RESTRICTED

PROVISIONAL SPECIFICATION FOR STANDARD ERA BOX (NO. HEMRL/MED/PS / 290)

HIGH ENERGY MATERIALS RESEARCH LABORATORY

DEFENCE RESEARCH & DEVELOPMENT ORGANISATION

PUNE

RESTRICTED

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PROVISIONAL SPECIFICATION FOR STANDARD ERA BOX (NO. HEMRL/MED/PS / 290)

PREPARED
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INDEX
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1.0 SCOPE.

This provisional specification for
STANDARD ERA BOX
covers the technical details such as introduction with illustrated figures, design drawings, material specifications, process schedule with sketches and inspection schedule.

1. INTRODUCTION.

1.1. Standard ERA box consists of a box container with clamp and collar made up of ultra high strength steel and a mild steel sheet lid. Container and Lid are assembled by means of rivetted pin at one end and a M5 screw with nut at other end. Rivetted pin allows the lid to slide over the box container and keeps the container and lid integral.

1.2. The main purpose of the box is to house the two explosive casettes at required angle. The clamps welded inside the box container provides the required angle to the explosive casettes . The holes drilled through the collars and lid are used for mounting purpose.

1.3. In general the box will be kept empty and whenever it is required to arm the ERA with explosive casettes, the M5 screw is unscrewed and explosive casettes are placed in side the box after sliding the lid. The fig 1.1, 1.2, 1.3, 1.4 & 1.5 shows the different parts of standard ERA box.

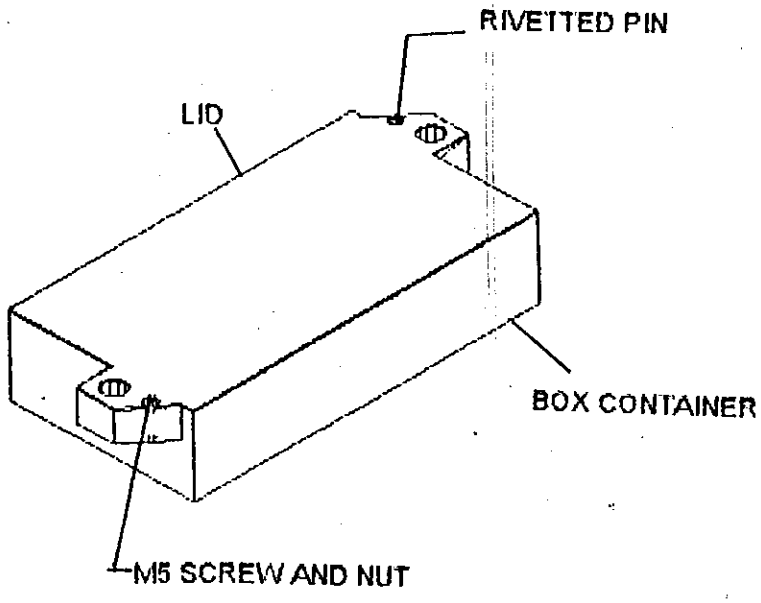


FIG. 1.1.
STANDARD ERA BOX

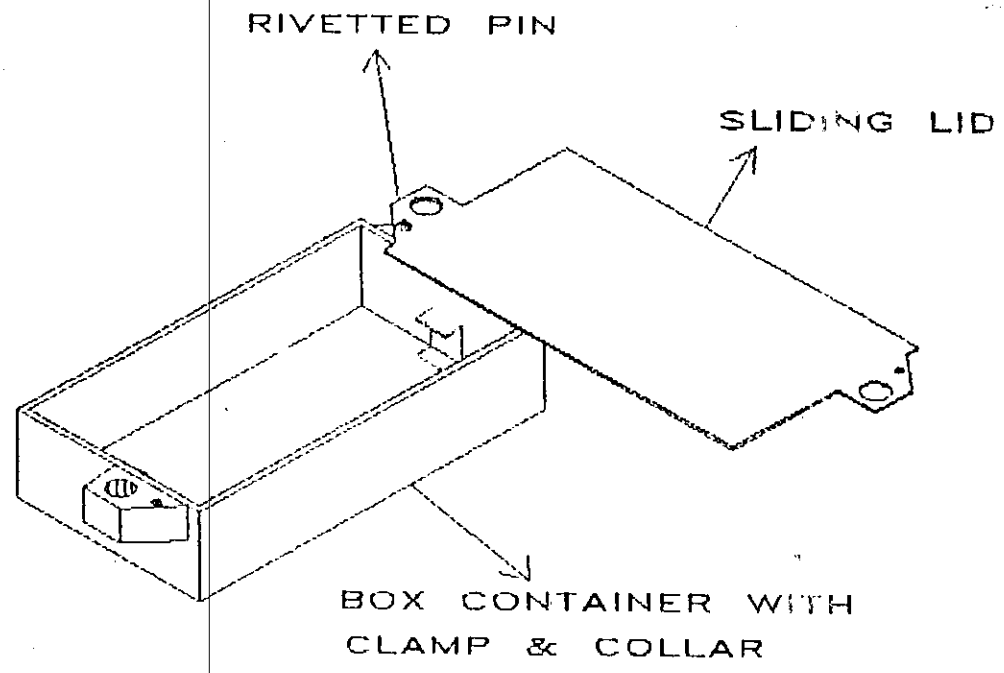


FIG. 1.2.

ERA BOX WITH LID IN OPEN POSITION

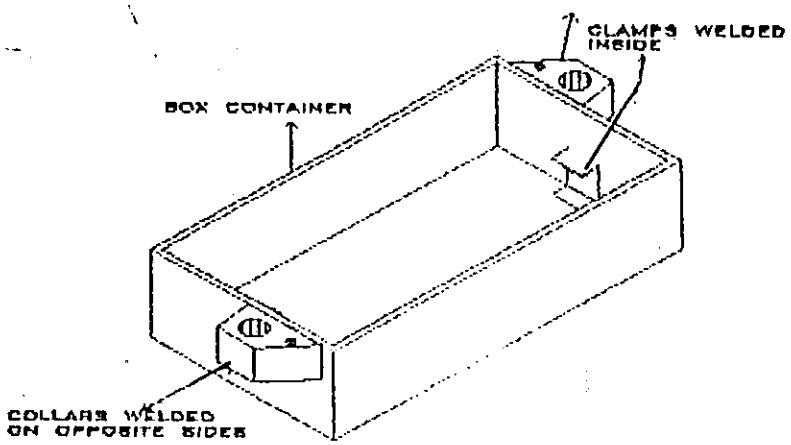


FIG. 1.3.
STANDARD ERA BOX CONTAINER
WITH CLAMP & COLLAR

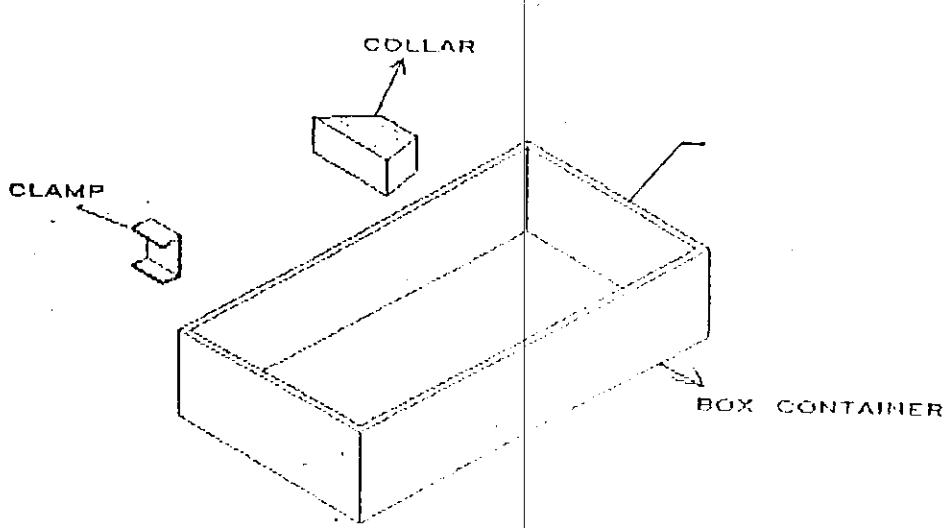


FIG.1.4.
STANDARD BOX CONTAINER, CLAMP & COLLAR

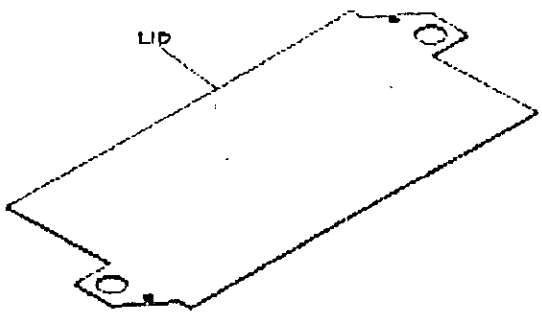


FIG. 1.5.
STANDARD ERA LID

2. DRAWINGS:

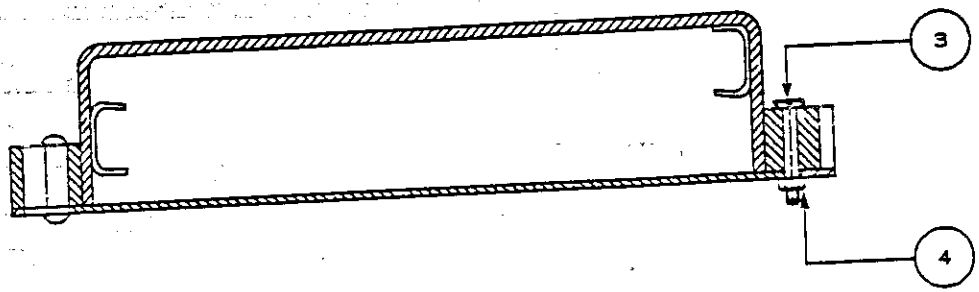
2.1 Drawings of STANDARD ERA BOX confirms to HEMRL. DRG. 1457/1 and the part drawings are as given below;

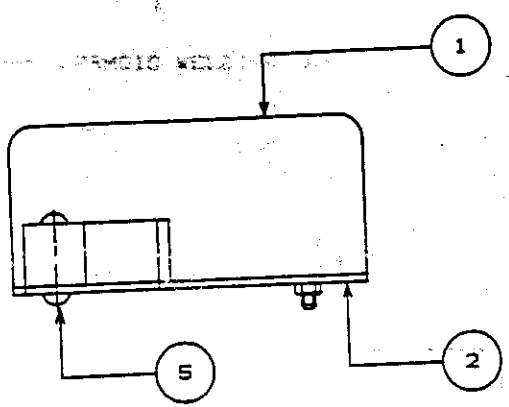
2.2. standard box container with clamp & collar ... HEMRL.DRG. 1457/ 2;
2.3. standard box container ..... HEMRL .DRG. 1457 / 3;
2.4. collar .....HEMRL.DRG. 1457/ 4;
2.5. clamp .... HEMRL.DRG. 1457 / 5;
2.6. lid (standard) .....HEMRL.DRG. 1457/ 6;

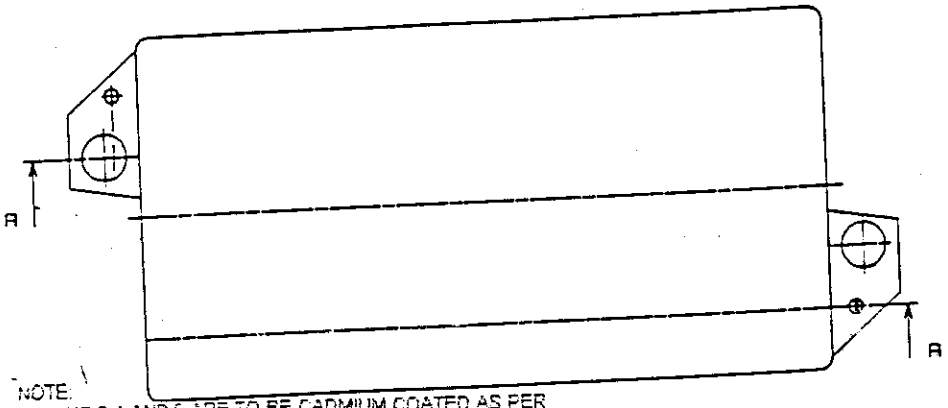
2.7. M5 screw with nut and rivet are standard items and IS number was specified on the drawing;

DRG. CONVENTIONS CONFORM TO ...
DIM. ARE IN mm
GEN. TOL. MEDIUM/~~COARSE/FINE~~ CLASS TO IS:2102

NPR17







NOTE:
1. ITEM NO 3,4 AND 5 ARE TO BE CADMIUM COATED AS PER IS 1572-1966 CLASS SE/CD9
2. ITEM NO 1 AND 2 ARE TO BE ZINC PHOSPHATED (INTERNAL AND EXTERNAL) AS PER IS 1368-1966 CLASS AZ
3. ITEM NO 1 AND 2 ARE TO BE GIVEN AN EXTERNAL COATING OF OLIVE GREEN PAINT AS PER JSS 6010 - 29.CQAEM/SS/97. SHADE CODE-220

LIST OF COMPONENTS

S.No	DESCRIPTION	DRG.No.	DET.No	PART No	No Off
1	STANDARD BOX CONTAINER WITH CLAMP & COLLAR	HEMRL DRG 1457	2		1
2	LID (STANDARD)	HEMRL DRG 1457	6		1
3	SLOTTED CHEESEHEAD SCREW, B M5 X 35 - IS: 1365- 4.8		-		1
4	HEX. NUT M5	IS 2389	-		1
5	SNAP HEAD RIVET 5x30	IS 2155-62	-		1

R. No.	DATE	AUTHORITY	REVISION	ZONE	AHSP SIG.	D.O.

DRG. SEALED :-

DRN: SKC | CHD:- | TRD:- | COMP:-
C.D'MAN | OIC D.O. | SCALE:- 1:2 | EST. MASS:-
APPD. FOR DIRECTOR | GAUGE SCHD:- | DATE:- 24-12-96
MATL:-
PROTECTIVE FINISH:-
Class-

ASSY. DRG. HEMRL DRG 1457
DESIGN AUTHORITY
HEMRL PUNE-411021
DRG. NO.
HEMRL DRG 1457
DET. No. 1 | SHTS. 6 | SHT. NO. 1
PART No.
D.S.CAT. No.

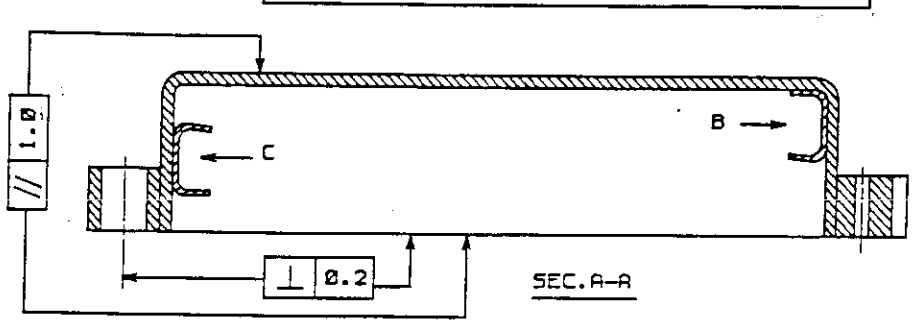
STANDARD ERA BOX

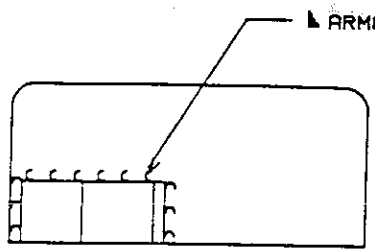
RESTRICTED

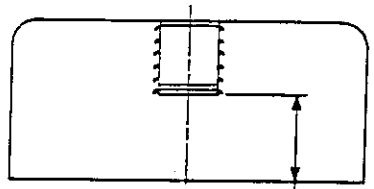
DRG. CONVENTIONS CONFORM TO IS:SPECIFICATIONS
DIM. ARE IN mm
GEN.TOL.MEDIUM/~~COARSE/FINE~~ CLASS TO IS:2102

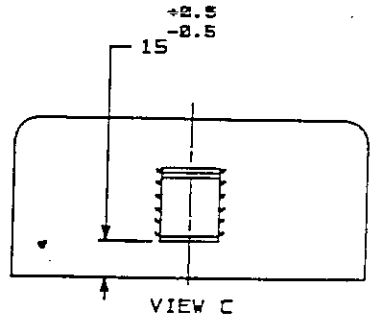
PART NO.

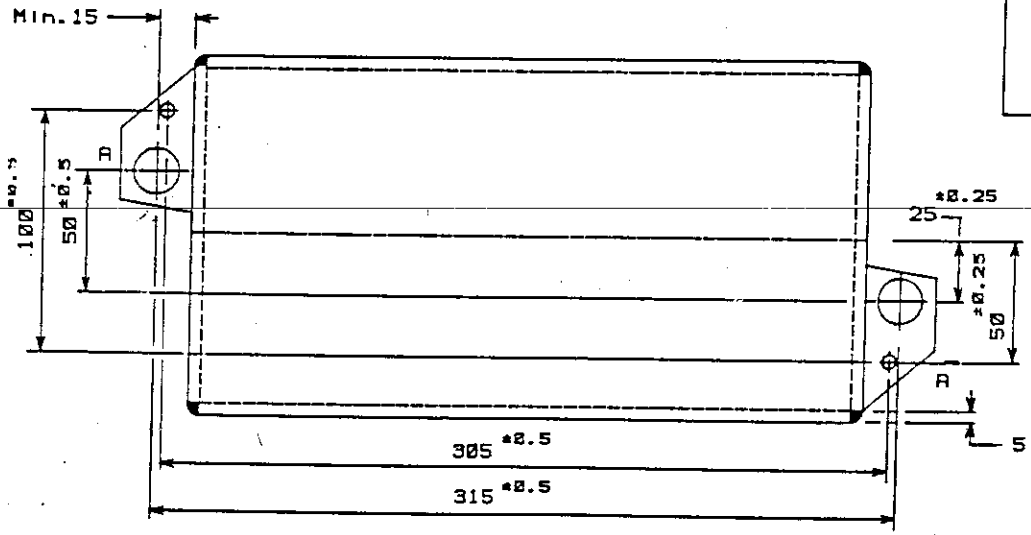
NPR18











LIST OF COMPONENTS

S.No	DESCRIPTION	DRG.No.	DET.No	PART No	No OFF
1	STANDARD BOX CONTAINER	HEMRL DRG 14457	3		1
2	COLLAR	HEMRL DRG 14457	4		2
3	CLAMP	HEMRL DRG 14457	5		2

NOTE:-FIRST COLLARS ARE TO BE WELDED TO THE BOX CONTAINER THEN HOLES ARE TO BE DRILLED KEEPING BOX & LID TOGETHER FOR PERFECT MATCHING OF HOLES.

HEAT TREATMENT-HARDNESS OF PART 1 SHOULD BE 560 ±20 HV.

R. No.	DATE	AUTHORITY	REVISION	ZONE	AHSP / SIG.	D.O.

DRG. SEALED:-

DRN: SKC | CHD:- | TRD:- | COMP:-
C.D'MAN | OIC D.O.
SCALE:- 1:2
EST. MASS:-
APPD. FOR DIRECTOR
GAUGE SCHD:-
DATE:- 24-12-96
MATL:-
PROTECTIVE FINISH:-
Class-

ASSY. DRG. HEMRL DRG 14457/2
DESIGN AUTHORITY
HEMRL PUNE-411021

DRG. NO. HEMRL DRG 14457
2. DET. No. 3 | SHTS. 6 | SHT. NO. 2
PART No.
D.S.CAT.No.
AHSP:-

STANDARD BOX CONTAINER WITH CLAMP & COLLAR.

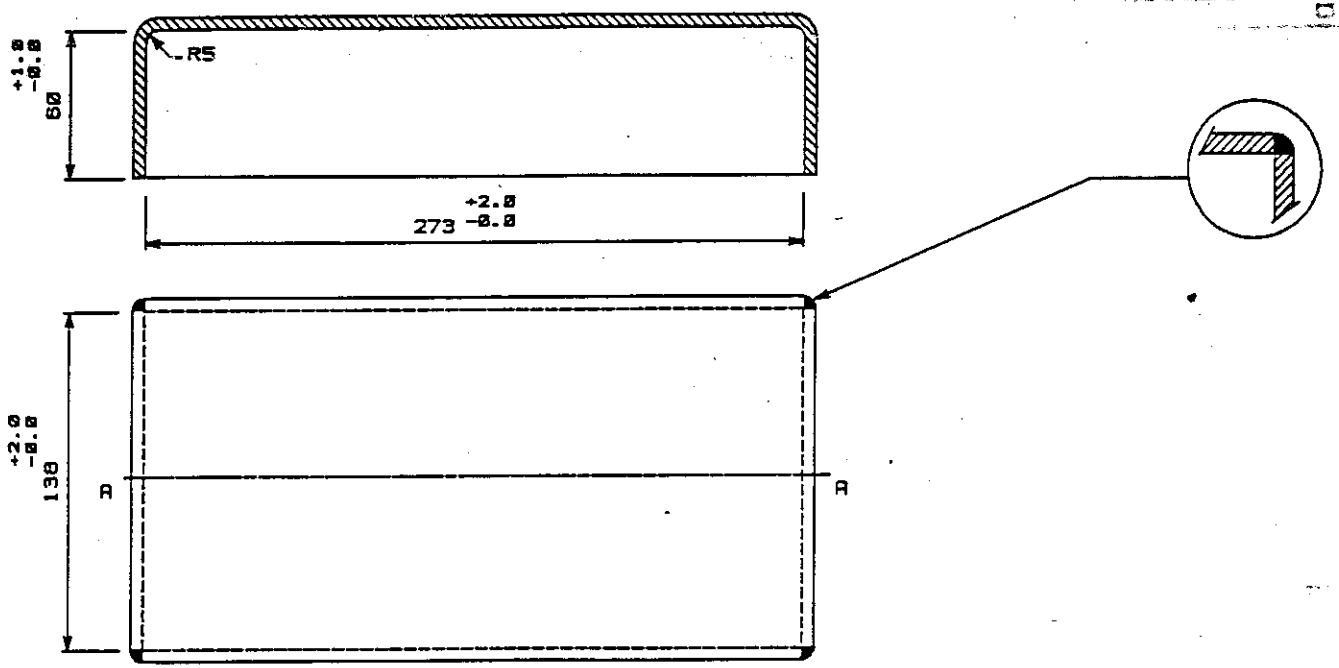
RESTRICTED

8	7	6	5	4	3	2	1

PART NO.

DRG. CONVENTIONS CONFORM TO IS:SPECIFICATIONS
DIM. ARE IN mm
GEN.TOL.MEDIUM/~~COARSE/FINE~~ CLASS TO IS:2102

NPR19



NOTE:-CONTAINER SHOULD BE MADE FROM SINGLE PLATE .
ALL FOUR CORNERS ARE TO BE JOINED BY ARMOUR WELDING
INSIDE BURRS ARE NOT ALLOWED.

NOTE:- ALL SHARP CORNERS TO BE REMOVED.

R. No.	DATE	AUTHORITY	REVISION	ZONE	AHSP SIG.	D.O.

DRG. SEALED:-

DRN:-SKC | CHD:- | TRD:- | COMP:-
C.D'MAN | OIC D.O. | SCALE:- 1:2 | EST. MASS:-
APPD. FOR DIRECTOR | GAUGE SCHD:-
DATE:- 24-12-96

MATL:-ULTRA HIGH STRENGTH STEEL [redacted] AS PER DMRL SPEC [redacted] GR6

PROTECTIVE FINISH:-
Class-

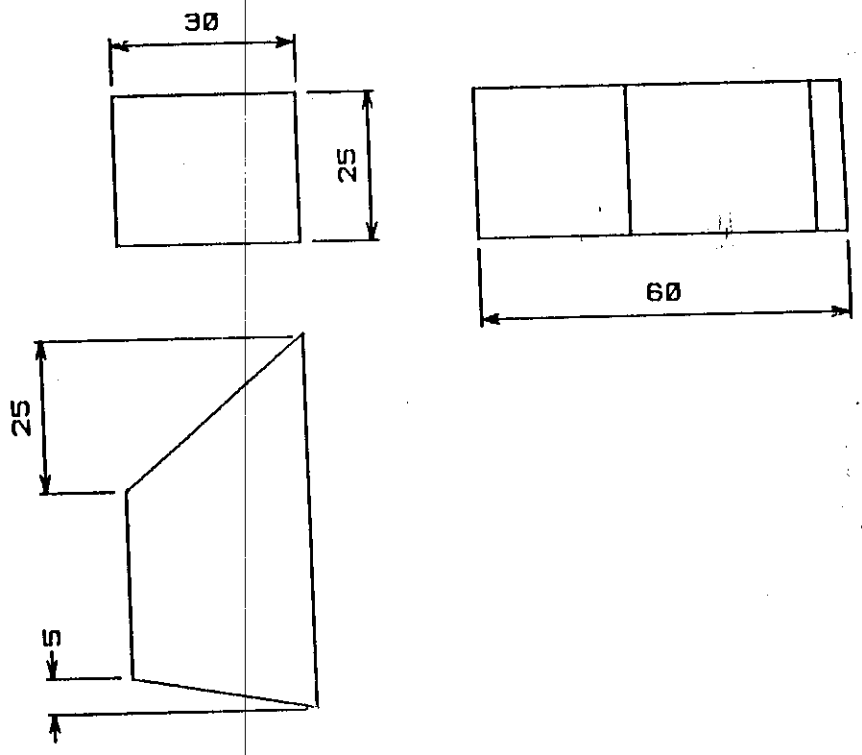
ASSY. DRG. HEMRL DRG 1457/2
DESIGN AUTHORITY
HEMRL PUNE-411021

DRG. NO.
HEMRL DRG 1457.
DET. No. 4 | SHTS. 6 | SHT. NO. 3
PART No.
D.S.CAT. No.

STANDARD BOX CONTAINER.

RESTRICTED

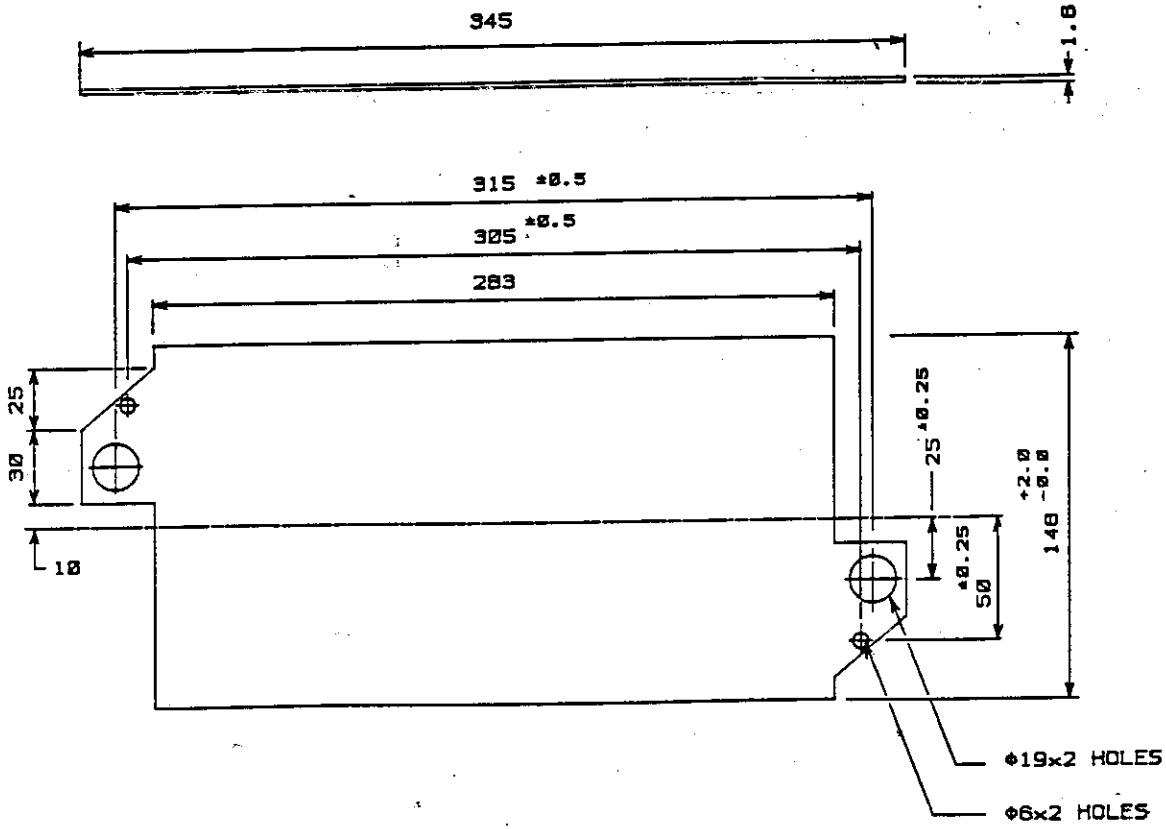
4	3	2	1
PART No.	ORG. CONVENTIONS CONFORM TO IS:SPECIFICATIONS		
	DIM. ARE IN mm		
NPR20	GEN. TOL. MEDIUM/COARSE/FINE CLASS TO IS:2102		



R No.	DATE	AUTHORITY	REVISION	ZONE	AHSP SIG.	D.O.
1						

DRG. SEALED:-			ASSY. DRG. HEMRL DRG 1457/2
DRN:- SKC	CHD:-	TRD:- COMP:-	DESIGN AUTHORITY
C.D'MAN	DIC D.D.	SCALE:- 1:1 EST MASS:-	HEMRL PUNE-411021
APPD.. FOR DIRECTOR		GAUGE SCHD:- DATE:-19-12-96	
MATL:-M.S. IS-2062/69			DRG. No. HEMRL DRG 1457
PROTECTIVE FINISH:-			DET. NO. 4 SHTS. 6 SHT. NO. 4
Class-			PART No.
COLLAR			D.S. CAT. No.
			AHSP:-

PART NO. NPR22	DRG. CONVENTIONS CONFORM TO IS:SPECIFICATIONS DIM. ARE IN mm GEN.TOL. MEDIUM/~~COARSE/FINE~~ CLASS TO IS:2102



NOTE:- ALL SHARP CORNERS TO BE REMOVED.

R. No.	DATE	AUTHORITY	REVISION	ZONE	AHSP SIG.	D.O.

DRG. SEALED:-

DRN: SKC	CHD:-	TRD:-	COMP:-
C.D'MAN	DIC D.O.	SCALE:- 1:2	
APPD. FOR DIRECTOR		EST. MASS:-	
		GAUGE SCHD:-	
		DATE:- 24-12-96	

MATL:-M.S. 1.6mm THICK, IS 513-1963

PROTECTIVE FINISH:-PHOSPHATING

Class-

ASSY. DRG. HEMRL DRG 1457/1

DESIGN AUTHORITY
HEMRL PUNE-411021

DRG. NO.
HEMRL DRG 1457

DET. No. 7	SHTS. 6	SHT. NO. 6

PART No.

D.S.CAT.No.

AHSP:-

LID (STANDARD)

RESTRICTED

NPR36

GAUGE NO.	DESCRIPTION OF GAUGES	STORE DIMNS.
	GAUGE FOR BOX CONTAINER	273.0 +2.0 -0.0 198.0 +2.0 -0.0 60.0 +1.0 -0.0
---	DYE PENETRANT TEST	QUALITY OF WELDING

DATE	BRIEF RECORD	AUTHORITY	I/C INITIALS	G.O.

STORE DRG. NO.	DATE	DATE	DATE
HEMRL DRG 11,57,3	27-12-96		

HEMRL PUNE-21

DRN:- SR | TRD | CHD [illegible] | SEALED

APPROVED [signature] FOR DIRECTOR

INSPECTION GAUGES FOR :-

STANDARD BOX CONTAINER

SCHEDULE NO. 1

1 SHEET OF 1

NPR40

GAUGE NO.	DESCRIPTION OF GAUGES	STORE DIMNS.
	STANDARD GAUGES	80,25,30, 25,5

DATE	BRIEF RECORD	AUTHORITY	I/C INITIALS	G.O. INITIALS

STORE DRG. NO.	DATE	DATE	DATE
HEMRL DRG [illegible]	27-12-96		

HEMRL PUNE-21

DRN :- SR | TRD | CHD [illegible] | SEALED

APPROVED [signature]
FOR DIRECTOR

INSPECTION GAUGES FOR :-

COLLAR

SCHEDULE NO. 2

1 SHEET OF 1

NPR37

GAUGE NO.	DESCRIPTION OF GAUGES	STORE DIMNS.
	GAUGE FOR CHECKING PITCH & WIDTH	$315.0^{\pm 0.5}$ $100.0^{\pm 0.5}$ $305.0^{\pm 0.5}$ $50.0^{\pm 0.5}$ 150.0 MAX
	GAUGE FOR CHECKING CLAMP POSITION	$15.0^{+0.5}_{-0.0}$
	GAUGE FOR CHECKING CLAMP POSITION	$30.0^{+0.5}_{-0.0}$
----	HARDNESS TESTER	$560.0^{+20.0}_{-20.0}$
----	DYE PENETRANT TEST	QUALITY OF HEAT TREATMENT
		⊥ 0.2
		// 1

DATE	BRIEF RECORD	AUTHORITY	I/C INITIALS	G.O.

STORE DRG. NO.	DATE	DATE	DATE
HEMRL DRG [illegible]	27-12-96		

DRN :- SR | TRD | CHD [illegible] | SEALED

HEMRL PUNE-21

INSPECTION GAUGES FOR :-

STANDARD BOX CONTAINER WITH CLAMP & COLLAR

APPROVED [signature] FOR DIRECTOR

SCHEDULE NO. 4

1 SHEET OF 1

RESTRICTED

GAUGE NO.	DESCRIPTION OF GAUGES	STORE DIMNS.
	GAUGE FOR CHECKING PITCH & WIDTH	315.0 ±0.5 100.0 ±0.5 305.0 ±0.5 50.0 ±0.5 150.0 MAX

DATE	BRIEF RECORD	AUTHORITY	I/C	G.O. INITIALS

STORE DRG. NO.	DATE	DATE	DATE
HEMRL DRG [illegible]	27-12-96		

DRN:- SR | TRD | CHD [illegible] | SEALED

INSPECTION GAUGES FOR :-

LID-[STANDARD)

HEMRL PUNE-21

APPROVED [signature]
FOR DIRECTOR

SCHEDULE NO.5

1 SHEET OF 1

RESTRICTED

NPR38

GAUGE NO.	DESCRIPTION OF GAUGES	STORE DIMNS.
	GAUGE FOR CHECKING PITCH & WIDTH	315.0 ±0.5 100.0 ±0.5 905.0 ±0.5 50.0 ±0.5 150.0 MAX

DATE	BRIEF RECORD	AUTHORITY	I/C INITIALS	G.O.

STORE DRG. NO.	DATE	DATE	DATE
HEMRL DRG [illegible]	27-12-96		

HEMRL PUNE-21

DRN:- SR	TRD	CHD [illegible]	SEALED

APPROVED [signature]
FOR DIRECTOR

INSPECTION GAUGES FOR :-

STANDARD ERA BOX

SCHEDULE NO.6

1 SHEET OF 1

Spec / MEDERATION To

3. MATERIAL SPECIFICATION;

3.1. for CLAMP & LID;

3.1.1. material should confirm to
LOW CARBON COLD ROLLED STEEL SHEET
IS 513 - 1986;

3.2. for COLLAR

3.2.1. material should confirm to
WELDABLE STRUCTURAL STEEL
IS 2062/69;

3.3. for BOX CONTAINER

3.3.1. material should confirm to
ULTRA HIGH STRENGTH STEEL
as per DMRL specification DMRL/ CDG / 6.
enclosed at appendix- A

4. PROCESS SCHEDULE.

The process of fabrication of ERA box from Ultra high strength steel and metallurgical treatment to be given during the process was developed by DMRL and is as below.

4.0. Fabrication of Standard ERA box consists of simple fabrication techniques and requires the following equipment.

4.0.1. EQUIPMENT:

1. SHEARING M/C
2. MILLING M/C
3. DRILLING M/C
4. PRESSING M/C
5. HEAT TREATMENT FURNACES
6. HARDNESS TESTER
7. WELDING EQUIPMENT
8. PHOSPHATING PLANT.

AND OTHER GENERAL PURPOSE TOOLS & EQUIPMENT.

4.0.2. PROCESS:

4.0.2.1. The overall process consists of fabricating box container, fabricating clamp ,machining collar separately and joining them by armoid welding to make the box container with clamp and collar. A mild steel sheet lid is also fabricated separately. After ther holes are to be drilled through the collars and lid in assembled condition. box container with clamp and collar is subjected to heat treatment for desired hardness. After that the box container and lid are assembled by means of a rivetted pin and a M5 screw.

4.0.2.2. The desired hardness is a very critical parameter and critical attention should be paid for this hardness measurement.

Detailed process is given below:

4.1. STANDARD BOX CONTAINER.

4.1.1. CUT THE SOFTENED UTS STEEL SHEET TO THE BLANK SIZE AS SHOWN IN FIG.4.1.

4.1..2. HEAT THE PLATE TO 700 + 10 C

4.1.3. CUT THE CORNERS AS SHOWN IN FIG 4.2.

4.1.4. FORM THE CONTAINER AS SHOWN IN FIG.4.3 & FIG 4.4.

4.1.5. WELD THE CORNERS WITH ARMOID ELECTRODES.

4.1.6. FOLLOW INSPECTION SCHEDULE NO.1

4.2.CLAMP

4.2.1. CUT THE LOW CARBON COLD ROLLED STEEL SHEET OF IS 513-1963 TO THE BLANK SIZE . AS SHOWN IN FIG 4(.7.

4.2.2. FORM THE CLAMP IN TWO STAGES AS SHOWN IN FIG.4.8 .

4.2.3.FOLLOW INSPECTION SCHEDULE NO.2

4.3. COLLAR

4.3.1. TAKE A BLOCK OF 64 X 54 X 29 MM OF WELDABLE STRCTURAL STEEL OF IS 2062/68 AS SHOWN IN FIG. 4.5.

4.3.2 MILL THE CORNER AS SHOWN IN FIG.4.6.

4.3.3 FOLLOW INSPECTION SCHEDULE nO.3

4.4. STANDARD BOX CONTAINER WITH CLAMP& COLLARS

4.4.1. WELD THE COLLARS , CLAMP THEN DRILL THE HOLES OF 9.19mm AND 6 mm AS SHOWN IN FIG.4.9

4.4.2. HEAT TREATMENT REFER MATERIAL SPECIFICATION FOR PROCESS

4.4.3. follow inspection schedule no 4

4.5. LID (STD)

4.5.1 CUT THE LOW CARBON COLD ROLLED STEEL SHEET OF IS 513-63 TO THE BLANK SIZE. AS SHOWN IN FIG.4.10.

4.5.2. CUT THE SHEET TO LID AS SHOWN FIG.4.11.

4.5.3. DRILL HOLES OF DIA 19 & 6 mm AS IN FIG 4.11.

4.5.4. FOLLOW INSPECTION SCHEDULE NO. 5

##

4.6. STANDARD ERA BOX

##

4.6.1. MATCH THE LID WITH BOX CONTAINER WITH CLAMPS & COLLAR AS SHOWN IN FIG 4.12.

4.6.2. BY RIVETTING PIN INTEGRATE LID. RIVETTING SHOULD ALLOW THE LID TO SLIDE OVER THE BOX. FIG.4.12.

4.6.3. FOLLOW INSPECTION SCHEDULE NO.6

4.6.4. PHOSPHATING INTERNAL & EXTERNAL

4.6.5. OLIVE GREEN PAINTING EXTERNAL

4.6.6. FINAL CHECKING

4.6.7. FOLLOW INSPECTION SCHEDULE NO.6

4.6.8. WITH THE HELP OF M5 BOLT & NUT CLOSE THE LID AS SHOWN IN FIG.4.13.

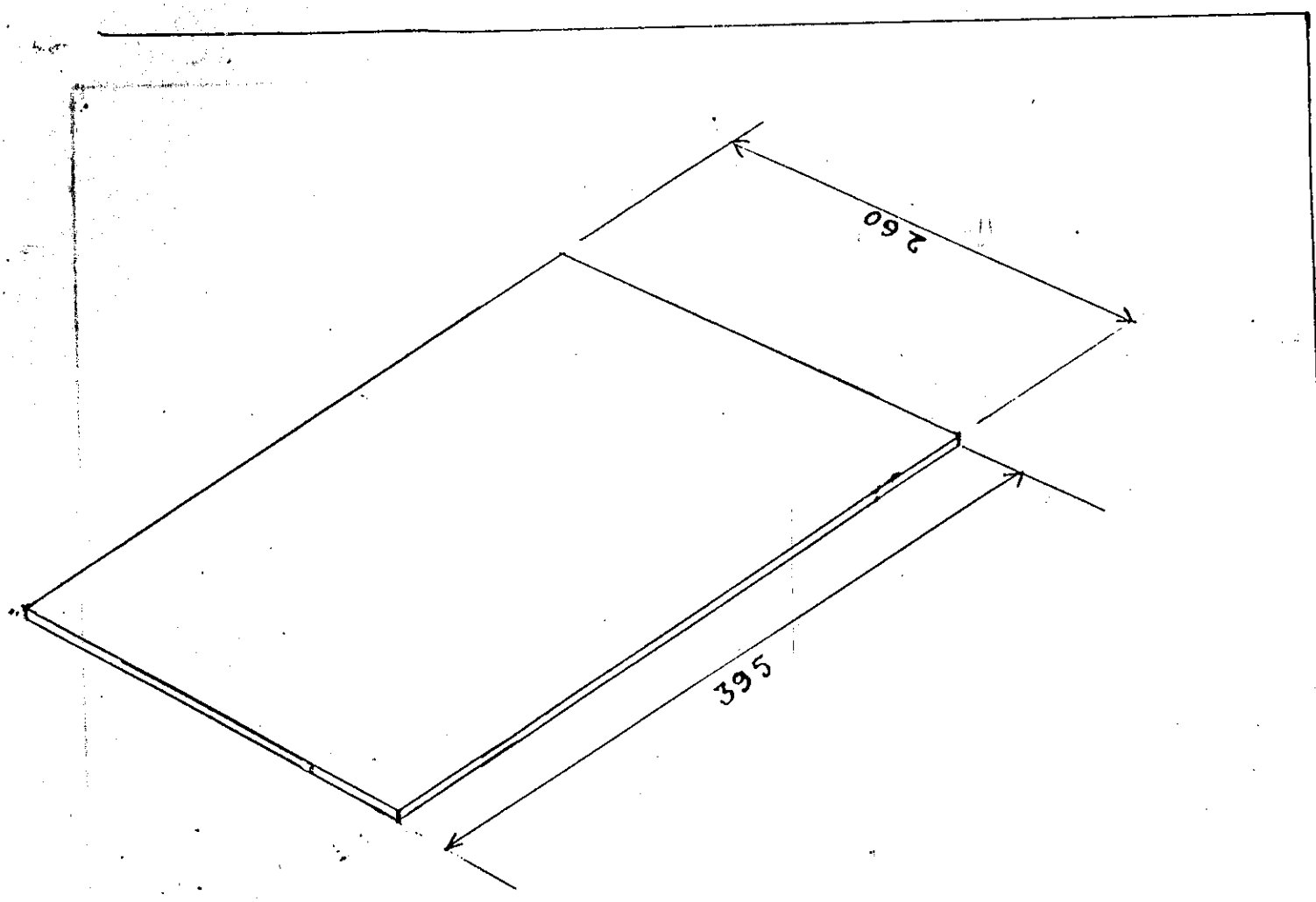


FIG.4.1. BLANK SHEET OF UHS STEEL FOR ERA BOX CONTAINER

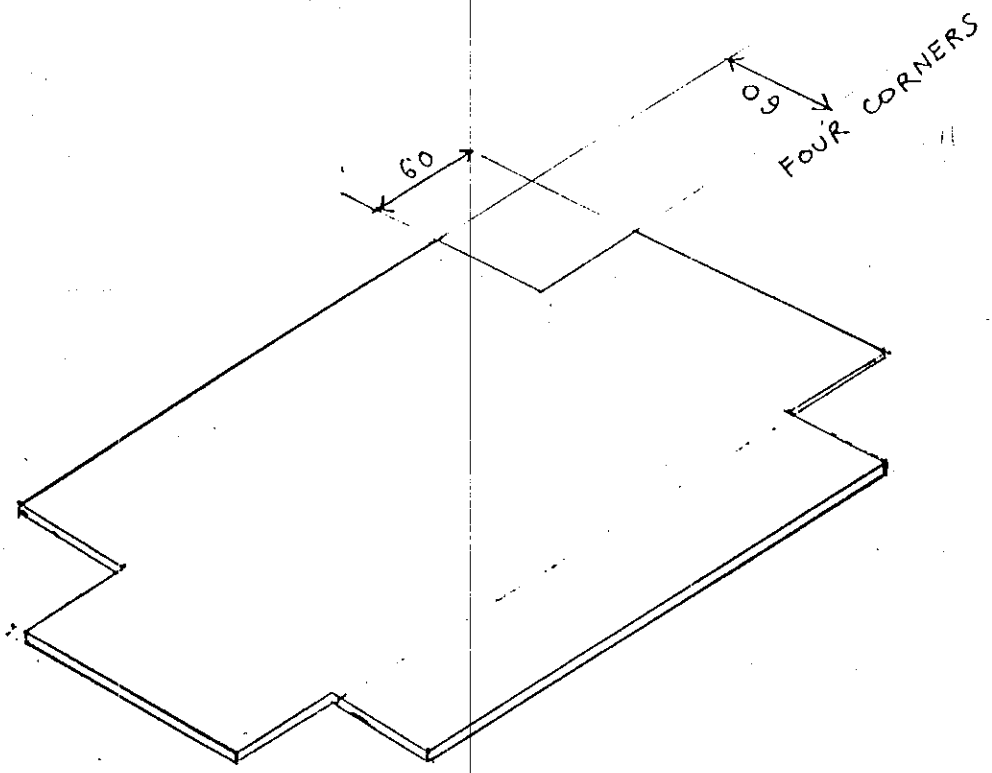


FIG.4.2. BLANK SHEET AFTER CUTTING OF FOUR CORNERS.

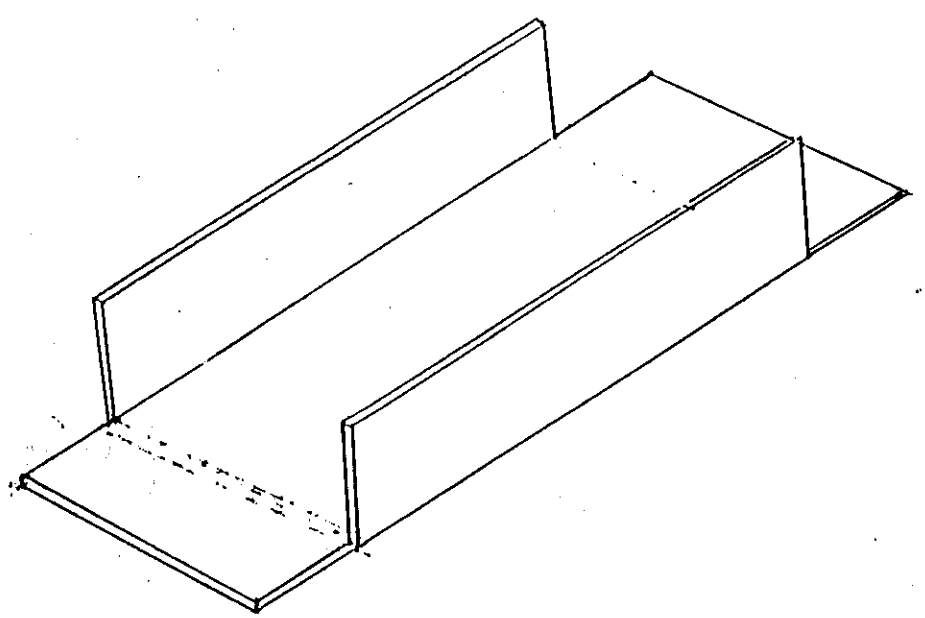


FIG.4.3.FIRST FOLDING OF BOX C NTAINER.

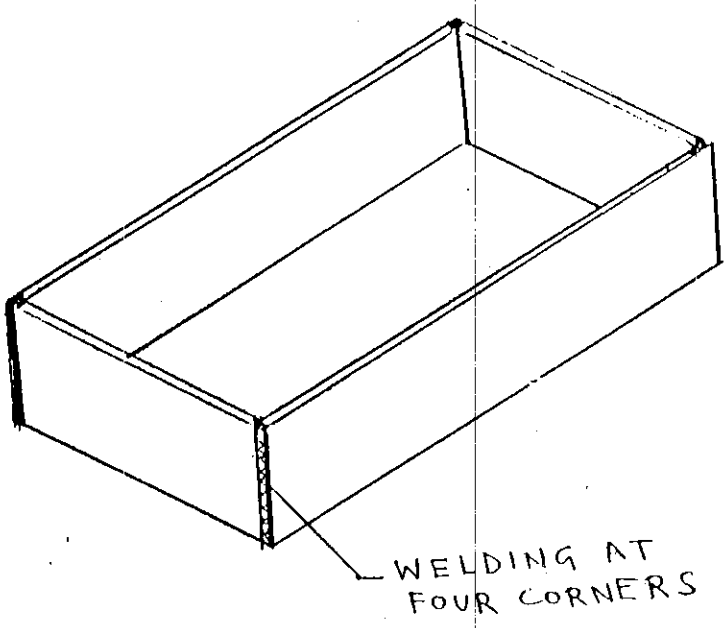


FIG.4.4. SECOND FOLDING OF BOX CONTAINER AND ARMOID WELDING AT FOUR CORNERS.

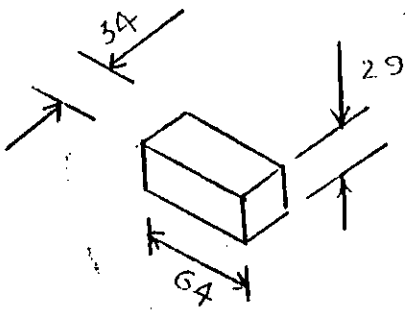


FIG.4.5. BLANK PIECE FOR COLLAR

FIG.4.7. BLANK SHEET FOR CLAMP.

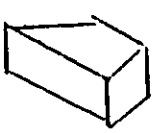


FIG.4.6. COLLAR AFTER MACHINING.

FIG.4.8. CLAMP AFTER FOLDING

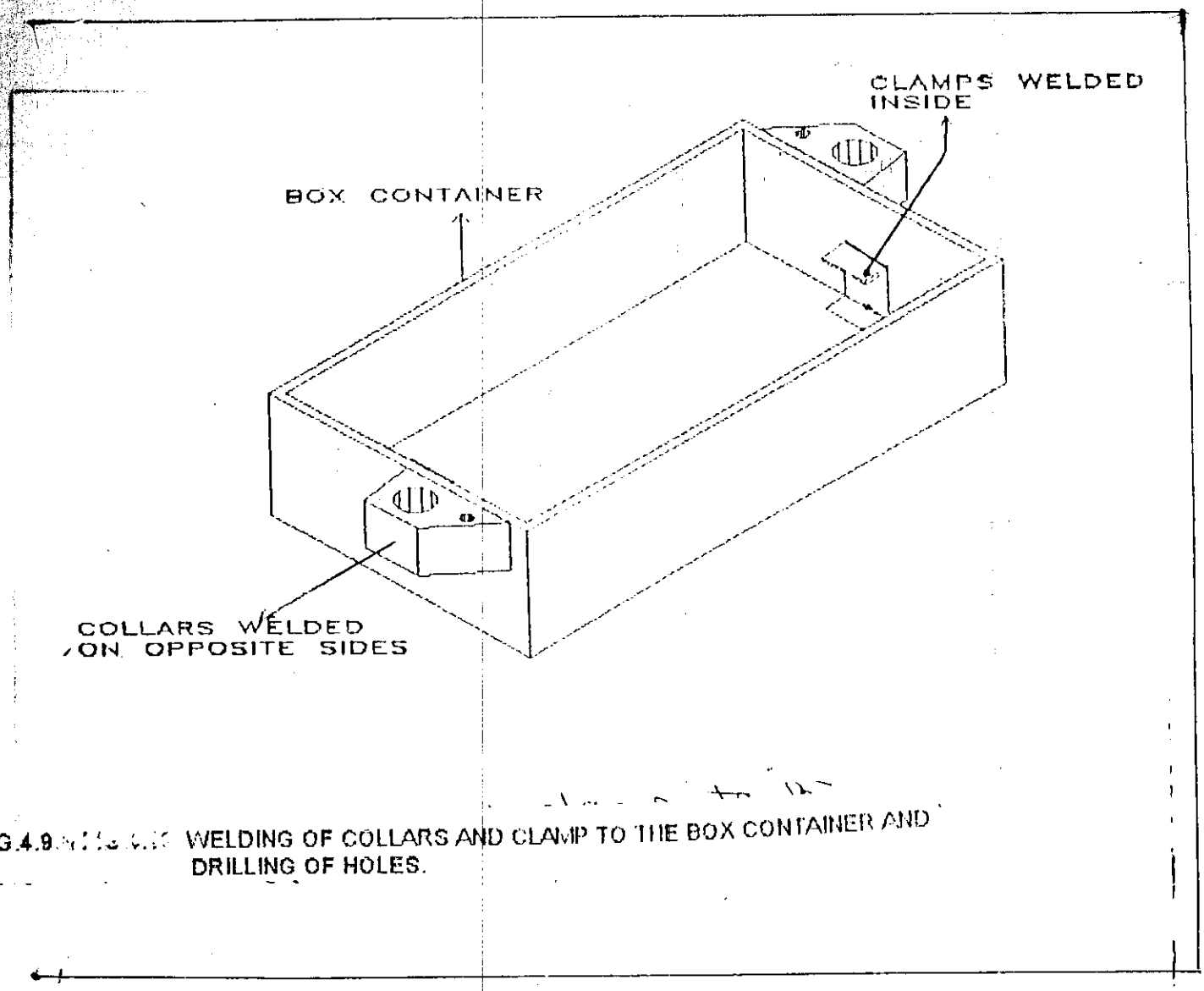


FIG.4.9 WELDING OF COLLARS AND CLAMP TO THE BOX CONTAINER AND DRILLING OF HOLES.

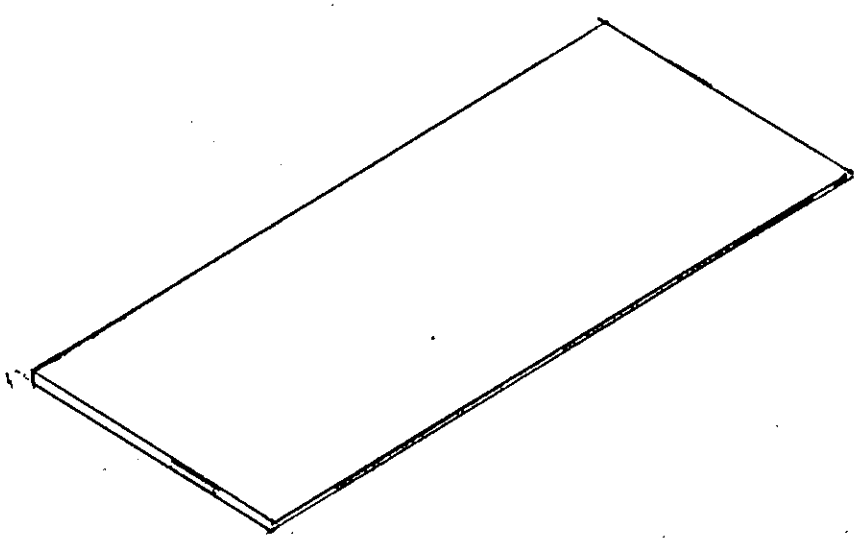


FIG.4.10. BLANK SHEET FOR LID.

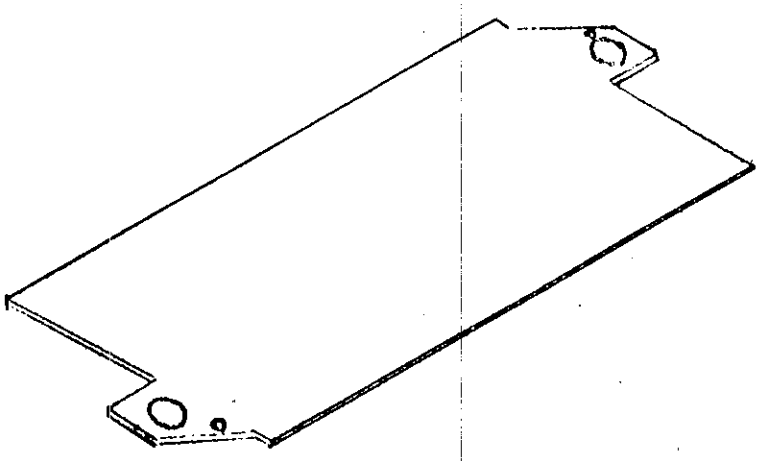


FIG.4.11. CUTTING IN TO LID SHAPE AND DRILLING OF HOLES.

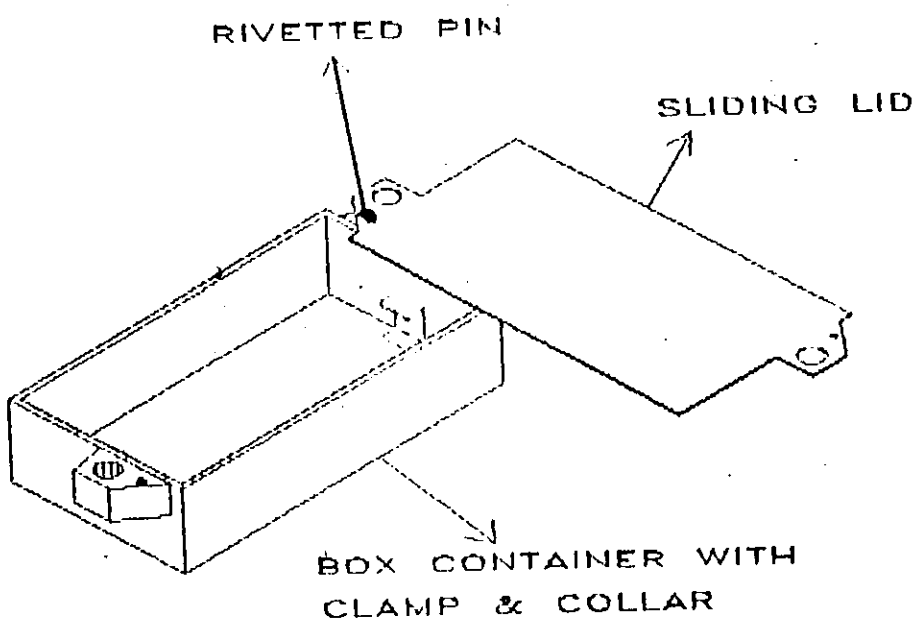


FIG.4.12 ASSEMBLING LID AND BOX CONTAINER.

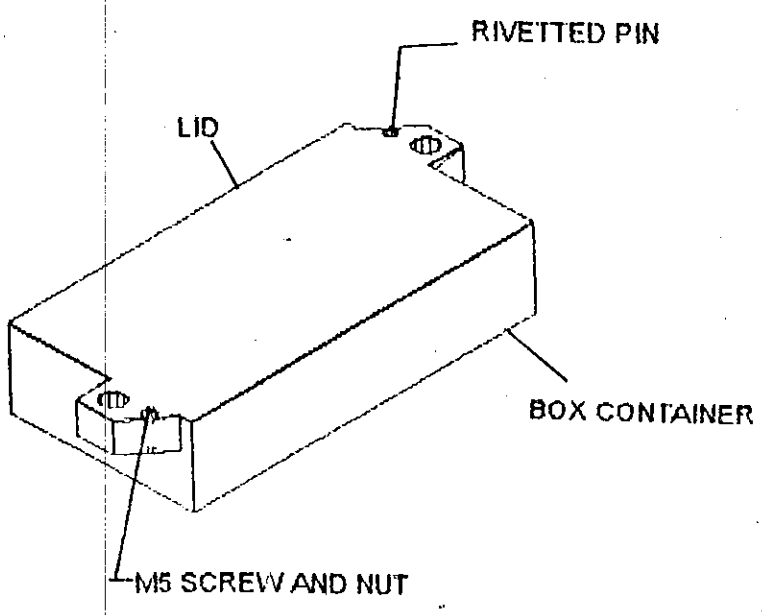


FIG.4.13. CLOSING THE BOX & LID WITH M5 SCREW & NUT.

5. INSPECTION SCHEDULE;

5.1. SCHEDULE NO. 1

FOR STANDARD BOX COTTAINER (HEMRL DRG. 1457 / 3)

5.1.0. VISUAL INSPECTION FOR MECHANICAL DAMAGES.

5.1.1. CHECK DIMENSION

5.1.1.1. 273.0 + 2.0 / -0.0 mm

5.1.1.2. 138.0 + 2.0 / -0.0 mm

5.1.1.3. 60.0 + 1.0 / -0.0 mm

5.1.2. CHECK FOR WELDING ..... DYE PENETRANT TEST:

5.2. SCHEDULE NO.2

FOR COLLAR (HEMRL DRG.1457 /4)

5.2.1. CHECK DIMENSION: 60,25,30,25,5 mm

5.3. SCHEDULE NO.3.

FOR CLAMP: (HEMRL DRG 1457 / 5)

5.3.1.CHECK DIMENSION: 30,15,25 mm
& 6 +0.5 / -0.0:

5.4. SCHEDULE NO.4:

FOR BOX COTAINER WITH CLAMP & COLLAR (HEMRL DRG 1457/ 2)

5.4.1. CHECK FOR QUALITY OF
WELDING DYE PENETRANT TEST

5.4.2. CHECK DIMENSION: 14.0 + 1.0 / -0.0:

5.4.3. CHECK FOR PITCH :

5.4.3.1. 315.0 +0.5/ -0.5mm & 100.0 +0.5/ -0.5 mm

5.4.3.2. 305.0 +0.5 / -0.5 mm & 50.0 +0.5 / -0.5 mm

5.4.4. L 0.2mm AND // 1mm

5.4.5. CHECK FOR HARDNESS : 560 ± 20 HV

NOTE:1: ONE PIECE FROM EACH HEAT TREATED LOT:
IN CASE THE HARDNESS IS LOWER THEN 540 HV
FUTURE LOT IS TO BE REJECTED & REHEAT
TREATMENT IS TO BE DONE
2. REHEAT TREATMENT IS PERMITTED ONLY ONCE
(refer section 1.9.2, 1.10 of the specification)

5.4.6. CHECK FOR CRACKS BY DYE PENETRANT TEST
(TWO PIECES FROM EACH HEAT TREATED LOT)

5.5. SCHEDULE NO.5;

FOR LID STANDARD (HEMRL DRG 1457 / 6)

5.5.1.CHECK FOR ALL DIMENSIONS
5.5.2 CHECK FOR PITCH
5.5.2.1. 315.0 +0.5 / -0.5; & 100.0 +0.5 / - 0.5;
5.5.2.2. 305.0 + 0.5 / -0.5 & 50.0 +0.5 / - 0.5;

5.6. SCHEDULE NO.6;

FOR STANDARD ERA BOX (HEMRL DRG 1457 / 1)

5.6.0. VISUAL INSPECTION FOR ANY MECHANICAL DAMAGES.
5.6.1. CHECK FOR PITCH
5.6.1.1. 315.0 +0.5 / -0.5 & 100.0 +0.5 / -0.5 mm;
5.6.1.2. 305.0 +0.5 / -0.5 & 50.0 +0.5 / -0.5 mm;
5.6.2. CHECK FOR FREE SLIDING OF THE LID.
5.6.3. QUALITY OF COATING & PAINTING

NOTE 1:PLEASE REFER TO GAUGE SCHEDULES .

APPENDIX A

No deviation is permissible in the specification without the permission of DMRL.

SPECIFICATIONS FOR HIGH STRENGTH STEEL SHEET FOR ERA CONTAINERS (no DMRL / CDG / 06)

SCOPE

This specification covers 5.3 to 0.3mm thick hot rolled sheet of ultra high strength low alloy steel having chemical composition given in Table 1.

PROCESS OF MANUFACTURE FOR THE STEEL.

The steel shall be primarily manufactured by electric steel melting followed by vacuum degassing.

All the necessary precautions shall be exercised to keep Hydrogen at 3ppm max; Nitrogen 120 ppm max. and oxygen 200 ppm max.

Rare earths can be added upto 0.06%.

CHEMICAL COMPOSITION

Each ingot of the heat shall conform to the chemical composition given in Table 1.

TABLE I. CHEMICAL COMPOSITION

Element	Wt. percent		Aim
	Minimum	Maximum	
Carbon	0.26	0.33	0.28
Silicon	0.15	0.35	0.25
Manganese	0.35	0.55	0.45
Chromium	2.40	3.20	2.80
Nickel	1.20	1.60	1.40
Molybdenum	0.15	0.30	0.22
Vanadium	--	0.10	0.05
Phosphorous	--	0.025	0.015
Sulphur		0.015	0.010
Iron	Balance		

3.2 Efforts should be made to achieve aimed composition at ladle stage.

3.3 Variation of the product analysis shall be as per Table II given below.

TABLE II. PRODUCT VARIATION OVER OR UNDER ON CHEMICAL COMPOSITION.

Element	Variation percent
Carbon	+ 0.01
Silicon	+ 0.02
Manganese	+ 0.02
Chromium	+ 0.05
Nickel	+ 0.10
Molybdenum	+ 0.02
Sulphur	+ 0.002
Phosphorous	+ 0.002

4. HEAT ANALYSIS

4.1 The chemical analysis shall be carried out on samples taken from the ladle just before teeming.

4.2 The chemical analysis shall be carried out by any of the following methods as applicable.

4.2.1 X-ray fluorescence.

4.2.2 Wet Chemical Analysis.

4.2.3 Atomic absorption/Instrumental Analysis

4.2.4 Spectrographic Analysis.

5. METALLURGICAL ANALYSIS

5.1 Inclusion Content :

Inclusion rating on samples as per IS:4163-1982 shall not be inferior than that given in Table III.

TABLE III. INCLUSION RATING

Type of Inclusion	Thin	Thick
Sulphide (A)	0.5max	--
Alumina	0.5max	--
Silicate (C)	0.5max	--
Globular oxide (D)	0.5max	1H

6. HEAT TREATMENT

6.1 Annealing:

The plates shall be annealed between 720°C to 750°C for appropriate time to ensure that the hardness in annealed condition is not higher than 250 BHN to facilitate further working.

7. GRAIN SIZE

The grain size of the annealed plates should be equal to ASTM 7 or finer.

8. DECARBURISED LAYER

Decarburised layer should not be more than 6%.

9. HEATTREATMENT:

9.1. Most critical stage of fabrication of PFA containers is the heattreatment for required hardness.

The method consists of

9.1.1. heating the container to 900 ± 10°C

9.1.2. Oil quenching (commercial oil can be used)

9.1.3. Tempering the container at 250 ± 10°C

9.1.4. Hardness of the container should be 500 ± 20 HV

9.1.5. Cleaning of the container either with sand blasting or by immersion in 10% HCL for 20 minutes.

10. QUALITY ASSURANCE AFTER HEAT TREATMENT

10.1. Strict control of hardness 500 ± 20 HV is to be mentained. In each heat treatment lot of 25 nos container is to be checked for desired hardness.

10.2. In case hardness is lower than 500 HV, the entire lot is to be reheattreated.

10.3. Rehardening is permitted only once. If the desired hardness is not achieved in reheattreatment, the entire lot is to be rejected.

10.4. Two containers from each heat treatment batch are to be subjected to dye penetrant tests to ensure freedom from cracks, cavities and other defects particularly at the welded joint.

11. MECHANICAL PROPERTIES:

11.1.	Ultimate tensile strength	: 1950 - 2150 MPa
11.2..	0.2% proof stress	: 1720 - 1990 MPa
11.3.	% Elongation	: 9 - 11 %
11.4.	Hardness	: 540 + 20 HV
11.5.	Klc	: 70 Mpa. m
11.6.	Impact Energy:	: 35 Joules.

11. MECHANICAL PROPERTIES:

11.1.	Ultimate tensile strength	: 1950 - 2150 MPa
11.2..	0.2% proof stress	: 1780 - 1890 MPa
11.3.	% Elongation	: 9 - 11 %
11.4.	Hardness	: 540 + 20 HV
11.5.	Klc	: 70 Mpa. m
11.6.	Impact Energy:	: 35 Joules.