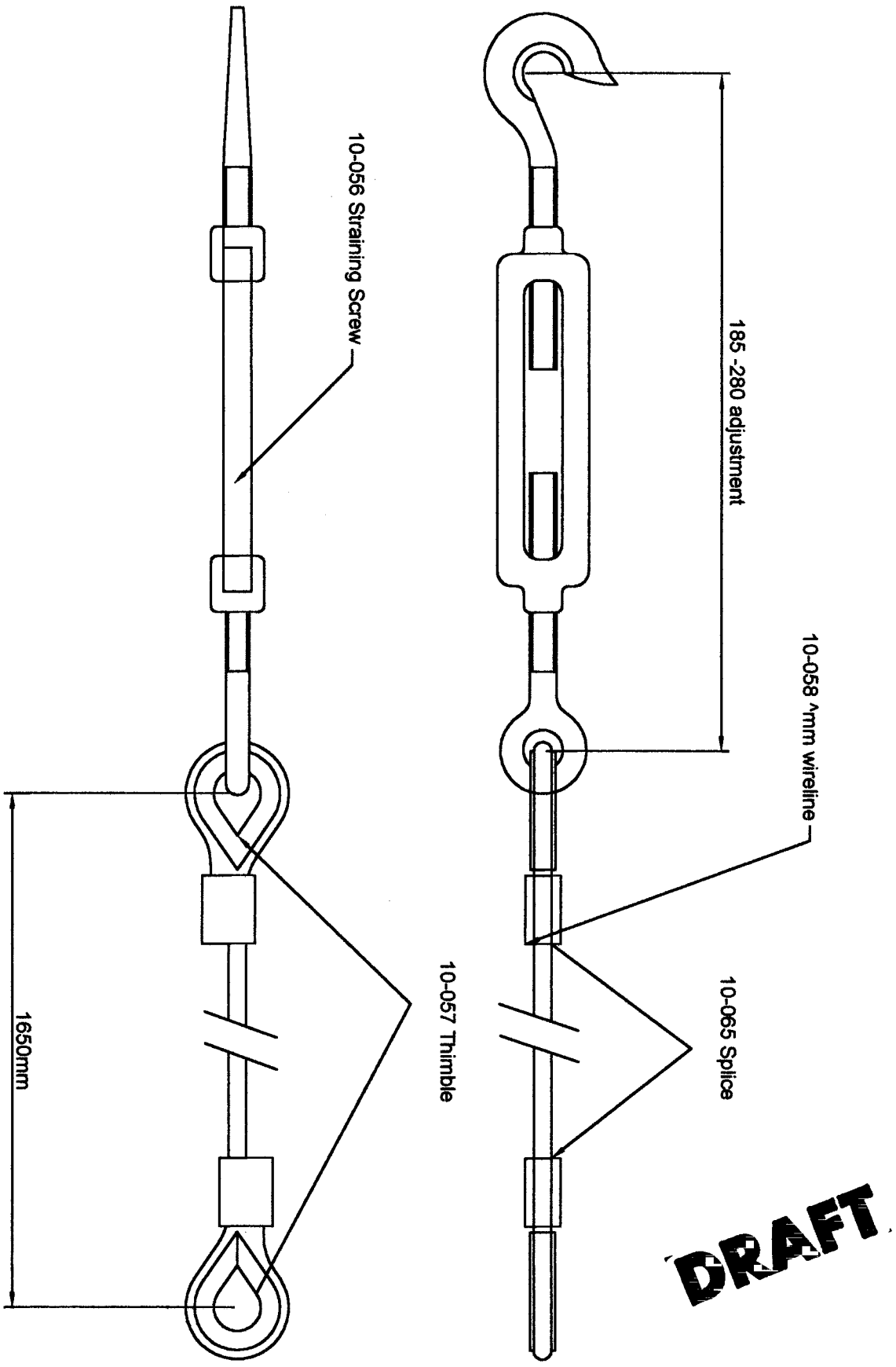


DRAFT

NOTE: Locate lock nuts in single plane and weld to assemble. Align fork with location arm!

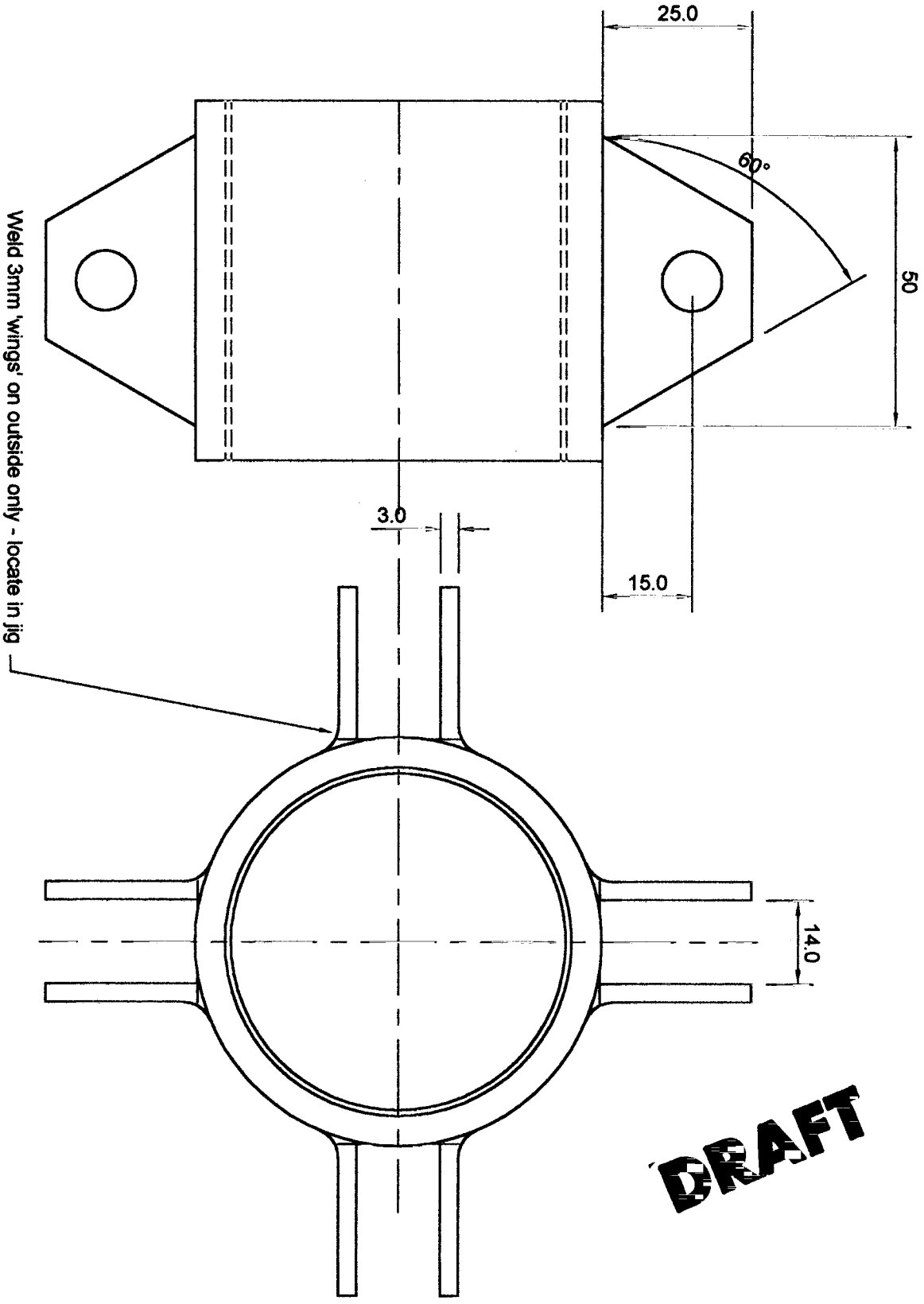
NOTES	DRAWN BY: Peter Ball	DATE: 27.4.2000	TITLE: Pivot Tube Complete Pounder Rig
	19 JUN 2000	SCALE: 1:2	
		DRG No. 40-009	SHT. 1 OF. 1

A4



NOTES	DRAWN BY: Peter Ball	DATE: 16.6.2000	TITLE Support Cables Pounder Rig
	19 JUN 2000	SCALE: 1:2	
		DRG No. 40-010	SHT. 1 OF. 1

A4

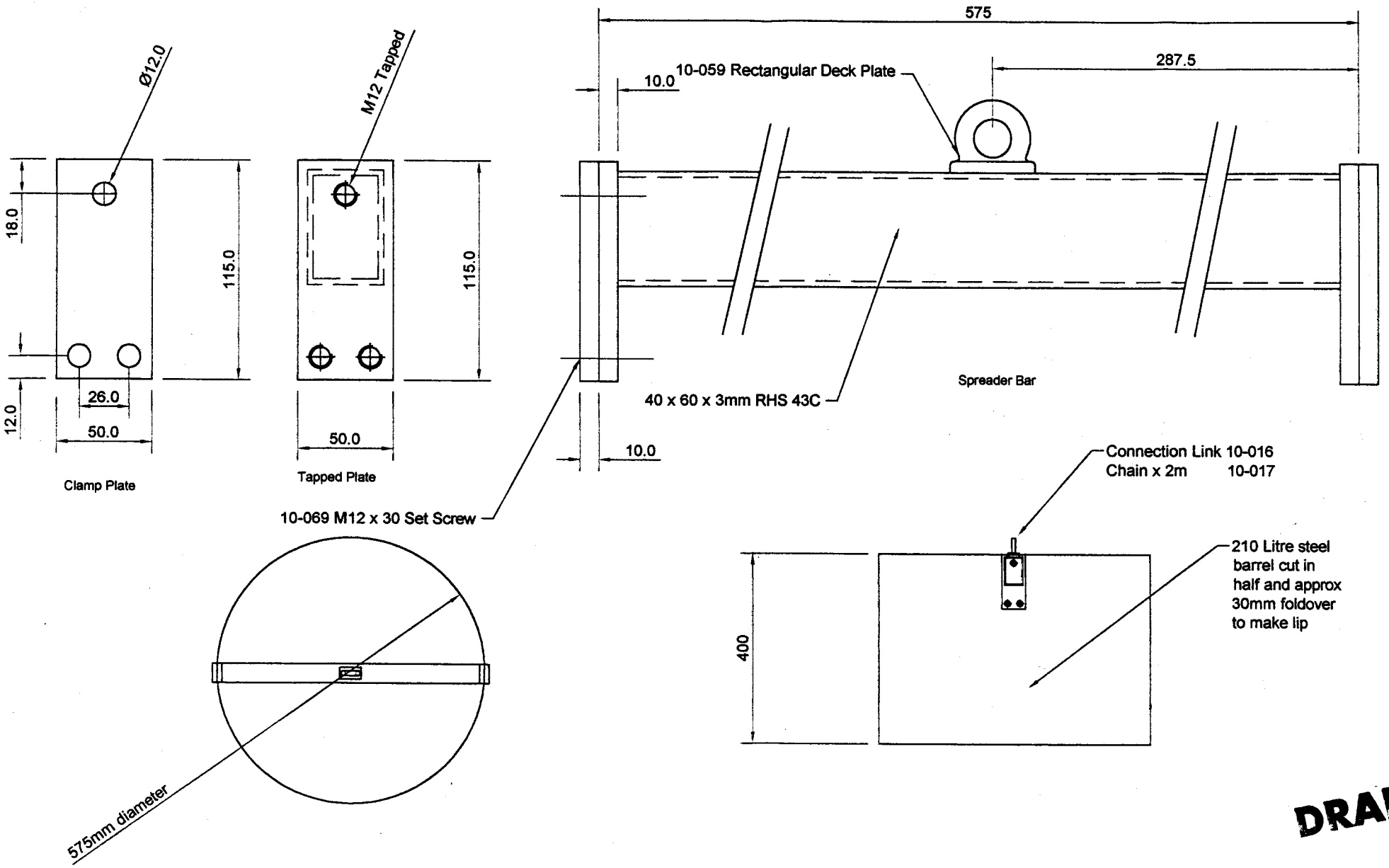


DRAFT

MATERIAL: 3mm MS plate & 2" BSP Pipe Iron Coupling

NOTES	DRAWN BY: Peter Ball	DATE: 26.4.2000	TITLE: Stabaliser Tube Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 40-015	SHT. 1 OF. 1

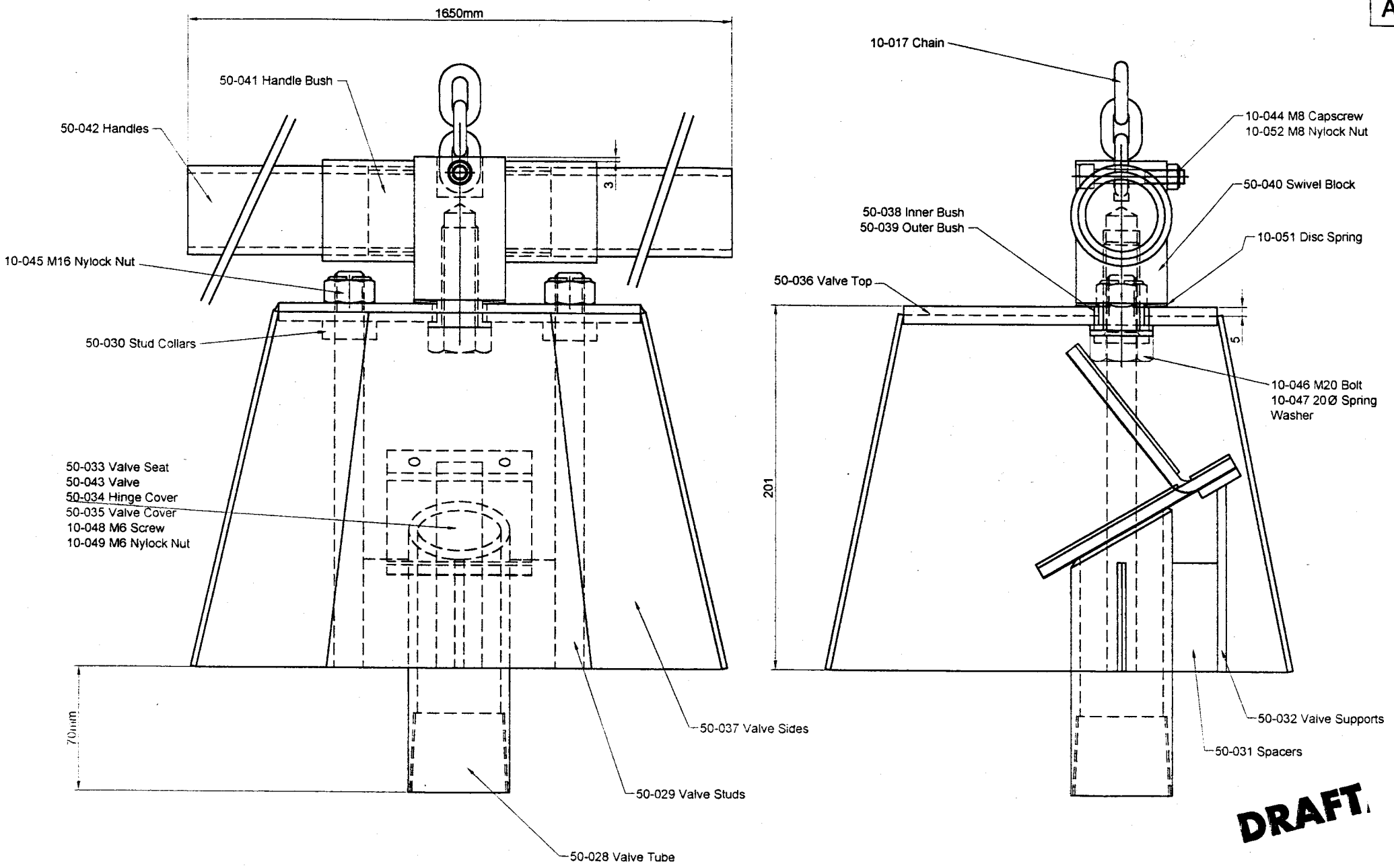
A3



DRAFT

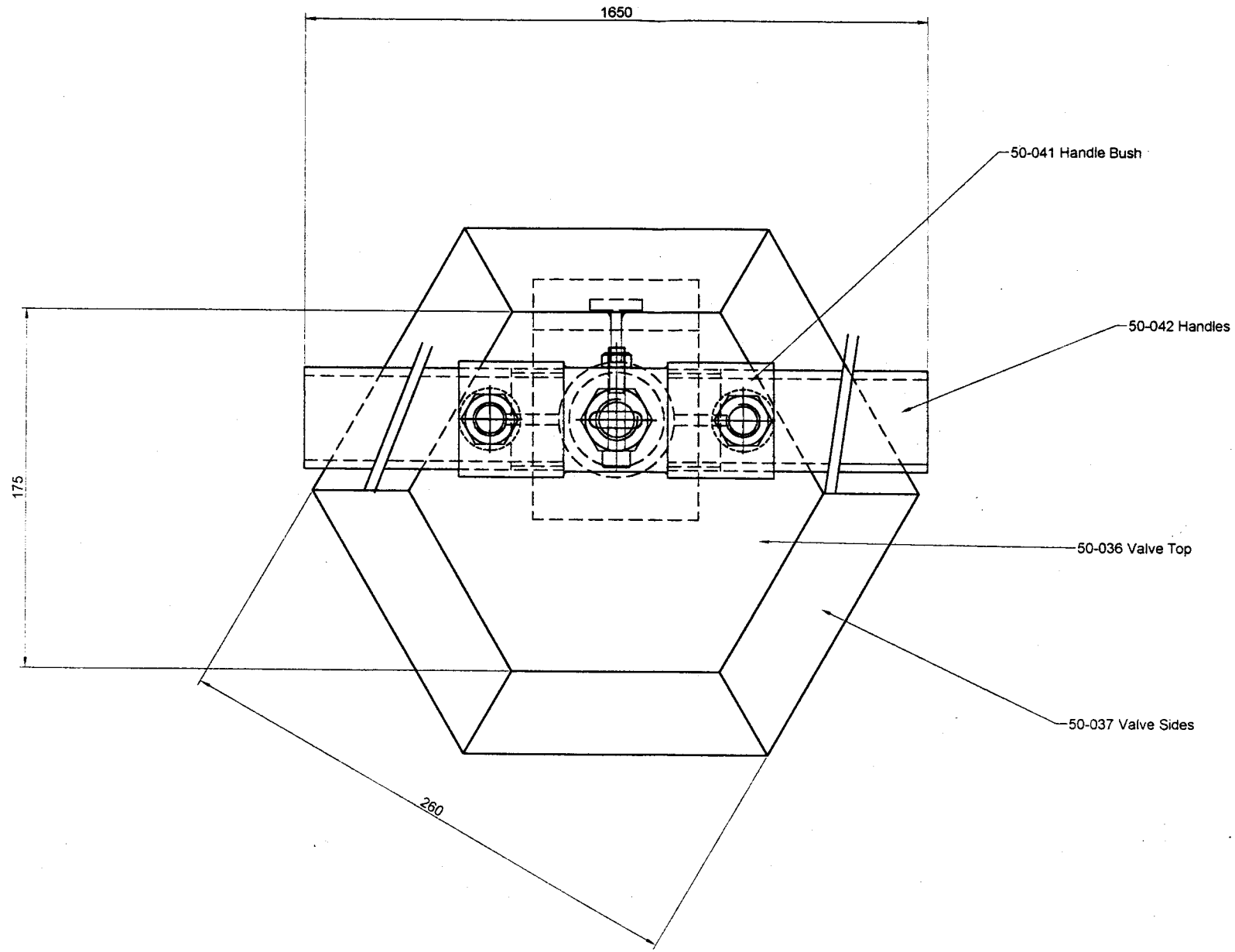
NOTES	DRAWN BY: Peter Ball	DATE: 12.6.2000	TITLE: Counterbalance Barrel Pounder Rig
	19 JUN 2000	SCALE: NTS	
		DRG No. 40-050	SHT. 1 OF 1

A3



NOTES	DRAWN BY: Peter Ball	DATE: 17.2.2000	TITLE: Sludging Valve Pounder Rig
	19 JUN 2000	SCALE: 1:2	
		DRG No. 50-027	SHT. 1 OF 2

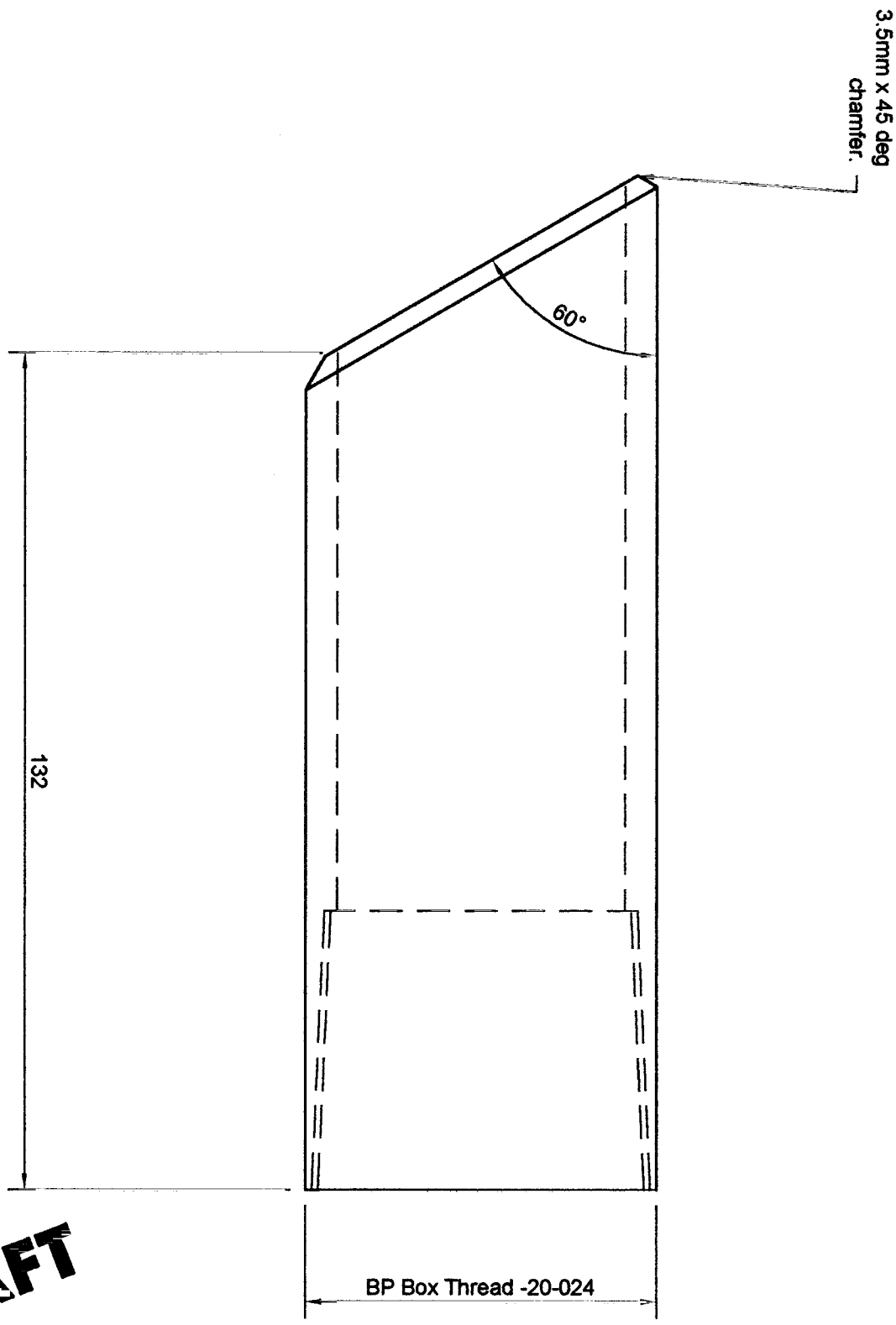
A3



DRAFT

NOTES	DRAWN BY: Peter Ball	DATE: 16.2.2000	TITLE: Sludging Valve Pounder Rig
	19 JUN 2000	SCALE: 1:2	
		DRG No. 50-027	SHT. 1 OF. 2

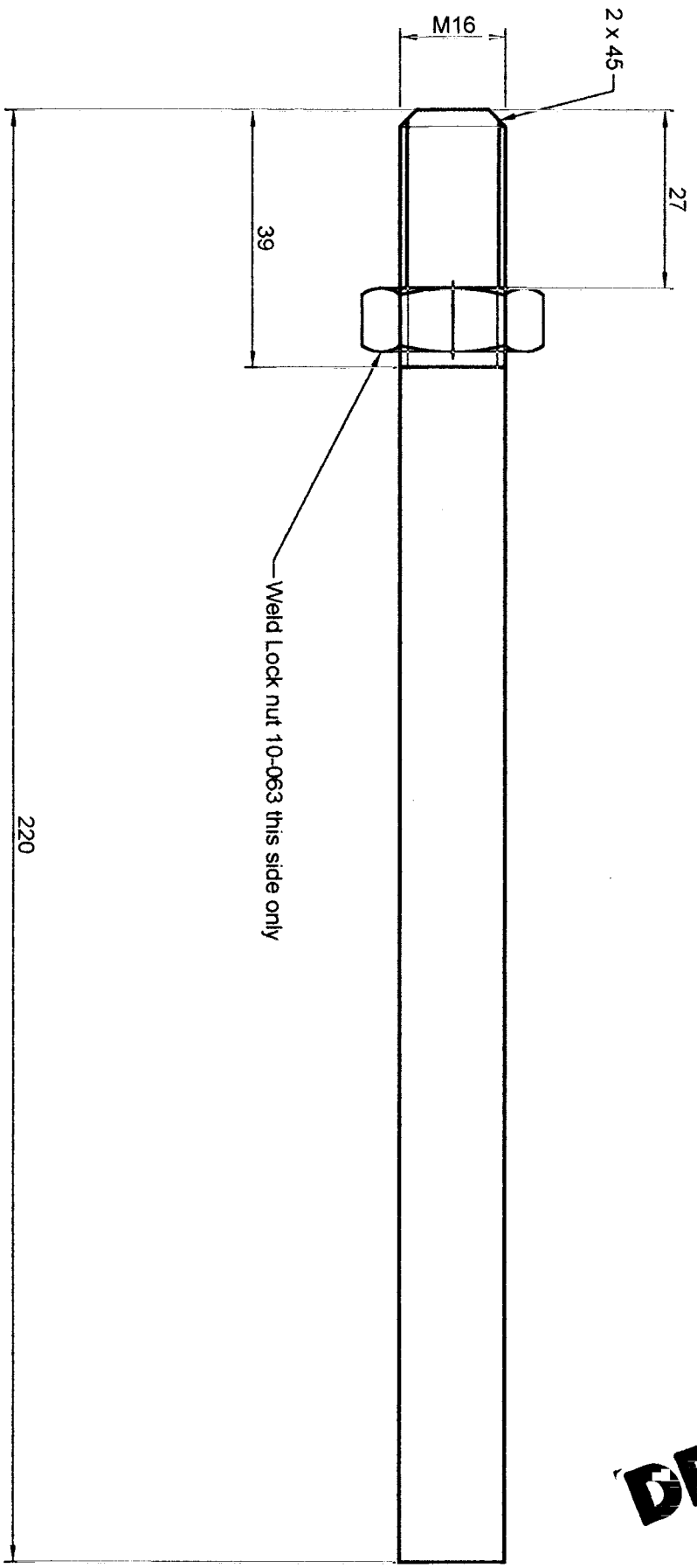
A4



DRAFT

NOTES	DRAWN BY:	DATE:	TITLE
Base material BP wireline drillpipe	Peter Ball	17.2.2000	Valve Tube Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 50-028	SHT. 1 OF. 1

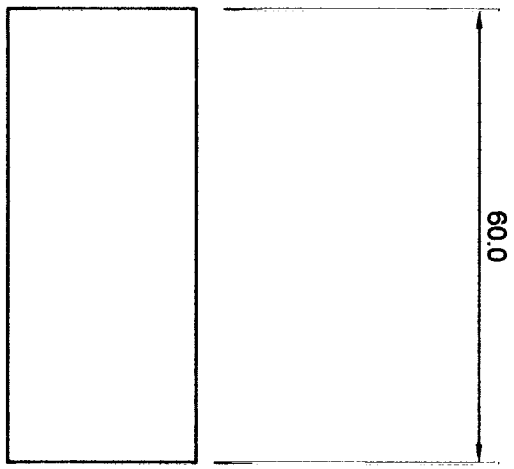
A4

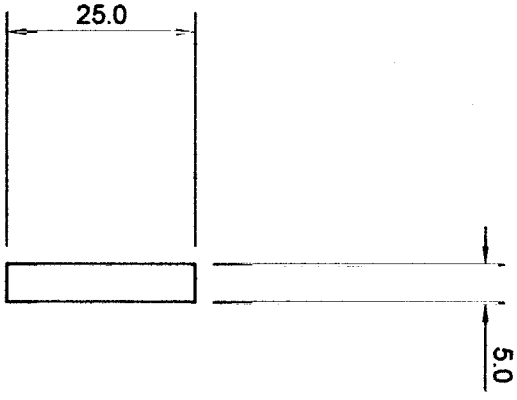


DRAFT

NOTES	DRAWN BY:	DATE:	TITLE
16Ø 080M40 (EN8) bright steel stock	Peter Ball	16.2.2000	Valve Studs
	19 JUN 2000	SCALE: Full	Pounder Rig
		DRG No. 50-029	SHT. 1 OF. 1

A4

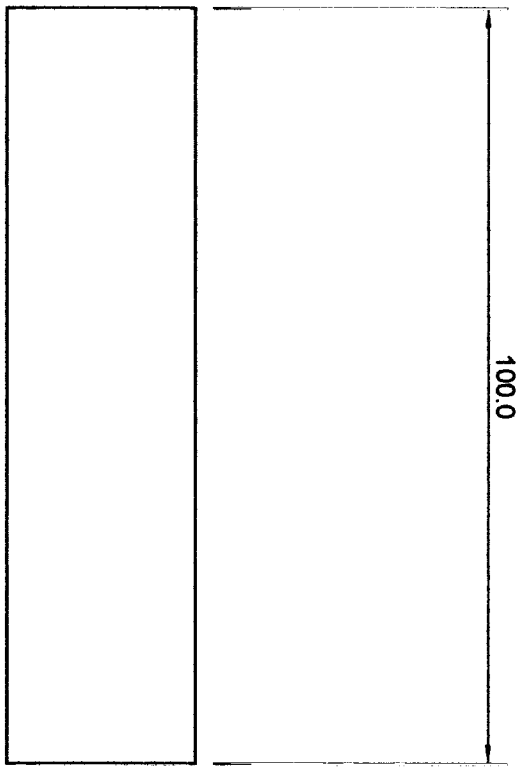


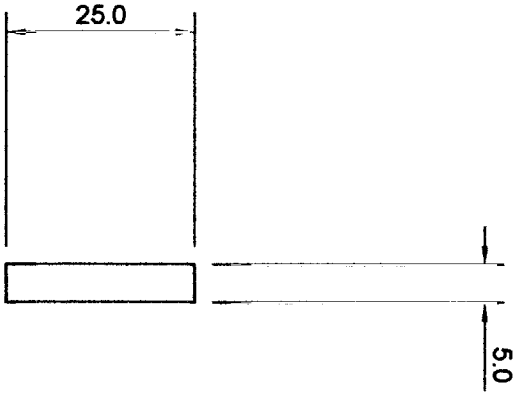


DRAFT

NOTES From 25 x 5 Bright Mild Steel	DRAWN BY: Peter Ball 19 JUN 2000	DATE: 17.2.2000 SCALE: Full	TITLE Spacers Pounder Rig DRG No. 50-031 SHT. 1 OF. 1

A4

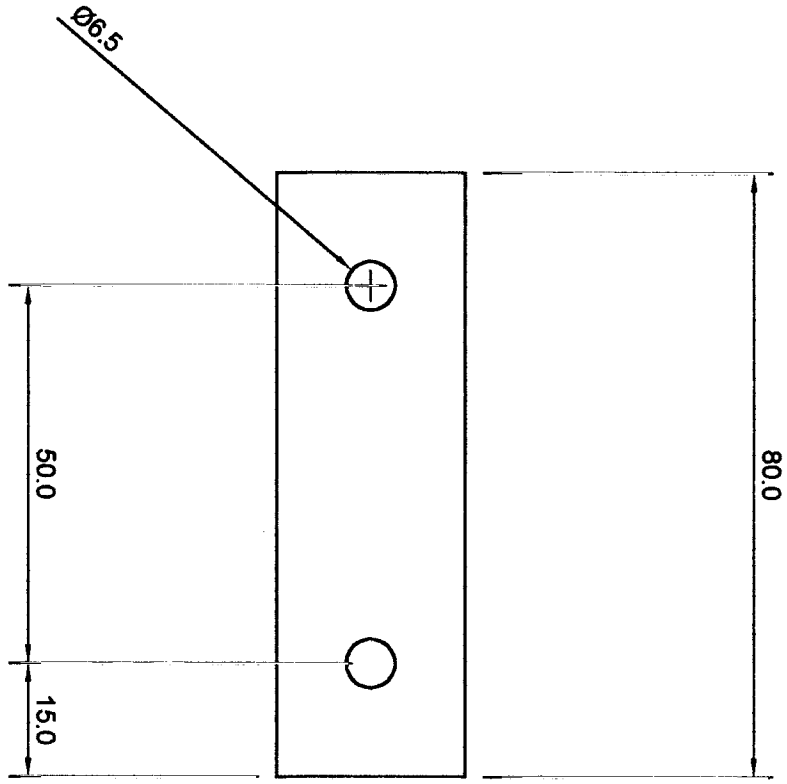


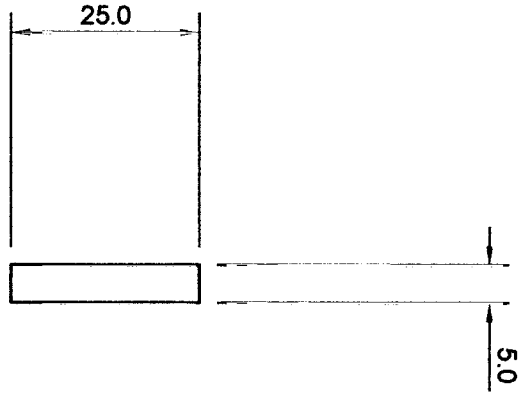


DRAFT

NOTES From 25 x 5 Bright Mild Steel	DRAWN BY: Peter Ball	DATE: 17.2.2000	TITLE Valve Support Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 50-032	SHT. 1 OF. 1

A4

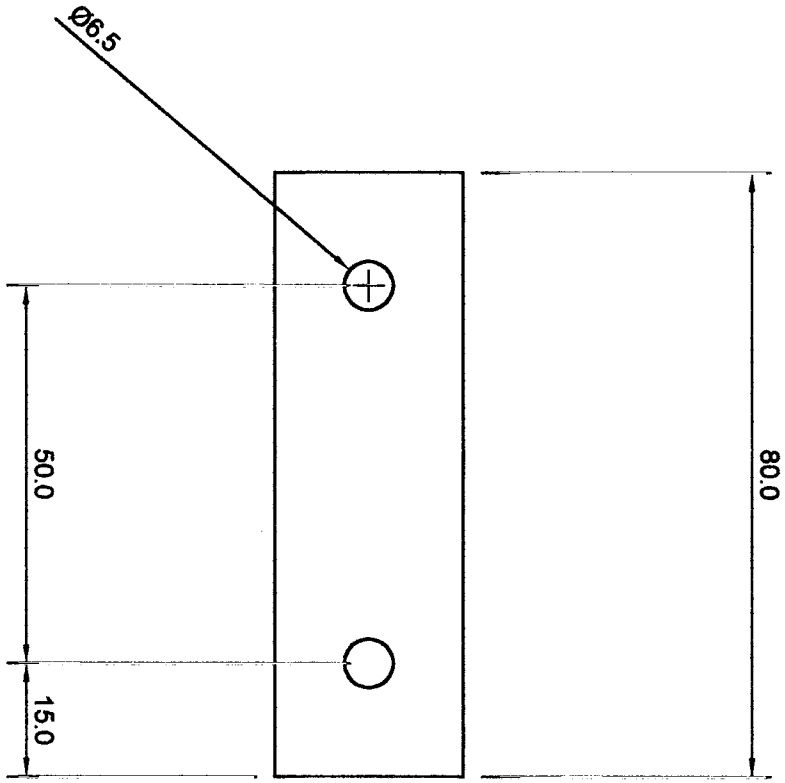


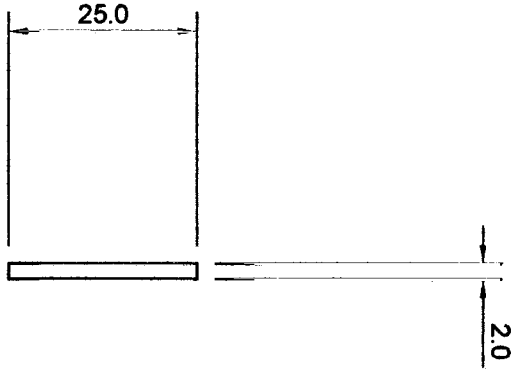


DRAFT

NOTES	DRAWN BY:	DATE:	TITLE
From 25 x 5 Bright Mild Steel	Peter Ball	17.2.2000	Valve Seat Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 50-033	SHT. 1 OF. 1

A4

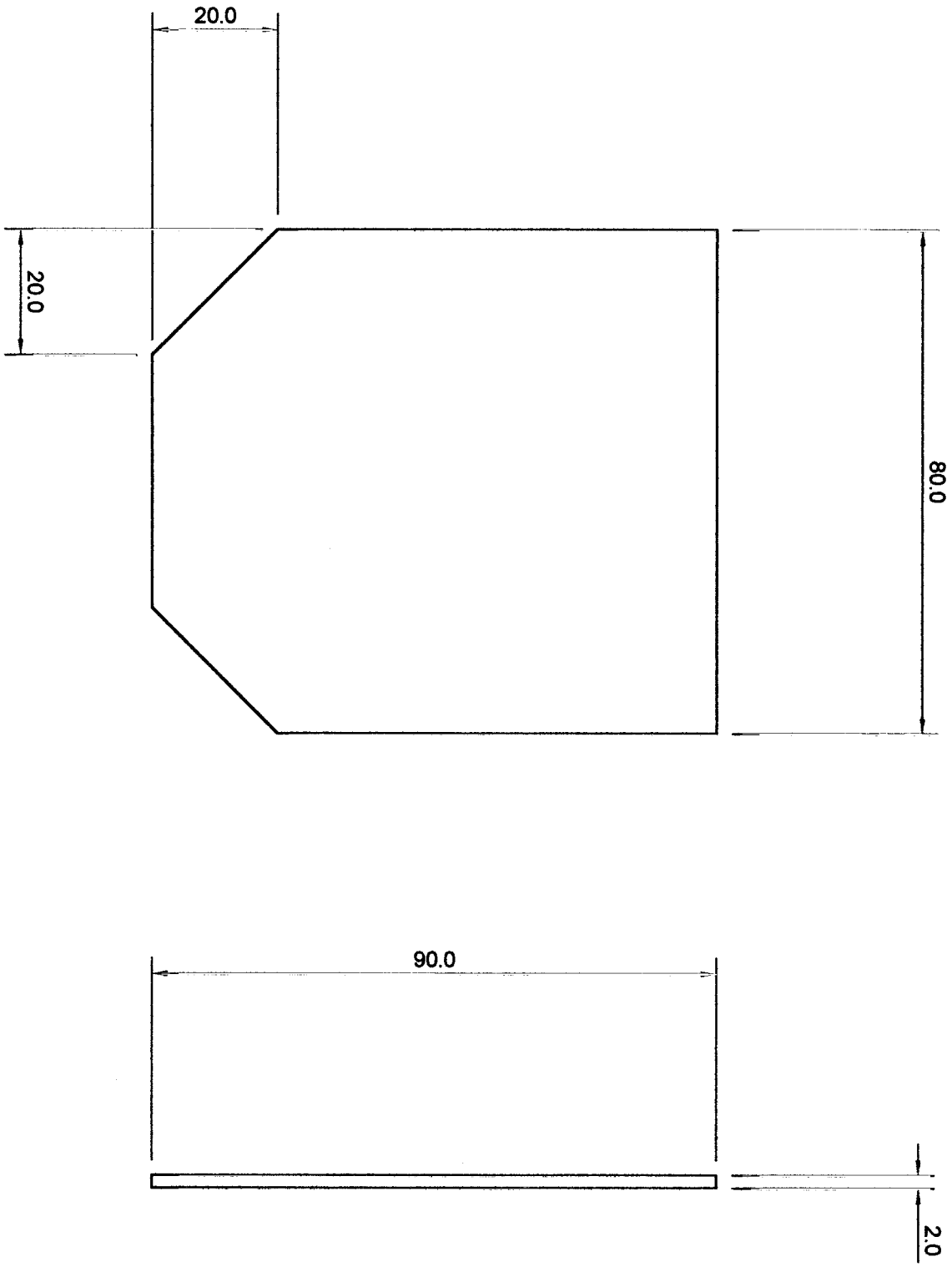




DRAFT

NOTES From 2mm Mild Steel Plate	DRAWN BY: Peter Ball	DATE: 17.2.2000	TITLE Hinge Cover Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 50-034	SHT. 1 OF. 1

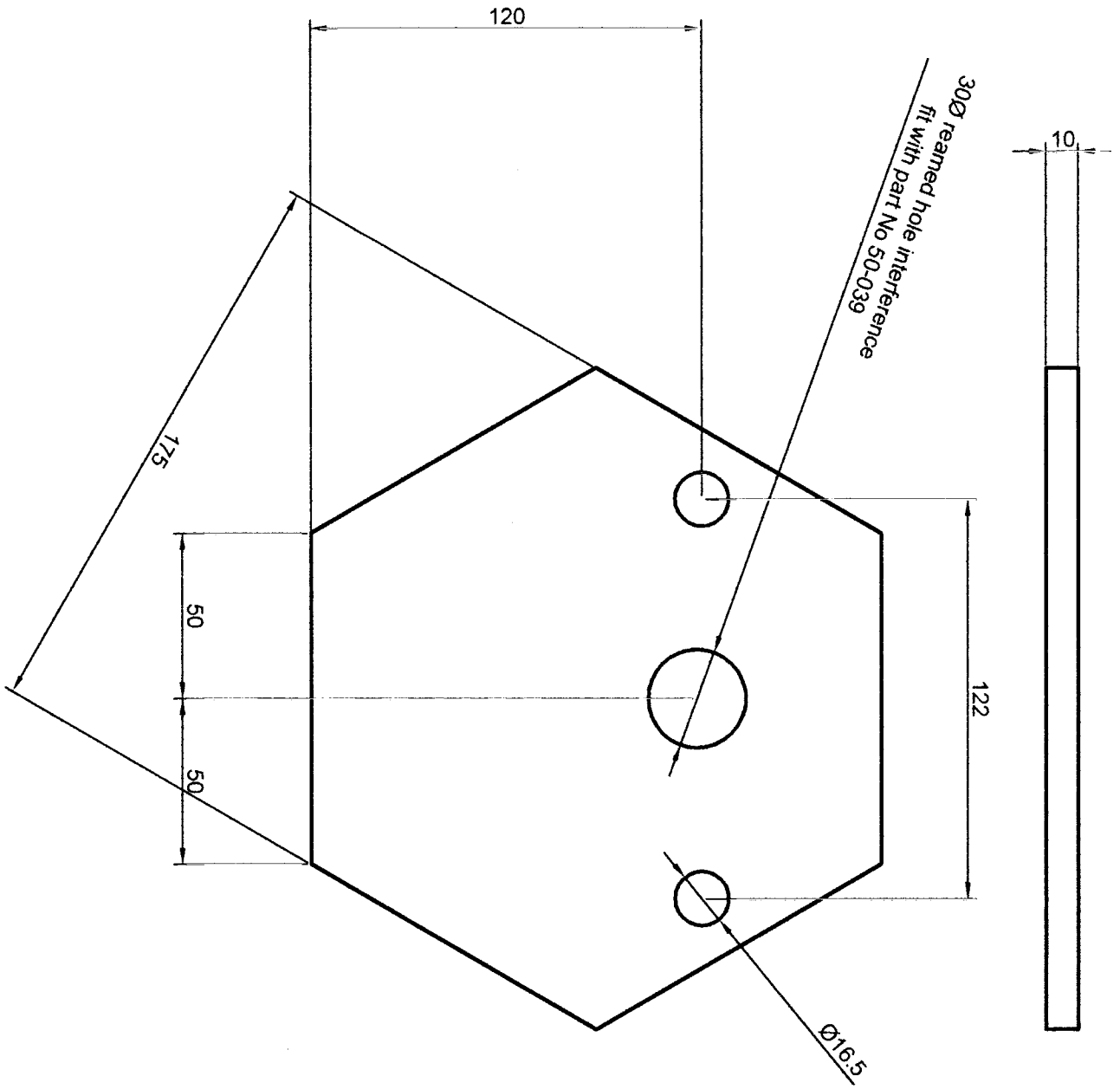
A4



DRAFT

NOTES	DRAWN BY.	DATE:	TITLE
From 2mm Mild Steel Plate	Peter Ball	17.2.2000	Valve Cover Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 50-035	SHT. 1 OF. 1

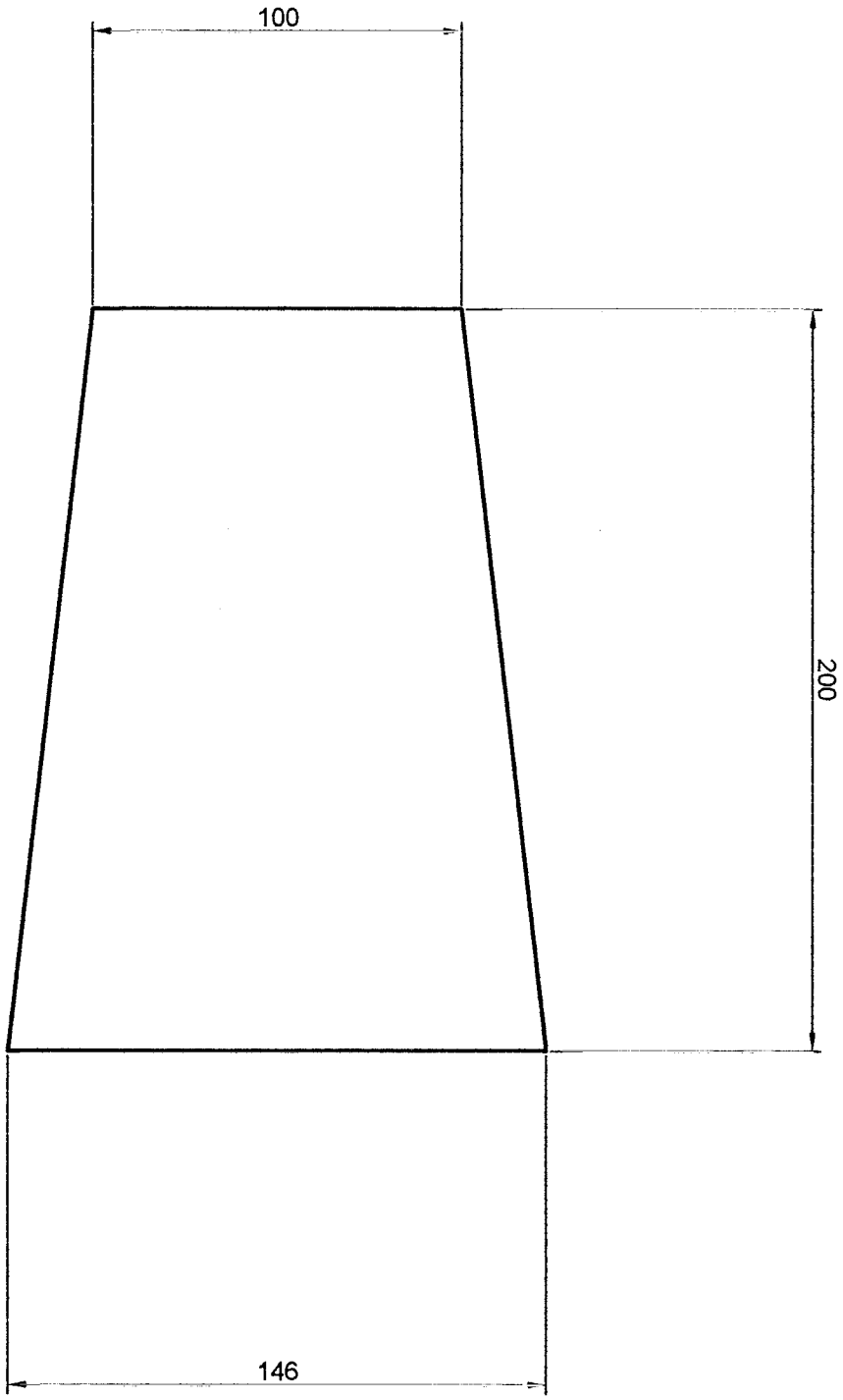
A4



DRAFT

NOTES	DRAWN BY:	DATE:	TITLE
Flame profiled from 10mm mild steel plate	Peter Ball	16.2.2000	Valve Top Pounder Rig
	19 JUN 2000	SCALE: 1:2	
		DRG No. 50-036	SHT. 1 OF. 1

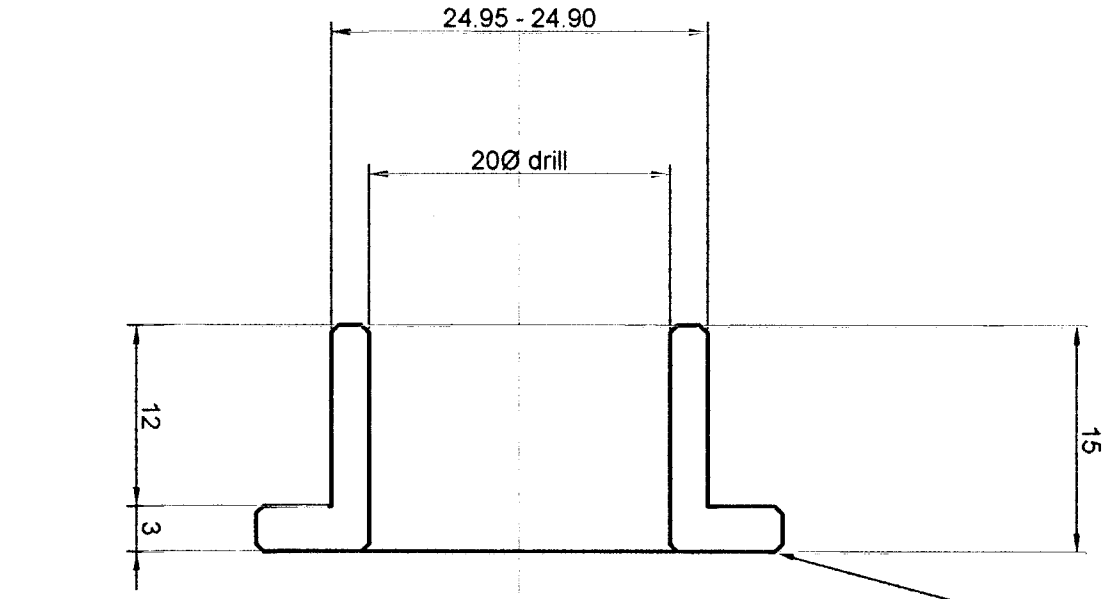
A4

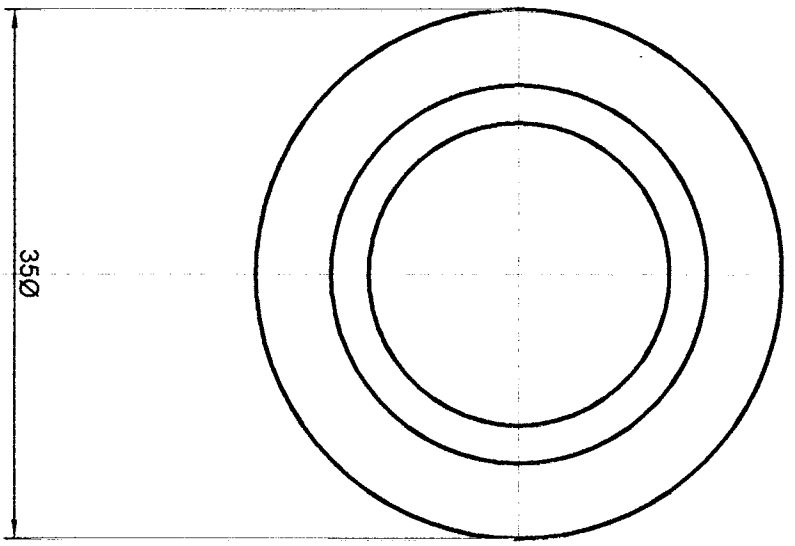


DRAFT

NOTES Sheared 3mm Mild steel Plate	DRAWN BY: Peter Ball	DATE: 16.2.2000	TITLE Valve Sides Pounder Rig
	19 JUN 2000	SCALE: 1:2	
		DRG No. 50-037	SHT. 1 OF. 1

A4

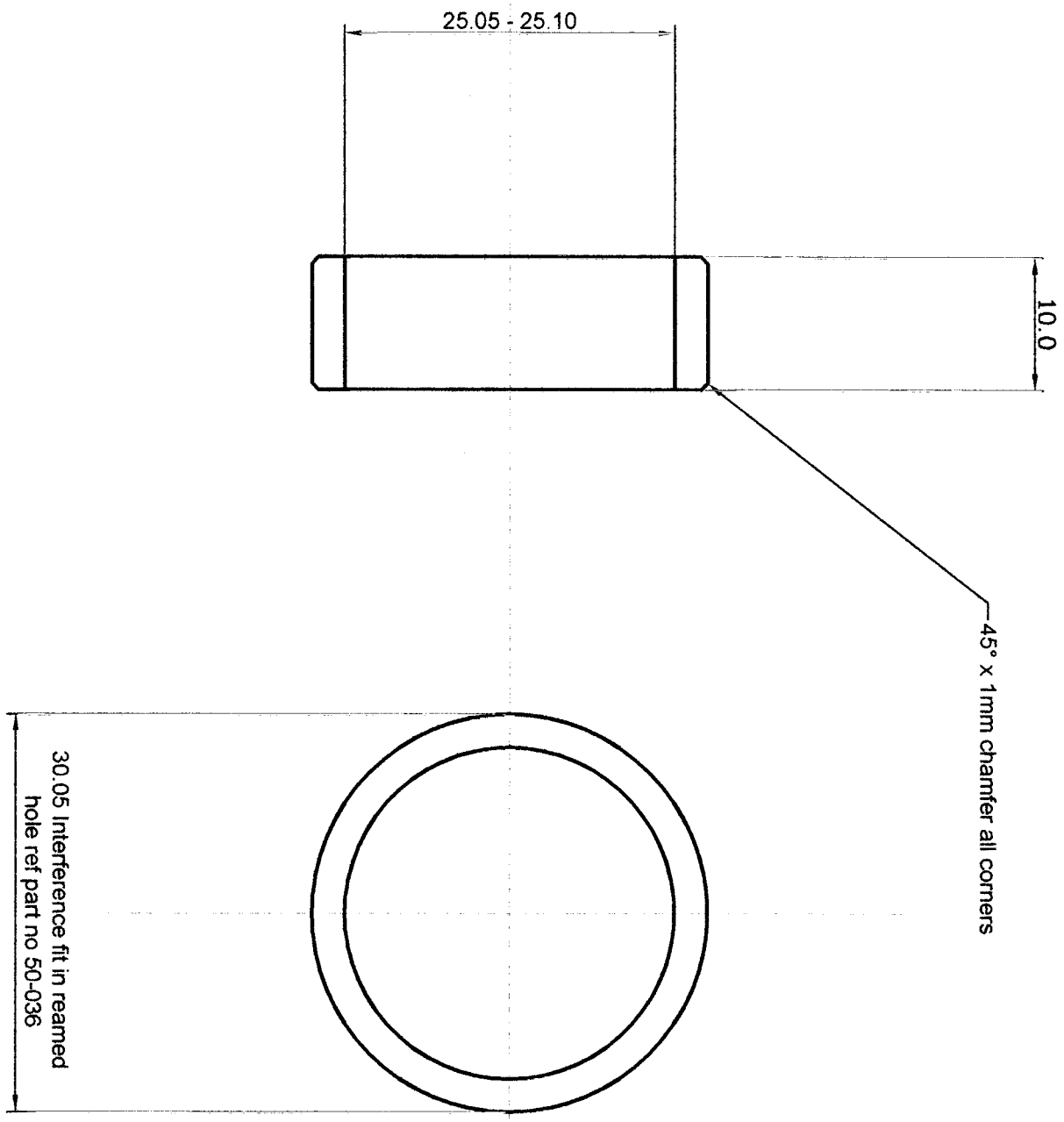




DRAFT

NOTES	DRAWN BY:	DATE:	TITLE
From 35+ BMS stock - Fully Machined and then case hardened	Peter Ball	16.2.2000	Inner Bush Pounder Rig
	19 JUN 2000	SCALE: 1:.5	
		DRG No. 50-038	SHT. 1 OF. 1

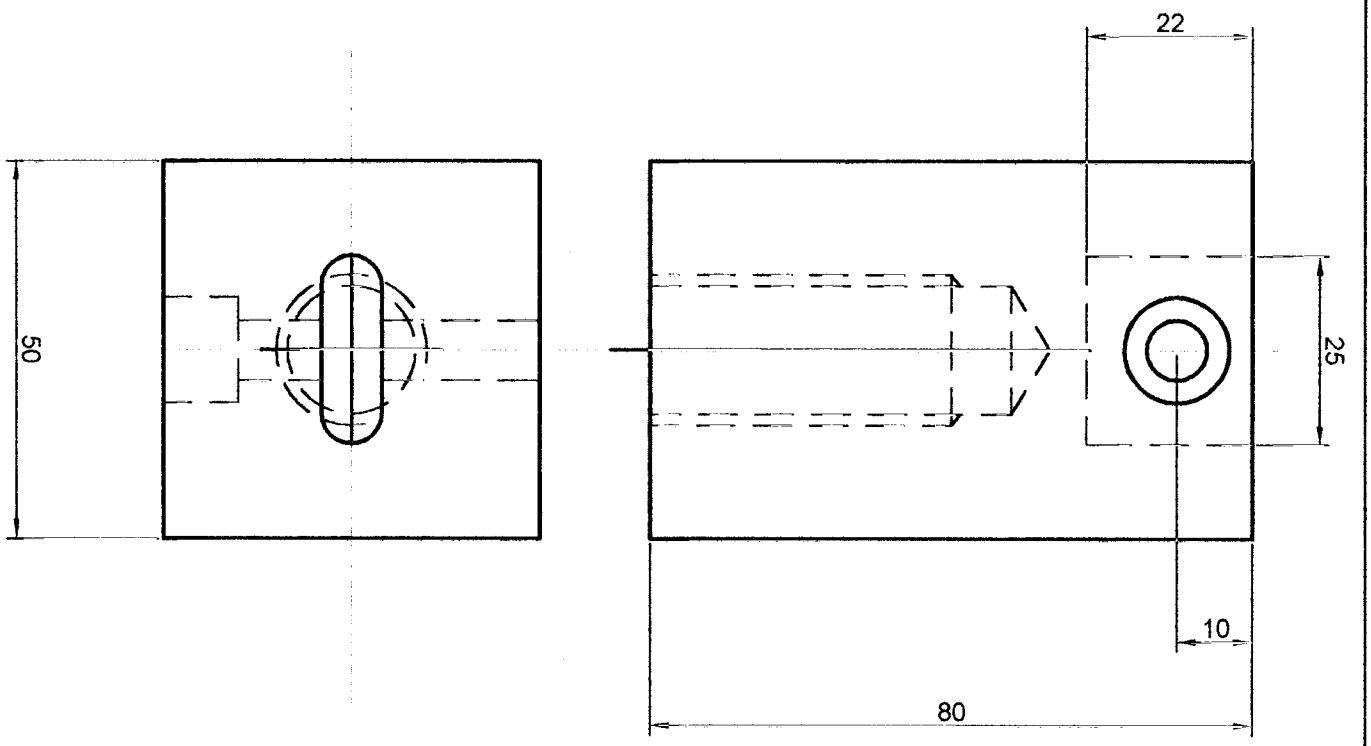
A4

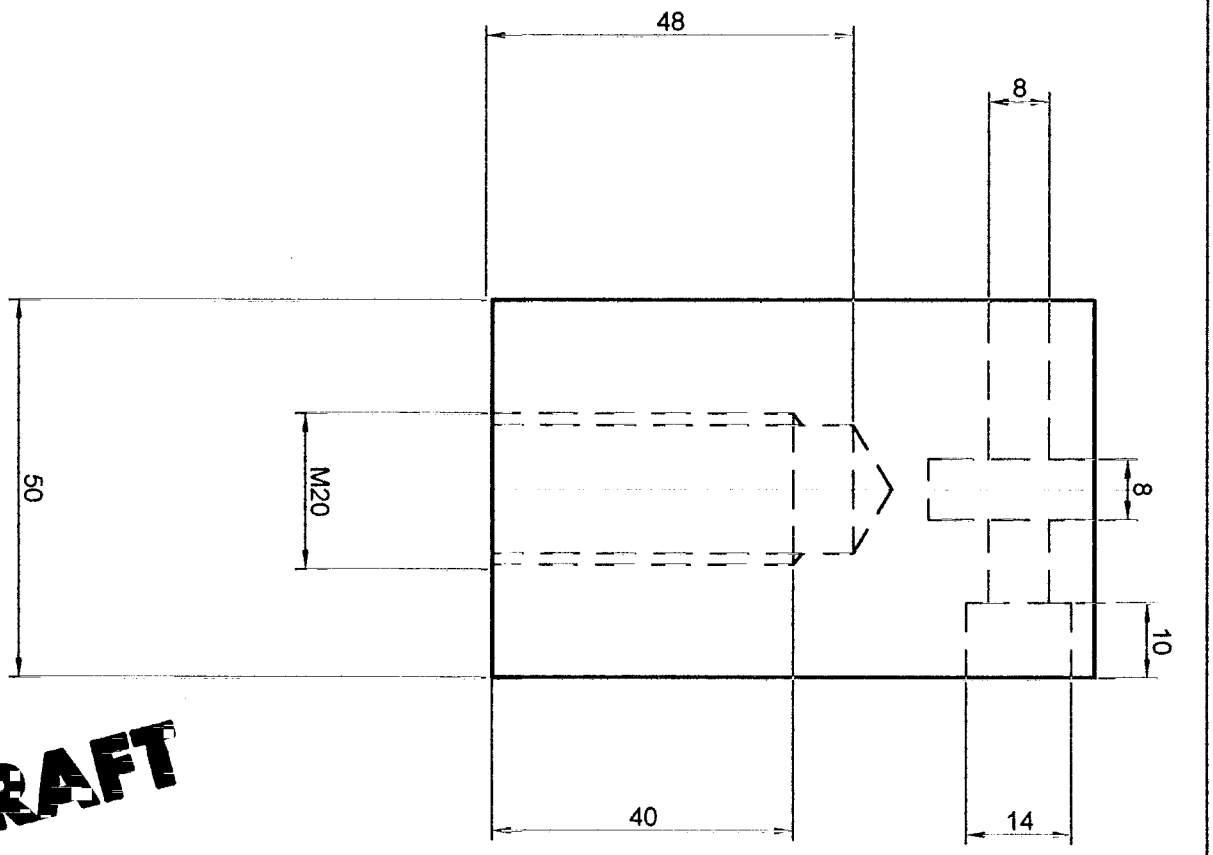


DRAFT

NOTES	DRAWN BY:	DATE:	TITLE
From BMS stock - Fully Machined and then case hardened	Peter Ball	16.2.2000	Outer Bush Pounder Rig
	19 JUN 2000	SCALE: 1:.5	
		DRG No. 50-039	SHT. 1 OF. 1

A4

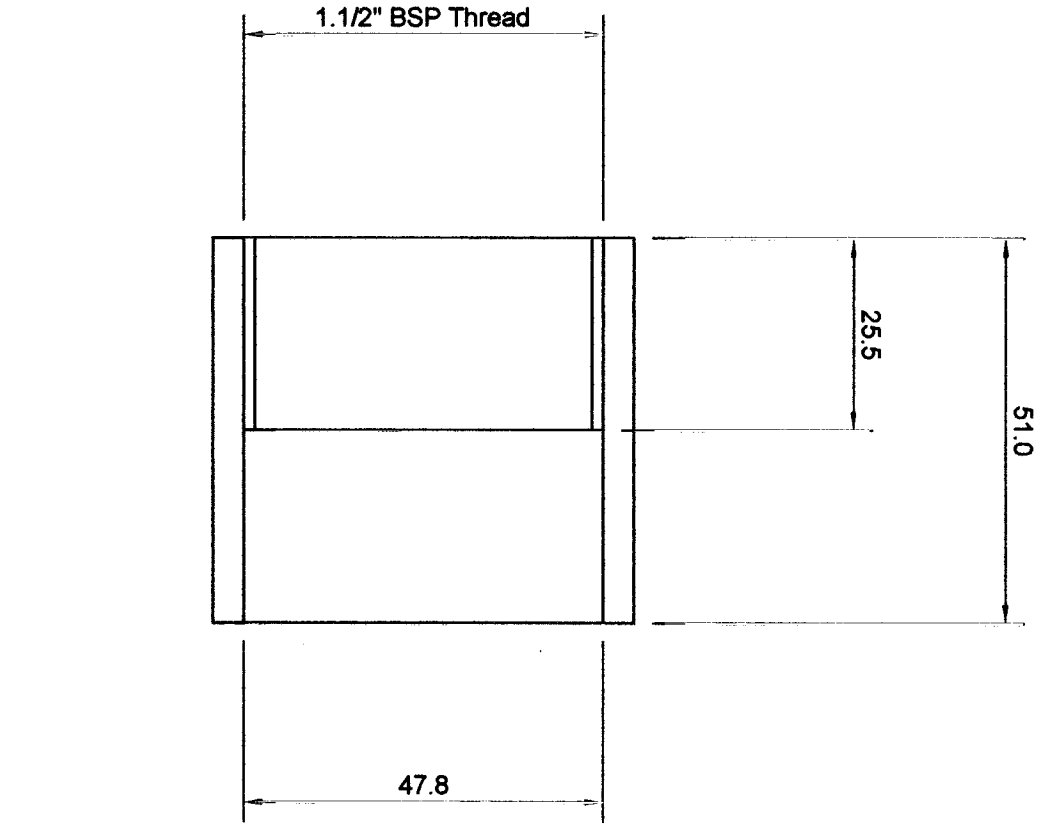


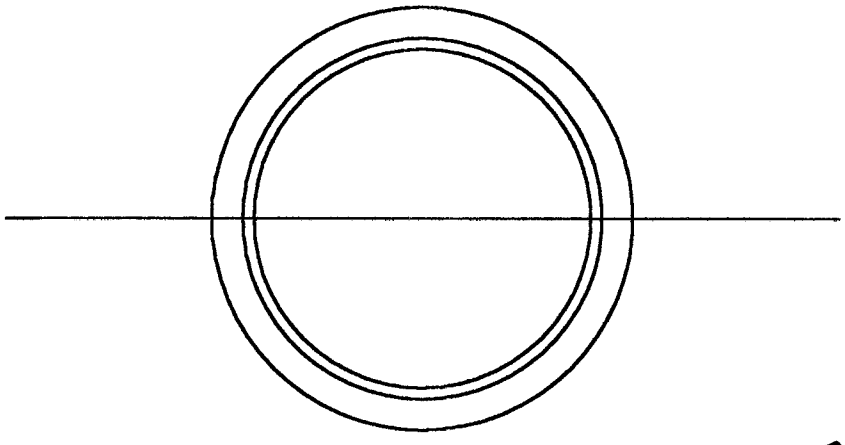


DRAFT

NOTES	DRAWN BY:	DATE:	TITLE
From 50 x 50 BMS	Peter Ball	16.2.2000	Swivel Block Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 50-040	SHT. 1 OF. 1

A4

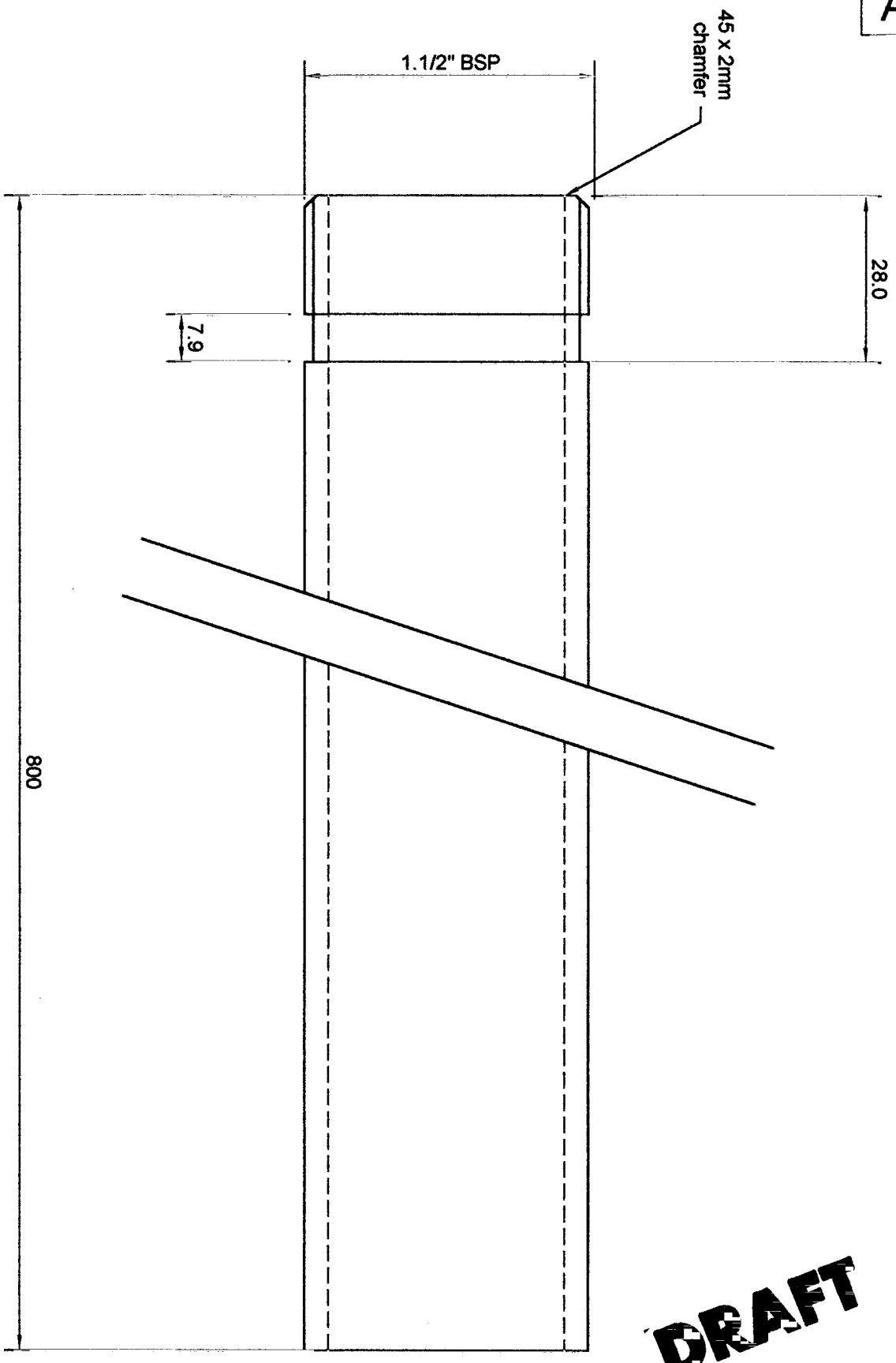




DRAFT

NOTES	DRAWN BY:	DATE:	TITLE
Machined from part 10-050 1.1/2" BSP Black Steel Socket	Peter Ball	16.2.2000	Handle Bush Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 50-041	SHT. 1 OF. 1

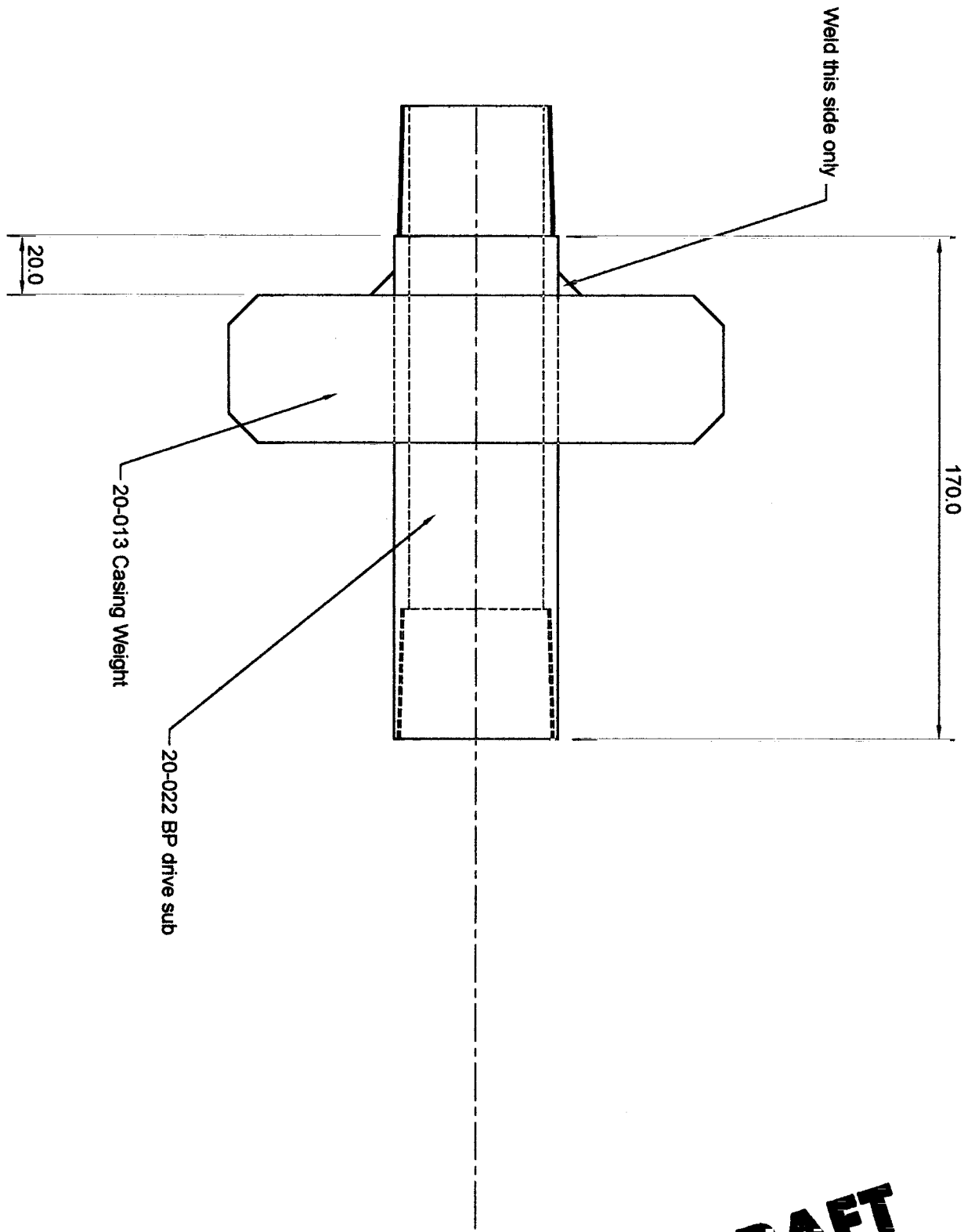
A4



DRAFT

NOTES	DRAWN BY:	DATE:	TITLE
Machined from 1.1/2" Aluminium Scaffold Tube	Peter Ball	16.2.2000	Handles Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 50-042	SHT. 1 OF. 1

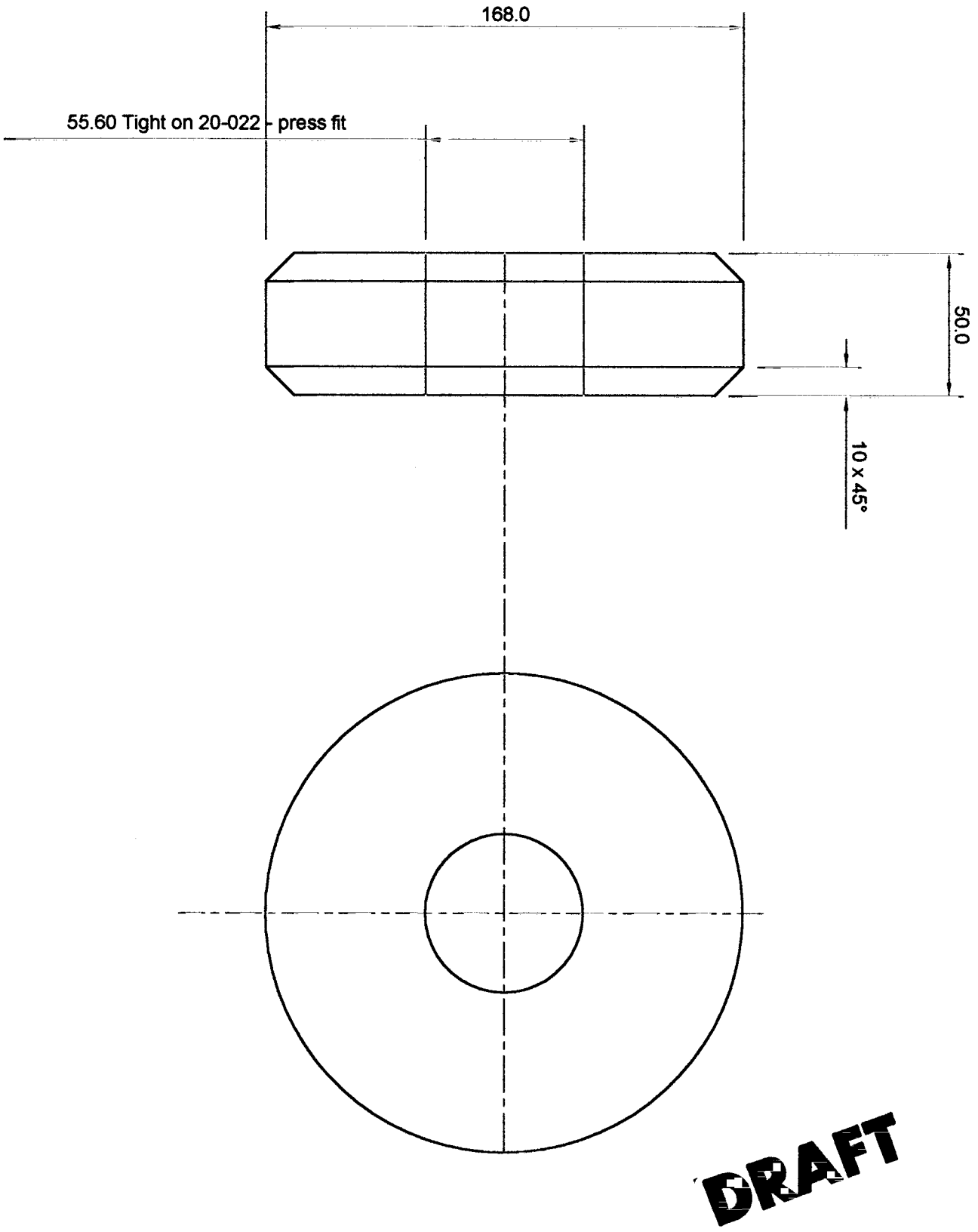
A4



DRAFT

NOTES	DRAWN BY: Peter Ball	DATE: 28.4.2000	TITLE BQ Driver Pounder Rig
	19 JUN 2000	SCALE: 1:2	
		DRG No. 20-023	SHT. 1 OF. 1

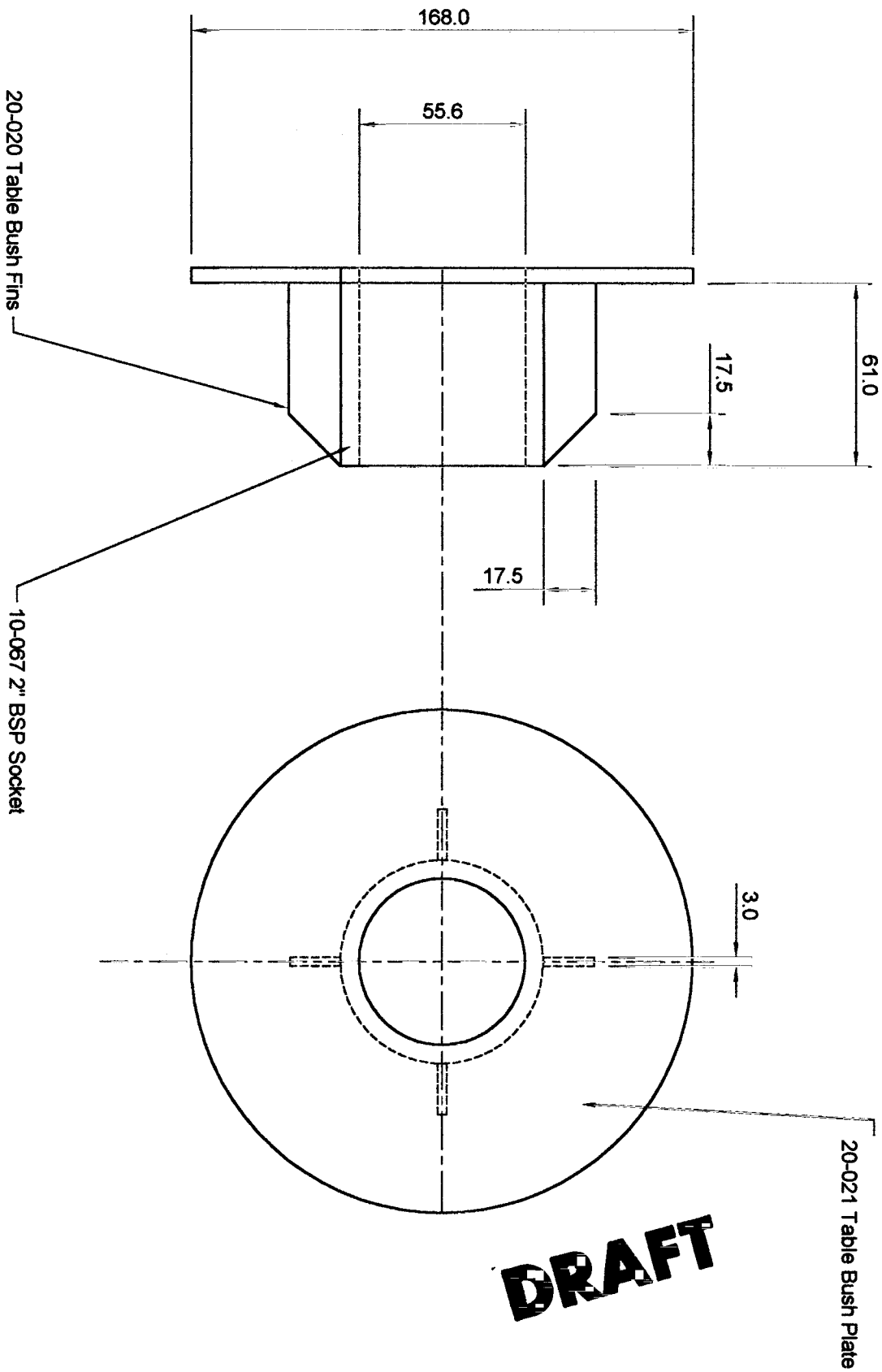
A4



DRAFT

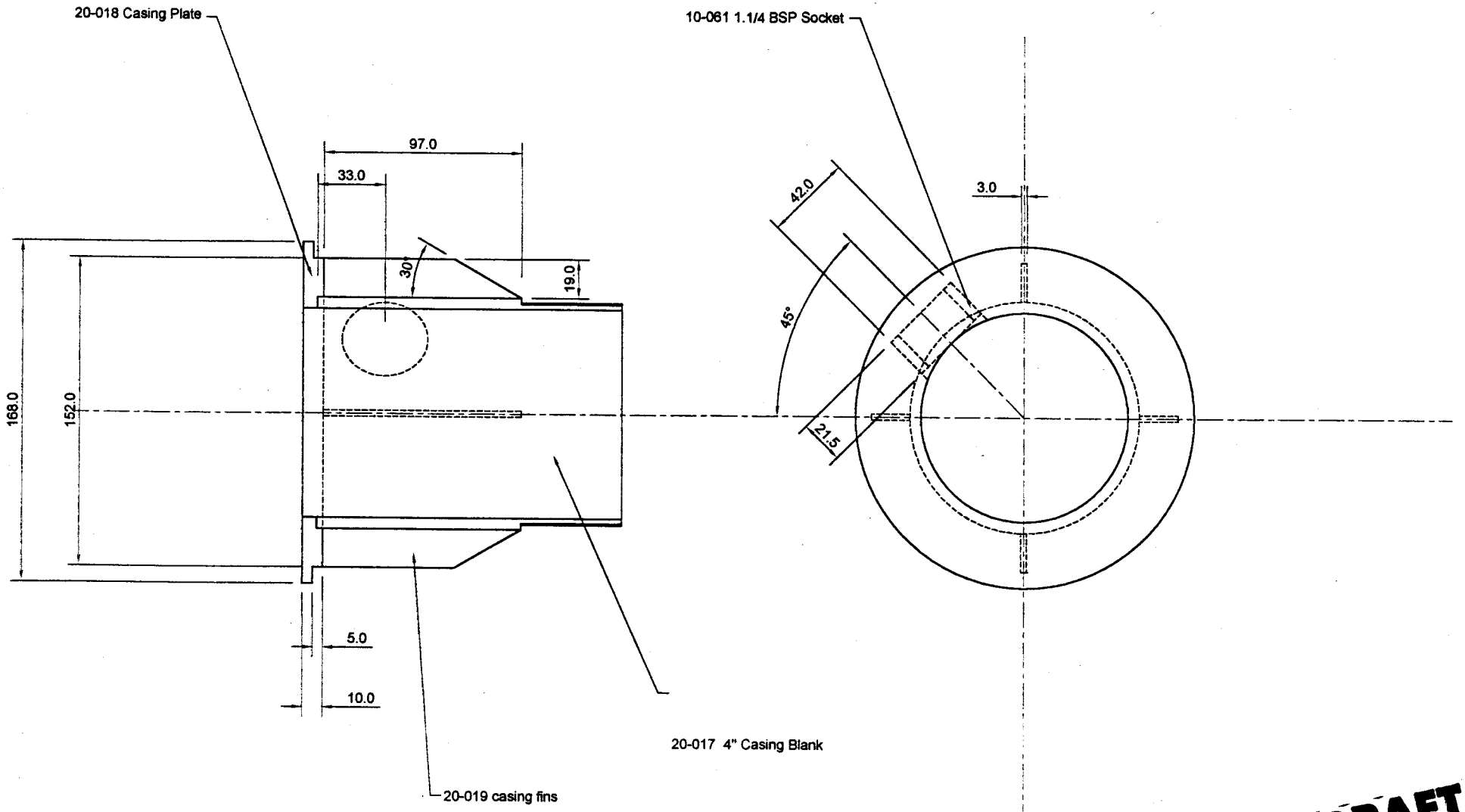
NOTES	DRAWN BY: Peter Ball	DATE: 28.4.2000	TITLE: BQ Casing Weight Pounder Rig
	19 JUN 2000	SCALE: 1:2	
		DRG No. 20-013	SHT. 1 OF. 1

A4



NOTES	DRAWN BY: Peter Ball	DATE: 27.4.2000	TITLE BP Table Bush Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 20-012	SHT. 1 OF. 1

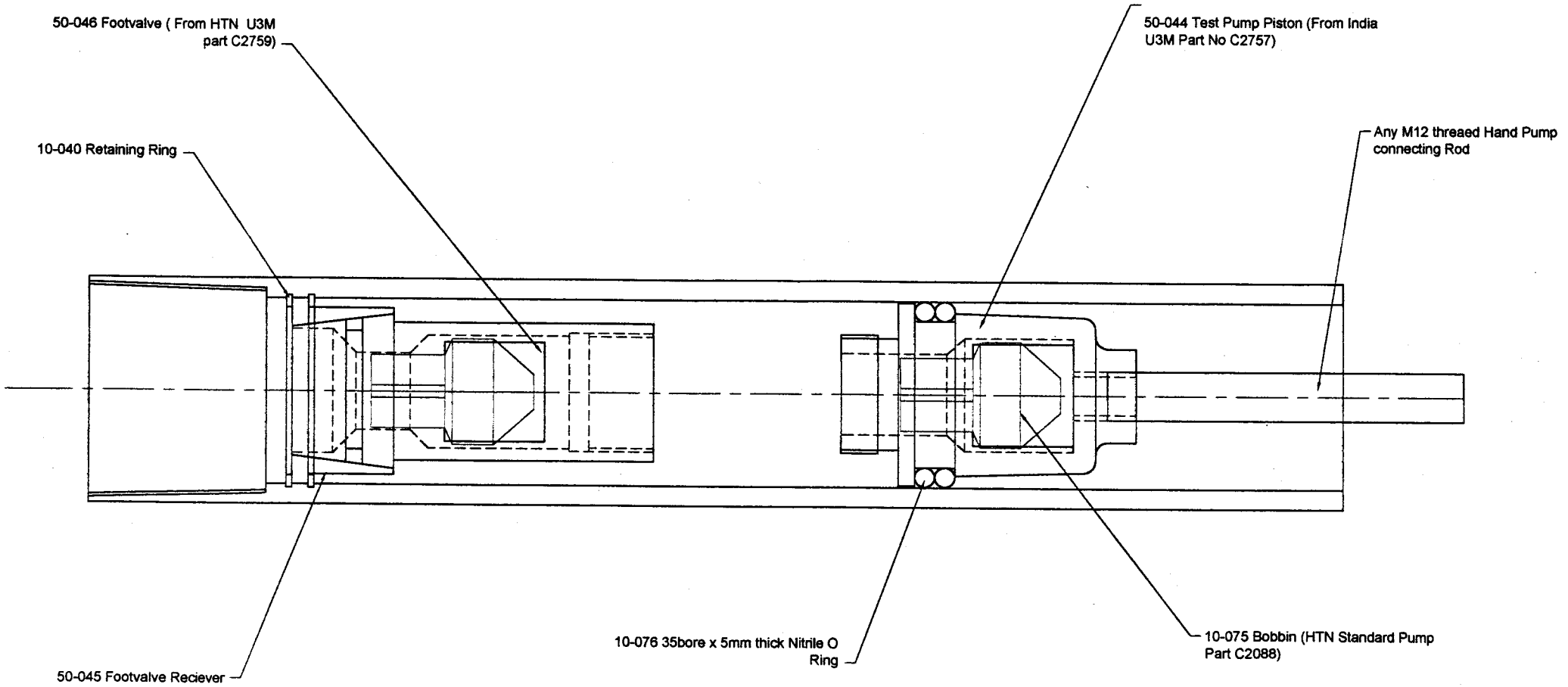
A3



DRAFT

NOTES	DRAWN BY: Peter Ball	DATE: 28.4.2000	TITLE: 4" Casing Top Pounder Rig
	19 JUN 2000	SCALE: 1:2	
		DRG No. 20-011	SHT. 1 OF. 1

A3



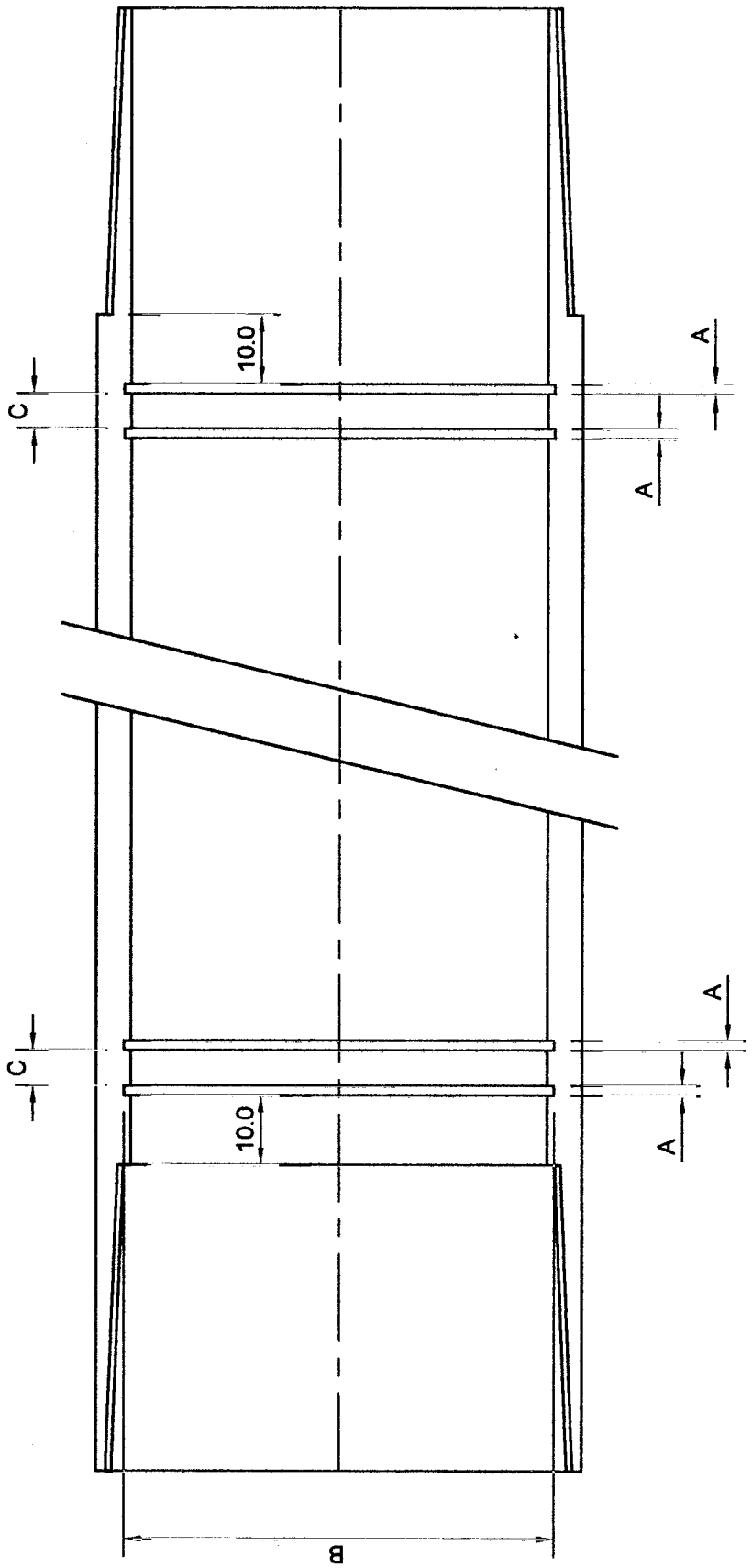
DRAFT

NOTES	DRAWN BY	DATE	TITLE
	Peter Ball	3.5.2000	Test Pump Arrangement Pounder Rig
	19 JUN 2000	SCALE Full	
		DRG No. 50-047	SHT 1 OF 1

A4

Size	Bore of Tube	Part No	Groove Width	Groove Dia	Dist between grooves	Ring Part No
			A	B	C	
BP	46	20-004	1.41	47.6	4.0	10-040
NP	60.3	20-005	1.41	64.0	5.0	10-041
HP	77.8	20-006	1.73	80.2	8.0	10-042

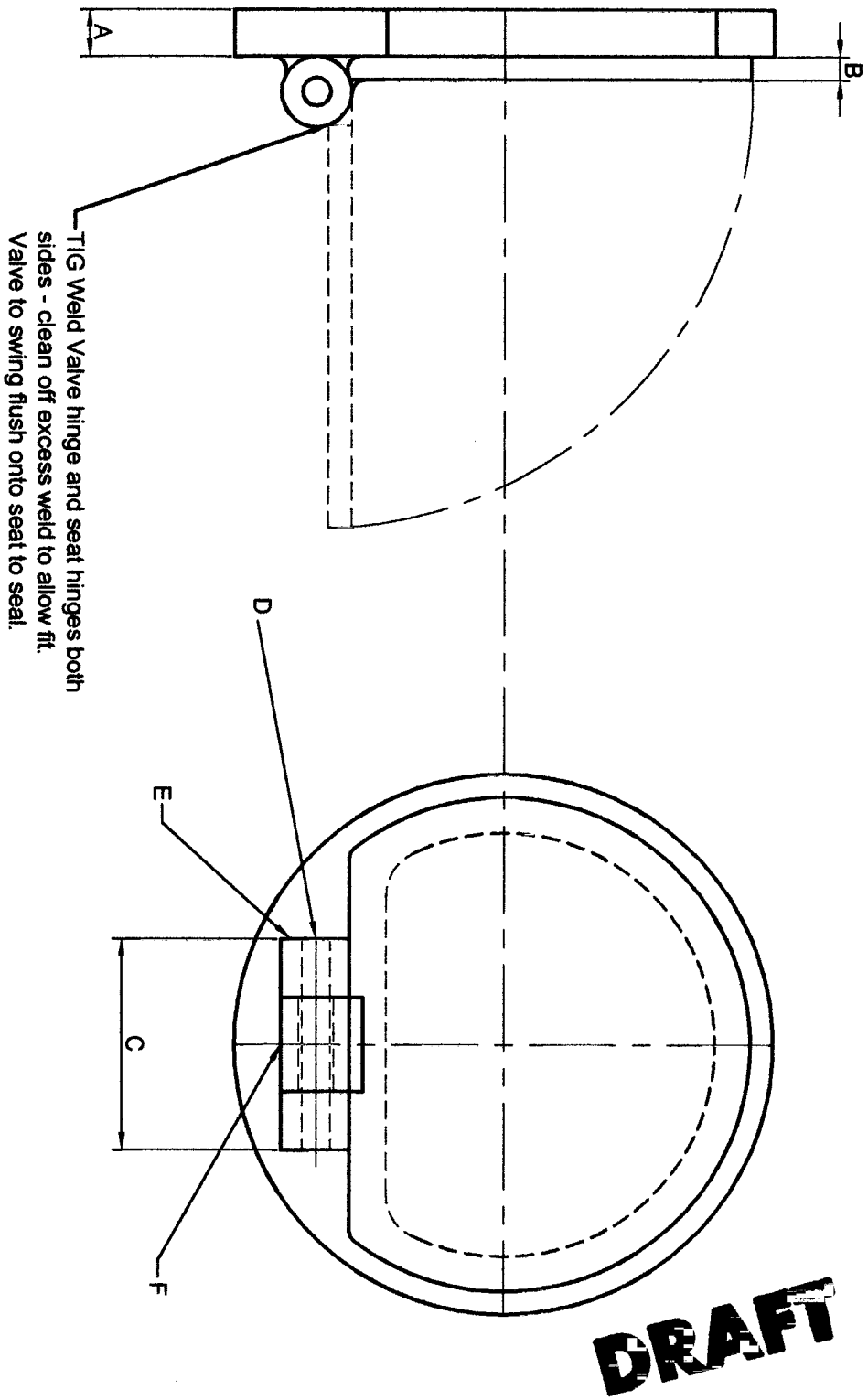
Tolerances - All Dims + .07 - 00



DRAFT

NOTES	DRAWN BY: Peter Ball	DATE: 27.4.2000	TITLE: Drillpipe Grooves Pounder Rig
	19 JUN 2000	SCALE: NTS	
		DRG No. 20-004,5&6	SHT. 1 OF. 1

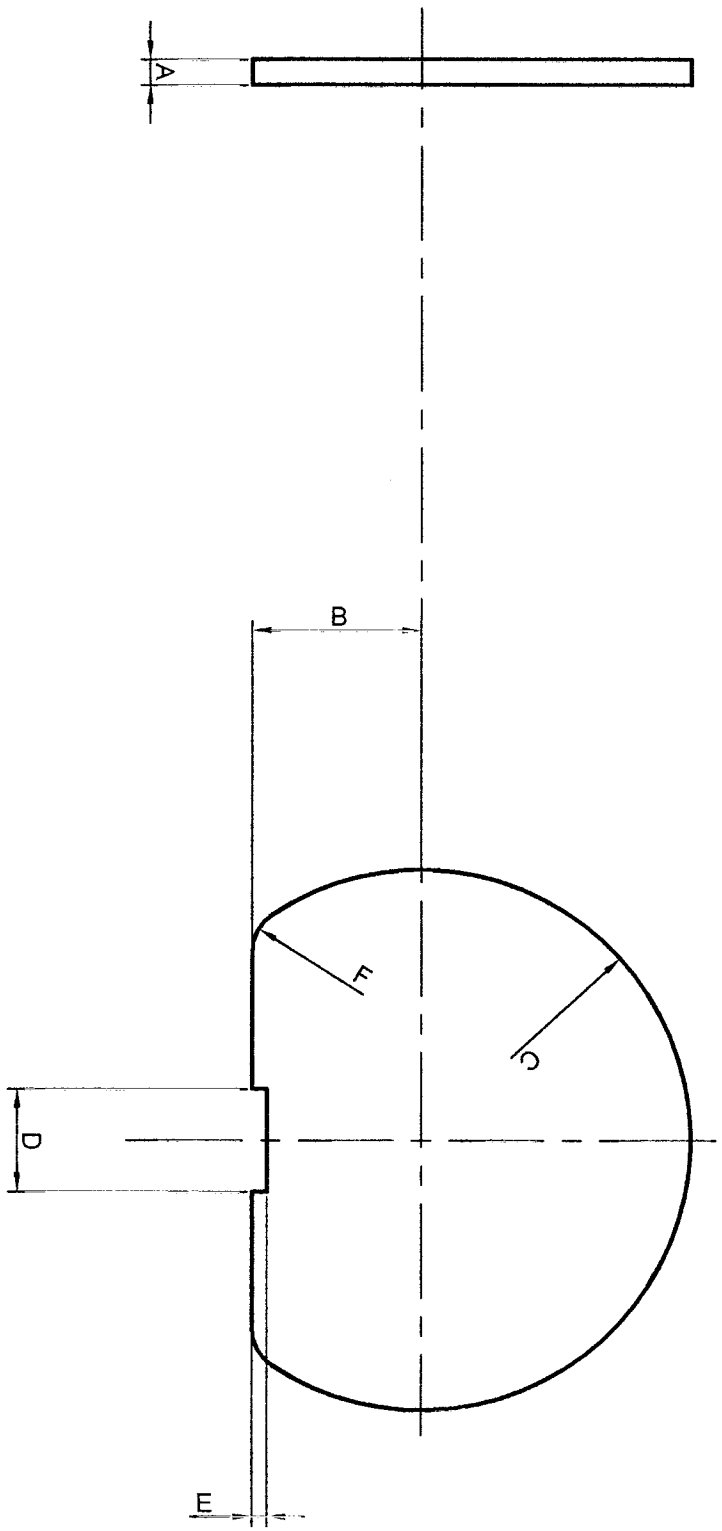
A4



Size	Bore of tube	Part No	Valve Seat A	Part No	Valve B	Part No	Roll Pin Lg C	Roll Pin Dia D	Roll Pin Pt No	Part No E	Part No F
BP	46	50-012	4mm	50-018	2mm	50-015	18mm	2.5mm	10-037	50-021	50-024
NP	60.3	50-013	5mm	50-019	3mm	50-016	25mm	4mm	10-038	50-022	50-025
HP	77.8	50-014	8mm	50-020	4mm	50-017	30mm	6mm	10-039	50-023	50-026

NOTES	DRAWN BY:	DATE:	TITLE
Fabricate and weld from SS Grade 304	Peter Ball	3/2/2000	Clack Valve Pounder Rig
	19 JUN 2000	SCALE: NTS	
		DRG No. 50-012,13,14	SHT. 1 OF. 1

A4

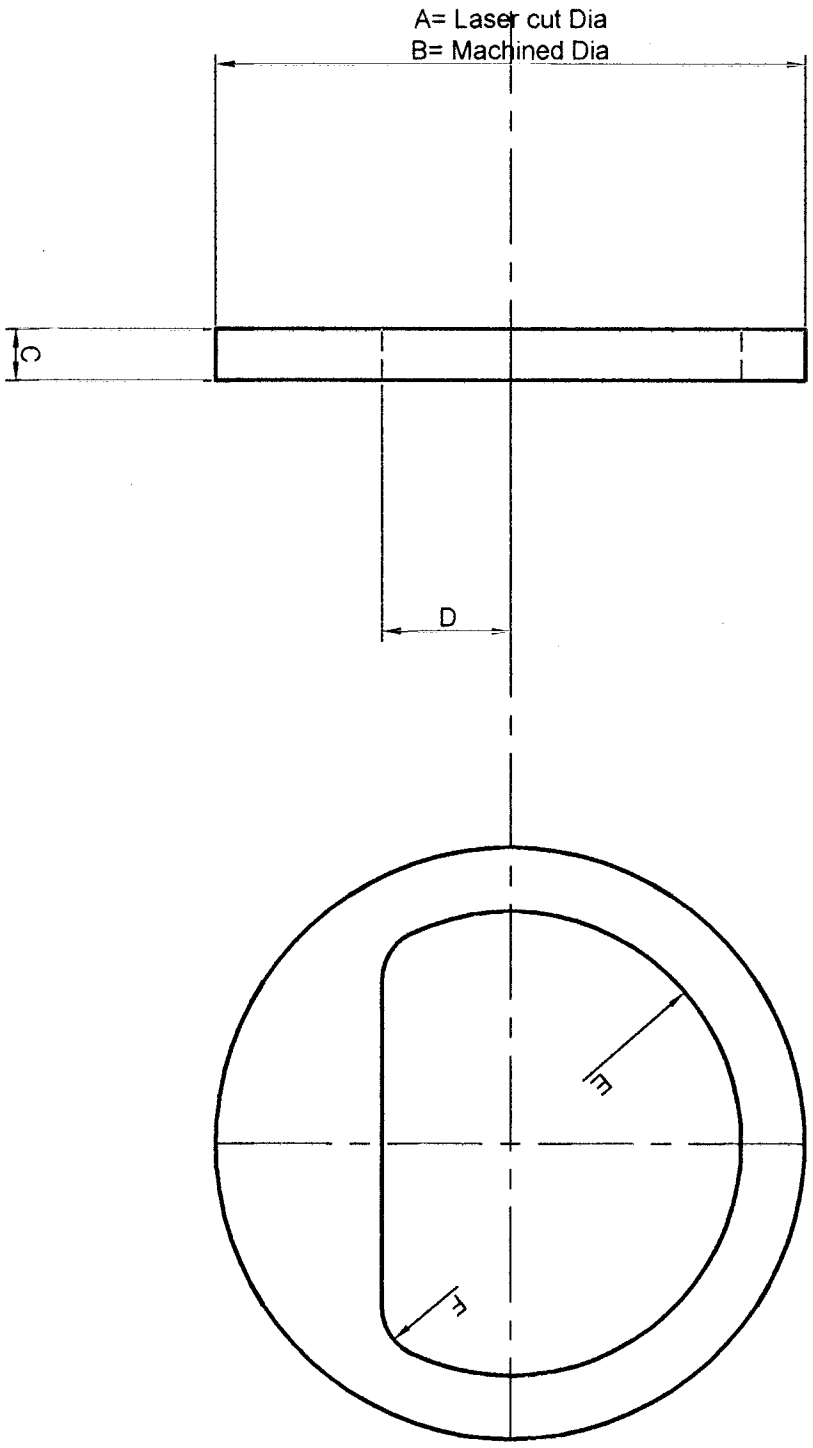


Size	Bore of tube	Part No	Thick	Offset	Dia	Cutout Width	Cutout depth	Rad
			A	B	C	D	E	F
BP	46	**50-015**	2	13.2	42	8	1	4
NP	60.3	**50-016**	3	17.3	55	10	1.5	5
HP	77.8	**50-017**	4	22.3	71	13.5	2	7

DRAFT

NOTES Stainless Steel Grade 304	DRAWN BY: Peter Ball	DATE: 3.2.2000	TITLE Valve Pounder Rig
	19 JUN 2000	SCALE: NTS	
		DRG No.	50-015,16,17 SHT. 1 OF. 1

A4



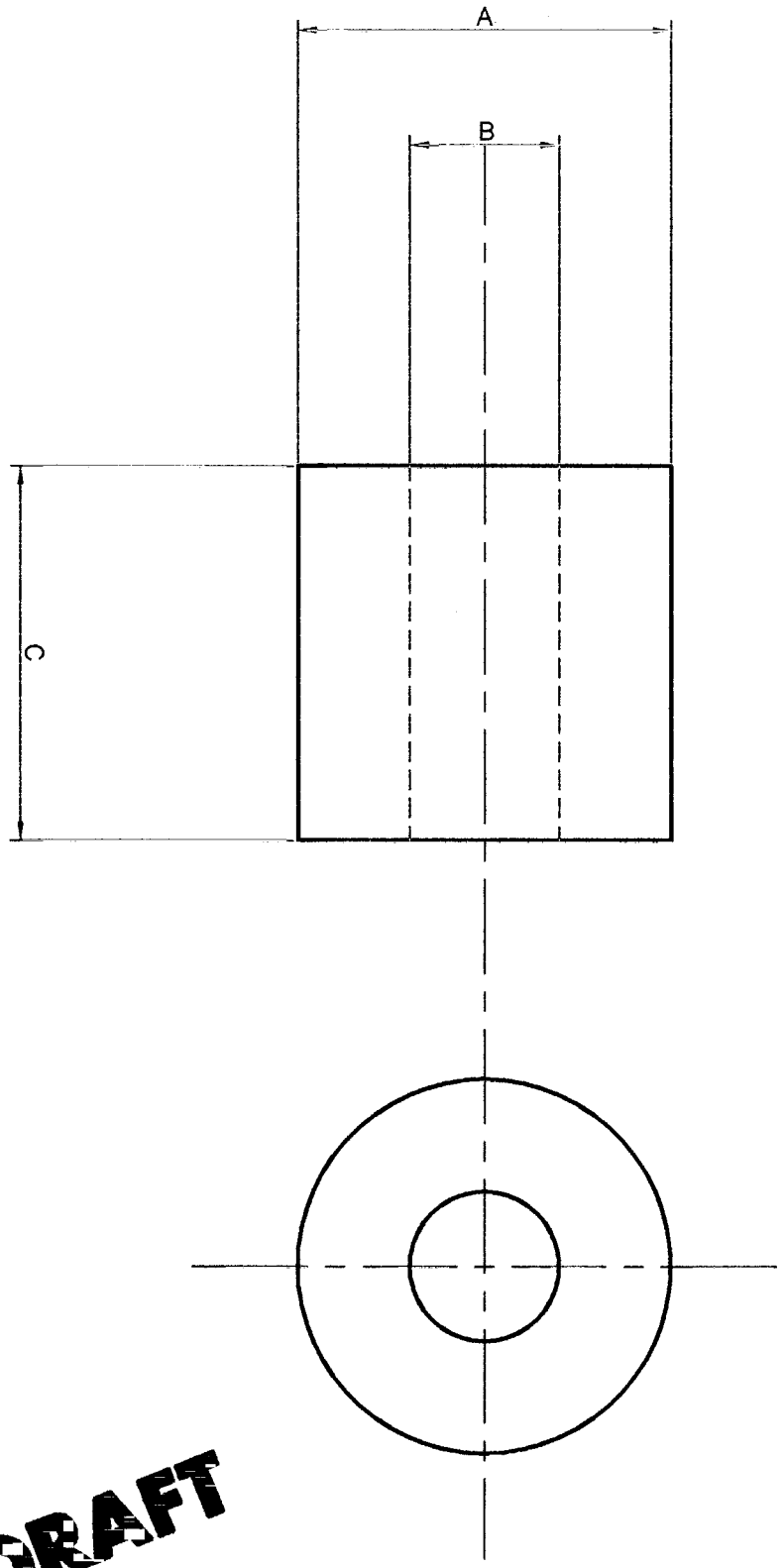
Size	Bore of tube	Part No	Lasercut dia +	Machined diameter		Thick	Offset	ID	Rad
			A	B		C	D	E	F
				Max	Min				
BP	46	**50-018**	48	46.00	45.90	4	10	36	4
NP	60.3	**50-019**	62	60.10	60.00	5	13	47	5
HP	77.8	**50-020**	80	77.70	77.50	8	17	61	7

DRAFT

NOTES	DRAWN BY:	DATE:	TITLE
Stainless Steel Grade 304	Peter Ball	3.2.2000	Valve Seat Pounder Rig
	19 JUN 2000	SCALE: NTS	
		DRG No.	50-018,19,20

SHT. 1 OF. 1

A4

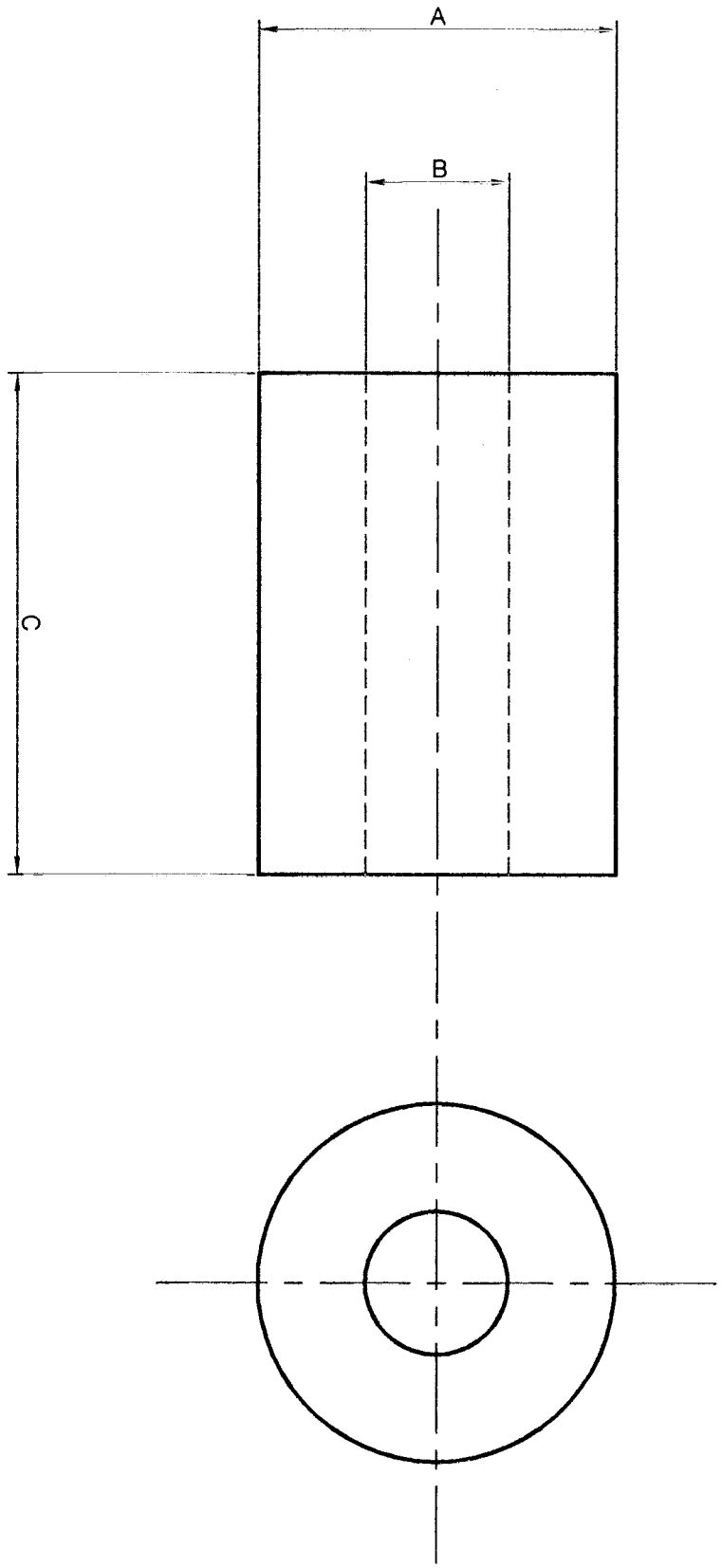


Size	Bore of tube	Part No	Thick	Offset	Dia
			A	B	C
BP	46	50-015	2	13.2	42
NP	60.3	50-016	3	17.3	55
HP	77.8	50-017	4	22.3	71

DRAFT

NOTES Stainless steel Grade 304	DRAWN BY: Peter Ball	DATE: 3.2.2000	TITLE Valve seat hinge Pounder Rig
	19 JUN 2000	SCALE: NTS	
		DRG No. 50-021,22,23	SHT. 1 OF. 1

A4

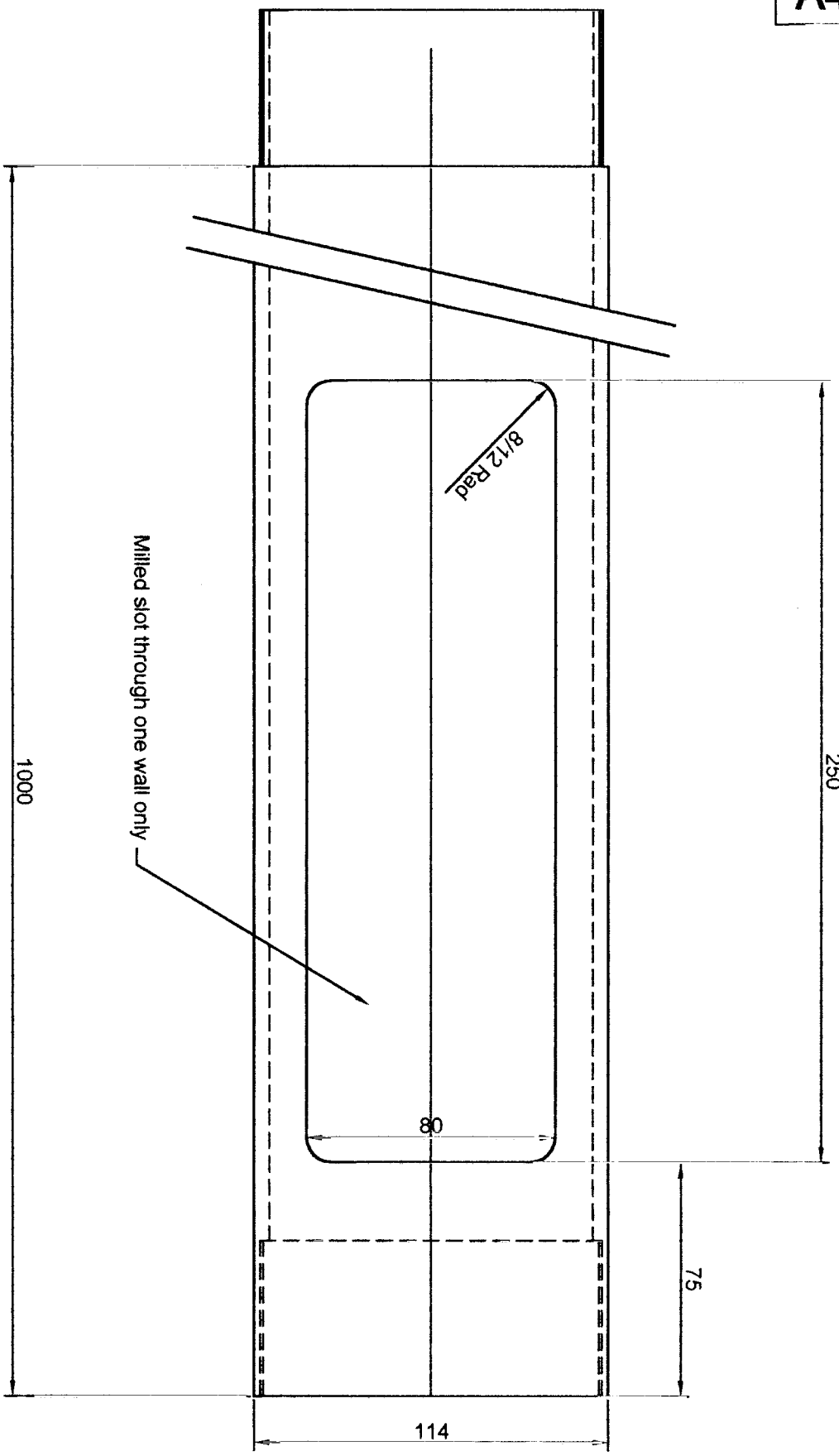


Size	Bore of tube	Part No		Thick	Offset	Dia
				A	B	C
BP	46	50-015		2	13.2	42
NP	60.3	50-016		3	17.3	55
HP	77.8	50-017		4	22.3	71

DRAFT

NOTES	DRAWN BY:	DATE:	TITLE
Stainless steel Grade 304	Peter Ball	3.2.2000	Valve hinge
	19 JUN 2000	SCALE: NTS	Pounder Rig
		DRG No.	50-024,25,26 SHT. 1 OF. 1

A4

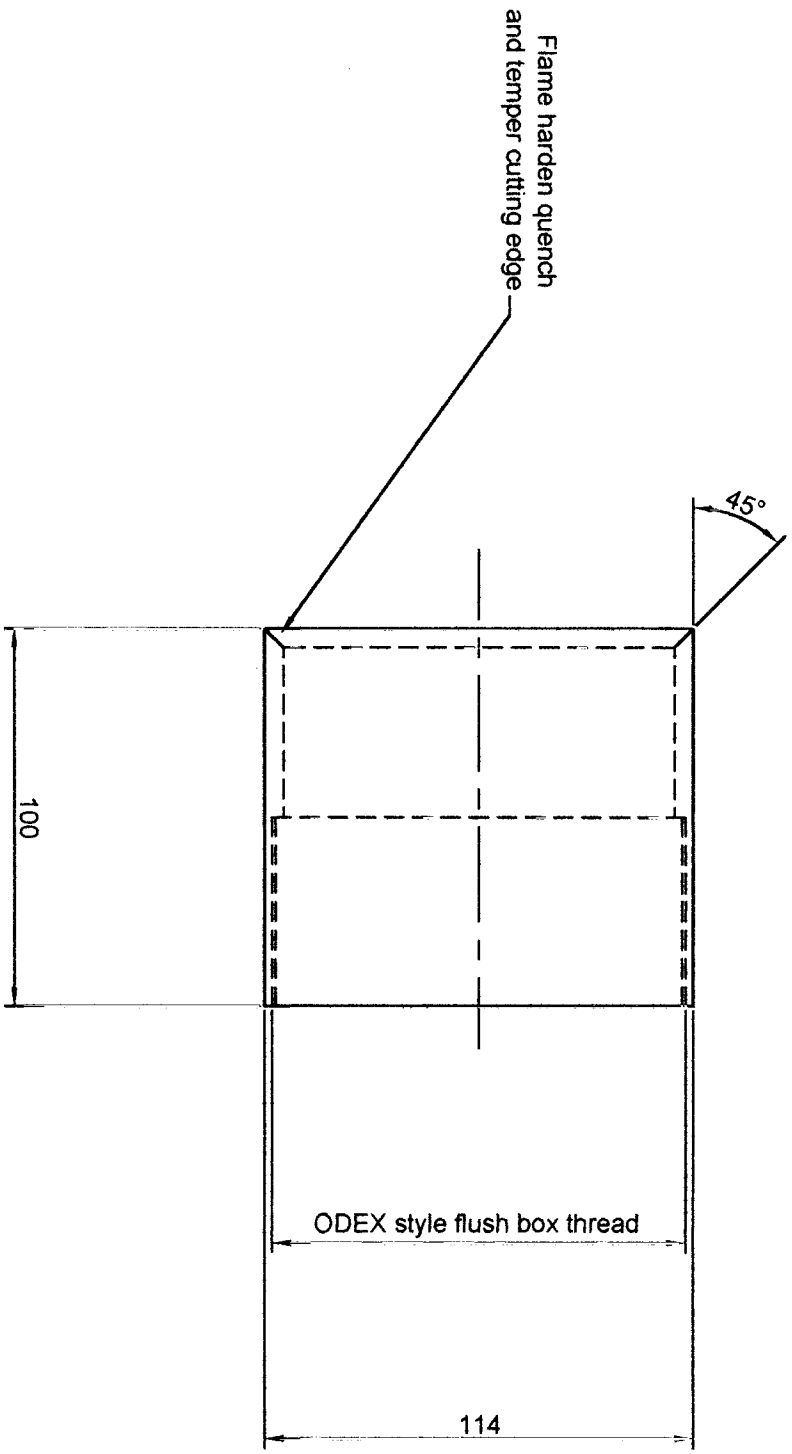


DRAFT

Material: 20-014 114mm x 1m steel casing

NOTES	DRAWN BY: Peter Ball	DATE: 15.6.2000	TITLE Conductor Casing Pounder Rig
	19 JUN 2000	SCALE: 1:2	
		DRG No. 20-027	SHT. 1 OF. 1

A4

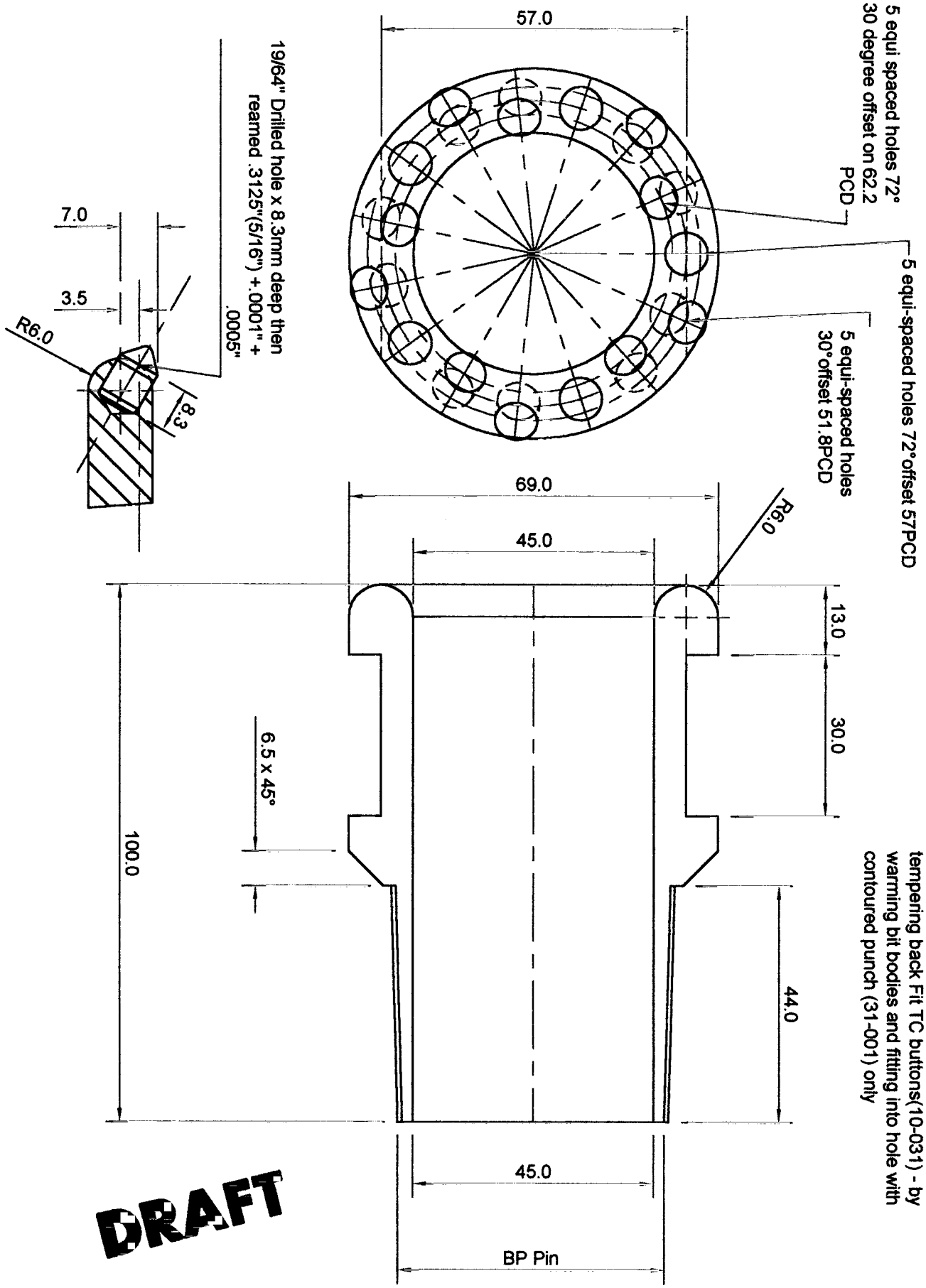


DRAFT

Material: 114mm x 5mm wall seamless steel casing

NOTES	DRAWN BY: Peter Ball	DATE: 16.6.2000	TITLE: Casing Shoe Pounder Rig
	19 JUN 2000	SCALE: 1:2	
		DRG No. 20-015	SHT. 1 OF. 1

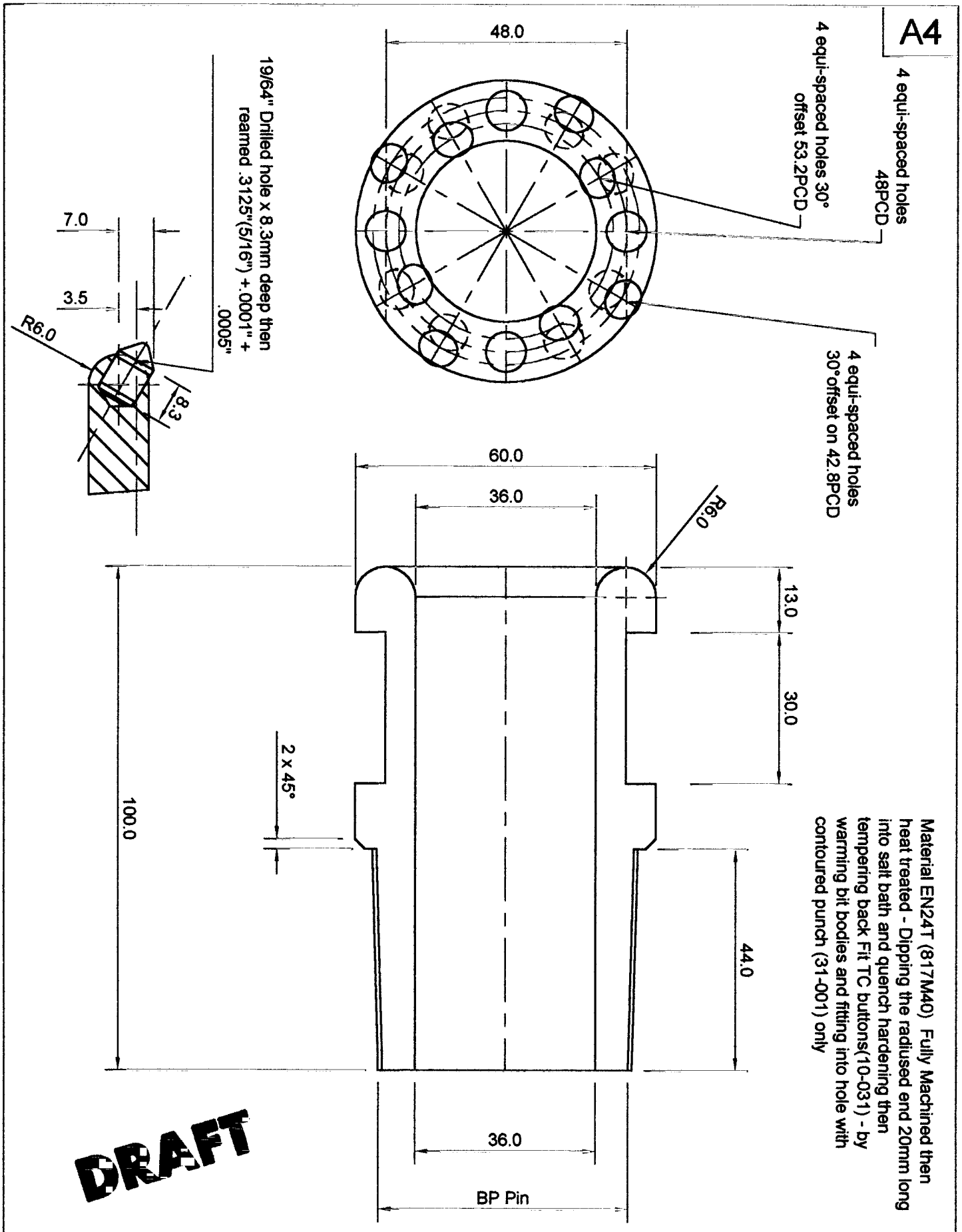
A4



Material EN24T (817M40) Fully Machined then heat treated - Dipping the radiused end 20mm long into salt bath and quench hardening then tempering back Fit TC buttons(10-031) - by warming bit bodies and fitting into hole with contoured punch (31-001) only

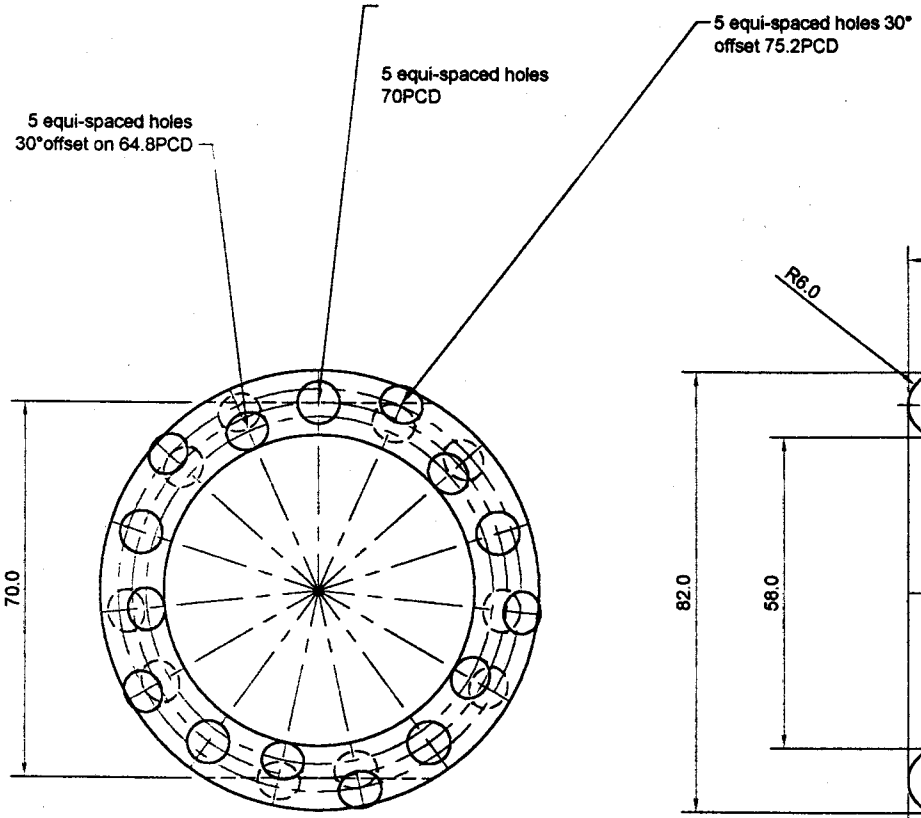
DRAFT

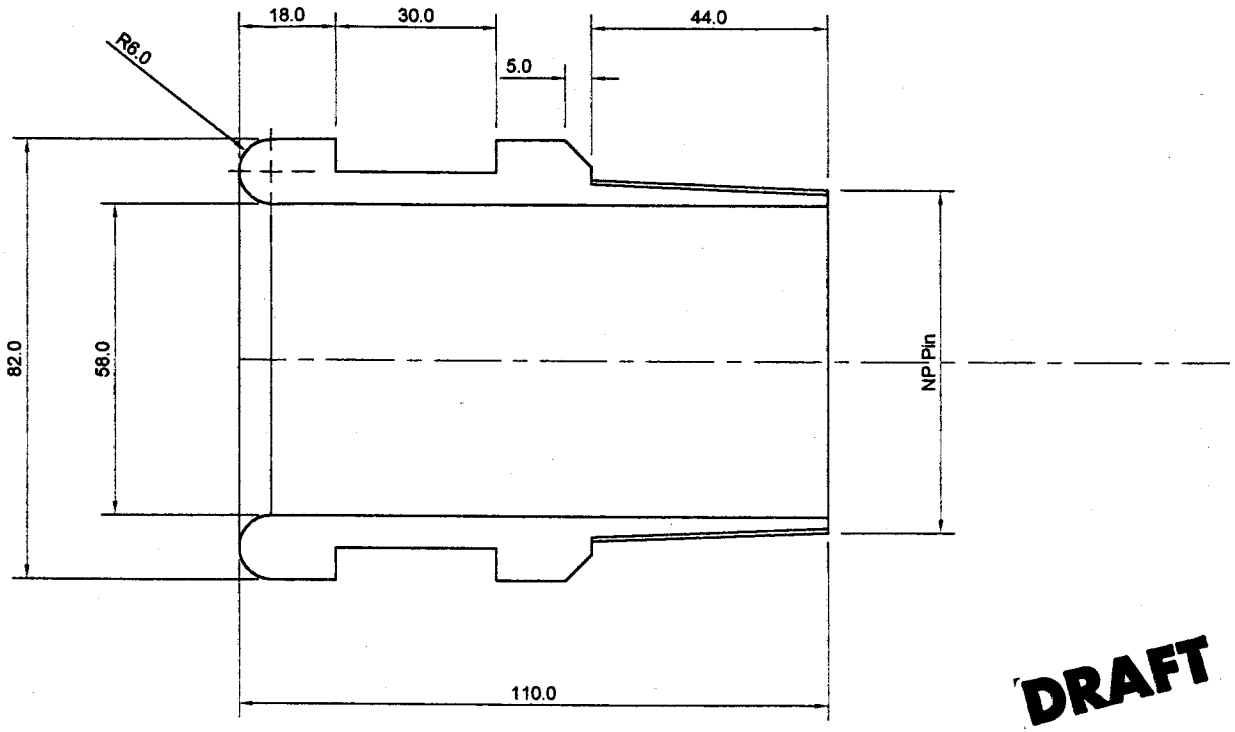
NOTES	DRAWN BY: Peter Ball	DATE: 21.4.2000	TITLE 69mm Button Bit Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 30-007	SHT. 1 OF. 1



NOTES	DRAWN BY: Peter Ball	DATE: 21.4.2000	TITLE 60mm Button Bit Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 30-008	SHT. 1 OF. 1

A3

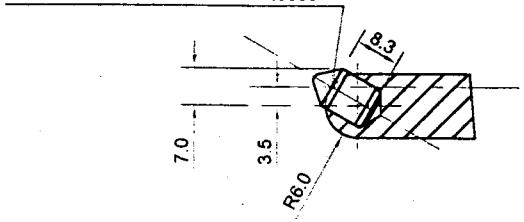




DRAFT

Material EN24T (817M40) Fully Machined then heat treated - Dipping the radiused end 20mm long into salt bath and quench hardening then tempering back Fit TC buttons(10-031) - by warming bit bodies and fitting into hole with contoured punch (31-001) only

19/64" Drilled hole x 8.3mm deep then reamed .3125"(5/16") +.0001" + .0005"

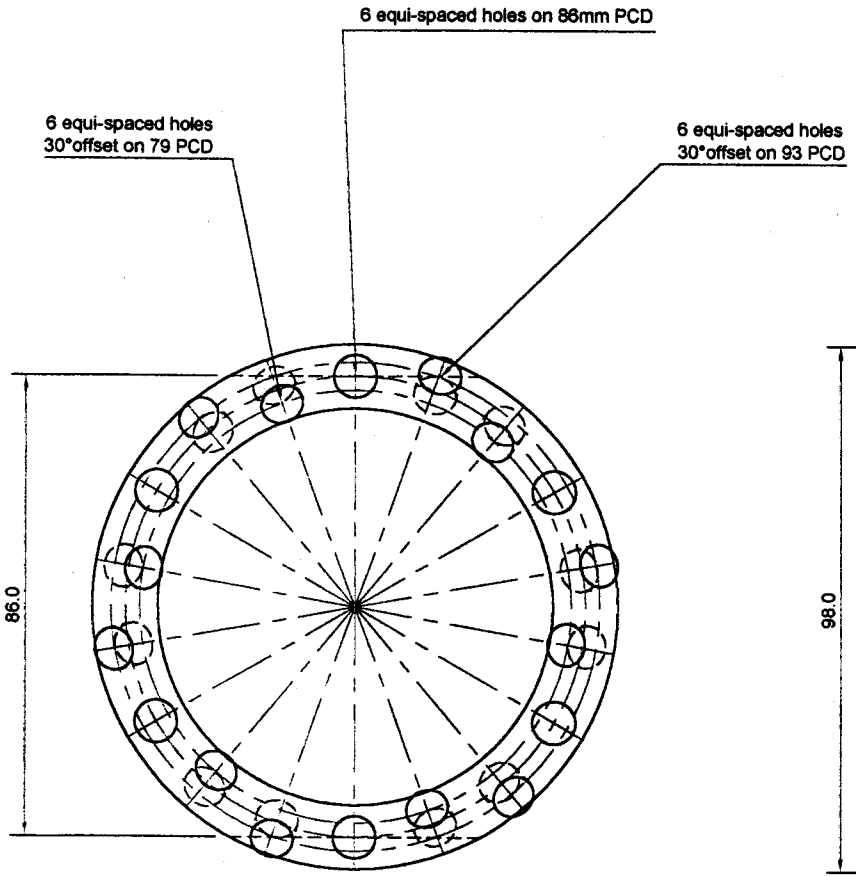


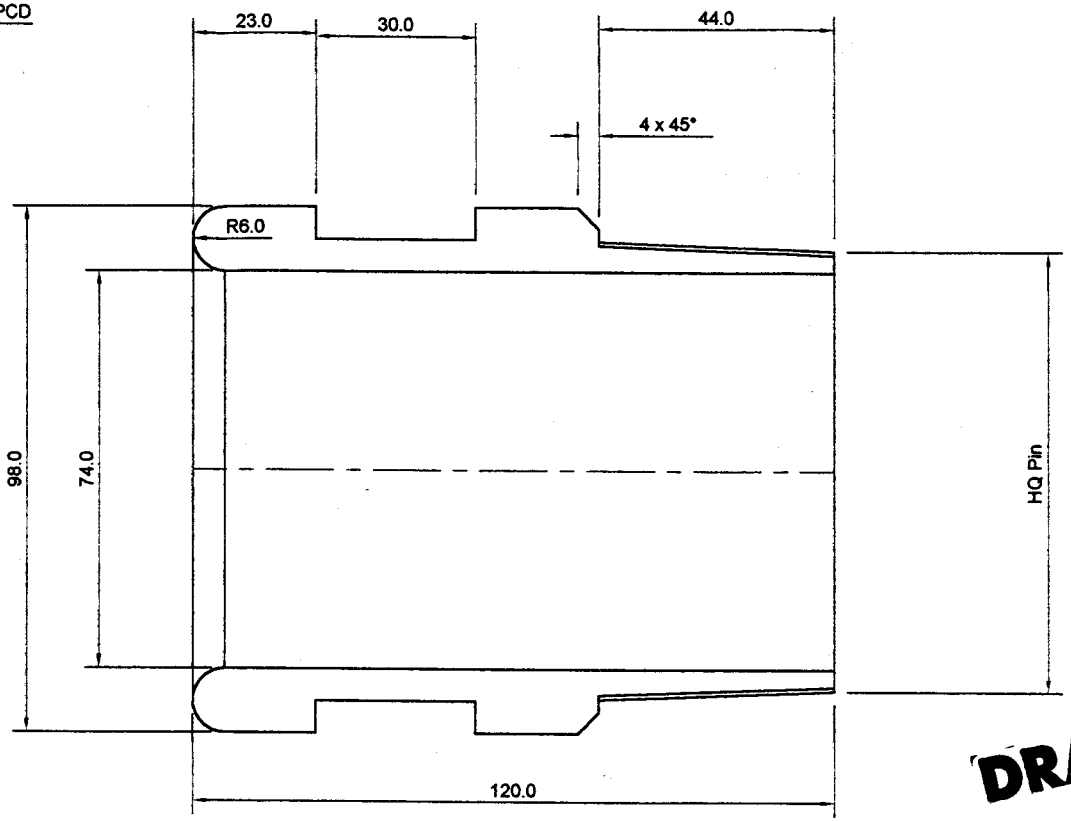
NOTES

Pound-a-Rig. Low cost Water Well Drilling Project by Cranfield University funded by UK Department for International Development (DFID)

DRAWN BY: Peter Ball	DATE: 22.4.2000	TITLE: 82mm Button Bit Pounder Rig	
19 JUN 2000	SCALE: Full	DRG No. 30-009	SHT 1 OF 1

A3

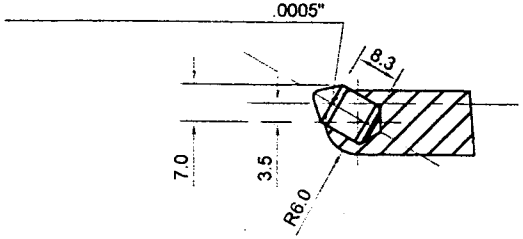




DRAFT

Material EN24T (817M40) Fully Machined then heat treated - Dipping the radiused end 20mm long into salt bath and quench hardening then tempering back Fit TC buttons(10-031) - by warming bit bodies and fitting into hole with contoured punch (31-001) only

19/64" Drilled hole x 8.3mm deep then reamed .3125"(5/16") +.0001" + .0005"

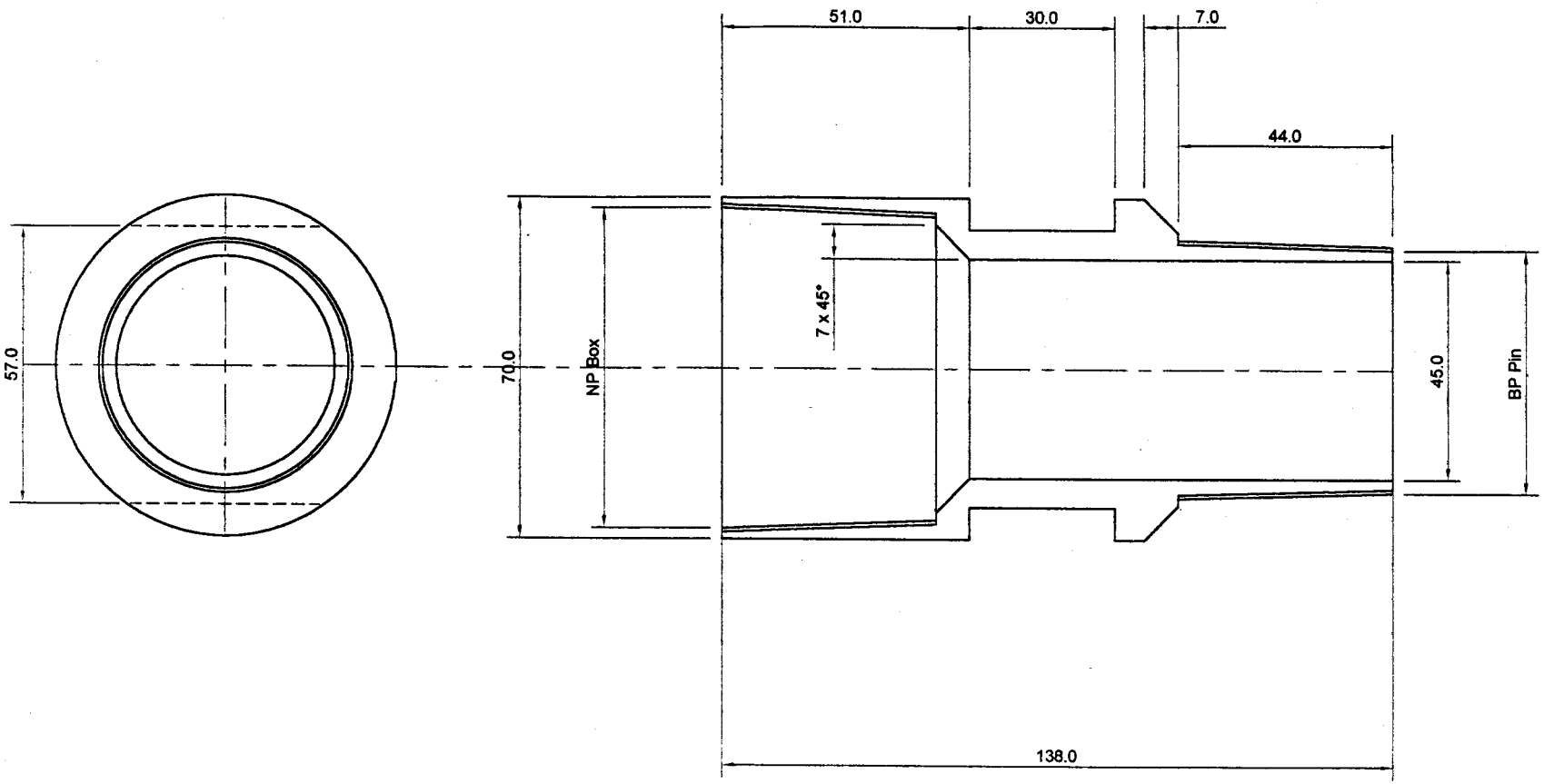


NOTES

Pound-a-Rig. Low cost Water Well Drilling Project by Cranfield University funded by UK Department for International Development (DFID)

DRAWN BY: Peter Ball	DATE: 21.2.2000	TITLE: 100mm button bit Pounder Rig	
19 JUN 2000	SCALE: Full		
	DRG No. 30-010	SHT 1 OF 1	

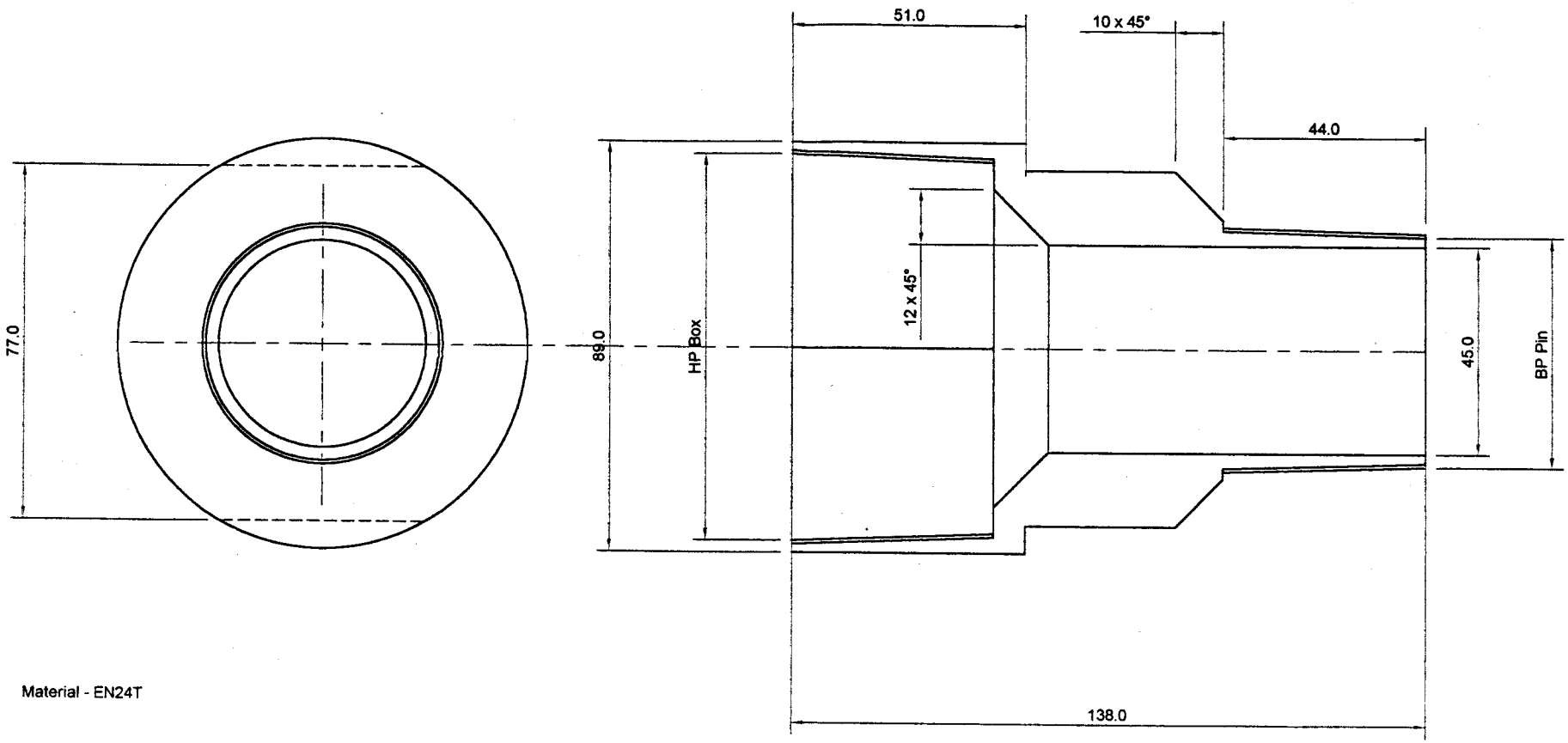
A3



DRAFT

NOTES	DRAWN BY	DATE	TITLE
Material EN24T	Peter Ball	22.4.2000	BP - NP Sub Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 30-012	SHT 1 OF 1

A3



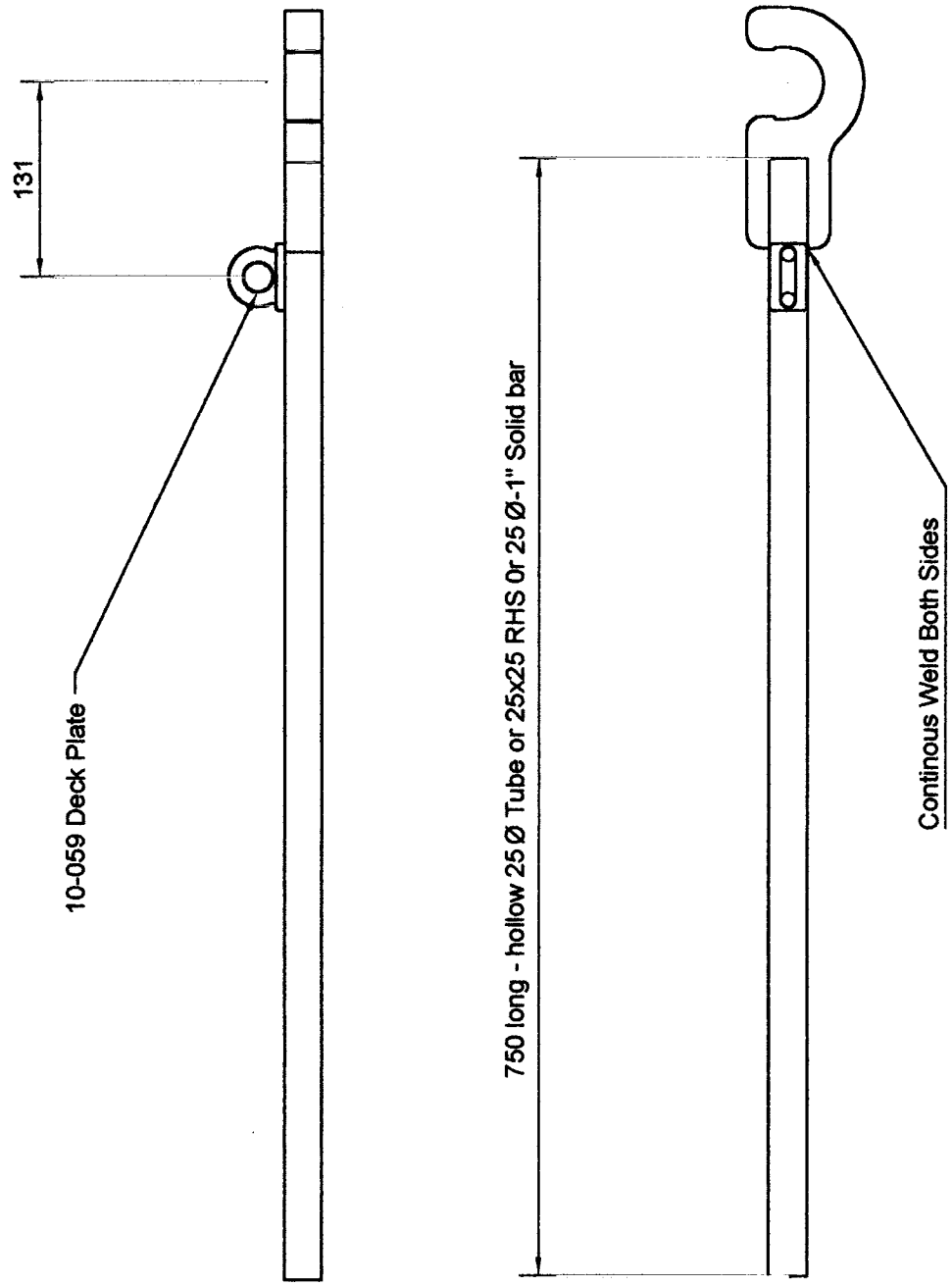
Material - EN24T

DRAFT

NOTES	DRAWN BY	DATE	TITLE
	Peter Ball	22.4.2000	BP-HP Sub
		SCALE. Full	Pounder Rig
	19 JUN 2000	DRG No. 30-013	SHT 1 OF 1

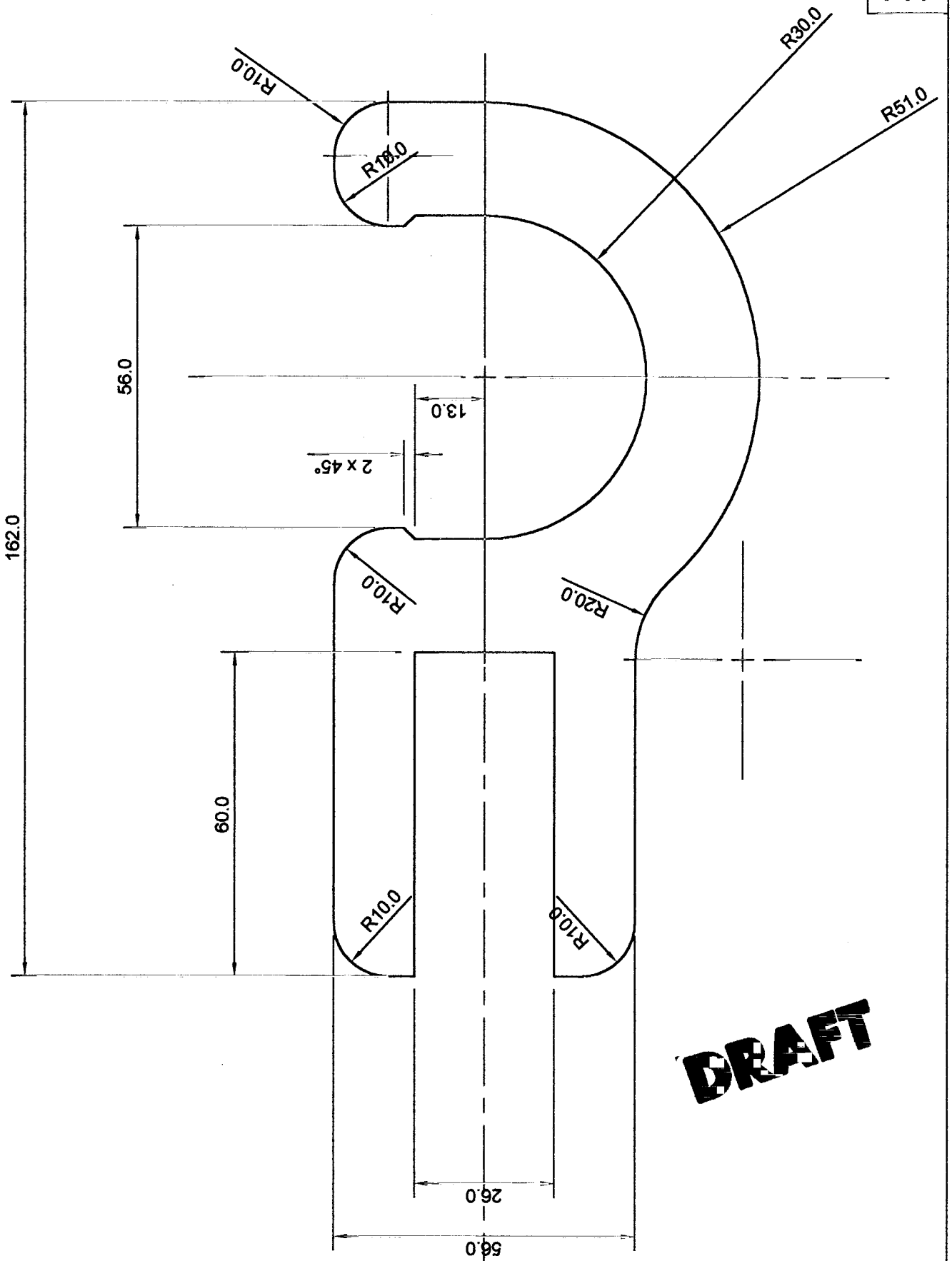
A4

DRAFT



NOTES	DRAWN BY: Peter Ball	DATE: 22.4.2000	TITLE BP Lifting Spanner Pounder Rig
	19 JUN 2000	SCALE: 1:5	
		DRG No. 20-010	SHT. 1 OF. 1

A4



DRAFT

NOTES	DRAWN BY:	DATE:	TITLE
25mm-1" EN8 Steel Plate - Flame Profiled	Peter Ball	27.4.2000	BP Lifting Piece
	19 JUN 2000	SCALE: Full	Pounder Rig
		DRG No. 20-009	SHT. 1 OF. 1

NOTES

Dimension Table For Drg 20-024,025 & 026 - BP,NP & HP threads details						
	BP		NP		HP	
	Mn	Max	Mn	Max	Mn	Max
A	3m	+ or - 1mm	3m	+ or - 1mm	3m	+ or - 1mm
B	1m	+ or - 1mm	1m	+ or - 1mm	1m	+ or - 1mm
C	50.47	50.62	64.87	64.92	83.27	83.33
D	52.09	52.14	66.39	66.44	84.80	84.85
E	48.97	49.07	63.27	63.37	81.71	81.76
F	60.47	60.52	64.74	64.79	85.25	85.30
G	48.84	48.89	63.12	63.17	81.63	81.68
H	52.07	52.12	66.37	66.42	84.87	84.92
I	46.02	46.20	60.15	60.65	77.55	77.90
J	55.35	55.85	69.70	70.30	88.50	89.30
K	See Drg 20-024,025 & 226 Sheet 1					
L						

DRAFT

DRAWN BY: Peter Ball

DATE: 5.6.2000

19 JUN 2000

SCALE: NTS

DRG No. 20-024,25 & 26

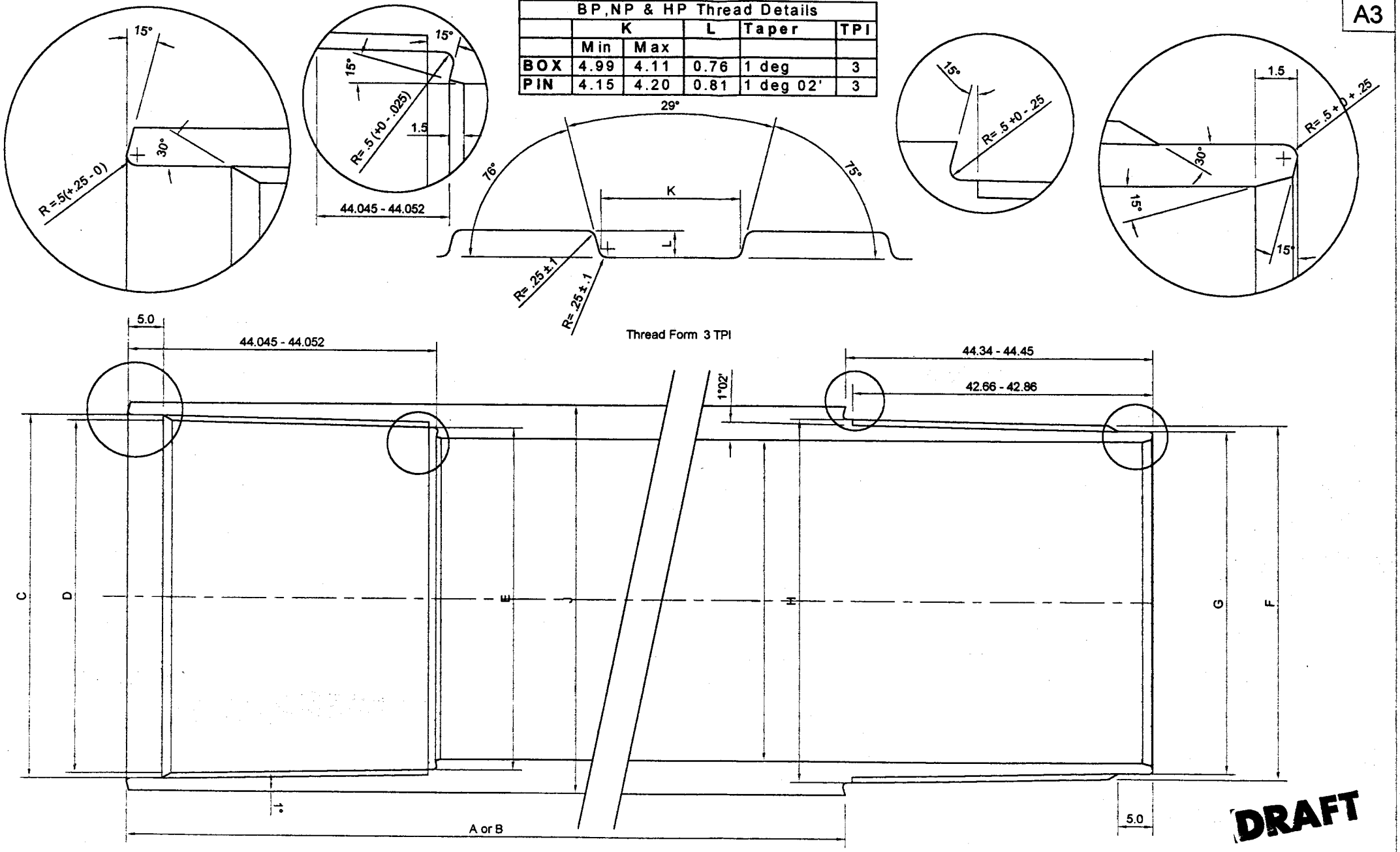
TITLE: BP,NP & HP Threads Pounder Rig

SHT. 2 OF. 2

A4

A3

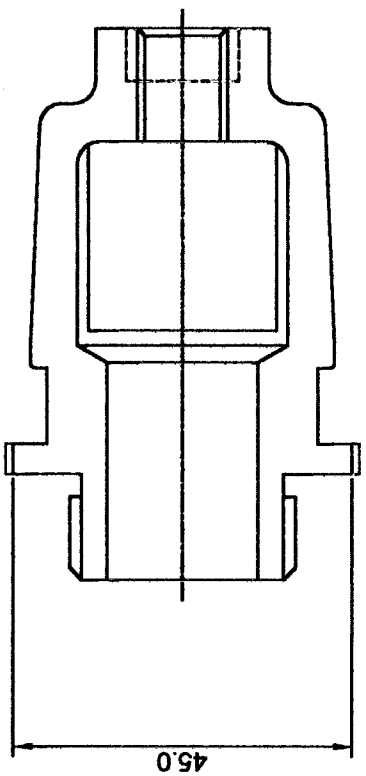
BP,NP & HP Thread Details					
	K		L	Taper	TPI
	Min	Max			
BOX	4.99	4.11	0.76	1 deg	3
PIN	4.15	4.20	0.81	1 deg 02'	3



DRAFT

NOTES	DRAWN BY:	DATE:	TITLE
	Peter Ball	5.6.2000	BP,NP & HP Threads
	19 JUN 2000	SCALE: NTS	Pounder Rig
		DRG No.	20-024,025 & 026 SHT 1 OF 2

A4

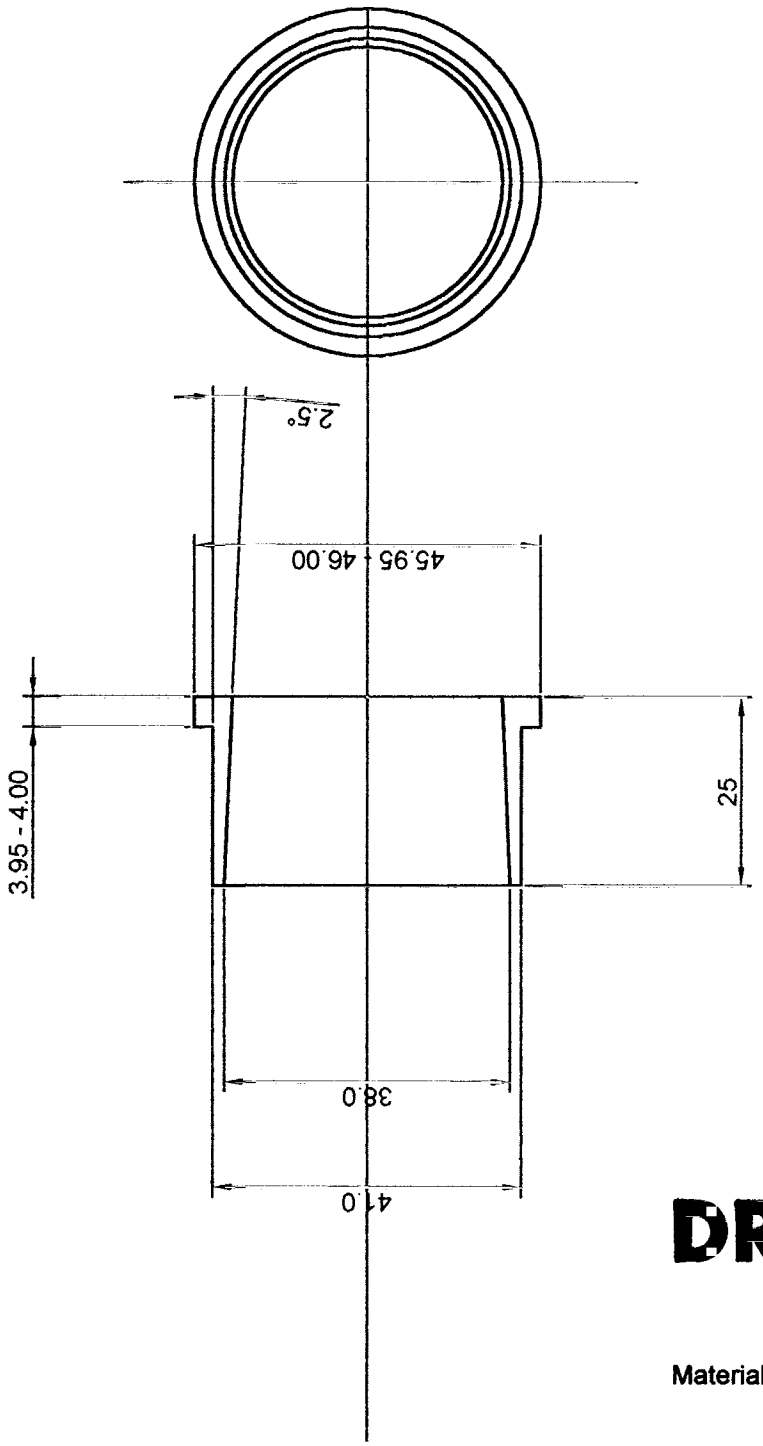


DRAFT

Material: machine flange from Skat Part No C2757

NOTES	DRAWN BY: Peter Ball	DATE: 28.6.2000	TITLE Test Pump Piston Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 50-044	SHT. 1 OF. 1

A4

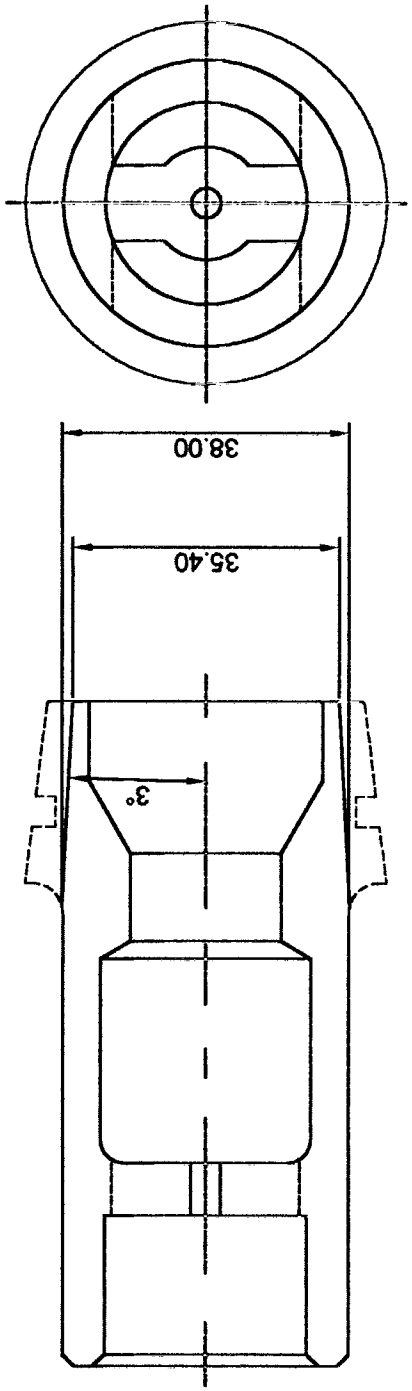


DRAFT

Material: Brass

NOTES	DRAWN BY: Peter Ball	DATE: 21.6.2000	TITLE: Footvalve Reciever Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 50-045	SHT. 1 OF. 1

A4



DRAFT

Material: machine smaller taper from Skat Part No C2759

NOTES	DRAWN BY: Peter Ball	DATE: 23.6.2000	TITLE Footvalve Pounder Rig
	19 JUN 2000	SCALE: Full	
		DRG No. 50-046	SHT. 1 OF. 1

https://dspace.org/

Specification and drawings for the pounder rig: a human-powered drill rig for constructing shallow small diameter wells for domestic and agricultural water supply.

Ball, Peter D.; Carter, Richard C.

2007-07-01T00:00:00Z

http://dspace.lib.cranfield.ac.uk/handle/1826/2748

Ball, P and Carter, R C (2000) Specification and drawings for the pounder rig: a human-powered drill rig for constructing shallow small diameter wells for domestic and agricultural water supply. Report of DFID KAR Project R7126, “Private Sector Participation in Low Cost Water Well Drilling”, Cranfield University. First Edition, July 2000.

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