REVISION OF SPECIFICATION / STR

Item Name: Upgraded High Tensile Centre Buffer Coupler For freight stock
Specification No. WD-70-BD-10 (Rev.4)

1. RDSO is reviewing the specification/STR to cater to the latest technological developments in the field, modify clauses not relevant in the present context and making them more enabling with focus on functional requirements.

2. It is requested that your comments / suggestions with regard to improvements /modifications in specification / STR of the above mentioned item may be submitted in the following format along with the justification for the changes required.

Part A: Basic Information

SN	Particulars	Information
1.	Name	
2.	Designation	
3.	Professional Qualification	
4.	Organization / Firm's Name	
5.	Address for Correspondence	
6.	Contact No.	
7.	Email ID	
8.	Whether firm is registered with RDSO for the subject item. If yes, details like date of registration, current status etc If no, firm's experience in manufacturing of subject item or similar item	
8.	Whether any technical document/Report/Study to support suggested changes is available / enclosed for better appreciation	

Part B: Comments / suggestions on the specification

SN	Clause No. of RDSO STR/ Spec	Clause, as it exists in RDSO STR/ Spec	Clause , as it should read after incorporation of comments /suggestions in the RDSO Spec / STR	Justification for changes

Comments may be sent to following address within 15 Days from the date of Publication on rdso.indianrailways.gov.in

Director/Wagon
Research Designs and Standards Organization
Manak Nagar, Lucknow – 226011

Email: directorwd2@gmail.com

INDIAN RAILWAYS

SCHEDULE OF TECHNICAL REQUIREMENT

No. WD-70-BD-10 (Rev. ~~3~~ 4)

FOR

UPGRADED HIGH TENSILE CENTRE BUFFER COUPLER
FOR
FREIGHT STOCK

Issued by

RESEARCH DESIGNS & STANDARDS ORGANISATION

MINISTRY OF RAILWAYS
LUCKNOW-226011

October, 2024

SCHEDULE OF TECHNICAL REQUIREMENTS FOR UPGRADED HIGH TENSILE CENTRE BUFFER COUPLER FOR FREIGHT STOCK

- **PREAMBLE**

Train parting due to breakage of CBC coupler components continues to be an area of concern for Indian Railways. Quality of CBC components has direct bearing on online failures and premature replacement of components during different maintenance schedules. This specification with latest alteration is an attempt to improve reliability of this critical sub-assembly of freight stock. This document covers works done for improving performance of CBC coupler, material specification, process of manufacturing, inspection, etc. testing, gauging etc.

~~Indian Railways suffers a large number of train partings because of coupler and knuckle breakage which results in heavy losses. Poor quality of CBC components causes large scale premature replacements of components during maintenance in workshop, depots and yards. The manpower and material costs of such replacement is very high. Even after large scale replacement of components during maintenance in workshops depots and yards, train partings are still taking place which reflect on the poor quality of coupler components. The direct and indirect cost of train parting is huge~~.

.1 CBC of Indian Railways is based on the AAR specification. In 1960 few manufacturers acquired TOT of Grade B castings from North American Manufacturers. For operating longer trains the material of CBC was first upgraded to "C" and then to "E" grade. For indigenous development and multi sourcing RDSO issued the drawings of CBC and gauges for CBC in 1980. However the coupler and knuckle failures continued unabated.

.2 During that period, following major problems were encountered in the manufacturing of the Grade E couplers:

- Difference in chemical composition between the imported Grade E coupler and the indigenous coupler. The AAR specification did not specify the alloying element which was being used in the imported coupler as analyzed in RDSO report No 6375.
- Non achievement of physical properties mentioned in the specification issued by RDSO, especially with respect to impact strength at -40° C. Most of the couplers were failing in the impact test.
  - Improper heat treatment.
  - Casting defects.
  - Poor dimensional control and surface finish.

.3 To improve the indigenous couplers, RDSO constituted a Technology Development Group; comprising of representatives of Wagon, QA and M&C directorates of RDSO along with representatives of Industry to improve the coupler and it's specifications. Three meetings of the Technology Development Group were held on 08.08.2006, 10.10.2007 and 26.06.2009. In addition Additionally these issues were also discussed in a meeting of RDSO and coupler manufacturers held on 19.03.2007. Following decisions were taken in the meeting of the Technology Development Group:

- To revise the chemical composition and inclusion of alloying elements by use of Nickel, chromium and molybdenum
- Manufacturers were asked to switchover from green sand moulding method to no-bake moulding method by March 2008. Only one firm reported that they had switched over to completely mechanized PLC controlled high pressure moulding line with automatic sand plant equipped with sand cooling system and the consistency of the coupler manufactured by this process was considerably better.

.4 Despite various initiatives taken by RDSO, there was tardy progress in the improvement of quality of coupler by various manufacturers as reflected by failures and the results of quality audits conducted, and Indian Railway had to take recourse to import of couplers from AAR approved sources for the new breed of high capacity wagons, viz, BOXNHL and BCNHL wagons. For this purpose RDSO specification no WD-66-BD-06 was issued.

.5 Since import of couplers is was not a long term solution, RDSO was assigned the ask of developing a new specification as a long term import substitute for the coupler. Following approach was adopted :

- Detailed investigation of failed couplers in RDSO. A detailed investigation into couplers failures reported to RDSO was undertaken and the investigations revealed that in addition to shrinkage and blow holes, the physical properties of the specification have not been met in the failed couplers.

- Two failed couplers were sent to National Metallurgical Laboratory for detailed investigations. As per the detailed investigations carried out the failures were attributed to improper steel chemistry and presence of casting defects such as blowholes, porosity, slag inclusions, shrinkage cavities and ~~ten order~~ lower impact energy. NML ~~have~~ concluded that factors such as moisture in moulding sand, improper ramming of the moulding sand, insufficient venting, improper degassing of the molten metal can give rise to blowholes and porosity in the casting. They ~~have~~ further stated that shrinkage cavities could be attributed to incorrect gate design, insufficient metal in the riser to compensate for contraction and interrupted metal pouring in the mould. They have also concluded that incorrect microstructure is due to improper heat treatment

- Two imported couplers to AAR specification were also tested in detail at National Metallurgical Laboratory to ensure adherence to specification.
- The RDSO drawings were checked and it was found that couplers manufactured to these drawings and gauged as per RDSO gauges would ensure interchangeability.
- In view of the consistency offered by the no-bake process and high pressure moulding as decided by the Technology Development Group, RDSO got prototypes manufactured through these processes. These couplers were manufactured to the chemical composition with alloying elements as stipulated in 48-BD-02 and heat treated. The couplers manufactured by these processes ~~have~~ had high dimensional accuracy.
- The prototype couplers were tested at National Metallurgical Laboratory and exceeded all the parameters for physical properties in the AAR specification. The impact property at -40 deg C was significantly higher than the AAR specifications. All the physical properties were from samples taken from product.

.6 This specification has been pre-validated through these studies to ensure that couplers manufactured against these match up to international standards and indigenous manufacturing capability is developed.

1.0 FOREWORD

1.1 This specification is intended to cover the technical provisions relating to material, process, manufacture, tests for couplers, and infrastructure for producing such upgraded couplers and does not include all the necessary provisions of the contract.

1.2 This Specification is issued under the fixed number WD-70-BD-10. The number after BD indicates year of issue.

1.3 This specification draws reference to the following

specifications: - (i) AAR M 118, M 201, M 205, M 211

(ii) AAR S 172 Section B Part- II & AAR S 137 Section B.

(iii) IS: 1875, 2004, 3885, 5517, 817 & 1181.

(iv) ASTM A 255, , A 370, E 208, E 446 and

E604.

(v) ASTM A 668, ~~IRS R-6~~.

2.0 SCOPE

This specification covers the supply and acceptance requirements for Upgraded High Tensile Centre Buffer Coupler and its components, outlines the process of manufacturing and lays down the infrastructural requirements for manufacturing of coupler and its components. Material requirements for coupler body, knuckle, coupler lock and coupler yoke must meet various requirements of AAR specifications M-201 and M-205 in addition to requirements mentioned in this specification.

2.1 CBC will consist of cast and forged components. Cast components are either of Grade B or Grade E. The details are given in the Table-I. The coupler component; Lock, if manufactured though forging process shall be manufactured with material grade Class L (LH) (Normalized, quenched, and tempered) and chemical composition X4 of ASTM A668/A668M-2a. Rotary bottom operated articulated lock lift assembly (Toggle, Connector and Hook) and Knuckle thrower; if manufactured through forging process shall be of material grade Class 2 of IS: 1875 or IS:2004.

TABLE- 1

SN	Name of Part	Cast/Forged	Numbers/ Coupler
1	Coupler Body with Shank wear Plate	Cast Grade E	1
2	Knuckle	Cast Grade E	1
3	Lock	Cast Grade E /Forged	1
4	Knuckle thrower	Cast Grade B /Forged	1
5	Knuckle Pin with Anti-theft cotter pin	Forged/Rolled (Forging Grade Steel 42 Cr4Mo2 to IS 5517-1993)	1

6	Rotary bottom operated articulated lock lift assembly	Cast Grade B / Forged (IS 1875-93)	1
7	Coupler Yoke	Cast Grade E	1
8	Yoke Pin	Forged/Rolled (Forging Grade Steel class 5 to IS: 1875 93)	1
9	Yoke pin support with wear plate	Cast Grade B / Forged (IS 1875-93)	1
10	Striker casting with wear plate	Cast Grade B	1
11	Back Stop	i) Cast Steel Gr 230-450, IS:1030-1998 ii) Forging (IS 1875-93, Grade 3A 0	2

Status of vendor and quantity restriction indicated against each registered vendor in the UVAM (Unified Vendor Approval Module) portal for coupler and its components shall be applicable for supply to Zonal Railways and Wagon Builders.

3.0 GENERAL REQUIREMENTS

3.1 Coupler Drawings

a) General arrangement of the coupler shall be to RDSO Drg. No. WD-81010-S-03, latest alteration.

b) Coupler body and shank wear plate shall be to Drg. No. SK-(Item 1 & Item 10 respectively), latest alteration. Shank wear plate shall be welded to the coupler shank as shown in the drawing. The Coupler body must be manufactured as per applicable requirements of this specification.

c) Knuckle shall be to Drg. No. SK-62724 (Item 2), latest alteration. The knuckle must be manufactured as per applicable requirements of this specification.

d) Lock shall be to Drg. No. SK-62724 (Item 8), latest alteration. The lock must be manufactured by lost wax /investment or forging process.

e) Knuckle thrower shall be to Drg. No. SK-62724 (Item 9), latest alteration. The knuckle thrower must be manufactured by a lost wax /investment or forging process.

f) Knuckle pivot pin with securing arrangement shall be to Drg. No. SK-62724 (Item 4), latest alteration.

g) Articulated Lock lift assembly consisting of Toggle, Universal Lock lift lever connector and Lock lift lever hook shall be to Drg No. SK-62724 (Item 5, 6 & 7 respectively), latest alteration. The knuckle lock lift assembly must be manufactured by a lost wax/ investment or forging process.

h) Coupler Yoke shall be to Drg. No. SK-62724 (Item 3) latest alteration. The Yoke must be manufactured as per applicable requirements of this specification.

i) Yoke pin shall be to Drg. No. SK-62724 (Item 12), latest alteration. Yoke pin shall be manufactured through forging or from rolled bars.

j) Yoke pin support shall be to Drg. No. WA/BD-4462 latest alteration. Yoke pin support shall be supplied complete with wear plate welded as shown in drawing.

k) Striker casting and Striker Casting Wear plate shall be to Drg. No. WA/BD-4460 and WD-87056-S-01 respectively, latest alteration. Striker casting shall be supplied complete with wear plate bolted and tack welded as shown in drawing.

l) Back Stop shall be to Drg. No. W/BD-669, latest alteration.

3.2 Draft Gear and Yoke

The coupler shall be suitable for fitment on freight stock along with Draft gear and its follower to Indian Railway's Schedule of Technical Requirement No. WD- 71-BD-15 (Latest Rev.) & No.49-BD-08 (Latest Rev.) and Drawing No. 81010-S-03 Alt 7 or latest.

3.3 Gauges

3.3.1 The CBC and all the coupler components shall be gauged with RDSO approved gauges manufactured as per RDSO Drawings of gauges given in Annexure-I. The manufacturer must possess at least 04 full sets of gauges for following purpose:

i. Master gauges.
ii. One set exclusively preserved for inspecting authorities.
iii. 02 sets for production/ internal inspection.

02 sets of gauges are prescribed for production/ internal inspection so as during calibration/ replacement, availability of all gauges is ensured for production/internal inspection. Master gauges shall be used for calibration of rest 03 sets of gauges at prescribed periodicity or after every 2000 pieces supplied whichever is earlier for which the manufacturer shall have a well-equipped facility. Periodicity of calibration shall be specified by OEM of these gauges and a record to this effect shall be maintained by the manufacturer. Master gauges shall be got calibrated only from OEM/ authorized agency at frequency prescribed for calibration of such master gauges. . Manufacturers can also use their in house calibration facility for master gauges only with prior approval of DG/Wagon/RDSO.

3.3.2 The gauges shall be colour coded with suitable colour to distinguish them from the uncalibrated gauges. The colour of the calibrated gauges used in the month shall be prominently displayed and updated by the standards section.

3.3.3. The drawings referred to in this schedule of requirements are available on RDSO/IREPS/UVAM website for download as per extant instructions.

3.4 Interchangeability

3.4.1 All couplers and coupler components shall be interchangeable. Manufacture and inspection for this interchangeability will be audited twice a year by wagon dte. or by nominated QA(Mechanical) unit by DG/Wagon/RDSO. RDSO shall audit the manufacturing process and shall check 20 couplers at random with the gauges defined in clause 3.3. This is not withstanding the regular inspection being done by the manufacturer.

3.4.2 The manufacturer shall provide labour, appliances and other details necessary for the inspection of the coupler and its components in accordance with this specification at his own cost.

3.5 Marking

3.5.1 All coupler components should have clear and legible manufacturers' name in short code and batch No. etc., which shall remain legible throughout the full service period as specified in RDSO Drawing No.SK - 62724 (latest alteration). Knuckle shall have the markings "for manufacturer's name in short code, serial number, month & year of manufacture etc. as shown in RDSO Drg. No. WD 87004-S-I (latest alteration).

3.5.2 The letter size and height of the raised letter shall be as specified in relevant RDSO drawing. The marking shall be done at the casting stage itself. The manufacturer will not be permitted to provide manufacturer's code and marking by electric arc welding in case these are not visible at casting stage. Coupler body, Knuckle, Yoke and Lock shall also be identified by raised letter UHTE whether made by casting or forging.

3.5.3 The coupler components found having illegible marking at the time of fitment in Railway

Workshops, Maintenance depot or on Wagon Builders premises shall be treated as rejected and shall be replaced by the manufacturers free of cost. The cost of transportation shall be borne by the manufacturer. Marking particulars of all coupler components shall be maintained by Wagon Builder/Workshops/Depot as per Annuxure – A.

3.6 Maintenance Spares

The Coupler Manufacturer shall supply all the spare parts required for maintenance of couplers supplied by them for use on Indian Railways against specific requirements of Railways. In case of failure, their registration is liable to be cancelled.

4.0 PARTICULAR REQUIREMENTS

4.1 REQUIREMENT FOR KNUCKLE PIN AND YOKE PIN

4.1.1 MATERIAL

Steel 42 Cr4Mo2 to IS 5517-1993 shall be used for the manufacture of knuckle pin.
Steel class 5 to IS: 1875 93 shall be used for manufacture of yoke pin.

4.1.2 HEAT TREATMENT

The pins shall be heat treated to meet the requirements specified in Para 4.2

4.2 MECHANICAL PROPERTIES REQUIREMENTS

4.2.1 KNUCKLE PIN

4.2.1.1 The material Grade- 42Cr4Mo2 to IS: 5517-1993 shall have following minimum requirements:

Tensile Strength	Yield Strength	Elongation
Kgf/mm^2	Kgf/mm^2	%
~~103~~ 91.8 - 107.1	~~63~~ 66.3	~~16.5~~ 11

4.2.1.2 Hardness value shall be within the range of 229 to 428 BHN. Two or more hardness determinations shall be made at locations approximately midway between the center and end of the knuckle pin on diametrically opposite sides from each other on the cylindrical surface. Hardness shall also be taken on the center ~~of the diameter of the pin at mid length~~ at both ends of the pin. Hardness shall be taken after decarburization by surface grinding up to a minimum depth of 0.20 mm.

4.2.2 YOKE PIN

4.2.2.1 The material shall have following minimum requirements:

Tensile Strength	Yield Strength	Elongation	Reduction in Area
Kgf/mm^2	Kgf/mm^2	%	%
95	53	18.5	44.8

4.2.3 Hardness shall be within the range of 262 to 302 BHN. Two or more hardness determinations shall be made on cylindrical surface at location approximately at the center and 25 mm from each end of the Yoke Pin. These locations should be diametrically opposite.

4.2.4 BACK STOP (Casting/Forging)

The material shall have following minimum requirements:

For Casting (Gr 230-450 IS:1030-1998):

Tensile Strength (Min.)	Yield Strength (Min.)	Elongation (Min.)	Reduction in Area (Min.)
Kgf/mm^2	Kgf/mm^2	%	%
46	23.5	22	31

For Forging (IS 1875-93 Class-3A):

Tensile Strength (Min.)	Yield Strength (Min.)	Elongation (Min.)	Reduction in Area (Min.)
Kgf/mm^2	Kgf/mm^2	%	%
55.06	28.5	20	-

4.3 GAUGING

All-important dimensions of the Knuckle/Yoke Pin as shown in RDSO Drawings shall be within the limits when gauged.

4.4 FINISH

The finished Knuckle/Yoke Pin shall be straight, free of scale and have surface finish of Ra 3.2 µm. Surface finish shall be checked using..... It shall not be painted. Surface shall be free from any visible defect .

4.5 MARKING

Manufacturer name in short code & year of manufacture shall be stamped on the head of each knuckle Pin and on the end of Yoke Pin.

4.6 REQUIREMENT FOR COMPONENTS MANUFACTURED BY STEEL CASTINGS/ FORGING

4.6.1 The casting/forging components shall be manufactured and tested as per the requirement of respective component specification given in component drawings. Dimensions shall be checked as per their respective drawings.

4.6.2 Surface finish requirement shall be as per the standards specified in drawings/ specifications.

5.0 MANUFACTURE

5.1 Material

The material of Upgraded High Tensile Centre Buffer Coupler components shall be as indicated in RDSO Drg. No. SK-62724 latest alteration and in the ~~this~~ specification.

5.2 Process of Steel Making

5.2.1 All steel melting and refinement must be performed with the use of an Electric Arc Furnace. Any other process of steel melting may also be employed provided it's capability of consistently attaining the required chemistry of castings is established to the ~~satisfaction~~ compliance of RDSO specification.

5.2.2 Ladle Analysis

The ladle analysis of steel when carried out by spectrometer to determine the percentage of carbon, manganese, phosphorous, sulphur, silicon chromium, nickel & molybdenum shall conform to the requirements as mentioned in Table 2.

Table -2

Element (%)	Casting Components		As per ASTM 668 (Grade-X4)	As per IS:1875-93 (Class-2/3)
	Grade E	Grade B		
Carbon	0.28 - 0.33	0.32 (Max)	0.45 (Max.)	0.15 - 0.25(for class 2) 0.30-0.40 (for class 3A)
Manganese	0.60 – 0.90	0.90 (Max.)	1.10 (Max.)	0.60 – 0.90
Phosphorus (max.)	0.03	0.03	0.025	0.04
Sulphur (max.)	0.03	0.03	0.025	0.04
Silicon	0.40 -0.60	0.60 (Max.)	0.35 (Max.)	0.15 - 0.35
Chromium	0.50 – 0.80	----	1.10 (Max.)	-
Aluminum	0.02 – 0.05		-	-
Nickel	0.50 – 0.60	----	-	-
Molybdenum	0.15 – 0.25	----	0.25 (Max.)	-

5.3 Manufacturing Process

5.3.1 Raw Material

Raw material, scrap and ferro-alloys used for the manufacture of steel castings/forging shall be analysed in advance and only those conforming to the QAP shall be used. Care should be taken to ensure that the scrap selected is free from rust, grease, oil and other prohibited contaminants.

5.3.2 Methoding

i Casting solidification software must be ~~utilized~~ available with the firm to evaluate castings for potential defects and to qualify the casting for production.

ii Standardized running, gating and risering system design and no. of cores including use of chills and chaplets shall be developed with the help of casting solidification software and only such system be employed for regular production of castings. Complete methoding system shall be part of approved QAP of the firm.

iii Casting solidity must be verified with the aid of casting solidification software to achieve proper internal solidity standards. These standards are measured by means of porosity percentage values. These porosity percentage values must not exceed the maximum severity levels of a particular sectional area as given in Para

7.2.5.

5.3.3 Moulding

Moulding shall be carried out by employing either of the following process given below:

(a) High Pressure Moulding Line with Intensive Mixture for Green sand mould with Automatic Moisture Control and addition of Binder in fixed rates

or

(b) Articulated Mixer (continuous type) with fume extraction facility & Compaction Table for No-Bake System.

~~Mould hardness shall be minimum 85 and the same should be uniform at all the surfaces (within ± 5% at all the surface including vertical) so as to get good dimensional accuracy in castings.~~ For High pressure moulding line mould hardness shall be minimum 85 and the same should be uniform at all the surfaces (Within 85 to 90 at the entire surface including vertical), and for No – Bake System scratch hardness of mould shall be minimum 60 and same should be uniform at all the surfaces so as to get good dimensional accuracy in castings.

5.3.4 Core making

- All cores shall be produced by No-bake process for which continuous mixer with compaction table/ batch mixer shall be available.
- Only single piece core ~~should~~ shall have be used for manufacture of coupler body and yoke. Any deviation will require prior approval from DG/Wagon/RDSO.

5.3.5 Melting

A sufficient carbon boil must be accomplished with a 20 point carbon reduction. Double slag process for proper removal of sulphur and phosphorus shall be followed. Argon purging may be carried out to ensure freedom from harmful gases. Ladle pre-heating at 600 to 700°C shall be carried out. Temperature checking in Furnace and in Ladle by Immersion Pyrometer shall be done before pouring in Mould.

5.3.6 Pouring

During pouring in mould, temperature checking by Laser Beam Type/Infrared Pyrometer shall be done. After pouring castings shall be allowed to cool to a temperature below 300°C, at a rate that will not be injurious to the castings. Moulding boxes shall be opened to extract the castings after they have cooled down sufficiently to room temperature.

5.3.7 Fettling

Risers, runners and ingates shall be removed from the castings. Use of knock-off risers shall be preferred for improving the surface condition of the castings. All castings shall thereafter be properly cleaned, dressed and shot blasted to ensure freedom from surface imperfections, loosely adherent sand, scale etc.

5.3.8 Heat-treatment

All castings shall be heat treated after fettling. Grade E steel castings shall be furnished normalised, quenched and tempered. Grade B steel castings shall be furnished normalized and tempered. State-of-the-art heat treatment furnaces shall

be employed and must be capable of maintaining an even heat distribution within +/- 10°C throughout. Verification must be established by performing a minimum of eight zone survey on monthly basis and record on the same shall be maintained by the manufacturer For optimum heat flow only 70-80% of total volumetric capacity of heat treatment furnace shall be used. Stacking diagram for coupler components for heat treatment shall be part of approved QAP of the manufacturer.

5.3.8.1 Normalized and tempered steel castings shall be processed in the following order:

Heat to the proper uniform temperature above the transformation range (890- 920 ºC) and hold for the proper time (1 Hr + 1Hr for each 25 mm section thickness) to achieve complete austenization and to refine the grain structure.

Withdraw from the furnace and cool in still air until casting in their entirety are below 300° C. Temper by reheating to the proper uniform temperature below the transformation range, but not less than 400° C and hold for the required time (1 Hr + 1Hr for each 25 mm section thickness). Remove the castings from the furnace and allow them to cool to room temp.

5.3.8.2 Normalised, Quenched and tempered steel castings shall be processed in the following manner:

Heating shall be done in the Furnace with Automatic Charging Arrangement and facility to quench within 60 seconds. Castings shall be heated to the proper uniform temperature above the transformation range (890º- 920ºC) and held for the proper time (1Hr + 1Hr for each 25mm section thickness) to achieve complete austenization and to refine the grain structure.

Withdraw from the furnace and cool in still air until casting in their entirety are below 500 ºC.

Castings shall be reheated to proper uniform temperature above the transformation range (880º- 900ºC) and held for the proper time (1Hr + 1Hr for each 25 mm section thickness) to achieve complete austenization and to obtain the finer grain structure.

Withdraw from furnace while castings are above the transformation range, subject to rapid cooling (quenching) in suitable liquid medium in a quench tank to a temperature substantially below the transformation range. Quenching Tank should have capacity of more than 10 times of charge with Cooling Tower system along with highly agitated liquid medium mechanical arrangement from bottom of the tank. Rise in the temperature of the quench tank after quenching shall not be more than 10 ºC.

Tempering should be done within one hour of quenching. Tempering is to be done in the Furnace equipped with Hot Air Circulation System at the top for better heat transfer from Hot Air to casting.

Temper by reheating to proper uniform temperature above the transformation range (590-620ºC) and held for the proper time (1Hr + 1Hr for each 25 mm section thickness). Hold for the required time, remove from the furnace and allow to cool to room temperature

5.3.8.3 All the stages of heat treatment with various temperature ranges of processes shall be clearly brought out in QAP. Inspecting Authority shall examine it with actual heat treatment process being followed during quality audit.

5.3.8.4 Heat-Treatment Documentation

The manufacturer is required to develop and document heat-treating standards that describe the processes, process control procedures, and record keeping requirements. These documents are to be presented and reviewed as part of the Foundry Approval Process and are intended to ensure that products are properly heat treated. Furnace temperatures for heat treatment shall be controlled by pyrometers having associated recording equipment that produce time-temperature record charts that are identified by date and furnace number. A log sheet for each load of castings heat treated (batch) should show all information pertinent to each heat-treat load including the following:

- Type of casting
- Prescribed heat treatment
- Serial numbers and the heat numbers of the castings
- Actual time of heat treatment.

Pyrometers shall be calibrated every 3 months. Records of time-temperature charts, furnace log sheets, and pyrometer calibrations will be maintained for 6 years and available to the purchaser/authorized personnel of Indian Railways upon request.

6.0 TEST SAMPLES

Test samples shall be prepared from the castings (coupler, yoke and knuckle) or from test coupons. An integrally cast test coupon needs to be physically continuous with the casting while gated test coupon would be separated from the casting by the gated system. Both methods would ensure that the casting and the test coupon were casted using the same molten metal. Further, for Coupler body, knuckle and Yoke two lugs shall be integrally cast. The location of test lugs shall be such that when removed, they shall indicate that condition of heat treatment on particular steel castings. The standard test lug shall be 25 mm in height by 25 mm in width and 13 mm or 16 mm in thickness where it joins with castings. Test lug shall not be used for preparation of test sample for checking mechanical properties. The samples from the casting, test coupon as well as test lugs must meet the properties of this specification. ~~However, when samples are taken from casting there will be variation from the test coupon depending on the location of casting~~. Manufacturer will submit drawings to RDSO regarding location of test ~~piece~~ lug on castings, similarly size of test coupon and casting method i.e. integral with casting or through separate gating system shall also be specified in the QAP. ~~where correspondence with test piece integrally cast will be determined and finalized to have minimum variation. If test piece is taken from any other location at random from the test coupon, the properties will be at least 80% of stipulated properties.~~

6.1 Test coupons

The coupons shall either be cast attached to the castings or the gating system and prepared in accordance with ASTM Standard A 370, latest revision. Coupons cast with coupler should be integral part and the same shall be removed only after the inspecting authority has inspected and passed the lot. For forging / investment casting components test sample shall be prepared from the product itself.

7.0 TESTING

7.1 Chemical Composition

The product analysis shall be carried out from the test sample (test lug or test coupon or sample prepared from the product) taken from finished component by spectrometer. Permissible variation in the case of such analysis from the limit specified in Table-2 (ladle analysis) shall be as follows:

Table-3

Element	Variation percent
Carbon	±0.03
Manganese	±0.04
Silicon	±0.05
Phosphorus	±0.005
Sulphur	±0.005
Chromium	± 0.04
Nickel	±0.03
Molybdenum	±0.03
Aluminum	±0.003

7.2 Mechanical Properties and Tests

Each heat shall be tested for mechanical properties after heat treatment. The coupons from each melt heat shall be heat treated with castings of the same grade, in the same manner as the casting they represent. .

7.2.1 Tension Test

Test shall be conducted in accordance with standard Methods and Definition for mechanical testing of steel products, ASTM standard A 370, latest revision, using 13 mm round, 51 mm gauge length specimens prepared from the test coupons/casting as illustrated in that specification. Specimens shall meet the following requirements:

Table-4

Mechanical Property	Grade-E		Grade-B	
	(If Test is performed on Test Coupon-sample)	**(If sample prepared from Castings)** (80% of Test Coupon values)	**(If Test is performed on Test Coupon-sample)**	**(If sample prepared from Castings)** (80% of Test Coupon values)
Tensile Strength N/Sq.mm. (Minimum)	825	660	485	388
Yield Strength N/Sq.mm. (Minimum)	690	552	260	208
Elongation on 51 mm gauge length (Minimum %)	14	11.2	24	19.2
Reduction in Area % (Minimum)	30	24	36	28.8

One specim One sample per heat for each grade of steel shall be tested. If test specimen shows a defect during machining or exhibits flaws before or after testing, it should be discarded and another specimen substituted. ~~If the test specimen is made from castings, the minimum requirement shall be 80% of above stated values .~~

7.2.2 Impact Test

This test consists of determining the average energy absorbed from three-impact specimen from the same heat. The manufacturer shall carry out test to determine impact properties by using Standard Charpy-V-Notch type A‖ specimen prepared in accordance with ASTM Standard A 370. Test Specimens shall be prepared from test coupons/casting. The test results should meet the following minimum requirements at the temperatures indicated against them.

Table-5

Cast Steel	Temp. (Deg. C)	Energy (Minimum) (If Test is performed on Test Coupon-sample)	Energy (Minimum) (If sample prepared from Castings) (80% of Test Coupon values)
Grade –E	-40	3.50 kg.m (34.3 J)	2.8 kg.m (27.5 J)
Grade –B	-7	2.07 kg.m (20.3 J)	1.7 kg.m (16.7 J)

~~If If the test specimen is made from castings, the minimum requirement shall be 80% of values stated in Table - 5 above.~~

7.2.3 Hardness

The heat treated cast steel components must meet the following Brinell hardness range as specified in Table-6 (i):

Table-6 (i)

Grade	Hardness(BHN)
Grade E steel castings (except knuckle)	241-311
Grade E, Knuckles	241-291
Grade B, castings	137-208

As Quenched Hardness:

Quenching operation should be performed after fettling and shot blasting operations. The cast steel components after quenching must meet the following Brinell hardness range as specified in Table-6(ii):

Table-6(ii)

Grade	Hardness(BHN)
Grade E steel castings	Minimum 429

Testing shall be done on a surface (that has been ground to remove decarburization) as well as in the core on the sectioned castings in accordance with

ASTM A 370.The hardness shall be checked on the location as shown in **Fig-1**. Hardness of the components not shown in figure shall be checked at suitable location. Hardness values will remain same irrespective of sample prepared from test coupon or from casting.

7.2.4 Nil Ductility Test

Fracture Toughness**/**Nil Ductility Test shall be conducted on test sample prepared from finished product in accordance with either ASTM E604 or E208 except that Nil –Ductility Transition Temperature (NDTT) shall be -57° C or lower for grade E. The test specimen shall withstand the test without showing any sign of distress. Only in case of Lock, test sample can be prepared from test coupon for casting or forged test sample.

7.2.5 Destructive Testing

Destructive test shall be carried out on the actual casting during prototype inspection as well as during acceptance inspection.

One casting per ~~300~~ 200 shall be subjected to destruction to examine the presence of casting defects. Defects such as blow holes, slag inclusions, shrinkage, etc. are not acceptable. Porosity to a level of 2% of the cross section may be considered acceptable.

Castings are to be sectioned in accordance with **Fig-2**.Areas to be rated for discontinuity severity level are illustrated in **Fig-3** and **Fig-4**. Casting areas for evaluation shall be rated as to level of severity by comparing them with "Standard Reference Photographs for Casting Solidity‖ included as **Annexure-III** of this specification and results shall be recorded. The rated level of severity for each section must not exceed those listed in the following table-7:

Table-7

	Sectional area Maximum severity Levels					
Component Type	A	B	C	D	E	F
Coupler Head	3	5	4	4	4	2
Knuckle	4	4	2	-	-	-
Coupler Shank	3	4	4	4	-	-

7.3 Non-Destructive Testing

7.3.1 ACCEPTANCE STANDARD FOR RADIOGRAPHIC EXAMINATION

Radiographic examination shall be conducted on Knuckle, Coupler Body & Yoke to the extent of 10% of the casting produced and level of acceptance shall be as per ASTM E 446 Level-II. The location for Radiographic test shall be as per **Annexure-II** (Sheet-1, 2, & 3). Radiographic testing facility to be available with the manufacturer i.e. testing to be in-house. The procedure of radiography is given in **Annexure-II.**

7.4 Metallographic Test

With a view to ensure the homogeneity of the steel and the quality of heat treatment, it is essential to examine the microstructure of the knuckles at the time of acceptance inspection. The samples should be taken from the lugs attached to actual castings

produced and not from the separately cast test bars/test coupons. Microstructure achieved shall be uniform fine tempered martensite.

7.5 Static Test

Manufacturers must maintain Internal Process Specification and Quality Assurance Program to control casting integrity. As a periodic check, a laboratory static test will be conducted on one (1) specimen of every 5,000 coupler bodies, knuckles and yokes being produced or once every three (3) or six months according to the following tabulation, whichever occurs first. If production is less than 1,000 in the frequency period, no test is required for that period. However, in any case, at least one (1) test is required per year. The specimen shall represent current production practices.

Table-8

Component	Frequency Period
Coupler Body	6 months
Knuckle	3 months
Yoke	6 months

Proof Test of Coupler Body and Knuckle:

Method of Testing:

Coupler bodies and knuckles must meet permanent set and ultimate strength requirements shown in Table-9. The dimensions shown in Fig-5 shall be used for determining permanent set and result shall be recorded. Special test knuckles for testing coupler bodies shall have a load capacity in excess of 408 tonnes. When testing coupler bodies, if test knuckle breaks before required loading is attained, the test shall be terminated and the load recorded as the “maximum applied load. "Test machines shall have a minimum capacity to meet specified loads and be calibrated to ASTM standards.

Static Tension Test Requirements:

Table-9

	Maximum Permanent Set – mm Grade E Steel		
	At 181.5 t	At 317.5 t	Minimum Ultimate Breaking force
* Knuckle	0.76	-	295 t.
Coupler body	-	0.76	408 t.

*Based on testing with dummy knuckle fixture.

Proof Test of Yoke:

Method of Testing:

The method of testing coupler yokes and measuring permanent set is shown in **Fig-6.** The support and loading of the yokes for these tests shall be equivalent to service application. In making deflection measurements, the measuring instruments shall be set at zero, after a load of 9 tonnes has been applied and released to datum load of 2.27 tonnes. The minimum ultimate load shall be considered the load at which distortion shall not exceed 6 mm over all, measured vertically or laterally.

Test Requirement

The maximum permanent set, measured from the point of load application to the point of support, and the minimum ultimate load, shall be as shown below:

~~Maximum permanent set -in mm~~

Table-10

Material of Yoke	Maximum permanent set - in mm	Minimum Ultimate breaking force
	At 340.2 t.	408 t.
Grade E steel	0.76	-

7.6 Type and Number of Tests

The quality control organization of the manufacturer should carry out tests as given below. Records must be maintained for the tests carried out.

S.N.	Parameters	Test to be done on	Sampling plan	Reference	Test specification
1.	Visual & Operational Check	CBC Components	10% of the offered lot or min. 10	Para:8.2 & 8.4	RDSO Drgs
2.	Dimensional	CBC Components	10% of the offered lot or min. 10	Para:3.3	RDSO Drgs
3.	Mechanical Properties i) Tensile strength ii) YS iii) Elongation iv) RA	Test coupon	1 per heat	Para:7.2	ASTM A370
4.	I. Proof Static tension test II. Proof static test of yoke	CBC Components	As per Table-8 One per Lot	Para:7.5	Para: 7.5
5.	Chemical composition	Lug/Test coupon	1 per heat	Table-2	IS-228
6.	Microstructure of Knuckle	Lug/Test coupon	1 per heat	Para:7.4	IS-7739
7.	Hardness	Castings	~~5%~~ 10% of the lot or min 10 numbers (in case of knuckle 100% checking internally) ~~castings~~	Table 6(i)	IS-1500
8.	Destructive test	CBC Components	1 per 100 or part thereof	Para:7.2.5	Para: 7.2.5
9.	As Quench hardness	E Grade Casting	5% of the castings or min. 05	Table 6(ii)	IS-1500
10.	Impact	Test Coupon/CBC components	Three per heat	Para:7.2.2	ASTM A370
11.	Nil ductility	CBC Components	1 per heat	Para:7.2.4	ASTM E604 or E208
12.	Weight variation	CBC Components	~~10% 100% of offered lot.~~ 10% of the lot or min 10 numbers (100% checking internally)	Para:8.6	Para 14 of AAR M-201
13.	Radiographic test	CBC Components	10 % of the offered lot	Para:7.3.1	Annexure-II

8.0 INSPECTION

8.1 Inspection procedure

The Inspecting Authority shall have free access at all times, while performing the work. The inspector shall comply with all applicable

safety rules and local regulations. The manufacturer shall afford the inspector, free of charge, all reasonable facilities and necessary assistance to satisfy the Inspector that the material is being furnished In accordance with this

specification. Tests and inspection shall be made prior to dispatch at the place of manufacture to ensure that provisions of this specification are being met. Any additional tests must be negotiated prior to placement of order. All inspections shall be conducted while not interfering with manufacturing operations. Manufacturer shall set aside one set of gauges for the exclusive use of inspector. All the drawings in original shall also be made available for checking the tolerances of these gauges. The cost of all tests and inspection shall be borne by the manufacturer. Record of the inspection and test samples shall be preserved for a period of 06 years

The purchase inspection shall be carried out as follows:-

The Inspecting Authority shall first check the records of the manufacturer to ensure that the item offered for inspection have been manufactured strictly to the requirement of this specification and QAP of the manufacturer in the manufacturer's premises.

- **A heat is defined as the total quantity of the castings produced in one melt and heat treated together i.e castings having same chemical composition. Since marking particulars on casting are created at the time of casting itself. Therefore, It will be mandatory to heat treat att items of one melt together to avoid may traceability related issue arising due to items poured together but no heat treatment simultaneously.**
- **One batch consists of castings having same chemical composition and undergoing same heat treatment in the heat treatment furnace. One batch can have more than one heat.**
- **A lot is defined as the total no. of castings offered for inspection and this may include several heats/batches.**

Inspecting Authority should also do at least one in PROCESS inspection during manufacture of casting for the followings:-

1. Chemical composition
2. Mechanical properties
3. Impact test.
4. Hardness test
5. General requirement of casting acceptance.
6. Requirements of components manufactured other than steel castings.

Records of these inspections shall be verified at the time of inspection.

After having been satisfied about offered inspection lot that the components are strictly manufactured to all the requirement of this specification, the Inspecting Authority shall carry out the inspection as per procedure given bellow:-

The manufacturer shall submit test results of Coupler/Coupler component offered for inspection with Heat No., Batch No. marking details and internal test details to Inspecting Authority. From a lot of 200 Couplers or a part there-of, following inspection shall be done.

.

(a) Ten percent (10%) Coupler shall be dismantled and each casting shall be checked for the following:-

a) Gauging of all components with calibrated gauges.
b) General requirement of casting acceptance.
c) Marking.
d) Weight variations.

On identification of a single defect on any of the components, the whole lot shall be rejected. However the manufacturer can re-offer the lot after carrying out internal inspection for identification of all defective components. Such defective component can be replaced by the manufacturer.

In the re-offered lot Twenty percent (20%) coupler/components shall be checked for the above requirement and whole lot shall be rejected if a single defect is identified in the re-offered lot.

(b) Components other than steel castings shall be checked as per requirement of this specification for the followings.

a) Dimensional accuracy
b) Surface finish requirements
c) Hardness testing

The dismantled components, if meet the requirements of the paragraph (a) and (b) above shall be assembled arbitrarily and following shall be checked.

a) Interchangeability of components
b) Easy assembly of components
c) Coupler operation

8.2 COUPLER OPERATION

Assembled couplers must be free of any foreign material that will prevent proper operations described in this Paragraph. A coupler inspection operating rod is illustrated in **Fig-7**.
The Coupler knuckle must rotate to the open position by a continuous rotary force applied by hand through the inspection operating rod from the rod handle.

The coupler knuckle must rotate to fully closed position to permit drop of the lock to the locked position by a continuous steady force applied by hand on the knuckle nose.

The coupler lock must automatically drop to the locked position when the knuckle is closed. The coupler knuckle is locked shut when the lock drops to seat on or within 6 mm of the knuckle tail lock shelf.

The coupler is put on lock set when the knuckle is restrained from opening while force is applied through the inspection operating rod while trying to raise the lock above the knuckle tail. When the rod is eased back and released, the lock must rest on the forward top edge of the knuckle thrower lock leg. The knuckle then must be free to rotate open by hand force applied on the inside face of the knuckle nose. The coupler then must perform the function of knuckle closure and lock drop.

Coupler must provide anti-creep protection to prevent accidental unlocking as specified in Section B, Part II, of AAR Standard S-172, Paragraph 4.2.8. Couplers furnished complete must be fitted with knuckles of the same grade of steel as the coupler body. Couplers must be fitted with grade E locks. The assembled coupler

must operate as described in the Section .

The lot shall be rejected on failure of coupler or coupler components on any of the above requirements. However, the manufacturer can re-offer the lot, after carrying out internal inspection and replacement or repair of all defective components. In re-offered lot, double sample will be drawn and all the above mentioned requirements (of Para 8.1 and 8.2) shall be checked.

8.3 In addition to the tests mentioned in para 8.1 and 8.2 the inspecting official will conduct tests as under :

S.N	Parameters	Test to be done on	Sampling plan	Reference	Test specification
1	**Mechanical Properties** • Tensile strength • YS • Elongation • RA	Test Coupon/CBC component	1 per lot	Para:7.2	ASTM A370
2	• Proof Static tension test • Proof static test of yoke	CBC Component	As per Table- 8 One per lot	Para:7.5	Para:7.5
3	Chemical composition	Lug/test coupon	3 per lot	Table-2	IS-228
4	Microstructure	Lug/test coupon	3 per lot	Para:7.4	IS-7739
5	Hardness	CBC component	~~5%~~ 10% of the lot or min 10 numbers (in case of knuckle 100% checking internally) ~~castings~~	Table 6(i)	IS-1500
6	Destructive test	CBC Component	1 per lot	Para:7.2.5	Para:7.2.5
7	Impact	Test Coupon/CBC component	1 per lot	Para:7.2.2	ASTM A370
8	Nil ductility	CBC components	1 per lot	Para:7.2.4	ASTM E604 or E208
9	Weight variation	CBC components	~~10%~~ manufacturer will conduct weighment of 100% components of which minimum 10% shall be checked by Inspecting Official.	Para:8.6	Para 14 of AAR M-201
10	Radiographic test	CBC components	10 % of the lot	Para:7.3.1	Annexure-II

i. On failure of sample in any of the above tests, the whole lot shall be rejected. However the manufacturer can re-offer the lot after removing all the defective components manufactured in that particular heat in which failed component was cast.

ii. In the re-offered lot double the sample shall be tested provided re-offered lot

meets the requirements of Para 8.1 and 8.2. There should not be any failure in re-offered lot.

iii. The coupler components with illegible marking shall be identified and rejected from the lot.

iv. On completion of inspection and acceptance by inspection authority, the coupler shall be painted as per paragraph 8.9 of this specification, before inspector's approval stamping & dispatch to consignee.

v. The components used for tests etc. from the lot during purchase inspection shall be replaced free of cost by manufacturer.

8.4 Casting Surface Finish

Riser pads and gate stubs shall not project more than 6 mm above the surrounding surface at any location. Where interference would exist in the operation or application or where serviceability would be affected, the riser pads and gate stubs shall be contoured to surrounding areas.

Castings shall be blasted sufficiently clean to permit thorough, visual Inspection. Prior to shipment, castings shall be free of dirt, rust, or loose material that would affect operation. Couplers must not be sand or shot blasted when completely assembled.

The castings shall not be painted or covered with any substance that will hide defects. However, manufacturer's and/or purchaser's paint identification marks are acceptable.

8.4.1 Surface Finish Acceptance Level

AAR spec. no.M-215 for coupling system, specify that steel casting must comply with all applicable provisions of spec. no.M-201 & M-211 including the surface finish and solidity requirements of spec. no.M-211. Under the para 13.2 of AAR spec. no.M-211 on "Coupler & yokes, AAR approved – purchase & acceptance", surface acceptance level have been stipulated for coupler components. Further, under the ASTM A 802-19 "Standard practice for steel casting, surface acceptance standards, visual examination", acceptance criteria for surface inspection of steel casting by visual examination have been provided. Following these guidelines casting surface finish is stipulated as under.

The minimum acceptable surface conditions for the defects described below shall govern. Acceptable surfaces shall be defined utilizing Steel Castings Research and Trade Association (SCRATA) Comparators for the Definition of Surface Quality of Steel Castings (1981). The listed defect classification does not apply to inaccessible areas. Surface defects described herein do not preclude the requirements of proper gauge application as defined elsewhere in this specification.

Surface conditions evaluated with SCRATA comparators:

		Critical Area (Fig-8)	Non Critical Area (Fig-8)
A	Surface Roughness	A3	A3
B	Surface Inclusion	B2	B4
C	Gas Porosity	C2	C3
D	Laps	D1	D4
E	Scabs	E2	E2
F	Chaplets	F2	F4
G	Thermal Dressing	G2	G3
H	Mechanical Dressing	H3	H4
J	Welds	J2	J3

Surface conditions B and C are acceptable if the depth of the defect does not exceed ten (10) percent of the section thickness at critical areas and twenty- five percent (25%) of the section thickness in non-critical areas.

Surface conditions not evaluated with SCRATA comparators. Offsets greater than ten percent (10%) of the casting wall thickness are not permitted. (Offsets: An offset is an abrupt, unintentional change in the casting surface.) Cracks, hot tears, cold shuts, and weld cracks , which are visually apparent, are not permitted Zone 1 areas must be prepared in accordance with Fig 9.

8.5 Wall Thickness

Wall thickness tolerances except where controlled by gauges or RDSO's drawings, are:

6 mm up to, not including 11mm wall,	+ 3 mm	- 0.8 mm
11 mm up to, not including 19mm wall,	+ 3 mm	- 2.4 mm
19 mm up to, not including 32mm wall,	+ 3 mm	- 3 mm
32 mm and over,	+ 4.8 mm	- 4 mm

8.6 Weight Variation:

Variation in weight of coupler body, yoke and other components, viz. knuckle, lock, rotary parts, shall not vary more than FIVE percent (5%) above or THREE percent (3%) below of that indicated in drawing no. SK-62724 ~~Alt 28 or~~ latest alteration. Those coupler components, which do not fall within the prescribed limits of weight variation, shall be rejected by manufacturer.

8.7 Illegible Markings

Illegible markings are markings that do not conform to paragraph 3.5 and coupler components with illegible markings shall be rejected.

8.8 Lubrication & Painting

Only dry lubricant shall be applied to the coupler head or the coupler head fittings. This lubricant may be applied using water, alcohol, or other non-petroleum based carrier.
Painting
Only exposed surfaces of Coupler and Yoke shall be painted with Black quick drying paint. Painting scheme and paint to be used shall be part of the approved QAP. Paint must not be applied to the inside of the Coupler or internal fittings. Painting shall be done after the completion of inspection on Coupler & Yoke of acceptable casting lot.
Any deviation in lubrication or painting is permitted only with prior approval of DG/Wagon/RDSO.

9.0 GUARANTEE

The coupler supplied shall be accompanied by a guarantee for a period of 72 months from the date of supply or 60 months from the date of fitment, whichever is earlier.

10.0 RECORD OF INTERNAL ACCEPTANCE TESTS:

The manufacturer will maintain a list of all internal acceptance tests being carried out by him at various stages of manufacturing of the product. Proper record of such internal acceptance tests shall be maintained by him and also included in the QAP. At the time of inspection of the product, these records shall be put up to the Inspecting Authority for scrutiny and countersign.
The manufacturer shall maintain records for a **minimum period of six years** of all weights, mechanical test reports, chemical test reports and heat treatment records applicable to the purchased castings. These records shall be made available to the purchaser upon request.

The manufacturer shall also maintain records for a minimum of six years that provide traceability from the serial number of individual castings, where applicable to the records stated above.

11.0 MINIMUM FOUNDRY INFRASTRUCTURE REQUIREMENTS

11.1 A foundry producing coupler castings should have the capacity to produce at least 5000 couplers and coupler components per year.

11.2 To ensure dimensional and feature control, the castings shall be produced by one of the following moulding processes mentioned in Clause 5.3.3 of this specification for which the necessary infrastructure should be available.

11.3 The foundry must have the ability to conduct all the tests mentioned in this specification.

11.4 Chemically bonded no bake sands out of a articulated continuous mixer with PLC control shall be used to produce casting cores for which necessary infrastructure should be available.

11.5 Melting furnace capacity should be a minimum of 5 MT utilizing electric arc.

11.6 Heat treating furnaces should be capable of holding at least 3 MT of castings and reaching and maintaining temperatures of 950 deg C. Furnaces should have automatic temperature control and be capable of operating as low as 500 deg C and fitted with an automatic digital recorder.

11.7 Other equipment to meet the requirements of this specification should be available.

11.8 The foundry shall hold a valid Quality Assurance Certification as per AAR M1003 or ISO 9001.

12.0 PROCESS FOR THE QUALIFICATION, APPROVAL AND VENDOR PROGRESSION OF A CASTING FOUNDRY FOR THE MANUFACTURE OF RAILROAD COUPLERS.

12.1 For consideration of foundry approval to produce couplers, yokes, knuckles, and coupler parts, the manufacturer must have the minimum infrastructure listed in Clause 11 of this specification. Thereafter the manufacturer shall submit a foundry approval application to RDSO containing the following information

- A description of the facilities processes and capabilities, along with detailed information on quality control procedures.
- A list of all components to be produced at the facility.

12.2 Along with the application, the foundry owner will request RDSO for an inspection only after fulfilling the following requirements.

- Their infrastructure is compliant with this specification and they meet the eligibility requirements.
- They will be in a position to manufacture 25 couplers during the visit of RDSO audit team.

12.3 INSPECTION OF MANUFACTURING FACILITY AND PROCESSES:

RDSO shall send a team for carrying out an audit of the manufacturing facilities and the quality assurance system to verify if the manufacturer is capable of manufacturing couplers to this specification. To facilitate the audit 25 couplers will be manufactured. Other extant guidelines for registration of vendor as per relevant ISO apex document of RDSO shall be applicable. The inspection procedure shall also include a review of the following items:

- Plant operation and procedures, including confirmation of certification tests, production and quality equipment inspection, employee interviews and finished product defect levels
- Process control plans, including critical inputs, outputs and specification limits,

sample size and frequency, control method and reaction plan.

- Critical processes, including practices for pattern and core boxes, core making, moulding, melting, pouring, cleaning, heat treating and casting quality.
- Organization, verifying separation between production and quality control responsibility, resolution mechanism for non-conforming product and controlled disposition of non-conforming product.
- Personnel, verifying procedures for qualifying employees, training of new employees, and existence of competent expertise.

12.4 TYPE TEST:

First article inspection of the couplers for dimensional control as per gauges will be carried out. Two samples (Coupler body, Yoke and knuckle) will be picked up by RDSO team and sent to National Metallurgical Laboratory for type testing. RDSO at its discretion may send the samples to another laboratory as well. The test charges will be borne by the manufacturer.

12.5 After successful conduct of capacity-cum-capability assessment as per extant guidelines given in relevant ISO apex document, and after successful type test as per Clause 12.4, RDSO will grant an approval for manufacture & supply as a developmental source. The developmental source will be placed in the List of RDSO registered Vendors for Developmental Orders available on UVAM portal with following restriction on supply.

i. Maximum permitted quantity-5000 Nos complete coupler sets and 5000 Nos of Grade E castings i.e. coupler body, knuckle and yoke.

ii. Other coupler components can be supplied without any restriction on quantity. The ceiling limit of supply beyond 5000 Nos on complete coupler set and 5000 Nos of Grade E castings i.e. coupler body, knuckle and yoke shall be withdrawn when the following is met:

500 couplers have completed one year of satisfactory service.

- **Satisfactory type tests on two coupler body and two knuckles which have completed one year of service similar to other stipulations of para 12.4.**
- **Samples picked up from the field must meet the physical and chemical properties of the specification. If first sample of two coupler body and knuckle fail for physical and chemical properties, the firm will be required to submit an explanation for the same. Based on rationality of the explanation, second sample of two coupler body and two knuckle will be picked up from field and shall be subjected to re-test.**
- **In case the second sample also fails during retesting, the firm shall be delisted from the vendor directory.**
- **No unresolved non conformances or not more than two line failures per year on manufacturing account.**
- **The manufacturer should also have infrastructure and processes to meet the following requirements.**

i. **Use of single piece core for coupler body & yoke.**

ii. **Casting component non-destructive testing requirements as per AAR M-220.**

12.6 Non conformances shall be reported to RDSO and the manufacturer, identifying the failed material or service provided by the manufacturer. The initiator of non-conformance reports may include the wagon builder or owner or Indian Railways. The non- conformance report shall identify the product, a description of the non-conformance and disposition of the product. The manufacturer shall respond to the report within 30 days, identifying the root cause and corrective action plan to address the non-conformance. A follow up plan shall also be included to ensure that the corrective action is effective and permanent. Inadequate or ineffective response to non-conformance will initiate a process of decertification at the discretion of RDSO.

12.7 A manufacturer will be placed in the List of Approved Vendors as per extant RDSO's ISO procedure.

12.8 The manufacturer seeking approval for manufacture & supply of complete assembly of Upgraded High Tensile Centre Buffer Coupler should have in-house manufacturing facilility for minimum five major components i.e. Coupler Body, Knuckle, Yoke, Striker Casting and Yoke Pin Support.

12.9 The manufacturer having status as an approved vendor for complete assembly of Upgraded High Tensile Centre Buffer Coupler will be permitted to use full quantity of in house manufactured sub components for supply of complete assembly even if the manufacturer is registered as a vendor with developmental status for the sub items of complete assembly of Upgraded High Tensile Centre Buffer Coupler.

13. MINIMUM INVESMENT CASTING INFRASTRUCTURE REQUIREMENTS:

Plant & Machinery

- One Wax melting machine & Wax Mixing Machine should be available for wax melting and mixing.
- Centralized wax filling facilities should be available for feeding to wax injection press.
- Sufficient Die should be available for pattern making.
- Runner Riser press should be available for making riser and runner in the pattern.
- Wax Injection Press should be available or making wax pattern.
- At least one Hot Plate should be available
- Extruder press for breaking different sizes of solid wax.
- Jar Mill for making slurry.
- At least one Slurry Tank should be available.
- Rain fall sander should be available for shell moulding.
- Facilities and space for drying moulds.
- De-waxing facilities should be available.
- Fluidizes sand bed
- Dust Collector
- One Auto clave should be available for de-waxing
- One Electric /Induction Furnace of 300 kgs (Min.) should be available for meting purpose.
- One Shell Baking Furness should be available.
- Sufficient nos of Vibrating Knockout, Grinding Machines should be available.

- One Wax Boiler should be available for melting of return wax
- One Centrifuge with tank should be available for screening of return wax
- One Steam Boiler is essential for de-waxing of mould.
- Digital pyrometer/ Immersion pyrometer are required for taking melting & pouring temperature of molten metal.
- Minimum one number of oil-fired / gas-fired / induction furnace for heating of components up to 1000ºC. The furnaces should be provided with automatic temperature controllers and recorders and temperature-time graph recording facilities. Hardening temperature to be maintained shall be controllable within ±10ºC. The furnace shall have facility for controlling the internal atmosphere to avoid undesirable scaling and decarburisation.
- One Oil/Water quenching tank with necessary heat exchanger and continuous circulation of oil facilities should be available. The quenching tank should be provided with automatic temperature recorder.
- One forced air circulation, electric or oil-fired / gas-fired tempering furnace of adequate capacity having automatic temperature controllers and recorder.

  The manufacturer must have the ability to conduct all the tests mentioned in this specification.

14. MINIMUM FORGING INFRASTRUCTURE REQUIREMENTS

- Covered area with adequate space underneath for storage of raw materials e.g. billets, round corner squares, rounds, etc.
- Minimum one band saw / billet shearing machine shall be available.
- At least two drop hammer with minimum capacity of 3.5 MT or double acting pneumatic hammer / forging press of equivalent capacity along with at least two trimming press.
- Minimum two compressors of 75 cfm minimum capacity each shall be installed, in addition to blower of minimum 5 HP.
- Minimum one number of oil-fired / gas-fired / induction furnace shall be available with hydraulic / mechanical operated for heating cut pieces of billets / RCS / rounds etc shall be available. The temperature range of these furnaces should be up to 1200ºC and should be provided with automatic temperature controllers. The controller should be calibrated once in six month. The desired temperature shall be achieved within an accuracy of ±10ºC.
- Minimum one number of oil-fired / gas-fired / induction furnace for heating of components up to 1000ºC. The furnaces should be provided with automatic temperature controllers and recorders and temperature-time graph recording facilities. Hardening temperature to be maintained shall be controllable within ±10ºC. The furnace shall have facility for controlling the internal atmosphere to avoid undesirable scaling and decarburisation.
- One oil/Water quenching tank with necessary heat exchanger and continuous circulation of oil facilities should be available. The quenching tank should be provided with automatic temperature recorder.
- One forced air circulation, electric or oil-fired / gas-fired tempering furnace of adequate capacity having automatic temperature controllers and recorders.
- One Normalising furnace of adequate capacity having automatic temperature controllers and recorders.
- One shot blasting machine with table dia of at least 3 ft. The shot blasting machine shall have in-built facility of sieving undersize shots.
- A die shop having adequate die sinking facilities comprising of spark erosion machines etc.

- Adequate machining facilities comprising of vertical milling machine / radial drilling machines / horizontal lathes with tapping arrangements etc. of suitable capacities and standard makes are required for preparation of die blocks and machining of forged components.
- Adequate numbers of hand grinders are required for removal of fins & burrs. Prior to release of dies for production, it should be ensured that the dies are checked dimensionally in all respects including its mounting or the forging hammer / press. The firm must list out the method of checking the dies i.e. either on plaster of Paris blocks of on auto-cad arrangement. Proper records of die inspection / checking showing the date of checking, important dimensions and contours must be maintained. Any ill effect of dies or forged components or their mismatching with forging hammers/press must be recorded. The remedial measures taken should also be documented.
- BHN testing machine with necessary standard test pieces. The hardness-testing machine shall have capacity to apply 3000 kgs load on one test specimen.
  The manufacturer must have the ability to conduct all the tests mentioned in this specification

15.0 AUTHORITY TO MAKE DEVIATIONS/RELAXATIONS FROM THIS SPECIFICATION

Normally there should be no deviation from this specification. Adhoc relaxations/ deviations often lead to dilution of technology and limits the quality and performance of the indigenous manufacture. A well-structured regime shall be followed put in place to administer any deviation/modifications in this specification after its finalization. Similar practice is also followed by AAR in respect of their coupler specifications.

15.1 Deviations to this specification shall be examined by the following Coupler Standards Committee‖ comprising the following functionaries of Indian Railways and RDSO:

15.1.1 Executive Director Standards, Wagon, RDSO as convener.

15.1.2 Executive Director Standards, Carriage, RDSO.

15.1.3 One SAG officer from Railways to be nominated by the Railway Board deviations/Modifications may be moved by manufacturers, users or by RDSO design directorates. The Coupler Standards Committee shall submit its recommendations to the Railway Board for approval before incorporating/ permitting the same.

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Annexure - A

Table for Marking Particular by the Wagon Builder/POH workshop

SN	Wagon builder/ POH shop/ Depot	Name of CBC Component	PO/ Contract No. and Date	IC/DM No. and Date	Make	Casting No.	Month/ Year	Whether marking as per class 3.5 of spec. and concerned drawing (Yes/No)	Sign.

Annexure-I

GAUGES TO ENSURE INTERCHANGEABILITY OF COUPLER AND ITS PARTS

	GAUGE NO.	DESCRIPTION
COUPLER HEAD	WD-84073-S-1-RC	10A Contour Gauge
	WD-84073-S-2-RC	Bottom Anticreep-Vertical Location
	WD-84073-S-3-RC	Bottom Anticreep-Horizontal Location
	WD-84073-S-4-RC	Top Anticreep-Vertical location
	WD-84073-S-5-RC	Pivot Lug
	WD-84073-S-6-RC	Pin Protector
	WD-84073-S-7-RC	Pulling Lug Gauge - Knuckle side
	WD-84073-S-8-RC	Pivot Pin
	WD-84073-S-9-RC	Lock Chamber
	WD-84073-S-10-RC	Lock Hole
	WD-84073-S-11-RC	Rotary Lug
	WD-84073-S-12-RC	Shank End Pin Hole
COUPLER PARTS	WD-84073-S-41-RC	Knuckle Bottom Pulling Lug
	WD-84073-S-42-RC	Knuckle Movable Point
	WD-84073-S-43-RC	Knuckle Hub
	WD-84073-S-44-RC	Knuckle Tail Height
	WD-84073-S-45-RC	Knuckle Top Pulling Lug
	WD-84073-S-46-RC	Knuckle Tail Shelf
	WD-84073-S-47-RC	Knuckle Pin Hole
	WD-84073-S-48-RC	Knuckle Length
	WD-00041-S-01	Gauges for Knuckle
	WD-84073-S-56-RC	Lock Contour Guard-Arm Side
	WD-84073-S-57-RC	Lock Contour - Knuckle Side
	WD-84073-S-58-RC	Lock Toggle
	WD-84073-S-59-RC	Lock Parallel and thickness
	WD-84073-S-60-RC	Lock Slot
	WD-84073-S-61-RC	Lock Toggle Arm Width-Go & No Go
	WD-84073-S-66-RC	Knuckle Thrower Contour
	WD-84073-S-67-RC	Knuckle Thrower Trunion
	WD-84073-S-76-RC	Lock Lift Assembly
	WD-84073-S-77-RC	Composite Gauge for Connector
	WD-84073-S-78-RC	Composite Gauge for Hook
	WD-84073-S-79-RC	Composite Gauge for Toggle
	WD-84073-S-96-RC	Knuckle pivot Pin Dia. & Length GO&NO GO
COUPLER SHANK	WD-84073-S-15-RC	Shank Height
	WD-84073-S-17-RC	Shank Butt Width
	WD-84073-S-18-RC	Pin Hole Shank Wail Thickness
	WD-84073-S-19-RC	Butt Rear Wall Thickness
	WD-84073-S-20-RC	Pivot Pin Hole
	WD-84073-S-21-RC	Shank Height with Wear Plate
	WD-84073-S-22-RC	Shank Length (Non-Transition)
	WD-84073-S-23-RC	Shank Butt End Contour
	WD-84073-S-24-RC	Spherical Butt and Pin Hole
	WD-84073-S-25-RC	Shank Butt Height

Annexure- II

Procedure for Radiography ~~of Knuckle~~

Procedure:

1. Radiograph shall be taken in open space.
2. Gamma Radiography shall be used for radiography.
3. Source of radiography shall be put into the pin Holes.
4. Put the Radiography film outside the pin Holes as shown in photograph.
5. Appropriate penetrameter shall be keep over the radiography film.
6. Sensitivity of radiography shall be set 2% of the thickness of the castings.
7. Radiography shall be taken for area of Knuckle, Coupler Body and Yoke shown in the photographs.

Acceptance Standard:

Acceptance Standard shall be as per ASTM E446 (Reference Radiographs for steel casting upto 2 in. (51 mm) in thickness), Volume-II.

(i) Sensitivity of radiography shall be 2% of the thickness of casting.
(ii) Defects like Gas Porosity, Sand & Slag inclusion and Shrinkage upto Level-II shall be accepted.
(iii) Defects like Hot Tear, Crack, Insert, and Mottling shall not be permitted.

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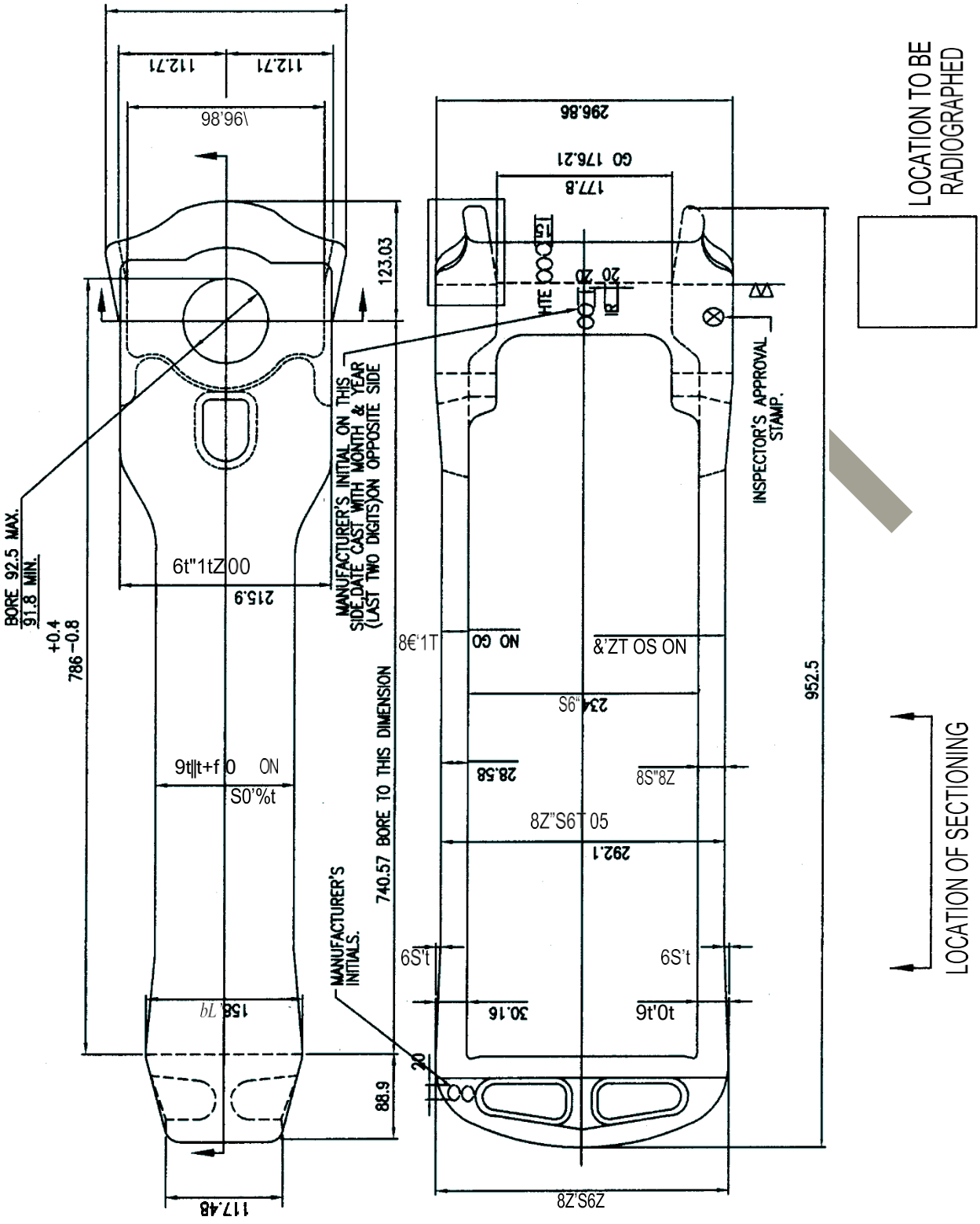
SPECIFICATION



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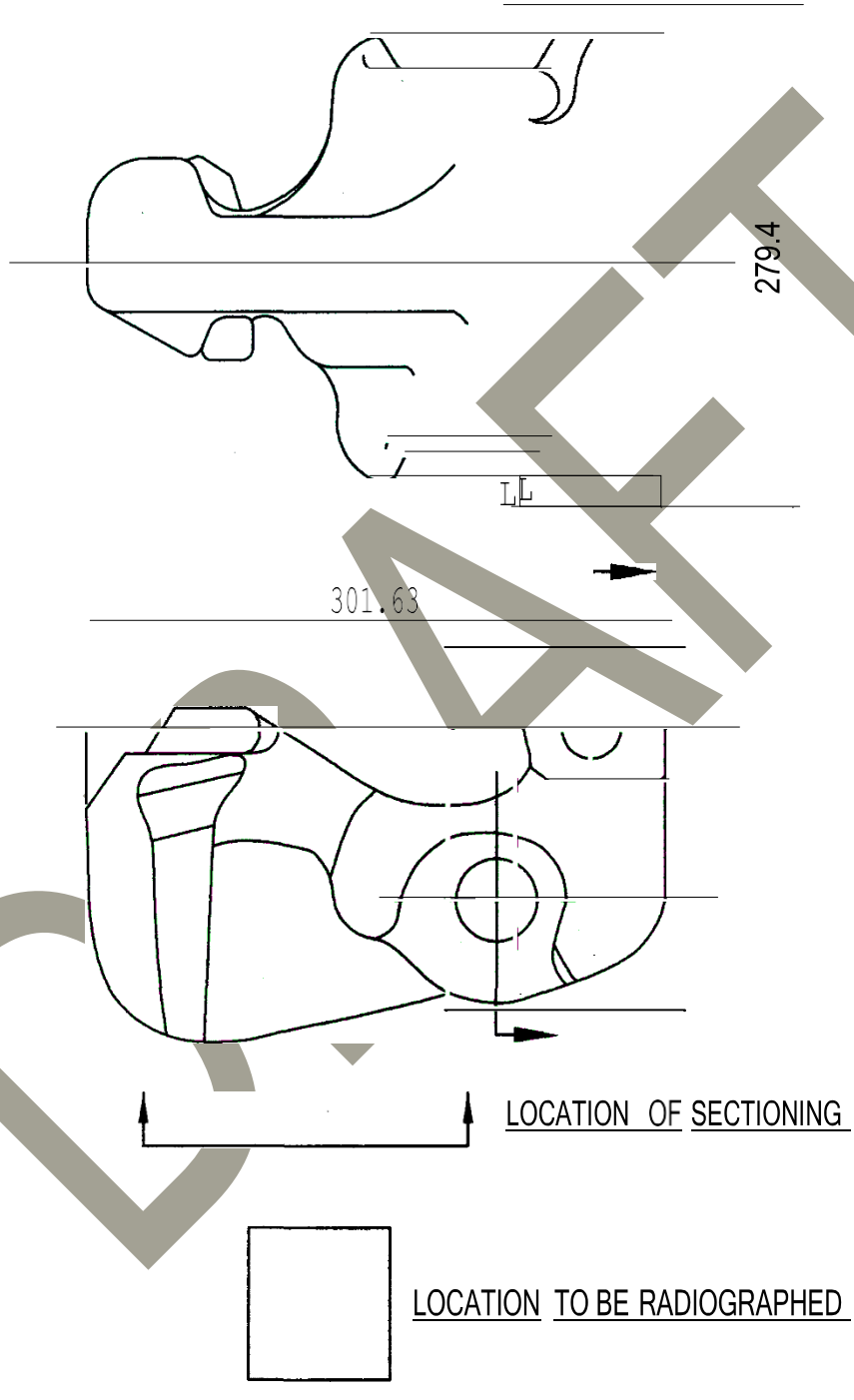

279.4
LL
301.63
LOCATION OF SECTIONING
LOCATION TO BE RADIOGRAPHED

Annexure-III

STANDARD REFERENCE PHOTOGRAPHS FOR CASTING SOLIDITY

1.0 SCOPE

1.1 The reference photographs illustrates various types and degrees of shrinkage occuring in coupler, knuckle and yoke sections. They are full scale and provide the following:-

1.1.1 A guide enabling recognition of shrinkage and its differentiation as to severity level.

1.1.2 Serve as standard for evaluating minimum acceptability as specified for the product.

1.2 The reference photographs show graded shrinkage in six levels of increasing severity.

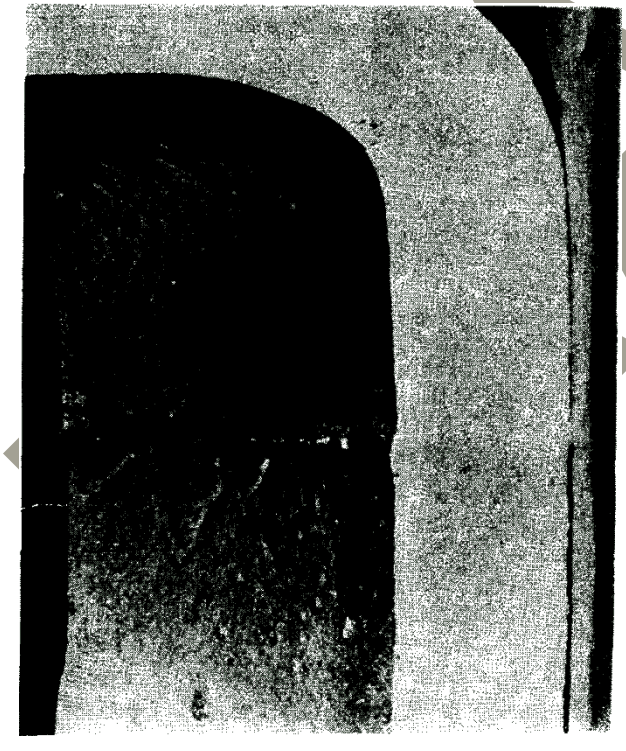
2.0 PREFACE

2.1 The reference photographs were prepared from actual production castings, which were first radiographed. The radiographs were evaluated and rated as to shrinkage severity level by comparison with the standard reference radiographs in ASTM E446 72. A saw cut was made through the rated shrinkage area of the casting at 90 degrees to the plane of radiograph. The casting section was then ground smooth and sand blasted to delineate shrinkage for photographs. The exposed shrinkage in section were then ranked visually according to severity and divided into levels corresponding to those found in ASTM E 446.

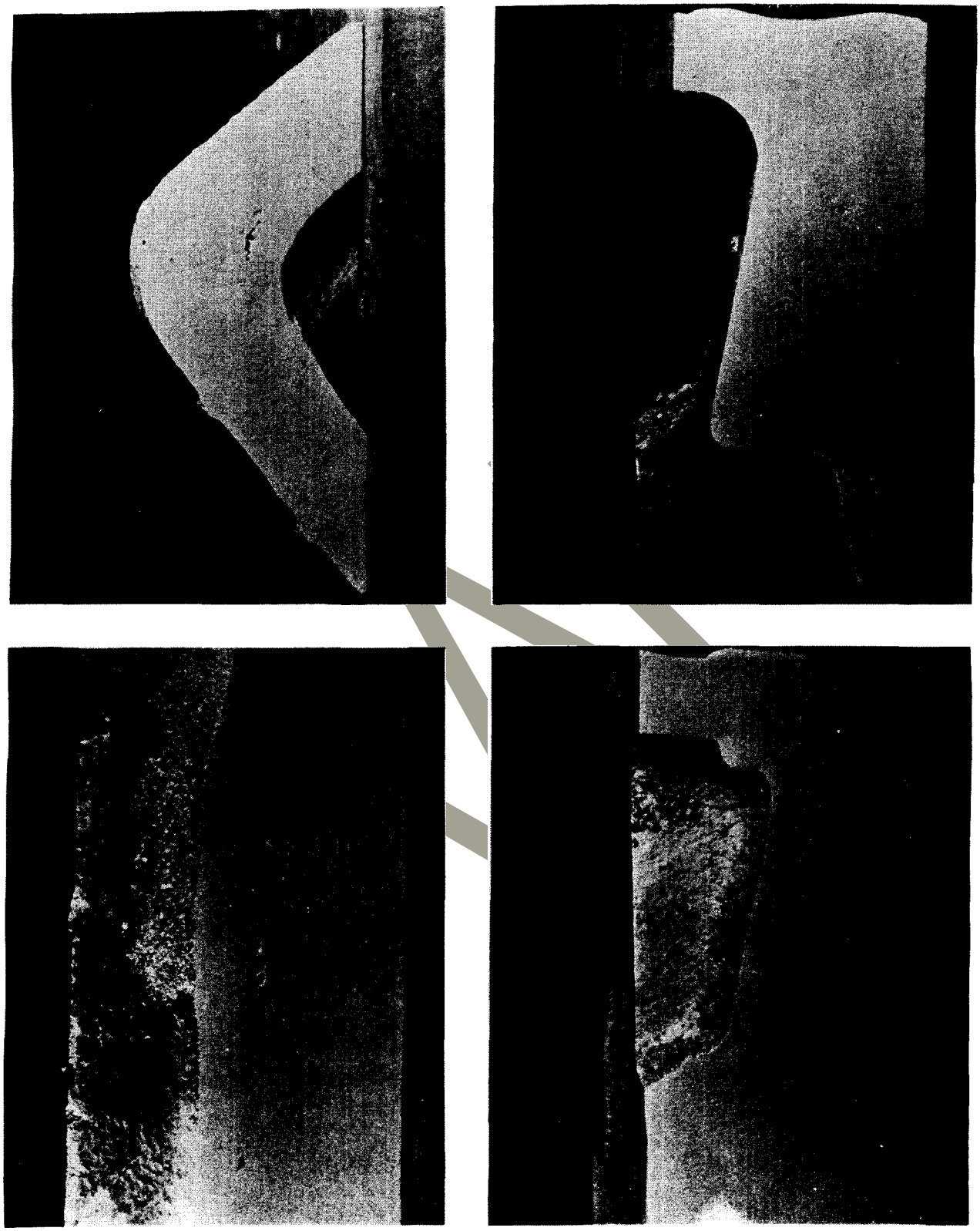
2.2 Radiographic evaluation of shrinkage is based on the greatest severity found in any 127mm x 178mm area of the section being examined. In a similar manner, evaluation of saw cut sections is predicated on the greatest shrinkage severity encountered in a 127mm length of the casting section. The difference and the judgment of an individual in determining the severity level of the radiographs combine to produce a possible variation in the severity level rating of the reference photographs that can amount to one level above or below the ASTM E446 reference radiograph rating.

3.0 EVALUATION

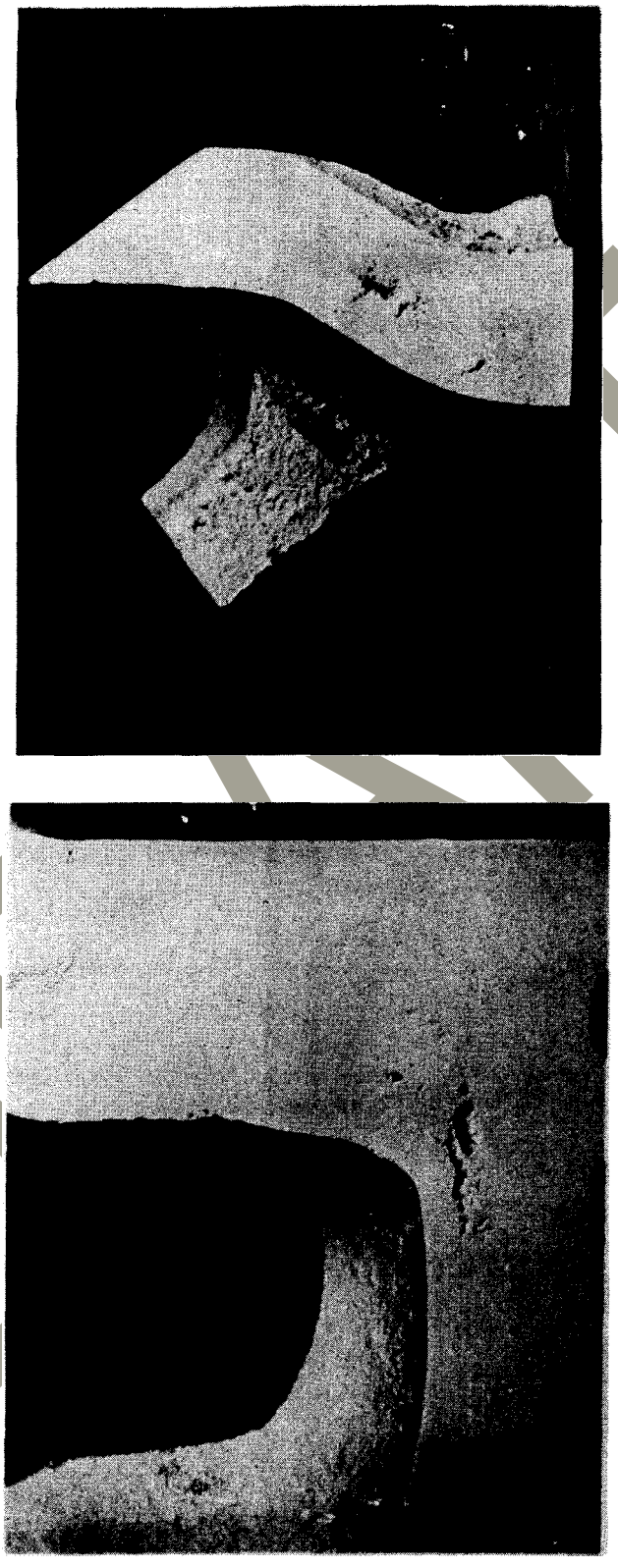
3.1 Severity level is established by determining which photograph of discontinuities most closely resembles the discontinuities present in the sectional area being investigated as illustrated in the attached photographs.



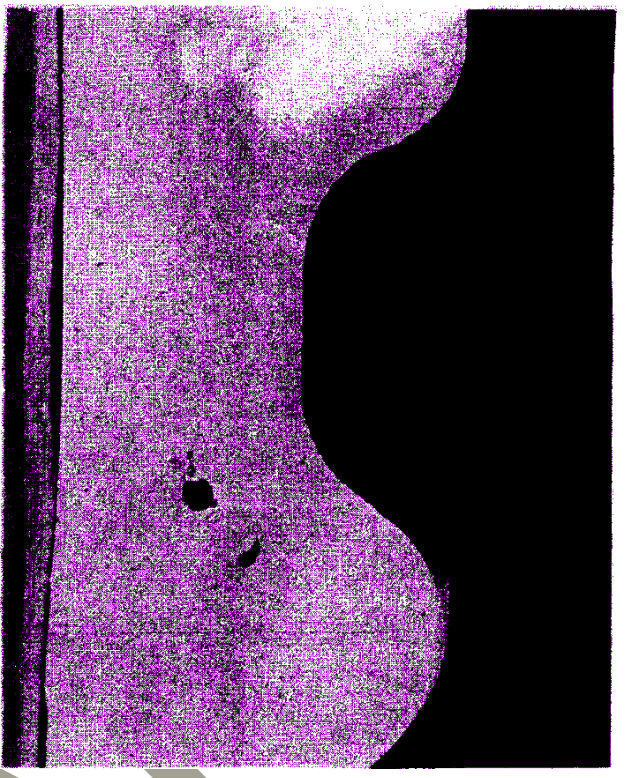
SHRINKAGEOFYISUALSEYERITY-1

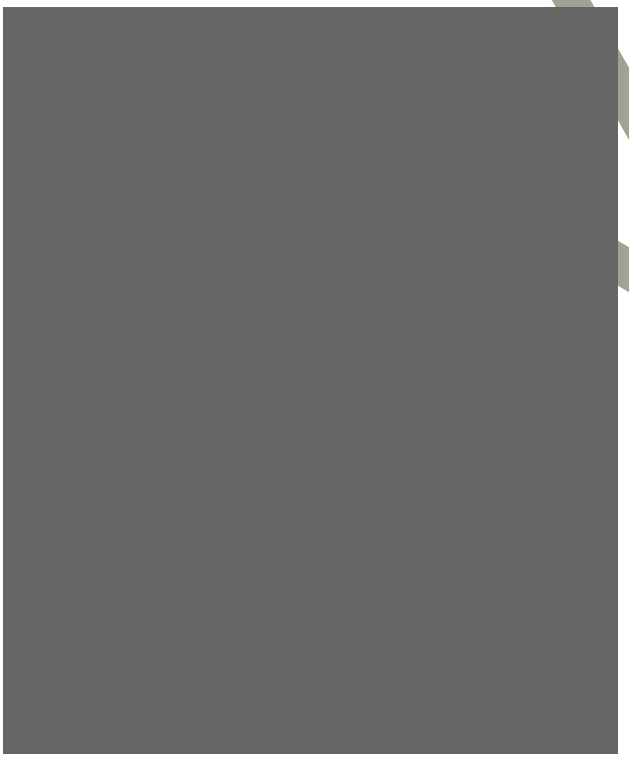


SHRINKAGE OF VISUAL SEVERITY- 2

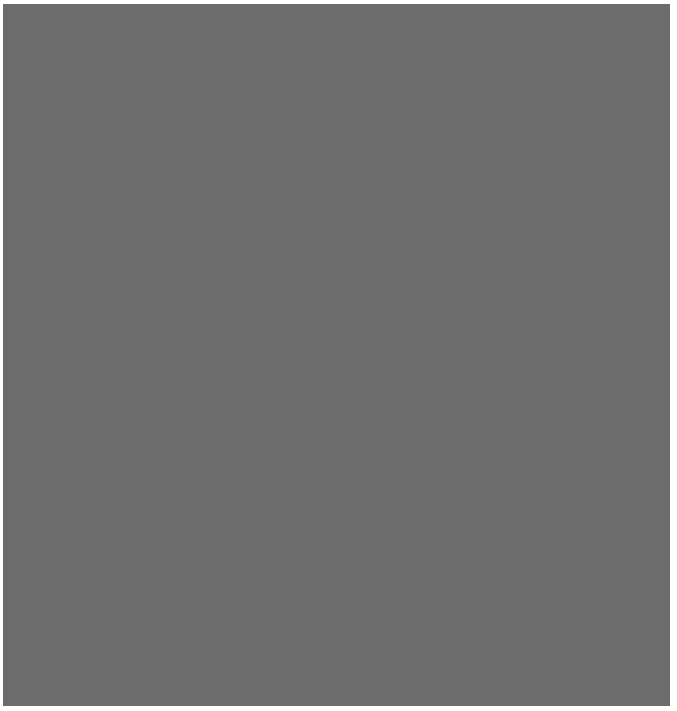


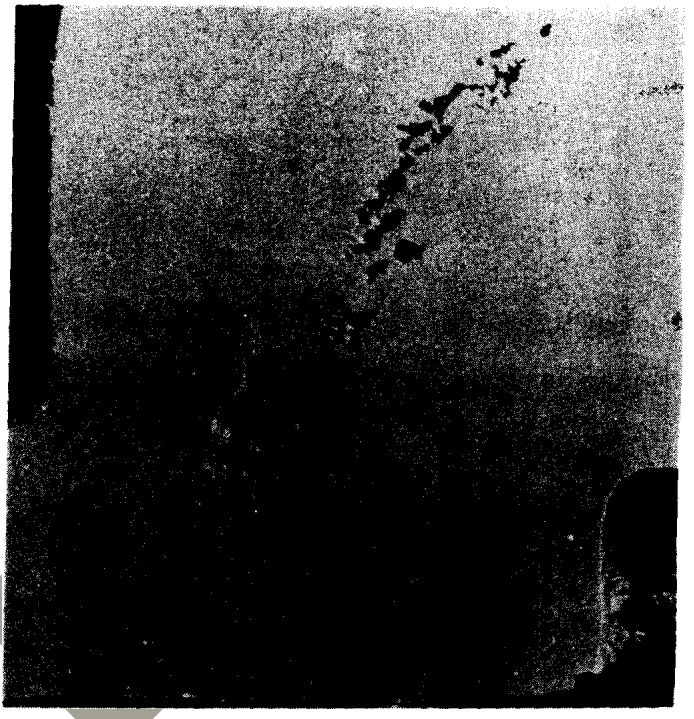
SHRINKAGE OF VISUAL
SEVERITY-3



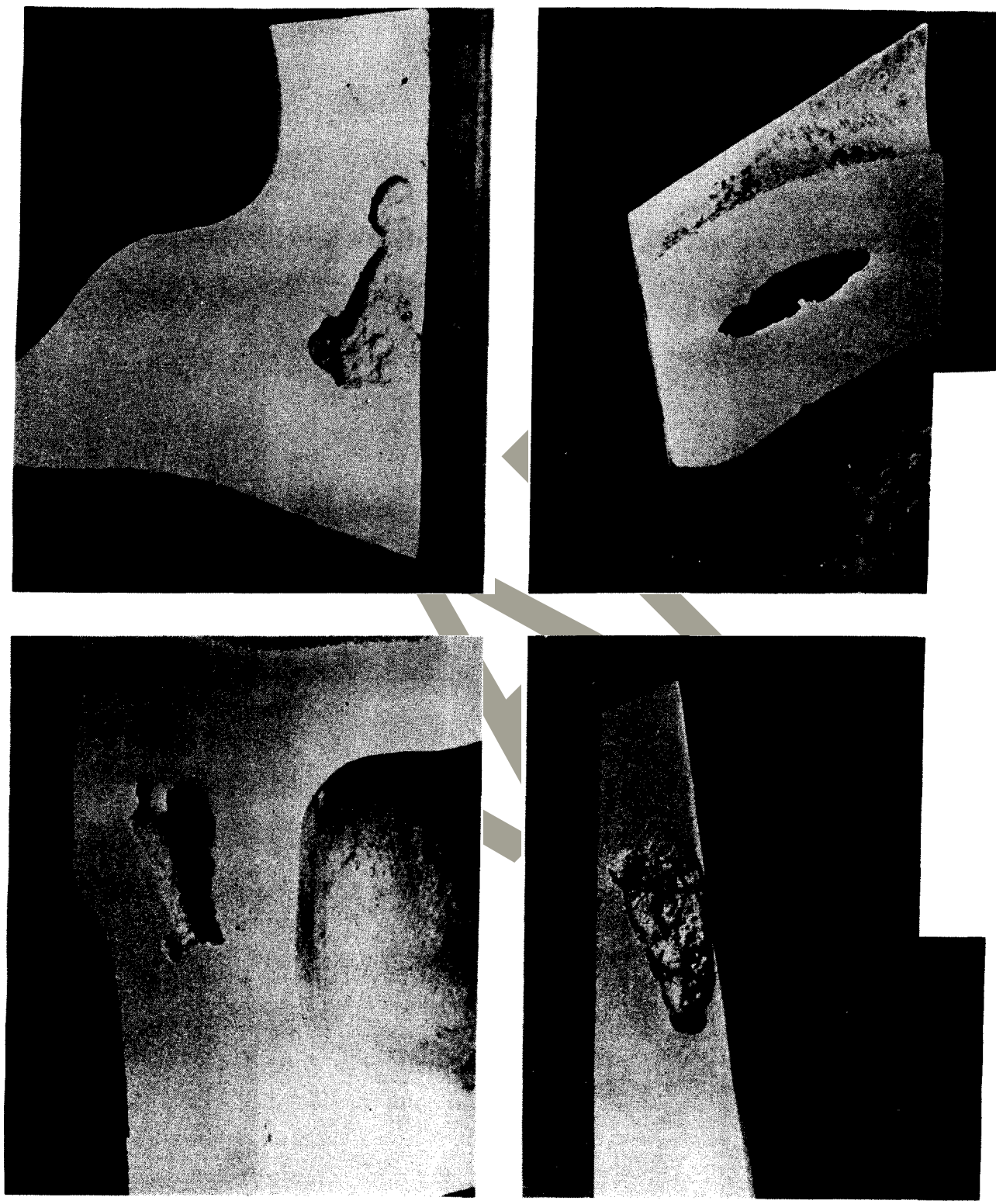


SHRINKAGE OF VISUAL SEVERITY-4





SHRINKAGE OF VISUAL SEVERITY-5



SHRINKAGE OF VISUAL SEVERITY-6

LOCATION FOR BRINELL HARDNESS READINGS

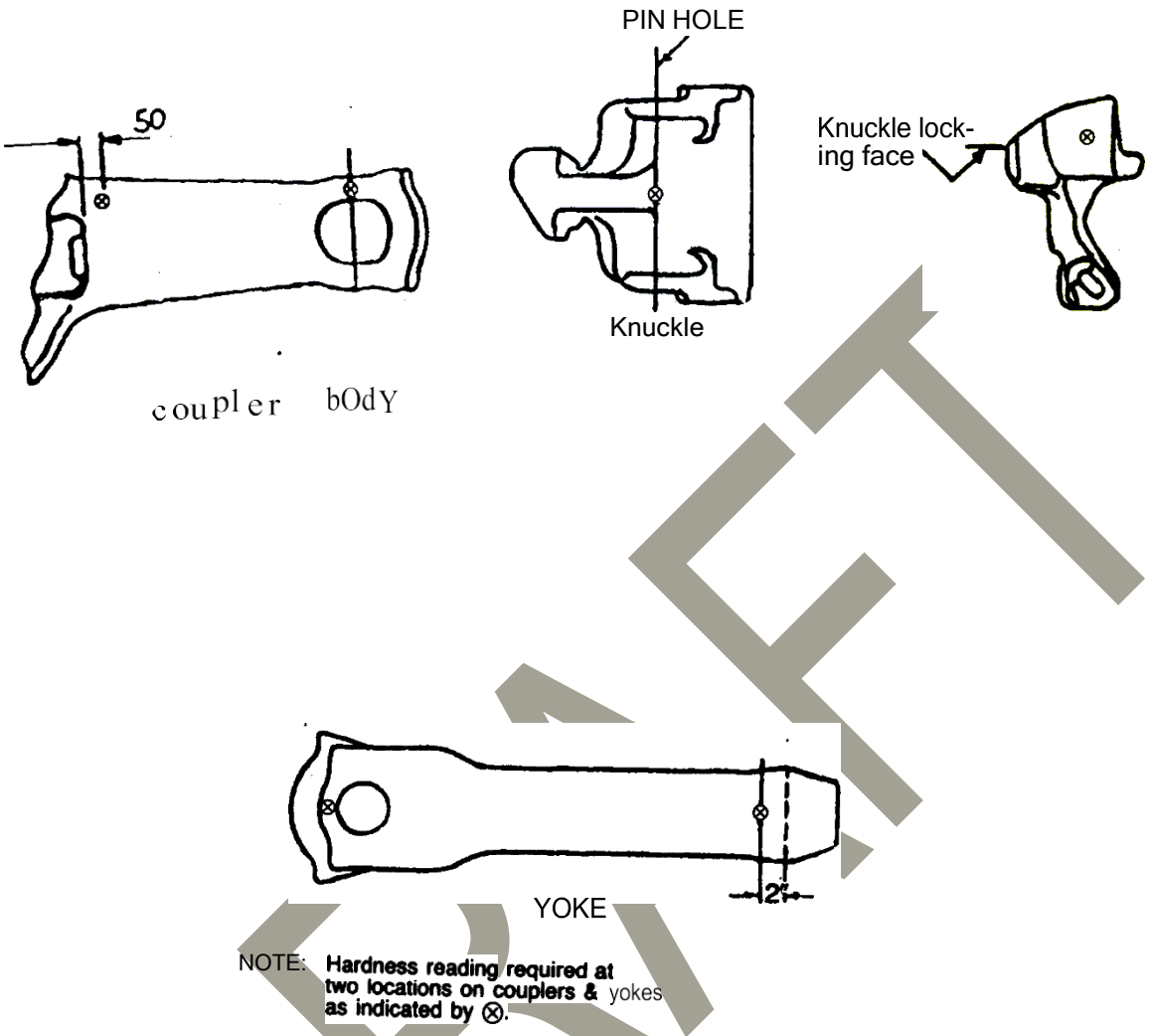


Figure No. 1

INTERNAL SOLIDITY SECTION CUT LOCATIONS

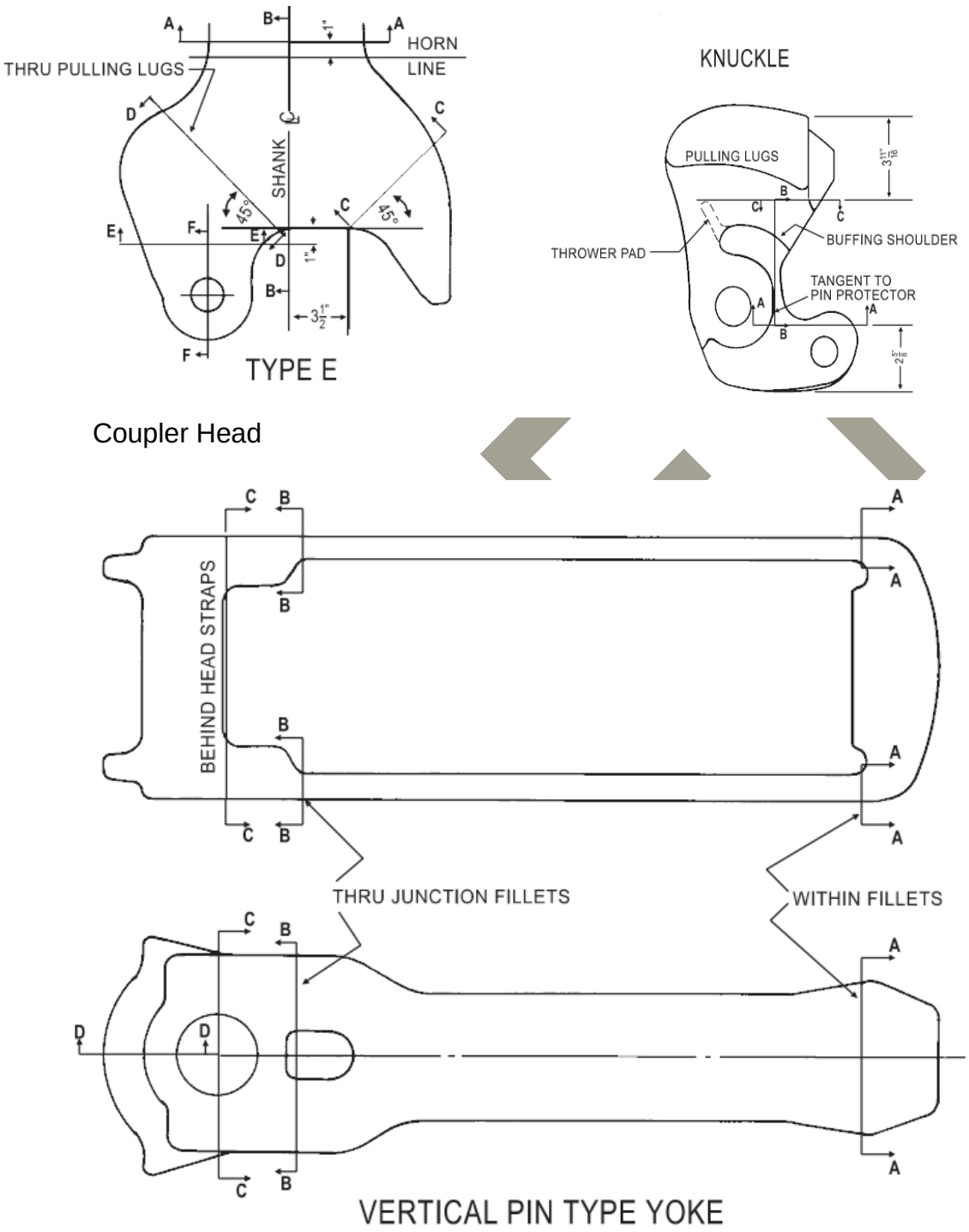
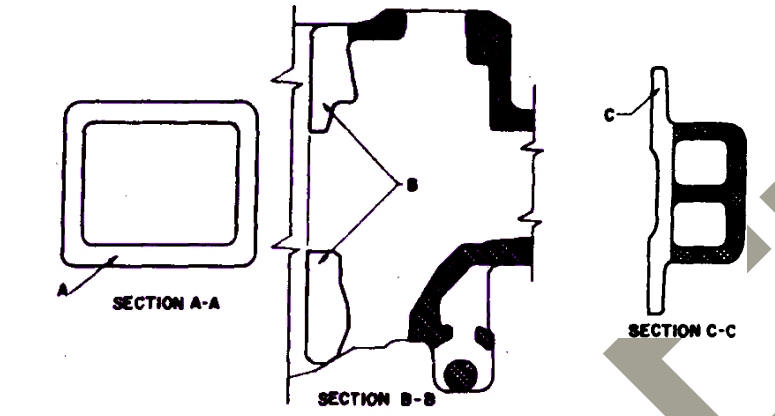
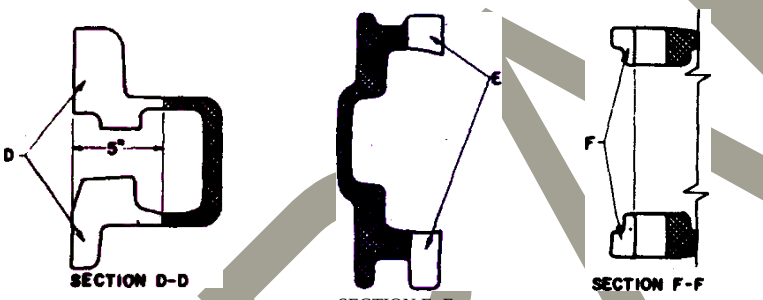


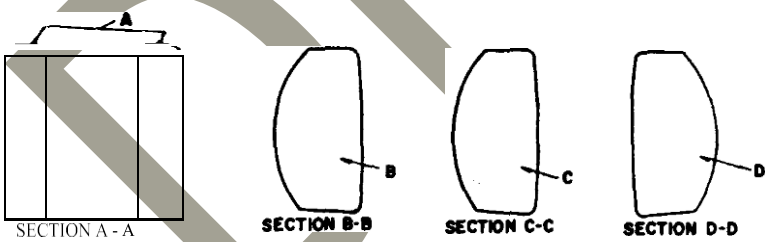
Figure -2

AREAS TO BE EYALUATED FOR DISCONTINUITY LEYELS





COUPLER HEAD

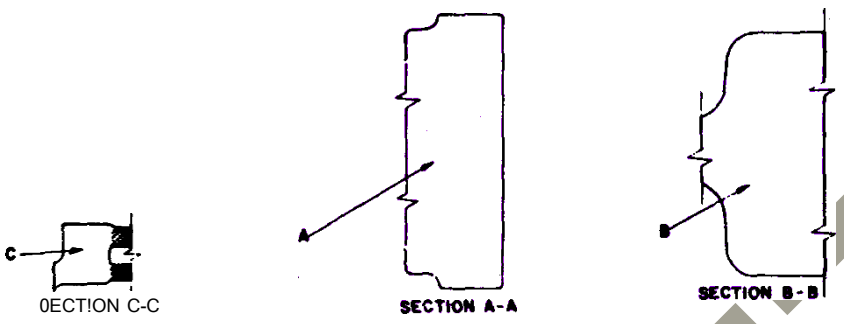


SHANK

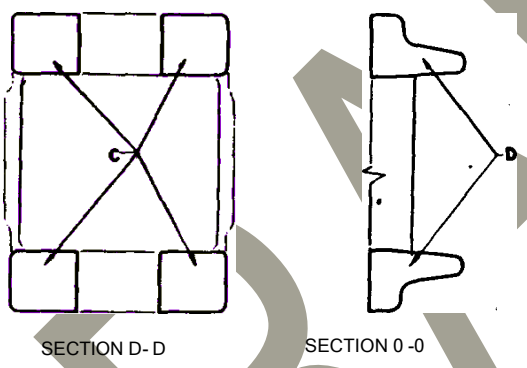
NOTE: SECTION CUT AREAS TO BE RATED FOR SOLIDITY ARE UNSHADED.

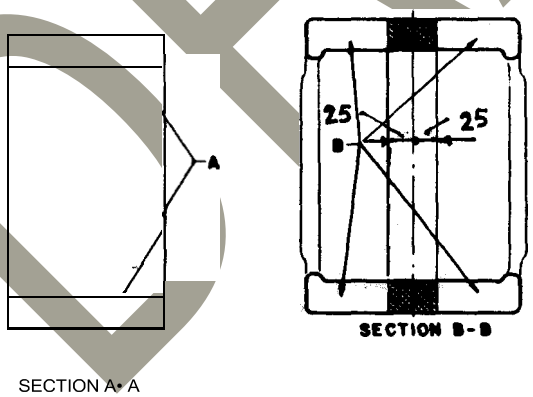
Figure -3

AREAS TO BE E.VALUATED FOR DISCONTINUITY LEYELS



KNUCKLE



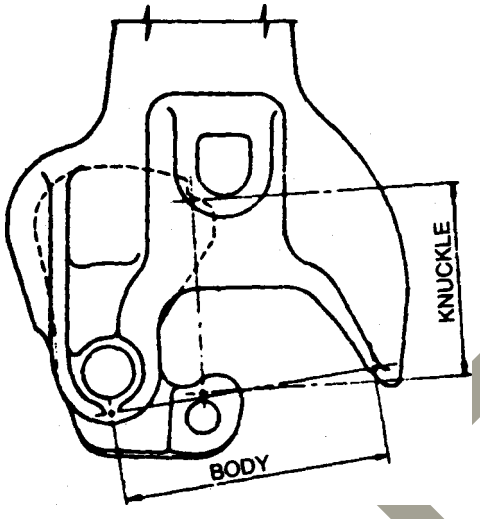


SECTION OF CUT AREAS TO BE EVALUATED FOR SOLIDITY ARE UNSHADED

YOKE

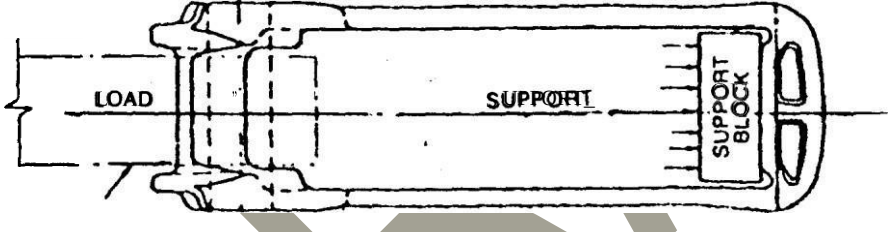
Figure-4

LOCATION OF PERMANENT SET
MEASUREMENTS FOR
COUPLER BODY, KNUCKLE & YOKE



COUPLER HEAD

Figure-5



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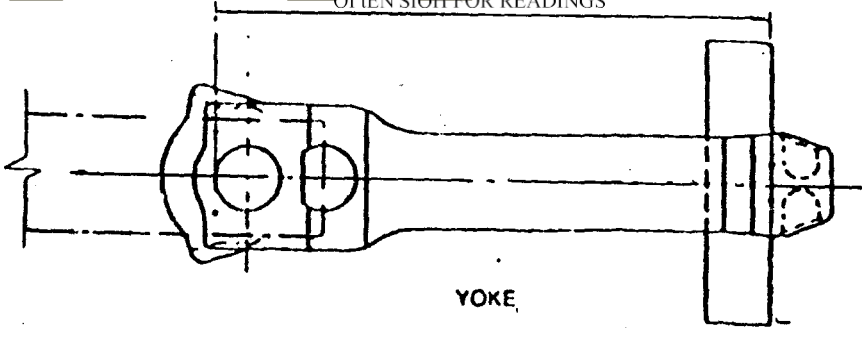
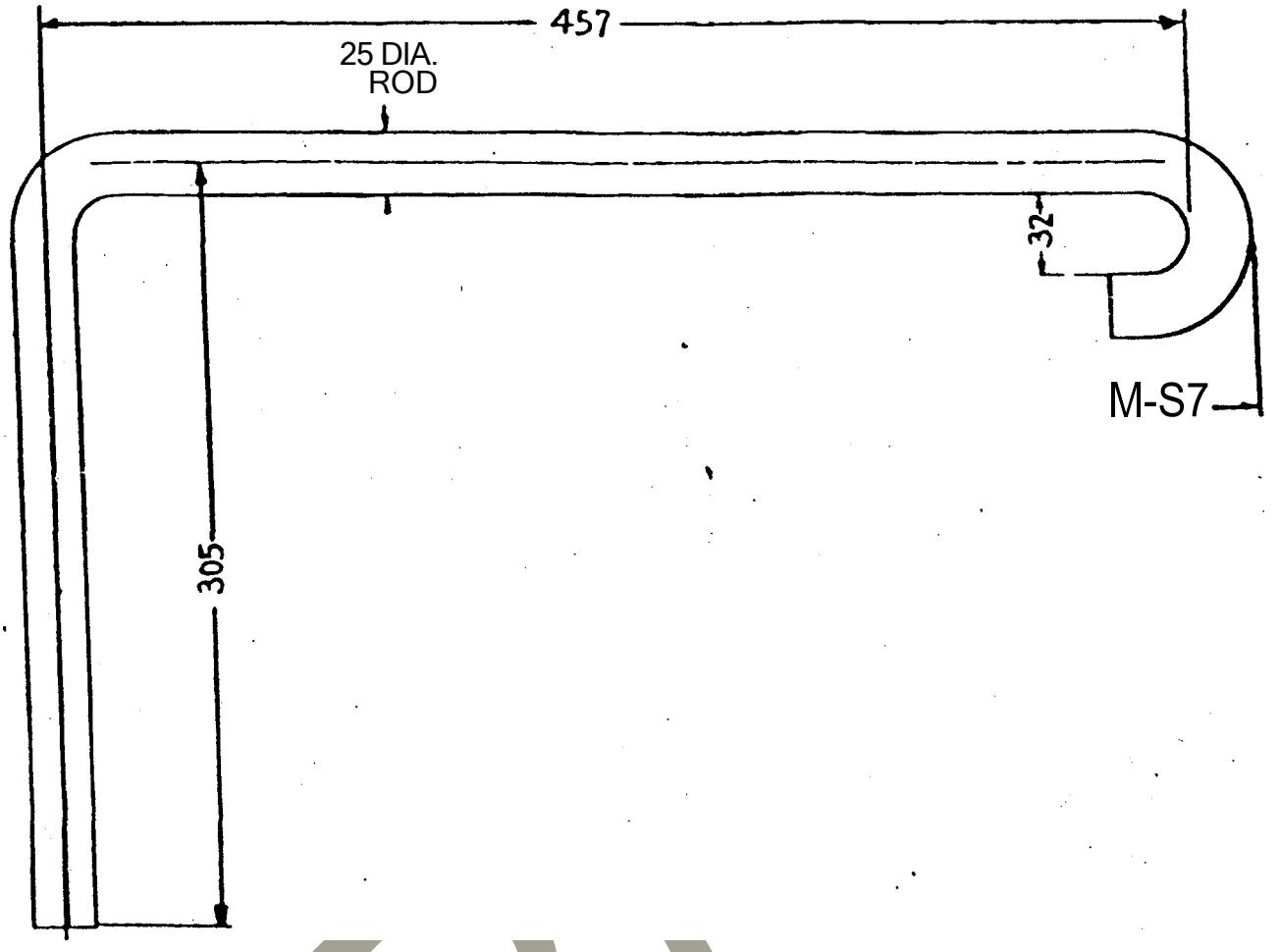


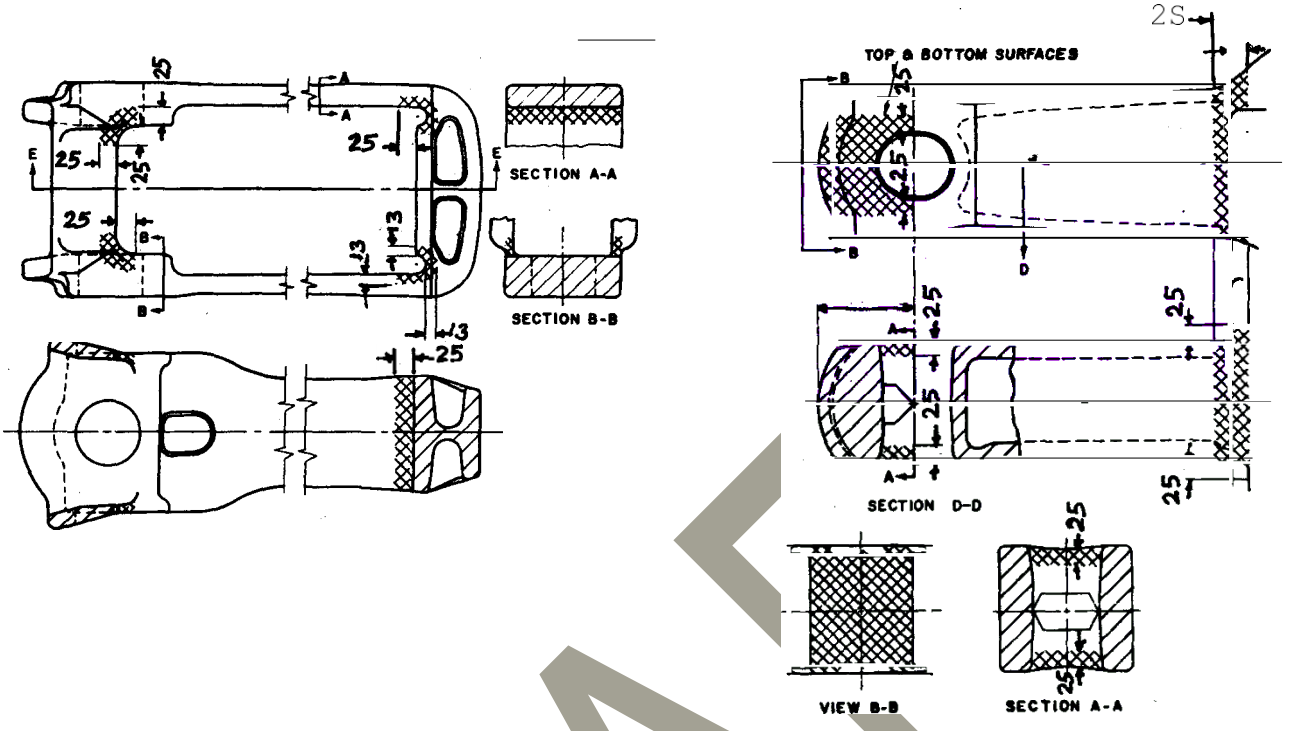
Figure -6



COUPLER INSPECTION
OPERATING ROD

Figure - 7

INSPECTION ZONES FOR CRITICAL AREAS



tsOTE. CRITIcAL• AREAS ARE SNO6N CR08SMTCHE0

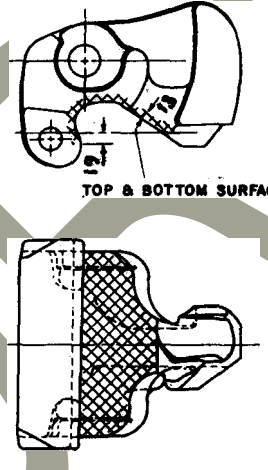
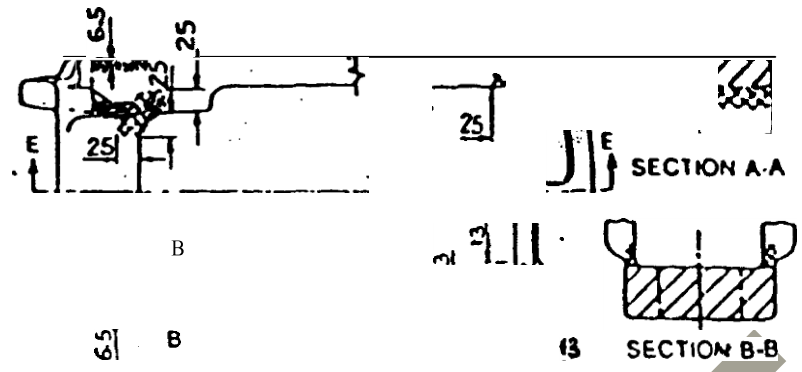
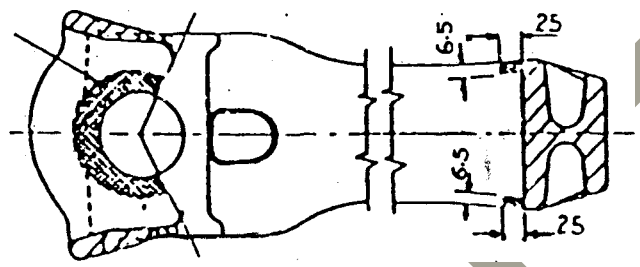


Figure - 8





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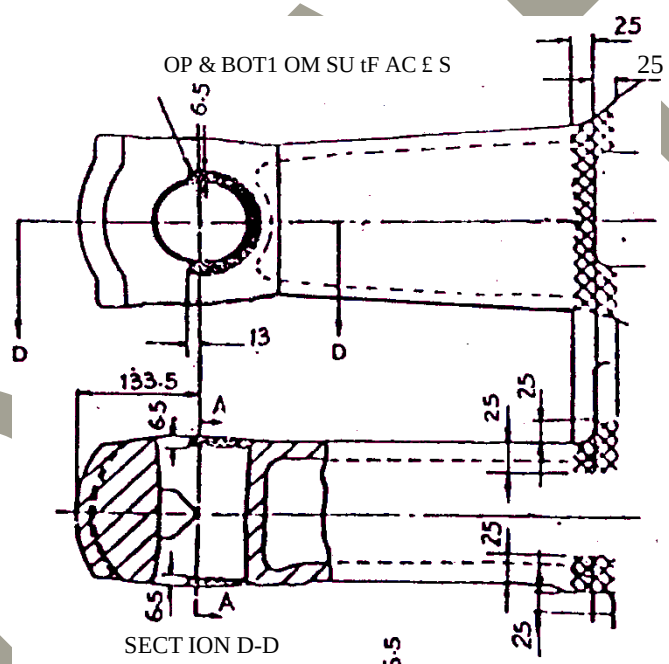

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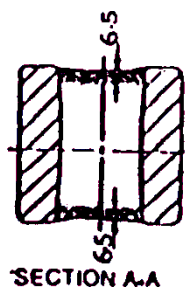

SECTION A-A

NOTES: 1. ZONE 1 IS SHOWN CROSSHATCHED.
2. BREAK SHARP CORNERS IN ZONE 1.
NO STRESS RISERS IN ZONE 1 SEE PARAGRAPH 3.4.1

Figure- 9