

**SPECIFICATION No.TM/HM/6/320 (Rev-3)**

**SPECIFICATION OF TUNGSTEN CARBIDE TAMPING TOOL  
(TCTT) FOR ON TRACK TAMPING MACHINES  
(July -2019)**

**1.0 Scope and Technical eligibility:**

This specification covers technical requirements of manufacture and supply of tungsten carbide tamping tool(s), hereinafter referred as "TCTT", for high output on track tamping machines deployed over Indian Railways.

- 1.1 The specification has been drawn to stipulate the performance and quality requirements of the TCTT, in an objective manner without reference to any specific manufacturer. If a manufacturer feels that his TCTT can generally meet the performance and quality requirements of the TCTT but does not fully satisfy a particular clause of the specification, then he shall furnish clause-wise details of deviations along with remarks in his offer.
- 1.2 The manufacturer should be aware of various types of tamping tool(s) used on tie tamping machines in operation on Indian Railways to avoid fitment and functional problem at later stage.
- 1.3 Following manufacturer or his authorized agent will be technically eligible for participating in the said tender.
  - Original Equipment manufacturer (OEM) of Tamping Machine on which TCTT is to be provided.
  - Manufacturer, who has successfully supplied tools equal to minimum 35% of tendered quantity in last ten calendar years and current calendar year to Indian Railways or operators on other world Railways with satisfactory performance. Proof of satisfactory performance should be submitted from at least two such clients in case of supply to operators on Railways other than Indian Railways.
- 1.4 New manufacturer who does not meet the above two criteria but who agrees to abide by the specification and has the Testing facilities as specified in the clause 13.0 and Quality Control System as specified in clause 14.0 respectively of the document. Offer of such new manufacturer shall be considered for developmental order only.

**2.0 Technical capability of TCTT:**

During tamping the tool should be able to withstand:

- a) Vibration frequency (minimum): 35 HZ.
- b) Squeezing pressure of (minimum): 135 Kg/sq cm.

### 3.0 Dimensional requirement of TCTT:

The position, type and number of tamping tools for CSM, Tamping express, UNIMAT and UNIMAT Split Head MFI (MPT) Tamping Machines on Indian Railways are shown in Annexure-I/1 & I/2. The tools are provided as per following drawings

Type of Machine	Used for	Drawing of Tamping tool
Tamping Express (09-3X)	Plain track	RDSO/TM/15A/16 (32 no. in a set) RDSO/TM/15E/16 (16 no. in a set)
CSM & Duomatic (Old models)	Plain track	RDSO/TM/14A/16 (16 no. in a set) RDSO/TM/14B/16 (04 no. in a set) RDSO/TM/14C/16 (04 no. in a set) RDSO/TM/14D/16 (08 no. in a set)
CSM ( New model CSM-955 on ward machines) & Duomatic	Plain track	RDSO/TM/15A/16 (08 no. in a set) RDSO/TM/15B/16 (08 no. in a set) RDSO/TM/15C/16 (08 no. in a set) RDSO/TM/15D/16 (08 no. in a set)
UNIMAT-2S & UNIMAT -3S	Tamping point & x-ing	RDSO/TM/01A/16 (08 no. in a set) & RDSO/TM/01C/16 (08 no. in a set)
UNIMAT-4S	-do-	RDSO/TM/ 01A/16 (08 no. in a set) & RDSO/TM/ 01B/16 (08 no. in a set)
UNIMAT Split Head MFI (MPT)	Plain track & point & x-ing	RDSO/TM/15A/16 (16 no. in a set)

The drawings are attached as Annexure II/1 to II/12. The manufacturer should note that the drawing is for general guidance purpose. Other minor deviations are also acceptable, but following should be ensured.

- The fixing arrangement of tools with the tamping bank should be same or similar so that no modification in the tamping bank is required.
- Length of TCTT and the size of spade should be within the range given in the drawings so that it can be fit in the tamping bank without any infringement.
- Thickness of carbide chips should not be less than 3 mm.

The TCTT shall have suitable shape for easy penetration into the ballast and it should be strong enough to meet the functional requirement for its entire life.

### 4.0 Steel for TCTT:

- TCTT shall be manufactured from chromium molybdenum /nickel chromium molybdenum alloy steel or any other special quality steel serving the functional requirement and having technical capability as mentioned in different clause of this specification. The mechanical properties of such steel should however meet the following minimum requirement:

- Tensile strength (min) - 800 N/mm<sup>2</sup>
- 0.2% proof stress (min) - 550 N/mm<sup>2</sup>
- Elongation %min - 10 %

The manufacturer should give the Grade (Indian standard or equivalent International standard as applicable) and corresponding parameters of steel used if required by the purchaser or the inspecting official. Proper treatment to steel in shank portion which is fitted to tamping arm of tamping bank should be given to prevent its wear and tear during service life of TCTT.

#### 4.2 **Chemical composition:**

The steel should be of quality and composition such that proper brazing/joining with tungsten carbide inserts is possible. The manufacturer shall however give the Grade (Indian standard or equivalent International standard as applicable) of steel and chemical composition of each cast of the steel and batch of forged and heat-treated TCTT, whenever required to do so by the purchaser or the inspecting official.

#### 5.0 **Manufacturing process for TCTT with respect to tungsten carbide inserts:**

5.1 The mechanical properties of tungsten carbide inserts should meet the following minimum requirement:

- Hardness (min): HRA 84/HRC 65 or its equivalent in any other recognized scale of measurement.
- Density (min): 13.2 g/cm<sup>3</sup>.
- Transverse rupture strength (min): 2600 N/mm<sup>2</sup>
- Ultimate compressive strength (min): 2600 N/mm<sup>2</sup>

The manufacturer should give the above details of tungsten carbide inserts used if so required by the purchaser or the inspecting official. Manufacturer shall also provide the test certificates including testing procedures/methodology and reference technical documents to the purchaser/inspecting authority in this regard. Suitable size of the tungsten carbide inserts shall be used for higher impact, wear resistance and better brazing.

5.2 Tungsten carbide inserts shall be joined with the steel spade of TCTT by brazing or other tried and proven method. The Brazing/Joining should be strong enough to meet the service life of the tamping tool as in clause 11.2. Failure of brazing or joint shall be treated as failure of tamping tool for all purpose as per clause 11.3.

5.3 TCTT should be of such design that it can be removed easily from tamping arm without hammering. If design is such that it requires external device for removing it from tamping arm, one such device should be supplied with each set of TCTT and rate should be quoted accordingly.

5.4 The forged TCTT should have the desired mechanical properties throughout the cross section of the component.

**6.0 Quality of product:** The TCTT shall be free from surface and internal forging defect i.e. laps, seams, bursts, cracks, pits, porosity, improper edges etc. which may impair

the end use. The TCTT shall be supplied to the prescribed dimensions and tolerances as mentioned at clause 3.0.

- 7.0 Branding:** All TCTT shall be branded with TCTT manufacturer's code, batch no., month and year of manufacture. From the batch no. of the finished TCTT, the process flow and composition of raw materials should be identifiable.

**8.0 Testing of TCTT:**

The consignment should be supplied in identifiable batches where testing for mechanical properties of sample will represent the quality of complete batch. The manufacturer should give the certificate that the batch has same mechanical properties and such certificate should be supported by relevant documents.

Each TCTT of the consignment shall be checked for their dimensional correctness as per clause 3.0.

Out of each such batch of consignment, one No. of TCTT for each 500 tools or part thereof will be subjected to various mechanical tests for ascertaining minimum standard mentioned in clause 4.0 and clause 5.0. The test shall be conducted as per relevant IS code or equivalent international code. The test shall be conducted in the manufacturer laboratory or in any other reputed laboratory as per the decision of the purchaser or inspecting official at the cost of the supplier/manufacturer. The supplier/manufacturer shall accordingly supply required additional tools for testing with each batch of consignment. Tools from the batch will be randomly picked up by the inspecting official for testing. Care should therefore be taken that while making the batch, the set of supplied tools in the consignment are not disturbed by such random selection of tools for testing. The cost of these additional sample tools used for testing shall also be borne by the supplier/manufacturer and should be accounted for while quoting the rates.

The inspecting official may conduct non-destructive test for ascertaining mechanical properties on other tools of the consignment.

**9.0 Inspection:**

The TCTT shall be inspected by Indian Railways' official(s) to ensure supply as per stipulation in this specification. Certificate of inspection and approval for dispatch of TCTT shall be issued by the nominated officer(s) as per Annexure-III For this purposes the supplier/manufacturer shall provide all necessary facilities including equipment and material required for testing free of cost. He shall also produce all relevant documents/certificates in respect to properties, source and quality etc. of the material. Copies of the Maker's certificate guaranteeing the performance of the TCTT should be shown to the inspecting official and shall be supplied in duplicate along with the delivery of each consignment.

**10.0 Acceptance criteria:**

- 10.1 If any sample selected from the batch, as mentioned at clause 8.0, fail to meet the requirement given in different clause of this specification, two further samples for

each 500 tools or part there of shall be selected from same batch of consignment. The batch shall be considered to conform to the requirements if test results of additional tools are satisfactory. This test shall be conducted at the cost of supplier/manufacturer. Even in case the tools confirm to the specification in this test but become unserviceable in the process, the cost of tool/tools shall be borne by the supplier/manufacturer and additional tool/tools will be supplied by them free of cost to complete the set. The manufacturer shall give a certificate that the extra tools so supplied in lieu of tested tools confirms to the specification. If any of the additional tools tested, fails to confirm to the specification, the batch shall be treated as rejected.

- 10.2 The components shall be carefully protected against corrosion. Packing of the TCTT must withstand the weight of the tool and tungsten carbide chips must be protected to prevent damage while handling. Holding area must be oiled with rust preventing oil.

#### 11.0 Performance monitoring of TCTT:

- 11.1 Service Life of each TCTT shall be taken as the Number of insertions before it becomes unserviceable. Set of tools for monitoring the performance shall be taken as a lot of 16 no. tool for one UNIMAT, 32 no. tool for one CSM/DUO and 48 no tools for one Tamping Express machine.. Average life of TCTT in a set shall be calculated as per formula given below:

$$\text{Average service life of TCTT in a set} = \frac{\text{Sum of service life of each TCTT in the set}}{\text{No of TCTT in the set}}$$

- 11.2 The average service life of TCTT in a set shall be guaranteed for tamping of minimum 2,50,000 insertions .However minimum service life of any one TCTT shall not be less than 50,000 insertions.

- 11.3 A TCTT shall become unserviceable when one or more than one of the following condition occurs:

- i) The effective reduced area of TCTT blade due to wear becomes less than 80% of the original surface area of the TCTT supplied .It will be termed as failure of TCTT.
- ii) Chipping off of more than 50% of carbide inserts, breakage of blade or arm of TCTT.

Such failures may occur under following conditions:

- a) Tungsten carbide inserts should not chip out and Blade or Arm of TCTT should not break during normal tamping work or by their occasional hitting with concrete sleepers, TCTT becoming unserviceable due to such reasons will be covered under warranty and will be termed as failure of TCTT.
- b) However the breakage of the Blade, Arm of TCTT or carbide inserts on the Blade due to direct hitting on hard objects hidden in ballast or otherwise like

rail foots, rail clamps, fishplates, concrete foundation etc. making the tool unserviceable shall not be covered under warranty and shall be termed as failure not attributed to failure of TCTT.

The performance of TCTT and reason for TCTT becoming unserviceable should be recorded by in-charge of the machine in Performa given at clause 11.7. The same shall be reviewed with the supplier or his nominee once in three months approximately or at interval as agreed with the supplier and reason ascertained and jointly recorded. In case of any dispute/disagreement, between supplier or his representative and machine operator /in-charge, decision of Dy Chief Engineer /Track Machine of Railway shall be final.

11.4 The TCTT may be required to be removed / replaced due to following reasons:

- TCTT becomes unserviceable for reasons given in clause 11.3 above. In such case, the action as detailed in clause 11.5 may be taken and average service life of set of TCTT may be calculated accordingly.
- If TCTT is replaced before it achieves its warranted average service life, due to failure of tamping arm/arms or tamping bank itself or due to POH/IOH or other maintenance of Machine which is termed as premature replacement. The action as detailed in clause 11.6 may be taken and average service life of set of TCTT may be calculated accordingly.

11.5 For calculating the average service life of TCTT in a set due to TCTT being unserviceable, following guideline shall be followed:

- i.) If any TCTT becomes unserviceable before achieving minimum service life of 50,000 insertions due to:
  - Failure of TCTT as defined at clause 11.3(i) and (ii) above: It shall be replaced free of cost by the supplier. The average service life of TCTT in a set for calculating performance shall however be taken on the basis of first tool and not the replaced tool.
  - Failure not attributed to failure of TCTT as defined at clause 11.3 (i) and (ii) above: Railway shall replace the tool at its own cost and the performance of that tool shall not be taken for calculating Average service life of TCTT.
- ii) If any TCTT becomes unserviceable between service life of 50000 insertions and 2,50,000 insertions due to:
  - Failure of TCTT as defined at clause 11.3(i) and (ii) above: Railway shall replace the tool at its own cost and the performance of that tool shall be taken for calculating Average service life of TCTT.
  - Failure not attributed to failure of TCTT as defined at clause 11.3(i) and (ii) above: Railway shall replace the tool at its own cost and the performance of that tool shall not be taken for calculating Average service life of TCTT.
- iii). If any TCTT becomes unserviceable after service life of 2,50,000 insertions:

- Failure of TCTT as defined at clause 11.3(i) and (ii) above: Railway shall replace the tool at its own cost and the performance of that tool shall be taken for calculating Average service life of TCTT.
- Failure not attributed to failure of TCTT as defined at clause 11.3(i) and (ii) above: Railway shall replace the tool at its own cost and the performance of that tool shall be taken for calculating Average service life of TCTT.

11.6 For calculating the average service life of TCTT due to premature replacement of TCTT as defined at clause 11.4 above following guideline should be followed:

- In case of tamping arm/arms failure, the TCTT should be put back after that arm is repaired.
- In case of tamping bank failure, the complete set which is in use should be put back after repair or replacement of tamping bank.
- In case of POH / IOH or other maintenance work of machine which is likely to keep the machine idle for long duration, railway may decide to shift the complete set to other similar machine

In all such case, the insertions for calculating service life of each TCTT will be counted in continuation of previous insertions recorded at the time of premature replacement.

11.7 Measurement/observation on performance of TCTT shall be recorded in the three Performa given below:

**I. PERFORMA A. :INITIAL OBSERVATION**

- Machine NO: \_\_\_\_\_
- Railway/Division/Section : \_\_\_\_\_
- Date of providing the tool: \_\_\_\_\_
- Sketch showing position of different tools marking each tool with different identification No (Similar to Annexure-I) : \_\_\_\_\_

Tool No.	Size of Blade			Area of carbide insert (sq mm)	Remarks	Signature	
	Width (mm)	Height (mm)	Area (sq mm)			Machine in-charge	Supplier's representative

In case the complete set of TCTT is shifted to other machine due to premature replacement as defined at clause 11.4, the TCTT details at the time of replacement shall be recorded again in the similar Performa. It shall be ensured that the Tools are provided at the same position as in previous machine.

## II. PERFORMA-B OBSERVATIONS DURING SERVICE:

Machine in-charge should record observation in this Performa at every 30 days interval (approximately)

Date of inspection:\_\_\_\_\_

Machine NO: \_\_\_\_\_

Railway/Division/Section: \_\_\_\_\_

[illegible]

The observation recorded shall be jointly reviewed with the supplier or his authorized representative at 3 months interval approximately or at interval as jointly agreed between railways and the supplier. However, if the supplier or his representative fails to attend the joint inspection at this frequency or on pre-decided date, the measurement taken by the machine supervisor shall be final. In case of any dispute/disagreement, between supplier or his representative and machine operator /in-charge, decision of Dy Chief Engineer /Track Machine of Railway shall be final.

- In case tool is prematurely replaced for reasons specified in clause 11.4 and action as specified in clause 11.6 is taken, the same should be recorded and insertions should accordingly be accounted.
- If at the time of measurement or at any time between two measurements, the tools are found to have reached the failure limit or become unserviceable, the same should be mentioned here and detail of all such failed tools should be recorded in Performa-C given below.

### III. PERFORMA-C OBSERVATION AT THE TIME OF FAILURE OF TCTT :

Dimension of all tools when it fails for reasons specified in clause 11.3, shall also be recorded in this Performa. This shall also be reviewed with supplier or his representative and jointly signed by Machine operator/in-charge and supplier's representative while reviewing entry in Performa-B

[illegible]



- This table will thus contain details of failure of each tool in the set. Reasons for replacement, clearly specifying whether it is attributed to manufacturer failure or Railways failure, shall be entered in remark column.
- Average service life of TCTT in a set will accordingly be calculated on the basis of entry in this Performa.

11.8. Whenever the failure of any TCTT occurs, the supplier/manufacturer or his authorized representative shall be informed in writing as early as possible and preferably within seven days of such failure for joint inspection. The supplier/manufacturer or his authorized representative should come for such inspection within 3 months of intimation being sent to them. Railway reserves the right to replace this tool with another tool immediately after failure so that the progress and quality of work is not hampered. Railway shall be liable to preserve such failed tools for three months from the date of sending intimation for joint inspection after which Railway reserves to dispose the tools at its discretion. In case of failure to report within this period, the measurement taken by Railway representative and cause of failure so ascertained shall be binding on the supplier/manufacturer. The cause of failure shall be recorded in Performa B and C as given under clause 11.7. In case there is dispute on cause of failure during joint inspection, the decision of Dy CE/Track machine of the railway shall be final and binding.

11.9 Required manual/instructions for installation, removal and upkeep of the TCTT shall be supplied by the manufacturer.

#### 12.0 **Warranty:**

The TCTT shall be warranted for the average service life specified in clause 11.2. This warranty shall expire 24 (twenty four) months after delivery at ultimate destination in India or eighteen months from the date of fitment on machine, whichever is earlier

#### 13.0 **Testing Facilities:**

The manufacturer, preferably, should have their own equipment/arrangement for conducting following tests. If the firm does not have the arrangement of their own, they must confirm a tie up with some reputed (NABL accredited or accredited by other international body like APLAC, MRA, ILAC etc) laboratories for conducting these tests.

- a) Chemical analysis of steel and facilities for the estimation of Silver brazing alloys.
- b) Universal Testing Machine of adequate capacity for tensile yield, elongation and bend tests.
- c) Metallurgical Microscope with magnification up to 500x. for Preparation of metallographic test specimen.

- d) Minimum one No. Magna flux crack detector of adequate amperage for longitudinal and circular magnetization of the TCTT.
- e) Brinell hardness Tester with standard calibration test pieces. for the inspection of hardness on Rockwell (A scale or equivalent scale ) of Tungsten carbide inserts, welding and TCTT.
- f) Dedicated proof load test set-up with capacity up-to 25t and with facility of recording load-deflection characteristics of the product.
- g) All required measuring instruments / gauges in adequate number should be available i.e. micrometers, dial gauges, vernier calipers, GO, NO-GO gauges for all-important dimensions of the product.

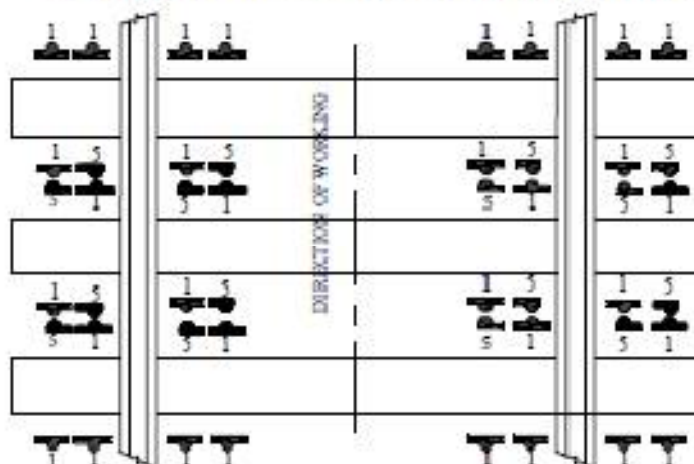
#### **14.0 Quality control requirements:**

The manufacturer of TCTT must be either ISO certified or they must have a system to ensure a uniform and good quality product. For this, below given system or some alternative system as suitable to ensure quality may be followed by the manufacturer:

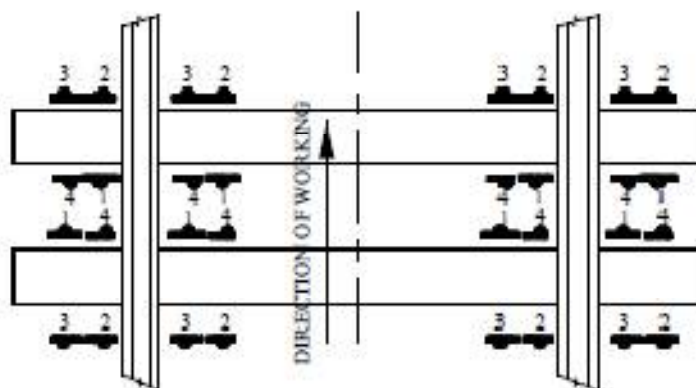
- a) There should be a system to ensure the traceability of the product from raw material stage to finished product stage. This system should also facilitate to identify the raw material composition from the finish product stage.
- b) There is a Quality Assurance Plan for the product detailing various aspects:
  - Organizational Chart
  - Flow Process Chart
  - Stage inspection details
  - Various parameters and to ensure control over them.
- c) The QAP must be provided by prospective venders as prerequisite for participation in the said tenders.
- d) They should ensure that proper analysis is being done on regular basis to study the rejection at various internal stages and it is documented properly.
- e) They should ensure that prior to release of dies for production it should be dimensionally checked in all respects including its mounting on the forging equipment.
- f) They should ensure that critical inspection of the first forging and last forging of a production run is essentially carried out to ascertain behavior of the dies in operation and product quality.

- g) They should ensure that all the relevant specifications, code; standards are available with the firm.
- h) Infrastructure and quality control work related with manufacture of Tungsten Carbide Tamping Tool shall be documented and furnished along with tender
- i) Individual component suppliers should be preferably certified ISO-9001 which include supplier of steel, forging tungsten carbide silver solder brazing and welding operations.

**15.0** The manufacturer may be following exceeding technical specification, which may be different in order to achieve higher service life of "TCTT". In case of any such deviations, manufacturer shall furnish the reasons of such deviations and also its implication on functional requirement and quality of product.

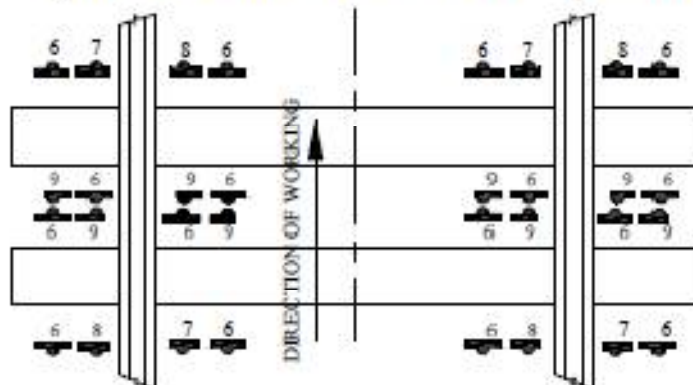
**POSITION OF TAMPING TOOLS OF 3-X TAMPING MACHINE**

TOOL DESCRIPTION FOR TAMPING EXPRESS (08-0X)		
TOOL	RD80 DRG. NO.	TOTAL NO REQUIRED OF A SET OF 48
1	RD80/TM/15A/18	32
5	RD80/TM/15B/18	16

**POSITION OF TAMPING TOOLS OF NEW CSM (MODEL CSM-955 ON WARD) & DUO**

TOOL DESCRIPTION FOR NEW CSM (MODEL 955 ON WARD) & DUO		
TOOL	RD80 DRG. NO.	TOTAL NO REQUIRED IN A SET OF 32
1	RD80/TM/15A/18	8
2	RD80/TM/15B/18	8
3	RD80/TM/15C/18	8
4	RD80/TM/15D/18	8

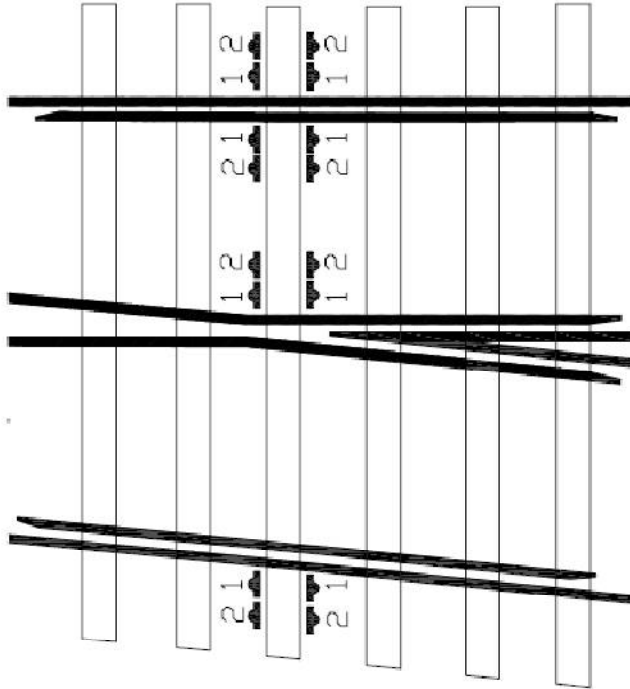
NOTE:  
NO. 2 & 4 CAN BE REPLACED BY EACHOTHER

**POSITION OF TAMPING TOOLS OF CSM & DUO (OLD MODEL)**

TOOL DESCRIPTION FOR CSM & DUO (OLD MODEL)		
TOOL	RD80 DRG. NO.	TOTAL NO REQUIRED IN A SET OF 32
6	RD80/TM/14A/18	16
7	RD80/TM/14B/18	4
8	RD80/TM/14C/18	4
9	RD80/TM/14D/18	8

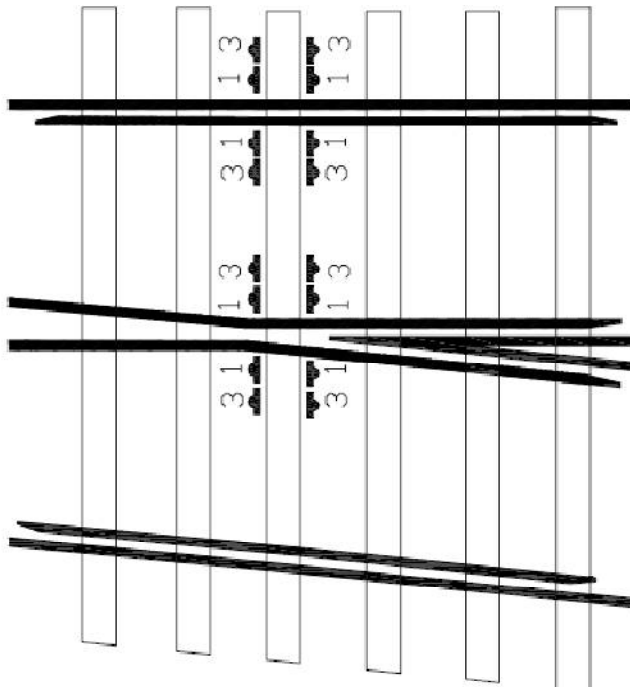
NOTE:-  
NO. 2 & 4 CAN BE REPLACED BY EACHOTHER

POSITION OF TAMPING TOOLS OF UNIMAT-4S  
TAMPING MACHINE

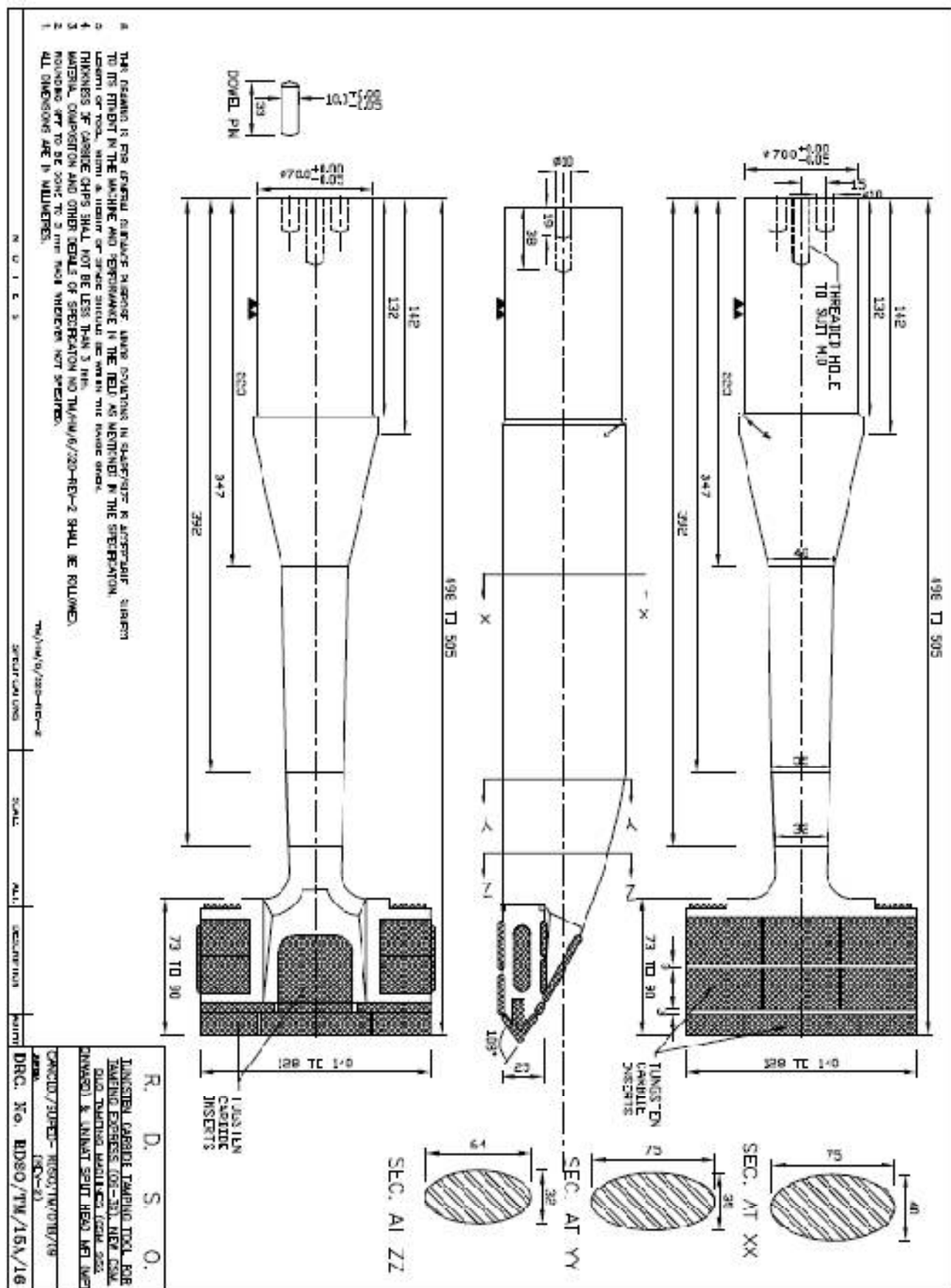


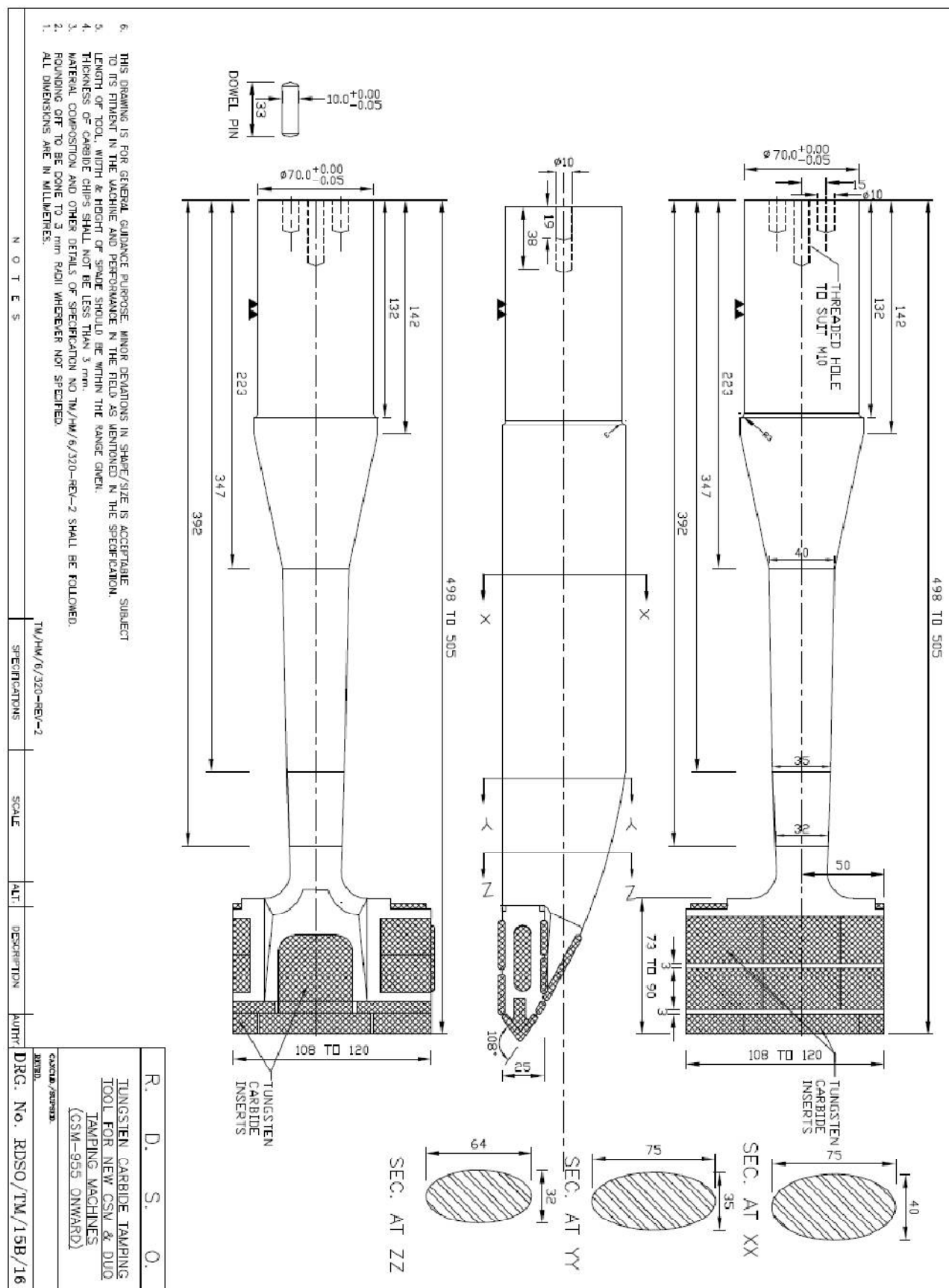
TOOL DESCRIPTION FOR UNIMAT-4S		
TOOL	RDSO DRG. NO.	TOTAL NO REQUIRED IN A SET OF 16
1	RDSO/TM/01A/16	8
2	RDSO/TM/01B/16	8

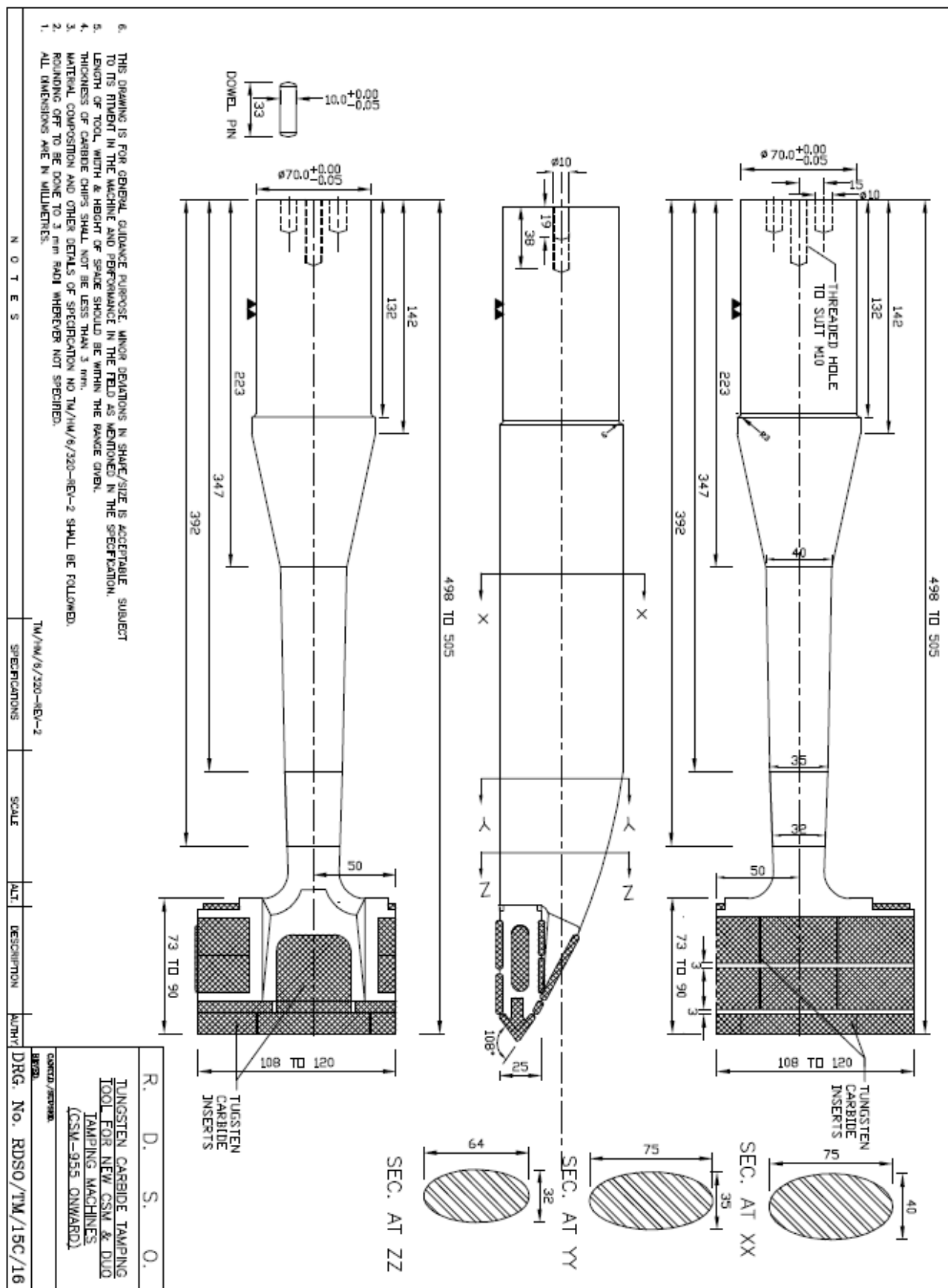
POSITION OF TAMPING TOOLS OF UNIMAT-2S&3S  
TAMPING MACHINE



TOOL DESCRIPTION FOR UNIMAT-2S&3S		
TOOL	RDSO DRG. NO.	TOTAL NO REQUIRED IN A SET OF 16
1	RDSO/TM/01A/16	8
3	RDSO/TM/01C/16	8

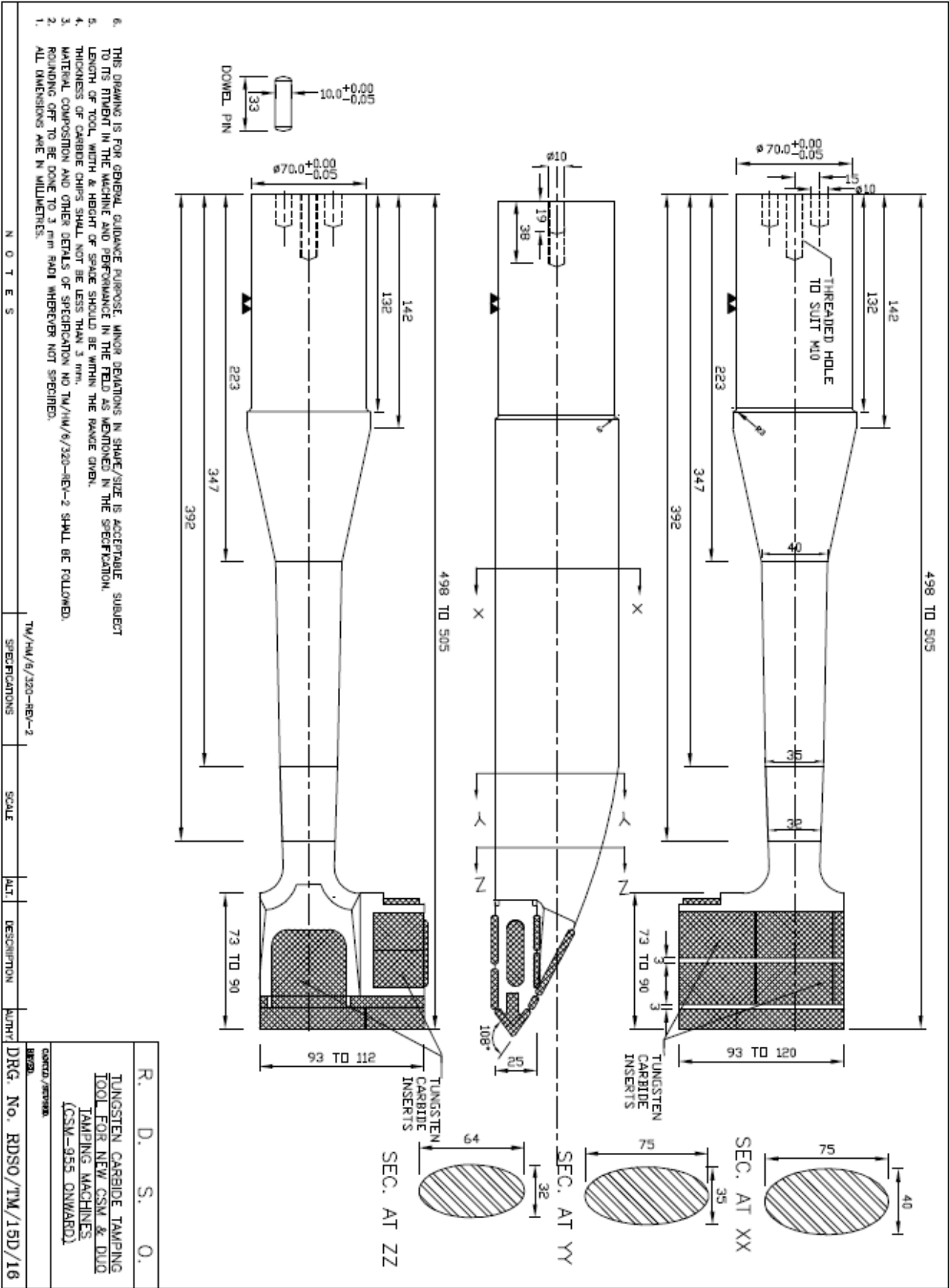




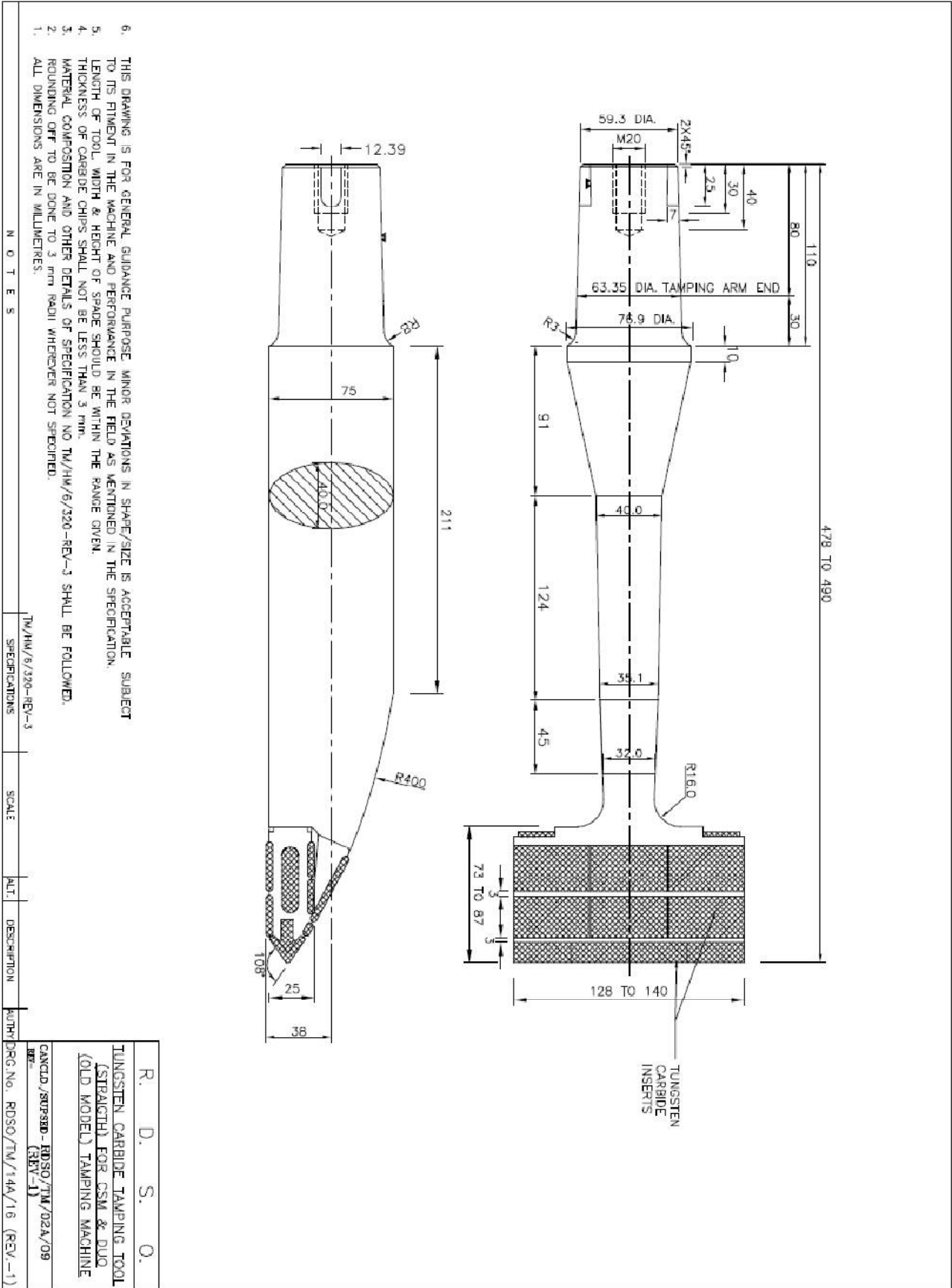


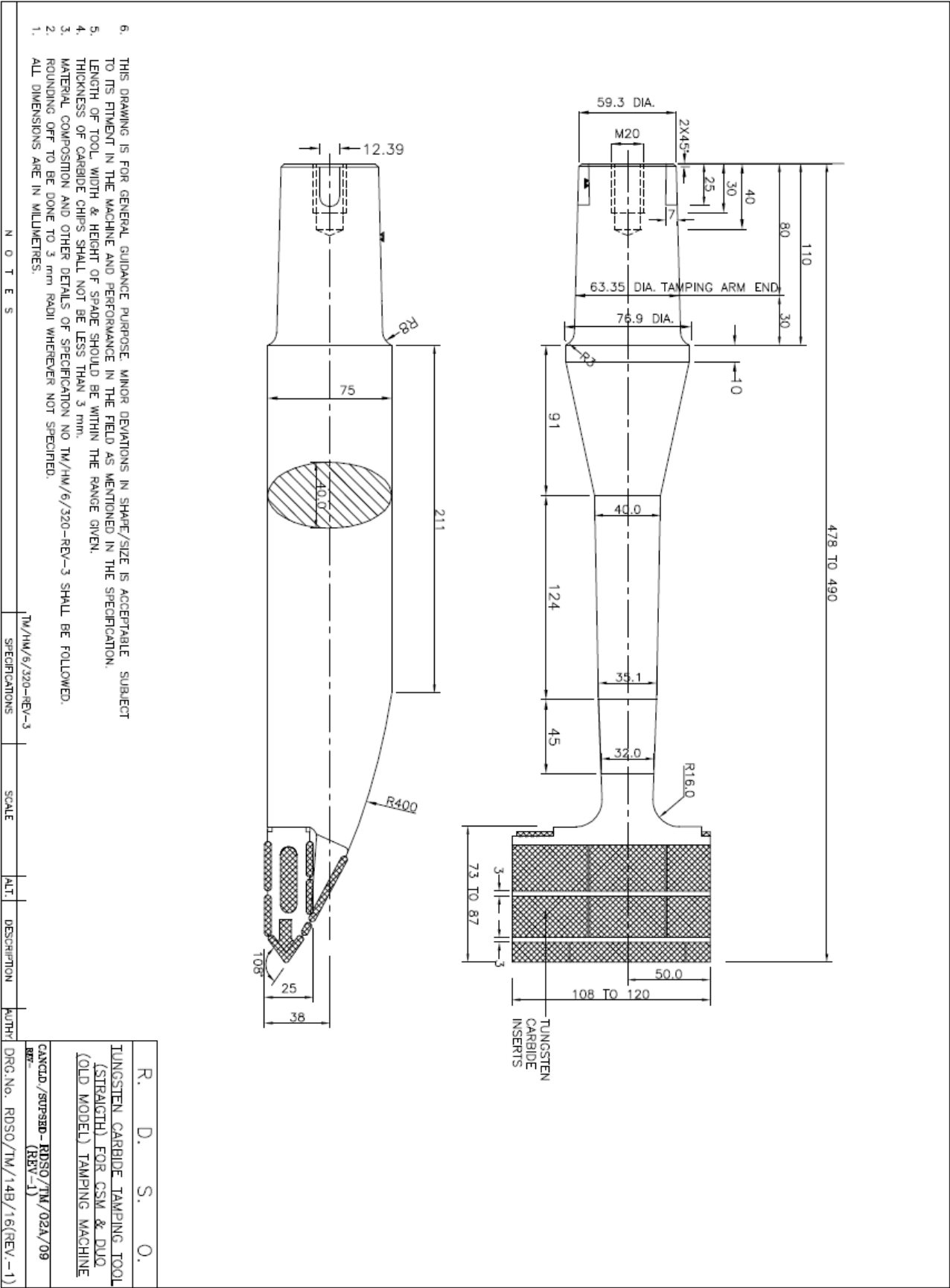


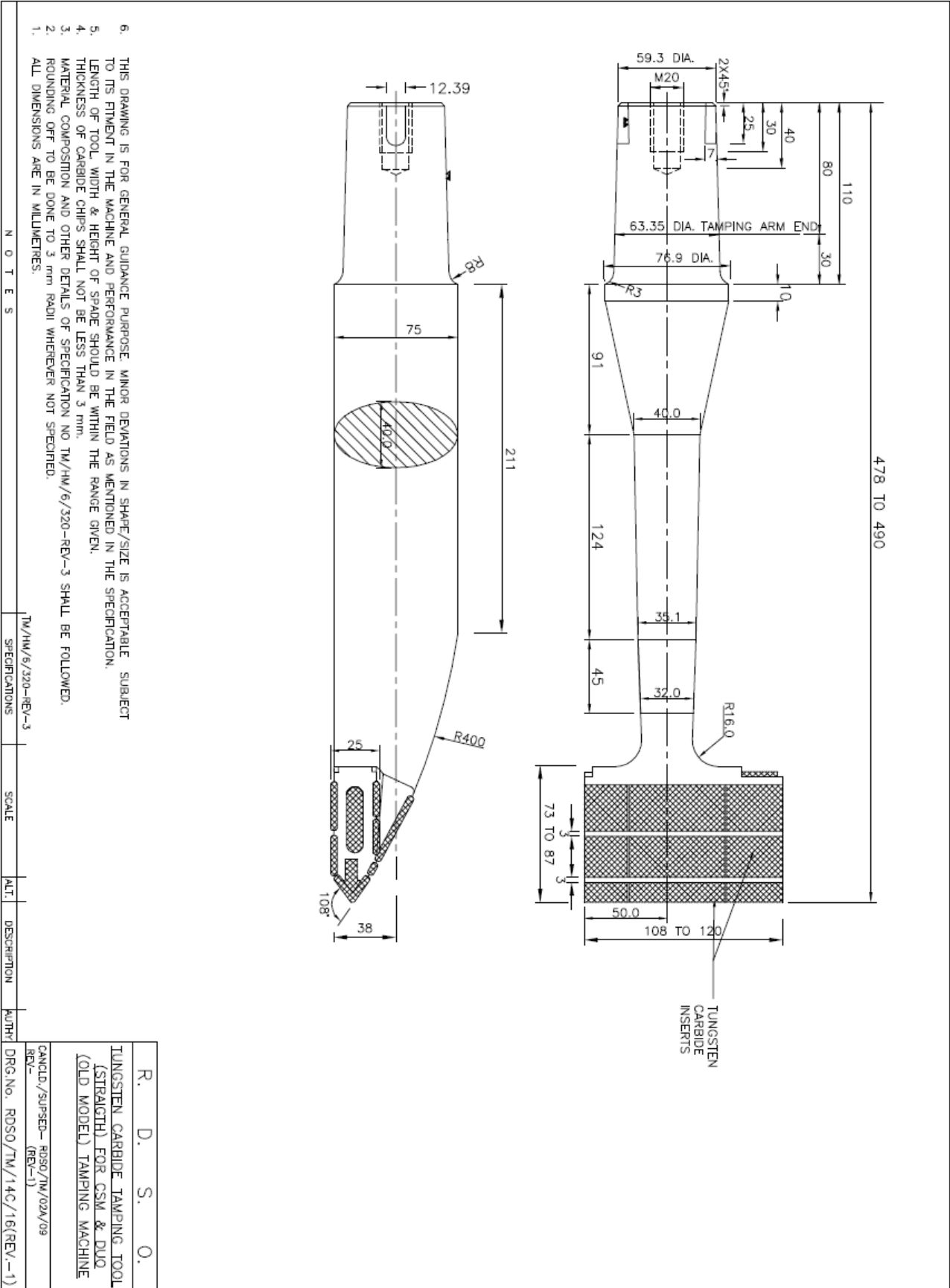
Annexure-II/4

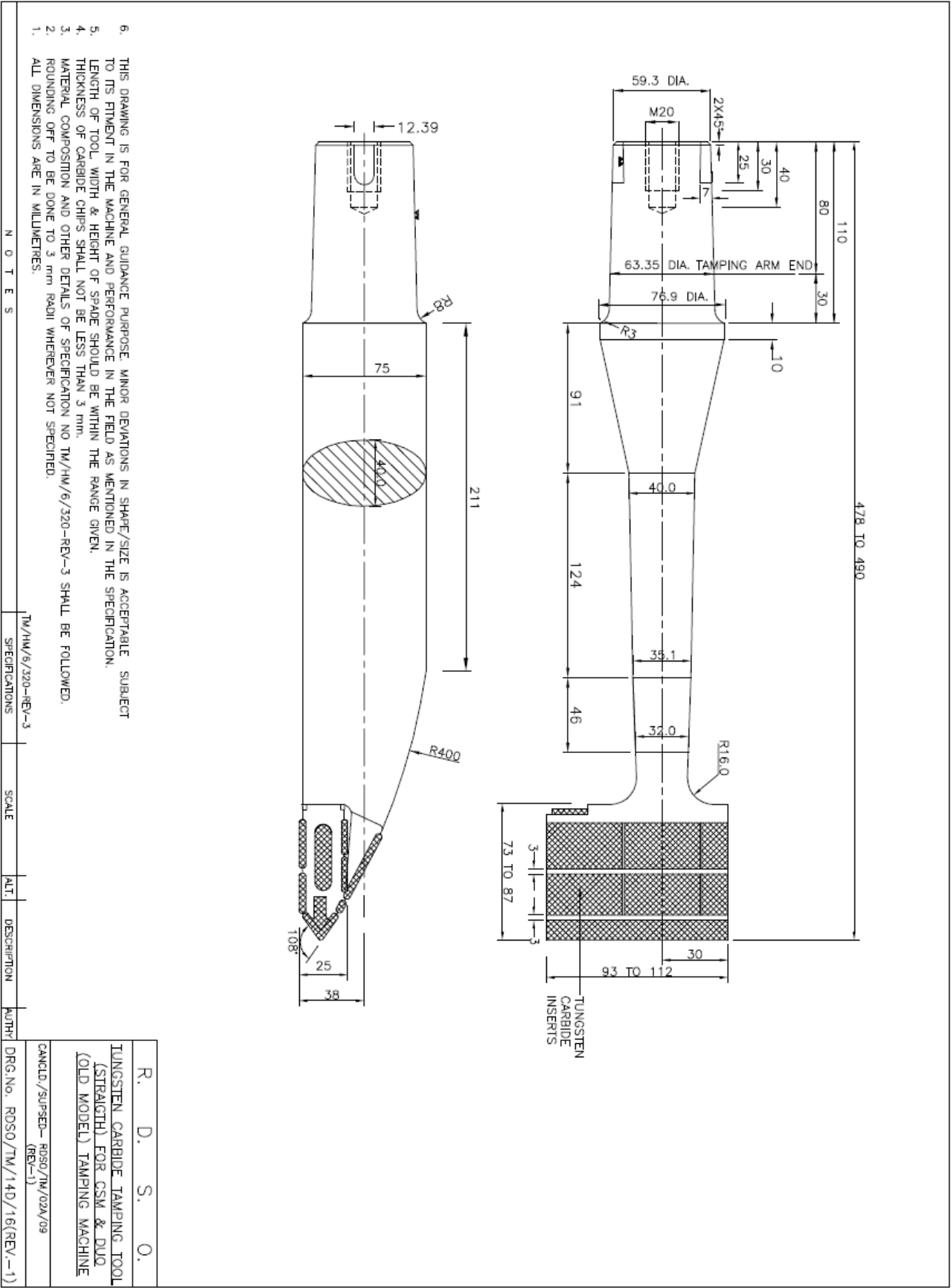


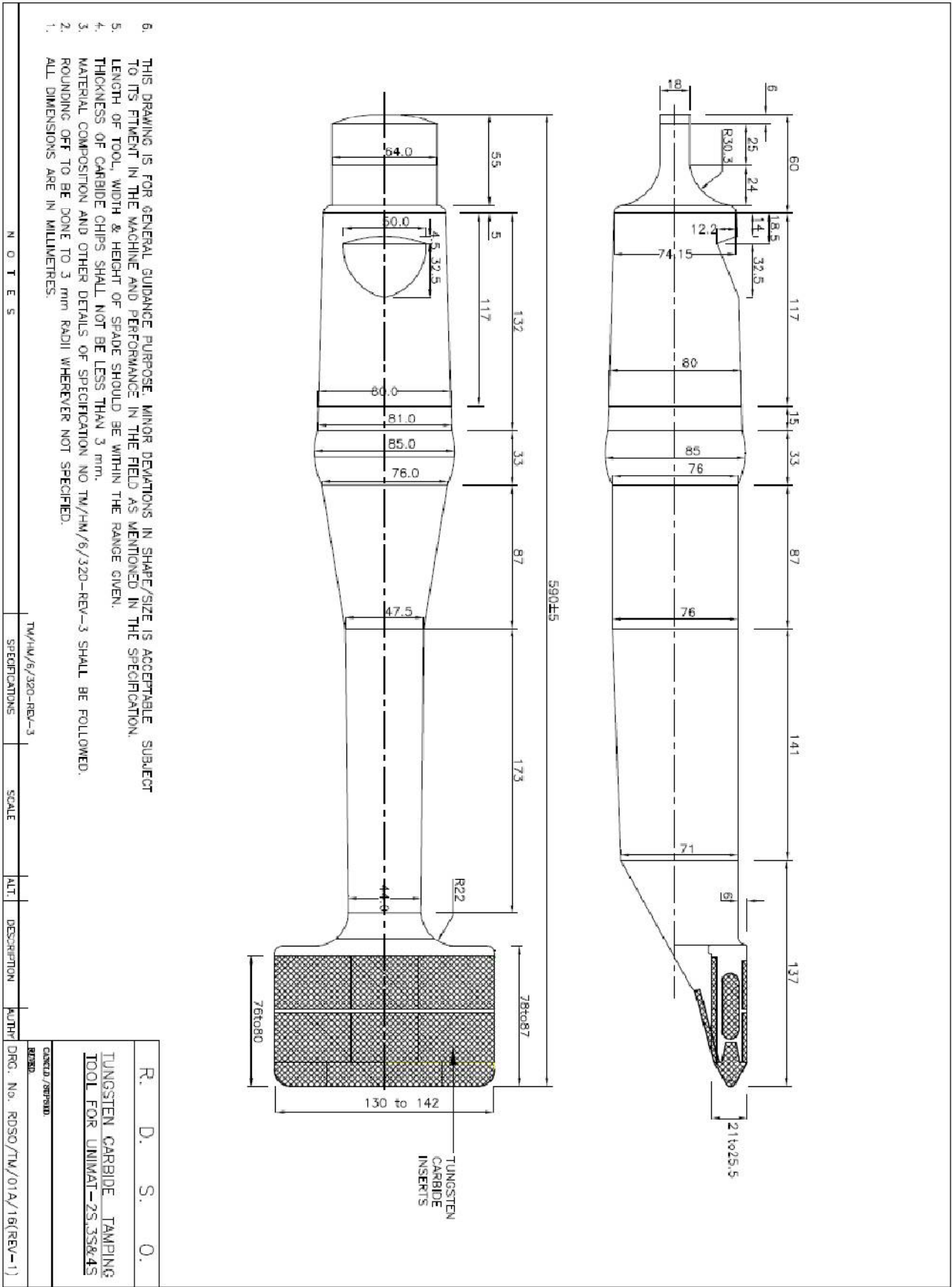


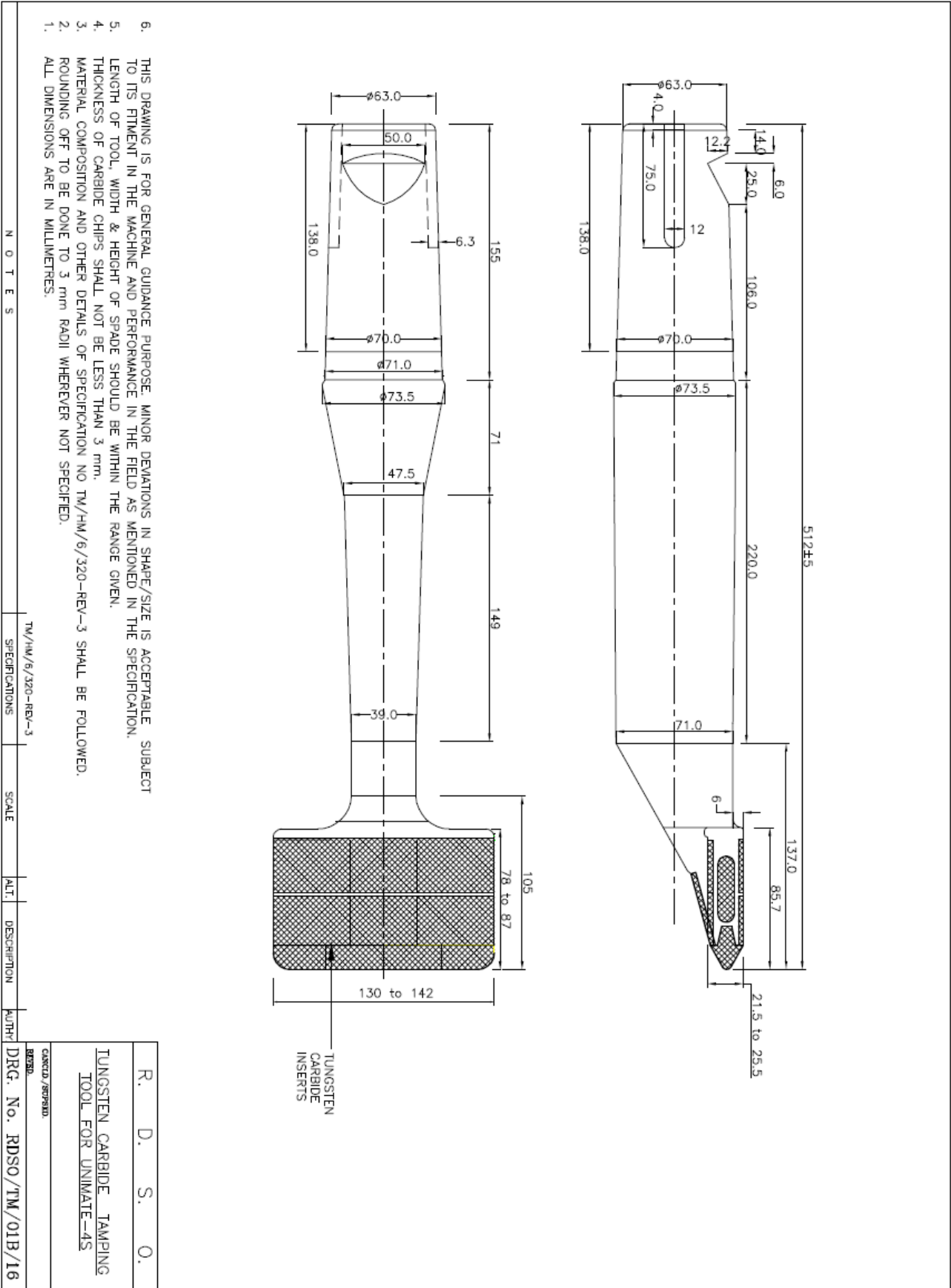




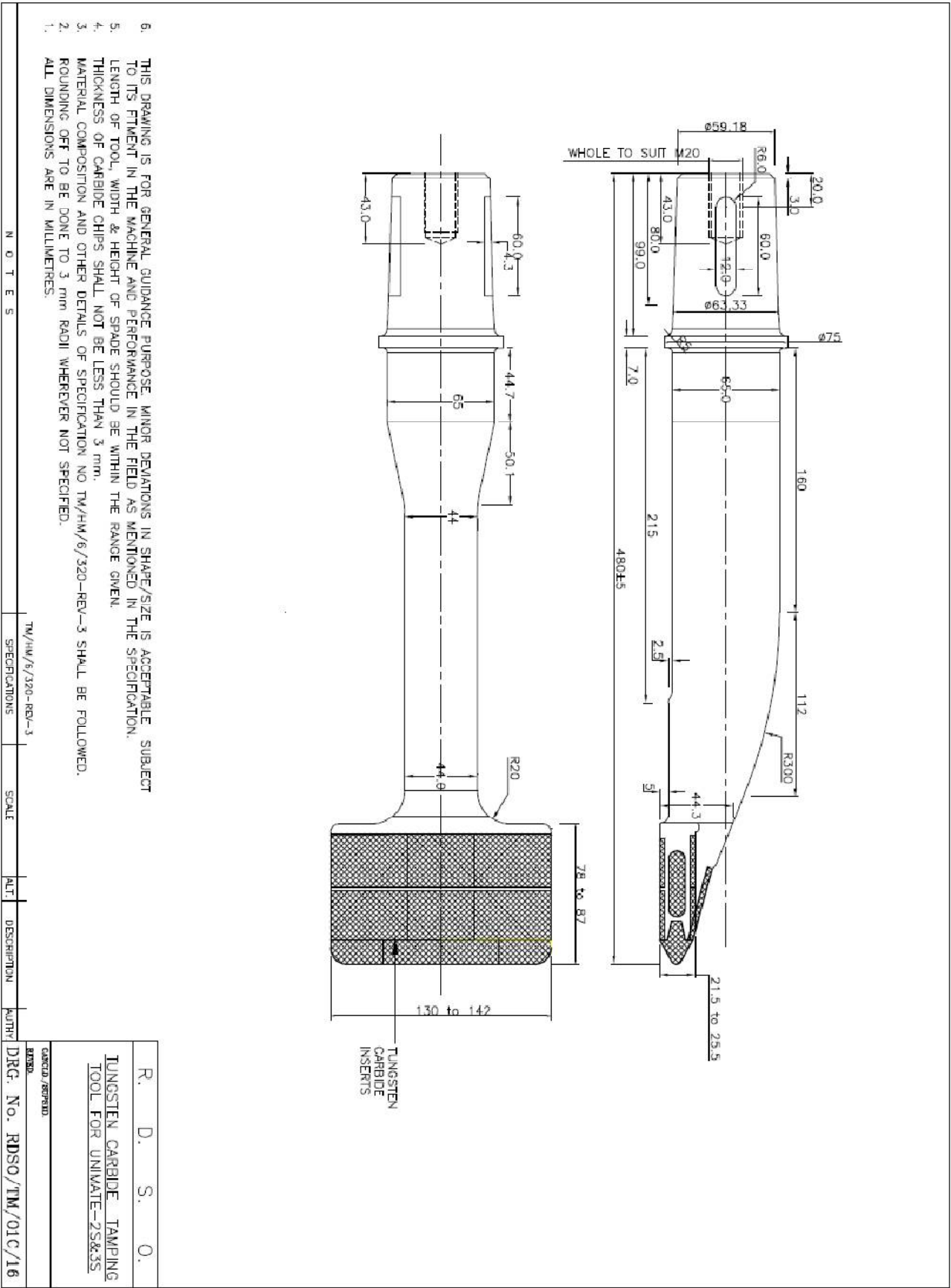












Annexure-III

**CERTIFICATE OF INSPECTION OF TCTT****BY INSPECTING OFFICIAL AND APPROVAL FOR DISPATCH**

(STRIKE OUT WHICHEVER IS NOT APPLICABLE)

This is to certify that I have inspected the TCTT (type) \_\_\_\_\_ bearing Sl. No. \_\_\_\_\_ from (date) \_\_\_\_\_ to \_\_\_\_\_ at place \_\_\_\_\_ for its conformity /non conformity with respect to laid down Technical Specifications in contract Agreement No \_\_\_\_\_ dated \_\_\_\_\_ between President Of India through nominated inspecting official and M/s (Name of Supplier)\_\_\_\_\_.

The detail inspection note regarding its conformity /non conformity to the laid down specifications is enclosed along with as Annexure-A. It is observed that (Strike out whichever is not applicable) :-

- The TCTT confirms to all laid down specifications.
- The TCTT confirms to all laid down specifications except those at Sl. No. \_\_\_\_\_
- The above deviations are major /minor affecting/not affecting the performance of the TCTT in substantial way.

The following T and P/manuals/drawings are to be supplied with the TCTT:

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

Based on the above, TCTT are certified /not certified to be confirming to the specifications.

The TCTT are approved/not approved for dispatch to \_\_\_\_\_ (consignee) Zonal Railway

**SIGNATURE AND DATE**

For M/s \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**INSPECTING OFFICIAL****(NAME AND DESIGNATION)****For and on behalf of President of India**