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LAND SEA AIR SPACE

Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

AEROSPACE RECOMMENDED PRACTICE

ARP 1111

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Revised

INSPECTION OF WORN INVOLUTE SPLINES

1. PURPOSE

This recommended practice defines a method for measuring worn fillet rootside fit involute splines.

2. SCOPE

2.1 This concept for measuring worn splines provides a direct wear depth dimension by utilizing the unworn involute surface as a contact point from which to measure the depth of wear on the spline tooth at the pitch diameter. Fig. 1 shows spline wear patterns and pitch diameter gaging points.

2.2 Gages encompassing this concept would basically consist of fixed and movable probes which contact the unworn involute surface known as the form clearance and the worn surface at the pitch diameter thus providing a direct wear reading which is reflected on a dial indicator. Refer to paragraphs 4 and 5 and Fig. 2.

3. INSPECTION HISTORY

3.1 Where gaging and limits have been provided, the inspection method has usually been similar to the manufacturing method of measurement, i.e., between or over gaging pins. In some instances for service inspection, balls have been substituted for pins to permit inspection at the worn areas.

3.2 Manufacturing tolerances in most cases absorb some of the service wear limit specified since the limits are calculated from the maximum tooth space for the internal spline and the minimum tooth thickness for the external spline.

3.3 The proposed gaging concept is affected to a negligible degree by manufacturing tolerances.

4. REQUIREMENTS

4.1 Gaging provided for splines utilizing the wear measuring concept of referencing the worn involute profile to the unworn involute profile area (C_F form clearance) shall be capable of providing a direct measurement between the two surfaces at the pitch diameter and such measurement shall be linear and reflected on a suitable dial indicator. Refer to paragraph 5 and Fig. 2.

4.2 The spline wear checking gage shall consist of three members (see Fig. 2). Members A and B which contact the worn and C_F areas shall be approximately 1/16 in. thick. Member C may vary to greater lengths provided the ability to traverse the length of the splined part is retained. One member is to be stationary and two are to be moveable with respect to each other. The member A which contacts the worn profile is to be symmetrically relieved (see Fig. 3) above and below the pitch line to insure proper contact. The reliefs shown for members B and C are considered optional. The gaging member A shall consist of three splined teeth spaced approximately 120 deg apart and the other members B and C shall have a full complement of teeth. Gaging members shall be motivated by springs actuated by a suitable lever or switch.

4.3 The spline wear checking gage shall have a spring loaded ability which will move the splined checking members A and B in the same direction and the locking member C in the relatively opposite direction to apply pressure on the opposite tooth profile to the tooth being checked. The two checking members are forced against the worn tooth, one member B contacting the unworn (C_F) area and the other A contacting the worn surface at the pitch diameter thus providing a direct reading of spline tooth wear on the indicator dial.

4.4 The spline wear checking gage members shall have the ability to move in either direction to obtain wear measurements on the loaded and unloaded sides of the spline. Control of direction is to be accomplished with the gage actuating lever.

4.5 Two master plug gages for internal splines and two master ring gages for external splines shall be provided for setting and calibration of the corresponding spline wear checking gage. One master plug gage and one master ring gage shall incorporate a known step representing a calibrated wear condition. The stepped master gages and the nonstepped master gages shall be used during quality control calibration for checking gage accuracy. The non-stepped master gages shall be used to set gages for zero readings at bench inspection. Both plug and both ring masters must be reversible to facilitate checking of spline gage accuracy and setting for zero readings under loaded conditions in both directions.

4.6 Both internal and external spline wear checking gages shall embody the same principles as described under paragraph 4 requirements.

5. METHODS

5.1 A check for determining accuracy of the spline wear gages, either external or internal, shall be made by utilizing the proper master gages in accordance with paragraph 5.1.1.

5.1.1 Pre-set the spline wear checking gage to a neutral position. Mate the gage with the corresponding plug or ring (non-stepped) master. Actuate the spline gage wear measuring members to make physical contact in the desired direction. With the master spline tooth surfaces under loaded condition, set the dial indicator to reflect a zero reading. Reset the gage to the neutral position and remove the (non-stepped) master. Mate the gage with the corresponding (stepped) master ensuring that the step is on the correct side and re-actuate the gaging members to make physical contact in the same direction. Under the loaded condition a "hands off" reading shall reflect the calibrated step dimension and will qualify the gage as satisfactory for inspection use.

5.2 Inspection of worn splined parts, either external or internal shall be made by utilizing the spline wear checking gage and the corresponding (non-stepped) master gage in accordance with paragraph 5.2.1.

5.2.1 Pre-set the spline wear checking gage to a neutral position. Mate the gage with the corresponding plug or ring (non-stepped) master. Actuate the spline gage wear measuring members to make physical contact in the desired direction. With the master spline tooth surfaces under loaded condition, set the dial indicator to reflect a zero reading. Reset the gage to the neutral position and remove the (non-stepped) master. Mate the gage with the worn splined part ensuring that the worn spline step is in the same relative loading direction used for zeroing the gage. Actuate the spline wear gage measuring members in the desired direction to make physical contact with the part spline teeth. Under the loaded condition a "hands off" reading will reflect the actual depth of the worn step along the pitch diameter circle. Return the gage to neutral position and recheck the worn spline in several positions along its full length to determine the maximum wear condition.

PREPARED BY
SAE COMMITTEE EG-1, DESIGN AND GENERAL STANDARDS FOR
AEROSPACE PROPULSION SYSTEMS

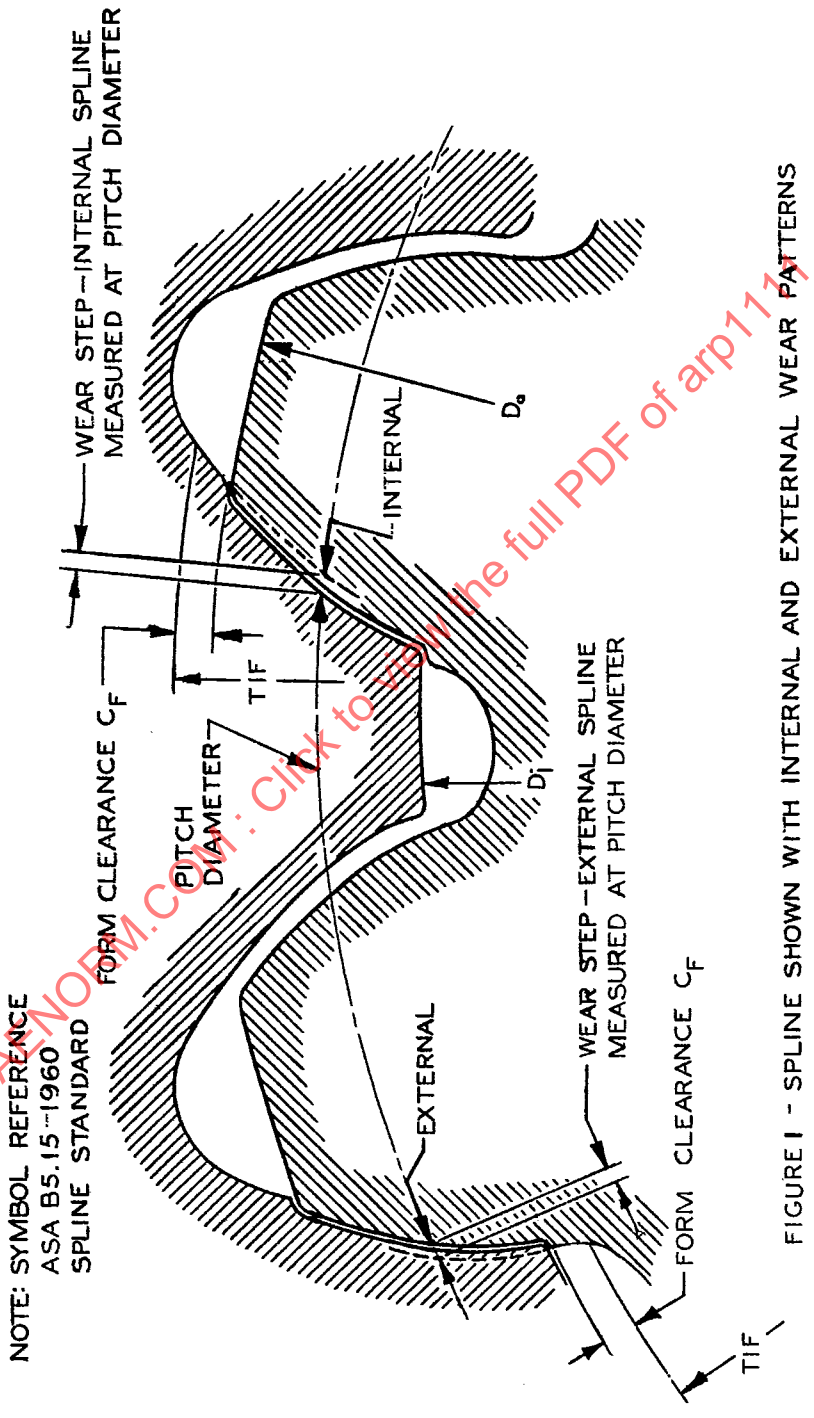
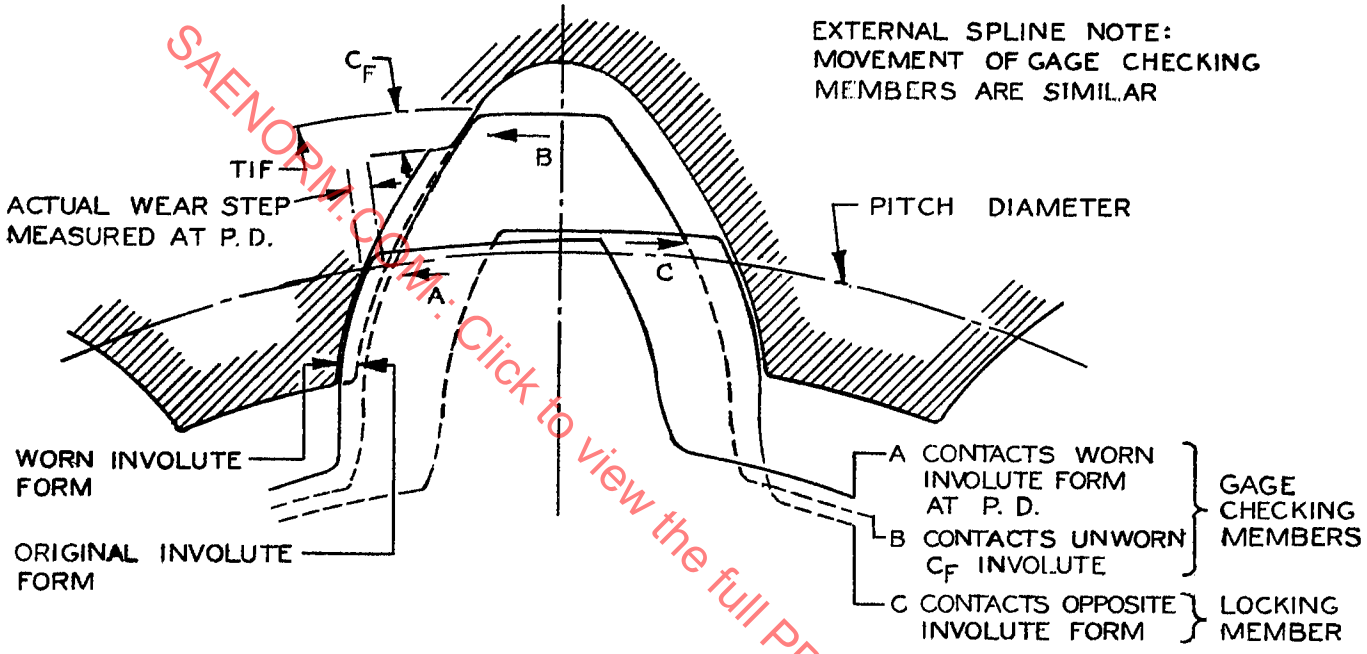


FIGURE 1 - SPLINE SHOWN WITH INTERNAL AND EXTERNAL WEAR PATTERNS



NOTE: THE GAGE CHECKING MEMBERS ARE SHOWN IN THE LOADED POSITION. ARROWS INDICATE DIRECTIONS OF GAGE CHECKING MEMBERS AGAINST INVOLUTE SURFACES. DIRECTIONS ARE REVERSIBLE. ALL GAGE CHECKING MEMBERS ARE CENTRALIZED WHEN GAGE IS IN NEUTRAL POSITION.

FIGURE 2 – INTERNAL SPLINE WEAR CHECKING GAGE