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**COMMITTEE OF EXPERTS ON THE TRANSPORT OF DANGEROUS GOODS AND ON THE GLOBALLY HARMONIZED SYSTEM OF CLASSIFICATION AND LABELLING OF CHEMICALS**

Sub-Committee of Experts on the
Transport of Dangerous Goods

Thirty-fourth session
Geneva, 1-9 December 2008
Item 2 of the provisional agenda

EXPLOSIVES AND RELATED MATTERS

HSL Flash Composition Test

Transmitted by the expert from the United Kingdom[1]

**Background**

1. At the 30th session of the Sub-Committee, the expert from the United Kingdom presented ST/SG/AC.10/C.3/2006/84 and informal document UN/SCETDG/30/INF3 which advocated changes to the time pressure test. During this session, it was agreed by the Sub-Committee that the definition of flash composition in 2.1.3.5.5 be changed because novel pyrotechnic compositions that had the same behaviour as flash compositions, but did not meet the definition, were being introduced (e.g. removing metal powder fuel and replacing with organic powder fuel). To address this problem, the Sub-Committee decided to amend Note 2 to 2.1.3.5.5 so firework compositions designed to produce an aural effect, or used as a bursting charge or lifting charge, should be considered as flash composition unless the time taken for the pressure rise is demonstrated to be more than 8ms for 0.5g of pyrotechnic composition in Test 2(c)(i) "Time pressure test" of the Manual of Test and Criteria.

[1] In accordance with the programme of work of the Sub-Committee for 2007-2008 approved by the Committee at its third session (refer to ST/SG/AC.10/C.3/60, para. 100 and ST/SG/AC.10/34, para. 14).

2. The expert from the United Kingdom has reported on the work carried out to improve the test and reduce the standard deviation and this was communicated to the Explosives Working Group at the July 2007 session (UN/SCETDG/31/INF.45) and in informal document UN/SCETDG/32/INF.36 "Modifications to the time/ pressure test for defining flash powders". The Sub-Committee was asked to provide comments to the expert from the United Kingdom on the modifications to the time pressure test (para. 36, ST/SG/AC.10/C.3/64). No comments were received by the expert from the United Kingdom. The expert from the United Kingdom submitted a further INF paper (UN/SCETDG/33/INF.37) with a proposal to amend the test to a screening test as an Appendix to the Manual of Tests and Criteria. This was discussed at the Explosives Working Group where it received unanimous support (para. 7(h) of informal document UN/SCETDG/33/INF.79).

**Proposal**

3. The expert from the United Kingdom proposes "HSL Flash Composition Test" should be included as a screening test and included as an appendix to the Manual of Test and Criteria as this would avoid having two ignition systems and test methods listed in Test 2(c)(i). If this is accepted, then Note 2 to 2.1.3.5.5 should be amended to read:

> "***NOTE 2:*** *"Flash composition" in this table refers to pyrotechnic compositions in powder form or as pyrotechnic units as presented in the fireworks, that are used to produce an aural effect, or used as a bursting charge or lifting charge, unless the time taken for the pressure rise is demonstrated to be more than 8 ms for 0.5 g of pyrotechnic composition in the HSL Flash Composition Test in Appendix X of the Manual of Tests and Criteria"*

[Note: the Drawing X.X.2 is to be replaced with a new drawing showing the new Cone in Plug firing plug and Drawing X.X.8 is to be redrawn. These will be included in an informal document. Comments have been received from a number of Experts and where possible these have been included. Some of these comments and changes are in square brackets. The informal document will deal with these issues following further comments by Experts]

# Appendix X

## HSL Flash Composition Test

### X.1 Introduction

This test is used to determine whether pyrotechnic compositions in powder form or as pyrotechnic units as presented in the fireworks, that are used to produce an aural effect, or used as a bursting charge or lifting charge, are considered to be flash compositions for the purposes of determining the classification of fireworks using the UN default fireworks classification table in 2.1.3.5.5 of Model Regulations.

### X.2 Apparatus and materials

X.2.1 The time/pressure apparatus (Figure X.X.2) consists of a cylindrical steel pressure vessel 89 mm in length and 60 mm in external diameter. Two flats are machined on opposite sides (reducing the cross-section of the vessel to 50 mm) to facilitate holding whilst fitting the "cone in plug" firing plug and vent plug. The vessel, which has a bore of 20 mm diameter, is internally rebated at either end to a depth of 19 mm and threaded to accept 1" British Standard Pipe (BSP). A pressure take-off, in the form of a side-arm, is screwed into the curved face of the pressure vessel 35 mm from one end and at 90° to the machined flats. The socket for this is bored to a depth of 12 mm and threaded to accept the 1/2" BSP thread on the end of the side-arm. A washer is fitted to ensure a gastight seal. The side-arm extends 55 mm beyond the pressure vessel body and has a bore of 6 mm. The end of the side-arm is rebated and threaded to accept a diaphragm type pressure transducer. Any pressure-measuring device may be used provided that it is not affected by the hot gases or decomposition products and is capable of responding to rates of pressure rise of 690-2070 kPa in not more than 1 ms.

X.2.2 The end of the pressure vessel furthest from the side-arm is closed with a "cone in plug" firing plug which is fitted with two electrodes, one insulated from and the other earthed to, the plug body. The other end of the pressure vessel is closed by an aluminium bursting disk 0.2 mm thick (bursting pressure approximately 2200 kPa) held in place with a retaining plug which has a 20 mm bore. A soft lead washer is used with both plugs to ensure a good seal.

X.2.3 A support stand (X.X.8) holds the assembly in the correct attitude during use. This comprises a mild steel base plate measuring 235 mm × 184 mm × 6 mm and a 185 mm length of square hollow section (S.H.S.) 70 × 70 × 4 mm. A section is cut from each of two opposite sides at one end of the length of S.H.S. so that a structure having two flat sided legs surmounted by an 86 mm length of intact box section results. The ends of these flat sides are cut to an angle of 60° to the horizontal and welded to the base plate.

X.2.4 A slot measuring 22 mm wide × 46 mm deep is machined in one side of the upper end of the base section such that when the pressure vessel assembly is lowered, firing plug end first, into the box section support, the side-arm is accommodated in this slot. A packing piece of steel 30 mm wide and 6 mm thick is welded to the lower internal face of the box section to act as a spacer. Two 7 mm thumb screws, tapped into the opposite face, serve to hold the pressure vessel firmly in place. Two 12 mm wide strips of 6 mm thick steel, welded to the side pieces abutting the base of the box section, support the pressure vessel from beneath.

X.2.5 The ignition system consists of a Vulcan electric fusehead, with lead wires, of the type commonly used for igniting pyrotechnic compositions. Fuseheads with equivalent properties may be used.

X.2.6 The procedure for the preparation of the ignition assembly starts with the cutting of the fusehead wires so that the fusehead sits 10mm above the substance contained within the "cone of the cone in plug" firing plug. The fusehead leads are held in position using the grub screws (see Figure X.X.3).

## X.3 Procedure

X.3.1 The cone, assembled complete with pressure transducer but without the aluminium bursting disk in position, is supported firing plug end down. 0.5g of the substance is introduced into the cone of the firing plug. No tamping is carried out when filling the apparatus. [Where the pyrotechnic composition is in consolidated form greater than 0.5g it should be broken to produce a piece as close to 0.5g as possible. Where the composition is in consolidated form less than 0.5g then whole and broken units should be chosen to give 0.5g pyrotechnic composition.] The lead washer and aluminium bursting disk are placed in position and the retaining plug is screwed in tightly. The charged vessel is transferred to the firing support stand, bursting disk uppermost, which should be contained in a suitable, armoured fume cupboard or firing cell. An exploder dynamo is connected to the external terminals of the firing plug and the charge is fired. The signal produced by the pressure transducer is recorded on a suitable system which allows both evaluation and a permanent record of the time/pressure profile to be achieved (e.g. transient recorder coupled to a chart-recorder).

X.3.2 The test is carried out three times. The time taken for the pressure to rise from 690 kPa to 2070 kPa above atmospheric is noted. The average of three firings should be used for classification.

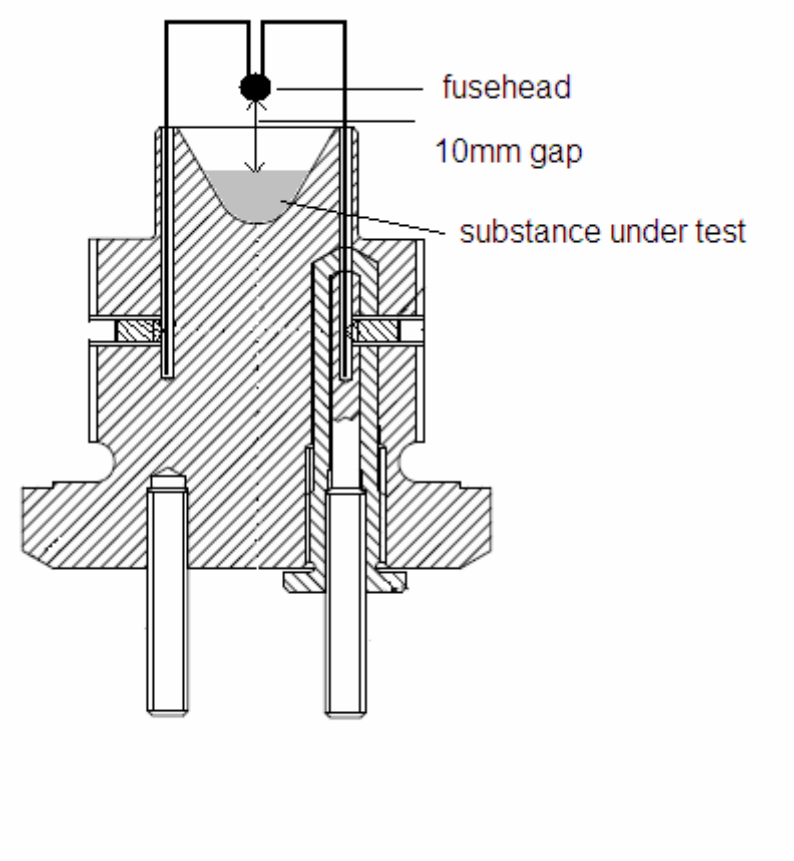
## X.4 Test criteria and method of assessing results

The test results are interpreted in terms of whether a gauge pressure of 2070 kPa is reached and, if so, the time taken for the pressure to rise from 690 kPa to 2070 kPa gauge. The pyrotechnic compositions in powder form or as pyrotechnic units as presented in the fireworks, that are used to produce an aural effect, or used as a bursting charge or lifting charge, is to be considered as flash composition if the [average/minimum] pressure rise is shown to be less than, or equal to, 8ms for 0.5g of pyrotechnic composition.

**[Example of Results:**

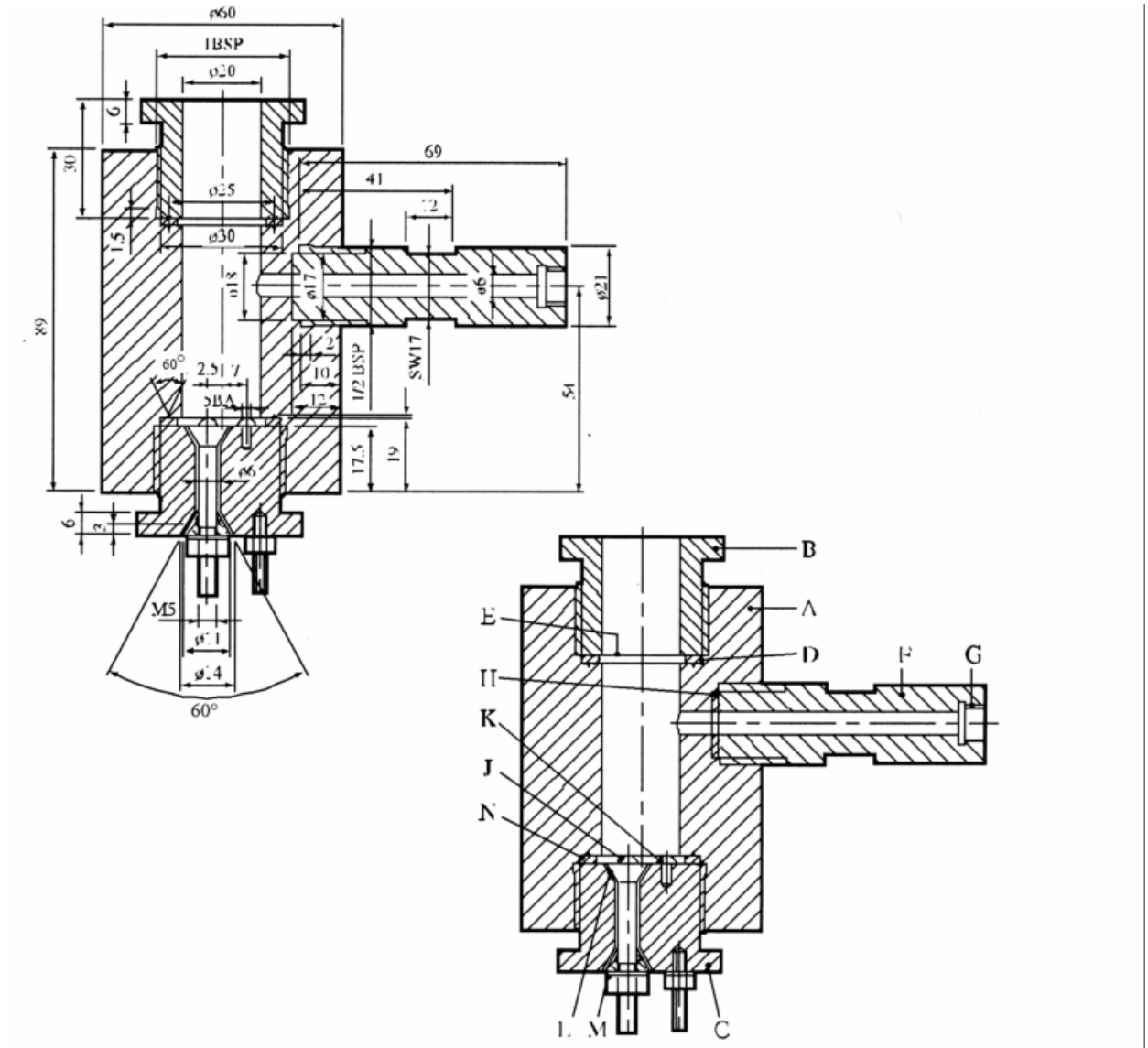
| Substance | Maximum Pressure Rise (kPa) | Mean time for a pressure rise from 690 to 2070kPa (ms) / | Result |
|---|---|---|---|
| 1 | >2070 | 0.70 | Flash Composition |
| 2 | >2070 | 4.98 | Flash Composition |
| 4 | >2070 | 1.51 | Flash Composition |
| 5 | >2070 | 0.84 | Flash Composition |

]




Sample setup

Figure X.X.1




| | | | |
|---|---|---|---|
| Pressure vessel body | | (B) | Bursting disc retaining plug |
| Firing plug | | (D) | Soft lead washer |
| Bursting disc | | (F) | Side arm |
| Pressure transducer thread | | (H) | Copper washer |
| Insulated Electrode | | (K) | Earthed electrode |
| Insulation | | (M) | Steel cone |
| Washer distorting groove | | | |

Figure X. X .2 Apparatus

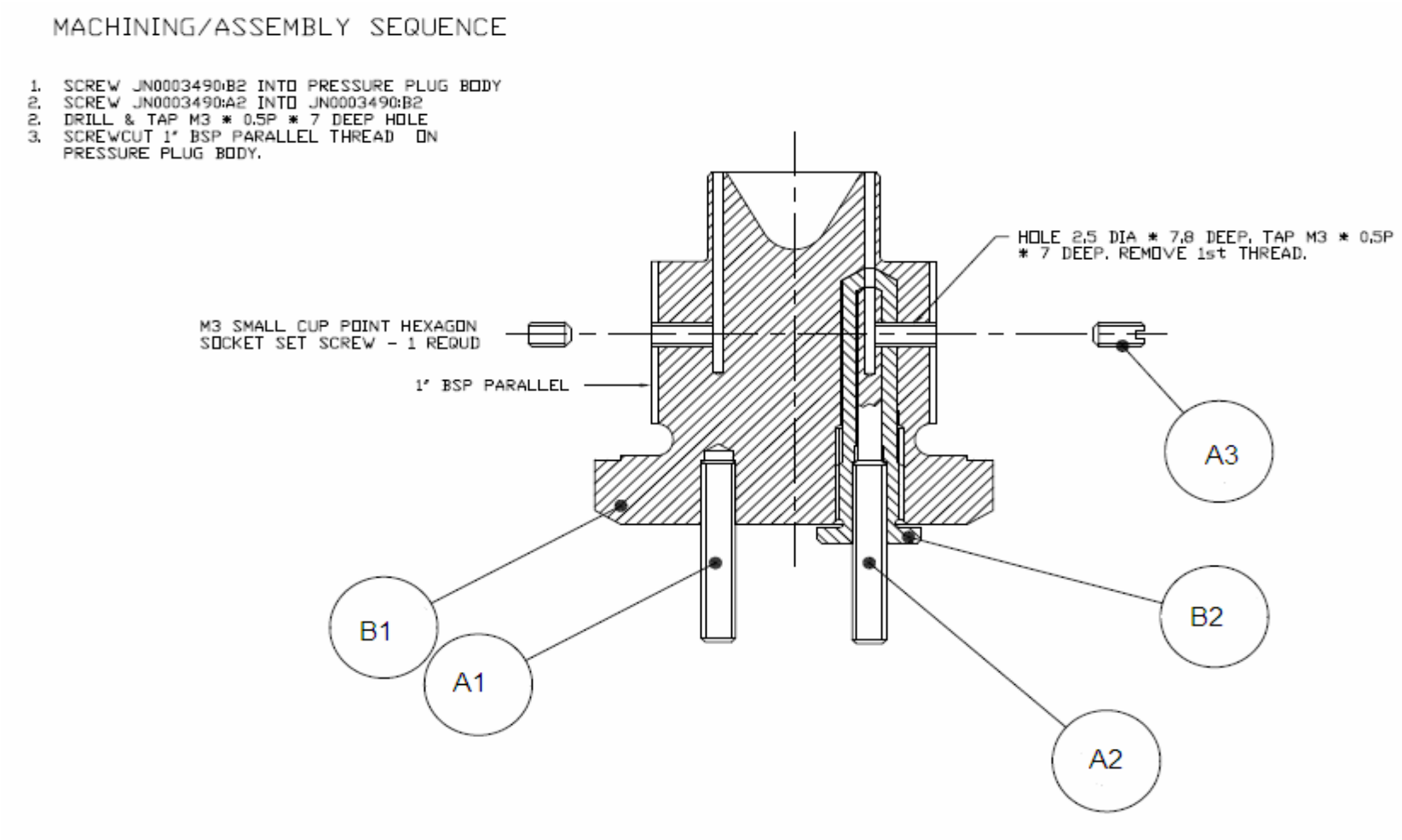
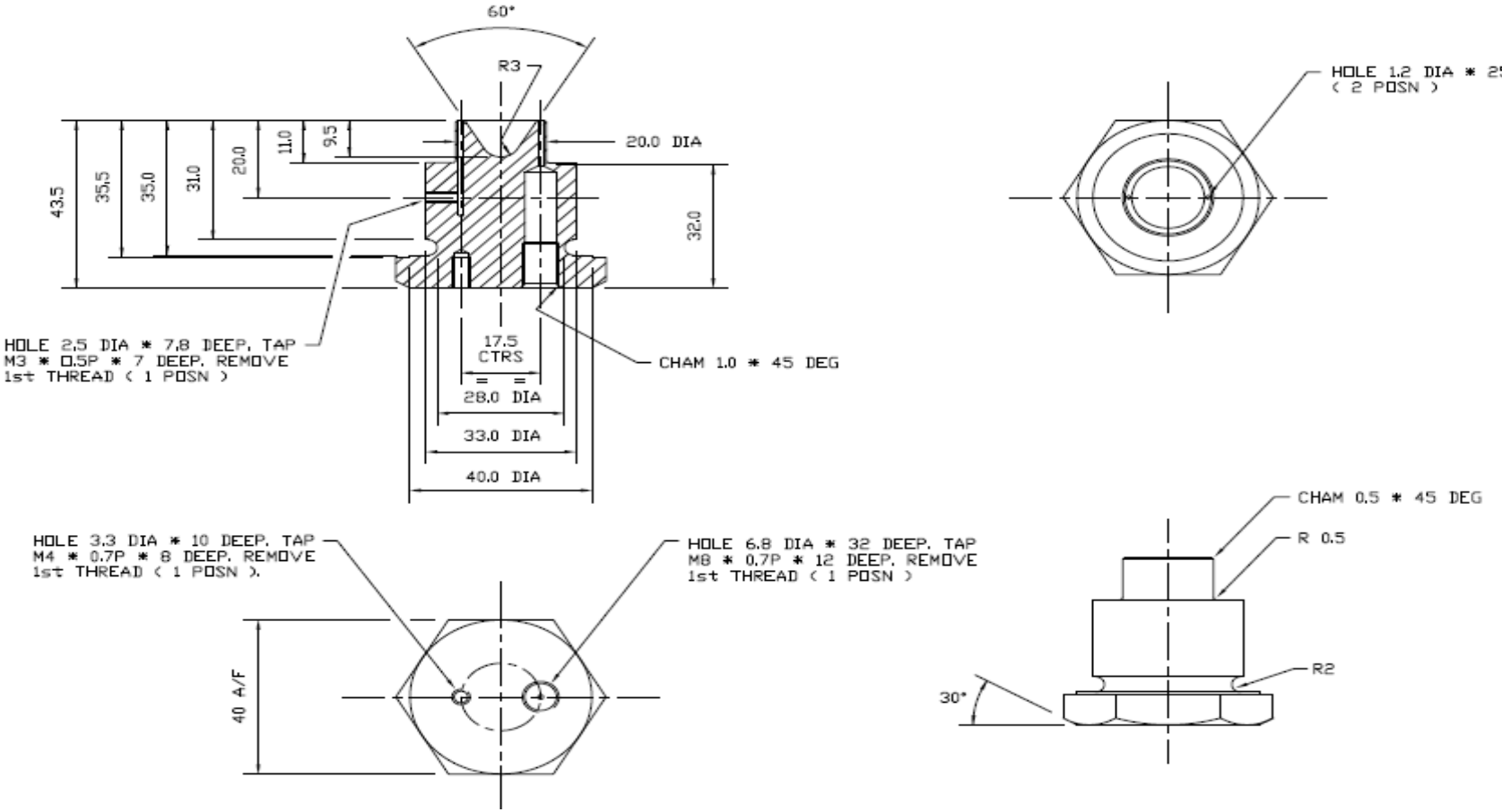

MACHINING/ASSEMBLY SEQUENCE
1. SCREW JN0003490:B2 INTO PRESSURE PLUG BODY
2. SCREW JN0003490:A2 INTO JN0003490:B2
2. DRILL & TAP M3 * 0.5P * 7 DEEP HOLE
3. SCREWCUT 1" BSP PARALLEL THREAD ON PRESSURE PLUG BODY.
HOLE 2.5 DIA * 7.8 DEEP, TAP M3 * 0.5P * 7 DEEP. REMOVE 1st THREAD.
M3 SMALL CUP POINT HEXAGON SOCKET SET SCREW - 1 REQUD
1" BSP PARALLEL
A3
B1
A1
B2
A2

Figure X.X.3




B1

Figure X.X.4

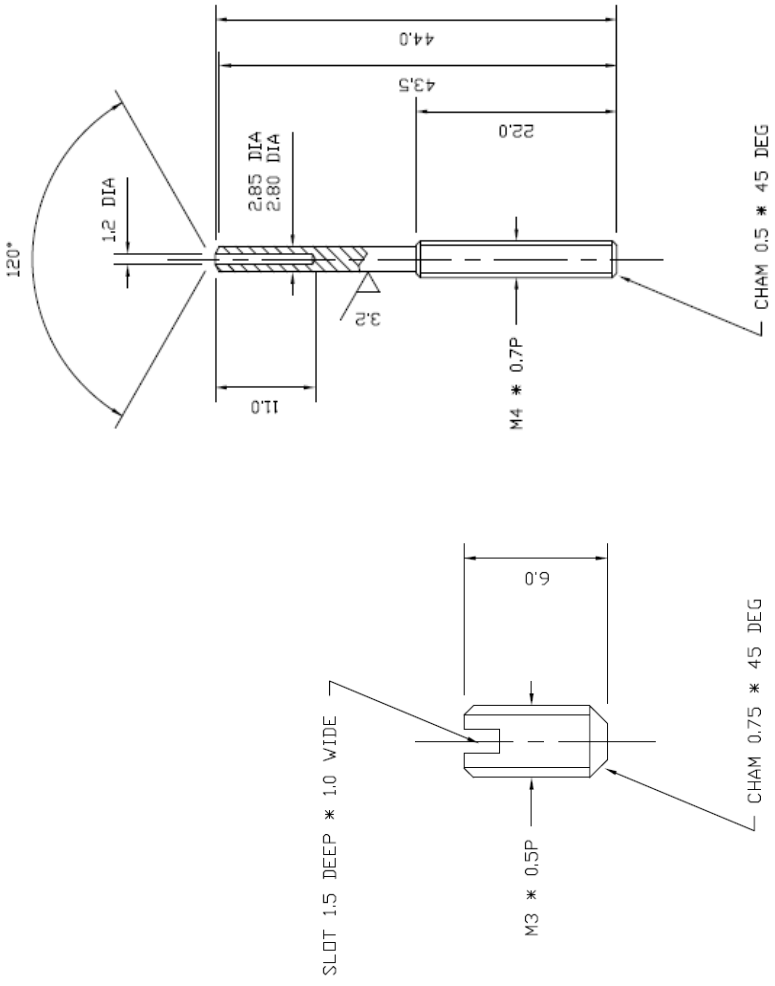
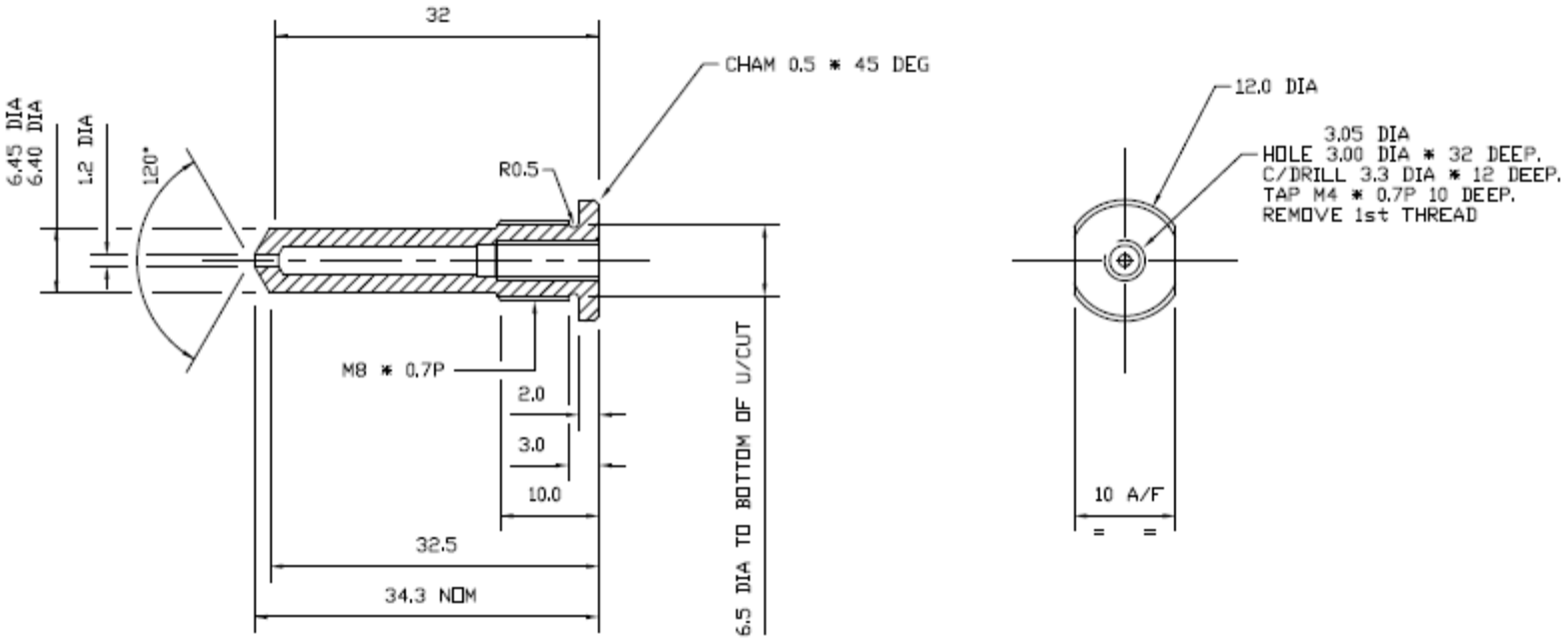

120°
1.2 DIA
2.85 DIA
2.80 DIA
44.0
43.5
22.0
11.0
3.2
M4 * 0.7P
CHAM 0.5 * 45 DEG
A1
6.0
SLOT 1.5 DEEP * 1.0 WIDE
M3 * 0.5P
CHAM 0.75 * 45 DEG
A3

Figure X.X.5




B2

Figure X.X.6

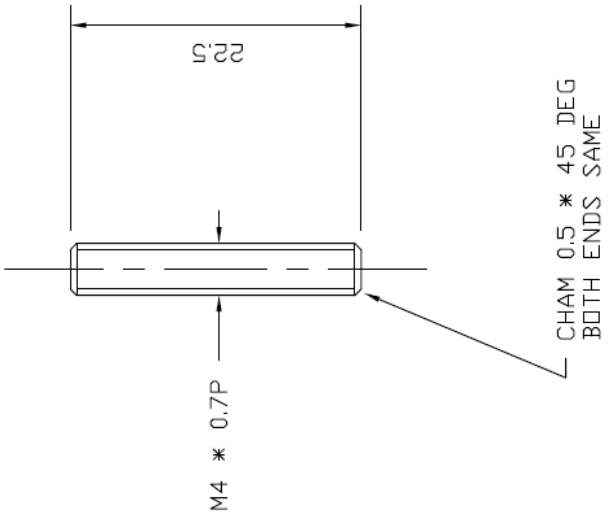



Figure X.X.7

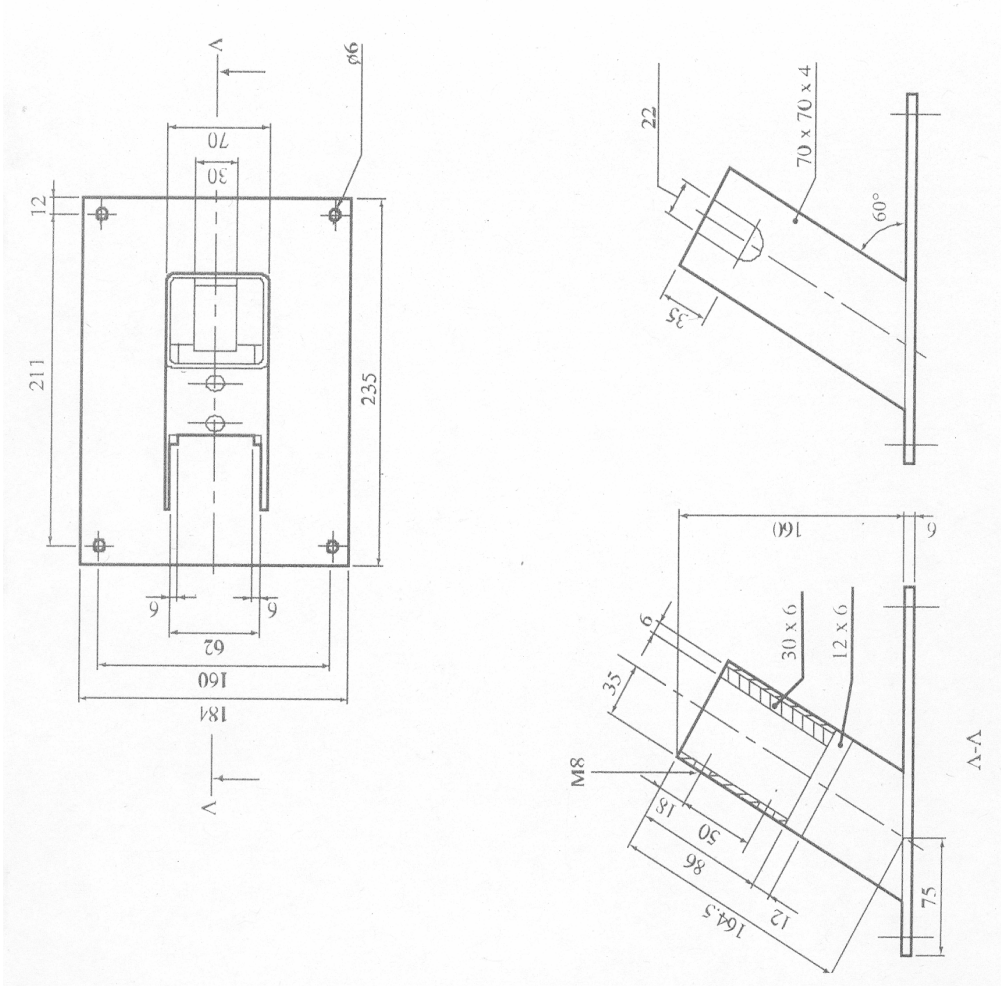



Figure X.X.8 Support Stand